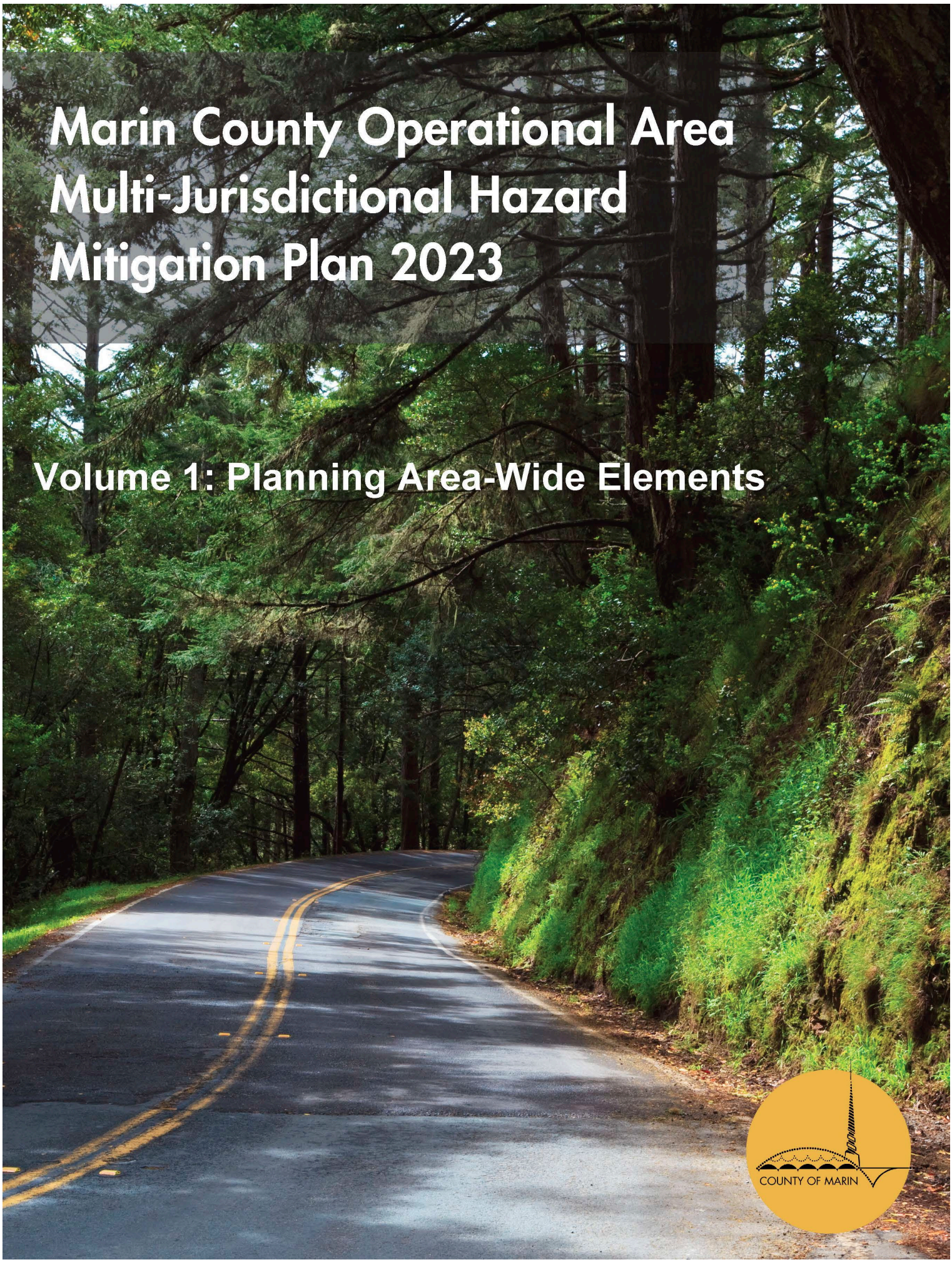
Marin County Operational Area Multi-Jurisdictional Hazard Mitigation Plan 2023

Volume 1: Planning Area-Wide Elements



Cover Photo: The image provided by the Marin County Office of Emergency Management, illustrates the precarious balance of mitigating potential wildfire fuels to ensure a safe evacuation corridor while preserving the exquisite natural beauty unique to Marin County.

EXECUTIVE SUMMARY

The Marin County Operational Area (OA) and the sixteen (16) jurisdictions and special districts within the Marin County OA prepared this Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) update to the 2018 Marin County MJHMP to guide County, City, and Special District managers in protecting the people and property within the County from the effects of natural disasters and hazard events. These planned actions will make Marin County and its residents less vulnerable to future hazard events, demonstrates the communities' commitment to reducing risks from hazards, and serves as a tool to help decision makers direct mitigation activities and resources.

HAZARD MITIGATION

Hazard Mitigation is defined as "any sustained action taken to eliminate or reduce long-term risk to human life, property, and the environment posed by a hazard".

Hazard mitigation planning is the process of making any sustained plan or course of action taken to reduce or eliminate long-term risk to people and property from both natural hazards and their effects. The planning process includes establishing goals and recommendations for mitigation strategies.

Hazard mitigation may occur during any phase of a threat, emergency, or disaster. Mitigation can and should take place during the preparedness (before), response (during), and recovery (after) phases. The process of hazard mitigation involves evaluating the hazard's impact and identification and implementation of actions to minimize the impact.

PURPOSE OF THE HAZARD MITIGATION PLAN

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. The Marin County OA planning area has been affected by hazards in the past and is thus committed to reducing future impacts from hazard events and becoming eligible for mitigation-related federal funding.

MITIGATION PLAN UPDATE

This 2023 MJHMP is a comprehensive update of the 2018 Marin County Local Hazard Mitigation Plan, which included the unincorporated county, eleven (11) jurisdictions and the North Marin Water District. FEMA approved the 2018 plan on December 27, 2018, and it will expire on December 27, 2023. The current update meets federal requirements for updating hazard mitigation plans on a five-year cycle. It represents the fifth iteration of the Marin County hazard mitigation plan. Fifty-eight planning partners participated in this update, as listed in Tables 2.2 and 2.4.

The Marin County Office of Emergency Management was the lead County Department coordinating this MJHMP update. The Marin County Office of Emergency Management

appointed new leadership in 2023 and the Director, Steven Torrance, made the update to this plan a priority.

The planning area and participating jurisdictions and special districts were defined to consist of the unincorporated county, eleven (11) jurisdictions and five (5) special districts within the geographical boundary of Marin County. All partners to this plan have jurisdictional authority within this planning area. The jurisdictions participating in the 2023 Marin County MJHMP were represented by:

Table 2.1: 2023 MJHMP Participating Jurisdictions

	Jurisdiction	Representative	Title
1	Marin County	Hannah Tarling	Emergency Management Coordinator
2	Marin County	Chris Reilly	OEM Project Manager
3	City of Belvedere	Irene Borba	Director of Planning
4	City of Larkspur	Loren Umbertis	Public Works Director
5	City of Mill Valley	Patrick Kelly	Director of Planning and Building
6	City of Novato	Dave Jeffries	Consultant/JPSC
7	City of San Rafael	Quinn Gardner	Deputy Emergency Services Coord.
8	City of Sausalito	Kevin McGowan	Director of Public Works
9	Town of Corte Madera and Sanitary District #2	RJ Suokko	Director of Public Works
10	Town of Fairfax	Loren Umbertis	Public Works Director
11	Town of Ross	Richard Simonitch	Public Works Director
12	Town of San Anselmo	Sean Condry	Public Works & Building Director
13	Town of Tiburon	Sam Bonifacio	Assistant Planner
14	Bolinas Community Public Utility District	Jennifer Blackman	General Manager
15	Las Gallinas Valley Sanitary District	Dale McDonald	Administrative Services Manager
16	North Marin Water District	Eric Miller	Asst. General Manager
17	Southern Marin Fire District	Marshall Nau	Fire Marshall/South Marin Fire Dist.

PARTICIPATING JURISDICTION HAZARD ASSESSMENT

Each Marin County OA MJHMP participating jurisdiction and special district reviewed and approved the Top Hazards identified by the Planning Team. Each participating jurisdiction and organization then completed a more complex assessment tool to further develop their hazard assessment and prioritization.

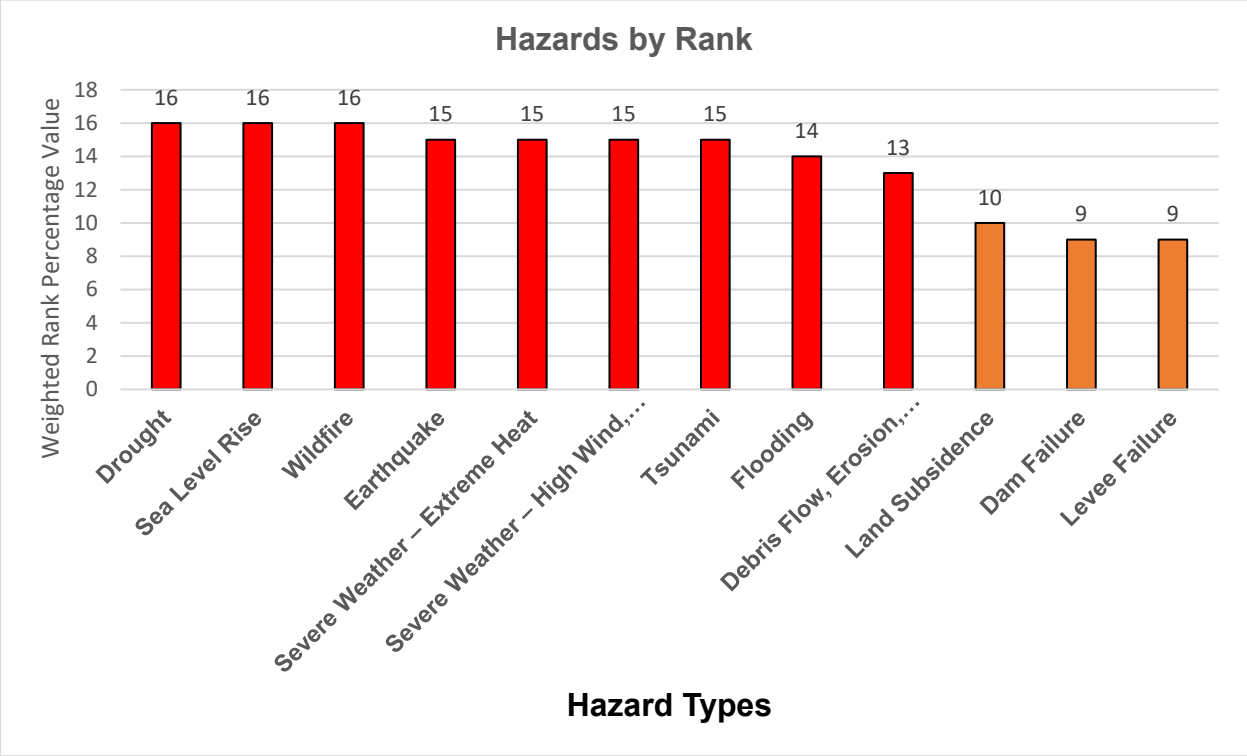
The planning process used the available FEMA tools to evaluate all the possible threats faced. The primary tool selected was the Hazard Assessment and Prioritization Tool. This matrix allowed the participating jurisdiction or organization to assess their own level of vulnerability and mitigation capability. Each participating Jurisdiction and organization assessed the top hazards for:

- Probability and frequency
- Impact to property, resources, and humans
- Mitigation capacity

The results of these participating jurisdiction and organization hazard assessment and prioritization are illustrated in the following tables.

Table 3.4: Marin County Hazard Risk Assessment

Hazard	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude / Severity	Climate Change Influence	Significance	Risk Score
Dam Failure	Unlikely	Negligible	Extreme	Low	Medium	**9.00**
Debris Flow, Erosion, Landslide, Post-Fire Debris Flow	Occasional	Extensive	Severe	Medium	Medium	**13.00**
Drought	Highly Likely	Extensive	Moderate	High	High	**16.00**
Earthquake	Highly Likely	Extensive	Extreme	None	High	**15.00**
Flooding	Highly Likely	Limited	Severe	High	Medium	**14.00**
Land Subsidence (Sinkhole)	Occasional	Limited	Moderate	Medium	Medium	**10.00**
Levee Failure	Unlikely	Negligible	Moderate	Medium	High	**9.00**
Sea Level Rise	Highly Likely	Limited	Extreme	High	High	**16.00**
Severe Weather – Extreme Heat	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Severe Weather – Wind, Tornado	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Tsunami	Highly Likely	Limited	Extreme	Medium	High	**15.00**
Wildfire	Highly Likely	Significant	Severe	High	High	**16.00**



Risk Level	Risk Numerical Score
High Risk	12 - 16
Serious Risk	8 - 11
Moderate Risk	4 - 7
Low Risk	1 - 3

MITIGATION GOALS

The information developed from the risk assessment was used as the primary basis for developing mitigation goals and objectives. Mitigation goals are defined as general guidelines explaining what each jurisdiction wants to achieve in terms of hazard and loss prevention.

Hazard Risk Prioritization

↓

Mitigation Goals & Objectives

↓

Mitigation Project Identification

↓

Mitigation Project Implementation

Goal 1: Minimize risk and vulnerability of the community to the impacts of natural hazards and protect lives and reduce damages and losses to property, economy, and environment in Marin County.

- Minimize economic and resource impacts and promote long-term viability and sustainability of resources throughout Marin County.
- Minimize impact to both existing and future development.
- Provide protection for public health.
- Prevent and reduce wildfire risk and related losses.

Goal 2: Provide protection for critical facilities, infrastructure, utilities, and services from hazard impacts.

- Incorporate defensible space and reduce hazard vulnerability.
- Develop redundancies in utilities and services.
- Enhance resilience through enhanced construction.

Goal 3: Improve public awareness, education, and preparedness for hazards that threaten our communities.

- Enhance public outreach and participation in the Alert Marin Emergency Notification System.
- Enhance public outreach, education, and preparedness program to include all hazards of concern.
- Increase public knowledge about the risk and vulnerability to identified hazards and their recommended responses to disaster events, including evacuation and sheltering options.
- Provide planning and coordination for "At-Risk" populations.
- Provide planning and coordination for companion animals, livestock, and other animal populations.
- Increase community awareness and participation in hazard mitigation projects and activities.

Goal 4: Increase communities' capabilities to be prepared for, respond to, and recover from a disaster event.

- Improve interagency (local, state, federal) emergency coordination, planning, training, and communication to ensure effective community preparedness, response and recovery.
- Enhance collaboration and coordination of disaster-related plans, exercises, and training with local, state, and federal agencies, neighboring communities, private partners, and volunteers.
- Enhance the use of shared resources/Develop a strong mutual aid support system.
- Create and maintain a fully functional, interoperable radio and communication system with all regional public safety partners.

Goal 5: Maintain FEMA Eligibility/Position the communities for grant funding.

- Review hazard events and ongoing hazard mitigation projects annually.
- Assess the need to pursue or adjust hazard mitigation projects after significant hazard events.

Goal 6: Reduce exposure to High Hazard Dams that pose an unacceptable risk to the public.

- Improve alert and warning systems to provide residents downstream of a High Hazard Dam to receive timely warning to evacuation when threatened by potential or imminent dam failure.
- Enhance overall community preparedness to respond and evacuate a potential or imminent dam failure.
- Increase public awareness of the risk posed by High Hazard Dams and the potential for relocation of housing outside a possible inundation zone.
- Prioritize High Hazard Dam Mitigation projects and programs.

MITIGATION STRATEGY

The mitigation strategies and activities designed to reduce or eliminate losses resulting from natural hazards are the centerpiece of the mitigation planning process. Through the mitigation actions, participating jurisdictions will become more resilient to disasters.

The 2023 Marin County OA MJHMP was revised to reflect progress in local mitigation efforts. Mitigation projects were selected for each hazard and for Marin County, the eleven (11) jurisdictions and the five (5) special districts based on the hazard risk assessment. The projects are supported by the mitigation goals and objectives and are ranked using the following criteria: approximate cost, timeframe of completion, whether the project requires Board of Supervisors regulatory action, and an assumption as to whether or not the project would be subject to CEQA or NEPA requirements. Funding sources are identified for all projects. All projects consider new, future, and existing development.

ACKNOWLEDGEMENTS

The Marin County Office of Emergency Management and Preparative Consulting would like to thank those collaborators and partners who participated in the planning and development of this document.

The official Marin County Operational Area Hazard Mitigation Steering Committee provided the oversight and dedication to this project that was required and without their commitment, this project would not be possible.

As with any working plan, this document represents planning strategies and guidance as understood as of the date of this plan's release. This plan identifies natural hazards and risks and identifies the hazard mitigation strategy to reduce vulnerability and make the communities of the Marin County Operational Area more disaster resistant and sustainable.

2023 Marin County Operational Area
Multi-Jurisdictional Hazard Mitigation Plan

Prepared For:

Marin County Fire Department
Office of Emergency Management
1600 Los Gamos Drive, Suite #301
415-473-6584

Prepared By:

Preparative Consulting
PO Box 143
Vacaville, CA 95696
707-685-2209

This page is intentionally blank.

LETTER OF PROMULGATION

March 5, 2024

To: Officials and Employees of Marin County

The preservation of life and property is an inherent responsibility of all levels of government. Whereas disasters may occur in devastating form at any time, Marin County must provide safeguards which will save lives and minimize property damage through mitigation planning and training. Sound mitigation planning carried out by knowledgeable and well-trained personnel can and will minimize losses.

The Marin County Operational Area Multi-Jurisdictional Hazard Mitigation Plan identifies the hazard risks and vulnerabilities for the Marin County Operational Area and identifies mitigation projects and actions to help reduce those risks. It provides for the integration and coordination of planning efforts of Marin County, the Cities of Belvedere, Larkspur, Mill Valley, Novato, San Rafael and Sausalito; the Towns of Corte Madera, Fairfax, Ross, San Anselmo and Tiburon; the Bolinas Community Public Utility District, the Central Marin Fire Department, the Las Gallinas Valley Sanitary District, the North Marin Water District, the Sanitary District Number 2, and the Southern Marin Fire Department.

The content of this plan is based upon guidance approved and provided by the Federal Emergency Management Agency and the California Governor's Office of Emergency Services. The intent of the Multi-Jurisdictional Hazard Mitigation Plan is to provide direction on how to mitigate against the threat of disaster through effective mitigation strategies and initiatives.

Once adopted, this plan will be reviewed and tested periodically and revised as necessary to meet changing conditions and requirements.

The Marin County Board of Supervisors gives its full support to this Multi-Jurisdictional Hazard Mitigation Plan and urges all public employees and individuals to mitigate against the threat of disaster before they occur.

Dennis Rodoni
President, Board of Supervisors
Marin County

This page is intentionally blank.

TABLE OF CONTENTS

Executive Summary ..... **i**
Acknowledgements **1**
Letter Of Promulgation **3**
Table of Contents **5**
SECTION 1.0: Introduction **9**
1.1 Hazard Mitigation Principles 9
1.2 Purpose 9
1.3 Scope 10
1.4 Legal Authorities 10
1.5 History and Overview 11
1.5.1 Demographics 25
1.5.2 Critical Facilities and Infrastructure 31
1.5.3 Natural, Historical, and Cultural Resources 33
1.5.4 National Risk Index and Social Vulnerability 55
1.5.5 Social Vulnerability and Risk in Marin County 60
1.5.6 Economics 66
1.6 Existing Authorities, Policies, Programs, and Resources 67
1.7 New Items for the 2023 MJHMP 68
1.7.1 Revision of the Hazard Identification and Risk Assessment 70
1.7.2 Climate Change 70
1.7.3 Progress on Local Mitigation Efforts 70
1.8 Plan Organization and Structure 70
SECTION 2.0: Planning Process **72**
2.1 Planning Approach 73
2.2 Grant Funding and Consultant Selection 74
2.3 Establish a Planning Partnership 74
2.4 Define the Planning Area and Participating Jurisdictions 75
2.5 Steering Committee 76
2.5.1 Steering Committee Planning Process 78
2.5.2 Steering Committee Tasks 79
2.5.3 Steering Committee Future Tasks 80
2.6 Coordination with stakeholders and agencies 80

2.7 Review and Incorporation of Existing Plans 87
2.8 Public Engagement 92
2.8.1 Website 94
2.8.2 Public Meetings 94
2.8.3 Social media 96
2.8.4 Press Releases 96
2.8.5 Survey 97
2.8.6 Public Comment on the Plan 98
SECTION 3.0: Hazard Identification and Risk Assessment 100
3.1 Hazard Identification 100
3.1.1 Disaster Declaration History 102
3.1.2 Omission of Hazards 104
3.2 Hazard Analysis 106
3.2.1 Climate Change 111
3.2.2 Participating Jurisdiction Hazard Assessment 119
3.3 Hazard Risk Assessment 120
3.3.1 Dam Failure 120
3.3.2 Debris Flow 154
3.3.3 Drought 176
3.3.4 Earthquake 185
3.3.5 Flooding 196
3.3.6 Land Subsidence 241
3.3.7 Levee Failure 247
3.3.8 Sea Level Rise 265
3.3.9 Severe Weather – Extreme Heat 276
3.3.10 Severe Weather – High Wind/Tornado 281
3.3.11 Tsunami 290
3.3.12 Wildfire 322
3.4 Additional Hazards Profiled 372
3.4.1 Air Pollution 373
3.4.2 Critical Infrastructure/ Utility Disruption 376
3.4.3 Cyber Threats 378
3.4.4 Oil Spills 383
3.4.5 Pandemic 386

3.4.6 Transportation Systems 392
SECTION 4.0: Mitigation Strategy 399
4.1 Changes in Development 399
4.2 Changes in Priorities 401
4.2.1 Vulnerability and Risk Reduction 401
4.3 Capability Assessment 402
4.3.1 Regulatory Capabilities 402
4.3.2 Administrative and Technical Capabilities 408
4.3.3 Fiscal Capabilities 412
4.3.4 Outreach and Partnerships Capabilities 414
4.4 Participation in the National Flood Insurance Program 415
4.4.1 Substantially Improved Or Substantially Damaged Properties 421
4.5 Mitigation Goals 423
4.6 Hazard Mitigation Actions 425
4.6.1 Progress in Local Mitigation Efforts 425
4.6.2 Status of Previous Mitigation Actions 426
4.6.3 New Mitigation Actions 430
4.7 Plan Integration 463
4.8 Future Development Trends 464
SECTION 5.0: Plan Review, Evaluation, and Implementation 468
5.1 Plan Adoption 468
5.2 Plan Monitoring And Public Engagement 468
5.3 Plan Evaluation 469
5.4 Plan Update 470
Figures and Tables Index 471
Acronyms 478
Appendix A: Adoption Letters 483
Appendix B: Documentation of the Planning Process 513
Appendix C: Public Outreach Survey 531

This page is intentionally blank.

SECTION 1.0: INTRODUCTION

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

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of six dollars in avoided future losses in addition to saving lives and preventing injuries.

This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 so that the Marin County Operational Area (OA) would be eligible for the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation and Hazard Mitigation Grant programs as well as to lower flood insurance premiums (in jurisdictions that participate in the National Flood Insurance Program's Community Rating System).

1.1 HAZARD MITIGATION PRINCIPLES

Hazard mitigation is any sustained action taken to eliminate or reduce long-term risk to human life, property, and the environment posed by a hazard.

Hazard mitigation planning is the process of making any sustained plan or course of action taken to reduce or eliminate long-term risk to people and property from both natural hazards and their effects. The planning process includes establishing goals and recommendations for mitigation strategies.

Hazard mitigation may occur during any phase of a threat, emergency, or disaster. Mitigation can and should take place during the preparedness (before), response (during), and recovery (after) phases.

The process of hazard mitigation involves evaluating the hazard's impact and identification and implementation of actions to minimize the impact.

1.2 PURPOSE

Marin County and its participating jurisdictions prepared this Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) update to the 2018 Marin County MJHMP in order to make the Marin County OA and its residents less vulnerable to future hazard events. This plan demonstrates the communities' commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This plan was also developed to make the Marin County OA eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP),

Building Resilient Infrastructure and Communities (BRIC) program, and Flood Mitigation Assistance (FMA) program.

1.3 SCOPE

The Marin County OA MJHMP is a multi-jurisdictional plan that geographically covers the Marin County OA, which encompasses the area within Marin County's jurisdictional boundaries. This area includes the County and its unincorporated communities, the Cities of Belvedere, Larkspur, Mill Valley, Novato, San Rafael and Sausalito; the Towns of Corte Madera, Fairfax, Ross, San Anselmo and Tiburon; the Bolinas Community Public Utility District, the Central Marin Fire Department, the Las Gallinas Valley Sanitary District, the North Marin Water District, the Sanitary District Number 2, and the Southern Marin Fire Department.

This MJHMP was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. The 2007 amendments also incorporate mitigation planning requirements of the Flood Mitigation Assistance program authorized by the National Flood Insurance Act of 1968. While the Disaster Mitigation Act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288).

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. The Marin County OA planning area has been affected by hazards in the past and is thus committed to reducing future impacts from hazard events and becoming eligible for mitigation-related federal funding.

1.4 LEGAL AUTHORITIES

Federal, state and local regulations and policies form the legal framework to implement Marin County's, and its participating jurisdictions', hazard mitigation goals and projects.

Federal Laws

- "The Federal Civil Defense Act of 1950"
- Public Law 96-342 "The Improved Civil Defense Act of 1980"
- Public Law 91-606 "Disaster Relief Act"
- Public Law 93-288 "The Robert T. Stafford Disaster Relief Act of 1974"
- Section 322, Mitigation Planning of the Robert T. Stafford Disaster Relief and Emergency Assistance Act
- Public Law 106-390 enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA)
- Interim Final Rule for DMA 2002 as published in the February 26,2002, 44 CFR Part 201

State Laws & Plans

California Government Code, Section 3100, Title 1, Division 4, Chapter 4

Defines public employees as disaster service workers. Disaster service workers are subject to such disaster service activities as assigned to them by their superiors or by law. The term "public employees" includes all persons employed by the state or any county, city, city and county, state agency or public district, excluding aliens legally employed. The law applies when:

- A local emergency has been proclaimed.
- A state of emergency has been proclaimed.
- A federal disaster declaration has been made.

This Section provides the basic authorities for conducting emergency operations following a proclamation of *Local Emergency*, *State of Emergency*, or *State of War Emergency*, by the Governor and/or appropriate local authorities, consistent with the provisions of this Act.

The California Emergency Plan - Revised

Promulgated by the Governor, and published in accordance with the Emergency Services Act, the Plan provides overall statewide authorities and responsibilities, and describes the functions and operations of government at all levels during extraordinary emergencies, including wartime. Section 8568 of the Act states, in part, that "...the State Emergency Plan shall be in effect in each political subdivision of the state, and the governing body of each political subdivision shall take such action as may be necessary to carry out the provisions thereof." Local emergency plans are, therefore, considered to be extensions of the California Emergency Plan.

California Civil Code, Chapter 9, Section 1799.102

This section of the California Civil Code provides for "Good Samaritan Liability" for those providing emergency care at the scene of an emergency. Specifically: "No person, who, in good faith and not for compensation, renders emergency care at the scene of an emergency, shall be liable for any civil damages resulting from any act or omission. The scene of an emergency shall not include emergency departments and other places where medical care is usually offered."

State Hazard Mitigation Plan (SHMP) - 2018

The State Hazard Mitigation Plan (SHMP) identifies policy, establishes goals, and stipulates actions associated with the implementation of enhanced hazard mitigation strategies for California. The SHMP is foundational for local government hazard mitigation planning efforts, and provides inter-organizational guidance and direction based upon established state agency actions and principles.

Operational Area Governmental Authorities & Plans - Local Codes and Ordinances

Local government codes, ordinances, and executive policies are identified in Section 4.3.

1.5 History and Overview

The first people to inhabit the area of Marin County thousands of years ago are the indigenous Coast Miwok. The origin of the name “Marin” is unclear, but it is thought to be either named after the Chief of the Licatiut, a Coast Miwok tribe, or after Bahía de Nuestra Señora del Rosario la Marinera Bay between San Pedro Point and San Quentin Point. European colonization of Marin County began in the 1500’s when Sir Francis Drake landed in the area of modern-day Drake’s Bay in 1579. The Spanish eventually made claims to California and established their first settlement in Marin County in 1817. The Settlement of Marin County was incorporated in 1850 as one of the original 27 counties of California.

Marin County is located on northern California's Pacific coast and is bordered by Sonoma County to the north; the Pacific Ocean to the west; San Pablo Bay and San Francisco Bay to the east, and the City and County of San Francisco to the south. Marin County spans 828 square miles, of which 520 square miles is land and 308 square miles is water. This footprint makes Marin County among the four smallest counties in the State. Within the boundaries of Marin County are 11 municipalities, 20 Census Designated Places, and 8 recognized unincorporated communities. The county seat is the City of San Rafael.

County Government

Marin County is a general law county, whereby the Board of Supervisors is elected by district and principal officers of the County are regulated by statutes that assign their duties. County departments are responsible for providing a wide array of services to the unincorporated areas of Marin County, as well as within municipalities. Departments are managed by elected officials or appointed directors who are responsible for administering local programs and services, in accordance with both applicable state law and county regulations. Many county departments are further sub-divided into divisions, offices, and programs, which provide specific services to the public. The following is a list of Marin County departments:

- Administrator
- Agriculture, Weights and Measures
- Assessor
- Board of Supervisors
- Child Support Services
- County Administrator
- County Counsel
- Community Development
- County Clerk
- Cultural Services
- District Attorney
- Finance
- Elections
- Enhanced Court Collections
- Farm Advisor
- Health and Human Services
- Housing
- Human Resources
- Information Services and Technology
- Library
- Parks
- Probation
- Public Administrator
- Public Defender
- Public Works
- Recorder
- Retirement
- Registrar of Voters
- Sheriff's Office
- Superior Court

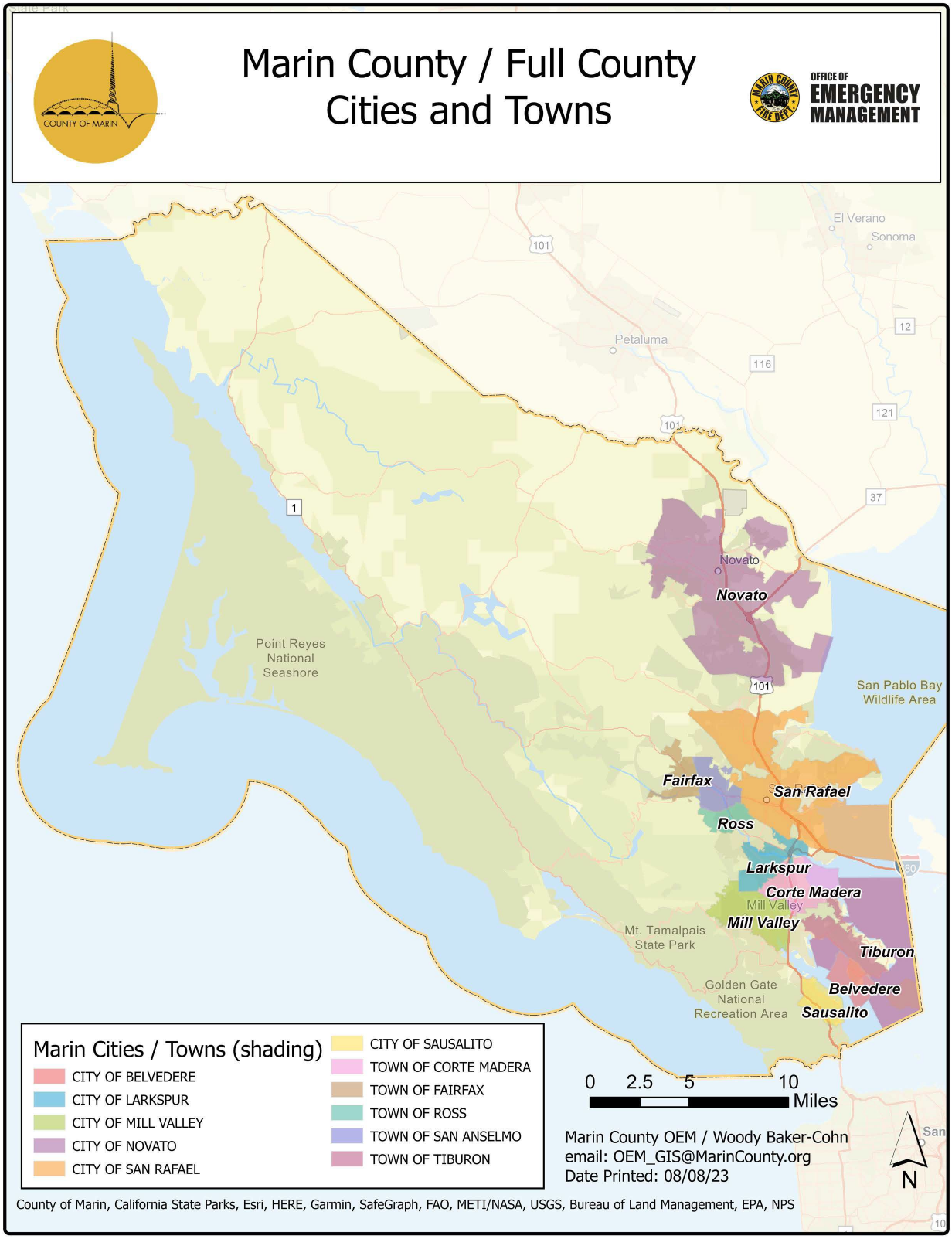


Figure 1.1: Map of Marin County
Source: Marin County OEM

Municipalities
Marin County has six cities and five towns.

City of Belvedere
The City of Belvedere was initially developed by the Belvedere Land Company who built homes and building sites, a water system, roads, and other amenities in the area. The city was officially incorporated on December 21st, 1896 and it's first post office was opened in 1897. Early Belvedere had a grocery store, telephone exchange, beauty shop, laundry, boatyard, plumber's shop, coal, wood and ice yard, blacksmith's shop, gas station and a jail. After World War 2, The Belvedere Land Company dredged a lagoon in San Francisco Bay and created additional living areas for Belvedere residents. The city has a total area of 2.4 square miles. It is predominantly hilly and is surrounded on three sides by San Francisco Bay. The City's population lives in three distinct neighborhoods: Belvedere Island, Belvedere Lagoon and Corinthian Island. Many City residences are considered historically significant.

Belvedere had an estimated population of 2,126 in 2020, with 1,060 housing units in the City. The median income for a household in the City was $246,500 and the per capita income for the City was $153,697. Approximately 4.4 percent of families and 5.8 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

Town of Corte Madera
The Town of Corte Madera is named after Corte Madera del Presidio, an 1834 Mexican land grant of the area to Irish immigrant John Reed that also established several communities in Marin County. Spanish for "cut wood", Corte Madera provided redwood and oak timber for the growth of early San Francisco, including much of the construction at the Presidio. As the timber disappeared, Corte Madera became a farming and ranching community. Corte Madera continued to grow with the formation of the North Pacific Coast Railroad Company in 1872, and a railroad station was constructed by 1875 with freight and commuter service. Development of the town's harbor allowed for further trade of goods. The town grew around the railroad station with the development of a town square and several neighborhoods. The Adams' Hotel and Tavern was the Town's first commercial business when built in 1898 and it served as the Town's first post office. The town was officially incorporated on June 10th, 1916. Further growth of the town occurred during World War II, when the Marinship Corporation built a shipyard in Sausalito and attracted thousands of ship workers to the area. The town currently has a total area of 3.2 square miles and is situated just south of the South Quentin Peninsula on San Francisco Bay. The terrain consists of hills and marshland where numerous creeks empty into San Francisco Bay.

The Town of Corte Madera had an estimated population of 10,222 in 2020, with 4,174 housing units in the Town. The Town has a total area of 4.406 square miles. The median income for a household in the Town was $183,661 and the per capita income for the Town was $95,257. Approximately 2.1 percent of families and 4.9 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

Town of Fairfax
The Town of Fairfax is named after Lord Charles Snowden Fairfax, whose estate in the area served as the site of the last political dual in California in 1861. Charles and Adele Pastori

purchased the Fairfax property and built a hotel and restaurant in the 1890's, attracting visitors who could take the ferry from San Francisco and travel on the newly constructed North Pacific Coast Railroad Company rail line. The first post office was opened in 1910. Fairfax continued to grow with the development of an incline railroad to Manor Hill in 1913, and numerous permanent residences were established. The town was officially incorporated on March 2nd, 1931. Fairfax continued to grow as a "center of grooviness" throughout the 1960's and 1970's. The town currently has a total area of 2.2 square miles and lies inland in the valleys of San Anselmo Creek and its tributary Fairfax Creek. Fairfax is generally hilly and is bordered to the south by the Mount Tamalpais protected watershed.

The Town of Fairfax had an estimated population of 7,441 in 2020, with 3,479 housing units in the Town. The Town has a total area of 2.204 square miles. The median income for a household in the Town is $111,290 and the per capita income for the Town is $59,011. Approximately 0.3 percent of families and 10.1 percent of the population is below the poverty line (2020 data, U.S. Census Bureau).

City of Larkspur

The City of Larkspur was first developed through an 1834 Mexican land grant to Irish immigrant John Reed that established several communities in Marin County. Much of the area of Larkspur was logged in the 1840's to supply lumber to San Francisco and the building of Presidio. Two sawmills were built to float logs down Corte Madera Creek to San Francisco Bay. Further growth was spurred by the formation of the North Pacific Coast Railroad Company railroad, with a railroad station being built in Larkspur. C.W. Wright and his American Land and Trust Company purchased much of present-day Larkspur in 1896, subdividing the land and piping in water. Wright's wife Georgina named the town Larkspur after she mistakenly identified the native lupine as Larkspur. C.W. Wright laid out the town in 1887 and the first post office opened in 1891. Larkspur quickly became a weekend destination for visitors from San Francisco, and a hotel, bathhouse, grocery store, and several retail shops were built. The City of Larkspur was officially incorporated on March 1st, 1908. Larkspur's Downtown Historic District, known also as Old Downtown Larkspur, was listed on the National Register of Historic Places in 1982. The city currently has a total area of 3.2 square miles and lies just inland of San Francisco Bay with hilly terrain on the southwest side.

The City of Larkspur had an estimated population of 13,064 in 2020, with 6,459 housing units in the City. The City has a total area of 3.243 square miles. The median income for a household in the City was $135,260 and the per capita income for the City was $94,909. Approximately 1.5 percent of families and 7.7 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

City of Mill Valley

The City of Mill Valley was first developed through two land grants: an 1834 Mexican land grant to Irish immigrant John Reed that established several communities in Marin County and an 1838 Mexican land grant to English immigrant William Richardson. A sawmill was built by Richardson in the 1830's to supply lumber to San Francisco and the building of Presidio, and a dairy ranch was established by Samuel Reading Throckmorton in 1854. Mill Valley continued to

grow with the development of the North Pacific Coast Railroad Company and the building of a resort hotel by Dr. John Cushing in the 1880's. The Tamalpais Land and Water Company took over possession of the land owned by Throckmorton and in 1889 built roads, pedestrian paths and step-systems and the Cascade Dam and Reservoir for water supply. They also set aside land for churches, schools and parks. New residents built houses and the City of Mill Valley was officially incorporated on September 1st, 1900. The post office opened under the name "Eastland" but was changed to "Mill Valley" in 1904. Mill Valley was almost lost to a wildfire in 1929, when 117 homes were destroyed, but a change in winds saved the city. Further growth of the town occurred during World War II, when the Marinship Corporation built a shipyard in Sausalito and attracted thousands of ship workers to the area. Since the mid-1960s, growth in the city has generally remained constant. The city currently has a total area of 4.9 square miles and is located between Mt. Tamalpais on the west and the Golden Gate National Recreational Area on the south. Mill Valley is generally hilly and wooded and is surrounded by hundreds of acres of state, federal, and county park lands. In addition, there are many municipally maintained open-space reserves, parks, and coastal habitats. The Arroyo Corte Madera del Presidio and Cascade Creek flow from the slopes of Mt. Tamalpais through Mill Valley to the San Francisco Bay.

The City of Mill Valley had an estimated population of 14,231 in 2020, with 6,502 housing units in the City. The City has a total area of 4.847 square miles. The median income for a household in the City was $179,529 and the per capita income for the City was $110,356. Approximately 2.4 percent of families and 4.5 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

City of Novato

The City of Novato is name after Rancho Novato, the first rancho established in the area through a Mexican land grant to Fernando Feliz in 1830. Novato was developed through four additional land grants that established ranchos in the area: Rancho Corte Madera de Novato to John Martin in 1839; Rancho San Jose to Ignacio Pacheco in 1840; Rancho Olómpali to Camilo Ynitia in 1843; and Rancho Nicasio to Pablo de la Guerra and John B.R. Cooper in 1844. Early pioneers Joseph Sweetser and Francis De Long planted orchards and vineyards in the area in the 1850's, and the original town grew around Novato Creek. A post office opened in 1856 and a school was built in 1859. With the development of the North Pacific Coast Railroad Company, the center of the town shifted around the newly built railroad station in 1879. Many farmers in Novato lost their land in the Great Depression, but growth accelerated with the building of the 101 freeway. The City of Novato was officially incorporated on January 20, 1960. The city has an area of 28 square miles and includes ten Marin County Open Space District preserves: Mount Burdell, Rush Creek, Little Mountain, Verissimo Hills, Indian Tree, Deer Island, Indian Valley, Ignacio Valley, Loma Verde, and Pacheco Valle. Novato is located on San Francisco Bay and has extensive farmland and wetlands with hilly terrain on the southwest side.

The City of Novato had an estimated population of 53,225 in 2020, with 21,271 housing units in the City. The City has a total area of 27.440 square miles. The median income for a household in the City was $107,975, and the per capita income for the City was $57,297. Approximately 2.5 percent of families and 7.9 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

Town of Ross

The Town of Ross was established as part of a Mexican land grant to Juan B.R. Cooper in 1840 known as Ranch Punta de Quentin Canada de San Anselmo. Ross was named in honor of James Ross, who purchased the land from Cooper in 1857. The first post office opened in 1887, and the Town of Ross was officially incorporated on August 21, 1908. The town continued to grow through the 1900's as residents moved into its shaded canyons and gently sloping hills. The town has an area of 1.6 square miles and lies inland of San Francisco Bay. Most of Ross is forested with greater open space on its east and west sides.

The Town of Ross had an estimated population of 2,338 in 2020, with 880 housing units in the Town. The Town has a total area of 1.556 square miles. The median income for a household in the Town is $250,000 and the per capita income for the Town is $128,126. Approximately 0 percent of families and 3.5 percent of the population is below the poverty line (2020 data, U.S. Census Bureau/ 2021 American Community Survey).

Town of San Anselmo

The Town of San Anselmo received its name came from the Punta de Quintin land grant, which marked the valley as the Canada del Anselmo, or Valley of Anselm. The original area of San Anselmo consisted mostly of cattle ranches until the North Pacific Railroad Company formed and built a railroad line through the area in 1874, bringing in visitors from San Francisco. The town began to grow with the building of the San Francisco Theological Seminary in 1892 and the first post office opened in the same year. Summer homes were built in the area by San Francisco residents, and many of these homes became permanent after the 1906 San Francisco Earthquake. The Town of San Anselmo was officially incorporated on April 9th, 1907. Growth in the town continued until leveling off in the 1960's. On March 12th, 1974, San Anselmo officially became a town. The town has a total area of 2.7 square miles and lies inland almost completely within the Ross Valley Watershed that flows into San Francisco Bay.

The Town of San Anselmo had an estimated population of 12,830 in 2020, with 5,518 housing units in the Town. The Town has a total area of 2.677 square miles. The median income for a household in the Town is $153,381 and the per capita income for the Town is $ $87,951. Approximately 0 percent of families and 3.9 percent of the population is below the poverty line (2020 data, U.S. Census Bureau). A large part of southern and western San Anselmo is built on a natural floodplain. San Anselmo's historic raised railroad bed acts as a dike, providing some flood protection to the west-side houses, upstream of the business district.

City of San Rafael

The City of San Rafael is the county seat of Marin County and is named for the Archangel Raphael. Mission San Rafael Archangel was founded in the area of what is now downtown San Rafael in 1817. In its first year, the Mission gained 300 converts. By 1828, there were 1,140 converts. The Mexican government took over the Mission in 1834. Mission San Rafael was abandoned in 1844, eventually deteriorating into ruin. The city continued to grow, however, and was officially incorporated on February 18th, 1874. Further growth of the city occurred when the North Pacific Railroad Company built a rail line through the area in 1879 and when Dominica University of California was built in 1890. The United States Navy operated a San Pablo Bay degaussing range from San Rafael through World War II. The city has a total area of 22.5

square miles and lies along San Francisco Bay. The San Rafael shoreline has been historically filled to a considerable extent to accommodate land development. San Rafael has a wide diversity of natural habitats from forests to marshlands.

The City of San Rafael is the county seat of Marin County. San Rafael had an estimated population of 61,271 in 2020, with 24,502 housing units in the City. The City has a total area of 22.422 square miles. The median income for a household in the City was $104,521 and the per capita income for the City was $61,962. Approximately 5 percent of families and 9.2 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

City of Sausalito

The City of Sausalito was founded as a place where ships near San Francisco could pick up fresh water in the 1830's. A mariner named William A. Richardson had arrived in the area and built a rancho in 1925 in the Marin headlands where a freshwater spring was located. Sausalito is named after the Spanish words for "little willow", for a stand of small willow trees in the town where the fresh water ran down to San Francisco Bay. The town grew throughout the mid-1800's into a small fishing, boat repair and ranching center, inhabited by both fisherman and yacht enthusiasts. The North Pacific Railroad Company developed a southern rail terminus in Sausalito in the 1870's, providing a link to the Sausalito pier where ferries transported people and goods to and from San Francisco. The first post office was opened in 1870, and the City of Sausalito was incorporated in September 4th, 1893. The neighborhoods of Sausalito continued to grow throughout the early 1900's, with the development of car ferries to and from San Francisco and the building of the Golden Gate Bridge in 1937. In 1941, the Marin Shipyard Corporation filled in a marshy area north of Sausalito to build the Marin Shipyard, bringing in thousands of ship builders to the area. After World War II, waterfront communities grew out of the abandoned shipyards, contributing to the development of houseboat communities that still exist today. Sausalito maintains its reputation as an art colony and literary enclave. The city has a total area of 2.3 square miles and encompasses both steep, wooded hillside and shoreline tidal flats.

The City of Sausalito had an estimated population of 7,269 in 2020, with 4,425 housing units in the City. The City has a total area of 2.257 square miles. The median income for a household in the City was $140,410 and the per capita income for the City was $111,167. Approximately 0 percent of families and 7.3 percent of the population were below the poverty line (2020 data, U.S. Census Bureau).

Town of Tiburon

The Town of Tiburon is named after the Spanish word for "shark." The town was first developed through an 1834 Mexican land grant to Irish immigrant John Reed that established several communities in Marin County. The town began to grow in 1884 with the formation of the North Pacific Railroad Company and the first post office opened the same year. The rail line extended from San Rafael to its original southern terminus in Point Tiburon with connection to San Francisco by ferry. Industry including codfish canning, brick making, powder making and train building and repair brought growth to the Tiburon area in the late 1800's and early 1900's. The U.S. Navy established a coaling station in Tiburon in 1904. World War II brought additional growth to Tiburon, and the Town of Tiburon was officially incorporated on June 23rd, 1964. The

town has a total area of 13.2 square miles, and lies on a peninsula jutting into San Francisco Bay.

The Town of Tiburon had an estimated population of 9,146 in 2020, with 4,047 housing units in the Town. The Town has a total area of 13.182 square miles. The median income for a household in the Town was $192,292 and the per capita income for the Town was $119,477. Approximately 0 percent of families and 1.3 percent of the population were below the poverty line (2010 data, U.S. Census Bureau).

Unincorporated Communities
All unincorporated areas of Marin County are under jurisdiction of the County. Unincorporated communities include Bel Marin Keys, California Park, Dogtown, Fallon, Forest Knolls, Greenbrae, Hamlet, Ignacio, Inverness Park, Lagunitas, Los Ranchitos, Lucas Valley, Marconi, Marshall, Olema, Paradise Cay, San Quentin, Tamalpais Valley and Tocaloma. In unincorporated areas, basic services like water, sewer, police and fire protection are provided by the county. The County Service Area (CSA) Law (Government Code §25210.1 et seq.) was created in the 1950's to provide a means of providing expanded service levels in areas where residents are willing to pay for the extra service. CSAs allow small communities in unincorporated areas to pay for and receive specific services from the county. The CSAs in Marin County include:

County Service Area 1 - Loma Verde
County Service Area 6 - Gallinas Creek
County Service Area 9 - Northbridge
County Service Area 13 - Upper Lucas Valley
County Service Area 14 - Homestead Valley
County Service Area 16 - Greenbrae
County Service Area 17 - Kentfield/Larkspur
County Service Area 18 - Las Gallinas
County Service Area 19 - Los Ranchitos, Country Club, and Santa Venetia
County Service Area 20 - Indian Valley
County Service Area 27 - Ross Valley
County Service Area 28 - West Marin
County Service Area 29 - Paradise Cay
County Service Area 31 - Fire Service in Unincorporated Marin
County Service Area 33 - Stinson Beach

Special Districts
The following is a list of independent Special Districts in Marin County:

Almonte Sanitary District
Alto Sanitary District
Bel Marin Keys Community Services District
Bolinas Community Public Utility District
Bolinas Fire Protection District
Homestead Valley Sanitary District
Inverness Public Utility District

Kentfield Fire Protection District
Las Gallinas Valley Sanitary District
Marin City Community Services District
Marin Healthcare District
Marin Municipal Water District
Marin Resource Conservation District
Marinwood Community Services District
Muir Beach Community Services District
North Marin Water District
Novato Fire Protection District
Novato Sanitary District
Richardson Bay Sanitary District
Ross Valley Sanitary District
Sausalito-Marin City Sanitary District
Sleepy Hollow Fire Protection District
Sonoma-Marin Area Rail Transit District
Southern Marin Fire Protection District
Stinson Beach Fire Protection District
Stinson Beach Water District
Strawberry Recreation District
Tamalpais Community Service District
Tiburon Fire Protection District
Tiburon Sanitary District No. 5
Tomales Village Community Service District

The following is a list of dependent jurisdictions in Marin County:

Corte Madera Sanitary District No. 2
Marin County Parks Open Space District
San Rafael Sanitation District
San Quentin Village Sewer Maintenance District
Sausalito Marin City Sanitary District
Sewerage Agency of Southern Marin
Murray Park Sewer Maintenance District

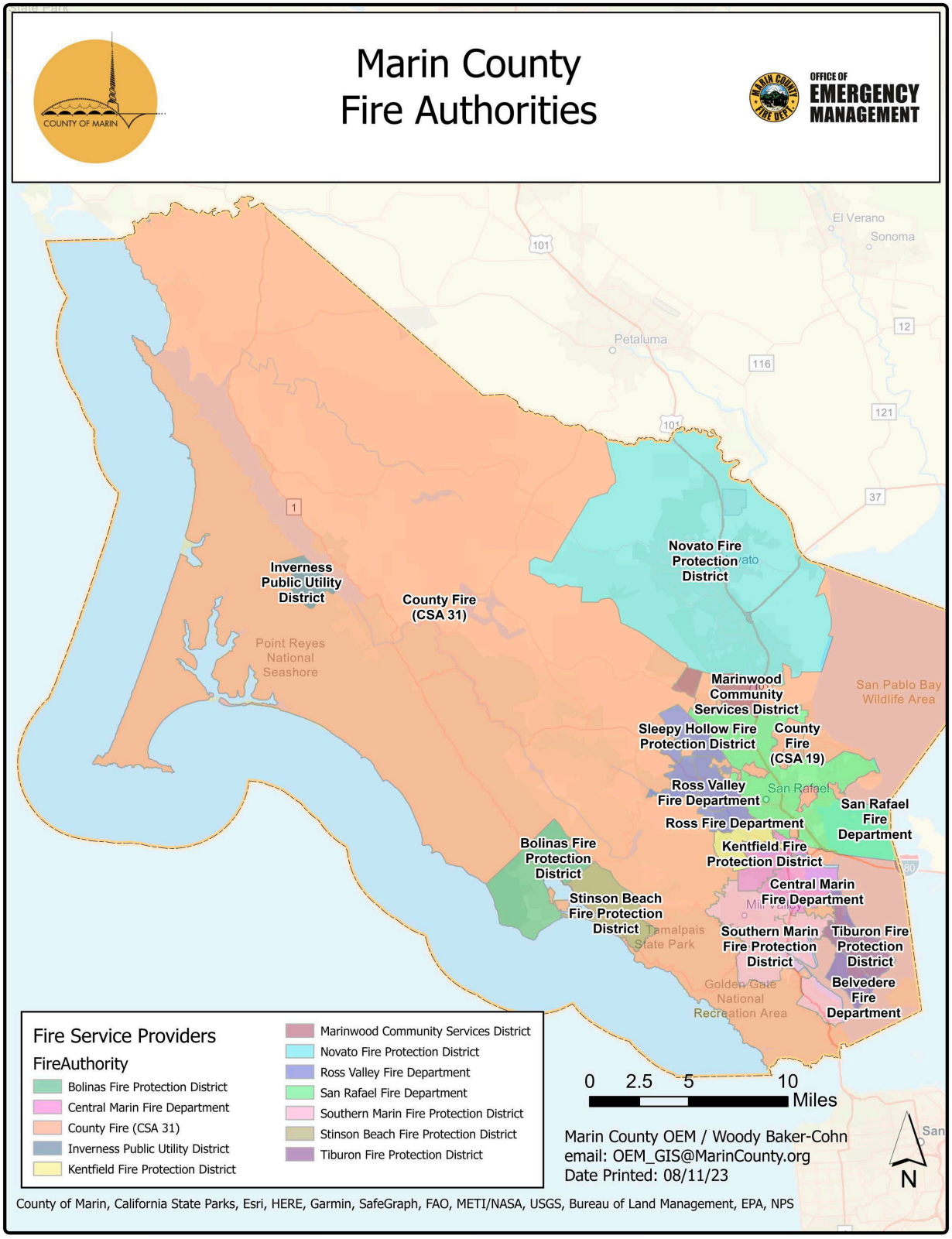


Figure 1.2: Fire Protection Districts in Marin County
Source: Marin County Community Wildfire Protection Plan

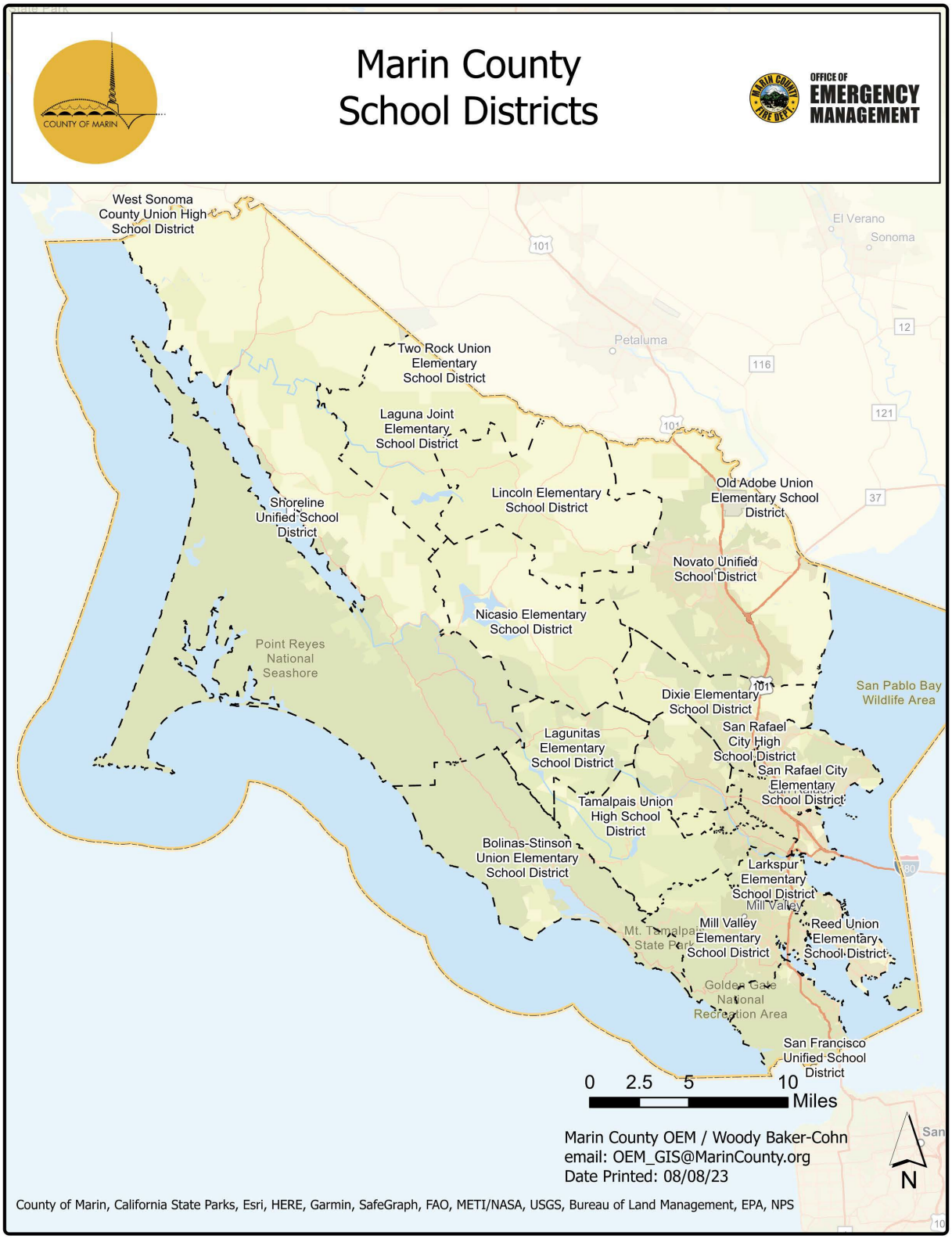


Figure 1.3: School Districts in Marin County
Source: Marin County OEM

Protected Areas

The following protected areas are within or contiguous to Marin County:

National Protected Areas

- Golden Gate National Recreation Area
- Marin Islands National Wildlife Refuge
- Muir Woods National Monument
- Point Reyes National Seashore
- San Pablo Bay National Wildlife Refuge
- Greater Farallones National Marine Sanctuary

State Parks

- Angel Island State Park
- China Camp State Park
- Mount Tamalpais State Park
- Olompali State Historic Park
- Samuel P. Taylor State Park
- Tomales Bay State Park

Marine Protected Areas

- Duxbury Reef State Marine Conservation Area
- Estero Americano State Marine Recreational Management Area
- Estero de San Antonio State Marine Recreational Management Area
- Point Reyes State Marine Reserve & Drakes Estero State Marine Conservation Area

Figure 1.4: Muir Woods National Monument
Source: National Park Service

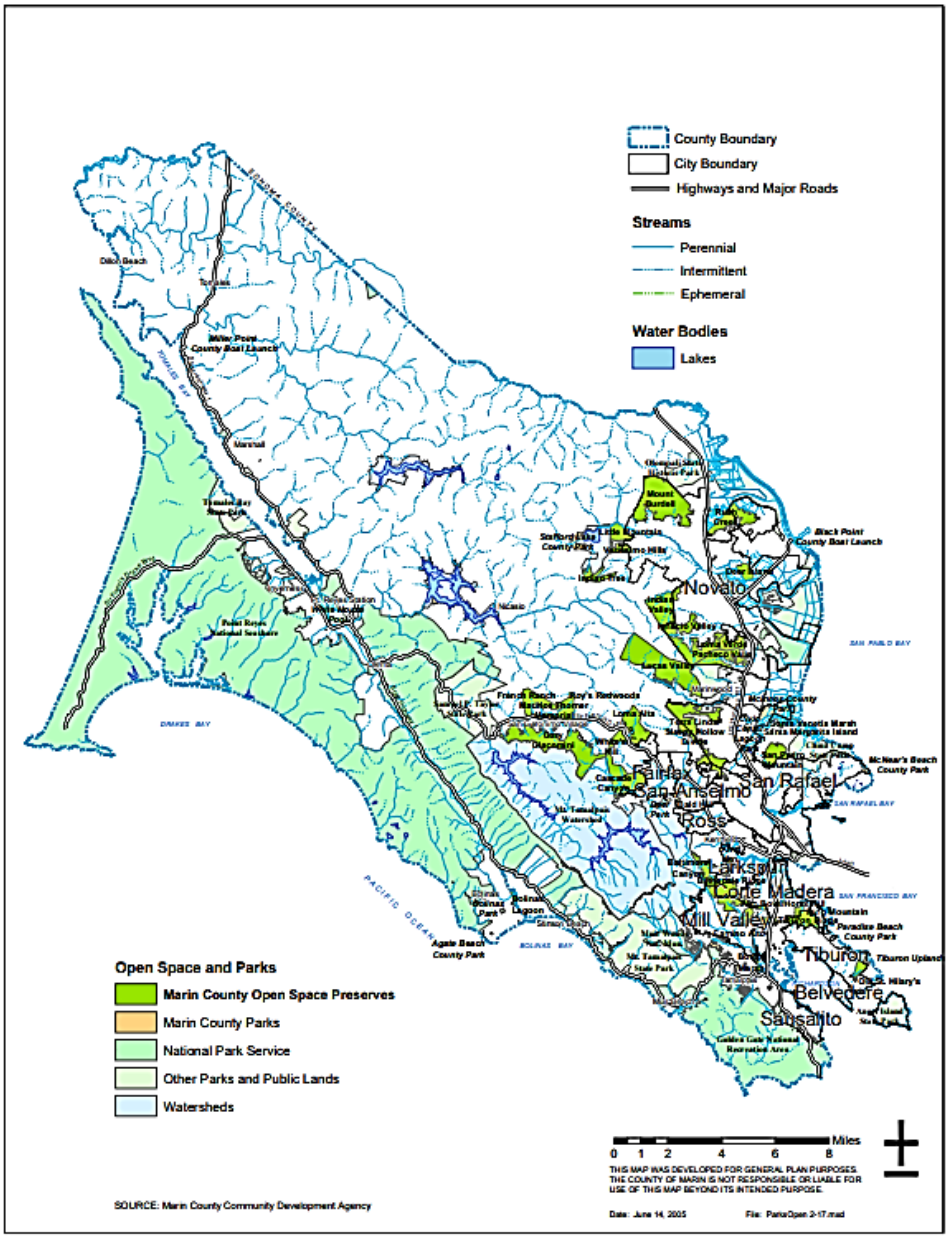


Figure 1.5: Marin County Parks and Public Lands
Source: Marin County

Marin County's identity is largely shaped by its abundant natural resources and long history of open space preservation efforts to retain its rural character. A variety of factors have strictly limited development in the County over the last 5 years including large swaths of permanently protected federal and state parkland, large acreage of farm and ranch lands permanently protected through conservation easements, and Countywide Plan policies and development codes which restrain growth in sensitive habitat areas and/or flood hazard areas. Similarly future development is limited by these same constraints, as outlined in Section 4.10 Future Development.

1.5.1 DEMOGRAPHICS

Marin County is the 26th most populated county in the state of California. According to the U.S. Census Bureau, the population of Marin County in July 2021 was 260,206, an increase of 2.99% from the 2010 population of 252,409. The estimated population of Marin County in 2023 is around 265,294.

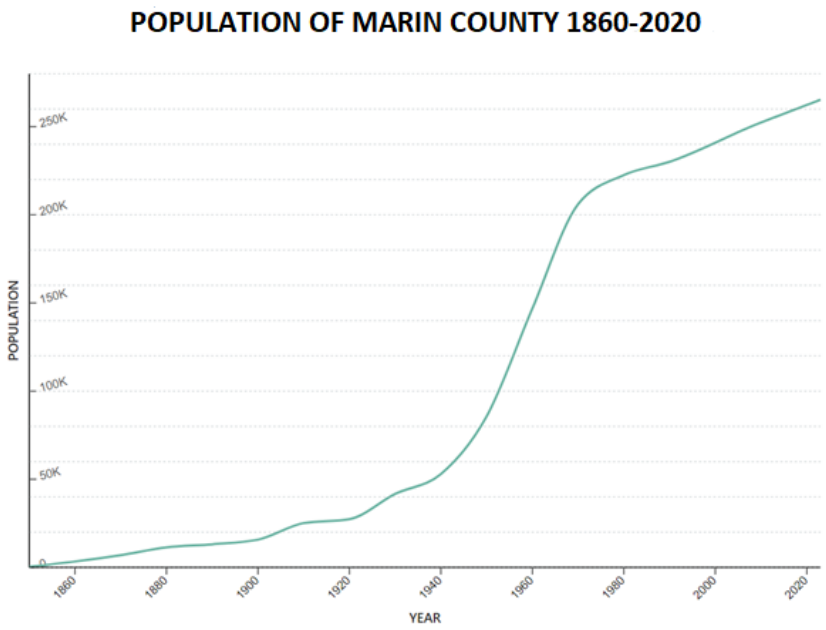


Figure 1.6: Population of Marin County 1860-2020
Source: U.S. Census Bureau 2020 Survey

Marin County grew rapidly from the 1930's to the 1970's, with slower growth from the 1970's to the 2020's. Between 1960 and 1970, the population of Marin County grew by 71.48% and has only grown by 21.45% since. Since the last plan update in 2018, the population of Marin County has remained fairly level.

Table 1.1: Marin County Population Changes 1860-2020

Year	Population	Change	Growth Rate
1850	323	N/A	N/A
1860	3,334	3,011	932.20%
1870	6,903	3,569	107.05%
1880	11,324	4,421	64.04%
1890	13,072	1,748	15.44%
1900	15,702	2,630	20.12%
1910	25,114	9,412	59.94%
1920	27,342	2,228	8.87%
1930	41,648	14,306	52.32%
1940	52,907	11,259	27.03%
1950	85,619	32,712	61.83%

1960	146,820	61,201	71.48%
1970	206,038	206,038	40.33%
1980	222,568	16,350	8.02%
1990	230,096	7,528	3.38%
2010	252,916	22,313	9.70%
2020	262,321	9,405	3.77%

Table 1.1: Marin County Population Changes 1860-2020
Source: U.S. Census Bureau 2020 Survey

The California Department of Finance shows an overall estimated decrease in the population of Marin County since the last plan update in 2018. Of the total estimated 257,135 residents of Marin County in 2022 based on the 2020 U.S. Census Survey, 190,148 residents live in the incorporated county and 66,987 residents live in the unincorporated county.

Table 1.2: Marin County Estimated Jurisdictional Population

Jurisdiction	Population 2022 (Estimate)	Population 2020	Population 2018 (Estimate)	Percent Change 2018-2022
Marin County	257,135	262,321	262,179	-1.92%
Unincorporated Marin County	66,987	66,987	68,963	-2.87%
City of Belvedere	2,080	2,126	2,102	-1.04%
City of Larkspur	12,797	13,064	12,396	3.13%
City of Mill Valley	13,850	14,231	14,702	-5.80%
City of Novato	52,441	53,225	54,036	-2.95%
City of San Rafael	60,560	61,271	59,851	1.17%
City of Sausalito	7,072	7,269	7,449	-5.06%
Town of Corte Madera	10,028	10,222	10,104	-0.75%
Town of Fairfax	7,418	7,605	7,625	-2.71%
Town of Ross	2,301	2,338	2,566	-10.33%
Town of San Anselmo	12,645	12,830	12,853	-1.62%
Town of Tiburon	8,956	9,146	9,542	-6.14%

Table 1.2: Marin County Estimated Jurisdictional Population
Source: California Department of Finance

Population counts of the Marin County unincorporated area were taken in the 2020 and 2010 U.S. Census Surveys.

Table 1.3: Marin County Estimated Jurisdictional Population			
Community	Population 2020	Population 2010	Percent Change 2010-2020
Marin County	262,321	262,179	-1.92%
Unincorporated Marin County	66,987	68,963	-2.87%
City of Belvedere	2,126	2,102	-1.04%
City of Larkspur	13,064	12,396	3.13%
City of Mill Valley	14,231	14,702	-5.80%
City of Novato	53,225	51,904	-2.95%
City of San Rafael	61,271	59,851	1.17%
City of Sausalito	7,269	7,449	-5.06%
Town of Corte Madera	10,222	10,104	-0.75%
Town of Fairfax	7,605	7,625	-2.71%
Town of Ross	2,338	2,566	-10.33%
Town of San Anselmo	12,830	12,853	-1.62%
Town of Tiburon	9,146	9,542	-6.14%

Table 1.3: Marin County Estimated Jurisdictional Population Change 2010-2020
Source: California Department of Finance

The Association Bay Area of Governments (ABAG) projects that the population in the unincorporated County will grow by only 2% in the next two decades. Tam Valley, Kentfield/Greenbrae, and the Marinwood/Lucas Valley communities are the most populous areas within the unincorporated County.

The median age of Marin County residents in 2020 is 47.1, with 45.6 for males and 48.4 for females. The male to female ratio in Marin County as of 2020 is 126,529 males (48.77%) and 132,912 females (51.23%.) There are 207,467 adults in Marin County as of 2020, 57,834 of whom are seniors.

Table 1.4: Marin County Population Age by Gender 2020			
Age	**Population**	**Male**	**Female**
Under 5 years	12,014	5,852	6,162
5 to 9 years	13,355	6,703	6,652
10 to 14 years	16,784	8,574	8,210
15 to 19 years	15,122	7,676	7,446
20 to 24 years	11,663	6,009	5,654
25 to 29 years	10,562	5,709	4,853
30 to 34 years	11,896	6,237	5,659

Table 1.4: Marin County Population Age by Gender 2020			
Age	**Population**	**Male**	**Female**
35 to 39 years	14,253	7,160	7,093
40 to 44 years	16,191	8,237	7,954
45 to 49 years	20,074	9,925	10,149
50 to 54 years	20,430	10,051	10,379
55 to 59 years	20,887	9,616	11,271
60 to 64 years	18,376	9,071	9,305
65 to 69 years	17,971	8,307	9,664
70 to 74 years	15,424	7,088	8,336
75 to 79 years	10,040	4,689	5,351
80 to 84 years	7,083	3,195	3,888
85 years +	7,316	2,430	4,886

Table 1.4: Marin County Population Age by Gender 2020
Source: U.S. Census Bureau 2020 Survey

By race, Marin County is predominantly white. According to the U.S. Census Bureau, 69.7% of the population is White, 17.1% is Hispanic, 7.1% is Asian, 4.3% is Two or more races, 2.7% is Black or African American, 1.0% is American Indian or Alaska Native, 0.3% is Native Hawaiian or Pacific Islander as of 2022.

Table 1.5: Marin County Population by Race or Ethnicity	
Race or Ethnicity	**Percent**
White, alone	**69.7**
Hispanic, Non-white	**17.1**
Asian, alone	**7.1**
Two or More Races	**4.3**
Black or African American, alone	**2.7**
American Indian or Alaska Native, alone	**1.0**
Native Hawaiian or Pacific Islander, alone	**0.3**

Table 1.5: Marin County Population by Race or Ethnicity
Source: U.S. Census Bureau 2022 Survey

The average family size in Marin County as of 2022 is 2.97, and the average household size is 2.41 with an approximate home ownership rate of 63.6%. As of 2022, 70.9% of the housing stock was single family structures, 27.3% was multi-family structures, and 1.8% were mobile homes and other types of units. In unincorporated Marin County, the largest proportion of the housing stock was built from 1960 to 1979, with 10,258 units constructed during this period. Since 2010, 1.2% of the current housing stock was built, which equates to 360 units.

Table 1.6: Marin County Housing Stock
2022 and 2018

Year		Total Units	Single Family		Multi-Family		Mobile Homes
			Detached	Attached	2 to 4	5 plus	
Marin County							
2022	Number	111,879	68,004	11,314	8,524	22,013	1,984
	Percent	100.0%	60.8%	10.1%	7.6%	19.7%	1.8%
2018	Number	112,294	68,697	11,318	8,307	21,986	1,986
	Percent	100.0%	61.2%	10.1%	7.4%	19.6%	1.8%
California							
2022	Number	14,583,998	8,341,577	1,010,851	1,168,669	3,500,674	562,223
	Percent	100.0%	57.2%	6.9%	8.0%	24.0%	3.9%
2018	Number	14,157,502	8,160,864	985,926	1,129,761	3,318,946	562,005
	Percent	100.0%	57.6%	7.0%	8.0%	23.4%	4.0%

Table 1.6: Marin County Housing Stock
Source: California Department of Finance

Table 1.7: Marin County Jurisdictional Housing Stock
2022 and 2018

Year		Total Units	Single Family		Multi-Family		Mobile Homes
			Detached	Attached	2 to 4	5 plus	
Unincorporated Marin County							
2022	Number	29,293	22,456	1,875	1,443	2,939	580
	Percent	100.00%	76.66%	6.40%	6.43%	10.03%	1.98%
2018	Number	29,723	22,833	1,909	1,409	2,993	579
	Percent	100.00%	76.82%	6.42%	4.74%	10.07%	1.95%
City of Belvedere							
2022	Number	1,062	890	51	84	37	0
	Percent	100.00%	83.80%	4.80%	7.91%	3.48%	0.00%
2018	Number	1,048	881	49	81	37	0
	Percent	100.00%	84.06%	4.68%	7.73%	3.53%	0.00%
City of Larkspur							
2022	Number	6,460	2,653	439	479	2,614	275
	Percent	100.00%	41.07%	6.80%	7.41%	40.46%	4.26%
2018	Number	6,479	2,650	427	488	2,625	289
	Percent	100.00%	40.90%	6.59%	7.53%	40.52%	4.46%

City of Mill Valley							
2022	**Number**	6,521	4,269	648	380	1,210	14
	Percent	100.00%	65.47%	9.94%	5.83%	18.56%	0.21%
2018	**Number**	6,509	4,296	657	331	1,212	13
	Percent	100.00%	66.00%	10.09%	5.09%	18.62%	0.20%
City of Novato							
2022	**Number**	21,337	12,465	3,395	1,362	3,572	543
	Percent	100.00%	58.42%	15.91%	6.38%	16.74%	2.54%
2018	**Number**	21,448	12,581	3,427	1,335	3,557	548
	Percent	100.00%	58.66%	15.98%	6.22%	16.58%	2.56%
City of San Rafael							
2022	**Number**	24,631	11,318	2,490	2,174	8,235	413
	Percent	100.00%	45.95%	10.11%	8.83%	33.43%	1.68%
2018	**Number**	24,078	11,123	2,399	2,090	8,059	407
	Percent	100.00%	46.20%	9.96%	8.68%	33.47%	1.69%
City of Sausalito							
2022	**Number**	4,435	1,711	802	934	906	82
	Percent	100.00%	38.58%	18.08%	21.06%	20.43%	1.85%
2018	**Number**	4,581	1,776	829	953	938	85
	Percent	100.00%	38.77%	18.10%	20.80%	20.48%	1.86%
Town of Corte Madera							
2022	**Number**	4,182	2,468	621	376	717	0
	Percent	100.00%	59.01%	14.85%	8.99%	17.14%	0.00%
2018	**Number**	4,207	2,498	609	373	727	0
	Percent	100.00%	59.38%	14.48%	8.87%	17.28%	0.00%
Town of Fairfax							
2022	**Number**	3,486	2,185	338	499	451	13
	Percent	100.00%	62.68%	9.70%	14.31%	12.94%	0.37%
2018	**Number**	3,594	2,281	345	486	469	13
	Percent	100.00%	63.47%	9.60%	13.52%	13.05%	0.36%
Town of Ross							
2022	**Number**	882	817	17	23	25	0
	Percent	100.00%	92.63%	1.93%	2.61%	2.83%	0.00%
2018	**Number**	892	831	16	19	26	0
	Percent	100.00%	93.16%	1.79%	2.13%	2.91%	0.00%
Town of San Anselmo							
2022	**Number**	5,539	4,177	266	376	683	37
	Percent	100.00%	75.41%	4.80%	6.79%	12.33%	0.67%
2018	**Number**	5,563	4,211	269	356	690	37
	Percent	100.00%	75.70%	4.84%	6.40%	12.40%	0.67%

Town of Tiburon							
2022	Number	4,051	2,645	386	383	624	14
	Percent	100.00%	65.29%	9.53%	9.45%	15.40%	0.35
2018	Number	4,036	2,644	384	370	624	14
	Percent	100.00%	65.51%	9.51%	9.17%	15.46%	0.35%

Table 1.7: Marin County Jurisdictional Housing Stock
Source: California Department of Finance

1.5.2 Critical Facilities and Infrastructure

A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. FEMA uses the following three categories of critical assets (Essential Facilities, High Potential Loss Facilities, and Infrastructure Systems). Essential facilities are those that if damaged would have devastating impacts on disaster response and/or recovery. High potential loss facilities are those that would have a high loss or impact on the community. Infrastructure systems are a third category of critical assets.

Marin County maintains a listing of critical facilities in Marin County and the list is categorized according to FEMA's critical facility definition. Additionally, each jurisdiction in Marin County lists the critical facilities specific to that jurisdiction. The following are general categories of critical facilities in the Marin County OA:

Critical facilities include, without limitation, public safety, emergency response, emergency medical, designated emergency shelters, communications, public utility plant facilities and equipment, and government operations.

- Public Safety - Police stations, fire and rescue stations, emergency operations centers
- Emergency Response - Emergency vehicle and equipment storage and essential governmental work centers for continuity of government operations
- Emergency Medical - Hospitals, emergency care, urgent care, ambulance services
- Designated Emergency Shelters
- Communications - Main hubs for telephone, main broadcasting equipment for television systems, radio and other emergency warning systems
- Public Utility Plant Facilities - including equipment for treatment, generation, storage, pumping and distribution (hubs for water, wastewater, power and gas)
- Essential Government Operations - Public records, courts, jails, building permitting and inspection services, government administration and management, maintenance and equipment centers, and public health
- Transportation Lifeline Systems - Airports, helipads, and critical highways, roads, bridges and other transportation infrastructure (Note: Critical highways, roads, etc. will be determined during any hazard-specific evacuation planning and are not identified in this plan)

At risk population facilities include, without limitation, pre-schools, public and private primary and secondary schools, before and after school care centers with 12 or more students, daycare centers with 12 or more children, group homes, and assisted living residential or congregate care facilities with 12 or more residents.

Hazardous materials facilities include, without limitation, any facility that could, if adversely impacted, release of hazardous material(s) in sufficient amounts during a hazard event that would create harm to people, the environment and property.

Transportation

Marin County has an ever-developing transportation system, with most travel concentrated along key highways and arterial streets. There are 5 Highways passing through, terminating, or located wholly in Marin County: Interstate 580, U.S. Route 101, State Route 1, State Route 37, and State Route 131.

Marin County is connected to surrounding communities by bridges. The Golden Gate Bridge is to the south; the Richmond/San Rafael Bridge is to the east; State Route 37 is to the northeast (across filled bay land over San Pablo Bay); and Highway 101 is to the north (which narrows to a 4-lane uncontrolled road that traverses San Antonio Creek). One of the major problems Marin County faces during an emergency is the possibility of being isolated from the surrounding communities and any resources or help. Light rail service recently began supplementing existing transportation options along U.S. Route 101 between Marin and Sonoma Counties.

Utilities

Municipal utilities in Marin County include water (drinking water, stormwater, sanitary sewerage), power (electricity and natural gas), telecommunications, and solid waste. Several water management utilities supply treated water for domestic and fire suppression purposes. These distribution systems rely largely on the County's topography for collecting surface water, storing it in reservoirs, and distributing it with gravity-fed systems. As such, the water management utilities are separated by both functional area and geography, but they are working more and more to coordinate within watersheds.

Marin Municipal Water District (MMWD) is the largest water district in Marin, serving central and southern portions of the county east of Mount Tamalpais and Bolinas Ridge. North Marin Water District (NMWD) serves Novato and communities along Tomales Bay including Olema, Point Reyes Station, Inverness, and Dillon Beach. Bolinas and Stinson Beach, two communities in West Marin, have separate water and sanitary districts. To include the Bolinas Community Public Utility District. Inverness Public Utility District is the primary water utility for Inverness Park and the Estero Mutual Water Company serves Dillon Beach. There are 23 agencies providing wastewater services in Marin County, including special districts, municipalities, JPAs and the Federal and State government.

Stormwater utilities such as open channels, catch basins and storm drains are managed by the cities, towns, and the county in unincorporated areas and are coordinated through the Marin County Stormwater Pollution Prevention Program (MCSTOPPP). Additionally, the Marin County Flood Control and Water Conservation District maintains some larger drainage infrastructure where zones have been designated. The District and some cities/towns such as San Rafael, Corte Madera, and Novato operate stormwater pump stations.

Natural gas and electricity distribution occurs through infrastructure owned and maintained by PG&E, a private utility corporation. Natural gas is piped into Marin from the central valley around the North Bay through Solano, Napa, and Sonoma Counties. The main transmission pipelines are underground along Highway 101 and flow south, branching into local distribution lines and private laterals. PG&E also brings power into Marin around the North Bay on overhead

transmission lines that emanate from the Ignacio substation in Novato. Additional substations are located along Hwy 101 in Las Gallinas, San Rafael, Greenbrae, and Mill Valley to the South and in Novato, Stafford, Tocaloma, Olema, Bolinas and Woodacre to the North and East.

Telecommunications include telephone service, cable television and wireless services. AT&T maintains infrastructure for providing landlines, while Comcast provides cable television. A variety of cellular and wireless service companies operate in Marin and provide access points in the form of cellular towers, wireless antennas and equipment.

There are six solid waste haulers that operate within Marin County organized geographically and with agreements with cities and towns. All of this garbage, recycling, and greenwaste is brought to one of two processing centers; Redwood Landfill in Novato and Marin Resource Recovery Center in San Rafael.

1.5.3 Natural, Historical, and Cultural Resources

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

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

Natural Resources

Marin County is located along California's Pacific Coast (between San Francisco and Sonoma), including 72 miles of coastline. The highest point in the county, Mount Tamalpais, is 2,572 feet above sea level. The county has many microclimates with varying weather patterns, but the climate is generally Mediterranean with an average annual temperature of 56.5 degrees Fahrenheit.

The Marin Countywide Plan divides the 606 square miles of land and water that make up Marin County into four distinct environmental regions called corridors. Each corridor is based on specific geographical and environmental characteristics and natural boundaries:

- The Coastal Corridor is adjacent to the Pacific Ocean and is primarily designated for federal parklands, recreational uses, agriculture, and the preservation of existing small coastal communities.
- The Inland Rural Corridor, in the central and northwestern part of the county, is primarily designated for agriculture and compatible uses, and for preservation of existing small communities.
- The City-Centered Corridor, along Highway 101 in the eastern part of the county near San Francisco and San Pablo bays, is primarily designated for urban development and

for protection of environmental resources. This corridor is divided into six planning areas generally based on watersheds.

- The Baylands Corridor, encompassing lands along the shoreline of San Francisco, San Pablo, and Richardson bays, provides heightened recognition of the unique environmental characteristics of this area and the need to protect its important resources. The area generally contains marshes, tidelands, and diked lands that were once wetlands or part of the bays, and adjacent, largely undeveloped uplands.

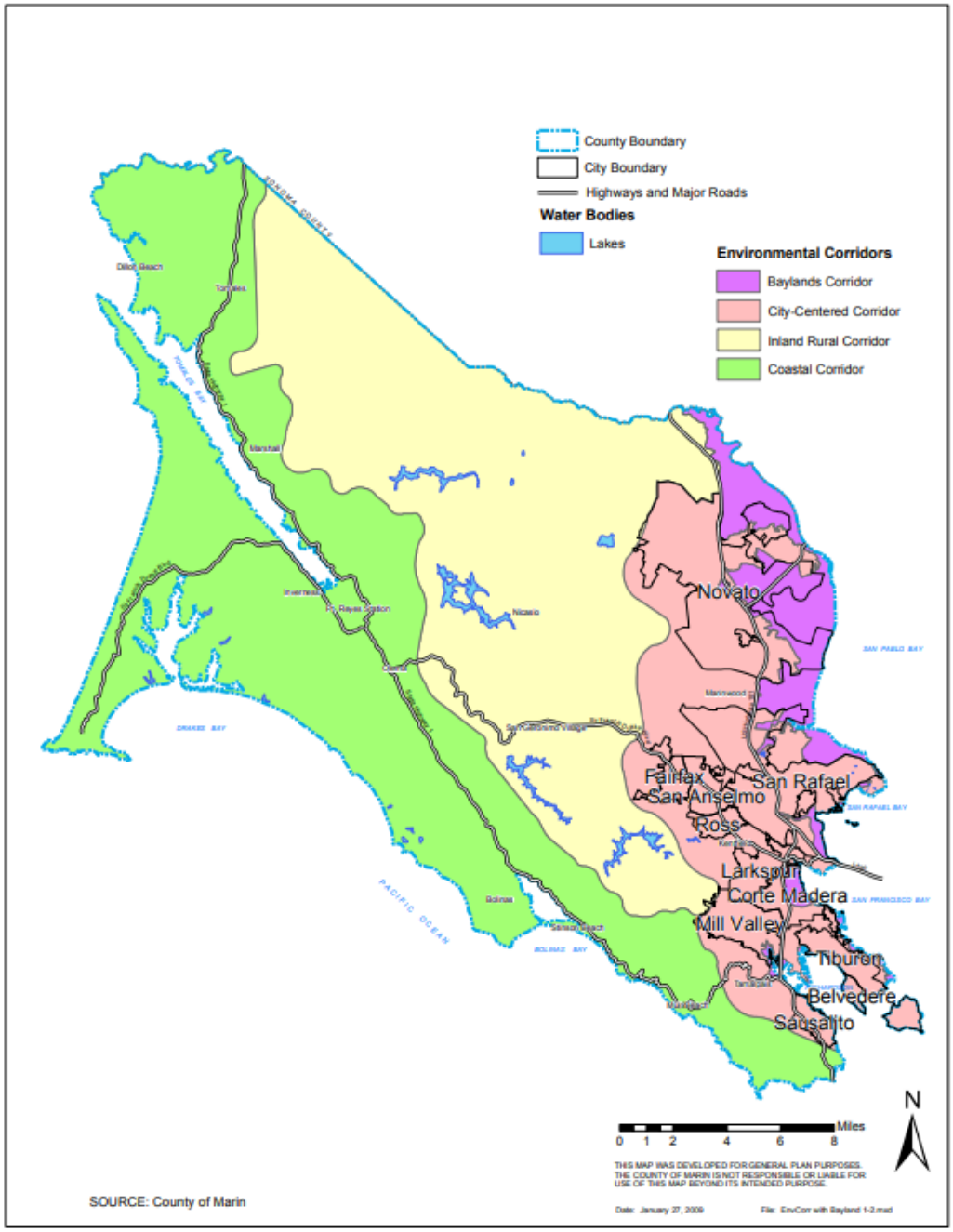


Figure 1.7: Marin County Environmental Corridors
Source: Marin Countywide Plan

Within its environmental corridors, Marin County is home to a number of diverse and important natural communities, from coastal marine environments to bay marshlands and mudflats, riparian habitats, and an upland mosaic of forests, woodlands, grasslands, and chaparral.

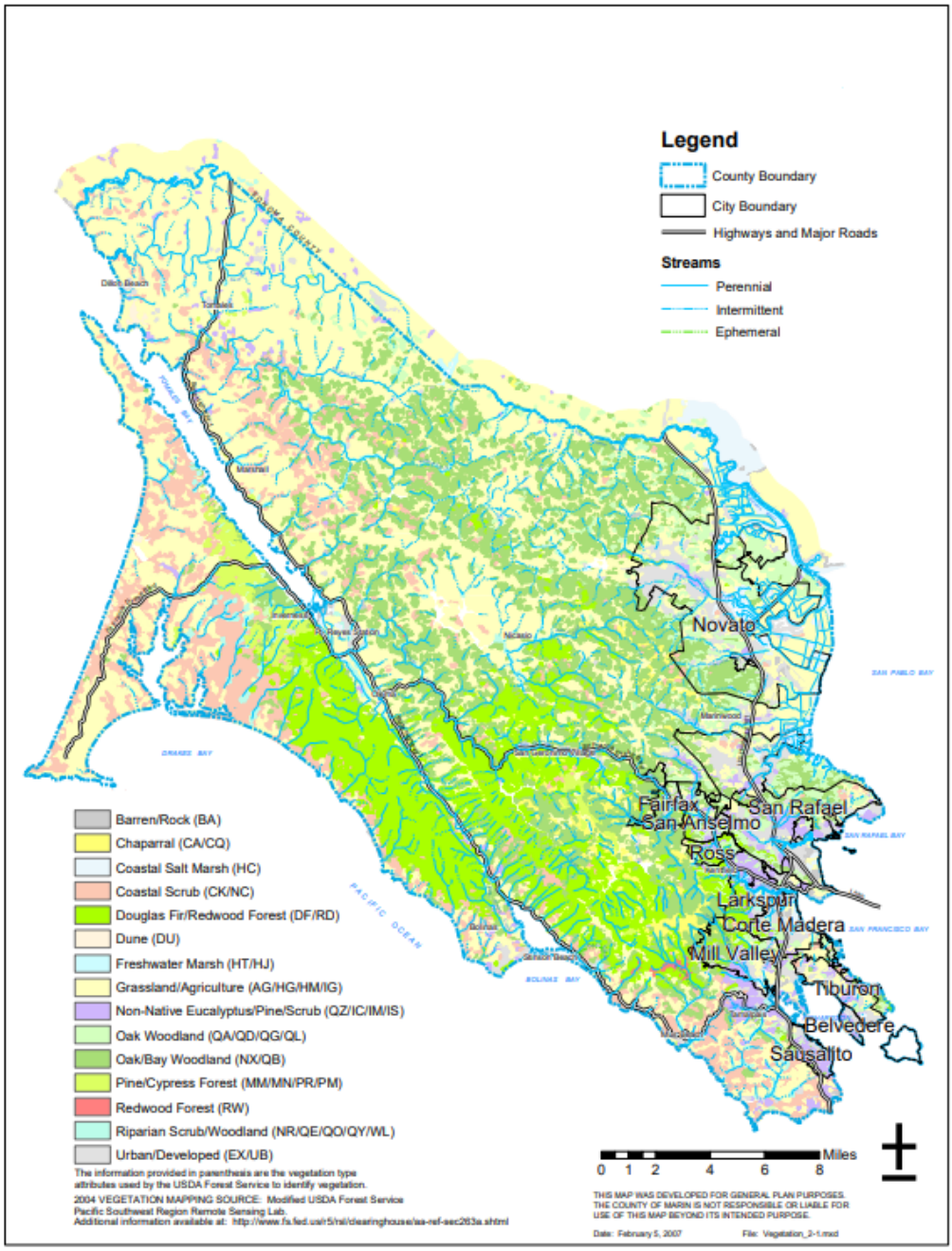


Figure 1.8: Marin County Habitat Types
Source: Marin Countywide Plan

Since the mid-19th century, grazing, logging, agriculture, road building, and development have markedly altered the natural landscape in Marin County. The continued loss of oak woodland, oak savannah, and other native woodland habitat through their conversion to primarily urban

uses resulted in the adoption of the County Native Tree Preservation and Protection Ordinance in 1999. This regulates the removal of native trees and is intended to use local regulations to protect sensitive resources. Sensitive natural communities are natural community types that are considered particularly rare or threatened by the California Natural Diversity Data Base of the California Department of Fish and Game. Sensitive natural community types in Marin include, but are not limited to, coastal and valley freshwater marsh, freshwater seep and spring, riparian forest and woodland, coastal brackish marsh, coastal terrace prairie, central dune scrub, coastal bluff scrub, northern coastal salt marsh, northern maritime chaparral, northern vernal pool, serpentine bunchgrass, valley needlegrass grasslands, old growth redwood and Douglas fir forests, and deciduous woodlands dominated by valley oaks or Oregon white oak.
Marin County's abundance of natural resources and progressive environmental leadership have supported a long legacy of open space preservation to help protect and restore wetlands and other ecosystems for both habitat and flood control, amongst other co-benefits. The Marin Countywide Plan includes goals, policies, and implementing programs for the acquisition, conservation, and restoration of wetlands, riparian areas, and other habitats.

Watersheds and Wetlands

Marin's watersheds and wetlands are some of its most valuable assets and can provide protective functions that reduce the magnitude of hazard events. Bounded by ridges, Marin's watersheds carry water, sediments, nutrients, and more, downstream into large water bodies including the Pacific Ocean, San Francisco Bay, and Tomales Bay. Wetlands can be found in the lower watersheds, with habitat types including fresh-, salt-, and brackish-water marshes which provide food and shelter for a variety of flora and fauna, including special status plants, fish, birds, amphibians, and mammals. These ecosystems can also buffer flood impacts by reducing wave attenuation from storm surge or serve as detention basins during large rainfall events. Sea level rise threats have led to heightened interest in the use of wetlands and other living shorelines such as oyster beds, eelgrass, and sand dunes as adaptation strategies to protect lives and properties while providing habitat, recreation, carbon sequestration, and other co-benefits.

One of the goals of Marin County is to avoid and minimize potential adverse impacts on existing wetlands and to encourage programs for restoration and enhancement of degraded wetlands. By establishing a Wetland Conservation Area, the County seeks to require that development to avoid wetland areas so that the existing wetlands and upland buffers are preserved and opportunities for enhancement are retained. Maintaining and enhancing wetlands serves to reduce the costs of flood damage, water pollution, and water supply redistribution. Several living shoreline pilot projects are currently underway throughout Marin County to demonstrate their effectiveness.

The Marin County Watershed Program identifies fourteen watersheds throughout the County. The following pages provide information about watersheds in the unincorporated area of the County.

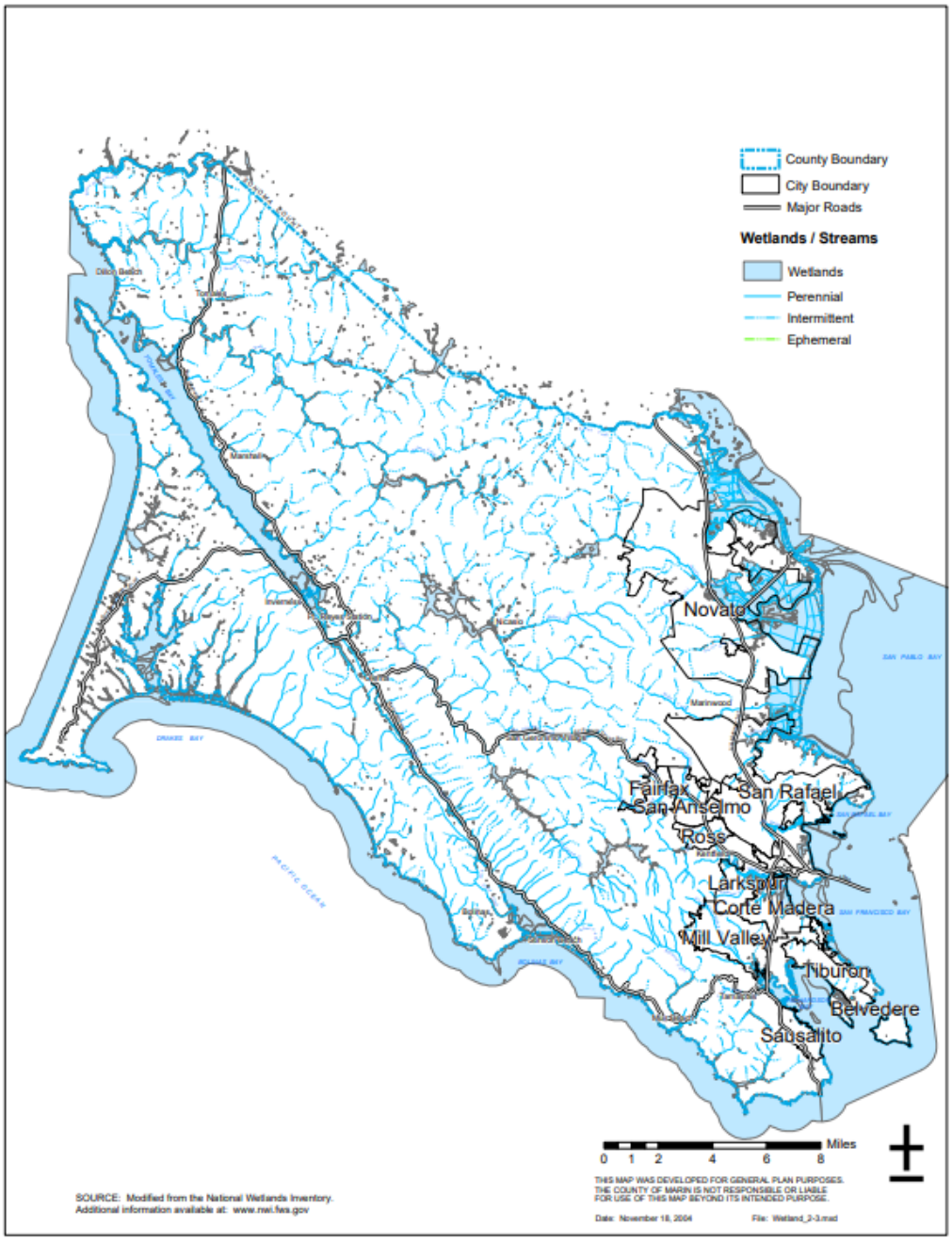


Figure 1.9: Marin County Wetlands
Source: Marin Countywide Plan

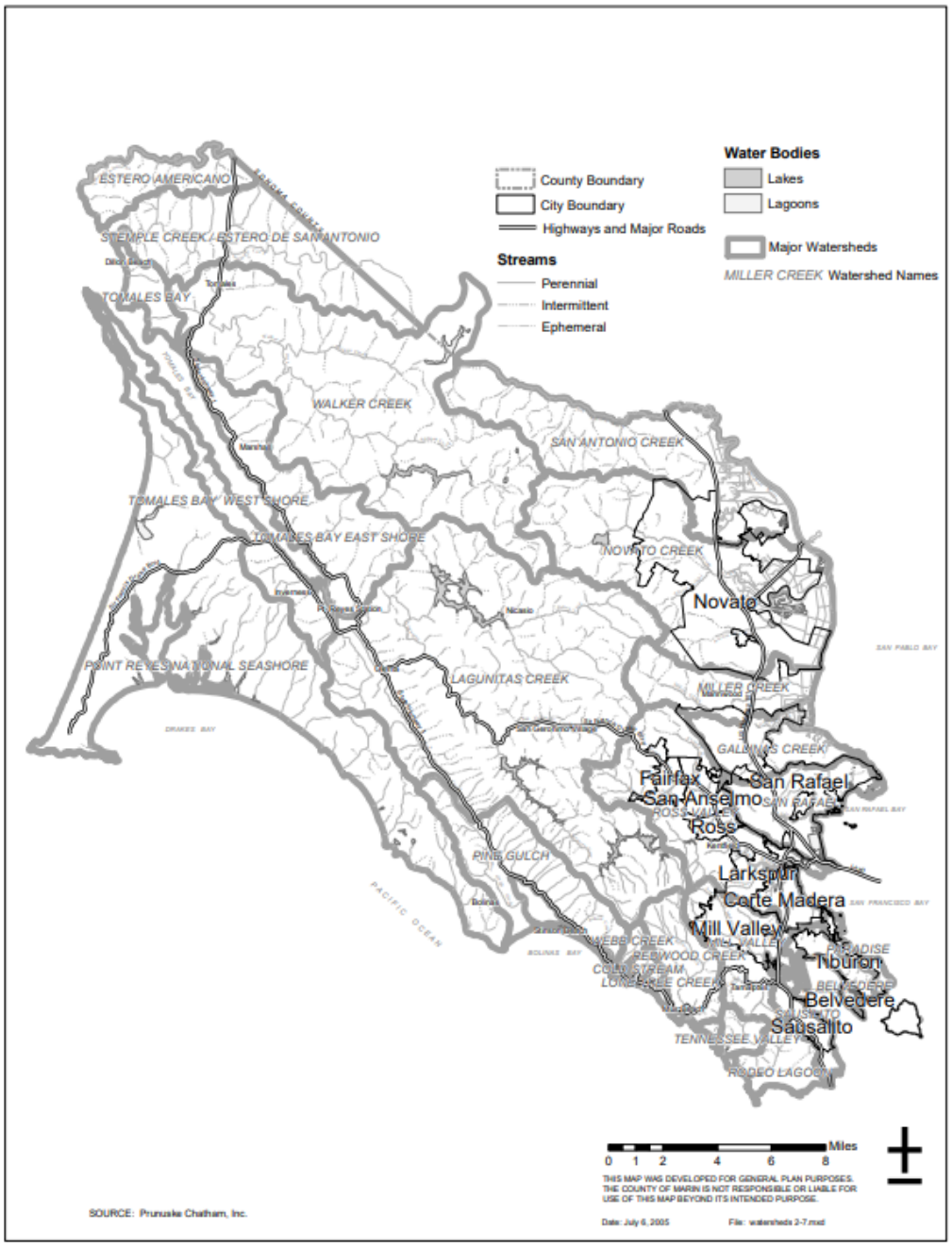


Figure 1.10: Marin County Watersheds
Source: Marin Countywide Plan

Bolinas Lagoon

With a 16.7 mi^2 watershed, Bolinas Lagoon consists of mudflats, marshes, tidal channels and a flood shoal island. Other watershed habitats include coastal scrub, Douglas fir, redwood forests, and grasslands as well as small patches of eucalyptus, oak and oak-bay woodland, and pine cypress forest. Noteworthy species include ridgeway and black rails, salt marsh common yellowthroat, California red-legged frog, California brown pelican, American peregrine falcon,

Point Reyes mountain beaver, Point Reyes jumping mouse, Coho salmon, steelhead trout, northern spotted owl, black swift, and Marin manzanita.

In 2008 the "Bolinas Lagoon Ecosystem Restoration Project: Recommendations for Restoration and Management" was completed by a working group of community representatives and scientists, with recommended actions including restoring natural sediment transport and ecological functions of the lagoon, identifying and managing non-native species, and protecting water quality. The Marin County Parks' Bolinas Wye Wetlands Resiliency Project also serves to restore habitat, improve road safety, and adapt to sea level rise in Bolinas Lagoon.

Estero Americano

The County's northernmost watershed, the 49 mi^2 Estero Americano watershed straddles the Marin and Sonoma County boundaries. Americano Creek draining into Bodega Bay, is the watershed's only tributary, and is ephemeral, generally drying up for 4-6 months between late spring and fall. The Estero Americano contains 301 acres of open water, and 412 acres of wetland habitat with mudflats, seasonal brackish marsh and freshwater marsh. With streamside habitat of grazed pastures with few trees interspersed with dense willow thickets, and coastal oak woodland in the upper watershed, Estero Americano has been identified by the California Department of Fish and Game as among the most significant habitat areas in the State. The watershed's special status species include the Northwestern pond turtle, steelhead trout, California red-legged frog, Myrtle's silverspot butterfly, tidewater goby, and tricolored blackbird.

A 1987 enhancement plan led to repair of many of the watershed's eroded areas, which was undertaken by the Gold Ridge Resource Conservation District (RCD) with funding from the State Coastal Conservancy. In 2007 the RCD developed the Estero Americano Watershed Management Plan.

Gallinas Creek

Located in Eastern Marin, the 5.6 mi^2 watershed has two main drainage areas; the north fork and South Gallinas Slough. The watershed is highly urbanized with fragmented native plant communities. Upper watershed habitats include annual grasslands interspersed with mixed evergreen forest, coastal scrub and small outcroppings of serpentine habitat. Continuous with China Camp State Park is a large tract of oak-bay woodland along the southern watershed boundary. Lower marsh habitats represent some of the largest remaining tidally influenced habitats in the Bay Area with noteworthy special status species including the San Pablo song sparrow, California black rail, salt marsh harvest mouse and the ridgeway rail.

A three-acre tidal marsh restoration effort by the Marin Audubon Society and Marin Community Foundation was completed in 1977. The Friends of Gallinas Creek, San Pablo Watershed Restoration Program Partners, the Bay Institute and Marin County Stormwater Pollution Prevention Program are planning extensive restoration in the upper and lower watershed to improve riparian cover, provide habitat, reduce erosion, and restore wetlands.

Tomales Bay

The Tomales Bay Watershed encompasses the subwatersheds of Lagunitas Creek, Walker Creek, Inverness Creek, and east shore drainages including Millerton Gulch, Grand Canyon, and Tomasini Canyon. Resource rich, nearly 500 species of birds and the most robust

population of native coho salmon remaining in the Central Coast region are supported by the Bay. Tomales Bay is a Ramsar Wetland of International Importance with intertidal, subtidal, and benthic habitas, as well as dunes, mud flats, salt marshes and freshwater marshes. Eelgrass beds are also found throughout Tomales Bay, and provide important habitat for fish, birds, and other species, while combatting shoreline erosion by dampening wave energy and storms.

The Tomales Bay Watershed Stewardship Plan was completed in 2003. Restoration projects are underway in the Walker and Lagunitas Creek areas.

Miller Creek

With a watershed covering 12 mi^2, Miller creek uniquely has a relatively intact riparian area with very high widths and depths relative to its drainage area. While relatively urbanized, the watershed still supports a small population of steelhead. Its lower marsh habitats include some of the Bay Area's largest remaining tidally-influenced habitats that support abundant waterfowl. The watershed is dominated by annual grasslands interspersed with oak-bay woodland and oak savanna in the upper watershed with patches of chaparral. Middle reaches are primarily urbanized. The watershed's lower reaches east of Highway 101 support saltwater and brackish-water marshes subject to tidal action.

Noteworthy special status species include the San Pablo Song Sparrow, California black rail, saltmarsh harvest mouse, ridgeway rail and steelhead trout.

Novato Creek

As Eastern Marin's largest watershed, Novato Creek Watershed's creeks flow eastward through oak and bay forests, grasslands, unincorporated Marin County, and the City of Novato, and into San Pablo Bay near the mouth of the Petaluma River. The basin is 45 mi^2 and its main drainage is the 17 mi^2 Novato Creek, which has 6 major tributaries. Diverse habitat types include saltwater marsh, brackish marsh, freshwater wetlands, oak woodlands, annual grasslands and oak savanna. Special status species include the San Pablo Song Sparrow, California black rail, saltmarsh common yellowthroat, ridgeway rail and Western pond turtle. Salmonids including steelhead and Chinook salmon are also found within the watershed.

Point Reyes National Seashore Creeks

This watershed is comprised of almost 100 mi^2 of land and nearly 80 miles of undeveloped coastline, with subwatersheds that drain into Drake's Estero, Abbotts Lagoon, Estero de Limanotour, the Pacific Ocean, portions of the Bolinas Lagoon and the Tomales Bay. Habitat types include estuaries, mud flats, sandy shores, intertidal communities and a variety of upland habitats. Special-status species include the endemic Mountain Beaver, Point Reyes jumping mouse, California freshwater shrimp, Myrtle's silverspot, Point Reyes blue butterfly, San Francisco forktail damselfly and steelhead trout.

Richardson Bay

With San Francisco Bay's second largest eelgrass bed, Richardson Bay supports genetically diverse and extensive intertidal habitat. As an Important Bird Area along the Pacific Flyway, the Bay supports hundreds of thousands of migrating waterbirds during the winter months. Noteworthy special-status species include the California black rail, San Pablo song sparrow, salt marsh harvest mouse, and Point Reyes bird's-beak.

Salmonids including steelhead trout are also supported.

Ross Valley
Receiving over 50 inches of rain annually, the 28 mi^2 Ross Valley watershed is one of Marin County's wettest areas. With 28 miles of stream channels, the watershed supports a great diversity of habitats including redwood forests, serpentine outcrops, chaparral, oak woodlands, grasslands and tidal wetlands. Special status wildlife include steelhead trout, spotted owls, San Pablo song sparrow, ridgeway and black rails, and salt marsh harvest mouse.

Led by the Marin County Flood Control and Water Conservation District, the Ross Valley Flood Protection & Watershed Program's objective is to reduce flooding throughout the watershed. Creek improvements being considered include debris clearance, invasive vegetation removal, creek bank stabilization, and habitat enhancement.

Rush Creek
At the Northern edge of Novato, Rush Creek's wetland habitats includes coastal saltwater and coastal brackish water marsh habitats. The wetlands provide suitable habitat for San Pablo song sparrow, California black rail, saltmarsh common yellowthroat, California brackishwater snail, and ridgeway rail. Restoration efforts include the Rush Creek and Bahia restoration projects.

San Antonio Creek
Covering around 25% of the Petaluma River watershed, the San Antonio Creek watershed extends from Antonio Mountain and Chileno Valley in the northwest to Petaluma Marsh and the Petaluma River to the southeast. The upper San Antonio Creek watershed is dominated by annual grassland and mixed evergreen forest with patches of oak and bay woodland. The lower watershed includes extensive coastal salt marsh and brackish marsh. Special status species include the California black rail, ridgeway rail, salt marsh common yellowthroat, San Pablo song sparrow, Townsend's big-eared bat, California red-legged frog, northwestern pond turtle, and salt marsh harvest mouse.

Limited salmonids have also been recorded in the watershed.

The Petaluma River Watershed Enhancement Plan was completed by the Southern Sonoma County RCD in 1999 with information on riparian and fisheries enhancement. In 2008 the Southern Sonoma County RCD completed the San Antonio Creek Watershed Plan in tandem with local landowners and residents.

San Rafael Creek
The 11 mi^2 San Rafael watershed is densely developed from its hills to filled wetlands. A small marsh at Pickleweed Park provides habitat for native species, and the watershed's northern edge include intact woodland, grassland and lagoon areas.

Southern Coastal Creeks
Several smaller watersheds along over 10 miles of southern Marin's rugged coastlines are protected within National and State Park boundaries. These include Webb Creek, Lone Tree Creek, Cold Stream, Redwood Creek, Alder Creek, Rodeo Lagoon and Tennessee Valley. A variety of habitat types exist amongst these watersheds including seasonal wetlands, riparian woodlands, and freshwater marsh. Special status species include Coho salmon, steelhead trout,

California red-legged frog, monarch butterflies, northwestern pond turtle, northern spotted owl and more.

Stemple Creek

Bisected by the Sonoma-Marin County boundary, this 50 mi^2 watershed begins just west of Petaluma and empties into the Pacific Ocean through the Estero de San Antonio. Like Estero Americano, the Estero de San Antonio was identified by the California Department of Fish and Game as among the most significant habitat areas in California with densely wooded riparian ravines, saltgrass areas, mudflats, eelgrass beds and freshwater ponds. Special-state species include the California freshwater shrimp, northwestern Pond Turtle, tidewater goby, Myrtle's silverspot butterfly, and the California red-legged frog.

In 1994 an enhancement plan was completed, leading to local landowner gully stabilization projects to reduce erosion. The Marin and Sonoma County RCDs, along with the Natural Resources Conservation Service have brought funding into the watershed to improve water quality.

Baylands

Baylands are areas between historic high and low tide elevations. The baylands ecosystem in Marin County forms a varied pattern of open water, tidal marshes and mudflats, rocky shoreline, seasonal wetlands, and adjacent uplands. Baylands ecosystems are vital to the health of San Pablo, San Francisco, and Tomales bays and have undergone tremendous change, as historical tidal areas were diked for agricultural use, marshes filled and drained for development, and channels dredged and straightened for navigation. An estimated 82% of the historic tidal marshlands along the edge of the San Francisco Bay–Delta Estuary has been filled or altered. Marin County seeks to a establish bayland buffer zones between development and remaining or historic tidelands and wetlands in order to enhance the diversity of its baylands ecosystems and reduce the costs of flood damage, water pollution, and habitat degradation.

Grasslands and Forests

Marin County has extensive topographic diversity that supports a variety of vegetation types. Environmental factors, such as temperature, precipitation, soil type, aspect, slope, and land use history, all help determine the existing vegetation at any given location. In the central and eastern parts of the county, north-facing slopes are usually densely wooded from lower elevations to ridge peaks with a mixture of mostly hardwood tree species such as coast live oak, California bay, Pacific madrone, and other oak species.

Grasslands with a mixture of native and nonnative annual and perennial plant species occur most often in the northern and western parts of the county due to a combination of soil type, lower rainfall, and a long history of ranching. The southern and western slopes tend to have a higher percentage of grasslands.

In the west portion of the county closer to the coast, where precipitation is higher and marine influence is greater, most areas are densely forested with conifer species including Bishop pine, Douglas fir, coast redwood, and associated hardwood species. Chaparral vegetation also occurs in parts of the county, especially on steeper south- and west-facing slopes.

Insect infestations and plant diseases, such as California oak mortality syndrome (Sudden Oak Death), are increasing and threaten to change the structure and overall health of native plant

communities in Marin County. Sudden Oak Death has had a major impact on native habitats in Marin since its initial detection in the mid-1990s in Mill Valley, The pathogen believed to be a major cause of Sudden Oak Death, Phytophthora ramorum, is known to affect at least 31 species of plants. Two other plant diseases prevalent in Marin County are pitch canker (which affects conifers such as Bishop pine and other pine species), and madrone twig dieback (which affects Pacific madrones).

Oak woodland and savannah are also threatened by development. The continued loss of oak woodland, oak savannah, and other native woodland habitat through their conversion to primarily urban uses in the County resulted in the adoption of the County Native Tree Preservation and Protection Ordinance in 1999. This regulates the removal of native trees and is intended to use local regulations to protect sensitive resources.

Geology

Marin County is located within the central portion of the Coast Range Physiographic Province of California, composed of a series of northwest-southeast aligned coastal mountain chains dominated by the San Andreas Fault Zone. The geology of Marin County is distinctly different on either San Andreas Fault, with areas east of the fault dominated by the Franciscan Formation and associated mélange and west of the fault by granitic rocks and overlying sedimentary rocks. Areas located east of the San Andreas Fault, have a geology dominated by Cretaceous and Jurassic Age Franciscan Complex bedrock composed of sedimentary and volcanic rocks, serpentine, and sheared mélange. Overlying the bedrock is a layer of colluvium and soil of varying thickness. Slopes underlain by the sheared mélange bedrock tend to have a higher density of deep seated landslides compared to those areas underlain by more competent sandstone. Alluvial sediments made up of unconsolidated sands, gravels, and silts are found along the valley bottoms.

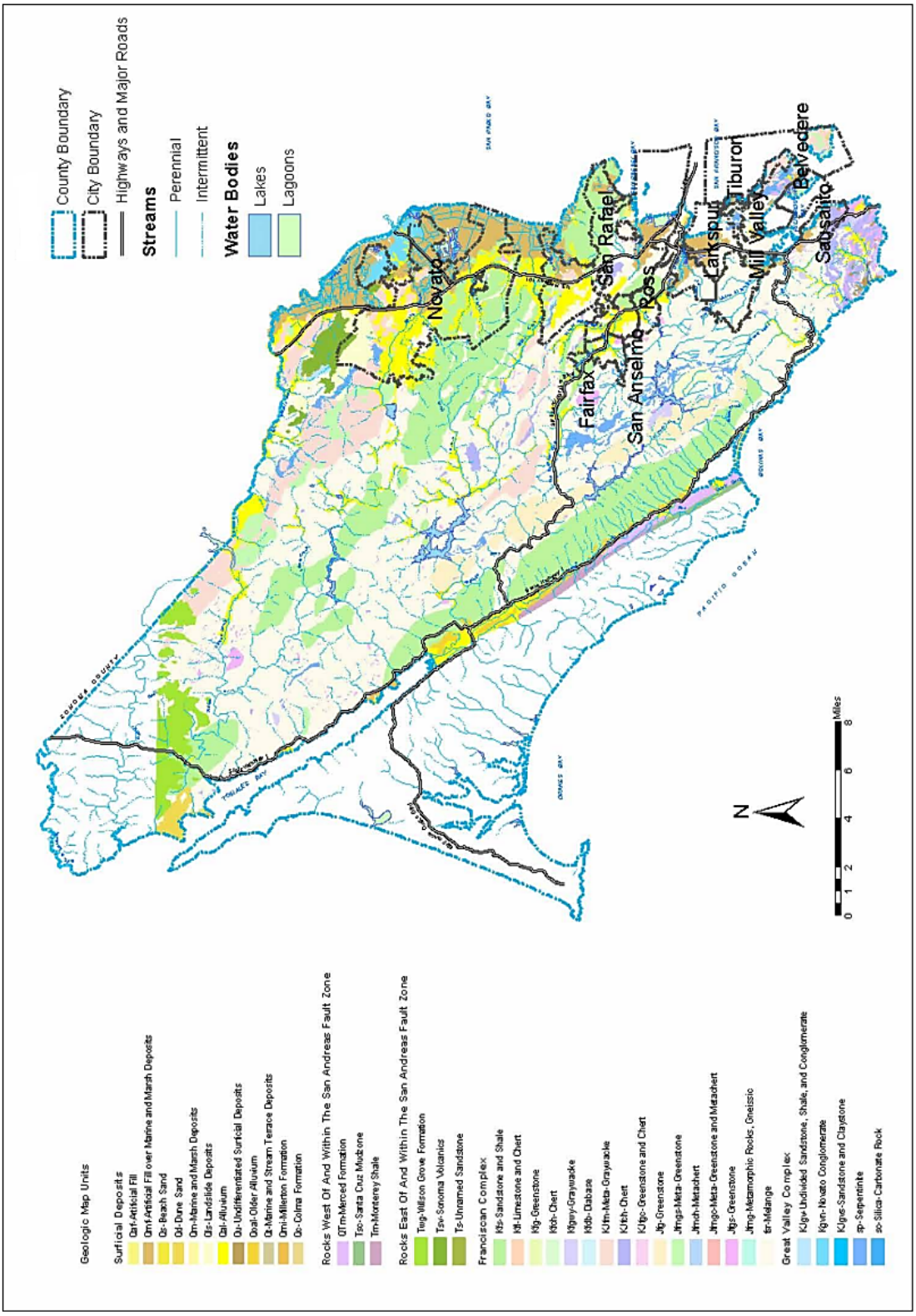


Figure 1.11: Marin County Geologic Units (East of San Andreas Fault)
Source: Marin Countywide Plan

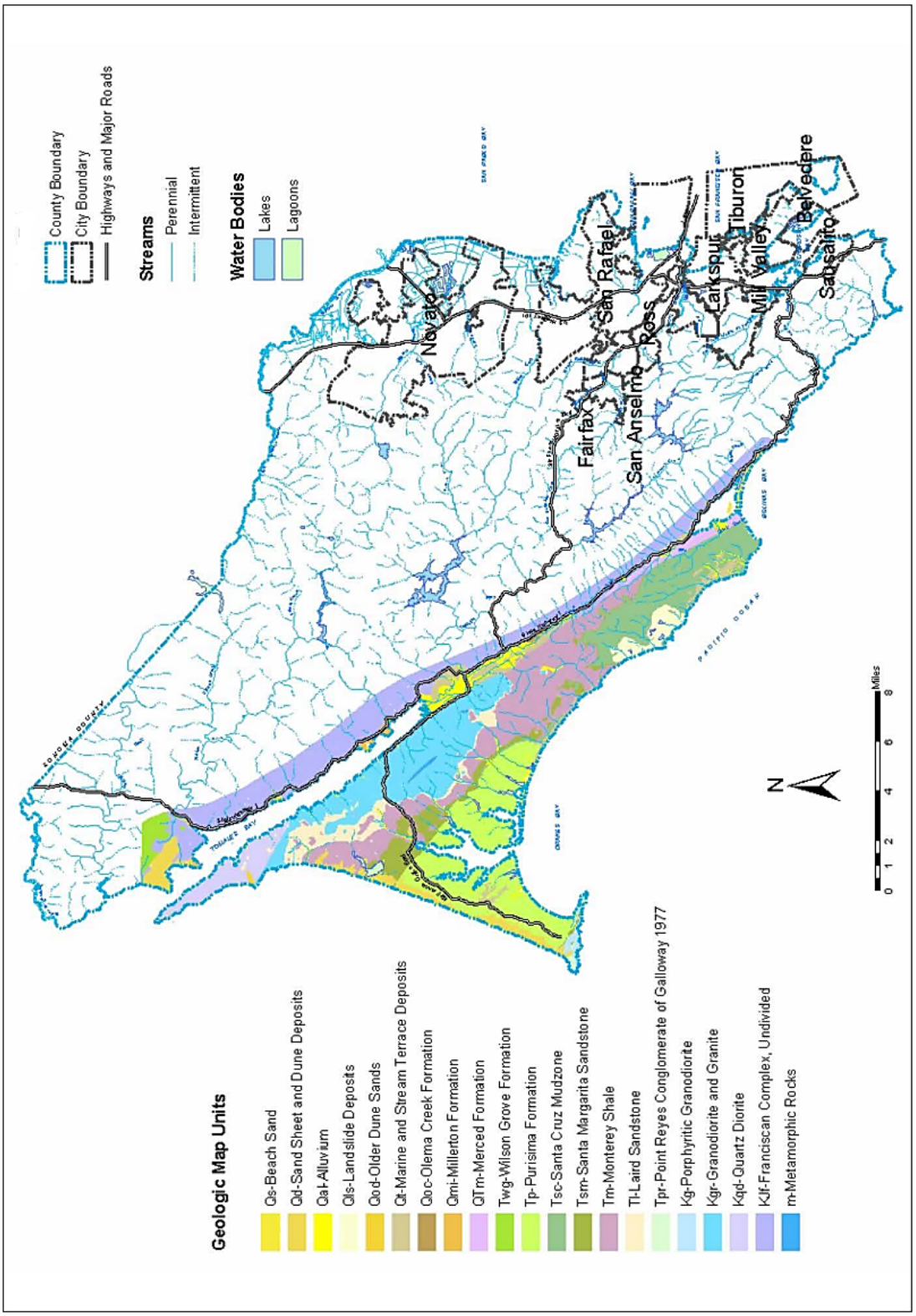


Figure 1.12: Marin County Geologic Units (West of San Andreas Fault)
Source: Marin Countywide Plan

Mineral Resource Zones are grouped by the State of California into four categories based on geologic factors, with Class 2 (MRZ-2) lands having the greatest importance. Class 2 sites are underlain by demonstrated mineral resources considered important to the region or the state as a whole. All of the Marin County's mineral resource sites are identified by the State as Class 2, except for Ring Mountain, which is considered a Scientific Resource Zone (and therefore not a production site) due to the presence of rare geologic formations.

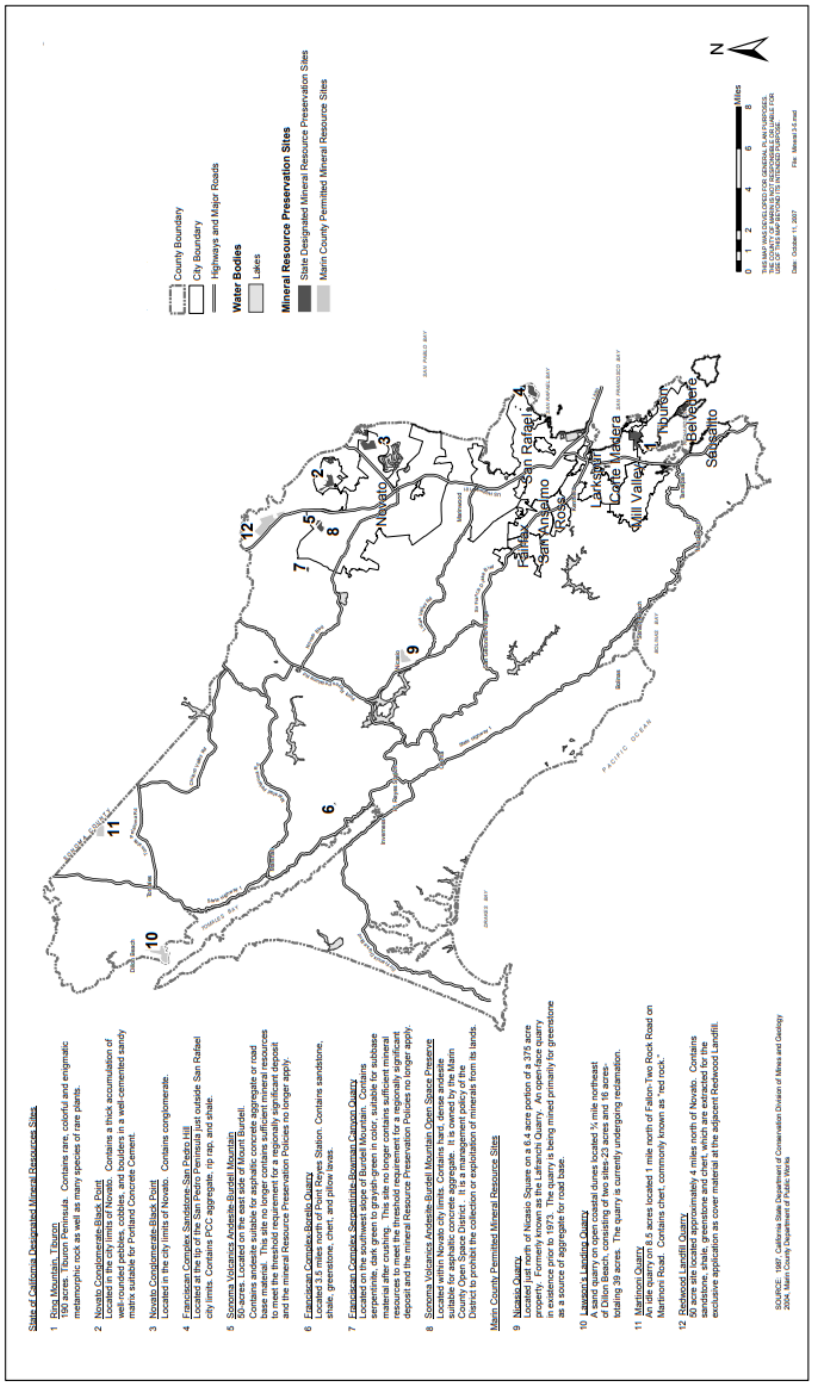


Figure 1.13: Marin County Mineral Resource Sites
Source: Marin Countywide Plan

Climate

Marin County has many microclimates with varying weather patterns, but the climate is generally Mediterranean with mild and wet winters and hot, dry summers. The average annual temperature is around 56.5 degrees. High temperatures normally range from 49 to 63 degrees in the summer months, which is cooler than most places in California. Low temperatures average around 42 degrees in the winter months, and rarely fall below freezing.

Precipitation generally increases with altitude. The topography in Marin County varies greatly, from sea level to elevations around 2,500 feet on Mount Tamalpais. Marin County averages 39 inches of rain per year, making it wetter than most places in California, though it rarely gets snow.

Figure 1.14 shows average annual precipitation and Figure 1.15 shows average annual temperature over time.

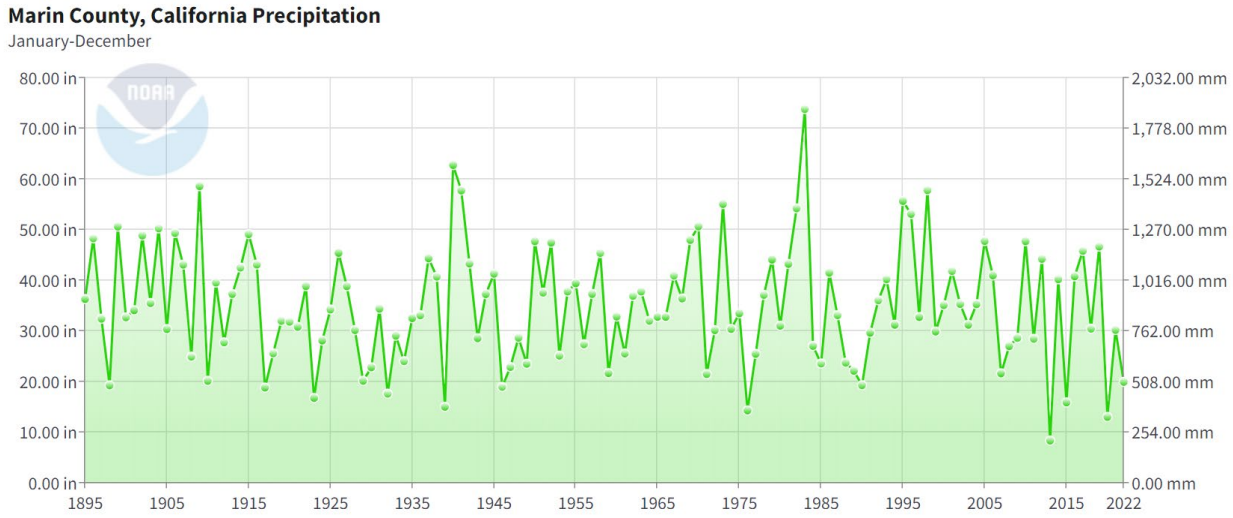


Figure 1.14: Marin County Average Precipitation 1895-2022
Source: National Oceanic Atmospheric Administration

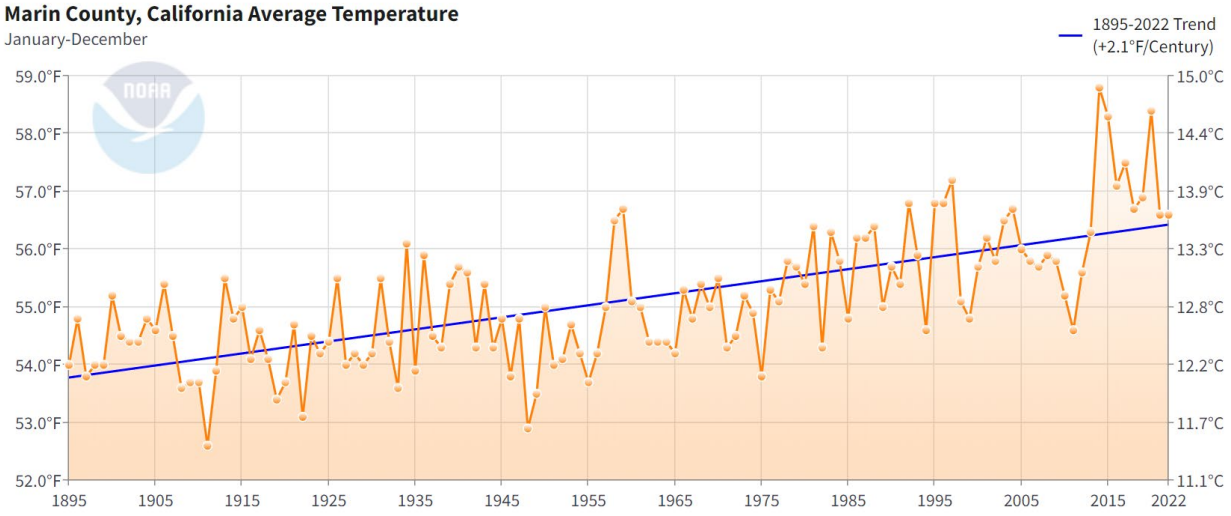


Figure 1.15: Marin County Average Temperature 1895-2022
Source: National Oceanic Atmospheric Administration

Marin County can experience Northern California Diablo winds in the late summer through early winter. These easterly winds occur as systems of high-pressure form in the Great Basin and flow over the Sierra Nevada Mountains toward the Pacific Ocean. As winds flow over the Sierra Nevada, the winds compress, become warmer, and lower the relative humidity while drying out vegetation. As the winds move through canyons, they pick up speed and create strong gusts which can contribute to large and destructive wildfires.

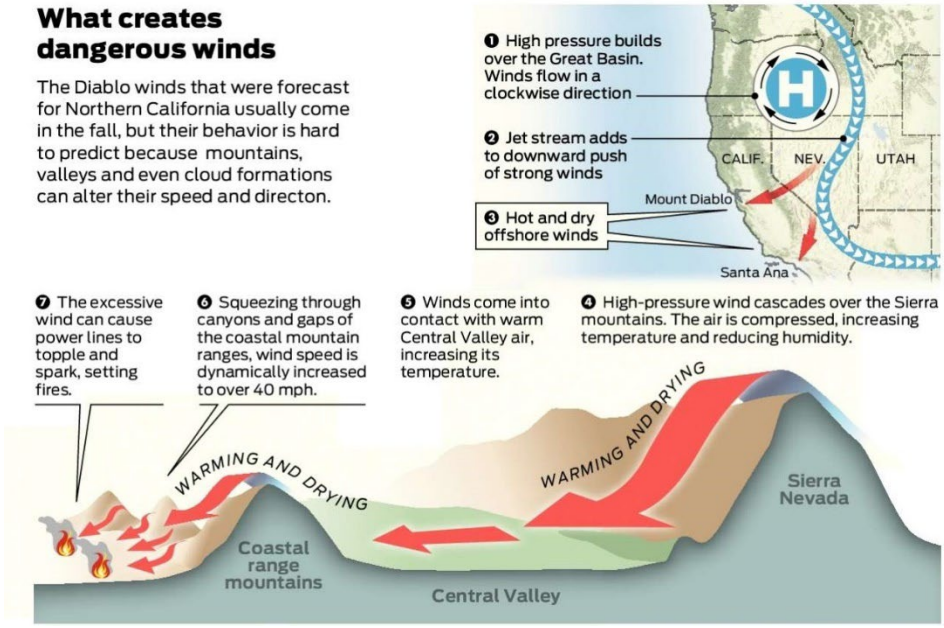


Figure 1.16: Diablo Wind Patterns
Source: National Oceanic Atmospheric Administration

Historic and Cultural Resources

Marin County has a large stock of historically significant homes, public buildings, and landmarks. To inventory these resources, the Marin County MJHMP Planning Team collected information from a number of sources. The California Department of Parks and Recreation Office of Historic Preservation (OHP) was the primary source of information. The OHP is responsible for the administration of federally and state mandated historic preservation programs to further the identification, evaluation, registration, and protection of California's irreplaceable archaeological and historical resources. The OHP administers the National Register of Historic Places, the California Register of Historical Resources, California Historical Landmarks, and the California Points of Historical Interest programs. Each program has different eligibility criteria and procedural requirements.

- The **National Register of Historic Places** is the nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.
- The **California Register of Historical Resources** program encourages public recognition and protection of resources of architectural, historical, archeological, and cultural significance and identifies historical resources for state and local planning purposes, determines eligibility for state historic preservation grant funding, and affords certain protections under the California Environmental Quality Act. The Register is the authoritative guide to the state's significant historical and archeological resources.
- **California Historical Landmarks** are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Landmarks #770 and above are automatically listed in the California Register of Historical Resources.
- **California Points of Historical Interest** are sites, buildings, features, or events that are of local (city or county) significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Points designated after December 1997 and recommended by the State Historical Resources Commission are also listed in the California Register.

It should be noted that as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

The Marin County OA has 52 places on the National Register of Historic Places. Notable architects that helped create the Marin County historic places including W.G. Carnes, Frank Lloyd Wright, James A. Shore, William Mercer and Solomon Pierce. Prominent architectural styles found in the Marin County OA are Bungalow/Craftsman, Italianate and Mission/Spanish Revival.

Table 1.8: Historic Sites in Marin County					
Name/Landmark State Plaque Number	**National Register (NR)**	**State Landmark**	**California Register**	**Date Listed (NR)**	**Jurisdiction**
Alexander-Acacia Bridge	X			1/5/1984	Larkspur
Angel Island, U.S. Immigration Station (529)	X	X	X	10/14/1971	Tiburon
William G. Barrett House	X			6/17/1980	Sausalito
Boyd House	X			12/17/1974	San Rafael
Bradford House	X			6/6/1980	San Rafael
Camilo Ynitia Adobe (210)		X	X		Novato
China Camp (924)	X	X	X	4/26/1979	San Rafael
The Dipsea Trail	X			6/4/2010	Mill Valley/ Stinson Beach
Dixie Schoolhouse	X			12/26/1972	San Rafael
Robert Dollar Estate	X			12/11/1972	San Rafael
Robert Dollar House	X			7/23/1991	San Rafael
Dolliver House	X			5/22/1978	Larkspur
Drakes Bay Historic and Archeological District	X			10/16/2012	Point Reyes Station
Lord Charles Snowden Fairfax Home (679)		X	X		Fairfax
Fashion Shop and Stephen Porcella House	X			6/25/1980	Novato
First Sawmill in Marin County (207)		X	X		Mill Valley
Forts Baker, Barry, and Cronkhite	X			12/12/1973	Unincorporated Marin County
Golden Gate Bridge (974)		X	X		Unincorporated Marin County

Table 1.8: Historic Sites in Marin County					
Name/Landmark State Plaque Number	**National Register (NR)**	**State Landmark**	**California Register**	**Date Listed (NR)**	**Jurisdiction**
Green Brae Brick Kiln Yard (917)	X	X	X	3/24/1978	Larkspur
Griswold House	X			9/12/1985	Sausalito
Hamilton Army Air Field Discontiguous Historic District	X			11/20/1998	Novato
Larkspur Downtown Historic District	X			10/7/1982	Larkspur
Lighter Wharf Site (221)		X	X		Bolinas
Lyford's Stone Tower	X			12/2/1976	Tiburon
Benjamin and Hilarita Lyford House	X			11/10/2000	Tiburon
Marconi-RCA Bolinas Transmitting Station	X			2/23/2018	Bolinas
Marin Art and Garden Center	X			6/6/2022	Ross
Marin City Public Housing	X			9/18/2017	Marin City
Marin County Civic Center (999)	X			7/17/1991	San Rafael
Marinship Machine Shop	X			12/20/2016	Sausalito
Erskine B. McNear House	X			1/11/1982	San Rafael
Miller Creek School Indian Mound	X			10/14/1971	San Rafael
Mission San Rafael Arcangel (220)		X	X		San Rafael
Mount Tamalpais Mountain Theater	X			2/2/2015	Mill Valley

Table 1.8: Historic Sites in Marin County					
Name/Landmark State Plaque Number	**National Register (NR)**	**State Landmark**	**California Register**	**Date Listed (NR)**	**Jurisdiction**
Muir Beach Archeological Site	X			1/26/1981	Marin City
Muir Woods National Monument	X			1/9/2008	Mill Valley
Olema Lime Kilns (222)	X	X	X	10/8/1976	Olema
Olema Valley Dairy Ranches Historic District	X			4/9/2018	Olema
Outdoor Art Club (922)	X	X	X	11/16/1978	Mill Valley
Pierce Ranch	X			12/6/1985	Inverness
Pioneer Paper Mill (552)		X	X		Lagunitas
Point Bonita Light Station	X			9/3/1991	Sausalito
Point Reyes Lifeboat Rescue Station, 1927	X			11/7/1985	Inverness
Point Reyes Light Station	X			9/3/1991	Point Reyes
Point Reyes Naval Radio Compass Station	X			6/29/2018	Inverness
Point Reyes Peninsula Dairy Ranches Historic District	X			10/29/2018	Inverness
RCA Point Reyes Receiving Station	X			2/23/2018	Inverness
Rancho Olompali	X			1/12/1973	Novato
Valentine Rey House	X			4/22/1982	Belvedere
St. Hilary's Mission Church	X			2/3/2020	Tiburon
San Francisco and North Pacific Railroad Station House-Depot	X			8/4/1995	Tiburon

Table 1.8: Historic Sites in Marin County					
Name/Landmark State Plaque Number	**National Register (NR)**	**State Landmark**	**California Register**	**Date Listed (NR)**	**Jurisdiction**
San Rafael Improvement Club	X			3/29/1984	San Rafael
Sausalito Woman's Club	X			4/15/1993	Sausalito
St. Vincent's School for Boys (630)		X	X		San Rafael
Brock Schreiber Boathouse and Beach	X			7/7/1978	Inverness
Station KPH Operating Station	X			7/24/1989	Marshall
Station KPH, Marconi Wireless Telegraph Company of America	X			7/24/1989	Marshall
Steamship TENNESSEE Remains	X			4/15/1981	Marin City
Tocaloma Bridge	X			9/14/2018	Tocaloma
Tomales Presbyterian Church and Cemetery	X			8/1/1975	Tomales
West Point Inn	X			12/22/2011	Mill Valley

Table 1.8: Historic Sites in Marin County
Source: California Office of Historic Preservation and the National Register of Historic Places

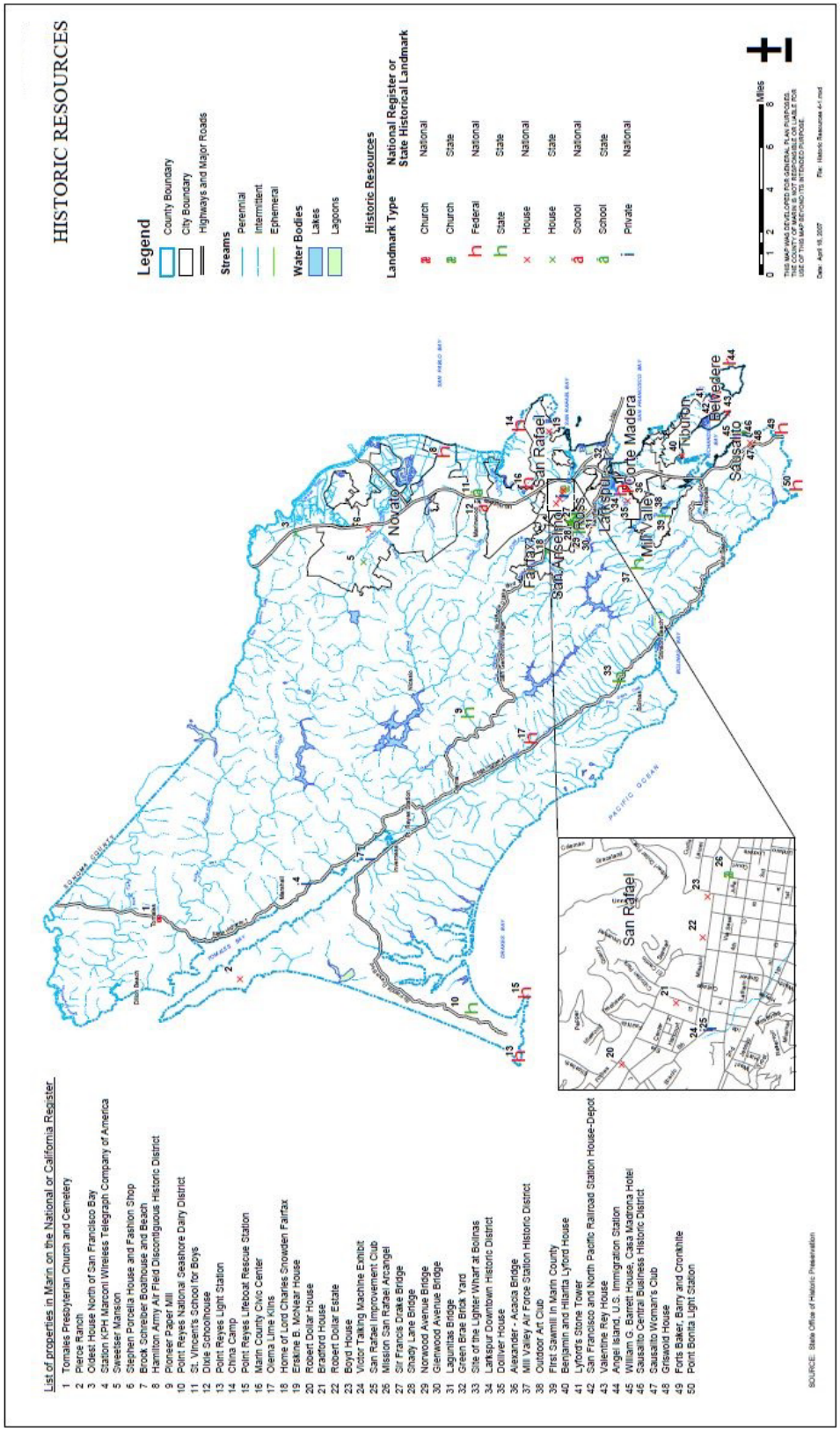


Figure 1.17: Historic Sites in Marin County
Source: California Office of Historic Preservation

1.5.4 National Risk Index and Social Vulnerability

All communities in the U.S. experience natural hazards, and there is a wide range of environmental, social, and economic factors that influence each community's risk to natural hazards. The likelihood that a community may experience a natural hazard can vary drastically, as can the associated consequences. Additionally, a community's risk is influenced by many social, economic, and ecological factors.

A community's susceptibility to natural hazards varies from location to location. The 18 hazard types evaluated by the National Risk Index were chosen after reviewing FEMA-approved State Hazard Mitigation Plans for all 50 states in early 2016.

Risk Calculation

In the National Risk Index, risk is defined as the potential for negative impacts as a result of a natural hazard. The risk equation behind the National Risk Index includes three components: a natural hazards risk component, a consequence enhancing component, and a consequence reduction component. Expected Annual Loss (EAL) is the natural hazards risk component, measuring the expected loss of building value, population, and/or agriculture value each year due to natural hazards. Social Vulnerability is the consequence enhancing component and analyzes demographic characteristics to measure the susceptibility of social groups to the adverse impacts of natural hazards. Community Resilience is the consequence reduction component and uses demographic characteristics to measure a community's ability to prepare for, adapt to, withstand, and recover from the effects of natural hazards. The Social Vulnerability and Community Resilience components are combined into one Community Risk Factor (CRF) which is multiplied by the EAL component to calculate risk using Equation 2.

Equation 2: Generalized National Risk Index Risk Equation

$$Risk = Expected\ Annual\ Loss \times Community\ Risk\ Factor$$

$$where\ Community\ Risk\ Factor = f\left(\frac{Social\ Vulnerability}{Community\ Resilience}\right)$$

Figure 1.18: Generalized NRI Risk Equation
Source: FEMA National Risk Index Technical Documentation, 2023

Risk Components Overview

The Risk Index score is based on Social Vulnerability, Community Resilience, and Expected Annual Loss, with EAL based on Exposure, Annualized Frequency, and historic loss ratio (HLR) factors, for a total of five risk factors. Each risk factor contributes to either the likelihood or consequence aspect of risk and are classified as one of two risk types: risk based on geographic location, represented by the Community Risk Factor (CRF), or risk based on the nature and historical occurrences of natural hazards, represented by EAL. The five risk factors are summarized in Table 1.9.

Table 1.9: Risk Components and Factors				
Risk Component	Risk Factors	Risk Factors Description	Risk Contribution	Risk Type Assignment
Social Vulnerability	Social Vulnerability	Consequence Enhancer	Consequence	Geographic Risk
Community Resilience	Community Resilience	Consequence Enhancer	Consequence	Geographic Risk
EAL	Exposure	Expected Consequence	Consequence	Natural Hazard Risk
EAL	Annualized Frequency	Probability of Occurrence	Likelihood	Natural Hazard Risk
EAL	HLR	Expected Consequence	Consequence	Natural Hazard Risk

Table 1.9: NRI Risk Components and Factors
Source: FEMA National Risk Index Technical Documentation, 2023

Social Vulnerability

According to the 2023 National Risk Index Technical Documentation, Social Vulnerability is broadly defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social Vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards. As a consequence-enhancing risk factor, the Social Vulnerability score represents the national percentile ranking of social vulnerability for a given county or Census tract in comparison to all other communities at the same level. The higher a county's or Census tract's Social Vulnerability is, the higher the risk. Because social vulnerability is unique to a geographic location—specifically, a county or Census tract—it is a geographic risk factor.

Social Vulnerability Source Data

Social Vulnerability source data provider: CDC/ATSDR SVI
SVI is a location-specific assessment of social vulnerability that utilizes 16 socioeconomic variables (listed below) deemed to contribute to a community's reduced ability to prepare for, respond to, and recover from hazards.

1. Below 150% Poverty
2. Unemployed
3. Housing Cost Burden
4. No High School Diploma
5. No Health Insurance
6. Aged 65 & Older
7. Aged 17 & Younger
8. Civilian with a Disability
9. Racial & Ethnic Minority Status
10. Multi-Unit Structures
11. Mobile Homes
12. Crowding
13. No Vehicle
14. Group Quarters
15. Single-Parent Households

16. English Language Proficiency

The dataset was acquired from the CDC/ASTDR website, and users looking for more information should consult CDC/ASTDR.

Social Vulnerability Consideration for Hazard Mitigation Funding

The California Governor's Office of Emergency Services (Cal OES) has initiated the "Prepare California" grant program focused on building community resilience amongst vulnerable individuals living in the areas of the state most susceptible to natural disasters. The Prepare California Initiative is aimed at reducing long-term risks from natural disasters by investing in local capacity building and mitigation projects designed to protect communities.

Prepare California leverages funds approved in Governor Gavin Newsom's 2021-22 State Budget and is designed to unlock federal matching funds for community mitigation projects that vulnerable communities would otherwise be unable to access. This program is intended for communities that are the most socially vulnerable and at the highest risk for future natural hazard events. The state identified communities by prioritizing California census tracts according to their estimated hazard exposures and social vulnerability.

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards: Avalanche, Coastal Flooding, Cold Wave, Drought, Earthquake, Hail, Heat Wave, Hurricane, Ice Storm, Landslide, Lightning, Riverine Flooding, Strong Wind, Tornado, Tsunami, Volcanic Activity, Wildfire, and Winter Weather.

National Risk Index (NRI) hazards align with of eight of the twelve Marin County OA MJHMP Hazards. NRI data is not available for Dam Failure, Land Subsidence, Levee Failure, or Sea Level Rise.

Table 1.10: NRI Hazards and Marin County MJHMP Hazards	
NRI Hazards	Marin County OA MJHMP Hazards
Earthquake	Earthquake
Riverine Flooding	Flooding
Coastal Flooding	Flooding
Wildfire	Wildfire
Landslide	Debris Flow
Drought	Drought
Heat Wave	Severe Weather -Extreme Heat
Tsunami	Tsunami
Tornado	Severe Weather – Wind, Tornado
Strong Wind	Severe Weather – Wind, Tornado

Table 1.10: NRI Hazards and Marin County OA MJHMP Hazards
Source: FEMA National Risk Index 2023

The National Risk Index leverages available source data for Expected Annual Loss (EAL) due to these 18 hazard types, Social Vulnerability, and Community Resilience to develop a baseline relative risk measurement for each United States county and Census tract. These measurements are calculated using average past conditions, but they cannot be used to predict future outcomes for a community. The National Risk Index is intended to fill gaps in available data and analyses to better inform federal, state, local, tribal, and territorial decision makers as they develop risk reduction strategies.

Calculating the Risk Index

Risk Index scores are calculated using an equation that combines scores for Expected Annual Loss due to natural hazards, Social Vulnerability and Community Resilience:

Risk Index = Expected Annual Loss (EAL) × Social Vulnerability ÷ Community Resilience

Hazard Type Risk Index

Hazard type Risk Index scores are calculated using data for only a single hazard type, and reflect a community's Expected Annual Loss value, community risk factors, and the adjustment factor used to calculate the risk value. Table 1.10 illustrates the NRI Hazard Type Risk Index for Marin County.

Calculating Expected Annual Loss

Expected Annual Loss scores are calculated using an equation that combines values for exposure, annualized frequency, and historic loss ratios for 18 hazard types:

Expected Annual Loss = Exposure × Annualized Frequency × Historic Loss Ratio

Community Risk Factor

The CRF is a scaling factor that incorporates Social Vulnerability and Community Resilience in the National Risk Index to arrive at a distribution of risk values that better reflects the impacts communities experience from natural hazards. By design, the CRF ensures that higher Social Vulnerability and lower Community Resilience, relative to all other communities at the same level (county or Census tract), result in higher Risk Index values for a given level of EAL.

To generate a CRF value for a community, its Social Vulnerability value is divided by its Community Resilience value, and this ratio is mapped to a triangular distribution with minimum 0.5, mode 1, and maximum 2 (see Equation 3).

Equation 3: CRF Equation

$$Community\ Risk\ Factor = f\left(\frac{Social\ Vulnerability}{Community\ Resilience}\right)$$

$$where\ \ f(\cdot) \rightarrow \tau(a = 0.5, b = 2, c = 1)$$

Table 1.11 illustrates the NRI Hazard Type Risk Index for Marin County.

Table 1.11: NRI Hazard Type Risk Index for Marin County						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$85,368,321	Relatively Low	Very High	1.02	$86,293,309	98.7
Riverine Flooding	$28,231,043	Relatively Low	Very High	1.02	$30,230,864	99
Coastal Flooding	$3,801,318	Relatively Low	Very High	1.02	$4,161,749	89.5
Wildfire	$2,436,548	Relatively Low	Very High	1.02	$2,205,455	91.8
Landslide	$770,102	Relatively Low	Very High	1.02	$736,098	98.3
Drought	$780,052	Relatively Low	Very High	1.02	$645,893	89.7
Heat Wave	$371,643	Relatively Low	Very High	1.02	$375,597	74.3
Tornado	$220,118	Relatively Low	Very High	1.02	$213,534	19.4
Tsunami	$34,530	Relatively Low	Very High	1.02	$26,783	62.2
Strong Wind	$13,888	Relatively Low	Very High	1.02	$13,688	4.4

Table 1.11: NRI Hazard Type Risk Index for Marin County
Source: FEMA National Risk Index 2023

Table 1.12 illustrates the NRI Social Vulnerability & Community Resilience Risk Index for the top 20 highest risk communities within Marin County.

Table 1.12: NRI Highest-Risk Communities in Marin County								
Rank	**Community**	**Jurisdiction**	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
1	Census tract 06041112202	San Rafael	$8,782,817	Relatively High	Very High	1.38	$12,103,320	99.66
2	Census tract 06041112100	San Rafael	$4,881,418	Relatively High	Very High	1.22	$5,938,596	98.31
3	Census tract 06041106001	San Rafael	$3,848,195	Very High	Very High	1.4	$5,369,158	97.88
4	Census tract 06041121200	Corte Madera	$4,505,215	Relatively Moderate	Very High	1.13	$5,078,528	97.58
5	Census tract 06041103200	Novato	$3,649,854	Relatively High	Very High	1.37	$5,016,752	97.53
6	Census tract 06041112204	San Rafael	$2,686,687	Very High	Very High	1.59	$4,274,415	96.57
7	Census tract 06041102203	Novato	$2,920,534	Relatively High	Very High	1.35	$3,955,365	95.97
8	Census tract 06041106002	County (Santa Venetia)	$3,505,637	Relatively Moderate	Very High	1.1	$3,843,988	95.73
9	Census tract 06041119201	Larkspur	$2,453,803	Relatively High	Very High	1.27	$3,113,358	93.73
10	Census tract 06041119100	County (Kentfield)	$3,547,224	Very Low	Very High	0.86	$3,034,275	93.41
11	Census tract 06041110100	San Rafael	$2,551,896	Relatively Moderate	Very High	1.11	$2,831,154	92.59

12	Census tract 06041117000	San Anselmo	$2,891,493	Relatively Low	Very High	0.96	$2,766,643	92.3
13	Census tract 06041120002	Larkspur	$2,825,836	Relatively Low	Very High	0.95	$2,698,515	91.98
14	Census tract 06041133000	County	$2,925,471	Relatively Low	Very High	0.93	$2,714,057	92.05
15	Census tract 06041104102	Novato	$2,251,767	Relatively High	Very High	1.19	$2,685,083	91.89
16	Census tract 06041111001	San Rafael	$2,462,117	Relatively Moderate	Very High	1.07	$2,629,315	91.59
17	Census tract 06041121100	Corte Madera	$3,328,198	Very Low	Very High	0.78	$2,588,404	91.38
18	Census tract 06041101200	Novato	$2,847,863	Relatively Low	Very High	0.88	$2,518,616	90.98
19	Census tract 06041108202	San Rafael	$1,698,202	Very High	Very High	1.4	$2,380,050	90.12
20	Census tract 06041104300	County (Bel Marin Keys)	$3,514,869	Very Low	Very High	0.65	$2,287,081	89.47

Table 1.12: NRI Highest-Risk Communities in Marin County
Source: FEMA National Risk Index 2023

1.5.5 Social Vulnerability and Risk in Marin County

Link to National Risk Index

Social vulnerability is an important factor to consider during all functions of emergency management (mitigation, preparedness, response, recovery). When we work to mitigate hazards, we are alleviating the stress a hazard may put on a community. If a community is considered more socially vulnerable, the residents' risk of disaster is higher, therefore, to reduce risk, considering the social makeup of a community is critical. Many methodologies exist to aggregate census data into one simple number to represent social vulnerability; this should be seen as macro, supplemental data. It is also important to have input from all sections of a planning area that can truly represent the experiences, needs, and lived risk in a community.

Metrics that create social vulnerability indices are meaningful to planning as they can signify a community's capacity to mitigate, prepare for, respond to, and recover from the impacts of a disaster. From mitigating your living environment to resist impacts, preparing a backup food source, to understanding alert and warning messages, and having insurance or obtaining government assistance after a disaster, all require time, financial resources, education and language abilities that not all of our community members have the luxury of. This is why looking at social vulnerability metrics is important to understanding where the needs are in Marin.

For a high-level view to assess what communities in Marin are most at risk, the Marin County OA MJHMP chose to use the National Risk Index as it combines Expected Annual Loss (a measurement of expected economic loss), the CDC's Social Vulnerability Index (2020), and the Community Resilience Index (CRI) to rank census tracts' risk across the nation. With the three metrics aggregated, we can understand, from a high level, what areas of Marin may be the most holistically impacted by hazards. The most recent version of the National Risk Index was released in 2023, making it one of the most up to date ways to assess hazard impact and social vulnerability. Furthermore, it is the best source for information for macro level assessments.

Expected Annual Loss (EAL) is calculated using hazard exposure, annual frequency of a hazard and historic loss. As a whole, EAL is an attempt to represent average yearly economic loss resulting from natural hazards (i.e., losses to buildings, population, and agriculture). The county as whole is ranked as “relatively high” EAL; ranking in the 96-percentile in the nation. Census tracts are also categorized, see Figure 1.24.

Three census tracts in Marin, all in San Rafael, rank “Very High” for EAL. Most of the county is categorized as either “Relatively High” or “Relatively Moderate”, four classify as “Relatively Low”. One is assigned “Very Low” EAL, this is the Marin City census tract; an unincorporated community in southern Marin that has historically been underserved (highlighted with red outline in the following maps). The main contributing factor to this result is the perceived limited economic value and unrecorded economic losses due to disasters in Marin City. The economic impact of disasters in underserved communities has been historically under- or unreported, explaining how a commonly flooded area, such as Marin City, may be reflected as “Very Low” on the EAL. Disruptive flooding in Marin City happens during any significant rain, and this has been happening for over 80 years (KQED, 2022). Lack of reporting may be two-fold; limited connection to government and social capacity of residents to report. Impacts of frequent flooding in Marin City damages residents’ cars and homes, roadways, other structures; it puts people at risk of being swept away in flood water, can expose them to contaminated water; it cuts off residents’ ability to leave for work or errands and return home. All of this damage has direct economic consequences for the residents of Marin City and the County. Despite being classified as “Low Risk” on the EAL, the County of Marin acknowledges the impact disasters have on Marin City.

In Figures 1.19, 1.20, and 1.21 the US Census Tracts are outlined in white, and color coded as indicated on the map legend. The City and Town Jurisdictions are outlined in black while the unincorporated area of Marin City is outlined in blue.

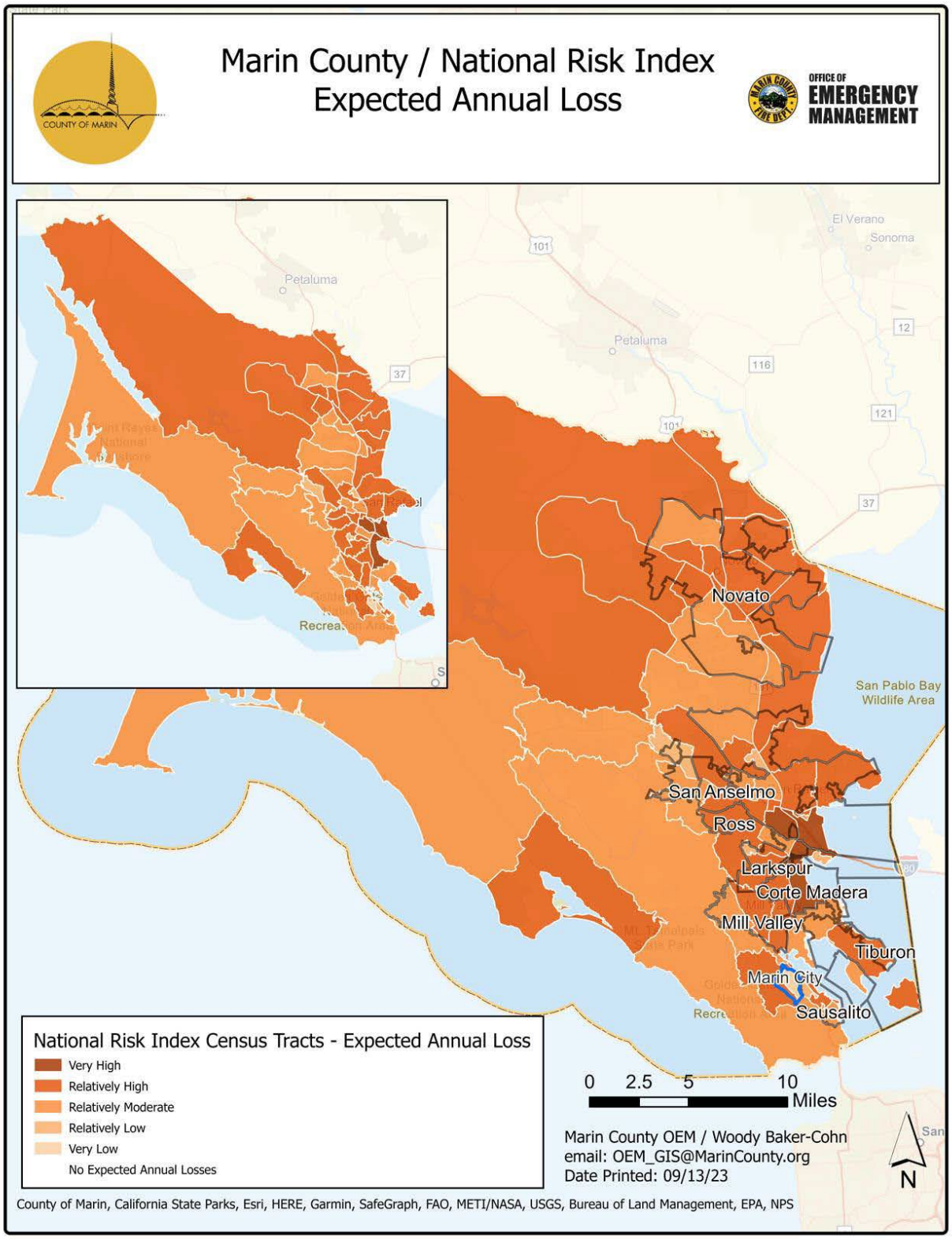


Figure 1.19: Marin County NRI – Expected Annual Loss
Source: FEMA National Risk Index 2023

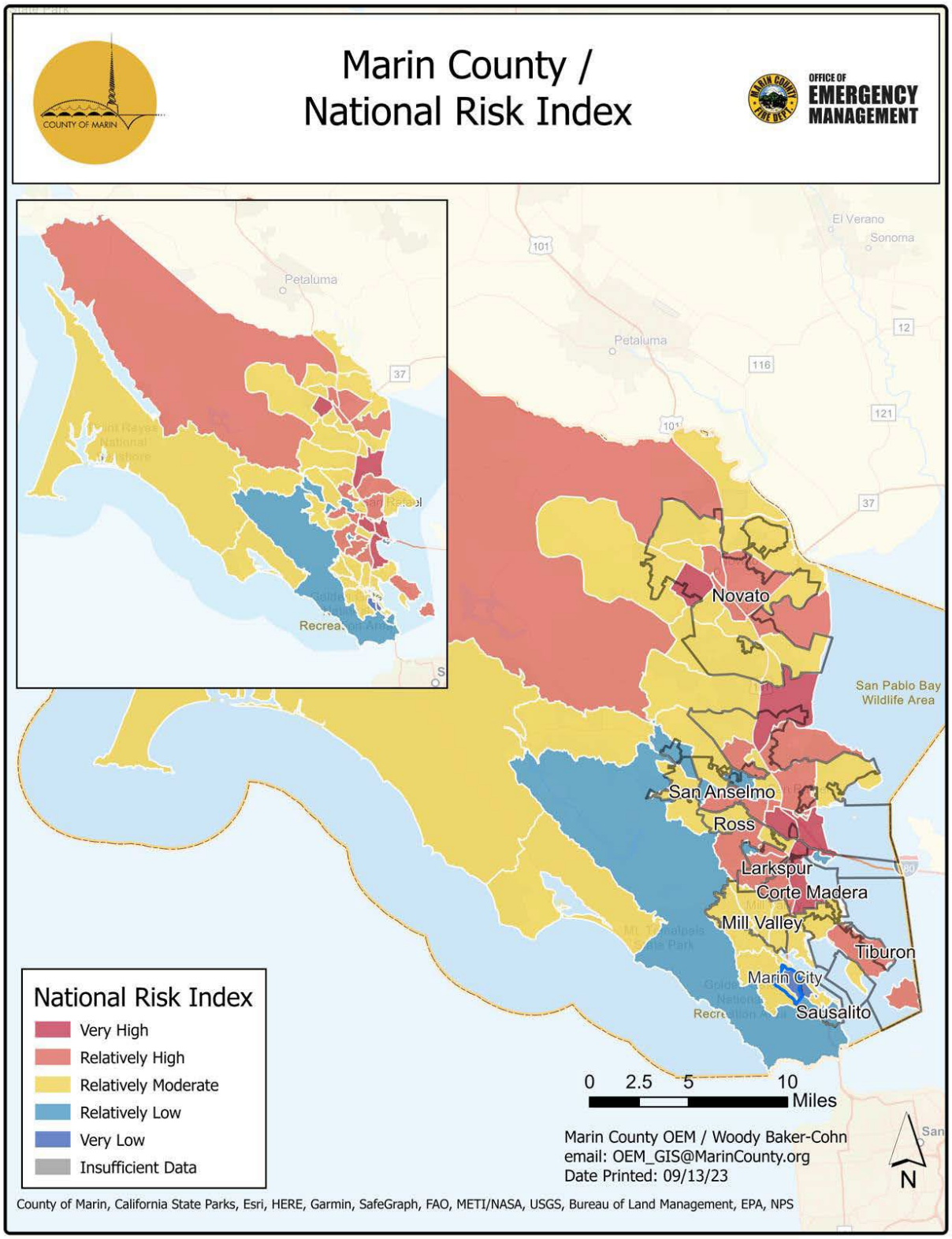


Figure 1.20: Marin County National Risk Index Map
Source: FEMA National Risk Index 2023

When looking at the CDC's SVI (see Figure 1.21), we see the most socially vulnerable residents reside in parts of Novato, parts of San Rafael, including in and around the Canal District, the Greenbrae neighborhood of Larkspur, and the unincorporated areas of Marin City and Santa Venetia. This aligns with what the County knows about Marin residents. However, discrepancy lies in the western, more rural area of the county. West Marin is comprised of seven villages, and other populated areas, that are distanced from the centralized resources in the eastern part of the county. At three local elementary school in West Marin (2022-2023 school year), the percentage of students eligible for free and reduced lunch program are, 62%, 41%, and 52%, a reflection of the financial capacity of local families. West Marin is home to many farms that may employ and house underrecognized workers that may not have taken part in a census survey, which is the basis for the SVI is calculation. In the fourth quarter of FY 2021/22 the bus routes traveling to West Marin (Rural Routes) were the only service category to have increased in ridership since pre-COVID (increase 0.1%; Marin Transit, 2022) showing the reliance of West Marin residents on public transportation; however, this data continues to adjust based upon the increase in alternate methods of mass transportation. Considering this, the County of Marin acknowledges that unique social factors in West Marin require different approaches than other parts of the County.

Looking to the community resilience index (CRI) results, the data is only calculated at the county-level and compared across the nation. As a whole, Marin County is considered to have a "very high" ability to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions when compared to the rest of the U.S. Unfortunately, this metric does not give us the distinct experiences of the diverse communities across Marin.

When the Estimated Annual Loss Index (EAL) , Social Vulnerability Index (SVI), and Community Resilience Index are aggregated as one, final results of the National Risk Index show Marin County as a whole to have "Relatively High" risk, this is due to the financial implications a disaster may have on the county. When broken out by census tract, five tracts are in the highest category ("Very High Risk"), this matches generally with the same tracts that are ranked in as higher social vulnerability; parts of Novato, parts of San Rafael, including in and around the Canal District, the Greenbrae neighborhood of Larkspur, and unincorporated areas of Santa Venetia.

However, Marin City is ranked as "Very Low" risk for the National Risk Index. Previous discussion highlighted why the Expected Annual Loss was low, but further discussion is required. As a County, we know Marin City should not be classified as "Very Low" on the NRI. Marin City residents, for example, only have one way in and out of their community and this road floods frequently, making it unsafe to cross and leave the community for work, school, medical resources. Additionally, there is only one "grocery" store, a Target, in Marin City. Both of these elements contribute to the vulnerability of residents as they may be unable to leave or return home and have limited access to groceries, relying on a single store's supply chain. At the local elementary school in Marin City, 47% of students are eligible for free and reduced-price meals (2022 – 2023 school year), a reflection of the financial capacity of local families. All this means, we can expect the social and built capacity of Marin City to be limited.

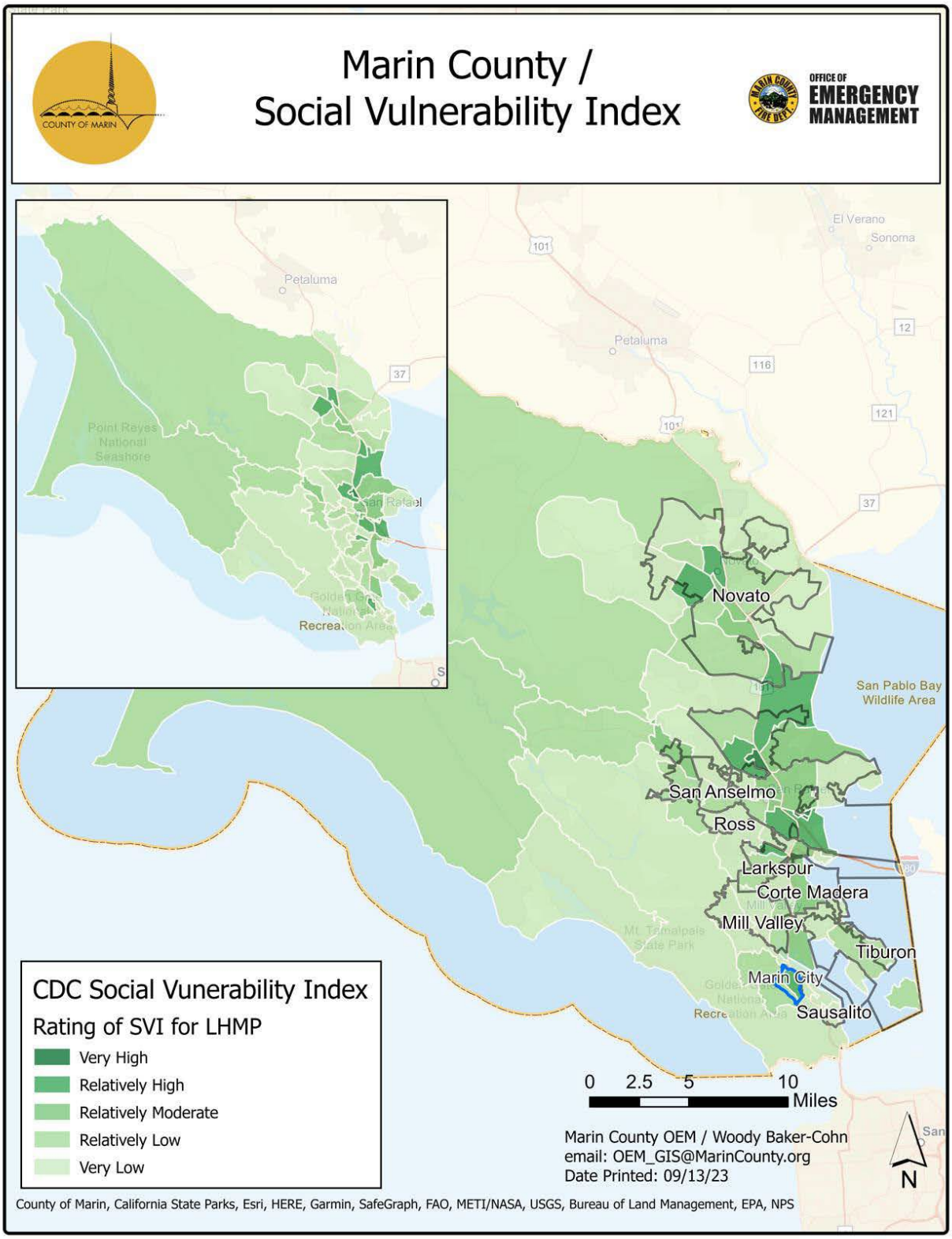


Figure 1.21: Marin County CDC Social Vulnerability Index Map
Source: FEMA National Risk Index 2023

The County of Marin has several outreach programs, specifically designed to reach and include traditionally underserved and underrepresented communities, including, Health and Human Services' Community Response Teams, Office of Equity's Participatory Budgeting program, and a community-created Race and Equity Plan. To receive feedback on the Marin County OA MJHMP, bilingual outreach was conducted through the Community Response Teams, which are led by local non-profits, representing four zones of Marin County. Local non-profits are selected for grant funding to be the Community Response Team lead. Additionally, County representatives went on the West Marin radio station, KWMR, to reach rural populations.

While decision makers in Marin acknowledge that aggregate hazard and social vulnerability data can be informative for understanding what resources can be most beneficial to what area of the county, it is acknowledged that this data is not considered to be fully representative of Marin's communities. It is critical to have a diversity of resident voices to represent a community's needs and experiences. Furthermore, this data does not consider trends and anticipated changes. Climate change continues to increase risk in our communities, with heat, sea level rise, increased flood events, longer droughts, and more powerful wildfires. Additionally, Marin's population is aging and growing to be less-White which will require the continued development of planning and response approaches to meet the needs of all residents.

1.5.6 Economics

Marin County has a strong economic base which has changed significantly over the last century. The county's economy was dominated by agriculture in the early part of its history. However, in recent years, Marin's economy has seen increasing job growth in technology-related fields such as biotechnology, computer software, and multimedia. With several attractions including beaches and parks in Marin, tourism is important to Marin County's economy.

The Marin County resident workforce is predominantly white collar. Over 92% of the County's residents age 25 or older have at least a high school diploma, compared with about 81% statewide; over 54% in this same age group have a bachelor's degree. These higher-than-average educational levels directly correlate with a low poverty rate of 7.5%, compared with 15.3% statewide. The County's largest employers include the County government, State Corrections Department, Marin General Hospital, Kaiser Permanente, Fireman's Fund Insurance, Lucas Licensing, Fair Isaac Corporation, and College of Marin. Over half the working population is employed in professional, management, or financial business occupations, but most of these workers are employed outside the County in urban centers such as San Francisco and Oakland. The services, construction, and transportation industries combined employ less than a quarter of the resident population but are major employment sectors within the County. According to the Marin Economic Commission, service industries based in Marin are a major source of employment for residents of surrounding counties who commute to Marin. The agricultural sector also retains a strong cultural and historical presence.

Table 1.13: Marin County Civilian Employed Population 16 Years and Over		
Industry	**Estimated Employment**	**Percent**
Civilian employed population 16 years and over	18,676,721	100
Agriculture, forestry, fishing and hunting, and mining	394,881	2.1
Construction	1,235,586	6.6
Manufacturing	1,676,715	9.0
Wholesale trade	501,378	2.7
Retail trade	1,919,513	10.3
Transportation and warehousing, and utilities	1,071,181	5.7
Information	539,683	2.9
Finance and insurance, and real estate and rental and leasing	1,107,961	5.9
Professional, scientific, and management, and administrative and waste management services	2,612,859	14.0
Educational services, and health care and social assistance	3,990,094	21.4
Arts, entertainment, and recreation, and accommodation and food services	1,835,141	9.8
Other services, except public administration	927,253	5.0
Public administration	864,476	4.6

Table 1.13: Marin County Civilian Employed Population 16 Years and Over
Source: US Census Bureau American Community Survey 2021 Estimates

1.6 Existing Authorities, Policies, Programs, and Resources

The jurisdictions represented in this plan are authorized by state law and qualify as separate governments. With the exception of the special districts, the jurisdictions all have a general plan that regulates current and future development through zoning based on described hazards. State law requires all California Cities and Counties to adopt general plans which include seven mandatory chapters: Land Use, Circulation, Housing, Conservation, Open Space, Noise and Safety. In addition to General Plans, each jurisdiction has an Emergency Action (or Operations) Plan and a Climate Action Plan.

The jurisdictions each have a municipal code of ordinances to establish the minimum requirements to safeguard the public health, safety, and general welfare through structural strength, means of egress facilities, stability, access to persons with disabilities, sanitation, adequate lighting and ventilation and energy conservation, and safety to life and property from fire and other hazards attributed to the built environment; to regulate and control the demolition of all buildings and structures, and for related purposes.

The jurisdictions all have planning departments that review proposed developments and new uses for conformance with policies plans and regulations and are served by law enforcement and fire departments.

Resources vary greatly between jurisdictions according to general funds and staff, which are roughly proportionate to population size and commercial activity. Regardless of size, mitigation actions tend to leverage federal, state, and regional financial resources heavily in the form of matching grants.

With the protection of plans and codes secured through statute, the expansion and improvement of policies and programs are dependent on the allocation of limited financial resources towards staff administration and implementation. An efficient means of improving and expanding programs is through shared resources. The many small jurisdictions in the County often do not have the resources to successfully accomplish the many requirements placed upon them, but through economies of scale they can provide better public service. One example of that is this Multi-Jurisdictional Local Hazard Mitigation Plan, which for most jurisdictions represents a much-needed update. For two of these jurisdictions this will be a new plan. See Section 4.0: Mitigation Strategy for further existing authorities, policies, programs, and resources in Marin County.

1.7 New Items for the 2023 MJHMP

The 2018 Marin County OA MJHMP contained a detailed description of the planning process, a risk assessment of identified hazards for the Marin County planning area, and an overall mitigation strategy for reducing risk and vulnerability from these hazards. Since approval of the plan by FEMA, progress has been made by the Marin County OA on implementation of the mitigation strategy. As part of this 2023 MJHMP Update, a thorough review and update of the 2018 plan was conducted to ensure that this update reflects current community conditions and priorities in order to realign the overall mitigation strategy for the next five-year planning period.

This MJHMP update involved a comprehensive review and update of each section of the 2018 plan and includes an assessment of the success of the participating communities in evaluating, monitoring and implementing the mitigation strategy outlined in the initial plan. Only the information and data still valid from the 2018 plan was carried forward as applicable into this MJHMP update.

Table 1.14: Marin County OA MJHMP Participants 2018 and 2023

	2018 Plan Participants	2023 Plan Participants
1	Marin County	Marin County
2	City of Belvedere	City of Belvedere
3	Town of Corte Madera	Bolinas Community Public Utility District
4	City of Fairfax	Town of Corte Madera
5	City of Larkspur	Sanitary District No. 2
6	City of Mill Valley	City of Fairfax
7	City of Novato	City of Larkspur
8	Town of Ross	Las Gallinas Valley Sanitary District
9	City of San Rafael	City of Mill Valley
10	Town of San Anselmo	North Marin Water District
11	City of Sausalito	City of Novato
12	City of Tiburon	Town of Ross
13	North Marin Water District	Town of San Anselmo

14	Marin County Flood Control and Water Conservation District	City of San Rafael
15		City of Sausalito
16		Southern Marin Fire Department
17		City of Tiburon

Table 1.14: Marin County OA MJHMP Participants 2018 and 2023

Also to be noted, the 2023 MJHMP update identifies key requirements for updating future plans:

- Considers changes in vulnerability due to action implementation;
- Documents success stories where mitigation efforts have proven effective;
- Documents areas where mitigation actions were not effective;
- Documents any new hazards that may arise or were previously overlooked;
- Incorporates new data or studies on hazards and risks;
- Incorporates new capabilities or changes in capabilities;
- Incorporates growth and development-related changes to inventories; and
- Incorporates new action recommendations or changes in action prioritization.

These requirements and others as detailed throughout this plan were also addressed during this plan update process.

As part of its 2023 Mitigation Strategy, Marin County and participating jurisdictions recognized that certain data, if available, would enhance the analyses presented in the risk assessment and utilized in the development of the mitigation strategy. New information and analyses contained throughout this plan update includes the following:

- A new assessment of hazards affecting the OA was completed resulting in the inclusion of additional hazards including climate change.
- An entire rework of the risk assessment for each identified hazard, including reworking the hazard profile and adding new hazard event occurrences; redoing the entire vulnerability analysis to add items identified below and updating the vulnerability assessment based on more recent hazard data as well as using the most current parcel and assessor data for the existing built environment.
- An update of the flood hazard analysis utilizing the 2017 DFIRMs to include an updated analysis of the 100-year flood, an analysis of the 500-year flood, and an enhanced analysis of the localized/stormwater flooding problems affecting the planning area.
- Development of an updated critical facility definition and a GIS mapping effort of critical facilities for the planning area.
- Greater analysis was performed on the wildfire hazard utilizing CalFire, Fire Severity GIS data and updated CalFire fire hazard severity maps from 2022.
- An enhanced vulnerability assessment which added an analysis of populations vulnerable to two priority hazards: flood and wildfire.
- An enhanced vulnerability assessment which added an analysis of future development in the planning area and specific to each of the mapped hazards.
- Incorporation and analysis of the new 2020 Census data was utilized for this MHHMP update.
- An analysis of the incorporation of the 2023 MJHMP into other planning mechanisms in the Marin County OA was performed.

Also, as required by the FEMA 2008 Local Multi-Hazard Mitigation Planning Guidance, the MJHMP an analysis of each jurisdictions' ongoing and continued compliance with the NFIP.

1.7.1 Revision of the Hazard Identification and Risk Assessment

This revised 2023 MJHMP now includes climate change in addition to the natural hazards facing our community. The risk assessment for each identified natural hazard was updated as determined by the Steering Committee. This included a reformulation of the hazard profiles and additions of new hazard occurrences. The vulnerability assessment was updated based on more recent hazard data.

1.7.2 Climate Change

According to the California Natural Resource Agency (CNRA), climate change is already affecting California and is projected to continue to do so well into the foreseeable future. Current and projected changes include increased temperatures, sea level rise, a reduced winter snowpack, altered precipitation patterns, and more frequent storm events. Over the long term, reducing greenhouse gases can help make these changes less severe, but the changes cannot be avoided entirely. Unavoidable climate impacts result in a variety of secondary consequences including detrimental impacts on human health and safety, economic continuity, ecosystem integrity and provision of basic services. Climate change is being profiled in the 2023 Marin County Hazard Mitigation Plan as a standalone hazard while addressing each of the other natural hazards. Marin County is considering climate change issues when identifying future mitigation actions.

1.7.3 Progress on Local Mitigation Efforts

There was success in the implementation of the mitigation actions as defined in the 2018 planning process, so the Steering Committee reassessed the need for those actions, looked at new actions and provided an explanation as to the methodology.

Details of 2018 projects are included in section 4.7 but multiple projects have had success, including completion and ongoing of retrofitting of critical county-owned buildings (project #2), completed construction of a flood basin on Fairfax Creek (project #3), and obtaining a grant to design the McInnis Marsh Restoration Project (project #23). The City of Mill Valley adopted a soft-story wood frame retrofit ordinance, updated the fire code, implemented updated vegetation management requirements, and has emergency generators available for all critical city facilities.

1.8 Plan Organization and Structure

The MJHMP has been developed using the latest guidance documents from the FEMA as listed:

- Local Mitigation Plan Review Guide dated October 11, 2011 and is structured similar to their Plan Review Tool.
- Local Mitigation Planning Policy Guide, April 19, 2023
- State Mitigation Planning Key Topics Bulletin: Mitigation Capabilities, November 2022
- State Mitigation Planning Key Topics Bulletin: Mitigation Strategy, October 2022

- State Mitigation Planning Key Topics Bulletins: Planning Process, October 2022
- State Mitigation Planning Key Topics Bulletin: Risk Assessment, October 2022

The Marin County OA Multi-Hazard Mitigation Plan is organized as follows:

- Section 1.0: Introduction
- Section 2.0: Planning Process
- Section 3.0: Hazard Identification and Risk Assessment
- Section 4.0 Mitigation Strategy
- Section 5.0: Plan Review, Evaluation, and Implementation
- Appendix A: Adoption Letters
- Appendix B: Documentation of the Planning Process
- Appendix C: Public Outreach Survey

SECTION 2.0: PLANNING PROCESS

44 CFR Requirement §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.

44 CFR Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Local governments have the responsibility to protect the health, safety, and welfare of their community members. Proactive mitigation policies and actions reduce risk and create safer, more disaster-resilient communities. Mitigation is an investment in Marin's safety and sustainability. Consider the critical importance of mitigation to:

- Reducing the devastating impacts that disasters can have on community members, workers, and businesses in Marin.
- Public safety and preventing loss of life and injury.
- Reducing harm to existing and future development.
- Preventing damage to a community's unique economic, cultural, and environmental assets.
- Minimizing operational downtime and accelerating recovery of communities, government and businesses after disasters.
- Reducing the cost of disaster response and recovery and the exposure to risk for first responders.
- Helping accomplish other community objectives, such as leveraging capital improvements, infrastructure protection, open space preservation, and economic resiliency.

The purpose of mitigation planning is to identify local policies and potential actions that can be implemented over the long term to reduce risk and future losses from hazards. Mitigation policies and actions are identified based on a hazard risk assessment and the participation of a wide range of stakeholders and the public in the planning process. Benefits of mitigation planning include:

- Identifying actions for risk reduction that are agreed upon by stakeholders and the public.
- Focusing resources on the greatest risks and vulnerabilities.
- Building partnerships by involving residents and visitors, organizations, and businesses.
- Increasing education and awareness of threats and hazards, as well as their risks.
- Communicating priorities to State and Federal officials.

- Aligning risk reduction with other community objectives.

2.1 Planning Approach

The initial phase of a planning approach is to identify risk associated with threats and hazards and identify projects to reduce that risk. The Marin Operational Area understands its hazards, vulnerabilities, and risks and is working together and with the public, to develop strategies, policies, and actions necessary to reduce risk and protect residents and visitors. Marin's hazard mitigation planning process engages the whole community and follows State and Federal planning guidance consistent with the requirements of the Stafford Act and the Federal Code of Federal Regulations (44 CFR Part 201).

The six elements of hazard mitigation planning include:

1. Introduction and Community Overview
2. Planning Process
3. Hazard Identification and Risk Assessment
4. Development of The Mitigation Strategy
5. Plan Review, Evaluation, And Implementation
6. Plan Adoption

This 2023 Marin County OA MJHMP is a comprehensive update of the 2018 Marin County OA MJHMP, which covered County of Marin the Cities of Belvedere, Larkspur, Mill Valley, Novato, San Rafael and Sausalito; the Towns of Corte Madera, Fairfax, Ross, San Anselmo and Tiburon; and the special districts of Bolinas Community Public Utility District, Las Gallinas Valley Sanitary District, North Marin Water District, Sanitary District No. 2, and Southern Marin Fire Protection District. FEMA approved the 2018 plan on December 27, 2018, and the plan is expiring on December 27, 2023. The current update meets federal requirements for updating hazard mitigation plans on a five-year cycle. It represents the third iteration of the Marin County Hazard Mitigation Plan, which was initially developed as a plan in 2013. Eighty-three planning partners have participated in the 2023 update, as listed in Table 2.2 and Table 2.4.

The 2023 Marin County OA MJHMP identifies the process that Marin County will use to develop their roles and responsibilities in hazard mitigation planning. The 2023 Hazard Mitigation Plan is the principal guide for Marin County to identify hazards and mitigation projects that will enhance the resilience of Marin communities from natural disasters.

The planning team used the Federal Emergency Management Agency (FEMA) Local Mitigation Plan Review Guide to ensure the Marin County OA MJHMP includes all necessary components.

The process followed to develop the 2023 Marin County OA MJHMP had the following primary objectives:

- Secure grant funding and select a consultant.
- Establish a planning partnership.
- Define the planning area and jurisdiction.
- Establish a steering committee and planning team.
- Coordinate with stakeholders and agencies.
- Review existing programs.
- Engage the public.

These objectives are discussed in the following sections.

2.2 Grant Funding and Consultant Selection

This planning effort was supplemented by a FEMA Hazard Mitigation Assistance grant in fiscal year 2019. Marin County OEM was the sub-applicant agent for the grant. It covered 75 percent of the cost for development of this plan; the County and planning partners covered the balance through in-kind contributions.

In November 2022, Marin County contracted for consultant services to assist in the update to their 2018 Multi-Jurisdictional Hazard Mitigation Plan. After a comprehensive review process, Preparative Consulting was selected to partner with representatives from Marin County and its participating jurisdictions to complete a comprehensive update of the 2018 Marin County OA MJHMP

2.3 Establish a Planning Partnership

As the lead organization, Marin County Fire Department Office of Emergency Management (OEM) established a Steering Committee with representatives from the County, Cities, Towns, and special districts. These participants were engaged to lead the planning process based on the contribution and input from relevant stakeholders and the public. Representatives should have the authority and knowledge to identify and commit resources during the planning process and have subject matter knowledge on local communities, hazards, and risks.

The majority of Marin County is unincorporated sparsely populated rural and protected lands. Most of the 262,000 county population is consolidated into the Eastern portion of the county. The County of Marin has a unique populated distribution where the participating planning jurisdictions and district's planning areas are located in an area of the county with similar climate, similar topography, and are exposed to many of the same hazards. Only three jurisdictions, Larkspur, Ross, and San Anselmo, are not coastal jurisdictions and are not impacted by Tsunami or Sea Level Rise.

The Marin County OA MJHMP Steering Committee and broader Planning Team approached the development of the Marin County OA MJHMP and the associated jurisdictional and district profiles from a coordinated and collaborative planning and public engagement unity of effort.

The Steering Committee felt a unified effort, led by the Marin County OEM, would be the most effective approach for this planning process. This approach allowed the small jurisdictions and districts with limited staffing and resources to take advantage of the combined efforts of the County and other jurisdictions to reach a broader segment of each of their populations and do so in a way to ensure greater equity and inclusion of the public in this planning process. Extensive and coordinated public outreach was done involving all participating jurisdictions and districts with an eye towards equity, inclusion, openness, accessibility, and ensuring they meet the population where they live, work, or recreate to provide the public convenience of access and ease of participation in this planning process.

Participating jurisdictions worked through multiple sessions and independently on:

- Facilitation of the planning process, including multi-agency collaboration and partnering.
- Identification of the primary local stakeholders – formation of the Marin County OA hazard mitigation Planning Team and hazard mitigation Steering Committee.
- Review of the 2018 Marin County OA MJHMP.
- Establishment of updated planning goals and objectives.

- Establishment of jurisdiction-specific hazard mitigation work groups to facilitate internal planning activities.
- Organization of jurisdiction/agency-specific hazard mitigation Working Groups.
- Revision of jurisdictional demographic and organizational data, and reformatting of information presentation.
- Identification and refined assessment of real or potential hazards and threat conditions.
- Development of prioritized hazard mitigation strategies and projects, keyed to identified hazards.
- Compliance with the Disaster Mitigation Act requirements as established by federal regulations and following FEMA's planning guidance.
- Prioritization of equity and engagement of the whole community with a focus on engaging hard-to-reach populations and providing translation and interpretation services in our public outreach and input process.
- Production of the draft and final plan documents; and
- Coordination with the California Office of Emergency Services (Cal OES) and FEMA Region IX plan reviews.

2.4 Define the Planning Area and Participating Jurisdictions

The planning area and participating jurisdictions and organizations were defined to consist of unincorporated Marin County, the Cities of Belvedere, Larkspur, Mill Valley, Novato, San Rafael and Sausalito; the towns of Corte Madera, Fairfax, Ross, San Anselmo and Tiburon; the Bolinas Public Utility District, the Las Gallinas Valley Sanitary District, the Sanitary District #2, the Southern Marin Fire Protection District, and the North Marin Water District. All participating jurisdictions are within the geographical boundary of Marin County and 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 3, along with a description of planning area characteristics.

This unity of effort approach allowed the Steering Committee to establish a more robust Planning Team representing local, countywide, regional, state, and federal stakeholders servicing the Marin County planning area. These stakeholders were in a unique position to provide informed and specific information and recommendations on hazard mitigation goals and actions, as well as population needs and social vulnerability for each of the jurisdictional and district planning areas. This united effort allowed the planning team to attend fewer meetings than they would have been required to attend if they were required to attend separate meetings for each participating jurisdiction and district. The reduced number of meetings allowed the planning team the opportunity and time to provide more detailed and thoughtful contributions to the planning effort.

Each jurisdiction wishing to join the planning partnership/Steering Committee 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, understanding of expectations, and commitment to adopt the approved Hazard Mitigation plan by their governing body. These expectations are detailed in section 2.5 STEERING COMMITTEE.

The jurisdictions participating in the 2023 Marin County OA MJHMP were represented by:

Table 2.1: 2023 MJHMP Participating Jurisdictions			
	Jurisdiction	Representative	Title
1	Marin County	Hannah Tarling	Emergency Management Coordinator
2	Marin County	Chris Reilly	OEM Project Manager
3	City of Belvedere	Irene Borba	Director of Planning
4	City of Larkspur	Loren Umbertis	Public Works Director
5	City of Mill Valley	Patrick Kelly	Director of Planning and Building
6	City of Novato	Dave Jeffries	Consultant/JPSC
7	City of San Rafael	Quinn Gardner	Deputy Emergency Services Coord.
8	City of Sausalito	Kevin McGowan	Director of Public Works
9	Town of Corte Madera and Sanitary District #2	RJ Suokko	Director of Public Works
10	Town of Fairfax	Loren Umbertis	Public Works Director
11	Town of Ross	Richard Simonitch	Public Works Director
12	Town of San Anselmo	Sean Condry	Public Works & Building Director
13	Town of Tiburon	Sam Bonifacio	Assistant Planner
14	Bolinas Community Public Utility District	Jennifer Blackman	General Manager
15	Las Gallinas Valley Sanitary District	Dale McDonald	Administrative Services Manager
16	North Marin Water District	Eric Miller	Asst. General Manager
17	Southern Marin Fire District	Marshall Nau	Fire Marshall/South Marin Fire Dist.

Table 2.1: 2023 Marin OA MJHMP Participating Jurisdictions

2.5 Steering Committee

The Steering Committee led the planning process based on the contribution and input from the whole community stakeholders who identified the community's concerns, values, and priorities. Preparative Consulting coordinated and facilitated the 2023 Marin County OA MJHMP update with the assistance of the Marin County Office of Emergency Management and acted as the central point of contact for all partnering jurisdictions and organizations. Preparative Consulting developed the draft plan in conjunction with and at the direction of the hazard mitigation Steering Committee members and served as a liaison between Marin County and the State regarding plan revision.

Table 2.2: 2023 MJHMP Steering Committee Members			
No.	Agency	Point of Contact	Title
1	Belvedere	Laurie Nilsen	Emergency Services Coordinator
2	Belvedere	Rebecca Markwick	Planning Director
3	Belvedere	Samie Malakiman	Associate Planner
4	Bolinas Com. PUD	Jennifer Blackman	General Manager
5	Bolinas Fire Protection Dist	Stephen Marcotte	Assistant Fire Chief
6	Central Marin Fire District	Matt Cobb	Battalion Chief/Fire
7	Central Marin Fire District	Ezra Colman	Battalion Chief/Fire
8	Central Marin Fire District	Rubin Martin	Fire Chief
9	Corte Madera	RJ Suokko	Director of Public Works
10	Corte Madera	Chris Good	Senior Civil Engineer
11	Sanitary District No. 2	RJ Suokko	Director of Public Works
12	Fairfax	Loren Umbertis	Public Works Director

13	Fairfax	Mark Lockaby	Building Official
14	Larkspur	Dan Schwarz	City Manager
15	Larkspur	Julian Skinner	Public Works Director/ City Engineer
16	Larkspur	Robert Quinn	Public Works Superintendent
17	Las Gallinas Valley Sanitary District	Dale McDonald	Administrative Services Mgr.
18	Las Gallinas Valley Sanitary District	Greg Pease	Safety Manager
19	Marin County	Steven Torrence	Director of Emergency Management
20	Marin County	Chris Reilly	OEM Manager
21	Marin County	Woody Baker-Cohn	Senior Emergency Management Coordinator
22	Marin County	Leslie Lacko	Community Development Agency
23	Marin County	Hannah Lee	Senior Civil Engineer
24	Marin County	Felix Meneau	Project Mgr./ FCWCD
25	Marin County	Julia Elkin	Department of Public Works
26	Marin County	Beb Skye	Department of Public Works
27	Marin County	Scott Alber	Fire
28	Marin County	Lisa Santora	Deputy Public Health Officer, Marin Health & Human Services
29	Marin County	Kathleen Koblick	Marin Health & Human Services
30	Marin County	Amber Davis	Public Health Preparedness
31	Mill Valley	Patrick Kelly	Director of Planning & Building Department
32	Mill Valley	Ahmed A Aly	Engineering Project Manager
33	Mill Valley	Jared Barrilleaux	Deputy Director of Engineering
34	Mill Valley	Daisy Allen	Senior Planner
35	Southern Marin Fire District	Tom Welch	Deputy Chief/South Marin Fire Dist.
36	Southern Marin Fire District	Marshall Nau	Fire Marshall/South Marin Fire Dist.
37	North Marin Water District	Eric Miller	Asst. General Manager
38	North Marin Water District	Tim Fuette	Senior Engineer
39	Novato	David Dammuller	Engineering Services Mgr.
40	Novato	Dave Jeffries	Consultant/JPSC
41	Ross	Richard Simonitch	Public Works Director
42	San Anselmo	Sean Condry	Public Works & Building Director
43	San Anselmo	Erica Freeman	Building Official
44	San Anselmo	Scott Schneider	Asst. PW Director
45	San Rafael	Quinn Gardner	Deputy Emergency Services Coord.
46	San Rafael	Cory Bytof	Sustainability
47	San Rafael	Joanna Kwok	Senior Civil Engineer
48	San Rafael	Kate Hagemann	Climate Adaptation & Resilience Planner
49	Sausalito	Andrew Davidson	Senior Engineer/ DPW
50	Sausalito	Kevin McGowan	Director of Public Works
51	Sausalito	Brandon Phipps	Planning Director
52	Sausalito	Ali Iqbal	Assistant Civil Engineer/ Public Works
53	Tiburon	Sam Bonifacio	Assistant Planner
54	Tiburon	Dina Tasini	Director of Community Development
55	Tiburon	Laurie Nilsen	Emergency Services Coordinator

Table 2.2: Marin County OA MJHMP Steering Committee Members

Table 2.3: Preparative Consulting Planning Team Members			
No.	**Agency**	**Point of Contact**	**Title**
1	Preparative Consulting	Paul Bockrath	Project Lead/Planner
2	Preparative Consulting	Candise Bockrath	Project Manager
3	Preparative Consulting	David M. Block	Lead Planner

Table 2.3: Marin County OA MJHMP Preparative Consulting Planning Team Members

The Steering Committee met and reviewed the mitigation recommendations and strategies identified within this plan. Each participating local jurisdiction established a mechanism for the development and implementation of jurisdictional mitigation projects, as identified within this plan and associated locally specific supporting documents. As deemed necessary and appropriate, participating jurisdictions will organize local mitigation groups to facilitate and administer internal activities.

44 CFR Requirement §201.6(a)(3): Multi-jurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

The Disaster Mitigation Act (DMA) planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning process. The Steering Committee assisted with the planning process in the following ways:

- Attending and participating in the Steering Committee meetings.
- Identification of potential mitigation actions.
- Updating the status of mitigation actions from the 2018 Marin County OA MJHMP.
- Collecting and providing other requested data (as available).
- Making decisions on plan process and content.
- Reviewing and providing comments on plan drafts; including annexes.
- Informing the public, local officials, and other interested stakeholders about the planning process and providing opportunity for them to be involved and provide comment.
- Coordinating, and participating in the public input process.
- Coordinating the formal adoption of the plan by the governing boards.

2.5.1 Steering Committee Planning Process

The Steering Committee met monthly to develop the plan. Email notifications were sent out to each Steering Committee member to solicit their participation in the Steering Committee meetings. The meetings were conducted using a Zoom platform videoconferencing. Meeting attendees signed in using the chat feature to record their attendance.

The Steering Committee agreed to make and pass plan-based general policy recommendations by a vote of a simple majority of those members present. The Steering Committee will also seek input on future hazard mitigation programs and strategies from the mitigation planning team by focusing on the following:

- Identify new hazard mitigation strategies to be pursued on a state and regional basis, and review the progress and implementation of those programs already identified.

- Review the progress of the Hazard Mitigation program and bring forth community input on new strategies.
- Coordinate with and support the efforts of the Marin County OEM to promote and identify resources and grant money for implementation of recommended hazard mitigation Strategies within local jurisdictions and participating public agencies.

During the planning process, the Steering Committee communicated through videoconferencing, face-to-face meetings, email, telephone conversations, and through the County website. The County website included information for all stakeholders on the MJHMP update process. Hannah Tarling of the Marin County Office of Emergency Management and Preparative Consulting established a Microsoft 365 SharePoint folder which allowed the Steering Committee members and Marin OEM and Preparative Consulting to share planning documents and provide a format for the planning partners to submit completed documents and access other planning related documents and forms. Draft documents were also posted on this platform and the Marin County OES website so that the Steering Committee members and the public could easily access and review them.

2.5.2 Steering Committee Tasks

The Steering Committee engaged in research to identify, document, and profile all the hazards that have, and could have, an impact on the planning area. The Steering Committee also conducted a capability assessment to review and document the planning area's current capabilities to mitigate the risk and vulnerability of each participating jurisdiction to each identified hazard. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the Steering Committee could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified.

Specific tasks were identified for the Steering Committee in order to ensure that project goals for the MJHMP revision were undertaken and completed. The following represents those primary Steering Committee tasks:

- Coordinate tasks and activities with the Marin County OEM to develop all-hazards disaster mitigation plan and oversee the planning process.
- Prioritize hazards vs. resources.
- Select highest and best mitigation recommendations and develop those recommendations for further action by Marin County and the Cities/Towns and special districts.
- Review planning drafts, recommendations and updates.
- Develop and implement long and short term goals.
- Integrate the plan with all phases of comprehensive emergency management planning.
- Provide for the implementation of committee decisions.
- Encourage, coordinate and provide a methodology for the implementation of public input.
- Provide for the implementation of Steering Committee decisions.

2.5.3 Steering Committee Future Tasks

Specific future tasks were identified for the Steering Committee in order to ensure that project goals for the MJHMP revision were continued. The following represents those primary Steering Committee future tasks:

- Define the mitigation constraints that the Marin County OA is required to follow in implementing recommendations from the Steering Committee.
  - Protection of sensitive information
  - Apply budget constraints to recommended hazard mitigation strategies
  - Apply state policy and legal constraints to mitigation strategies brought forward by the Steering Committee.
- Meet on an annual basis to review the work of and contribute to the Steering Committee activities.
- Bring forth the concerns and views of the community to the Steering Committee for consideration in the ongoing hazard mitigation planning process.
- Consider utilizing the California Department of Public Health Community Assessment for Public Health Emergency Response (CASPER) to provide public health leaders and emergency managers with a rapid community assessment to determine household-based information about a community following a disaster.
- Assist in informing the public and community of the hazard mitigation strategies recommended by the Steering Committee.
- Define the constraints for implementation of prioritized mitigation strategies within the authorities, laws, and regulations of the local entities existing within the Marin County OA.
- Carry out the goals and objectives of the Marin County OA MJHMP.
- Support and review the input from meetings of the adjunct members with individuals, agencies and jurisdictions.
- Assure that the public is kept informed of changing strategies and implementation actions periodically.

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (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. (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

2.6 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)).

Early in the planning process, the Steering Committee determined that data collection, risk assessment analyses, mitigation strategy development, and plan approval would be greatly

enhanced by inviting other local, state and federal agencies and organizations to participate in the process. Based on their involvement in hazard mitigation planning, their landowner status in the County, and/or their interest as a neighboring jurisdiction, representatives from the following groups were invited to participate on the Planning Team:

Table 2.4: Marin County OA MJHMP Planning Team Members

No.	Agency	Point of Contact	Title
	Special Districts & Partner Agencies		
1	Bolinas Fire Protection District	Stephen Marcotte	Assistant Fire Chief
2	County of Sonoma	Jeffrey DuVall	Deputy Director, County of Sonoma OEM
3	County of Marin Disability Access Program	Laney Davidson	Disability Access Manager/ ADA Coordinator
4	County of Marin Disability Access Program	Peter Mendoza	Disability Access Manager/ ADA Coordinator
5	Emergency Medical Services	Chris Le Baudour	EMS Authority
6	Fire Departments	Jason Weber	Fire Chief
7	Golden Gate Bridge, Highway & Transportation District	Daniel Rodriguez	Security, Emergency Management Specialist
8	Golden Gate Bridge, Highway & Transportation District	Dennis Mulligan	General Manager & CEO,
9	Marin City Climate Resilience and Health Justice	Terrie Green	Executive Director
10	Marin Center for Independent Living	Peter Mendoza	Director of Advocacy and Special Projects
11	Marin City Community Services District	Juanita Edwards	Interim General Manager
12	Marin County Community Development Agency	Leslie Lacko	Community Development Agency
13	Marin County Flood Control & Water Conservation District	Garry Lion	Advisory Board Member
14	Marin County Office of Education	Michael Grant	Director, Marin County Office of Education
15	Marin County Parks	Max Korten	General Manager and Director
16	PG&E	Mark Van Gorder	Government Affairs, North Bay
17	PG&E	Ron Karlen	PG&E Public Safety Specialist
18	Sonoma Marin Area Rail Transit (SMART)	Jennifer McGill	Chief of Police
19	Transportation Authority of Marin (TAM)	Anne Richmond	Executive Director
20	Willow Creek School	Itoco Garcia	Superintendent
	State Agencies		
21	Cal OES - ESC	Sarah Finnigan	Cal OES, Sr. Emergency Services Coordinator
22	Cal OES, Division of Safety of Dams	Danielle Jessup	Coordinator/ Dam Safety Planning Division
23	California Department of Public Health	Svetlana Smorodinsky	Disaster Epidemiologist/ Environmental &

Table 2.4: Marin County OA MJHMP Planning Team Members			
No.	**Agency**	**Point of Contact**	**Title**
			Occupational Emergency Preparedness Team
24	California Department of Public Health	Patrice Chamberlain	Health Program Specialist II / Environmental & Occupational Emergency Preparedness Team
25	California Department of Water Resources	Julia Ekstrom, PhD	Supervisor, Urban Unit Water Use Efficiency Branch
26	Caltrans	Trang Hoang	Senior Transportation Engr/ Office of Advance Planning
27	Caltrans	Markus Lansdowne	Caltrans D4 Emergency Coordinator
Federal Agencies			
27	Army Corps of Engineers	Jessica Ludy	Flood Risk Management, Equity, and Environmental Justice
28	National Park Service	Stephen Kasierski	OneTam
29	US Coast Guard	LT Tony Solares	Sector SF Waterways Safety Branch
30	US Coast Guard	MST1 Brandon M. Ward	Emergency Management Specialist
31	US Coast Guard	LT William K. Harris	USCG SEC San Francisco

Table 2.4: Marin County OA MJHMP Planning Team Members

Coordination with key agencies, organizations, and advisory groups throughout the planning process allowed the Planning Team to review common problems, develop policies and mitigation strategies, as well as identifying any conflicts or inconsistencies with regional mitigation policies, plans, programs and regulations. For example, in conjunction with the kick off meetings, several key stakeholder/agency conversations were held at the beginning of the project to solicit input and to identify and obtain data at the beginning of the project. This included initial discussions with: Cal OES, DWR, Marin County Flood Control & Water Conservation District and Marin County Fire Agencies. Coordination with these key agencies continued throughout the project. Representatives from Cal OES attended most of the Planning Team meetings where they helped present, answered questions and provided input and support on the MJHMP process and plan requirements and provided details as requested on other related programs, such as FEMA grant programs. Through their attendance at Planning Team meetings, these key stakeholders and agencies provided ongoing information and data as requested to support the overall plan development process.

These key agencies, organizations, and advisory groups received meeting announcements, agendas, and minutes by e-mail throughout the plan update process. They supported the effort by attending meetings or providing feedback on issues. All the agencies were provided with an opportunity to comment on this plan update and were provided with a copy of the plan to review and offer edits and revisions. They were also provided access to the Marin County OEM hazard mitigation plan website to review all planning documents and hazard mapping tools.

Each was sent an e-mail message informing them that draft portions of the plan were available for review. In addition, the complete draft plan was sent to the California Governor's Office of

Emergency Services (Cal OES) and FEMA Region IX for a pre-adoption review to ensure program compliance.

In addition, through the public meetings conducted at the beginning of the planning process, members of the planning team, the public, and other key stakeholders were invited to participate in the planning process through public outreach activities.

The Steering Committee used technical data, reports, and studies from the following agencies and groups:

- California Governor's Office of Emergency Services
- California Department of Forestry and Fire Protection
- California Department of Finance
- California Department of Fish and Game
- California Department of Forestry and Fire Protection
- California Department of Water
- California Geological Survey
- California Register of Historic Places
- Federal Emergency Management Agency
- National Oceanic and Atmospheric Association
- National Performance of Dams Program
- National Register of Historic Places
- National Resource Conservation Service
- National Weather Service
- United States Army Corps of Engineers
- United States Bureau of Land Management
- United States Department of Agriculture
- United States Drought Impact Reporter
- United States Farm Service Agency
- United States Forestry Service
- United States Geological Survey
- Western Regional Climate Center

Several opportunities were provided for the groups listed above to participate in the planning process. At the beginning of the planning process, invitations were extended to these groups to actively participate on the Planning Team. Participants from these groups assisted in the process by providing data directly as requested in worksheets or through data contained on their websites or as maintained by their offices. Further as part of the public outreach process, all groups were invited to attend the public meetings and to review and comment on the plan prior to submittal to Cal OES and FEMA.

The following planning meetings were held with the planning team:

Table 2.5: Marin County OA MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
1	10/26/22	Steering Committee	Project Overview Meeting	• Plan Overview – Steps and Timeline • Planning Process • Steering Committee Role
2	11/9/22	Steering Committee	Steering Committee Kickoff Meeting	• Hazard Mitigation and Emergency Management Overview • Plan Overview – Steps and Timeline • Community Overview • Planning Process • Hazard Identification and Risk Assessment • Stakeholders and Planning Team Identification
3	12/6/22	Steering Committee, Planning Team	Planning Team Kickoff Meeting	• Hazard Mitigation and Emergency Management Overview • Plan Overview – Steps and Timeline • Community Overview • Planning Process • Hazard Identification and Risk Assessment
4	02/07/23	Steering Committee	Steering Committee Hazard Profile Meeting	• Jurisdictional Letter of Commitment • Identify Planning Team Members • Hazard Risk Ranking Worksheets • Jurisdictional Profiles • Jurisdictional/ District Capability Assessment • 2018 Hazard Mitigation Project Status Update
5	03/07/23	Steering Committee/ Planning Team	Planning Team Public Outreach Strategy Meeting	• Planning Goals and Objectives • Hazard Risk Ranking Worksheets • Jurisdictional Profiles • Jurisdictional/ District Capability Assessment • 2018 Hazard Mitigation Project Status Update • Public Outreach Strategy

Table 2.5: Marin County OA MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
6	04/04/23	Steering Committee	Steering Committee Meeting	• HMGP (DR-4683) Funding Timeline • Public Outreach • Planning Goals and Objectives • Jurisdictional Hazard Vulnerability Maps • Jurisdictional Profiles • Jurisdictional/ District Capability Assessment • 2018 Hazard Mitigation Project Status Update
7	04/13/23	General Public, Steering Committee, Planning Team	Public Outreach Town Hall Meeting #1 (In-person and virtual on Zoom) Thursday, 6:00 pm to 7:30 pm Marin County BOS Chambers	• Meeting translated live in Spanish with 29 language subtitle capability for virtual participants. • Meeting also interpreted in American Sign Language • Meeting recorded and posted on Hazard Mitigation website. • Hazard Mitigation and Emergency Management Overview • Planning Process • Hazard Identification and Risk Assessment • Planning Goals and Objectives • Hazard Mitigation Projects • Community Input
8	04/29/23	General Public, Steering Committee, Planning Team	Public Outreach Town Hall Meeting #2 (In-person and virtual on Zoom) Saturday, 10:00 am to 11:30 am Marin County Health and Wellness Center	• Meeting translated live in Spanish with 29 language subtitle capability for virtual participants. • Meeting also interpreted in American Sign Language • Meeting recorded and posted on Hazard Mitigation website. • Hazard Mitigation and Emergency Management Overview • Planning Process • Hazard Identification and Risk Assessment • Planning Goals and Objectives • Hazard Mitigation Projects • Community Input

Table 2.5: Marin County OA MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
9	05/31/23	Steering Committee	Steering Committee Hazard Ranking Meeting	• HMGP (DR-4683) Funding Timeline • Public Outreach Status • Jurisdictional Hazard Vulnerability Maps • OEM Overview of Hazard Maps and Marin Maps • Marin Co. MJHMP Risk Assessment Tool Overview • 2018 Hazard Mitigation Project Status Update • Hazard Working Groups
10	06/27/23	Steering Committee, Planning Team	Marin County Planning Team Meeting	• HMGP (DR-4683) & BRIC Grant Funding Timeline • Public Outreach Status • Jurisdictional Hazard Risk Assessment Tool • OEM Overview of Hazard Maps and Marin Maps • Marin County Hazards over the Last 5-Years • 2018 Hazard Mitigation Project Status Update • 2023 Hazard Mitigation Projects/Capital Improvement Projects • Hazard Working Groups
11	07/01/23-09/01/23	Steering Committee Members	Steering Committee Members Plan Development Sessions	• Individual phone or conference calls with planning jurisdictions and districts to answer specific questions and assist them in developing their profile annex.
12	11/27/23	Steering Committee, Planning Team	Marin County Final Planning Team Meeting	• Presentation and review of the Draft Marin County OA MJHMP and Jurisdictional/District Annexes
13	11/28/23	General Public	Public Outreach Presentation on Marin County Office of Emergency Management Website	• Presentation and review of the Draft Marin County OA MJHMP and Jurisdictional/District Annexes. • Opportunity for public comment and questions and answers.

Table 2.5: Marin County OA MJHMP Planning Meetings

2.7 Review and Incorporation of Existing Plans

Planning efforts are supportive of each other. Information from the Marin OA MJHMP is incorporated into and used to support the City, County, and Town General Plans, Emergency Operations Plans, and continuity plans. Many of these planning efforts incorporate all Marin County jurisdictions and Special Districts. The development of this plan incorporated information from the following existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions:

All Jurisdictions (Marin County OA)

- Association of Bay Area Governments (ABAG) 2010 multi- jurisdictional Local Hazard Mitigation Plan for the San Francisco Bay Area, 2010 Update of 2005 Plan
- Marin Map- online mapping tool includes hazard data, assets, zoning, current FEMA flood maps www.marinmap.org
- FEMA data via Flood Insurance Studies, BureauNet
- Marin County - Community Wildfire Protection Plan(CWPP) www.firesafemarin.org/cwpp
- Marin Community Wildfire Protection Plan, 2020.
- Marin Shoreline Sea Level Rise Vulnerability Assessment
- DSOD dam safety information
- ABAG earthquake: https://abag.ca.gov/our-work/resilience/data-research/earthquake
- 2018 State of California Hazard Mitigation Plan
- Marin Stormwater Resource Plan 2017
- The Scoop on Marin County Sewer Systems: Part I 2013/2014 Marin County Civil Grand Jury
- U.S. Census Bureau 2010 Census
- The studies detail flood depths and base flood elevations. Used in development of risk assessments and mitigation actions
- Marin Municipal Water District Urban Water Management Plan 2015 (approved June 7, 2016)
- Countywide Watershed Stewardship Plan
- Plan Bay Area 2040
- Sonoma County Water Agency Local Hazard Mitigation Plan
- CAL FIRE & Marin County Fire Department Strategic Fire Plans
- International Urban-Wildland Interface Code 2003
- Community Exposure to Tsunami Hazards in California report & National Geodetic Data Center database of tsunami occurrences
- Cliff and Erosion Technical Background Report, 2003 prepared for Marin County Local Coastal Program update
- Landslide Inventory, California Department of Conservation
- California Building, Plumbing and Mechanical Codes

Unincorporated Marin County

Marin County's 2023 MJHMP will be referenced in the 2023 County of Marin General Plan: Safety Element and Housing Element 2023 Update.

- 2007 Marin Countywide Plan
- Local Coastal Program

City of Belvedere

Belvedere's 2023 General Plan Environmental Hazards Element has thorough treatment of environmental hazards and references the City's participation in the 2018 Marin County MJHMP and development of the 2023 update. The City's 2011 Local Hazard Mitigation Plan (LHMP) was contained its Flood Mitigation Plan.

- 2023 General Plan
- Flood Mitigation Plan
- Capital Improvement Plan
- Emergency Operations Plan (EOP)
- Traffic Safety Study

Town of Corte Madera

Corte Madera's General Plan was updated in 2023. The General Plan calls for implementation of a Hazard Plan. The Town's Capital Improvement Plan and building and municipal codes have been updated since 2011 and incorporate portions of the Marin County OA MJHMP Corte Madera Community Profile.

- Capital Improvement Plan (CIP)
- General Plan Safety Element
- Housing Element

City of Larkspur

Larkspur is in process of updating its General Plan, which was last updated in 2023. The updated plan will comply with the Disaster Management Act 2000 by including a Safety Element that references this Hazard Mitigation Plan. The following documents are examples of the City's continuing progress implementing mitigation measures.

- General Plan Safety Element
- Comprehensive Emergency Management Plan

City of Mill Valley

Mill Valley's participation in the 2018 Marin County MJHMP was approved in 2019 and it has been incorporated it into other mechanisms such as the City's General Plan (MV2040, adopted 2014) which calls for maintenance, updates, and implementation of the All Hazard Mitigation Plan.

- 2023 General Plan Update '2040 General Plan' including Climate Action Plan & Housing Element
- General Fund and Capital Improvement Plan
- Sewerage Agency of Southern Marin (SASM) Master Plan
- City of Mill Valley Emergency Operations Plan
- City of Mill Valley Bicycle and Pedestrian Master Plan Update 2017

City of Novato

Novato participated in the 2018 Marin County MJHMP and is currently updating its General Plan. The current draft Safety and Health strategy #7a is to "Periodically update the City's Emergency Operations Plan and Local Hazard Mitigation Plan to coordinate with emergency plans of other governmental agencies and respond to changing conditions". The new general plan also refers to the previous hazard mitigation plan for additional information on certain hazards such as wildfire.

- 2035 General Plan
- Existing Conditions Report, April 2014

- 2008 City Flood Mitigation Plan
- Emergency Preparedness Plan
- Emergency Operations Plan
- Stafford Dam Emergency Action Planning and Risk Awareness in 2015
- Identified Site Emergency Planning Application, (ISEPA)
- Novato Elected/Appointed Official Guide to Disaster Operations 2017
- City of Novato Local Drainage Master Plan
- City of Novato Repetitive Loss Plan

City of San Rafael

The City's "General Plan 2040" updated in 2021 calls for preparation and adoption of an LHMP. Since then, the City has prepared and adopted an LHMP.

City of San Rafael 2040 General Plan

- City of San Rafael 2040 General Plan Background Report
- City of San Rafael Climate Change Action Plan
- City of San Rafael Community Emergency Preparedness Plan
- City of San Rafael Greenhouse Gas Reduction Strategy Report
- Climate Adaptation – Sea Level Rise, San Rafael CA. White Paper
- Marin Bay Shoreline Sea Level Rise Vulnerability Assessment

City of Sausalito

Sausalito participated in the 2018 Marin County MJHMP that it incorporated into other mechanisms.

- 2021 General Plan
- 2021 General Plan, including Climate Action Plan & Hazards & Public Safety Element

Town of Fairfax

The Town's 2012 General Plan and 2011 ABAG Hazard Mitigation Plan Annex were developed concurrently, so the General Plan Advisory Committee (GPAC) reviewed, refined, and incorporated selected mitigation strategies into the final draft 2021 General Plan Safety Element. The Safety Element states that it "is intended to complement and support not only the other General Plan Elements, but also other Town plans and documents, such as the Emergency Operations Plan (EOP), the Local Hazard Mitigation Plan (LHMP), and the Flood Mitigation Plan (FMP).

- 2021 General Plan Safety Element
- Capital Improvement Plan (CIP)
- Emergency Response Plan
- Community Preparedness Plan

Town of Ross

Ross's General Plan was completed and adopted in 2007, before its participation in the 2018 Marin County MJHMP. The 2018 Marin County MJHMP has been incorporated into other planning mechanisms.

- Town of Ross General Plan 2007 – 2025
- 2023 General Plan – Housing Element
- 2018 Marin County MJHMP
- Ross Valley Sanitary District Strategic Plan
- Ross Valley Sewer System Replacement Master Plan 2007

- Ross Valley Sanitary District response to Grand Jury Report Dated June 16, 2011: "Ross Valley Sanitary District: Not Again!"

Town of San Anselmo

San Anselmo's participated in the 2018 Marin County MJHMP, and has incorporated it into other planning mechanisms such as the General Plan, which was adopted in 2019. 2011 Climate Action Plan

- 2011 Capital Improvement Plan Study for Flood Damage Reduction and Creek Management in Flood Zone 9/Ross Valley
- Town of San Anselmo 2019 General Plan
- 2023 General Plan – Housing Element
- 2008 Flood Mitigation Plan
- Town of San Anselmo Municipal Code
- 7-year Capital Improvement Plan 2015
- Corte Madera Creek 2010 Flood Control Study Baseline Report Available through US Army Corps of Engineers and Ross Valley Flood Control Program website

Town of Tiburon

Tiburon's "General Plan 2040" from 2023 calls for the adoption of an LHMP to comply with DMA 2000. Since then the Town has adopted the ABAG LMHP Annex in 2012.

- 2023 General Plan Update '2040 General Plan' including Climate Action Plan & Hazards & Public Safety Element
- Capital Improvement Plan
- Emergency Operations Plan
- General Plan Safety Element

North Marin Water District

- 2017 Stafford Dam Emergency Action Plan
- 2015 Master Plan Update for the Oceana Marin Wastewater System, NMWD Job File 8 4046.00
- 2018 Novato Water System Master Plan Update, NMWD Job File 1 7039.02

Coordination with other community planning efforts is also paramount to the success of this plan. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Marin County uses a variety of comprehensive planning mechanisms, such as general plans and ordinances, to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from the following existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions:

- California Drought Contingency Plan.
- California Volcanoes and Volcanics. U.S. Geological Survey, Cascades Volcano Observatory.
- Central Valley Flood Control Project.
- Cities/Counties Ranked by Size, Numeric, and Percent Change. State of California Department of Finance. 2014.

- Community Rating System. Federal Emergency Management Agency National Flood Insurance Program.
- Contingency Plan for Excessive Heat Emergencies – A Supporting Document to the State Emergency Plan, April 2010.
- Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies. Federal Emergency Management Agency. FEMA 386-3. 2003.
- Ebbets Pass Special Plan. 1988.
- Enhanced Fujita Scale. National Oceanic and Atmospheric Administration Storm Prediction Center. 2007.
- Future Eruptions in California's Long Valley Area—What's Likely? U.S. Geological Survey. Fact Sheet 073-97. 1997.
- Getting Started: Building Support for Mitigation Planning. Federal Emergency Management Agency. FEMA 386-1. 2002.
- Hazard Mitigation Planning and Hazard Mitigation Grant Program. Federal Register. Interim Final Rule. February 26, 2002.
- HAZUS-MH 2.1. Federal Emergency Management Agency. 2012.
- Integrating Manmade Hazards into Mitigation Planning. Federal Emergency Management Agency. FEMA 386-7. 2003.
- Introduction to Hazard Mitigation. Federal Emergency Management Agency. FEMA IS-393.A. 2006.
- Multi-Hazard Identification and Risk Assessment. Federal Emergency Management Agency. 1997.
- Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. National Institute of Building Science Multi-Hazard Mitigation Council. 2005.
- Probabilistic Seismic Hazard Assessment for the State of California. California Geological Survey. Open-File Report 96-08. 1996.
- Robert T. Stafford Disaster Relief and Emergency Act. Public Law 93-288, as amended, 42 U.S.C. 5121-5207. June 2007.
- Saddle Creek Special Plan. 2008.
- Spatial Hazard Events and Losses Database for the United States. University of South Carolina Hazards Research Lab.
- State of California Multi-Hazard Mitigation Plan. California Emergency Management Agency. 2013.
- Understanding Your Risks: Identifying Hazards and Estimating Losses. Federal Emergency Management Agency. FEMA 386-2. 2001.

Data from these plans and ordinances were incorporated into the risk assessment and hazard vulnerability sections of the plan. Where the data from the existing studies and reports is used in this plan update, the source document is referenced throughout this plan update. The data was also used in determining the capability of the community in being able to implement certain mitigation strategies.

A key example of coordinating with other planning efforts is the coordination of this MJHMP with local-CWPPs. This is critical for two important reasons. First, wildfires do not stop at corporate or jurisdictional boundaries and evaluating fire risk issues on a regional basis provides a comprehensive approach to understanding and addressing identified wildfire risk and vulnerability. Second, a successful mitigation strategy requires that these planning efforts be coordinated.

Many other local, state, and federal documents were reviewed and considered, as appropriate, during the collection of data which include the hazard identification, vulnerability assessment, and capability assessment.

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

2.8 Public Engagement

The Public Outreach efforts mirrored the Planning Team approach with a unified effort, led by the County OEM, involving all participating jurisdictions and districts. Extensive and coordinated public outreach was done involving all participating jurisdictions and districts with an eye towards equity, inclusion, openness, accessibility, and ensuring we meet the population where they live, work, or recreate to provide convenience of access and ease of participation in this planning process.

Early discussions with the Marin County OEM established the initial plan for public engagement to ensure a meaningful and inclusive public process with a focus on equity and accessible to the whole community. Public outreach for this plan update began at the beginning of the plan development process with an informational press release to inform the community of the purpose of the hazard mitigation planning process for the Marin County planning area and to invite the public to participate in the process.

Public involvement activities for this plan update included press releases; website postings; a community survey; stakeholder and public meetings; tabling at local events: and the collection of public and stakeholder comments on the draft plan which was posted on the County website. Information provided to the public included an overview of the mitigation status and successes resulting from implementation of the 2018 plan as well as information on the processes, new risk assessment data, and proposed mitigation strategies for the plan update.

The County of Marin has several outreach programs, specifically designed to reach and include traditionally underserved and underrepresented communities, including, Health and Human Services' Community Response Teams, Office of Equity's Participatory Budgeting program, and a community-created Race and Equity Plan. To receive feedback on the Marin County OA MJHMP, bilingual outreach was conducted through the Community Response Teams, which are led by local non-profits, representing four zones of Marin County. Local non-profits are selected for grant funding to be the Community Response Team lead. Additionally, County representatives went on the West Marin radio station, KWMR, to reach rural populations.

Equity and Whole Community Approach

The Marin County OEM and the Steering Committee prioritized equity and engagement of the whole community in the development of the Marin County Multijurisdictional Hazard Mitigation Plan. As a means to reach as many members of the community as possible, Marin County OEM required that services be universally designed and delivered from the beginning to allow for the greatest level of engagement and feedback possible. Elements of the equity approach included:

- Providing multiple means for public engagement via hybrid meetings (in-person meetings with a virtual attendance and comment option).
- All presentations were accompanied by American Sign Language (ASL), Closed-Captioning, and Spanish Interpretation
- Presentations were reviewed by accessibility professionals prior to broadcasting to ensure the documents were able to be read by screen-readers.
- All presentations were available on-line and recorded for persons who may not have been able to attend the live presentations.

Engaging hard-to-reach populations

This effort was to ensure the greatest equity and access to the public to enable participation in the process. The Marin County OEM outreach strategy is to "meet people where they are." The Town hall meetings were conducted at different familiar locations within the county where people could easily access them and were conducted on both a weekday and weekend, and in the evening and during the daytime. The meetings were offered in-person with a virtual broadcast using Zoom videoconferencing and streamed live on the Marin County OEM Facebook account. After the meetings, Marin County OEM uploaded the recorded meetings to their website to allow the public on demand access to the meetings.

Translation and Interpretation Services

The survey and outreach materials were provided in both English and Spanish to improve accessibility among populations with limited English proficiency. The website uses Google Translate for accessibility in multiple languages. Interpretation services were offered for both town hall meetings. Each town hall meeting included, live Spanish translation and subtitles, live American Sign Language/ Certified Deaf Interpreter (ASL/CDI) interpretation, the ability for the Zoom videoconferencing attendee to activate subtitles in 28 different languages, and vision accessible PowerPoint slides.

Three stakeholder and public meetings were held, two at the beginning of the plan development process and one prior to finalizing the updated plan. Where appropriate, stakeholder and public comments and recommendations were incorporated into the final plan, including the sections that address mitigation goals and strategies. Specifically, public comments were obtained during the plan development process and prior to plan finalization.

All press releases and website postings are on file with the Marin County OEM. Public meetings were advertised in a variety of ways to maximize outreach efforts to both targeted groups and to the public at large. Advertisement mechanisms for these meetings and for involvement in the overall MJHMP development process include:

- Development and publishing of an MJHMP public outreach article
- Providing press releases to local newspapers and radio stations
- Posting meeting announcements on the local County MJHMP website
- Email to established email lists
- Personal phone calls

The public outreach activities were conducted with participation from and on behalf of all jurisdictions participating in this plan.

The Steering Committee has made the commitment to periodically bring this plan before the public through public meetings and community posting so that community members may make input as strategies and implementation actions change. Public meetings will continue to be held twice a year. Public meetings will continue to be stand-alone meetings but may also follow a council meeting or other official government meeting. The public will continue to be invited to public meetings via social media messaging, newspaper invitations, and through the website for each jurisdiction participating in the plan. Each jurisdiction is responsible for assuring that their community members are informed when deemed appropriate by the Steering Committee.

2.8.1 Website

At the beginning of the plan update process, Marin County OEM established a hazard mitigation website (https://emergency.marincounty.org/pages/lhmp) to keep the public posted on plan development milestones and to solicit relevant input. The website also provided information on signing up for Alert Marin, provided detailed information about the hazard mitigation process and plan development, provided a URL and QR code link to the survey in both English and Spanish, and provided information about upcoming town hall meetings. (See Figure 2.1)

The site's address was publicized in all press releases, surveys and public town hall meetings. Each planning partner also established a link on their own agency website. Information on the plan development process, the Steering Committee, a link to the Hazard Mitigation survey, and drafts of the plan were made available to the public on the site. Marin 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.

Figure 2.1: Marin County OEM MJHMP Website
Source: Marin County OEM

2.8.2 Public Meetings

Two separate Marin County OA MJHMP Public Town Hall Meeting were conducted at different locations within the County, on different days of the week and during different times of the day. This effort was to ensure the greatest equity and access by the public to enable

participation in the process. The Marin County OEM outreach strategy is to “meet people where they are”. Each Town Hall Meeting included, live Spanish translation and subtitles, Live American Sign Language (ASL/CDI) interpretation, the ability for the Zoom videoconferencing attendee to activate subtitles in 28 different languages, and vision accessible PowerPoint slide.

The first Town Hall Meeting was conducted on Thursday, April 13, 2023, from 6:00 pm to 7:30 pm, at the Marin County Board of Supervisors Chambers, Marin County Civic Center, 3501 Civic Center Drive, Room #330 San Rafael, CA 94903. The in-person meeting was also broadcast virtually using Zoom videoconferencing and streamed live on Marin County OEM Facebook account. Each of the jurisdictions participating in the MJHMP released a Press Release on their respective websites announcing the Public Town Hall Meeting and providing the date, time, and URL link to the Zoom Meeting for the public to log in and attend the Zoom Meeting. Marin County OEM also posted a notice for the Public Town Hall Meeting on their Facebook account. At the conclusion of the presentation, a question and answer session was held to answer questions from the attendees.

The second Town Hall Meeting was conducted on Saturday, April 29, 2023, from 10:00 am to 11:30 am, at the Marin County Health and Wellness Center, 3240 Kerner Ave. Rooms #109 and #110 San Rafael, CA. 94903. The meeting followed the same format as the first and hosted the same access level of equity and accessibility.

The Marin County MJHMP Public Town Hall Meeting was recorded and downloaded from Zoom and made available to all of the jurisdictions and districts to place on their websites and local Access TV for the public to view.

Meeting participants were also invited to complete the Hazard Mitigation Survey and were provided the URL link to the Survey Monkey website to complete the survey.

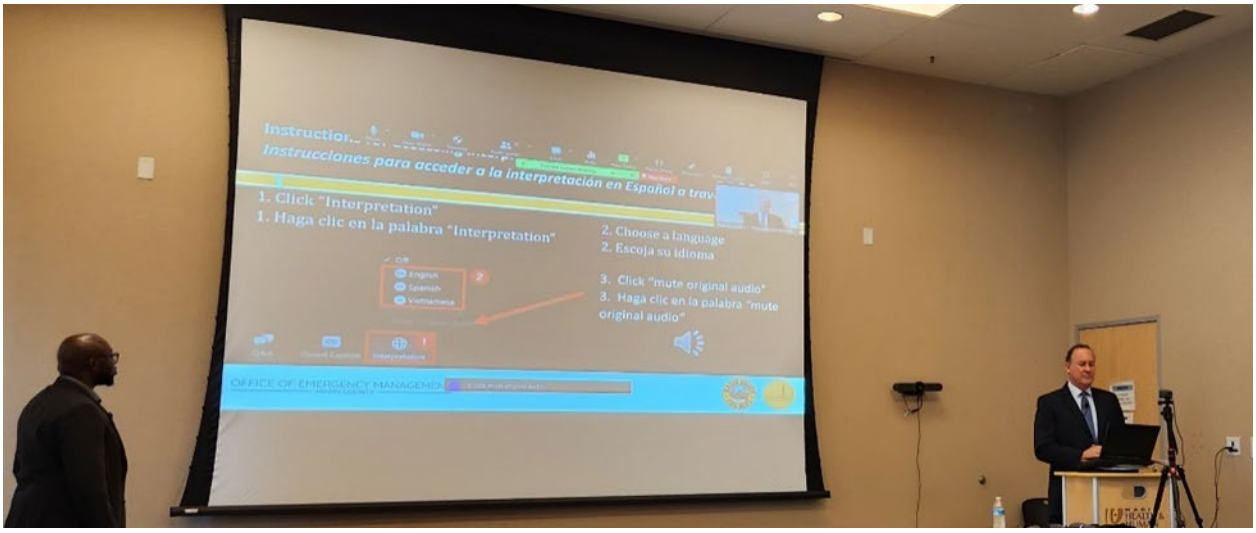


Figure 2.2: Marin County OA MJHMP Town Hall Meeting
Source: Preparative Consulting

Figure 2.3: Collecting community feedback on the MJHMP
Source: Marin County OEM

2.8.3 Social Media

Marin County and its participating jurisdictions utilized several forms of social media to reach residents and customers. Information about the Hazard Mitigation Planning process was communicated to the public via Facebook, Twitter, and local access TV. Residents and customers were invited to complete the Hazard Mitigation Plan survey which was accessible via an attached URL or QR Code and provide feedback on potential hazard mitigation projects or programs.

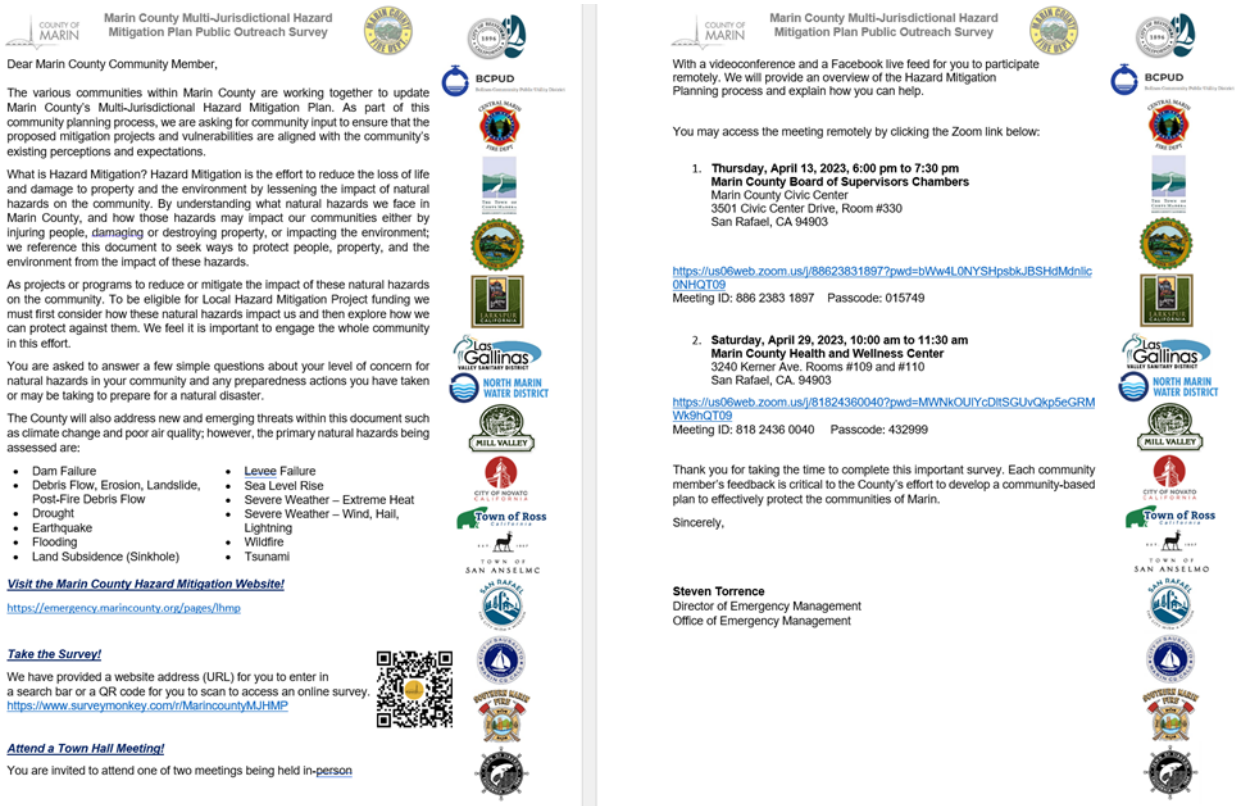
The results of the survey were provided to each of the planning partners and used to support the jurisdictional annex process. Each planning partner was able to use the survey results to help identify actions as follows:

- Gauge the public's perception of risk and identify what community members 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.

During this planning process, completed surveys were submitted. The complete survey can be found in Appendix C of this plan.

2.8.4 Press Releases

Press releases were distributed over the course of the plan's development as key milestones were achieved and prior to each Marin County OA MJHMP Public Town Hall Meeting. All press releases were made available to the community in both English and Spanish.



Marin County Multi-Jurisdictional Hazard Mitigation Plan Public Outreach Survey

Dear Marin County Community Member,

The various communities within Marin County are working together to update Marin County's Multi-Jurisdictional Hazard Mitigation Plan. As part of this community planning process, we are asking for community input to ensure that the proposed mitigation projects and vulnerabilities are aligned with the community's existing perceptions and expectations.

What is Hazard Mitigation? Hazard Mitigation is the effort to reduce the loss of life and damage to property and the environment by lessening the impact of natural hazards on the community. By understanding what natural hazards we face in Marin County, and how those hazards may impact our communities either by injuring people, damaging or destroying property, or impacting the environment; we reference this document to seek ways to protect people, property, and the environment from the impact of these hazards.

As projects or programs to reduce or mitigate the impact of these natural hazards on the community. To be eligible for Local Hazard Mitigation Project funding we must first consider how these natural hazards impact us and then explore how we can protect against them. We feel it is important to engage the whole community in this effort.

You are asked to answer a few simple questions about your level of concern for natural hazards in your community and any preparedness actions you have taken or may be taking to prepare for a natural disaster.

The County will also address new and emerging threats within this document such as climate change and poor air quality; however, the primary natural hazards being assessed are:

- Dam Failure
- Debris Flow, Erosion, Landslide, Post-Fire Debris Flow
- Drought
- Earthquake
- Flooding
- Land Subsidence (Sinkhole)
- Levee Failure
- Sea Level Rise
- Severe Weather – Extreme Heat
- Severe Weather – Wind, Hail, Lightning
- Wildfire
- Tsunami

Visit the Marin County Hazard Mitigation Website!

https://emergency.marincounty.org/pages/lhmp

Take the Survey!

We have provided a website address (URL) for you to enter in a search bar or a QR code for you to scan to access an online survey. https://www.surveymonkey.com/r/MarincountyMJHMP

Attend a Town Hall Meeting!

You are invited to attend one of two meetings being held in-person

Marin County Multi-Jurisdictional Hazard Mitigation Plan Public Outreach Survey

With a videoconference and a Facebook live feed for you to participate remotely. We will provide an overview of the Hazard Mitigation Planning process and explain how you can help.

You may access the meeting remotely by clicking the Zoom link below:

1. **Thursday, April 13, 2023, 6:00 pm to 7:30 pm**
   Marin County Board of Supervisors Chambers
   Marin County Civic Center
   3501 Civic Center Drive, Room #330
   San Rafael, CA 94903

https://us06web.zoom.us/j/88623831897?pwd=bWw4L0NYSHpsbkJBSHdMdnllc0NHQT09
Meeting ID: 886 2383 1897 Passcode: 015749

2. **Saturday, April 29, 2023, 10:00 am to 11:30 am**
   Marin County Health and Wellness Center
   3240 Kerner Ave. Rooms #109 and #110
   San Rafael, CA. 94903

https://us06web.zoom.us/j/81824360040?pwd=MWNkOUlYcDltSGUvQkp5eGRMWk9hQT09
Meeting ID: 818 2436 0040 Passcode: 432999

Thank you for taking the time to complete this important survey. Each community member's feedback is critical to the County's effort to develop a community-based plan to effectively protect the communities of Marin.

Sincerely,

Steven Torrence
Director of Emergency Management
Office of Emergency Management

Figure 2.4: Hazard Mitigation Plan Public Outreach Press Release
Source: Marin County OEM

2.8.5 Survey

A hazard mitigation plan survey (see Figure 2.5) was developed by the Steering Committee and made available to the public in both English and Spanish. 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 10 questions helped guide the Steering Committee in defining our hazards, and selecting goals, objectives, and mitigation strategies. The survey was made available on the hazard mitigation plan website, advertised in press releases, and at town hall meetings. Finally, the survey and the process of public input was advertised throughout the course of the planning process. The survey was made available to the public on March 13, 2023, and closed on June 12, 2023. At the conclusion of the planning process 293 surveys were completed by the public.

Public Comments Considered by the Planning Team

The Planning Team used the following information gathered from the Public Outreach Survey to inform decisions regarding hazard mitigation strategies, actions, and priorities.

- Climate Change, Wildfire, and Drought were the top hazards of concern for the public.
- Text messages, mail, and the County website were the preferred methods for receiving hazard mitigation information.

- 48% of respondents expressed that they were “Very Much” concerned and 31% were “Moderately” concerned that a natural disaster could impact their home or place of residence.
- 85% of respondents own their own home.
- 99% of respondents have access to the internet.

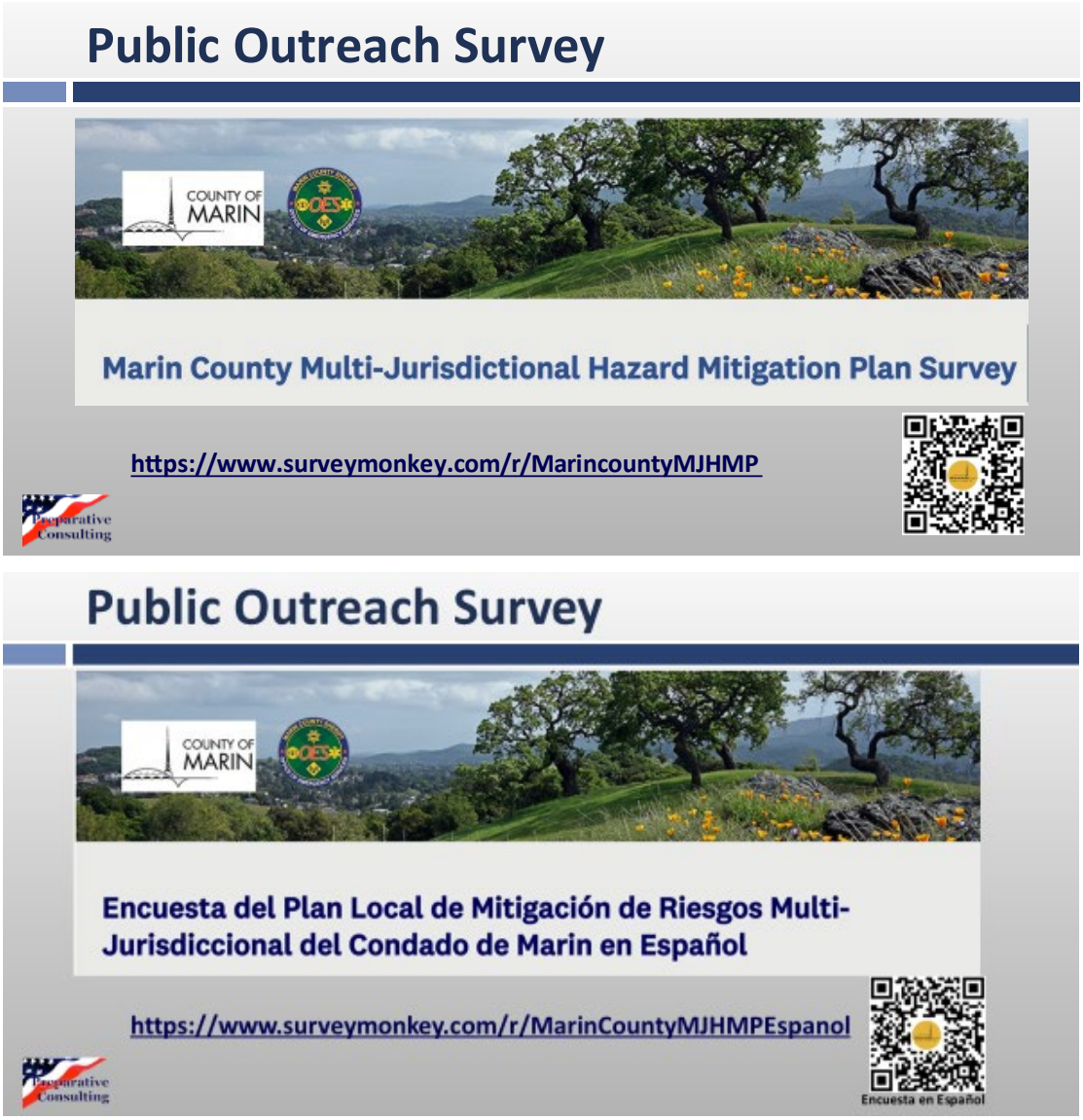


Figure 2.5: Hazard Mitigation Plan Survey
Source: Preparative Consulting

2.8.6 Public Comment on the Plan

To solicit public feedback on the draft plan, Marin OEM engaged in a multi-faceted approach intended to reach as many Marin residents as possible, including members of the community who are under-served and under-represented. All members of the community had the opportunity to provide initial comments on the plan during a two-week period from

Wednesday, December 4, 2023, to Wednesday, December 18, 2023. Although the initial comment period was listed as two weeks, the public could submit comments indefinitely via the County's website to support the County's continuous improvement efforts. The base plan, as well as city, town and special district annexes, were available for download on emergency.marincounty.org (include photos). The website additionally asked for feedback in a survey in English and Spanish (include photos), the survey was designed to establish where that person lives or works, their top hazards of concern, elicit feedback on the plan and offer a place for them to share projects to reduce risk in their community. The survey collected responses from the community in English and in Spanish.

The website and survey were shared through traditional and social media (photos) The Marin Independent Journal (Marin IJ) used the press release to write an article (hopefully; include photos). Social media accounts were updated four times with an initial ask, two reminders, and a closing announcement. The Marin OEM Public Information Officer coordinated with the Marin County Public Information Officers (MAPIO) working group to distribute information to partner jurisdictions (city, town, and special districts) to share this information on their social media sites and with the communities in the area.

To reach those who may not be engaged digitally, the planning team worked with Marin County Community Response Teams, (CRTs are a collaboration of non-profit organizations supporting underrepresented communities in four zones) to conduct outreach with half-sheet flyers in English and Spanish to share in the 4 CRT zones (southern Marin, north Marin, west Marin, San Rafael). These half sheets were also shared county-wide at libraries, including in areas not covered by CRTs, like at the Fairfax library. CRTs are designed to reach Marin's traditionally underserved and underrepresented communities, so by conducting outreach through this method, we were able to inform residents who may not have been engaged otherwise, including residents in Marin City, West Marin, and the Canal District of San Rafael.

The 14-day public comment period gave the public an opportunity to comment on the draft plan update prior to the plan's submittal to Cal OES. Comments received on the draft plan are available upon request. All comments were reviewed by the planning team and incorporated into the draft plan as appropriate.

Public Comments Considered by the Planning Team

The Marin County OEM posted the draft Hazard Mitigation Plan and hazard mitigation actions on their website and solicited public comments on the content. The Planning Team gathered public comments and information on the Marin County OEM website regarding proposed and current Hazard Mitigation Actions. The Planning Team used the comments and suggestions to inform decisions regarding hazard mitigation strategies, actions, and priorities. Most comments included ideas for hazard mitigation projects and comments on the effectiveness of current mitigation projects. These comments were used to revised the proposed hazard mitigation actions which resulted in the final list of hazard mitigation actions listed in 4.9 Hazard Mitigation Actions.

SECTION 3.0: HAZARD IDENTIFICATION AND RISK ASSESSMENT

The Marin County Operational Area (OA) is at risk from a variety of hazards. Many of these hazards, could result in a disastrous impact on the county.

Although an attempt has been made to identify all major hazards and their respective impacts within Marin County, it must be highlighted that we live in a time of new and emerging threats. To the extent to which there are certain natural events which are inevitable and necessary for the environment to remain in balance (e.g., earthquakes, wildfires, and flooding), the County of Marin recognizes that no natural hazard is solely natural, and the risk assessments identified within this plan are linked to human influences from local and global human actions or inaction.

Risk to natural hazards is a combination of hazard, vulnerability, and capability. The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The goal of the risk assessment is to estimate the potential losses in Marin County from a hazard event. This process also allows communities in Marin County to better understand their potential risk to human-influenced, natural hazards and provides a framework for developing and prioritizing mitigation actions to reduce risks from future hazards in Marin County.

3.1 HAZARD IDENTIFICATION

44 CFR Requirement §201.6(c)(2)(i) [The risk assessment shall include a] description of the type, 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.

The process of identifying hazards that do or could potentially affect Marin County at various levels was the first step in assessing overall risk. Recognizing the potential required an analysis of known, suspected, and emerging hazards existing within or directly affecting Marin County. Some of the following questions were used during the analysis:

- What are the known hazards?
- What are the suspected hazards?
- What are the potential, new, or emerging hazards?
- What are the elements of the hazard?
- What are the conditions associated with the occurrence of a hazardous event?
- What factors are required for an event to turn hazardous?

The Steering Committee reviewed data from the following sources on hazards affecting the county: the Federal and State Disaster Declaration History, the State of California Hazard Mitigation Plan (2018), the Safety Element of the participating jurisdictions, and the 2018 Marin County OA MJHMP. Additional documents are noted in the reference section of this document.

The Steering Committee came to agreement on significant hazards to the Marin County OA. The following natural hazards are detailed in this section and are profiled for each jurisdiction participating in the Marin County OA MJHMP:

Table 3.1: Marin County OA MJHMP Hazard Identification and Comparison

2023 Hazards	Climate Profile	2018 Hazards	Comment
Climate Change	Yes	Climate Change – not included	The impact of climate change profiled and discussed in all applicable hazards.
		Coastal Erosion	Now profiled under debris flows/landslide.
Dam Failure		Earthquake	Now profiled as a separate hazard.
Debris Flow	Yes	Severe Storm and Wildfire	Now profiled as a separate hazard.
Drought	Yes	Wildfire	Now profiled as a separate hazard.
Earthquake		Earthquake	Continued as a hazard.
Flood	Yes	Severe Storm	Now profiled as a separate hazard.
Land Subsidence	Yes	Severe Storm	Now profiled as a separate hazard.
Levee Failure	Yes	Severe Storm	Now profiled as a separate hazard.
		Liquefaction	Now profiled under Earthquake.
Sea Level Rise	Yes	Sea Level Rise – Severe Storms	Sea Level Rise now profiled as a separate hazard.
Severe Weather – Extreme Heat	Yes	Wildfire	Now profiled under Severe Weather.
Severe Weather – High Wind/Tornado	Yes	Severe Storm	Continued as a hazard under Severe Weather.
Tsunami	Yes	Tsunami/Seiche	Continued as a hazard
Wildfire	Yes	Wildfire	Continued as a hazard

Table 3.2 below lists additional hazards of interest that were identified by the Steering Committee as having some potential to impact the planning area but are not hazards eligible for Hazard Mitigation Grant Funding. These hazards have been briefly profiled to illustrate their potential impact on the County of Marin. No formal risk assessment of these hazards was performed. 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.

Table 3.2: Marin County OA MJHMP Other Hazards Profiled
Critical Infrastructure/ Utility Disruption
Cyber Threats
Oil Spills
Pandemic
Air Pollution
Transportation Systems

Table 3.2: Marin County OA MJHMP Other Hazards Profiled

3.1.1 Disaster Declaration History

One method to identify hazards is to look at the events that have triggered federal and/or state disaster declarations that included Marin County. The following table lists the disaster declarations where Marin County was designated federal and/or state disaster declarations since the 2018 MJHMP update.

Table 3.3 shows the number of state and federal declared disasters in Marin County in relation to the rest of California from 1950-2023.

Table 3.3: State and Federal Declared Disasters in Marin County				
Location	Event Type(s)	Year	State/Federal #	Damage Est.*
Tomales	Tornado	1996		$205,000
Southern Marin	Flash Flood	1998		$2,000,000
Corte Madera	Heavy Rain	2002		$200,000
Coastal Marin	Coastal Flood	2005/ 2006		$340,000
Countywide	Flood	2005/ 2006		$219,000,000
Interior Valleys	Debris Flow	2006		$45,900,000
Coastal Marin	Strong Wind	2006		$500,000
Interior Valleys	Frost/Freeze	2007		$3,000,000
Corte Madera	Flash Flood	2008		$50,000
Interior Valleys and Mountains	Strong Wind	2009		$140,000
Countywide (Santa Venetia)	Flood/Wind	2009		$260,000
Interior Valleys	Strong Wind	2009		$85,000
Coastal Marin	Coastal Flood, Strong Wind, Flood	2010		$770,000
Countywide (Larkspur)	Heavy Rain/ Strong Wind	2010		$100,000

Countywide	Strong Wind	2010		$85,000
Coastal Marin	Strong Wind/Storm Surge	2011		$325,000
Interior Valleys	Strong Wind	2011		$50,000
Interior Valleys	Strong Wind	2011		$200,000
Interior Valleys	Strong Wind	2012		$60,000
Interior Valleys and Coast	Strong Wind	2012		$501,500
Interior Valleys	Strong Wind	2012		$150,000
Interior Valleys	Strong Wind	2012		$50,100
Countywide	Flood/Strong Wind	2012		$210,100
Mountains	Strong Wind	2013		$80,000
Countywide (Greenbrae, Novato, Marin City, Tamalpais Valley, Olema)	Flash Flood/Debris Flow	2014		$6,001,000
Interior Valleys/Coast	Strong Wind	2014		$115,600
Interior Valleys and Mountains	Strong Wind	2015		$23,500
Mill Valley AFS	Heavy Rain	2015		No data
Interior Valleys	Coastal Flood	2016		No data
Interior Valleys	Strong Wind	2016		No data
Alto	Flash Flood	2016		No data
Countywide	Severe Winter Storms, Flooding, Landslides	2017	Fed 3381	No data
Countywide	Severe Winter Storms, Flooding, Landslides	2017	Fed 4301	No data
Countywide	Severe Winter Storms, Flooding, Landslides	2017	Fed 4302	No data
San Rafael and Corte Madera	Flood	2017	Local	No data
Kentfield	Flash Flood	2017	Local	No data
Tomales	Flood	2017	Local	No data
Corte Madera	Flood	2017	Local	No data
Ignacio, Burdell, Marin City, Mountains	Strong Wind, Flash Flood, Flood	2017	Local	No data
Interior Valleys	Strong Wind	2017	Local	No data
Mountains	Strong Wind	2017	Local	No data
Mountains and Coast	Strong Wind	2017	Local	No data

Interior Valleys and Mountains	Strong Wind	2017	Local	No data
Greenbrae and Mountains	Strong Wind, Flood	2017	Local	No data
Interior Valleys and Coast	Strong Wind	2017	Local	No data
Corte Madera	Flood	2018	Local	No data
Countywide	Public Safety Power Shutoff (PSPS)	2019	Local	
Countywide	Severe Winter Storms, Flooding, Landslides	2019	Fed 4431	
Countywide	Severe Winter Storms, Flooding, Landslides	2019	Fed 4434	
Countywide	COVID-19	2020	Fed 4482	
Woodward Valley Trail and the Coast Trail (Woodward Fire)	Lightning, Wildfire	2020	Local	
Pt Reyes	Coastal Oil Spill (American Challenger ship wreck)	2021	Local	
Countywide	Drought	2021	Local	
Countywide	Extreme Heat Event	2021	Local	
Countywide	Atmospheric River, Severe Winter Storms, Flooding	2021	CDAA 2022-02	
Countywide	Severe Winter Storms, Flooding, Landslides	2022	Fed DR-4683	
Countywide	Severe Winter Storms, High Winds, Flooding, Landslides	2022	Fed DR-4699	
Countywide	Severe Winter Storms, Flooding, Landslides	2022-2023	CDAA 2023-01 CDAA 2023-02	
Countywide	Severe Winter Storms, Flooding, Landslides	2023	CDAA 2023-03	

* Damage estimates may be initial damage estimates for the Local Proclamations and do not necessarily represent the final damage estimates.

Table 3.3: State and Federal Declared Disasters in Marin County

3.1.2 Omission of Hazards

Several natural hazards were omitted from further analysis for all participating jurisdictions due to either their low probability of occurrence or minimal impact:

Avalanche: An avalanche is a rapid flow of snow down a hill or mountainside. The Marin County OA rarely gets snow and not in significant enough quantities to cause an avalanche.

Fog: Fog is a collection of water droplets or ice crystals suspended in the air at or near the Earth's surface. While the Marin County OA experiences severe and dense fog, Marin County does not consider it to be a significant enough threat for profiling in the 2023 Marin County OA MJHMP.

Haboob: A haboob is a type of intense dust storm carried on an atmospheric gravity current known as a weather front. Haboobs occur primarily in arid regions including parts of Arizona, New Mexico, and Texas. The Marin County OA does not have arid land and does not experience haboobs.

Severe Weather – Hail/Ice/Snow: Hail is pellets of frozen rain that fall in showers from cumulonimbus clouds while snow is atmospheric water vapor frozen into ice crystals and falling in light white flakes. There have been minor occurrences of hail, ice, and snow in Marin County, but none that have had significant impacts. A significant event is not expected to occur in the Marin County OA due to its mild winter temperatures and climate.

Severe Weather – Freeze/Extreme Cold: Freeze and extreme cold are defined as a period in which temperatures fall below the freezing point of 32 degrees Fahrenheit or 0 degrees Celsius. The Marin County OA rarely experiences freezing temperatures or extreme cold due to its mild winter temperatures and climate.

Space Weather: Space weather includes conditions and events on the sun, in solar wind, in near-Earth space, and in Earth's upper atmosphere that can affect space-borne and ground-based technological systems. Space weather also includes asteroids, comets, and meteors. There have been no space weather events in Marin County. While a solar flare has the potential to disrupt communications and while an impact from a space object could cause significant loss of life and destruction, the unknown results of these events limit the County's ability to truly profile and assess this hazard.

Tropical Storm/Hurricane: A tropical storm is a tropical cyclone with winds of 39-73 miles per hour while a hurricane is a tropical cyclone with winds of 74 miles per hour or greater. Though tropical cyclones have passed over Southern California, none have reached Marin County due to its northern latitude and climate. Whereas climate change may include the likelihood of a Tropical Storm and Hurricane reaching the Bay Area, the Marin Operational Area will view these hazards as a severe storm, strong winds, and/ or flooding events, which are profiled within the document.

Volcano: A volcano is a mountain that opens downward to a reservoir of molten rock below the surface of the earth. While there are volcanoes in the Cascade Range to the north of Marin County that could potentially impact the Marin County OA with ash fall upon eruption, the Marin County OA does not consider volcanoes to be significant enough for profiling in the 2023 Marin County OA MJHMP.

3.2 Hazard Analysis

44 CFR Requirement §201.6(c)(2)(ii) [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:

(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;

(B) An estimate of the potential dollar losses to vulnerable structures identified in … this section and a description of the methodology used to prepare the estimate.

(C) 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.

§ 201.6(c)(2)(iii) For multi - jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

The Hazard Identification and Risk Assessment (HIRA) provides the factual basis for activities proposed in the mitigation strategy that will reduce losses from identified hazards. The HIRA makes a clear connection between the community's vulnerability and the hazard mitigation actions. According to Section 44 of the Code of Federal Regulations, The MJHMP must include a definition and description of the natural hazards that can affect the jurisdiction(s) in the planning area, as well as several additional required elements for natural hazards:

Location and Previous Occurrences
Location means the geographic areas in the planning area that are affected by each hazard. This information is shown in narrative form and/or in maps. The MJHMP also includes the history of previous hazard events for each of the identified hazards.

Impacts
Impact means the consequence or effect of the hazard on the community and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community.

Extent
Extent describes the potential severity of a disaster and any secondary events caused by the hazard in the operational area. Extent is classified by the following:

- **Catastrophic:** More than 50 percent of the operational area affected
- **Critical:** Between 25-50 percent of the operational area affected
- **Limited:** 10-25 percent of the operational area affected
- **Negligible:** Less than 10 percent of the operational area affected

Probability
Probability notes the frequency of past events and is used to gauge the likelihood of future occurrences. Based on historical data, the probability of future occurrences is categorized into

one of the following classifications:

- **Highly Likely:** Near 100 percent chance of occurrence next year or happens every year
- **Likely:** Between 10 percent and 100 percent chance of occurrence in the next year or has a recurrence interval of 10 years or less
- **Occasional:** Between 1 percent and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 50 years
- **Unlikely**: Less than 1 percent chance of occurrence in next 50 years or has a recurrence interval of greater than every 50 years

The probability, or chance of occurrence, was calculated where possible based on existing data. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period, which suggests a 10 percent chance of that hazard occurring in any given year.

Vulnerability

The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to natural hazards. The vulnerability assessment for this plan followed the methodology described in the FEMA 386-2, Understanding Your Risks – Identifying Hazards and Estimating Losses.

The vulnerability assessment was conducted based on the best available data and the significance of the hazard. Data to support the vulnerability assessment was collected from the following sources:

- County and jurisdictional GIS data (hazards, base layers, and other government data) through MarinMap
- Statewide GIS datasets compiled by CalOES to support mitigation planning
- Written descriptions of assets and risks provided by participating jurisdictions
- Existing plans and reports
- Personal interviews with jurisdictional representatives and other stakeholders

The vulnerability assessment describes the assets at risk in Marin County, including the total exposure of people and property; critical facilities and infrastructure; natural, cultural, and historic resources; and economic assets.

During the Kickoff Meeting with the MJHMP Planning Team and the Steering Committee, the group was provided with a Hazard Risk Ranking Worksheet to complete. The members were asked to provide their opinion on the types of hazards that may impact Marin County. These hazards will be included in the Hazard Identification and Risk Assessment portion of the MJHMP and considered in the Mitigation Strategy portion of the MJHMP. They were asked to consider a hazard from the perspective of the worst-case scenario. Members were provided a list of hazards from the 2018 MJHMP and additional hazards they presented for consideration. The list of hazards was consolidated to group similar hazards and focused on only natural hazards, per FEMA's guidance for local hazard mitigation planning. Members were asked to choose the most likely hazards within the County.

The results of the assessment from the Planning Team and Steering Committee assessment were presented to the Steering Committee to validate. The Steering Committee came to agreement on the following significant hazards to Marin County and its participating jurisdictions. These significant natural hazards are detailed and ranked in this section:

Table 3.4: Marin County Hazard Risk Assessment

Hazard	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Dam Failure	Unlikely	Negligible	Extreme	Low	Medium	**9.00**
Debris Flow, Erosion, Landslide, Post-Fire Debris Flow	Occasional	Extensive	Severe	Medium	Medium	**13.00**
Drought	Highly Likely	Extensive	Moderate	High	High	**16.00**
Earthquake	Highly Likely	Extensive	Extreme	None	High	**15.00**
Flooding	Highly Likely	Limited	Severe	High	Medium	**14.00**
Land Subsidence (Sinkhole)	Occasional	Limited	Moderate	Medium	Medium	**10.00**
Levee Failure	Unlikely	Negligible	Moderate	Medium	High	**9.00**
Sea Level Rise	Highly Likely	Limited	Extreme	High	High	**16.00**
Severe Weather – Extreme Heat	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Severe Weather – Wind, Tornado	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Tsunami	Highly Likely	Limited	Extreme	Medium	High	**15.00**
Wildfire	Highly Likely	Significant	Severe	High	High	**16.00**

Once the Steering Committee determined the hazards to be profiled, they were asked to assess the vulnerability and risk to their jurisdictions or districts posed by these hazards. To inform this assessment the Steering Committee completed a detailed list of their critical facilities, critical infrastructure, and high potential loss facilities in their jurisdiction or district. This information was inputted into the County of Marin Office of Emergency Management GIS mapping program and plotted on a map of their jurisdiction or district. Each hazard profiled was then separately overlayed onto the map of the jurisdiction or district to show the impact the hazard may have on the critical facilities, critical infrastructure, and high potential loss facilities.

The Steering Committee was provided a hazard vulnerability and risk assessment tool to assess and score each hazard based on five categories: Probability/ Likelihood of Future Events, Geographic Extent, Magnitude/ Severity, Climate Change Influence, and Significance. Since each jurisdiction or special district is vulnerable to some but not all hazards, such as sea level rise that threatens coastal communities but not all communities within Marin County, each

jurisdiction or special district was asked to consider their exposure to each hazard. If their jurisdiction or district is not vulnerable to sea level rise then they might assess their vulnerability to that hazard as "None." For hazards that they are vulnerable to they were asked to assess them using the extent, likelihood, and severity categories discussed above.

Probability/ Likelihood of Future Events

- **Unlikely:** Occurs in intervals greater than 100 years - Less than 1% probability of occurrence in the next year or a recurrence interval greater than 100 years.
- **Occasional:** Occurring every 11 to 100 years - 1-10% probability of occurrence in the next year or a recurrence interval of 11 to 100 years.
- **Likely:** Occurring every 1 to 10 years - 10-90% probability of occurrence in the next year or recurrence interval of 1 to 10 years.
- **Highly Likely:** Occurring almost every year - 90-100% probability of occurrence in the next year or a recurrence interval of less than 1 year.

Geographic Extent

- **Negligible:** Less than 10% of the planning area
- **Limited:** 10-25% of the planning area
- **Significant:** 25-75% of planning area
- **Extensive:** 75-100% of planning area

Magnitude/ Severity

- **Weak:** Limited classification on scientific scale, slow speed of onset or short duration of event, resulting in little to no damage.
- **Moderate:** Moderate classification on scientific scale, moderate speed of onset or moderate duration of event, resulting in some damage and loss of services for days.
- **Severe:** Severe classification on scientific scale, fast speed of onset or long duration of event, resulting in devastating damage and loss of services for weeks or months.
- **Extreme:** Extreme classification on scientific scale, immediate onset or extended duration of event, resulting in catastrophic damage and uninhabitable conditions.

Table 3.5: Hazard Magnitude and Severity Scale

Hazard	Scale/Index	Weak	Moderate	Severe	Extreme
Drought	Palmer Drought Severity Index	+1.99 to -1.99	-2.00 to -2.99	-3.00 to -3.99	-4.00 and below
Earthquake	Modified Mercalli	I to IV	V to VII	VIII	IX to XII
	Richter Magnitude	2,3	4,5	6	7,8
Hurricane Wind	Saffir-Simpson Hurricane Wind Scale	1	2	3	4,5
Tornado	Fujita Tornado Damage Scale	FO	F1, F2	F3	F4, F5

Climate Change Influence

- **Low:** Minimal potential impact
- **Medium:** Moderate potential impact
- **High:** Widespread potential impact

Significance

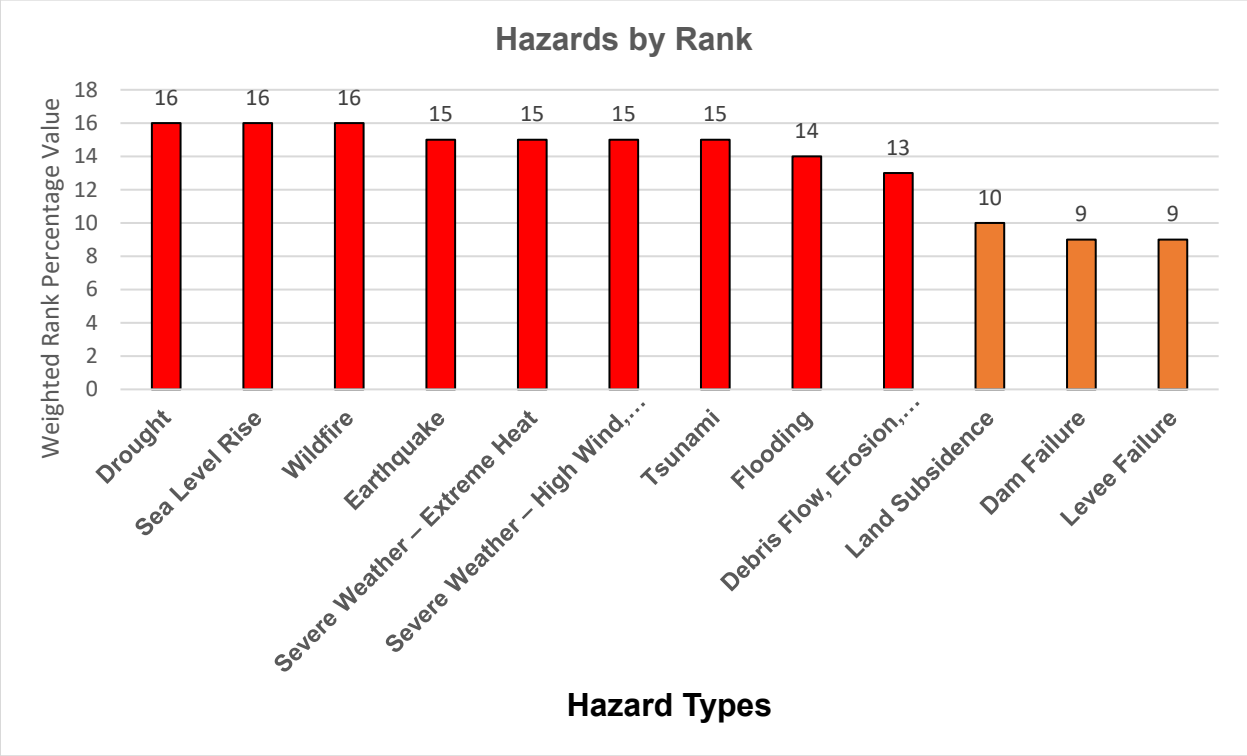
- **Low:** Minimal potential impact - Two or more criteria fall in lower classifications, or the event has a minimal impact on the planning area. This rating is sometimes used for hazards with a minimal or unknown record of occurrences or for hazards with minimal mitigation potential.
- **Medium:** Moderate potential impact - The criteria fall mostly in the middle ranges of classifications and the event's impacts on the planning area are noticeable but not devastating. This rating is sometimes used for hazards with a high extent rating but very low probability rating.
- **High:** Widespread potential impact - The criteria consistently fall in the high classifications and the event is likely/highly likely to occur with.

Each jurisdiction and district completed the Hazard Vulnerability and Risk Assessment Tool, and their individual results are recorded in their Jurisdictional or District Profile. The following Table 3.4 illustrates the results of the Marin County Risk Assessment.

Table 3.6: Marin County OA Hazard Risk Assessment – Top Hazards Scored

Hazard Ranking	Score
1. Drought	16
2. Sea Level Rise	16
3. Wildfire	16
4. Earthquake	15
5. Severe Weather – Extreme Heat	15
6. Severe Weather – Wind, Tornado	15
7. Tsunami	15
8. Flooding	14
9. Debris Flow, Erosion, Landslide, Post-Fire Debris Flow	13
10. Land Subsidence (Sinkhole)	10
11. Dam Failure	9
12. Levee Failure	9

Table 3.6: Marin County Hazard Risk Assessment – Top Hazards Scored



Risk Level	Risk Numerical Score
High Risk	12 - 16
Serious Risk	8 - 11
Moderate Risk	4 - 7
Low Risk	1 - 3

Figure 3.1: Marin County Risk Assessment – Top Hazards Graphed

3.2.1 Climate Change

The County of Marin and associated jurisdictions profiled jointly recognize that the earth's climate is forcibly being augmented due to humans' reliance on fossil fuels and non-natural resources which pose negative impacts on the earth's climate. Reliance on fossil fuels and non-natural products results in the climate shifting to include unseasonable temperatures, more frequent and intense storms, prolonged heat and cold events, and a greater reliance on technological advancements to maintain the wellbeing of community members and balance of the environment. The forced adaptation to climatic shifts is necessary for the County and jurisdictions to understand and include with these assessments.

Locally to Marin, drought and rain events have already had devastating impacts to critical infrastructure, agriculture, and water resources; and globally, unseasonable temperatures have been identified as the cause for enhanced wildfires, severe droughts, ice sheets and glaciers disappearing, and persons emigrating from their countries due to a lack of sustainable, local resources. Melting land ice contributes additional water to the oceans and as ocean temperatures rise the water expands, both of which contribute to increase rates of sea level rise. Marin is bordered on the west by the Pacific Ocean and on the east by San Francisco Bay, making it particularly vulnerable to flooding and erosion caused by sea level rise.

The cause of current climate change is largely human activity, burning fossil fuels, natural gas, oil, and coal. Burning these materials releases greenhouse gases into Earth's atmosphere. Greenhouse gases trap heat from the sun's rays inside the atmosphere causing Earth's average temperature to rise. This rise in the planet's temperature was formerly called, "global warming", but climate change has shown to include both intense heat and cold shifts. The warming of the planet impacts local and regional climates. Throughout Earth's history, climate has continually changed; however, when occurring naturally, this is a slower process that has taken place over hundreds and thousands of years. The human influenced climate change that is happening now is occurring at an abnormally faster rate with devastating results.

GLOBAL OBSERVED AND PROJECTED CLIMATE CHANGE IMPACTS AND RISKS

The Intergovernmental Panel on Climate Change (IPCC) assesses the impacts of climate change, looking at ecosystems, biodiversity, and human communities at global and regional levels. The IPCC also reviews vulnerabilities and the capacities and limits of the natural world and human societies to adapt to climate change. In their Sixth Assessment Report from 2022[1], the following observations were made:

- Human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability.
- Global warming, reaching 1.5°C in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans.
- Beyond 2040 and depending on the level of global warming, climate change will lead to numerous risks to natural and human systems.
- The magnitude and rate of climate change and associated risks depend strongly on near-term mitigation and adaptation actions, and projected adverse impacts and related losses and damages escalate with every increment of global warming.
- Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions.

A 2020 study by the National Aeronautics and Space Administration (NASA) [2] confirmed that climate models are getting future warming projects right, finding the following:

- If global warming transiently exceeds 1.5°C in the coming decades or later, then many human and natural systems will face additional severe risks.
- An estimated 60% of today's methane emissions are the result of human activities. The largest sources of methane are agriculture, fossil fuels, and decomposition of landfill waste.

[1] Intergovernmental Panel on Climate Change, Headline Statements from the Summary for Policymakers, 2022. https://www.ipcc.ch/report/ar6/wg2/resources/spm-headline-statements/

[2] Study Confirms Climate Models are Getting Future Warming Projections Right, 2020. https://climate.nasa.gov/news/2943/study-confirms-climate-models-are-getting-future-warming-projections-right/

- The concentration of methane in the atmosphere has more than doubled over the past 200 years. Scientists estimate that this increase is responsible for 20 to 30% of climate warming since the Industrial Revolution (which began in 1750).
- According to the most recent National Climate Assessment, droughts in the Southwest and heat waves (periods of abnormally hot weather lasting days to weeks) are projected to become more intense, and cold waves less intense and less frequent.
- The last eight years have been the hottest years on record for the globe.

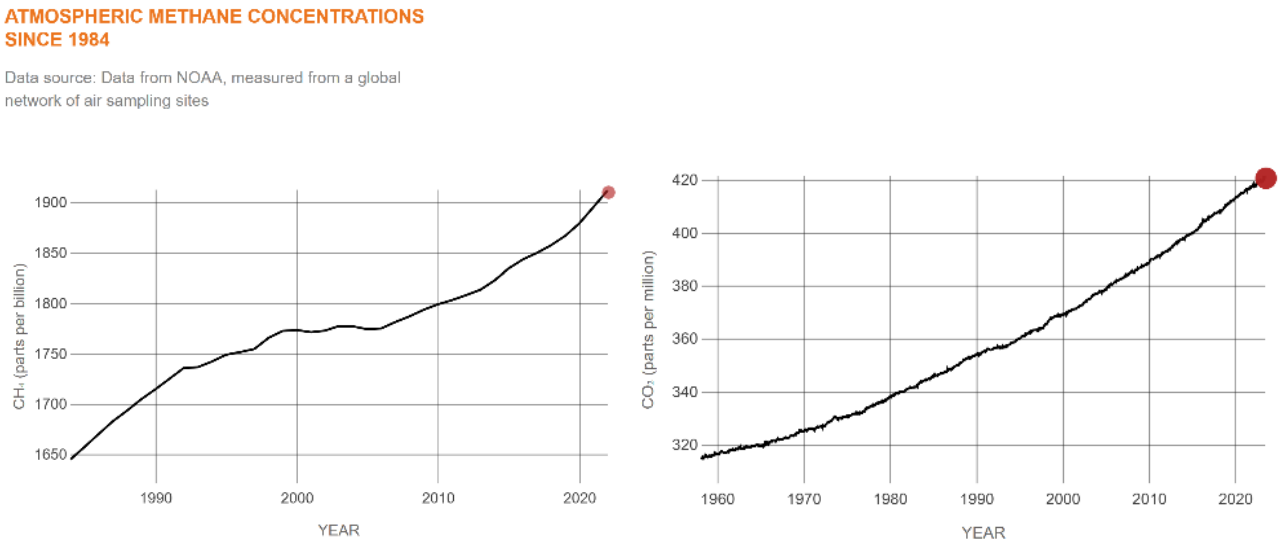


Figure 3.2: NASA Global Temperature Change CO2 Gas
Source: NASA Global Climate Change, 2022

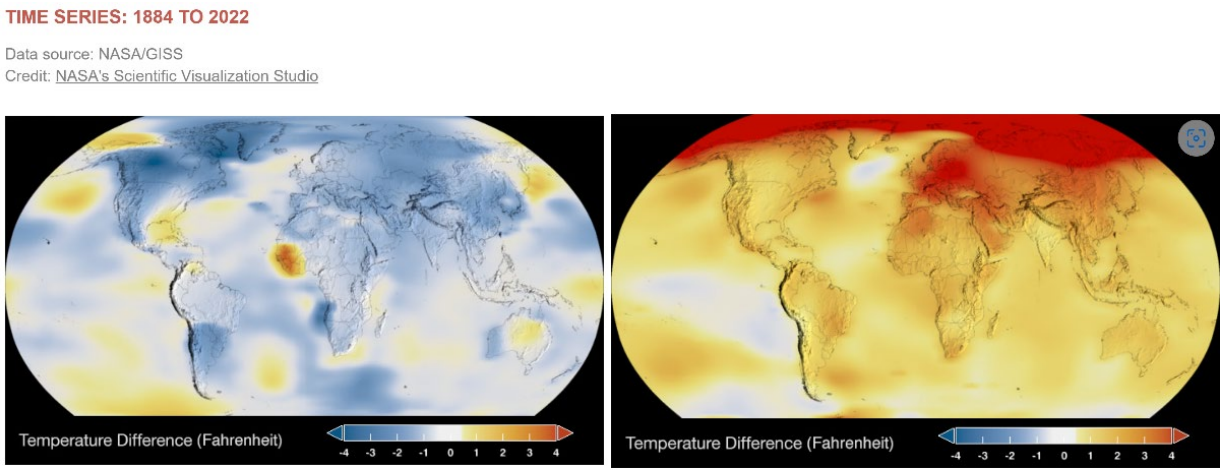


Figure 3.3: NASA Global Temperature Change 1884 to 2022
Source: NASA Global Climate Change, 2022

Drought

- The 22-year-long megadrought in southwestern US was the driest the territory had experienced in at least 1,200 years and was expected to persist.

Sea Level Rise

- Global sea levels are rising as a result of human-caused global warming, with recent rates being unprecedented over the past 2,500-plus years.
- U.S. sea levels are projected to rise 1 to 6.6 Feet by 2100. (Note: Global sea levels have risen about 8 inches (0.2 meters) since reliable record-keeping began in 1880. By 2100, scientists project that it will rise at least another foot (0.3 meters), but possibly as high as 6.6 feet (2 meters) in a high-emissions scenario.)
- Sea ice cover in the Arctic Ocean is expected to continue decreasing, and the Arctic Ocean will very likely become essentially “ice-free” in late summer seasons if current projections hold. This change is expected to occur before mid-century.
- An indicator of changes to the projected sea level rise is the Arctic Sea ice minimum over time. Arctic Sea ice to this extent both affects and is affected by global climate change.

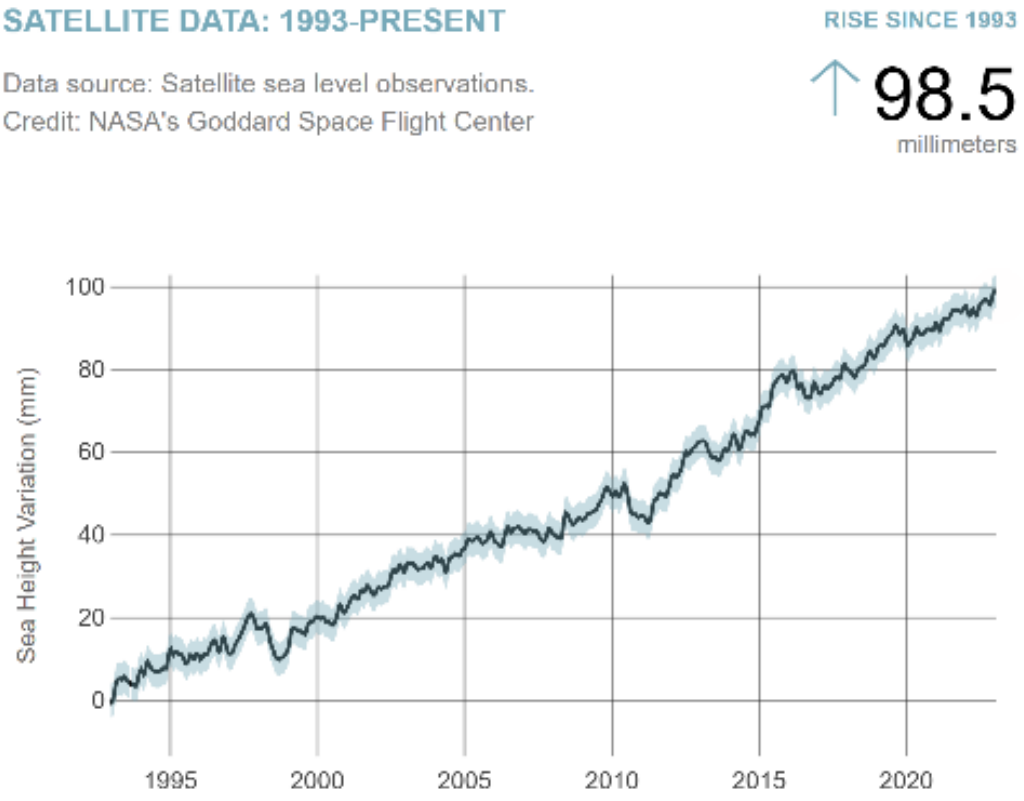


Figure 3.4: NASA Global Temperature Change Sea Level
Source: NASA Global Climate Change, 2022

Wildfire

- Warming temperatures have extended and intensified wildfire season in the West, where long-term drought in the region has heightened the risk of fires.

- Scientists estimate that human-caused climate change has already doubled the area of forest burned in recent decades. By around 2050, the amount of land consumed by wildfires in Western states is projected to further increase by two to six times.
- Even in traditionally rainy regions like the Southeast, wildfires are projected to increase by about 30%.

Flooding (Precipitation)

- Climate change is having an uneven effect on precipitation (rain and snow) in the United States, with some locations experiencing increased precipitation and flooding, while others suffer from drought.
- On average, more winter and spring precipitation is projected for the northern United States, and less for the Southwest, over this century.
- Projections of future climate over the U.S. suggest that the recent trend toward increased heavy precipitation events will continue. This means that while it may rain less frequently in some regions (such as the Southwest), when it does rain, heavy downpours will be more common.

Extreme Cold

- The length of the frost-free season, and the corresponding growing season, has been increasing since the 1980s, with the largest increases occurring in the western United States.

Climate change can also have numerous general impacts on human health (see Figure 3.5).

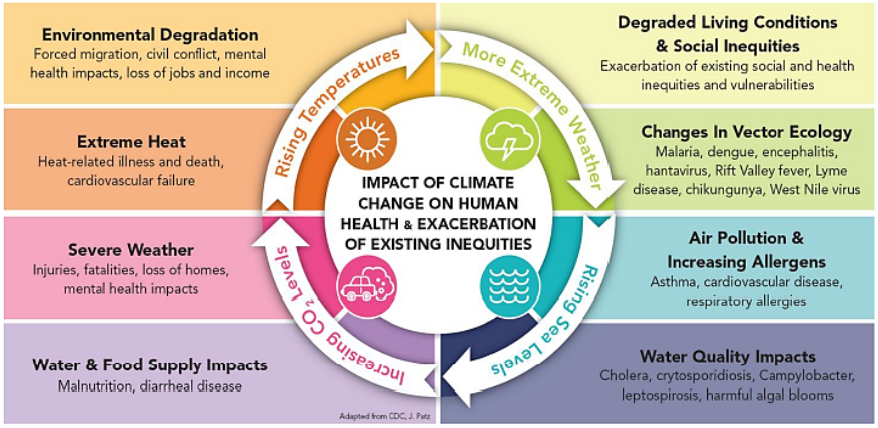


Figure 3.5: Human Health Impacts from Climate Change
Source: U.S. Center for Disease Control and Prevention

INDICATORS OF CLIMATE CHANGE IN CALIFORNIA

According to the California Natural Resource Agency (CNRA), climate change is already affecting California and is projected to continue to do so well into the foreseeable future. Current and projected changes include increased temperatures, sea level rise, a reduced winter snowpack, altered precipitation patterns, and more frequent storm events. Over the long term, reducing greenhouse gases can help make these changes less severe, but the changes cannot be avoided entirely. Unavoidable climate impacts result in a variety of secondary consequences including detrimental impacts on human health and safety, economic continuity, ecosystem

integrity and provision of basic services. Climate change is being profiled in the 2023 Marin County Hazard Mitigation Plan as a standalone hazard while addressing each of the other natural hazards. Marin County is considering climate change issues when identifying future mitigation actions.

California is experiencing a climate crisis that is increasingly taking a toll on the health and well-being of its people and on its unique and diverse ecosystems. Every Californian has suffered from the effects of record high temperatures, dry winters, prolonged drought, and proliferating wildfires in recent years. California's biodiversity is threatened as alterations to habitat conditions brought about by a changing climate are occurring at a pace that could overwhelm the ability of plant and animal species to adapt.

The California Office of Environmental Health Hazard Assessment (OEHHA) found the following indicators of climate change in California in a 2022 report[3]:

- Since 1895, annual average air temperatures in California have increased by about 2.5 degrees Fahrenheit (°F). Warming occurred at a faster rate beginning in the 1980s.
- Recent years have been especially warm: Eight of the ten warmest years on record occurred between 2012 and 2022; 2014 was the warmest year on record.
- Of all the Western states, California endured the hottest temperatures for the longest time, driving the average statewide temperature to the second warmest over the past 128 years.
- Extreme heat ranks among the deadliest of all climate-driven hazards in California, with physical, social, political, and economic factors effecting the capacity of individuals, workers, and communities to adapt, and with the most severe impacts often on communities who experience the greatest social and health inequities.
- Glaciers have essentially disappeared from the Trinity Alps in Northern California
- In 2020, wildfire smoke plumes were present in each county for at least 46 days.
- The 2022 fire season saw more fires than the previous fire season along with continued extreme drought and heat conditions.
- The drought, begun in 2019, was the third statewide drought declared in California since 2000.
- This drought has been marked by extreme swings; the state received record-breaking amounts of precipitation in October and December 2021 that were offset by the driest January, February, and March 2022 dating back more than 100 years. The year 2023 opened with California simultaneously managing both drought and flood emergencies.
- A series of storms in late December 2022 and early January 2023 broke rural levees, disrupted power, flooded roads, downed trees, and eroded coastal land.
- Sea level rise accelerates coastal erosion, worsens coastal flooding during large storms and peak tidal events, and impacts important infrastructure positioned along our state's 1,100-mile coast.
- The western drought which impacted all of California and the western United States was nearly lifted due to unseasonably heavy rains in late 2022 and early 2023.

[3] 2022 Report: Indicators of Climate Change in California. https://oehha.ca.gov/climate-change/epic-2022

The graph below shows the relative change, in millimeters, in sea levels at Crescent City (1933-2020), San Francisco (1900-2020), and La Jolla (1925-2020) as a result of climate change:

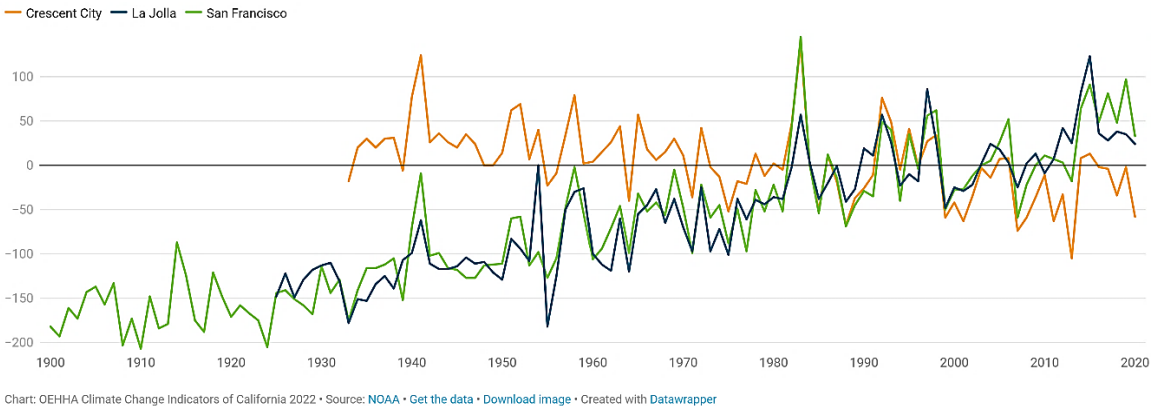


Figure 3.6: Annual Mean Sea Level Trends
Source: 2022 Report: Indicators of Climate Change in California | OEHHA

The impact of climate change in California varies across the state due to diversity in biophysical setting, climate, and jurisdictional characteristics. The California Adaptation Planning Guide organized the state into climate impact regions based on county boundaries in combination with projected climate impacts, existing environmental settings, socioeconomic factors, and regional designations and organizations (see Figure 3.7).

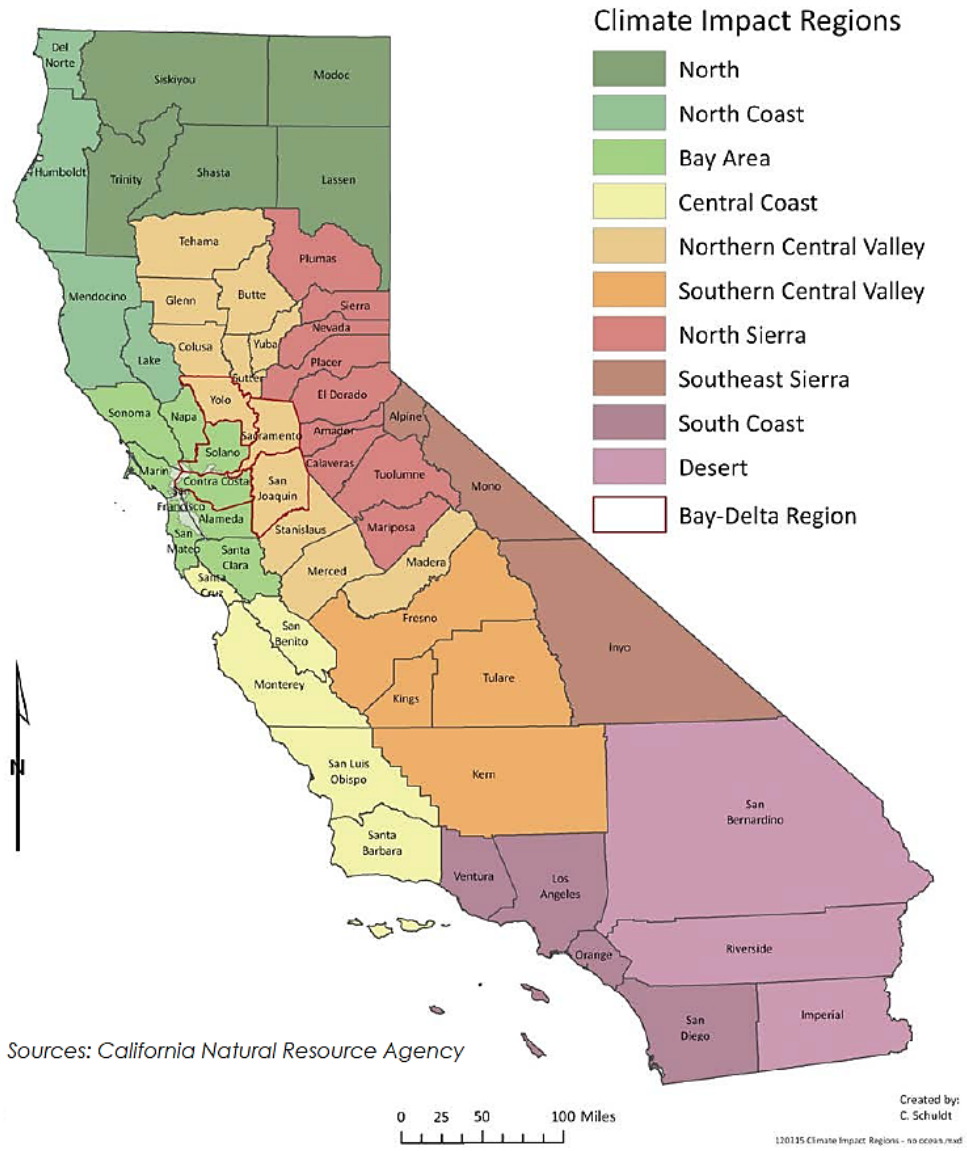


Figure 3.7: California Climate Impact Regions
Source: California Adaptiation Planning Guide

CLIMATE CHANGE IN THE MARIN COUNTY OPERATIONAL AREA

Climate change is already having significant impacts across California and the Marin County OA. Temperatures are warming, heat waves are more frequent, seas are rising and precipitation has become increasingly variable. Climate change will continue to alter Marin County OA ecosystems as a result of rising temperatures, changes in precipitation, and sea level rise, which will increase the severity and occurrence of natural hazards across the Marin County OA well into the future. Coastal cooling processes that keep temperatures down, such as fog, will continue to decrease. Rising temperatures will exacerbate drought conditions and raise the potential for significant wildfires and associated smoke as vegetation becomes drier and tree mortality increases. Forested woodlands that play a major role in carbon reduction will gradually transition into chaparral and shrublands. There will be more extreme storms and

weather events, including expanded heat waves and increased rain events with changes in precipitation, placing increased strain on levees and dams across the Marin County OA. Significant rain events will lead to an increase in flooding and the potential for severe landslides. Shoreline communities will become inundated with sea level rise, storm surge, high tide events, and potential tsunamis. Marshlands and wetlands that act as natural storm barriers will disappear as they transition into open water.

Notable impacts from climate change that are already evident in the Marin County OA and surrounding region as identified in a 2020 Marin County Civil Grand Jury Report include:

- From 1895-2018, the average temperature in Marin County increased by 2.3 degrees Fahrenheit.
- Over the past century, sea level rise in the San Francisco Bay Area rose by eight inches and has accelerated rapidly since 2011.
- The threat of wildfires in 2019 was so severe that Pacific Gas and Electric shut off electric power to the County for multiple days.

Climate change will continue to affect homes, businesses, infrastructure, utilities, transportation systems and agriculture across the Marin County OA. The risk to socially vulnerable populations will increase as they feel the immediate impacts of climate change more significantly and are less able to adapt to climate changes and recover from its impacts.

The Marin County OA has adopted numerous planning initiatives and mitigation measures to help combat the effects of climate change across the OA. The Marin Climate Energy Partnership (MCEP), which is a partnership program including numerous Marin County jurisdictions, the County of Marin, and regional agencies, adopted a model Climate Action Plan (CAP) that is intended to support countywide strategic efforts and is currently being used to update or establish climate action plans for additional jurisdictions within Marin County. The adopted Climate Action Plan serves as the adopted plan for the unincorporated County, which was completed in 2020. The MCEP also collects data and reports on progress in meeting each County jurisdictions' individual greenhouse gas emission targets. In October 2022, the County published the Greenhouse Gas Inventory for Unincorporated Community Emissions for the Year 2020. Marin County OA jurisdictions have already met their greenhouse reduction goals for 2020 and are about halfway to meeting the statewide goal to reduce emissions 40% below 1990 levels by the year 2030. Marin County also formed a Sea Level Marin Adaptation Response Team in 2018 and had a Sea Level Rise Vulnerability Assessment and associated Adaptation Report completed for the County and each of its jurisdictions in 2017 as part of their Bay Waterfront Adaptation and Vulnerability Evaluation. Additional Marin County OA climate change mitigation programs and initiatives include Marin Clean Energy, Electrify Marin, the Marin Solar Project, the Marin Energy Watch Partnership, Resilient Neighborhoods, and Drawdown: Marin.

3.2.2 Participating Jurisdiction Hazard Assessment

Each Marin County OA MJHMP participating jurisdiction and organization reviewed and approved the Top Hazards identified by the Planning Team. Each participating jurisdiction and organization then completed a more complex assessment tool to further develop their hazard assessment and prioritization. The completed Hazard Risk Assessment Tables are located in the Section 2.0: Hazard Identification and Risk Assessment of the Jurisdictional or Special District Annex Profile.

The planning process used the available FEMA tools to evaluate all the possible threats faced. The primary tool selected was the Hazard Risk Assessment and Prioritization Tool. This matrix allowed the participating jurisdiction or organization to assess their own level of vulnerability and mitigation capability. Each participating Jurisdiction and organization assessed the top hazards for:

- Probability/Likelihood of future events or frequency
- Geographic Extent
- Impact to property, resources, and humans
- Magnitude/Severity
- Significance
- Climate Change Influence
- Mitigation capacity

Through the threat analysis process, the most probable, frequent and devastating threats to Marin County were identified. Other threats not identified in this plan, that could potentially affect Marin County, are identified and addressed in other plans such as the County Emergency Operations Plan, functional annexes, operational response plans, and various policies and procedures.

3.3 Hazard Risk Assessment

3.3.1 Dam Failure

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

Dam failure is the uncontrolled release of impounded water from behind a dam. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, and terrorism can all cause a dam to fail. Dam failure causes downstream flooding that can affect life and property. Dam failures can result from any one or a combination of the following causes:

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

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response

capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, healthcare facilities, schools, homes, and hazardous materials storage facilities. Electric generating facilities and transmission lines could also be damaged and affect life support systems in communities outside the immediate hazard area. Associated water supply, water quality and health concerns could also be an issue. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

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

The California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) has jurisdiction over impoundments that meet certain capacity and height criteria. Embankments that are less than six feet high and impoundments that can store less than 15 acre-feet are non-jurisdictional. Additionally, dams that are less than 25 feet high can impound up to 50 acre-feet without being jurisdictional. The Cal DWR DSOD assigns hazard ratings to large dams within the State. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in three categories that identify the potential hazard to life and property:

- **High hazard** indicates that a failure would most probably result in the loss of life.
- **Significant hazard** indicates that a failure could result in appreciable property damage.
- **Low hazard** indicates that failure would result in only minimal property damage and loss of life is unlikely.

Since 1929, the state has supervised all non-federal dams in California to prevent failure for the purpose of safeguarding life and protecting property. Supervision is carried out through the state's Dam Safety Program under the jurisdiction of DWR. The legislation requiring state supervision was passed in response to the St. Francis Dam failure and concerns about the potential risks to the general populace from a number of water storage dams. The law requires:

Examination and approval or repair of dams completed prior to August 14, 1929, the effective date of the statute.
Approval of plans and specifications for and supervision of construction of new dams and the enlargement, alteration, repair, or removal of existing dams.
Supervision of maintenance and operation of all dams under the state's jurisdiction.

The 1963 failure of the Baldwin Hills Dam in Southern California led the Legislature to amend the California Water Code to include within state jurisdiction both new and existing off-stream storage facilities.

Dams and reservoirs subject to state supervision are defined in California Water Code §6002 through §6004, with exemptions defined in §6004 and §6025. In administering the Dam Safety Program, DWR must comply with the provisions of the California Environmental Quality Act (CEQA). As such, all formal dam approval and revocation actions must be preceded by appropriate environmental documentation.

In 1972, Congress moved to reduce the hazards from the 28,000 non-federal dams in the country by passing Public Law 92-367, the National Dam Inspection Act. With the passage of this law, Congress authorized the U.S. Army Corps of Engineers (USACE) to inventory dams located in the United States. The action was spurred by two disastrous earthen dam failures during the year, in West Virginia and South Dakota, that caused a total of 300 deaths.

The Water Resources Development Act of 1986 (P.L 99-662) authorized USACE to maintain and periodically publish an updated National Inventory of Dams (NID). The Water Resources Development Act of 1996 (P.L. 104-303), Section 215, re-authorized periodic updates of the NID by USACE.

Location and Previous Occurrences

Reservoirs for water supply and the dams that impound them are integral parts of the municipal infrastructure in Marin County. Unlike most other counties in California, Marin does not import or export water through the Central Valley State and Federal water projects. The Marin Municipal Water District (MMWD) and the North Marin Municipal Water District (NMWD) operate and maintain eight major dams for municipal water supplies within their jurisdictions (see Table 3.7) MMWD dams include Alpine Dam, Bon Tempe Dam, Lagunitas Dam, Phoenix Dam, Peters Dam (Kent Lake), Nicasio Dam, and Soulajule Dam. NMWD maintains and operates one dam at Stafford Lake on Novato Creek for its smaller service area. None of these reservoirs generate hydroelectricity nor are they actively managed for downstream flood control.

The California Water Code entrusts dam safety regulatory power to the California Department of Water Resources (DWR), Division of Safety of Dams (DSOD). Dams greater than 6-feet in height and impounding 50 acre feet or more of water, and dams greater than 25-feet in height and impounding more than 15 acre-feet of water are subject to DSOD jurisdiction. According to the California water code, owners of regulated dams are responsible for emergency preparedness with regard to potential loss of life or property. All regulated dams are inspected by DSOD annually. MMWD inspection reports are available on their website. As of 2017 DSOD classifies the public safety risk of all jurisdictional dams.

Dam locations of high, significant, and low hazard dams that may affect the Marin County OA are shown in Figure 3.10.

Table 3.7 shows dams in Marin County that could impact the OA.

Table 3.7: Hazard Ranked Dams in Marin County with Potential to Impact to the OA

Dam Name/ Dam Number	Hazard Class	Latitude	Longitude	Nearest City/ Distance	Population At Risk	Capacity (acre-feet)	Dam Height	Dam Owner
Alpine 33-0	**High**	37.94	-122.64	Stinson Beach, CA 2.76 miles	10 - 100	8,892	143	Marin Municipal Water District
Big Rock Ranch 437-0	**High**	38.05	-122.63		> 1,000	91	45	Lucasfilm, LTD
Bon Tempe 33-6	**High**	37.96	-122.61	Fairfax, CA 2.49 miles	100 – 1,000	4,300	98	Marin Municipal Water District
Lagunitas 33-2	**Significant**	37.95	-122.60	Kentfield, CA 2.14 miles	100 – 1,000	341	48	Marin Municipal Water District
Novato Creek/ Stafford Lake 88-0	**Extremely High**	38.12	-122.64	Novato, CA 3.76 miles	10 - 100	140	76	North Marin County Water District
Peters 33-7	**High**	38.00	-122.70	Lagunitas, CA 1.00 miles	0	32,900	320	Marin Municipal Water District
Phoenix Lake 33-3	**High**	37.96	-122.58	Kentfield, CA 1.01 miles	10 - 100	612	90	Marin Municipal Water District
Seeger 33-8	**High**	38.08	-122.76		1 - 10	22,400	115	Marin Municipal Water District
Soulajule 33-9	**High**	38.15	-122.78	Inverness, CA 5.26 miles	1 - 10	10,700	122	Marin Municipal Water District
Vonsen 430-0	**High**	38.18	-122.68	Sheep Ranch 6 miles	10 - 100	70	35	Private Property

Table 3.7: Hazard Ranked Dams in Marin County with Potential to Impact to the OA
Source: California Department of Water Resources, Division of Safety of Dams

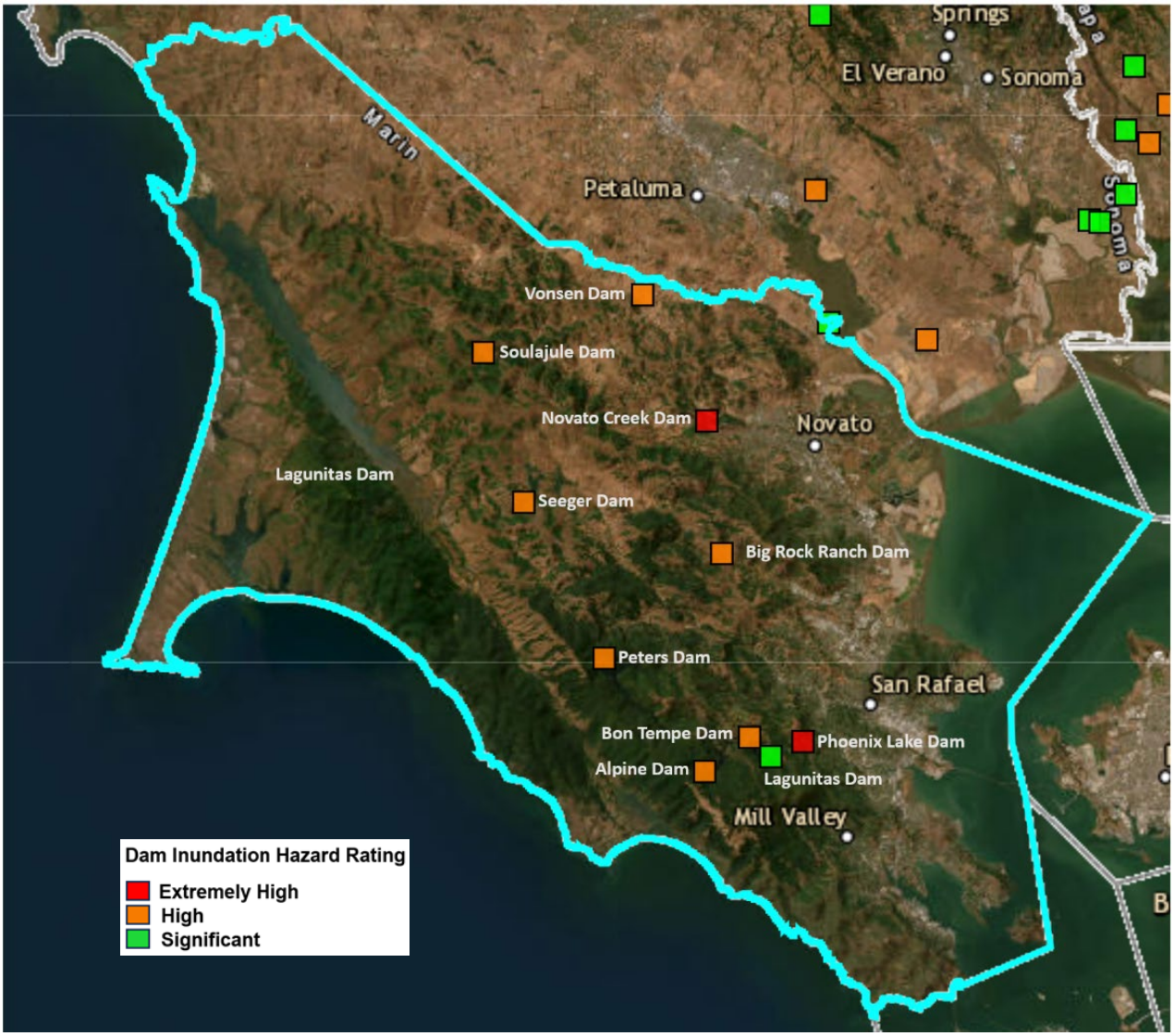


Figure 3.8: Dams in and around the Marin County OA
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Figure 3.9 illustrates the Dam Failure risk to Marin County.

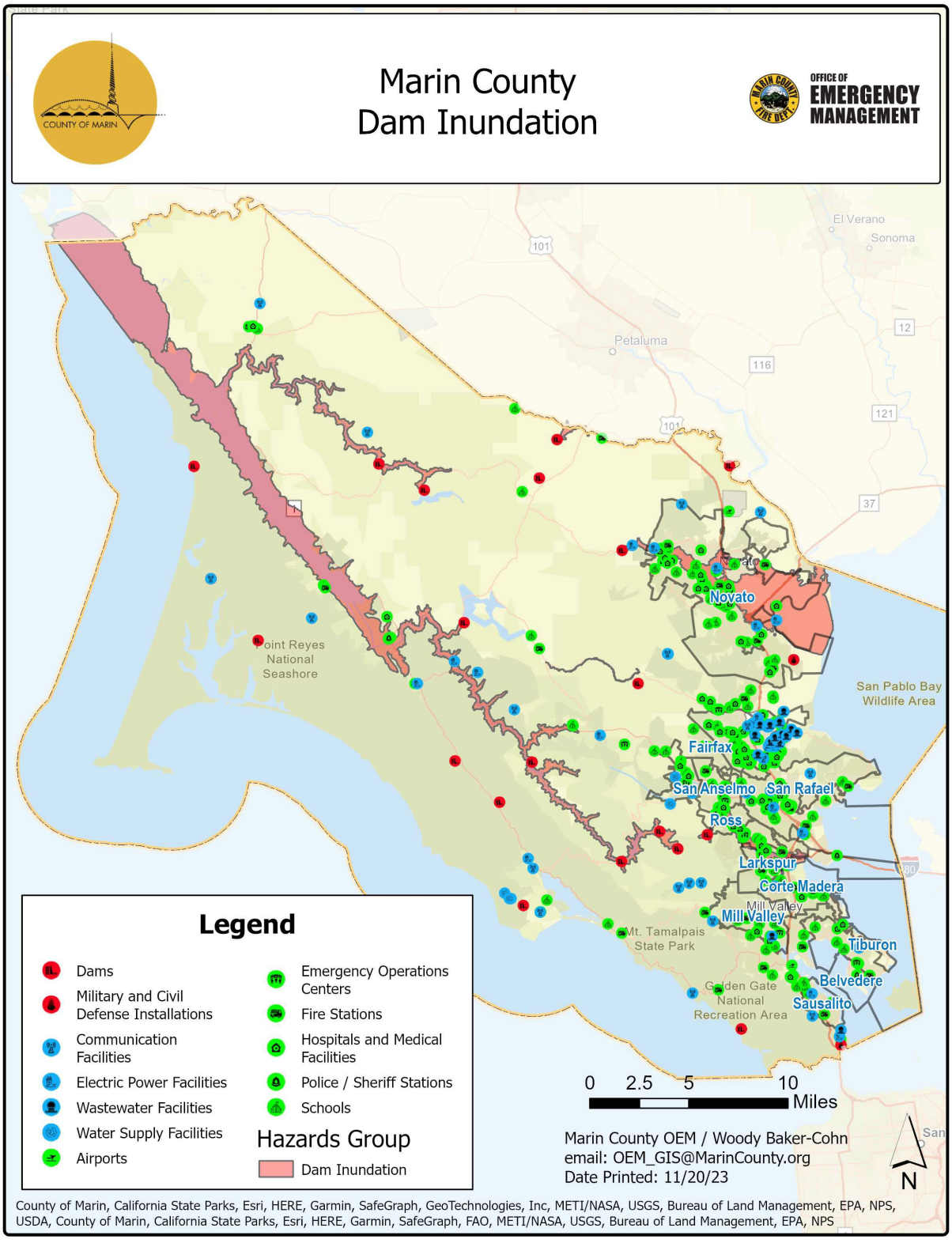


Figure 3.9: Marin County Dam Inundation Susceptibility to Critical Facilities
Source: Marin County OEM

California has had about 45 failures of non-federal dams. The failures occurred for a variety of reasons, the most common being overtopping. Other reasons include specific shortcomings in the dams themselves or an inadequate assessment of surrounding geomorphologic characteristics.

California's first notable dam failure was in 1883 in Sierra County, while the most recent failure occurred in 1965. The most catastrophic event was the failure of William Mulholland's infamous St. Francis Dam, which failed in 1928 and killed an estimated 450 people, only slightly fewer than the 1906 San Francisco earthquake. The actual number of dead from the St. Francis Dam failure was likely substantially higher. San Francisquito Canyon, which was flooded in the event, was home to hundreds of transients and illegal immigrants who were never accounted for in the death totals.

In February 2017 California witnessed the failure of the spillway and emergency spillway at Lake Oroville leading to the evacuation of 188,000 people from the downstream inundation area. Situations like this, overtopping and erosion of a dam's face as a result of flows exceeding the capacity of spillway is another mechanism of dam failure, however reservoir inflows in the Marin County OA do not have to accommodate the volatility of melting snowpack that occurs in the Sierra Nevada foothills.

There is no record of a failure of any regulated dam located in the Marin County OA.

Impacts

Areas of Marin County could be significantly impacted by a failure of any one of its high hazard dams. Inundation maps are based on a hypothetical failure of a dam or critical appurtenant structure and the information depicted on the maps is approximate.

Phoenix Lake Dam

Failure of the Phoenix Lake Dam with Phoenix Lake at full capacity could flood about five miles along Ross Creek down to the Town of Ross, part of San Anselmo where Ross Creek meets Corte Madera Creek, along Corte Madera Creek to unincorporated Kentfield, through the edge of Larkspur and Corte Madera and out into San Pablo Bay. Inundation maps and a discussion of vulnerability for San Anselmo, Ross, Larkspur and Corte Madera can be found in their respective Annexes.

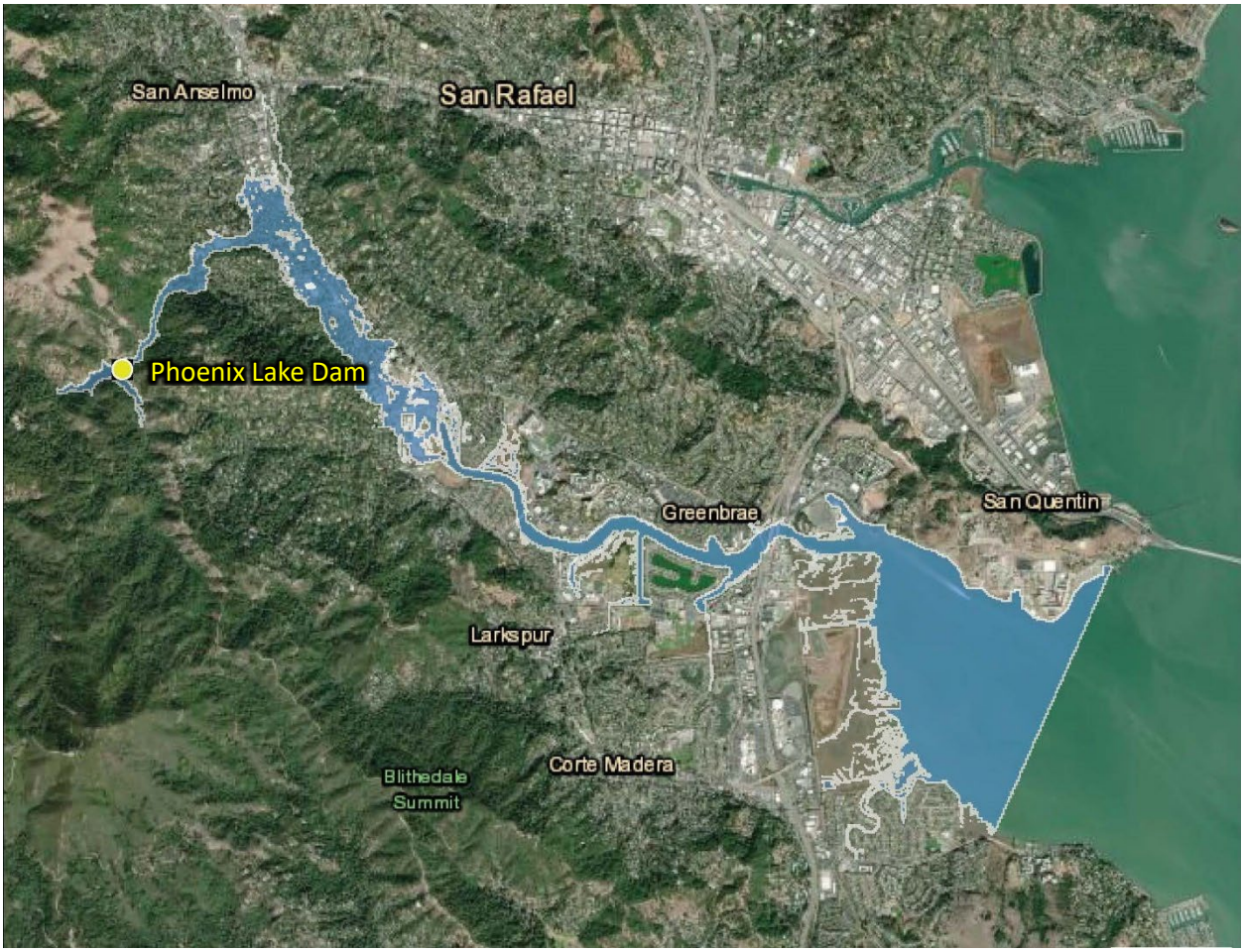


Figure 3.10: Phoenix Lake Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

In the unlikely event of a dam failure associated with Phoenix Lake Dam, floodwaters could reach the commercial center of Kentwood in approximately half an hour, inundating it up to five feet in some areas. Sections of critical infrastructure, including Sir Francis Drake Boulevard and several medical facilities could flood as a result of this dam failure. Dozens of homes and apartment complexes, numerous commercial buildings and community facilities, the Kent Middle School, part of the College of Marin-Kentfield Campus including the College of Marin Police Department station, and the Marin County Sherriff's Office Kentfield Substation could all experience flooding.

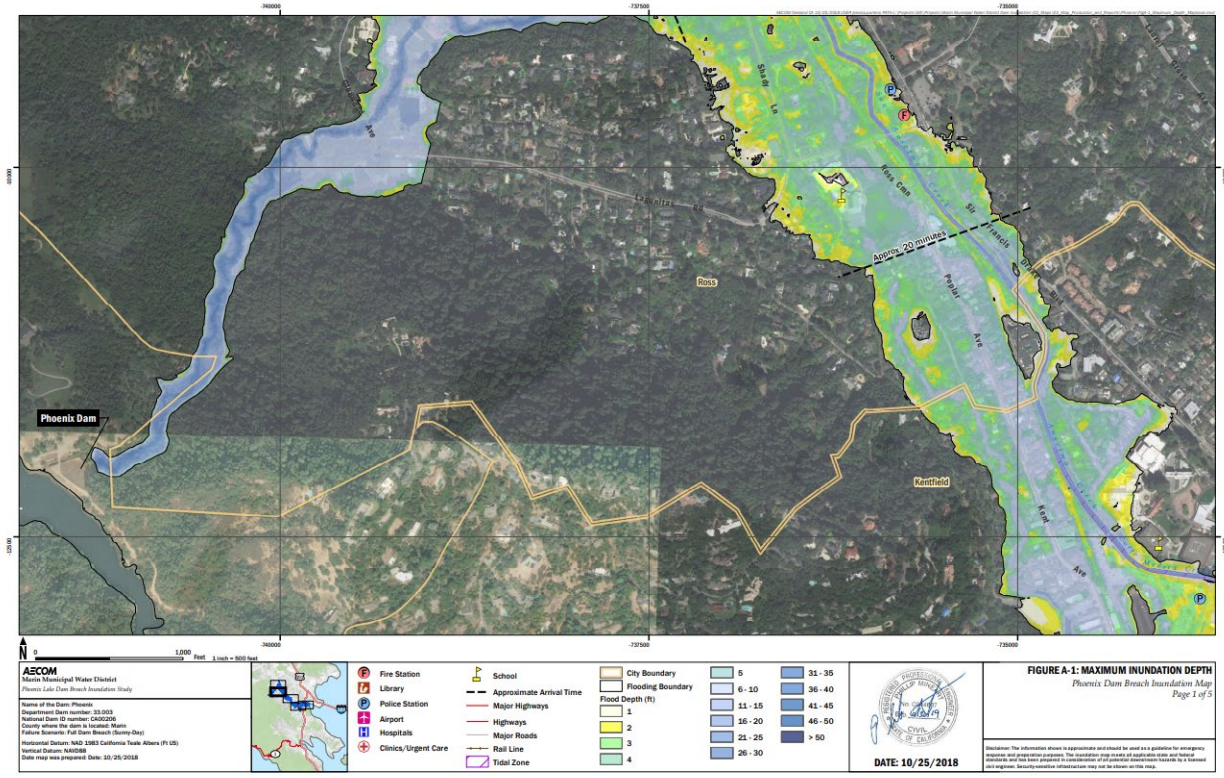


Figure 3.11: Phoenix Lake Dam Inundation Area – Kentfield North
Source: California Department of Water Resources

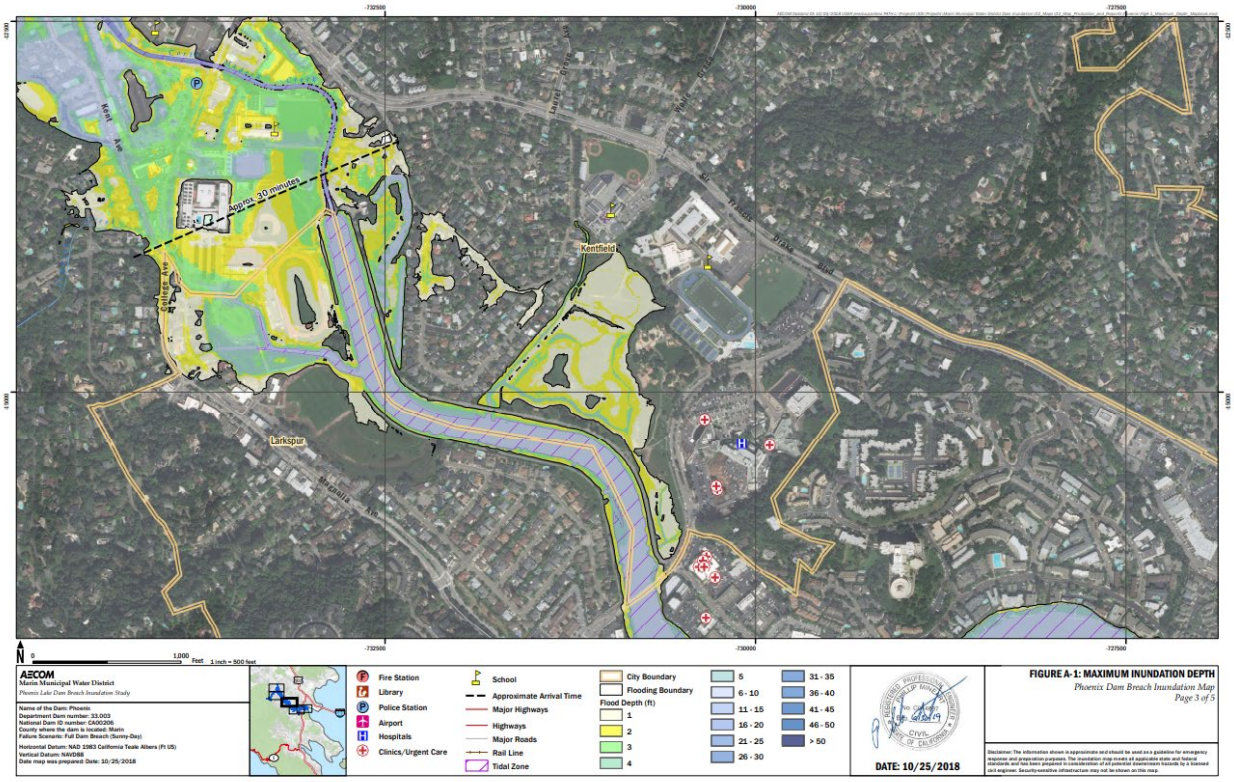


Figure 3.12: Phoenix Lake Dam Inundation Area – Kentfield South
Source: California Department of Water Resources

Novato Creek/Stafford Lake Dam

Failure of the Novato Creek Dam with Stafford Lake at full capacity would affect an area that extends approximately five miles down Novato Creek through parts of the unincorporated County and the City of Novato to San Pablo Bay at Bel Marin Keys. Inundation maps and a discussion of vulnerability for Novato can be found in Annex I.

Figure 3.13: Novato Creek/ Stafford Lake Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Parts of Ohair Park adjacent to the dam and along Novato Creek could be immediately inundated with up to ten feet of water. After passing through Novato, floodwaters could reach the Novato RV Park in approximately two hours and some businesses and the Novato Fire Protection District Station 62 along Atherton Avenue in the Green Point area in approximately ten to fifteen hours, inundating them in over ten feet of water. Floodwaters could reach Bel Marin Keys in ten to fifteen hours. While most homes in Bel Marin Keys should be protected from floodwaters, some homes could be flooded up to several feet. Parts of Bel Marin Keys Boulevard could become flooded in several feet of water, possibly turning Bel Marin Keys into an island temporarily. A PG&E substation at Hamilton Wetlands along with the Bel Marin Gardens Hospital could be inundated with several feet of water.

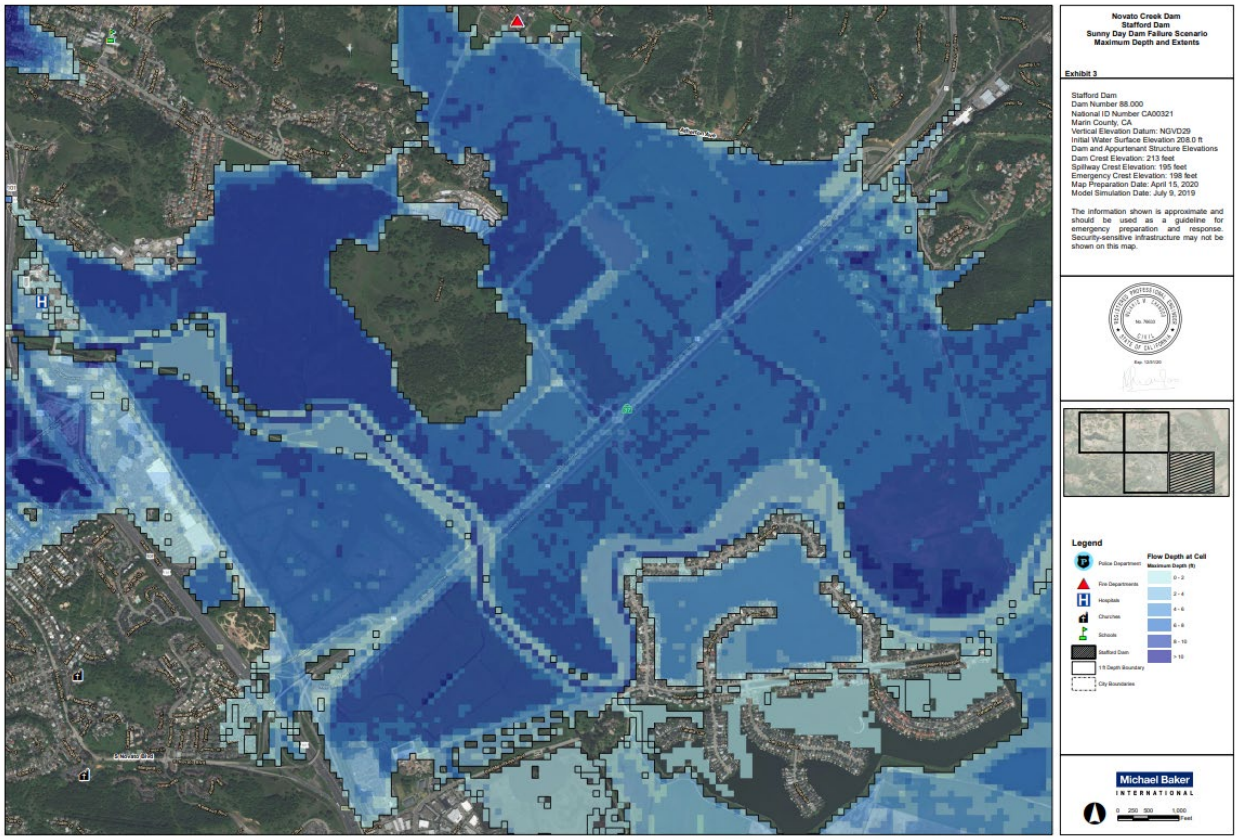


Figure 3.14: Novato Creek Dam Inundation Area – Green Point and Bel Marin Keys
Source: California Department of Water Resources

Bon Tempe Dam

Failure of the Bon Tempe Dam with Kent Lake at full capacity could result in flooding in unincorporated areas of West Marin County, stretching about 10 miles from the reservoir down to Point Reyes Station at Highway 1 and into Tomales Bay.

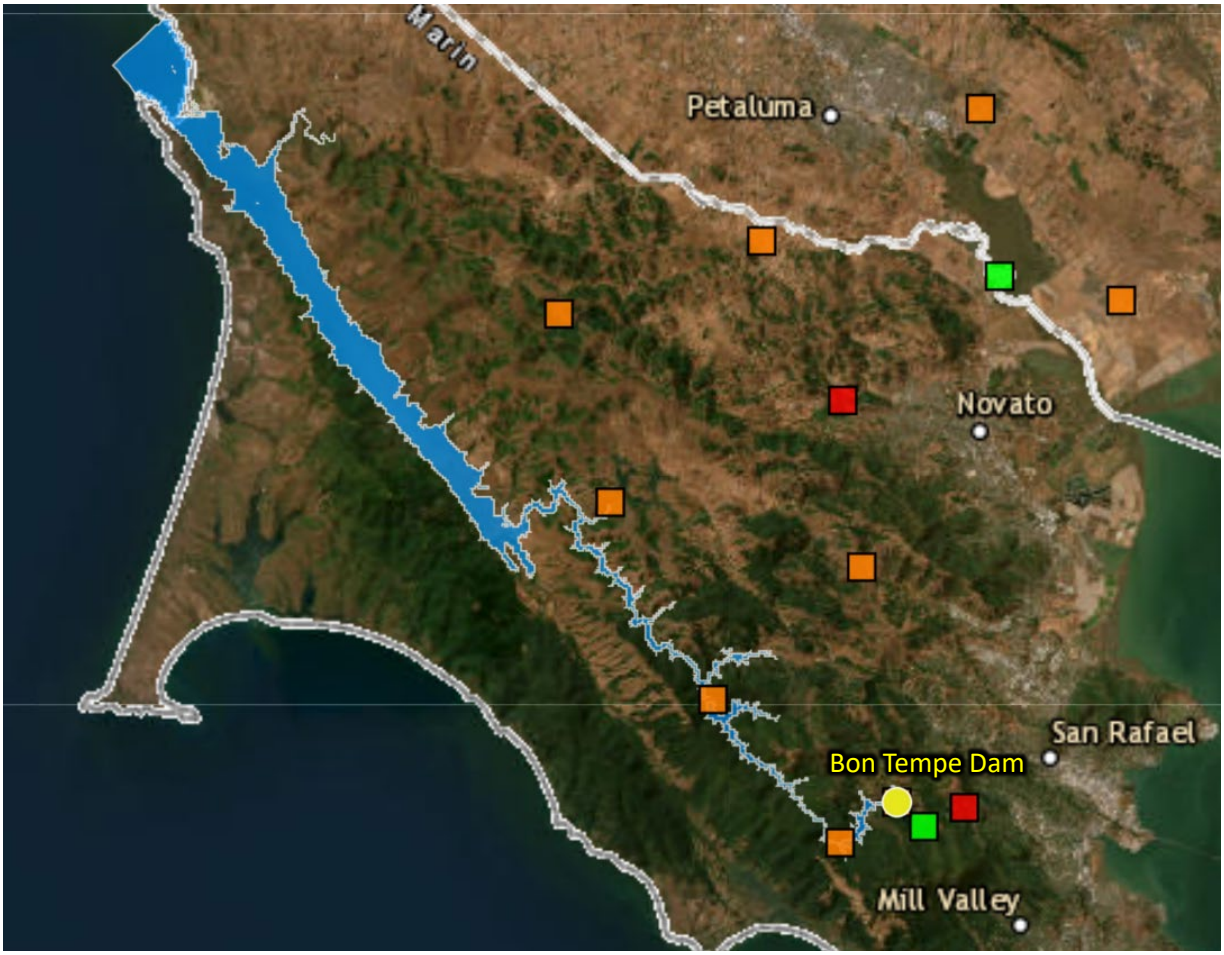


Figure 3.15: Bon Tempe Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

On its path, floodwaters could extend up San Geromino Creek in approximately one hour, flooding dozens of homes and buildings along the creek in Lagunitas and Forest Knolls in a depth up to fifty feet in some areas. Floodwaters from the creek could extend into the western edges of San Geronimo in approximately one and half hours, impacting several shelters, the San Geronimo Valley Community the San Geronimo Valley School, and the Lagunitas School with a depth of several feet.

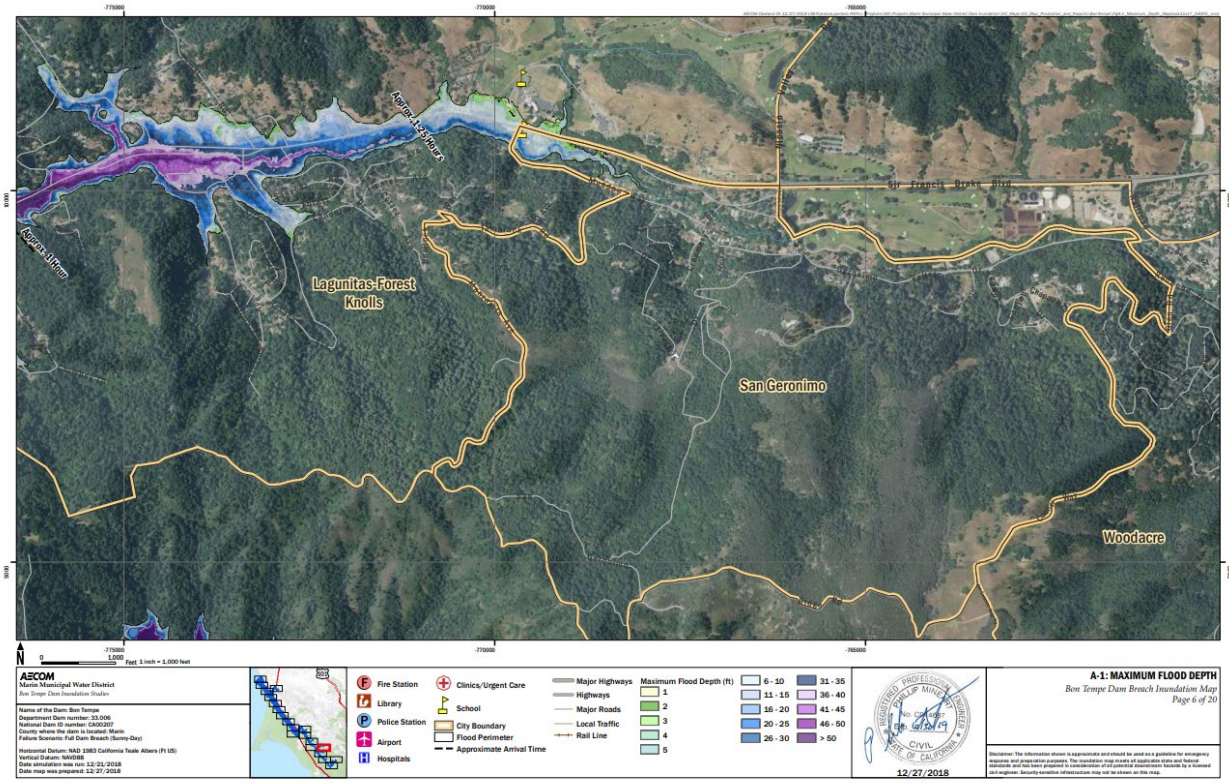


Figure 3.16: Bon Tempe Dam Inundation Area – Lagunitas-Forest Knolls-San Geronimo Area
Source: California Department of Water Resources

Further down Lagunitas Creek, water could flood parts of Samuel P. Taylor State Park including camping areas. Water could flood around five miles of Sir Francis Drake Boulevard along Lagunitas Creek and several dozen buildings along the road including the PG&E substation at Tocaloma. Floodwaters could extend down Platform Bridge Road towards Point Reyes Petaluma Road at a depth up to fifty feet in some areas. Eventually the inundation area could reach Point Reyes Station, with floodwaters extending into the southern end of the community around Highway 1 in the commercial core at a depth of several feet including the Marin County Point Reyes Fire Station, The Marin County Sherrif's Office Point Reyes Substation and the West Marin Elementary School. Floodwaters could reach up to thirty feet in some areas surrounding Point Reyes Station. Floodwaters could eventually reach Tomales Bay in approximately six hours, impacting the Tomales Bay estuary with an influx of fresh water. The unincorporated community of Inverness could experience a surge from Tomales Bay, with flooding up to several feet in residences, marinas, hotels, and other facilities along Sir Francis Drake Boulevard including the main commercial area. Inundation from Tomales Bay could also impact some homes and businesses on the east side of the Bay, including up Walker Creek and around Nick's Cove, Marshall, and Marconi in up to ten feet of water.

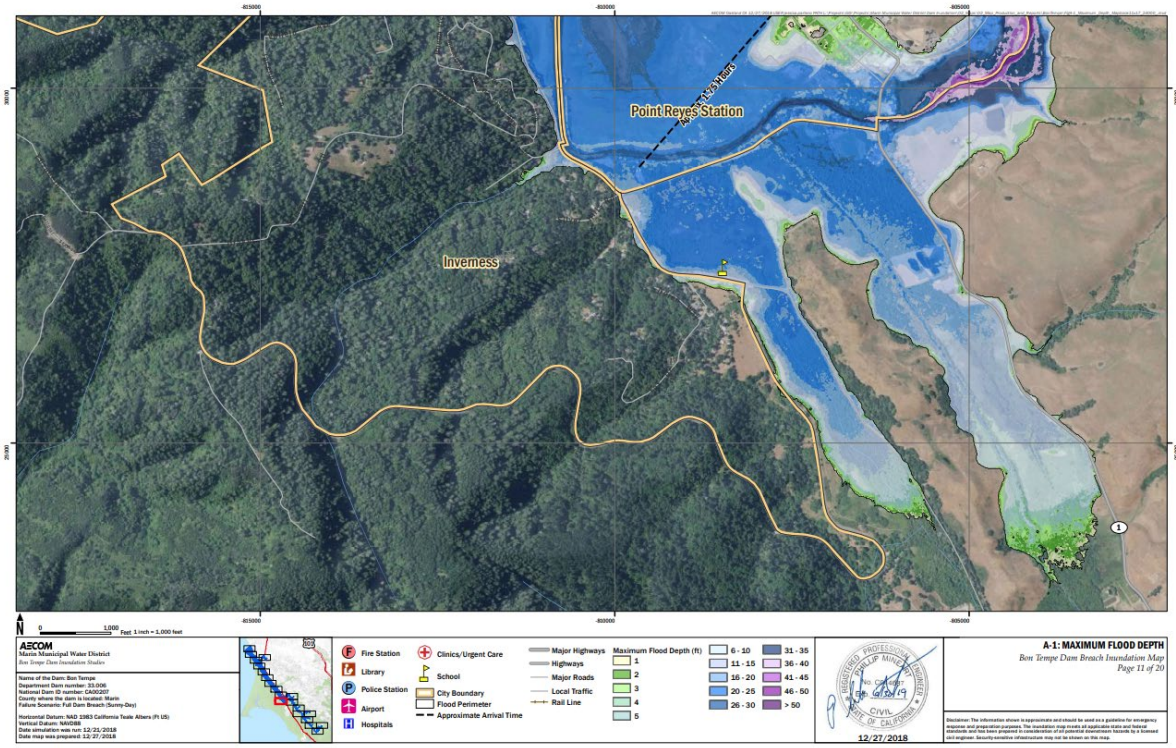


Figure 3.17: Bon Tempe Dam Inundation Area – Point Reyes Station Area South
Source: California Department of Water Resources

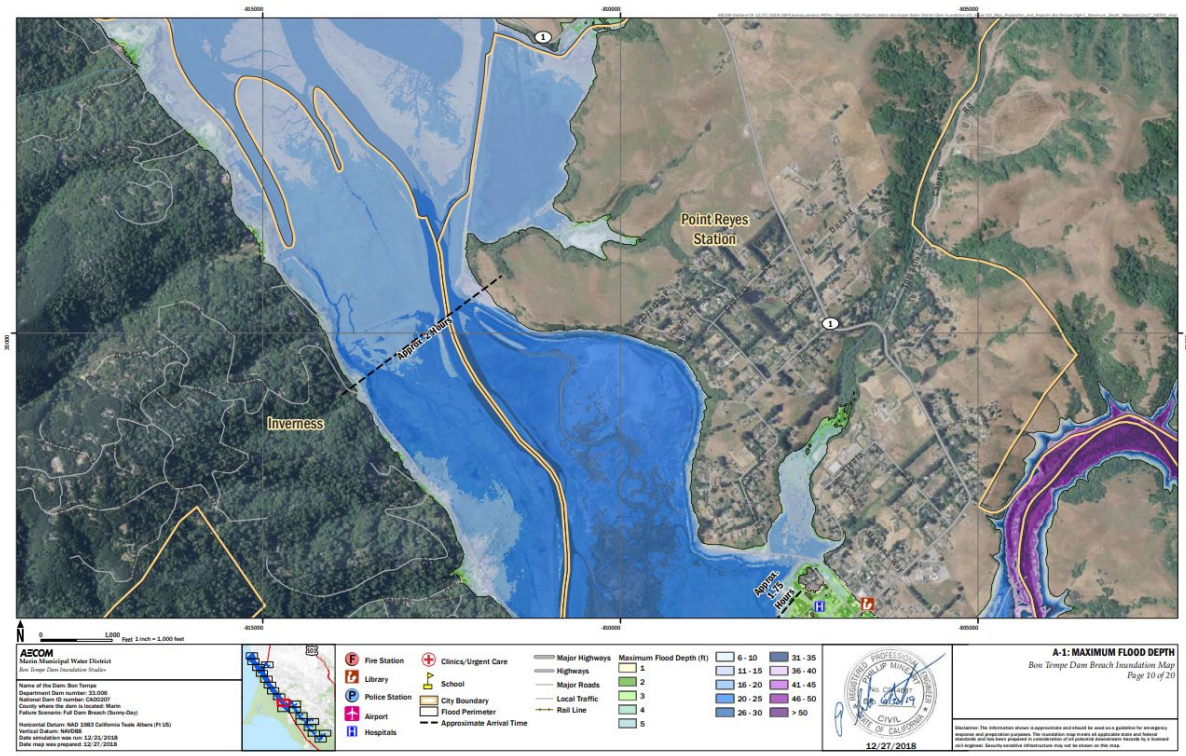


Figure 3.18: Bon Tempe Dam Inundation Area – Point Reyes Station Area North and Inverness
Source: California Department of Water Resources

Peters Dam

Failure of the Peters Dam with Kent Lake at full capacity could result in flooding in unincorporated areas of West Marin County with similar impacts as a failure of the Bon Tempe Dam but to a different extent.

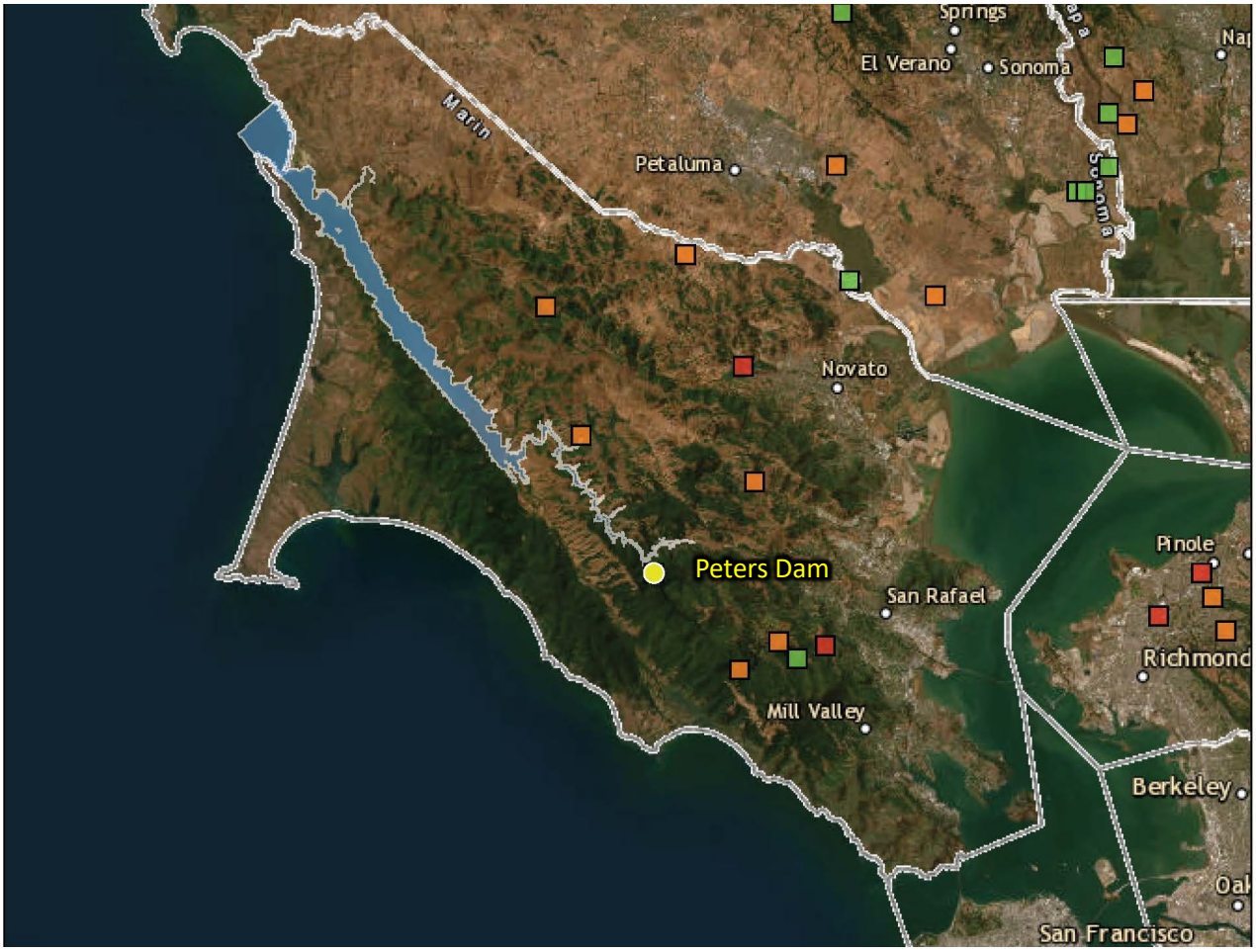


Figure 3.19: Peters Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

While floodwaters could extend up San Geronimo Creek in approximately half an hour and flood dozens of homes in Lagunitas and Forest Knolls in a depth up to twenty feet in some areas, the floodwaters are not expected to reach San Geronimo.

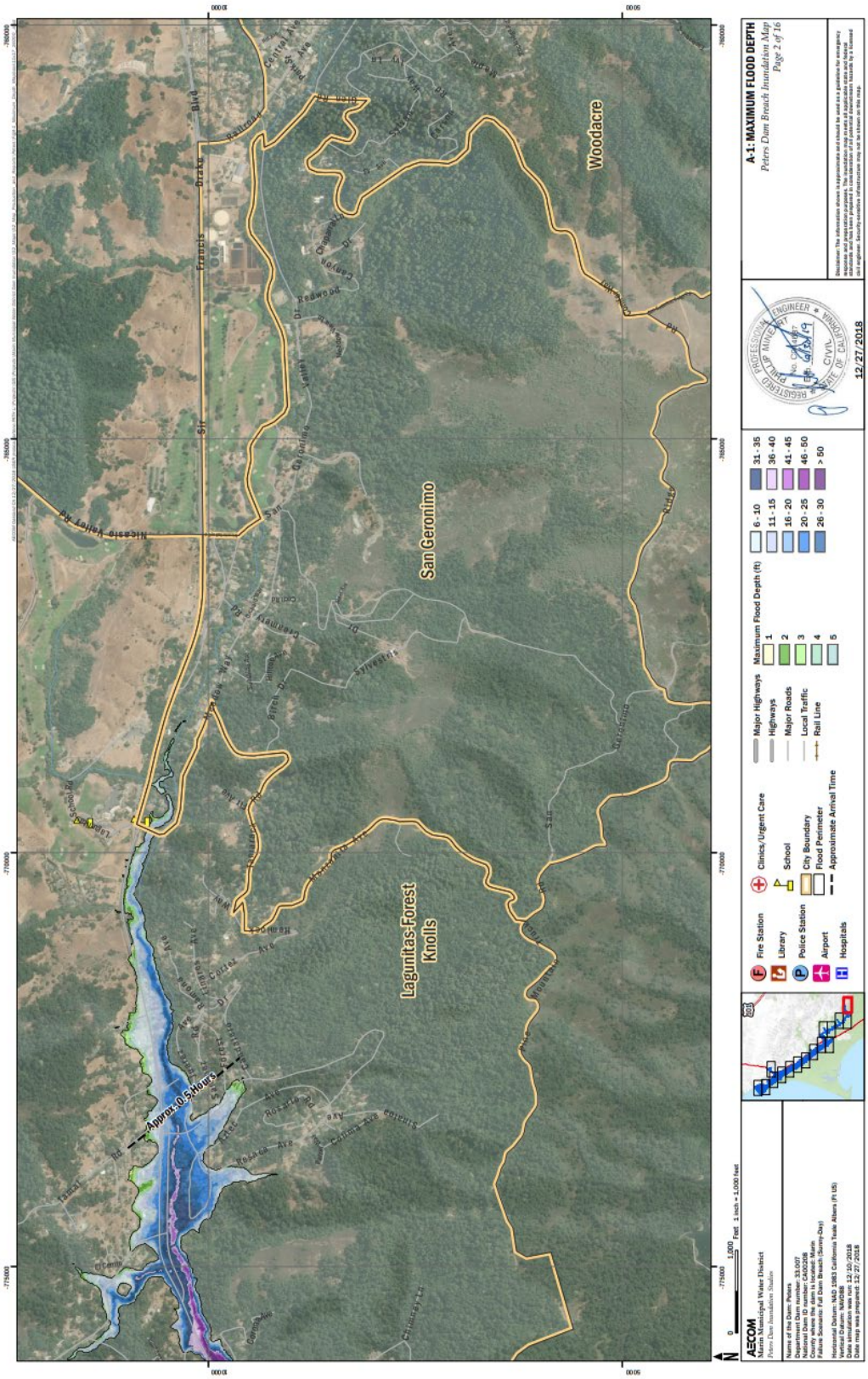


Figure 3.20: Peters Dam Inundation Area – Lagunitas-Forest Knolls Area
Source: California Department of Water Resources

Water could flood parts of Samuel P. Taylor State Park including camping areas. Water could flood around five miles of Sir Francis Drake Boulevard along Lagunitas Creek and several dozen buildings along the road to a depth of several feet. Floodwaters could extend down Platform Bridge Road towards Point Reyes Petaluma Road. Eventually the inundation area could reach Point Reyes Station at approximately one hour after dam failure. Floodwaters could extend at a depth of several feet into the southern end of the community around Highway 1 and up to thirty feet in surrounding areas but would not reach as far as with a failure of the Bon Tempe Dam. Numerous homes and businesses in the commercial core of Point Reyes Station could still be flooded. Floodwaters could eventually reach Tomales Bay in approximately an hour and a half, impacting the Tomales Bay estuary with an influx of fresh water. The unincorporated community of Inverness could experience a surge from Tomales Bay, with flooding up to several feet in residences, marinas, hotels, and other facilities along Sir Francis Drake Boulevard including the main commercial area. Inundation from Tomales Bay could also impact some homes and businesses on the east side of the Bay, including up Walker Creek and around Nick's Cove, Marshall, and Marconi in several feet of water.

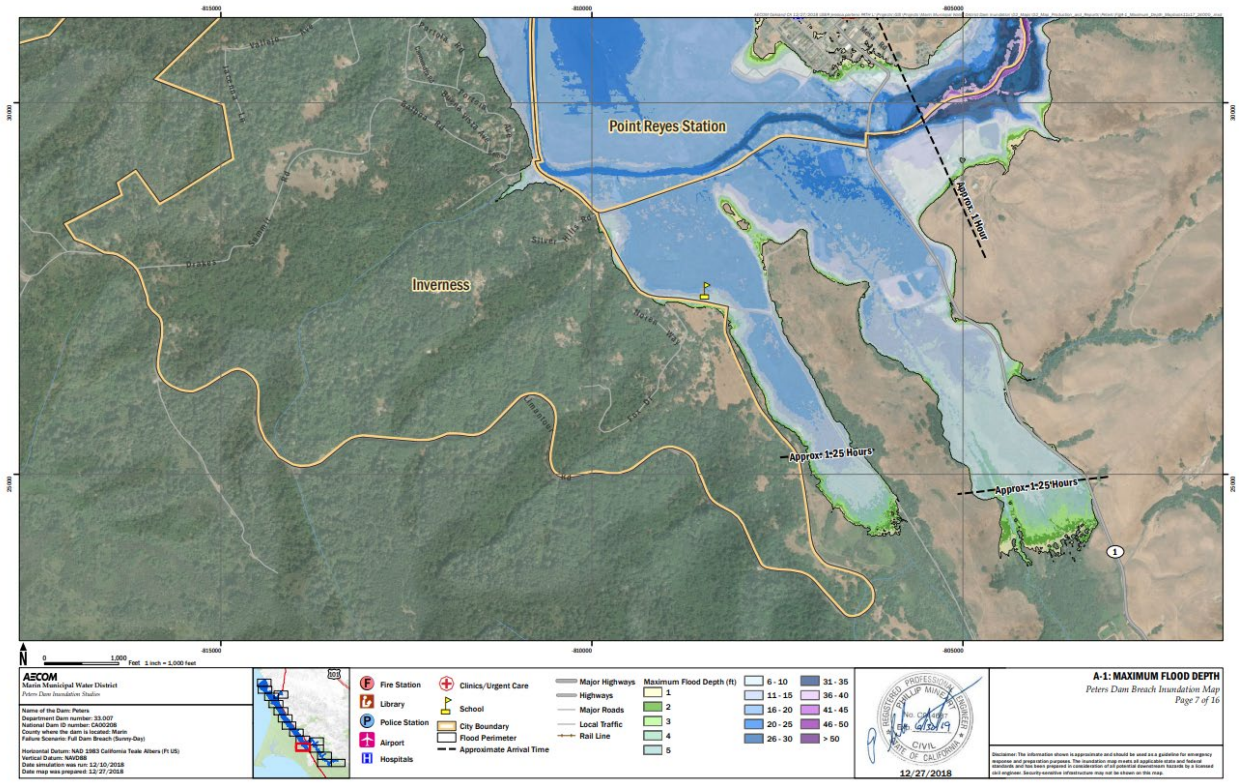


Figure 3.21: Peters Dam Inundation Area – Point Reyes Station Area
Source: California Department of Water Resources

Alpine Dam

Failure of the Alpine Dam with Alpine Lake at full capacity could result in flooding in unincorporated areas of West Marin County along a similar path as a failure of the Bon Tempe and Peters Dam but to a lesser extent.

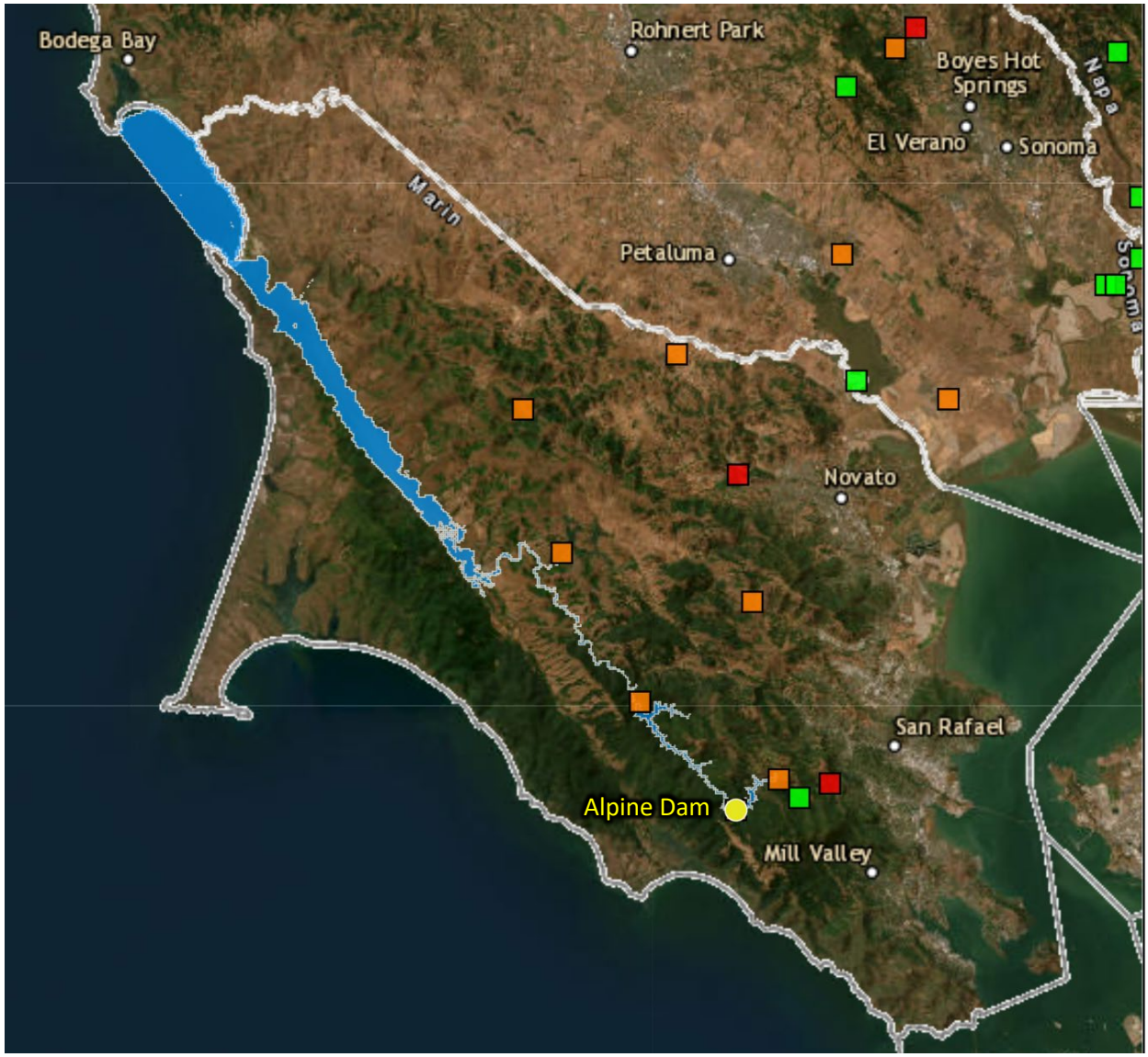


Figure 3.22: Alpine Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Water would not extend as far out along Lagunitas Creek and would not extend up San Geronimo Creek into Lagunitas and Forest Knolls. While a failure of the dam could still flood around five miles of Sir Francis Drake Boulevard and several dozen buildings along that road including the PG&E substation at Tocaloma, the inundation area skirts the edge of Point Reyes Station where there is less of a risk for flooding of homes and facilities than with a failure of the Bon Tempe Dam or the Peters Dam. Floodwaters could reach the Point Reyes Station area around Highway 1 in approximately four hours with a depth up to ten feet in some areas. Floodwaters could eventually reach Tomales Bay in approximately six hours, impacting the

Tomales Bay estuary with an influx of fresh water. Floodwaters are not expected to reach the community of Inverness or have any major flooding to residents and businesses along the east side of Tomales Bay.

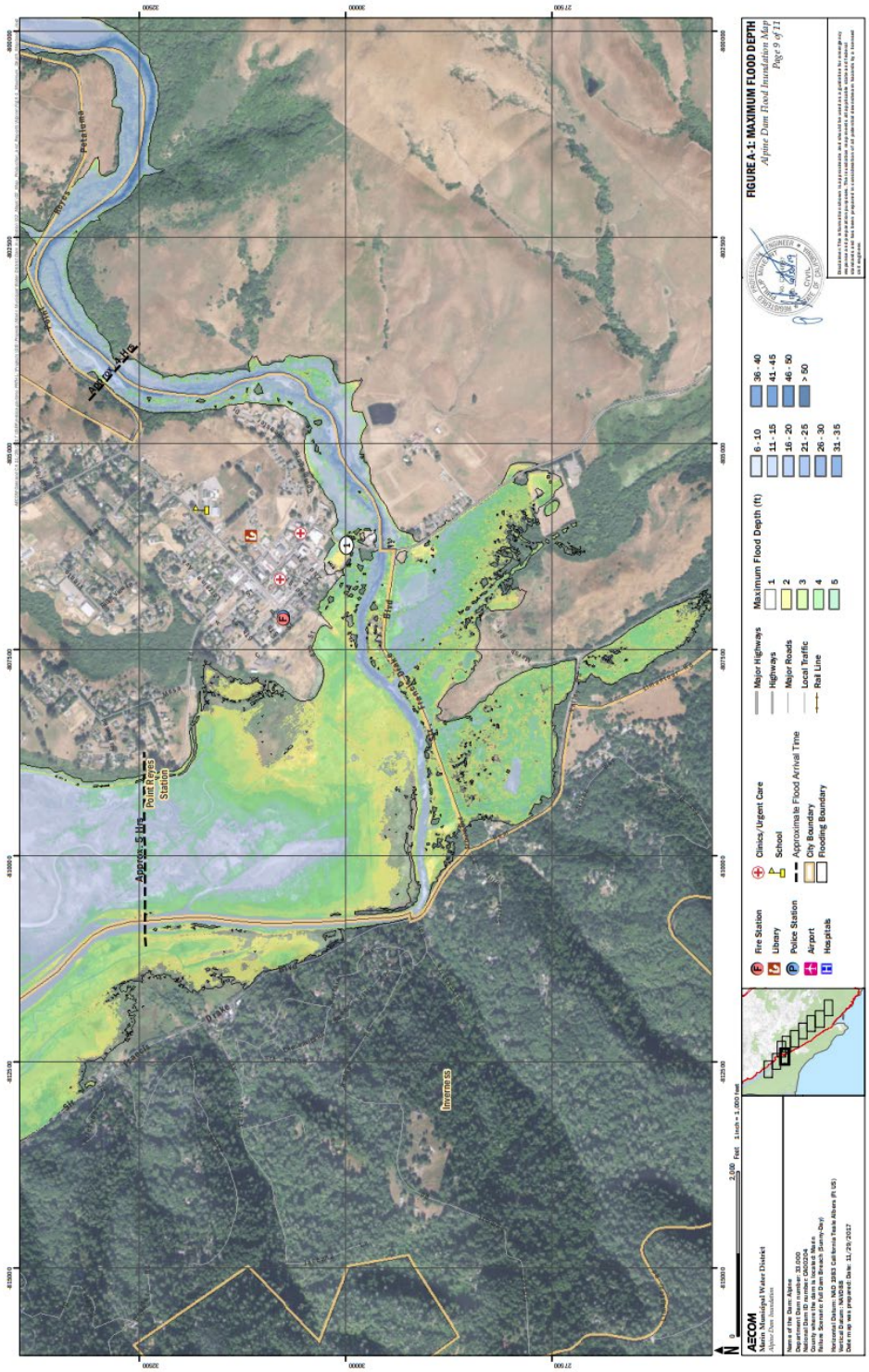


Figure 3.23: Alpine Dam Inundation Area – Point Reyes Station
Source: California Department of Water Resources

Lagunitas Dam

Failure of the Lagunitas Dam with Lake Lagunitas at full capacity could result in flooding in unincorporated areas of West Marin County along a similar path as a failure of the Bon Tempe, Peters, and Alpine Dams but to a much lesser extent. Water would stay mostly confined to Lagunitas Creek before it reached Tomales Bay in approximately 32 hours and no major flooding impacts would be expected.

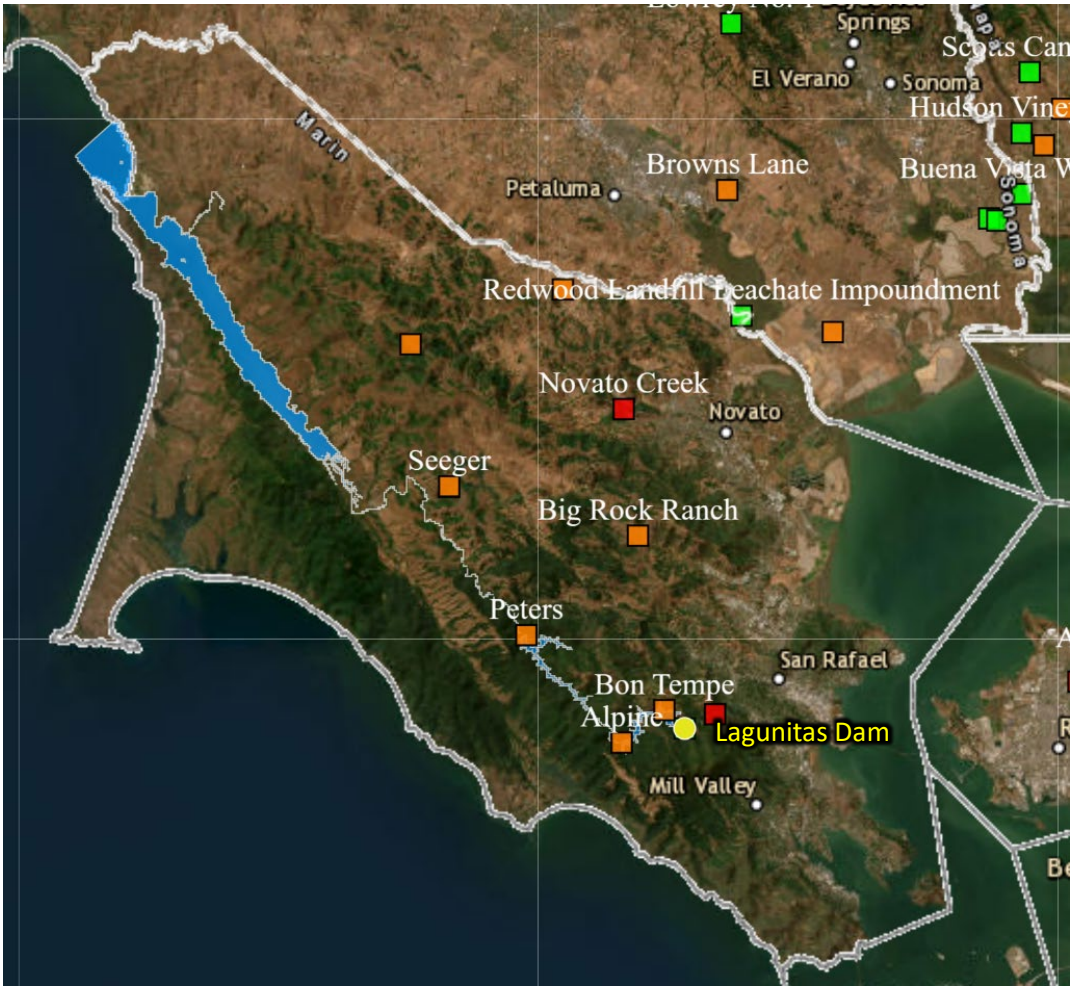


Figure 3.24: Lagunitas Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Seeger Dam

Failure of the Seeger Dam with Nicasio Reservoir at full capacity could send water several miles down Novato Creek to Lagunitas Creek and could result in flooding in unincorporated areas of West Marin County.

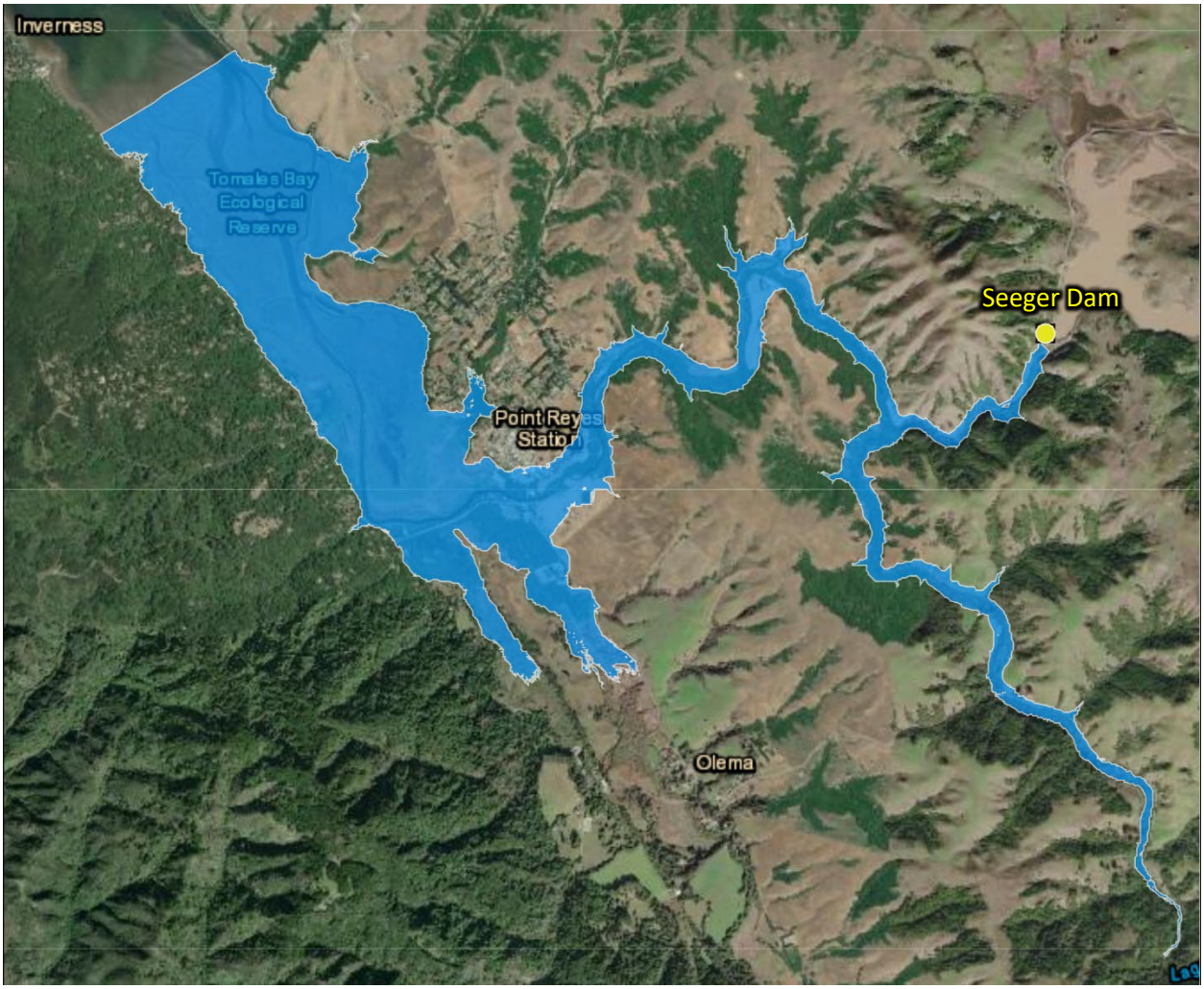


Figure 3.25: Seeger Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Floodwaters could extend down Lagunitas Creek and Point Reyes Petaluma Road, eventually reaching the commercial core of Point Reyes Station at approximately one hour after dam failure. Floodwaters could extend to a depth of several feet into the southeastern end of the community inundating numerous homes and businesses and could extend to a depth up to thirty feet in surrounding area. Floodwaters could travel down Sir Francis Drake Boulevard, inundating it in several feet of water, before eventually reaching Tomales Bay in approximately 45 minutes. The Tomales Bay estuary would be inundated with an influx of fresh water. The unincorporated community of Inverness could experience flooding of a few feet in residences, marinas, hotels, and other facilities along Sir Francis Drake Boulevard including in the main commercial area.

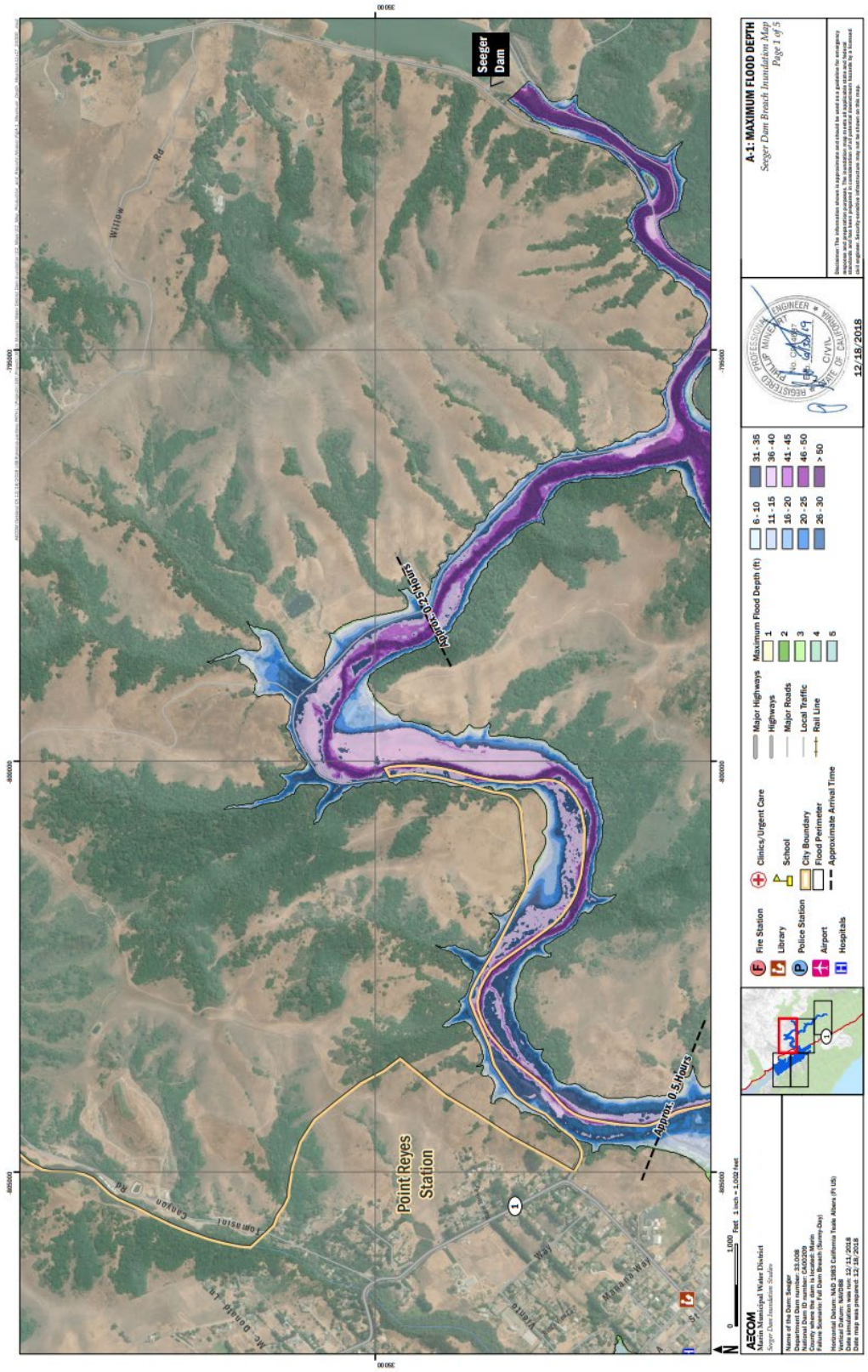


Figure 3.26: Seeger Dam Inundation Area – Point Reyes Station East
Source: California Department of Water Resources

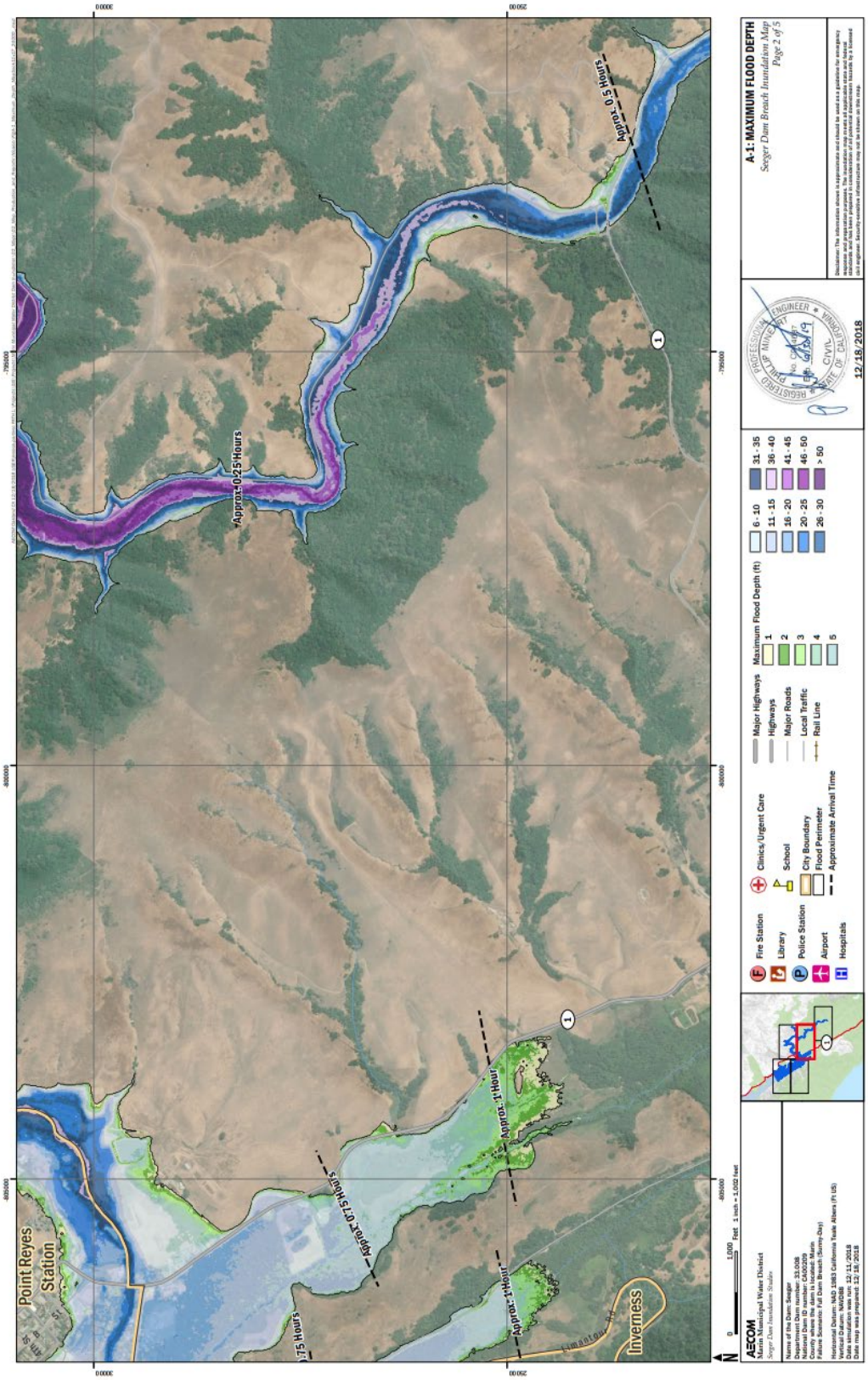


Figure 3.27: Seeger Dam Inundation Area – Point Reyes Station West
Source: California Department of Water Resources

Floodwaters could also extend up Lagunitas Creek and Platform Bridge Road to Sir Francis Drake Boulevard at approximately half an hour and extend as far south as the edge of Samuel P. Taylor State Park before becoming contained in the creek. Both roadways could flood in several places with up to fifty feet of water. Several dozen buildings along both roads including the PG&E substation at Tocaloma could be inundated with several feet of water.

Big Rock Ranch Dam

Failure of the Big Rock Ranch Dam with Big Rock Ranch Lake at full capacity could send water several miles down Nicasio Creek.

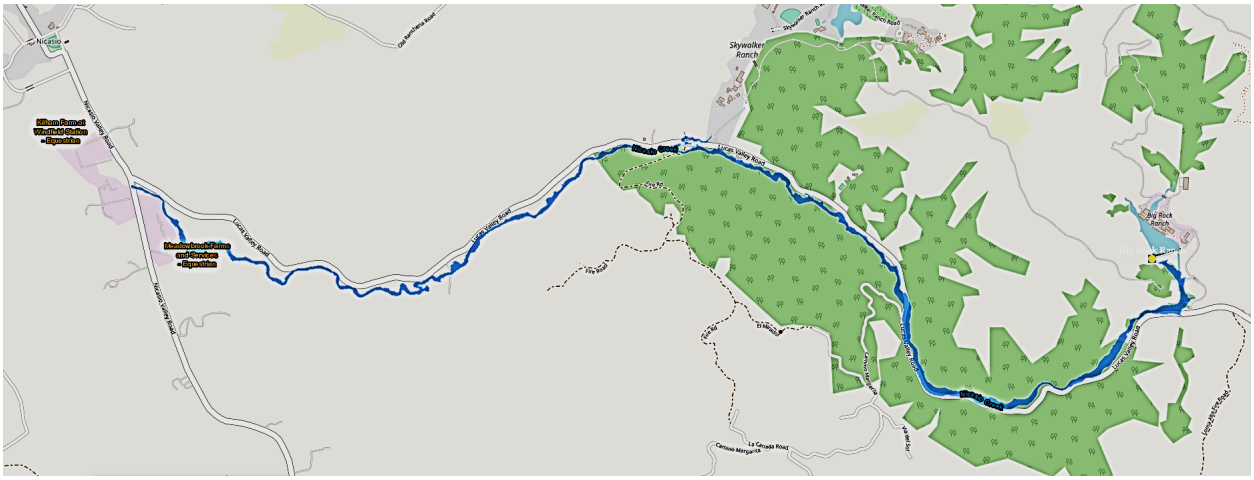


Figure 3.28: Big Rock Ranch Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Water could flood sections of Lucas Valley Road in up to five feet of water in some places and could flood several homes in several feet of water. Floodwaters could eventually reach Nicasio Valley Road in approximately eighty minutes and then be contained in the creek without impacting the community of Nicasio.

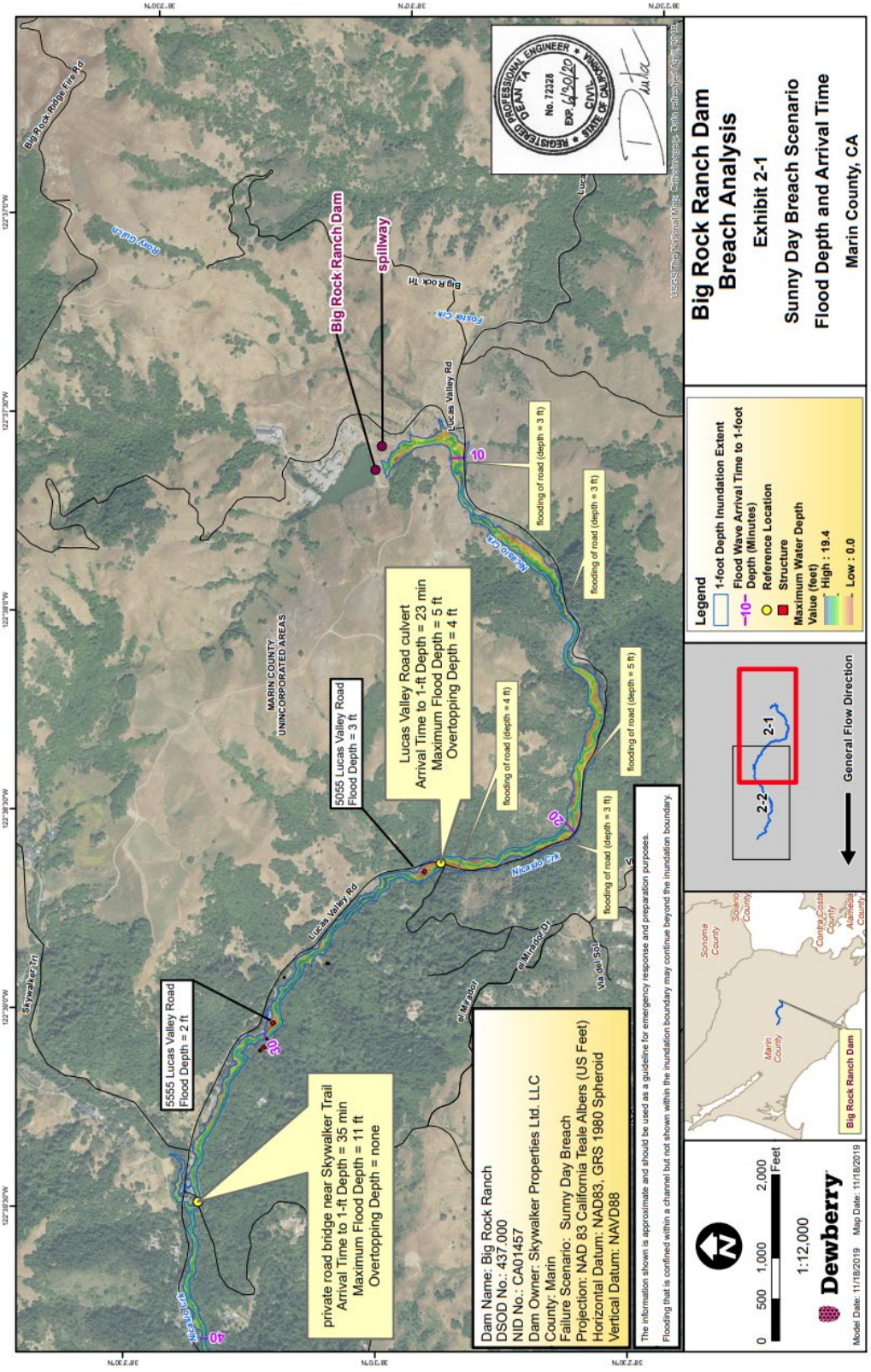


Figure 3.29: Big Rock Ranch Dam Inundation Area East
Source: California Department of Water Resources

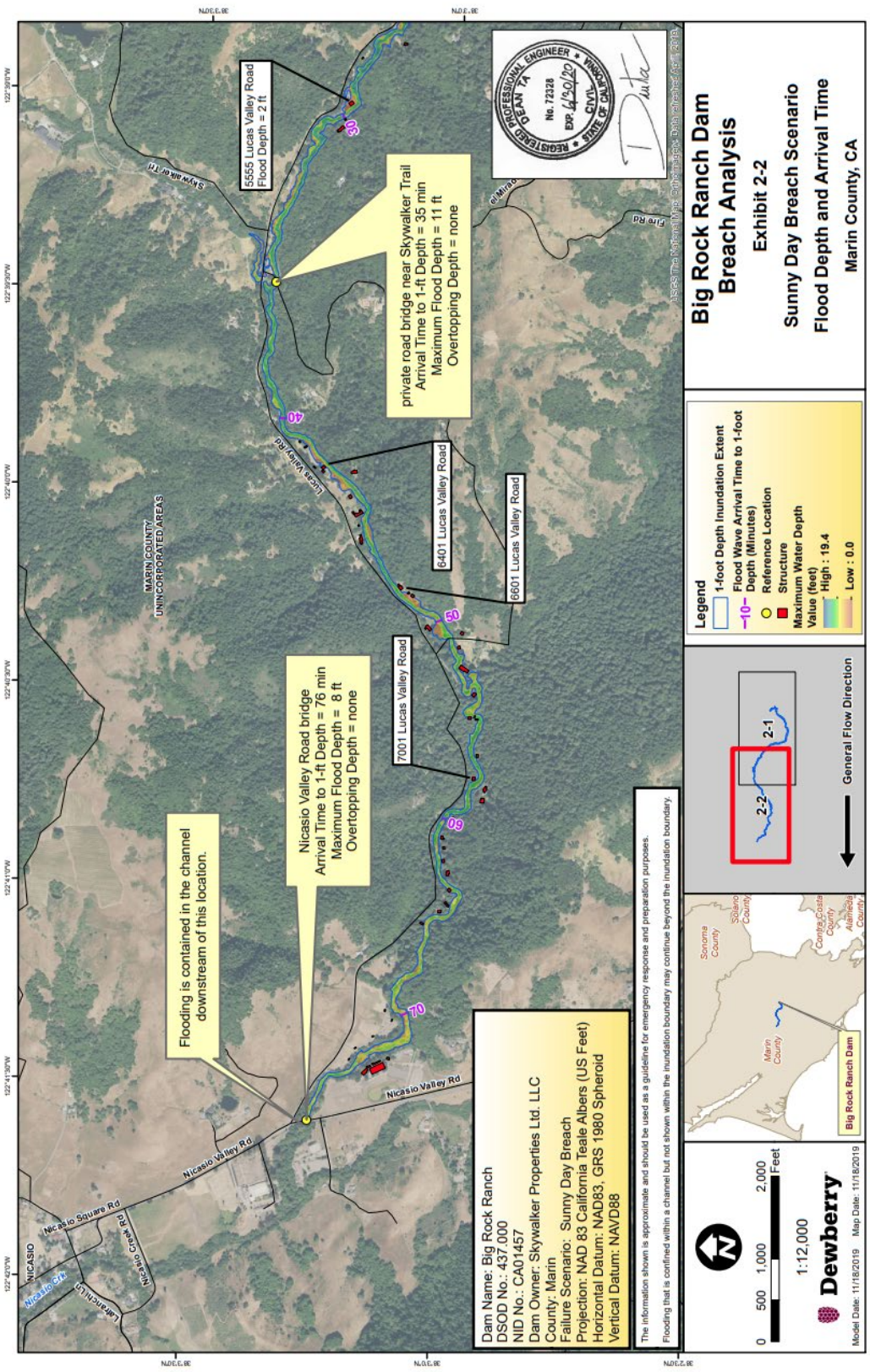


Figure 3.30: Big Rock Ranch Dam Inundation Area West
Source: California Department of Water Resources

Soulajule Dam

Failure of the Big Rock Ranch Dam with Soulajule Reservoir at full capacity could send water several miles down Walker Creek in a mostly rural area of western Marin County.

Figure 3.31: Soulajule Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

Marshall Petaluma Road could become inundated with up to forty feet of water where it runs along Walker Creek and part of Salmon Creek, with several buildings along the road to the east and west of the intersection of Arroya Sausal Road becoming inundated with several feet of water. Parts of the Marin County Office of Education at Walker Creek Ranch and the Walker Creek Ranch itself could be inundated with up to twenty feet of water in approximately half an hour after dam failure.

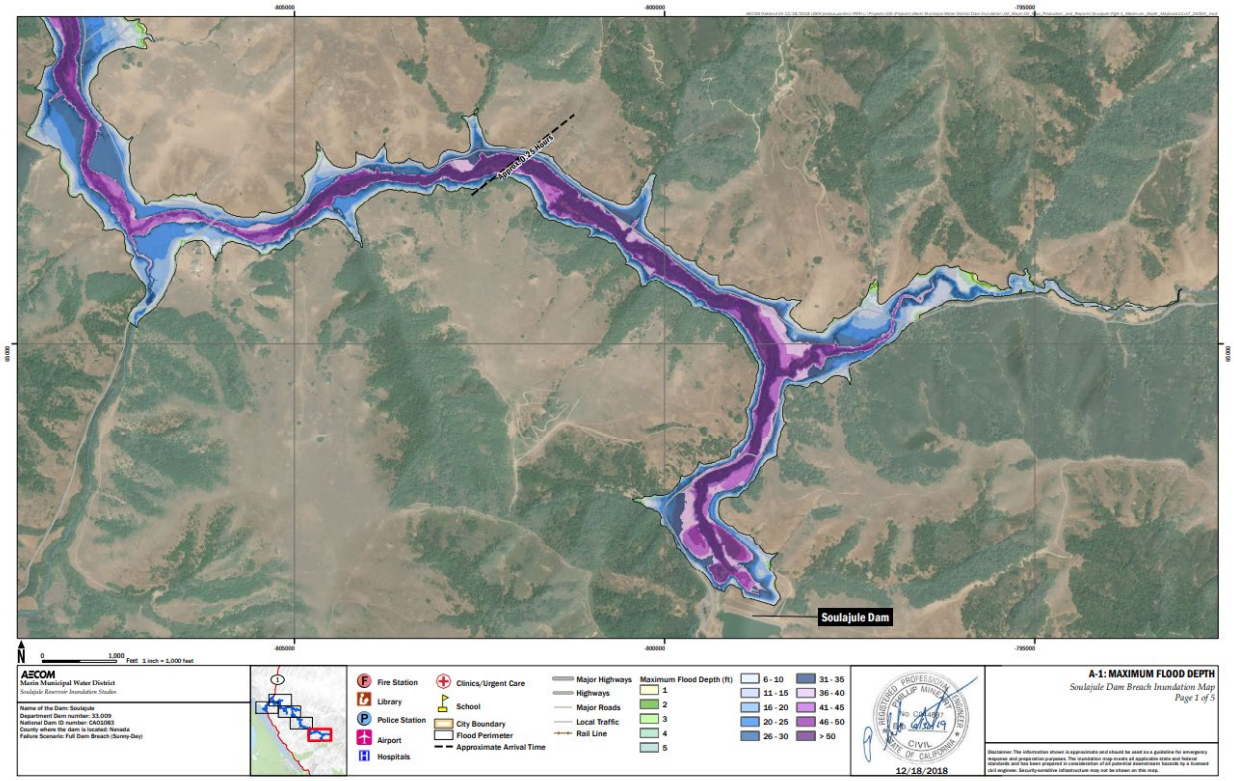


Figure 3.32: Soulajule Dam Inundation Area around Soulajule Dam
Source: California Department of Water Resources

Floodwaters along Walker Creek could eventually reach Highway 1 south of Tomales in approximately three hours, inundating the roadway with several feet of water before emptying into Tomales Bay in approximately three and half hours. There are a few residences and other buildings along Walker Creek and Highway 1 that could be impacted by floodwaters several feet deep.

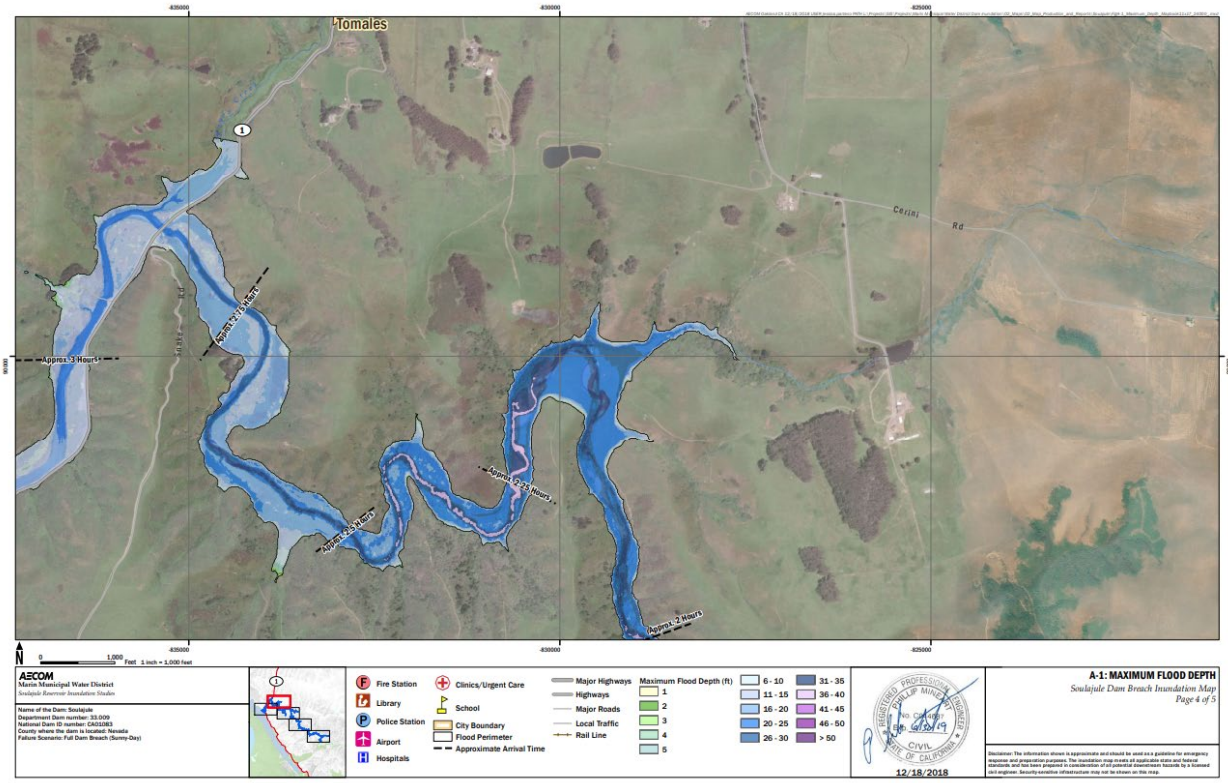


Figure 3.33: Soulajule Dam Inundation Area – Walker Creek at Highway 1
Source: California Department of Water Resources

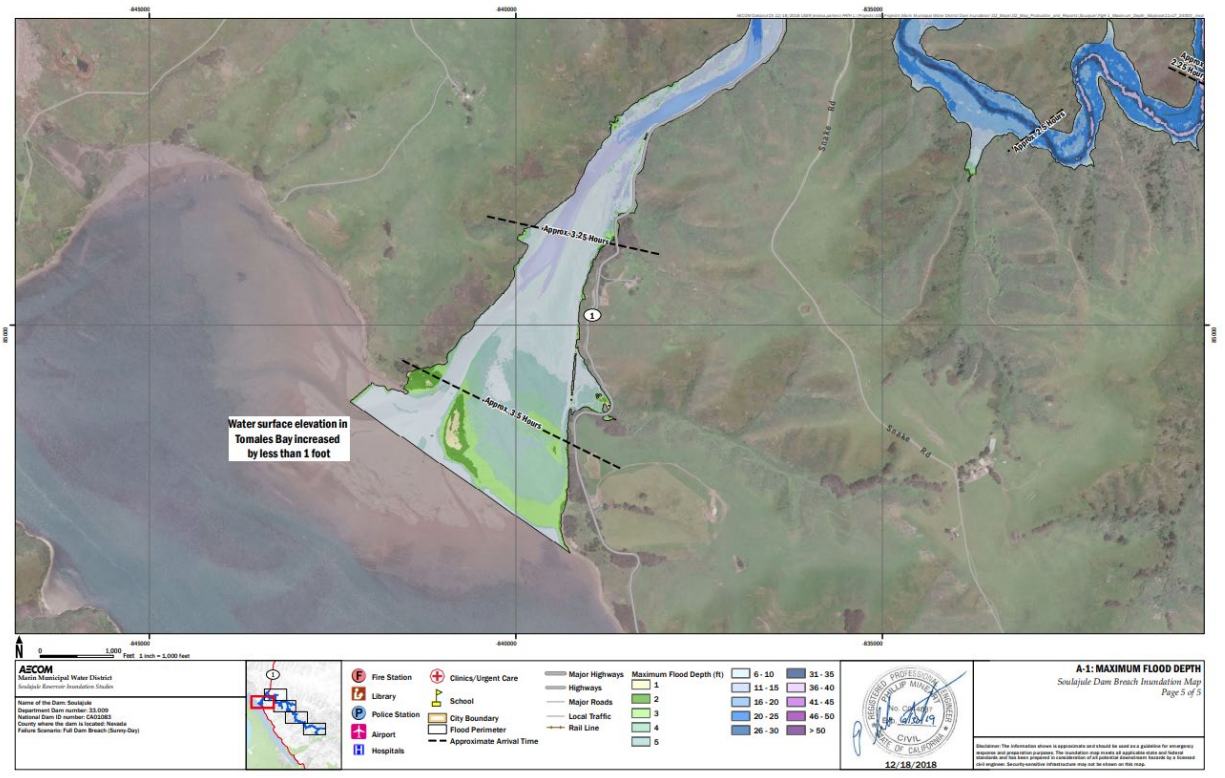


Figure 3.34: Soulajule Dam Inundation Area – Walker Creek at Highway 1 and Tomales Bay
Source: California Department of Water Resources

Vonsen Dam

Failure of the Vonsen Dam could inundate several homes around the dam and along San Antonio Creek for several hundred feet with up to a foot of water before floodwaters are contained within the creek.

Figure 3.35: Vonsen Dam Inundation Area
Source: Cal OES, Department of Water Resources, DSOD, 11/27/23

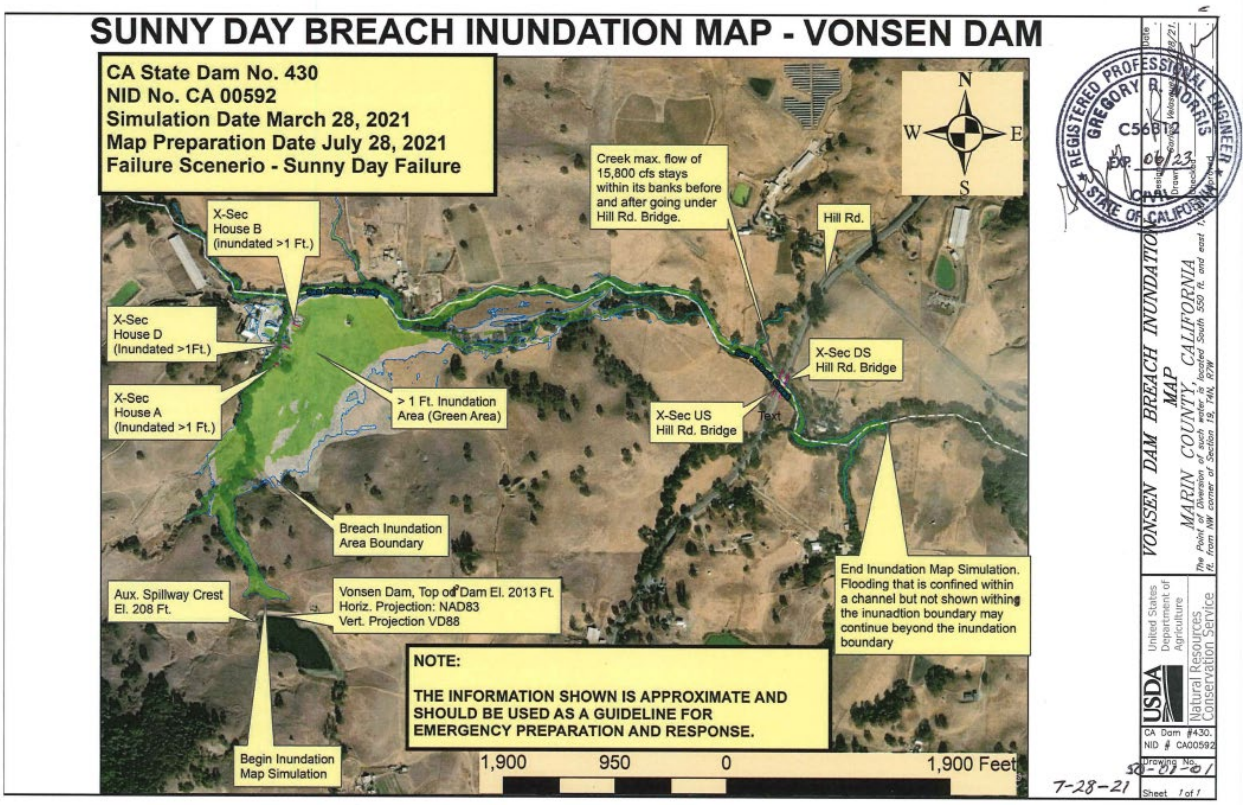


Figure 3.36: Vosen Dam Inundation Area
Source: California Department of Water Resources

Extent and Probability

According to the 1988 Town of Ross General Plan Safety Element, "in 1974, a seismic stability analysis of Phoenix Lake Dam was conducted for the Marin Municipal Water District. The purpose of this study was to assess the risk of seismically induced flooding associated with failure of Phoenix Lake Dam. The earth dam was constructed just prior to the 1906 earthquake, which created a landslide on the inside portion of the dam embankment. The slope stability analysis conducted in 1974 concluded that the dam spillway could settle from 4 – 6 feet during an earthquake with a Richter magnitude of 8.5 generated along the San Andreas fault. The 1906 San Francisco earthquake had a Richter magnitude of 8.3…In response to this assessment, the Marin Municipal Water District has widened the spillway by 5 to 6 feet and has lowered the spillway by 6 feet. Accordingly, these improvements to the dam have reduced the flood risk to one flood in 30,000 years."

According to MMWD, "the dam has been modified several times in the last 100 years including increased height of fill, outlet works changes, an embankment buttress fill in the 1960s and a new spillway, designed for a spillway design flood with a recurrence interval of once in 10,000 years or so, and an increase in freeboard in the mid-1980s."

The Town of Ross's 2017 Local Hazard Mitigation Plan states "the dam is inspected yearly by the California Division of Safety of Dams and has been rated by that agency as acceptable for continued operation. Their rating for the facility is 3C, there is a potential for damage should the dam fail but that the dam is in good condition for its age.

"MMWD has a comprehensive Dam Safety Program to ensure all of the MMWD dams and spillways are safe and functioning properly. This program includes three main components: monitoring, routine inspections and maintenance, and emergency preparedness and response planning. The district also works closely with state and federal regulators and local emergency response partners to ensure public safety. MMWD produced a February 13, 2017 inspection report documenting the current conditions.

"The Phoenix Lake Dam is over 100 years old. According to ABAG, when a dam in known to have a failure potential, the water level is reduced to allow for partial collapse without loss of water as required by the State Division of Safety of Dams and by safety protocols established by dam owners. Thus, the probability of failure resulting in damage from the inundation is low." According to the City of Novato's 2011 Local Hazard Mitigation Plan, a seismic stability analysis prepared for the North Marin Water District by Woodward-Clyde Consultants in 1992 confirmed the Stafford Dam was designed to withstand a magnitude 8.25 Richter earthquake on the San Andreas Fault, with a design epicenter located 10 miles from the dam.

Table 3.8: Marin County OA Hazard Risk Assessment – Dam Failure

Jurisdiction	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Marin County	Unlikely	Negligible	Extreme	Low	Medium	**9.00**
City of Belvedere	Unlikely	Negligible	Extreme	High	High	**12.00**
Town of Corte Madera	Unlikely	Negligible	Weak	None	None	**3.00**
Town of Fairfax	None	None	None	None	None	**0.00**
City of Larkspur	Unlikely	Limited	Severe	Low	Low	**8.00**
City of Mill Valley	None	None	None	None	None	**0.00**
City of Novato	Unlikely	Significant	Severe	Low	Low	**9.00**
Town of Ross	Unlikely	Limited	Severe	Low	Medium	**9.00**
Town of San Anselmo	Unlikely	Negligible	Weak	Low	Low	**5.00**
City of San Rafael	None	None	None	None	None	**0.00**
City of Sausalito	None	None	None	None	None	**0.00**
Town of Tiburon	Unlikely	Negligible	Extreme	None	Medium	**8.00**

Bolinas Public Utility District	Unlikely	Limited	Extreme	Medium	Medium	**11.00**
Las Gallinas Valley Sanitary District	None	None	None	None	None	**0.00**
North Marin Water District	Unlikely	Extensive	Extreme	High	High	**15.00**
Southern Marin Fire District	None	None	None	None	None	**0.00**

Table 3.8: Marin County OA Hazard Risk Assessment – Dam Failure
Source: Profiled Jurisdictions and Districts

Vulnerability

Because of the catastrophic nature of the threat of dam inundation, dams tend to be built conservatively and the actual likelihood of either dam overflow or dam failure are extremely low. The Phoenix Lake and Novato Creek Dams in particular are expected to withstand an earthquake at least magnitude 8.2 on the San Andreas Fault, which is a rare magnitude to encounter. Earthquakes of a magnitude 8.0 or greater are expected once every 494 years in California according to USGS.

The areas of unincorporated Marin County most vulnerable to the threat of a dam failure are those areas most like to be impacted by one. Several incorporated jurisdictions in the Marin County OA would be affected by a failure of either the Phoenix Lake or Novato Creek Dams, and their vulnerability assessments can be found in their respective Annexes.

The community of Point Reyes Station and the surrounding area lies in the inundation path of several dams including the Bon Tempe, Peters, Alpine, Lagunitas, and Seeger Dams. Major roadways, including Highway 1, Sir Francis Drake Boulevard, Platform Bridge Road and Point Reyes Road are particularly vulnerable to a failure of any one of these dams which would limit access to the communities of Point Reyes Station and Inverness from the south. Residences, businesses, critical facilities, and other buildings around the Point Reyes and Inverness areas and along the eastern and western shores of Tomales Bay that are not built to withstand the depth and velocity of floodwaters from a dam failure would be most vulnerable, including older buildings and those that are not elevated. A failure of the PG&E substation at Tocaloma could cause power outages throughout the area. Older docking facilities along Tomales Bay are particularly vulnerable to a surge in Tomales Bay as a result of a dam failure.

The communities of Lagunitas and Forest Knolls and to a lesser extend the community of San Geronimo are also susceptible to a failure of the Bon Tempe and Peters Dams. With flooding of Sir Francis Drake Boulevard, these communities would effectively be cut off from the west. Residences, businesses, schools, and other buildings in these communities that are not elevated to withstand the depth of floodwaters are most susceptible.

The community of Kentwood is vulnerable to a failure of the Phoenix Lake Dam, particularly the areas closest to Corte Madera Creek. Residences, businesses, commercial facilities, and critical facilities around the College of Marin Kentfield Campus that are not elevated to withstand floodwaters are particularly susceptible.

Areas of Green Point would be most susceptible to a failure of the Novato Creek Dam, as most of Bel Marin Keys should avoid major flooding. Buildings that are not elevated and those that are not as able to withstand the velocity of floodwaters from a dam failure, such as mobile home parks, would be most susceptible.

Climate Change and Future Development Considerations

Most dams in the United States are aging and are at significant risk from increased storm events as a result of climate change. The average dam age in the United States is 60 years, and more than 8,000 dams in the United States including the Phoenix Lake Dam are over 90 years old. More than 200 U.S. dams have failed in bad weather since 2000. As the climate warms, rain events are predicted to become more intense. An increase in rainfall and runoff as a result of climate change will increase the potential for higher water levels in reservoirs across the Marin County OA, placing increased stress on its dams and increasing the potential for a dam failure. As development increases in the populated areas of the Marin County OA downstream of its dams, particularly in the inundation area of the Phoenix Lake Dam, the potential for significant impacts to residents and infrastructure will only increase.

3.3.2 Debris Flow

For the purposes of the Marin County OA MJHMP, debris flows are classified as landslides (including rockslides) and mud flows.

A landside is the breaking away and gravity-driven downward movement of hill slope materials, which can travel at speeds ranging from fractions of an inch per year to tens of miles per hour depending on the slope steepness and water content of the rock/soil mass. Landslides range from the size of an automobile to a mile or more in length and width and, due to their sheer weight and speed, can cause serious damage and loss of life. The rate of a landslide is affected by the type and extent of vegetation, slope angle, degree of water saturation, strength of the rocks, and the mass and thickness of the deposit. Some of the natural causes of this instability are earthquakes, weak materials, stream and coastal erosion, and heavy rainfall. In addition, certain human activities tend to make the earth materials less stable and increase the chance of ground failure. These activities include extensive irrigation, poor drainage or groundwater withdrawal, removal of stabilizing vegetation and over-steepening of slopes by undercutting them or overloading them with artificial fill. These activities can cause slope failure, which normally produce landslides.

Landslide material types are often broadly categorized as either rock or soil, or a combination of the two for complex movements. Rock refers to hard or firm bedrock that was intact and in place prior to slope movement. Soil, either residual or transported material, means unconsolidated particles. The distinction between rock and soil is most often based on interpretation of geomorphic characteristics within landslide deposits but can also be inferred from geologic characteristics of the parent material described on maps or in the field. Landslide movements are also based on the geomorphic expression of the landslide deposit and source area, and are categorized as falls, topples, spreads, slides, or flows. Falls are masses of soil or rock that dislodge from steep slopes and free fall. Topples move by the forward pivoting of a mass around an axis below the displaced mass. Lateral spreads move by horizontal extension and shear or tensile fractures. Slides displace masses of material along one or more discrete planes and can either be rotational or transitional. Flows mobilize as a deforming, viscous mass without a discrete failure plane.

Natural conditions that contribute to landslide include the following:

- Degree of slope
- Water (heavy rain, river flows, or wave action)
- Unconsolidated soil or soft rock and sediments
- Lack of vegetation (no stabilizing root structure)
- Previous wildfires and other forest disturbances
- Earthquake

In addition, many human activities tend to make the earth materials less stable and, thus, increase the chance of ground movement. Human activities contribute to soil instability through grading of steep slopes or overloading them with artificial fill, by extensive irrigation, construction of impermeable surfaces, excessive groundwater withdrawal, and removal of stabilizing vegetation.

Another hazard related to landslide and erosion is the fall of a detached mass of rock from a cliff or down a very steep slope (rockfall). Weathering and decomposition of geological materials produce conditions favorable to rockfalls. Other causes include ice wedging, root growth, or ground shaking (earthquake). Destructive landslides and rockfalls usually occur very suddenly with little or no warning time and are short in duration.

Landslides can cause high mortality and injuries from rapidly flowing water and debris. The most common cause of death in a landslide is trauma or suffocation by entrapment. Broken power, water, gas or sewage pipes can also result in injury or illness in the population affected, such as water-borne diseases, electrocution or lacerations from falling debris. People affected by landslides can also have short- and long-term mental health effects due to loss of family, property, livestock or crops. Landslides can also greatly impact the health system and essential services, such as water, electricity or communication lines.

Landslide susceptibly can be characterized by looking at both slope class and rock strength. Landslide susceptibility classes express the generalization that on very low slopes, landslide susceptibility is low even in weak rock, and that landslide susceptibility increases with slope and in weaker rocks. Very high landslide susceptibility includes very steep slopes in hard rocks and moderate to very steep slopes in weak rocks. Figure 3.39 shows landslide susceptibility classes.

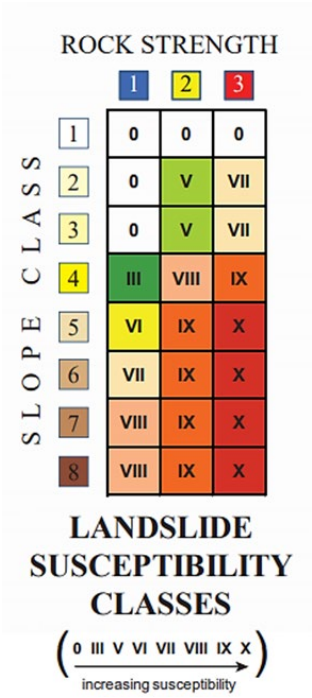


Figure 3.37: Landslide Susceptibility Classes
Source: USGS

A mud flow is a general term for a mass-movement landform and process characterized by a flowing mass of fine-grained earth material with a high degree of fluidity. Heavy rainfall, snowmelt, or high levels of groundwater flowing through cracked bedrock may trigger a movement of soil or sediments. Floods and debris flows may also occur when strong rains on hill or mountain slopes cause extensive erosion and/or what is known as "channel scour". Some broad mud flows are rather viscous and therefore slow; others begin very quickly and continue like an avalanche. Mud flows are composed of at least 50% silt and clay-sized materials and up to 30% water.

The point where a muddy material begins to flow depends on its grain size and the water content. Fine grainy material or soil has a smaller friction angle than a coarse sediment or a debris flow, but falling rock pieces can trigger a material flow, too. When a mud flow occurs it is given four named areas, the 'main scarp', in bigger mud flows the 'upper and lower shelves', and the 'toe'. See Figure 3.40 for the typical areas of a mud flow, with shelves (right) and without (left). The main scarp will be the original area of incidence, the toe is the last affected area(s). The upper and lower shelves are located wherever there is a large dip (due to mountain or natural drop) in the mud flow's path. A mud flow can have many shelves.

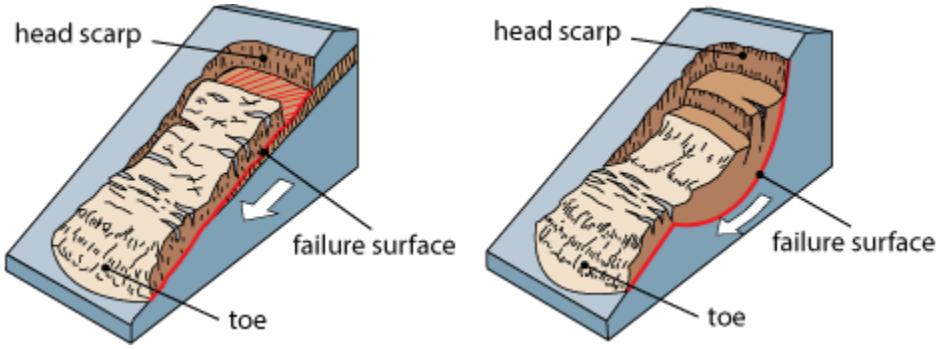


Figure 3.38: Mud Flow Areas
Source: Washington Department of Natural Resources

If large enough, mud flows can devastate villages and country-sides. Mud flows are common in mountain areas prone to wildfire, where they have destroyed many homes built on hillsides without sufficient support after fires destroy vegetation holding the land. The area most generally recognized as being at risk of a dangerous mud flow are:

- Areas where wildfires or human modification of the land have destroyed vegetation.
- Areas where landslides have occurred before.
- Steep slopes and areas at the bottom of slopes or canyons.
- Slopes that have been altered for construction of buildings and roads.
- Channels along streams and rivers.
- Areas where surface runoff is directed.

Location and Previous Occurrences

Landslides are a part of natural geologic processes and have impacted both private and public property in various areas throughout Marin County since development began. Much of the Marin County OA was developed in the early 20th century prior to the implementation of grading requirements and road design standards. During this time, many of the roads in the Marin County OA were benched or cut into steep hillsides without sufficient compaction of the roadbed. Furthermore, the use of earth retaining structures was not common in roadway construction and/or retaining structures were built using wood materials that have since deteriorated. Figure 3.39 shows landslide susceptibility across the Marin County OA.

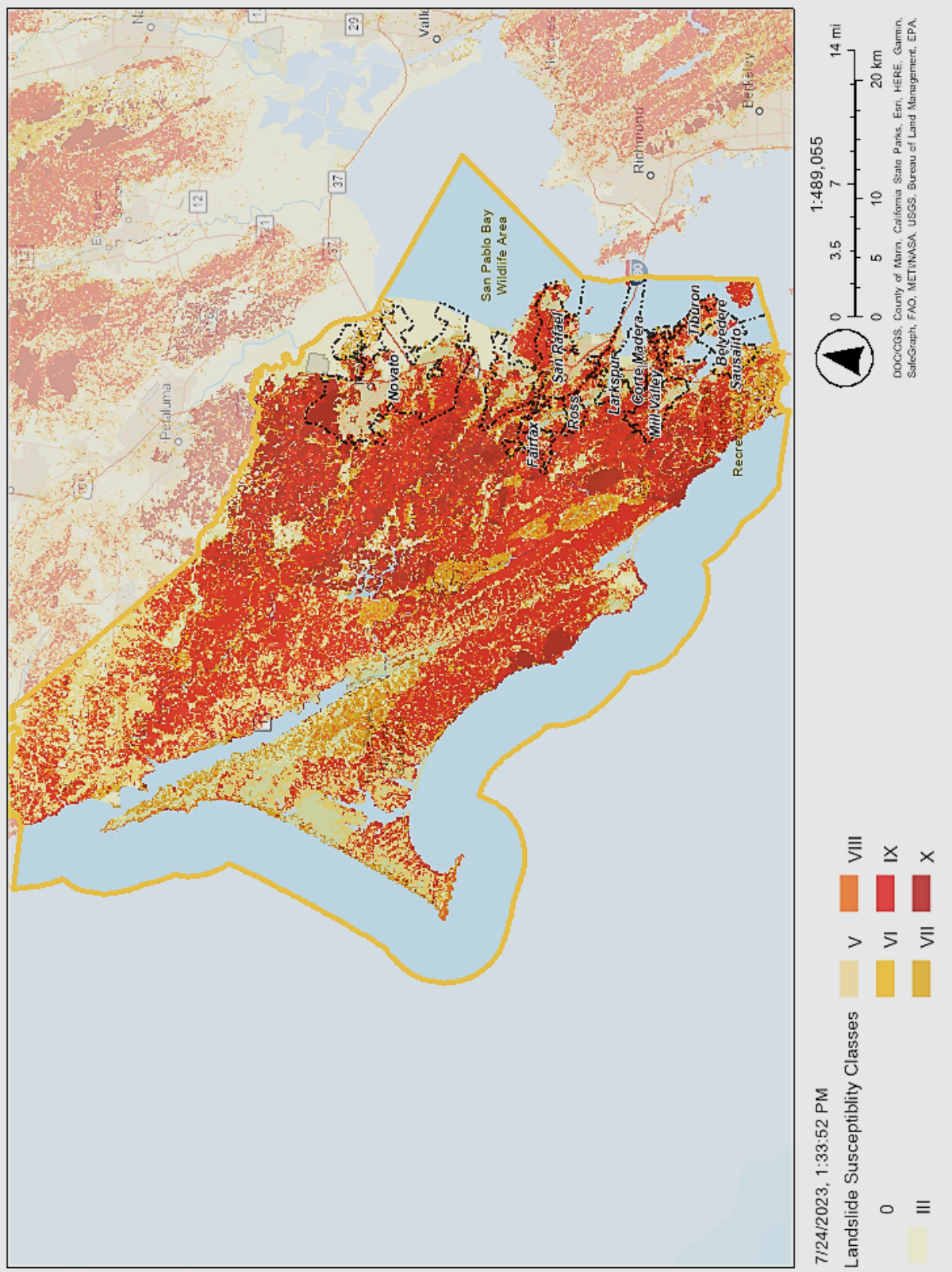


Figure 3.39: Landslide Susceptibility in the Marin County OA
Source: USGS

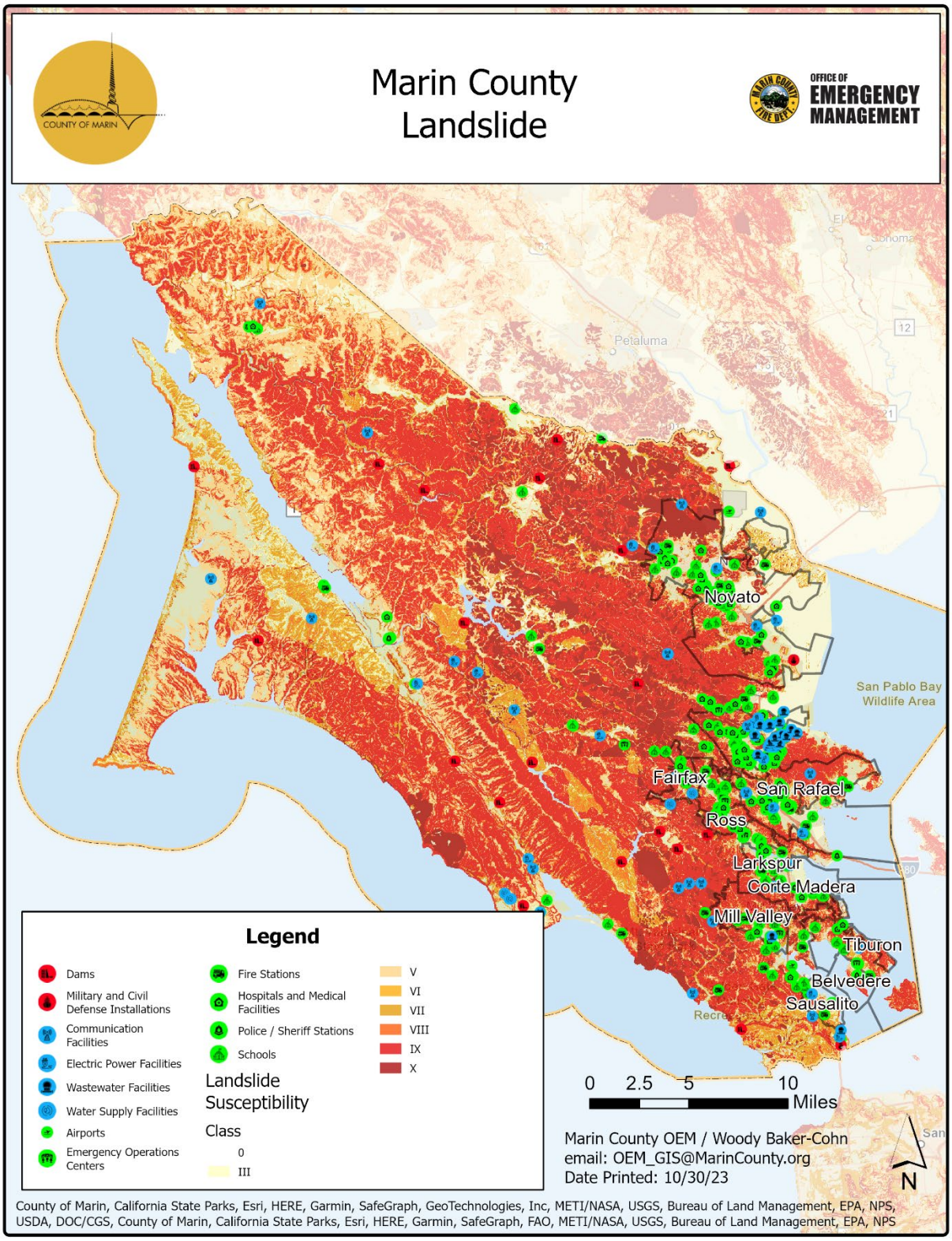


Figure 3.40: Marin County Landslide Susceptibility for Critical Facilities Map
Source: Marin County OEM

Several unincorporated communities in Marin County have high to extreme landslide susceptibility, which are shown below.

Figure 3.41 shows landslide susceptibility in Lagunitas, Forest Knolls, San Geronimo and Woodacre.

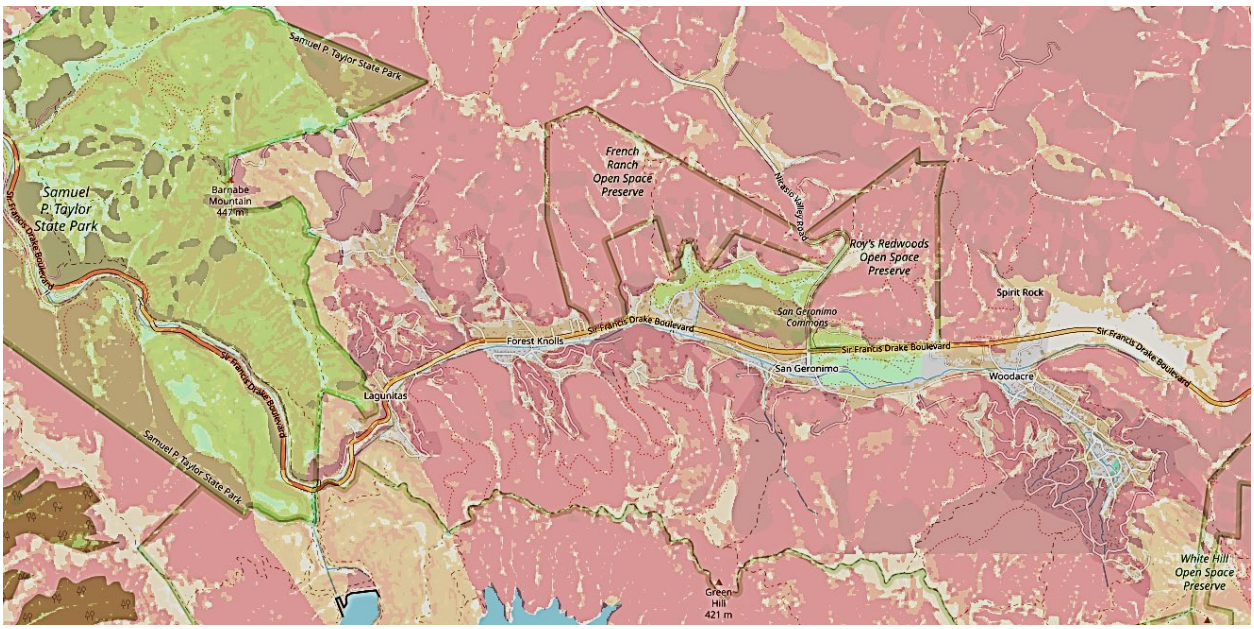


Figure 3.41: Landslide Susceptibility – Lagunitas, Forest Knolls, San Geronimo and Woodacre
Source: Marin County, 11/27/23

Figure 3.42 shows landslide susceptibility in Nicasio and Tocoloma.

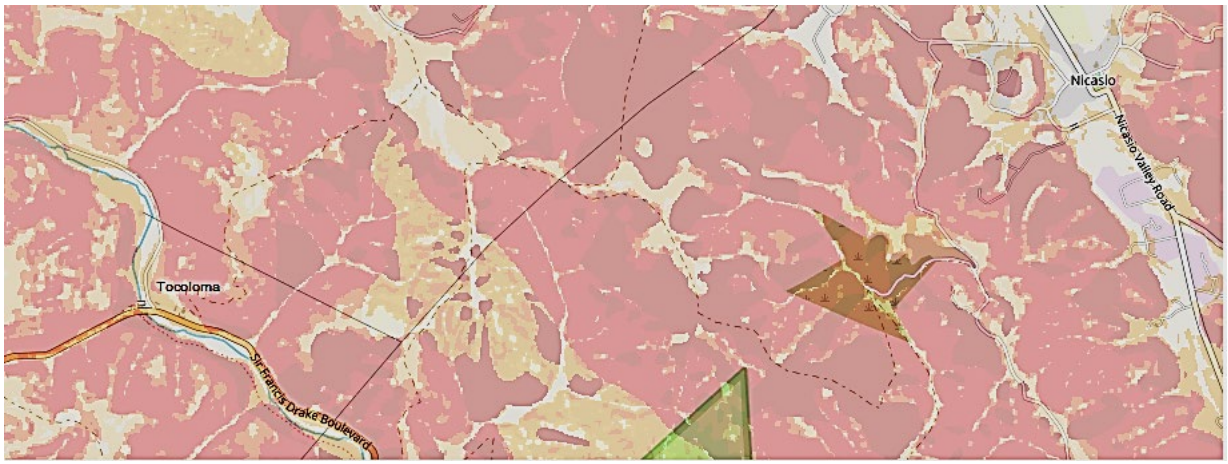


Figure 3.42: Landslide Susceptibility – Nicasio and Tocoloma
Source: Marin County, 11/27/23

Figure 3.43 shows landslide susceptibility in Olema and Point Reyes Station.

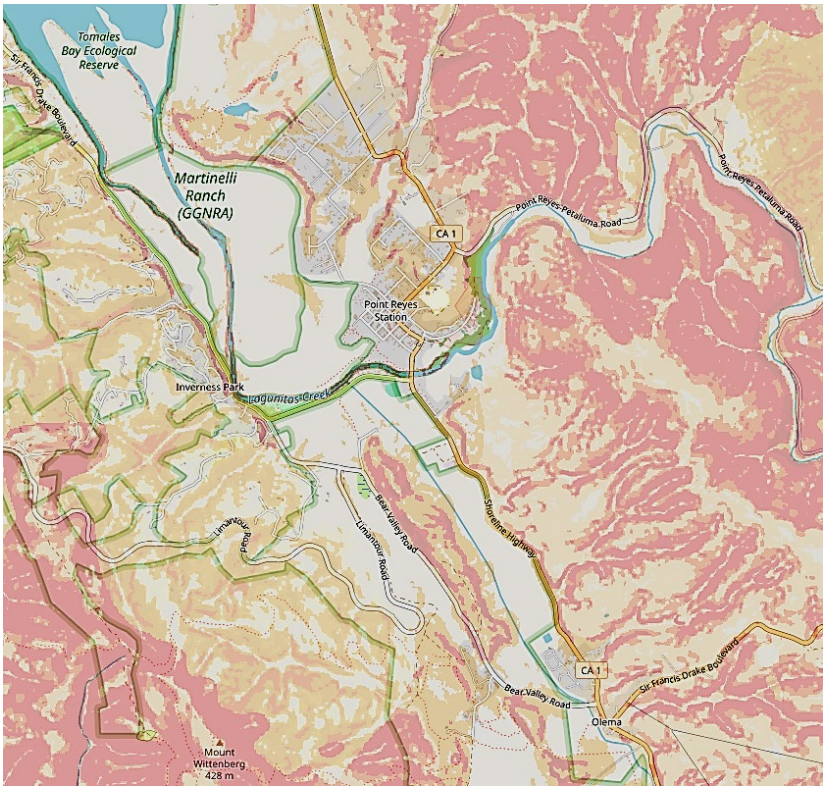


Figure 3.43: Landslide Susceptibility – Olema and Point Reyes Station
Source: Marin County, 11/27/23

Figure 3.44 shows landslide susceptibility in Inverness.

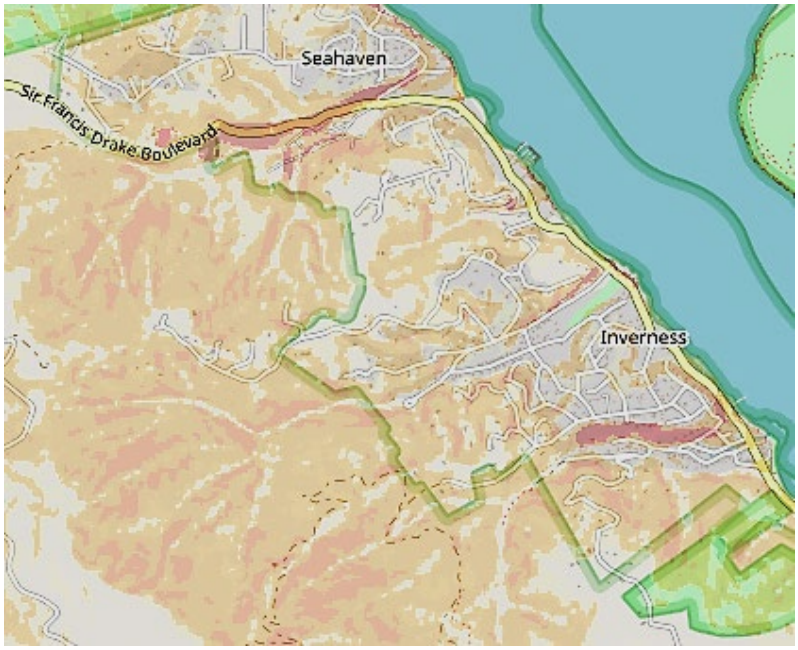


Figure 3.44: Landslide Susceptibility – Inverness
Source: Marin County, 11/27/23

Figure 3.45 shows landslide susceptibility in Dillon Beach and Tomales.

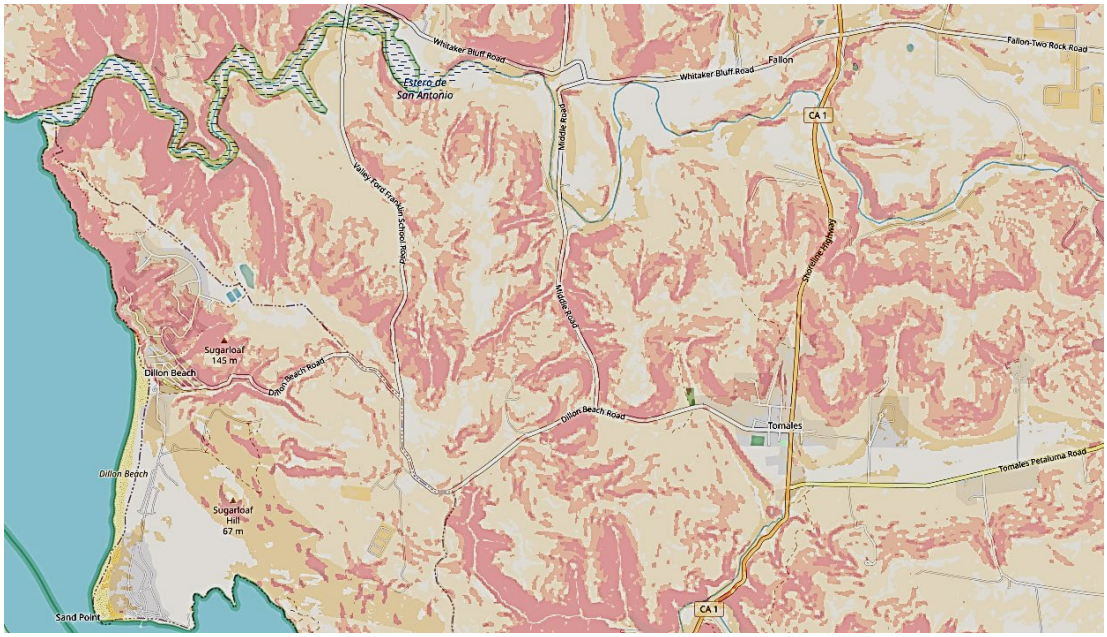


Figure 3.45: Landslide Susceptibility – Dillon Beach and Tomales
Source: Marin County, 11/27/23

Figure 3.46 shows landslide susceptibility in Dogtown, Bolinas and Stinson Beach.

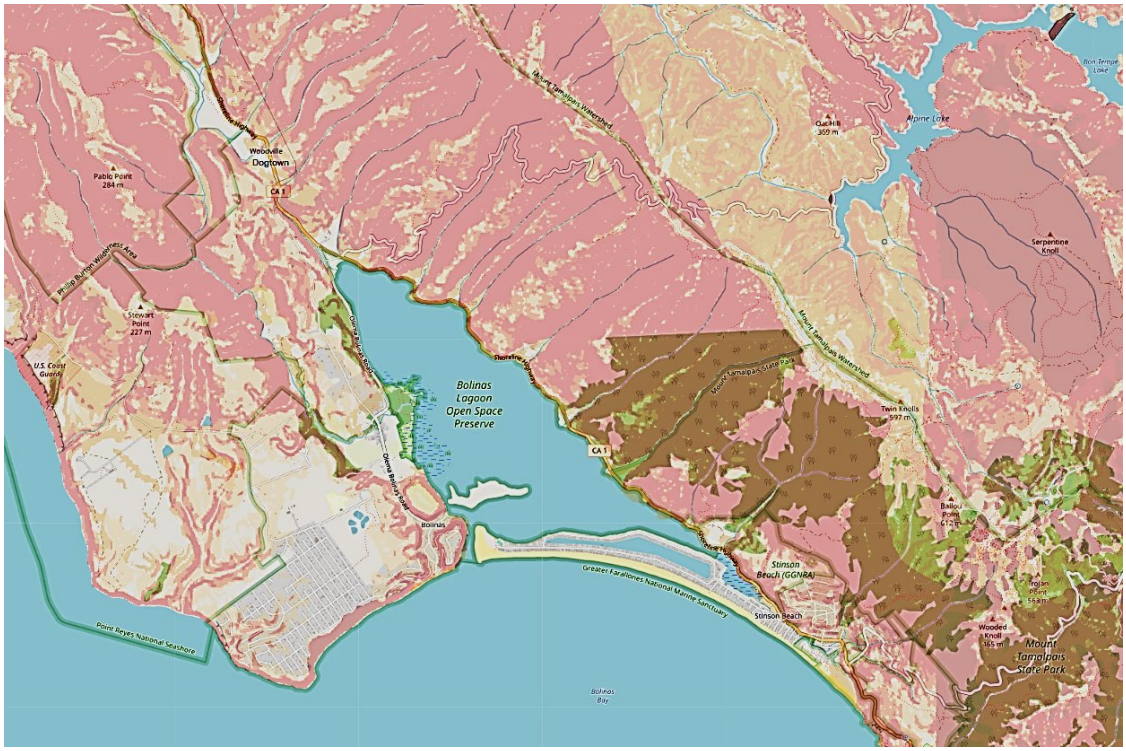


Figure 3.46: Landslide Susceptibility – Dogtown, Bolinas and Stinson Beach
Source: Marin County, 11/27/23

Figure 3.47 shows landslide susceptibility in the unincorporated area of Southern Marin County.

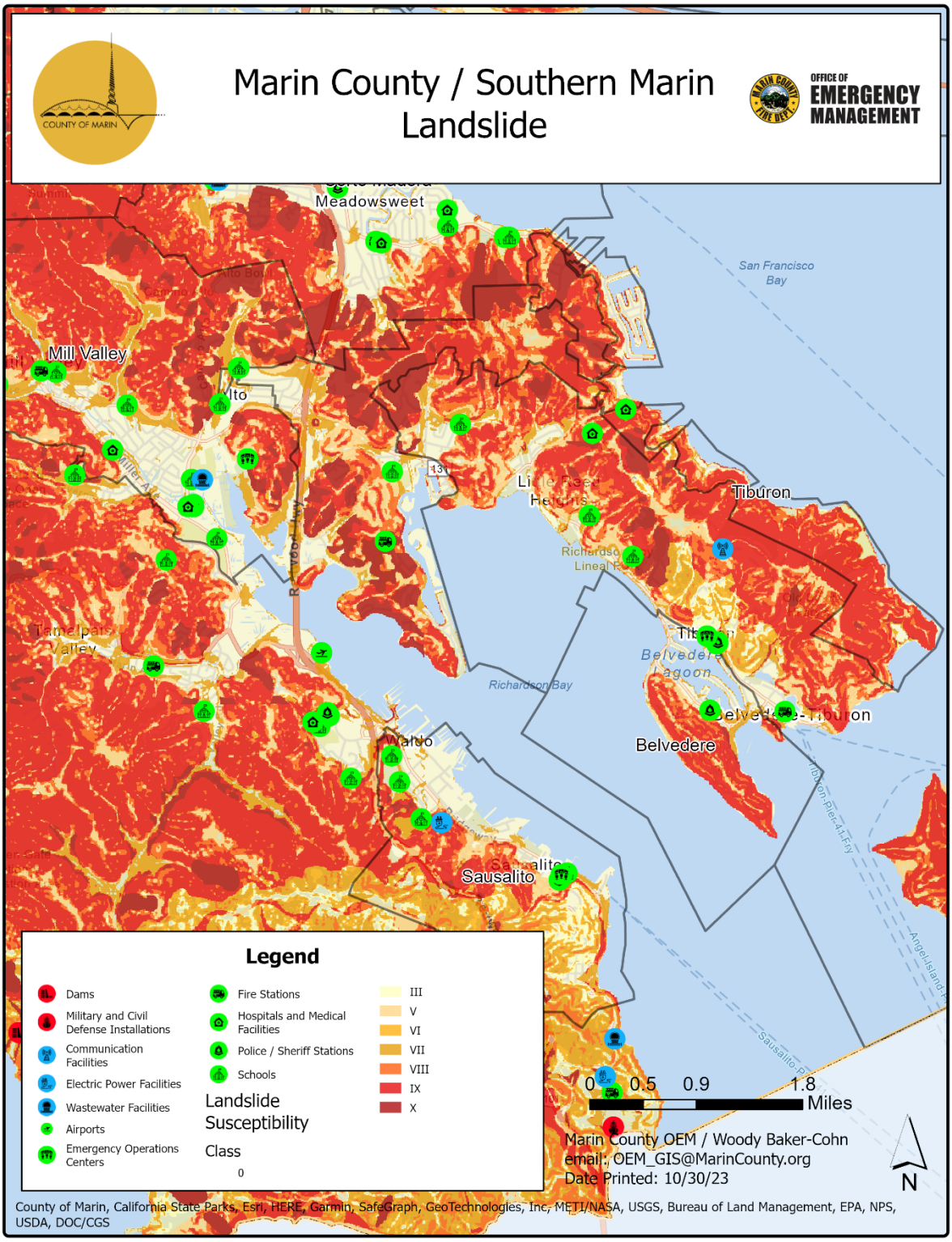


Figure 3.47: Landslide Susceptibility – Southern Marin County
Source: Marin County

Figure 3.48 shows landslide susceptibility in the unincorporated area of west central Marin County.

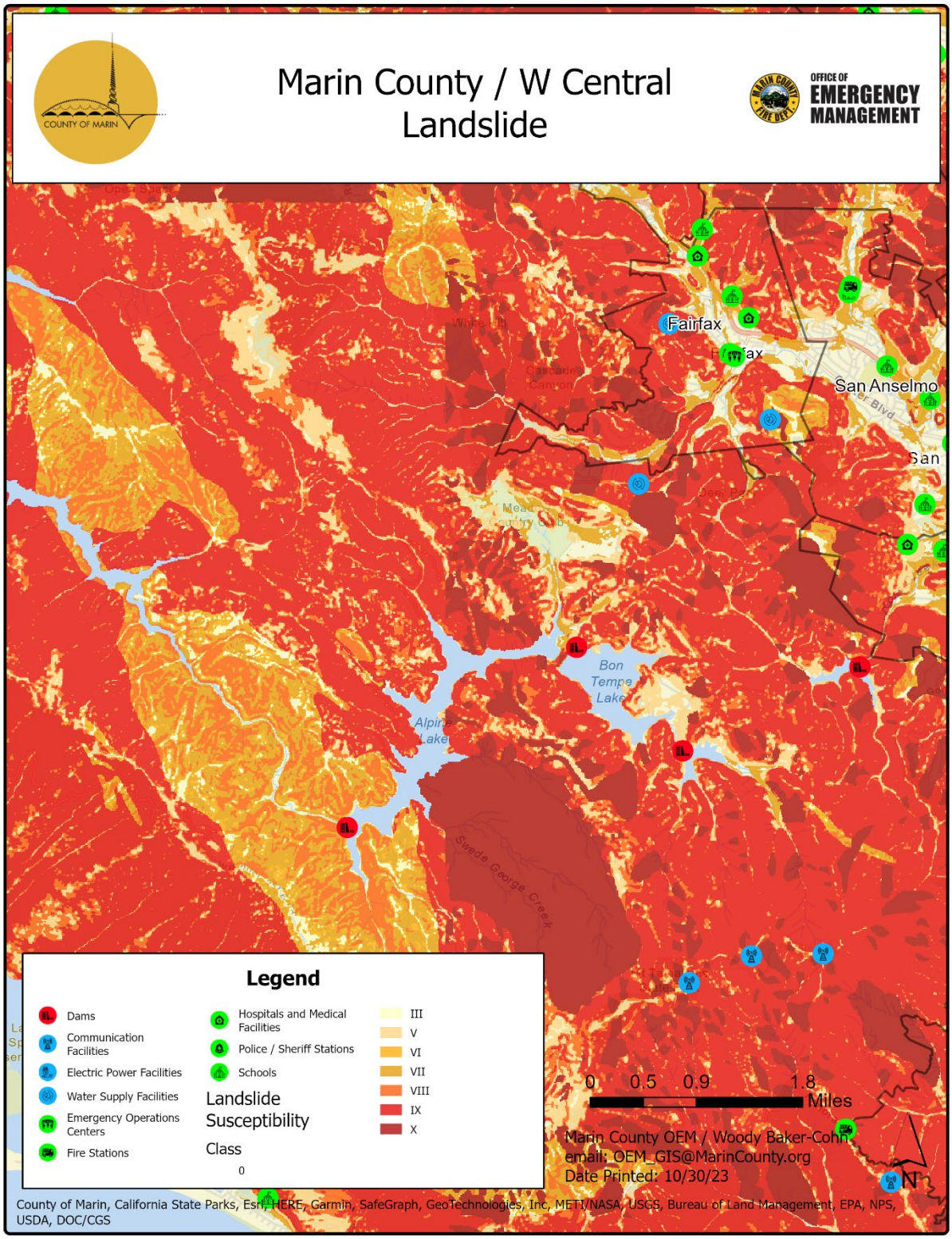


Figure 3.48: Landslide Susceptibility – West Central Marin County
Source: Marin County

Figure 3.49 shows landslide susceptibility in the unincorporated area west of Novato.

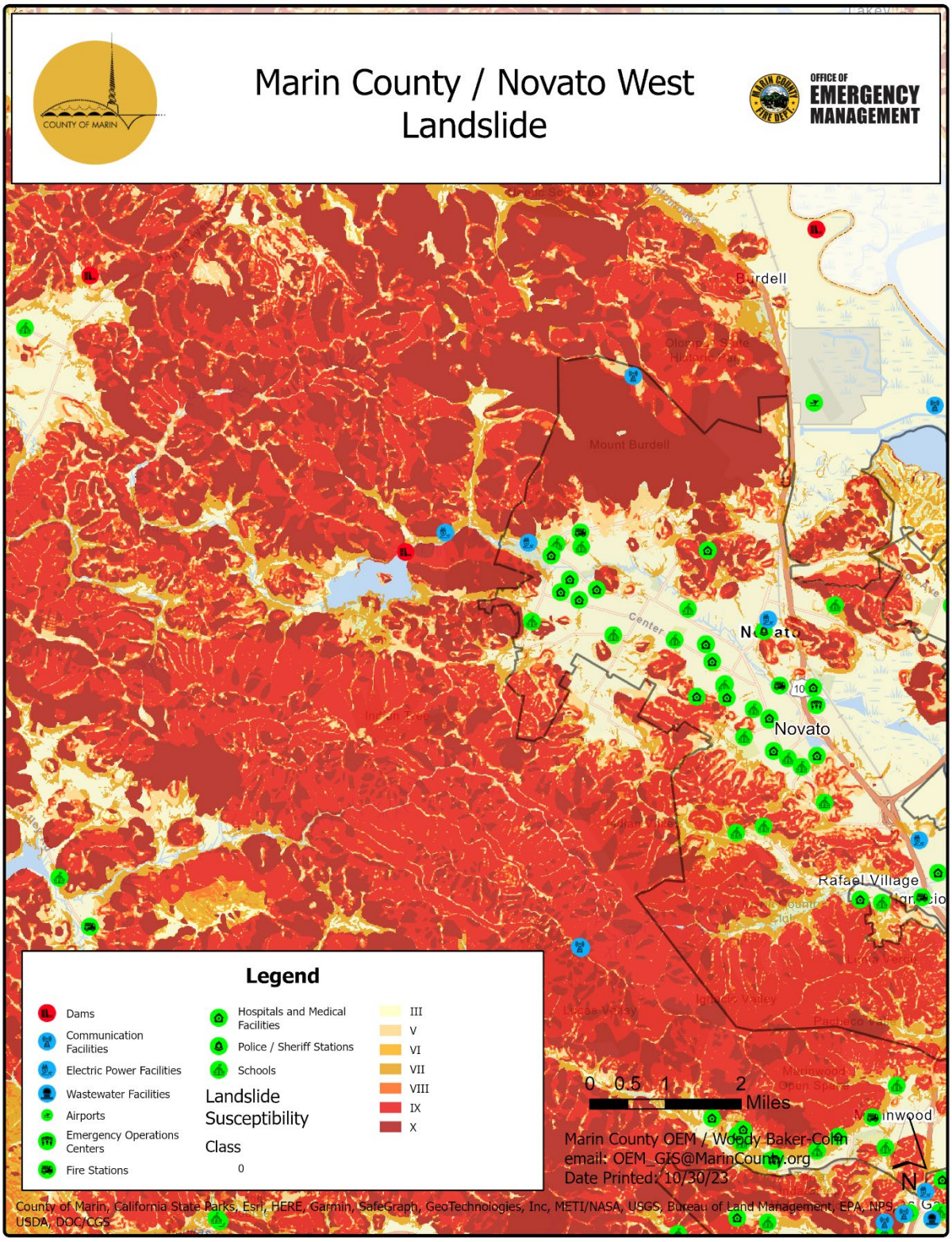


Figure 3.49: Landslide Susceptibility – Novato West
Source: Marin County OEM

Figure 3.50 shows landslide susceptibility in the unincorporated area of west central Marin.

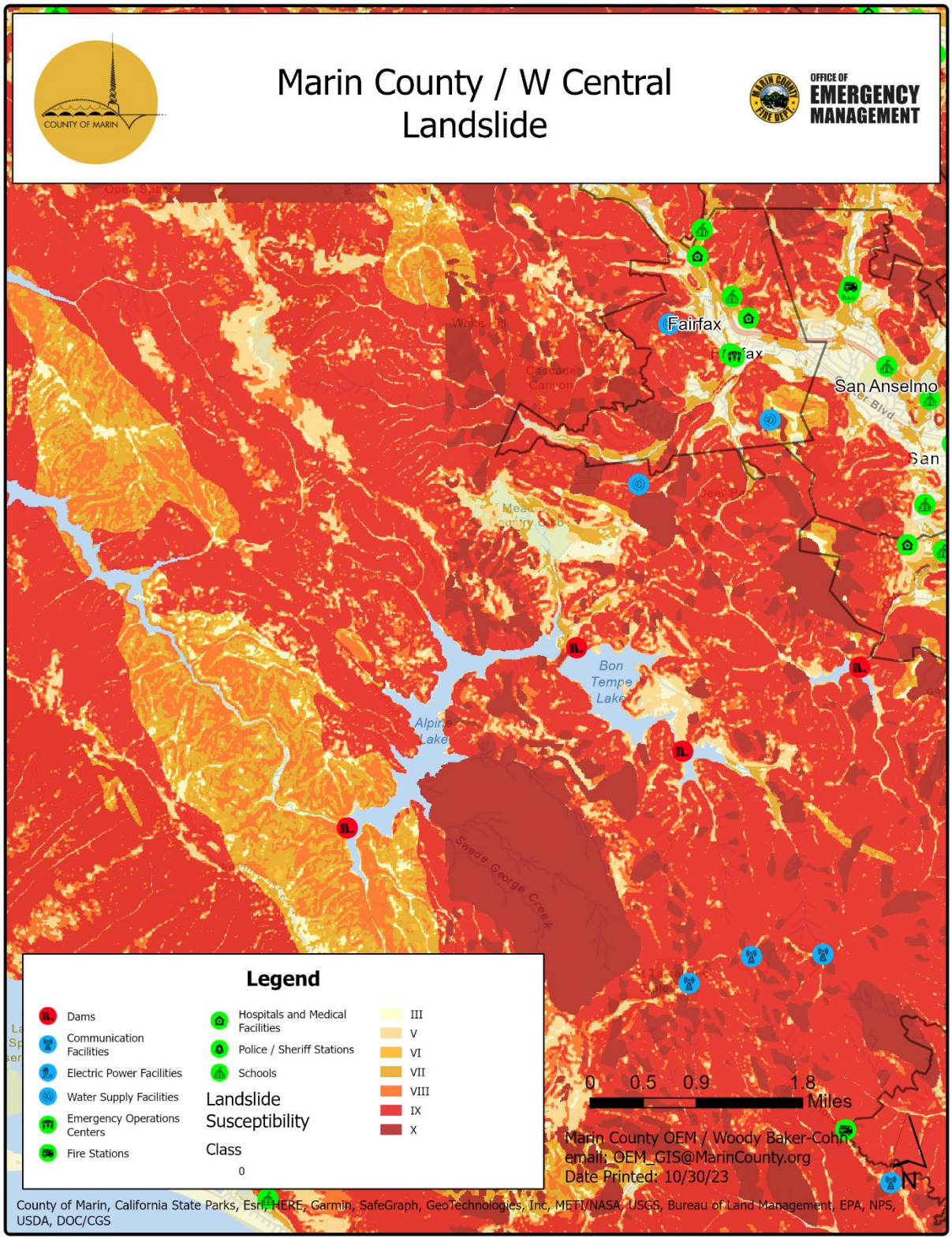


Figure 3.50: Landslide Susceptibility – West Central Marin County
Source: Marin County OEM

Figure 3.51 shows landslide susceptibility in unincorporated area of North Novato.

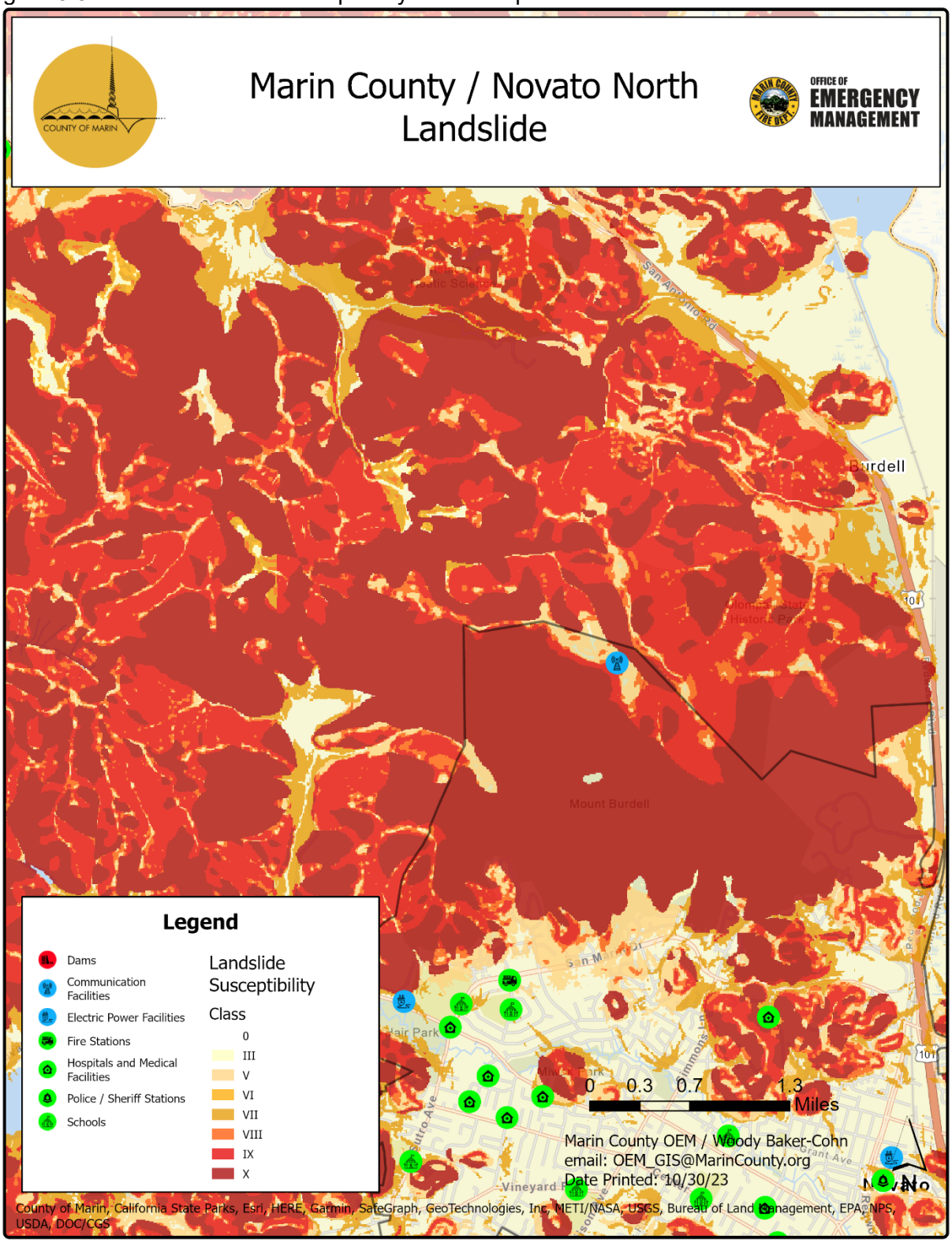


Figure 3.51: Landslide Susceptibility – North Novato
Source: Marin County OEM

The California Geological Survey has an interactive landslide inventory map available on their website that shows records associated with past landslide events in Marin County.

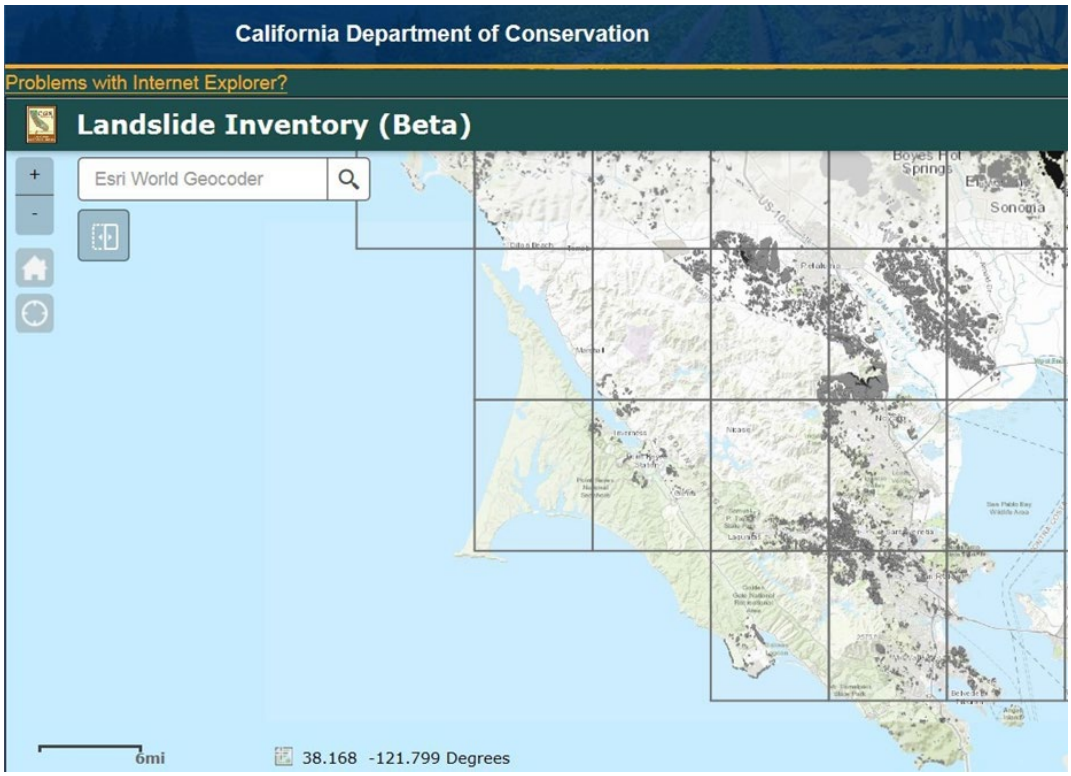


Figure 3.52: Landslide Inventory in the Marin County OA
Source: California Geological Survey, 11/27/23

The inventory shows extensive areas of prior landslides around the county particularly in developed areas. Affected areas notably include many landslides near Bolinas Lagoon, Inverness and Bolinas (Point Reyes Station) ridges on the west coast; throughout Ross Valley including Sleepy Hollow, Fairfax and San Anselmo; San Rafael just outside downtown at Lincoln, Lock Lomond affecting many residences, San Quentin potentially affecting a wastewater treatment plant, and Bret Harte potentially affecting Highway 101; Santa Venetia affecting N. San Pedro Rd; Novato at Little Mountain and Mount Burdell affecting major roads such as Center Road, San Marin Drive and Novato Blvd and their nearby residential areas; Paradise Cay and Reed residential areas near Tiburon; and Mill Valley at Homestead Valley. Smaller scale, and/or more isolated slides occur throughout the county where there are slopes. These are typically of concern if there are roads or structures affected.

A massive mudslide occurred in Marin County during a storm from January 3-5, 1982, weakening foundation of the Golden Gate Bridge. The bridge had to be closed for several days, cutting off the one road linking Marin County to San Francisco and stranding residents. Another landslide blocked Highway 101, closing it completely. The Point Reyes and Inverness areas were especially hard hit. The unincorporated community of Inverness was isolated for several days when numerous slides covered the road into town. The storm caused huge amounts of water to rush down canyons, scouring them as rocks, mud, trees and massive trunks hit roads and houses on their way downward. Inverness and Inverness Park were inundated in rocks and mud.

Figure 3.53: Damage in Inverness from the January 1982 Storm
Source: Jack Mason Museum of West Marin History

Twelve houses in Inverness were destroyed or damaged by mudslides, mostly in the Alder Creek Canyon area and the Vallejo Avenue area of Inverness Park. Over 300,000 cubic yards of mud was removed from public property in Inverness. The Inverness water system was destroyed when a main pipe ruptured and reservoirs were damaged.

Figure 3.54: January 1982 Highway 101 Mudslide in Marin County
Source: San Francisco Chronicle

From January to March of 1995, a series of winter storms caused several mudslides in Marin County, blocking roads and damaging residential and public property.

Marin County sustained significant damage as a result of the Winter and Spring storms of 2006 (DR-1628 and DR-1646) which resulted in hundreds of locations in Marin County where damage occurred; many of those being landslides, rock fall, or other infrastructure damage related to slope instability.

In 2011, a $1.5M emergency slide repair was constructed at the intersection of Terrace Avenue and Overlook Drive on the Bolinas Mesa to repair recent drastic settlement (up to 8-feet) such that access for emergency vehicles and resident egress could be maintained. As much as 20,000 cubic yards of material was excavated and re-compacted in lifts with earth reinforcing fabric to affect the repair.

In 2014, several debris flows impacted Marin County. On February 28th, a mudslide blocked part of Highway 1 at Panoramic. On December 11th, a mudslide occurred along Tennessee Valley Road, causing $1 million in property damage. Another landslide under sixty feet of Highway 1 near Muir Beach on the same day resulted in a full closure of the road, causing $1 million in damages.

Severe damage occurred during the January and February Winter storms of 2017 (DR-4305 and DR-4308) resulting in over 100 locations in Marin County where damage occurred. Landslides occurred along Highway 101 and several local roads.

Figure 3.55: February 2017 Landslide on Lucas Valley Road
Source: Marin County

Significant damage in Marin County occurred during the January and February Winter storms of 2019 (DR-4431 and DR-4344), where a series of atmospheric rivers caused separate mudslides on Sir Francis Drake Boulevard in Lagunitas and on Highway 101 in Waldo (shutting down the road southbound).

On March 22, 2023, a mudslide severely damaged and buckled a 100-foot stretch of road on Redwood Boulevard adjacent to Highway 101 and just west of the Marin County Airport, forcing the closure of Olompali State Historic Park. The mudslide uncovered one of two PG&E gas lines but it remained intact.

Figure 3.56: March 2023 Mudslide in Marin County
Source: San Francisco Chronicle

Impacts

Marin County is largely undeveloped and has a widespread natural environment where creeks and rivers adjoin both private and public infrastructure. During times of intense rainfall, creeks tend to rise and the resulting high flows can erode roadway supporting earthen embankments leading to landslides and sometimes property damage. Historic development in the Marin County OA tends to be concentrated in small areas, with many homes located along creeks and on steep hillsides potentially impacted by precipitation-induced landslides. Thousands of existing structures have the potential to be impacted by landslides, including over ten thousand single family homes, in addition to multi-family, commercial structures, and structures on a few industrial parcels. Notably, hundreds of miles of roads are potentially impacted by landslides which can lead to their short-term closure during and after intense storm events and some power utility facilities could also be affected. Infrastructure, such as natural gas pipelines and water or wastewater infrastructure, can break or malfunction if the soil supporting them fails. This can lead to disruptions in energy delivery and water or wastewater services. Landslides, mudslides, and debris flows can move fast enough to damage or destroy homes or other structures in their path, block roadways (including evacuation routes), and injure or kill people caught in them. For most jurisdictions in the Marin County OA, at least 10% of its homes and roadways can potentially be impacted by landslides. Landslides and debris flows could also have ecological impacts for numerous waterbodies in Marin County, including Tomales Bay and the Bolinas Lagoon.

Extent and Probability

Slope instability throughout much of the Marin County OA is related to many factors, including, but not limited to; type(s) of soil involved and various geologic factors (presence of faults or other weakened soil planes), steepness of the slope and surrounding topography, intensity and duration of rainfall, presence of underground springs or groundwater, adequacy of surface water management, and proper erosion protection. While landslides occur in any given year, the frequency and number of landslides has been observed to be directly proportionate to the frequency and duration of rainfall events. A landslide and/or a debris flow could occur in any

unincorporated community of Marin County and throughout much of the Marin County OA due to its overall moderate to high landslide susceptibility.

Landslides are less likely to occur during the fall months (October-November) when the ground is sufficiently dry and can absorb the moderate rain events typically observed during this time of year. Landslides are more often observed between December and May when rain events are usually more intense and/or frequent. Under these circumstances, the ground has been saturated, becomes heavier, and the presence of water within the soil increases the pore pressure thereby reducing the friction between soil particles – which leads to sliding. Proper drainage management to maintain existing sufficient drainage patterns (on both private and public lands) is essential to limiting potential future landslide events. In the Marin County OA, renewed and potentially widespread landslide activity will most likely occur during or after future periods of prolonged or intense rainfall.

The extent of typical landslides in the Marin County OA, including in the unincorporated area, as estimated from previous occurrences, is on the order of 500 cubic yards of material displaced from an area 100 feet long and 30 feet deep. According to County engineering staff, Marin County seems to have bad slide years during heavy storms every five years. During these years, the County repairs a half dozen slides or more, so there might be a dozen bad slides across the County including incorporated areas. According to NOAA, the 5-year recurrence interval precipitation amount is 4 inches of rain in 12 hours, 5.8 inches of rain in 24 hours, or 7.6 inches of rain in 2 days.

Table 3.9: Marin County OA Hazard Risk Assessment – Debris Flows

Jurisdiction	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Marin County	Occasional	Extensive	Severe	Medium	Medium	**13.00**
City of Belvedere	Occasional	Extensive	Severe	Medium	Medium	**13.00**
Town of Corte Madera	Likely	Limited	Severe	Low	Medium	**11.00**
Town of Fairfax	Likely	Limited	Moderate	Medium	Low	**10.00**
City of Larkspur	Likely	Limited	Severe	Medium	Medium	**12.00**
City of Mill Valley	Likely	Significant	Moderate	Medium	High	**13.00**
City of Novato	Likely	Negligible	Weak	Low	Low	**7.00**
Town of Ross	Occasional	Significant	Moderate	Medium	Medium	**11.00**
Town of San Anselmo	Likely	Limited	Moderate	Medium	Medium	**11.00**

City of San Rafael	Highly Likely	Significant	Moderate	Medium	Medium	**13.00**
City of Sausalito	Likely	Significant	Severe	Medium	High	**14.00**
Town of Tiburon	Occasional	Extensive	Severe	Medium	Medium	**13.00**
Bolinas Public Utility District	Highly Likely	Limited	Moderate	High	High	**14.00**
Las Gallinas Valley Sanitary District	Occasional	Negligible	Weak	Low	Low	**6.00**
North Marin Water District	Occasional	Significant	Moderate	High	Medium	**12.00**
Southern Marin Fire District	Likely	Significant	Moderate	Low	Low	**10.00**

Table 3.9: Marin County OA Hazard Risk Assessment – Debris Flow
Source: Profiled Jurisdictions and Districts

Vulnerability

Landslides due to storms are a relatively frequent occurrence in many populated areas of the Marin County OA, including in the unincorporated area, making it quite vulnerable to landslides. Areas with slopes greater than 50 percent have extreme susceptibility to landslide. Areas of particular concern are those that include high elevations and steep ravines and gulches associated with river and stream channels. Numerous major roads in unincorporated Marin County, including Sir Francis Drake Boulevard, Point Reyes Petaluma Road, Marshall Petaluma Road, Nicasio Valley Road, Lucas Valley Road, Highway 1 and Highway 101 all run through areas of steep slopes where a landslide could occur. A major closure of any of these roads could cut off access to communities, particularly in western Marin County, and limit access to emergency vehicles. Many of these major roads and communities along them, such as Lucas Valley, Marinwood, Lagunitas, Forest Knolls, San Geronimo, Woodacre, Olema and Point Reyes Station, lie along creeks that could impact them with debris flows.

Areas located at the base of creek alluvial fans have extreme susceptibility to mud flows, including after major fires where loose soil and ash can become deposited. Areas of particular concern are those where the widespread and lateral movement of mud and debris can occur. Areas where mud and debris can be channeled, including downslope roads and waterways, are also susceptible to mud flows. Overgrowth of vegetation in creeks and changes to natural drainage due to development can inhibit the flow of water and muddy debris, causing it to spill over creek banks and create overflow channels onto roadbeds and into adjacent communities in a debris flow or flooding event. A major wildfire and/or rain soaking event in any area of unincorporated Marin County could threaten creek-side communities with a debris flow. In addition, the Bolinas Lagoon and Highway 1 running along the east side of it lie at a natural alluvial fan of the Mount Tamalpais Watershed and could be susceptible to mud and debris from a wildfire around Mount Tamalpais. The Stinson Beach area is particularly vulnerable to any debris flows and subsequent flooding in the Bolinas Lagoon.

Critical infrastructure and facilities that are built into steep slopes, including water access delivery and communication systems, are all susceptible to landslides. Populations serviced by this infrastructure and/or that live in extreme landslide susceptibility zones are subsequently susceptible as well. Numerous communication facilities and other critical infrastructure lie in areas of western Marin County where there is high landslide susceptibility. The Marin County OA is hilly and mountainous overall and the distribution of the landslide hazard is varied across the county as indicated in figure 3.40. The combination of factors that cause landslides, including geology, vegetation, local drainage, and local grading make slope a poor proxy of landslide risk. However, parcels with an average slope above 20 percent are considered hillside lots and risks of slides are present on slopes of 30 percent and above. Slopes as high as 60 or 65 percent are common on hillsides throughout the county.

Numerous unincorporated communities in the Marin County OA have susceptibility to a debris flow: Lagunitas, Forest Knolls, San Geronimo and Woodacre all lie along San Geronimo Creek and a stretch of Sir Francis Drake Boulevard with high to moderate landslide susceptibility and could be vulnerable to debris flows. Numerous residences, businesses, schools and community centers lie in this area.

Outlying areas of Nicasio, particularly on the west side of Nicaso Valley Road, where there are multiple residences, have high to moderate susceptibility to landslides. Tocoloma lies along a section of Lagunitas Creek and could be susceptible to debris flow. The Tocoloma PG&E substation lies adjacent to the creek.

Several residences and businesses in Olema lie along Olema Creek and could be susceptible to debris flow. Point Reyes Station lies along Lagunitas Creek, though most of the buildings around the downtown core are not adjacent to the creek. There are residences and businesses in the outlying areas south of Point Reyes Station that could be susceptible to a debris flow in Lagunitas Creek. The hilly northern area of Point Reyes Station where there are residences is more susceptible to landslide.

Parts of Inverness are particularly susceptible to a landslide, including the southern end where there are numerous residences, a school, and the Inverness Fire Department. Areas of Seahaven where there are numerous residences are also particularly susceptible to a landslide. Large sections of Point Reyes National Seashore where there are residences, historic ranches, and other structures lie in areas of high landslide susceptibility.

Sections of the east shore of Tomales Bay along Highway 1, including north of Bivalve, from Marconi to Marshall, and from the area of Clarke Road north to Walker Creek are susceptible to a landslide. There are numerous residences and businesses along the shore, including in Marshall and at Marconi Conference Center State Historic Park (which is a critical facility), that lie in areas of high landslide susceptibility. While most of Tomales is in an area of moderate landslide susceptibility, the area is hilly and there are numerous residences, businesses, community facilities, schools, and emergency facilities susceptible to landslide. Areas of Dillon Beach where there are numerous residences have a high landslide susceptibility, particularly on the northern outlying areas of the community.

Areas in and around Bolinas where there are numerous homes, schools, and community facilities have a high landslide susceptibility. The Woodrat Water Treatment Plant and associated facilities along with the Bolinas PG&E substation north of Bolinas lie in areas of moderate to high landslide susceptibility. The community of Dogtown, where there are numerous residences, lies in areas of moderate to high landslide susceptibility. There are also numerous creeks that run through Dogtown that could impact it with debris flows. Parts of

Stinson Beach, particularly northeast of Highway 1 in the foothills. where there are numerous residences, the Stinson Beach Community Center and the Stinson Beach Fire Station, lie in areas of moderate to high landslide susceptibility.

Most all of Muir Beach and the surrounding area, where there are numerous residences, the Muir Beach Community Center and the Muir Beach Fire Station, lie in an area of high landslide susceptibility. Much of Tamalpais Valley and the outskirts of Marin City lie in an area of high landslide susceptibility. There are hundreds of residences along with several schools, community centers and emergency facilities that lie in this area, including on the northern end of Marin City. While Alto has low landslide susceptibility, most of Strawberry down to Harbor Point lies in an area of moderate to high landslide susceptibility. Parts of Paradise Cay and most of the east side of the Tiburon Peninsula also have high landslide susceptibility. There are hundreds of residences and several schools and community centers in these areas, as well as the Southern Marin Fire Protection District Station #9.

Areas of Kentfield, particularly in the foothills of Mount Tamalpais and on the northeast side of Sir Francis Drake Boulevard down into Greenbrae, and most of California City have moderate to high landslide susceptibility. There are hundreds of residences in this area. Most critical facilities in Kentwood do not lie in areas of landslide susceptibility but are located along Corte Madera Creek and could be susceptible to debris flows that originate along the flanks of Mount Tamalpais. The northern end of San Quentin is in an area of moderate to high landslide susceptibility, and parts of San Quentin State Prison are vulnerable to a landslide.

Residences on the outskirts of Lucas Valley, Marinwood, and Sleepy Hollow that lie in the foothills have a moderate to high susceptibility to landslides, as do residences in most of Los Ranchitos and in the area of Marinwood and Saint Vincent around Highway 101. Several health care facilities and schools also lie in this fringe. Areas of Lucas Valley and Marinwood along Miller Creek may be particularly susceptible to a debris flow in the creek. Numerous residences and a school lie in this area. Areas of Santa Venitia around the San Pedro Mountain Open Space Preserve have moderate to high susceptibility to landslides. There are dozens of homes in this area. Most critical facilities in Santa Venitia lie outside areas of landslide susceptibility.

The western side of the Green Point-Black Point area has high landslide susceptibility while the eastern side is more moderately susceptible with pockets of high susceptibility. The entire area is primarily residential and hundreds of homes along with a school have some vulnerability to a landslide. There are residential areas in the unincorporated County west of Novato in the foothills with hundreds of homes that have moderate to high susceptibility of a landslide and could be vulnerable to a debris flow from any of the creeks that originate in the mountains.

Landslides, mudslides, and debris flows can move fast enough to damage or destroy homes or other structures in their path, block roadways (including evacuation routes), and injure or kill people caught in them. Marin County OA populations that are most vulnerable to the effects of landslides, debris flows, and post-fire debris flows include:

- Low-income households
- Households in poverty
- Renters
- Persons living in mobile homes
- Persons living on single access roads
- Persons without access to transportation or telecommunications
- Outdoor workers

- Houseless population
- Persons with disabilities

The most vulnerable populations are those that may be unable to evacuate due to limited mobility, lack of access to a vehicle, or language barriers that may prevent awareness of emergency notifications. Those living on single-access roadways in the hilly areas of the County or those living in less resilient housing may lose access to their homes if roadways or the structures are damaged or destroyed by a landslide. Development on hillsides in places like Mill Valley was done in the 1920s and 1930s, long before landslides were factored into design and construction regulations.

Climate Change and Future Development Considerations

Extreme storm events and more frequent wildfires as a result of climate change have the potential to increase the amount and severity of landslides, including disastrous debris flows. Climate change is leading to more volatile precipitation patterns around the world with very dry stretches punctuated by storms that drop large amounts of rain in a short amount of time. Landslides in wetter regions of California, including the Marin County OA, move on average faster and farther downhill during rainy periods compared to drought years, according to a 2022 study by the American Geophysical Union (AGU), showing the increased potential for landslides in the Marin County OA in rainy years. As development increases in the numerous canyons and around the many open spaces of the Marin County OA, the potential for significant impacts from a landslide and/or mudflow increases. Future development should take into account the movement of mud and debris in waterways after a major rain event. Adequate space adjacent to susceptible waterways should be maintained free of development to allow for the passage of mud and debris, and catchment basins should be built in these areas to help capture any excess mud and debris.

3.3.3 DROUGHT

A drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. Drought is a temporary aberration from normal climatic conditions and can thus vary significantly from one region to another. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Drought is a complex issue involving many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities.

There are several types of drought which can often be defined regionally based on their effects:

- Meteorological drought is usually defined by a period of below average water supply, based on the degree of dryness (in comparison to normal or average) and the duration of the dry period. Drought onset generally occurs with a meteorological drought.
- Agricultural drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock. Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, soil water deficits, reduced ground water or reservoir levels needed for irrigation.

- Hydrological drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as stream flow, snowpack, and as lake, reservoir, and groundwater levels. Hydrological drought usually occurs following periods of extended precipitation shortfalls.
- Socioeconomic drought occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

Location and Previous Occurrences

Historically, California has experienced multiple severe droughts. According to the California Department of Water Resources (DWR), droughts exceeding three years are relatively rare in Northern California, the source of much of the State's developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. The driest single year of California's measured hydrologic record was 2013. A drought emergency was declared for the state in 2014, and lifted in 2017 after a series of strong winter storms.

The U.S. Drought Monitor provides a general summary of current drought conditions. See Figure 3.57 for drought conditions in 2023, Figure 3.58 for drought conditions in 2020 and Figure 3.59 for drought conditions in 2016.

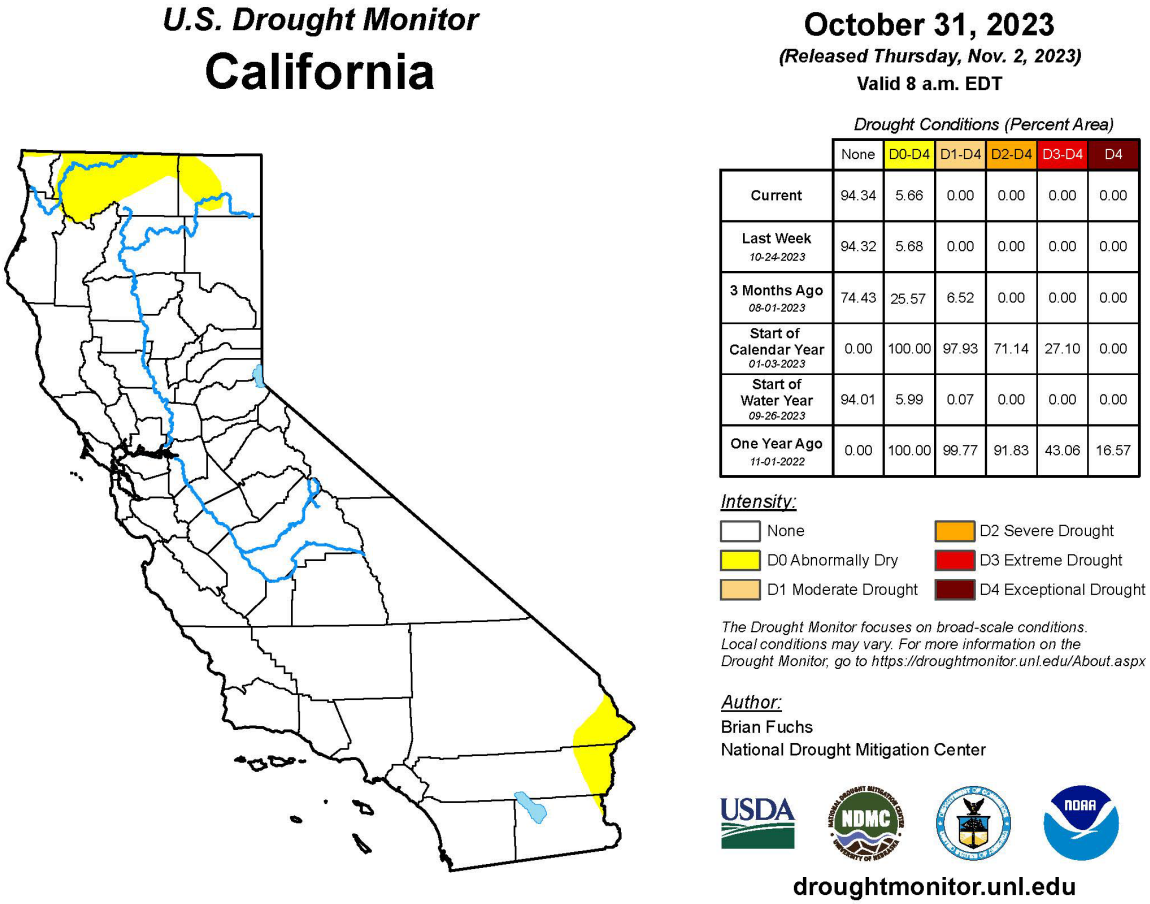


Figure 3.57: U.S. Drought Monitor for California (2023)
Source: USDA

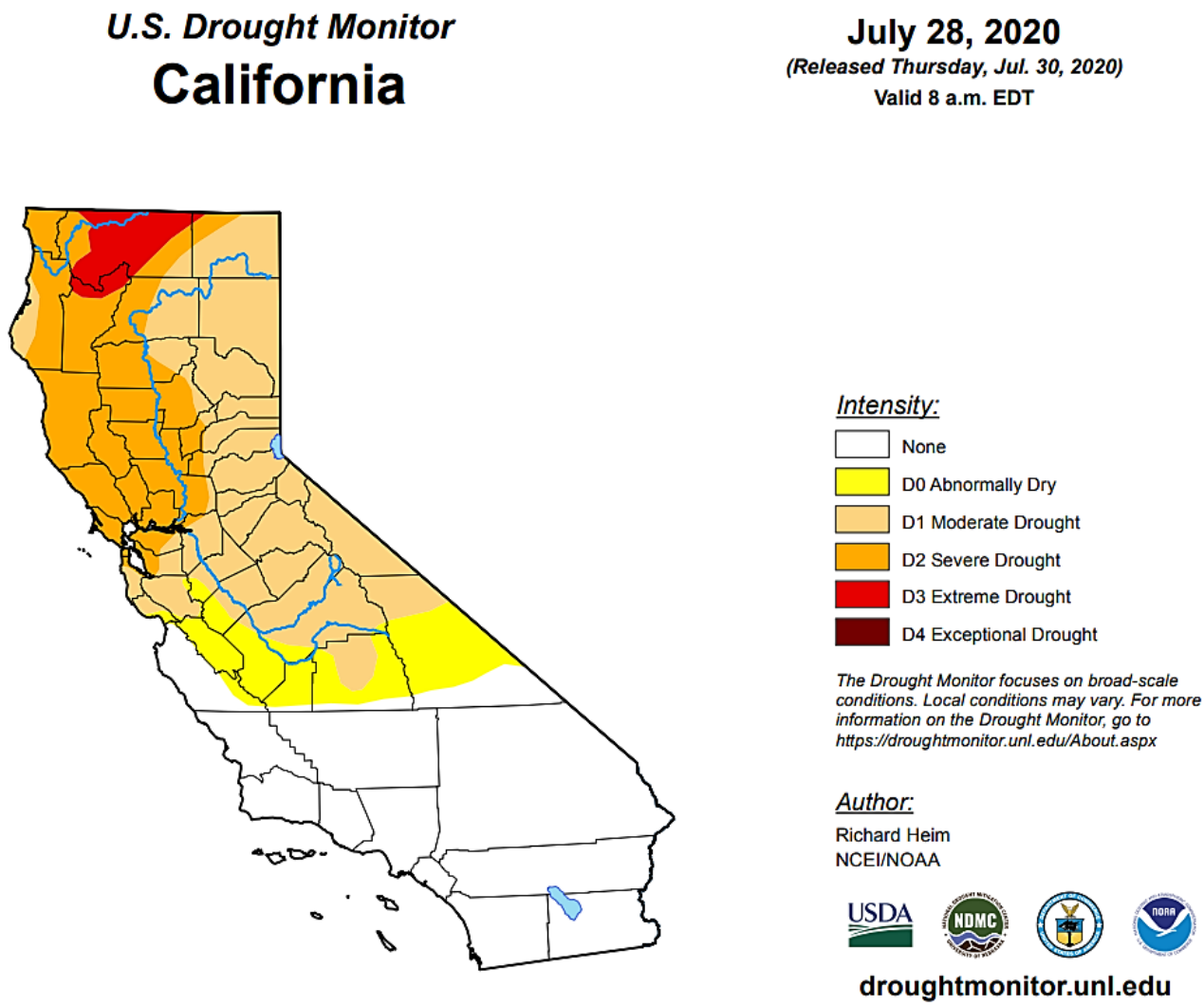


Figure 3.58: U.S. Drought Monitor for California (2020)
Source: USDA

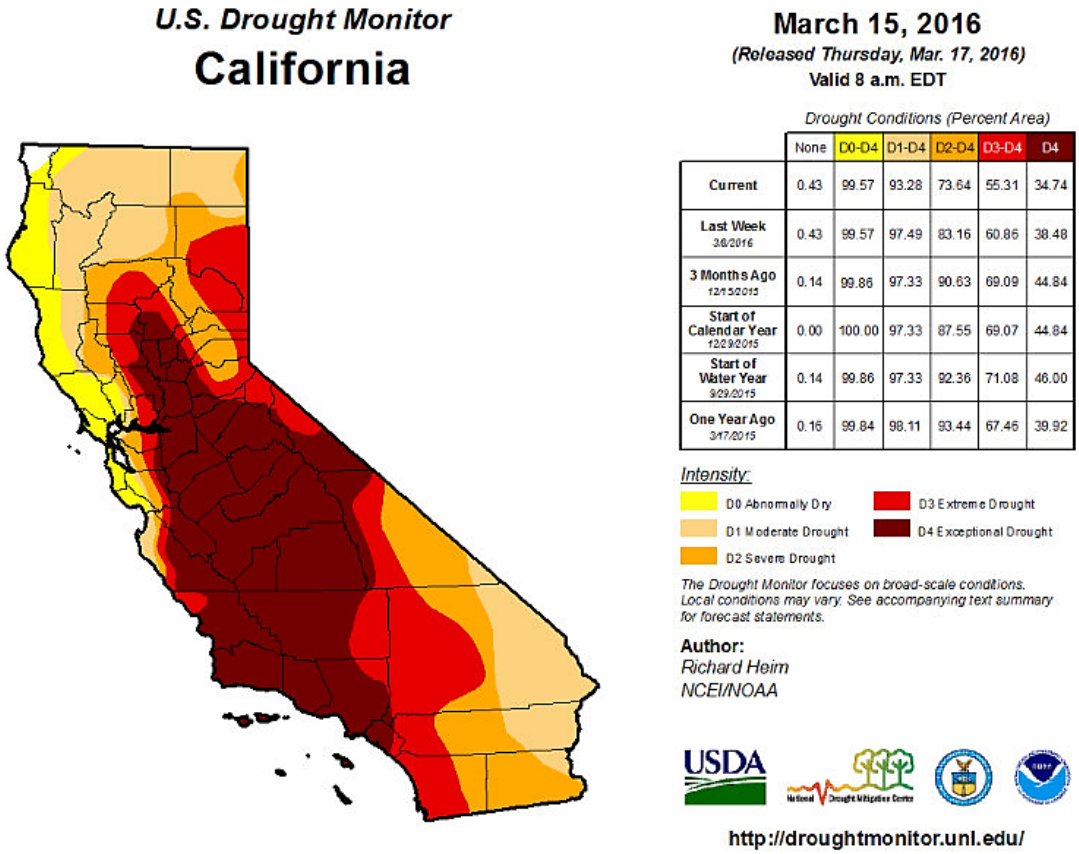


Figure 3.59: U.S. Drought Monitor for California (2016)
Source: USDA

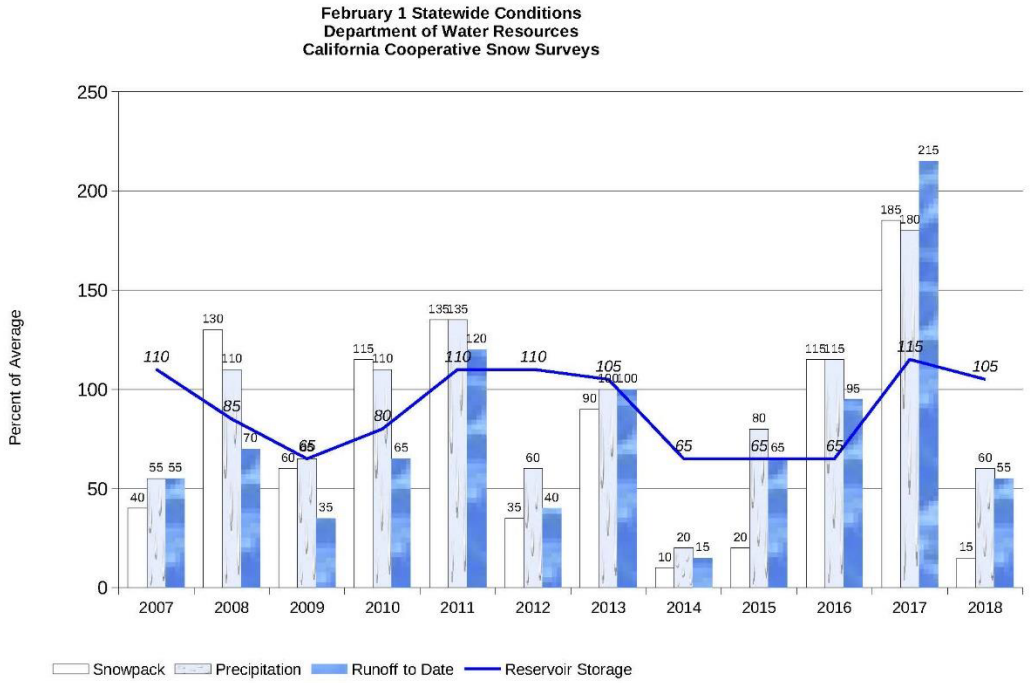


Figure 3.60: Water Supply Conditions in California 2005-2018
Source: 2018 State of California Hazard Mitigation Plan

A drought emergency for the State of California was issued on January 17, 2014. This declaration came on the heels of a report that stated that California had the least amount of rainfall in its 163-year history. Drought conditions worsened through 2014 and into 2015. On April 1, 2015, following the lowest snowpack ever recorded, actions were announced by the State that would save water, increase enforcement to prevent wasteful water use, streamline the State's drought response, and invest in new technologies to make California more drought resilient. The State Water Resources Control Board was directed to implement mandatory water reductions in cities and towns across California to reduce water usage by 25 percent. This savings amounted to approximately 1.5 million acre-feet of water through the end of 2015.

In July 2021, the State of California added Marin County to its list of counties falling under its state of emergency regarding deepening drought conditions and record-breaking high temperatures statewide. After hearing details about local dry conditions and water supplies, the Marin County Board of Supervisors voted unanimously on May 18, 2021 to declare a local emergency and acknowledge the imminent threat of disaster. The declaration acknowledged the extent and impacts of the drought in Marin, which is severely affecting dairies and ranchers in West Marin. It also made the County eligible for California Disaster Assistance and other forms of state funding and resources. The local declaration cleared the way for state authorities to aid response and recovery efforts available to the County, water suppliers, farmers, impacted businesses and residents. In August 2021, with reservoir levels at historic lows, both MMWD and NMWD declared a water shortage emergency and adopted mandatory water use restrictions, with respective reduction goals of 40 percent and 20 percent. In October 2021, the Governor of California signed a proclamation extending the drought emergency statewide. In March 2023 the Governor eased drought restrictions and ended the drought emergency.

All areas of the Marin County OA could experience drought, including vegetated areas where drier conditions could lead to an increase in wildfires and tree mortality.

Impacts

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in the planning area are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. During a drought, allocations go down, which results in reduced water availability. Voluntary conservation measures are typically implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Drought can have secondary impacts. For example, drought is a major determinant of wildfire hazard, in that it creates greater propensity for fire starts and larger, more prolonged conflagrations fueled by excessively dry vegetation, along with reduced water supply for firefighting purposes. Drought is also an economic hazard. Significant economic impacts on California's agriculture industry can occur as a result of short- and long-term drought conditions; these include hardships to farmers, farm workers, packers, and shippers of agricultural products. Health and property impacts, such as water contamination (especially private wells), economic losses to individuals, physical and mental health impacts may also occur. In some cases, droughts can also cause significant increases in food prices to the consumer due to shortages, causing possible food insecurity or dietary changes, which may lead to poorer health outcomes. Drought can also result in lack of water and subsequent feed available to grazing

livestock, potentially leading to risk of livestock death and resulting in losses to the State's and Marin County's agricultural economy.

Based on historical information, the occurrence of drought in California, including the Marin County OA, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users.

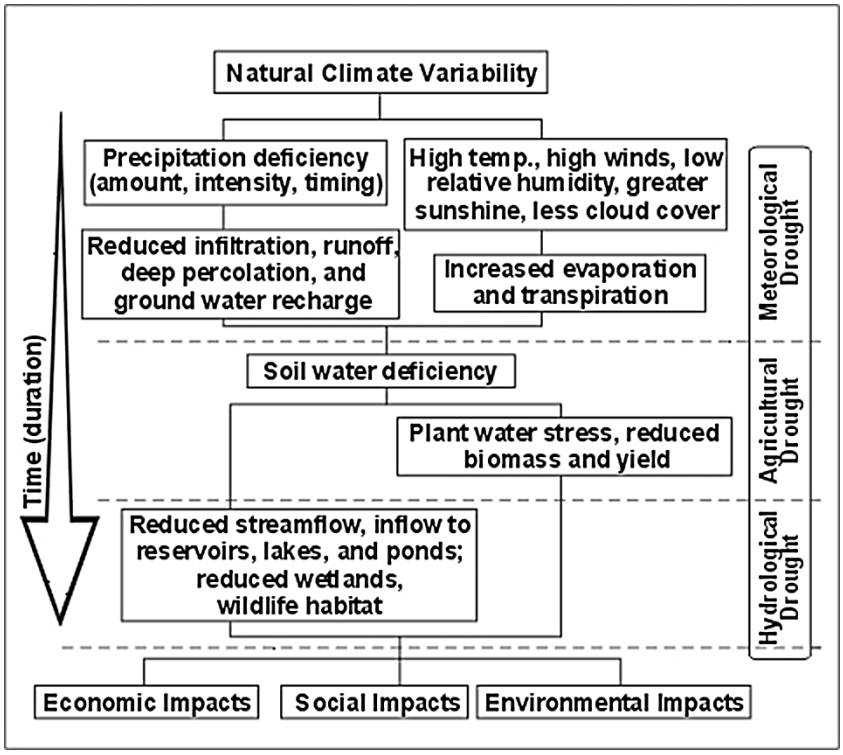


Figure 3.61: Drought Impacts
Source: National Drought Mitigation Center

Drought also has a significant impact on tree mortality. Figures 3.64 shows the impact of tree mortality in Marin County in 2022.

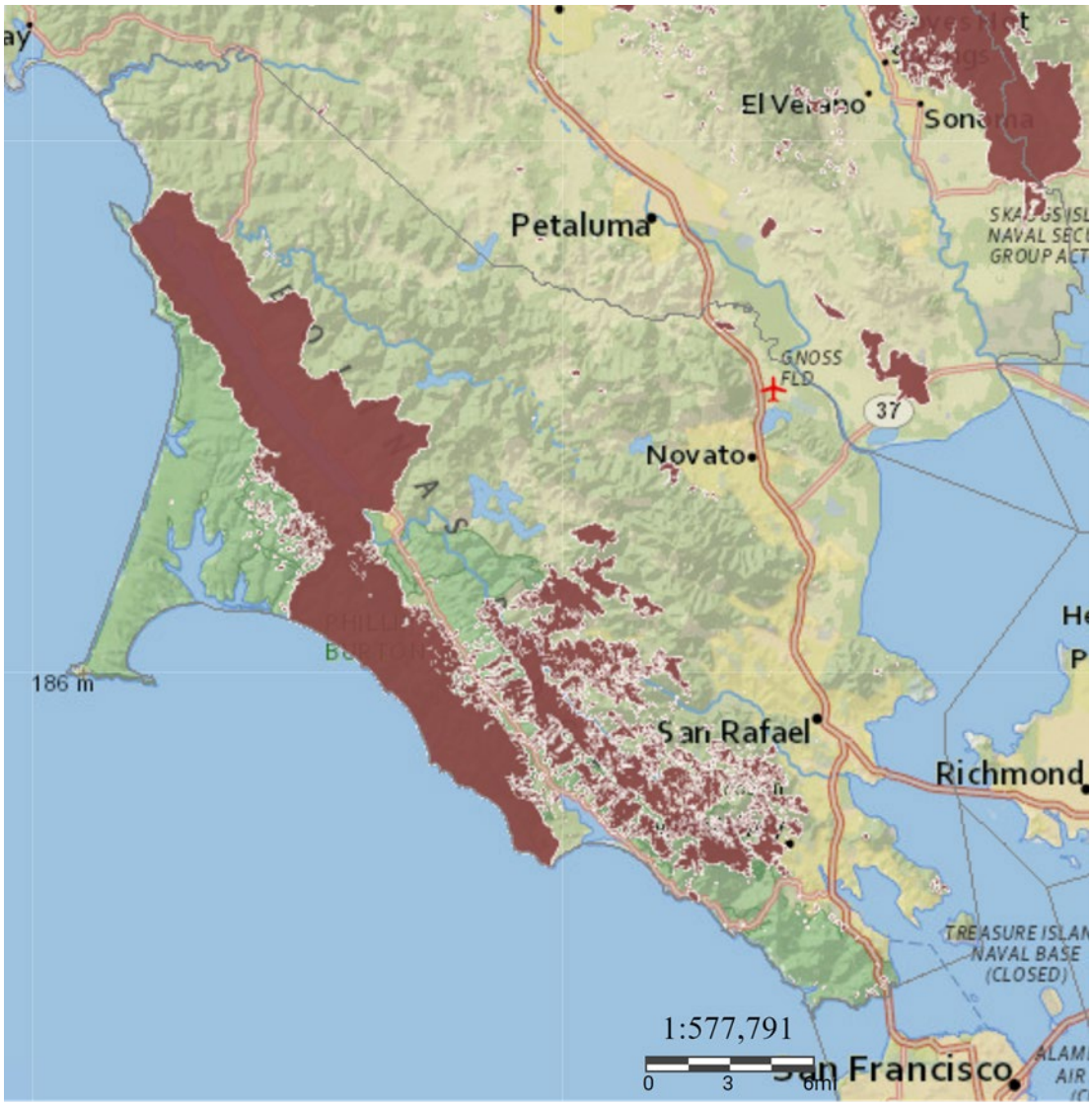


Figure 3.62: 2022 Locations of Tree Mortality in the Marin County OA
Source: CALFIRE

Extent and Probability

Scientists expect that climate change will lead to more frequent and more intense droughts statewide. Overall, precipitation levels are expected to stay similar, and may even increase in some places. However, the state's current data say that there will be more years with extreme levels of precipitation, both high and low, as a result of climate change. This is expected to cause more droughts that last longer and are more intense, compared to historical norms. Higher air temperatures are expected to increase evaporation, causing more water loss from lakes and reservoirs and decreasing soil moisture to greater depths.

Table 3.10: Marin County OA Hazard Risk Assessment – Drought						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Highly Likely	Extensive	Moderate	High	High	**16.00**
City of Belvedere	Highly Likely	Extensive	Moderate	High	High	**16.00**
Town of Corte Madera	Likely	Extensive	Weak	High	Medium	**13.00**
Town of Fairfax	Occasional	Extensive	Weak	Medium	Low	**10.00**
City of Larkspur	Occasional	Extensive	Moderate	High	Medium	**13.00**
City of Mill Valley	Likely	Extensive	Weak	High	Medium	**13.00**
City of Novato	Likely	Extensive	Weak	High	Medium	**13.00**
Town of Ross	Likely	Extensive	Moderate	Medium	High	**14.00**
Town of San Anselmo	Likely	Extensive	Extreme	High	High	**17.00**
City of San Rafael	Likely	Extensive	Moderate	High	Medium	**14.00**
City of Sausalito	Unlikely	Negligible	None	Low	Low	**4.00**
Town of Tiburon	Highly Likely	Extensive	Moderate	High	High	**16.00**
Bolinas Public Utility District	Highly Likely	Extensive	Severe	High	High	**17.00**
Las Gallinas Valley Sanitary District	Likely	Limited	None	High	Medium	**10.00**
North Marin Water District	Occasional	Extensive	Severe	High	Medium	**14.00**
Southern Marin Fire District	Likely	Significant	Severe	High	Medium	**14.00**

Table 3.10: Marin County OA Hazard Risk Assessment – Drought
Source: Profiled Jurisdictions and Districts

Vulnerability

The vulnerability of the Marin County OA to drought is countywide, but impacts may vary by area and include reduction in water supply, agricultural losses, and an increase in dry fuels.

During drought, declines in surface water flows can be detrimental to water supplies for agriculture and cities, hydropower production, navigation, recreation, and natural ecosystems, particularly habitat for aquatic and riparian species. Communities in the Marin County OA, may experience water shortages during drought conditions which lead to mandatory water use restrictions and possibly the importation of water. During drought events, the flow of water in creeks and streams is reduced, creating more slow-moving or standing water. This can concentrate sediment and toxins in the low water levels, causing harm to plants and animals. Many fish species also rely on specific water temperatures and stream flow speeds, especially for spawning and egg incubation, and changes to stream velocity as a result of drought conditions can affect reproduction. Droughts can also indirectly lead to more wildfires, and the stress caused by water shortages can weaken plants, making them more susceptible to pests and diseases. As drought persists, longer-term impacts can emerge, such as land subsidence, seawater intrusion, and damage to ecosystems. During prolonged or severe drought, County residents would be impacted by water use restrictions and changes to water supply.

Climate Change and Future Development Considerations

Climate change increases the odds of worsening drought. Warmer temperatures enhance evaporation, which reduces surface water and dries out soils and vegetation. This makes periods with low precipitation in the summer drier than they would be in cooler conditions. Climate also alters the timing of water availability as warmer winter temperatures cause less precipitation to fall. During droughts, communities in the Marin County OA may have limited access to water for household use, including drinking, cooking, cleaning, and watering plants, as well as for agriculture, transportation, and power generation. Drought may lead to higher water costs, rationing, or even the decimation of important water sources like wells in the Marin County OA. As more people move into the Marin County OA, additional strain will be placed on the OA's water supply. Drought can affect livestock and crops in the Marin County OA, impacting its economy. Drought can increase the occurrence and severity of wildfires and tree mortality in the Marin County OA. Impacts to residents and infrastructure from wildfire as a result of drought will increase as more development occurs in the mountainous areas of the Marin County OA where wildfires are more likely to occur. Drought also increases the amount of carbon dioxide in the atmosphere, including by decreasing land productivity, which reduces the amount of vegetation storing carbon dioxide. In addition, increases in drought-related wildfire and soil erosion can release carbon dioxide sequestered in trees and plants back into the atmosphere. This will only worsen climate change for the Marin County OA into the future. When considering future development, the Marin County OA can help prepare for both future droughts and climate change by practicing and promoting water conservation and enhancing water efficiency throughout landscapes, city plans, and water infrastructure. The Marin County OA can also identify alternative water supplies, create drought emergency plans, and encourage farmers to plant drought-resistant crops.

3.3.4 EARTHQUAKE

Earthquakes are sudden rolling or shaking events caused by movement under the earth's surface. Earthquakes happen along cracks in the earth's surface, called fault lines, and can be felt over large areas, although they usually last less than one minute.

The amount of energy released during an earthquake is usually expressed as a magnitude and is currently measured by seismologists on the Moment Magnitude (Mw Scale). The Mw Scale was developed to succeed the previously used Richter Scale and is measured on a scale of zero to ten with increasing values reflecting increasing intensity.

The other commonly used measure of earthquake severity is intensity, which is an expression of the amount of shaking at any given location on the ground service. Intensity is most commonly measured on the Modified Mercalli Intensity (MMI) Scale (see Figure 3.63).

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest,especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Figure 3.63: Modified Mercalli Intensity Scale

Figure 3.64 gives intensities (measured on the MMI scale) that are typically observed at locations near the epicenter or earthquakes of different magnitudes.

Richter Magnitude Scale	Typical Maximum Modified Mercalli Intensity Scale
1.0 – 2.9	I
3.0 – 3.9	II – III
4.0 – 4.9	IV – V
5.0 – 5.9	VI – VII
6.0 – 6.9	VII – IX
7.0 or higher	VIII or higher

Figure 3.64: Mercalli Scale vs. Magnitude

The extent of ground shaking also depends in large part on how soft the underlying soil is. Soft soils amplify ground shaking (see Figure 3.65). This was observed during the 1989 Loma Prieta Earthquake when the most significant damages experienced in San Francisco were in the Marina District, which was built on fill.

Soil type A	Vs > 1500 m/sec	Includes unweathered intrusive igneous rock. Occurs infrequently in the bay area. We consider it with type B (both A and B are represented by the color blue on the map). Soil types A and B do not contribute greatly to shaking amplification.
Soil type B	1500 m/sec > Vs > 750 m/sec	Includes volcanics, most Mesozoic bedrock, and some Franciscan bedrock. (Mesozoic rocks are between 245 and 64 million years old. The Franciscan Complex is a Mesozoic unit that is common in the Bay Area.)
Soil Type C	750 m/sec > Vs > 350 m/sec	Includes some Quaternary (less than 1.8 million years old) sands, sandstones and mudstones, some Upper Tertiary (1.8 to 24 million years old) sandstones, mudstones and limestone, some Lower Tertiary (24 to 64 million years old) mudstones and sandstones, and Franciscan melange and serpentinite.
Soil Type D	350 m/sec > Vs > 200 m/sec	Includes some Quaternary muds, sands, gravels, silts and mud. Significant amplification of shaking by these soils is generally expected.
Soil Type E	200 m/sec > Vs	Includes water-saturated mud and artificial fill. The strongest amplification of shaking due is expected for this soil type.

Figure 3.65: Soil Types

An earthquake fault is defined as “a fracture or fracture zone in the earth’s crust along which there has been displacement of the sides relative to one another.” For the purpose of planning there are two types of faults, active and inactive. Active faults have experienced displacement in historic time, suggesting that future displacement may be expected. Inactive faults show no evidence of movement in recent geologic time, suggesting that these faults are dormant.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible ground shaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

Location and Previous Occurrences

The potential for earthquake damage exists throughout Marin County because of a combination of the number of active faults within and near the County and the presence of soils vulnerable to liquefaction. These faults are shown on the California Geological Survey (CGS) Fault Activity Map of California (see Figure 3.68. Fault Activity Map below). Descriptions of the most significant active faults to Marin are provided below.

San Andreas fault: The San Andreas Fault traverses Marin County running north and south in the western quarter of the county. It enters Marin on the Pacific Coast near Bolinas, follows the path of Highway 1 and Tomales Bay, exiting Marin at sea just west of Dillon Beach. Hayward fault: the eastern, more heavily populated part of Marin is less than ten miles from the northern section of the Hayward fault. Rodgers Creek fault: The northern part of Marin is less than ten miles from the Rodgers Creek fault. See Figure 3.66 for a map of earthquake faults and probability of shaking across the Marin County OA.

Earthquake Shake Intensity

The colors on Figures 3.66 and 3.67 represent the level of ground shaking intensity of a potential future earthquake. The result is expressed as the level of ground shaking (**expressed as a percentage of gravity**) that on average occurs every 500 years.

This map shows the expected relative intensity of ground shaking and damage in California from anticipated future earthquakes. The shaking potential is calculated as the level of ground motion that has a 2% chance of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2500 year average repeat time. The relatively long-period (1.0 second) earthquake shaking is shown here. Long period-shaking affects tall, relatively flexible buildings, but also correlates well with overall earthquake damage.

Earthquake Shaking Potential Maps for California depict expected intermediate period (1s or 1hz) ground motions with 2% exceedance probability in 50 years.

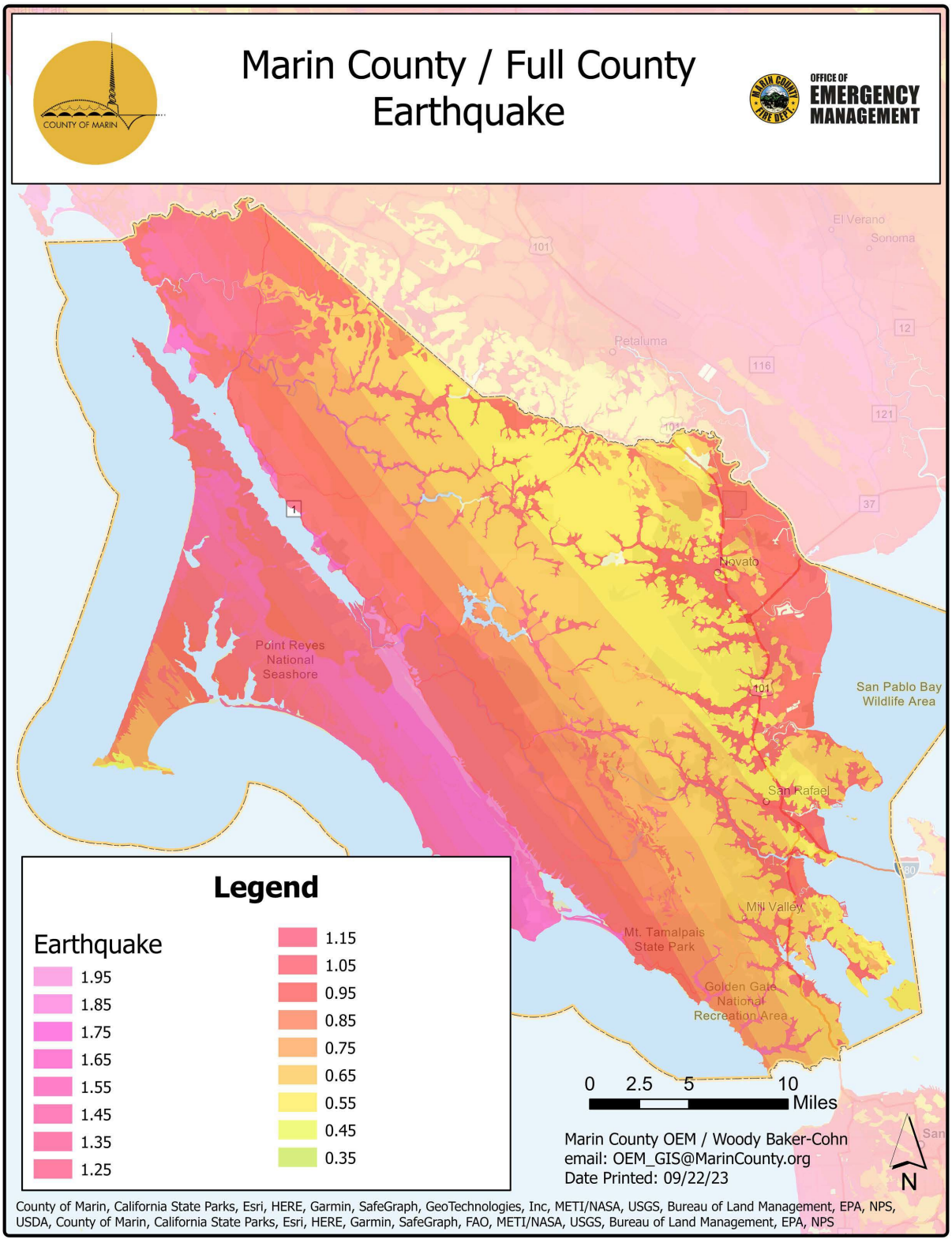


Figure 3.66: Earthquake Faults and Probability of Shaking in the Marin County OA
Sources: Marin County OEM, USGS

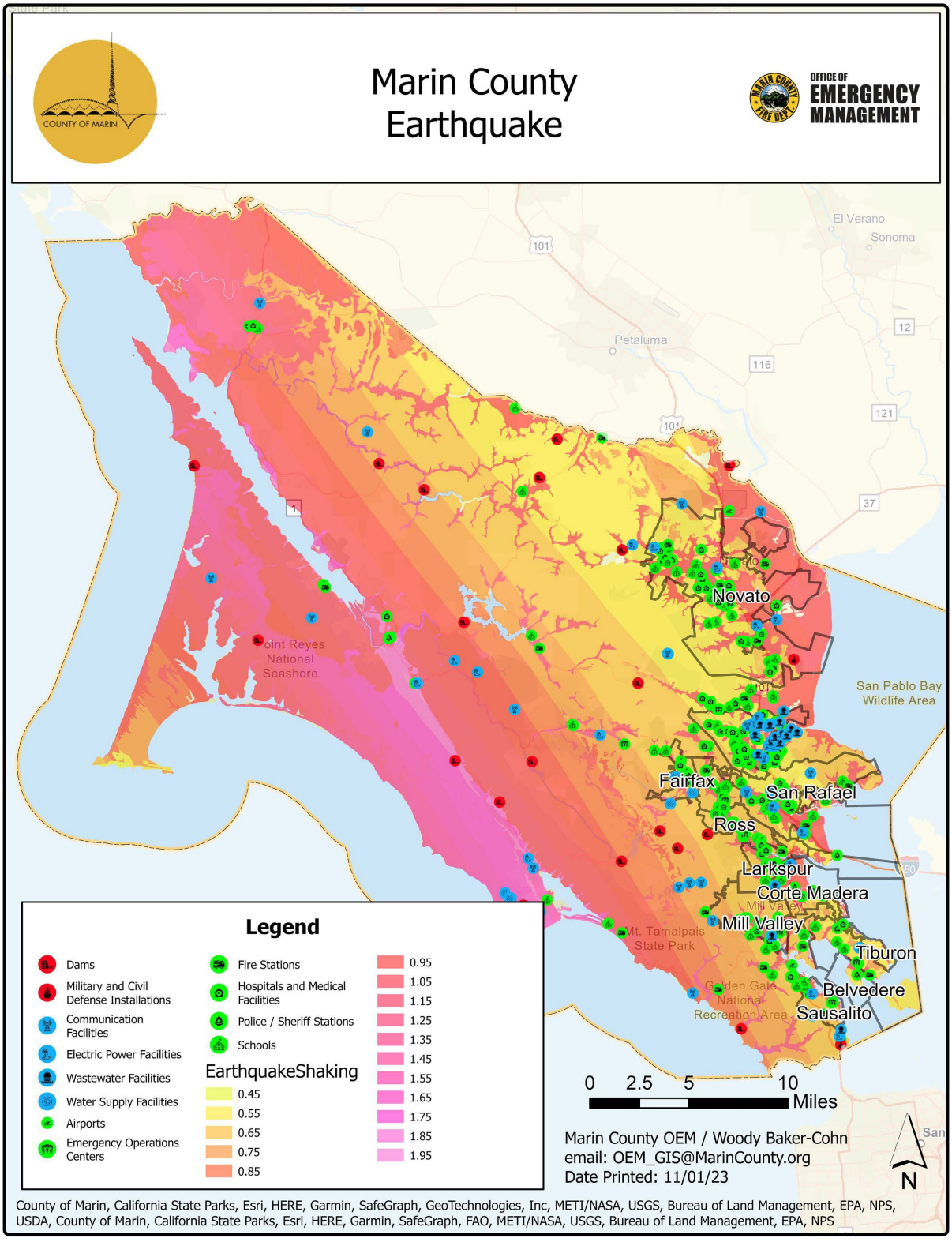


Figure 3.67: Marin County Earthquake Shaking Potential and Critical Facilities
Source: Marin County OEM

There are faults that do not traverse the Marin County OA that may cause shaking effects to occur inside the County.

According to the Association of Bay Area Governments Resilience Program, “the San Andreas Fault was the source of the magnitude of 7.8 earthquake in 1906. Marin was sparsely inhabited at that time and experienced relatively moderate property loss and only two deaths. The epicenter was just two miles west of San Francisco and West Marin experienced some pronounced earthquake effects. This included a horizontal earth displacement of 21 feet near the head of Tomales Bay.

On October 17, 1989, a magnitude 7.1 earthquake occurred on the San Andreas Fault, the largest earthquake to occur in the San Francisco Bay Area since 1906. This earthquake was named the Loma Prieta Earthquake due to its calculated epicenter. The impact of the Loma Prieta Earthquake was most apparent in the northeast area of Santa Cruz. If the fault rupture location were closer, a strong shaking such as this could have caused severe damage within Marin County, including damage to life-line routes. The Loma Prieta Earthquake was not “the big one,” which is a common reference to an event with a magnitude of 8 or larger (such as the 1906 San Francisco quake).

Impacts

Ground shaking is the primary earthquake hazard. Many factors affect the survivability of structures and systems from earthquake-caused ground motions. These factors include proximity to the fault, direction of rupture, epicenter location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems. Ground motions become structurally damaging when average peak accelerations reach 10 to 15 percent of gravity, average peak velocities reach 8 to 12 centimeters per second, and when the Modified Mercalli Intensity Scale is about VII (18-34 percent peak ground acceleration), which is considered to be very strong (general alarm; walls crack; plaster falls).

Earthquakes can result in liquefaction. Liquefaction is a process whereby soil is temporarily transformed to a fluid form during intense and prolonged ground shaking. Areas most prone to liquefaction are those that are water saturated (e.g., where the water table is less than 30 feet below the surface) and consist of relatively uniform sands that are loose to medium density. In addition to necessary soil conditions, the ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction.

Liquefaction during major earthquakes has caused severe damage to structures on level ground as a result of settling, tilting, or floating. Such damage occurred in San Francisco on bay-filled areas during the 1989 Loma Prieta earthquake, even though the epicenter was several miles away. If liquefaction occurs in or under a sloping soil mass, the entire mass may flow toward a lower elevation. Of particular concern in terms of developed and newly developing areas are fill areas that have been poorly compacted.

Earthquakes can cause settlement. Settlement can occur in poorly consolidated soils during ground shaking. During settlement, the soil materials are physically rearranged by the shaking to result in a less stable alignment of the individual minerals. Settlement of sufficient magnitude to cause significant structural damage is normally associated with rapidly deposited alluvial soils or improperly founded or poorly compacted fill. These areas are known to undergo extensive settling with the addition of irrigation water, but evidence due to ground shaking is not available.

Earthquakes can also cause seiches, landslides, and dam failures. A seiche is a periodic oscillation of a body of water resulting from seismic shaking or other factors that could cause flooding. Earthquakes may cause landslides, particularly during the wet season, in areas of high water or saturated soils. Earthquake impact on life, property, and environment may include cascading impacts of lifelines loss (water, electricity), loss of housing, injuries and mortality, surge in healthcare facilities, and disruption to EMS services.

Most structures in the Marin County OA, including in the unincorporated area, were built before 1970, when major seismic design changes were made to the building code and are particularly vulnerable to earthquakes and liquefaction. Wood framed homes, however, are light and flexible and can often survive earthquakes with minimal damage as long as the foundations are properly retrofitted (bolted and braced). The County of Marin and its political subdivisions have adopted California Building, Plumbing, Electrical and Mechanical Codes whereby no building or structure is erected, constructed, enlarged, improved, removed, or converted without a permit. Adherence to these codes currently allows the county to gather data on retrofitting and current building code compliance. It is important to note that these data continue to have limitations for assessing overall vulnerability in the county for all structures.

The majority of the Marin County OA's single-family buildings with foundations to bedrock will perform well in a shake. Modern multi-story buildings with foundations to bedrock should not be subject to collapse, although some serious damage may occur. However, many heavier developed areas of the Marin County OA are built on soft alluvial soils or filled-in water ways. Due to liquefaction, these soils will significantly increase the shaking effects and will account for the majority of damaged and destroyed structures, regardless of their proximity to the fault line. Liquefaction occurs when ground shaking causes loose, saturated soil to lose strength and act as a viscous fluid. When liquefaction occurs, it can result in the sidelong movement of large masses of soil, loss of strength in the soil supporting structures causing structures to collapse, and/or consolidation due to soil settlement decreasing soil surface elevations. The county's topography includes large areas of steep slopes, adding to the vulnerability of earthquake induced disasters with the additional danger of debris flow (landslides). Bluff erosion along the coastal areas also poses unique threats to coastal structures and roads during times of earthquake.

Extent and Probability

An earthquake could occur and affect any area of the Marin County OA, including the unincorporated area. The ABAG Resilience Program analysis shows risk of liquefaction in Corte Madera, Larkspur, Bel Marin Keys, Novato, Ross Valley along creeks (Ross, San Anselmo, Fairfax), San Geronimo, San Rafael, Santa Venetia, communities around Richardson Bay (Belvedere, Marin City, Mill Valley, Sausalito, Strawberry, Tam Valley, Tiburon), Stinson Beach, Tomales Bay-side communities, and the county-owned Gnoss Field Airport.

According to a September 24, 2016 article in the Marin Independent Journal, "The Working Group on California Earthquake Probabilities has updated its earthquake forecast and determined there is a 72 percent probability - up from 63 percent - of at least one earthquake of magnitude 6.7 or greater striking somewhere in the Bay Area before 2043." The Association of Bay Area Governments (ABAG) Resilience Program projects a 52% chance of a 6.7 or greater earthquake on one of the faults affecting Marin between now and 2036 (21% at San Andreas fault and 31% on Hayward/Rodgers Creek). Supporting this article's assertions is the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3), which provides authoritative estimates of the magnitude, location, and time-averaged frequency of potentially damaging

earthquakes in California (see Figure 3.68). Uniform California Earthquake Rupture Forecast primary achievements have been to relax fault segmentation assumptions and to include multi-fault ruptures, both limitations of the previous model (UCERF2).

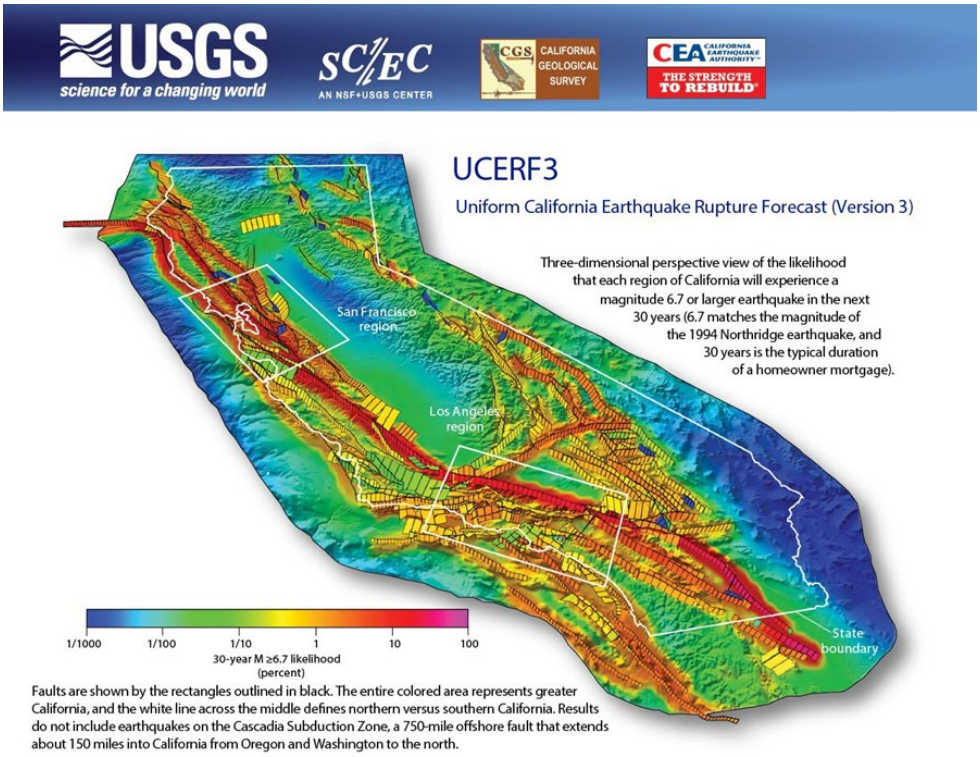


Figure 3.68: Uniform California Earthquake Rupture Forecast Version 3
Source: USGS

The September 24, 2016 article goes on to say “Marin sits smack dab (sic) in the middle of two major faults. To the east is the Rodgers Creek-Hayward fault just a few miles from Marin’s shores through San Pablo Bay, which the U.S. Geological Survey estimates has a 33 percent likelihood of a 6.7-magnitude quake or greater in the next 30 years — the highest probability of any Bay Area fault to slip. But movement on those faults could be worse than originally thought.” The Rodgers Creek-Hayward fault, thought to be two separate faults, actually may be linked and have the potential to cause more damage than previously determined, according to USGS research.

“The Rodgers Creek Fault runs from Sonoma County into San Pablo Bay near Marin’s shore. The Hayward Fault runs through the western part of Alameda County into San Pablo Bay east of San Rafael and Novato. They were thought to be offset by about two miles under San Pablo Bay. But underwater exploration done in 2014 seems to link them. More study will occur to confirm those initial findings.”

Table 3.11: Marin County OA Hazard Risk Assessment - Earthquake						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Highly Likely	Extensive	Extreme	None	High	**15.00**
City of Belvedere	Highly Likely	Extensive	Extreme	None	High	**15.00**
Town of Corte Madera	Occasional	Extensive	Severe	None	High	**12.00**
Town of Fairfax	Highly Likely	Extensive	Extreme	None	High	**15.00**
City of Larkspur	Occasional	Extensive	Extreme	None	High	**13.00**
City of Mill Valley	Occasional	Extensive	Extreme	Low	Medium	**13.00**
City of Novato	Occasional	Extensive	Extreme	None	Medium	**12.00**
Town of Ross	Likely	Significant	Severe	None	Medium	**11.00**
Town of San Anselmo	Occasional	Extensive	Extreme	High	High	**16.00**
City of San Rafael	Occasional	Significant	Severe	None	Medium	**10.00**
City of Sausalito	Occasional	Limited	Moderate	Low	Low	**8.00**
Town of Tiburon	Highly Likely	Extensive	Extreme	None	High	**15.00**
Bolinas Public Utility District	Occasional	Extensive	Severe	None	High	**13.00**
Las Gallinas Valley Sanitary District	Occasional	Extensive	Extreme	None	Medium	**12.00**
North Marin Water District	Occasional	Extensive	Extreme	Low	Medium	**13.00**
Southern Marin Fire District	Occasional	Extensive	Extreme	None	High	**13.00**

Table 3.11: Marin County OA Hazard Risk Assessment – Earthquake
Source: Profiled Jurisdictions and Districts

Vulnerability

The areas most vulnerable to earthquake in the Marin County OA, including the unincorporated area, are on bay mud and current and former marshlands. Many of these areas have been artificially filled over the last century. Other areas with some risk of liquefaction include those along creeks due to fluvial and alluvial deposits. Unfortunately, much of Marin's residential areas and infrastructure are located on former marshes and along creeks. Tens of thousands of acres of residential areas, along with roads, airports, military facilities, retail centers, schools, hospitals, prisons, jails, government administration centers, convention centers, recreation areas, croplands/pasture are in areas vulnerable to liquefaction in the Marin County OA.

For all three faults mentioned above that run through the Marin County OA, many areas of the most severe vulnerability to earthquake coincide with the heavily populated Highway 101 corridor on the eastern side of the county. Numerous unincorporated communities with large populations and buildings lie in this area. According to the ABAG Resilience Program, a 7.8 magnitude earthquake on the San Andreas fault would leave 3,100 homes in the Marin County OA uninhabitable, displace 6,200 households, and result in total building damage of $1,260 billion dollars. Because many people in the region do not have earthquake insurance, many homeowners will not be able to afford to rebuild their homes.

In addition to damaging buildings, a 7.8 magnitude San Andreas earthquake could close 77 roads in Marin due to faulting, liquefaction, debris flow/ landslide, shaking damage to bridges and interchanges, threat of building collapse, structural damage to highway and rail structures, small hazardous material releases, water and gas pipe leaks, and other miscellaneous reasons for closure.

Figure 3.69 shows the social vulnerability of Marin County populations to earthquake in relation to the rest of California.

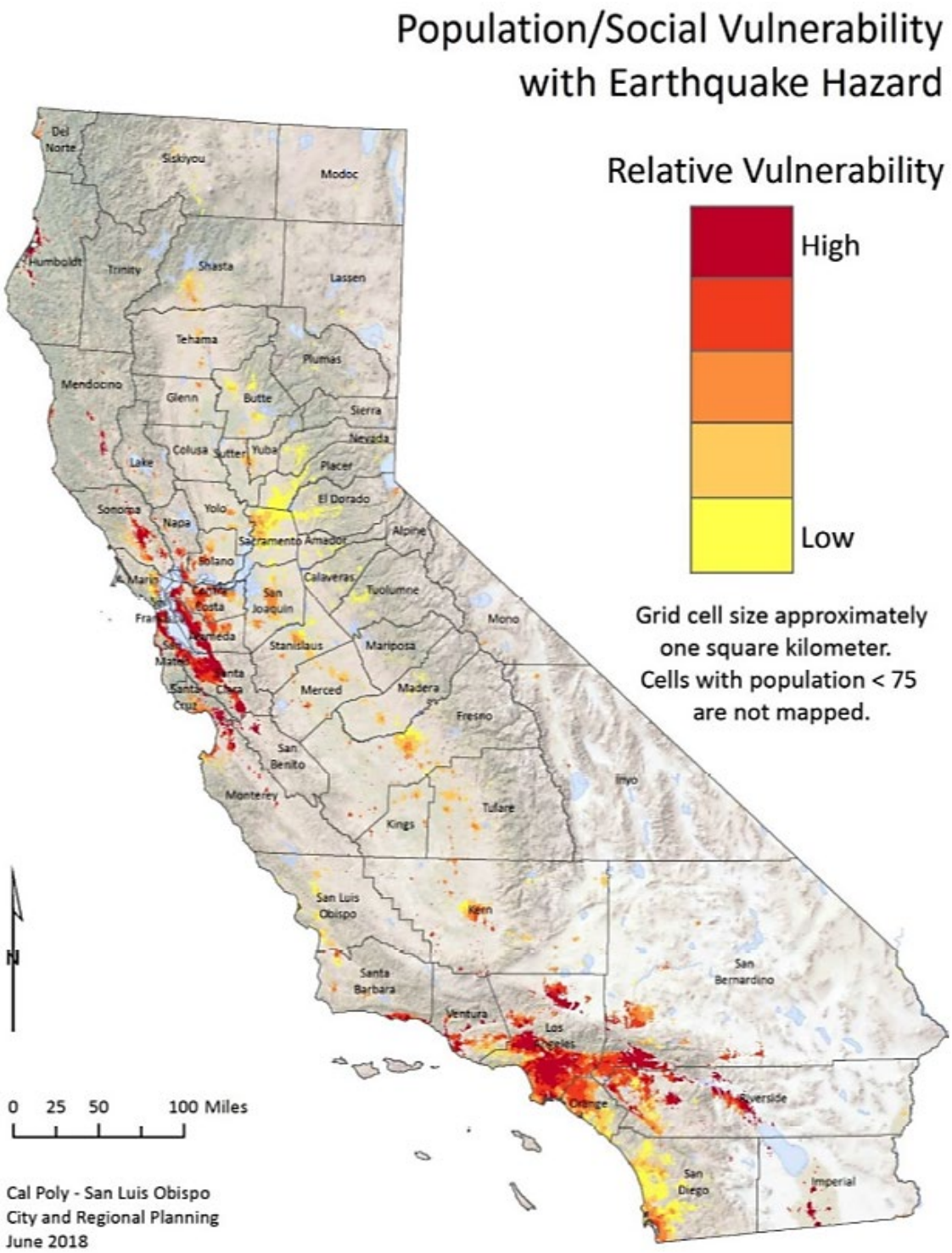


Figure 3.69: Population/Social Vulnerability to an Earthquake in California
Source: 2018 State of California Hazard Mitigation Plan

Climate Change and Future Development Considerations

There is no direct link between climate change and seismic activity that could impact the Marin County OA, so climate change is not expected to cause any changes to the frequency or intensity of seismic shaking. According to a 2018 study by the Institute of Physics (IOP), climate change could result in "isostatic rebounds," or a sudden upward movement of the crust because of reduced downward weight caused by glaciers. As glaciers are known to melt when overall global temperatures increase, climate change could indirectly lead to an increase in seismicity in the Marin County OA. Climate change could also impact earthquakes felt in the Marin County OA as droughts can further deteriorate existing fault lines and pumping groundwater can put further pressure on the earth's crust. Future development in the populated areas of Marin County OA where seismic shaking and subsidence are more prevalent could exacerbate the impacts of an earthquake.

3.3.5 FLOODING

Flooding is the rising and overflowing of a body of water onto normally dry land. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. The area adjacent to a channel is the floodplain. Floodplains are illustrated on inundation maps, which show areas of potential flooding and water depths. In its common usage, the floodplain most often refers to that area that is inundated by the 100-year flood, the flood that has a one percent chance in any given year of being equaled or exceeded. The 100-year flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program. The 200-year flood is one that has 0.5% chance of being equaled or exceeded each year. The 500-year flood is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity such as construction of bridges or channels. In areas where flow contains high sediment load, such as Easkoot Creek in Stinson Beach (due to an active landslide upstream), the flow carrying capacity of the channel may be reduced dramatically during a single flood event. Coastal floodplains may also change over time as waves and currents alter the coastline (especially wetlands) and sea levels rise.

Flooding can occur in several ways:

Riverine flooding – Riverine flooding, defined as when a watercourse exceeds its "bank-full" capacity, generally occurs as a result of prolonged rainfall, or rainfall that is combined with snowmelt and/or already saturated soils from previous rain events. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include one or more independent river basins. The onset and duration of riverine floods may vary from a few hours to many days and is often characterized by high peak flows combined with a large volume of runoff. Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization. In the Marin County OA, riverine flooding can occur anytime from November through April and is largely caused by heavy and continued rains, sometimes combined with snowmelt, increased outflows from upstream dams, and heavy flow from tributary streams. These intense storms can overwhelm the local waterways as well as the integrity of flood control structures. Flooding is more severe when

antecedent rainfall has resulted in saturated ground conditions. The warning time associated with slow rise riverine floods assists in life and property protection.

Flash flooding – Flash flooding describes localized floods of great volume and short duration. This type of flood usually results from a heavy rainfall on a relatively small drainage area. Precipitation of this sort usually occurs in the winter and spring. Flash floods often require immediate evacuation within the hour and thus early threat identification and warning is critical for saving lives.

Localized/Stormwater flooding – Localized flooding problems are often caused by flash flooding, severe weather, or an unusual amount of rainfall. Flooding from these intense weather events usually occurs in areas experiencing an increase in runoff from impervious surfaces associated with development and urbanization as well as inadequate storm drainage systems.

Tidal flooding – Tidal flooding develops when high tides exceed either the top of bank elevation of tidal sloughs and channels, or the crest of bay levees. An especially high tide event that occurs during alignment of the gravitational pull between the sun and the moon, causes tidal water levels to rise to higher-than normal levels. King tides are normal, predictable events that occur semi-annually during winter months. Typically storms in which high tides coincide with peak stormwater flow are the most damaging.

The area is also at risk of flooding resulting from levee failures and dam failures. Dam failure flooding is discussed separately in the Dam Failure Section of this document; levee failure flooding is discussed separately in the Levee Failure Section of this document. Regardless of the type of flood, the cause is often the result of severe weather and excessive rainfall, either in the flood area or upstream reach.

A weather pattern called the “Atmospheric River” contributes to the flooding potential of the area. An Atmospheric River brings warm air and rain to the West. A relatively common weather pattern brings southwest winds to the Pacific Northwest or California, along with warm, moist air. The moisture sometimes produces many days of heavy rain, which can cause extensive flooding. The warm air also can melt the snowpack in the mountains, which further aggravates the flooding potential. In the colder parts of the year, the warm air can be cooled enough to produce heavy, upslope snow as it rises into the higher elevations of the Sierra Nevada or Cascades. Forecasters and others on the West Coast often used to refer to this warm, moist air as the “Pineapple Express” because it comes from around Hawaii where pineapples are grown. A diagram of an atmospheric river event is shown in Figure 3.70.

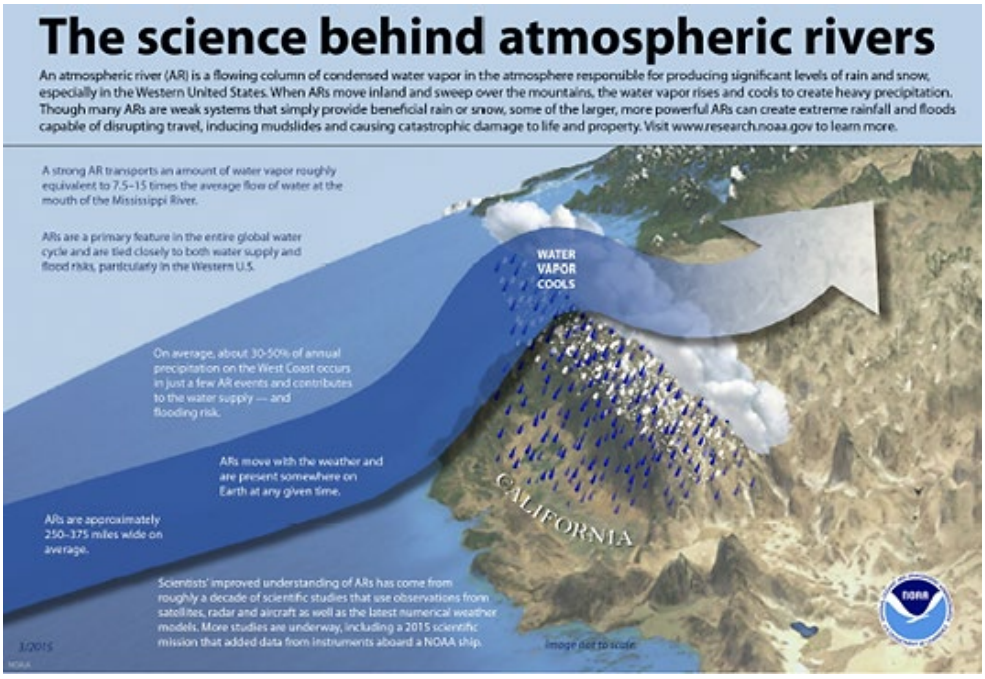


Figure 3.70: Diagram of an Atmospheric River Event
Source: NOAA

The Marin County OA is susceptible to various types of flood events. In coastal areas, flooding may occur when strong winds or tides result in a surge of seawater into areas that are above the normal high tide line. Other types of flooding in Marin include isolated ponding and stormwater overflow. Isolated ponding is when pools form on the ground and can occur in any area that doesn't drain effectively – for example, in a natural depression in the landscape. Stormwater overflow is when storm drains back up. Stormwater drainage systems quickly convey rainwater through underground pipes to creeks and the Bay. When the stormdrains are obstructed or broken or when the water bodies to which they lead to are already full, water backs up onto the streets. Although stormwater overflow and isolated ponding also occur throughout the County, the effects are typically not widespread or significantly damaging.

Location and Previous Occurrences

Figure 3.71 shows the Federal Emergency Management Agency (FEMA) flood hazard zones in the Marin County OA, using the Flood Insurance Rate Maps (FIRMs) for Marin County.

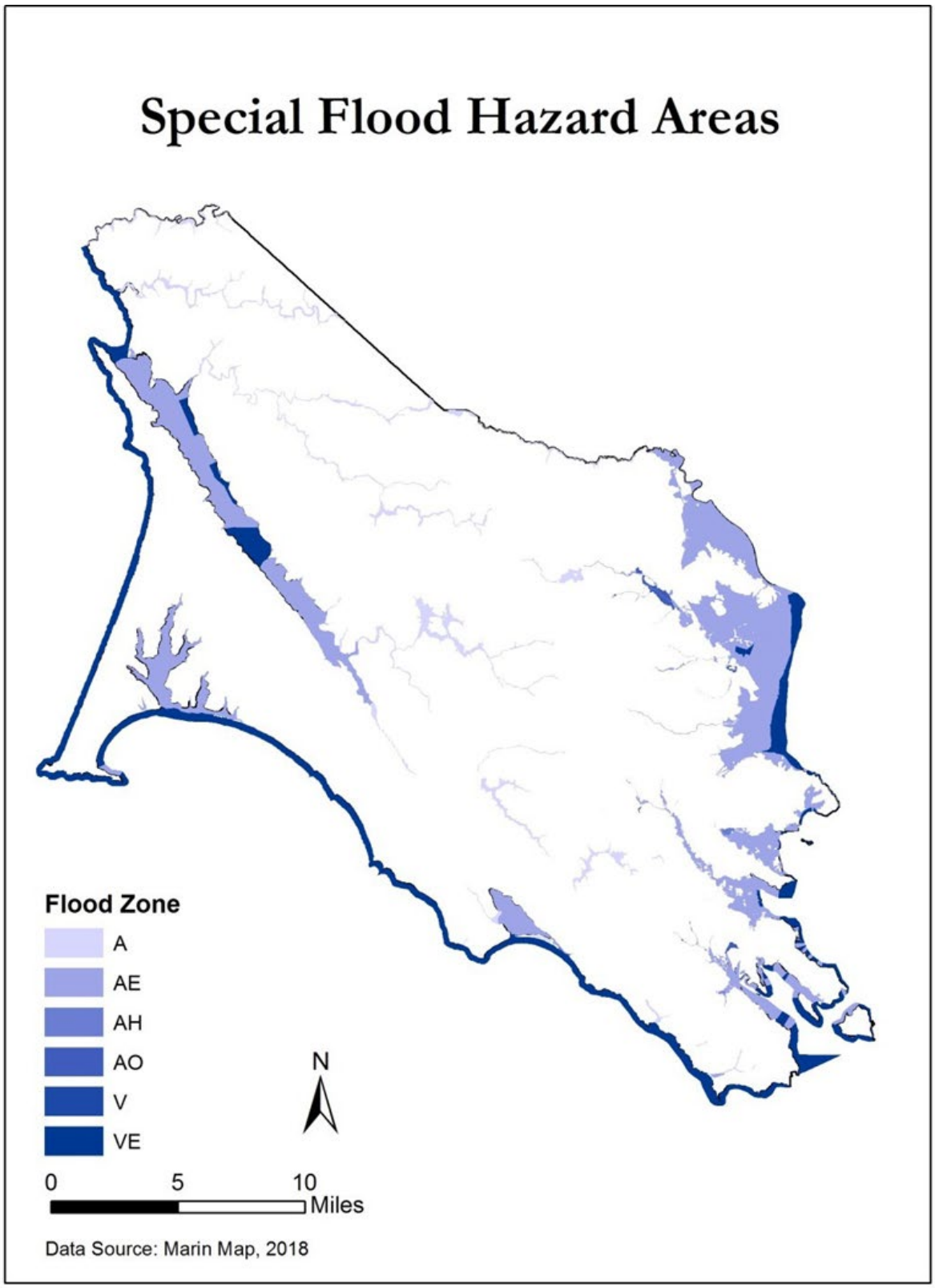


Figure 3.71: FIRM Zones in the Marin County OA
Source: FEMA

Major county watersheds where significant numbers of structures are at risk from riverine flooding include Coyote Creek, Arroyo Corte Madera del Presidio, East and West Creek watersheds, Corte Madera Creek, Novato and Rush Creeks, Miller Creek, Easkoot Creek (Stinson Beach), Gallinas Creek. Additionally, many locations along Richardson Bay, Tomales Bay, lower Las Gallinas Creek, the San Rafael Canal, East San Rafael and Novato shores, and the outer Pacific coastline are vulnerable to coastal flooding.

In many cases, where there is a significant history of flooding there is a Marin County Flood Control & Water Conservation District "Flood Zone" established. There are 8 County Flood Zones located in the following areas as described in Table 3.11 .

Table 3.11: The 100-year, 200-year and 500-year floodplains in the Marin County OA

Zone No.	Name	Location
1	Novato	**Northern Marin: Most of City of Novato and some surrounding areas within the Novato Creek watershed.**
3	Richardson Bay	**Southern Marin: Marin City watershed, Coyote Creek watershed (includes Tamalpais Valley and Almonte); Arroyo Corte Madera del Presidio watershed and Ryan Creek watershed (both include much of the City of Mill Valley), and a watershed including Sutton Manor/Alto/part of Strawberry.**
4	Bel Aire	**Southern Marin: East and West Creek watersheds which run through the Bel Aire neighborhood of the Town of Tiburon and part of (unincorporated) Strawberry.**
5	Stinson Beach	**West Marin: Part of the lower Easkoot Creek watershed at Stinson Beach**
6	San Rafael Meadows	**Central Marin: A part of the Las Gallinas Creek watershed in the City of San Rafael across from the County Civic Center.**
7	Santa Venetia	**Central Marin: The unincorporated community of Santa Venetia along Las Gallinas Creek.**
9	Ross Valley	**Central Marin: The Corte Madera Creek watershed, including the towns of Fairfax, San Anselmo, Ross, and Larkspur, as well as unincorporated parts of San Anselmo, Fairfax, Kentfield and Greenbrae.**
10	Inverness	**West Marin: Inverness, along the west shore of Tomales Bay and the East flank of Inverness Ridge.**

Figure 3.72: The 100-year, 200-year and 500-year floodplains in the Marin County OA.

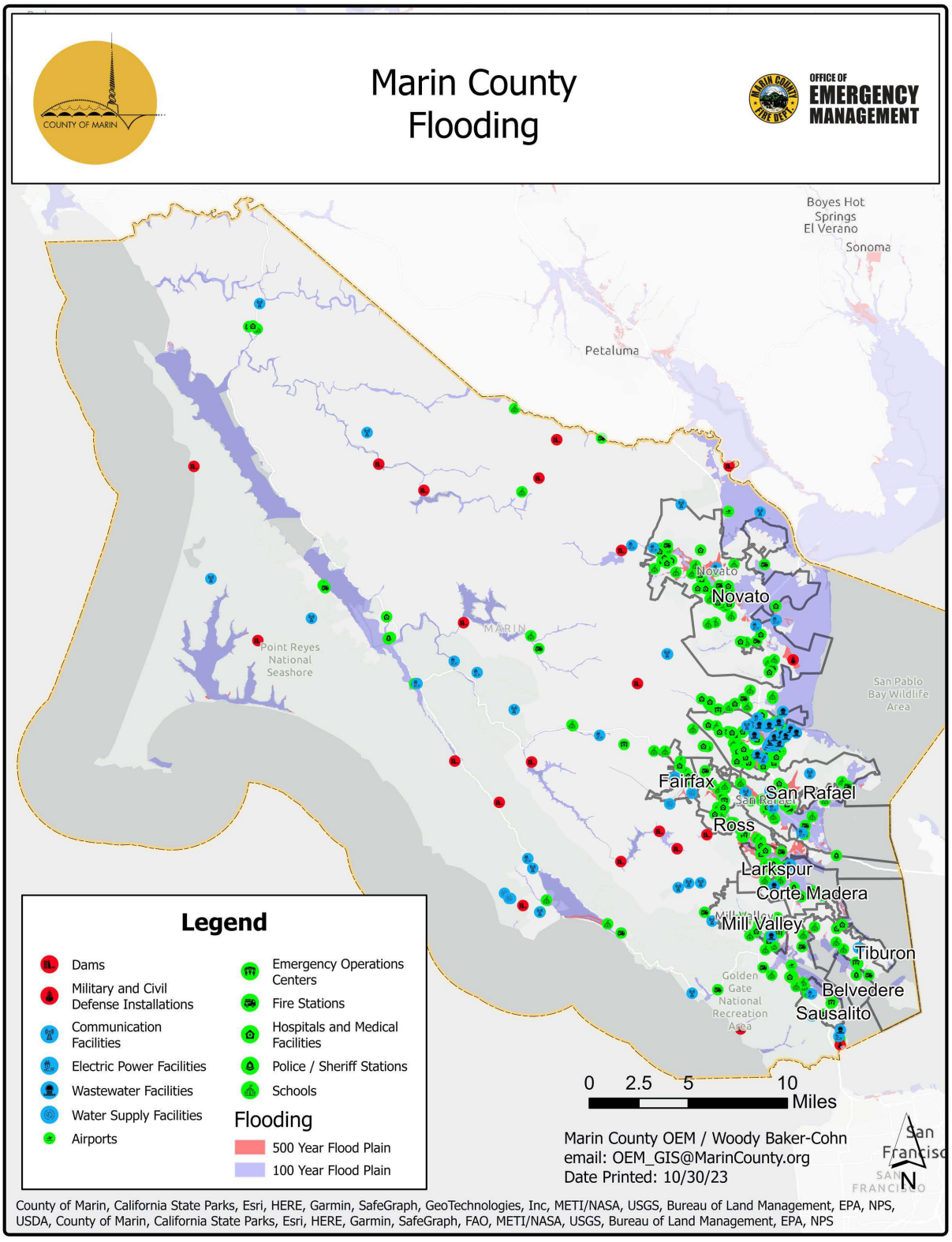


Figure 3.73: 100, 200, 500-Year Floodplains in the Marin County OA
Source: Marin OEM

Several unincorporated communities in Marin County lie in a special flood hazard area (the 100-year floodplain), which are shown below along with the 500-year floodplain, where applicable.

Figure 3.74 shows the 100-year floodplain in the Lagunitas area.

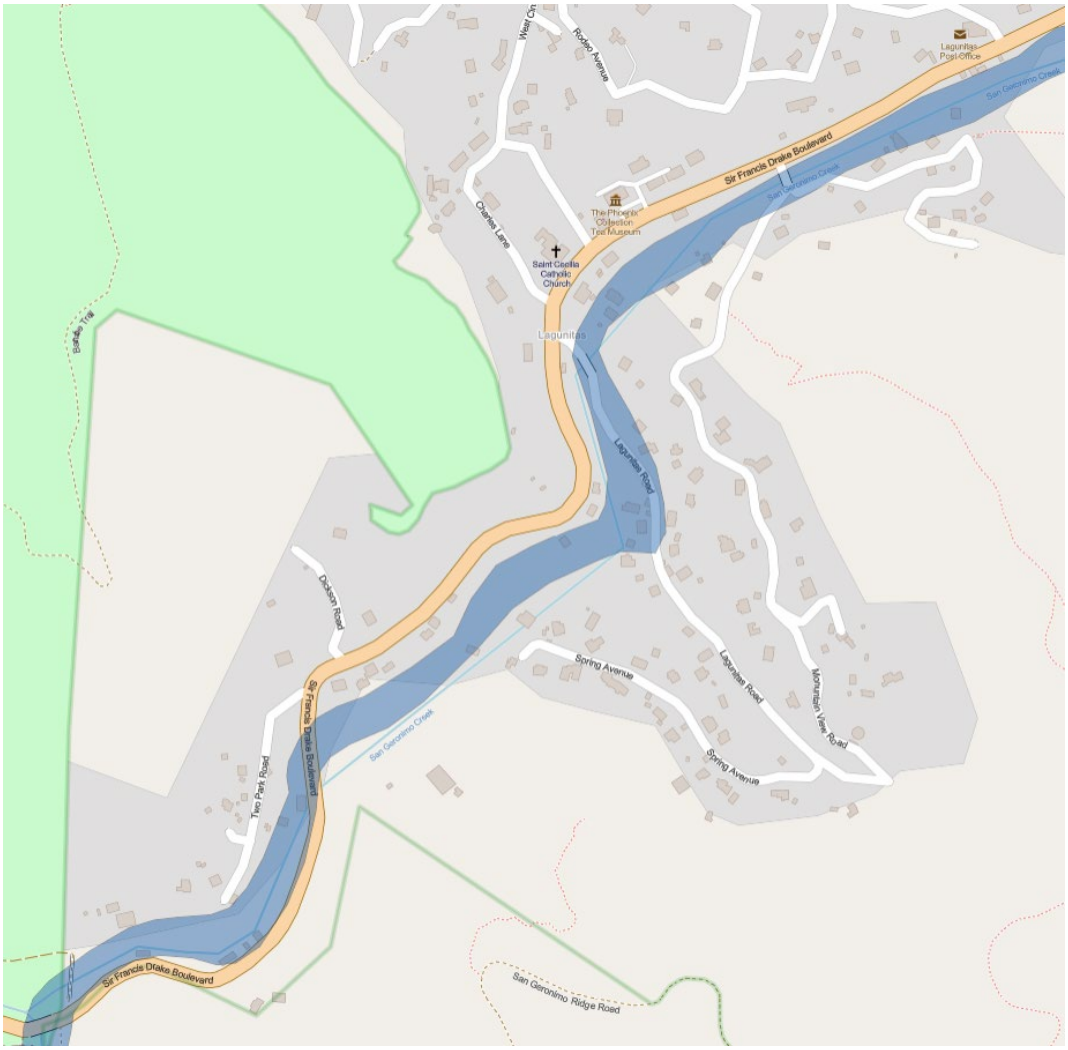


Figure 3.74: 100-Year Floodplain – Lagunitas
Source: Marin County, 11/27/23

Figure 3.75 shows the 100-year floodplain in the Forest Knolls are.

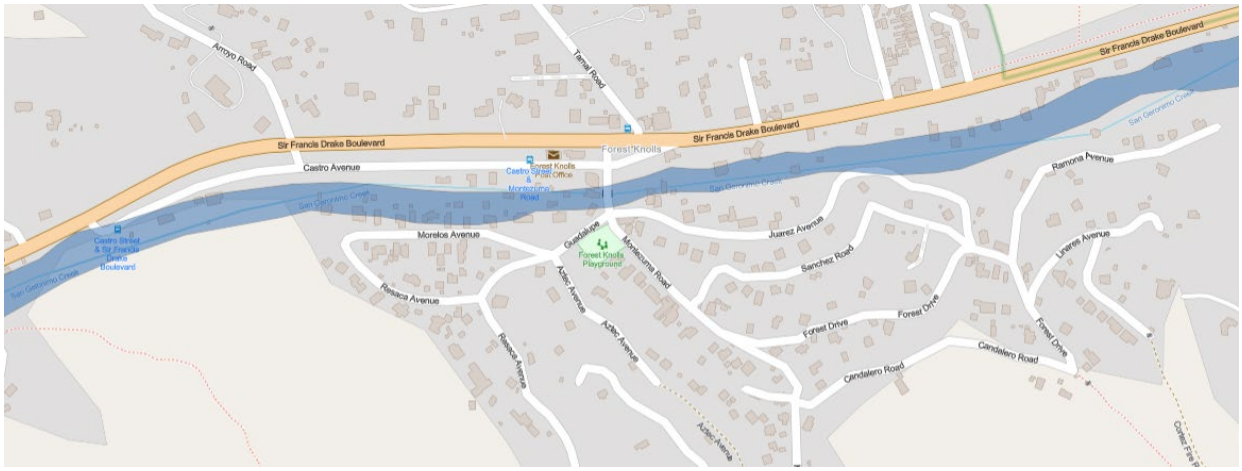


Figure 3.75: 100-Year Floodplain – Forest Knolls Area
Source: Marin County, 11/27/23

Figure 3.76 shows the 100-year floodplain in the San Geronimo area.

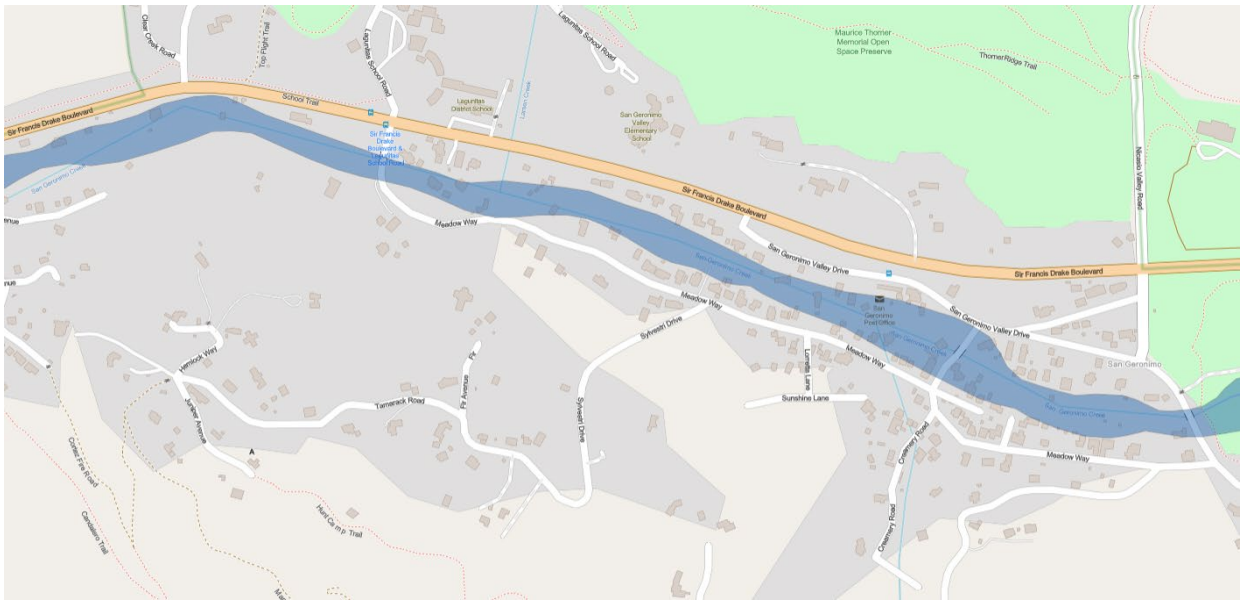


Figure 3.76: 100-Year Floodplain – San Geronimo Area
Source: Marin County, 11/27/23

Figure 3.77 shows the 100-year floodplain in the Woodacre area.

Figure 3.77: 100-Year Floodplain – Woodacre Area
Source: Marin County, 11/27/23

Figure 3.78 shows the 100-year floodplain in Tocoloma.

Figure 3.78: 100-Year Floodplain – Tocoloma
Source: Marin County, 11/27/23

Figure 3.79 shows the 100-year floodplain in Nicasio.

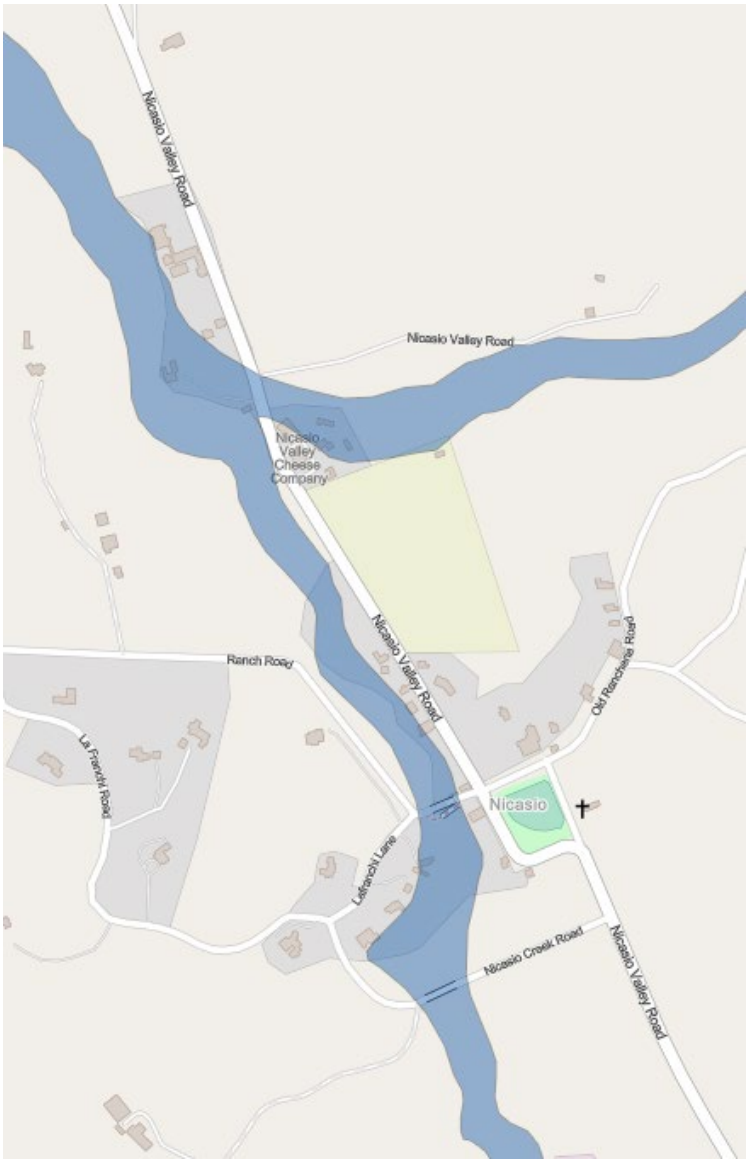


Figure 3.79: 100-Year Floodplain – Nicasio
Source: Marin County, 11/27/23

Figure 3.80 shows the 100-year floodplain outside of Nicasio to the east.

Figure 3.80: 100-Year Floodplain –Nicasio East
Source: Marin County, 11/27/23

Figure 3.81 shows the 100-year floodplain in Olema.

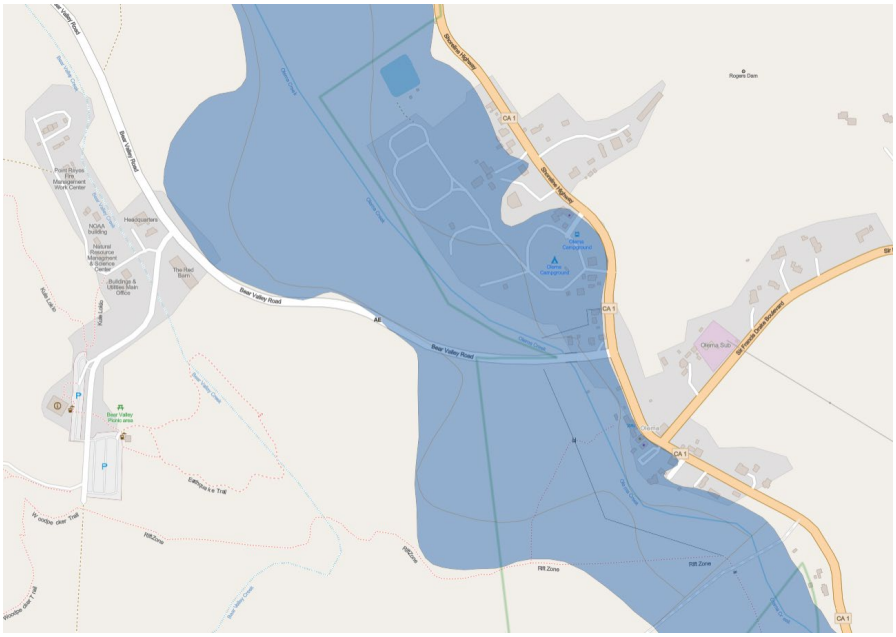


Figure 3.81: 100-Year Floodplain –Olema
Source: Marin County, 11/27/23

Figure 3.82 shows the 100-year floodplain in Point Reyes Station and the area immediately south.

Figure 3.82: 100-Year Floodplain – Point Reyes Station Area - South
Source: Marin County, 11/27/23

Figure 3.83 shows the 100-year floodplain in the northern end of Point Reyes Station.

Figure 3.83: 100-Year Floodplain – Point Reyes Station Area - North
Source: Marin County, 11/27/23

Figure 3.84 shows the 100-year floodplain in the Inverness Park area.

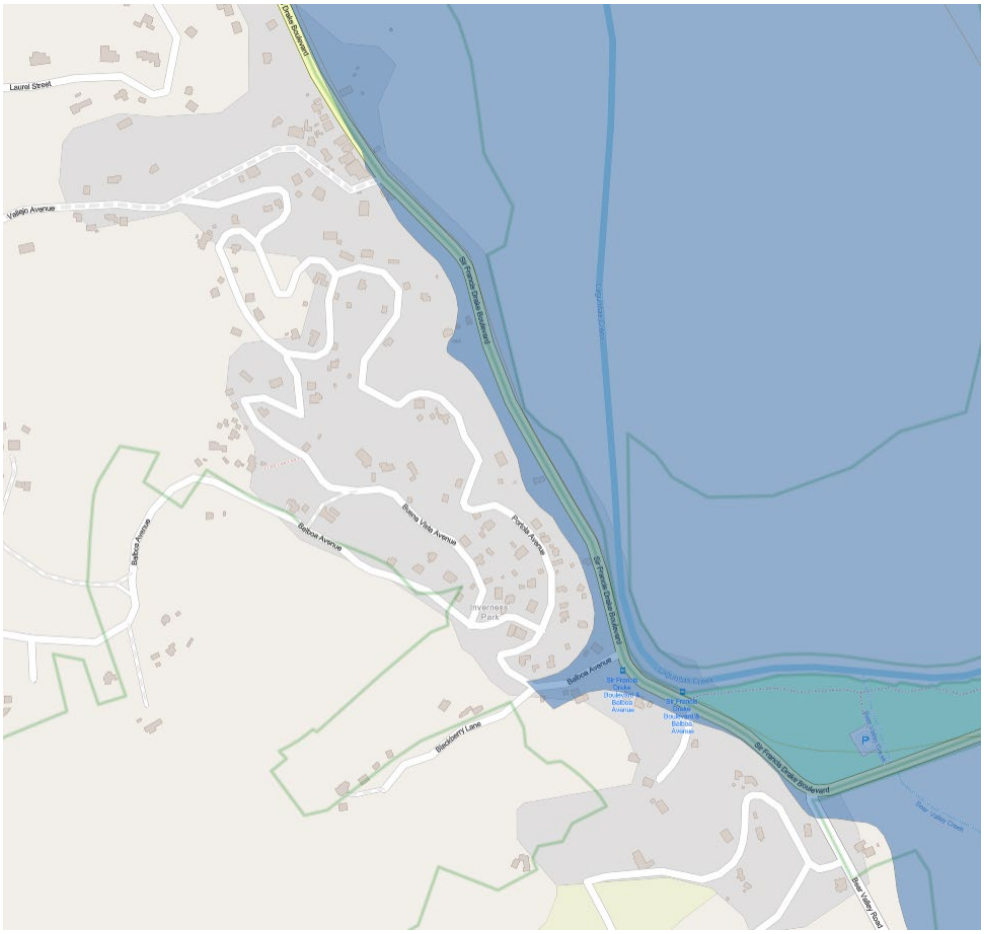


Figure 3.84: 100-Year Floodplain – Inverness Park Area
Source: Marin County, 11/27/23

Figure 3.85 shows the 100-year floodplain in the area south of Inverness.

Figure 3.85: 100-Year Floodplain – Inverness South
Source: Marin County, 11/27/23

Figure 3.86 shows the 100-year floodplain in Inverness.

Figure 3.86: 100-Year Floodplain – Inverness
Source: Marin County, 11/27/23

Figure 3.87 shows the 100-year floodplain in Reynolds/Marconi area.

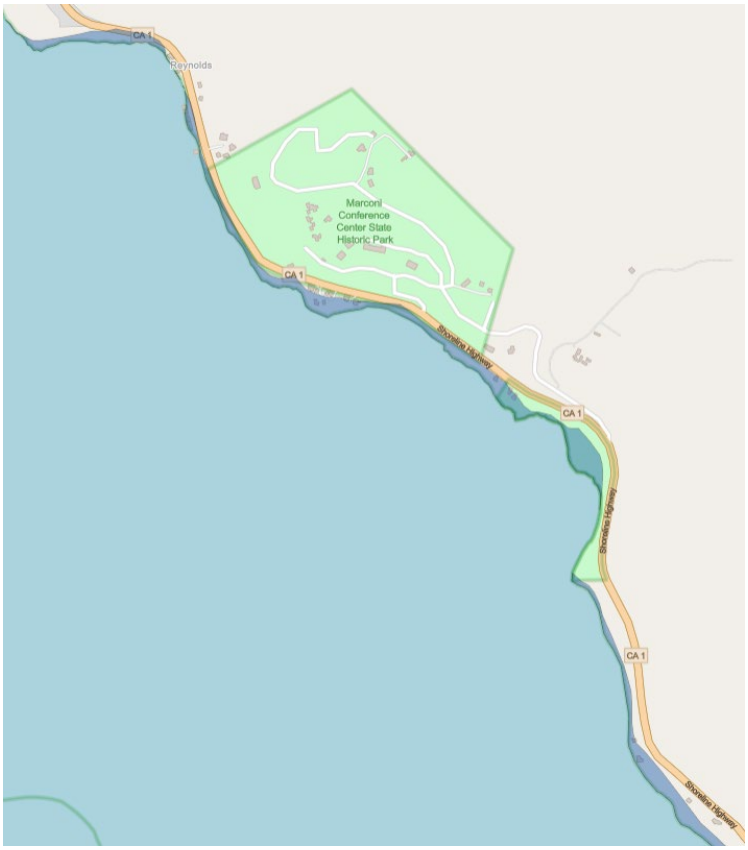


Figure 3.87: 100-Year Floodplain – Reynolds and Marconi Area
Source: Marin County, 11/27/23

Figure 3.88 shows the 100-year floodplain in the Marshall area.

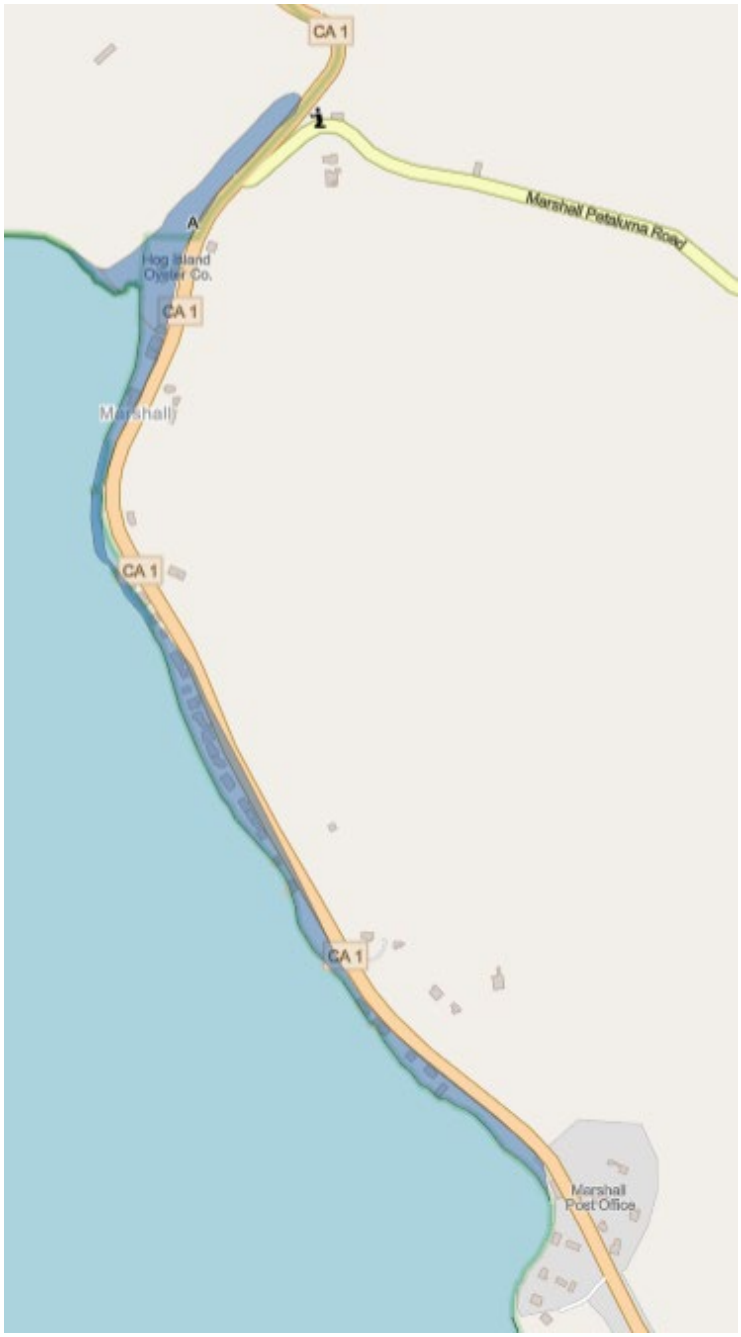


Figure 3.88: 100-Year Floodplain – Marshall Area
Source: Marin County, 11/27/23

Figure 3.89 shows the 100-year floodplain in the Tomales area.

Figure 3.89: 100-Year Floodplain – Tomales Area
Source: Marin County, 11/27/23

Figure 3.90 shows the 100-year floodplain in the area north of Bolinas.

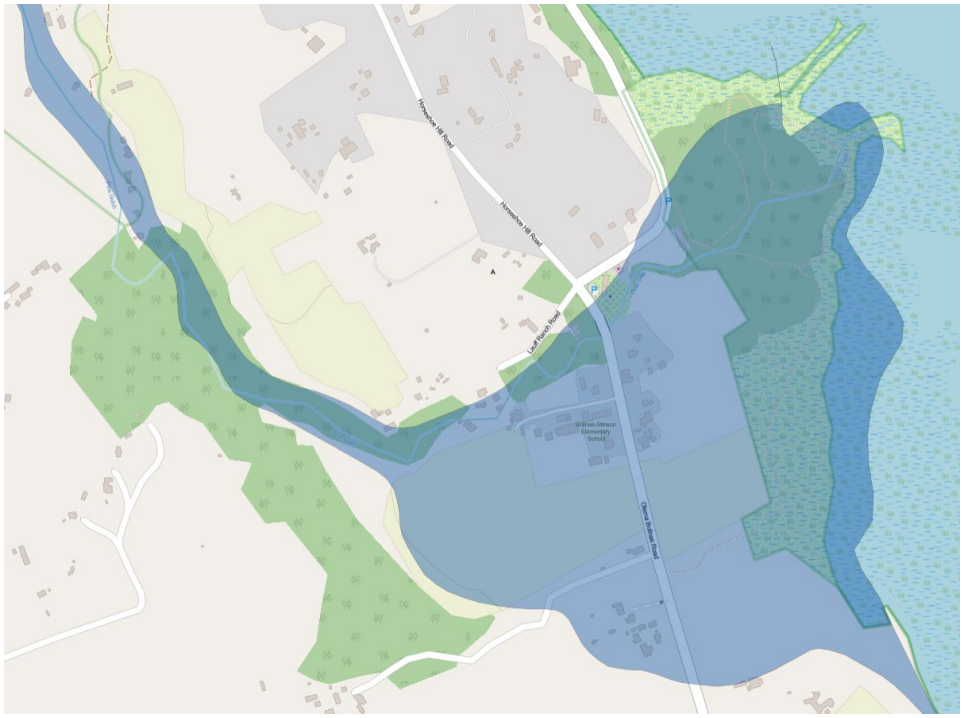


Figure 3.90: 100-Year Floodplain – Bolinas North
Source: Marin County, 11/27/23

Figure 3.91 shows the 100-year floodplain (blue) and the 500-year floodplain (brown) in Bolinas and the area west of Stinson Beach.

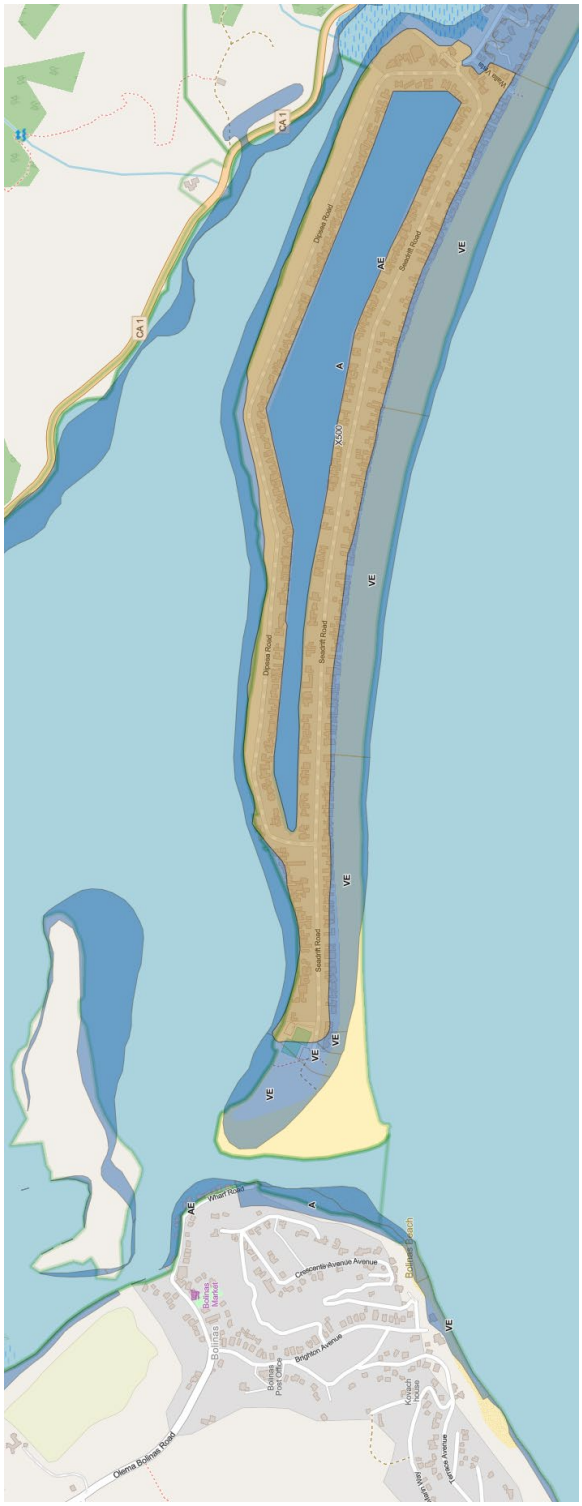


Figure 3.91: 100-Year and 500-Year Floodplain – Bolinas and Stinson Beach West
Source: Marin County, 11/27/23

Figure 3.92 shows the 100-year floodplain (blue) and the 500-year floodplain (brown) in Stinson Beach.

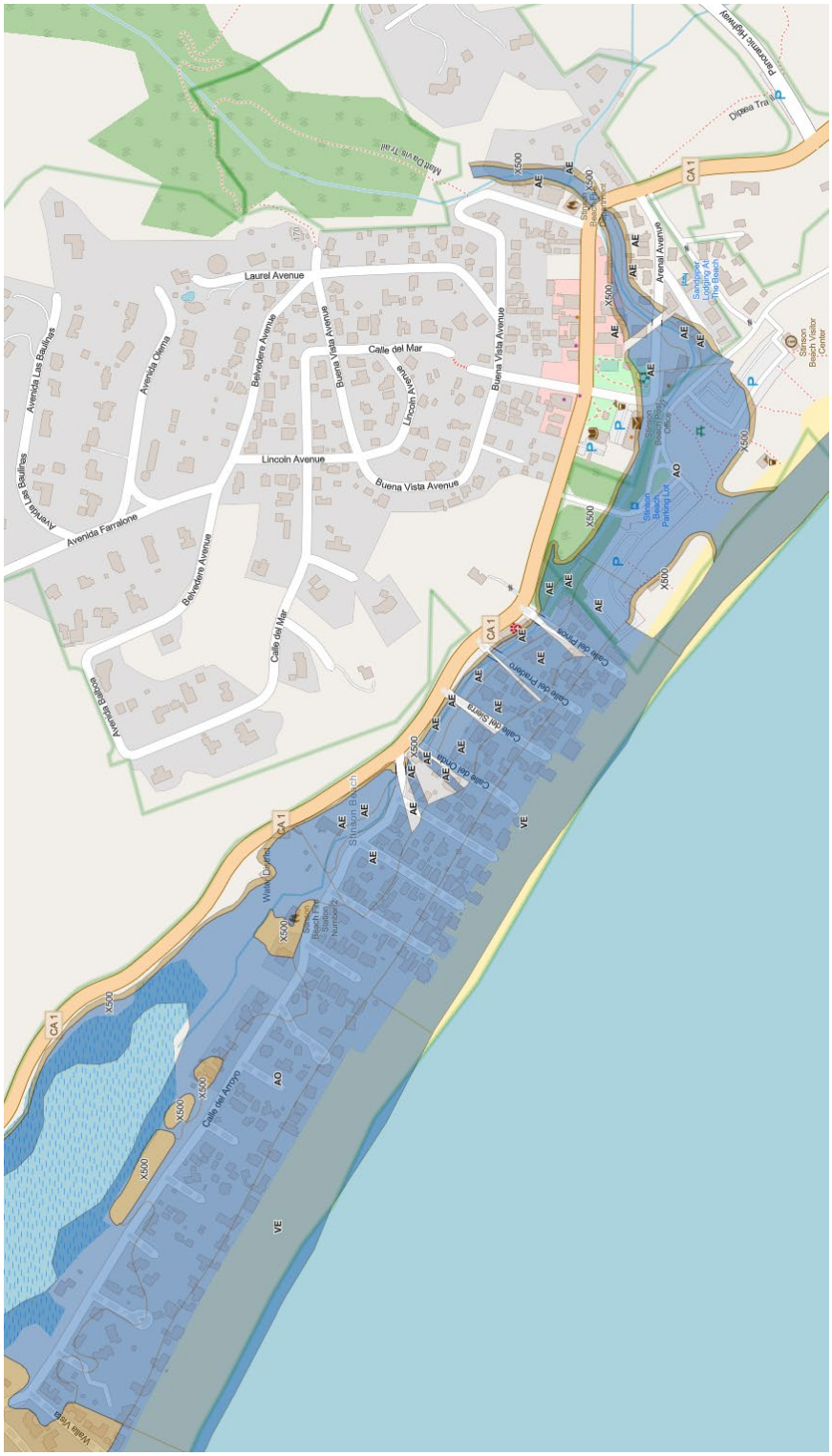


Figure 3.92: 100-Year and 500-Year Floodplain – Stinson Beach
Source: Marin County, 11/27/23

Figure 3.93 shows the 100-year floodplain in Muir Beach.

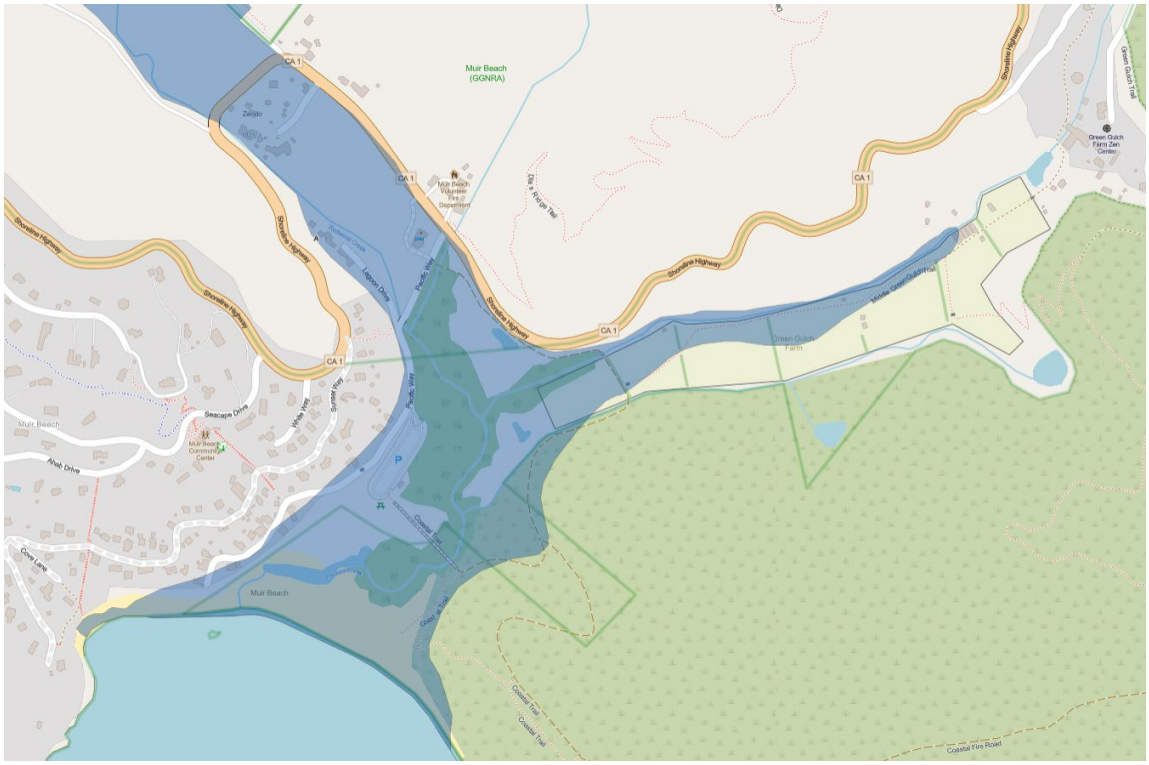


Figure 3.93: 100-Year and 500-Year Floodplain – Muir Beach
Source: Marin County, 11/27/23

Figure 3.94 shows the 100-year floodplain (blue) and the 500-year floodplain (brown) in the Tamalpais Valley Area.

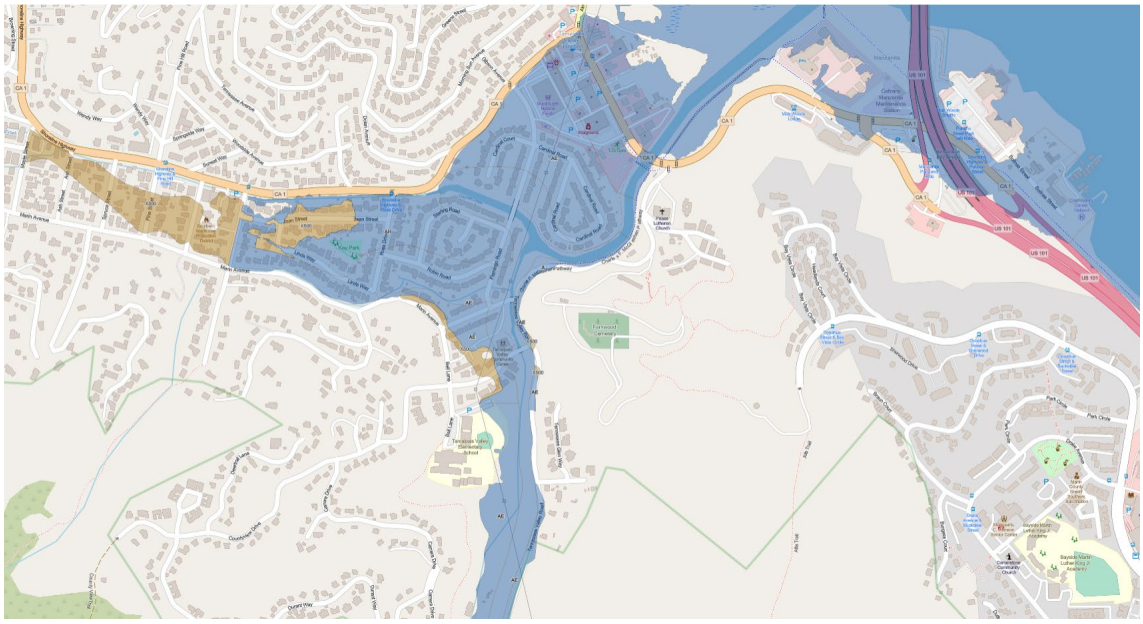


Figure 3.94: 100-Year and 500-Year Floodplain – Tamalpais Valley Area
Source: Marin County, 11/27/23

Figure 3.95 shows the 100-year floodplain in Alto and Strawberry.

Figure 3.95: 100-Year and 500-Year Floodplain – Alto and Strawberry
Source: Marin County, 11/27/23

Figure 3.96 shows the 100-year floodplain (blue) and the 500-year floodplain (brown) in Kentfield and Greenbrae.

Figure 3.96: 100-Year and 500-Year Floodplain – Kentfield and Greenbrae
Source: Marin County, 11/27/23

Figure 3.97 shows the 100-year floodplain in California City.

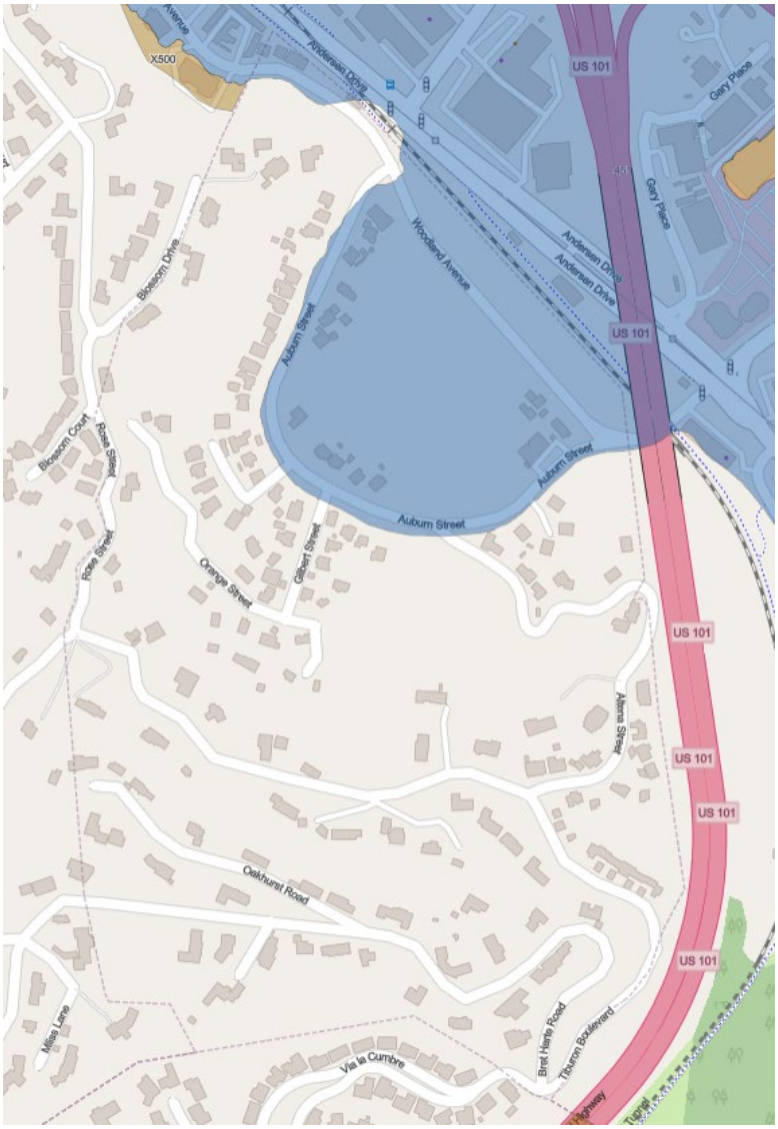


Figure 3.97: 100-Year Floodplain – Marin City
Source: Marin County, 11/27/23

Figure 3.98 shows the 100-year floodplain in Lucas Valley and Marinwood.

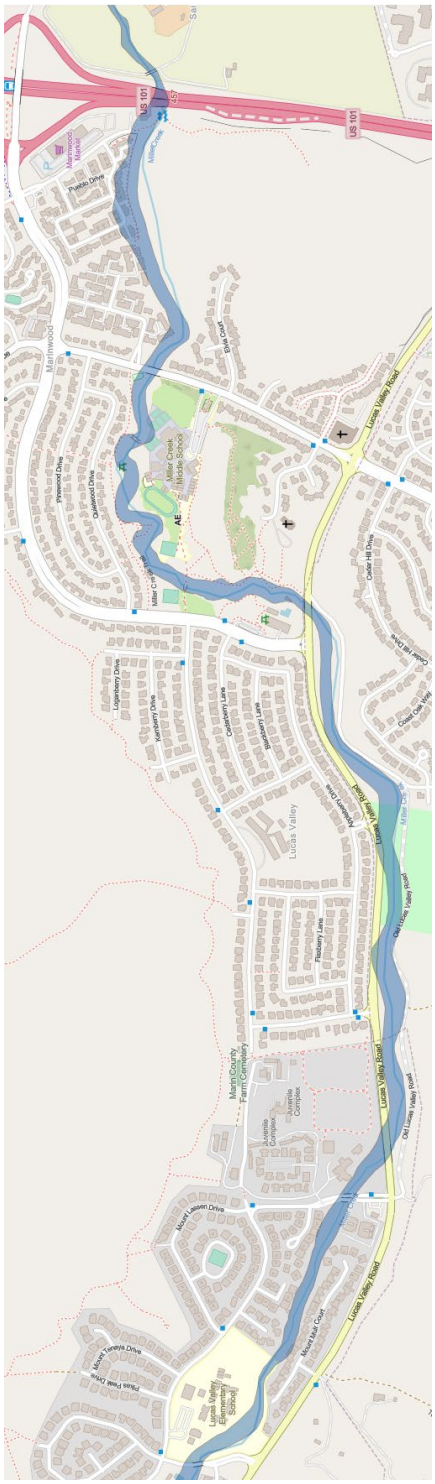


Figure 3.98: 100-Year Floodplain – Lucas Valley and Marinwood
Source: Marin County, 11/27/23

Figure 3.99 shows the 100-year floodplain in Saint Vincent.

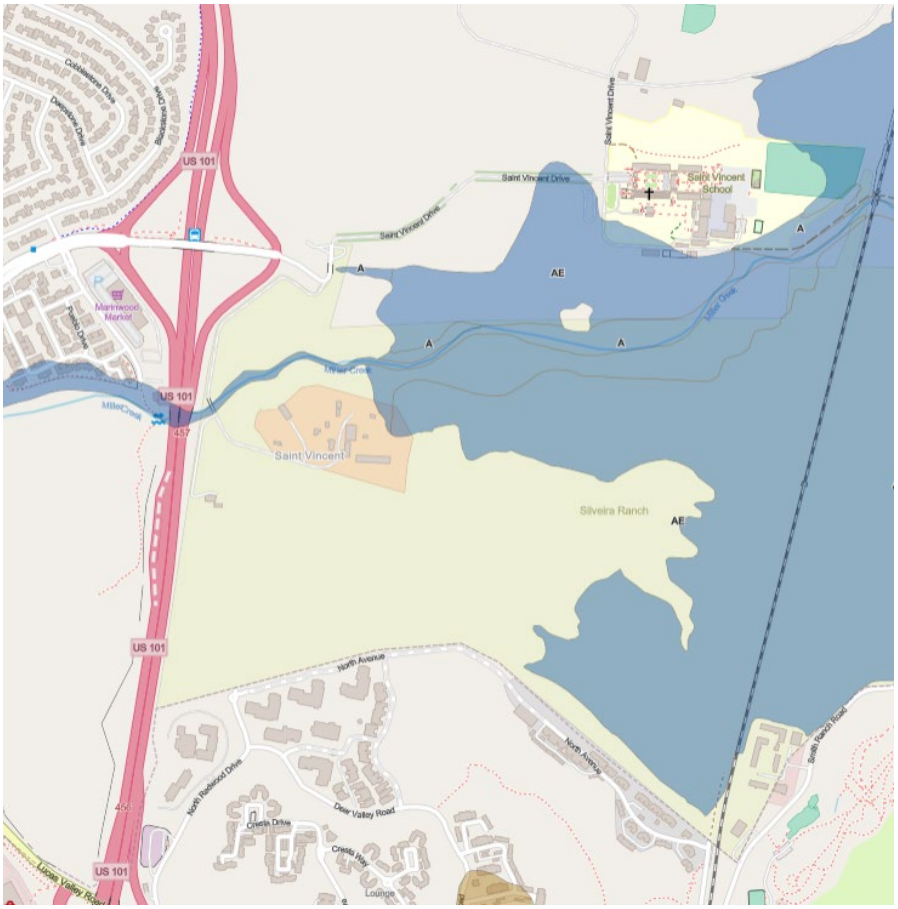


Figure 3.99: 100-Year Floodplain – Saint Vincent
Source: Marin County, 11/27/23

Figure 3.100 shows the 100-year and 500-year floodplain in the Santa Venetia area.

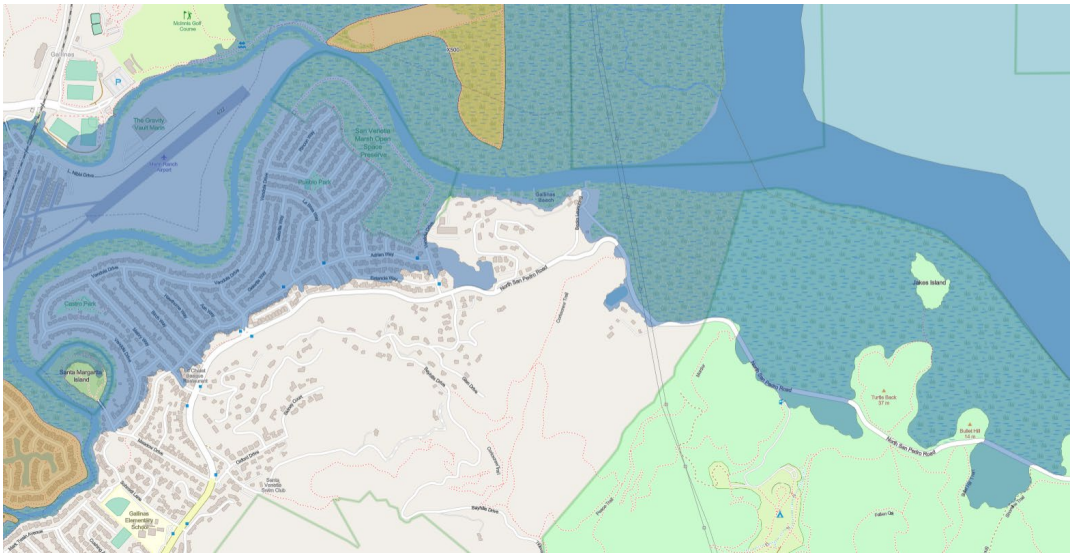


Figure 3.100: 100-Year and 500-Year Floodplain – Santa Venetia Area
Source: Marin County, 11/27/23

Figure 3.101 shows the 100-year floodplain (blue) and the 500-year floodplain (brown) in the San Pedro Hill area.

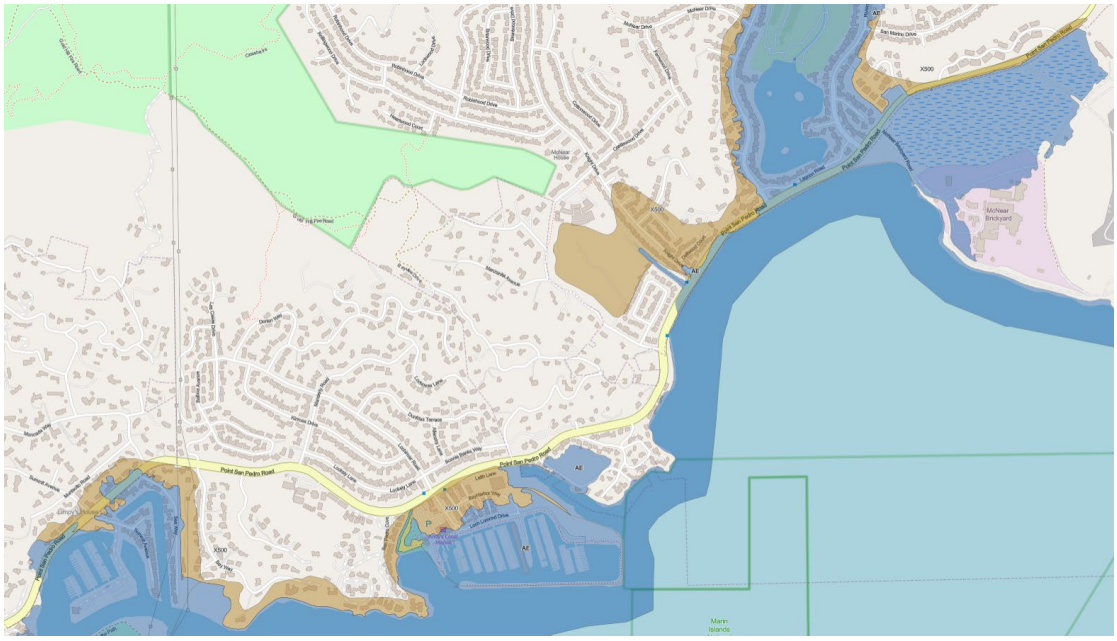


Figure 3.101: 100-Year and 500-Year Floodplain – San Pedro Hill Area
Source: Marin County, 11/27/23

Figure 3.102 shows the 100 and 500-year floodplains in Novato with critical facilities including the Marin County Landfill and the Marin County Airport.

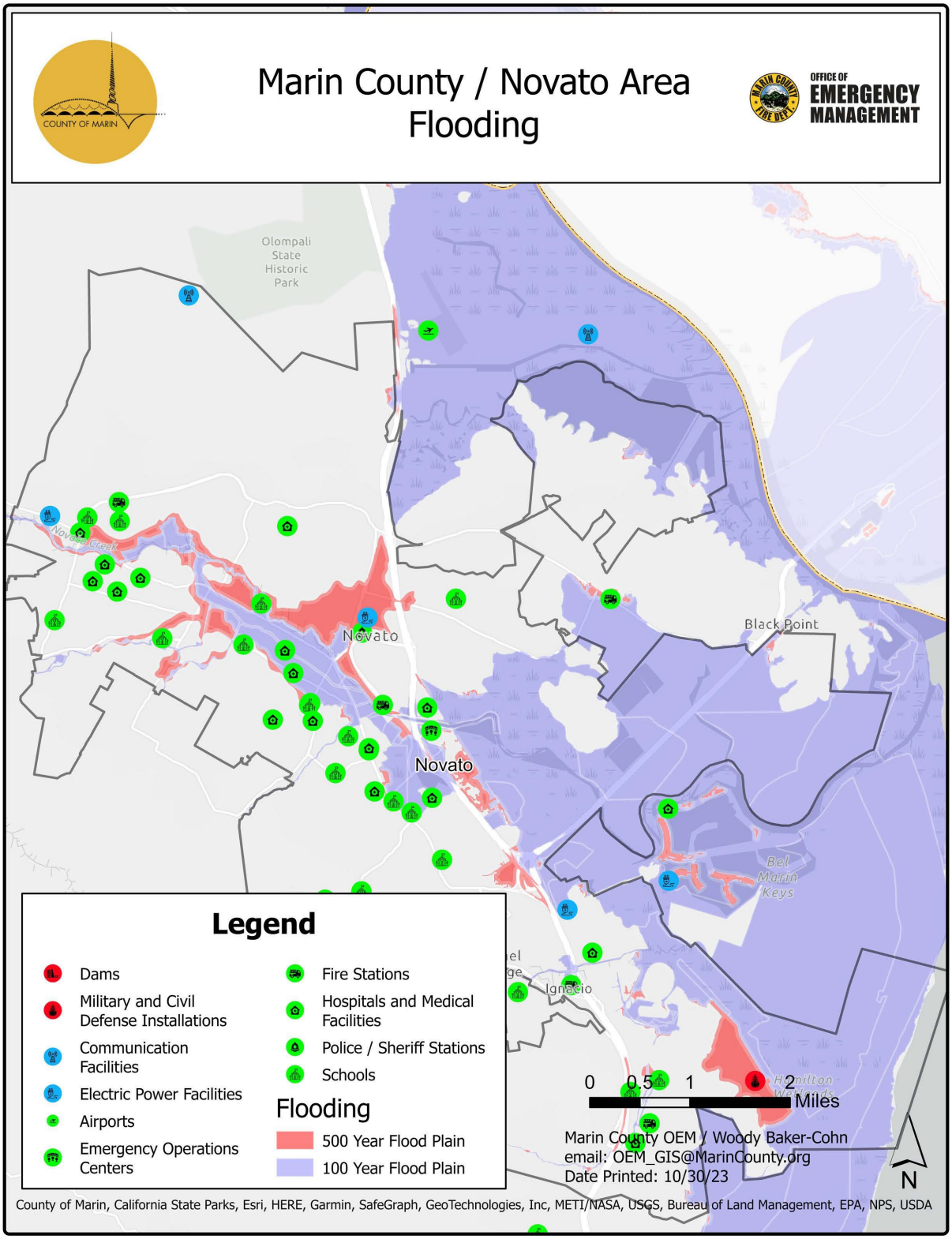


Figure 3.102: Novato Flooding - Marin County Landfill and Marin County airport
Source: Marin County

Figure 3.103 shows the100- and 500-year floodplain in San Rafael Area.

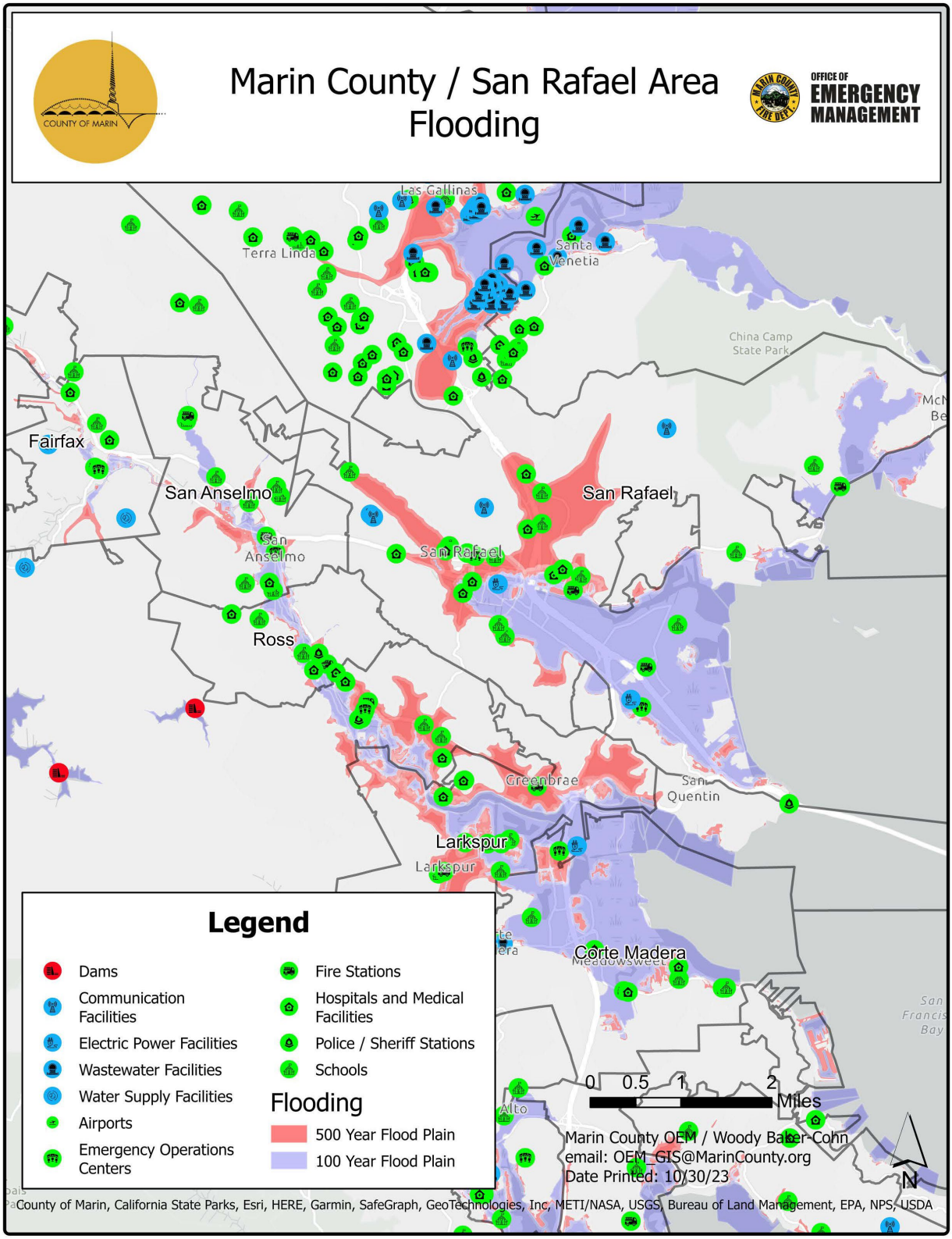


Figure 3.103: Flooding in San Rafael Area
Source: Marin County OEM

Figure 3.104 shows the 100-year floodplain in Bel Marin Keys.

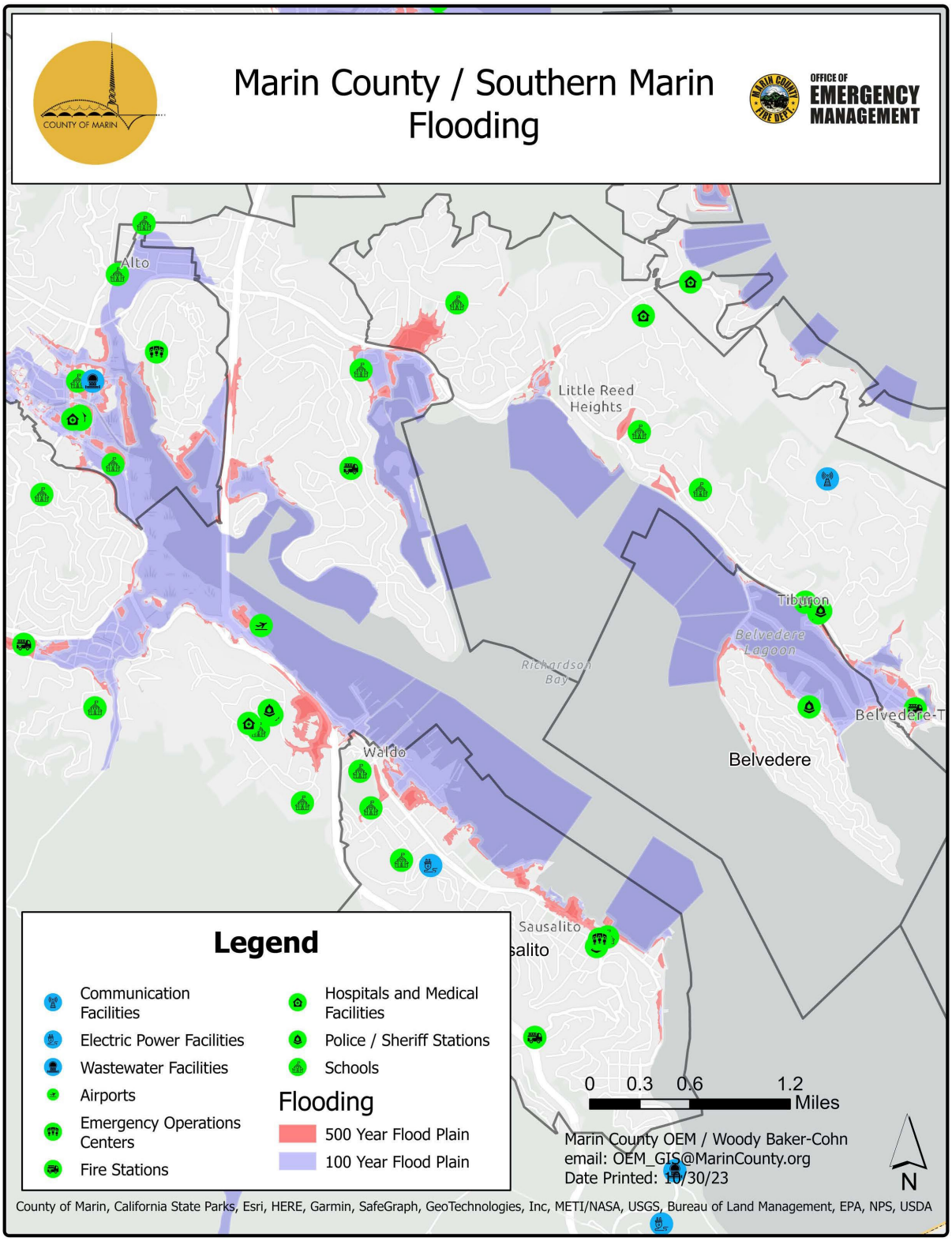


Figure 3.104: 100-Year Floodplain – Bel Marin Keys
Source: Marin County OEM

Figure 3.105 shows the 100-year floodplain in Bolinas.

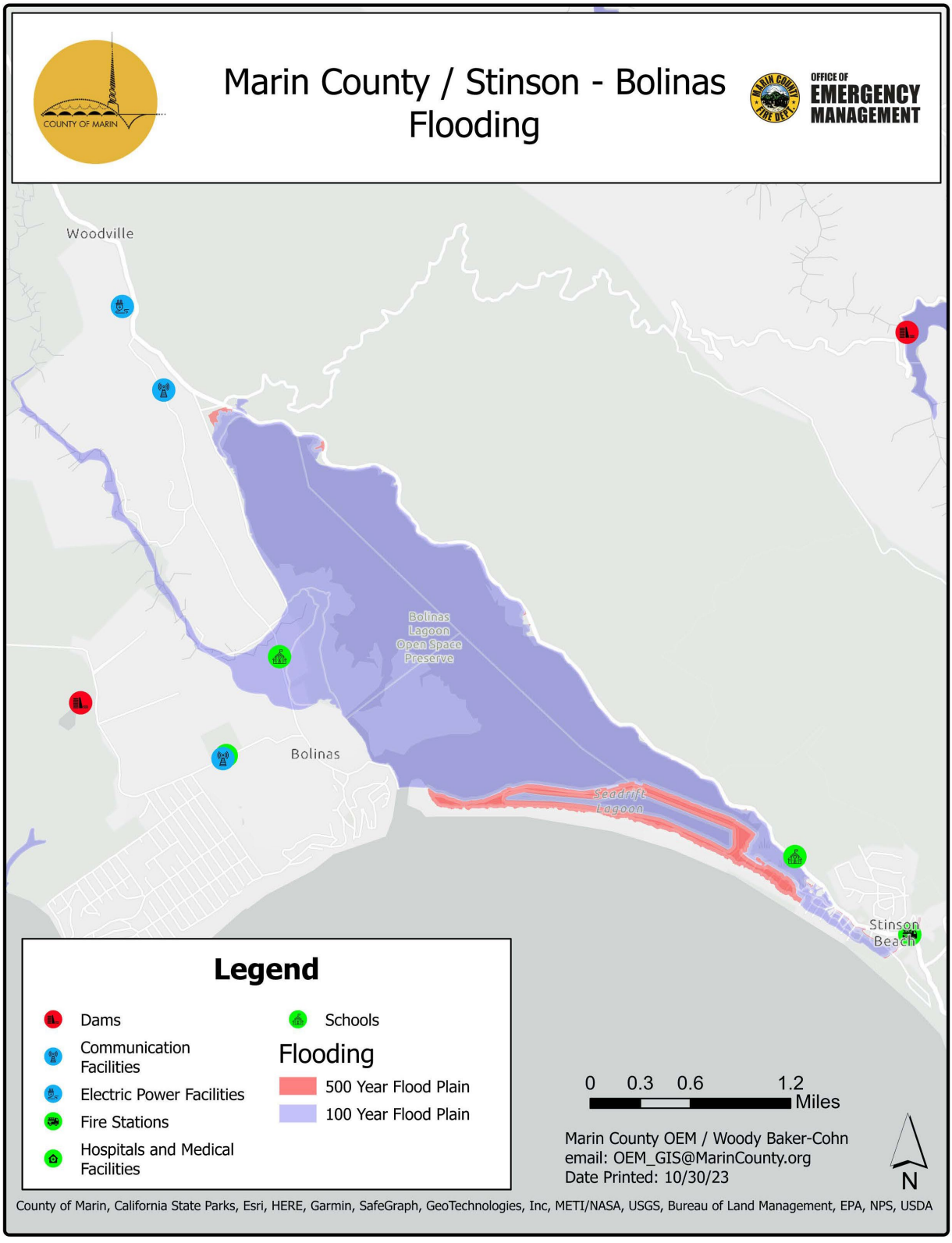


Figure 3.105: Stinson - Bolinas Area Flooding
Source: Marin County OEM

Figure 3.106 shows flood control zones in the Marin County OA.

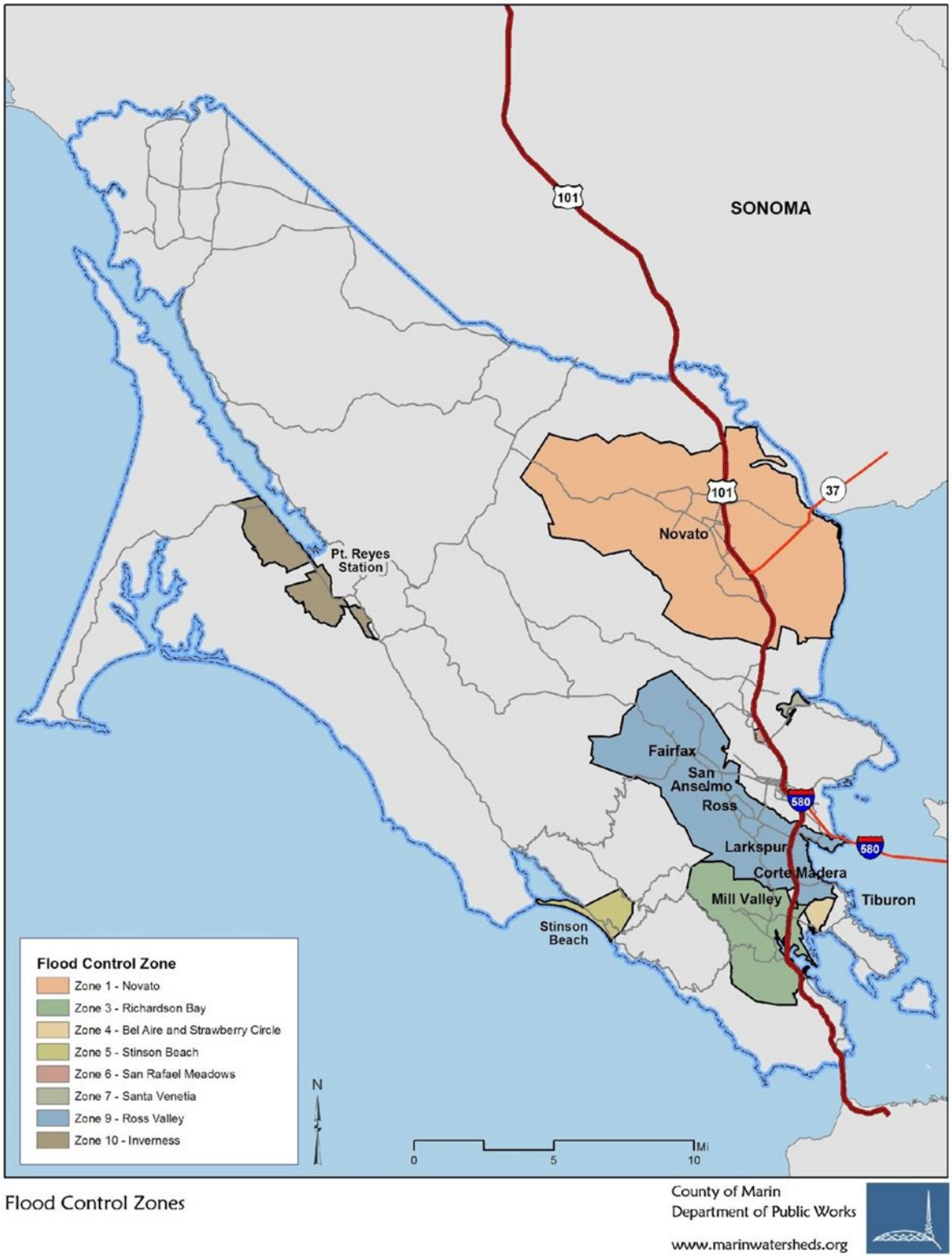


Figure 3.106: Flood Control Zones in the Marin County OA
Source: Marin County

Novato Creek in the northern part of the county historically caused damage to large numbers of homes, particularly in the 1960's, until the Novato Flood Control Project was completed in eight construction phases starting in the 1980's and continuing through 2006. Novato still experiences some damage during significant winter storms despite the completed Novato Creek Flood Control project. Power outages are also a frequent problem for one of the major pump stations in the area.

Although the current Corte Madera Creek Flood Control project is partially complete (Unit 4 in the Town of Ross is yet to be constructed), flooding will still occur for storms greater than about a 5-year recurrence flood event. Potentially all nine southerly and some centrally located communities of the Marin County OA on this creek are impacted by high tides and heavy rains in above average winter storms. The north-east part of the county, densely populated around the floodplain zones, is threatened every winter and still experiences some damage during winter storms despite the completed Novato Creek Flood Control project.

Since the middle of the last century, the winter/spring storms of 1950, 1955*, 1958*, 1963, 1964*, 1965, 1969*, 1970*, 1973*, 1978, 1980, 1982*, 1983*, 1986*, 1995*, 1996, 1997*, 1998*, 2002, 2005/2006*, 2006*, 2008, 2014, 2017, 2019 and 2023 caused significant damage across the Marin County OA.

*Major Federal Disasters declared for flood.

Flooding in December 1964 and January 1965 had widespread impacts across the Marin County OA. Floods were generally moderate to high. Precipitation was heavy in the San Rafael-Kentfield area. From December 19th-23rd, precipitation was 8.49 inches at Kentfield. From January 2nd-7th, precipitation at Kentfield was 7.45 inches. The flow in Corte Madera Creek was moderate but the stream flows and overflows of drains caused some local flooding in areas that are subject to frequent flooding in Kentfield. Flood flows in the Walker Creek basin in the northwestern part of Marin County exceeded previous maximum flows.

A major winter storm originating over the Pacific Ocean moved through Marin County in early January 1982. The maximum rainfall from an area of high rainfall in southern Marin County was about 16 inches. The center of this storm was near Kentfield. Large areas of southern and western Marin County had total storm rainfall exceeding 10 inches. Numerous towns were under water, homes and businesses were destroyed, and many roads were damaged across the Marin County OA. The Inverness area was especially hit hard with floodwaters and debris flows.

Figure 3.107: Damage in Inverness from 1982 Storm
Source: Jack Mason Museum of West Marin History

The New Year's Eve 2005-2006 flood caused widespread damage in the Marin County OA. Easkoot Creek in Stinson Beach overflowed its banks. At least $219 million in damage was reported in the Marin County OA due to this storm. Over a thousand homes, apartments and businesses across the OA were damaged or destroyed. The Marin City exit off of Highway 101 was inundated with water and water covered all but one lane of southbound 101, creating a giant traffic jam. Western Marin County was scattered with downed trees, flooded roadways and mudslides.

In 2014, Marin County sustained an estimated $13,321,134 in damage from flooding, mudslides, winds, high tides and other storm damage from a December 10th-11th downpour. There was an estimated $9,324,134 in damage to public property and $3,997,000 in private damages includes 34 homes, 11 businesses and two outbuildings.

In 2017, a powerful February storm thrashed Marin County. Kentfield received 6.3 inches of rain in a 24-hour period. Other rainfall totals for the period included 2.3 inches in Point Reyes. The College of Marin closed its Kentfield campus because of the storm, and nine school districts canceled classes. Eleven private schools were closed. Pacific Gas and Electric Co. reported thousands of power outages in Marin, including in Kentfield and Lagunitas. Olema Road was closed at Westbrae Drive because of mud, flooding and debris, and flooding was reported on Sir Francis Drake Boulevard at the Bon Air Shopping Center in Greenbrae. In the San Geronimo Valley, flooding closed Sir Francis Drake Boulevard at West Cintura Avenue in Lagunitas. The National Park Service closed Muir Woods National Monument because of the weather. The Lagunitas School District and the Laguna Joint School canceled classes, while the Bolinas-Stinson Union School District closed the Stinson Beach campus and held classes at the Bolinas campus.

In 2019, a storm on February 13th brought heavy rains to Marin County, saturating the ground and exacerbating high tides. County-maintained roads washed out and creeks overflowed their banks, endangering public infrastructure. Flooding occurred in Marin City and was particularly severe in areas of rural Marin. Highway 1 was impassable south of Tomales Petaluma Road and Sir Francis Drake Boulevard was only passable with high-clearance vehicles at Mount

Vision Road in Inverness. Rainfall totals for the storm included 4.3 inches on Mount Tamalpais and 4.16 inches in Kentfield.

Figure 3.108: Flooding in Marin City – 2019 Storm
Source: Marin Independent Journal

In 2023, a storm on January 9th battered Marin county with rain and wind. Rainfall totaled 0.91 inches in Dillon Beach, 1.14 inches in Point Reyes Station, 1.69 inches in Kentfield, 3.04 inches in Woodacre and 2.04 inches on the middle peak of Mount Tamalpais. The Lagunitas School District, Shoreline Unified School District and two elementary schools in the Ross Valley School District stayed closed. More than 4,700 PG&E customers across the Marin County OA had no power at one point.

Impacts

Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues throughout the Marin County OA, including in the unincorporated area. Floodwaters can transport large objects downstream, which can damage or remove stationary structures. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utilities lines and interrupt services. Standing water can cause damage to crops, roads, foundations, and electrical circuits. Certain health hazards are also common to flood events. Standing water can also cause septic tank failure and well contamination. Standing water and wet structures can become breeding grounds for microorganisms such as bacteria, mold, and viruses. This can cause disease, trigger allergic reactions, and damage materials long after the flood. When floodwaters contain sewage or decaying animal carcasses, infections become a concern. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts from any type of flooding.

Certain health hazards are also common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle and hogs are kept or their wastes are stored can contribute polluted waters to the receiving streams.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e. coli and other disease-causing agents. Floodwaters may scour stream banks, edging properties closer to the floodplain or causing structures to collapse into floodwaters. 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 storm drains.

The second type of health problem arises after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If a water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Additional growth in or around the Marin County OA could contribute to increased flooding in the county. Many historic and cultural resources are located in the mapped flood zones.

The impact of damage resulting from the flooding hazard, as mentioned, can be extremely variable. Nevertheless, most damage results from rising water that inundates residences and buildings, damage to infrastructure and critical facilities, and loss of ingress and egress by the population in the affected areas and the inability of the jurisdictions emergency response capabilities. Damage from flooding can range from minimal, where the damage to an individual home can be on the order of a few thousand dollars to the complete loss of a building or loss of life from the inability to evacuate from the rising floodwaters.

The diversity and dispersion of the Marin County OA's flood hazards, in addition to the tendency for floods to be flashy in nature, make response to emergencies more difficult and increase the need for planning and community awareness in areas of increased flood risk. While property damage to structures within 100-year flood zones is a major concern, damage to roads, utilities, and other supporting infrastructure located in these zones can potentially impact areas of the community outside of the flood zones as well.

Arroyo Corte Madera del Presidio is at risk of overtopping due to less than a 5-year flow. On average Corte Madera Creek and Easkoot Creek are at risk of overflowing their banks due to 5-10 year flow events. Novato Creek overflows in some locations due to 10-year flow. Coyote

Creek and Gallinas Creek are more vulnerable to overtopping due to tidal elevations and may be able to carry 100-year riverine flows at low tides.

Extent and Probability

In areas such as Marin County that do not have extended periods of below-freezing temperatures or significant snowfall, floods usually occur during the season of highest precipitation or during heavy rainfalls after prolonged dry periods. Marin County is dry during the late spring, summer, and early fall and receives most of its rain during the winter months. The rainfall season extends from November through April, with most rainfall occurring during this period. Due to varying microclimates within the County, rainfall measured in water year 2016-2017 where there are Marin County Flood Control & Water Conservation District-owned gages ranged inland from as low as 47 inches in Novato to over 82 inches in Kentfield. Along the coast, rainfall ranged from 36 inches at Oceana Marin to 45 inches at Point Reyes Station.

In should be noted winter 2016-2017 was an unusually wet year. An average of 56 inches of rain falls each year at the summit of Mount Tamalpais, at 2,572 feet elevation. The rain collects in several channels, flowing down steep slopes and onto broad, flat valleys, many of which are populated. The valleys usually only receive on average 32 inches of rain per year, thus flows from the uplands contribute greatly to flows on the valley floor. During most rainfall events, waterways remain within their channels or underground pipes until they reach a bay or the ocean.

The Marin County OA has several major 100-year and 500-year floodplains which are mapped by FEMA in the most recent Flood Insurance Rate Maps (FIRM), several of which were recently updated in 2016 and 2017 (see above). While they may look small relative to the size of the County as a whole, the bulk of the floodplains are located in some of the County's most heavily populated areas along the eastern shoreline: notably portions of Novato, San Rafael, and Mill Valley. These floodplains vary in size, probability and severity of inundation, underlying causes (riverine, tidal, etc.), and potential impacts to the communities in them. The areas of most concern are located in what is designated by FEMA as a 100-year flood zone or Special Flood Hazard Area (SFHA). What is currently considered a 100-year flood may occur more often due to climate change. Due to the increased probabilities of flooding (1% chance in any given year), these properties face high insurance premiums and major restrictions on further development. Along the Pacific Ocean there are a number of homes in Stinson Beach which are mapped as being in a VE zone. A VE zone is a 100-year flood zone where tsunamis or other forms of wave action threaten low lying coastal areas.

For some of the developments along the San Francisco Bay, such as Santa Venetia and Tamalpais Valley, the main issues concern poor drainage due to flat terrain and/or differential settlement, low elevation relative to the tides, and the reliance on a system of pumps and levees to keep floodwaters from inundating homes. Runoff collecting in this area can be especially difficult to remove during high tides.

Other more inland areas, such as areas along Corte Madera Creek and its tributaries, have higher elevations yet still contain properties located in 100-year flood zones. This is mainly due to threats caused by local creeks which have a tendency to overflow their banks when rainfall reaches critical levels. Properties along Novato Creek and its tributaries face similar threats. The main stems of these creeks and many of their tributaries are constrained by development on the banks.

When flooding occurs in the Marin County OA, depths are commonly on the order of 0-2 feet in streets and sidewalks. This level occurs when storm drains are overwhelmed and/or during king

tides. Flood depths on the order of 2- 4 feet have occurred in recent memory and represent significant flood events that caused damage to structures and property. 1982 was the most extreme flood of record along Corte Madera Creek in Central Marin County and probably had some inundations depths as high as 5 feet. In 2016 the FEMA San Francisco Bay Coastal Study became effective and raised the static Base Flood Elevation of the Bay to an elevation of 10-feet NAVD88. This level of flooding has not been observed but is feasible in any given year. If this level of tidal flooding was to occur along the bay shoreline there would be inundation depths as much as 6-8 feet in neighborhoods such as Santa Venetia.

On the Marin County OA's outer coast V zones have BFEs of up to 22 feet according to FIRMs updated August 2017. In the unincorporated community of Stinson Beach this corresponds to a maximum inundation depth of 8-10 feet. Although some houses were destroyed by wave action and storm surge during the 1982 event, nothing approaching this level of inundation has occurred in recorded history here.

The other index for extent is the speed of onset of flooding or the rainfall-runoff lag time, which doesn't apply to tidal flooding. The riverine flooding comes directly from rainfall runoff of adjacent uplands in the County's series of relatively small, short watersheds. While antecedent moisture is a big factor, this flash flooding is typically short duration and directly associated with the magnitude of the passing storm system. These storms, often in the form of atmospheric rivers coming off the Pacific Ocean, can last anywhere from a few hours to a day or two. The speed of onset of flooding ranges from minutes to about 2 hours after the precipitation exceeds the drainage capacity.

Table 3.12: Marin County OA Hazard Risk Assessment – Flooding						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Highly Likely	Limited	Severe	High	Medium	**14.00**
City of Belvedere	Highly Likely	Limited	Severe	High	Medium	**14.00**
Town of Corte Madera	Likely	Significant	Severe	High	High	**15.00**
Town of Fairfax	Occasional	Limited	Moderate	Medium	Medium	**10.00**
City of Larkspur	Occasional	Limited	Severe	High	Medium	**12.00**
City of Mill Valley	Occasional	Extensive	Severe	Medium	Medium	**13.00**
City of Novato	Likely	Negligible	Weak	Medium	Low	**8.00**
Town of Ross	Highly Likely	Significant	Severe	High	High	**16.00**
Town of San Anselmo	Occasional	Limited	Moderate	Medium	Medium	**10.00**
City of San Rafael	Highly Likely	Significant	Severe	High	High	**16.00**
City of Sausalito	Likely	Significant	Moderate	High	Medium	**13.00**
Town of Tiburon	Highly Likely	Limited	Severe	High	Medium	**14.00**
Bolinas Public Utility District	Likely	Limited	Moderate	High	Medium	**12.00**
Las Gallinas Valley Sanitary District	Likely	Significant	Moderate	Medium	High	**13.00**
North Marin Water District	Occasional	Significant	Severe	High	Medium	**13.00**
Southern Marin Fire District	Likely	Limited	Moderate	Medium	Medium	**11.00**

Table 3.12: Marin County OA Hazard Risk Assessment – Flooding
Source: Profiled Jurisdictions and Districts

Vulnerability

Prior to development, the Marin County OA's flat lowlands flooded frequently. When rain fell on the Marin County OA, it infiltrated into the ground and moved slowly toward creek channels. The ground acted like a sponge, storing water and releasing it slowly. While water moved underground, it was naturally cleansed by physical and biological processes. Annual floods brought life-giving water to parched floodplains, nourishing them with fresh sediment. They recharged aquifers and allowed fish to swim over normally dry land that was rich with food. Tides flooded biologically rich marshes along the bay perimeter twice a day. When humans began to develop the land, they created conflicts between what was built and the natural tendency of creeks to flood. Much of the development in the Marin County OA was built in flood-prone areas which put it at risk of inundation. Roads, parking lots, roofs, and other impervious surfaces prevent water from infiltrating the ground. Instead, the water moves quickly across the landscape into pipes and creeks further increasing flood risk downstream. Homes, commercial areas, schools, hospitals, police and fire stations, roads and highways, sanitary sewers and waterlines, sewage treatment plants, pump stations are all located in floodplains in the Marin County OA.

All of Marin County OA's watersheds are small and largely prone to flash flooding. Flash floods are particularly dangerous. The National Weather Service (NWS) defines a flash flood as one in which the peak flow travels the length of a watershed within a 6-hour period. These floods arise when storms produce a high volume of rainfall in a short period over a watershed where runoff collects quickly. They often affect populated areas of the Marin County OA's cities and towns. They often strike with little warning and are accompanied by high velocity flow.

All incorporated cities and towns in the Marin County OA have flood risk – and are in fact participants in the National Flood Insurance Program. Even those that are not in a Marin County Flood Control & Water Conservation District "Flood Zone," have robust maintenance and capital improvement programs that help manage and mitigate flood risk. These cities without District Flood Zones include most of San Rafael and Tiburon, and all of Corte Madera, Sausalito, and Belvedere. Additionally, San Anselmo, Ross, Larkspur, Fairfax, Mill Valley and Novato have flood mitigation programs that operate largely independently of the Flood District, although extensive coordination of activities and collaboration with the Flood District is facilitated through the Marin County Watershed Program (part of the County Department of Public Works). Every city and town, and many unincorporated communities in Marin contain FEMA Special Flood Hazard Areas (SFHA), meaning they lie in the 100-year floodplain and have at least a 1% chance of flooding in a given year. They all participate in the National Flood Insurance Program and many of the structures in the SFHA carry FEMA flood insurance or private flood insurance. Flood risk to the Marin County OA's incorporated cities and towns are discussed in their respective Annexes. Most unincorporated communities in the Marin County OA have some level of flood risk, as discussed below:

Lagunitas, Forest Knolls, San Geronimo and Woodacre all lie along San Geronimo Creek. Dozens of homes lie in the 100-year floodplain of the creek and could be susceptible to flooding. Sir Francis Drake Boulevard could be susceptible to flooding where it is crossed by Lagunitas Creek and San Geronimo Creek at the south end of Lagunitas. Several road bridges on the south side of San Geronimo Creek that connect residential communities to Sir Francis Drake Boulevard could be susceptible to flooding that could cut off ingress and egress to the area.

Numerous residences and businesses in Nicasio and along Lucas Valley Road to the west of Nicasio lie in the 100-year floodplain and could be susceptible to flooding. Nicasio Valley Road could flood in several places on both sides of Nicasio. Numerous buildings in Tocoloma, including the Tocoloma PG&E substation, lie in the 100-year floodplain. Sir Francis Drake

Boulevard could also be susceptible to flooding where Lagunitas Creek crosses it at Platform Bridge Road.

Much of Olema west of Highway 1 and along Olema Creek is in the 100-year floodplain. There are numerous residences and businesses in this area, including the Olema Campground. The southern end of Point Reyes Station is particularly susceptible to flooding, including the area where Highway 1 intersects with Sir Francis Drake Boulevard. There are numerous homes and businesses in this area, along with the CalTrans Point Reyes Maintenance Station that lie in the 100-year floodplain. Flooding along Highway 1 and Sir Francis Drake Boulevard from either Lagunitas Creek or Tomales Bay could affect ingress and egress to Point Reyes Station, Inverness and Point Reyes National Seashore. Several buildings in the south and west sides of Point Reyes Station and at the U.S. Coast Guard Station lie in the 100-year floodplain and could be susceptible to flooding. Highway 1 and several homes north of Point Reyes Station also lie in the 100-year floodplain and could be susceptible to flooding.

Several homes, businesses and sections of Sir Francis Drake Boulevard from Inverness Park to Inverness lie in the 100-year floodplain and could be susceptible to flooding from either Tomales Bay or inland canyons.

Sections of the east shore of Tomales Bay along Highway 1, including around Reynolds and Marconi, lie in the 100-year flood plain and are susceptible to flooding. Most of the residences and businesses in Marshall lie in the 100-year floodplain and could be susceptible to flooding from Tomales Bay. While most of Tomales is outside the 100-year floodplain, the area south of it has numerous residences and businesses along Keys Creek and Walker Creek that are in the 100-year floodplain and could be susceptible to flooding.

An area north of Bolinas along Pine Gulch Creek and the Bolinas lagoon lie in the 100-year floodplain. Numerous residences, the Bolinas-Stinson Elementary School, and a section of Olema Bolinas Road are in this area and could be susceptible to flooding. While most of Bolinas lies outside the 100-year floodplain, there are numerous residences along Bolinas Lagoon and Bolinas Bay that are in the 100-year floodplain and could be susceptible to flooding. Most of the residences in Stinson Beach along Dipsea Road and Seadrift Road in Stinson Beach lie in the 500-year floodplain, though several lie in an area of the 100-year floodplain and could be particularly susceptible to coastal flooding. Most of the residences closer to Stinson Beach along Cale del Arroyo lie in the 100-year floodplain and could be susceptible to flooding, with some that could be particularly susceptible to coastal flooding. Some homes, the Stinson Beach Fire Station 32, and the Stinson County Water District Office lie in the 500-year plain in this area and could also be susceptible to flooding. Numerous residences and businesses in and around the southern core of Stinson Beach lie in the 500 and 100-year floodplain and could be susceptible to flooding.

The east side of Muir Beach along Railroad Creek lies in the 100-year floodplain. Numerous residences and a section of Highway 1 could be susceptible to flooding in this area. Flooding of Highway 1 could affect ingress and egress north towards Stinson Beach.

Most of the Tamalpais Junction area of Tamalpais Valley along Coyote Creek and the creek along Tennessee Valley Road lies in the 100-year floodplain, with a smaller section lying in the 500-year floodplain. Numerous residences lie in the 500-year floodplain and could be susceptible to either creek flooding or flooding from Richardson Bay. Hundreds of residences, a church, the Tamalpais Valley Community Center, part of the Tamalpais Valley Elementary School, a large shopping center with numerous businesses, the CalTrans Manzanita Station, sections of Highway 1, a section of Highway 101 and the Commodore Center Heliport all lie in

the 100-year floodplain and could be susceptible to flooding. Most of the Strawberry and Alto areas lie outside the 100 and 500-year floodplain, though dozens of residences, several apartment complexes, numerous commercial buildings and part of the Strawberry Point Middle School lie in the 100-year floodplain and could be susceptible to flooding. A small area north of Keil Cove on the Tiburon Peninsula where there are several homes also lies in the 100-yearfloodplain and could be susceptible to flooding.

A large part of Kentfield lying along Corte Madera Creek is in the 100-year floodplain. Dozens of homes, numerous businesses and shopping centers, the Adeline E. Kent Middle School, parts of the College of Marin and the Kentfield Hospital, and sections of major thoroughfares including Sir Francis Drake Boulevard and College Avenue lie in this area and could be susceptible to flooding. Most of the College of Marin (including the College of Marin Police Department), part of the Kentfield Hospital and the Marin Health Medical Center, all of Marin Catholic High School and Anthony G. Bacich Elementary School, the Kentfield Fire Station #17, several medical facilities, dozens of homes, numerous businesses and a large section of Sir Francis Drake Boulevard in the Kentfield area lie in the 500-year floodplain and could be susceptible to flooding. There are dozens of homes in the Greenbrae area that lie in the 500-year floodplain and could be susceptible to flooding. A section of California City on the north side near Anderson Drive and the railroad tracks lie in the 100-year floodplain and there are several homes here along with the Montessori School of Central Marin that could be susceptible to flooding.

The 100-year floodplain in Lucas Valley and Marinwood is mostly confined to Miller Creek and while most buildings and infrastructure are not in the 100-year floodplain, part of it runs along the edge of Lucas Valley Elementary School, the Miller Creek Middle School and the Marin County Juvenile Complex that could all be susceptible to flooding. There are several bridges, including on Lucas Valley Road and Highway 101, along with several homes in Marinwood that lie in the 100-year floodplain and could be susceptible to flooding. Part of the Saint Vincent School in Saint Vincent is also in the 100-year floodplain and could be susceptible to flooding.

The northwestern corner of Santa Venitia along the San Venetia Open Space Preserve lies in the 100-year floodplain, and there are several hundred homes along with a few pump stations and critical care facilities in this area that could be susceptible to flooding. Sections of San Pedro Boulevard and areas of San Pedro Point, including part of the McNear Brickyard, lie in the 100-year floodplain and could be susceptible to flooding. Several homes in the unincorporated County along San Pedro Boulevard near San Rafael lie in either the 100-year or 500-year floodplain and could be susceptible to flooding.

Part of the County Redwood Landfill and all of the Marin County airport, including the access road, lie in the 100-year floodplain and could be susceptible to flooding. This area is mostly marshland that could experience coastal flooding. Most of the Green Point-Black Point area lies outside the 100-year floodplain though there are several homes in the Black Point area near marshland that lie in the 100-year floodplain and could be susceptible to flooding.

Numerous homes in Bel Marin Keys and sections of Bel Marin Keys Boulevard lie in the 100-year floodplain and could be susceptible to flooding. A flooding event could affect ingress and egress to Bel Marin Keys.

San Antonio Creek forms part of the boundary between Marin and Sonoma Counties from the area around Chileno Valley Road east to the Petaluma River and there are several homes along it that lie in the 100-year floodplain and that could be susceptible to flooding. There are also

several road bridges that cross the creek in the 100-year floodplain and that could be susceptible to flooding.

Figure 3.109 shows the social vulnerability of the Marin County OA's population to flooding in relation to the rest of California.

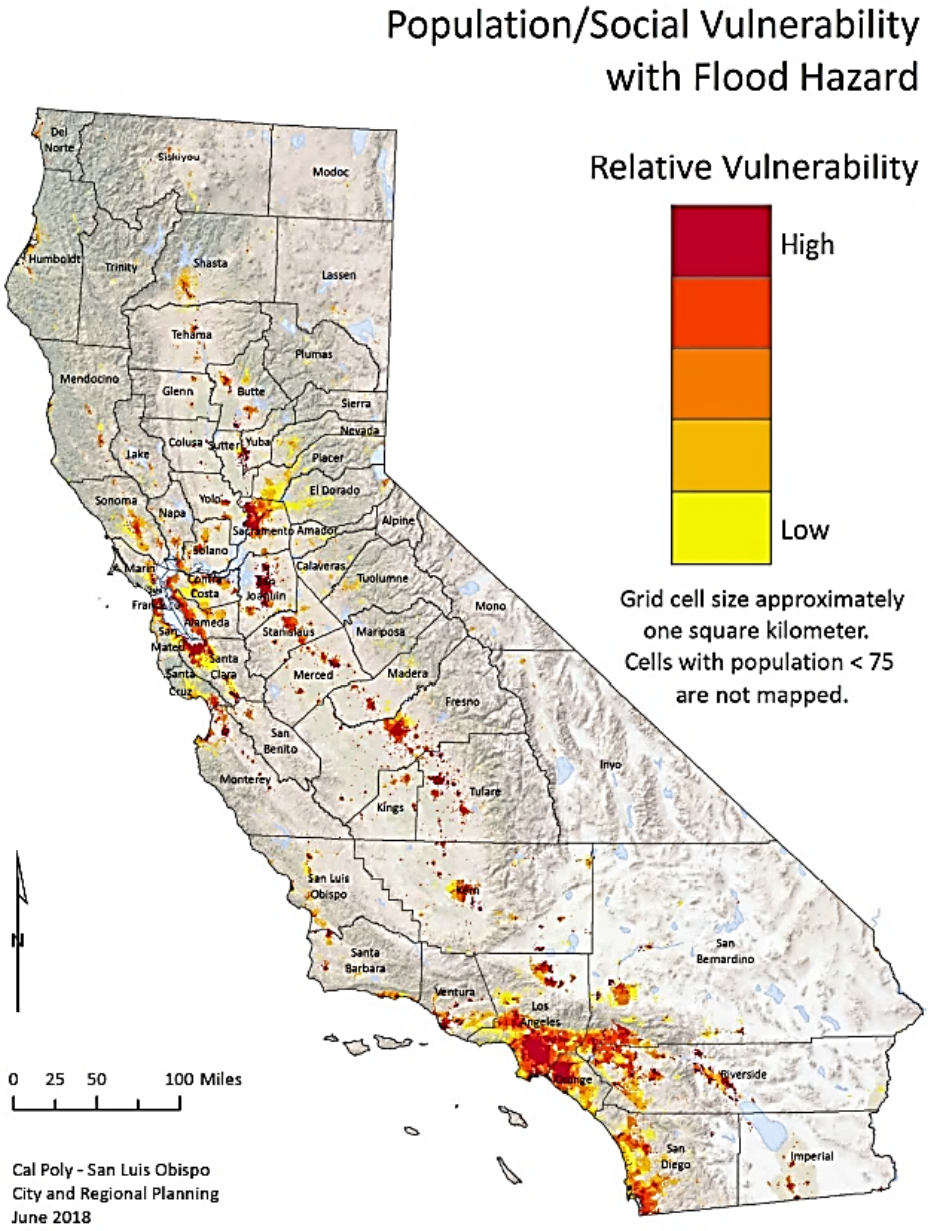


Figure 3.109: Population/Social Vulnerability to Flooding in California
Source: 2018 State of California Hazard Mitigation Plan

Climate Change and Future Development Considerations

Climate change is expected to affect California's precipitation patterns, which are likely to influence future flood events. A 2017 study found that the number of very intense precipitation days in California is projected to more than double by the end of the century, increasing 117 percent, making it likely that flood events will become more frequent in the Marin County OA. Climate change is expected to alter rainfall patterns in Northern California, including the Marin County OA. As the climate warms, rain events are predicted to become more intense. The Marin County OA will likely experience more rain inundation events that lead to flooding and increase the potential threat of dam and levee failure, tree mortality, and other potential hazards. Sea level rise as a result of climate change will exacerbate the impacts of tidal flooding in the lowland areas of the Marin County OA. Future development in these areas will expose more people and infrastructure to the effects of flooding in the Marin County OA. Development in marshland of the Marin County OA would expose additional people and infrastructure to flooding as marshlands act as a natural buffer to storm surge.

3.3.6 Land Subsidence

Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials. The principal causes are aquifer-system compaction, drainage of organic soils through groundwater pumping, underground mining, hydro-compaction, natural compaction, sinkholes, and thawing permafrost. More than 80 percent of the identified subsidence in the United States is a consequence of underground water exploitation. The increasing development of land and water resources threatens to exacerbate existing land-subsidence problems and initiate new ones.

Sinkholes can form in three primary ways. Dissolution sinkholes form when dissolution of the limestone or dolomite is most intensive where the water first contacts the rock surface. Aggressive dissolution also occurs where flow is focused in preexisting openings in the rock, such as along joints, fractures, and bedding planes, and in the zone of water-table fluctuation where groundwater is in contact with the atmosphere. See Figure 3.110 for a picture and description of how dissolution sinkholes form.

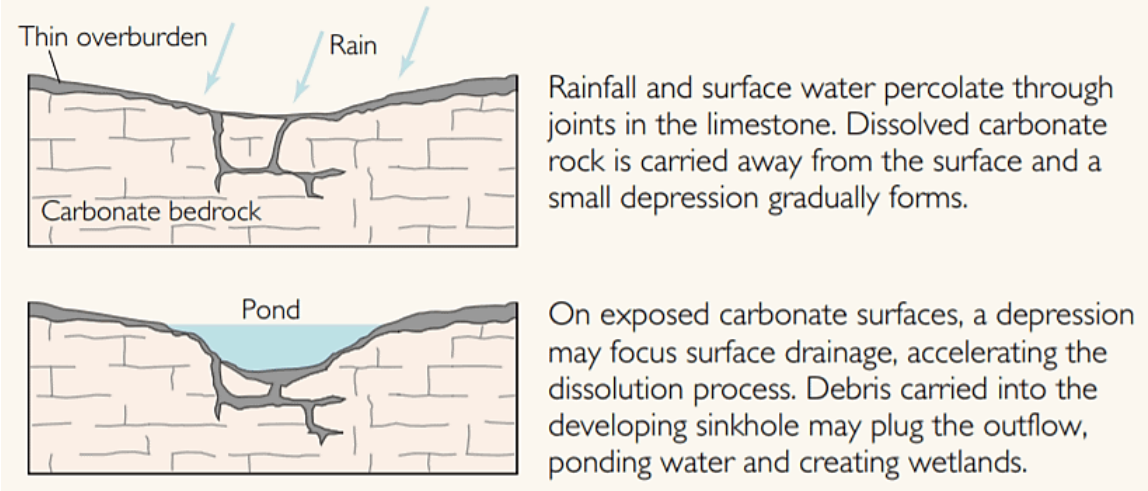


Figure 3.110: Dissolution Sinkhole Formation
Source: USGS

Cover-subsidence sinkholes tend to develop gradually where the covering sediments are permeable and contain sand. In areas where cover material is thicker, or sediments contain more clay, cover-subsidence sinkholes are relatively uncommon, are smaller, and may go

undetected for long periods. See Figure 3.111 for a picture and description of how cover-subsidence sinkholes form.

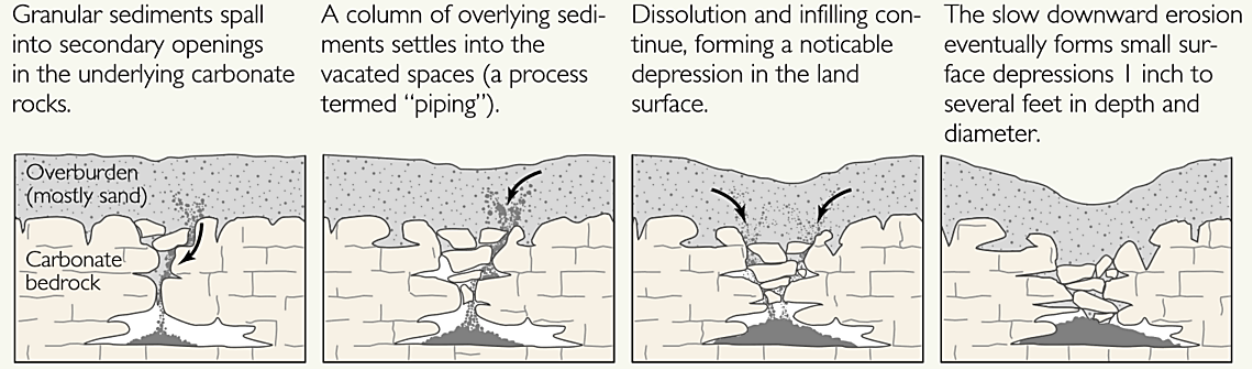


Figure 3.111: Cover-Subsidence Sinkhole Formation
Source: USGS

Cover-collapse sinkholes may develop abruptly over a period of hours and cause catastrophic damages. They occur where the covering sediments contain a significant amount of clay. Over time, surface drainage, erosion, and deposition of sediment transform the steep-walled sinkhole into a shallower bowl-shaped depression. See Figure 3.112 for a picture and description of how cover-collapse sinkholes form.

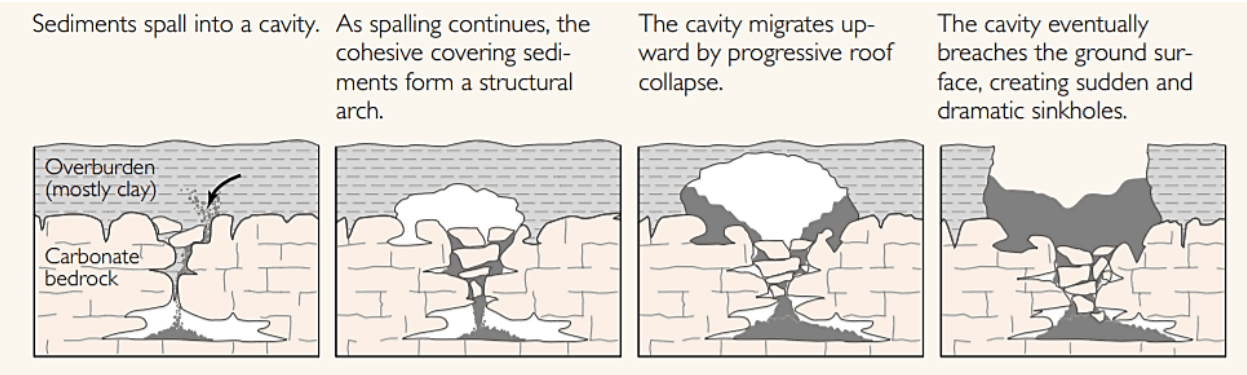


Figure 3.112: Cover-Collapse Sinkhole Formation
Source: USGS

New sinkholes have been correlated to land-use practices, especially from groundwater pumping and from construction and development practices that cause land subsidence. Sinkholes can also form when natural water-drainage patterns are changed and new water-diversion systems are developed. Some sinkholes form when the land surface is changed, such as when industrial and runoff-storage ponds are created. The substantial weight of the new material can trigger an underground collapse of supporting material, thus causing a sinkhole.

The overburden sediments that cover buried cavities in the aquifer systems are delicately balanced by groundwater fluid pressure. The water below ground helps to keep the surface soil in place. Groundwater pumping for urban water supply and for irrigation can produce new sinkholes in sinkhole-prone areas. If pumping results in a lowering of groundwater levels, then underground structural failure, and thus, sinkholes, can occur.

Location and Previous Occurrences

Collapsible soils with the potential for subsidence (i.e., vertical displacement of the ground surface over a locality or region) are more present in the low-lying flatland deposits along the Marin County OA's valley basins and bays, including in the unincorporated area. In the low-lying exposed areas in nearly every community, except Kentfield, subsidence is an ongoing issue. Roadways throughout the Marin County OA along the shoreline, notably US Highway 101, and roads in lower Paradise Cay, already experience subsidence. See Figure 3.113 for a map of land subsidence and uplift in California and the Marin County OA from 2007-2018. Areas of increased subsidence occur along San Francisco Bay with an area of uplift on both sides of the northern end of Tomales Bay.

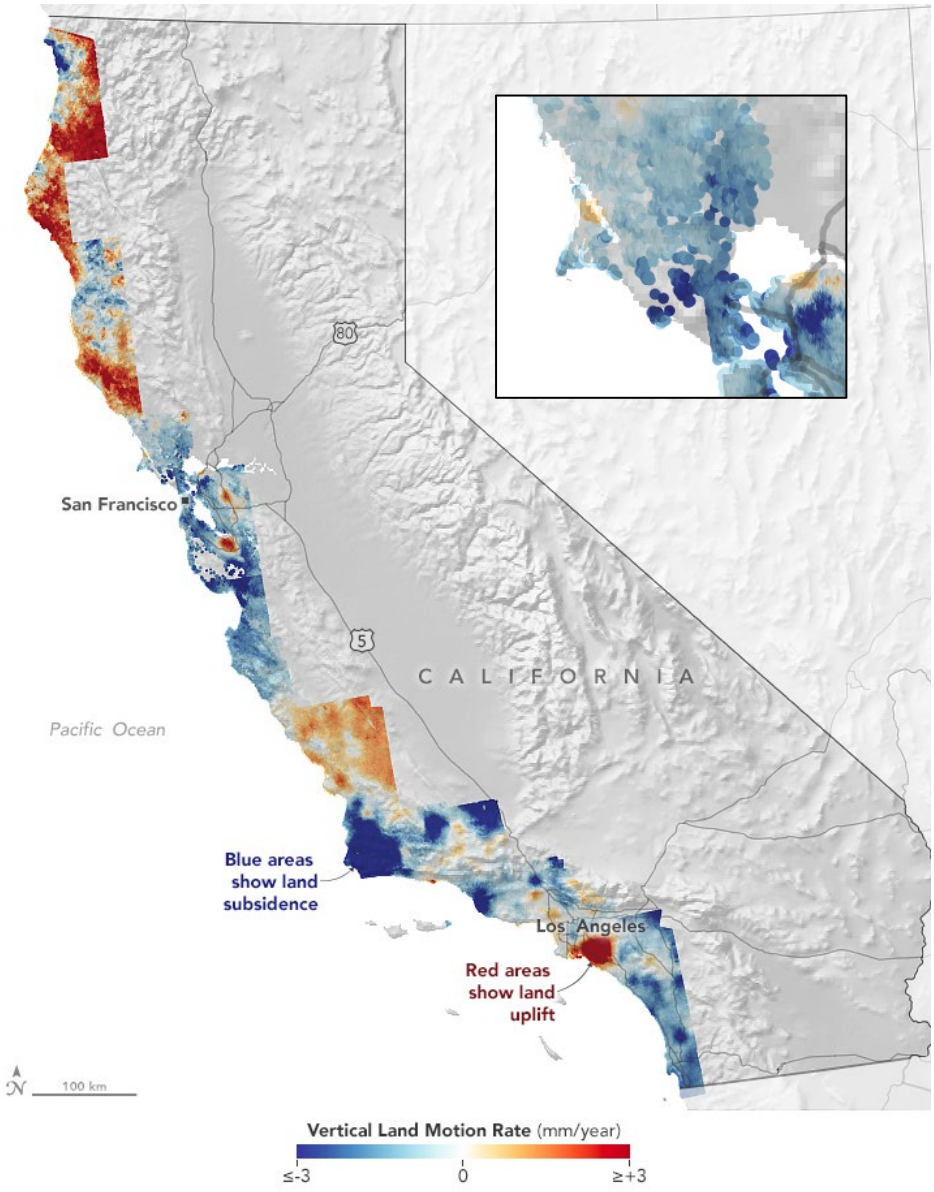


Figure 3.113: Land Subsidence in California 2007-2018 with Marin County Cutout

Source: NASA

Figure 3.114 shows the areas of the United States where certain rock types that are susceptible to dissolution in water occur. In these areas the formation of underground cavities can form, and sinkholes can happen. These rock types are evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite).

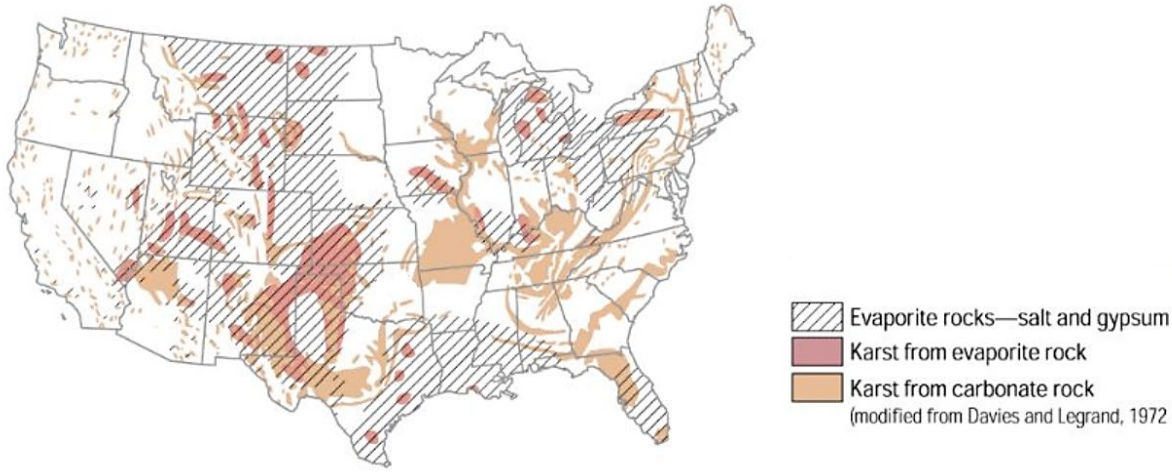


Figure 3.114: U.S. Rock types Susceptible to Water Dissolution
Source: USGS

Impacts

Land subsidence has the potential to damage drinking water wells and infrastructure throughout the Marin County OA, including in the unincorporated area. Loss of drinking water for rural communities can cause health problems as well as significant financial impacts with the re-drilling and testing of wells and providing alternate potable water sources for community members. Prolonged drought can exacerbate the impacts from land subsidence. As the water table is drawn down, land can sink even further and damage underground aquifers. Critical infrastructure such as highways, sewer lines, and gas lines can also become undermined due to land subsidence and sinkholes, becoming a threat to public safety and resulting in the devotion of significant financial resources to fix any damages. Sinkholes can form in parking lots, or directly under houses and other structures, potentially causing loss of life and significant damage.

Extent and Probability

Many shoreline properties in the Marin County OA, including in the unincorporated area, are built on fill and mud, and underlying soils will become more saturated under sea level rise conditions and, consequently, vulnerable to increasing rates of subsidence. Subsidence is already a factor for many roads and will likely worsen as the ground becomes saturated with bay or coastal waters further inland. Utilities infrastructure located along the shoreline on fill and mud and in the bay itself, which already experiences the effects of subsidence, will be subject to increased levels of subsidence in the future.

Table 3.13: Marin County OA Hazard Risk Assessment – Land Subsidence						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Occasional	Limited	Moderate	Medium	Medium	**10.00**
City of Belvedere	Occasional	Limited	Moderate	Medium	Medium	**10.00**
Town of Corte Madera	Likely	Negligible	Weak	Low	Low	**7.00**
Town of Fairfax	Occasional	Negligible	Weak	Low	Low	**6.00**
City of Larkspur	Occasional	Limited	Moderate	Medium	Medium	**10.00**
City of Mill Valley	Likely	Negligible	Moderate	Low	Low	**8.00**
City of Novato	Likely	Negligible	Weak	Low	Low	**7.00**
Town of Ross	Unlikely	Limited	Weak	Low	Low	**6.00**
Town of San Anselmo	Unlikely	Negligible	Moderate	Low	Low	**6.00**
City of San Rafael	Highly Likely	Significant	Weak	Low	Medium	**11.00**
City of Sausalito	Likely	Limited	Moderate	Medium	Medium	**11.00**
Town of Tiburon	Occasional	Limited	Moderate	Medium	Medium	**10.00**
Bolinas Public Utility District	Likely	Limited	Moderate	Medium	Medium	**11.00**
Las Gallinas Valley Sanitary District	Occasional	Negligible	Weak	Low	Low	**6.00**
North Marin Water District	Occasional	Negligible	Moderate	Medium	None	**7.00**

Southern Marin Fire District	Unlikely	Negligible	Severe	None	Low	**6.00**

Table 3.13: Marin County OA Hazard Risk Assessment – Land Subsidence
Source: Profiled Jurisdictions and Districts

Vulnerability

Land subsidence can severely impact public facilities and infrastructure as well as private development in areas where it occurs through the damage or compete failure of underground utilities, damaged building or utility infrastructure foundations, damaged roadways, etc. Vulnerable substations; electrical transmission towers and lines; underground natural gas water supply, and sanitary sewer pipelines; pump stations; hazardous facilities, including those with underground storage tanks (e.g., gas stations); and other facilities and infrastructure along the shoreline would be compromised by subsidence. Subsidence can lead to damage to healthcare facilities, private wells, and general drinking water quality. Subsidence can place pressure on underground utility pipelines when roadways begin to sink around the pipes, causing them to bend. Electrical transmission towers, including land-based towers east of Bel Marin Keys and South of Novato over to the Sonoma County border and in the bay off the shores of Corte Madera and Mill Valley, are subject to increased rates of subsidence, which can impact the mounting platforms that support the towers. Landfills are often subjected to subsidence because they are typically located where marshes once existed, and because buried materials settle over time. Jetties, which are structures built into the water to protect a harbor or shore, are also prone to subsidence.

Transportation facilities along the OA's coastline are vulnerable to subsidence. Increased subsidence could warp the buildings and runways at Marin County Airport in North Novato and San Rafael Airport. Parking and access areas along Richardson Bay, including those in Waldo Point Harbor, are also prone to continuous subsidence. As discussed above, roadways and highways along the shoreline also suffer from subsidence.

Important cultural resources, including archaeological sites at or near the edge of the bay may be vulnerable to subsidence. Vulnerable sites include permanent settlements represented by shell mounds or middens associated with marshes and other locations at or near the edge of the bay where shellfish/marine resources were available.

The areas of the Marin County OA most vulnerable to land subsidence are those underlain with the younger Holocene unconsolidated alluvial and colluvial sediments, and even more so the younger bay muds. In general, Marin County unincorporated community shoreline properties, especially those in Southern Marin on fill in the low-lying areas east of US Highway 101, are the most exposed and vulnerable to subsidence. Almonte, Belvedere, Santa Venetia, Paradise Cay and Bel Marin Keys were built on bay fill and mud, and already experience subsidence. This impacts buildings, roads, and utility infrastructure. These areas could anticipate increased rates of subsidence as bay waters saturate the soil from below.

Land subsidence is an ongoing issue in the low-lying exposed areas of nearly every unincorporated Bayshore community, except for Kentfield, and sea level rise associated with climate change would only exacerbate existing subsidence impacts.

Climate Change and Future Development Considerations

Climate change could indirectly influence land subsidence as more severe and prolonged periods of drought may encourage more groundwater withdrawals. In coastal areas like the Marin County OA, land subsidence leads to higher sea levels and increased flood risk. The rate of land subsidence could increase across the Marin County OA as a result of climate change. The impacts of land subsidence on infrastructure, including roads and underground utilities, in the Marin County OA could increase with future development in the lowland populated areas where land subsidence is more likely to occur.

3.3.7 Levee Failure

Levee failure is the overtopping, breach or collapse of the levee. Levees can fail in the event of an earthquake, internal erosion, poor engineering/construction or landslides, but levees most commonly fail as a result of significant rainfall or very high tides. During a period of heavy rainfall, the water on the water-body side of the levee can build up and either flow over the top ("overtopping") or put pressure on the structure causing quickening seepage and subsequent erosion of the earth. The overflow of water washes away the top portion of the levee, creating deep grooves. Eventually the levee weakens, resulting in a breach or collapse of the levee wall and the release of uncontrollable amounts of water. Figure 3.115 shows a levee and the multiple ways it can fail.

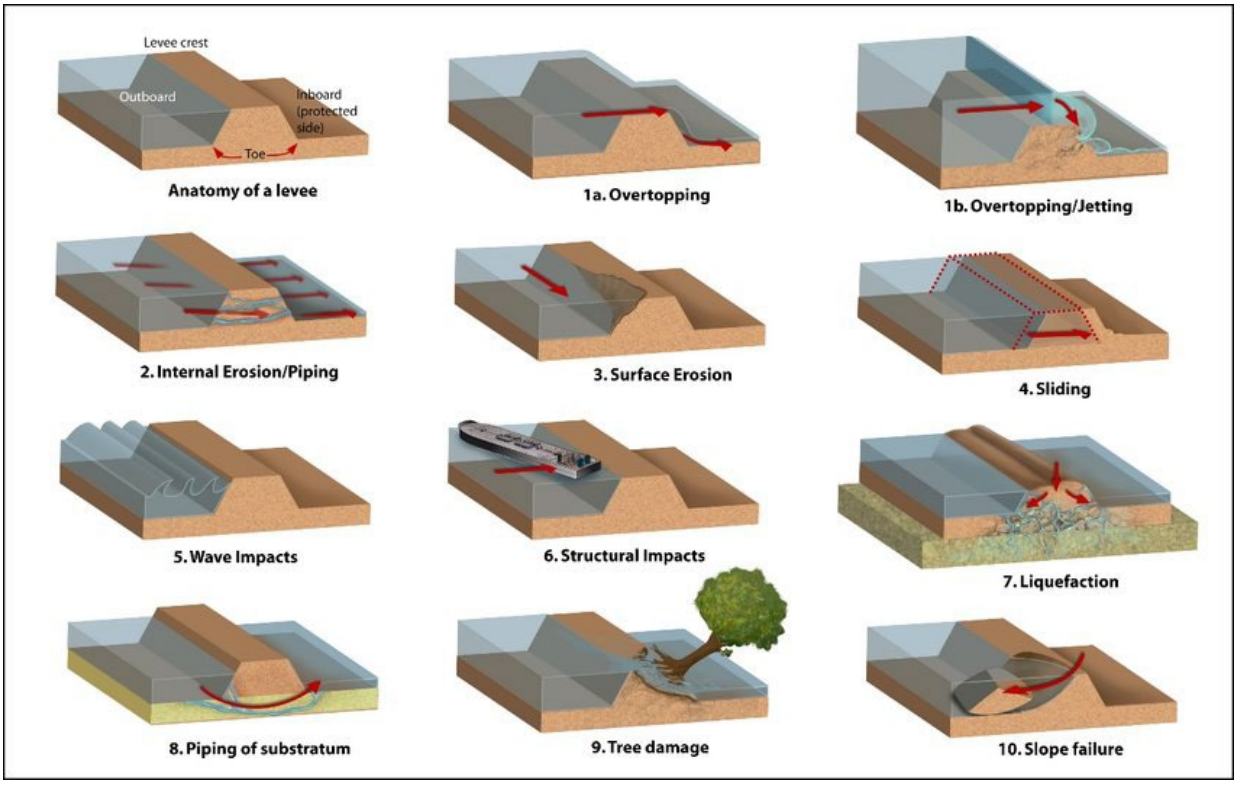


Figure 3.115: Levee Failure Mechanisms
Source: University of California

Location and Previous Occurrences

Several Marin County OA communities, such as Tamalpais Valley, Santa Venetia, Corte Madera, Belvedere, and parts of Strawberry, Novato, and Ross Valley are protected by levees.

Levees are typically earthen embankments designed to contain, control, or divert the flow of water to provide some level of protection from flooding. No levee system provides full protection from all flooding events to the people and structures located behind it. Some level of flood risk exists in the levee-affected areas. Except for one levee system in Novato-Hamilton, none of the County's levees are FEMA-accredited. Many were built many decades ago (non-engineered) by farmers or developers and material may have been added over the years.

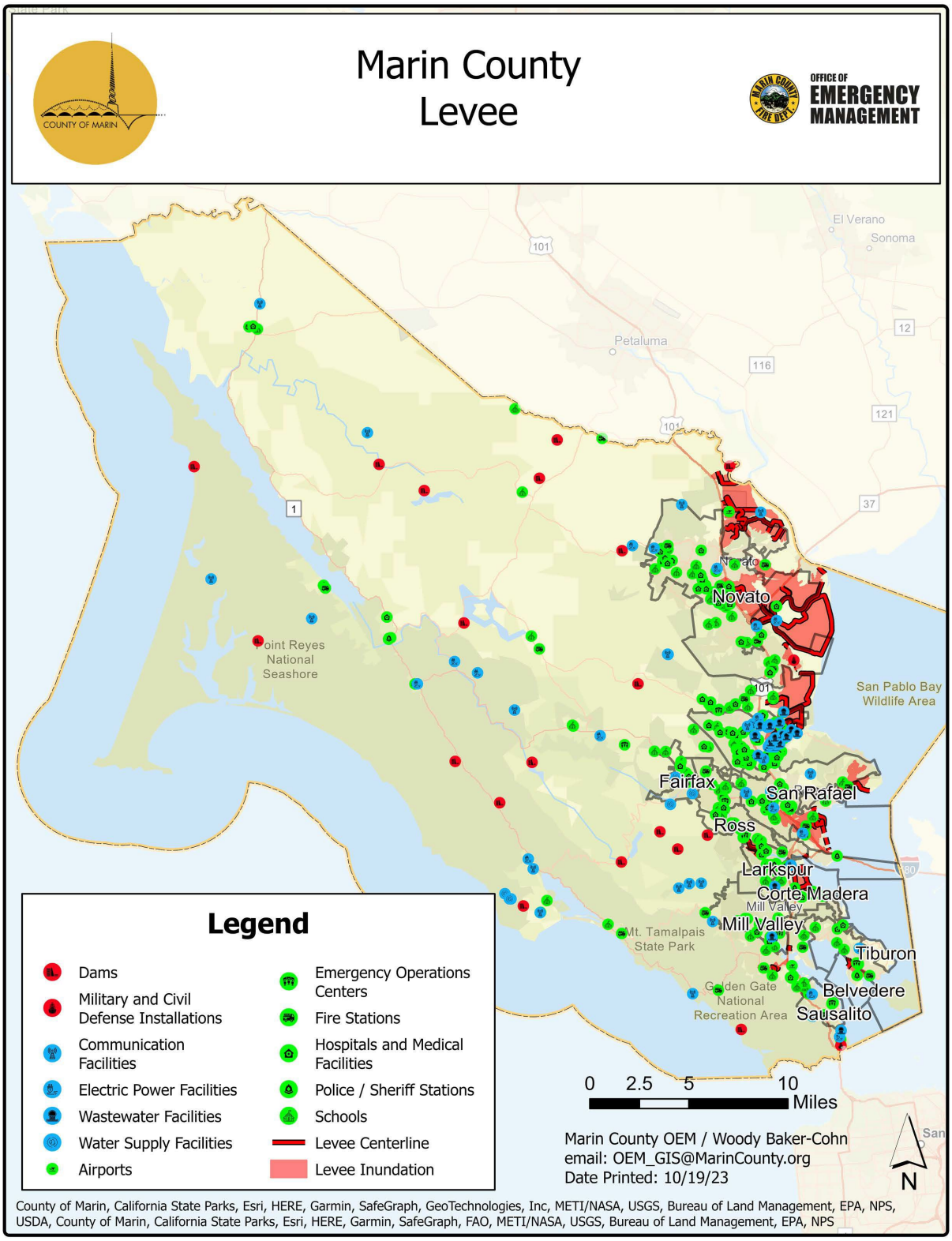


Figure 3.116: Marin County Levee System
Source: Marin County OEM

The Coyote Creek Left Bank Levee System (COYL) is a federally authorized and non-federally operated and maintained project and is located in the County of Marin on the west shore of Richardson Bay, an arm on the western side of San Francisco Bay where the Coyote Creek drains approximately 2,200 acres of the eastern slopes of the Marin Peninsula. The COYL is 0.96 miles long with a maximum height of four feet. The COYL is one of the two flood protection systems of the Coyote Creek flood control project and is situated along the left bank of the creek when looking downstream. The other system is along the right bank of Coyote Creek. There is only one segment within the COYL. The subject levee system is located along the left bank of Coyote Creek and is approximately 1.5 miles long. The purpose of the levee is to provide flood protection to the community of Tamalpais Valley, California. The channel improvement project for Coyote Creek, located in the County of Marin, California, was authorized by the Chief of Engineers on January 15, 1963, under the provisions of Section 205 of the Flood Control Act of 1948, as amended by the Flood Control Act of 1962. The COYL was completed in February 1965. Improvements to the project to address the local subsidence were completed in 1977. The public sponsor of the COYL is the Marin County Department of Public Works.

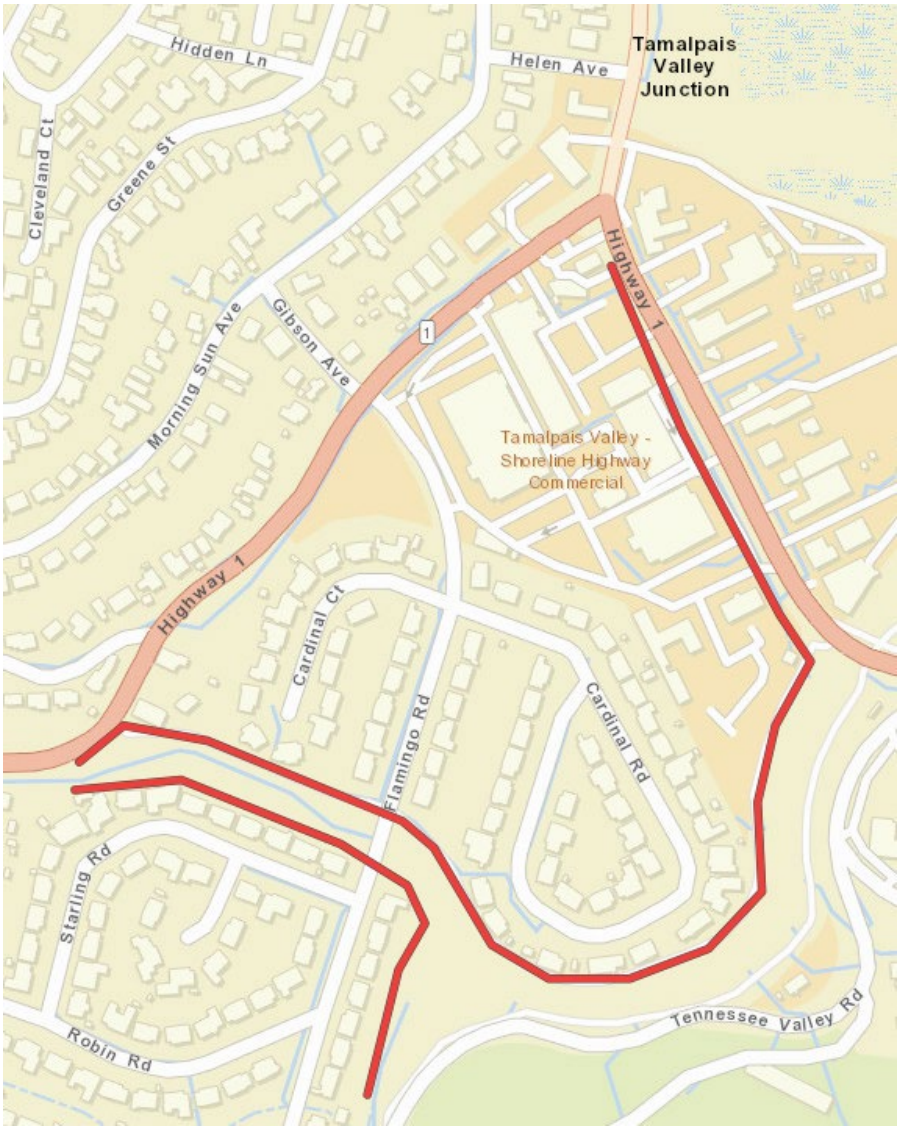


Figure 3.117: Levees in Tamalpais Valley
Source: U.S. Army Corps of Engineers, 11/27/23

The other Coyote Creek Levee system is an additional smaller levee that was constructed on the right bank in 1965. It is 0.22 miles long with a maximum height of four feet. The levee from the Highway 1 bridge to the downstream end is no longer maintained.

Figures 3.17 - 3.19 show the levees and Levee inundation in the Tamalpais Valley

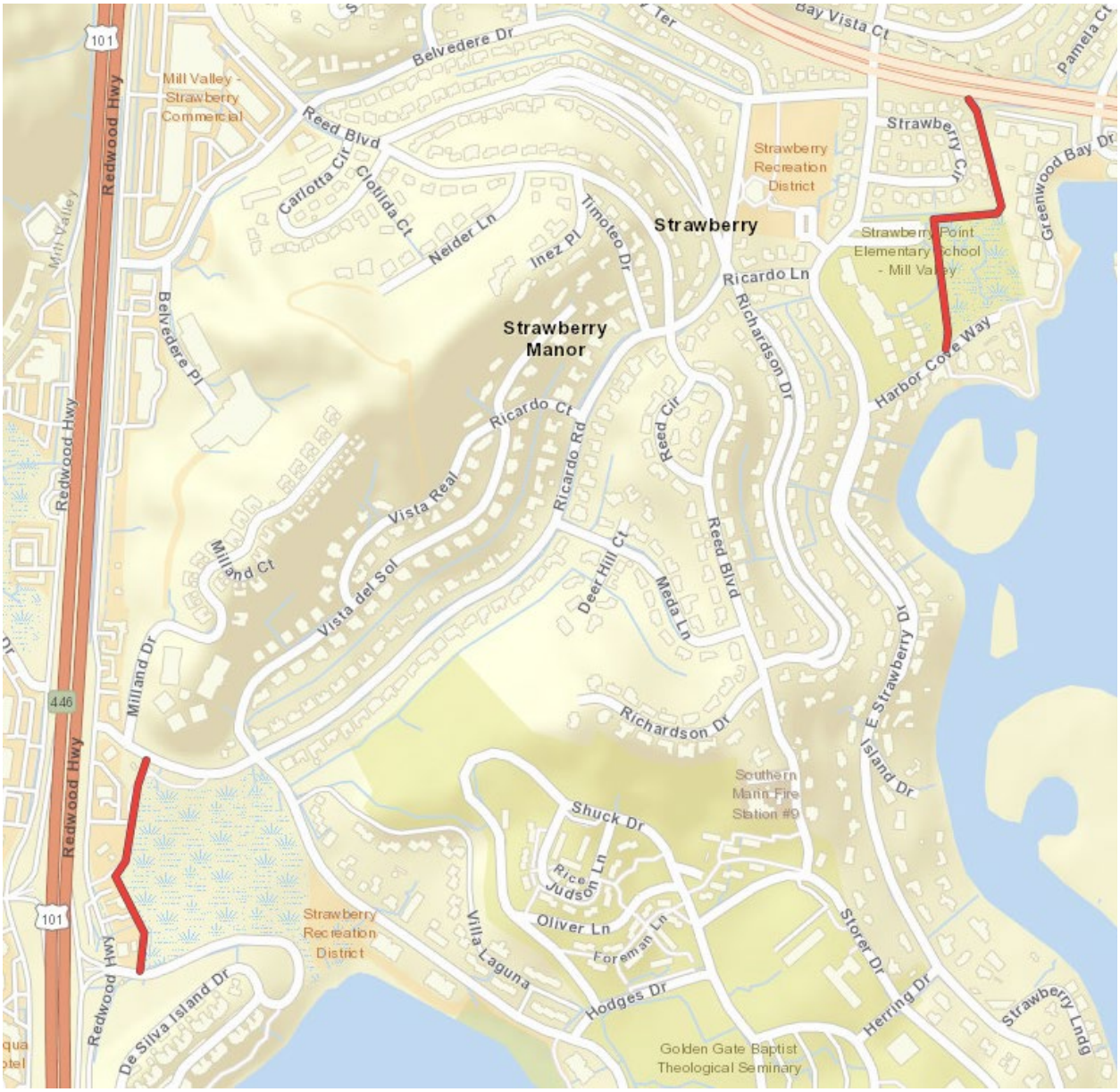


Figure 3.118: Levees in Strawberry
Source: U.S. Army Corps of Engineers, 11/27/23

The horseshoe shaped levee at the Sewerage Agency of Southern Marin (SASM) shown in Figure 3.121, according to the Mill Valley Department of Public Works, the levee at the SASM is above the high tide water mark and is not technically a levee but rather a berm to hold extra water storage at the side. It is not acting as a flood wall. The City of Mill Valley has no risk of levee failure.

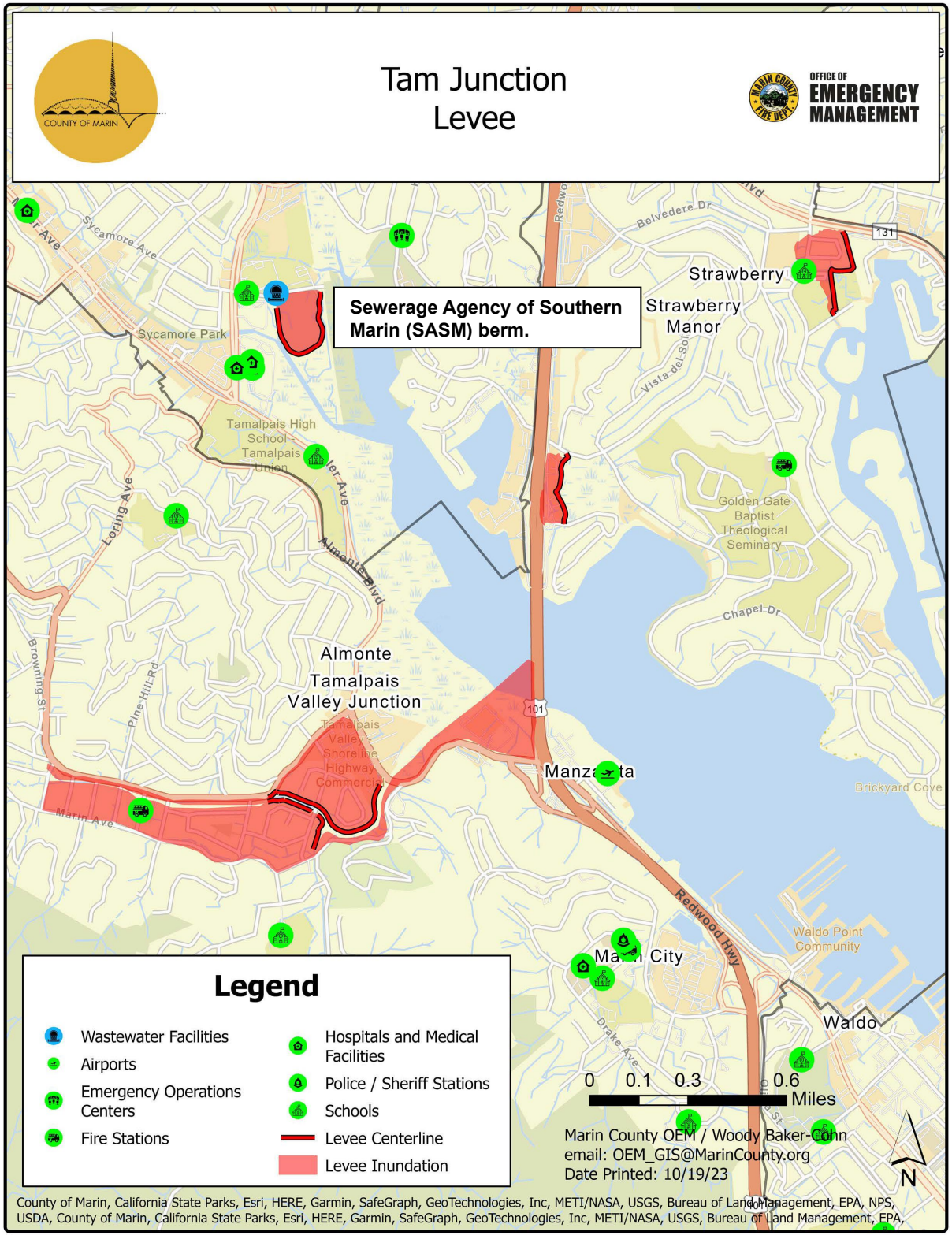


Figure 3.119: Tam Junction Levees
Source: Marin County OEM

One levee system exists in Kentfield and is located along Corte Madera Creek. The Corte Madera Creek Left Bank Levee is 0.7 miles long with an undocumented height. Figure 3.120 shows the Corte Madera Creek Left Bank Levee in Kentfield.

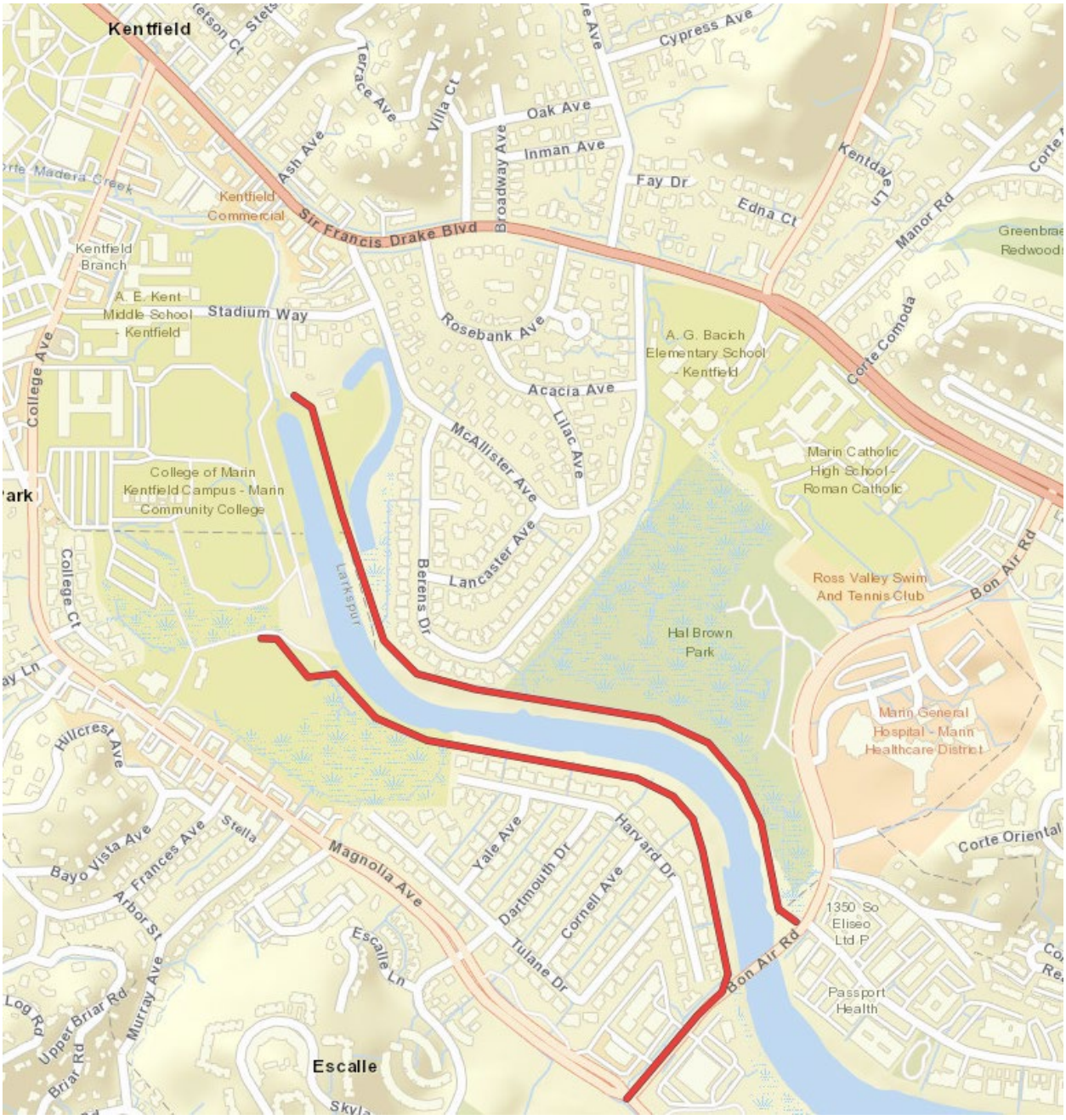


Figure 3.120: Levee in Kentfield
Source: U.S. Army Corps of Engineers, 11/27/23

Figure 3.121 shows the Greenbrae Levee system:

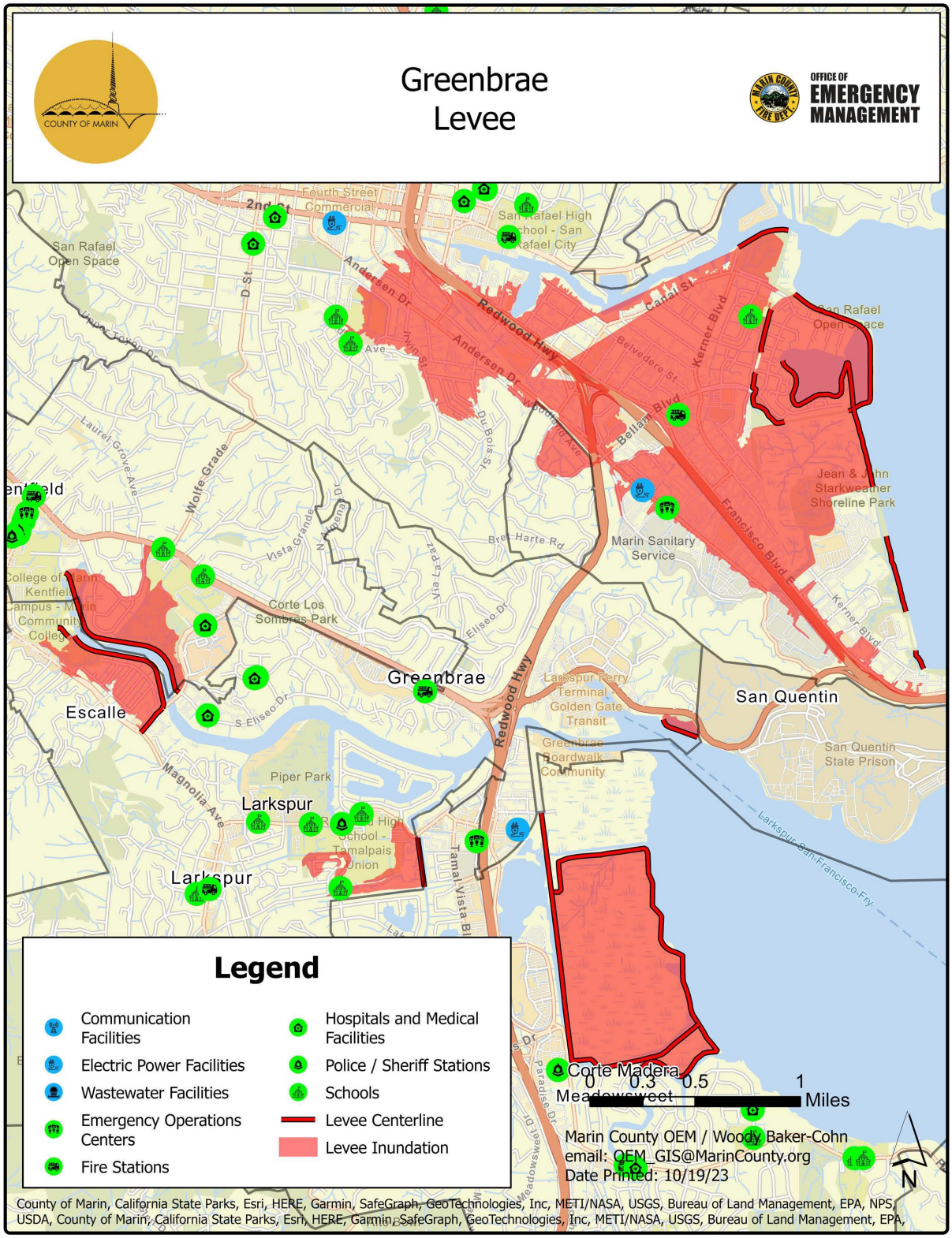


Figure 3.121: Greenbrae Levee System
Source: Marin County OEM

The McNears sea wall runs along Point San Pedro Road from roughly Marine Drive to the McNear Brickyard and is located along San Pablo Bay. The McNears sea wall is approximately 1.4 miles long with an undocumented height. Figure 3.122 shows the sea wall.

Figure 3.122: McNears Sea Wall in the San Pedro Hill Area
Source: U.S. Army Corps of Engineers, 11/27/23

One levee system exists in Santa Venetia and is located along the South Fork of Galinas Creek. The Santa Venetia Levee is 1.45 miles long with an undocumented height. Figure 3.123 shows the Santa Venetia Levee in Santa Venetia.

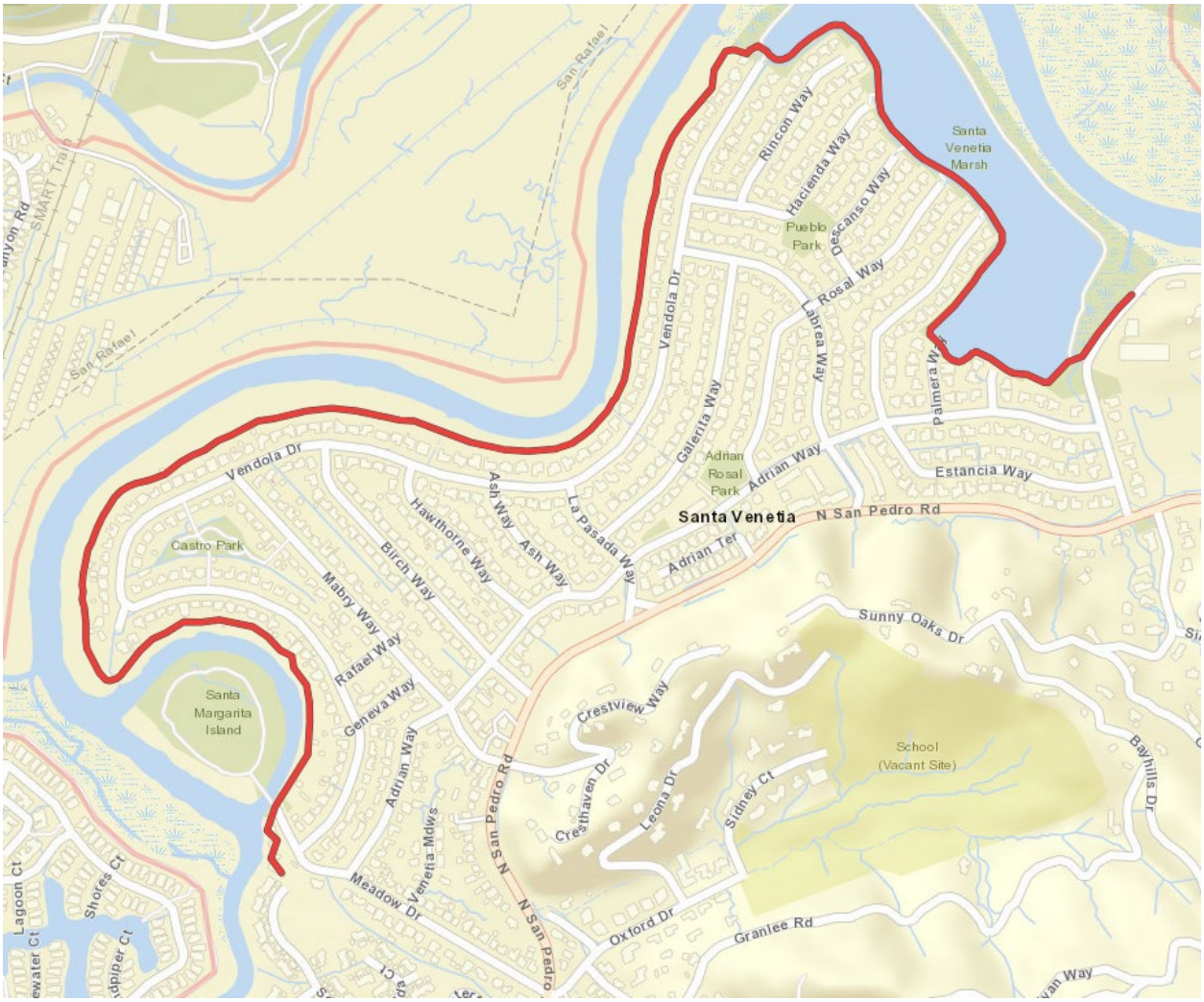


Figure 3.123: Santa Venetia Levee in Santa Venetia
Source: U.S. Army Corps of Engineers, 11/27/23

Three levee systems exist in St. Vincent. Two of them, Marin County Levee 33 and Marin County Levee 24, are located along the north bank of Miller Creek. Marin County Levee 33 is 0.25 miles long with an undocumented height and Marin County Levee 24 is 0.2 miles long with an undocumented height. The third levee is the Las Galinas Valley Sanitary District Levee which extends along the north and east bank of Miller Creek before diverging north to the Hamilton Wetlands and west to Long Point. It is 3.63 miles long with an undocumented height. Figure 3.124 shows the three levees in St. Vincent.

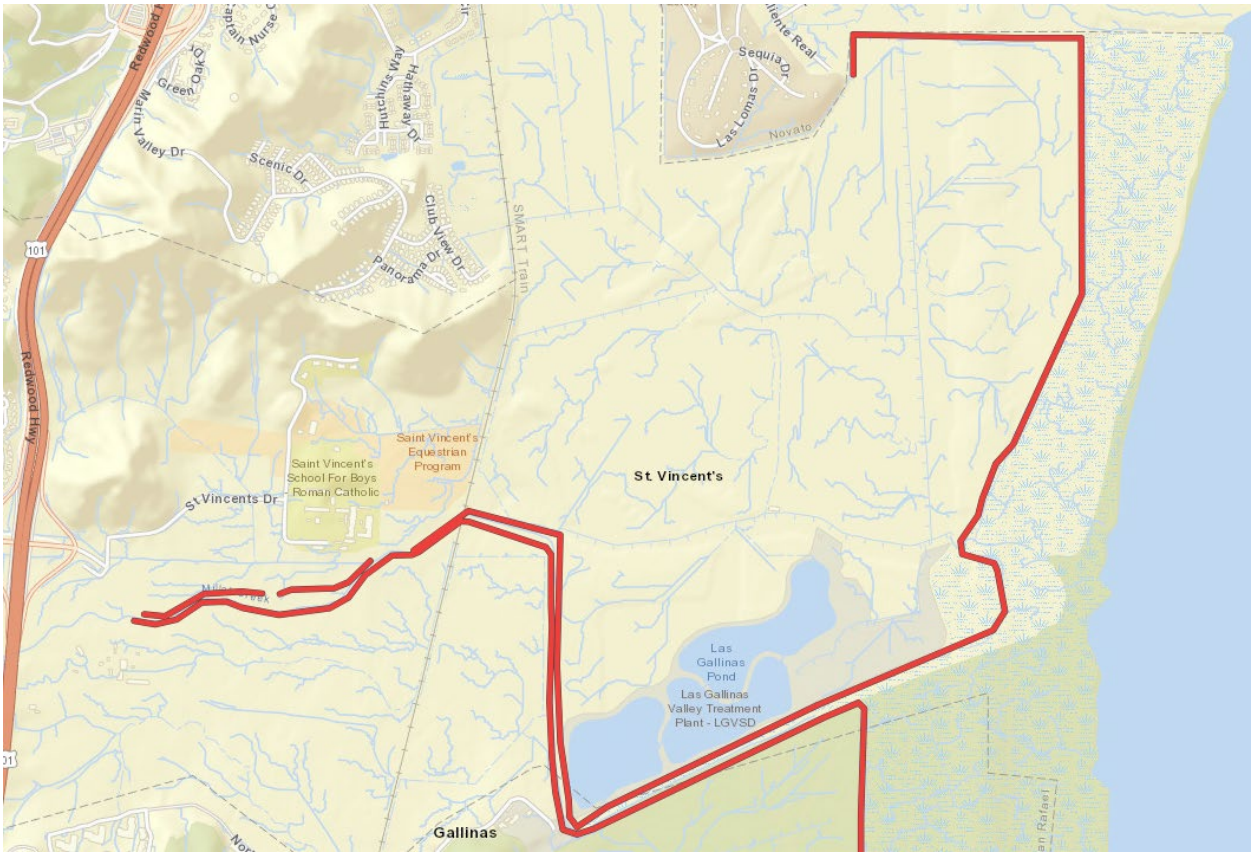


Figure 3.124: Marin Levee 33, Marin County Levees 33 and 24 and the Las Gallinas Valley Sanitary District Levee in St. Vincent
Source: U.S. Army Corps of Engineers, 11/27/23

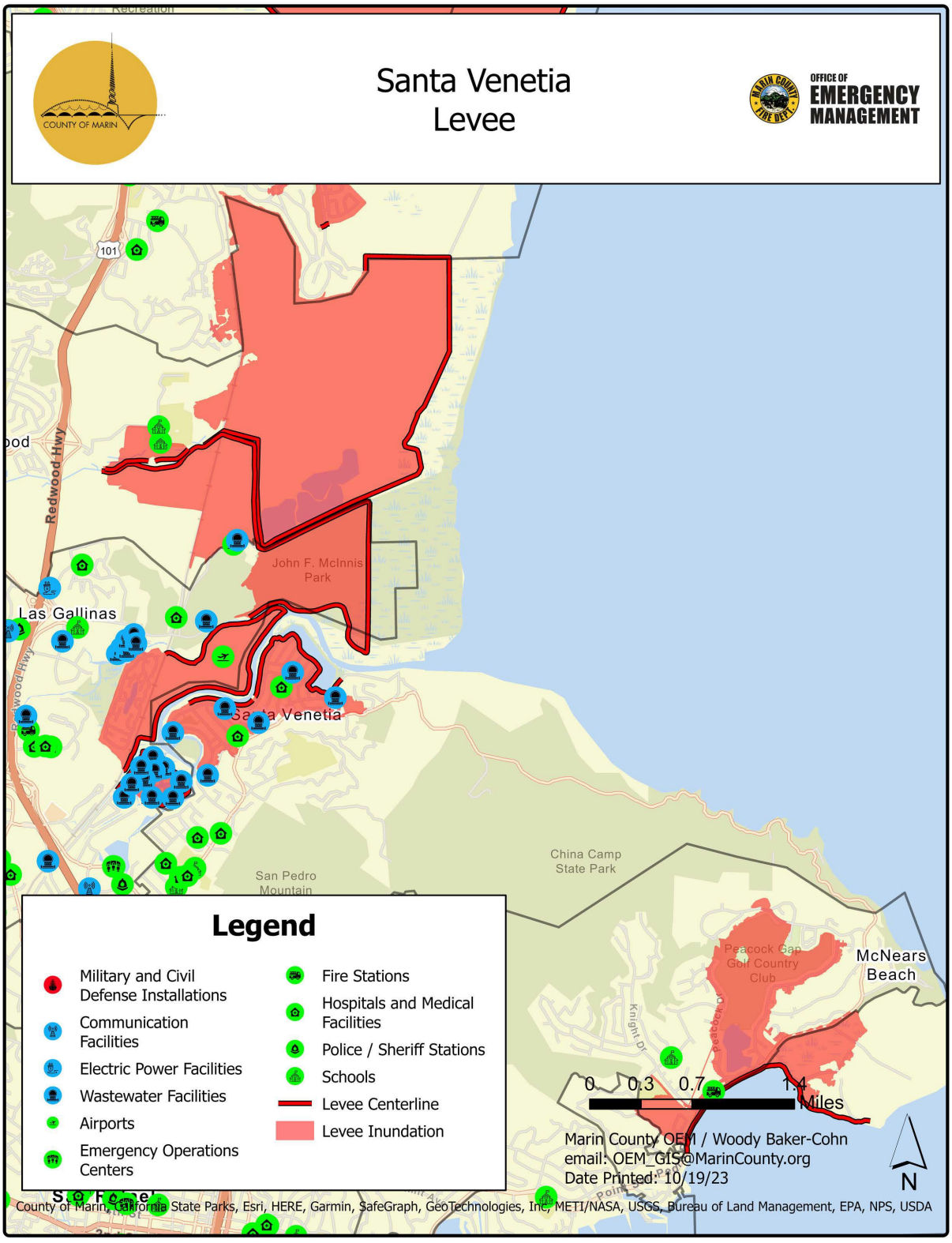


Figure 3.125: Santa Venetia Levee System
Source: Marin County OEM

Several levee systems exist around Bel Marin Keys and the Black Point area, but their failure does not present a risk to the communities.

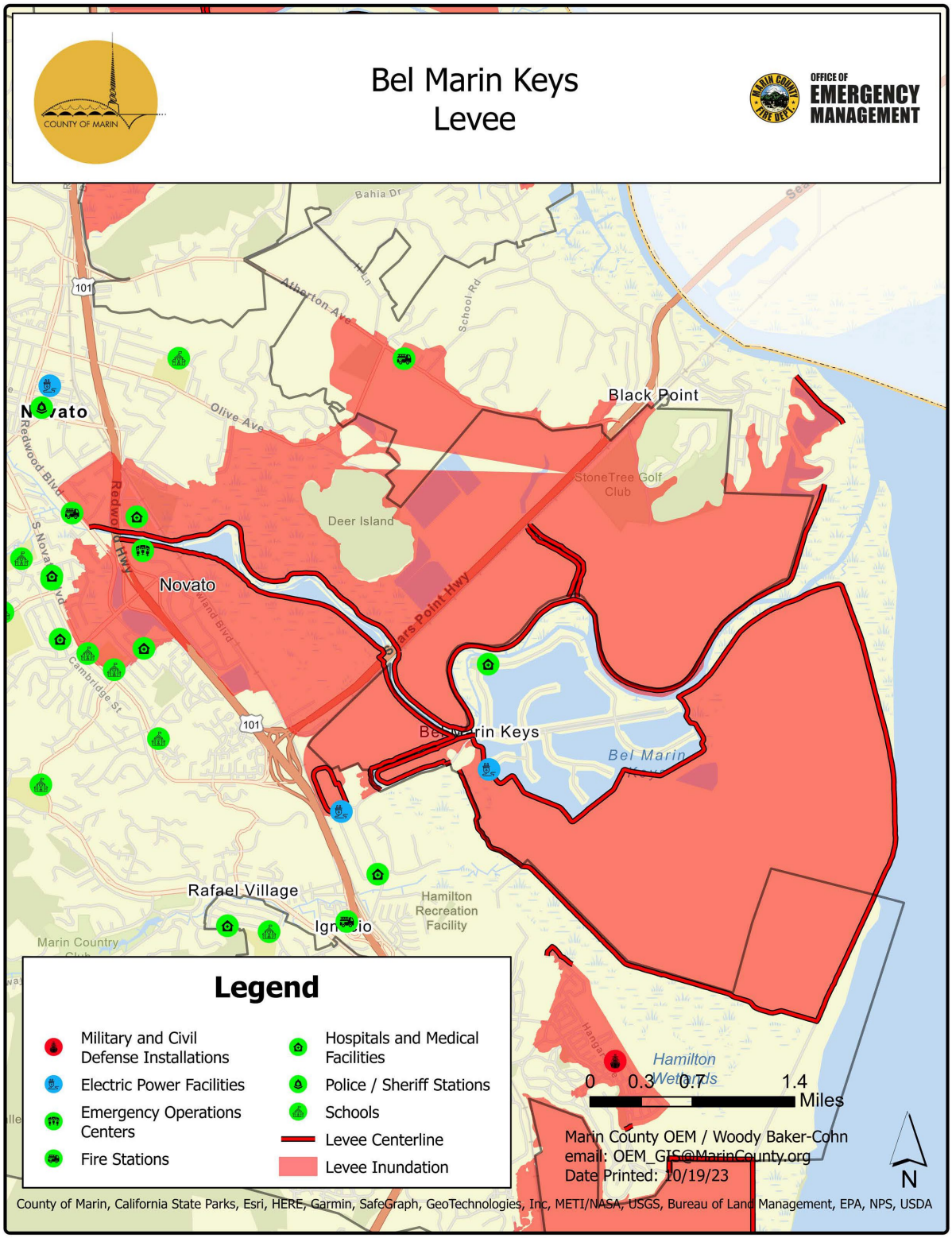


Figure 3.126: Bel Marin Keys Levee System
Source: Marin County OEM

Two levee systems are located around the Marin County Airport. The State Fish and Game Levee surrounds the Airport property and neighboring wetlands on three sides to the north, south, and east. The Gnoss Airport Levee consists of two sections that intersect the airport property. One section is 2.59 miles long with an undocumented height and the other section is 0.43 miles long with an undocumented height. Figure 3.127 shows the levee systems around the Marin County Airport.

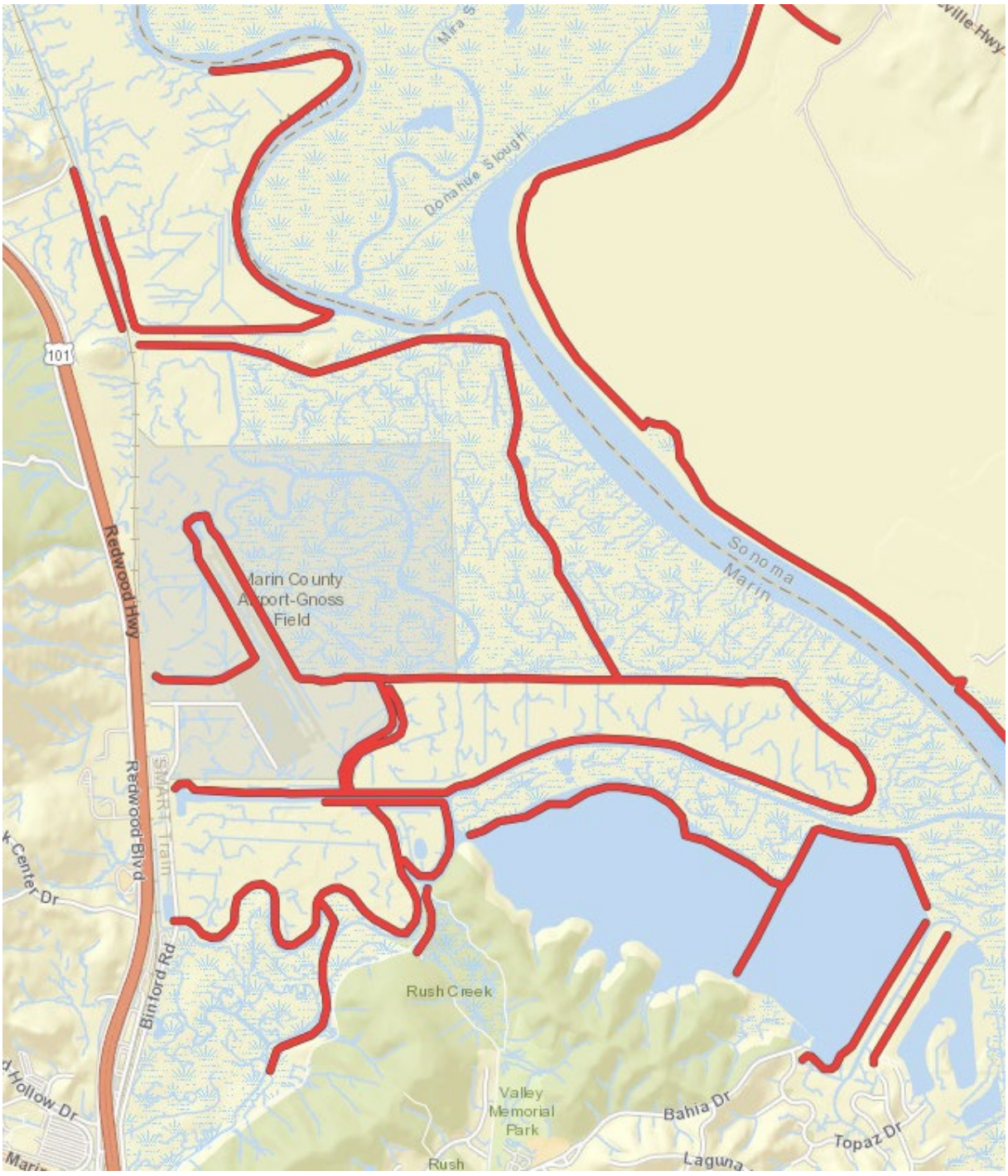


Figure 3.127: Levees Around the Marin County Airport
Source: U.S. Army Corps of Engineers, 11/27/23

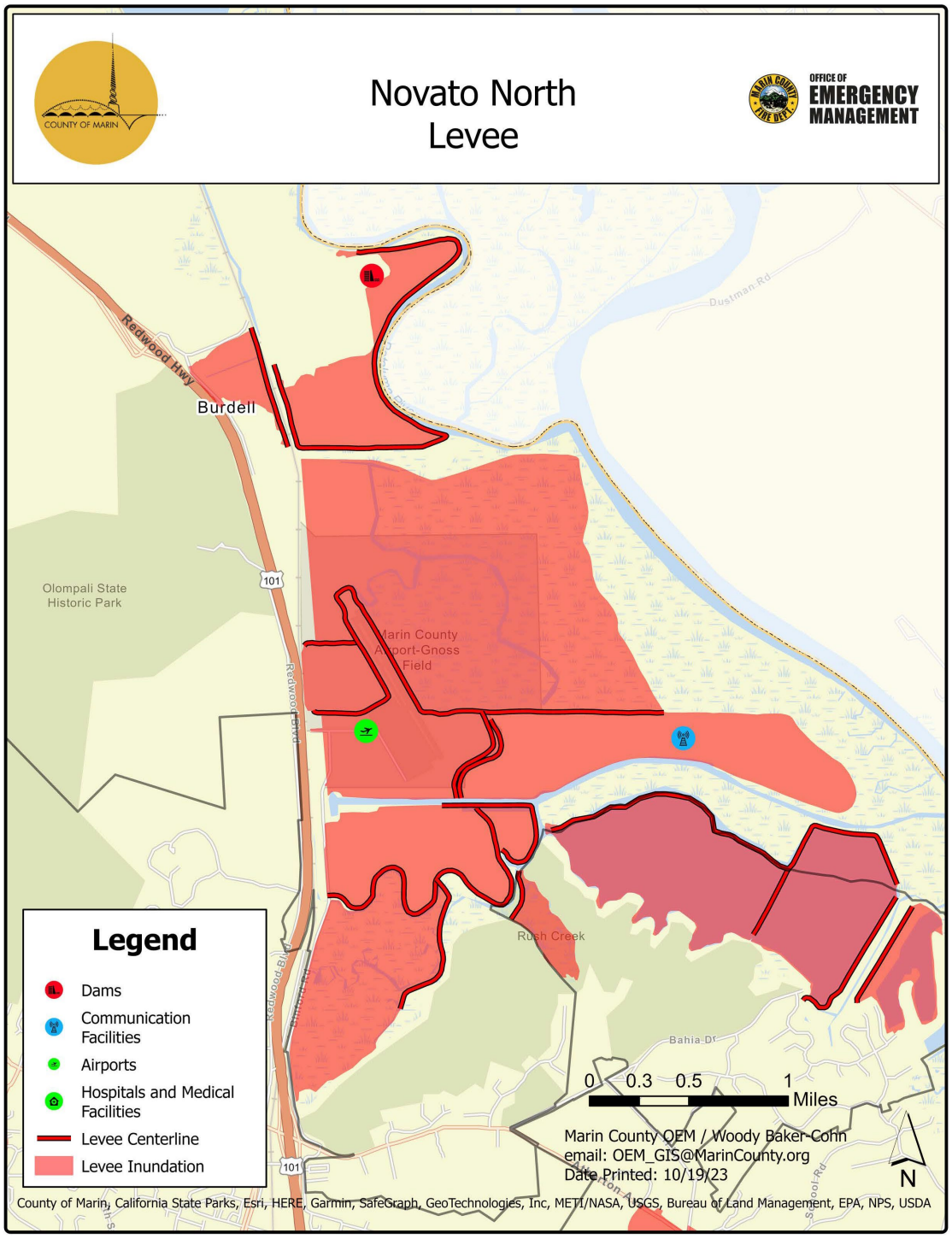


Figure 3.128: Novato North Levee System
Source: Marin County OEM

In 1982 a levee in Santa Venetia was breached by tidal elevations and flooded the neighborhood with 2-3 feet of water.

Over a million dollars-worth of levee damage on Novato Creek occurred in 2014 and 2017 and a heavy burden on stormwater pumping systems caused additional damage to pumping system components.

Over a million dollars-worth of levee damage on Novato Creek occurred in 2014 and 2017 and a heavy burden on stormwater pumping systems caused additional damage to pumping system components.

Impacts

Levee failure flooding would vary depending on which structure fails and the nature and extent of the failure and associated flooding. This flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, agricultural industry, and the local and regional economies.

The overall impact to the community from levee breach or failure includes:

- Injury and loss of life;
- Commercial and residential structural damage;
- Disruption of and damage to public infrastructure;
- Health hazards associated with mold and mildew;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values;
- Long dewatering periods;
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.
-

Extent and Probability

The probability of future levee failures in the Marin County OA is largely unknown but may result from a large winter storm or seismic event.

Table 3.14: Marin County OA Hazard Risk Assessment – Levee Failure						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Unlikely	Negligible	Moderate	Medium	High	**9.00**
City of Belvedere	Occasional	Limited	Moderate	Medium	Medium	**10.00**
Town of Corte Madera	Unlikely	Limited	Severe	High	Medium	**11.00**
Town of Fairfax	None	None	None	None	None	**0.00**
City of Larkspur	Unlikely	Negligible	Moderate	Medium	Low	**7.00**
City of Mill Valley	None	None	None	None	None	**0.00**
City of Novato	Occasional	Negligible	Weak	Medium	Low	**7.00**
Town of Ross	None	None	None	None	None	**0.00**
Town of San Anselmo	None	None	None	None	None	**0.00**
City of San Rafael	Unlikely	Significant	Severe	High	High	**13.00**
City of Sausalito	Occasional	Negligible	Weak	Low	Low	**6.00**
Town of Tiburon	Unlikely	Negligible	None	None	High	**5.00**
Bolinas Public Utility District	Unlikely	Limited	Extreme	High	Medium	**12.00**
Las Gallinas Valley Sanitary District	Unlikely	Significant	Severe	High	High	**13.00**
North Marin Water District	Unlikely	Significant	Extreme	High	Medium	**13.00**
Southern Marin Fire District	None	None	None	None	None	**0.00**

Table 3.14: Marin County OA Hazard Risk Assessment – Levee Failure
Source: Profiled Jurisdictions and Districts

Vulnerability

The areas of the Marin County OA most vulnerable to levee failure are those with levees that could fail. Several unincorporated communities in Marin County are susceptible to levee failure:

A small area of Tamalpais Valley is protected from the Coyote Creek Levees (COYL) and could be susceptible to a levee failure. This area includes dozens of homes along with several commercial buildings and a section of Highway 1. Approximately 206 people and 105 buildings are at risk from a failure of the COYL levee, with a property value risk of around $59.4 million. Approximately 557 people and 265 buildings are at risk from the levee on the southern bank of Coyote Creek, with a property value risk of around $156 million. The risk is considered to be low LSAC 4 (Levee Safety Action Classification) for both levees prior to overtopping and overtopping breach scenarios. The levee has an overtopping recurrence of 1/100 USACE with low life safety risk. Seepage has not been documented since the construction of a seepage barrier in 2005 (the levee was loaded 75% in 2008). Some uncertainty exists in the condition of culvert penetrations. Areas of oversteepened slope and erosion at the waterside levee toe are also moderate concerns. No loss of life is anticipated, and economic damages are anticipated to be low.

Two small areas of Strawberry are protected by levees and could be susceptible to levee failure. The area protected by the Seminary Marsh Levee consists of several businesses adjacent to Highway 101. Approximately 325 people and 13 buildings are at risk from a failure of the Seminary Marsh Levee, with a property value risk of $20.9 million. The area protected by the Strawberry Marsh Levee consists of several homes and Strawberry Elementary School. Approximately 488 people and 36 buildings are at risk from a failure of the Strawberry Marsh Levee, with a property value risk of around $17.2 million.

Part of the southern end of Kentfield is protected from Corte Madera Creek by the Corte Madera Creek Left Bank Levee and could be susceptible to a levee failure. This area includes a few dozen homes and the Marin General Hospital. Approximately 260 people and 104 buildings are at risk from a failure of the Corte Madera Creek Left Bank Levee, with a property value risk of around $40.3 million. The Levee was assessed in 2021 and the risk was determined to be low.

Numerous homes along with San Pedro Point Road and the McNears Brickyard are susceptible to a failure of the McNears sea wall. Approximately 604 people and 242 buildings in the unincorporated area and the City of San Rafael are at risk from a failure of the sea wall, with a total property value risk of around $169 million.

Part of the northern area of Santa Venetia is protected from the South Fork of Galinas Creek by the Santa Venetia Levee. There are several hundred homes in this area along with numerous pump stations and several medical facilities that could be susceptible to a levee failure. Approximately 1,901 people and 676 buildings are at risk from a failure of the Santa Venetia Levee, with a property value risk of around $323 million.

The area of St. Vincent, which includes the St. Vincent School and the Las Galinas Valley Treatment Plant, is protected from Miller Creek and San Pablo Bay from Marin County Levee 33, Marin County Levee 24 and the Las Gallinas Valley Sanitary District Levee and could be susceptible to a levee failure. Approximately 8 buildings are at risk from a failure of both Marin County Levee 33 and Marin County Levee 24. Approximately 19 people and 9 buildings are at

risk from a failure of the Las Gallinas Valley Sanitary District levee, with a property value risk of around $9.47 million.

The Marin County Airport is protected by the State Fish and Game Levee and the Gnoss Levees, and airport facilities along with the access road could be susceptible to a levee failure. The qualitative risk of the levees around the Airport is unknown.

Climate Change and Future Development Considerations

Climate change is expected to lead to an increase in the frequency and severity of major storm events, which can place added strain on levee systems. An increase in rainfall and runoff as a result of climate change will increase the potential for higher water levels in leveed areas across the Marin County OA, increasing the potential for a levee failure. Rising seas will lead to increased stress on the levees around the Marin County OA shoreline, particular during a major tidal event and potential tsunami. As development increases in the populated areas of the Marin County OA protected by its levees, particularly in coastal areas, the potential for significant impacts to residents and infrastructure will only increase.

3.3.8 Sea Level Rise

Climate change is the distinct change in measures of weather patterns over a long period of time, ranging from decades to millions of years. More specifically, it may be a change in average weather conditions such as temperature, rainfall, snow, ocean and atmospheric circulation, or in the distribution of weather around the average. While the Earth's climate has cycled over its 4.5-billion-year age, these natural cycles have taken place gradually over millennia, and the Holocene, the most recent epoch in which human civilization developed, has been characterized by a highly stable climate until recently.

The Marin County OA MJHMP is concerned with human-induced climate change that has been rapidly warming the Earth at rates unprecedented in the last 1,000 years. Since industrialization began, the burning of fossil fuels (coal, oil, and natural gas) at escalating quantities has released vast amounts of carbon dioxide and other greenhouse gases responsible for trapping heat in the atmosphere, increasing the average temperature of the Earth. Secondary impacts include changes in precipitation patterns, the global water cycle, melting glaciers and ice caps, and rising sea levels. According to the Intergovernmental Panel on Climate Change (IPCC), climate change will "increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" if unchecked.

Through changes to oceanic and atmospheric circulation cycles and increasing heat, climate change affects weather systems around the world. Climate change increases the likelihood and exacerbates the severity of extreme weather – more frequent or intense storms, floods, droughts, and heat waves. Consequences for human society include loss of life and injury, damaged infrastructure, long-term health effects, loss of agricultural crops, disrupted transport and freight, and more. Climate change is not a discrete event but a long-term hazard, the effects of which communities are already experiencing.

Climate change adaptation is a key priority of the State of California. The 2013 State of California Multi- Hazard Mitigation Plan stated that climate change is already affecting California. The State has also seen increased average temperatures, more extreme hot days,

fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

Rising sea levels are considered a secondary effect of climate change due to warming ocean temperatures and melting glacial ice sheets into the ocean. The California coast has already seen a rise in sea level of four to eight inches over the 20th century due to climate change. Sea level rise impacts can be exacerbated during coastal storms, which often bring increased tidal elevations called “storm surge.” The large waves associated with such storm surges can cause flooding in low-lying areas, erosion of coastal wetlands, saltwater contamination of drinking water, disruption of septic system operations, impacts on roads and bridges, and increased stress on levees. In addition, rising sea levels result in coastal erosion as shoreline sediment is re-deposited back into the ocean. Evidence shows that winter storms have increased in frequency and intensity since 1948 in the North Pacific, increasing regional wave heights and water levels during storm events.

According to the 2017 “Rising Seas in California, An Update on Sea-Level Rise Science” report Marin County may experience impacts from Sea Level Rise over defined periods of time, to include long-term changes (second half of this century and beyond), and short- to mid-term projections (within the next two or three decades).

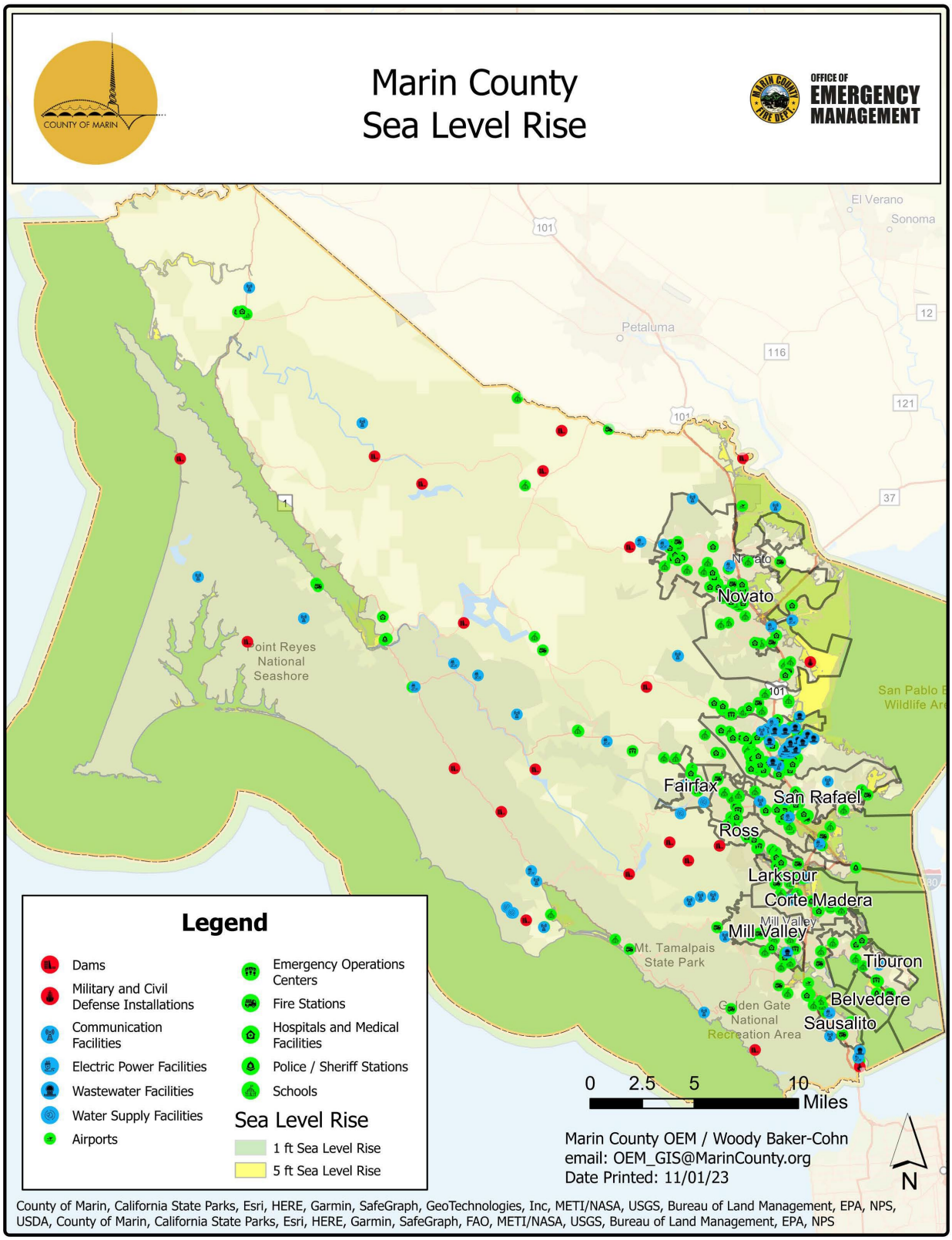
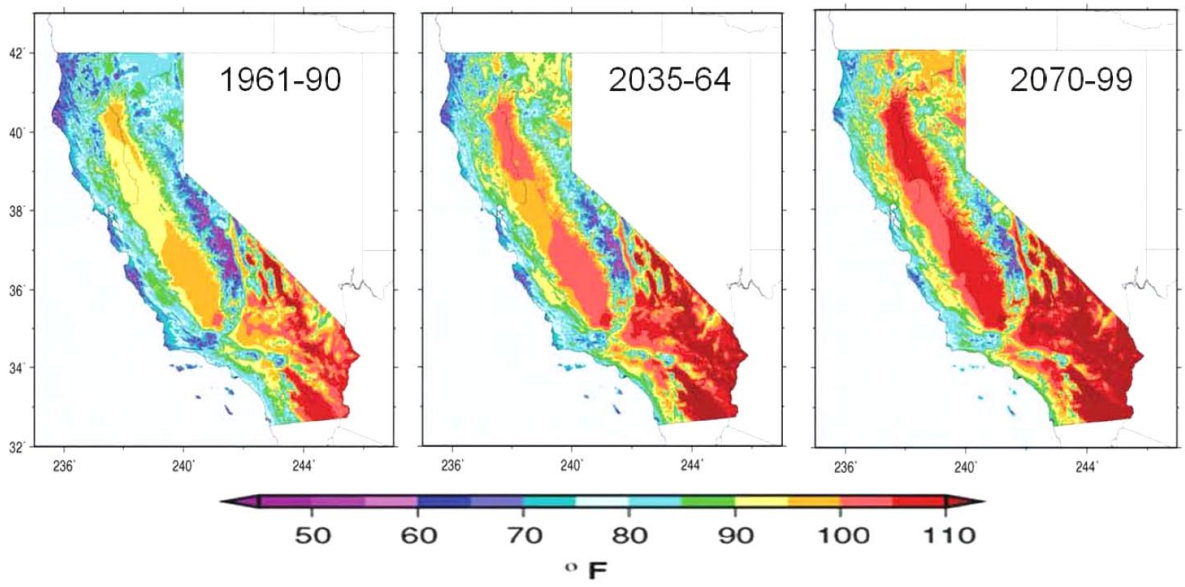


Figure 3.129: Marin County Sea Level Rise Susceptibility to Critical Facilities
Source: Marin County OEM

Location and Previous Occurrences

Past flooding, wildfire, levee failure, and drought disasters have been exacerbated by climate change in frequency of occurrence and intensity. Unlike earthquakes and floods that occur over a finite time period, climate change may be experienced as a compounding, long term hazard, the effects of which some communities may already be experiencing.

The 2018 State of California Multi-Hazard Mitigation Plan states that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing. This data suggests that the effects of climate change have been occurring in the Marin County area. See Figure 3.130 for the historic and future change in average July temperatures across California.



Source: Dan Cayan et al. 2009.

Figure 3.130: Average July Temperatures in California
Source: California Climate Adaptation Strategy

Impacts

During the next few decades, scenarios project average temperature to rise between 1°F and 2.3°F in California. As such, temperatures across the Marin County OA, including in the unincorporated area, would be expected to rise, leading to increase in drought conditions that could lead to forest devastation and wildfires, and an increase in major flooding and associated debris flow events. These extreme weather events can cause additional injuries and fatalities and can cause worsened damage or destruction to homes and critical facilities and infrastructure across the County. Socioeconomic disruption can also occur across the County as a result of climate change.

Dealing with flooding from rain and upstream runoff is already complicated. Sea level rise will make it even more complicated by increasing the frequency and duration of flooding. When water temperature increases, warm water expands and takes up more space than colder water. As the planet warms, the water in the ocean warms, expands, and elevates sea levels. The changing climate has also melted parts of the ice caps at the North and South Poles. As this ice melts and flows into the ocean, it increases the amount of water in the ocean and raises sea levels even more. Sea levels in San Francisco Bay have risen seven inches over the past century. Predictions of future sea level rise vary from 12 inches by 2030 to 60 inches by 2100. The Bay Conservation and Development Commission (BCDC) recommends using 36 inches of sea level rise for planning purposes. Rising sea levels increase the upstream extent of tidal flooding, worsen creek overflow due to backwater effects of elevated high tides, and create larger, stronger waves which erode the shoreline and destroy sensitive marshes. Coastal flooding will have a large impact on cities and habitat.

A 36-inch increase in sea levels will greatly impact people's lives throughout the Marin County OA, including in the unincorporated area. Daily high tides will inundate major thoroughfares, schools, retirement communities, private homes, shopping areas, bike paths, and stormwater detention ponds. Valuable marsh and mudflat habitat will be permanently flooded. Infrastructure will need to be armored, abandoned, or relocated. Shorelines will be eroded by increased wave erosion, threatening even more infrastructure. With sea level rise it is projected that more land along Marin's coastline and bayside will be permanently inundated or subject to more regular flooding, while the frequency and intensity of storm events are anticipated to increase with climate change. Greater riparian flooding may also occur with sea level rise and future storm events, though modeling is necessary to better understand the extent of such hazards. As previously discussed best available sea level rise and future flood models indicate that by 2100 around 7,000 acres, 9,000 parcels, 10,000 buildings and 120 miles of roads throughout Marin County may be exposed to flooding due to future sea level rise and 100-year storm events.

Extent and Probability

Table 3.15: Marin County OA Hazard Risk Assessment - Sea Level Rise						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Highly Likely	Limited	Extreme	High	High	**16.00**
City of Belvedere	Highly Likely	Limited	Extreme	High	High	**16.00**
Town of Corte Madera	Occasional	Significant	Weak	High	Medium	**11.00**
Town of Fairfax	None	None	None	None	None	**0.00**
City of Larkspur	Highly Likely	Limited	Extreme	High	High	**16.00**
City of Mill Valley	Highly Likely	Limited	Weak	High	Medium	**12.00**
City of Novato	Occasional	Limited	Moderate	High	Medium	**11.00**
Town of Ross	None	None	None	None	None	**0.00**
Town of San Anselmo	None	None	None	None	None	**0.00**
City of San Rafael	Highly Likely	Significant	Moderate	High	High	**15.00**
City of Sausalito	Likely	Significant	Severe	High	Medium	**14.00**
Town of Tiburon	Highly Likely	Limited	Extreme	High	High	**16.00**
Bolinas Public Utility District	Likely	Extensive	Severe	High	High	**18.00**
Las Gallinas Valley Sanitary District	Likely	Significant	Moderate	High	High	**14.00**
North Marin Water District	Occasional	Significant	Moderate	High	Medium	**12.00**
Southern Marin Fire District	Likely	Significant	Extreme	Medium	Low	**13.00**

Table 3.15: Marin County OA Hazard Risk Assessment - Sea Level Rise
Source: Profiled Jurisdictions and Districts

Vulnerability

All residents in the Marin County OA, including in the unincorporated area, are susceptible to climate change, with effects being more prevalent in those with pre-existing health conditions and the elderly. Communities most vulnerable to the impacts of sea level rise in unincorporated Marin County include Muir Beach, Stinson Beach, Bolinas, Inverness, Pt. Reyes Station, East Shore, and Dillon Beach.

Coping with a changing climate presents opportunities for local health departments and partners in Marin County to consider policies, actions, and infrastructure design that will not just protect the public from climate change threats, but also establish health equity, resiliency, and sustainability. A critical step for building resilience is to improve capacity of communities to prepare, respond, and recover from climate-related health risks.

The most vulnerable assets in Marin County OA's unincorporated communities in the near-term are Shoreline Highway through Almonte, Waldo Point Harbor houseboats and facilities, Greenbrae homes and facilities, and Paradise Cay homes and marina. The elevated homes on Greenbrae Boardwalk and floating homes in Waldo Point Harbor may be more adaptable in the near term than homes with solid foundations. In the medium-term, portions of Bel Marin Keys could face impacts, as would Santa Venetia homes, Tamalpais Valley homes, and the Greenwood Cove, Strawberry Circle, Strawberry Village Shopping Center, homes along Seminary Drive in Strawberry, and Kentfield creek side homes. In the long-term, Black Point and North Novato could anticipate damaging impacts. In the medium-term timeframe, regular high tide tidal flooding could adversely impact the same locations tidally flooded in the near-term, though more severely. Storm surge flooding could be 10 inches with a 100-year storm surge, and extend further inland beyond the marshy areas of Mill Valley, Strawberry, San Rafael, St. Vincent's, and North Novato. In the long-term (second half of this century and beyond), regular tidal flooding could adversely impact the same locations impacted in the near- and medium-terms (within the next two or three decades) and significant portions of what would have previously only flooded from the 100-year storm surge. The additional areas that would tidally flood at 60 inches of sea level rise are:

- Tamalpais Valley
- Mill Valley from the Richardson's Bay shoreline up to and beyond Camino Alto between Miller and East Blithedale Avenues
- Mill Valley and Strawberry fronting US Highway 101 between Seminary Drive and Tiburon Boulevard
- Santa Venetia north of N. San Pedro Boulevard
- Cove Neighborhood, Tiburon
- Belvedere Lagoon neighborhood
- Paradise Cay
- Mariner Cove, Marina Village, Madera Gardens, and major retail centers lining US Highway 101
- Riviera Circle, Creekside, and Heatherwood neighborhoods, Larkspur
- Interstate 580 and westward towards Andersen Drive in San Rafael and the community of California Park
- Marin Lagoon and Peacock Gap neighborhoods, San Rafael
- Bel Marin Keys northern and southern lagoon areas

- Hamilton, Vintage Oaks, and pockets of development east of US Highway 101 at Rowland Boulevard and State Route 37 in Novato, and
- North Novato at US Highway 101 and Binford Road.

Bayside areas that could anticipate increased storm surge flooding are:

- Sausalito west of Bridgeway
- Marin City neighborhood
- Mill Valley east of East Blithedale Avenue at Alto Shopping Center
- Las Gallinas and North San Pedro Boulevard, east of US Highway 101, San Rafael
- Bayside Acres
- Country Club
- Kentfield

In their current conditions, the most vulnerable coastal Marin County OA infrastructure, in order of onset and flood depth, includes

Near term (ten years):

- Beaches, underground on-site wastewater treatment systems (OWTS), buildings, and streets in Stinson Beach west of Shoreline Highway
- Shoreline Highway between Stinson Beach and Bolinas, at Green Bridge over Lagunitas Creek in Pt. Reyes Station, the Walker Creek crossing in Marshall, and bridges on Middle Road and Valley Ford Lincoln School Road
- Beaches and beach front and downtown buildings and streets in Bolinas
- Septic systems, beaches, marshes, and buildings along the eastern and western shores of Tomales Bay
- The water distribution pipe underneath Shoreline Highway and Sir Francis Drake
- Boulevard serving many Inverness residents
- Intertidal rocky lands in Muir Beach and Duxbury Reef in Bolinas
- Fire service facilities and tsunami evacuation routes in Stinson Beach
- Recreational facilities at Dillon Beach Resort and Lawson's Landing
- Blufftop buildings in Muir Beach, Bolinas, and Dillon Beach may be vulnerable to accelerated erosion

Medium Term (thirty years):

- Olema-Bolinas Road, which is the only road to Downtown Bolinas
- Additional buildings and streets in downtown Bolinas, including the historic district
- Bolinas Public Utilities District lift station at the end of Wharf Road
- Shoreline Highway in Pt. Reyes Station and East Shore, and Sir Francis Drake Blvd. in Inverness
- Along the east shore of Tomales Bay, homes on piers over the water are particularly vulnerable

Long Term (seventy years):

- Shoreline Highway along the East Shore

- Buildings in Inverness west of Sir Francis Drake Blvd
- Downtown Bolinas up to Brighton Road, including the market, library, community center, gas station, museum, and other valued places

Along the bay shoreline, in the near-term timeframe, tidal flooding at 10 inches of sea level rise could reach 5,000 acres, 1,300 parcels, and 700 buildings, potentially impacting tens of thousands of residents, employees, and visitors. With an additional 100-year storm surge, the previously impacted acres, parcels, and buildings could face tidal and storm surge flooding. An additional 3,000 acres, 2,500 parcels, and 3,800 buildings could anticipate storm surge flooding across the Marin County OA. Eight miles of road could expect tidal flooding. Smaller public and private and marinas and boat launches along the bay in Strawberry, Bel Marin Keys, and Black Point could be flooded out and unusable. Storm surges can be powerful enough to damage and sink boats, including those belonging to the Southern Marin Fire Protection. Most concerning, however, is the potential inability of emergency professionals and vehicles to access people in or through flooded areas.

In this medium-term timeframe, tidal flooding at 20 inches of sea level rise could reach nearly 7,000 acres, 3,000 parcels, and 2,000 buildings in the Marin County OA, potentially impacting even more residents, employees, and visitors than in the near-term. With an additional 100-year storm surge, the previously impacted acres, parcels, and buildings could face tidal and storm surge flooding, and an additional 7,000 acres, 2,200 parcels, and 3,600 buildings in the Marin County OA could anticipate storm surge flooding. Most levees south of Novato are not designed to withstand this level of flooding and could be overtopped.

Eighteen miles of roadway, ten more miles than in the near-term, could expect tidal flooding. Many of the impacted roads are the same as those impacted in the near-term, though much greater lengths could anticipate tidal flooding and flooding depths would increase. Storm surge flooding could reach a total of 44 additional miles of roadway. Water travel could experience similar outcomes as in the near-term, though the highest high tides and storms surges would cause even more damage than weathered twenty years earlier.

Pipelines under vulnerable roads, and lateral pipes to vulnerable properties, would become squeezed between rising groundwater and the confining roadway. This could cause pipes to bend and break and could even damage roadways. In the medium-term, impacts to the North Marin Water District service area would impact water service in Bel Marin Keys and unincorporated area around Novato. Vulnerable substations, electrical transmission towers and lines, and underground natural gas pipelines along the shoreline would be compromised by flooding and subsidence. Disruptions or failures in this network could also have far reaching impacts in transportation, sanitary service, stormwater management facilities, food storage, communications, and general public safety.

In the long-term timeframe, tidal flooding at 60 inches of sea level rise could reach nearly 7,000 acres, 8,000 parcels, and 9,000 buildings in the Marin County OA, potentially impacting hundreds of thousands of residents, employees, and visitors. In the long-term scenario, storm surge flooding could occur on nearly 13,500 acres hosting 12,600 parcels with 12,000 buildings in the Marin County OA, potentially impacting 200,000 residents, thousands of employees, and several million visitors.

One-hundred miles of public and private roadways in the Marin County OA could be vulnerable to tidal exposure. Roads could degrade more quickly, or if flood waters are deep enough, become impassable. Lane miles could be more than double this figure. An additional 30 miles of roadway could be vulnerable at 60 inches of sea level rise and a 100-year storm surge. Moreover, several park and rides, several hundred bus stops, and bus transit and SMART rail routes could flood. Breakdowns in the transportation network would have major impacts on the economy and daily life functions. In addition, significant safety hazards could cause injury or loss of life. Flooding at the Sewerage Agency of Southern Marin (SASM) and Novato Sanitary Wastewater Treatment Plants is a significant vulnerability that could arise, potentially disrupting hundreds of thousands of people.

By this time, much of the low-lying shoreline sanitary sewer and stormwater infrastructure could be flooded out. By the end of the century, sea level rise could have direct impacts to the Novato Atherton Avenue Fire Station. A few emergency shelters in Southern Marin communities could be vulnerable to tidal flooding, and several more could expect storm surge flooding and may not be available when needed most.

Beaches, estuaries, marshes, wetlands, and intertidal areas on the Marin County OA coast, including in the unincorporated area, are vulnerable to sea level rise and storms. Nearly all beaches except Dillon Beach and the federal portion of Stinson Beach, could be lost entirely in the long-term. Roughly 9,000 acres in the estuaries of Tomales Bay, Bolinas Lagoon, and Esteros Americano and San Antonio, 1,800 acres of wetlands and marshlands could be impacted to varying degrees across all of the scenarios in all of the communities. Sea level rise may push coastal habitats inland where possible, flooding tidal areas more frequently and inundating new inland areas with saltwater. The North Central California Coast and Ocean Vulnerability Assessment identified the five most vulnerable species to sea level rise as the Western snowy plover, black oystercatcher, black rail, California mussel, and red abalone.

On the bayside, the marshlands that buffer the shoreline communities from high tides and storm surges could begin to experience transitions in habitat, especially those in the Southern Marin County OA where they are typically bordered by urban development. Consequently, the waters here would get deeper and flood out the existing habitat, shifting high marsh to low marsh, low marsh to mud flat, and mud flats to open water. Without adequate light of shallow water, eelgrass beds would shrink. Collectively, these habitat shifts could have significant impacts on vulnerable species such as the salt marsh harvest mouse, Ridgway's Rail, or the long-fin smelt. A twenty-inch increase in sea level in the medium-term would continue to shrink the Southern Marin County OA, Tiburon Peninsula, and Pt. San Pedro marsh and tidal habitats.

Southern Marin County OA marshes may no longer exist by the end of the century, destroying the habitat of several shoreline birds and mammals. Northern Marin marshes would become increasingly tidally influenced, with tide water reaching US Highway 101 in Bel Marin Keys and North Novato up the Petaluma River. Typically freshwater marshes west of US Highway 101, for example, Sutton Marsh, could also expect damaging salinity impacts. Tidal marsh lands may increase in Northern Marin if they are not prevented from migrating inland. Approximately 1,358 acres on 30 agricultural parcels could be vulnerable to sea level rise and storm conditions. Another 3,000 acres are public agency lands near Bel Marin Keys, Hamilton Field, and the Novato Sanitary District that are leased for agricultural use. Higher high tides could push brackish conditions inland, reducing grazing, manure spreading, and cultivation area.

Loss of or compromised emergency services could be more devastating to communities with higher populations that fall into certain demographic categories. Communities with higher populations that fall into these categories include Marin City and the canal neighborhoods in the unincorporated area around the City of San Rafael. Marin County OA populations that are most vulnerable to the effects of sea level rise include:

- Low-income households
- Households in poverty

Climate Change and Future Development Considerations

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. Climate change is affecting natural and built systems around the world, including the California coast. In the past century, average global temperature has increased about 1.4°F, and average global sea level has increased 7 to 8 inches. Sea level rise in the San Francisco Bay Area is projected to increase by eight inches MHW in 2050 and could reach 4.5 to eight feet by 2021 if greenhouse gas emissions aren't reduced[4].

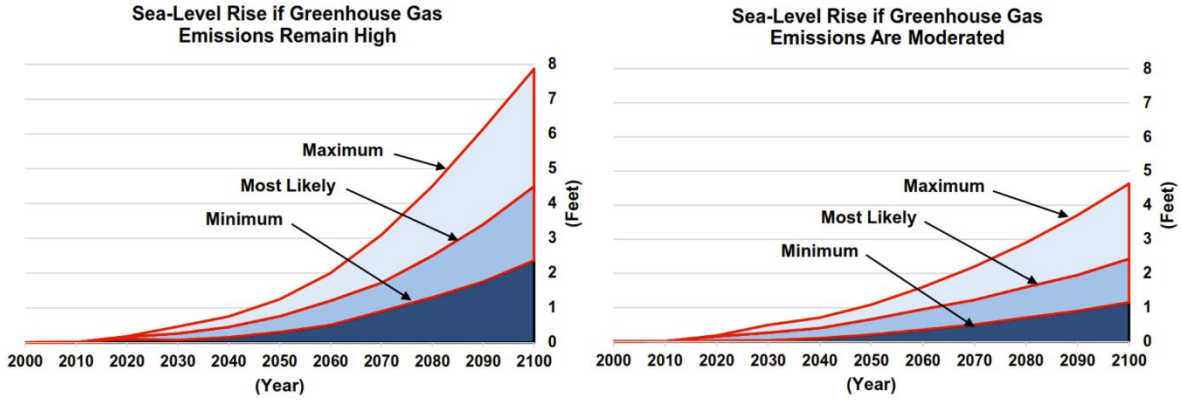


Figure 3.131: Projections of Sea Level Rise in the San Francisco Bay Area, 2000-2100
Source: 2019–2020 Marin County Civil Grand Jury, Climate Change: How Will Marin Adapt?

While the Marin County OA shoreline already experiences regular erosion, flooding, and significant storm events, sea level rise will exacerbate these natural processes, leading to significant social, environmental, and economic impacts. The third National Climate Assessment cites strong evidence that the cost of doing nothing exceeds the costs associated with adapting to sea level rise by 4 to 10 times. Sea level rise will continue to affect the Marin County OA with increased tidal flooding and storm surge during severe weather events, and future along the Marin County OA shoreline will only amplify these impacts. Sea level can also lead to increased land subsidence and the potential of levee failure. The impacts of a tsunami would also be magnified with rising seas. Future development in the coastal areas of Marin County will put more people and property at risk from flooding as a result of sea level rise. Roads and utility infrastructure across the Marin County OA will continue to become inundated.

[4] 2017 Marin Shoreline Sea Level Rise Vulnerability Assessment. https://www.marincounty.org/-/media/files/departments/cd/planning/slr/baywave/vulnerability-assessment-final/final_allpages_bvbconsulting_reduced.pdf?la=en

3.3.9 SEVERE WEATHER – EXTREME HEAT

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. A heat wave is an extended period of extreme heat, often with high humidity. When relative humidity is factored in, the temperature can feel much hotter as reflected in the Heat Index (see Figure 3.132):

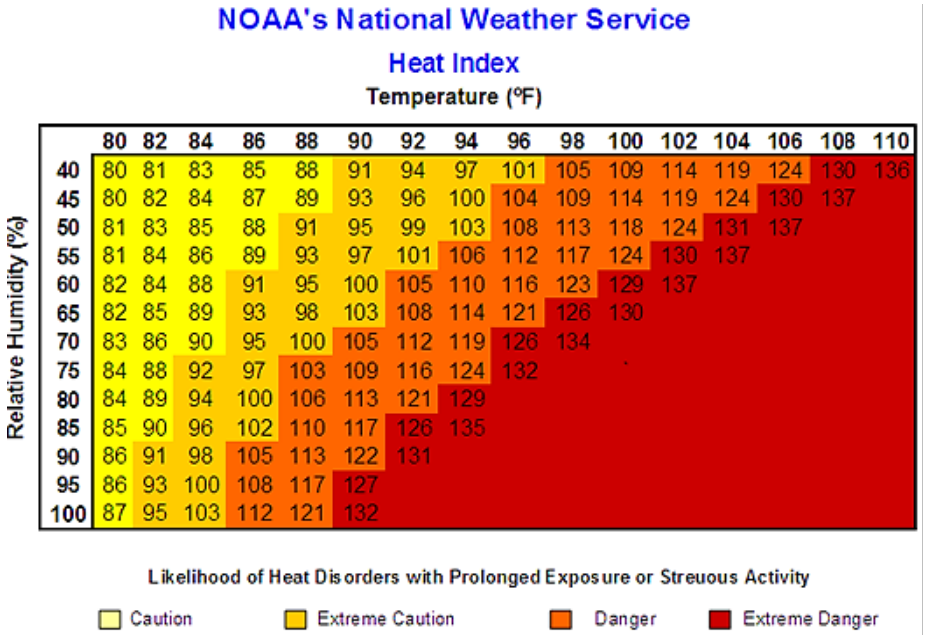


Figure 3.132: Heat Index
Source: NOAA

Heat kills by taxing the human body beyond its abilities. In a normal year, about 1,300 Americans succumb to the demands of summer heat. Heat is the leading weather-related cause of mortalities in the US. In 2006, California reported a high of 204 heat related deaths, with 98 reported in 2017 and 93 deaths reported in 2018.

Location and Previous Occurrences

Extreme heat has the potential to impact all areas of the Marin County OA, though more predominantly in the lower elevations further away from the coast. In the unincorporated area this includes the Tamalpais Valley, Kentwood, Lucas Valley-Marinwood and Santa Venetia areas. Communities along the Pacific Ocean and Tomales Bay including Muir Beach, Stinson Beach, Bolinas, Inverness and Point Reyes Station tend to have cooler temperatures due to the ocean and bay breezes.

In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died. According to the 2018 California State Hazard Mitigation Plan, the worst single heat wave event in California occurred in Southern California in 1955, when an eight-day heat wave resulted in 946 deaths.

Impacts

Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations. Heat waves do not cause damage or elicit the immediate

response of floods, fires, earthquakes, or other more “typical” disaster scenarios. While heat waves are obviously less dramatic, they are potentially more deadly. Heat emergencies are often slower to develop, taking several days of continuous, oppressive heat before a significant or quantifiable impact is seen. Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations. Sickness can occur if someone has been in extreme heat for too long, or has over-exercised for his or her age or physical condition. Extreme heat can be more dangerous for older people, the very young, and people who are sick or overweight. See Figure 3.133 for a description of possible heat disorders by heat index level.

Heat Index	Category	Possible heat disorders for people in high risk groups
130°F or higher	Extreme Danger	Heatstroke risk extremely high with continued exposure.
105° - 129° F	Danger	Sunstroke, Heat Cramps and Heat Exhaustion likely, Heatstroke possible with prolonged exposure and/or physical activity.
90° - 105° F	Extreme Caution	Sunstroke, Heat Cramps and Heat Exhaustion possible with prolonged exposure and/or physical activity.
80° - 90°F	Caution	Fatigue possible with prolonged exposure and/or physical activity.

Figure 3.133: Heat Disorders by Heat Index Level
Source: National Weather Service (NWS)

Rural buildings without electricity, some mobile homes, or older homes that have not been retrofitted for AC, can become susceptible to extreme heat effects. The OA may open cooling centers as a result of heat or prolonged period of hot temperatures. When combined with low humidity, extreme heat can contribute to the start and spread of wildfires.

The NWS will issue a Heat Advisory, Watch, or Warning when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for the issuance of excessive heat alerts is when the maximum daytime high is expected to equal or exceed 105°F and a nighttime minimum high of 80°F or above is expected for two or more consecutive days. The NWS office in Sacramento can issue the following heat-related advisory as conditions warrant.

Heat Advisory means that temperatures of at least 100°F or Heat Index values of at least 105°F are expected. Consider postponing or rescheduling any strenuous outdoor activities. If you must be outside, be sure to drink plenty of water and take frequent breaks in the shade. The young and elderly and those with medical conditions should use extra caution outdoors.

Excessive Heat Watch means that Heat Index values are expected to reach or exceed 110°F and not fall below 75°F for at least a 48 hour period. Plan to suspend all major daytime outdoor activities if a warning is issued. If you do not have air conditioning, locate the nearest cooling shelter or discuss staying with nearby family or friends who have A/C.

Excessive Heat Warning means that Heat Index values are expected to reach or exceed 110°F and not fall below 75°F for at least a 48-hour period, beginning in the next 24 hours. A warning may also be issued for extended periods with afternoon heat index values of 105°F-110°F. Refrain from outdoor activities of any nature during the warmest time of the day. Drink plenty of water and

take frequent breaks if you must be outside. Stay indoors in an air-conditioned building as much as possible. Check on elderly family members if they are living alone.

Extent and Probability

The frequency, intensity, and duration of extreme heat events and heat waves are expected to rise as a result of climate change, with an increased number of extreme heat days and nights, increased temperatures over extreme heat days and greater duration of extreme heat events. By the end of the century, most of the region will average six heat waves a year, with the average longest heat wave lasting ten days. Extreme heat events will also extend seasonally into spring and fall.

Table 3.16: Marin County OA Hazard Risk Assessment – Severe Weather, Extreme Heat

Jurisdiction	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Marin County	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
City of Belvedere	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Town of Corte Madera	Likely	Extensive	Weak	Medium	Low	**11.00**
Town of Fairfax	Unlikely	Significant	Weak	Medium	Low	**8.00**
City of Larkspur	Likely	Extensive	Moderate	High	Medium	**14.00**
City of Mill Valley	Likely	Extensive	Moderate	Medium	Medium	**13.00**
City of Novato	Likely	Extensive	Weak	Medium	Medium	**12.00**
Town of Ross	Likely	Significant	Moderate	Medium	Medium	**12.00**
Town of San Anselmo	Likely	Extensive	Extreme	High	High	**17.00**
City of San Rafael	Likely	Extensive	Moderate	High	Low	**13.00**
City of Sausalito	Unlikely	Negligible	Weak	Low	Low	**5.00**
Town of Tiburon	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Bolinas Public Utility District	Unlikely	Extensive	Weak	Low	Low	**8.00**

Las Gallinas Valley Sanitary District	Highly Likely	Negligible	Weak	High	Low	**10.00**
North Marin Water District	Likely	Extensive	Weak	Medium	Medium	**12.00**
Southern Marin Fire District	Likely	Significant	Moderate	High	High	**14.00**

Table 3.16: Marin County OA Hazard Risk Assessment – Severe Weather, Extreme Heat
Source: Profiled Jurisdictions and Districts

Vulnerability

Extreme heat can affect a range of key infrastructure from energy systems, water and wastewater treatment systems, the operation of government buildings, and public transit. While higher summer temperatures increase electricity demand for cooling, at the same time, they also can lower the ability of transmission lines to carry power, possibly leading to electricity reliability issues during heat waves. Increased temperatures also impact the efficiency of solar power infrastructure by increasing the surface temperature of solar panels, which reduces the voltage that panels can generate and thereby lowers efficiency. Although warmer winters will reduce the need for heating, modeling suggests that total U.S. energy use will increase in a warmer future. Extreme heat can also increase the risk of other types of disasters and exacerbate the urban heat island effect. Heat can exacerbate drought, and hot dry conditions can in turn create wildfire conditions. In cities, buildings, roads and infrastructure can be heated to 50 to 90 degrees hotter than the air while natural surfaces remain closer to air temperatures. The heat island effect is most intense during the day, but the slow release of heat from the infrastructure overnight (or an atmospheric heat island) can keep cities much hotter than surrounding areas. People who are required to work outside during extreme heat are especially vulnerable to the effects of extreme heat. In California , between 2000-2017, 15,996 workers experienced heat related illness (Risk factors for occupational heat-related illness among California workers, 2000-2017 - PubMed (nih.gov). Animals, including livestock, poultry, and domestic pets are susceptible to extreme heat. For example, dogs and cats are in danger of heat stroke in temperatures of 110°F. The heat wave of 2006 resulted in more than 25,000 cattle, 700,000 fowl, and 15 reported heat-related pet deaths in California. Heat wave impacts on livestock and poultry can lead to financial losses in agriculture.

High temperature can be felt throughout the Marin County OA, though the lower elevations of the County are more vulnerable to higher temperatures than the higher elevations. People who live in the more urban areas of the County can be at greater risk to heat because concrete and asphalt store heat for longer and release it throughout the night. High temperatures can cause brownouts and increase the susceptibility of people to the effects of heat. Though crops in the Marin County OA are adaptable to heat, they can become vulnerable to prolonged periods of high temperatures.

Northern Marin County (roughly north of Point Reyes, Nicasio, and Lucas Valley-Marinwood to the northern County line) is likely to see greater increases in annual average maximum temperatures due to climate change at a faster rate than southern portions of the County. While

climate change induced extreme heat events will impact County residents in the future, extreme heat effects will be less severe in the County relative to other areas of the state, including the Central Valley, that already experience higher temperatures and more extreme heat events. In terms of overall level of impact to County residents and infrastructure, extreme heat due to climate change will be less of a concern compared to flooding, sea level rise, wildfire, and landslides, debris flows, and post-fire debris flows in most cases. However, extreme heat will have a relatively greater impact on certain populations. Marin County OA populations most vulnerable to the effects of extreme heat include:

- Low-income households
- Households in poverty
- Persons without access to transportation or telecommunications
- Low-resources racial or ethnic minorities
- Outdoor workers
- Healthcare workers, first responders, and protective service occupations
- Houseless population
- Children
- Persons with disabilities
- Persons with chronic health problems
- Senior community members

In extreme temperatures, air quality is also affected. Hot and sunny days can increase ozone levels, which in turn affects Nitrogen Oxides Control levels. In addition, greater use of heating and cooling of indoor spaces requires more electricity and, depending on the electricity source, can emit more of other types of pollution, including particulates. These increases in ozone and particulate matter can pose serious risks to people, particularly the same vulnerable groups directly impacted by heat mentioned above.

Climate Change and Future Development Considerations

The primary effect of climate change is warmer average temperatures. The annual average daily high temperatures in California are expected to rise by 2.7°F by 2040, 5.8°F by 2070, and 8.8°F by 2100 compared to observed and modeled historical conditions[5]. At the current rate, annual average temperatures in the Marin County region and Bay Area will likely increase by approximately 4.4 degrees by 2050 and 7.2 degree by the end of the century unless significant efforts are made to reduce greenhouse emotions according to California's latest climate change assessment.

[5] California Adaptation Planning Guide

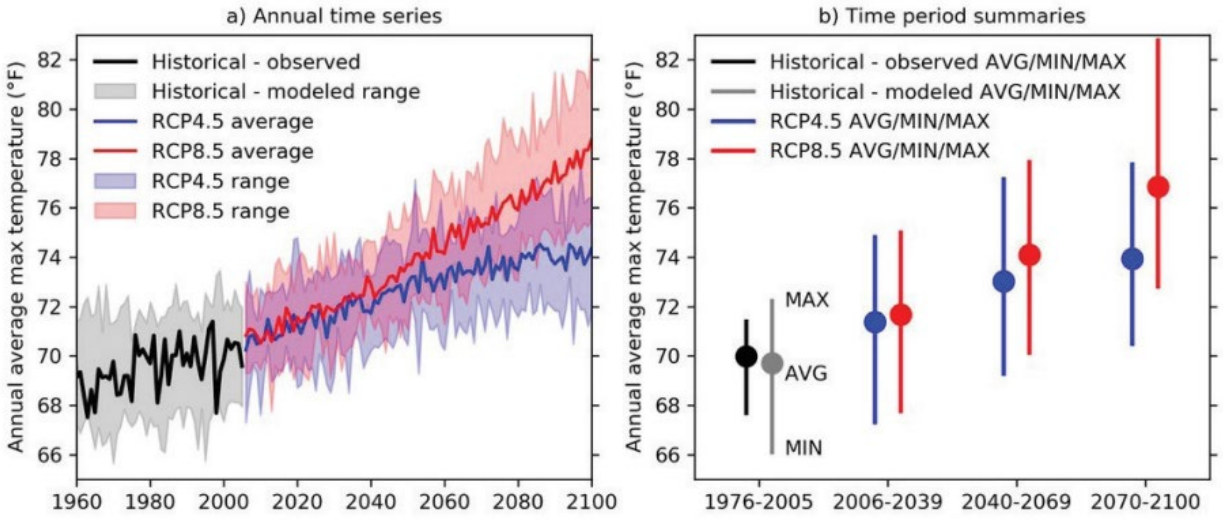


Figure 3.134: Annual Average Temperatures in the San Francisco Bay Area, 2000-2100
Source: California Climate Change Assessment (Fourth Edition)

As climate change accelerates in the 21st century, it is anticipated that extreme heat events will become more frequent and intense across the Marin County OA. There will be increased residential and business needs for cooling and addressing heat-related issues. Heat waves also tax the energy grid. Future development in the Marin County OA could exacerbate the impacts from heat related events, particularly in electricity provision and water delivery. Increased temperatures will also lead to an increase in the occurrence and severity of wildfires across the Marin County OA as conditions become hotter and drier. Future development near the many open spaces around Marin Couty could expose more people and infrastructure to the threat of a major wildfire as a result of increasing temperatures.

3.3.10 Severe Weather – High Wind/Tornado

High Wind

High wind is defined as a one-minute average of surface winds 40 miles per hour or greater lasting for one hour or longer, or winds gusting to 58 miles per hour or greater regardless of duration that are either expected or observed over land. These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events such as thunderstorms. The Beaufort scale is an empirical measure that relates wind speed to observed conditions on land and is a common measure of wind intensity (see Figure 3.135).

Beaufort number	Description	Wind speed		Land conditions
		kts	km/h	
0	Calm	< 1	< 1	Calm. Smoke rises vertically.
1	Light air	1 – 2	1 – 5	Wind motion visible in smoke.
2	Light breeze	3 – 6	6 – 11	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	7 – 10	12 – 19	Leaves and smaller twigs in constant motion.
4	Moderate breeze	11 – 15	20 – 28	Dust and loose paper raised. Small branches begin to move.
5	Fresh breeze	16 – 20	29 – 38	Branches of a moderate size move. Small trees begin to sway.
6	Strong breeze	21 – 26	39 – 49	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	High wind, Moderate gale, Near gale	27 – 33	50 – 61	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	Gale, Fresh gale	34 – 40	62 – 74	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9	Strong gale	41 – 47	75 – 88	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	Storm, Whole gale	48 – 55	89 – 102	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	Violent storm	56 – 63	103 – 117	Widespread vegetation damage. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	Hurricane	≥ 64	≥ 118	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.

Figure 3.135: Beaufort Wind Scale
Source: NOAA

Windstorms in the Marin County OA are typically straight-line winds. Straight-line winds are generally any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 mph, which represent the most common type of severe weather and are responsible for most wind damage related to thunderstorms.

Location and Previous Occurrences

The entire Marin County OA, including the unincorporated area, is susceptible to storms and damage from wind. The coastal and mountainous areas are particularly susceptible to wind, although wind has caused damages throughout the county. High winds often occur with the onset of atmospheric river events. Figure 3.136 shows wind zones for the United States. The

Special Wind Region is an area of higher wind occurrence, primarily where down-slope mountain wind occurs.

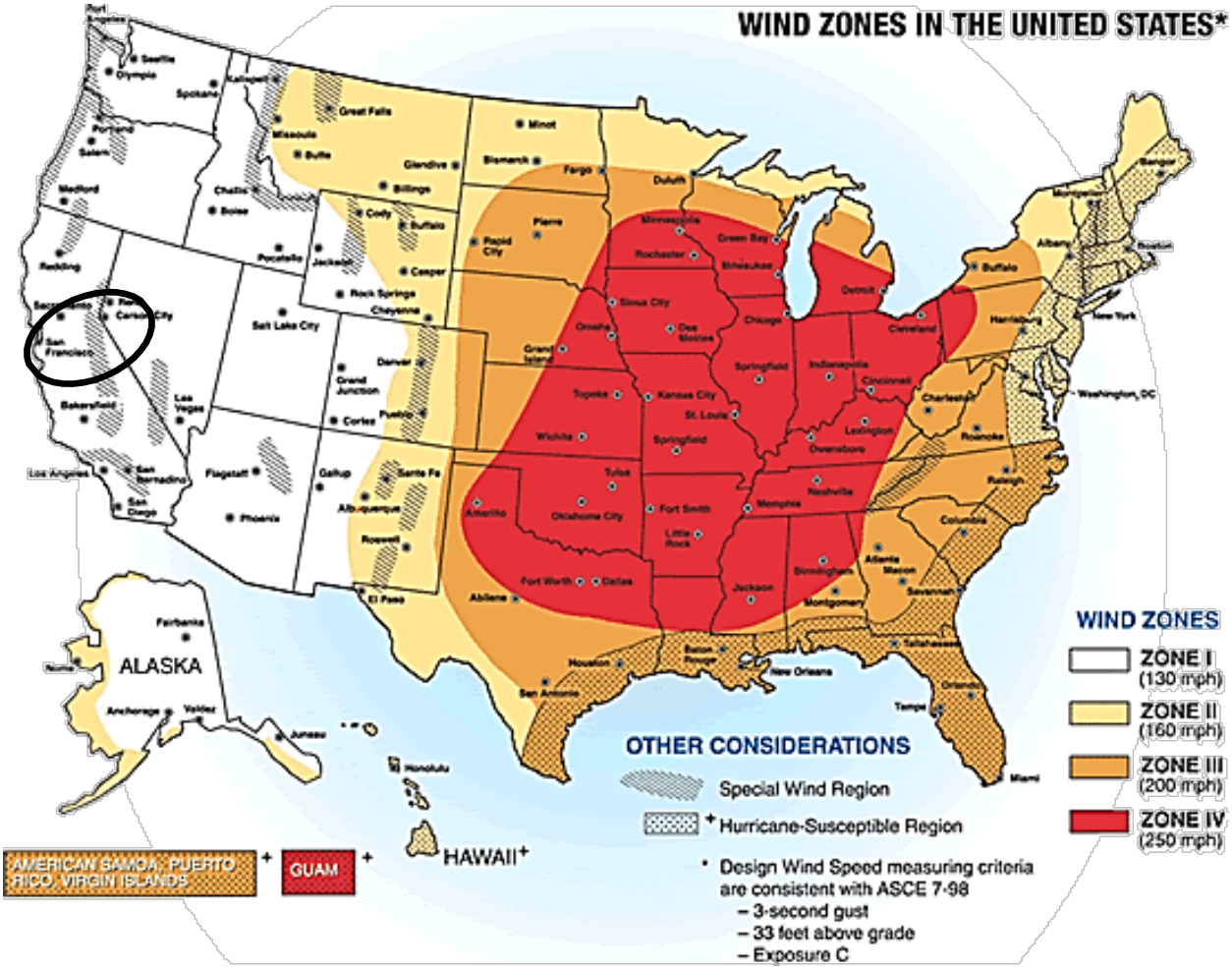


Figure 3.136: Wind Zones in the US
Source: FEMA

The National Climatic Data Center (NCDC) provides a listing of all the high wind events to affect Marin County since 1950. Most high wind events occur between November and March.

12/27/2006 - One person died when gusty winds knocked a tree into a home in Lagunitas. More than 50 trees toppled in Point Reyes National Seashore, including a 150-foot Douglas fir that slammed into the picnic area at the Bear Valley Visitor Center in Olema. Winds in the National Seashore were estimated between 80-100 mph. Manaka's Inverness Lodge burned to the ground in a fire triggered by a falling tree.

1/19/2010 - High winds brought an 18-inch diameter tree and power lines down along Lucas Valley Road about one-half mile east of Nicasio Valley Road blocking both lanes of traffic.

1/20/2010 - Strong winds and saturated soil combined to knock over a 50-foot Douglas fir tree along Turnagain Road in Kentfield.

10/24/2010 – A tree knocked down a power line when it fell in Inverness Park near the intersection of Portola Avenue and Vallejo Avenue.

2/15/2011 – High winds knocked down more than a dozen power poles across Marin County.

1/21/2012 – High winds caused over 4,000 homes to lose power across Marin County.

2/6/2015 – High winds blew multiple trees down onto Bear Valley Road near Inverness, closing the road in both directions.

2017 - In Inverness, the boulevard was closed at Pierce Point Road because of fallen trees. Nicasio Valley Road was closed between Sir Francis Drake Boulevard and Lucas Valley Road while crews removed fallen trees.

1/2023 – In Bolinas, extreme high winds estimated at close to 100 mph knocked down numerous trees across Mesa Road, closing the road several times, causing power outages and, in one case, injury.

Impacts

Straight-line winds may exacerbate existing weather conditions by increasing the effect on temperature and decreasing visibility due to the movement of particulate matters through the air, as in dust and snow storms. The winds may also exacerbate fire conditions by drying out the ground cover, propelling fuel around the region, and increasing the ferocity of exiting fires. These winds may cause personal injury, damage crops, push automobiles off roads, damage roofs and structures, overturn mobile homes, tear roofs off of houses, topple trees, snap power lines, shatter windows, sandblast paint from cars, and cause secondary damage due to flying debris. Other associated hazards include utility outages, arcing power lines, debris blocking streets, dust storms, and an occasional structure fire. Due to the wildfire threat posed by trees falling or leaning on power lines as a result of high winds and other conditions, Pacific Gas and Electric began initiating Public Safety Power shutoffs (PSPS) events after the 2017 Northern California Wildfires and the 2018 Camp Fire (see wildfire profile) in order to prevent the start of wildfires. These PSPS events can have numerous impacts on residents who rely on electricity for cooling their homes, powering water pumps, keeping critical medical equipment operable and other needs.

In the Marin County OA, storms with strong winds knock down trees and power lines nearly every year and continue to slowly erode vulnerable coastal areas and critical inland ponds (i.e. reservoirs/dams, berms/levees around stormwater detention ponds, wastewater treatment/storage ponds). Although the entire OA is affected by wind, coastal areas tend to be impacted more frequently by the strongest winds (9+ on the Beaufort scale) than inland areas. The Marin County OA's coastal areas have small resident populations but large visiting populations, such as Muir Beach, Stinson Beach, and Bolinas that can be impacted by strong winds. Beachgoers and boaters would be particularly impacted by wind hazards. Tourism is a key part of the economy in Marin County, particularly in coastal communities, and thus there are potentially significant economic impacts of wind events. Some communities, such as Oceana Marin and Olema, rely on water and wastewater infrastructure that has potential to be impacted by coastal erosion, wind driving up wave elevations, and erosion from waves forming due to

wind over treatment and storage ponds. Inland critical ponds are also impacted by wind-driven wave erosion such as dams on drinking water reservoirs, and levees/berms containing stormwater retention and detention ponds. Across the county powerlines are potentially impacted by wind, potentially affecting commercial, industrial, and residential areas, and most years downed trees lead to temporary road closures.

Extent and Probability

The Marin County OA's most damaging wind events tend to range between 7 and 11 on the Beaufort scale, or 30 to 60 knots. These wind strengths are characterized as high wind to violent storm. Thus, most years whole trees are put in motion and the ocean heaps up and white foam and spindrift form. Slight structural damage and uprooted trees can result occasionally. Wind events and associated damages are expected to continue to occur several times per year.

Table 3.17: Marin County OA Hazard Risk Assessment – Severe Weather; Wind and Tornado

Jurisdiction	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Marin County	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
City of Belvedere	Highly Likely	Extensive	Moderate	High	Medium	**15.00**
Town of Corte Madera	Likely	Negligible	Weak	Low	Low	**7.00**
Town of Fairfax	Likely	Limited	Moderate	Medium	Medium	**11.00**
City of Larkspur	Likely	Extensive	Moderate	High	Medium	**14.00**
City of Mill Valley	Highly Likely	Significant	Moderate	High	Medium	**14.00**
City of Novato	Likely	Extensive	Weak	Medium	Medium	**12.00**
Town of Ross	Occasional	Significant	Moderate	Medium	Medium	**11.00**
Town of San Anselmo	Likely	Extensive	Extreme	High	High	**17.00**
City of San Rafael	Occasional	Extensive	Moderate	Medium	Medium	**12.00**
City of Sausalito	Likely	Significant	Moderate	Medium	Medium	**12.00**
Town of Tiburon	Highly Likely	Extensive	Moderate	High	Medium	**15.00**

Bolinas Public Utility District	Highly Likely	Extensive	Moderate	High	High	**15.00**
Las Gallinas Valley Sanitary District	Likely	Negligible	Weak	Medium	Medium	**9.00**
North Marin Water District	Likely	Extensive	Weak	Medium	Medium	**12.00**
Southern Marin Fire District	Likely	Significant	Moderate	High	Medium	**13.00**

Table 3.17: Marin County OA Hazard Risk Assessment – Severe Weather; Wind
Source: Profiled Jurisdictions and Districts

Vulnerability

Areas of the Marin County OA, including the unincorporated area – coastal, mountainous and inland valleys where there are power lines, roads, and creeks/bridges, and ponded water for infrastructure (stormwater, wastewater, drinking water purposes), are particularly vulnerable to disruption due to wind damage, as are private structures with nearby trees. Certain locations are even more susceptible to damage due to building construction and the amount of tree canopy. Trees can fall on power lines, sparking wildfires and causing power outages. Trees can also fall on people and cars. People who live in homes with large tree branches over their roofs are particularly susceptible to high winds. Mobile home parks are vulnerable to high wind due to their light frame construction. Aviation vehicles, including small airplanes, are also susceptible to high winds and potential issues can arise when they are taking off and landing. Specific building codes should be considered for construction in Special Wind Regions. The systems that are most vulnerable are those that wouldn't be able to be fully repaired quickly should there be a catastrophic failure during an extreme wind event, such as a breach of a levee or dam due to wave erosion. Some examples of vulnerable facilities include:

- Oceana Marin Force Main Pump Station is 60 feet from the edge of a coastal bluff.
- Coastal erosion rates up to 4.4 feet/year were anticipated in the Dillon Beach area (where Oceana Marin is located) according to a 2003 Cliff and Erosion Technical Background report prepared to support a Marin County Local Coastal Program update. Although only a small community would be affected by the failure, it would be a long time before the critical water supply facility could be replaced. Additionally, the community has a sewer line potentially vulnerable to coastal erosion.
- Wind driven waves could flood the Olema Domestic Water Pump Station which would cause electrical and water supply failure to 43 residents, 3 hotels, a church, and a campground.
- Stafford Dam's (earthen) upstream face is subject to wind and wave action which has been eroding the gunite and welded wire reinforcement. A catastrophic failure could lead to inundation of the City of Novato and areas of the unincorporated County around it (see the subsection on Dam Failure for vulnerability analysis).

Tornado

Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes are the most powerful storms that exist, and damage paths can be in excess of one mile wide and 50 miles long. The Enhanced Fujita Scale (see Figure 3.137) is commonly used to rate the intensity of tornadoes in the United States based on the damages that they cause.

Enhanced Fujita Scale	
EF-0	65-85 mph winds
EF-1	86-110 mph winds
EF-2	111-135 mph winds
EF-3	136-165 mph winds
EF-4	166-200 mph winds
EF-5	>200 mph winds

Figure 3.137: Enhanced Fujita Scale
Source: NOAA

Tornadic waterspouts are tornadoes that form over water, or move from land to water. They have the same characteristics as a land tornado. They are associated with severe thunderstorms, and are often accompanied by high winds and seas, large hail, and frequent dangerous lightning.

Figure 3.138: Waterspout Formation
Source: MarineInsights

Location and Previous Occurrences

Compared to the areas east of the Rocky Mountains, tornado occurrence over the western United States is much less frequent and even more rare across the Marin County OA due to its topography. A tornado in the Marin County OA would most likely begin as an off-shore waterspout that comes ashore off the coast and transitions into a tornado over lower-lying terrain, particularly in the area of Tomales Bay. Tornadoes could also form in the low-lying northerly parts of the OA near Sonoma County.

Table 3.18: shows a map of all tornado activity in the Marin County OA since 1973.

Column Definitions: 'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

Table 3.18: Tornados Activity in the Marin County OA

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
TOMALES	MARIN CO.	CA	12/23/1996	10:00	PST	Tornado	F1	0	0	200.00K	5.00K
Totals:								0	0	200.00K	5.00K

Table 3.18: Tornado Activity in the Marin County OA
Source: NOAA

From 1950 to 2020, there has been only one recorded tornado in the Marin County OA according to the National Weather Service. An EF-1 touched down in Tomales on December 23rd, 1996. This storm began over the ocean as a waterspout that moved in land. It destroyed a large barn and 10 large eucalyptus trees, and five telephone poles. It also ripped the roof off

another house. A farmer was in the barn when it was blown over but he was not injured. There were over $200,000 in damages. At least two other waterspouts were reported as well as heavy rain and small hail in the Tomales Bay area. Larger and more destructive tornados have occurred just north of the Marin County OA in Sonoma County, including an EF 2 tornado near Petaluma in 1958 and an EF 1 tornado near Santa Rosa in 1996 that caused over $1 million in damages.

Impacts

Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, the majority of injuries and deaths generally result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

Extent and Probability

The Marin County OA would most likely experience an EF-0 or an EF-1 tornado, with little to moderate damage. The potential does exist for an EF-0 or an EF-1 tornado to cause injury and death.

While unlikely, a stronger EF-2 tornado does have the potential to occur in the Marin County OA and could cause considerable damages to buildings and infrastructure. Such a tornado could destroy mobile homes, tear roofs off well-constructed houses, shift the foundations of frame houses, and lift cars off the ground.

The probability of a tornado occurring in the Marin County OA is extremely rare.

Vulnerability

As with high winds, certain locations are more susceptible to damage due to building construction and the amount of tree canopy. Trees can fall on power lines and cause power outages and can also fall on people and cars. Power lines, transmission lines, and radio towers are all vulnerable to a direct hit from a tornado. A greater amount of property is vulnerable to damage from a tornado than a regular wind due to the higher wind speeds of tornado. Mobile home parks are vulnerable to tornadoes due to their light frame construction, as are industrial and commercial sites with loose materials. Aviation vehicles, including small airplanes, are also susceptible to tornadoes.

Climate Change and Future Development Considerations

It is anticipated that the atmospheric rivers that deliver storms to Northern California may intensify because of climate change. This increase in storm intensity may bring more intense winds and potential tornados to Northern California, including the Marin County OA. Significant wind events and tornadoes can topple trees, particularly those that may be saturated, or drought stressed as a result of climate change. An increase in fallen trees as a result of increased storms due to climate change can lead to an increase in power outages. Future development in any of the forested areas of the Marin County OA will increase the effects of severe wind events.

3.3.11 TSUNAMI

Tsunamis consist of waves generated by large disturbances of the sea floor, which are caused by volcanic eruptions, landslides or earthquakes. Shallow earthquakes along dip slip faults are more likely to be sources of tsunami than those along strike slip faults. The West Coast/Alaska Tsunami Warning Center (WC/ATWC) is responsible for tsunami warnings. Tsunamis are often incorrectly referred to as tidal waves. They are actually a series of waves that can travel at speeds averaging 450 (and up to 600) miles per hour with unusual wave heights. Tsunamis can reach the beach before warnings are issued.

Location and Previous Occurrences

Tsunamis could occur in numerous areas of the Marin County OA. The California Department of Conservation updated the tsunami hazard maps for Marin County in 2022. Figure 3.139 shows all the tsunami inundation areas of the Marin County OA.

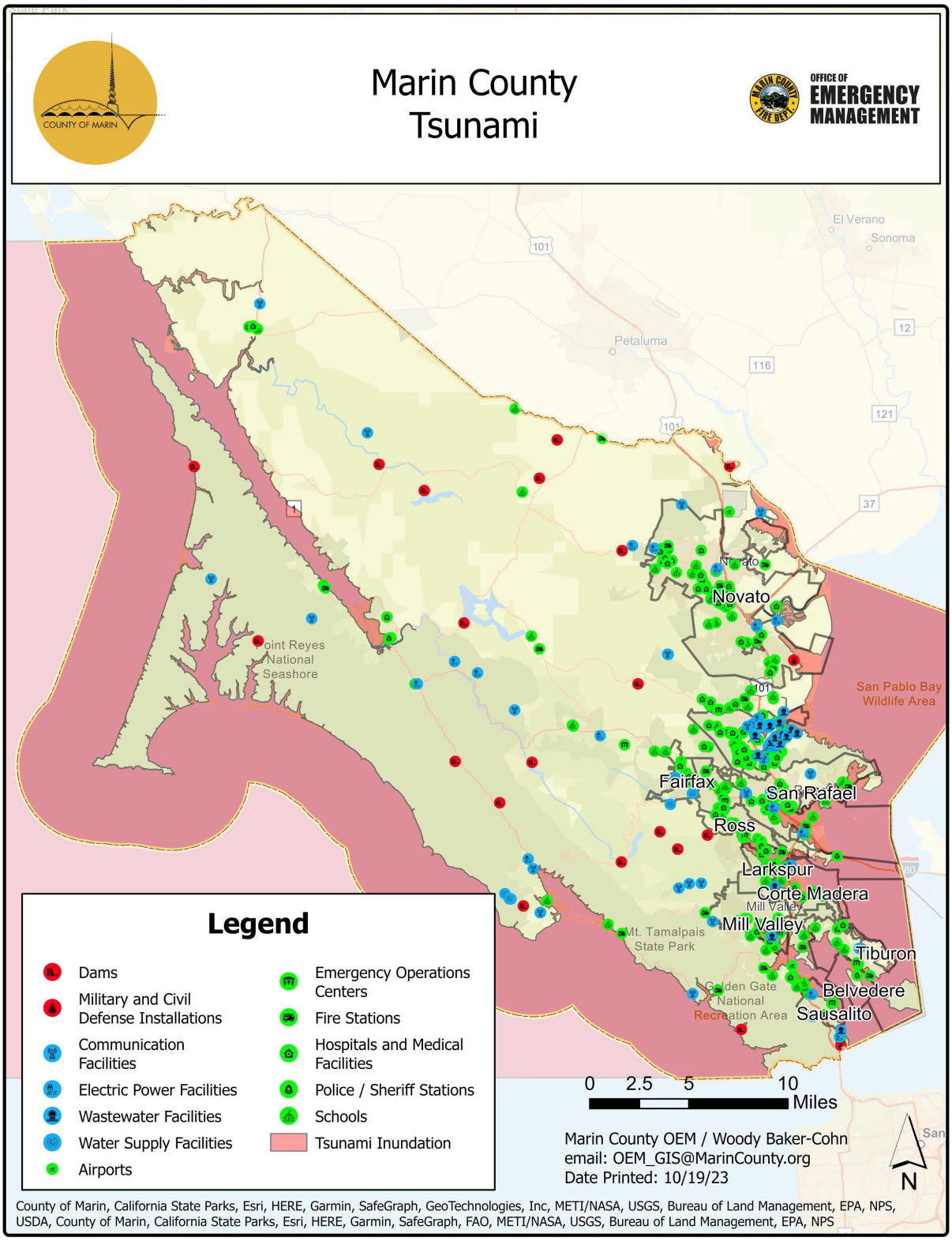


Figure 3.139: Tsunami Inundation Zones in the Marin County OA
Source: Marin County OEM

Tsunami inundation zones extend into several unincorporated communities in Marin County which are shown below.

Figures 3.140 and 3.141 show the tsunami inundation zone in and around Inverness.

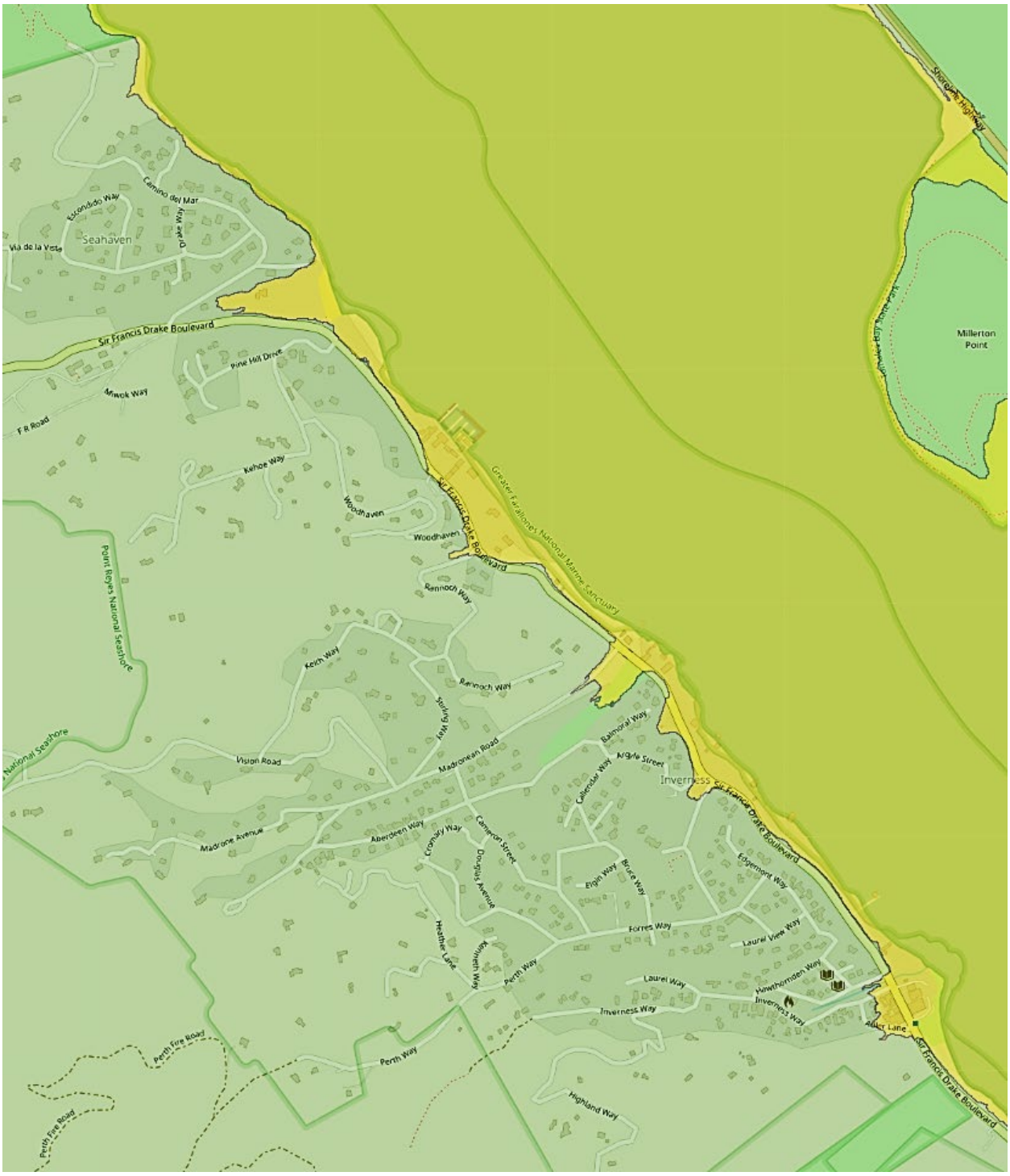


Figure 3.140: Tsunami Inundation Zone – Inverness Area
Source: California Department of Conservation, 11/27/23

Figure 3.141: Tsunami Inundation Zone – Inverness
Source: California Department of Conservation, 11/27/23

Figure 3.142 shows the tsunami inundation zone south of Inverness.

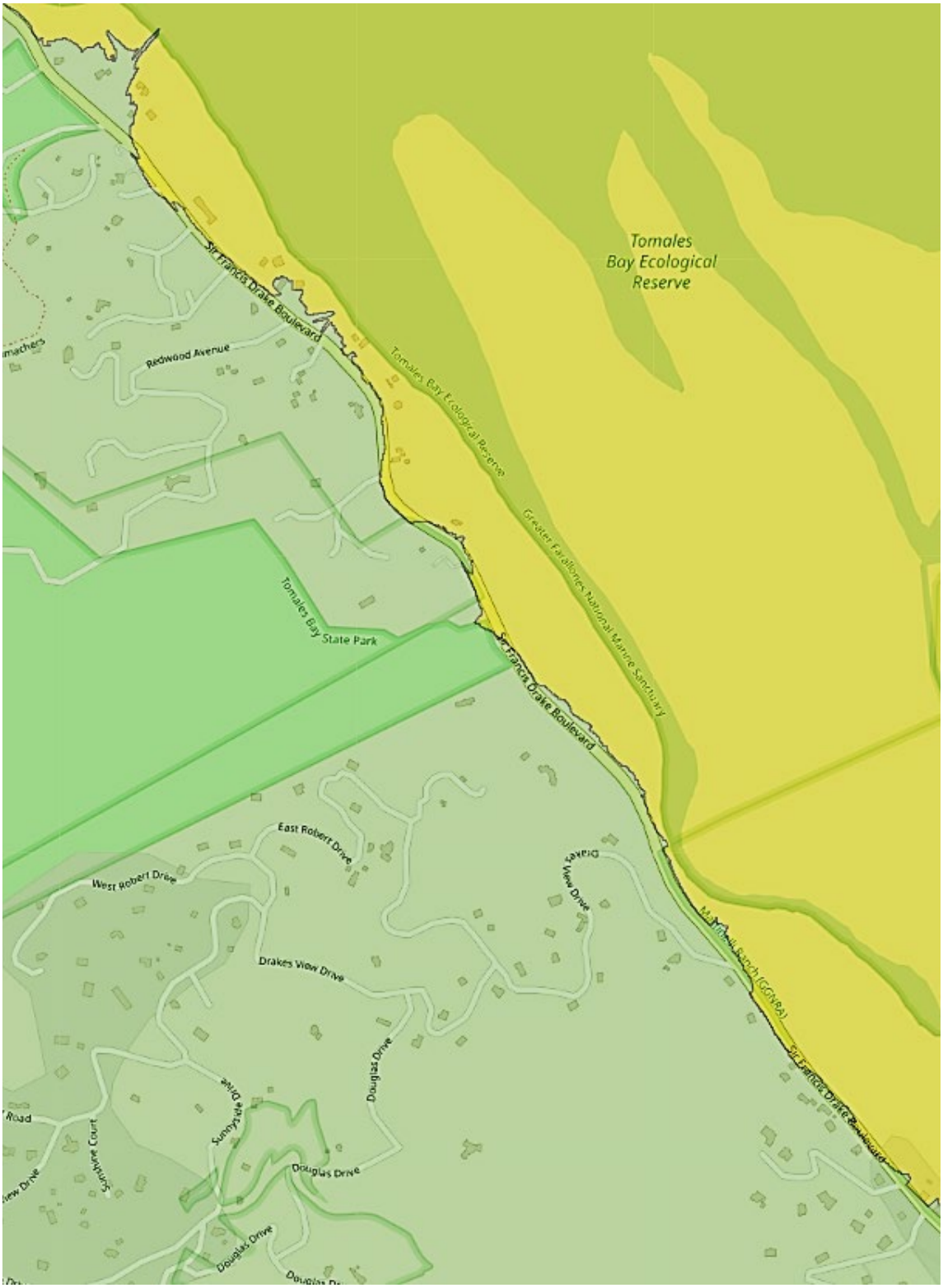


Figure 3.142: Tsunami Inundation Zone – South of Inverness
Source: California Department of Conservation, 11/27/23

Figure 1.143 shows the tsunami inundation zone around Inverness Park and Point Reyes.

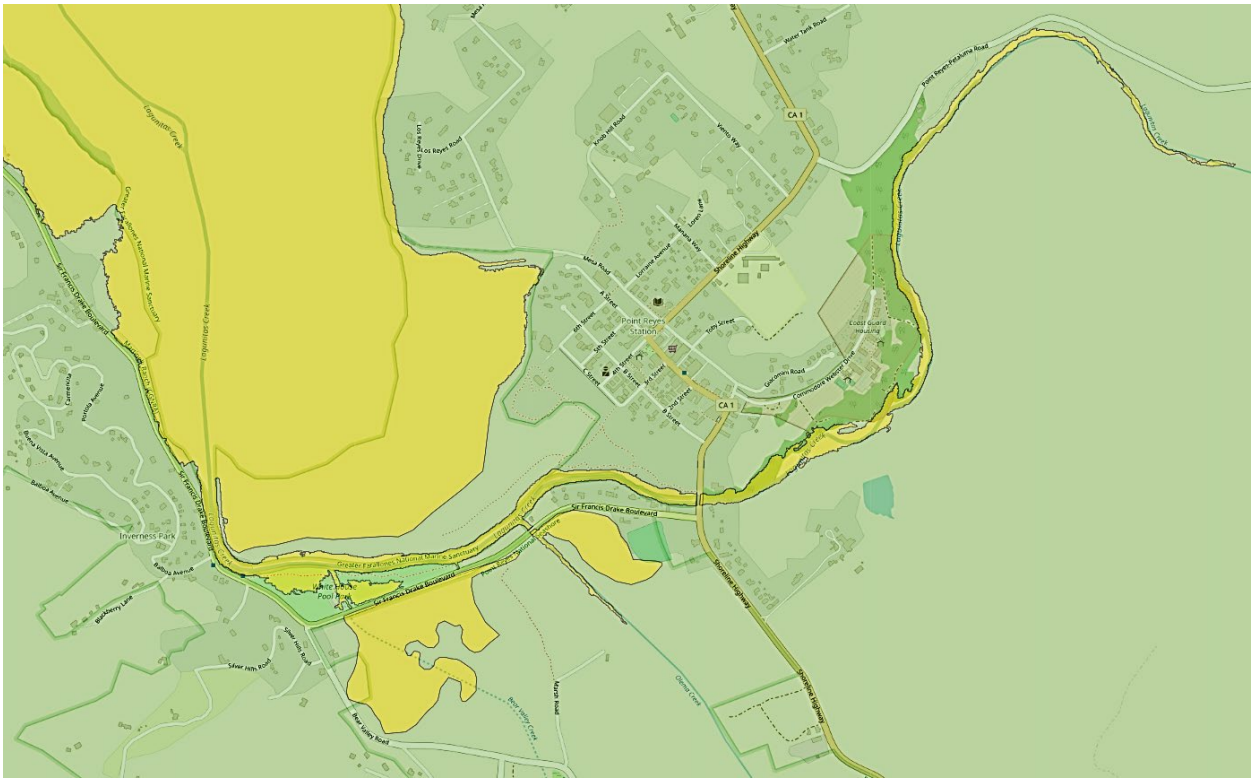


Figure 3.143: Tsunami Inundation Zone – Inverness Park and Point Reyes
Source: California Department of Conservation, 11/27/23

Figure 3.144 shows the tsunami inundation zone around Reynolds and Marshall.

Figure 3.144: Tsunami Inundation Zone – Reynolds and Marshall
Source: California Department of Conservation, 11/27/23

Figure 3.145 shows the tsunami inundation zone around McDonald and Blakes Landing.

Figure 3.145: Tsunami Inundation Zone – McDonald and Blakes Landing
Source: California Department of Conservation, 11/27/23

Figure 3.146 shows the tsunami inundation zone south of Tomales.

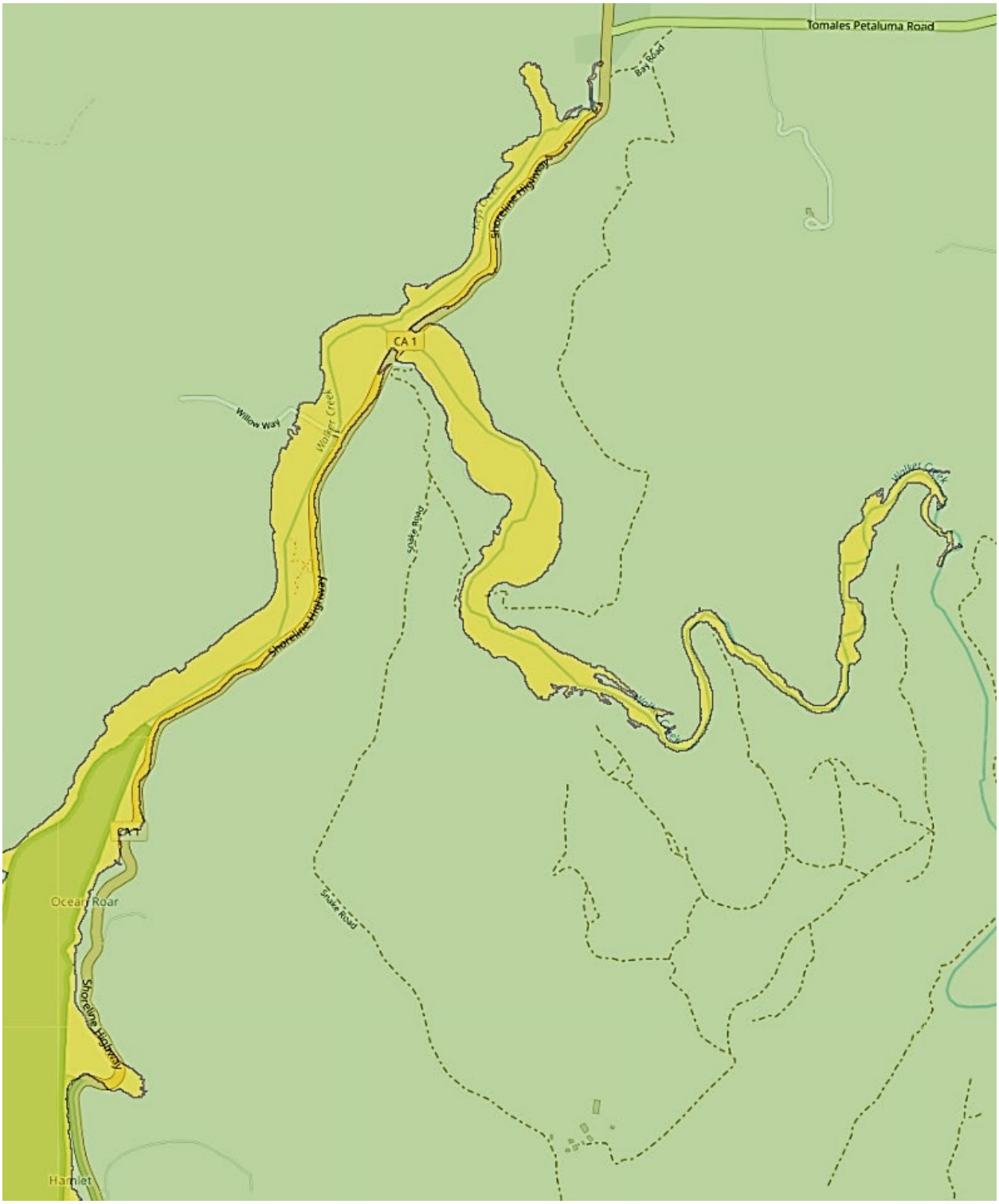


Figure 3.146: Tsunami Inundation Zone – South of Tomales
Source: California Department of Conservation, 11/27/23

Figure 3.147 and 3.148 shows the tsunami inundation zone in and around Dillon Beach.

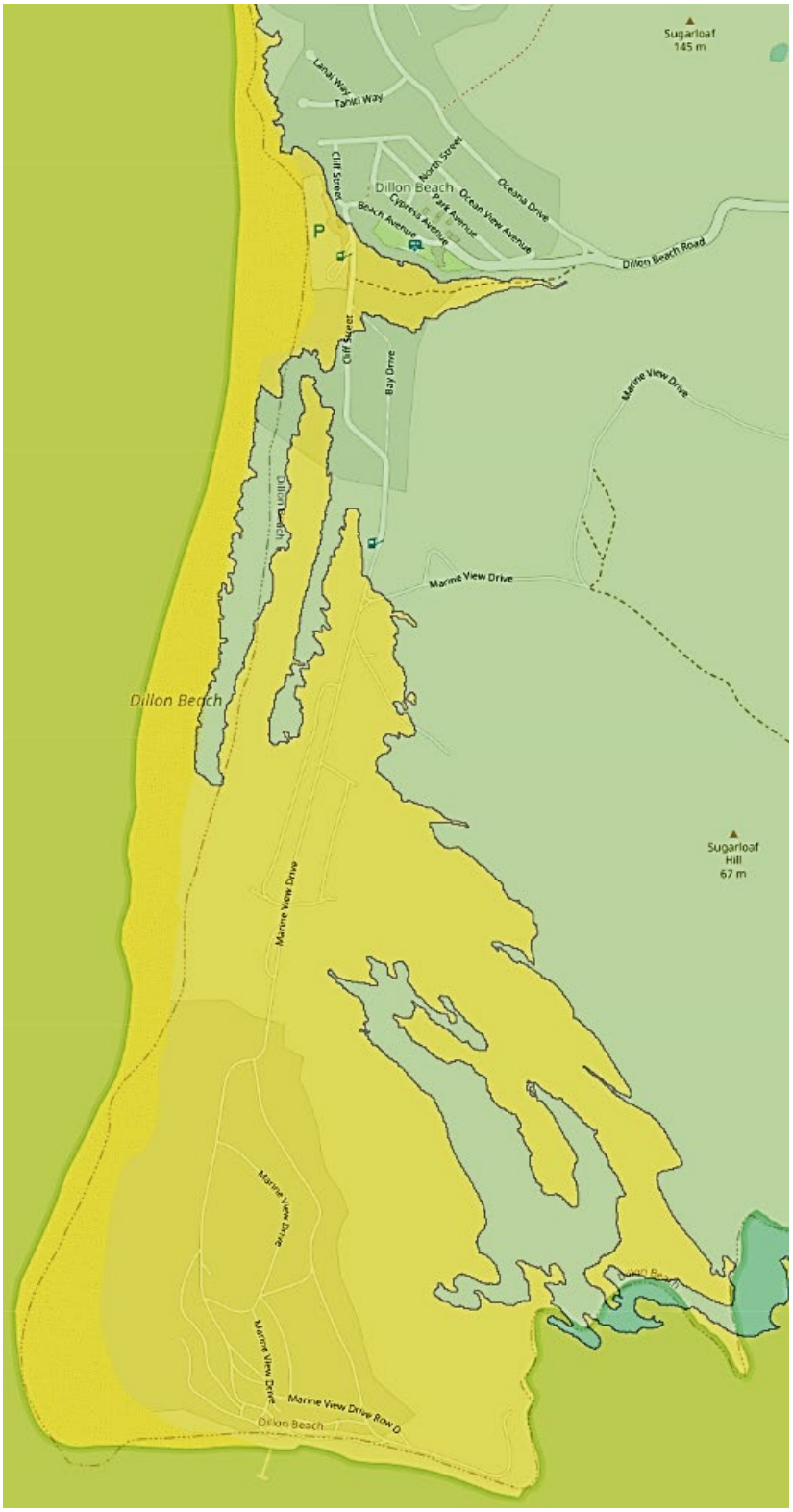


Figure 3.147: Tsunami Inundation Zone – Dillon Beach Area
Source: California Department of Conservation, 11/27/23

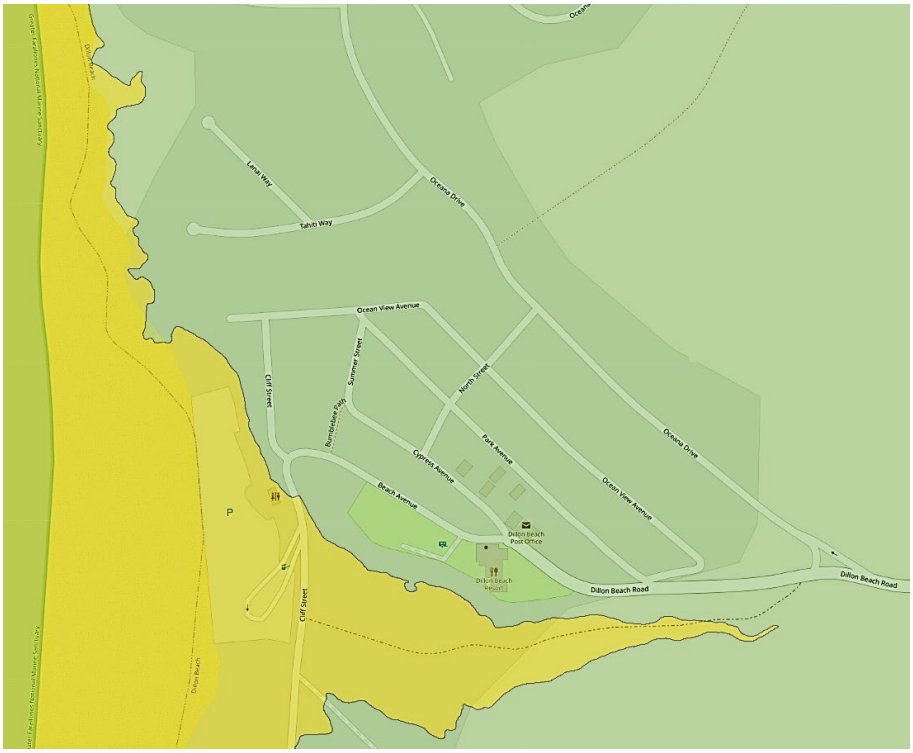


Figure 3.148: Tsunami Inundation Zone – Dillon Beach
Source: California Department of Conservation, 11/27/23

Figure 3.149 shows the tsunami inundation zone around the northern Bolinas Lagoon.

Figure 3.149: Tsunami Inundation Zone – Bolinas Lagoon North
Source: California Department of Conservation, 11/27/23

Figures 3.150, 3.151 and 3.152 shows the tsunami inundation zone in and around Bolinas.

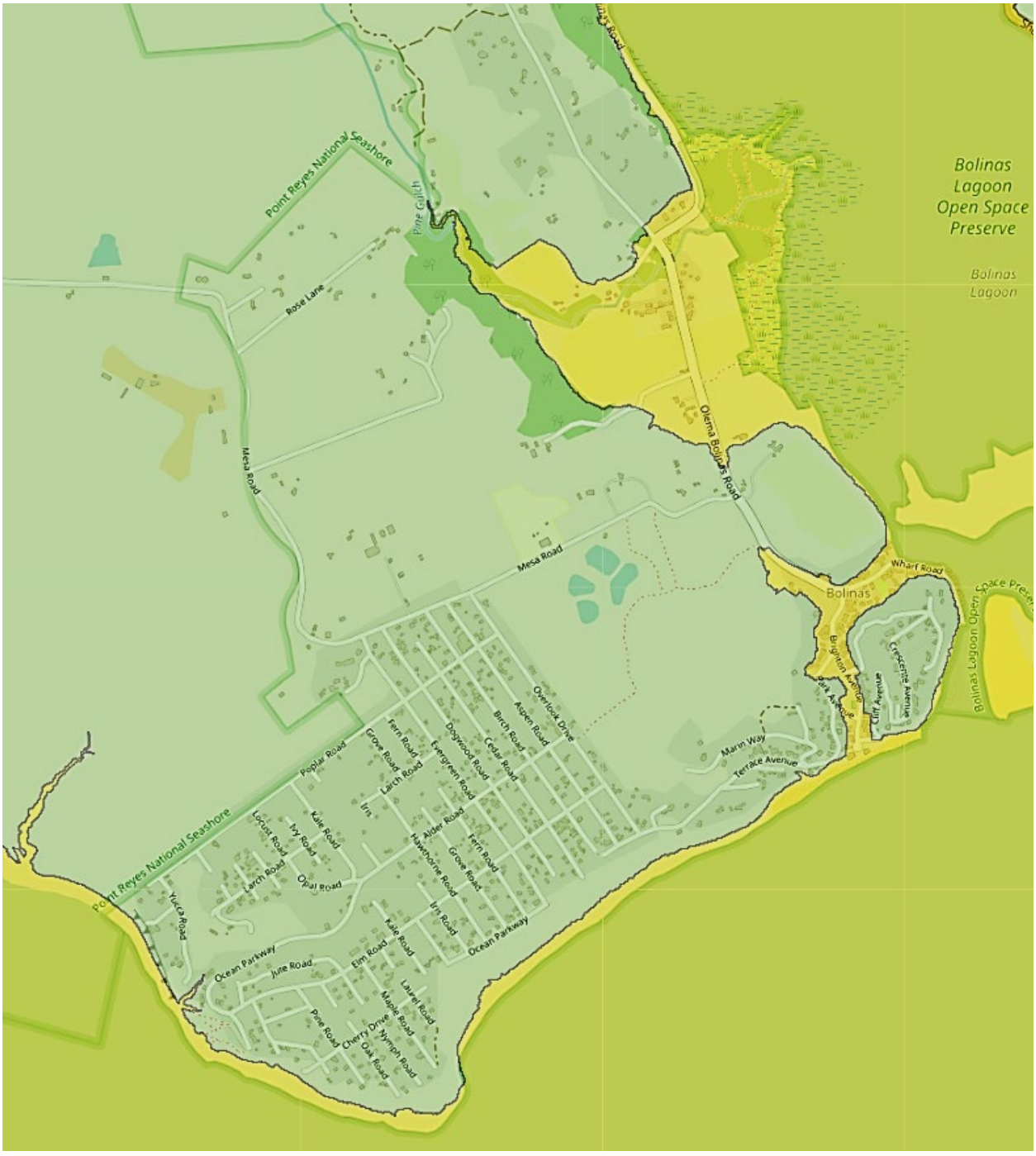


Figure 3.150: Tsunami Inundation Zone – Bolinas Area
Source: California Department of Conservation, 11/27/23

Figure 3.151: Tsunami Inundation Zone – Bolinas Core
Source: California Department of Conservation, 11/27/23

Figure 3.152: Tsunami Inundation Zone – Bolinas North
Source: California Department of Conservation, 11/27/23

Figure 3.153 and 3.154 shows the tsunami inundation zone in and around Stinson Beach.

Figure 3.153: Tsunami Inundation Zone – Stinson Beach Area
Source: California Department of Conservation, 11/27/23

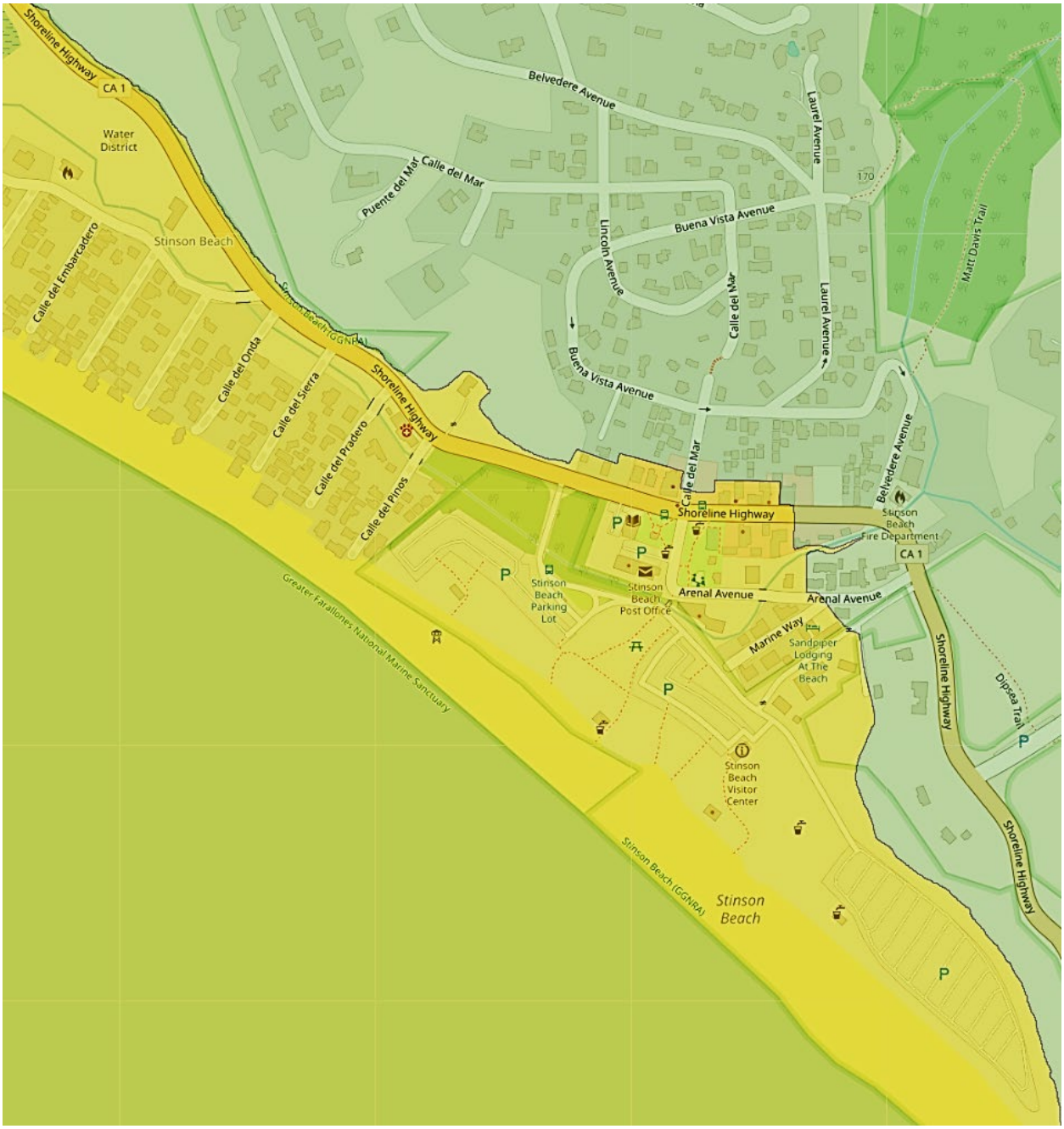


Figure 3.154: Tsunami Inundation Zone – Stinson Beach
Source: California Department of Conservation, 11/27/23

Figure 3.155 shows the tsunami inundation zone in Muir Beach.

Figure 3.155: Tsunami Inundation Zone – Muir Beach
Source: California Department of Conservation, 11/27/23

Figure 3.156 and 3.157 shows the tsunami inundation zone in Tamalpais Valley.

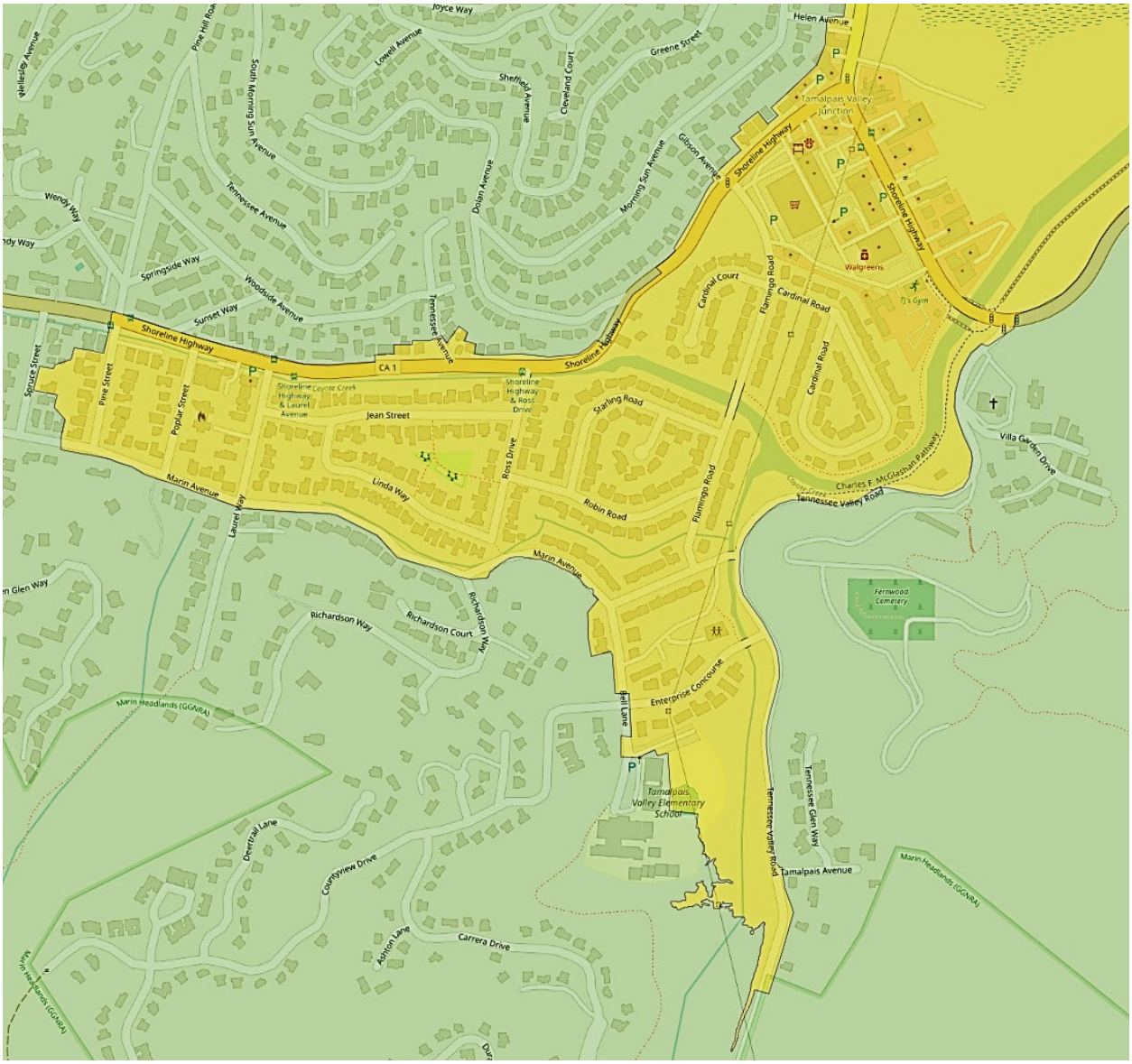


Figure 3.156: Tsunami Inundation Zone – Tamalpais Valley South
Source: California Department of Conservation, 11/27/23

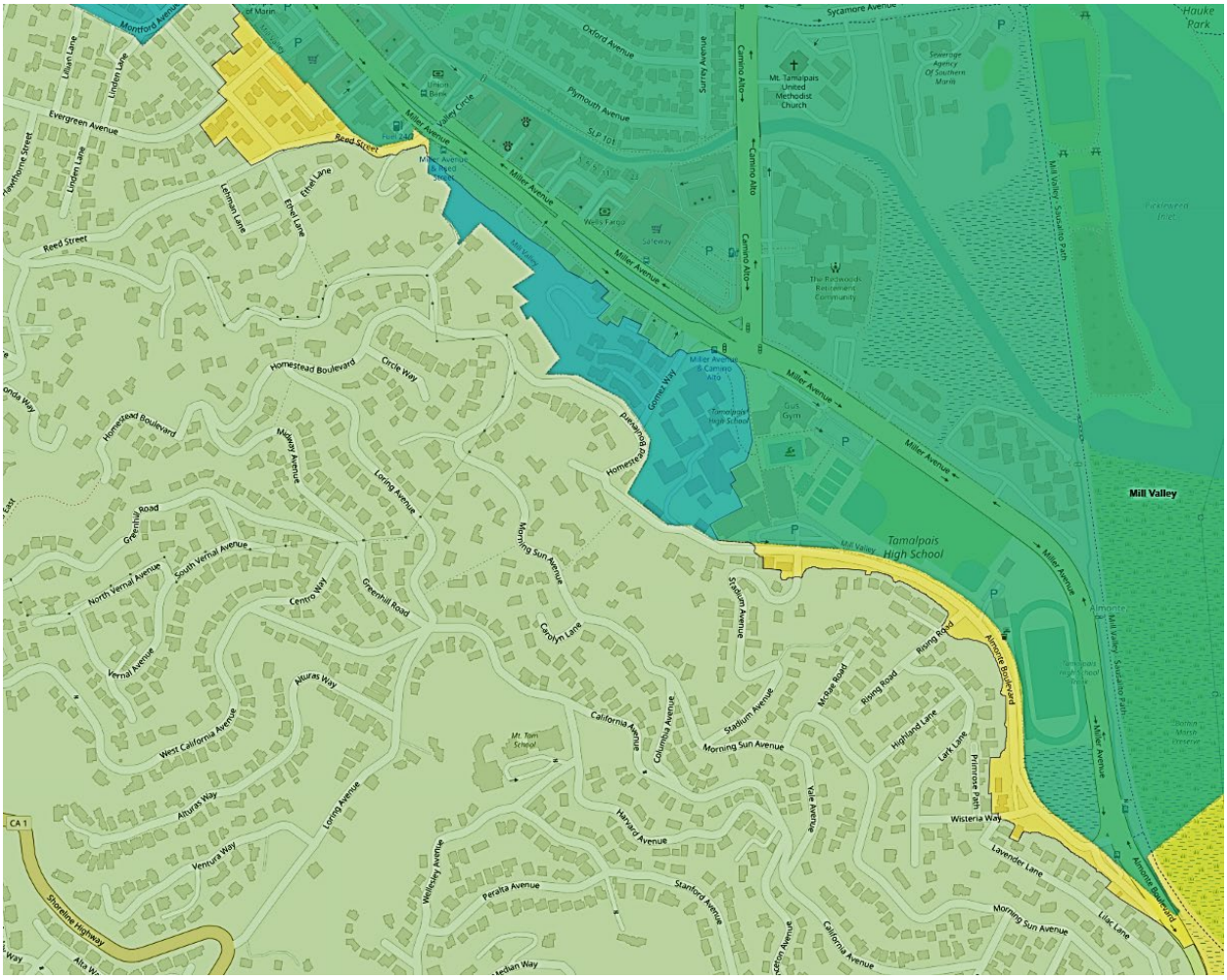


Figure 3.157: Tsunami Inundation Zone – Tamalpais Valley North
Source: California Department of Conservation, 11/27/23

Figure 3.158 shows the tsunami inundation zone in Marin City.

Figure 3.158: Tsunami Inundation Zone – Marin City
Source: California Department of Conservation, 11/27/23

Figure 3.159 shows the tsunami inundation zone in Manzanita.

Figure 3.159: Tsunami Inundation Zone – Manzanita
Source: California Department of Conservation, 11/27/23

Figure 3.160 and 3.1561 shows the tsunami inundation zone in Strawberry.

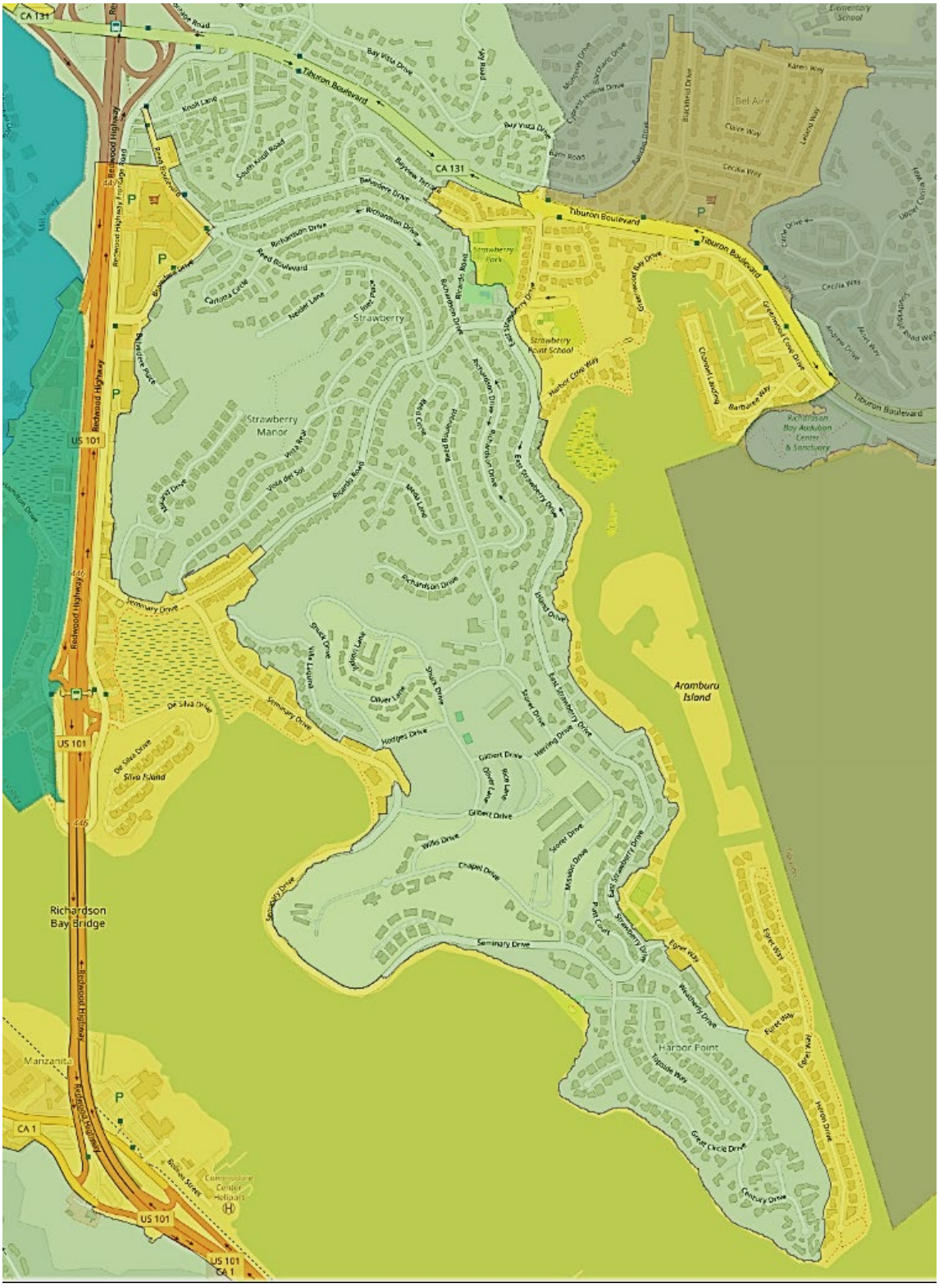


Figure 3.160: Tsunami Inundation Zone – Strawberry South
Source: California Department of Conservation, 11/27/23

Figure 3.161 shows the tsunami inundation zone in the unincorporated area of the Tiburon Peninsula.

Figure 3.161: Tsunami Inundation Zone – Unincorporated Tiburon Peninsula
Source: California Department of Conservation, 11/27/23

Figure 3.162 shows the tsunami inundation zone in Paradise Cay.

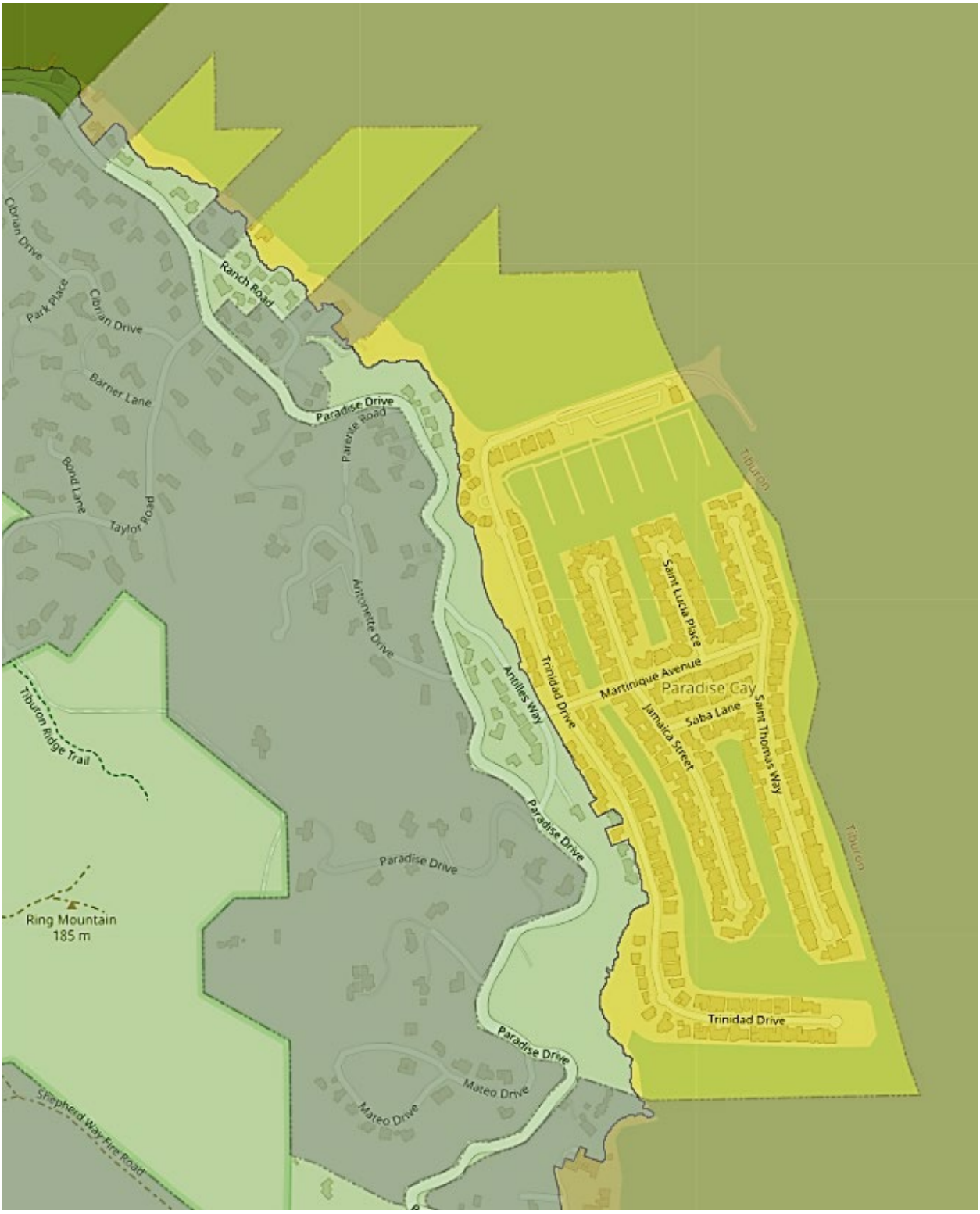


Figure 3.162: Tsunami Inundation Zone – Paradise Cay
Source: California Department of Conservation, 11/27/23

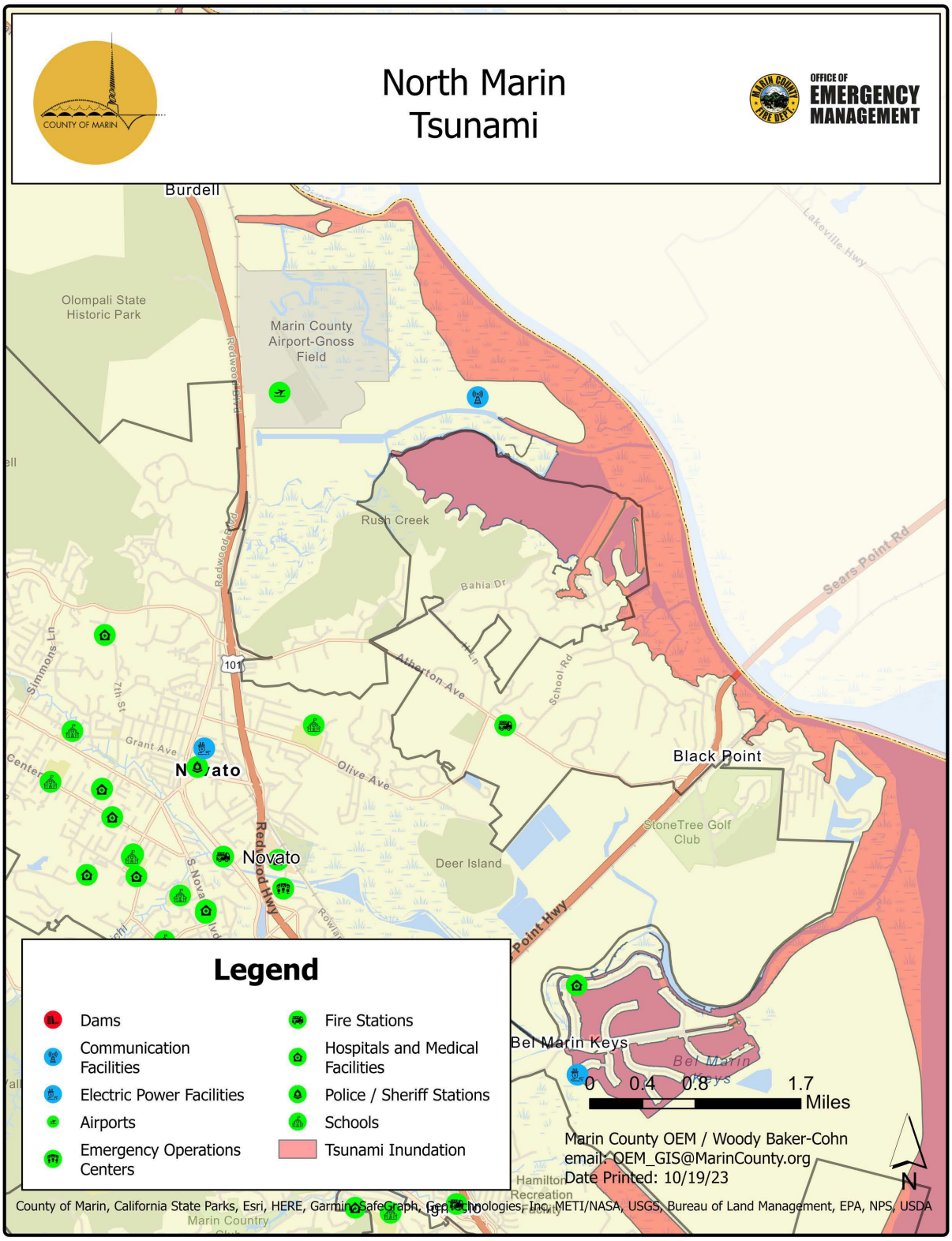


Figure 3.163: North Marin Tsunami Inundation Zones
Source: Marin County OEM

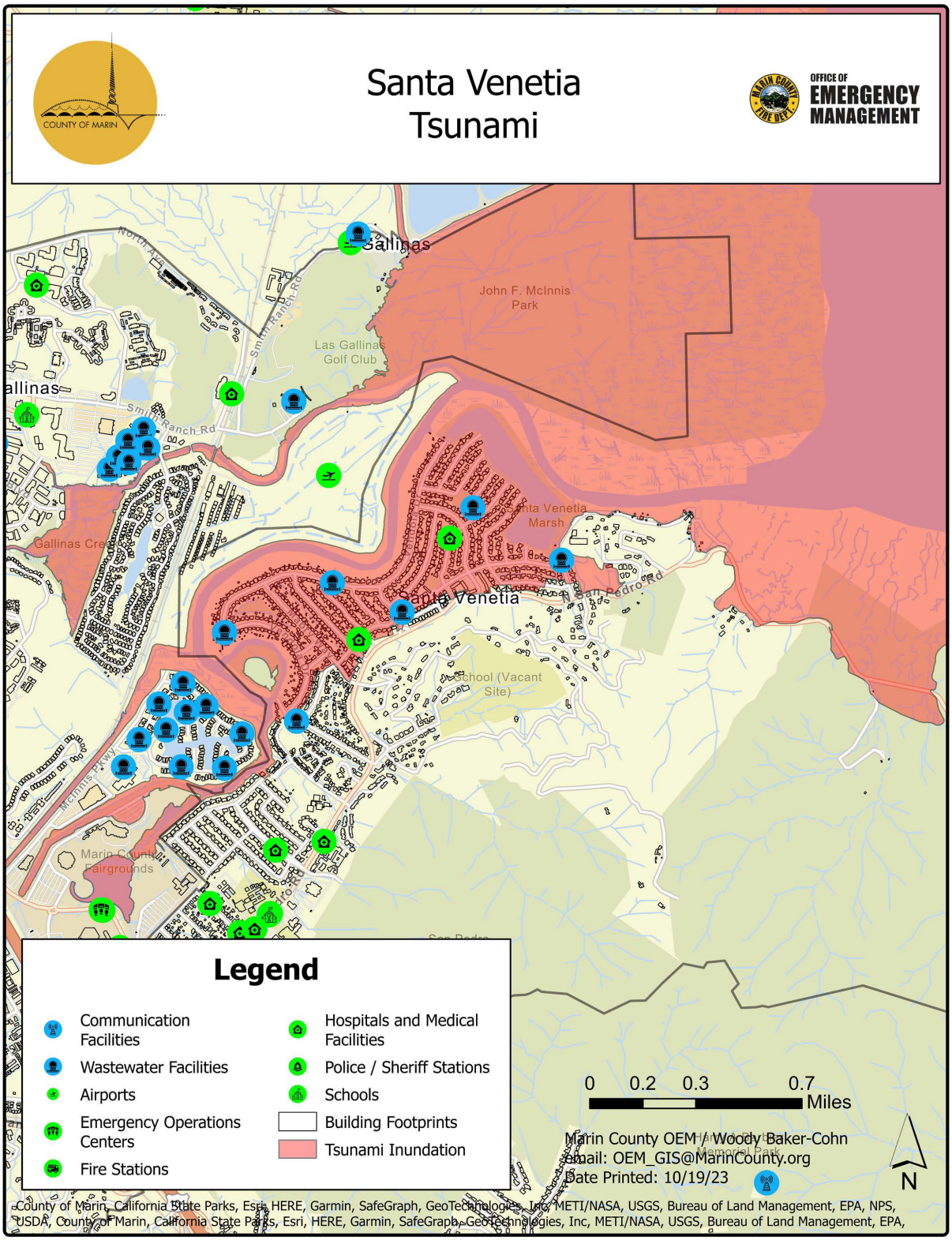


Figure 3.164: Santa Venetia Tsunami Inundation Zones
Source: Marin County OEM

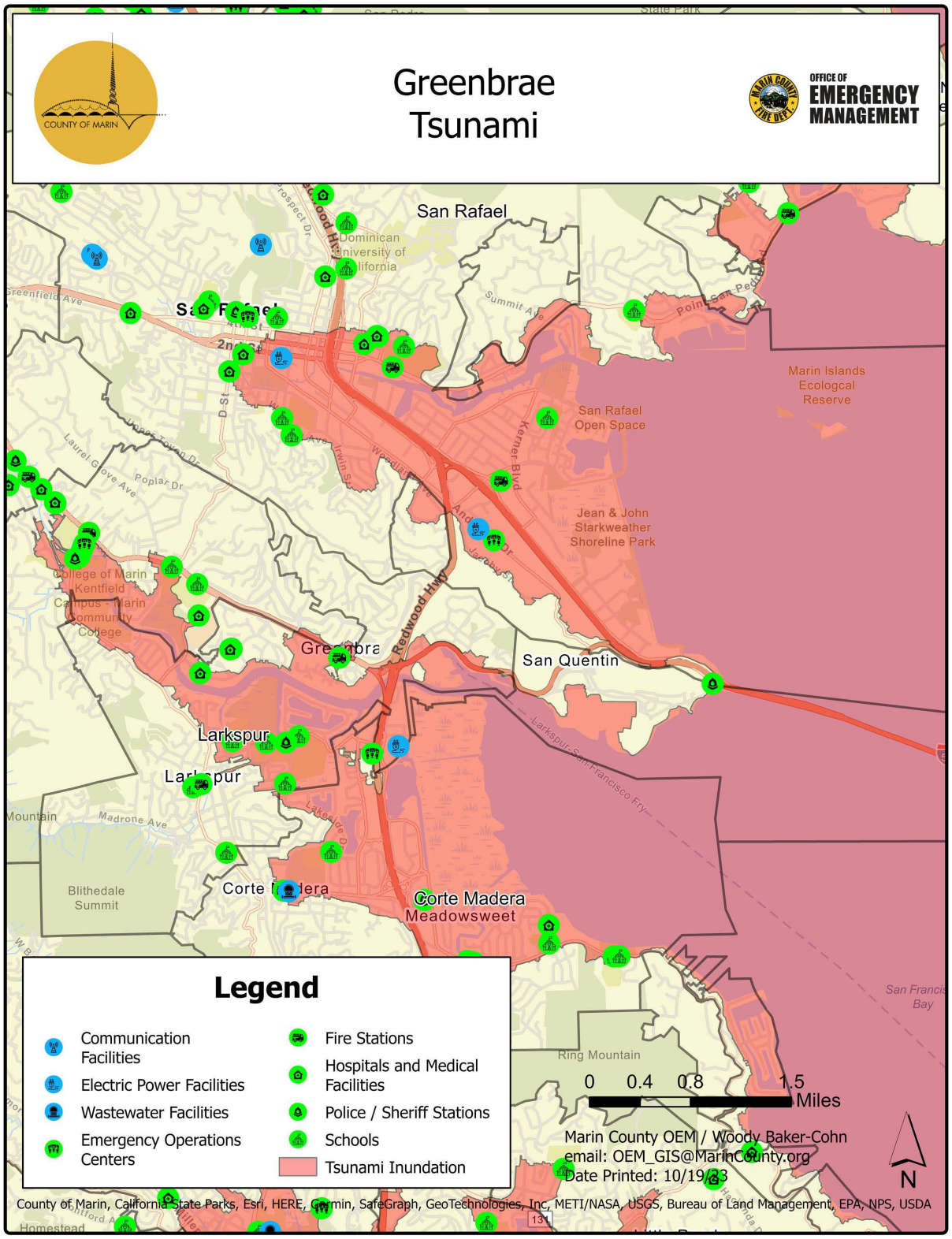


Figure 3.165: Greenbrae Tsunami Inundation Zones
Source: Marin County OEM

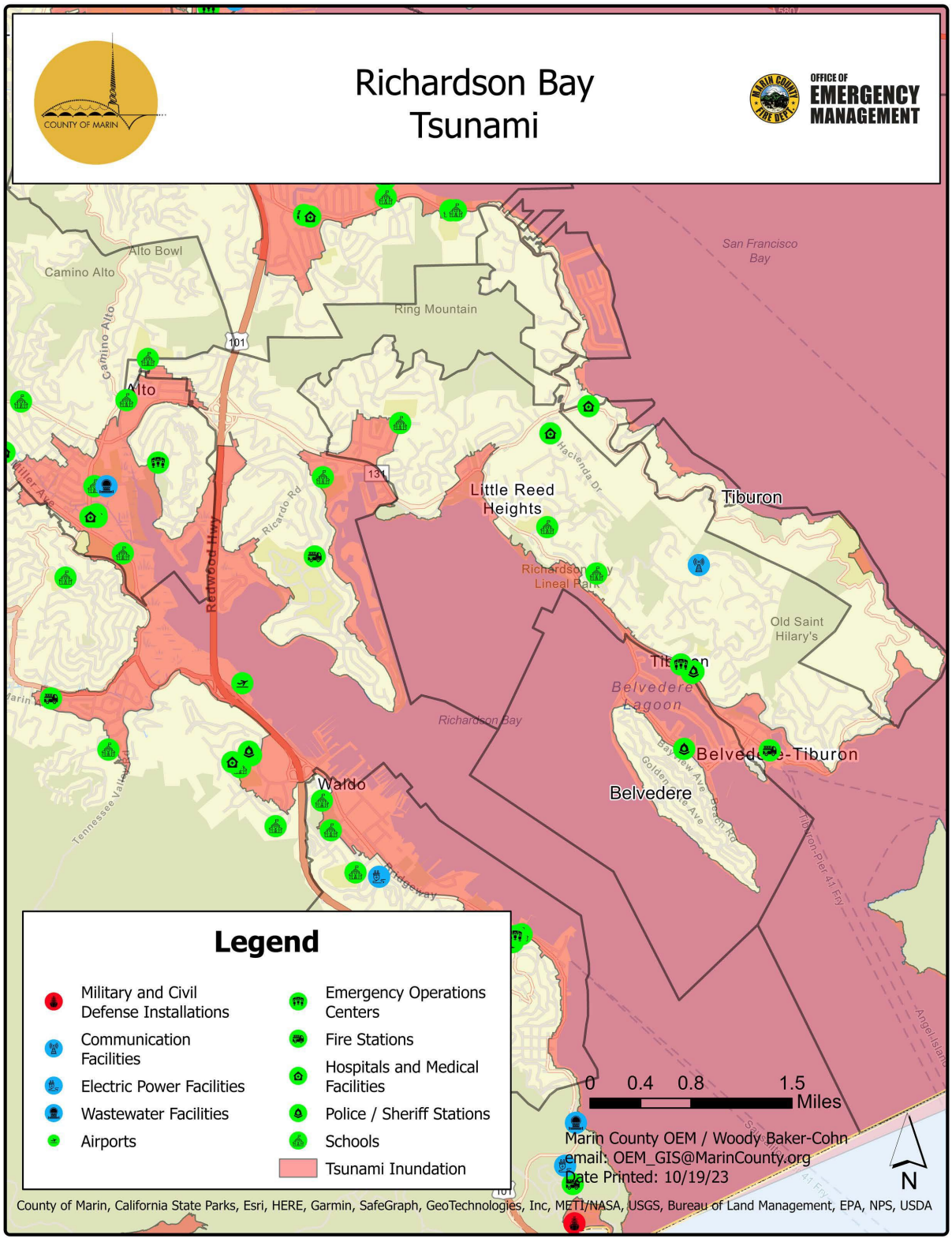


Figure 3.166: Richardson Bay Tsunami Inundation Zones
Source: Marin County OEM

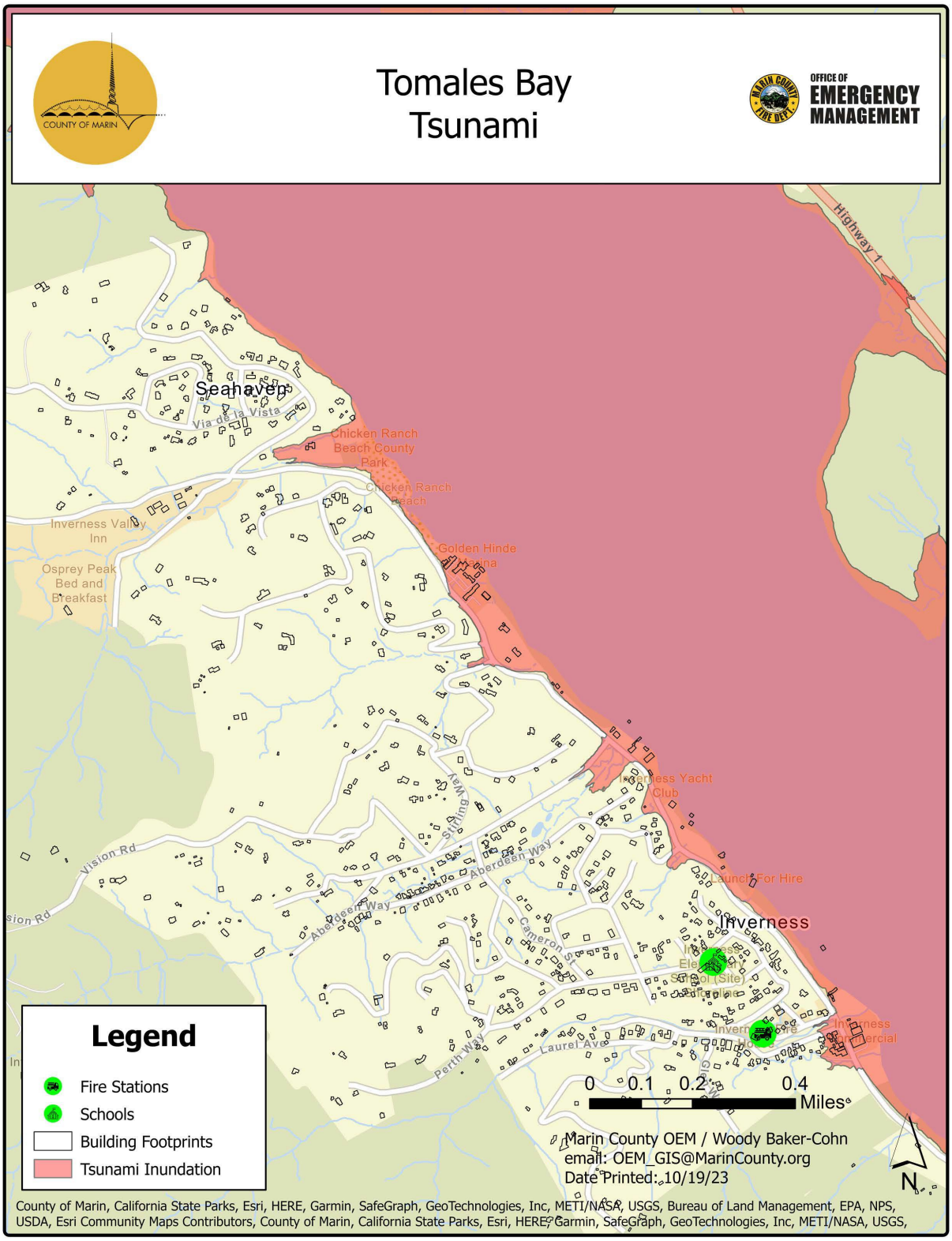


Figure 3.167: Tomales Bay Tsunami Inundation Zones
Source: Marin County OEM

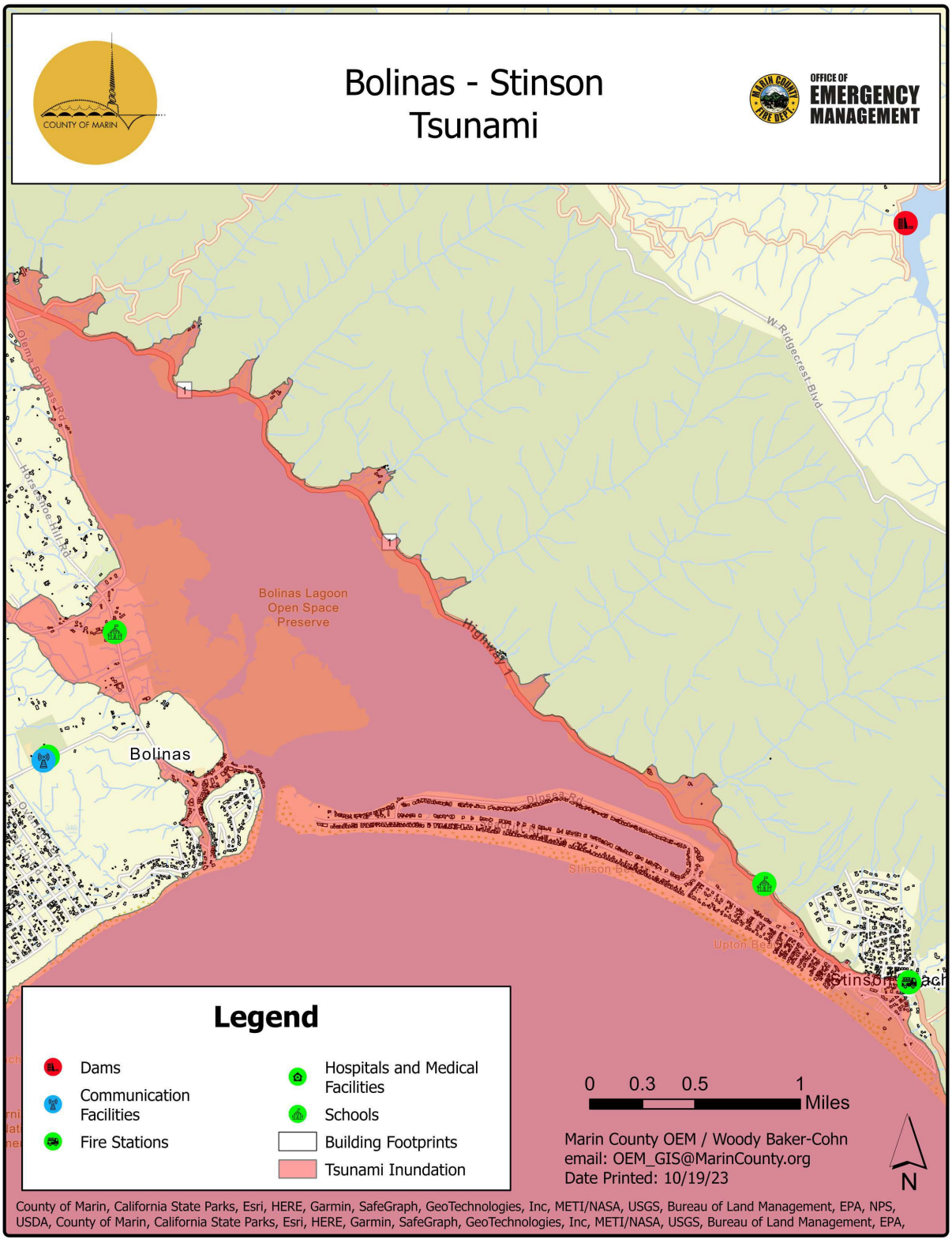


Figure 3.168: Bolinas – Stinson Tsunami Inundation Zones
Source: Marin County OEM

Tsunamis have caused loss of life and damaged property in Hawaii, Alaska and the West Coast over the last hundred years. Over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. Since 1946, there have been five tsunamis known to have caused damage to ports and harbors in California with several impacting unincorporated Marin County:

In 1960, a tsunami caused by a magnitude 9.5 earthquake offshore from Chile resulted in minor inundation to the beach at Stinson Beach.

In 1964, a tsunami caused by a magnitude 9.2 earthquake offshore from Alaska resulted in 12 deaths in California and destroyed portions of downtown Crescent City. There was damage to Lawson's Pier in Tomales Bay. A man drowned in Bolinas.

A 2006 tsunami (originating in the Kurile Islands region) caused approximately $20 million in damage to Crescent City harbor.

A 2010 tsunami (originating offshore from Chile) caused several million dollars in damage to ports and harbors in the state.

A tsunami in 2011 caused by a magnitude 9.0 earthquake offshore of Japan killed one person at the mouth of the Klamath River and caused up to $100 million damage to 27 ports, harbors, and marinas throughout the state.

Impacts

Community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the incorporated communities and the unincorporated areas of the county are communities that have the highest number of people and businesses in the tsunami-inundation zone. The communities of Belvedere and Sausalito have the highest percentages of people and businesses in this zone.

Extent and Probability

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, causing severe damage to coastal development. Recent studies of the continental shelf off the California coast indicate a potential for underwater landslides capable of generating damaging tsunamis that could threaten coastal communities. Tsunamis are a relatively infrequent occurrence in the Marin County OA.

Table 3:19: Tsunami Hazard Risk Assessment						
Jurisdiction	**Probability/ Likelihood of Future Events**	**Geographic Extent**	**Magnitude/ Severity**	**Climate Change Influence**	**Significance**	**Risk Score**
Marin County	Highly Likely	Limited	Extreme	Medium	High	**15.00**
City of Belvedere	Highly Likely	Significant	Severe	High	High	**16.00**
Town of Corte Madera	Unlikely	Limited	Moderate	Low	Low	**7.00**
Town of Fairfax	None	None	None	None	None	**0.00**
City of Larkspur	Occasional	Limited	Extreme	None	High	**11.00**
City of Mill Valley	Unlikely	Negligible	Severe	Medium	Medium	**9.00**
City of Novato	Unlikely	Negligible	Weak	None	Low	**4.00**
Town of Ross	None	None	None	None	None	**0.00**
Town of San Anselmo	None	None	None	None	None	**0.00**
City of San Rafael	Unlikely	Limited	Moderate	None	Medium	**7.00**
City of Sausalito	None	Limited	Weak	Low	Low	**5.00**
Town of Tiburon	Highly Likely	Limited	Extreme	Medium	High	**15.00**
Bolinas Public Utility District	Occasional	Limited	Severe	Low	High	**11.00**
Las Gallinas Valley Sanitary District	Unlikely	Extensive	Severe	None	Medium	**10.00**
North Marin Water District	Unlikely	Negligible	Extreme	Low	Low	**8.00**
Southern Marin Fire District	Likely	Limited	Moderate	Low	Low	**8.00**

Table 3.19: Marin County OA Hazard Risk Assessment - Tsunami
Source: Profiled Jurisdictions and Districts

Vulnerability

Some Marin County OA communities may be more vulnerable to tsunamis because of the location and quality of the built environment. Several unincorporated communities could be particularly susceptible to a tsunami:

Numerous shoreline homes, businesses, buildings and sections of Sir Francis Drake Boulevard along the west shore of Tomales Bay from Seahaven down through Inverness to Inverness Park lie in a tsunami inundation zone and could be susceptible to a tsunami. The downtown commercial district of Inverness, including the Post Office and several businesses, lie in a tsunami inundation zone and could be susceptible to a tsunami.

Numerous shoreline homes, businesses, buildings and sections of Highway 1 along the east shore of Tomales Bay from Bivalve to Hamlet and up Keys Creek south of Tomales lie in a tsunami inundation zone and could be susceptible to a tsunami. Low lying areas of Dillon Beach, including the main beach parking area and access road, lie in a tsunami inundation zone and could be susceptible to a tsunami.

Both the east and west sides of the Bolinas Lagoon lie in a tsunami inundation zone, including all of Highway 1 on the west side from Stinson Beach to the intersection of Olema Bolinas Road north of Bolinas. The northern end of Bolinas, including several homes, the Bolinas-Stinson Elementary School, and a section of Horseshoe Hill Road, lie in a tsunami inundation zone and could be susceptible to a tsunami. The community of Bolinas is particularly susceptible to a tsunami as it could essentially be isolated with access roads north and south becoming flooded in a tsunami. Most of the commercial center of Bolinas, including several businesses, residences, the College of Marin-Bolinas Campus and the Bolinas Library lie in a tsunami inundation zone and could be susceptible to a tsunami.

Most of Stinson Beach south of Highway 1, including Seadrift Road, Dipsea Road, and Calle del Aroyo lie in a tsunami inundation zone, and there are hundreds of homes and buildings in this area along with the Stinson Beach Fire Station #2 and the Water District office that could be susceptible to a tsunami. The commercial center of Stinson Beach, including several businesses, the entire beach area including access roads and parking lots, and a section of Highway 1 lie in a tsunami inundation zone and could be susceptible to a tsunami.

A section of Muir Beach up Redwood Creek that includes several homes and businesses, the Muir Beach Fire Station, and a section of Highway 1 lie in a tsunami inundation zone and could be susceptible to a tsunami.

A large section of Tamalpais Valley, including smaller sections to the north adjacent to and including the City of Mill Valley, lie in a tsunami inundation zone and could be susceptible to a tsunami pushing water up Coyote Creek. There are hundreds of homes, commercial buildings, the Southern Marin Fire Protection District Station #4 and part of Tamalpais Valley Elementary School that lie in this area. Most of the commercial core of Marin City, including the Gateway Shopping Center, the Martin Luther King Jr. Academy, the Marin City Fire Station, and numerous residences lie in a tsunami inundation zone and could be susceptible to a tsunami. The Waldo Point community consisting of dozens of floating homes in Richardson Bay could be susceptible to a tsunami. The area around the intersection of Highways 1 and 101 including the highways themselves, the Commodore Heliport and several businesses lie in a tsunami inundation zone and could be susceptible to a tsunami.

Both sides of the Strawberry Peninsula lie in a tsunami inundation zone and could be susceptible to a tsunami. There are dozens of homes in this area along with numerous commercial buildings, the Strawberry Point elementary school and a large section of Highway 101 that could be susceptible to a tsunami. There are also several homes in the northwest corner of Strawberry near Alto that lie in a tsunami inundation zone and could be susceptible to a tsunami.

The eastern side of the Tiburon Peninsula, where there are dozens of homes and buildings along with the Sanitary District #5 - Paradise Cove Treatment Plant, lies in a tsunami inundation zone and could be susceptible to a tsunami. Most of Paradise Cay lies in a tsunami inundation zone. There are dozens of homes in this area that could be susceptible to a tsunami.

The southwest side of Kentfield lies in a tsunami inundation zone and could be susceptible to a tsunami. There are dozens of homes and numerous businesses in this area along with the A.E. Kent Middle School, the Anthony Bacich G. Elementary School, part of the parking lot for the Marin General hospital, and most of the College of Marin campus and part of Sir Francis Drake Boulevard. A small section of Greenbrae that consists of a few homes and a section of Sir Francis Drake Boulevard, along with a small Section of California City that consists of a few homes, lie in a tsunami inundation zone and could be susceptible to a tsunami. A large section of San Quentin lies in a tsunami inundation zone and could be susceptible to a tsunami.

There are dozens of homes along San Pedro Road in the unincorporated county south of the City of San Rafael that lie in a tsunami inundation zone and could be susceptible to a tsunami. The McNear Brick Yard and parts of Point San Pedro lie in a tsunami inundation zone and could be susceptible to a tsunami.

Most of northern Santa Venetia along the Santa Venitia Marsh and the South Fork of Galinas Creek lies in a tsunami inundation zone and could be susceptible to a tsunami. There are several hundred homes in this area along with numerous pump stations and several medical facilities.

While most of Bel Marin Keys lies outside of a tsunami inundation zone, the far eastern side has several homes that lie inside a tsunami inundation zone and could be susceptible to a tsunami. The Hamilton Wetlands PG&E substation could also be susceptible to a tsunami, as it lies on the fringe of a tsunami inundation zone.

Parts of the Black Point area close to the Petaluma River Marsh lie on the edge of a tsunami inundation zone and could be susceptible to a tsunami. There are several homes in this area that mostly lie at the end of cul de sacs.

The principal exposure to the Marin County OA will be people, buildings, and infrastructure located in the low-lying potential inundation areas. Especially at risk are visitors, hikers, campers, and non-residents who might be on the shore when the tsunami strikes.

Associated risks to tsunami include flooding, contamination of drinking water, ruptured tanks or gas lines, lack of ingress and egress, and the loss of vital community infrastructure.

Climate Change and Future Development Considerations

The biggest threat to tsunamis is sea level rise which is a direct result of climate change. Sea level rise can make tsunamis worse than they already are because higher sea levels allow for tsunamis to travel further inland and cause even more damage. Sea level rise results in more

vulnerable coastlines which make coastal communities even more vulnerable to an incoming tsunami as the natural buffer to absorb the energy of an incoming tsunami will cease to exist. This is particularly true in the Marin County OA, where most of the developed population lies in an area vulnerable to sea level rise. Furthermore, it has been theorized that ocean warming, caused by climate change, can impact the tectonic plates that rest below large bodies of water. Ultimately, this can result in more geological activities and worse tsunamis. Climate change has also affected ocean patterns, which could eventually lead to tsunamis distributing themselves across the ocean and impacting areas that are currently not susceptible to a tsunami. Tsunamis as a result of climate change and associated sea level rise will exacerbate the impacts of flooding in the lowland areas of the Marin County OA. Future development in these areas will expose more people and infrastructure to the effects of flooding in the Marin County OA as tsunami inundation areas expand with climate change. Development in marshland in the Marin County OA would expose additional people and infrastructure to flooding as marshlands act as a natural buffer to a tsunami. Flooding could be exacerbated in areas where levees could fail as a result of high wave heights associated with a more significant tsunami.

3.3.12 WILDFIRE

A wildfire is a fire that occurs in an area of combustible vegetation. The three conditions necessary for a wildfire to burn are fuel, heat, and oxygen. Fuel is any flammable material that can burn, including vegetation, structures, and cars. The more fuel that exists and the drier that fuel is, the more intense the fire can be. Wildfires can be started naturally through lightning or combustion or can be set by humans. There are many sources of human-caused wildfires including arson, power lines, a burning campfire, an idling vehicle, trains, and escaped controlled burns. On average, four out of five wildfires are started by humans. Uncontrolled wildfires fueled by wind and weather can burn acres of land and everything in their path in mere minutes and can reach speeds up to 15 miles per hour. On average, more than 100,000 wildfires burn 4 to 5 million acres of land in the United States every year. Although wildfires can occur in any state, they are most common in the Western states including California where heat, drought, and thunderstorms create perfect wildfire conditions.

Wildfires are of primary concern when they occur in the Wildland Urban Interface (WUI), which is defined as areas where homes are built near or among lands prone to wildfire. Even relatively small acreage fires may result in disastrous damages. Most structures in the WUI are not destroyed from direct flame impingement, but from embers carried by wind. The damages can be widely varying, but are primarily reported as damage to infrastructure, built environment, and injuries to people. WUI fires have unique chemistry due to the combination of natural and human-made fuels that are burned, which may lead to the formation or release of toxic emissions not found in purely wildland fires.

The pattern of increased damages is directly related to increased urban spread into historical forested areas that have wildfire as part of the natural ecosystem. Many WUI fire areas have long histories of wildland fires that burned only vegetation in the past. However, with new development, a wildland fire following a historical pattern may now burn these newly developed areas. WUI fires can occur where there is a distinct boundary between the built and natural areas or where development or infrastructure has encroached or is intermixed in the natural area. WUI fires may include fires that occur in remote areas that have critical infrastructure

easements through them, including electrical transmission towers, railroads, water reservoirs, communications relay sites or other infrastructure assets.

Consequently, wildland fires that burn in natural settings with little or no development are part of a natural ecological cycle and may actually be beneficial to the landscape. Century old policies of fire exclusion and aggressive suppression have given way to better understanding of the importance fire plays in the natural cycle of certain forest types.

Warning times are usually adequate to ensure public safety, provided that evacuation recommendations and orders are heeded in a timely manner. While in most cases wildfires are contained within a week or two of outbreak, in certain cases, they have been known to burn for months, or until they are completely extinguished by fall rains.

Wildfire poses the greatest risk to human life and property in the Marin County OA's densely populated WUI, which holds an estimated 69,000 living units. Marin County is home to 23 communities listed on CAL FIRE's Communities at Risk list, with approximately 80% of the total land area in the county designated as having moderate to very high fire hazard severity ratings. The county has a long fire history with many large fires over the past decades, several of which have occurred in the WUI. To compound the issue, national fire suppression policies and practices have contributed to the continuous growth (and overgrowth) of vegetation resulting in dangerous fuel loads. The Community Wildfire Protection Plan (CWPP) provides a scientifically based assessment of wildfire threat in the WUI of the Marin County OA.

Fire protection in California is the responsibility of either the federal, state, or local government. On federally owned land, or federal responsibility areas (FRA), fire protection is provided by the federal government, or in partnership with local agreements. In state responsibility areas (SRA), CAL FIRE typically provides fire protection. However, in some counties CAL FIRE contracts with county fire departments to provide protection of the SRA – this is the case in Marin County, where CAL FIRE contracts with Marin County Fire Department (MCFD). Local responsibility areas (LRA) include incorporated cities and cultivated agriculture lands, and fire protection is typically provided by city fire departments, fire protection districts, counties, and by CAL FIRE under contract to local government.

The MCFD is responsible for the protection of approximately 200,000 acres of SRA within the county and is the primary agency that handles wildland fires. MCFD also provides similar protection services to approximately 100,000 acres of FRA in the Golden Gate National Recreation Area (GGNRA), the Muir Woods National Monument, and the Point Reyes National Seashore.

Figure 3.169 indicates the federal responsibility areas, state responsibility areas and local responsibility areas in the Marin County OA.

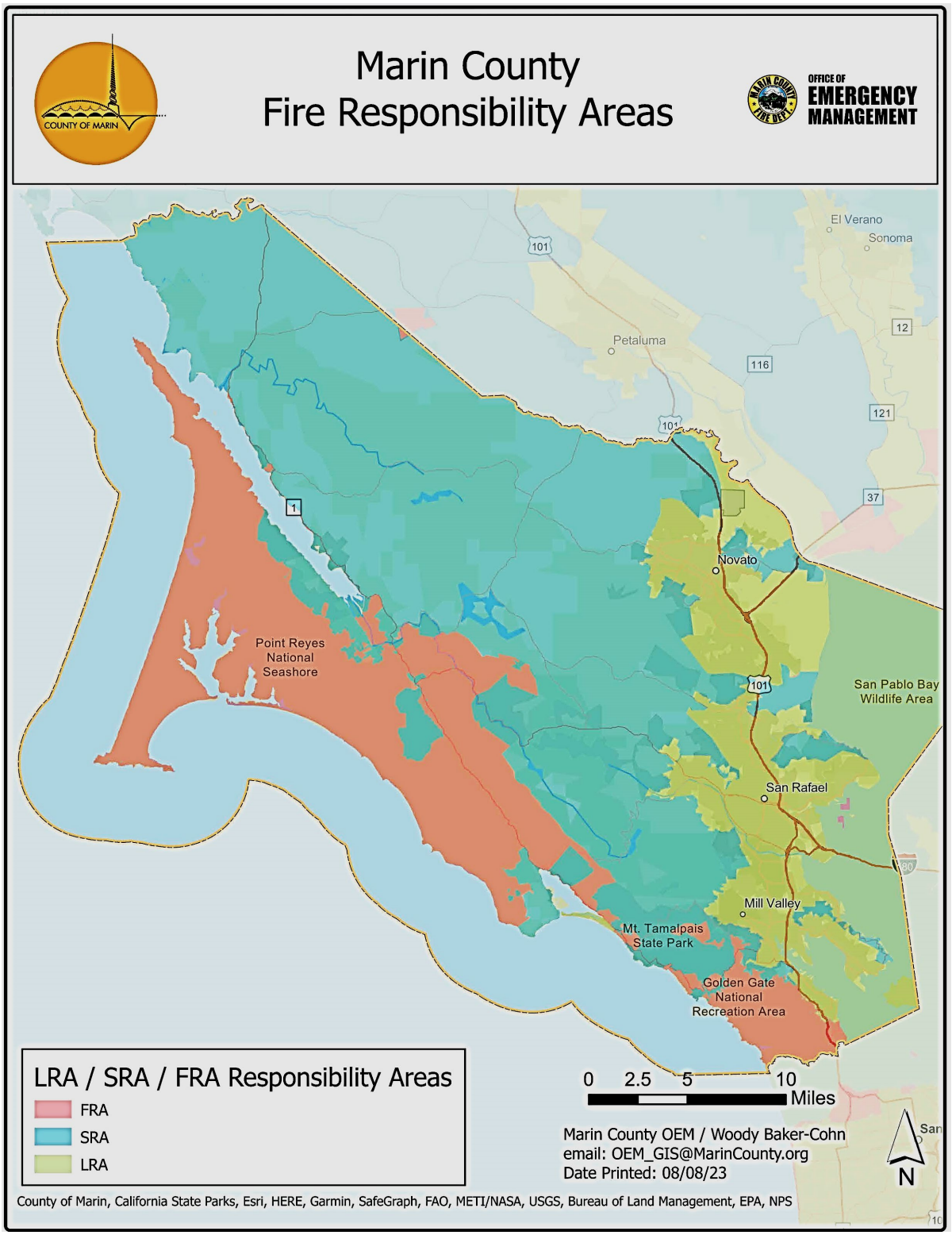


Figure 3.169: Federal, State and Local Responsibility Areas in the Marin County OA
Source: Marin County OEM

The mix of weather, diverse vegetation and fuel characteristics, complex topography, and land use and development patterns in the Marin County OA are important contributors to the fire

environment. The MCFD Woodacre Emergency Command Center currently manages the data from four Remote Automated Weather Stations (RAWS) for predicting fire danger utilizing the National Fire Danger Rating System (NFDRS) during the fire season. The RAWS are located in Woodacre, Middle Peak, Barnabe, Big Rock and a new station will be coming online in Novato.

Marin County is bounded by the cool waters of the Pacific Ocean to the west, the San Francisco and Richardson Bays to the southeast, the San Pablo Bay to the east, and Sonoma County agricultural lands to the north. The combination of these large bodies of water, location in the mid-latitudes, and the persistent high pressure over the eastern Pacific Ocean results in several micro-climates. Weather in the OA consists of warm, dry summers and cool, wet winters. The climate in early fall and late spring is generally similar to the summer, and late fall is similar to winter. Spring is generally cool, but not as wet as the winter. While these general weather conditions are fairly representative of the typical Marin County weather, complex topography, annual variability of weather patterns, and less frequent and transient weather patterns are important to fire conditions.

In the late spring through early fall, the combination of frequent and strong high-pressure systems (known as the Pacific High) over California combined with the cool waters of the ocean/bays results in persistent fog and low clouds along the coast (including over southern Marin County near the San Francisco Bay). The fog often penetrates into the inland valleys of northern and central Marin County, especially during overnight hours. At the coastline, mist from fog can keep the land surfaces modestly moist while inland land surfaces above the fog or inversion are often very dry.

The Pacific High that persists from late spring through early fall over the eastern Pacific, combined with a thermal low pressure over the Central Valley of California, results in an almost continuous sea breeze. These winds usher in cool and moist air and can be strong (15 to 25 mph), especially over the ridge tops and through northwest to southeast lying valleys, including San Geronimo/Ross, Hicks, and Lucas Valleys. These westerly winds are usually highest in the afternoon, decrease in the evening, and are light overnight before increasing again in the late morning/early afternoon.

Occasionally in the summer and more often in the fall, the Pacific High moves inland and centers over Oregon and Idaho, while low pressure moves from the Central Valley of California to southern California and Arizona. The resulting north-to-south pressure gradient can be strong enough to retard the typical sea breeze and can even result in winds blowing from the land to the ocean (offshore winds). As the offshore winds move air from the Great Basin to the coastal areas of California, the air descends and compresses, which greatly warms and dries the air. Under these “Diablo” wind conditions, temperatures in the Marin County OA can reach 100°F in the inland areas and even 80°F at the coast, and relative humidity can be very low. In addition, wind speeds can be high (20 to 40 mph) and gusty and are often much faster over the mountains and ridge tops such as Mt. Tamalpais, Loma Alta, and Mt. Burdell compared to low-lying areas. Wind speeds can be high over the ridges and mountains at all times of day under this “offshore” wind pattern and are often much slower or even calm at night in low-lying areas because nighttime cooling decouples the aloft winds from the surface winds. It is during these Diablo wind events that there is a high potential for large, wind-driven fires should there be an ignition. Historically, the largest and most destructive fires have occurred during these offshore (also known as Foehn) wind events including the Angel Island and the Vision fires.

A few times per year in the summer and early fall, monsoonal flow from Mexico brings in moist and unstable air over central and northern California, which can result in thunderstorms with or without precipitation. With the otherwise dry summer conditions, the lightning can ignite fires. These monsoonal flow patterns are usually only one to two-day events.

Beginning in late November and lasting through the end of March, the Pacific High moves south and weakens, allowing storms that originate in the Gulf of Alaska to move over California.

These storms bring precipitation and, at times, strong winds out of the south. Each storm usually results in one fourth inch to several inches of rain over a day or so. Near Mt. Tamalpais, rainfall amounts are enhanced by orographic lifting, resulting in higher rain amounts in the Kentfield and Fairfax areas compared to the rest of the county. Typically, after the first rain in November, the cool weather and occasional storm keeps the ground wet through late Spring. However, in some years, significant rain does not occur until later in the year (e.g., early-to-late December) and there can be several weeks without any storms and rain. During storms, temperatures are usually mild.

When there are no storms over California, a land-breeze typically forms (i.e., winds blowing from the Central Valley to the Pacific Ocean). These winds can reach 30 mph, and travel through the southeast to northwest lying valleys, over low-lying ridges such as the Marin Headlands, and through the Golden Gate. These winds are usually highest in the mid-morning hours and decrease in the afternoon as the Central Valley warms during the day. The winds are associated with cold and modestly moist air.

In late February/early March through late April, the Pacific High strengthens and moves north, and storms impacting the county become less frequent. During this time of year there is often a low-pressure area over the desert in southwest California. The combination of the Pacific High to the north and low-pressure to the southwest results in strong winds blowing from the northwest to the southeast. Like the sea breeze, these winds bring in cool, moist air and are usually highest in the afternoon hours. Because of winter and spring rains, the land is wet and there is little danger of wildland fire despite the strong winds and only occasional precipitation. There is often little coastal fog this time of year.

Vegetation, which is also known as fuel, plays a major role in fire behavior and potential fire hazards. A fuel's composition, including moisture level, chemical make-up, and density, determines its degree of flammability. Of these, fuel moisture level is the most important consideration. Generally, live trees contain a great deal of moisture while dead logs contain very little. The moisture content and distribution of fuels define how quickly a fire can spread and how intense or hot it may become. High moisture content will slow the burning process since heat from the fire must first eliminate moisture.

In addition to moisture, a fuel's chemical makeup determines how readily it will burn. Some plants, shrubs, and trees such as chamise and eucalyptus (both present in the Marin County OA) contain oils or resins that promote combustion, causing them to burn more easily, quickly, and intensely.

Finally, the density of a fuel influences its flammability; when fuels are close together but not too dense, they will ignite each other, causing the fuel to spread readily. However, if fuels are so close that air cannot circulate easily, the fuel will not burn freely.

The Marin County OA has extensive topographic diversity that supports a variety of vegetation types.

Environmental factors, such as temperature, precipitation, soil type, aspect, slope, and land use history, all help determine the existing vegetation at any given location. In the central and eastern parts of the county, north facing slopes are usually densely wooded from lower elevations to ridge peaks with a mixture of mostly hardwood tree species such as coast live oak, California bay, Pacific madrone, and other oak species. Marshlands are also present throughout the county; once ignited marsh fires can be difficult to contain and extinguish.

Grasslands with a mixture of native and nonnative annual and perennial plant species occur most often in the northern and western parts of the county due to a combination of soil type, lower rainfall, and a long history of ranching. The southern and western facing slopes tend to have a higher percentage of grasslands, which in turn have the potential to experience higher rates of fire spread. Grassland fires are dangerous even without extreme fire weather scenarios due to the rapid rate of fire spread; in some cases, fires spread so quickly that large areas can burn before response resources are able to arrive.

In the west portion of the county closer to the coast, where precipitation is higher and marine influence is greater, most areas are densely forested with conifer species (i.e., Bishop pine, Douglas-fir, and coast redwood) and associated hardwood species. Chaparral vegetation also occurs in parts of the county, especially on steeper south and west facing slopes. This mix of densely forested areas mixed with chaparral results in higher fuel loads and potentially higher fire intensity. Expansion of the residential community into areas of heavier vegetation has resulted in homes existing in close proximity to dense natural foliage; these homes are often completely surrounded by highly combustible or tall vegetation, increasing the potential that wildland fires could impact them.

As part of the development of the CWPP, an updated vegetation map layer was created using the most recent vegetation information available from a variety of state and local data sources.

Vegetation distribution in the Marin County OA is characterized by approximately 20 different types of vegetation which have been classified into 15 fire behavior fuel models.

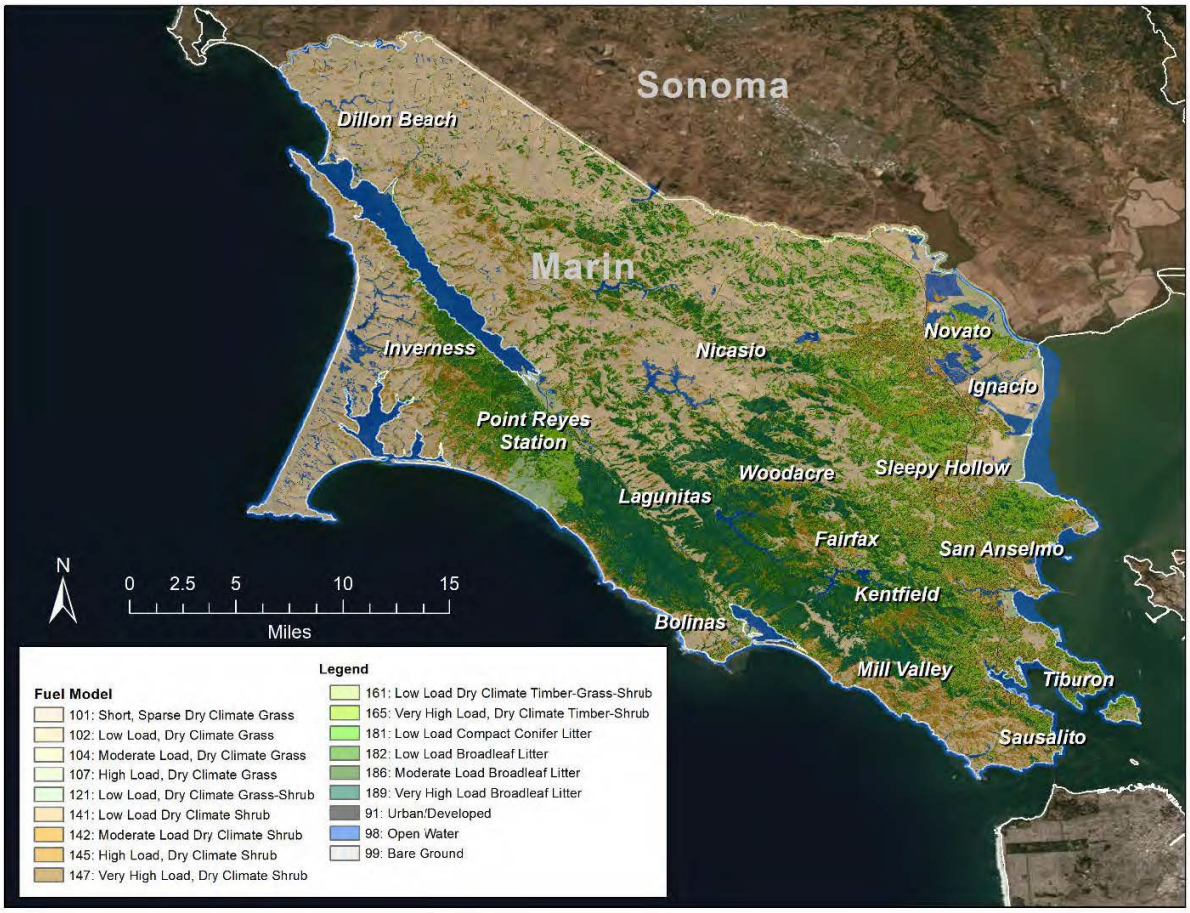


Figure 3.170: Fuel Model Map for the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Insect infestations and plant diseases, such as California oak mortality syndrome (sudden oak death), are increasing and threaten to change the structure and overall health of native plant communities in Marin County. Sudden oak death has no known cure and is the biggest concern; this syndrome is caused by the fungus-like Phytophthora ramorum, which has led to widespread mortality of several tree species in California since the mid-1990s; the tanoak (Lithocarpus densiflorus) in particular appears to have little or no resistance to the disease. Sudden oak death has resulted in stands of essentially dead trees with very low fuel moistures.

Studies examining the impacts of sudden oak death on fire behavior indicate that while predicted surface fire behavior in sudden oak death stands seems to conform to a common fuel model already in use for hardwood stands, the very low moisture content of dead tanoak leaves may lead to crown ignitions more often during fires of “normal” intensity.

Two other plant diseases prevalent in the Marin County OA are pitch canker (which affects conifers such as Bishop pine and other pine species), and madrone twig dieback (which affects Pacific madrones). Pitch canker is caused by the fungus Fusarium circinatum (F. subglutinans, F. sp. pini), which enters the tree through wounds caused by insects. While some trees do recover, most infected trees are eventually killed by the fungus. Management of this disease largely focuses on containment to reduce the fungus spreading to other trees. Pitch canker is a

particular issue in the NPS lands of Pt. Reyes National Seashore, where many acres of young Bishop Pines that were seeded on the Inverness Ridge by the Mount Vision Fire of 1995 have been infected.

These dead and dying trees have created large swaths of land with dense and dry fuel loads. Madrone twig dieback is caused by the native fungus Botryosphaeria dothidea and appears to be getting worse throughout the county due to drought effects on Pacific madrones. Three additional threats to trees common to the Marin County OA include:

- Bark and ambrosia beetles (Monarthrum dentiger and monarthrum scutellare), which target oak and tanoak trees. Sudden oak death may be exacerbating the effects of beetle infestations which prey on trees already weakened by this disease.
- Root rot, caused by oak root fungus (Armillaria mellea), is primarily associated with oaks and other hardwoods but also attacks conifers. These fungal infestations cause canopy thinning and branch dieback and can kill mature trees. As with the beetle infestations, sudden oak death may be exacerbating the effects of root rot fungus in the county forests.
- Velvet-top fungus (Phaeolus schweinitzii) is a root rot fungus affecting Douglas-fir and other conifers, with the infection typically occurring through a wound.

Topography characterizes the land surface features of an area in terms of elevation, aspect, and slope. Aspect is the compass direction that a slope faces, which can have a strong influence on surface temperature, and more importantly on fuel moistures. Both elevation and aspect play an important role in the type of vegetation present, the length of the growing season, and the amount of sunlight absorbed by vegetation. Generally, southern aspects receive more solar radiation than northern aspects; the result is that soil and vegetation on southern aspects is warmer and dryer than soil and vegetation on northern aspects. Slope is a measure of land steepness and can significantly influence fire behavior as fire tends to spread more rapidly on steeper slopes. For example, as slope increases from 20 – 40%, flame heights can double and rates of fire spread can increase fourfold; from 40 – 60%, flame heights can become three times higher and rates of spread can increase eightfold.

The Marin County OA is topographically diverse, with rolling hills, valleys and ridges that trend from northwest to southeast. Elevation throughout the county varies considerably, with Mt. Tamalpais' peak resting at 2,574 feet above sea level and many communities at or near sea level. Correspondingly, there is considerable diversity in slope percentages. The San Geronimo Valley slopes run from level (in the valley itself) to near 70%. Mt. Barnabe has slopes that run from 20 to70%, and Throckmorton ridge has slopes that range in steepness from 40 – 100%. These slope changes can make fighting fires extremely difficult.

In the WUI where natural fuels and structure fuels are intermixed, fire behavior is complex and difficult to predict. Research based on modeling, observations, and case studies in the WUI indicates that structure ignitability during wildland fires depends largely on the characteristics and building materials of the home and its immediate surroundings.

The dispersion of burning embers from wildfires is the most likely cause of home ignitions. When embers land near or on a structure, they can ignite near-by vegetation or accumulated debris on the roof or in the gutter. Embers can also enter the structure through openings such as an open window or vent and could ignite the interior of the structure or debris in the attic.

Wildfire can further ignite structures through direct flame contact and/or radiant heat. For this reason, it is important that structures and property in the WUI are less prone to ignition by ember dispersion, direct flame contact, and radiant heat.

Public Safety Power Shutoff (PSPS) Events

As a result of the 2017 Northern California Wildfires, the 2018 Camp Fire in Butte County and other wildfires caused by power line infrastructure, Pacific Gas & Electric (PG&E) began initiating Public Safety Power Shutoff (PSPS) events in their service areas (including Marin County) to help prevent the start of future wildfires. PG&E will initiate a PSPS if conditions indicate potentially dangerous weather conditions in fire-prone areas due to strong winds, low humidity, and dry vegetation. During these events, PG&E will proactively turn off power in high fire risk areas to reduce the threat of wildfires. The most likely electric lines to be considered for a public safety power outage will be those that pass through areas that have been designated by the California Public Utilities Commission (CPUC) High Fire-Threat District at elevated (Tier 2) or extreme risk (Tier 3) for wildfire. Customers outside of these areas could have their power shut off, though, if their community relies upon a line that passes through a high fire-threat area or an area experiencing severe weather. PG&E will consider numerous factors and analyze historical data to help predict the likelihood of a wildfire occurring, and closely monitoring weather watch alerts from the National Weather Service (NWS). These factors generally include, but are not limited to:

- A Red Flag Warning declared by the National Weather Service
- Low humidity levels, generally 20 percent and below
- Forecasted sustained winds generally above 25 mph and wind gusts in excess of approximately 45 mph, depending on location and site-specific conditions such as temperature, terrain and local climate
- Condition of dry material on the ground and live vegetation (moisture content)
- On-the-ground, real-time observations from PG&E's Wildfire Safety Operations Center and field crews

Pacific Gas & Electric Company (PG&E) operates a total of 1,179 miles of overhead electricity transmission and distribution lines in the Marin County OA. Overhead electricity lines and poles can be damaged or downed under severe weather conditions, particularly severe wind conditions, which increases the potential for wildfire ignition. 52 percent of PG&E’s overhead distribution lines and 41 percent of its overhead transmission lines are located in CPUC-identified High-Fire Threat Districts subject to elevated or extreme fire risk. PG&E is currently planning and implementing safety measures to prevent wildfires and reduce the impacts of Public Safety Power Shutoff (PSPS) events on communities in the Marin County OA and throughout California.

These measures include installing weather stations; installing high-definition cameras; installing sectionalizing devices on its overhead lines to separate the grid into smaller sections; hardening the system by installing stronger power poles, covering lines, and undergrounding lines in targeted areas; creating temporary microgrids to provide electricity during PSPS events; and enhancing existing vegetation management activities. From 2018 to July 2021, PG&E hardened three miles of overhead lines, installed 68 transmission and distribution sectionalizing devices, completed enhanced vegetation management on approximately 51 of overhead line miles, installed 28 weather stations, and installed 12 high-definition cameras in the Marin County OA.

Location and Previous Occurrences

In the time before the county was settled, fire was a natural part of the ecosystem. Much of the vegetation in what is now the wildlands of Marin County depended on fire to renew itself by removing old, dead fuel in order to make room for healthy new vegetation and promote the growth of native plant species. Once the land was settled, business operators, landowners, and homeowners had an interest in protecting the natural assets of Marin County and their own investments. Uncontrolled fires had already burned large tracts in the past and valuable lumber, structures, and field crops had been destroyed. A series of fires that occurred in the late 1800s prompted the organization of the first fire departments in Marin County around the turn of the century.

Since then, national fire suppression policies and practices (among other factors) have contributed to the continuous growth (and overgrowth) of vegetation resulting in dangerous fuel density, or fuel loads. Combined with this fuel accumulation, people have been building homes closer and closer to wildlands, which is creating the WUI fire issues that are now present in many parts of Marin County and the country.

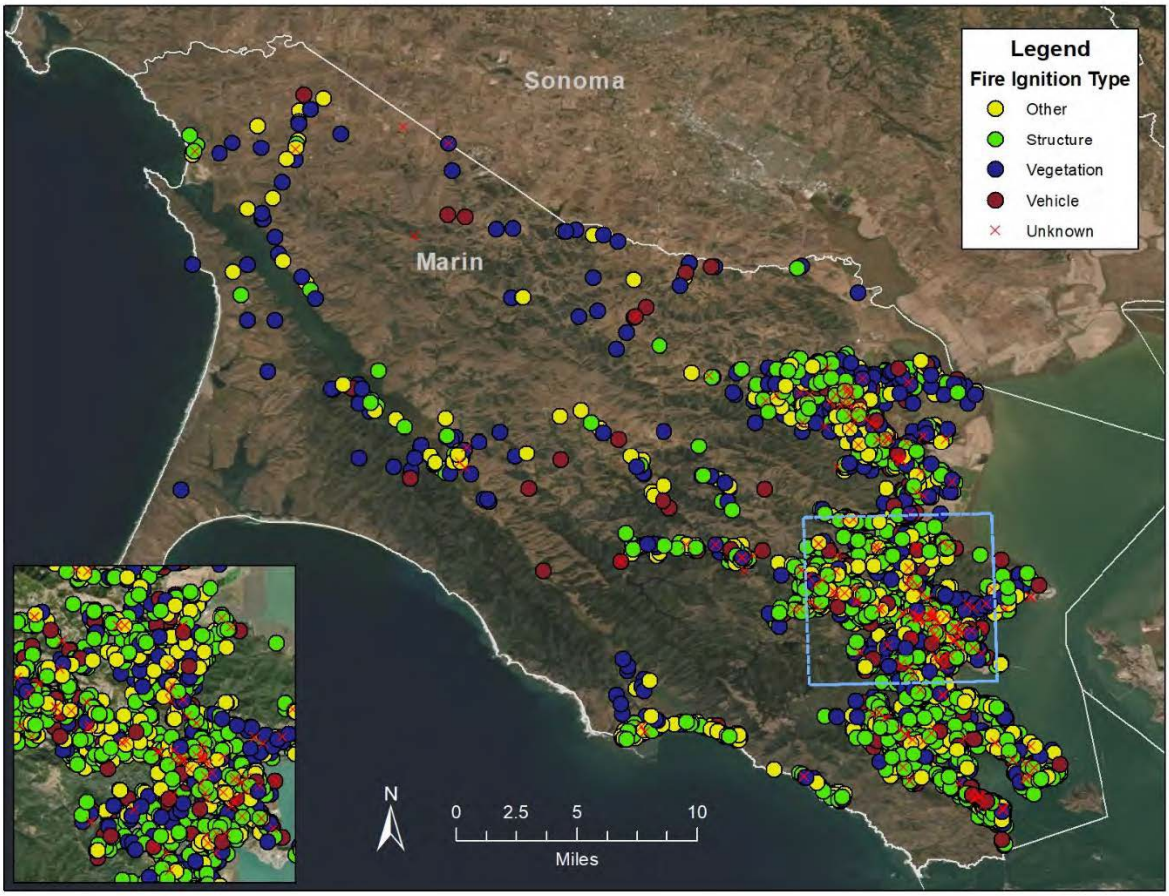


Figure 3.171: Wildfire Ignition Points in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Homes and structures located anywhere in and around the WUI are at a higher risk for exposure to wildland fire. Fire can spread rapidly throughout WUI areas through adjacent structures and/or vegetation, or by ember dispersion. Property owners in the WUI have a

responsibility to prepare their property for structure defense by providing adequate defensible space and complying with WUI building codes and ordinances. The WUI boundaries for Marin County were determined based on areas with high structure density and proximity to areas with a high density of burnable fuels.

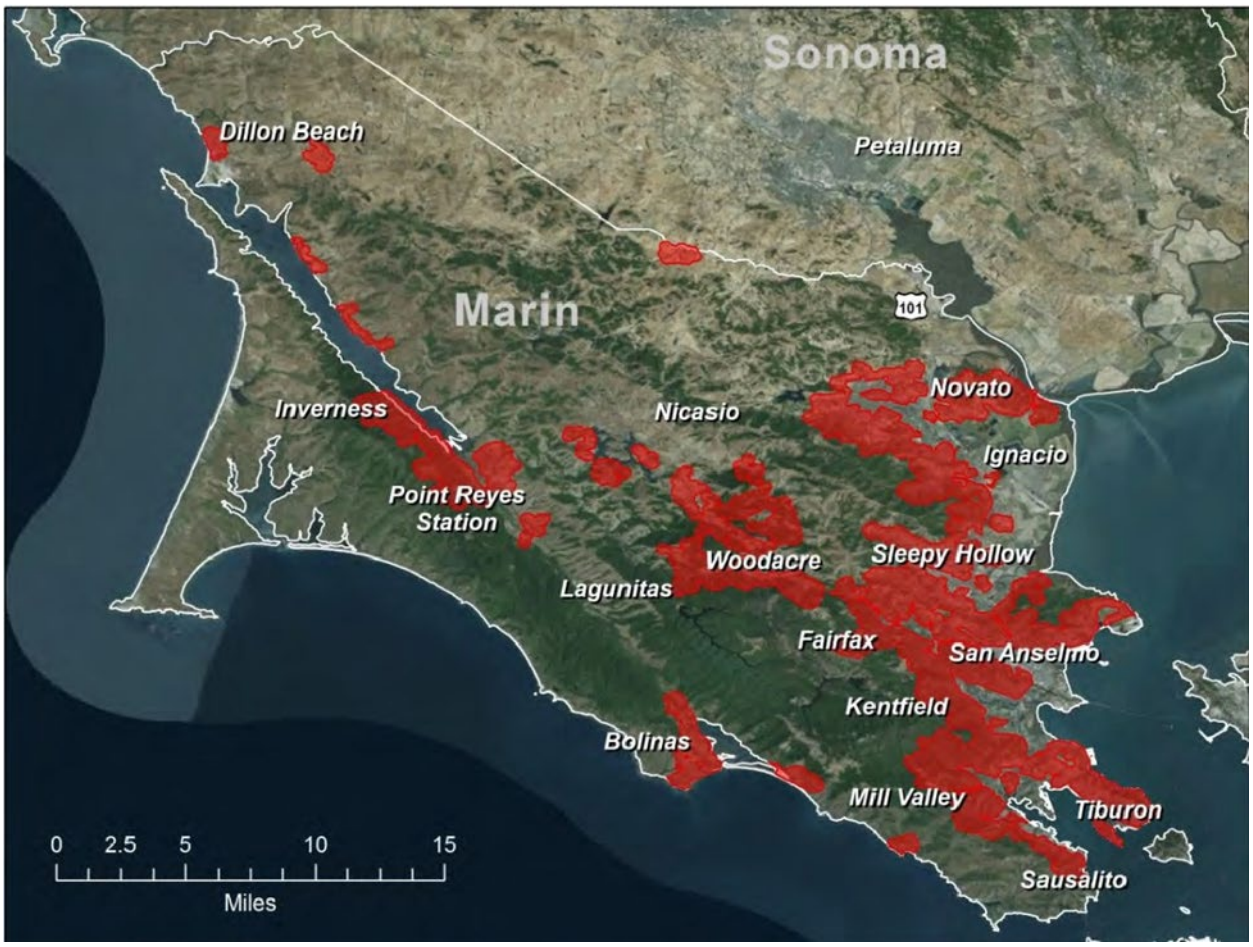


Figure 3.172: WUI Boundary in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Approximately 60,000 acres—18% of the county's land area—falls within the wildland urban interface (WUI) where residences (i.e., homes and structures) are intermixed with open space and wildland vegetation. Within Marin County, there are 96,195 parcels and 106,679 living units; of these living units, an estimated 69,000 units are located in the WUI. A recent assessment by the Marin County Fire Department (MCFD) revealed that these living units within the WUI are valued at $59 billion (Marin County Fire Department, 2015). Because of the mix and density of structure and natural fuels combined with limited access and egress routes, fire management becomes more complex in WUI environments. In Marin County specifically, many of the access roads within the WUI are narrow and winding and are often on hillsides with overgrown vegetation, making it even more difficult and costly to reduce fire hazards, fight wildfires, and protect homes and lives in these areas.

To quantify the potential risk from wildfires, CalFire has developed a Fire Hazard Severity Scale which uses three criteria in order to evaluate and designate potential fire hazards in wildland

areas. The criteria are fuel loading (vegetation), fire weather (winds, temperatures, humidity levels and fuel moisture contents) and topography (degree of slope). In 2022, CalFire began the process of updating the 2007 map of the Fire Hazard Severity Zones (FHSZ) statewide. It is projected that the Very High Fire Severity Zone (VHFSZ) will grow significantly in the Mount Tamalpais watershed area between Mill Valley and Muir Beach, and in the area of Inverness and Marshall. Most of western Marin County that used to fall under the Moderate Fire Severity Zone (MFSZ) is projected to change to High Fire Severity Zone (HFSZ). As the new FHSZ maps are still pending final approval as of 2023, the Marin County OA has been advised by CalFire to use the 2007 FHSZ maps as current for wildfire analysis in the 2023 Marin County OA MJHMP. The updated FHSZ maps planned for final approval in 2024 will be used for wildlife analysis in the 2028 Marin County OA MJHM. Figure 3.173 shows the current 2007 map of the FHSZ for Marin County.

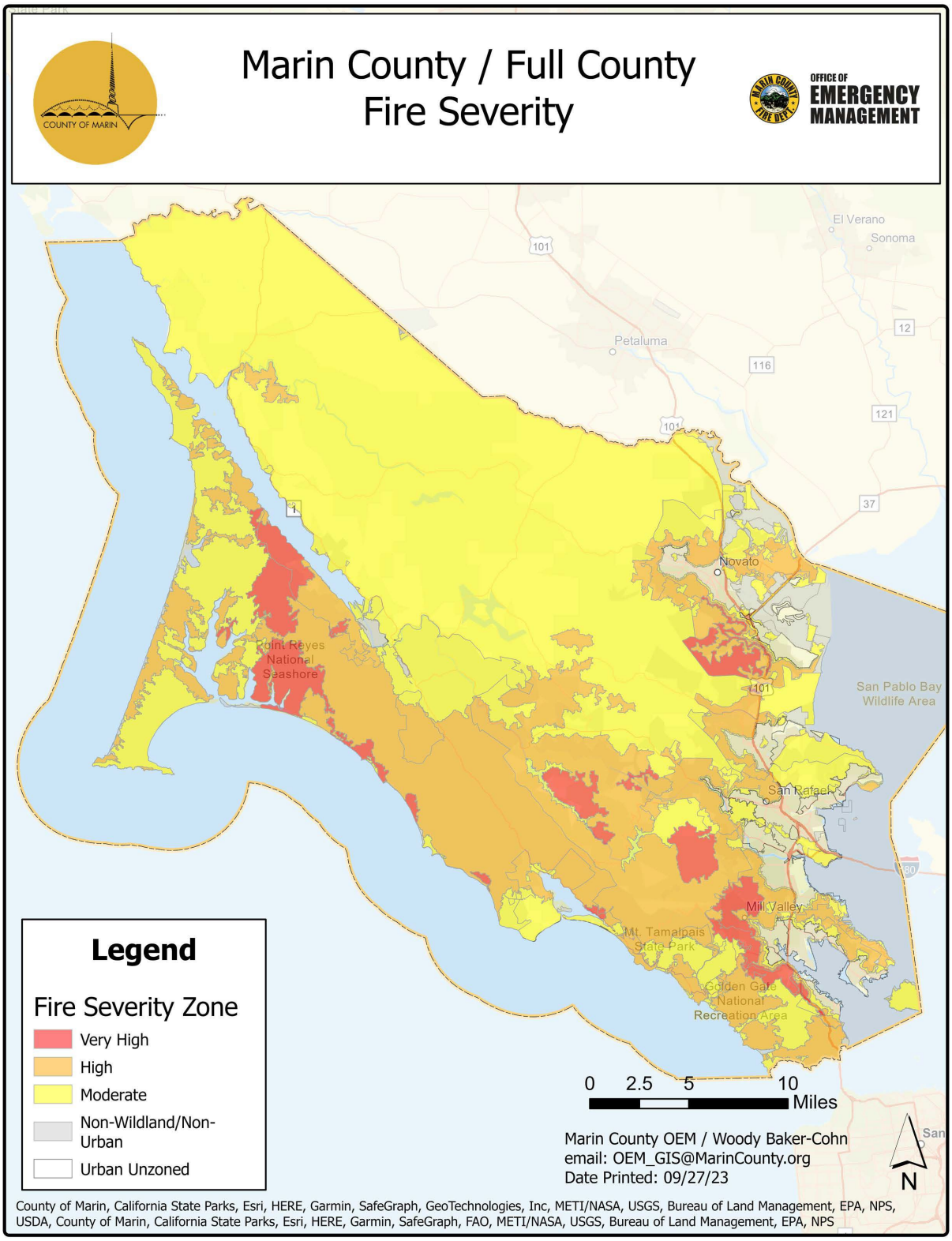


Figure 3.173: Fire Hazard Severity Zones (FHSZ) in the Marin County OA
Source: Marin OEM, CALFIRE

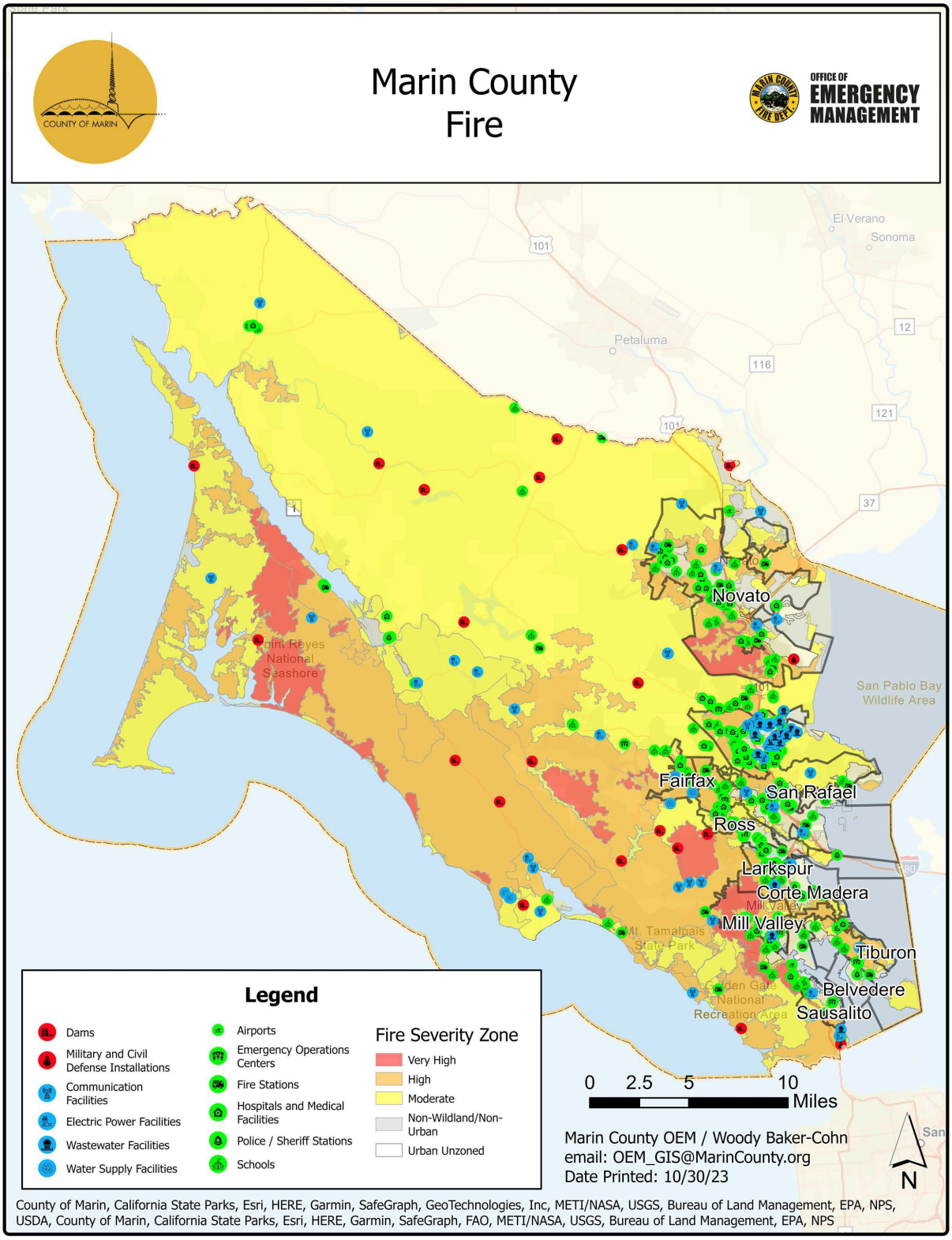


Figure 3.174: Marin County Wildfire Susceptibility to Critical Facilities
Source: Marin County OEM

As of 2007, several unincorporated communities in Marin County lie in moderate to very high wildfire hazard severity zones, which are shown below.

Figure 3.175 shows the fire hazard severity zones in and around Lagunitas, Forest Knolls and San Geronimo.

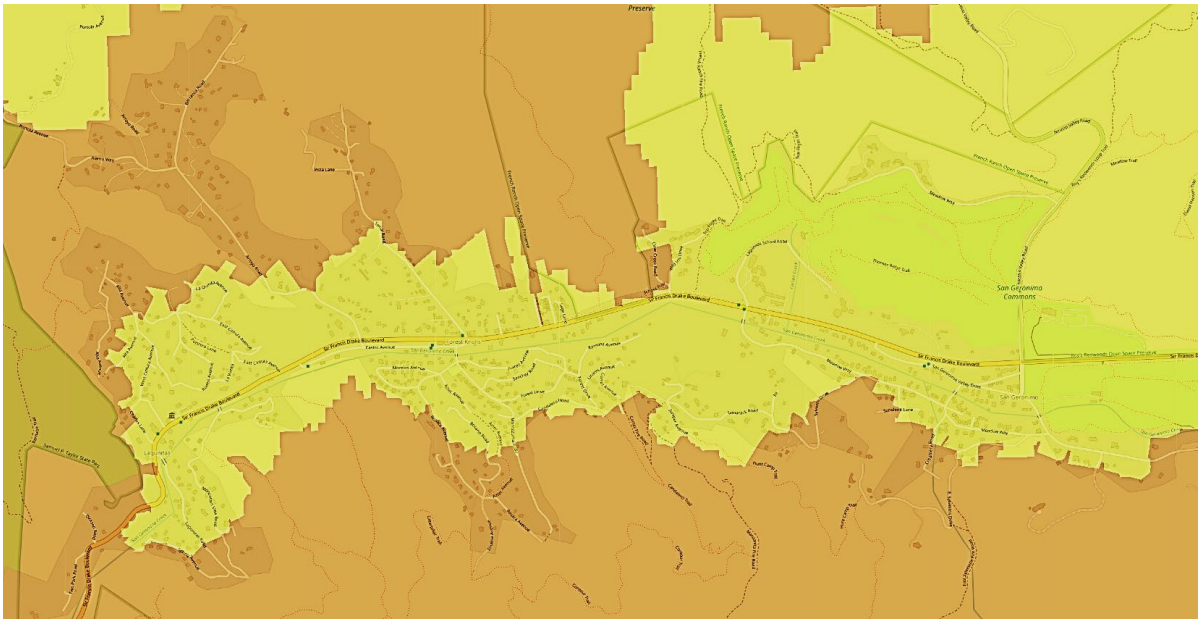


Figure 3.175: Fire Hazard Severity Zones – Lagunitas, Forest Knolls, San Geronimo and Woodacre
Source: CalFire, 11/27/23

Figure 3.176 shows the fire hazard severity zones in and around Woodacre.

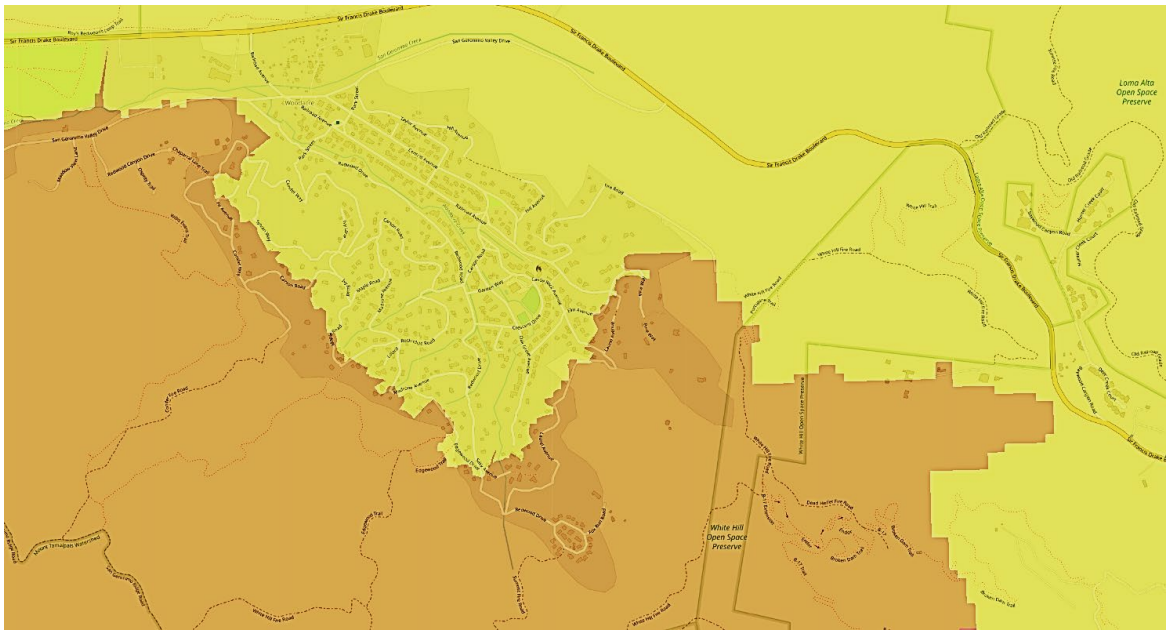


Figure 3.176: Fire Hazard Severity Zones –Woodacre
Source: CalFire, 11/27/23

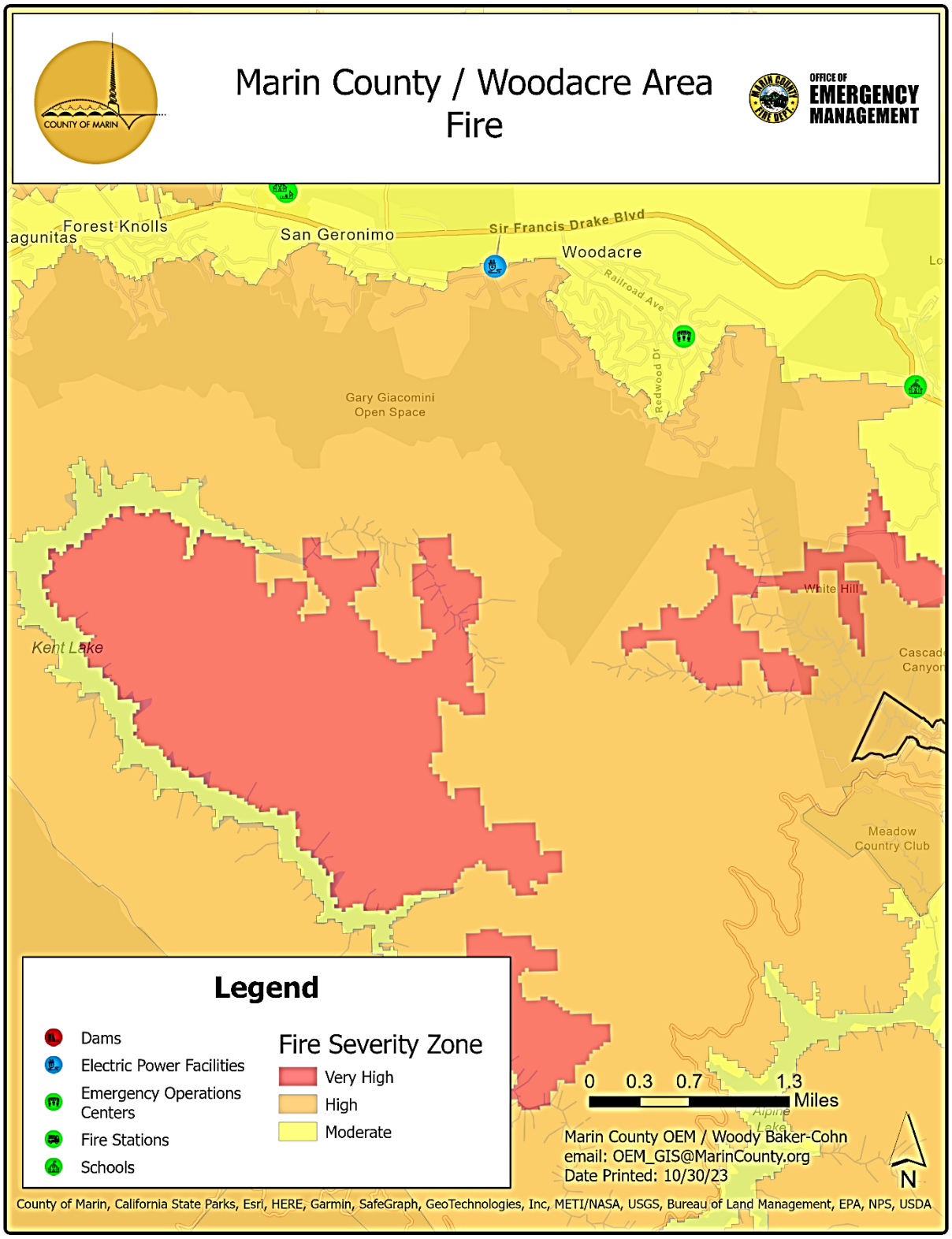


Figure 3.177: Fire Hazard Severity Zones –Woodacre Area
Source: CalFire

Figure 3.178 shows fire hazard severity zones in and around Nicasio.

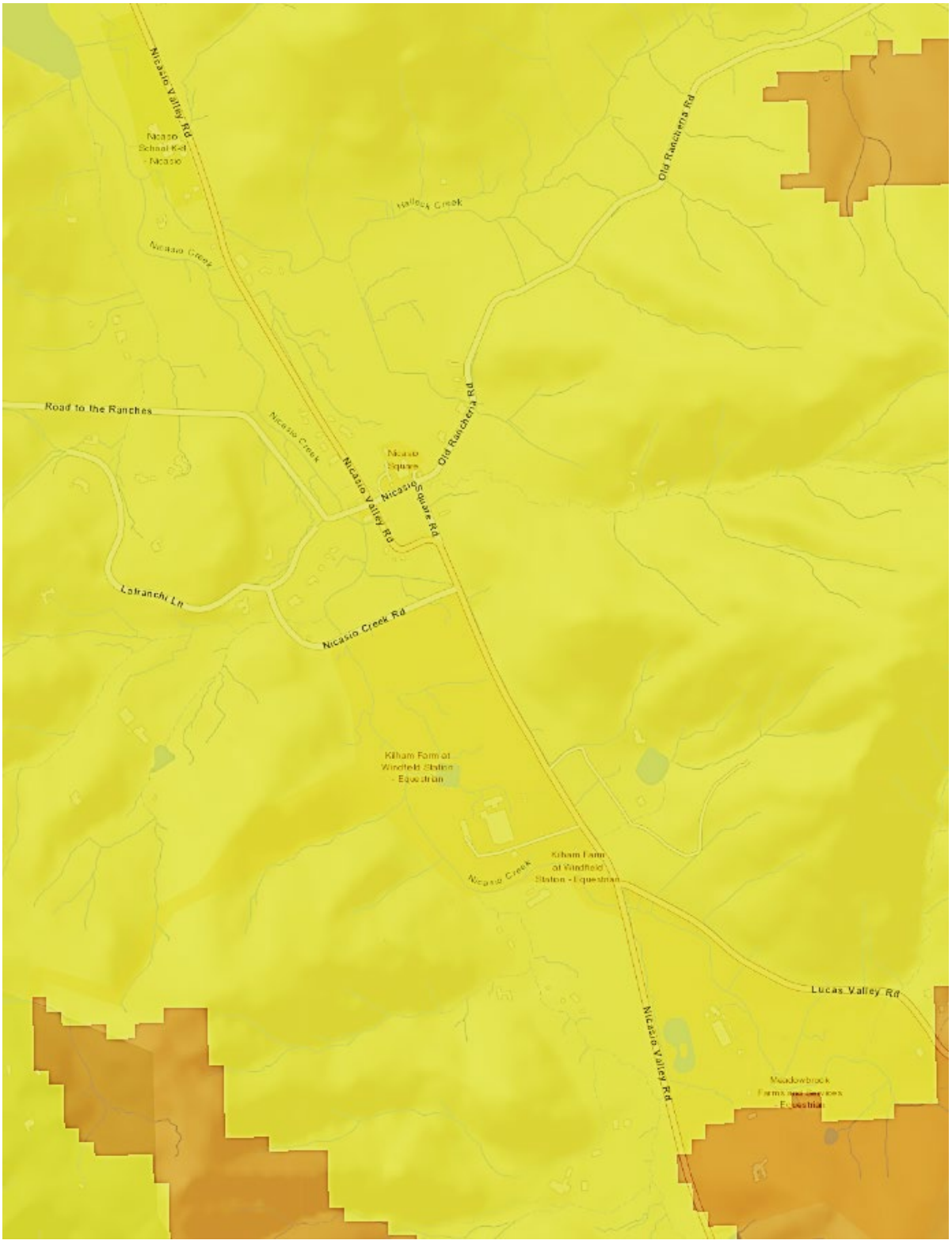


Figure 3.178: Fire Hazard Severity Zones – Nicasio
Source: CalFire, 11/27/23

Figure 3.179 shows the fire hazard severity zone in and around Tocoloma.

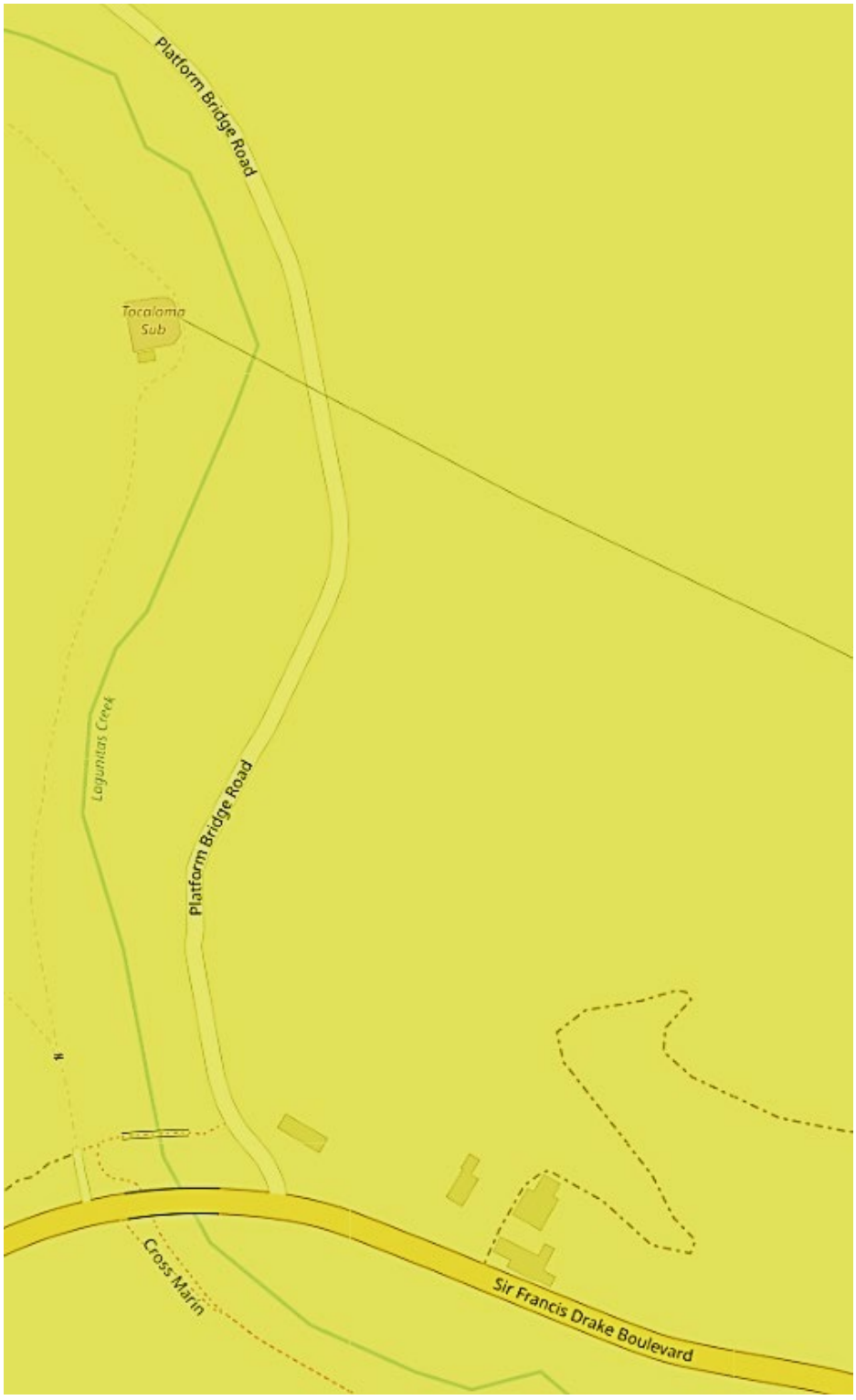


Figure 3.179: Fire Hazard Severity Zones – Tocoloma
Source: CalFire, 11/27/23

Figure 3.180 shows the fire hazard severity zones in and around Olema.

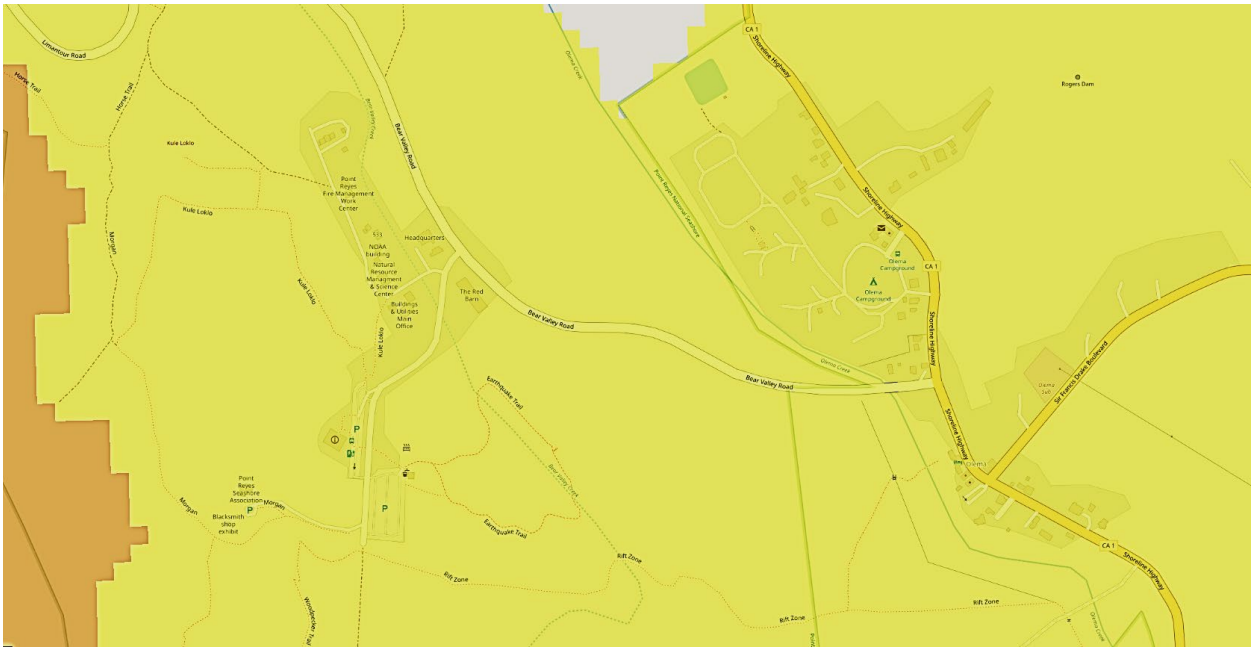


Figure 3.180: Fire Hazard Severity Zones – Olema
Source: CalFire, 11/27/23

Figure 3.181 shows the fire hazard severity zones in and around Point Reyes Station.

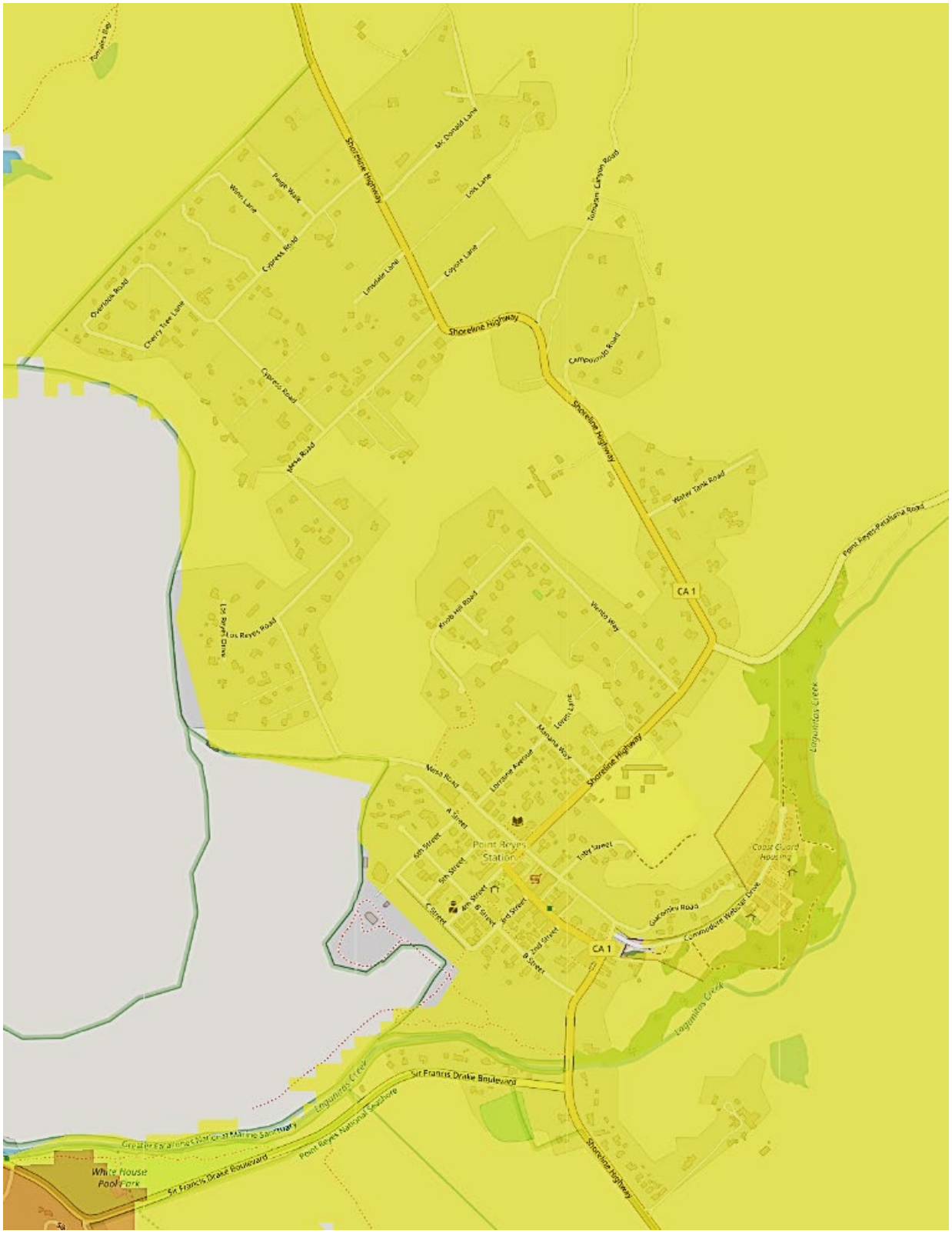


Figure 3.181: Fire Hazard Severity Zones – Point Reyes Station
Source: CalFire, 11/27/23

Figure 3.182 shows the fire hazard severity zones in and around Inverness Park.

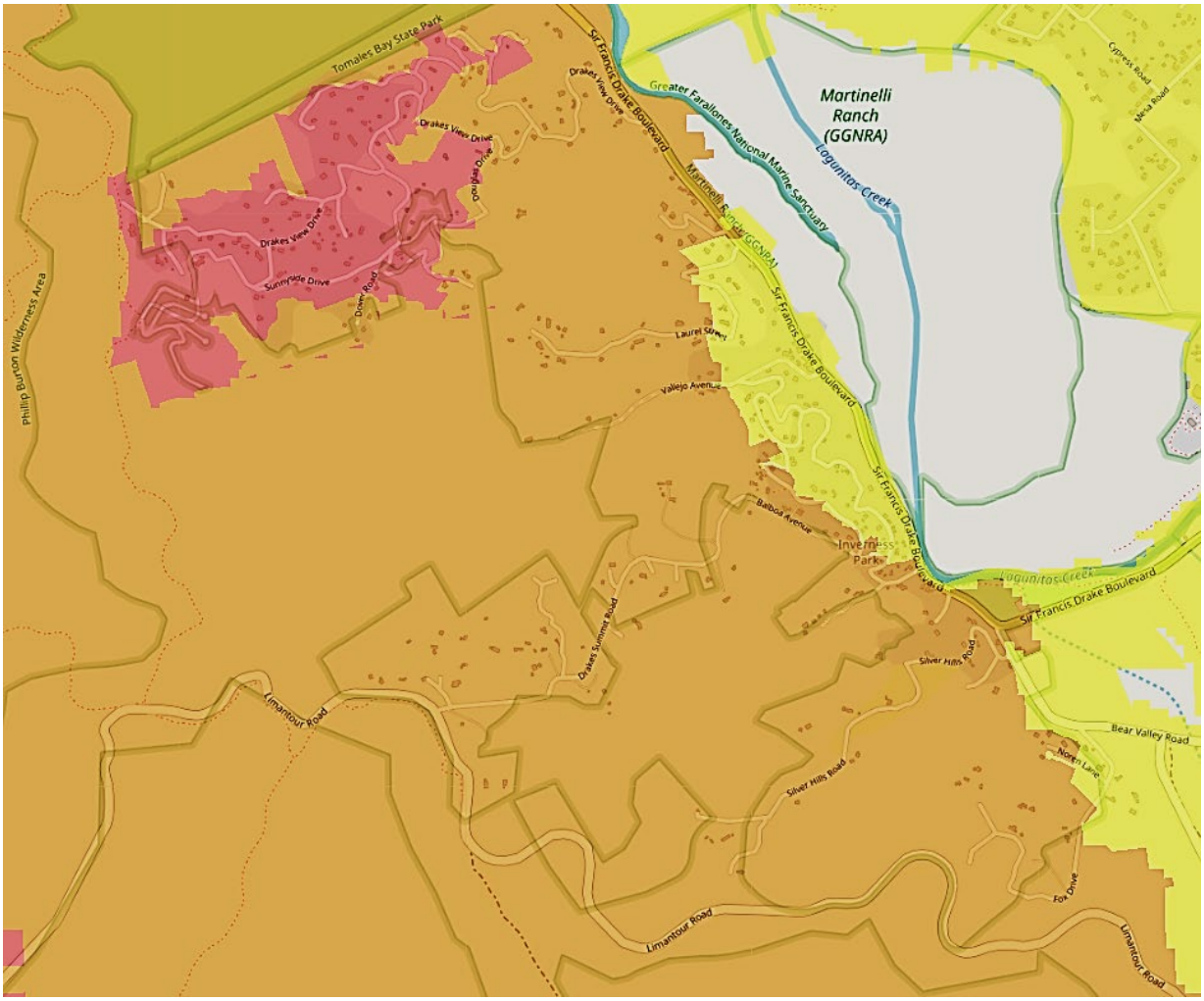


Figure 3.182: Fire Hazard Severity Zones – Inverness Park
Source: CalFire, 11/27/23

Figures 3.183 and 3.184 show the fire hazard severity zones in and around Inverness.

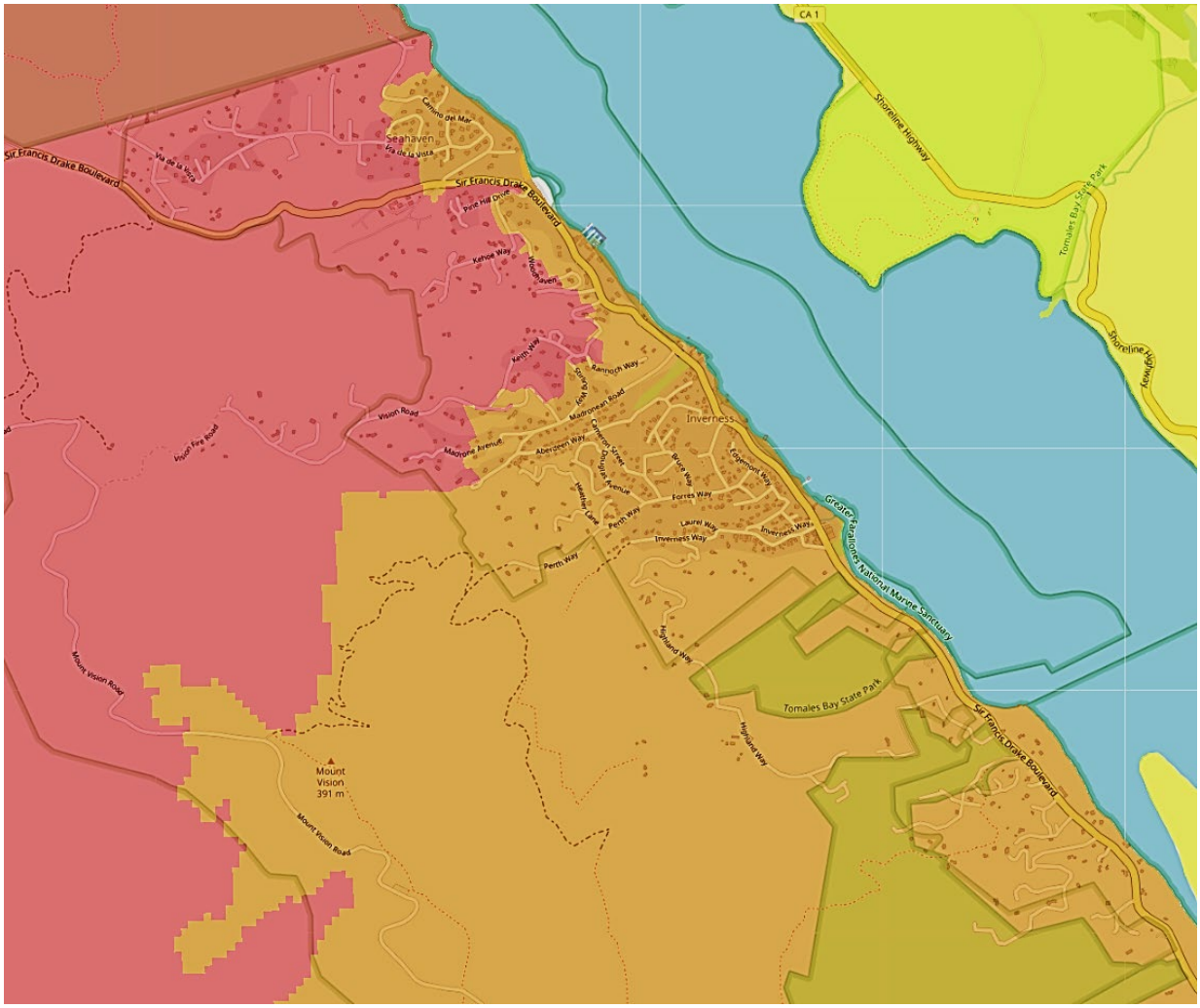


Figure 3.183: Fire Hazard Severity Zones – Inverness
Source: CalFire, 11/27/23

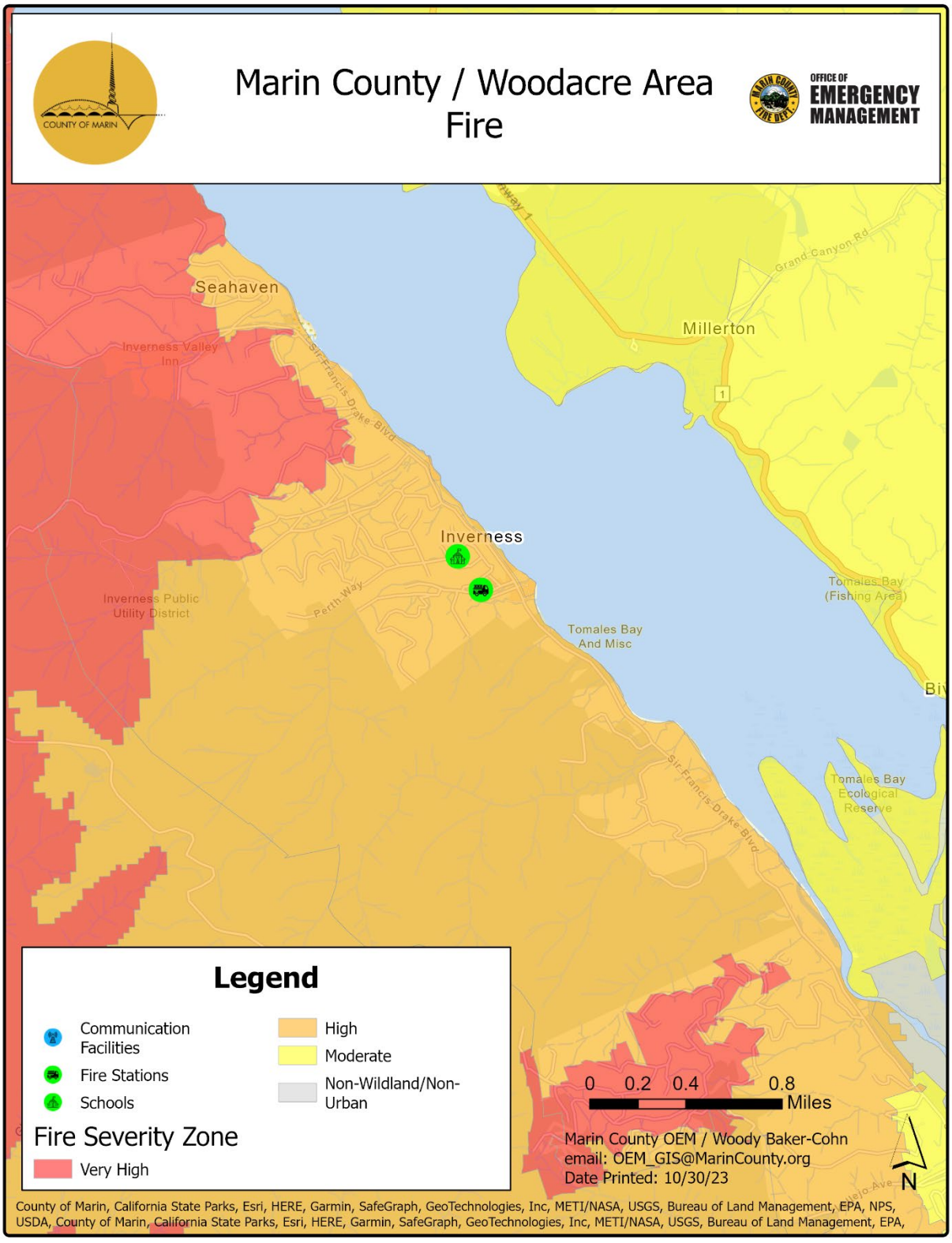


Figure 3.184: Fire Hazard Severity Zones – Inverness Area
Source: CalFire

Figure 3.185 shows the fire hazard severity zone in and around the Marconi/Marshall Area.

Figure 3.185: Fire Hazard Severity Zones – Marconi/Marshall Area
Source: CalFire, 11/27/23

Figure 3.186 shows the fire hazard severity zones in and around the McDonald/Blakes Landing area.

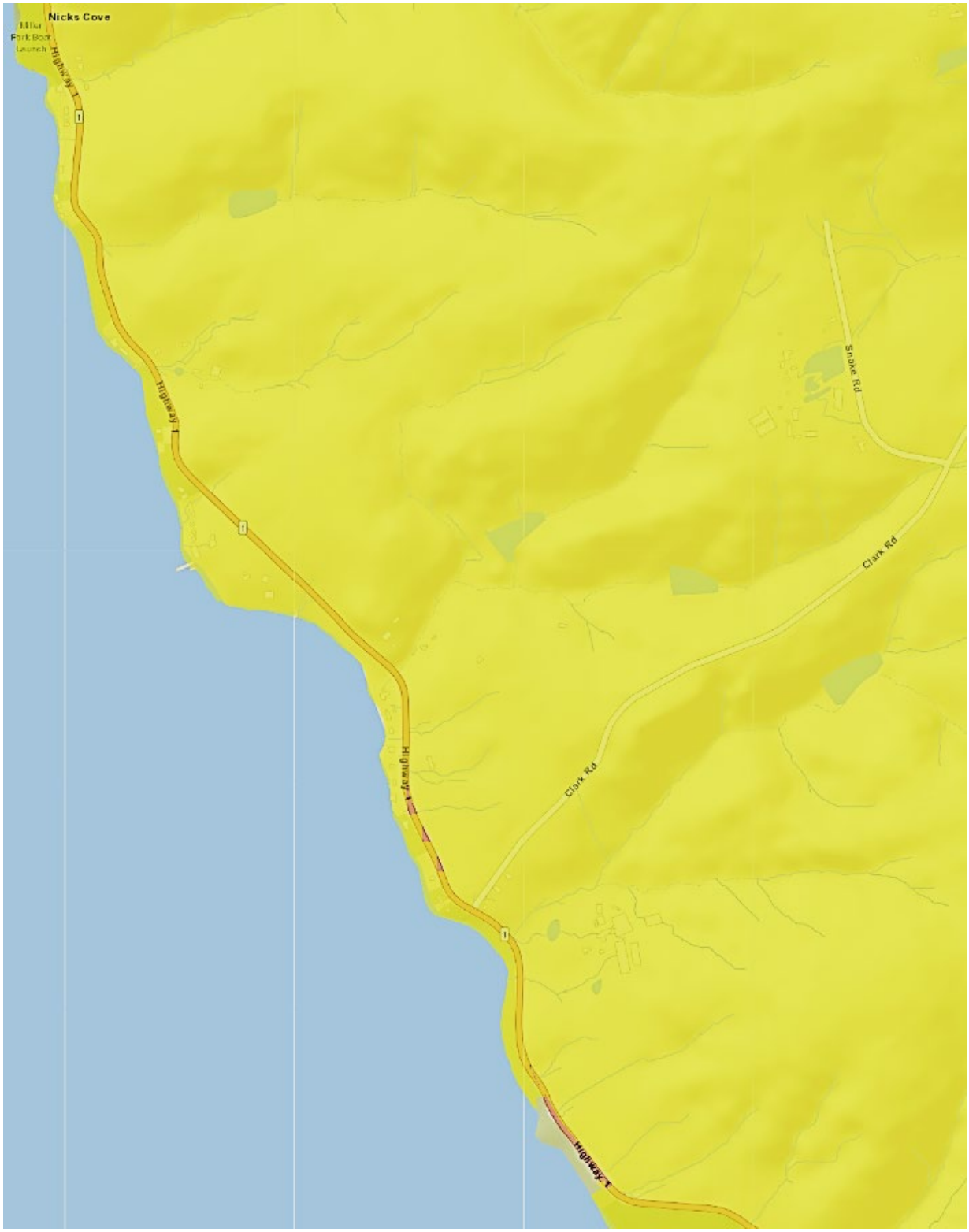


Figure 3.186: Fire Hazard Severity Zones – McDonald/Blakes Landing Area
Source: CalFire, 11/27/23

Figure 3.187 shows the fire hazard severity zone in and around the Tomales area.

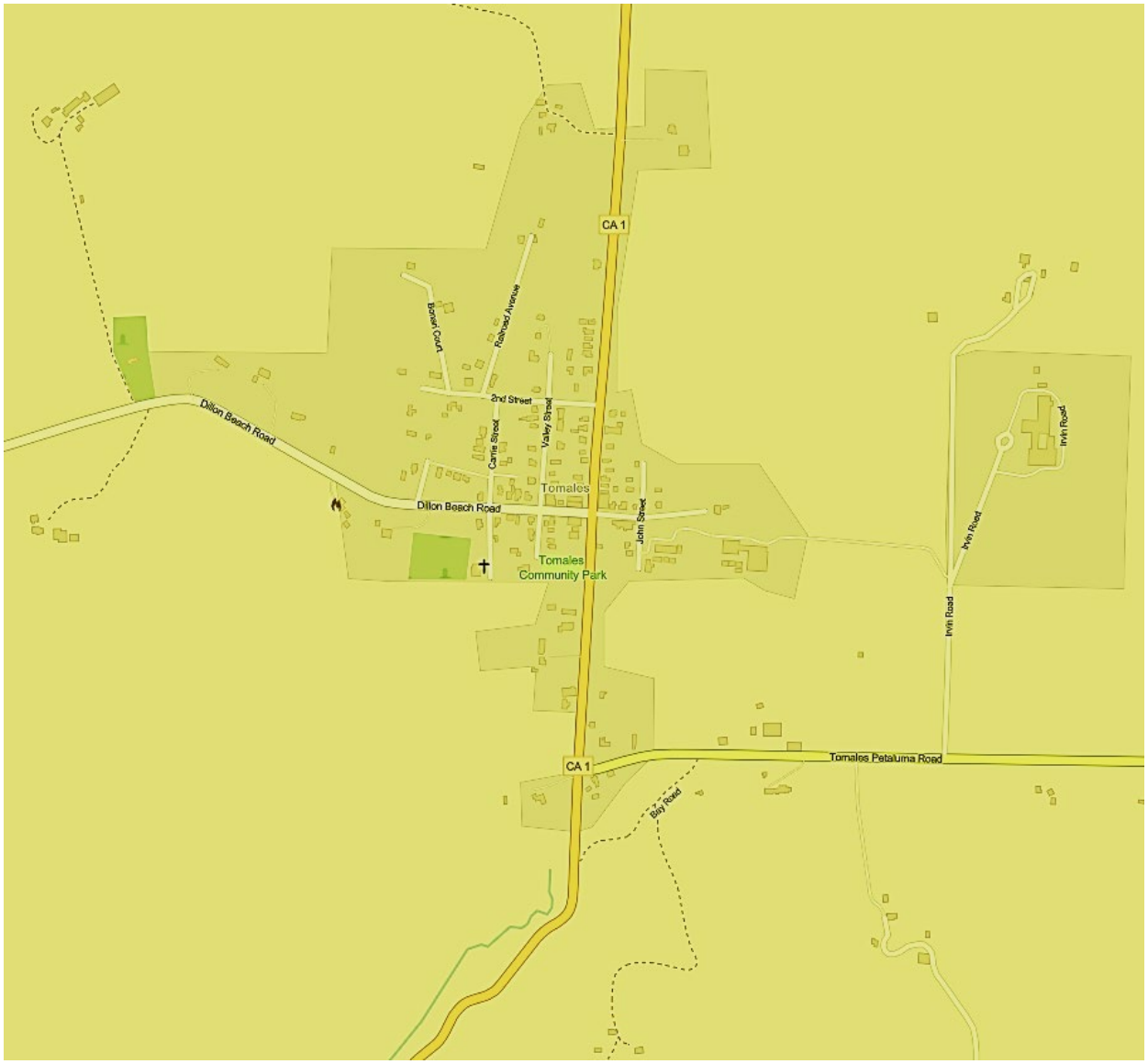


Figure 3.187: Fire Hazard Severity Zones – Tomales
Source: CalFire, 11/27/23

Figure 3.188 shows the fire hazard severity zone in and around the Dillon Beach area.

Figure 3.188: Fire Hazard Severity Zones – Dillon Beach
Source: CalFire, 11/27/23

Figure 3.189 shows the fire hazard severity zones in and around the Dogtown area.

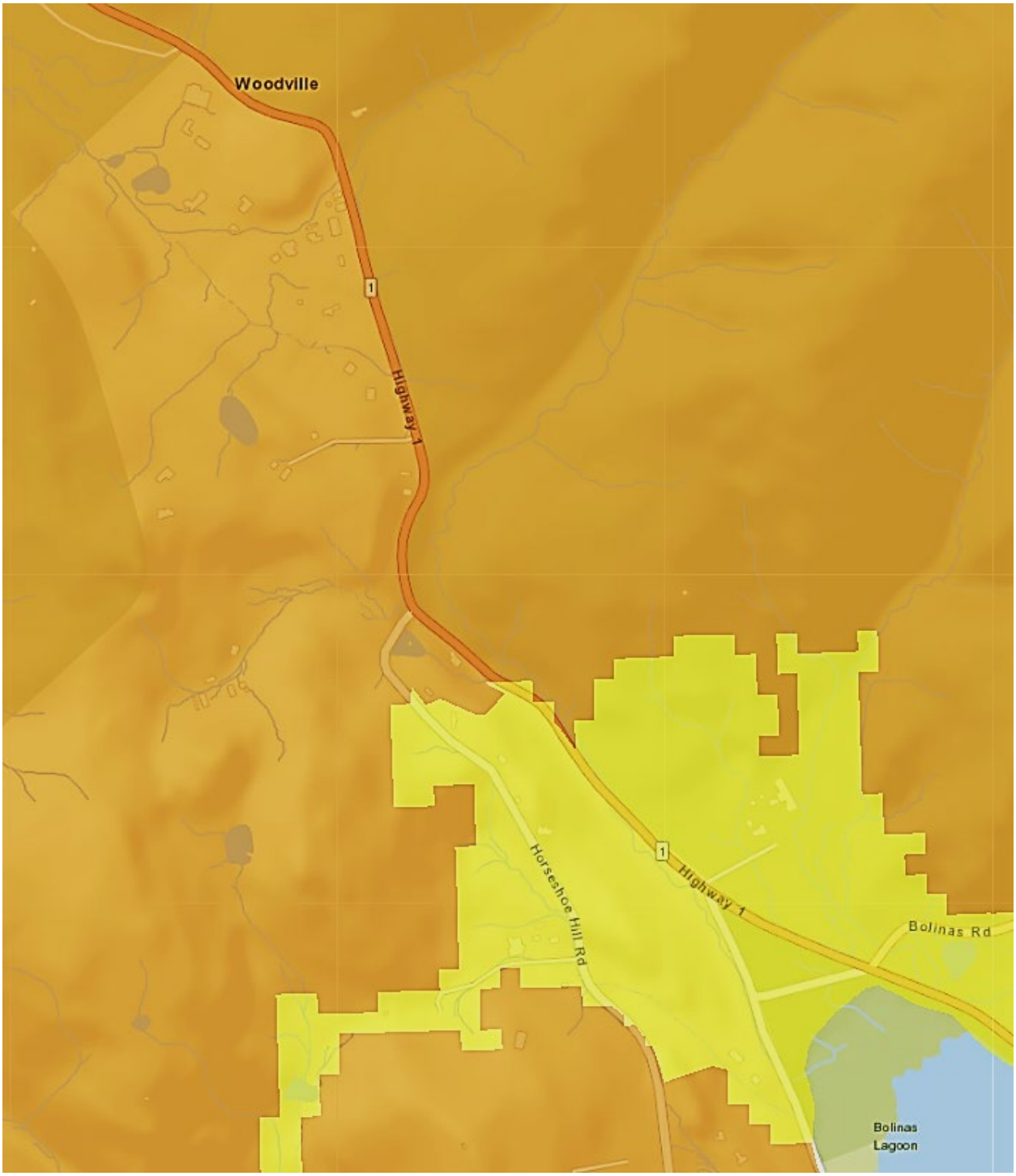


Figure 3.189: Fire Hazard Severity Zones – Dogtown
Source: CalFire, 11/27/23

Figure 3.190 shows the fire hazard severity zones in and around the Bolinas area.

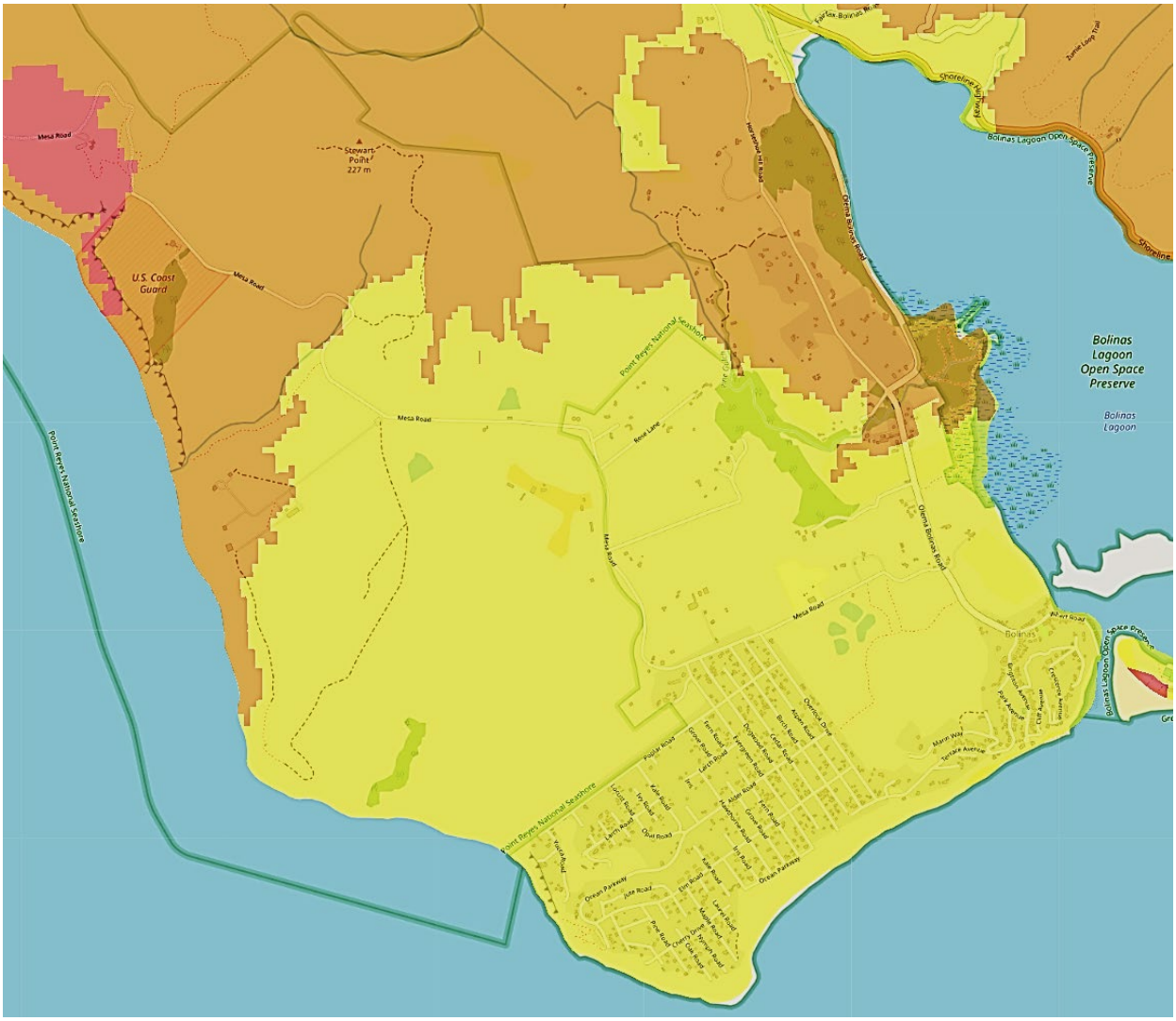


Figure 3.190: Fire Hazard Severity Zones – Bolinas
Source: CalFire, 11/27/23

Figure 3.191 and Figure 3.192 shows the fire hazard severity zone in and around the Stinson Beach area.

Figure 3.191: Fire Hazard Severity Zones – Stinson Beach and Surrounding Area
Source: CalFire, 11/27/23

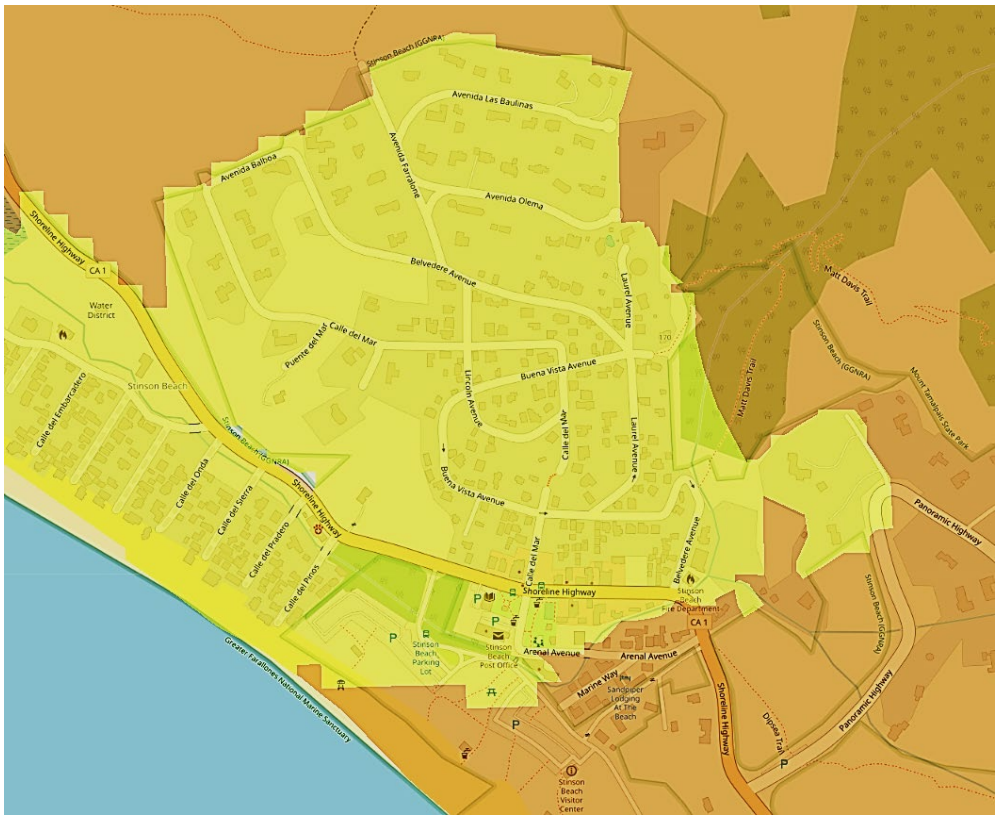


Figure 3.192: Fire Hazard Severity Zones – Stinson Beach
Source: CalFire, 11/27/23

Figure 3.193 shows the fire hazard severity zone in and around the Muir Beach area.

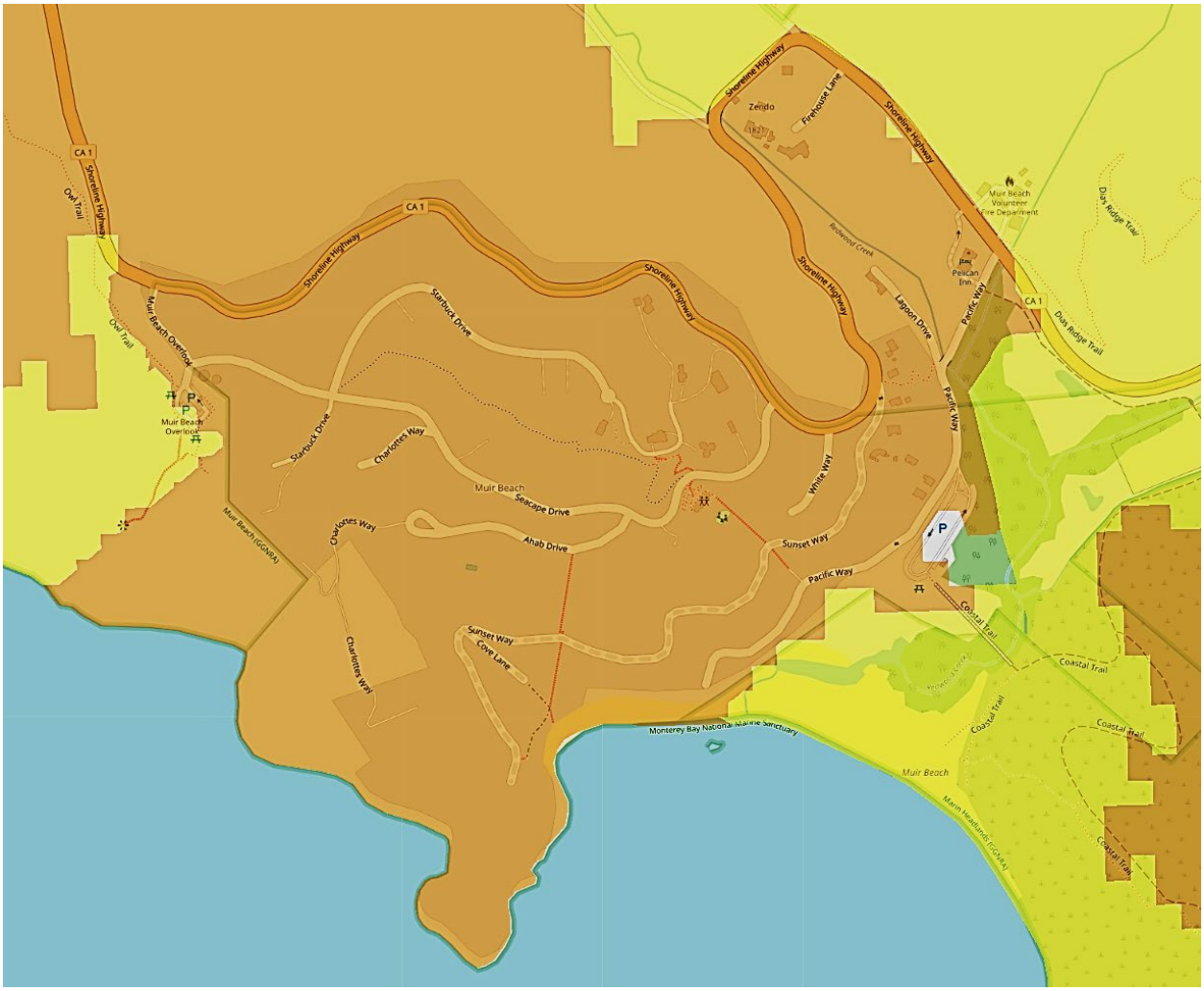


Figure 3.193: Fire Hazard Severity Zones – Muir Beach
Source: CalFire, 11/27/23

Figure 3.194 shows the fire hazard severity zones in and around Tamalpais Valley and Marin City.

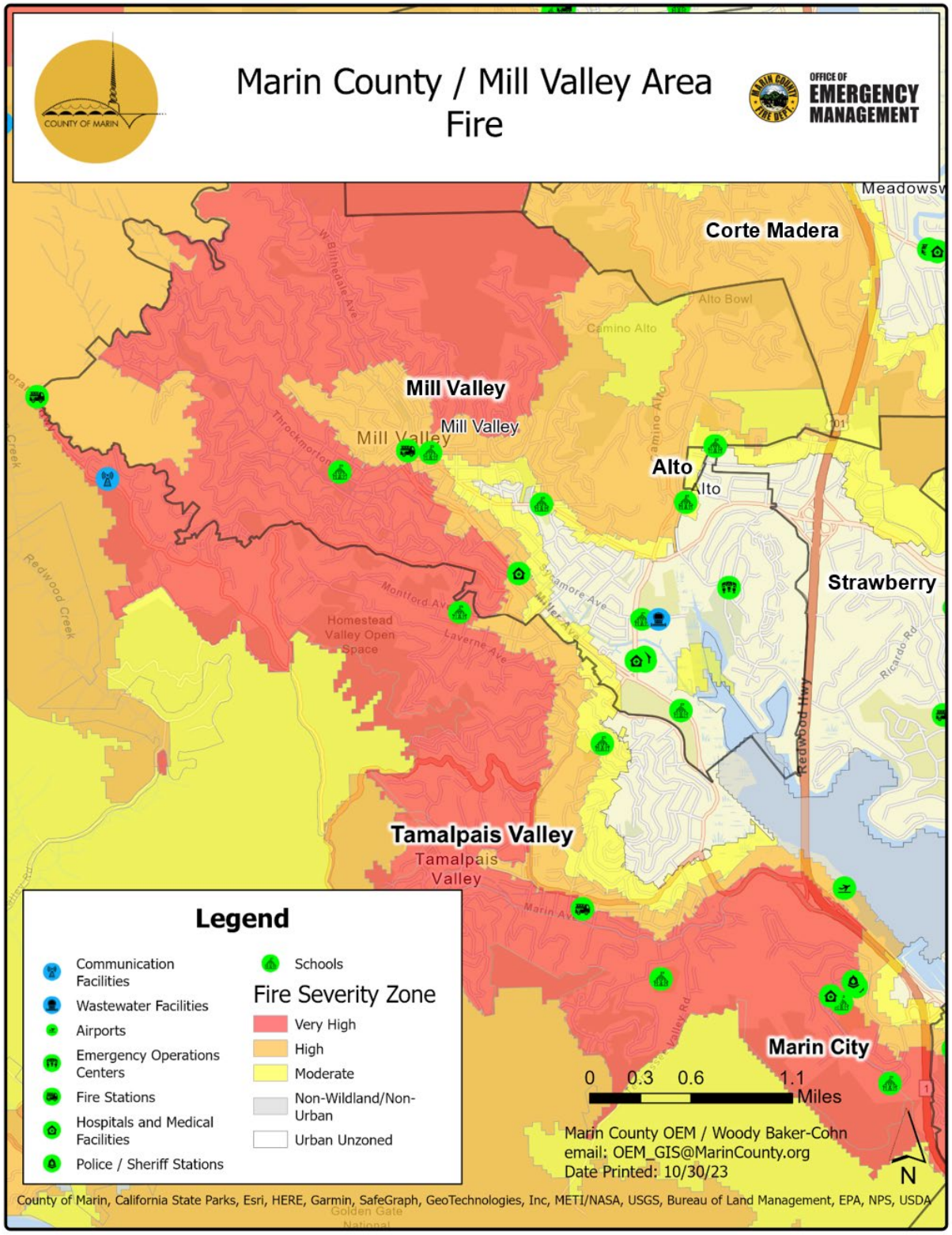


Figure 3.194: Fire Hazard Severity Zones – Tamalpais Valley and Marin City
Source: CalFire

Figure 3.195 shows the fire hazard severity zone in and around the unincorporated area of the Tiburon Peninsula, including Paradise Cay.

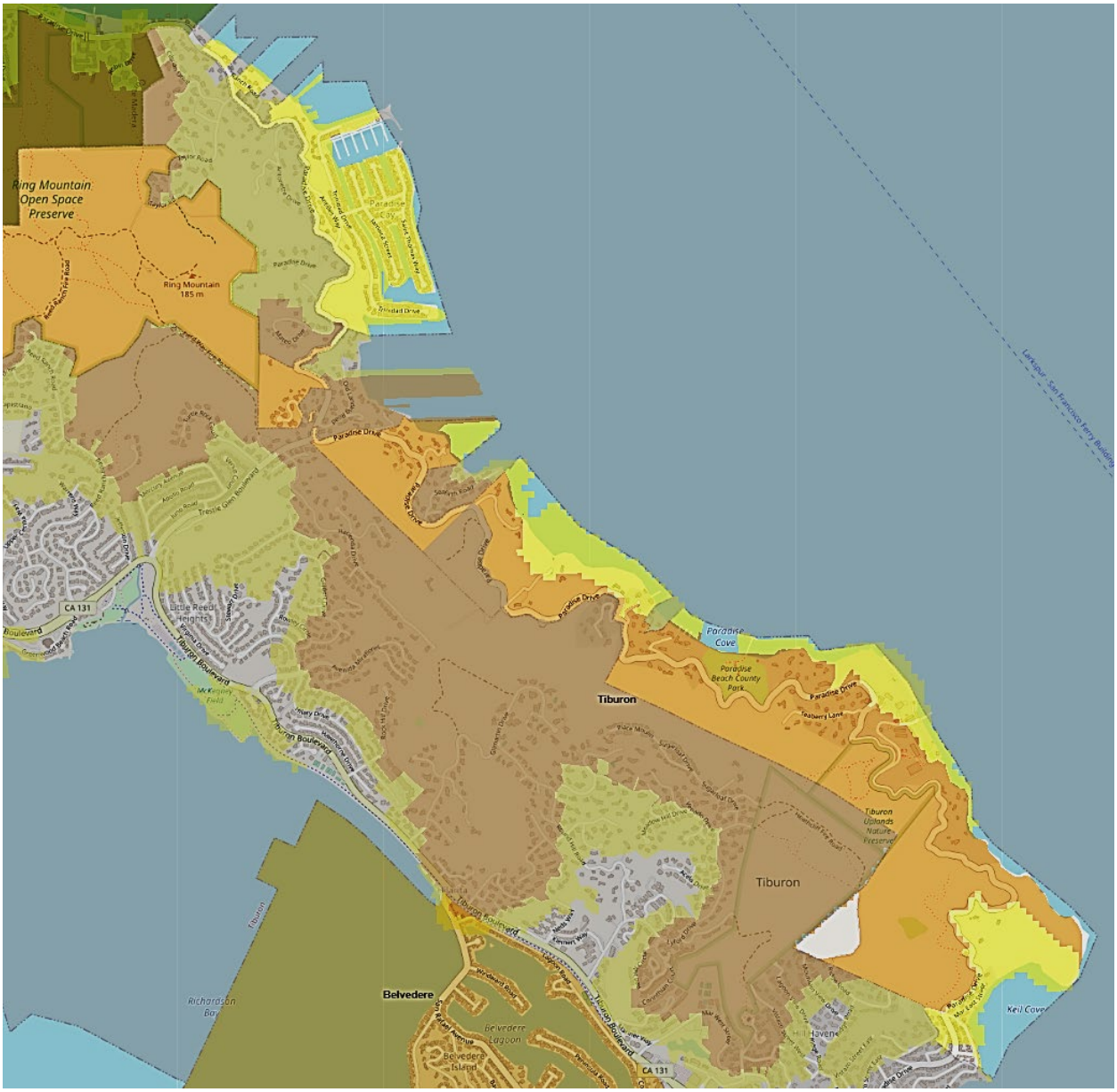


Figure 3.195: Fire Hazard Severity Zone – Unincorporated Tiburon Peninsula and Paradise Cay
Source: CalFire, 11/27/23

Figure 3.196 shows the fire hazard severity zone in and around San Quentin.

Figure 3.196: Fire Hazard Severity Zones – San Quentin
Source: CalFire, 11/27/23

Figure 3.197 shows the fire hazard severity zones in and around Lucas Valley and Marinwood.

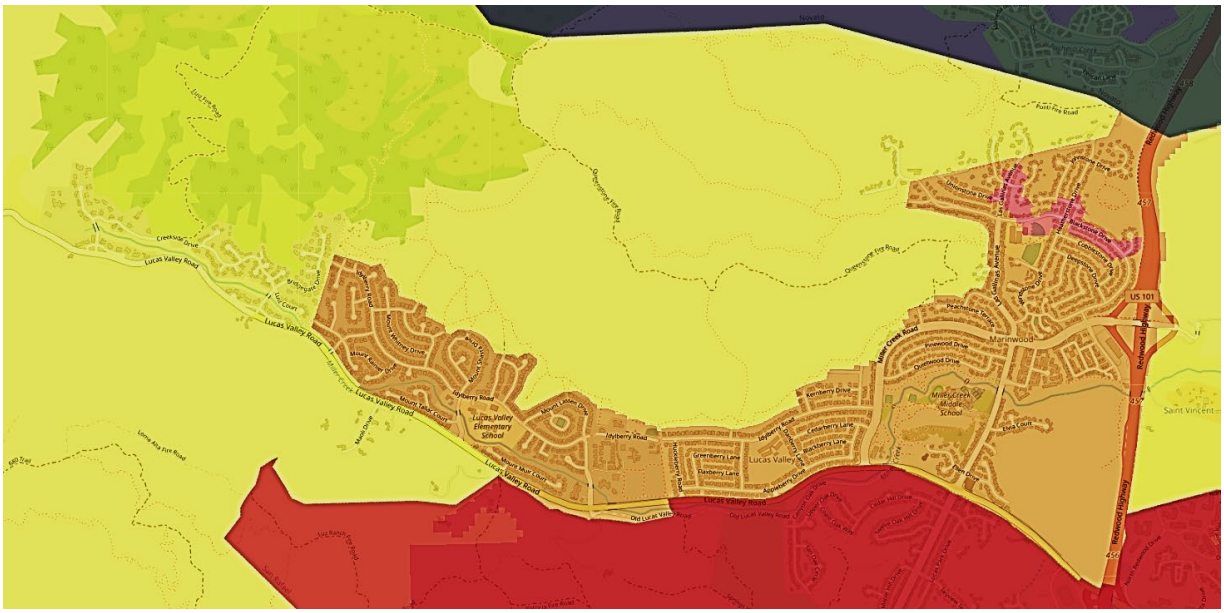


Figure 3.197: Fire Hazard Severity Zones – Lucas Valley and Marinwood
Source: CalFire, 11/27/23

Figure 3.198 shows the fire hazard severity zones in and around the unincorporated area of Bel Marin Keys and Loma Verde.

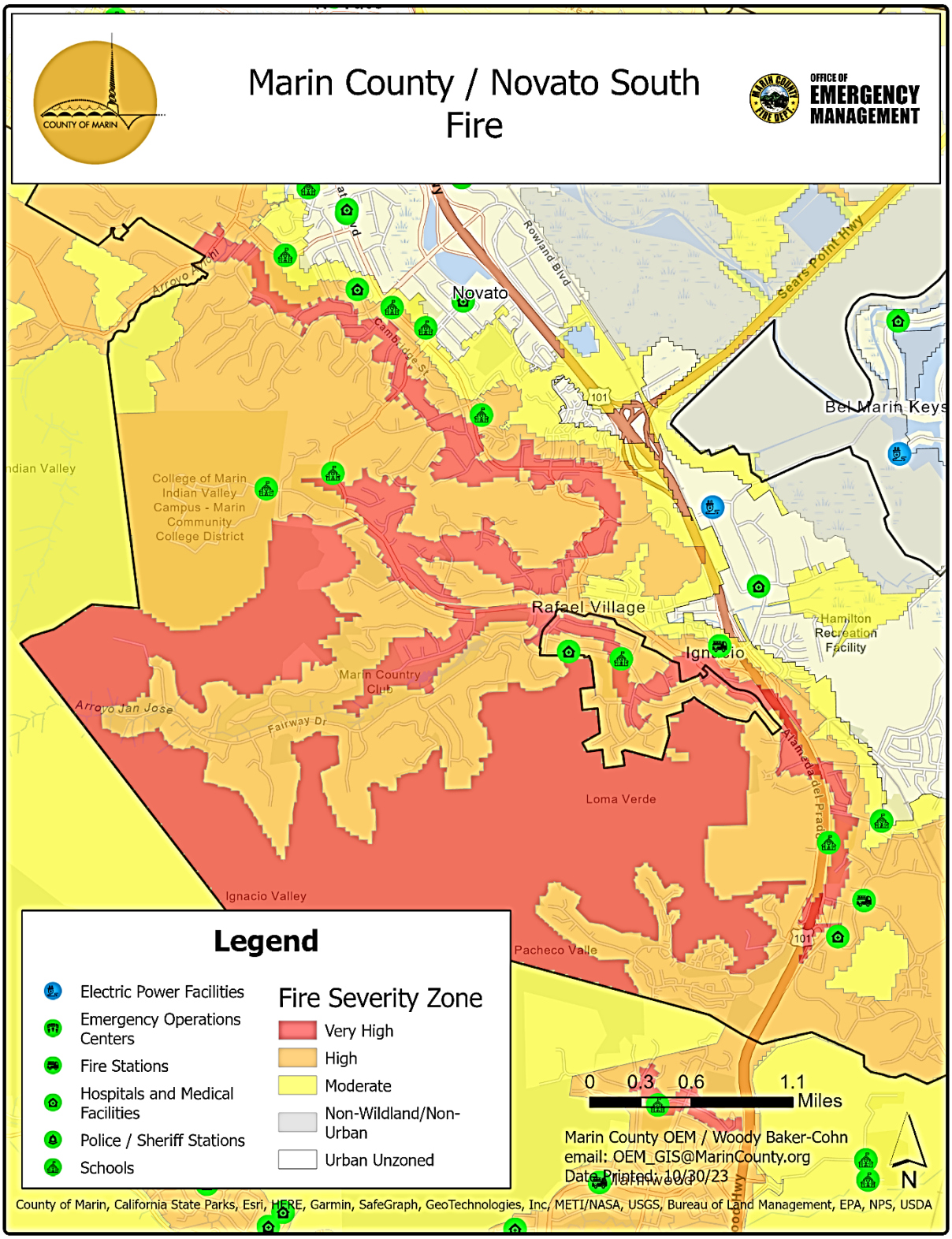


Figure 3.198: Fire Hazard Severity Zone – Bel Marin Keys and Loma Verde
Source: CalFire

Figure 3.199 shows the fire hazard severity zone around San Antonio and the Marin County airport.

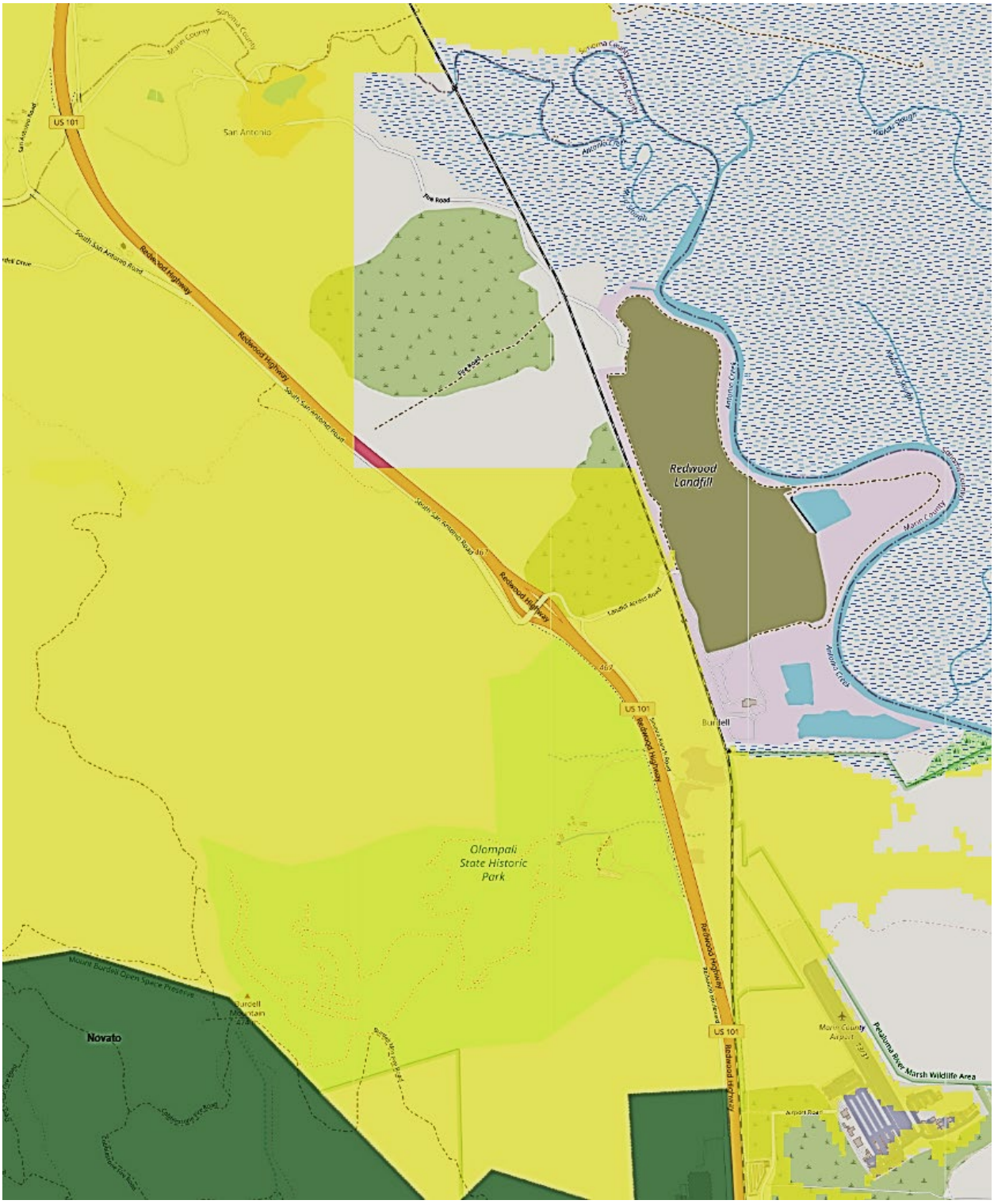


Figure 3.199: Fire Hazard Severity Zone – San Antonio & Marin County Airport
Source: CalFire, 11/27/23

Figure 3.200 shows the number of state and federal declared wildfire disasters in Marin County in relation to the rest of California.

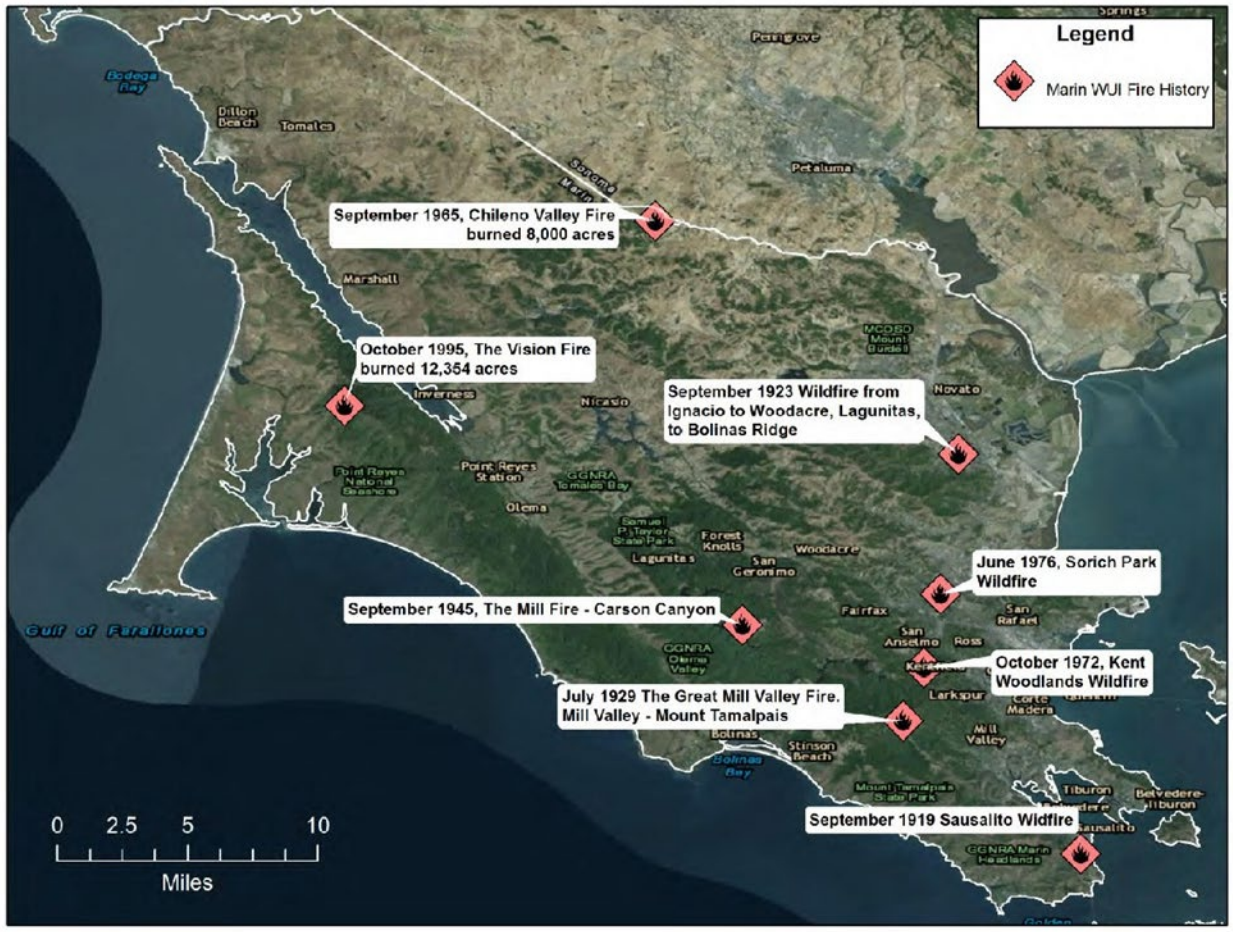


Figure 3.200: Historic Wildfires in the Marin County OA 1919 - 1995
Source: Marin Community Wildfire Protection Plan

Throughout its history, Marin County has experienced many wildland fires. Figure 3.201 shows a map of large fires that have occurred in Marin County's unincorporated WUI.

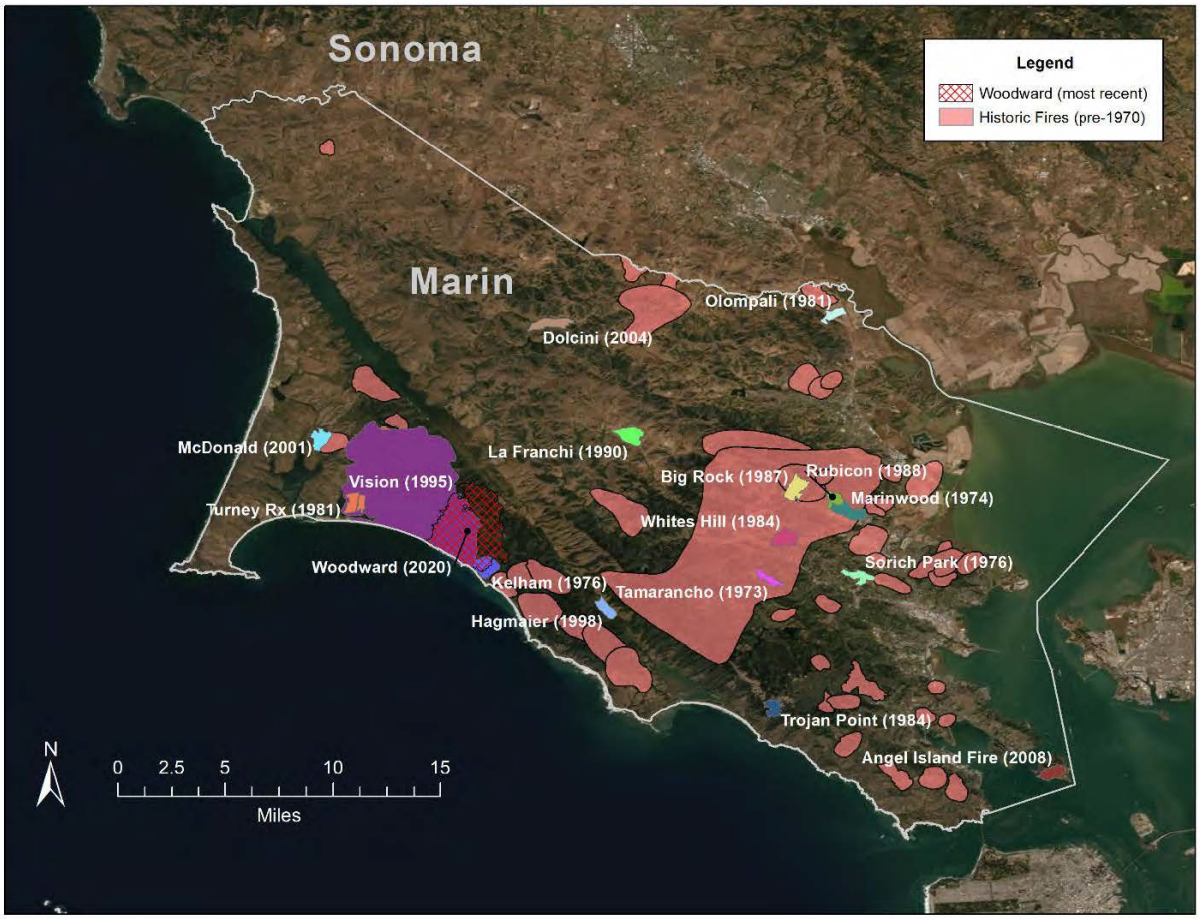


Figure 3.201: Historic Wildfires in the Marin County OA 1973 - 2020
Source: Marin Community Wildfire Protection Plan

9/14/1904 – A wildfire burned 15,000-20,000 acres on Bolinas Ridge.

10/1917 – A wildfire burned 2,000 acres on a ridge near the unincorporated community of Inverness.

7/8/1913 – A wildfire started by a train or a discarded cigarette burned over 1,500 acres on Mount Tamalpais and threatened the City of Mill Valley.

9/17/1923 – September 1923 Wildfire
A wildfire started in the unincorporated community of Ignacio and threatened or destroyed thousands of homes around the unincorporated communities of Ignacio, Woodacre, Lagunitas, and Bolinas Ridge. Thirty-five homes were destroyed in Woodcare, leaving only five left standing. Large areas of timber and grazing land burned. Damage was estimated at $250,000.

9/27/1945 – The Mill Fire
Two brush fires merged together near the unincorporated community of Lagunitas and quickly spread across Bolinas Ridge coming within a quarter mile of the unincorporated community of Stinson Beach. The unincorporated community of Woodacre and the Town of Fairfax were threatened, with over 3,000 residents put on alert for evacuation. Over 18,000 acres burned.

9/1965 – Chileno Valley Fire
Over 8,000 acres burned and several ranches were destroyed in a wildfire.

10/3-10/16/1995 – The Vision Fire
A wildfire started from an illegal campfire burned over 12,000 acres in Point Reyes National Seashore and destroyed 48 structures in the unincorporated community of Inverness.

Figure 3.202: 1995 Vision Fire
Source: Richard Blair

10/13/2008 – Angel Island Fire
A human-caused wildfire burned over 300 acres on Angel Island in Angel Island State Park. No structures were destroyed.

8/27/2019 – Spirit Fire
A wildfire started by arson burned 16 acres above the Sprit Rock Meditation Center near Woodacre.

10/24/2019 – Muir Fire
A 58-acre wildfire burned between the unincorporated communities of Muir Beach and Stinson Beach, closing Highway 1.

8/17/2020 – Woodward Fire
A wildfire burned over 700 acres in a remote area of Point Reyes National Seashore, causing evacuation warnings in the unincorporated community of Olema.

7/14/2021 – Dolcini Fire
A wildfire burned over thirty acres west of Novato.

9/6/2021 – Lucas Valley Wildfire
A wildfire started by a lawn mower burned over 40 acres, prompting evacuations in parts of the unincorporated communities of Lucas Valley and Marinwood.

As part of the CWPP, Ignition data for all authorities having jurisdiction were acquired and analyzed for 2002 through 2011 to evaluate ignition trends within the county.

Impacts

Potential losses from wildfire include human life, structures and other improvements, natural and cultural resources, quality and quantity of water supplies, cropland, timber, and recreational opportunities. Urban wildfires often occur in the WUI, where development has expanded into the rural areas. A wildfire in the WUI can result in major losses of property and structures. Also of significant concern to the planning area are the secondary impacts associated with a large burn area. Wildfires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the County by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. These problems can be compounded by climate conditions.

Although the physical damages and casualties arising from wildland-urban interface fires may be severe, it is important to recognize that they also cause significant economic impacts by resulting in a loss of function of buildings and infrastructure. In some cases, the economic impact of this loss of services may be comparable to the economic impact of physical damages or, in some cases, even greater. Economic impacts of loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Threats to healthcare, hazmat releases, ash deposition on properties (including schools), need for proper cleanup, and high costs of hazardous waste cleanup. Both environmental and economic losses occur from contamination of properties which grow produce, both for personal sustenance and commercial distribution. Wildfires and subsequent smoke can have a negative impact on tourism and visitor use in the County. Wildfires can also cause major damage to power plants and power lines needed to distribute electricity to operate facilities.

Urban structural fires release toxic pollutants into air and water, cause injuries and deaths, mental/behavioral health issues, economic loss consequences of loss/damage to residences or places of business, displacement, cleanup costs to communities and governments, potential increased healthcare utilization due to injuries or chronic disease exacerbations, long term public health impacts including injuries to the response personnel.

There is also a mitigation opportunity. Even though smoke detectors are required in CA, there is no data on how many residential units in CA do not have a smoke detector, whether they have functioning smoke detectors, and whether residents are aware where to place them and how to maintain them. Conducting a rapid community assessment using established methods is one way to gather this information, which could be considered a mitigation action.

Poor air quality can result from wildfires. Sensitive individuals including the very young, elderly and those with respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD) are at the greatest risk of developing aggravated symptoms such as coughing, watery and itchy eyes, headache, scratchy throat, and difficulty in breathing.

PSPS events can have numerous impacts on residents who rely on electricity for cooling their homes, powering water pumps, keeping critical medical equipment operating, and who have other critical needs. These impacts can become exacerbated during a period of higher temperatures, when community members are unable to cool their homes. PSPS events sometimes occur with little to no warning, and with no clear timeframe on how long the event may last, which presents a challenging situation for community members to be able to prepare for prolonged power outages.

Extent and Probability

Wildfire threat can be defined as the result of an analysis of potential fire behavior and the likelihood of fire to occur relative to the assets (or communities) at risk. Recent research indicates that higher summer temperatures will likely increase fire severity in California. Future changes in fire frequency and severity are difficult to predict; however, regional climate change associated with elevated greenhouse gas concentrations could alter large weather patterns and produce conditions conducive to extreme fire behavior. A warmer climate will bring drier winters and higher spring temperatures. Combined with drought conditions, this leads to drier soils in early summer, drier vegetation, and an increase in the number of days in the year with flammable fuels, all which further raise the likelihood of fires.

The western U.S. is likely to continue its trend toward warmer and drier conditions, on average, with warmer spring and summer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons. Models and observations, including reconstructions of fire and climate in the past; trends over the last few decades; and predictive models, predict that warming and drying conditions are likely to cause increased fire activity in the future.

Table 3.20: Marin County OA Hazard Risk Assessment – Wildfire

Jurisdiction	Probability/ Likelihood of Future Events	Geographic Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Marin County	Highly Likely	Significant	Severe	High	High	**16.00**
City of Belvedere	Highly Likely	Limited	Extreme	Medium	High	**15.00**
Town of Corte Madera	Occasional	Significant	Extreme	High	High	**15.00**
Town of Fairfax	Highly Likely	Significant	Severe	Medium	Medium	**14.00**
City of Larkspur	Likely	Significant	Extreme	High	High	**16.00**
City of Mill Valley	Likely	Extensive	Severe	High	High	**16.00**
City of Novato	Likely	Limited	Weak	Medium	Medium	**10.00**
Town of Ross	Likely	Extensive	Severe	Medium	High	**15.00**
Town of San Anselmo	Likely	Extensive	Extreme	High	High	**17.00**
City of San Rafael	Likely	Significant	Severe	High	Medium	**14.00**
City of Sausalito	Occasional	Limited	Moderate	High	Medium	**11.00**
Town of Tiburon	Highly Likely	Significant	Severe	High	High	**16.00**

Bolinas Public Utility District	Occasional	Extensive	Severe	High	Medium	**14.00**
Las Gallinas Valley Sanitary District	Likely	Negligible	Moderate	Medium	Medium	**10.00**
North Marin Water District	Occasional	Extensive	Extreme	Medium	High	**15.00**
Southern Marin Fire District	Occasional	Extensive	Severe	High	Medium	**15.00**

Table 3.20: Marin County OA Hazard Risk Assessment – Wildfire
Source: Profiled Jurisdictions and Districts

Vulnerability

While the Cal Fire FHSZ maps are useful in examining potential fire hazard severity at the state level, the underlying data and methods used to develop the FHSZ maps can be improved upon by using local (and more recent) fuel characteristics and improved fire modeling methods. The Cal Fire FHSZ maps also do not take into account local perspectives and priorities regarding communities at risk and areas of concern.

To improve upon the currently available state-level fire hazard assessment information, an independent hazard, asset, risk assessment was performed to help identify and prioritize areas within the county that are potentially at a high threat from wildfire based on more recent fuels data, advanced modeling techniques, and local input. The assessment was performed by modeling potential fire behavior and the probability or likelihood that an area will burn given an ignition. Next, the fire modeling output was combined with areas of concern and assets at risk. Composite maps were generated indicating relative potential fire hazards throughout the county.

Assets at risk are defined as structures and resources that can be damaged or destroyed by wildland fire. Assets in the Marin County OA include real estate (homes and businesses), all types of healthcare facilities, emergency communication facilities, transportation and utility infrastructure, watersheds, protected wildlands, tourist and recreation areas, and agricultural lands. In addition to providing a framework for protecting community members and providing for firefighter safety, the California Fire Plan identifies the following assets warranting consideration in pre-fire planning: watersheds and water; wildlife; habitat; special status plants and animals; scenic, cultural and historic areas; recreation; rangeland; structures; infrastructure; and air quality.

There are approximately 111,000 living units in the Marin County OA with a median home value of approximately $1 million. As many homes in the county are located in the WUI, if a major wildland fire were to result in the loss of many homes, it could have a short-term negative impact on the Marin County OA's property tax base.

The Mt. Tamalpais watershed supplies central and southern Marin County with 75% of their fresh water. Given the area's seasonal rainfall, any major wildfire impacting the heavily forested watershed will result in major silting and subsequent degradation of water quantity and quality in

the watershed. These watershed lands—as well as the lands managed by Marin County Open Space District (MCOSD), state parks, and NPS—are largely contiguous. They harbor several endangered, threatened, and special-status species, including the coho salmon and northern spotted owl.

The area is also part of a major migrating bird flyway and nesting area. The Marin County OA is also a major tourist destination. Major parks within Marin County include California State Parks (Mt. Tamalpais, Samuel P. Taylor, and China Camp), NPS's Golden Gate National Recreation Area (GGNRA), Muir Woods National Monument, and Point Reyes National Seashore. The Point Reyes National Seashore and Muir Woods National Monument together attract 3.5 million visitors annually. The GGNRA, a majority of which resides within Marin County, attracts an additional 14.9 million visitors per year and contributes an estimated $365.2 million annually to the economy. A major wildfire affecting any of these parks could have negative impacts on the local economy for years after the event.

The Marin County OA's agricultural land base includes nearly 137,000 acres of privately owned agriculturally zoned land and 32,000 acres of federally-owned land that is leased to agricultural operators. Agricultural operations include livestock and livestock products; aquaculture; field crops; fruit, vegetable, and nursery crops. The gross value of all agricultural production was approximately $101 million in 2014. To help protect people and property from potential catastrophic wildfire, the National Fire Plan identifies communities that are at high risk of damage from wildfire. These high-risk communities identified within the WUI were published in the Federal Register in 2001. In California, CAL FIRE has the responsibility for managing the list. With California's extensive WUI situation, the list of communities extends beyond just those adjacent to Federal lands; there are 1,329 communities currently on the California Communities at Risk List. The Marin County OA has 23 of these at-risk communities. A countywide assessment of the wildland fire threat undertaken by CAL FIRE revealed that nearly 313,000 acres (approximately 82% of the total land area of the county) are ranked as having moderate to very high fire hazard severity zone ratings.

Using the methodology described in the CWPP, a series of models of the hazards, assets, and risks were completed. One model was the average fire season flame length, with lengths above 8 feet possibly exhibiting the more extreme fire behavior and be relatively more hazardous from a fire suppression perspective. Rate of spread is defined as the rate of forward spread of the fire head expressed in feet per minute. The higher the rate of spread, the more difficult a fire is to suppress. A composite map of the flame length, rate of spread, and population density for the average fire season scenario is shown in Figure 3.203; orange and red show areas where more extreme fire behavior is likely given an ignition.

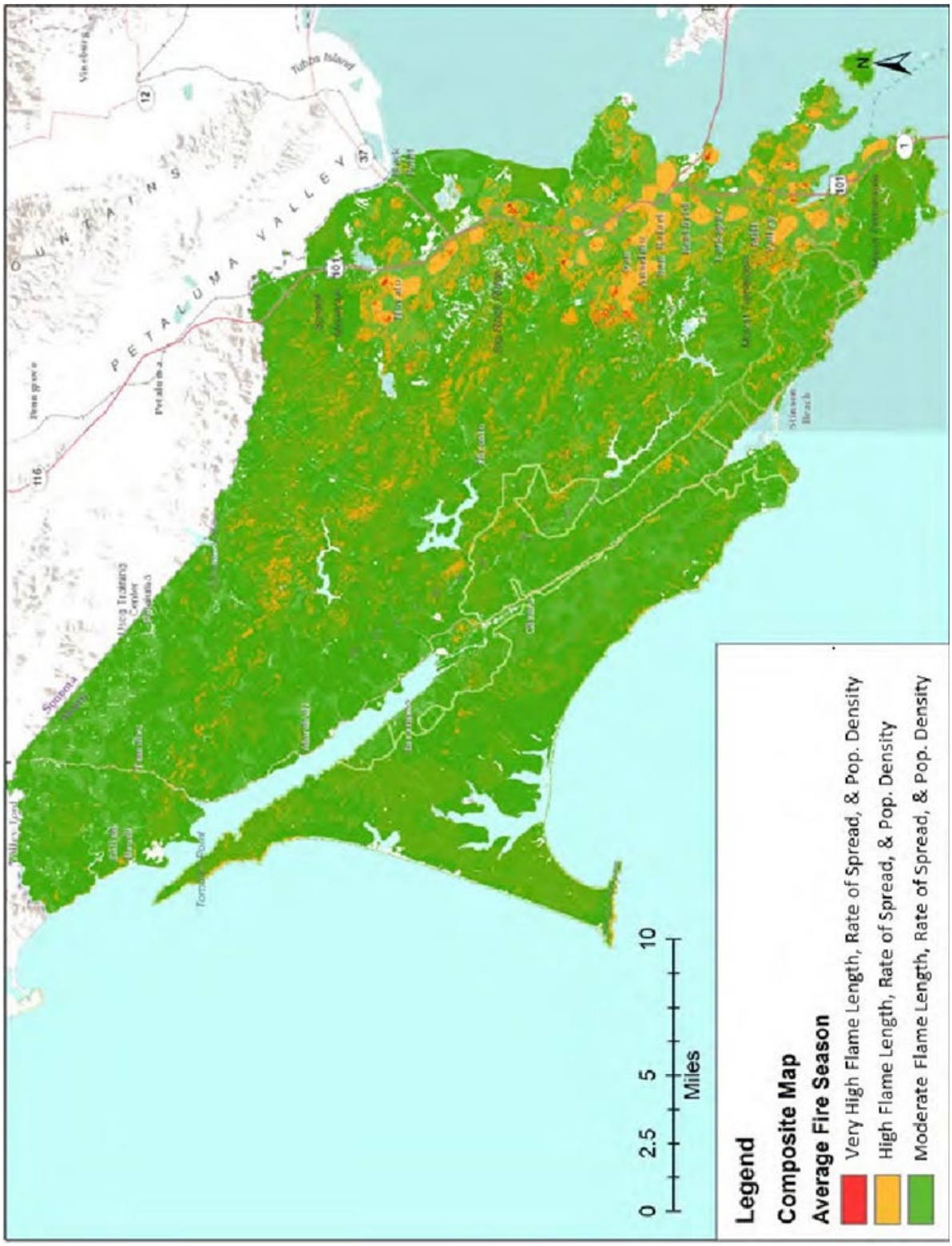


Figure 3.203: Population Density, Flame Length, and Rate of Spread for the Average Fire Season in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Figure 3.204 shows areas of concern for the average fire season in the OA where fuel reduction and hazard mitigation efforts might be focused.

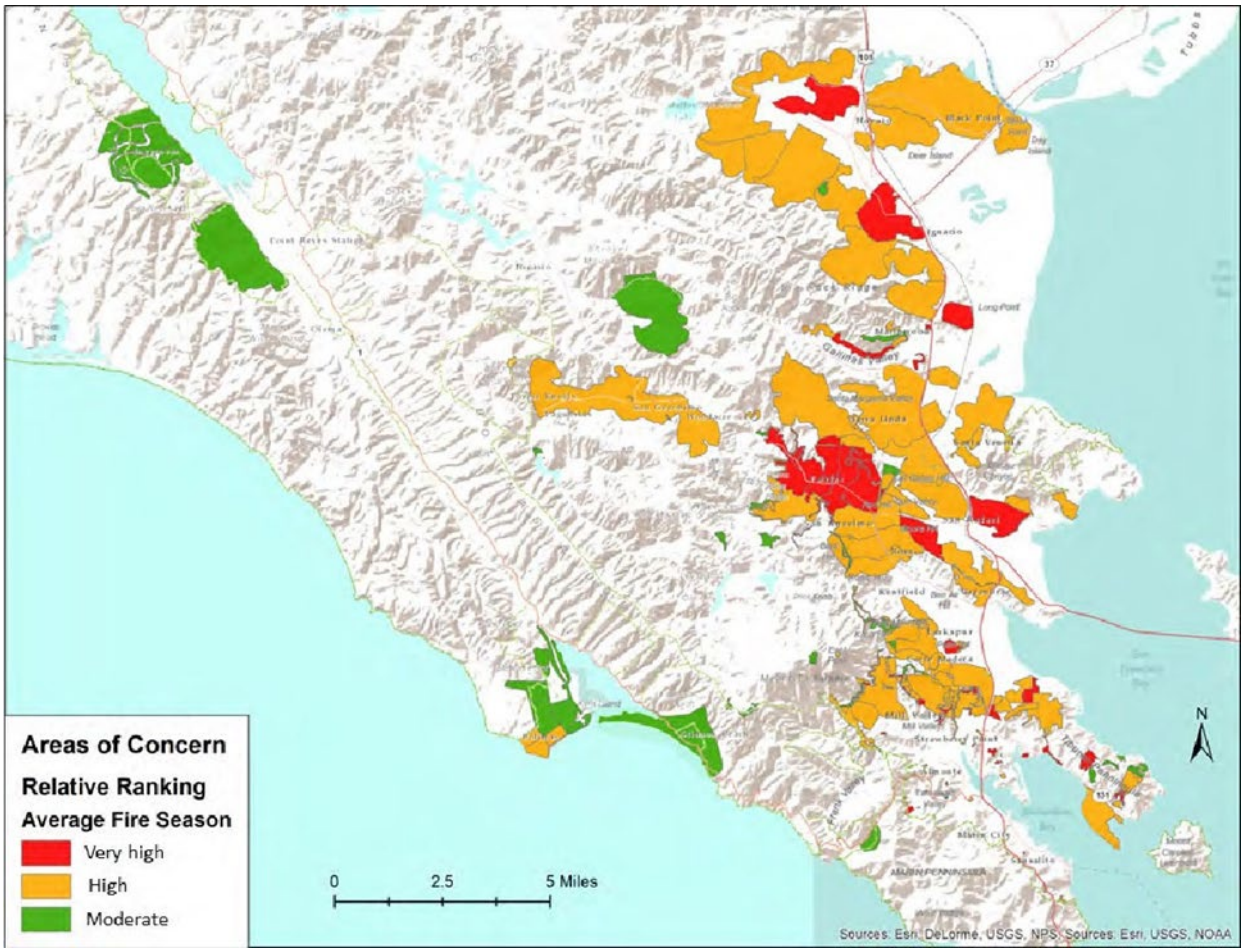


Figure 3.204: Areas of Concern for the Average Fire Season in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Figure 3.205 shows areas of concern for the average fire season in the OA where fuel reduction and hazard mitigation efforts might be focused.

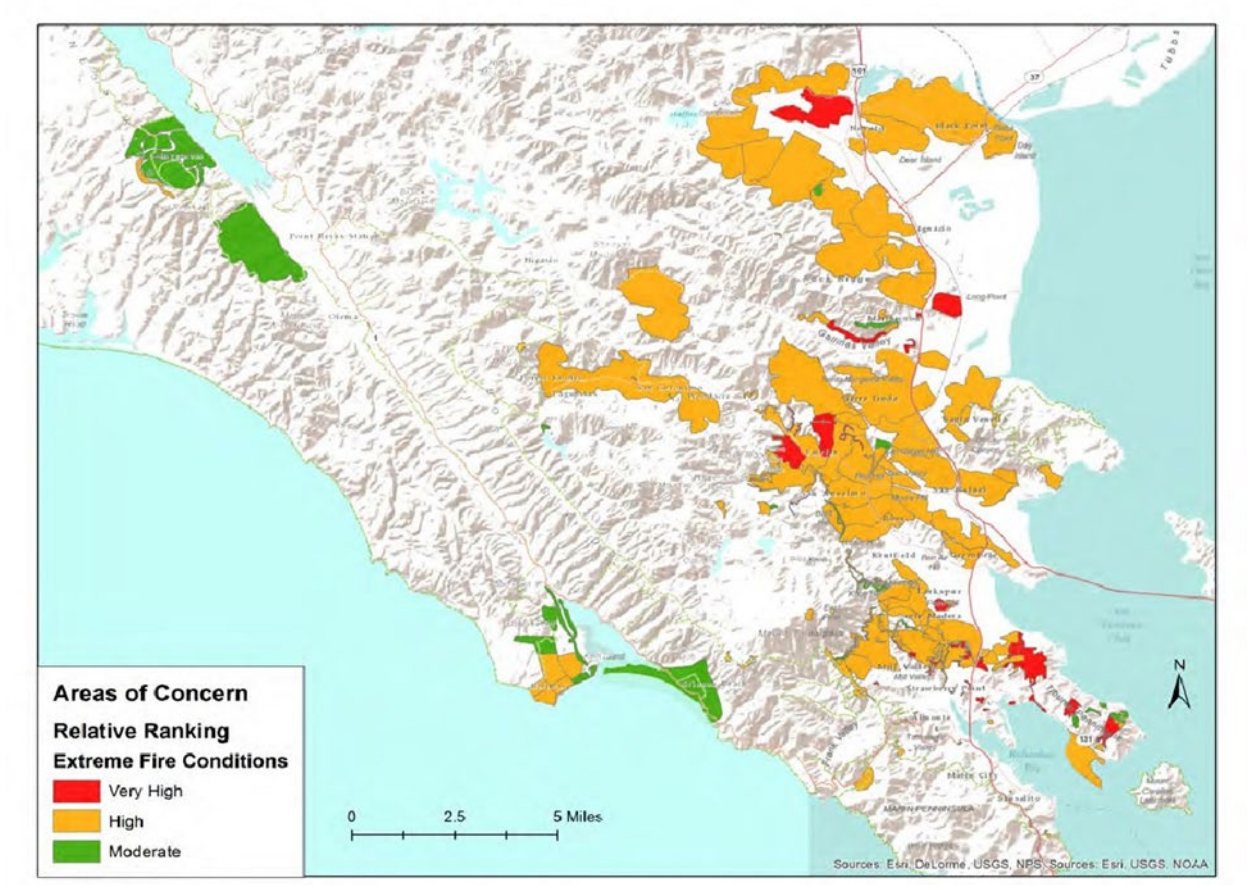


Figure 3.205: Areas of Concern for the Extreme Fire Season in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

Unincorporated rural areas within the OA include the coastal communities of Muir Beach, Stinson Beach, and Bolinas; communities near Tomales Bay including Olema, Point Reyes Station, Inverness, Inverness Park, Marshall, Tomales, and Dillon Beach; and rural areas in the interior valleys including Nicasio, Lagunitas, Forest Knolls, San Geronimo, and Woodacre.

These communities are primarily situated within or adjacent to the WUI, with moderate to dense concentrations of structures. The Marin County OA has approximately 60,000 acres of WUI adjacent to 200,000 acres of watershed. Response times in these communities present significant challenges to keeping fires from directly impacting the communities and sub divisions (especially those within the SRA) as emergency fire access and evacuation egress is limited by narrow, winding roads lined with dense vegetation. Figure 3.206 shows the WUI boundary and population density in the OA.

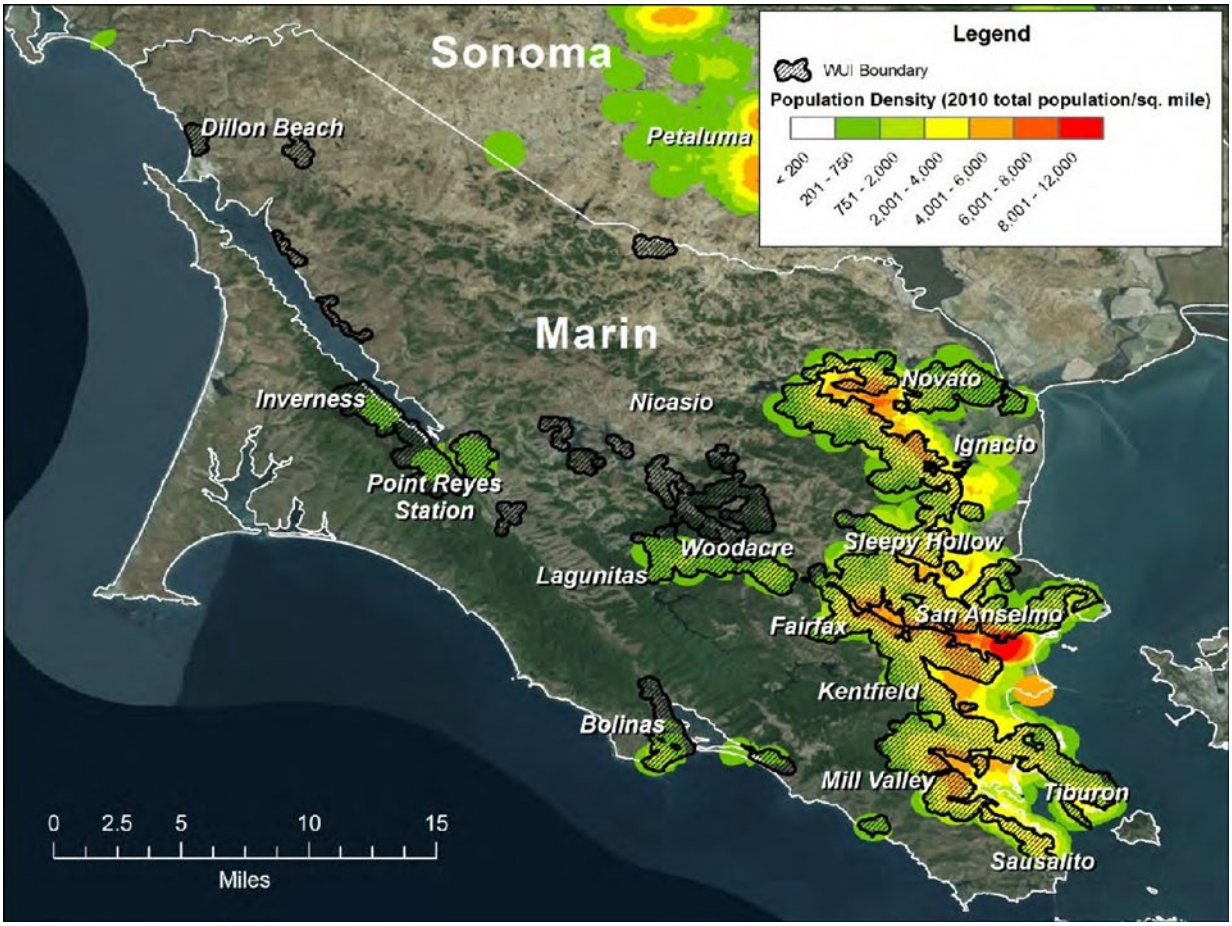


Figure 3.206: WUI Boundary and Population Density in the Marin County OA
Source: Marin Community Wildfire Protection Plan, 2020

In the Marin County OA, cul-de-sacs generally service new housing developments and most of the smaller canyons, valleys, and hillsides. Some planned unit developments are served by privately- maintained roads, which create access issues (i.e., narrow paved widths and limited on-street parking). According to California Fire Code specifications, roadways that are considered hazardous in terms of fire access and protection are those with

- less than 20 feet of unobstructed paved surface and 13.6 vertical feet;
- dead-ends longer than 800 feet, and;
- cul-de-sac diameter less than 68 feet.

Driveways that are less than 16 feet wide or that do not have adequate turnaround space are also considered hazardous. A large number of roadways and driveways in many of the Marin County OA's communities fall into one or more of the above categories.

Several communities in the Marin County OA lie partially or completely in a High and/or Very High FHSZ and could have a higher susceptibility to wildfire. They are highlighted below.

While most of Lagunitas, Forest Knolls San Geronimo and Woodacre lie in a Moderate FHSZ, the surrounding foothills lie in a High FHSZ. There are hundreds of homes in the High FHSZ along with the Woodacre PG&E substation that could have higher susceptible to wildfire. There are hundreds of homes and numerous businesses and critical facilities including the San

Geronimo Community Center, San Geronimo Valley Elementary School, Lagunitas Elementary School, the Woodacre Fire Station and the Heartwood Charter School that lie in the Moderate FHSZ and could be susceptible to wildlife.

The area west and north of Inverness Park primarily lies in a High FHSZ. There are dozens of homes in this area that could have higher susceptibility to wildfire. There is a residential area north of Inverness Park with several dozen homes that lie in a Very High FHSZ and could have an even higher susceptibility to wildfire. Most of the core of Inverness lies in a High FHSZ but the outlying areas north lie in a Very High FHSZ. There are dozens of homes in both these areas that could have higher susceptibility to wildfire. The Inverness Fire Department, Inverness Elementary School and a Marin Emergency Radio Authority (MERA) antenna site lie in a High FHSZ area and could have higher susceptibility to wildfire. Populations from Inverness to Inverness Park are particularly susceptible to wildfire as there is essentially only one main road, Sir Francis Drake Boulevard, that could be used in an evacuation and in only one direction (south).

Most of Dogtown and the northern end of Bolinas lie in a High FHSZ. Several residences, the Bolinas PG&E substation and the Bolinas-Stinson Elementary School lie in this area and could have higher susceptibility to wildfire. Most of Bolinas, where there are dozens of homes, the Bolinas Community Center, the Bolinas Stinson School, the MERA antenna sites at Horseshoe Hill and Bolinas, the Bolinas Community Health Center and the Woodrat Water Treatment Plant lie in a Moderate FHSZ and could be susceptible to wildfire.

While most of Stinson Beach is in a Moderate FHSZ, the surrounding area to the south is in a High FHSZ. Several residences and businesses are in this area and could have higher susceptibility to wildfire. The downtown core of Stinson Beach along with the Stinson Beach Fire Department Stations #1 and #2 lie in a Moderate FHSZ just outside of the High FHSZ and could be susceptible to wildfire. The western end of Stinson Beach along Dipsea Road and Seadrift Road also lies in a Moderate FHSZ and includes dozens of homes that could be susceptible to wildfire.

Most of Muir Beach lies in a High FHSZ. This area includes dozens of homes, several businesses and the Muir Beach Community Center that have higher susceptibility to wildfire. The Muir Beach Fire Department lies just outside the High FHSZ in a Moderate FHSZ and could be susceptible to wildfire.

Most of Tamalpais Valley and Marin City lie in a Very High FHSZ. There are thousands of homes and buildings in this area of Tamalpais Valley, along with a MERA antenna site, the Marin Horizon School, the Southern Marin Fire Protection District Station #4 and the Tamalpais Valley Elementary School that could have a very high susceptibility to wildfire. Populations in this area are particularly susceptible to wildfire due to the presence of numerous cul de sacs and windy secondary roads that could impede an evacuation. Numerous homes and critical facilities, including the Marin City Health and Wellness Center, the Bayside Martin Luther King Jr. Academy, and the Marin City Fire department lie in the Very High FHSZ of Marin City and could have a very high susceptibility to wildfire. The Very High FHSZ in Tamalpais Valley and Marin City is bordered to the east by a High FHSZ. Hundreds of homes and numerous businesses along with the Commodore Center Heliport lie in the High FHSZ and could have higher susceptibility to wildfire. The Mount Tamalpais School lies in the Moderate FHSZ and could be susceptible to wildfire.

A small area in the north of Strawberry lies in a High FHSZ with a larger area that lies in a moderate FHSZ. There are several homes in this area that could have higher susceptibility to wildfire.

Most of the unincorporated area of the Tiburon Peninsula lie in a High FHSZ. There are dozens of homes in this area that could have higher susceptibility to wildfire. The eastern boundary of the peninsula lies in a Moderate FHSZ and has several homes that could be susceptible to wildfire.

The far northern and western side of Kentfield lie in a High FHSZ and are bordered to the immediate west by a Very High FHSZ. There are dozens of homes, numerous businesses, the Kentfield Hospital and part of the College of Marin that lie in this area and that have higher susceptibility to wildfire. A smaller part of Kentfield and part of Greenbrae and California City lie in a Moderate FHSZ. There are several homes along with part of the College of Marin that lie in this area and that could be susceptible to wildfire. All of San Quentin, including San Quentin State Prison, lies in a Moderate FHSZ and could be susceptible to wildfire.

While all of Sleepy Hollow lies in a Moderate FHSZ, it is bordered to the east, west, and south by areas of a High FHSZ. Dozens of homes along with the San Domenico School, Sleepy Hollow Villa Medical Facility and the Hidden Valley School that lie in this area could be susceptible to wildfire. Most of Los Ranchitos lies in a High FHSZ with a small part in a moderate FHSZ. There are dozens of homes in this area that could be susceptible to wildfire.

Most of Lucas Valley and Marinwood lie in a High FHSZ. There are hundreds of homes and critical facilities, including several medical facilities, Lucas Valley Elementary School, the Marin County Juvenile Complex, Lucas Valley School, the Marinwood Fire Department, Miller Creek School that lie in this area and have a high susceptibility to wildfire. There is a small section of Marinwood with several homes and part of the Mary E. Silveria Elementary School that lie in a Very High FHSZ and that could have an even higher susceptibility to wildfire. The far eastern end of Lucas Valley, which consists of several homes, lies a Moderate FHSZ and could be susceptible to wildfire.

All of the Saint Vincent area, which includes the Saint Vincent School, lies in a Moderate FHSZ and could be susceptible to wildfire. The Saint Vincent area is surrounded to the west, north and south by a High FHSZ.

Most of San Venetia is not in a FHSZ but the eastern foothills of the San Pedro Mountain Open Space Preserve are in a Moderate FHSZ. There are numerous homes and medical facilities along with the Marin School that lie in this area and that could be susceptible to wildfire. Part of the unincorporated community south of China Camp State Park lies in a Moderate FHSZ. There are dozens of homes in this area that could be susceptible to wildfire. The southwest side of San Pedro Hill lies in a High FHSZ with a small part lying in a Moderate FHSZ. The McNear Brickyard and other industrial facilities lie in this area and could have an even higher susceptibility to wildfire.

The unincorporated residential area west of Novato lies mostly in a High FHSZ. There are hundreds of homes in this area that could have a high susceptibility to wildfire. The Loma Verde area, which includes dozens of homes and the Loma Verde Elementary School, also lies in a

High FHSZ and could have a high susceptibility to wildfire. This area is bordered to the south by a Very High FHSZ in the City of Novato.

Most of the Black Point-Green Point area lies in a High FHSZ. There are dozens of homes, several businesses, and the Novato Fire Protection District Station #62 that lie in this area and could have a high susceptibility to wildfire. A smaller section south of the Rush Creek Marsh Wildlife Area lies in a Moderate FHSZ. There are numerous homes and businesses in this area that could be susceptible to wildfire.

Numerous unincorporated communities in Marin County include all or part of a Moderate FHSZ and have no High or Very High FHSZ's including Point Reyes Station, Olema, Nicasio, Tocoloma, Marshall, Tomales, Dillon Beach, Alto, Paradise Cay, and Bel Marin Keys. Hundreds of homes, numerous businesses, and several critical facilities lie in these communities and could be susceptible to wildfire. Critical facilities in these communities susceptible to wildfire include the Nicasio Fire Department, the Nicasio Elementary School, the Tocoloma PG&E substation, the MERA antenna site at Mt. Barnabe, the Olema PG&E substation, the Point Reyes National Seashore Headquarters and Fire Department, the Point Reyes Fire Station, the Marin County Sherrif's Substation at Point Reyes, the CalTrans Point Reyes Maintenance Station, West Marin Elementary School, Tomales High School, Tomales Elementary School, Tomales Fire Station, MERA antenna site at Tomales and several medical facilities.

The Marin County Airport, the community of San Antonio, and the unincorporated County along the border of Sonoma County all lie in a Moderate FHSZ. There are numerous rural homes, businesses and buildings along with critical facilities including the Hicks Valley Fire Station, Laguna School, Lincoln School, Stafford Junction PG&E substation, MERA antenna site at Coyote Peak that lie in this area and could be susceptible to wildfire.

Marin County populations within the above-listed communities that are most vulnerable to the effects of wildfire include:

- Low-income households
- Households in poverty
- Persons living on single access roads
- Mobile homeowners
- Persons without access to transportation or telecommunications
- Outdoor workers
- Healthcare workers, first responders, and protective service occupations
- Houseless population
- Children
- Persons with disabilities
- Persons with chronic health problems,
- Senior community members, and
- Persons living alone.

See the Marin County CWPP for additional information on the susceptibility of the Marin County OA to wildfire.

Climate Change and Future Development Considerations

Climate change can lead to an increase in wildfire events. Climate change has been a key factor in increasing the risk and extent of wildfires in the western United States. Changes in climate create warmer, drier conditions. Increased drought, and a longer fire season are boosting these increases in wildfire risk.

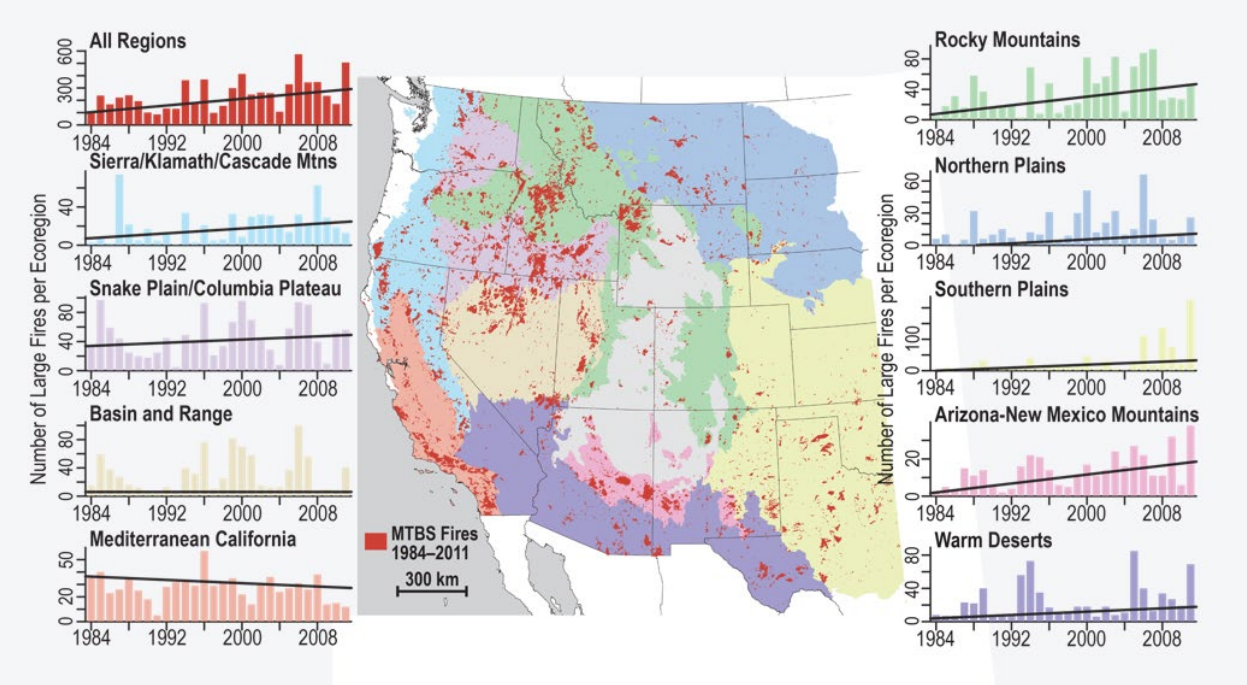


Figure 3.207: Trends in the Annual Number of Large Wildfires in the United States
Source: Fourth Climate Change Assessment

As summer conditions in Northern California become hotter and drier due to climate change, the occurrence and severity of wildfires will only increase. The Marin County OA is particularly susceptible to these future impacts of climate change on wildfire, as the OA's climate has generally been wet enough historically to avoid major wildfires. Extreme heat events and high wind events could cause electrical systems to become overloaded and fail, sparking wildfires. An increase in wildfires as a result of climate change could lead to more significantly burned areas that could contribute to debris flows after a significant storm event. Future development in the WUI throughout the Marin County OA will expose more people and property to the impacts of a potentially significant wildfire. The growing number of people in the Marin County OA WUI can increase risk to life, property and public health as a result of a wildfire.

3.4 Additional Hazards Profiled

Additional non-natural hazards were identified as having some potential to impact the planning area. The sections below provide short profiles of each of these hazards, including qualitative discussion of their potential to impact Marin County. No formal risk assessment of these hazards was performed, and no mitigation initiatives have been developed to address them.

3.4.1 Air Pollution

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Pollutants of major public health concern and their effects on health and the environment include:

Ozone (O3)

- Respiratory symptoms
- Worsening of lung disease leading to premature death
- Damage to lung tissue
- Crop, forest and ecosystem damage
- Damage to a variety of materials, including rubber, plastics, fabrics, paint and metals

PM2.5 (particulate matter less than 2.5 microns in aerodynamic diameter)

- Premature death
- Hospitalization for worsening of cardiovascular disease
- Hospitalization for respiratory disease
- Asthma-related emergency room visits
- Increased symptoms, increased inhaler usage

PM10 (particulate matter less than 10 microns in aerodynamic diameter)

- Premature death & hospitalization, primarily for worsening of respiratory disease
- Reduced visibility and material soiling

Nitrogen Oxides (NOX)

- Lung irritation
- Enhanced allergic responses

Carbon Monoxide (CO)

- Chest pain in patients with heart disease
- Headache
- Light-headedness
- Reduced mental alertness

Sulfur Oxides (SOX)

- Worsening of asthma: increased symptoms, increased medication usage, and emergency room visits

Lead

- Impaired mental functioning in children
- Learning disabilities in children
- Brain and kidney damage

Hydrogen Sulfide (H2S)

- Nuisance odor (rotten egg smell)
- At high concentrations: headache & breathing difficulties

Sulfate

- Same as PM2.5, particularly worsening of asthma and other lung diseases
- Reduces visibility

Vinyl Chloride

- Central nervous system effects, such as dizziness, drowsiness & headaches
- Long-term exposure: liver damage & liver cancer

Visibility Reducing Particles

- Reduced airport safety, scenic enjoyment, road safety, and discourages tourism

Toxic Air Contaminants (about 200 chemicals have been listed as toxic air contaminants)

- Cancer
- Reproductive and developmental effects
- Neurological effects

Outdoor and indoor air pollution cause respiratory and other diseases and are important sources of morbidity and mortality.

The World Health Organization (WHO) shows that almost all of the global population (99%) breathe air that exceeds WHO guideline limits and contains high levels of pollutants, with low- and middle-income countries suffering from the highest exposures.

Air quality is closely linked to the earth's climate and ecosystems globally. Many of the drivers of air pollution (i.e. combustion of fossil fuels) are also sources of greenhouse gas emissions. Climate change–fueled wildfires and extreme heat are adding to the challenges of protecting public health. Policies to reduce air pollution, therefore, offer a win-win strategy for both climate and health, lowering the burden of disease attributable to air pollution, as well as contributing to the near- and long-term mitigation of climate change.

Mold and allergens from trees, weeds, and grass are also carried in the air, are exacerbated by climate change, and can be hazardous to health. Though they aren't regulated and are less directly connected to human actions, they can be considered a form of air pollution. Pollen allergies are worsening because of climate change.

135 million people or four out of ten U.S. residents live in counties with unhealthy levels of air pollution. Air monitoring shows that over 90 percent of Californians breathe unhealthy levels of one or more air pollutants during some part of the year. In the U.S., the Clean Air Act has been a crucial tool for reducing air pollution since its passage in 1970. The most effective way to control air pollution is to speed up the transition to cleaner fuels and industrial processes. By switching over to renewable energy sources such as wind and solar power, maximizing fuel efficiency in vehicles, and replacing more and more gasoline-powered cars and trucks with electric versions, air pollution can be limited at its source while also curbing the global warming that worsens so many of its worst health impacts.

Air Quality Index (AQI) & Health

Millions of people live in areas where air pollution can cause serious health problems. Local air quality can affect our daily lives. Like the weather, it can change from day to day. The Environmental Protection Agency (EPA) developed the Air Quality Index, or AQI, to make information available about the health effects of the five most common air pollutants, and how to avoid those effects.

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health affects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country.

https://www.airnow.gov/

https://airnow.gov/index.cfm?action=aqi_brochure.index

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories: Note: Values above 500 are considered Beyond the AQI. Follow recommendations for the Hazardous category. Additional information on reducing exposure to extremely high levels of particle pollution is available here. Each category corresponds to a different level of health concern. The six levels of health concern and what they mean are depicted in the figure below.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Figure 3.208: Air Quality Index Concern Levels
Source: AirNow.gov

In the Bay Area, a certain amount of air pollution comes from industrial sources, such as refineries and power plants. But a greater percentage of harmful air emissions comes from cars and trucks, construction equipment, and other motor vehicles. In the wintertime, the largest single source of air pollution is residential wood burning. Ozone and fine particle pollution, or PM2.5, are the major regional air pollutants of concern in the San Francisco Bay Area. Ozone is primarily a problem in the summer, and fine particle pollution in the winter. Along the Marin County coast and in southern Marin County, clean air from the Pacific Ocean helps to keep air pollution at a minimum. Elsewhere in the Marin County OA, ozone only rarely becomes a concern, but the hilly terrain and colder winter temperatures can trap PM2.5 near the surface, resulting in air quality that exceeds health standards.

The Bay Area Air Quality Management District (BAAQMD) is the official air pollution control agency for the San Francisco Bay Area, which includes Marin County. They have issued numerous poor air quality advisories for Marin County over the years as a result of wildfires.

3.4.2 Critical Infrastructure/ Utility Disruption

Critical Infrastructure and utility disruption is defined as the disruption of one or more of the physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society. Examples of infrastructure disruptions include building collapses, water main breaks, gas pipe ruptures, steam pipe explosions, communication system failures and related types of events. These disruptions can be caused by natural disasters such as a landslide or earthquake, by man-made disasters such as a train or major vehicle crash, or by acts of sabotage including terrorism.

Climate change is expected to heavily affect infrastructure through heatwaves, floods and droughts. Figure 3.208 shows critical infrastructure across the Marin County OA.

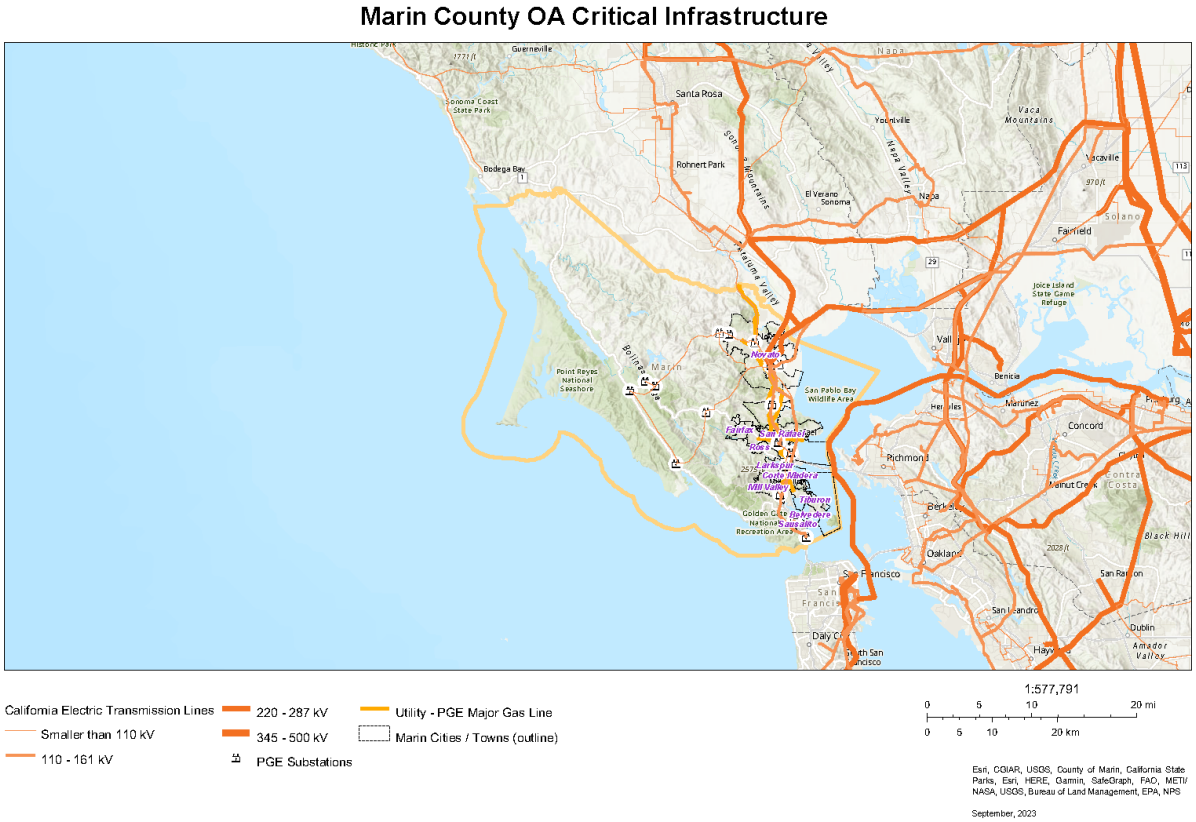


Figure 3.209: Marin County OA Critical Infrastructure
Source: Marin County

The availability of critical infrastructure and utilities are crucial for timely recovery after a disaster induced by natural hazards. Maintaining or quickly restoring road access, drinking water supply or healthcare can save lives. Very often disasters are exacerbated by poor infrastructure. Preparing critical infrastructures, as well as the population, for long-term outages due to natural hazards is crucial. When critical infrastructure and utilities have a disruption, it can disproportionately affect socially vulnerable populations. For individuals stuck at home and who rely on timely medication or electrical devices, a situation can quickly become critical if road access and power supplies are damaged. The increasing complexity, interdependency and scale of infrastructure networks can make them more difficult to protect. While technological developments have improved the quality of essential services, this progress itself creates new vulnerabilities.

Beyond power outages caused by storms, wildfires and PSPS events, the Marin County OA has had no significant critical infrastructure or utility disruptions. Other critical infrastructure and utility disruptions across California and the United States have occurred, however, and could similarly occur in the Marin County OA including the 2011 Southwest power failure, the 2010 San Bruno PG&E gas line explosion, and the 2007 I-35 bridge collapse in Minneapolis, Minnesota.

3.4.3 CYBER THREATS

A cyber threat is any circumstance or event with the potential to adversely impact organizational operations (including mission, functions, image, or reputation), organizational assets, or individuals through an information system via unauthorized access, destruction, disclosure, modification of information, and/or denial of service. A cyber threat is also the potential for a threat-source to successfully exploit a particular information system vulnerability. Cyber threats include:

Malware
Malware — or malicious software — is any program or code that is created with the intent to do harm to a computer, network or server. Malware is the most common type of cyberattack, mostly because this term encompasses many subsets such as ransomware, trojans, spyware, viruses, worms, keyloggers, bots, cryptojacking, and any other type of malware attack that leverages software in a malicious way. Types of malware include:

Ransomware: In a ransomware attack, an adversary encrypts a victim's data and offers to provide a decryption key in exchange for a payment. Ransomware attacks are usually launched through malicious links delivered via phishing emails, but unpatched vulnerabilities and policy misconfigurations are used as well.

Fileless Malware: Fileless malware is a type of malicious activity that uses native, legitimate tools built into a system to execute a cyber attack. Unlike traditional malware, fileless malware does not require an attacker to install any code on a target's system, making it hard to detect.

Spyware: Spyware is a type of unwanted, malicious software that infects a computer or other device and collects information about a user's web activity without their knowledge or consent.

Adware: Adware is a type of spyware that watches a user's online activity in order to determine which ads to show them. While adware is not inherently malicious, it has an impact on the performance of a user's device and degrades the user experience.

Trojan: A trojan is malware that appears to be legitimate software disguised as native operating system programs or harmless files like free downloads. Trojans are installed through social engineering techniques such as phishing or bait websites.

Worm: A worm is a self-contained program that replicates itself and spreads its copies to other computers. A worm may infect its target through a software vulnerability or it may be delivered via phishing or smishing. Embedded worms can modify and delete files, inject more malicious software, or replicate in place until the targeted system runs out of resources.

Rootkit: Rootkit malware is a collection of software designed to give malicious actors control of a computer network or application. Once activated, the malicious program sets up a backdoor exploit and may deliver additional malware.

Mobile Malware: Mobile malware is any type of malware designed to target mobile devices. Mobile malware is delivered through malicious downloads, operating system vulnerabilities, phishing, smishing, and the use of unsecured WiFi.

Exploit: An exploit is a piece of software or data that opportunistically uses a defect in an operating system or an app to provide access to unauthorized actors. The exploit may be used to install more malware or steal data.

Scareware: Scareware tricks users into believing their computer is infected with a virus. Typically, a user will see scareware as a pop-up warning them that their system is infected. This scare tactic aims to persuade people into installing fake antivirus software to remove the "virus." Once this fake antivirus software is downloaded, then malware may infect your computer.

Keylogger: Keyloggers are tools that record what a person types on a device. While there are legitimate and legal uses for keyloggers, many uses are malicious. In a keylogger attack, the keylogger software records every keystroke on the victim's device and sends it to the attacker.

Botnet: Botnet is a network of computers infected with malware that are controlled by a bot herder. The bot herder is the person who operates the botnet infrastructure and uses the compromised computers to launch attacks designed to crash a target's network, inject malware, harvest credentials or execute CPU-intensive tasks.

Denial and Distributed Denial of Service Attacks

A Denial-of-Service (DoS) attack is a malicious, targeted attack that floods a network with false requests in order to disrupt business operations.

In a DoS attack, users are unable to perform routine and necessary tasks, such as accessing email, websites, online accounts or other resources that are operated by a compromised computer or network. While most DoS attacks do not result in lost data and are typically resolved without paying a ransom, they cost the organization time, money and other resources in order to restore critical business operations.

The difference between DoS and Distributed Denial of Service (DDoS) attacks has to do with the origin of the attack. DoS attacks originate from just one system while DDoS attacks are launched from multiple systems. DDoS attacks are faster and harder to block than DOS attacks because multiple systems must be identified and neutralized to halt the attack.

Phishing

Phishing is a type of cyberattack that uses email, SMS, phone, social media, and social engineering techniques to entice a victim to share sensitive information — such as passwords or account numbers — or to download a malicious file that will install viruses on their computer or phone. Types of phishing include:

Spear Phishing: Spear-phishing is a type of phishing attack that targets specific individuals or organizations typically through malicious emails. The goal of spear phishing is to steal sensitive information such as login credentials or infect the targets' device with malware.

Whaling: A whaling attack is a type of social engineering attack specifically targeting senior or executive employees with the purpose of stealing money or information, or gaining access to the person's computer in order to execute further cyberattacks.

SMiShing: Smishing is the act of sending fraudulent text messages designed to trick individuals into sharing sensitive data such as passwords, usernames and credit card numbers. A smishing attack may involve cybercriminals pretending to be your bank or a shipping service you use.

Vishing: Vishing, a voice phishing attack, is the fraudulent use of phone calls and voice messages pretending to be from a reputable organization to convince individuals to reveal private information such as bank details and passwords.

Spoofing

Spoofing is a technique through which a cybercriminal disguises themselves as a known or trusted source. In so doing, the adversary is able to engage with the target and access their systems or devices with the ultimate goal of stealing information, extorting money or installing malware or other harmful software on the device. Types of spoofing include:

Domain Spoofing: Domain spoofing is a form of phishing where an attacker impersonates a known business or person with fake website or email domain to fool people into the trusting them. Typically, the domain appears to be legitimate at first glance, but a closer look will reveal subtle differences.

Email Spoofing: Email spoofing is a type of cyberattack that targets organizations by using emails with forged sender addresses. Because the recipient trusts the alleged sender, they are more likely to open the email and interact with its contents, such as a malicious link or attachment.

ARP Spoofing: Address Resolution Protocol (ARP) spoofing or ARP poisoning is a form of spoofing attack that hackers use to intercept data. A hacker commits an ARP spoofing attack by tricking one device into sending messages to the hacker instead of the intended recipient. This way, the hacker gains access to your device's communications, including sensitive data.

Code Injection Attacks

Code injection attacks consist of an attacker injecting malicious code into a vulnerable computer or network to change its course of action. Types of code injection attacks include:

SQL Injection: A Structured Query Language (SQL) Injection attack leverages system vulnerabilities to inject malicious SQL statements into a data-driven application, which then allows the hacker to extract information from a database. Hackers use SQL Injection techniques to alter, steal or erase application's database data.

Cross-Site Scripting (XSS): Cross Site Scripting (XSS) is a code injection attack in which an adversary inserts malicious code within a legitimate website. The code then launches as an infected script in the user's web browser, enabling the attacker to steal sensitive information or impersonate the user. Web forums, message boards, blogs and other websites that allow users to post their own content are the most susceptible to XSS attacks.

Malvertising: Malvertising attacks leverage many other techniques to carry out the attack. Typically, the attacker begins by breaching a third-party server, which allows the cybercriminal to inject malicious code within a display ad or some element thereof, such as banner ad copy, creative imagery or video content. Once clicked by a website visitor, the corrupted code within the ad will install malware or adware on the user's computer.

Identity-Based Attacks

Identity-based attacks are attacks on the behavior of an individual and are extremely hard to detect. When a valid user's credentials have been compromised and an adversary is masquerading as that user, it is often very difficult to differentiate between the user's typical behavior and that of the hacker using traditional security measures and tools. Types of identity-based attacks include:

Kerberoasting: Kerberoasting is a post-exploitation attack technique that attempts to crack the password of a service account within the active directory where an adversary masquerading as an account user with a service principal name requests a ticket, which contains an encrypted password, or Kerberos.

Man-in-the-Middle (MITM) Attack: A man-in-the-middle attack is a type of cyberattack in which an attacker eavesdrops on a conversation between two targets with the goal of collecting personal data, passwords or banking details, and/or to convince the victim to take an action such as changing login credentials, completing a transaction or initiating a transfer of funds.

Pass-the-Hash Attack: Pass the hash (PtH) is a type of attack in which an adversary steals a "hashed" user credential and uses it to create a new user session on the same network. It does not require the attacker to know or crack the password to gain access to the system. Rather, it uses a stored version of the password to initiate a new session.

Silver Ticket Attack: A silver ticket is a forged authentication ticket often created when an attacker steals an account password. A forged service ticket is encrypted and enables access to resources for the specific service targeted by the silver ticket attack.

Credential Stuffing: Credential stuffing attacks work on the premise that people often use the same user ID and password across multiple accounts. Therefore, possessing the credentials for one account may be able to grant access to other, unrelated account.

Password Spraying: The basics of a password spraying attack involve a threat actor using a single common password against multiple accounts on the same application. This avoids the account lockouts that typically occur when an attacker uses a brute force attack on a single account by trying many passwords.

Brute Force Attacks: A brute force attack uses a trial-and-error approach to systematically guess login info, credentials, and encryption keys. The attacker submits combinations of usernames and passwords until they finally guess correctly.

Insider Threats

Insider threats are internal actors such as current or former employees that pose danger to an organization because they have direct access to the company network, sensitive data, and

intellectual property (IP), as well as knowledge of business processes, company policies or other information that would help carry out such an attack.

Internal actors that pose a threat to an organization tend to be malicious in nature. Some motivators include financial gains in exchange for selling confidential information on the dark web, and/or emotional coercion using social engineering tactics. On the other hand, some insider threat actors are not malicious in nature but instead are negligent in nature. To combat this, organizations should implement a comprehensive cybersecurity training program that teaches stakeholders to be aware of any potential attacks, including those potentially performed by an insider.

Supply Chain Attacks
A supply chain attack is a type of cyberattack that targets a trusted third-party vendor who offers services or software vital to the supply chain. Software supply chain attacks inject malicious code into an application in order to infect all users of an app, while hardware supply chain attacks compromise physical components for the same purpose. Software supply chains are particularly vulnerable because modern software is not written from scratch: rather, it involves many off-the-shelf components, such as third-party APIs, open-source code and proprietary code from software vendors.

DNS tunneling
DNS Tunneling is a type of cyberattack that leverages domain name system (DNS) queries and responses to bypass traditional security measures and transmit data and code within the network. Once infected, the hacker can freely engage in command-and-control activities. This tunnel gives the hacker a route to unleash malware and/or to extract data, IP or other sensitive information by encoding it bit by bit in a series of DNS responses. DNS tunneling attacks have increased in recent years, in part because they are relatively simple to deploy. Tunneling toolkits and guides are even readily accessible online through mainstream sites like YouTube.

IoT-Based Attacks
An IoT attack is any cyberattack that targets an Internet of Things (IoT) device or network. Once compromised, the hacker can assume control of the device, steal data, or join a group of infected devices to create a botnet to launch DoS or DDoS attacks. Given that the number of connected devices is expected to grow rapidly over the next several years, cybersecurity experts expect IoT infections to grow as well. Further, the deployment of 5G networks, which will further fuel the use of connected devices, may also lead to an uptick in attacks.

The Marin County OA has had several cybersecurity issues. More than $300,000 was stolen by fraudulent electronic transfers at the Marin County Civic Center, unwittingly approved by county financial gatekeepers in 2018. Marin County's computer network has been hacked into and breached at least five times between July 2017 and August 2018. In addition, more than half of Marin's cities — Corte Madera, Fairfax, Larkspur, Novato, Sausalito and Tiburon — have had their cybersecurity compromised including:

Town of Fairfax: In July 2016, Fairfax was victimized by a ransomware attack. An employee received an email with a malware program attached; and when the employee clicked on the attachment, the town's servers were infected and became unusable. No ransom was paid, but the town was forced to use a previous backup in order to rebuild its systems. The Town lost data

for the day of the attack, since it had not yet been backed up. The Town suffered a similar breach in October 2014.

City of Novato: In 2017, Novato fell victim to a phishing attack. A city employee received an email purporting to be from a senior city official, requesting a wire transfer of funds. The employee initiated the wire transfer to the account specified by the hacker. The breach was reported to local law enforcement and the FBI. After the attack, the City strengthened its email security and implemented mandatory employee training to reduce its vulnerability to email-based attacks.

City of Sausalito: In January 2018, Sausalito was the victim of a phishing attack in which a fake email, purporting to be from the city manager, was sent to a city employee. This employee complied with the fake email's request for copies of the W-2 tax forms of all of the city's employees and councilmembers. As a result, all these individuals were exposed to the risk of identity theft. The Sausalito breach was reported to the FBI. For two years after the attack, the city provided free credit monitoring services to all employees, at a cost of approximately $27,000. Nevertheless, three employees had fraudulent state tax returns filed in their names, although the attempts were unsuccessful because taxing authorities had been alerted.

Town of Tiburon: In 2019, Tiburon suffered a ransomware attack, also initiated by a fake email attachment opened by an employee. No ransom was paid, but the Town's systems were largely disabled for more than three days. Most of its data was recovered using a backup, but the town discovered that one of its applications was not being backed up properly, so the town needed to rebuild much of that data by hand from paper records.

Town of Corte Madera: In 2019, Corte Madera suffered a direct attack. During a brief moment when a vendor intentionally disabled the town's firewall for system updates, hackers were able to access its network and disable it using ransomware. No ransom was paid, but the system had to be restored from a backup.

City of Larkspur: In August 2019, Larkspur's network was compromised in a direct attack. Four of its computers were reportedly accessed from one of the public computers in the Larkspur library. It is unknown what data may have been accessed.

Having a comprehensive cybersecurity strategy is vital. Organizations should secure their critical areas of risk, know their threats, be ready to respond quickly to a threat, monitor the criminal underground through hidden messaging platforms and dark web forums, utilize technology to stop sophisticated threats, and build a comprehensive cybersecurity training program.

3.4.4 Oil Spills

Oil spills can happen anywhere oil is drilled, transported, or used. They can happen in many different ways including when pipelines break, oil tanker ships sink, or drilling operations go wrong. Consequences to ecosystems and economies can be felt for decades following a large oil spill. Thousands of oil spills occur in U.S. waters each year. Most of these spills are small but can still cause damage, especially if they happen in sensitive environments, like beaches and wetlands. Large oil spills can be significant disasters.

Where oil is spilled, what kinds of plants, animals, and habitats are found there, and the amount and type of oil, among other things, can influence how much harm an oil spill causes. Generally, oil spills harm ocean life in two ways:

Fouling or oiling: Fouling or oiling occurs when oil physically harms a plant or animal. Oil can coat a bird's wings and leave it unable to fly or strip away the insulating properties of a sea otter's fur, putting it at risk of hypothermia. The degree of oiling often impacts the animal's chances of survival.

Oil toxicity: Oil consists of many different toxic compounds. These toxic compounds can cause severe health problems like heart damage, stunted growth, immune system effects, and even death. Our understanding of oil toxicity has expanded by studying the effects of the 2010 Deepwater Horizon oil spill.

Wildlife recovery, cleaning, and rehabilitation is often an important part of oil spill response. However, wildlife is difficult to find and catch, oil spills can happen over wide areas, and some animals (like whales) are too big to recover. Unfortunately, it's unrealistic to rescue all wildlife impacted during oil spills.

The U.S Coast Guard is primarily responsible for cleaning up oil spills, while NOAA provides scientific support to make decisions that protect people and the environment. There are different equipment and tactics that trained experts can use to contain or remove oil from the environment when a spill occurs:

Booms are floating physical barriers to oil, which help keep it contained and away from sensitive areas, like beaches, mangroves, and wetlands.

Skimmers are used off of boats and can "skim" oil from the sea surface. In situ burning, or setting fire to an oil slick, can burn the oil away at sea, and chemical dispersants can break up oil slicks from the surface.

Cleanup activities can never remove 100% of the oil spilled, and scientists have to be careful that their actions don't cause additional harm.

Figure 3.209 shows the largest oil spills affecting United States waters from 1969-2017.

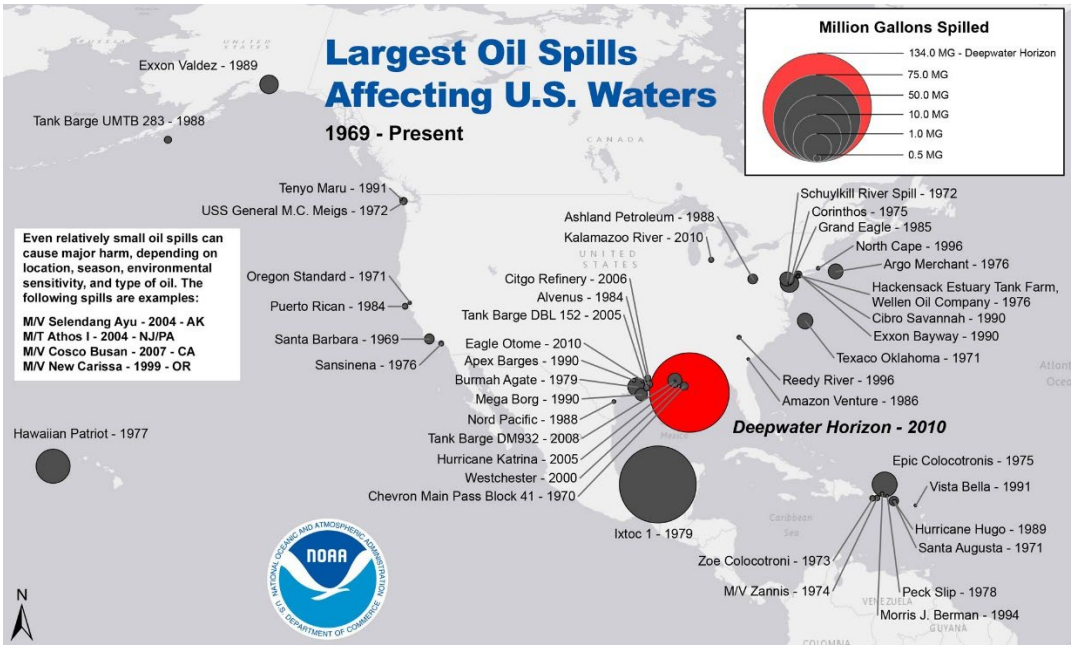


Figure 3.210: Largest Oil Spills Affecting U.S. Waters 1969-2017
Source: NOAA

The Marin County OA has been impacted by oil spills. In 2007, an oil tanker colided with one of the San-Francisco Oakland Bay Bridge towers. It spilled 53,569 gallons of bunker fuel into San Francisco Bay. The tidal mechanics of San Francisco Bay caused the spill to spread rapidly, affecting a large area of the California North Coast, including the Golden Gate National Recreation Area, Ocean Beach and the Marin Headlands. More than 50 public beaches were closed, including Crissy Field, Fort Point, Baker Beach, China Beach and Kirby Cove. Beaches as far south as Pacifica, California were closed due to the spill. According to Federal and State natural resource trustee agencies, the spill is estimated to have killed 6,849 birds. Several fisheries in the Bay Area may have been affected by the spill, and the crab and sport fishing seasons were postponed by several weeks. As of the end of November 2007, State biologists had tested more than 1100 samples of fish, mussels and Dungeness crab in San Francisco Bay and coastal waters outside the Golden Gate. The tests found unsafe levels of contaminants in mussels from Rodeo Beach and the Berkeley pier. An estimated 1,079,900 recreational use days were also lost as a result of the spill. This includes general shoreline use as well as recreational fishing and boating. Total monetary damages were estimated at more than $70 million for oil spill cleanup.

In 1971, a spill occurred in the San Francisco Bay when two tankers collided and spilled 800,000 gallons of oil, threatening significant sensitive habitat inside and outside the Bay, including the Bolinas Lagoon.

On March 6, 2021, a steel shackle connecting a tugboat to the American Challenger, a 90-foot decommissioned vessel, failed in Bodega Bay, causing the American Challenger to drift into shore. A Coast Guard crew was monitoring it at the time and reported the commercial vessel grounded north of Dillon Beach, off Pt Reyes.

Officials representing the Marin County Sheriff's Office of Emergency Services, the U.S. Coast Guard, the EPA, California Department of Fish and Wildlife, the National Oceanic and Atmospheric Administration, and state Office of Spill Prevention and Response, responded to the scene and attempted to contain the oil and other hazardous materials leaking from the vessel, ensuring debris and toxic substances did not stray into the surrounding Greater Farallones National Marine Sanctuary. About $2.3 million was spent on the initial response and costs related to the stranding, including oil booms, environmental assessments, shoreline surveys and Coast Guard costs, according to the Office of Spill Prevention and Response. The Environmental Protection Agency, Region 9, paid an estimated $1 million for the dismantling and disposal of the vessel.

Additional oil spills have impacted other areas of California:

In 1910, The Lakeview Gusher created the largest accidental oil spill in history, lasting 18 months and releasing an estimated 9 million barrels of crude oil. It occurred due to an eruption of hydrocarbons from a pressurized oil well in the Midway-Sunset Oil Field in Kern County, California.

In 1969, a blowout on an offshore platform off the coast of Santa Barbara, California, spilled over four million gallons of oil.

In 2021, a major oil spill occurred in Orange County, California, originating from an underwater pipe connected to the Elly platform about 4.5 miles offshore near Long Beach. The U.S. Coast Guard estimated that spill covered 8,320 acres of the ocean's surface, spilling approximately 24,696 gallons of oil.

Two of the most significant marine oil spills in American history, each of which was the largest oil spill into American waterways at the time, include:

In 1989, the Exxon Valdez oil tanker ran aground in the Prince William Sound in Alaska, spilling over 11 million gallons of oil.

On April 20, 2010, an explosion occurred on the Deepwater Horizon drilling platform in the Gulf of Mexico, killing 11 people. Before it was capped three months later, approximately 134 million gallons of oil had spilled into the ocean making it the largest marine oil spill in U.S. history. That is equivalent to the volume of over 200 Olympic-sized swimming pools.

While there is currently no oil drilling offshore of Northern California, including Marin County, the potential exists for new drilling to occur in the area in the future. Onshore drilling also does not occur in the Marin County OA. Currently, an oil spill affecting Marin County would most likely emanate from a ship accident as there are no oil pipelines in the Marin County OA. Environmental, economic, and recreational impacts to the Marin County shoreline could be significant depending on the location of the spill and the tides.

3.4.5 Pandemic

A pandemic is a disease outbreak that spreads across countries or continents. It affects more people and takes more lives than an epidemic.

An epidemic is when an infectious disease spreads quickly to more people than experts would expect. It usually affects a larger area than an outbreak.

An outbreak is when an illness happens in unexpected high numbers. It may stay in one area or extend more widely. An outbreak can last days or years. Sometimes, experts consider a single case of a contagious disease to be an outbreak. This may be true if it's an unknown disease, if it's new to a community, or if it's been absent from a population for a long time.

The number of lives lost in a pandemic depends on:

- How many people are infected.
- How severe of an illness the virus causes (its virulence).
- How vulnerable certain groups of people are.
- Prevention efforts and how effective they are.

The California Department of Public Health has identified several diseases that could contribute to an outbreak, epidemic or pandemic in California:

Animal Transmitted
These are diseases that are transmitted to humans by domestic or non-domestic animals. Examples include:

- Brucellosis (undulant fever)
- Campylobacteriosis
- Cat scratch disease
- Cryptosporidiosis
- Escherichia coli (E. coli)
- Giardiasis
- Middle Eastern Respiratory Syndrome (MERS)
- Plague
- Psittacosis (ornithosis, parrot fever)
- Q Fever
- Rabies
- Ringworm
- Salmonellosis
- Toxoplasmosis
- Tularemia

Bloodborne

Viruses, bacteria and parasites that can be carried in blood and cause disease are known as bloodborne pathogens. Transmission of these diseases may be from direct blood contact, needle sticks, intravenous drug use, sexual behavior, insects or other vectors. Examples include:

- Tularemia
- Ebola
- Hepatitis C
- Malaria

Community-Acquired Infections

Community-acquired infections are infections that are contracted outside of a hospital (or are diagnosed within 48 hours of admission) without any previous health care encounter. Examples include:

- Adenovirus
- Bed Bugs
- Body Lice
- Campylobacteriosis
- Conjunctivitis (pink eye)
- Common cold viruses
- Enterovirus, non-polio
- Hand, foot, and mouth disease
- Head Lice (‘ukus)
- Impetigo
- Influenza (flu)
- Invasive Group A Streptococcus (necrotizing fasciitis)
- Legionnaires’ Disease/Pontiac Fever

Foodborne

Foodborne diseases can be spread when food becomes contaminated with fecal matter containing bacteria, viruses, or parasites. This contamination can happen at a farm, manufacturing plant, restaurant, or home. Foodborne diseases usually result in gastrointestinal illness, which can include symptoms such as diarrhea, vomiting, nausea, stomachache, and fever. People who are ill with a foodborne disease can give the infection to others, so proper hygiene and hand washing practices are essential to limit the spread of disease. People experiencing gastrointestinal symptoms should not prepare or handle food for others. Examples include:

- Amebiasis
- Angiostrongyliasis (rat lungworm)
- Anisakiasis
- Botulism
- Brucellosis (undulant fever)
- Campylobacteriosis
- Cholera
- Ciguatera fish poisoning
- Cryptosporidiosis
- Cyclosporiasis
- Escherichia coli (E. coli)
- Giardiasis
- Listeriosis
- Norovirus
- Salmonellosis
- Scombroid
- Shigellosis
- Tularemia
- Typhoid Fever
- Vibriosis
- Yersinia enterocolitica

Influenza

Influenza is an infectious viral disease of birds and mammals commonly transmitted through airborne aerosols such as coughing or sneezing. Symptoms are chills, headache, fever, nausea, muscle pain and occasionally pneumonia. Flu pandemics in the late 19th and 20th centuries include:

- Russian flu
- 1918 Spanish flu
- Asian flu
- Hong Kong flu
- A/H1N1 or the swine flu.

Avian flu strains H5N1 and H7N9 caused human deaths but did not escalate to pandemic proportions.

Mosquito-Transmitted

Mosquitoes found in California are capable of spreading many diseases to humans and animals. Examples include:

- Malaria
- Yellow fever
- Dengue
- Chikungunya
- Zika
- Canine heartworm
- West Nile virus
- Other encephalitis viruses

Historically, California has experienced local transmission of malaria, western equine encephalomyelitis, St. Louis encephalitis, California encephalitis viruses, canine heartworm, and West Nile virus. Canine heartworm and West Nile virus continue to have frequent local transmission in California, with West Nile virus human cases numbering in the hundreds every year. With increased global travel, the potential exists for the introduction or reintroduction of many mosquito-borne diseases into California.

Waterborne Diseases

Diseases caused by micro-organisms transmitted in water can be spread while bathing, washing, drinking water, or eating food exposed to contaminated water.

- Cholera
- Giardiasis
- Legionnaires' Disease /Pontiac Fever
- Leptospirosis
- Typhoid Fever

Sexually Transmitted Disease

HIV/AIDS, chlamydia, gonorrhea, and syphilis are the predominant sexually transmitted infections.

- Chlamydia
- Genital warts
- Gonorrhea
- Hepatitis A, B, and C
- Herpes
- Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS)
- Human papillomavirus
- Syphilis
- Zika

Respiratory Viruses

Respiratory viruses are responsible for influenza-like illness. They can also cause the common cold. The virus that caused the Covid-19 pandemic is a respiratory virus. People at high risk (those with certain underlying conditions, the elderly, the very young, and pregnant women) can develop severe illness that results in hospitalization or death. The best protection is proper hygiene and avoiding contact with sick individuals. The best way for those who are infected to protect others is to cover their nose and mouth when sneezing and coughing, use good hand hygiene, and stay home from work or school.

- Adenovirus
- Coronaviruses
- Influenza
- Parainfluenza
- Parvovirus B19
- Respiratory Syncytial Virus
- Rhinovirus (Common Cold)
- Measles
- Pertussis (whooping cough)

Marin County, like the rest of the United States, was included in the March 2020 FEMA major disaster declaration for the COVID-19 coronavirus pandemic. Since March 2020, Marin County Public Health collected and analyzed information about COVID-19 impact in every community. Figure 3.210 shows Marin County Covid-19 hospitalizations and Figure 3.211 shows Marin County Covid-19 cases, hospitalizations by demographic.

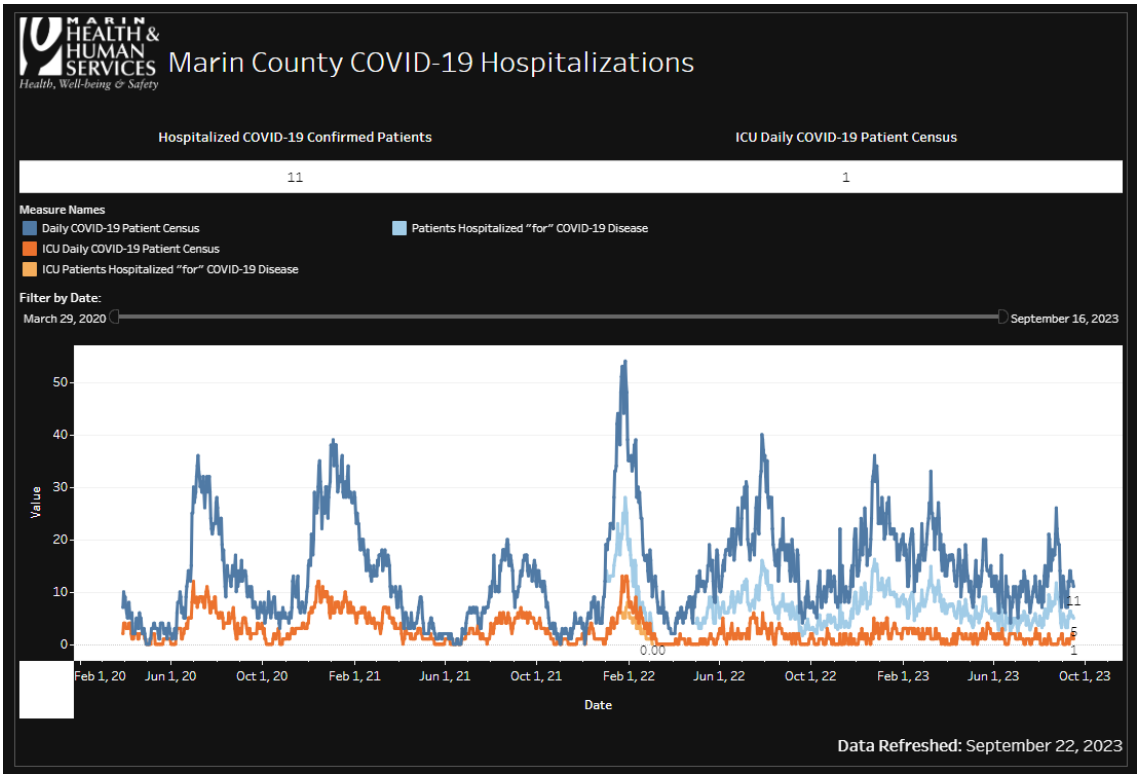


Figure 3.211: Marin County Covid-19 Hospitalizations
Source: California Department of Public Health

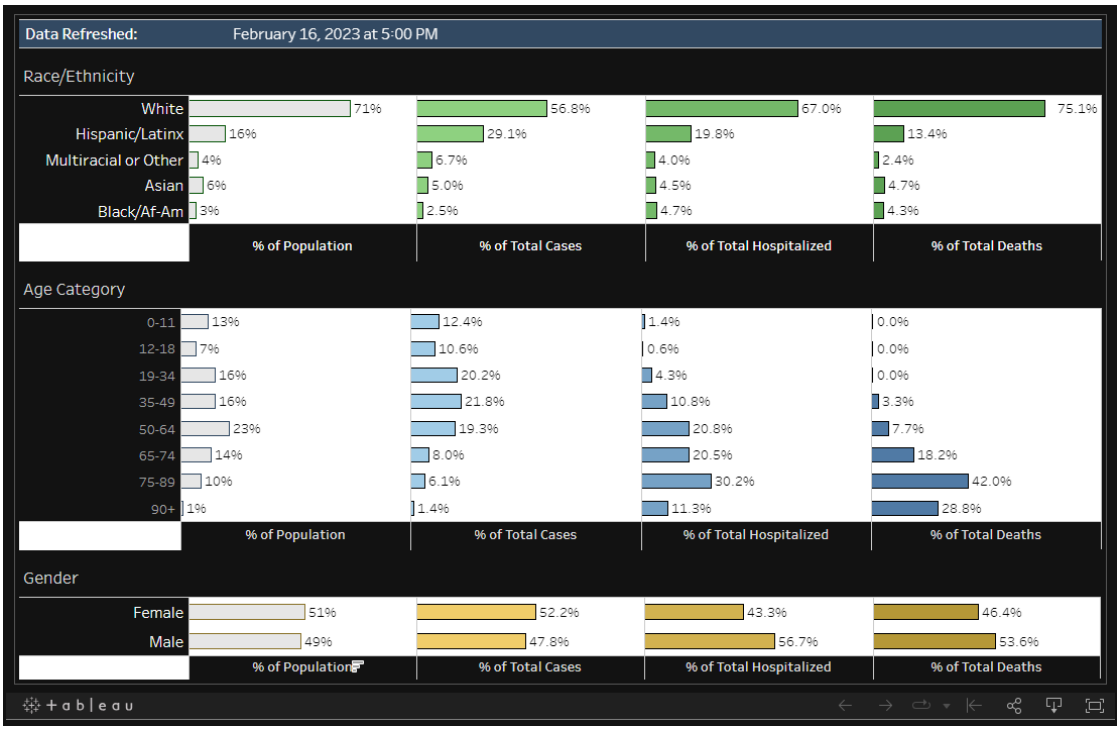


Figure 3.212: Marin County Covid-19 Hospitalizations by Demographics
Source: California Department of Public Health

The 1918 Spanish Flu also had impacts on the Marin County OA. San Rafael city officials took action before the disease hit the rest of Marin County. All unnecessary public gatherings in social halls and fraternal lodge were prohibited in San Rafael. Schools remained open but theaters were closed. The City of San Rafael passed an ordinance authorizing the arrest of people who failed or refused to wear gauze masks when appearing on the streets. Masks were considered a necessity and ultimately the rest of the Marin County OA public was mandated to wear them. By October 24, 1918, all Marin County schools had been closed and churches and lodges were ordered to postpone all planned meetings. The first death in Marin from the flu was reported that same day "when Seth Morby, of Kentfield was taken." The Hotel Rafael in San Rafael was used to house flu patients. A resurgence of flu cases across the Marin County OA occurred throughout much of 1919. Several additional deaths occurred and emergency measures had to be reinstated before being lifted again later in the year.

Climate Change

Climate change is expected to have an impact on health hazards. Projected increases in hot days and extreme heat events will increase the risk of heat-associated deaths. Air quality impacts and drier conditions may exacerbate respiratory and cardiovascular conditions through greater concentrations of pollution and allergens. Prolonged droughts from climate change can also affect the quality of drinking water (Centers for Disease Control and Prevention, 2020).

The *California 4th Climate Assessment* finds that Bay Area public health is threatened by a number of climate related changes, including more extreme heat events, increased air pollution from ozone formation and wildfires, longer and more frequent droughts, and flooding from sea level rise and high-intensity rain events. Heat waves pose increased health risks due to urban heat islands and lack of local experience and cooling infrastructure (air conditioning) in bayside cities. These risks are compounded for low-income communities.

3.4.6 Transportation Systems

Vehicle Accident

A vehicle accident occurs when a motor vehicle collides with another vehicle or object. Vehicle collisions can result in mass fatalities and property damage. A number of factors contribute to the risk of a collision including vehicle design, speed of operation, road design, road environment, driver skill, and impairment due to drugs or alcohol. There are numerous different types of vehicle collisions; of primary concern are the ones that result in a mass fatality and/or a hazmat incident. These incidents can occur due to a single vehicle accident, such as with a tour bus or a truck carrying hazardous materials, or due to a multi-vehicle accident. Multi-vehicle collisions generally occur on high capacity and high-speed routes such as freeways. The only interstate in the Marin County OA is Interstate 580 which connects Marin County to Contra Costa County via the Richmond-San Rafael Bridge. There are several major state highways that traverse the Marin County OA including Highways 101, 1 and 37. See figure 3.212 for a map of roadways in the Marin County OA.

Figure 3.213: Marin County Highways
Source: Marin Convention and Visitors Bureau

Multi-vehicle accidents usually occur in low-visibility conditions. Marin County often experiences fog which can hamper visibility. Road hazards, including black ice and landslides, can cause multi-vehicle accidents in good visibility. On roads with high traffic volume, a chain-reaction crash can occur when motorists are unable to stop. Determining the cause of multi-vehicle accidents is often difficult. Multi-vehicle accidents are particularly deadly due to the heightened risk of injury and chances of a fire occurring. Multi-vehicle accidents can also overwhelm local responding units, making rescue more difficult. Accidents in remote areas can hamper the

ability to receive medical help. A mass fatality and/or hazmat incident could occur on any one of Marin County's major highways.

In March 2006, a freak blizzard with two to four inches of slush caused a 28-car pileup on Highway 101 at the then Waldo Tunnel. Two people were killed and more than a dozen injured, and the northbound lanes were closed for 11 hours. The pileup scattered wreckage 350 to 400 feet along the road.

In December 2022, a Marin Transit bus overturned in rainy weather in San Rafael but there was only one person aboard.

Train Accident

A train accident is a violent and destructive crash involving a train. There are several different kinds of train accidents that can occur. A train can derail due to defects in or the compromising of track infrastructure, human error, mechanical or maintenance issues on the train itself, and/or from hitting another object such as a vehicle or another train. A train can also hit another object without derailing. Train accidents can be classified in terms of both cause and effect:

Classification of train accidents by cause:

Engineer/Conductor Error

- Passing signals at danger
- Excessive speed

Mishandling of the engine

- Failure to check brakes and safety systems
- Failure to stop at required positions

Controller Error

- Allowing two trains into the same occupied block section
- Other Railway Personnel Error (shunters, porters, maintenance workers)
- Accidental track obstruction
- Improper maintenance activities (leading to warped rails, damaged ties, faulty signals, etc.)

Mechanical Failure of Rolling Stock (Train Cars)

- Poor maintenance
- Poor design
- Undetected damage
- Overloading of or improperly secured freight
- Combustion fire

Civil Engineering Failure

- Track faults
- Bridge and tunnel collapses
- Poor track or junction layout

Non-Railway Personnel Error

- Accidental track obstruction

Deliberate Acts

- Deliberate track obstruction
- Intentional damage to track infrastructure or the train itself
- Level crossing misuse

Natural Causes

- Track obstruction due to landslides, avalanches, floods, or felled trees
- Fog or snow that can obscure signals or the position of a train
- Wet leaves

Classification of Train Accidents by Effect:

Collision (any of which can cause a derailment)

- Head-on collision
- Rear collision
- Slanting collision
- Collision with buffer stops
- Collision with obstructions of the track

Derailment

- Plain track
- Curve
- Junction

Other

- Fires, explosions, and release of hazardous chemicals
- People falling from trains

A train accident can cause significant loss of life and/or property and environmental damage depending on the severity of the accident and the type of materials involved. In addition to hazardous commodities being transported, fuel tanks on locomotives can also cause a fire and/or an environmental hazard.

The Sonoma-Marin Area Rail Transit (SMART) is the North Bay's passenger rail service for Marin County. SMART is a Class 4 railroad. The current 45-mile system includes stations in Novato, San Rafael, and Larkspur. SMART's system also includes a bicycle and pedestrian pathway along the rail corridor. SMART also provides freight service to North Bay businesses in Marin County on the same line. SMART Freight operates on the historic rail corridor constructed by Southern Pacific Railroad in the late 1800s and later utilized by Northwestern Pacific Railroad (NWP) beginning in 1914. See Figure 3.213 for a map of the SMART commuter and freight line.

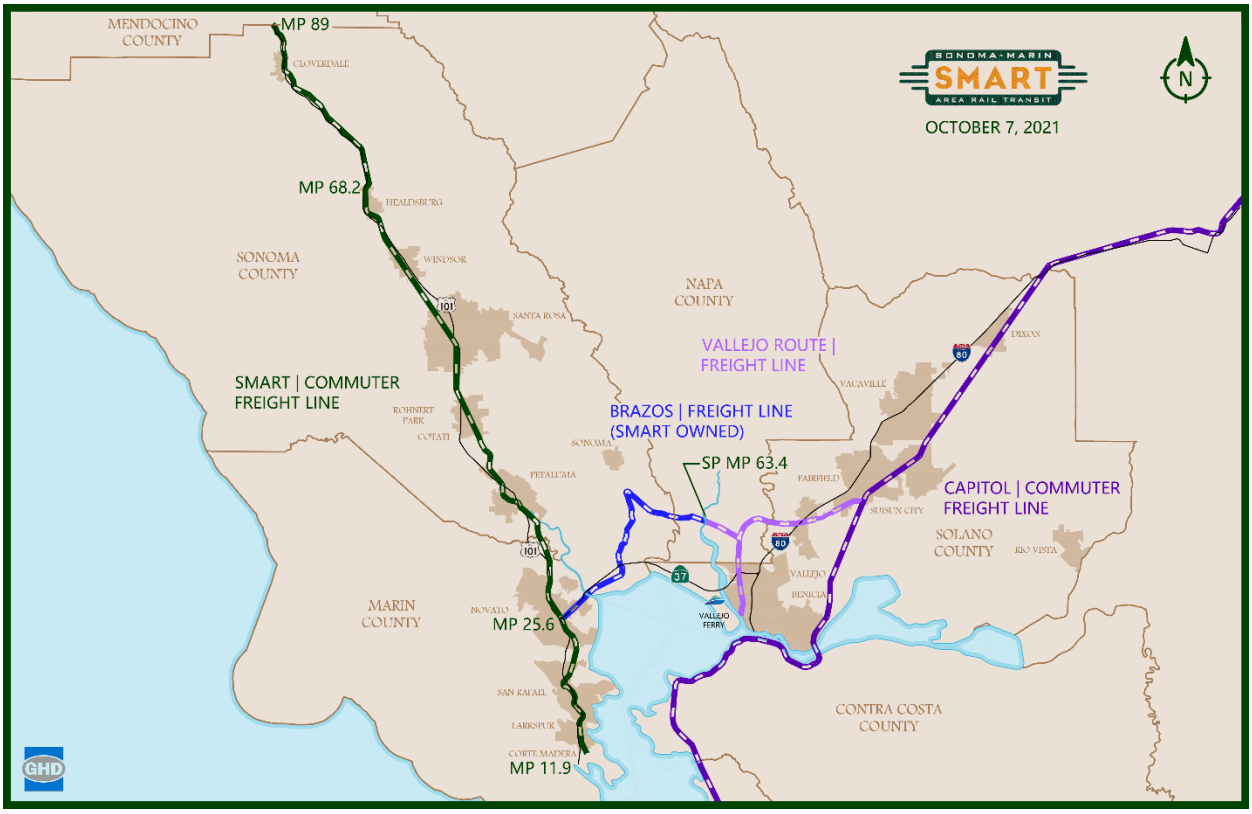


Figure 3.214: SMART Commuter and Freight Line
Source: SMART

There are currently 24 bridges in the segment of the SMART line from San Rafael to Santa Rosa in Sonoma County as well as 63 at grade crossings. A positive train control system was implemented for the length of the service corridor for customer and pedestrian safety.

The SMART commuter fleet consists of nine two-car Nippon Sharyo DMU trainsets. Each DMU car is powered by a Cummins QSK19-R diesel engine. Trains may be as long as station platforms provided there are cabs facing the outer ends. Each two-car train has room for over 300 passengers. Trains operate 19 round trips on weekdays at an average of 34.1 miles per hour. SMART freight trains do not transport hazardous materials and currently carry grain, food supplies and lumber.

On March 19th, 2023, a SMART freight train carrying corn tipped over in Sonoma County after heavy rainfall saturated the railroad tracks. Several cars derailed. There were no injuries.

On February 10th, 2023, a SMART commuter train hit a car in Novato, killing a woman. No passengers on the train were injured.

On September 17th, 2020, a SMART commuter train hit a car in San Rafael, injuring a woman. No passengers on the train were injured.

A July 2016 fire aboard one of Toronto's Nippon Sharyo units revealed a design flaw in the engine's crankshaft that would result in premature wear. SMART delayed operations until the engines could be serviced to correct the problem.

In December 2014, rains washed away some of the SMART train track beds near Petaluma in Sonoma County, but the trains were not running.

Airplane Accident
An airplane accident is an occurrence associated with the operation of an airplane where a person is fatally or seriously injured and where the aircraft sustains damage or loss. Airplane accidents can occur as a result of pilot error, mechanical issues associated with aircraft, terrorism, weather, or other human error. The majority of airplane accidents and fatalities occur before or during takeoff and during approach or landing.

There are two airports, two heliports and a seaplane base in Marin County, though none of them serve commercial flights. They are all private with the exception of the Gnoss Field Airport which is operated by Marin County Public Works.

Gnoss Field Airport - DVO
Novato, California

San Rafael Airport - CA35
San Rafael, California

San Rafael Private Heliport - 5CA3
San Rafael, California

Commodore Center Heliport - JMC
Sausalito, California

Commodore Center Seaplane Base - 22CA
Sausalito, California

There could be numerous different impacts from an airplane crash in the Marin County OA. The worst-case scenario would be if a large commercial aircraft were to crash in any heavily populated area of the OA resulting in a mass casualty incident and significant damage on the ground. The chances of this occurring are small. The most likely significant event would be a small to medium size airplane having an incident in a heavily populated area of the OA.

On July 8th 2023, a single-engine Cessna 172 plane crashed near San Rafael Airport. The plane's tail hit power lines before the plane struck the ground. One person was killed.

On May 9th, 2022, a fixed-wing, single-engine Vans RV-10 plane crashed into a hillside near the Golden Gate Bridge. At the time of the crash, the area was surrounded by thick fog. Two people were killed.

On May 16th, 1946, a U.S. Army B-17 Flying Fortress aircraft crashed into White's Hill near Fairfax, California. Two people were killed and six seriously injured.

Ship Accident
A ship accident is a marine event that occurs directly in connection with the operation of a ship and results in loss of life, environmental damage, material damage to a ship, and/or the total loss of a ship. Ship accidents can occur as a result of a fire, explosion, collision, grounding/shoaling, contact, heavy weather damage, hull cracking, or hull defect that can result in the immobilization of main engines, penetration of the ship, extensive structural damage,

and/or a breakdown that necessitates towing assistance. A ship accident can occur with both cargo and passenger ships.

Since the closure of the Marinship shipyard, Marin County does not have a marine port. There are several ferry terminals in Marin County that cater to passenger vessels:

Larkspur Landing, also known as the Larkspur Ferry Terminal, serves the Golden Gate Ferry which travels to two locations in San Francisco.

The Tiburon Ferry Terminal serves the Golden Gate Ferry which travels to two locations in San Francisco and the Angel Island–Tiburon Ferry Company for ferry service to Angel Island State Park.

The Sausalito Ferry Terminal serves the Golden Gate Ferry and the Blue & Gold Fleet which both travel to San Francisco.

The Golden Gate Ferry has a fleet of four catamarans and three monohull vessels. The monohull vessels are named M.S. Marin, M.S. San Francisco, and M.S. Sonoma. The Marin can carry 750 passengers, and the San Francisco and Sonoma can carry 630 passengers each. The catamarans are named the M.V. Del Norte, M.V. Golden Gate, M.V. Mendocino, and M.V. Napa. The Del Norte has a capacity of 400 passengers while the other three vessels have a capacity of 450 passengers. The Blue & Gold Fleet operates a fleet of 21 vessels, the largest of which can hold approximately 450 people. The Angel Island Tiburon ferry operates three vessels, the largest of which can hold 400 people.

There are numerous public and private marinas and boating facilities in the Marin County OA along San Francisco Bay, Richardson Bay and Tomales Bay that serve smaller passenger watercraft and commercial fishing vessels.

The most significant maritime incident that could occur in the Marin County OA would be from a large ferry at full capacity having an incident in San Francisco or Richardson Bay or at one of the ferry terminals.

On November 23rd, 2018, a ferry carrying 53 passengers from Larkspur to San Francisco crashed into the dock at the San Francisco Ferry Terminal. Two people on board were injured. Both the ferry and the San Francisco Ferry Building dock sustained damage in the crash.

SECTION 4.0: MITIGATION STRATEGY

44 CFR Requirement §201.6(c)(3) [The plan shall include the following:] 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.

§ 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.

§201.6(c)(3)(ii) [The hazard 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. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

§201.6(c)(3)(iii) [The hazard mitigation strategy shall include an] action plan, describing how the action identified in paragraph (c)(3)(ii) of this section 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.

§ 201.6(c)(3)(iv) For multi‐jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

§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

Mitigation projects that address the goals and objectives developed in the previous section were identified, evaluated, and prioritized. These actions form the core of the hazard mitigation plan. A capabilities assessment was conducted by Marin County and its participating jurisdictions, reviewing existing local plans, policies, and regulations for any other capabilities relevant to hazard mitigation planning. An analysis of their capability to carry out these implementation measures with an eye toward hazard and loss prevention was conducted.

The capabilities assessment required an inventory of each jurisdiction's legal, administrative, fiscal and technical capacities to support hazard mitigation planning. After completion of the capabilities assessment, each jurisdiction evaluated and prioritized their proposed mitigations. Each jurisdiction considered the social, technical, administrative, political, legal, economic, and environmental opportunities and constraints of implementing a particular mitigation action. This step resulted in a list of acceptable and realistic actions that address the hazards identified in each jurisdiction.

4.1 CHANGES IN DEVELOPMENT

Overall hazard vulnerability has remained unchanged over the past 5 years due to development and population changes. Marin County development and populations have increased in some cities and decreased in several others over the last 5 years. Overall vulnerability and risk reduction has been achieved through carefully planned development and application of the capabilities detailed in Section 4.3 CAPABILITY ASSESSMENT.

Marin County is a county located in the northwestern San Francisco Bay Area. As of the 2020 census, the population was 262,231. Its county seat and largest city is San Rafael. Marin County is across the Golden Gate Bridge from San Francisco and is included in the San Francisco–Oakland–Berkeley, CA Metropolitan Statistical Area.

Unincorporated Marin County includes most of West Marin, which borders the Pacific Coast and is the most rural part of the county, with Golden Gate National Recreation Area and the Point Reyes National Seashore occupying much of the area and small communities mixed throughout. There are also pockets of unincorporated areas along the central, Highway 101 corridor and the San Francisco Bay shoreline. Altogether, there are 22 distinct communities within unincorporated Marin County.

According to the U.S. Census, the population in unincorporated Marin is 66,987. While population in both the unincorporated County and the County grew in the first half of the 2010s, since 2017 the population has decreased in both areas, with the most significant drop occurring in the most recent year. Between 2020 and 2021, the population in the unincorporated County decreased by 2.6%, over twice as much as in the County as whole (1.2%). The Association Bay Area of Governments (ABAG) projects that the population in the unincorporated County will grow by only 2% in the next two decades.

Based on 2021 data from the California Department of Finance (DOF), the unincorporated area of Marin has 24,778 single-family homes constituting 83% of the total housing stock, 4,452 multi-family homes comprising 15% of all housing, and 588 mobile homes, for a total of 29,818 homes. The beauty of the natural landscape helps define the character of the community, but it also presents risk of natural hazards that present challenges to locating and building new housing, which have been skillfully met in the 2023 update to Marin County's Housing Element.

The Regional Housing Needs Assessment (RHNA) allocation for unincorporated Marin for the 2023-31 planning period has been determined by ABAG to be 3,569 housing units, including 550 units for extremely low income, 550 units for very low-income households, 634 units for low-income households, 512 units for moderate-income households, and 1,323 units for above moderate-income households.

Table 4.1 presents entitled projects and pending entitled projects in unincorporated Marin County.

Table 4.1: Unincorporated Marin County Future Growth Areas

Development	# of Units	# of Parcels	Project Date	Acres	Fire Severity Zone	Flood Zone
North Knoll Rd/Saint Thomas Dr	59	2	N/A	3.7	NA	NA
Pan Pac Ocean Site	32	4	N/A	16	NA	NA
Strawberry Commercial	60	4	N/A	2	NA	NA
Strawberry Rec District Site	46	1	N/A	2.3	NA	NA
Strawberry Village Center	100	2	N/A	3.3	NA	NA
Oak Manor Commercial Center	36	2	N/A	1.6	NA	NA
Kentfield Commercial Underutilized	71	12	N/A	2.4	Moderate	AE
Sloat Garden Center	31	2	N/A	1.1	NA	AO
Marin County Juvenile Hall	80	1	N/A	2.7	High	NA
Marinwood Plaza	125	4	N/A	125	High	NA
Office Building (Across from Juvenile Hall)	58	1	N/A	2.32	High	NA

St. Vincents	680	3		34	NA	NA
Marin Gateway Center	100	1		5	NA	X02
MLK Academy School	63	1		6	High	NA
825 Drake	74	1			Moderate	NA
Atherton Corridor	147	4		7.4	Moderate	NA
Black Point (Vacant)	58	1		14.5	Moderate	NA
Buck Center Vacant Property	249	2		12.5	NA	NA
Greenpoint Nursery	53	1		3.5	Moderate	AE
Bernard Osher Marin Jewish Community Center	49	4		1.6	Moderate	NA
Cal Park	110	11		3.7	NA	AE
Church of Jesus Christ	35	1		1.2	Moderate	NA
McPhail School	33	3		1.1	NA	AE
Old Gallinas Children Center	50	1		1.7	Moderate	NA
San Quentin Adjacent Vacant Property	230	1		7.7	NA	NA
Office – Lagunitas (Upper Floors and Rear Prop)	30	2		1.5	Moderate	NA
San Domenico School	50	1		1.7	High	NA
Sacramento/San Anselmo Properties	64	4		2.1	Moderate – NA	NA
Holiday Inn Mill Valley	72	1		2.4	NA	AE
Jack Krystal Hotel Parcel Site	36	1		1.2	NA	AE
Shoreline Unified School District	44	2		2.2	Moderate	NA
Olema Underutilized	36	4		3.6	Moderate – NA	AE
Pt Reyes Coast Guard Rehabilitation/Conversion	50	1		10	Moderate	NA
Pt. Reyes County Vacant Site	37	2		1.9	Moderate	NA
Shoreline Unified School District	44	2		2.2	Moderate	NA
Tomales (Vacant)	30	5		32	Moderate	NA
Total	**3,122**	**95**				

Table 4.1: Unincorporated Marin County Future Growth Areas
Source: Marin County Department of Community Development

4.2 Changes in Priorities

The overall hazard mitigation priorities in Marin County and its participating jurisdictions have not changed since the 2018 MJHMP update. However, the strategies that support the overall county priorities have changed since the 2018 MJHMP and are reflected in the sections below. There were many projects that were either ongoing day-to-day activities or were response related that were deleted from the 2018 MJHMP project list and not carried over to this plan update. Several actions were completed, and new projects were added to coincide with the changes in priorities, progress in local mitigation efforts and changes in development.

4.2.1 Vulnerability and Risk Reduction

All new development occurring in the future growth area identified in Table 4.1 will provide hazard vulnerability and risk reduction for the county. This reduction will occur due to the anticipated improvements and investments implemented in the 2023 revisions to the Marin County General Plan. In addition, any new development will comply with the most up-to-date building codes and use the latest techniques, further reducing vulnerabilities throughout the County.

4.3 Capability Assessment

Capabilities are the programs and polices currently in place to reduce hazard impacts or that could be used to implement hazard mitigation activities. The capability assessment identifies the local planning mechanisms where information from the 2018 MJHMP is incorporated and where updated hazard mitigation information from this 2023 MJHMP will be incorporated once approved. The capability assessment is divided into four sections: regulatory, administrative and technical, fiscal, and outreach and partnerships.

4.3.1 Regulatory Capabilities

The legal and regulatory capabilities include existing ordinances and codes that affect the county's or city's physical or built environment. Examples of legal and/or regulatory capabilities can include: a jurisdiction's building codes, zoning ordinances, subdivision ordnances, special purpose ordinances, growth management ordinances, site plan review, general plans, capital improvement plans, economic development plans, emergency response plans, and real estate disclosure plans. The table below lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place.

Table 4.2: Legal and Regulatory Capabilities

Plans	Yes/No Latest Update	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Countywide Plan: Water Resources, Environmental Hazards, and Public Safety Sections	Y 2023	Describes hazard areas and regulates current and future development based on known hazard areas. **Expansion and Improvement:** The HMP will be informed by referencing the Safety Element of the General Plan. The City will adopt the approved HMP as part of the General Plan Safety Element to meet the requirements of AB 2140.
Local Coastal Program	Y 2023	Pursuant to the California Coastal Act, Marin County's Local Coastal Program guides land use and development to ensure protection of public access and other coastal resources along Marin County's Pacific coastline. **Expansion and Improvement:** Included is a hazards section with policies that guide development standards and project review for areas subject to hazards including flooding, bluff retreat, earthquakes, and coastal erosion.
County Emergency Operations Plan	Y 2018	This plan describes what the County's actions will be during a response to all hazards. Includes annexes that describe in more detail the actions required of departments/agencies. Further, this plan describes the role of the Emergency Operation Center (EOC) and the coordination that occurs between the EOC and the local jurisdiction's departments and other response agencies. **Expansion and Improvement:** This plan may be used for mitigation in that it describes risk and vulnerability in the county.

Area Housing Authority Organizational Emergency Response Plan	Y	Enhances the Area Housing Authority's ability to effectively respond to emergencies by establishing procedures and assigning responsibilities. **Expansion and Improvement:** This plan may be used for mitigation in that it describes risk and vulnerability in the county.
Strategic Plan	No	
Capital Improvements Plan	Y 2021	The Capital Improvement Plan (CIP) was developed through collaboration between Capital Project staff of Public Works (DPW) and the County Administrator's office. Significant input was provided by multiple County departments, special districts, and enterprise funds of outside the general County General Funds. The CIP presents the proposed funding for the fiscal year (FY) of 2021-2022 to improve four key areas. Facility improvements, water resources, road infrastructure, and airports. **Expansion and Improvement:** CIP identifies potential hazard mitigation projects.
Economic Development Plan	Y 2022	The Marin County Economic Vitality Strategic Plan outlines "Flagship Initiatives" that the County of Marin and community partners will pursue over the next 5 years. Ultimately, the actions taken are intended to create a dynamic economy, providing equitable access to good jobs, opportunities for new business creation and a high quality of life for all Marin's residents. **Expansion and Improvement:** The plan has a strong focus on the impact of Covid-19 on the local economy, so may be used to show how disasters impact Marin's businesses and workforce, but does not have mitigation projects.
Continuity of Operations Plan	N	
Flood Safety Plan	Y	Plan addresses flood hazard response, not mitigation. It was created in 2018 and a 2023 update is in progress.
Engineering Studies for Streams	Y	There are many existing studies on marinflooddistrict.org. A study of Novato Creek is currently underway. **Expansion and Improvement:** These studies do identify potential hazard mitigation projects.
Open Space Management Plan	Y	Marin County Parks holds numerous plans that guide open space management: Strategic Plan, Road and Trail Management Plan, Vegetation and Biodiversity Management Plan, Inclusive Access Plan. **Expansion and Improvement:** Some of these plans contain guidance for mitigation projects and will be aligned with the MJHMP to describe developmental trends, hazards, and potential development in hazard areas.
Regional Transportation Plan (RTP)	Y 2021	The Transportation Authority of Marin (TAM) participates in the nine-county Metropolitan Transportation

		Commission, which adopted Plan Bay Area 2050. The plan outlines strategies spread across transportation, housing, the economy and the environment that seek a more equitable Bay Area. **Expansion and Improvement:** The plan does outline regional strategies for mitigation that may be used in Marin.
Stormwater Management Plan/Program	Y 2022	SWRP is a watershed-level resource planning document covering the County and Marin's 11 cities that describes watershed issues, identifies project opportunities with multiple benefits, and creates a prioritized list of project opportunities based on quantifying multiple benefits. **Expansion and Improvement:** The Plan will be aligned with the MJHMP in describing and developing mitigation actions to address climate change and drought. Water demand reduction strategies contained in the plan should be considered for inclusion as mitigation activities in the MJHMP.
Repetitive Loss Area Analysis	Y	On July 18, 2023, an expanded and updated multi-jurisdictional analysis was adopted by the County Board of Supervisors.
Community Wildfire Protection Plan	Y 2020	CWPP addresses wildfire risk and mitigation measures to take throughout the county. **Expansion and Improvement:** The plan can be used to support and guide mitigation efforts.
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Y	25 Community and area plans within Marin. Climate change adaptation policies and programs in Countywide Plan Safety, Element/Environmental Hazards section. Policies and programs address sea level rise, flooding, extreme heat, wildfire, equitable safety planning for vulnerable populations.
Building Code, Permitting, and Inspections	Y/N	Are codes adequately enforced?
Building Code	Y	Yes, the Community Development Agency established a code compliance program to ensure adherence with the County's law and regulations related to zoning, construction, and environmental health. **Expansion and Improvement:** Adherence to building codes, including local codes, regulates growth and controls land use patterns. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Building Code Effectiveness Grading Schedule (BCEGS) Score	Y 3	Yes, codes are adequately enforced. The County's score is 3.
Fire department ISO rating:	Y 3/3X	The County's ISO Rating is 3/3x; to be rated a "3" the parcel must be within 1000-ft of a municipal fire hydrant and 5-miles from a fire station. If either of those criteria are not met, the parcel is 3x (the old 9). Furthermore, per the State, if the parcel is more than 5-miles from a fire station, the parcel is rated "10". Yes, our codes are adequately

		enforced.
Site plan review requirements	Y	Yes, this is adequately achieved.
Land Use Planning and Ordinances	Y/N	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
County Code of Ordinances	Y	The purpose of this code is to establish the minimum requirements to safeguard the public health, safety, and general welfare through structural strength, means of egress facilities, stability, access to persons with disabilities, sanitation, adequate lighting and ventilation and energy conservation, and safety to life and property from fire and other hazards attributed to the built environment; to regulate and control the demolition of all buildings and structures, and for related purposes. **Expansion and Improvement:** Adherence to local ordinances regulates growth and enforces standards. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Zoning ordinance	Y 2023	Zoning ordinances are regularly updated (last update 2023). Yes, they are adequately administered and enforced. **Expansion and Improvement:** Adherence to local ordinances regulates growth and enforces standards. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Subdivision ordinance	Y	Yes, the ordinance is adequately administered and enforced. It is regularly updated (last update 2023). **Expansion and Improvement:** Adherence to local ordinances regulates growth and enforces standards. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Floodplain ordinance	Y	Marin County Code 23.09 Floodplain Management. Ordinance 3293 Sec 1, 1999 **Expansion and Improvement:** Adherence to local ordinances regulates growth and enforces standards. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)		Hazards are addressed in the Development Code, Title 22. Regularly updated. **Expansion and Improvement:** Adherence to local ordinances regulates growth and enforces standards. Addressing known hazards, as codes are updated, results in lowered risk and potentially fewer losses.
Flood insurance rate maps	Y	Hard copies of the FEMA Flood Insurance Rate Maps (FIRM) are maintained in the DPW Land Development office. Electronic copies are available on MarinMap.org. **Expansion and Improvement:** The maps can be used to support and guide mitigation efforts.

Elevation Certificates		Elevation Certificates are required for all new and substantially remodeled structures. Hard copies of all Elevation Certificates since 1982 are maintained in the DPW Land Development office. **Expansion and Improvement:** The certificates can be used to support and guide mitigation efforts.
Acquisition of land for open space and public recreation uses	Y	The County of Marin is committed to continuing to preserve open space. **Expansion and Improvement:** As a member of Together Bay Area, the County has prioritized purchasing multiple open space properties to that may be used as open space preserves and recreation space.
Erosion or sediment control program	Y	Requires property owners to have effective Best Management Practices in place to control pollutants in runoff from certain earth-disturbing activities. **Expansion and Improvement:** The program can be used to support and guide mitigation efforts.

Table 4.2: Marin County Legal and Regulatory Capabilities
Source: Marin County

Plans

44 CFR Requirement §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 improvements, when appropriate.

Marin General Plan

California Government Code 65300 requires that every City and County in the state have a General Plan. The Marin General Plan, adopted in 2007, was prepared over a multiyear period that included an extensive public review process. The Marin General Plan was updated in 2015, with the Housing and Safety Elements updated in 2023. The Marin General Plan is the most important policy and planning document in the county and is used by virtually every department. The Marin General Plan is the County's statement of its vision for the future. The Marin General Plan contains policies covering every aspect of the County: land use (how land can be developed), circulation, noise, air quality, housing, open space and conservation, and health and safety.

Marin County specific goals and policies related to mitigation of natural hazards are as follows:

Table 4.3: County of Marin General Plan	
Goal/Policy/ Program	**Explanation**
Land Use Element	
Goals	The requirements of the land use element are met in the following sections of the General Plan: water resources, community development, planning areas. The goals for these elements are: To support healthy watersheds and provide clean and adequate water for wildlife and humans. To utilize the Environmental Corridor Land Use Framework, coordinate with other jurisdictions, and map land use designations. To establish land use policies for the seven planning areas.
Policies	Overall policies for land use are intended: to protect, improve, and restore resources, including, directing land use to appropriate areas, reducing impacts, establishing land use designations and categories, and setting land use standards.
Programs	Programs for land use include, setting standards, monitoring and assessing programs, coordinating with other jurisdictions, following best practices, maintaining urban, agricultural, and natural corridors, consider amending urban service areas preserve resources, consider sea level rise. Programs also include, updating plans, reviewing codes, and revising zoning maps.
Conservation and Open Space Element	
Goal	To sustainably manage and preserve open space and biological resources for the benefit of the environment and Marin residents.
Policy	Policies for Conservation and Open Space include; support efforts and continue to acquire open space, balance shoreline protection and access, protect natural resources, support vegetation and wildlife disease management, control non-native plants and species, and restrict use of toxic chemical substances in habitats.
Program	Conservation programs include mapping natural communities, developing monitoring programs, and partnering with local actors. Open space programs include, coordinating with partners, establish compatible policies, inform and enforce, research, and acquire and protect lands.
Safety Element	
Goals	To reduce risk, increase safety, and bolster resilience in an equitable manner.
Policies	Policies in the Safety Element are to represent an inclusive, community-led approach to bolstering resilience. Furthermore, policies are evidence of an all-hazard informed, approach to protection, planning, and regulation.
Programs	Programs in the Safety Element include specific outreach and support to vulnerable populations, working with local leaders, coordinating with private and public partners, improving hazard information sharing with residents, improving infrastructure and systems to support/improve emergency response, and utilizing planning functions.
Public Facilities Element	
Goal	To provide adequate public facilities and services to accommodate the level of development planned by cities and towns and the County.
Policies	Policies to support the County's Public Facility Element include requiring cost sharing, effective planning, discouraging privatization, and reducing demand on public facilities.
Programs	Programs include requiring fair share contributions, planning for service expansion, preparing naming and sponsorship guidelines, and reducing demand on public facilities.

Table 4.3: Marin County Goals and Policies
Source: Marin County General Plan

4.3.2 Administrative and Technical Capabilities

The administrative and technical capability assessment identifies the personnel responsible for activities related to mitigation and loss prevention in Marin County. Many positions are full time and/or filled by the same person.

Table 4.4: Administrative and Technical Capabilities

Administrative	Yes/No	Is coordination effective?
Planning Commission	Y	Administrative Services Division handles finance and purchasing, budgeting, risk management, information technology, and business licensing for the community. The department may be responsible for implementing mitigation actions related to the department's scope. **Expansion and Improvement:** Prioritize new initiatives that support mitigation activities within the county.
Marin Operational Area Hazard Mitigation Working Group	Y	The County participates in the Marin Operational Area Hazard Mitigation Working Group that meets quarterly to review and manage Hazard Mitigation projects and programs. The Hazard Mitigation Committee is the supporting branch of the disaster council. **Expansion and Improvement:** Prioritize new initiatives that support mitigation activities within the County.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Many Flood Zones have creek and drainage maintenance programs. These only cover a small portion of creeks in the County, where residents formed a flood zone and where a project was initiated and right of way acquired by the Marin County Flood Control & Water Conservation District. Under the guidelines of the 2020 Pacific Gas and Electric Wildfire Mitigation Plan, PG&E will assist with mitigation efforts by clearing trees. **Expansion and Improvement:** The Marin Wildfire Prevention Authority will provide funding and educational programs on best practices for prevention efforts. Brush clearance and controlled burns will assist with mitigation efforts.
Mutual aid agreements	Y	Fire, Law, PW, Water agencies, MHOAC
Technical	Yes/No	Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Utilizes the emergency warning systems through the EAS system as their primary warning capability. Utilizes the emergency warning systems through telephone, text, and email notification utilizing reverse 911. **Expansion and Improvement:** To ensure the effectiveness of the emergency warning system and proper community response, monthly LRAD testing, and IPAWs drills are required.
Hazard data and information	Y	Yes, previous and new mitigation projects are informed by hazard data and information.

Grant writing	Y	Yes
Hazus analysis	N	
Staff/Personnel Resources	Yes/No Full Time/ Part Time	Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?
Chief Building Official	Y/PT	Yes **Expansion and Improvement:** Integrate mitigation actions and strategies into the Capital Improvements Program and annual budgeting.
Planner(s), engineer(s) and technical staff knowledge of land development, land management practices, and natural hazards.	Y/FT	Develops and maintains the General Plan, including the Safety Element. Develops area plans based on the General Plan, to provide more specific guidance for the development of more specific areas. Reviews private development projects and proposed capital improvements projects and other physical projects involving property for consistency and conformity with the General Plan. Anticipates and acts on the need for new plans, policies, and Code changes. Applies the approved plans, policies, code provisions, and other regulations to proposed land uses. **Expansion and Improvement:** Provide opportunities for continued education to staff to maintain knowledge of new code and regulatory requirements.
Engineer(s), Building Inspectors/Code Enforcement Officers or other professional(s) and technical staff trained in construction requirements and practices related to existing and new buildings.	Y/FT	Oversees the effective, efficient, fair, and safe enforcement of the California Building Code **Expansion and Improvement:** Provide opportunities for continued education to staff to maintain knowledge of new code and regulatory requirements.
GIS Coordinator	Y/FT	Yes
Community Development Staff	Y/FT	Develops and maintains the General Plan, including the Safety Element. Develops area plans based on the General Plan, to provide more specific guidance for the development of more specific areas. Reviews private development projects and proposed capital improvements projects and other physical projects involving property for consistency and conformity with the General Plan. **Expansion and Improvement:** Provide opportunities for continued education to staff to maintain knowledge of new code and regulatory requirements.

Engineer(s), project manager(s), technical staff, equipment operators, and maintenance and construction staff.	Y/FT	Maintains and operates a wide range of local equipment and facilities as well as providing assistance to members of the public. These include providing sufficient clean fresh water, reliable sewer services, street maintenance, storm drainage systems, street cleaning, streetlights and traffic signals. **Expansion and Improvement:** Provide opportunities for continued education to staff to maintain knowledge of new code and regulatory requirements.
Floodplain Administrator	Y/FT	Reviews and ensures that new development proposals do not increase flood risk, and that new developments are not located below the 100 year flood level. In addition, the Floodplain Administrator is responsible for planning and managing flood risk reduction projects throughout the unincorporated county. **Expansion and Improvement:** Provide opportunities for continued education to staff to maintain knowledge of new code and regulatory requirements.
Emergency Management	Y/FT	Maintains and updates the Emergency Operations Plan for the county. In addition, coordinates local response and relief activities within the Emergency Operation Center, and works closely with local, state, and federal partners to support planning and training and to provide information and coordinate assistance. **Expansion and Improvement:** Develop a quarterly countywide emergency management and hazard mitigation coordination meeting.
Procurement Services Manager	Y/FT	Provides a full range of municipal financial services, administers several licensing measures, and functions as the county's Procurement Services Manager.
Marin County Sheriff's Office Staff	Y/FT	Yes, the Marin County Sheriff's Office is comprehensively staffed and trained on hazards. In addition to field services, the responsibilities of the Sheriff's Office include maintaining the county jail, providing security to the Superior Court, operating a countywide communications division, operating a documentary services division consisting of records, warrants, civil units, and more. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate with neighboring jurisdictions to increase County and region-wide capabilities.
Marin County Fire Staff	Y/FT	The Marin County Fire has responsibility for fire suppression and emergency response in commercial, residential, wildland / urban interface. The Marin County Fire supports implementation of mitigation actions that reduce the risk of wildfire. The Marin County Office of Emergency Management, a division of the County Fire Department, conducts

		emergency preparedness activities for the community. Mitigation activities related to emergency preparedness can be implemented by OEM in partnership with other county partners. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate with neighboring jurisdictions to increase County and region-wide capabilities.

Table 4.4: Marin County Goals and Policies
Source: Marin County General Plan

4.3.3 Fiscal Capabilities

The fiscal capability assessment shows specific financial and budgetary tools available to Marin County such as community development block grants; capital improvements project funding; authority to levy taxes for specific purposes; fees for water, sewer, gas, or electric services; impact fees for homebuyers or developers for new development; ability to incur debt through general obligations bonds; and withholding spending in hazard-prone areas.

Table 4.5: Marin County Fiscal Capabilities

Financial	Yes/No	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	Yes, Capital Improvements Project funding has been used in the past and can be used for future mitigation projects.
Authority to levy taxes for specific purposes	Y	Post Prop 13 and Prop 218 the success in levying taxes for mitigation projects has been significantly reduced. Many flood-prone areas historically relied on special taxes to build out levee improvements and pump stations. In the last 20 years (a total of 4) special tax measures for flood mitigation projects have not passed. In March 2020, tax Measure C was passed. The measure will raise approximately $20 million annually to fund wildland fire hazard mitigation efforts throughout the county. Marin Wildfire Prevention Authority (MWPA) was formed to serve as the governing body to manage the funds raised through Measure C funds go to public outreach, vegetation management, fire hazard assessments, among other projects.
Fees for water, sewer, gas, or electric services (water - fire flow increase, sewer, more research on G&E)	Y	Funding has not been used in the recent past for mitigation, but could possibly fund future mitigation activities. For example, some Special Districts are considering potential projects with dual water storage and flood benefit utilizing water fees.
Impact fees for new development	Y	Road and transportation related impact fees are collected in connection with building permit issuance. These funds are not available for future mitigation.
Storm water utility fee	Y	Storm water fees have been used for mitigation projects in Flood Zone 9, including: bridge replacement, pump stations, levee evaluations, and stormwater detention basin construction. The Zone 9 fee expires in 2027. We are following the work of other agencies after SB 231 to see if the County would pursue it again.
Incur debt through general obligation bonds and/or special tax bonds	N	This approach has been taken in the 1980s for flood mitigation in Novato creek, but not recently. They typically require voter approval to levy a special tax to pay back the bonds but those have not been successful in recent years.
Incur debt through private activities	N	

Community Development Block Grant	Y	The County has been administering the CDBG program for 30+ years through a collaboration with the cities and towns. Funds are currently used to serve low-income residents of Marin and address historical patterns of segregation in our communities. Priorities for the use of funds are set through a Countywide Priority Setting committee. Given the small amount of funds available, less than $1.5 million countywide and many competing needs, this may not be a viable source for mitigation funds.
Other federal funding programs	Y	Yes, federal funding has been used for mitigation projects through Emergency Management Performance Grant and the Hazard Mitigation Assistance Program.
State funding programs	Y	There have been several Department of Water Resources grants in support of flood mitigation projects and there will likely continue to be in the foreseeable future. The State Coastal Conservancy grants have funded sea level rise adaptation.

Table 4.5: Marin County Fiscal Capabilities
Source: Marin County

4.3.4 Outreach and Partnerships Capabilities

The outreach and partnerships capability assessment shows outreach and public education programs available to the County and the County partnerships utilized to promote those programs.

Table 4.6: Marin County Community Outreach

Outreach and Partnerships	Yes/No	Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	Yes, these groups can assist with informing project plans. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate with neighboring jurisdictions to increase County and region-wide capabilities.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes	Yes, these communities can assist with informing project plans. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate with communities to increase educational opportunities.
Natural disaster or safety related school programs	Yes	Yes, school partners can assist with informing project plans. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate with schools to increase educational opportunities.
StormReady certification	Yes	Marin County is a StormReady community. **Expansion and Improvement:** Proactively identify opportunities to expand participation.
Firewise Communities certification	Yes	With over 80 Firewise Communities, Marin is the fastest growing "Firewise USA" county in the nation. These communities can assist with informing project plans. **Expansion and Improvement:** Proactively identify opportunities to expand participation and increase educational opportunities.
Community Rating System	Yes	Marin County is a Class 6 CRS community
Public-private partnership initiatives addressing disaster-related issues	Yes	Through Marin Voluntary Organizations Active in Disasters, the County of Marin leverages partnerships with public-private partners for disaster related initiatives. **Expansion and Improvement:** Proactively identify opportunities to coordinate and collaborate.

Table 4.6: Marin County Community Outreach
Source: Marin County

4.4 Participation in the National Flood Insurance Program

Marin County has participated in the Regular Phase of the NFIP since March 1, 1982. Since then, the County has administered floodplain management regulations that meet or exceed the minimum requirements of the NFIP. Under that arrangement, residents and businesses paid the same flood insurance premium rates as most other communities in the country.

The Community Rating System (CRS) was created in 1990. Marin County has been in the CRS program since May 1, 2016. The program is designed to recognize floodplain management activities that are above and beyond the NFIP's minimum requirements. CRS is designed to reward a community for implementing public information, mapping, regulatory, loss reduction and/or flood preparedness activities. On a scale of 10 to 1, Marin County is currently ranked Class Six community, which gives a 20% premium discount to individuals in the unincorporated Marin County Special Flood Hazard Area (SFHA), and a 10% discount to policyholders outside the SFHA.

Presently, the County manages its floodplains in compliance with NFIP/CRS requirements and implements a floodplain management program designed to protect the people and property of the County. Floodplain regulations are a critical element in local floodplain management and are a primary component in Marin County's participation in the NFIP. As well, Marin County's floodplain management activities apply to existing and new development areas, implementing flood protection measures for structures and maintaining drainage systems to help reduce the potential of flooding within the unincorporated Marin County.

As part of the County's efforts to comply with NFIP, Marin County will make updates and revisions to these regulations periodically to ensure they are most effective at minimizing the threat of harm from flood events. These updates and revisions may be promoted by changes in local demographics, shifts in land use, changes to flood regimes such as frequency and intensity of flood events, and other factors that may warrant action. The County will also continue to incorporate any changes to the locations and designations of mapped floodplains into future planning documents, including future updates to this Plan.

The County will also explore opportunities to enforce or enhance County ordinances, building code, and other regulatory actions to address substantial improvements/substantial damage properties. Marin County will consider developing a Substantial Damage Management Plan.

The Marin County will continue to manage their floodplains in continued compliance with the NFIP. An overview of the Marin County's NFIP status and floodplain management program is discussed in Table 4.7. Additional information on the Marin County's CRS program follows.

The activities credited by the CRS program provide direct benefits to Marin County and its residents,

including:

- Enhanced public safety;
- A reduction in damage to property and public infrastructure;
- Avoidance of economic disruption and losses;
- Reduction of human suffering; and
- Protection of the environment.

The activities for which Marin County implements and receives CRS credits include:

310 Elevation Certificates – Marin County receives credit for creating Construction Certificate Management Procedures as well as to maintaining Post-FIRM elevation certificates.

320 Map Information Services – Marin County receives credit for providing map information to inquirers in all seven elements such as providing information from the FIRM necessary for flood insurance, notifying inquirers of the mandatory purchase of flood insurance for all federally backed loans, providing information regarding properties located in a floodway, sea level rise area, tsunami or dam inundation area, repetitive loss areas, and areas that should be protected such as wetlands and critical habitat.

330 Outreach Projects – Marin County has a robust outreach program and receives maximum credit for this Activity. The County mails out an annual brochure prior to the rainy season to properties in the Special Flood Hazard Area, Repetitive Loss Areas, Tsunami and Dam inundation areas and to local lenders, real estate brokerages and insurance companies. Marin County also receives credit for its social media outreach on Facebook, Twitter and NextDoor.

340 Hazard Disclosure – Marin County works with local real estate brokerages to encourage them to advise prospective home buyers of required disclosures and receives credit for this Activity.

350 Flood Protection Information – Marin County receives credit for Elements in this Activity by maintaining required information documents available in the Marin County Library catalog as well as documents that are pertinent to residents. The County also receives credit for maintaining a presence on the County Public Works website.

360 Flood Protection Assistance – Marin County receives credit for providing property protection advice. The County also provides information about available financing, such as grants and other funding sources, to all who inquire. County staff is also available to make site visits to assist residents.

370 Flood Insurance Promotion – Marin County receives credit for advising people about flood insurance.

410 Floodplain Mapping – Marin County receives credit for mapping special hazards such as tsunamis.

420 Open Space Preservation – Marin County receives credit for preserving open space, preserving the natural functions of open space, creating incentives for preserving open space and for maintaining low density zoning regulations.

430 Higher Regulatory Standards – Marin County receives credit for many of the elements under this Activity such as freeboard, foundation protection, providing local drainage protection, and administering floodplain management regulations. The County also receives credit for

creating, adhering, and enforcing a robust building code. The County also enforced the floodplain management provisions of our zoning, subdivision and building code ordinances.

440 Flood Data Maintenance – Marin County receives credit for maintaining digital Flood Rate Insurance Maps (FIRM). Electronic availability improves public access. Maintaining copies of previous version of the FIRMs provides a significant research tool and valuable service to the residents of Marin County.

450 Stormwater Management – Marin County receives credit for maintaining a Storm Water Management system via healthy erosion and sediment control requirements and water quality regulations. The County regulates development on a case-by-case basis to ensure that runoff is treated before it leaves the site. The County also ensures that stormwater runoff from a site will not exceed the pre-development runoff. The County promotes the use of onsite bio-retention areas or other treatment facilities have been provided to mitigate runoff and water quality. The County enforces regulations to minimize erosion from land disturbance due to construction.

502 Repetitive Loss – Marin County is a Category C community with greater than 50 repetitive Loss properties. The repetitive loss areas are mapped and can be viewed by the public on MarinMap.org. A notice is mailed to each property in the repetitive loss area to advise them of flood prevention measures, insurance requirements and availability, and available financial assistance.

510 Floodplain Management – Marin County receives credit for both its Floodplain Management Plan and its Repetitive Loss Area Analysis. The County has adopted the Marin County Multi-Jurisdictional Local Hazard Mitigation Plan and produces an annual progress report. Marin County participates in FEMA's Home Elevation Program which is actively raising homes in the Special Flood Hazard Area.

520 Acquisition and Relocation – Marin County receives some credit for removing homes that have been demolished from the Special Flood Hazard Area.

530 Flood Protection – Marin County receives credit for elevating structures in the Special Flood Hazard Area above the Base Flood Elevation. Staff also provide information on other flood protection techniques such as barriers, wet floodproofing and dry floodproofing. Marin County participates in FEMA's Home Elevation Program which is actively raising homes in the Special Flood Hazard Area.

540 Drainage Systems Maintenance – Marin County receives credit for removing debris from natural drainage channels and maintaining an active and ongoing maintenance program of problem site area. Marin County also has strong stream dumping regulations which includes outreach to the public.

610 Flood Warning and Response - Marin County receives credit for all of the Elements in the Flood Warning and Response Activity. These Elements include our flood threat recognitions system that identifies an impending flood, our emergency warning dissemination system that warns the public of impending flood, our flood response plan and operations, and coordination with critical facility operators. Marin County is also a registered Storm Ready Community and a Tsunami Ready Community. Marin County receives credit for annual outreach advising

residents of flood warning and safety precautions. The County organizes and participates in an annual flood exercise with the purpose of being prepared for an actual activation of the operations. Following an exercise, the County produces an After Action Report which includes lessons learned as a method to document and improve our flood warning and response procedures.

630 Dams: Credit is provided for a State Dam Safety Program.

Table 4.7: Participation in the National Flood Insurance Program (NFIP)

NFIP Topic	Source of Information	Comments
Insurance Summary		
How many NFIP policies are in the community? What is the total premium and coverage?	State NFIP Coordinator or FEMA NFIP Specialist	As 10/2/23 there are 1327 policies in force. Total premiums $1,734,601. Coverage is $406,7104,000.
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were for substantial damage?	FEMA NFIP or Insurance Specialist	As of 10/2/23 the total number of claims was 773. Total amount of paid claims is $10,173,472.49. Since 1978, there have been 51 substantial damage claims.
How many structures are exposed to flood risk within the community? *"flood risk" is defined as the 1% annual chance flood (100-year flood. Numbers are from overlay of FEMA SFHA and building stock data.	Community Floodplain Administrator (FPA)	There are 4536 buildings in the SFHA in the unincorporated County
Describe any areas of flood risk with limited NFIP policy coverage	Community FPA and FEMA Insurance Specialist	None
Staff Resources		
Is the Community Floodplain Administrator or NFIP Coordinator certified?	Community FPA	No
Is floodplain management an auxiliary function?	Community FPA	Yes
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	Community FPA	Permits are reviewed for FEMA regulation and compliance. GIS is used to ascertain if property is in a flood zone. A final inspection is performed to ensure compliance. An annual outreach is mailed to all properties in SFHA.
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	There are no barriers to running an effective NFIP program.

Table 4.7: Participation in the National Flood Insurance Program (NFIP)

NFIP Topic	Source of Information	Comments
Compliance History		
Is the community in good standing with the NFIP?	State NFIP Coordinator, FEMA NFIP Specialist, community records	yes
Are there any outstanding compliance issues (i.e., current violations)?		no
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?		9/15/20
Is a CAV or CAC scheduled or needed?		The next scheduled CAV will be October 19, 2023
Regulation		
When did the community enter the NFIP?	Community Status Book http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book	March 1, 1984
Are the FIRMs digital or paper?	Community FPA	Marin County has both digital and paper FIRMS
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	Community FPA	Marin County regulations meet and exceed FEMA requirements in the following: development limitations, higher regulatory standards for freeboard, foundation protection, and building codes. Marin has adopted and enforces international building Codes.
Provide an explanation of the permitting process.	Community FPA, State, FEMA NFIP Flood Insurance Manual http://www.fema.gov/flood-insurance-manual Community FPA, FEMA CRS Coordinator, ISO representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	Permit applications are received, reviewed, and approved by professional staff. Inspections are required at foundation, close-in and at final. All projects that will be constructed in the SFHA will be subject to the provisions of Marin County Code 24.04 Development Code and 23.09 Floodplain Management Code. The finished floor elevation of any substantial remodel in the SFHA must be at least 1 foot above the BFE.
Community Rating System (CRS)		
Does the community participate in CRS?	Community FPA, State, FEMA NFIP	yes
What is the community's CRS Class Ranking?	Flood Insurance Manual http://www.fema.gov/flood-insurance-manual	Class 6

Table 4.7: Participation in the National Flood Insurance Program (NFIP)		
NFIP Topic	**Source of Information**	**Comments**
What categories and activities provide CRS points and how can the class be improved?		Marin receives credit in Series 310, 320, 330, 340, 350, 360, 370, 410, 420, 430, 440, 450, 510, 520. 530, 540, and 610. Marin County could improve its class ranking by doing more work in Activities 420, 430, 450, 520, and 630
Does the plan include CRS planning requirements	Community FPA, FEMA CRS Coordinator, ISO representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	yes

Table 4.7: Participation in the National Flood Insurance Program (NFIP)
Source: FEMA, Marin County

NFIP Insurance Coverage Details

Unincorporated Marin County joined the NFIP on March 1, 1982. NFIP insurance data provided by FEMA indicates that as of June 22, 2023, there were 1462 policies in force in the unincorporated Marin County with $1,994,164 in premiums, resulting in $452,421,500 of insurance in force.

There have been 889 closed paid losses totaling $10,360,625. Fifty-one (51) of the claims were considered substantial damage losses.

Of these losses, 572 parcels were in A or V zones, and 317 were in B, C, or X zones. Of the 889 claims, 736 were associated with pre-FIRM structures and 33 with post-FIRM structures.

As of October 19, 2023, there were ninety-three (93) repetitive loss structures in the unincorporated County. Five (5) were in X zones, one (1) was in an A 0.2% zones, one (1) was in an AH zone, three(3) were in AO zones , four (4) were in A zones, fifty-four (54) were in AE zones, fifteen (15) were in AE Floodway zones, and ten (10) were in VE zones. These repetitive loss structures account for $5,090,322 of the total losses in unincorporated Marin County. There were 11 severe repetitive loss properties in unincorporated Marin County totaling $1,152,259.

Repetitive Loss Structures
Repetitive Loss Residential Structures: 84
Repetitive Loss Non-Residential Structures: 9
Severe Repetitive Loss Residential Structures: 6
Severe Repetitive Loss Non-Residential Structures: 3

4.4.1 Substantially Improved Or Substantially Damaged Properties

The NFIP includes a requirement that new buildings and substantially improved buildings be constructed in ways that minimize or prevent damage during a flood. This requirement grew out of the recognition that there were large numbers of buildings already located in flood prone areas that would continue to be subject to damage.

The purpose of the substantially improved (SI) or substantially damaged (SD) requirements is to protect the property owner's investment and safety, and, over time, to reduce the total number of buildings that are exposed to flood damage, thus reducing the burden on taxpayers through the payment of disaster assistance. The SI/SD requirements are triggered when the local official determines that the cost of repairing or improving a building in an SFHA equals or exceeds 50 percent of the building's market value (excluding land value).

The Marin County Code 23.09 addresses Floodplain Management standards of construction. The Marin County Construction Certificate Management Procedures, updated May 2023, describes of how the County implements the substantial improvement/substantial damage provisions of their floodplain management regulations.

The Department of Public Works, Land Development Division is responsible for the review, approval and inspection of all land development issues within the County of Marin including FEMA related administrative documents. Review, approval, and inspections of the structure associated with permits are conducted by both the Land Development Division of Public Works and the Building and Safety Division of the Community Development Department.

The following explains the management procedures for review of Elevation Certificates and all other required floodplain-related construction certificates including, but not limited to, Floodproofing Certificates, V Zone design certificates, and engineered flood opening certificates. These procedures outline the types of certificates required, the collection and review of all certificates, how corrections should be made, where the certificates are stored/archived, and how we make these certificates available to the public.

(a) TYPES OF CERTIFICATES REQUIRED

When any new construction, substantial improvement or repair for a substantially damaged building is conducted in the Special Flood Hazard Area (SFHA) the Land Development Division of Public Works shall require an Elevation Certificate and any other floodplain-related certificates that are appropriate such as Floodproofing Certificate for Non-Residential Structures, V Zone design certificate, and certification of engineered flood openings for the development.

(a) & (b) WHEN CERTIFICATES ARE REQUIRED

The applicant shall submit an Elevation Certificate marked "construction drawings" with the building permit application. This Elevation Certificate shall be used to determine that the proposed design is in compliance with the *Marin County Code 23.09*. After the foundation is built and the elevation of the lowest floor is determined, another Elevation Certificate shall be submitted that is marked "building under construction." This will document the elevation of surrounding grades and the lowest floor to ensure they comply with the approved plans before further construction is allowed. Once construction on the building is finished and all adjacent grading is finalized, a complete and correct "finished-construction" Elevation Certificate must be submitted by the applicant to show the "as-built" characteristics of the building. A "finished-

construction" Elevation Certificate must be received, reviewed, and corrected (if necessary) before a final inspection can be scheduled. At this point, all other required certificates must also be submitted and reviewed.

Standard Operating Procedure: A final Elevation Certificate is required as a condition to be completed before the final inspection of the building permit. Prior to issuance a hold is placed on the permit pending the submittal of the Elevation Certificate to the Department of Public Works (DPW).

As part of the County's efforts to comply with NFIP, Marin County and the Marin OA Hazard Mitigation Working Group will annually review and make updates and revisions to these regulations as necessary to ensure they are most effective at minimizing the threat of harm from flood events. These updates and revisions may be promoted by changes in local demographics, shifts in land use, changes to flood regimes such as frequency and intensity of flood events, and other factors that may warrant action. The County will also continue to incorporate any changes to the locations and designations of mapped floodplains into future planning documents, including future updates to this Plan.

The County will also explore opportunities to enforce or enhance County ordinances, building code, and other regulatory actions to address substantial improvements/substantial damage properties. Marin County will consider developing a Substantial Damage Management Plan.

4.5 MITIGATION GOALS

44 CFR Requirement § 201.6(c)(3)(i) [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long - term vulnerabilities to the identified hazards.

The information developed from the risk assessment was used as the primary basis for developing mitigation goals and objectives. Mitigation goals are defined as general guidelines explaining what each jurisdiction wants to achieve in terms of hazard and loss prevention.

Hazard Risk Prioritization

↓

Mitigation Goals & Objectives

↓

Mitigation Project Identification

↓

Mitigation Project Implementation

Goal statements are typically long-range, policy-oriented statements representing jurisdiction-wide visions. Objectives are statements that detail how each jurisdiction's goals will be achieved, and typically define strategies or implementation steps to attain identified goals. Other important inputs to the development of jurisdiction-level goals and objectives include performing reviews of existing local plans, policy documents, and regulations for consistency and complementary goals, as well as soliciting input from the public.

The following represents overarching strategic goals associated with the identification and eventual implementation of appropriate and meaningful hazard mitigation efforts in relation to prioritized hazards and threats confronting Marin County. These goals form the basis for specific supporting process objectives and are shown from the highest priority, at the top of the list, to those of lesser importance.

The establishment of hazard mitigation goals represents both individual and collective strategies that have been mutually agreed upon by the Steering Committee and have changed with the 2023 MJHMP update. Objectives were added to Goals 2 and 5. Eventually, these goals have been adopted by Marin County and its participating jurisdictions as the guiding policy behind local hazard mitigation efforts, in conjunction with other associated principles.

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the community;
- Encompass all aspects of community, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- A time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation. Implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that they

are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals. Objectives define strategies to attain the goals and are more specific and measurable.

Goal 1: Minimize risk and vulnerability of the community to the impacts of natural hazards and protect lives and reduce damages and losses to property, economy, and environment in Marin County.

- Minimize economic and resource impacts and promote long-term viability and sustainability of resources throughout Marin County.
- Minimize impact to both existing and future development.
- Provide protection for public health.
- Prevent and reduce wildfire risk and related losses.

Goal 2: Provide protection for critical facilities, infrastructure, utilities, and services from hazard impacts.

- Incorporate defensible space and reduce hazard vulnerability.
- Develop redundancies in utilities and services.
- Enhance resilience through enhanced construction.

Goal 3: Improve public awareness, education, and preparedness for hazards that threaten our communities.

- Enhance public outreach and participation in the Alert Marin Emergency Notification System.
- Enhance public outreach, education, and preparedness program to include all hazards of concern.
- Increase public knowledge about the risk and vulnerability to identified hazards and their recommended responses to disaster events, including evacuation and sheltering options.
- Provide planning and coordination for "At-Risk" populations.
- Provide planning and coordination for companion animals, livestock, and other animal populations.
- Increase community awareness and participation in hazard mitigation projects and activities.

Goal 4: Increase communities' capabilities to be prepared for, respond to, and recover from a disaster event.

- Improve interagency (local, state, federal) emergency coordination, planning, training, and communication to ensure effective community preparedness, response and recovery.
- Enhance collaboration and coordination of disaster-related plans, exercises, and training with local, state, and federal agencies, neighboring communities, private partners, and volunteers.
- Enhance the use of shared resources/Develop a strong mutual aid support system.
- Create and maintain a fully functional, interoperable radio and communication system with all regional public safety partners.

Goal 5: Maintain FEMA Eligibility/Position the communities for grant funding.

- Review hazard events and ongoing hazard mitigation projects annually.

- Assess the need to pursue or adjust hazard mitigation projects after significant hazard events.

Goal 6: Reduce exposure to High Hazard Dams that pose an unacceptable risk to the public.

- Improve alert and warning systems to provide residents downstream of a High Hazard Dam to receive timely warning to evacuation when threatened by potential or imminent dam failure.
- Enhance overall community preparedness to respond and evacuate a potential or imminent dam failure.
- Increase public awareness of the risk posed by High Hazard Dams and the potential for relocation of housing outside a possible inundation zone.
- Prioritize High Hazard Dam Mitigation projects and programs.

4.6 Hazard Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii) [The hazard 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. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

§201.6(c)(3)(iii) [The hazard mitigation strategy shall include an] action plan, describing how the action identified in paragraph (c)(3)(ii) of this section 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.

§ 201.6(c)(3)(iv) For multi‐jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

The 2023 Marin County OA MJHMP was revised to reflect progress in local mitigation efforts. Mitigation projects were selected for each hazard and for Marin County and its participating jurisdictions based off the hazard risk assessment. The projects are supported by the mitigation goals and objectives, and are ranked using the following criteria; approximate cost, timeframe of completion, whether the project requires Board of Supervisors regulatory action, and an assumption as to whether or not the project would be subject to CEQA or NEPA requirements. Funding sources are identified for all projects. All projects consider new, future, and existing development. Project worksheets are used by the Planning Team and Steering Committee to describe criteria for each project.

4.6.1 Progress in Local Mitigation Efforts

This plan has been created as a "living" document with input from the population and professionals within Marin County and its participating jurisdictions. Based on the planning meetings and the progress monitored by the steering committee members, several mitigation

actions were accomplished since the last planning cycle. Table 4.8 provides a brief description of the progress made in the local mitigation efforts and the plan for those mitigation actions that were not completed or are ongoing.

4.6.2 Status of Previous Mitigation Actions

Table 4.8 summarizes the actions that were recommended in the previous version of the hazard mitigation plan and their implementation status at the time this update was prepared.

Table 4.8: Status of Previous Hazard Mitigation Actions

Action Number / Name	Completed	Ongoing	Not Started	Still Relevant	Included in Updated Action Plan
(1) Seismic Retrofit of County-owned buildings not current to code. West Marin Service Center, Point Reyes Station	X				N
(2) Seismic Retrofit of County-owned buildings not current to code. Civic Center Roof Replacement	X				N
(3) Seismic Retrofit of County-owned buildings not current to code. Tomales Fire Station- Replacement	X				N
(4) Seismic Retrofit of County-owned buildings not current to code. 120 N. Redwood- Seismic Assessment		X			Y
(5) Seismic Retrofit of County-owned buildings not current to code. Marin Center- Seismic Assessment of the Veteran's Memorial Auditorium & Exhibit Hall		X			Y
52 Follow all four phases of FEMA's How-to-Guide: "Integrating Historic Property and Cultural Resource Considerations Hazard Mitigation Planning"			X		N
Acquire electric bikes and safety equipment for official use during major disasters.			X		N
Arroyo Corte Madera del Presidio Riverine Flood Risk Reduction project: Assist with reducing the frequency and severity of flooding. Study completed on 03/2022 with the best option to move forward with a restoration project.			X		N
Assess bulkheads surrounding Tomales Bay		X			Y
Azalea Ave Bridge Replacement project will replace the original Azalea Bridge, to decrease flood hazards.					Town of Fairfax is project lead.
Bothin Marsh Restoration project. Thin-lift placement of sediment from Coyote Creek into Bothin Marsh.		X			Y
Improve City of Novato Drainage Improvement informed by study currently in process. Goal to bypass high flows, increase storage, develop flood barriers, daylighting drainages, and install pump stations and/ or tide gates.		X			Y
Conduct a comprehensive finished floor-elevation inventory. Project to understand a Floor Elevation Survey to determine the floor elevation of a structure.	X				N
Consider sea level rise adaptation from Collaboration: Sea-level Marin Adaption Response Team (C-SMART).		X			Y

Table 4.8: Status of Previous Hazard Mitigation Actions

Action Number / Name	Completed	Ongoing	Not Started	Still Relevant	Included in Updated Action Plan
Continue supporting the Sonoma County Water Agency led Advanced Quantitative Precipitation Information effort.		X			Y
Corrillo Drive Pipe Rehabilitation was completed by San Rafael in cooperation with flood zone 6.	X				N
Corte Madera Creek Flood Risk Management Project will help to reduce the frequency of flooding by enhancing natural stream functions. An HMGP application for components in the channel that reduce flood risk was submitted August 4, 2023		X			Y
Cove Pump Station Improvements were completed in 2022 and will assist with the updates to the pump.	X				N
Coyote Creek Levee Improvements - a levee study was completed, and a portion of the levee system has a project underway for seepage mitigation. It is in the design phase.		X			Y
Crest Marin, Cardinal, and Shoreline Pump Station Upgrades. A condition assessment for Crest Marin is nearly complete.		X			Y
Deer Island Basin Project to setback levees, restore tidal wetlands, and increase tidal prism to reduce sedimentation and flood risk. CEQA complete, design underway.		X			Y
Develop Renters and Homeowners Guides to Flood Preparedness project outlining safety directives for homeowners and renters during a potential flood hazard.			X	Y	Y
Easkoot Creek Flood Flow Bypass Project. National Park Service is working with FHWA and the Flood District to identify and plan a potential overflow channel from Easkoot Creek to the Ocean.		X			Y
East Creek Outfall Modifications project is a pavement rehabilitation project and potentially include tide gates to reduce sunny day flooding of Tiburon Blvd.		X			Y
Encourage property owners in SFHAs to purchase flood insurance.		X			Y
Establish additional local funding mechanisms for increased flood and fire mitigation.		X			Y
Estancia Ditch and Pump Station improvement project. All pump stations in Santa Ventia were upgraded to the Trimble Unity systems. Additional upgrades needed.		X			Y
Flood Preparedness Pilot Program identifies resources for flood preparedness on county website.		X			Y
Gallinas Creek Geomorphic Dredge, currently in design phase for the placement of 100,000 cubic yards of dredge sediment		X			Y
Initiate Community Plans for Adapting to Coastal Hazards		X			Y
Karen Way Ditch Improvements is currently on hold		X			Y
Las Gallinas Levee Evaluation provides geotechnical engineering service for the elevation and assessment consistent with the Corps of Engineers (USACE) Publication Number EM 1110-2-1913.	X				N

Table 4.8: Status of Previous Hazard Mitigation Actions

Action Number / Name	Completed	Ongoing	Not Started	Still Relevant	Included in Updated Action Plan
Levee Setback and Upgrade Project. Initiation of this project depends on completion of a land exchange through State Lands Commission. County is working on surveying needed to support that exchange.		X			Y
Lower Corte Madera Creek Improvements: Levee evaluation completed in 2020 under a DWR grant and a geomorphic dredge assessment in process to be completed in 2023					Y
Lower Ryan Creek Pump Station Study and Upgrades is currently on hold					Y
Madrone Ave Bridge Replacement project will reduce impacts from floods.					Town of San Anselmo is project lead.
Manzanita Modifications Project. Caltrans is working on a project initiation document for December 2023 for sea level rise adaptation at the US 101/SR 1 between Manzanita and Marin City. County is supporting this work through hydraulic studies.		X			Y
Marin City Drainage Improvements Project, currently in the planning phase of project.		X			Y
Marin County Structure Elevation Program provides federal assistance to homeowners with cost-effective projects. FEMA funding approved; 7 permits are being reviewed.		X			Y
Marin County Watershed Program provides a framework to integrate flood protection and environmental restoration with public and private partners to protect and enhance Marin's watersheds.	X				N
McInnis Park Wetland Restoration Project proposes to restore subtidal and intertidal habitat at an 180-acre are of diked wetlands.		X			Y
Meadow Drive Interceptor and Ditch Upgrades. Interim upgrades were made by adding an in-line check valve to prevent tides from flooding Meadow Dr. No funding (or local match) currently available for full conceptual upgrades to proceed to design.		X			Y
Mill Valley Comprehensive Flood Control & Drainage Master Plan	X				N
Nokomis Ave Bridge Replacement project will assist with the replacement of the Nokomis Ave Bridge, with the hopes of reducing flood hazards.					Town of San Anselmo is project lead.
Novato Levee Study, completed in 2020 under a DWR grant.	X				N
Pacheco Pond Project is currently on hold		X			Y
Protect and restore natural buffers. Two funded and completed nature-based studies explored the feasibility of these projects and follow up work is now happening through the Stinson ARC project and through pursuit of other grant opportunities.		X			Y
Pump Station No. 1 Upgrade is currently on hold.		X			Y

Table 4.8: Status of Previous Hazard Mitigation Actions

Action Number / Name	Completed	Ongoing	Not Started	Still Relevant	Included in Updated Action Plan
Pump Station No. 2 Upgrade, and interconnection to Pump Station No. 1 is currently on hold.		X			Y
Pump Station No. 5 Upgrade on hold.		X			Y
Richardson Bay Shoreline Protection work is to be integrated into future sea level rise adaptation planning.			X	Y	Y
Ross Valley 10 Year Work Plan described technical rationale for a suite of on-the-ground flood reduction measures, spread watershed-wide, that work together as a system to reduce flooding and seek to restore the ecological health and function of Corte Madera Creek and its tributaries	X				N
Rush Creek Drainage Improvements is currently on hold		X			Y
San Anselmo Flood Risk Reduction Project. Construction of flood detention basin on Fairfax Creek was substantially completed and the basin operational in November 2022. The outfall pipe slide gate can be operated manually and pending installation of electrical paneling March 2023 for electrical control operation. The project to remove the building bridge in downtown San Anselmo is in the final planning phase		X			Y
Santa Venetia and Rafael Meadows Street Drain Upgrades. Coordinating with County Engineering to include drainage upgrades with road rehabilitation projects. Labrea Way, vulnerable to recurrent stormwater ponding, is currently in design.		X			Y
Santa Venetia Pump Station No. 4 Upgrades on hold		X			Y
Santa Venetia Floodwall Project (Formerly the Santa Veneita Timber-Reinforced Berm Improvement Project)		X			Y
Seismic Retrofit of County-owned buildings not current to code.		X			Y
Seismic upgrades (bolting and anchoring pumps and roof) to the Cove Pump Station building in Tiburon.		X			Y
Simmons Slough Flood Risk Reduction Project	X				N
Strawberry Levee Improvements will be incorporated into sea level rise planning			X	Y	Y
The Sycamore Ave Bridge Replacement project will reduce the impact of flooding.					Town of San Anselmo is project lead and federally funded.
Tiburon Street Drainage Improvements Plan identifies support to the town of Tiburon's storm drainage, providing upgrades to the Cove Stormwater pump station.		X			Y
The upgrade Farmers, Cheda, and Lynwood pump stations is currently on hold.		X			Y

Table 4.8: Status of Previous Hazard Mitigation Actions					
Action Number / Name	**Completed**	**Ongoing**	**Not Started**	**Still Relevant**	**Included in Updated Action Plan**
The West Creek Flood Wall Alternative Restoration Project is currently on hold.		X			Y
The Winship Bridge Replacement project will reduce the impact of flooding.					Town of Ross is the project lead and federally funded.

Table 4.8: Status of Previous Hazard Mitigation Actions
Source: Marin County

4.6.3 New Mitigation Actions

Based on the hazard profiles, threat assessment, capabilities assessment, community survey results, discussions among the Hazard Mitigation Planning Team members, and existing best practices, a set of potential mitigation actions was developed and then evaluated based on the following criteria:

- FEMA requires local governments to evaluate the monetary and non-monetary costs and benefits of potential mitigation actions. Although local governments are not required to assign specific dollar values to each action, they should identify the general size of costs and benefits.
- The Hazard Mitigation Planning Team may elect to include measures with a high cost or low benefits, but such measures should be clearly beneficial to the community and an appropriate use of local resources.

In addition, FEMA directs local governments to consider the following questions as part of the financial analysis:

- What is the frequency and severity of the hazard type to be addressed by the action, and how vulnerable is the community to this hazard?
- What impacts of the hazard will the action reduce or avoid?
- What benefits will the action provide to the community?

The Hazard Mitigation Planning Team also chose to review and revise the potential hazard mitigation actions with consideration for climate impact and social vulnerability. Projects and programs were assessed with consideration of these variables.

Prioritization

As part of the mitigation actions development and review, the Hazard Mitigation Planning Team also prioritized the actions. The prioritization efforts looked at the risks and threats from each hazard; lifesaving, life safety, property protection and lastly environmental protection; financial costs and benefits; technical feasibility; consideration for climate impact, and social vulnerability, and community values. Hazard Mitigation Planning Team members were asked to identify their priority actions using the following criteria.

Implementation priority ratings were assigned as follows:

- **High Priority** - An action that meets multiple objectives, is linked to a high risk hazard, has benefits that exceed costs, and has a potential source of funding. Action can begin within the short term (1 to 5 years).
- **Medium Priority** - An action that meets multiple objectives, is linked to a high or medium risk hazard, has benefits that exceed costs, and is eligible for funding though no funding has yet been secured for it. Action can begin within the short term (1 to 5 years) 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.

Table 4.9 lists the Current Hazard Mitigation Actions for Marin County.

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-1	Develop a Vulnerable Communities Index specific to Marin County, aggregating economic, gender, age, linguistic, ethnic, and racial characteristics; geographic locations; hazard impact; and adaptive capacity.	All Hazards 1, 2, 3, 4, 5, 6	County of Marin - CDA	New	TBD Cost General Funds/Grants HMPG, BRIC, CDC, CDPH Public Health Emergency Preparedness	2-5 years Medium	Safety Element Action CA Dept. of Public Health - Community Assessment for Public Health Emergency Response (CASPER)
MC-2	Develop a climate change preparedness outreach program for higher risk populations.	All Hazards 1, 3	County of Marin – CDA, OEM/Fire, Fire Agencies	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Action
MC-3	Provide grants for alternative housing to community members at risk of climate change impacts.	All Hazards 1, 3	County of Marin – CDA, OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	5+ years Low	Safety Element Action
MC-4	Mitigate by planning in advance for climate change impacts and incorporating lessons learned in neighboring counties.	All Hazards All goals	County of Marin – OEM/Fire, CDA, DPW	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Action
MC-5	Develop a Property Rating System.	All Hazards 1	County of Marin - CDA	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Action
MC-6	Develop Resilience Hubs.	All Hazards 1, 2, 4	County of Marin – CDA	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Action

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-7	Focus improvements on the transportation network for risk reduction, especially informed by new and emerging climate risk.	All Hazards 1, 2, 5	County of Marin – CDA	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-8	Conduct study to identify natural methods to limit coastal erosion	Land Subsidence 1, 4, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-9	Conduct research on best natural methods to mitigate erosion on highways and roads and implement planning and strategy stage.	Land Subsidence 1, 4, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Low	
MC-10	Conduct research on best natural methods to mitigate erosion in and around rivers and streams and implement planning and strategy stage.	Land Subsidence 1, 2, 4, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Low	
MC-11	Addition of vegetation in soil eroded areas.	Land Subsidence 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-12	Increase conventional storage that is filled during high-flow periods	Drought, Flooding 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/FMA, DWR, HMGP, BRIC	5+ Years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-13	Provide multilingual outreach on mitigation tactics to well-dependent residents	Drought 1, 3	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-14	Conduct Outreach and acquire grants to pass to rural communities for installing Rainwater Harvesting systems	Drought 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-15	Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers	Drought 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-16	Remove non-native plants and trees from all County and City and Town facilities, replace with drought tolerant, native plants	Flooding, Drought 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-17	Turn soil to increase infiltration rate and pore space to absorb more water	Flooding, Drought 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-18	Encourage soil turning on private land	Flooding, Drought 1, 3, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-19	Install new HVAC systems at schools and critical infrastructure facilities	Heat 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-20	Implement non-AC solutions to cool buildings - green roof and nature-based infrastructure systems	Heat 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-21	Paint roofs with pigments to reduce heat inside buildings	Heat 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-22	Outreach to communities at high risk of heat impacts	Heat 1, 3, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-23	Establish policy for cooler homes / Earthship homes	Heat 1, 4, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-24	Provide grants for high-risk residents to improve and acquire cooling mechanism in home.	Heat 1, 3, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-25	Provide alternative locations and equitable response actions for residents to seek cooler environments (e.g., movie theaters) via regional heat response plans	Heat 1, 3, 5	County of Marin – OEM/Fire		TBD Cost General Funds/Grants HMPG, BRIC	0-2 years Medium	
MC-26	Establish additional and expand functionality of heating, cooling centers and resiliency hubs.	Heat 1, 3, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-27	Replace concrete sidewalks with DG	Heat, Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-28	Implement green streets initiatives in identified areas	Heat, Flooding 1, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-29	Install green roofs on public buildings supported by non-potable water	Heat, Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-30	Conduct a whole county study on what areas could benefit from more shaded areas; a green streets program.	Heat, Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-31	Conduct study on how much concrete can be removed	Heat, Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-32	Implement countywide flood monitoring system to inform mitigation future projects	Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Medium	
MC-33	Conduct research on widening storm channels and aged infrastructure which has not been climate change adapted and in need of enhancements	Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC, BRIC technical assistance	2-5 years Low	
MC-34	Widen storm channels in high-density areas and urban settings	Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	5-10 years Low	
MC-35	Develop policy to remove concrete parking lots	Flooding 1, 4, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-36	Expand culverts in areas classified as 100- or 500-year flood plain	Flooding 1, 2, 5	County of Marin – OEM/Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	5-10 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-37	Assess County and Town owned parking lots to implement catch basins	Flooding 1, 2, 5	County of Marin – OEM/Fire, Cities and Towns	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-38	Design creek restoration projects on East and West Creek to improve flood conveyance capacity	Flooding 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Medium	
MC-39	Marin City Stormwater improvement project to limit standing water and flooding.	Flooding 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-7 years High	
MC-40	Research, design, and construct the Santa Venetia Floodwall Project	Flooding 1, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC, BRIC technical assistance	5-10 years Low	
MC-41	Novato Bypass improvement project to reduce flooding	Flooding 1, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-7 years Low	
MC-42	Corte Madera Creek Flood Risk Management Project Phase 1, Access Ramp and Granton Park Pump Station	Flooding 1, 5	County of Marin – DPW	New	$4,104,227.00 bid + contingency. 50% reimbursed by DWR Grant, 50% paid by FCZ 9.	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-43	Develop Integrated Flood Modeling System to New Weather Radars	Flooding 1, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-44	Apply below grade waterproofing and implement other water-intrusion mitigation measures to protect facilities that are experiencing increased levels of hydrostatic pressure.	Flooding 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-45	Cardinal Rd Levee Upgrade - Seepage Mitigation for a segment of Coyote Creek Levee (~1,000 LF)	Flooding, Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-46	Conduct sea level rise vulnerability analysis of County Flood Control District-owned and operated flood control assets	Flooding, Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-47	Harden the North San Pedro Road Improvement at China Camp to preserve the transportation corridor through China Camp State Park. Preserve the corridor for emergency evacuations route and future sea level rise.	Flooding, Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-48	Construct coarse-grained beach marsh and shoreline edge restoration to inhibit marsh and bay coastal shoreline edge erosion due to wind-wave erosion and SLR	Sea Level Rise 1, 5	County of Marin - DPW	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-49	Construct Corte Madera Creek Flood Risk Management Project Phase 1, Lower COM Restoration	Sea Level Rise 1, 5	County of Marin – DPW	New	Cost Estimate $3,000,000. 50% eligible for reimbursement by DWR Grant, 50% to be covered by FCZ 9 with additional construction grant funding being sought.	2-7 years Medium	100% design, seeking additional construction funding
MC-50	Reduce impacts from Sea level rise and protect natural storm barriers by researching and restoring Tiscornia Marsh and other wetlands and marsh areas	Sea Level Rise 1, 5	County of Marin – OEM / Fire, City of San Rafael	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC, BRIC technical assistance	2-10 years Medium	
MC-51	Create offshore wetlands in low lying areas susceptible to climate driven sea level rise	Sea Level Rise 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-52	Implement vegetation in coastal areas to limit sea level rise and storm surge	Sea Level Rise 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-5 years Low	
MC-53	Enhance public awareness of evolving flood risk hazards due to sea level rise, both on county's coast and bay side	Sea Level Rise 1, 3, 5	County of Marin – DPW, OEM	New	TBD Cost General Funds/Grants FMA, DWR, HMGP, BRIC	2-5 years, ongoing Medium	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-54	Novato Baylands Resilience Projects - including, Levee Improvements, Setback Levee Construction, Pump Station Construction and Tidal Restoration	Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants FMA, DWR, HMGP, BRIC	2-10 years Low	
MC-55	Geomorphic dredging of Tidal Flood Control Channels and Thin-Lift Marsh Augmentation for SLR Resiliency	Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants FMA, DWR, HMGP, BRIC	2-7 years Low	
MC-56	Southern Marin Levee Improvements and New Levee Construction with Associated Pumping for Direct Coastal Flooding Impacts	Sea Level Rise 1, 2, 5	County of Marin – DPW	New	TBD Cost General Funds/Grants FMA, DWR, HMGP, BRIC	2-7 years High	
MC-57	Complete designs and implement wetland restoration project to protect Bothin Marsh Open Space Preserve and Bay Trail	Sea Level Rise 1, 5	County of Marin – Parks	New	$25,000,000 General Funds/Grants FMA, DWR, HMGP, BRIC	15 years Medium	Preliminary designs completed
MC-58	Develop designs and implement wetland resilience improvements along shoreline of Bolinas Lagoon	Sea Level Rise 1, 5	County of Marin – Parks	New	$15,000,000 General Funds/Grants FMA, DWR, HMGP, BRIC	15 years Low	Letter Property and Pine Gulch Creek
MC-59	Develop designs and implement McInnis Marsh and Bucks Landing wetland resilience features	Sea Level Rise 1, 5	County of Marin – Parks	New	$35,000,000 General Funds/Grants FMA, DWR, HMGP, BRIC	15 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-60	Develop plan to prioritize high value areas of potential wetland expansion	Sea Level Rise 1, 5	County of Marin – Parks	New	$500,000 General Funds/Grants FMA, DWR, HMGP, BRIC	3 years Low	
MC-61	Research, Plan, and Construct Tsunami Evacuation structures near high-risk areas vulnerable to tsunami inundation	Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-10 years Low	
MC-62	Enhance public awareness of mitigation approaches for tsunami, including on bay side of county	Tsunami 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years, ongoing Medium	
MC-63	Provide incentives to guide development away from high-risk areas	Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-64	Plan for tsunami evacuation routes	Tsunami 1, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-65	Put signage in place for evacuation routes	Tsunami 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years High	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-66	Research, Analyze, and Harden schools in tsunami inundation zones	Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-10 years Medium	
MC-67	Harden piers and boat ramps to withstand tsunami forces	Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-68	Create barriers around public safety water resources to mitigate tsunami forces	Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-69	Harden and lift critical infrastructure in 1 and 3 feet for sea level rise areas.	Sea Level Rise, Flooding, Tsunami 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-10 years Low	
MC-70	Strengthen roads to withstand natural hazards like fires and water inundation. Reduce regulatory impediments to road construction, widening, and other improvements by amending relevant sections of Marin County Code Titles 22, 23, and 24 to eliminate discretionary permit requirements and replace them with ministerial review to ensure that both public and private roads comply with codified engineering standards	Wildfire, Flooding 1, 2, 4, 5	County of Marin – CDA, DPW, Fire Agencies	New	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-10 years Low	Safety Element Activity

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-71	Review permit processes to ensure that all applications for new development comply with fire safety and building code standards, including but not limited to ensuring the provision of adequate water supply for fire suppression and fire flow requirements.	Wildfire 1, 4, 5	County of Marin – CDA, Fire Agencies	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Medium	Safety Element Activity
MC-72	Electric signage for in VHFD and HFD areas alerting residents on red flag days	Wildfire 1, 3, 5	County of Marin – OEM, HHS	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-73	Amend Wildlands Urban Interface (WUI) Regulations. Work with Marin Fire agencies to prepare and adopt WUI regulations for new development and substantial remodels to reduce fire hazards. Track and update standards as the areas of high and extreme fire hazard areas are defined.	Wildfire 1, 4, 5	County of Marin – CDA, Fire agencies	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Activity
MC-74	Identify Areas with Insufficient Evacuation Opportunities.	Wildfire 1, 5	County of Marin – CDA, Fire Agencies	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	Safety Element Activity
MC-75	Remove hazardous trees and vegetation, including non-native species throughout the High and Very High Fire Danger Areas.	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-10 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-76	County-wide assessment of hazardous trees and vegetation	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-77	Deploy additional AI cameras for fire ignition and detection	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-78	Conduct research on impact of wildfire smoke on southeastern portion of the county	Wildfire 1, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Low	
MC-79	Create green breaks in county in VHFD and HFD Areas	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-80	Expand fuel management by collaborating with land management agencies	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-81	Encourage vegetation modification at private residences	Wildfire 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-82	Conduct a county wide fuels study to understand how different vegetation would behave when ignited	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-83	Conduct a vegetation study in high and very high fire hazard areas	Wildfire 1, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-84	Implement culturally informed (especially native tribal culture) wildfire mitigation projects	Wildfire 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-85	Encourage fire resistant construction and landscaping	Wildfire 1, 2, 3, 4, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-86	Exceed codes and standards for fire resistant construction	Wildfire 1, 2, 3, 4, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years High	
MC-87	Harden fire roads to withstand impacts from natural hazards	Wildfire 1, 2, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-88	Conduct brush clearance around fire roads	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-89	Provide grants to harden existing structures against fires	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-90	Plant native fire-resistant vegetation	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-91	Conduct brush clearance around evacuation routes	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-92	Deploy livestock to remove vegetation	Wildfire 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-93	Collaborate with land management agencies to manage vegetation in open space and common space areas	Wildfire 1, 2, 5	Co County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-94	Provide direct assistance to property owners in need of vegetation management to improve defensible space	Wildfire 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-95	Retrofit any current roads, highways and bridges to endure high magnitude earthquakes in areas with 0.55 or higher shaking intensity.	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-96	Establish policy for soft story homes	Earthquake 1, 4, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-97	Research and assess current roads, highways, and bridges probability to endure a high magnitude earthquake	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Low	
MC-98	Replace or enhance water and sewage pipes and joints within areas vulnerable to liquefaction with flex pipes or alternate infrastructure.	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-10 years Low	
MC-99	Retrofit all County and City and Town facilities to withstand large earthquakes.	Earthquake 1, 2, 5	County of Marin – OEM / Fire, Cities and Towns	New	TBD Cost General Funds/Grants HMPG, BRIC	2-10 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-100	Identify pre-1933 school buildings and critical infrastructure	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-101	Retrofit all critical infrastructure to resist severe earthquake shaking above 0.55 intensity.	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-15 years Low	
MC-102	Expand community outreach to Great Shakeout Drill – Use Shaker trailer	Earthquake 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-103	Outreach to hospitals and other critical care facilities on infrastructure risk	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	
MC-104	Conduct Research on impacts of San Andreas Fault in West Marin	Earthquake 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Medium	
MC-105	Provide outreach and education on San Andreas Fault in West Marin	Earthquake 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Medium	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-106	Study dam spillways and emergency spillways, specifically for seepage and to reassess geological assumptions	Dam Inundation 1, 2, 5, 6	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-107	Widen dam spillways in areas where dams may receive additional water due to climate change	Dam Inundation 1, 2, 5, 6	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	5-15 years Low	
MC-108	Harden dam spillway infrastructure to prevent spillway failures during controlled / emergency releases	Dam Inundation 1, 2, 5, 6	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	5-15 years Low	
MC-109	Research effective methods to strengthen wind load for existing utilities and critical infrastructure	High Wind 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC, BRIC technical assistance	2-5 years Low	
MC-110	Conduct geotechnical survey of slope stability county wide	Debris Flow 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	
MC-111	Seed and transplant fire resistant and native plants and trees on vulnerable sloped areas	Debris Flow 1, 2, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years Low	

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-112	Outreach and education to areas at risk of debris flow	Debris Flow 1, 3, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-5 years, ongoing Medium	
MC-113	Acquire land and or design new codes for areas in high-risk landslide areas and minimize new construction via policy recommendations	Debris Flow 1, 2, 4, 5	County of Marin – OEM / Fire	New	TBD Cost General Funds/Grants HMPG, BRIC	2-10 years Low	
MC-114	Marin County Structure Elevation Program	Flooding 1, 2, 4, 5	County of Marin - DPW	Existing, New	$4M General Funds/Grants (HMGP)	0-5 years In progress	Provides federal assistance to homeowners with cost-effective projects. FEMA funding approved and 7 permits are being reviewed
MC-115	Seismic Retrofit of County-owned buildings not current to code.	Earthquake 1, 2, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants HMPG, BRIC	0-5 years In progress	Staff also continue gathering available seismic assessment data on County-owned (and possibly leased sites in the future) facilities. This information will be brought into an asset management database, which is in the early stages of development, and will support risk assessment and work plan development

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-116	Seismic Retrofit of County-owned buildings not current to code. 120 N. Redwood- Seismic Assessment	Earthquake 1, 2, 5	County of Marin - DPW, CDA	Existing (2018)	TBD Cost General Funds/Grants HMPG, BRIC	0-5 years In progress	Local hazard mitigation by the States Office
MC-117	Seismic Retrofit of County-owned buildings not current to code. Marin Center- Seismic Assessment of the Veteran's Memorial Auditorium & Exhibit Hall	Earthquake 1, 2, 5	County of Marin - DPW, CDA	Existing (2018)	TBD Cost General Funds/Grants HMPG, BRIC	0-5 years In progress	Completed assessment, and HMGP grant secured for upgrades. Seismic retrofit work at the Exhibit Hall completed in November 2022. The retrofit design work for the Veterans' Memorial Auditorium is complete. Construction work anticipated to run from April 2023 thru January 2024.
MC-118	San Anselmo Flood Risk Reduction Project.	Flooding 1, 2, 5	San Anselmo is project lead	Existing (2018)	$17.6M/ Flood Zone 9/ General Funds/Grants (DWR, HMGP application)	0-5 years In progress	Construction of flood detention basin on Fairfax Creek was substantially completed and the basin operational in November 2022. Outfall pipe slide gate can be operated manually and pending installation of electrical paneling March 2023 for electrical control operation. The project to remove the building bridge in downtown San Anselmo is in the final planning phase

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-119	Arroyo Corte Madera del Presidio Riverine (Corte Madera Creek) Flood Risk Management Project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$14M/Flood Zone 9: General Funds/Grants (DWR, applications for FEMA, NOAA)	0-5 years In progress	Construction in progress through 2023 - The Marin County Flood Control and Water Conservation District (District) proposed the Corte Madera Creek Flood Risk Management Project, Phase 1 to reduce the 25-year flood risk along Corte Madera Creek in the Town of Ross and unincorporated Kentfield and to enhance natural stream functions. An HMGP application for components in the channel that reduce flood risk was submitted August 4, 2023
MC-120	Azalea Ave Bridge Replacement	Flooding 1, 5	Town of Fairfax	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years	Town of Fairfax is project lead.
MC-121	Nokomis Ave Bridge Replacement	Flooding 1, 5	Town of San Anselmo	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years	Town of San Anselmo is project lead.
MC-122	Madrone Ave Bridge Replacement	Flooding 1, 5	Town of San Anselmo	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years	Town of San Anselmo is project lead.

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-123	Winship Bridge Replacement	Flooding 1, 5	Town of Ross	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years	Town of Ross is the project lead.
MC-124	Sycamore Ave bridge replacement	Flooding 1, 5	Town of San Anselmo	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years	Currently on hold. A watershed study has been scoped out, but not enough funding has been identified.
MC-125	Lower Corte Madera Creek Improvements	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$2M/Flood Zone 9/ General Funds/Grants (DWR)	0-5 years In progress	Currently on hold
MC-126	Continue supporting the Sonoma County Water Agency led Advanced Quantitative Precipitation Information effort.	Flooding 1, 4, 5	County of Marin - DPW	Existing (2018)	$1.5M General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Working to expand storm drainage improvement planning into Nave Gardens through a Flood District funded study currently underway through 2023. The study is looking at ways of most effectively bypassing high flows and potential options such as increasing storage, building flood barriers, daylighting drainages, and installing pump stations and/or tide gates. Funding for future improvements would likely be sought through FEMA HMGP.

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-127	Pacheco Pond Project - flood flow diversion to wetlands to improve water quality and habitat. Upgrade title gages.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Annual outreach conducted in October
MC-128	Deer Island Basin Project to setback levees, restore tidal wetlands, and increase tidal prism to reduce sedimentation and flood risk.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$10M/ Flood Zone 1/ General Funds/Grants (SFBRA grant)	0-5 years In progress	National Park Service is working with FHWA and the Flood District to identify and plan a potential overflow channel from Easkoot Creek to the Ocean.
MC-129	Rush Creek Drainage Improvements	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	2-3 years Low	During final design of the levee upgrade in February 2022, the engineer's updated construction cost estimate came in at $12M, exceeding the project's available funding for project design and construction. The District continues to track opportunities for project construction funding.
MC-130	The upgrade Farmers, Cheda, and Lynwood pump stations	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years Low	Interim upgrades were made by adding an in-line check valve to prevent tides from flooding Meadow Dr. No funding (or local match) currently available for full conceptual upgrades to proceed to design.

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-131	City of Novato Drainage Improvement	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Flood Zone 1/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently on hold
MC-132	Encourage property owners in SFHAs to purchase flood insurance.	Flooding 1, 3, 5	County of Marin - DPW, OEM/Fire	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	Ongoing In progress	Currently on hold
MC-133	Easkoot Creek Flood Flow Bypass Project. (National Park Service/ FHWA project being scoped currently as part of parking lot work)	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently on hold
MC-134	Santa Venetia Floodwall Project (Formerly the Santa Venetia Timber-Reinforced Berm Improvement Project)	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$12 Million General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Coordinating with County Engineering to include drainage upgrades with road rehabilitation projects. Labrea Way, vulnerable to recurrent stormwater ponding, is currently in design.
MC-135	Meadow Drive Interceptor and Ditch Upgrades.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years Low	Currently in design phase for the placement of 100,000 cubic yards of dredge sediment. Goal to support navigation and storm drain outfall.
MC-136	Santa Venetia Pump Station No. 4 Upgrades on hold	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$3M/ Flood Zone 7 General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	In 2021, County and Parks staff received a grant from the San Francisco Bay Restoration Authority (SFBRA) Measure AA

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
							Bay region wetlands grant program. This grant funding will allow the McInnis Marsh Restoration project to continue work on final design, compliance with the California Environmental Quality Act (CEQA) and permitting including the proposed CSA 6 Gallinas Creek geomorphic dredge project. Note that the proposed McInnis Marsh Restoration project is not currently funded for implementation.
MC-137	Pump Station No. 2 Upgrade, and interconnection to Pump Station No. 1 is currently on hold.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$3M General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Initiation of this project depends on completion of a land exchange through State Lands Commission. County is working on surveying needed to support that exchange.
MC-138	Pump Station No. 5 Upgrade	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$3M General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently on hold
MC-139	Santa Venetia and Rafael Meadows Street Drain Upgrades.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	In 2022 all pump stations in Santa Venetia were upgrade to Trimble Unity System for alerts and notifications to staff. Funding for additional

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
							upgrades not available at this time.
MC-140	Gallinas Creek Geomorphic Dredge	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$3M/ County Service Area 6/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Flood district is supporting the Town of Tiburon's storm drainage master plan implementation out by designing the upgrade to the Cove Stormwater Pump Station (construction completed, Project 33 in 2018 LHMP) to have capacity to handle the increased flows that would be conveyed to the station by the full buildout of the Town's master plan.
MC-141	McInnis Park Wetland Restoration Project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently on hold
MC-142	Levee Setback and Upgrade Project.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Integrated into future sea level rise adaptation planning.

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-143	Pump Station No. 1 Upgrade	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$2M General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	On hold due to lack of property owner easements. Considering a creek restoration project instead.
MC-144	Estancia Ditch and Pump Station improvement project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$4M/ Flood Zone 7/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Coordinating with Caltrans on a scheduled 2024 pavement rehabilitation project to potentially include tide gates to reduce sunny day flooding of Tiburon Blvd.
MC-145	Tiburon Street Drainage Improvements Plan	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	A levee study was completed, and a portion of the levee system has a project underway for seepage mitigation. It is in the design phase.
MC-146	Karen Way Ditch Improvements	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost/ Flood Zone 4/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently in the planning phase of project.
MC-147	Strawberry Levee Improvements	Sea Level Rise 1, 5	County of Marin - DPW	Existing (2018)	$1M / Flood Zone 4/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Integrated into future sea level rise adaptation planning.
MC-148	West Creek Flood Wall Alternative Restoration Project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	5-10 years In progress	The district is working with the County's Parks Department to evaluate a potential pilot project for thin-lift placement of sediment from Coyote

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
							Creek in Bothin Marsh. It would require a Measure AA grant to design, permit, construct, and monitor.
MC-149	East Creek Outfall Modifications Project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$10M/ Flood Zone 4/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	3 years In progress	Caltrans is working on a project initiation document for December 2023 for sea level rise adaptation at the US 101/SR 1 between Manzanita and Marin City. County is supporting this work through hydraulic studies.
MC-150	Coyote Creek Levee Improvements	Flooding 1, 2, 5	County of Marin - DPW	Existing (2018)	$40M/ Flood Zone 3/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Currently on hold
MC-151	Marin City Drainage Improvements Project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Following the condition assessment design will proceed in 2024. After construction of the crest Marin improvements a study of Cardinal and shoreline pump stations and associated drainage is anticipated.
MC-152	Richardson Bay Shoreline Protection work is to be integrated into future sea level rise adaptation planning.	Sea Level Rise 1, 5	County of Marin - DPW	Existing (2018)	$150M TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	5-10 years In progress	County maintains a flood preparedness webpage with resources and information for landowners.

Table 4.9: Marin County Current Hazard Mitigation Actions

No.	Mitigation Action	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/Progress
MC-153	Bothin Marsh Restoration project	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$2.4 M General Funds/Flood Zone 3/Grants (SFBRA application in progress)	5-10 years In progress	Ongoing through Local Coastal Program update, funded and completed, nature-based adaptation studies, and the Safety Element update.
MC-154	Manzanita Modifications Project. To support/supplement a Caltrans project	Flooding, Sea Level Rise 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Funded through Ocean Protection Council grant and AARPA funds. Ongoing Stinson Beach Adaptation and Resilience Collaboration (Stinson ARC) project.
MC-155	Lower Ryan Creek Pump Station Study and Upgrades	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$2.5M/ Flood Zone 3/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	5-10 years In progress	Project has not started due to lower community priority. However, the project has not been abandoned and may be completed in the next year.
MC-156	Crest Marin, Cardinal, and Shoreline Pump Station Upgrades.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	$7.5M/ Floods Zone 3/ General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years In progress	Two funded and completed nature-based studies explored the feasibility of these projects and follow up work is now happening through the Stinson ARC project and through pursuit of other grant opportunities.
MC-157	Flood Preparedness Pilot Program	Flooding 1, 3, 5	County of Marin - DPW	Existing (2018)	Negligible cost General funds	0-5 years In progress	In Progress

Table 4.9: Marin County Current Hazard Mitigation Actions							
No.	**Mitigation Action**	**Hazards Mitigated/ Goals Met**	**Jurisdiction/ Responsible Agency**	**New, Existing, Completed, Removed**	**Estimated Cost and Potential Funding Source**	**Timeline/ Priority**	**Comments/Progress**
MC-158	Consider sea level rise adaptation from Collaboration: Sea-level Marin Adaption Response Team (C-SMART).	Sea Level Rise 1, 4, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	Ongoing In progress	
MC-159	Initiate Community Plans for Adapting to Coastal Hazards	Flooding, Sea Level, Rise, Tsunami 1, 2, 3, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	Ongoing In progress	
MC-160	Develop Renters and Homeowners Guides to Flood Preparedness project	Flooding 1, 3, 5	County of Marin - DPW, OEM	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	0-5 years Low	
MC-161	Protect and restore natural buffers.	Flooding 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	Ongoing In progress	
MC-162	Assess bulkheads surrounding Tomales Bay	Flooding (coastal) 1, 5	County of Marin - DPW	Existing (2018)	TBD Cost General Funds/Grants/ FMA, DWR, HMGP, BRIC	Ongoing In progress	

Table 4.9: Marin County Current Hazard Mitigation Actions
Source: Marin County

4.7 PLAN INTEGRATION

For hazard mitigation planning, “integration” means that hazard mitigation information is used in other relevant planning mechanisms, such as general planning, capital facilities planning, emergency management, hazard specific planning, and that relevant information from those sources is also used in hazard mitigation. This section identifies where such integration is already in place from the 2018 MJHMP, and where the 2023 MJHMP will be used for further integration.

The Marin County Office of Emergency Management will be the central coordination point for maintaining this plan and will serve as a lead staff for grant project applications on the countywide projects selected for application under the Hazard Mitigation Assistance grant programs. Additionally, each participating jurisdiction applying for grant funds on its own will serve as lead staff for project implementation with assistance from the County and participating Steering Committee members as requested.

An important integration mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other county, city and town plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. As described in this plan’s capability assessment, Marin County and its jurisdictions already implement policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms. These existing mechanisms include:

- **County, City and Town general and master plans** - Integrates hazard mitigation through the consideration of hazards most likely to impact the County. These hazards are considered in the Safety Element, Housing Element and Open Space Element.
- **County, City and Town Emergency Operations Plans** - Integrates hazard mitigation through the consideration of the Town’s planned response to hazards most likely to impact the Town.
- **County, City and Town ordinances** - Integrates hazard mitigation through the consideration of plans and policies outlined in the capability assessments in the jurisdictional annexes.
- **Flood/storm water management/master plans** - Integrates hazard mitigation through the consideration of strategies to reduce flood risk and storm water management for the protection of life and property.
- **Community Wildfire Protection plan** - Integrates hazard mitigation through the consideration of strategies to reduce fire hazard and the risk of catastrophic wildfires in the WUI, while promoting the protection and enhancement of the county’s economic assets and ecological resources.
- **Capital improvement plans and budgets** - Integrates hazard mitigation through the consideration of strategies for the development and funding a critical facilities and infrastructure.
- Other plans and policies outlined in the capability assessments in the jurisdictional annexes.

- Other plans, regulations, and practices with a mitigation focus

Steering Committee members involved in these other planning mechanisms will be responsible for integrating the findings and recommendations of this plan with these other plans, programs, etc., as appropriate. Implementation and incorporation into existing planning mechanisms will be done through the routine actions of:

- Monitoring other planning/program agendas
- Attending other planning/program meetings
- Participating in other planning processes
- Monitoring community budget meetings for other community program opportunities

The successful implementation of this mitigation strategy will require constant and vigilant review of existing plans and programs for coordination and multi-objective opportunities that promote a safe, sustainable community. A few examples of incorporation of the MJHMP into existing planning mechanisms include:

1) As recommended by Assembly Bill 2140, each community should adopt (by reference or incorporation) this MJHMP into the Safety Element of their General Plans. Evidence of adoption (by formal, certified resolution) shall be provided to CalOES and FEMA
2) Integration of flood actions identified in this mitigation strategy with the actions and implementation priorities established in existing Flood Management Programs
3) Using the risk assessment information to update the hazards section in the County, City and Town Emergency Operations Plans

Efforts should continuously be made to monitor the progress of mitigation actions implemented through these other planning mechanisms and, where appropriate, their priority actions should be incorporated into updates of this hazard mitigation plan.

4.8 Future Development Trends

Marin County's abundance of natural, recreational, and scenic resources has supported a long history of open space preservation. Its rolling hills, expansive ranchlands, beaches, coastlines, and more are appreciated by both visitors and locals alike. This quote, from the Marin Independent Journal 1934 Editorial captures this sentiment:

"No community on earth is more favored than Marin with the wealth and beauty of potential playgrounds. If we don't acquire some of these lands, the opportunity will surely slip away from us."

In the 1960s, housing/transportation development proposals were underway throughout Marin County including for the Marin Headlands, outer coast, Tomales Bay area and more. Such proposals threatened Marin's rural character and long heritage of family farming, sparking community activism which drew national attention. These efforts led to the employment of land use planning tools to ensure the County's natural and agricultural areas remain protected in perpetuity. Establishment of the Point Reyes National Seashore in 1962, and a handful of other Federal/State Park units, ensured the protection of a large amount of the County's most

cherished lands as publicly accessible open space. Additionally, the Marin Agricultural Land Trust, established in 1980, has placed agricultural conservation easements on over 60,000 acres of farmland, to ensure protection from development in perpetuity.

Furthermore in 1972 the California Coastal Commission was established as a regulatory agency whose mission is “To protect, conserve, restore, and enhance the environment of the California coastline”. Pursuant to the California Coastal Act of 1976, the agency is tasked with the protection of a variety of resources including public access, habitat, and water quality. The Commission issues Coastal Development Permits, until a local agency has a certified Local Coastal Program (LCP), with a land use plan and implementation plan.

West Marin’s coastal zone covers approximately 82,168 acres. Of this approximately 33,913 acres are owned and managed by the National Park Service, leaving 48.255 acres under County Jurisdiction subject to the LCP. This encompasses a handful of small communities along the Pacific Coast and Tomales Bay shorelines including Muir Beach, Stinson Beach, Bolinas, Inverness, Point Reyes Station, East Shore and Dillon Beach. New growth in these communities is limited by a variety of factors including few remaining undeveloped parcels; land use policies and plans which protect public access and natural resources; and environmental features such as the coast itself, Tomales Bay, and steep bluffs which naturally restrain development.

Development in the County over the last 5 years has been limited due to build out, and similarly future development is limited by these same constraints. For this reason, development related considerations to plan updates were not applicable to the planning process. Instead, the plan was revised to consider regional development trends and incorporation of new science such as potential climate change impacts.

Marin County has focused on sea level rise planning and climate action for several years. Currently, the LCP is being updated to reflect the changing risks to coastal areas and develop appropriate policies and actions to avoid and minimize the risk of disaster and harm to its residents, infrastructure and coastal resources. Coastal Act policies Sections 30210, 30240, and 30251 dictate that new development shall be safe from hazards and recognize that shoreline protective devices such as seawalls may be appropriate in certain instances to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion.

However, shoreline protective devices must be designed to eliminate or mitigate the adverse impacts on the sand supply of surrounding natural shorelines. Other development-limiting Coastal Act policies include:

Section: 30210: Development shall not interfere with the public’s right of access to the sea including the use of beaches

Section 30240: Environmentally Sensitive Habitat Areas (ESHA) shall be protected.

Section 30251: The scenic and visual qualities of coastal areas shall be considered and protected as resources of public importance.

The 2040 population projection for Marin County is 277,087 (Department of Finance). In order to accommodate population growth over the next several years, Marin County and its incorporated cities have implemented a number of land use plans and development policies to direct growth away from hazardous conditions. For example, as required by state law, the County and each

incorporated city have a general plan with a safety element that identifies hazards affecting the County and incorporated cities. Likewise, the County and the incorporated cities have a number of planning policies, such as floodplain ordinances and building codes, restricting new development in hazard areas and/or increasing construction requirements in hazard areas.

In addition to steering away growth from hazard areas, Marin County and its incorporated cities have a history of aggressive growth management that seeks to limit growth overall and to direct it within the incorporated cities and urban areas of the unincorporated County.

The 2007 Marin Countywide Plan was last updated in 2015 to reflect the theme of planning for sustainable communities. Twelve principles support this theme including the preservation of natural assets and the protection of agricultural assets in order to minimize development in open space. The plan is divided into specific elements, each with goals, policies, and implementation programs. The Plan's land use pattern reflects existing development potential shifted to a degree from environmentally constrained sites to more appropriate locations. Specific Countywide Plan policies which limit urban development through the protection of open space resources include:

- Biological Resources 1.1 Protect Wetland Habitats for Special-Status Species, Sensitive Natural Communities, and Important Wildlife Nursery Areas and Movement Corridors.
- Biological Resources 1.2 Acquire Habitat
- Biological Resources 2.1 Include Resource Preservation in Environmental Review Biological Resources 2.2 Limit Development Impacts
- Biological Resources 3.1 Protect Wetlands
- Biological Resources 4.1 Restrict Land Use in Stream Conservation Areas
- Biological resources 5.1 Protect the Baylands Corridor
- Biological Resources 5.2 Limit Development and Access
- Biological Resources 5.3 Leave Tidelands in Their Natural State
- Air 4.m Focus Development in Urban Corridors
- Open Space 2.2 Continue to Acquire or Otherwise Preserve Open Space Countywide Open Space 2.4 Support Open Space Efforts Along Streams
- Open Space 2.5 Support Open Space Efforts in the Inland Rural Corridor
- Open Space 2.6 Support Open Space Efforts in the Coastal Corridor
- Agriculture 1.1 Limit Residential Use
- Agriculture 1.2 Encourage Contractual Protection
- Agriculture 1.3 Preserve Agricultural Zoning
- Agriculture 1.4 Limit Non-Agricultural Zoning
- Agricultural 1.5 Restrict Subdivision of Agricultural Lands Within the Coastal, Inland Rural and Baylands Corridors
- Agriculture 1.6 Limit Non-Agricultural Development
- Additionally, the Plan includes policies to limit development in hazardous areas, including:
- Environmental Hazards 3.a Regulate Development in Flood and inundation Areas
- Environmental Hazards 3.e Restrict Development in Flood Prone Areas
- Environmental Hazards 4.1 Limit Fire Risks to Structures

Implementation tools such as the County Development Code are used to carry out Countywide Plan goals. Some of the policies and programs in the Countywide Plan will require rezoning of individual properties for consistency with land use designations and policies. Furthermore, many unincorporated communities are guided by community plans which may include customized building and site design standards, ridgeline and view corridor protection mechanisms, home size regulations and more.

SECTION 5.0: PLAN REVIEW, EVALUATION, AND IMPLEMENTATION

44 CFR Requirement §201.6(d)(3) A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit if for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

§201.6(d)(5) [The 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 commissioner, Tribal Council). For multi‐jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

The strategies presented are deemed appropriate and effective by recommendation of the Marin County OA Hazard Mitigation Steering Committee, senior management of local governments and public agencies, and individual organizations and groups that have participated in its creation, or reviewed the end product.

5.1 PLAN ADOPTION

Upon submission to the California Office of Emergency Services (CalOES) for review, and subsequent approval by the Federal Emergency Management Agency (FEMA), the Marin County OA MJHMP will be presented to local government for formal adoption. It will then be incorporated into local general plans for integration into organizational policy.

5.2 PLAN MONITORING AND PUBLIC ENGAGEMENT

The process of hazard mitigation does not end with the completion, approval, and adoption of the Marin County OA MJHMP. During the five-year lifespan the Marin plan, the County, cities, towns and special districts, along with community-based organizations will ensure that the mitigation goals and strategies identified are exercised and monitored under a collaborative and cooperative umbrella, and that the document itself is properly maintained.

The Marin County Office of Emergency Management, as lead coordinating agency for hazard mitigation planning within the Marin County OA, leads the Marin Operational Area Hazard Mitigation Working Group that meets quarterly to review and manage the plan, projects, and programs. The review will identify changing community priorities, updated or new planning documents and the progress or status of the mitigation actions as detailed in the mitigation strategy. Additional questions to complete the review will be considered as follows:

- Do the goals address current and expected conditions?
- Are the goals and objectives consistent with changes in the local, state, and federal policy?
- Status updates on all mitigation actions?
- Have the hazards or risks changed?
- Are current resources appropriate for implementing the MJHMP?
- Have the outcomes occurred as expected?

- Is the County and jurisdictions or districts participating in the plan implementation process as expected?

The Working Group is a subgroup of the Marin Disaster and Citizens Corps Council. During the five-year update cycle, the Marin Operational Area Hazard Mitigation Working Group will have quarterly update meetings with the Hazard Mitigation Planning Committee and local stakeholders to discuss revisions to the plan and progress updates for the hazard mitigation actions. Further, Marin OEM will host an annual one-day mitigation summit to increase engagement and enhance collaboration on the plan and projects. The summit will also have the goal to educate stakeholders on innovative approaches to mitigation, trends, and new plan requirements. Marin OEM, as the host, will seek subject matter experts, state and federal officials, and representatives from within the Marin OA to speak to mitigation and planning. The knowledge gathered and the coordination facilitated during the summit will be used to update the base plan and annexes.

Marin OEM has the capacity to lead the Working Group and Multi-Jurisdictional Planning with one coordinator assigned with direct maintenance of the plan, a department analyst assigned to support the coordinator with project and grant tracking, and a community preparedness coordinator assigned with conducting regular public outreach on the plan and education on mitigation. Community feedback and integration will continue through outreach events and OEM website, where residents and visitors are invited to provide feedback through a survey, available in English or Spanish.

Specific plan maintenance activities by the Marin County Office of Emergency Management and its participating jurisdictions/special districts may include:

- Hold quarterly update meetings with the Hazard Mitigation Planning Committee and local stakeholders to discuss revisions to the plan and progress updates for the hazard mitigation actions.
- Annual Hazard Mitigation Summit
- Holding public meetings after the first quarter and third quarter update meetings.
- Maintaining the Marin County OEM Hazard Mitigation Website, which provides the public with the ability to access identified hazard impact maps, location address search capability, and a listing of hazard mitigation actions.
- Monitoring of the Marin County and all participating jurisdiction mitigation project activities and dissemination of status reports.
- Generation of reports relative to plan status, project management, and revision updates to executive leadership.
- Preparations for the plan's future revision and updating.

5.3 Plan Evaluation

Upon approval and adoption by Marin County and all participating jurisdictions, the prioritized mitigation strategies will be further developed for funding and implementation by the lead agencies. The plan describes the potential sources of hazard mitigation funding, and general procedures to obtain that funding.

The mitigation strategies represented and adopted within this plan are recommendations only and must be approved and funded in order to be implemented as official mitigation solutions. Ultimately, it is the responsibility of jurisdictional and agency officials within the Marin County Operational Area to undertake project implementation based upon identified mitigation

strategies, funding availability, and local need when it arises. The Marin County Office of Emergency Management will meet with the Marin Operational Area Hazard Mitigation Working Group to evaluate the plan after each update meeting.

5.4 Plan Update

During the five-year update cycle, the Marin County Office of Emergency Management will be responsible for updating the MJHMP. This update process will begin in 2024 through quarterly update meetings by the Marin Operational Area Hazard Mitigation Working Group and local stakeholders. The Marin OEM will lead these meetings to discuss revisions to the plan and progress updates for the hazard mitigation actions. Additional plan update actions are described in 5.2 Plan Monitoring and Public Engagement. The Marin County Office of Emergency Management and all participating jurisdictions and special districts will continue to hold public meetings after the first quarter and third quarter update meetings annually and will continue to invite public participation in the update process via updated public surveys.

FIGURES AND TABLES INDEX

FIGURES

Figure 1.1: Map of Marin County 13
Figure 1.2: Fire Protection Districts in Marin County 21
Figure 1.3: School Districts in Marin County 22
Figure 1.4: Muir Woods National Monument 23
Figure 1.5: Marin County Parks and Public Lands 24
Figure 1.6: Population of Marin County 1860-2020 25
Figure 1.7: Marin County Environmental Corridors 34
Figure 1.8: Marin County Habitat Types 35
Figure 1.9: Marin County Wetlands 37
Figure 1.10: Marin County Watersheds 38
Figure 1.11: Marin County Geologic Units (East of San Andreas Fault) 44
Figure 1.12: Marin County Geologic Units (West of San Andreas Fault) 45
Figure 1.13: Marin County Mineral Resource Sites 46
Figure 1.14: Marin County Average Precipitation 1895-2022 47
Figure 1.15: Marin County Average Temperature 1895-2022 48
Figure 1.16: Diablo Wind Patterns 48
Figure 1.17: Historic Sites in Marin County 54
Figure 1.18: Generalized NRI Risk Equation 55
Figure 1.19: Marin County NRI – Expected Annual Loss 62
Figure 1.20: Marin County National Risk Index Map 63
Figure 1.21: Marin County CDC Social Vulnerability Index Map 65
Figure 2.1: Marin County OEM MJHMP Website 94
Figure 2.2: Marin County OA MJHMP Town Hall Meeting 95
Figure 2.3: Collecting community feedback on the MJHMP 96
Figure 2.4: Hazard Mitigation Plan Public Outreach Press Release 97
Figure 2.5: Hazard Mitigation Plan Survey 98
Figure 3.1: Marin County Risk Assessment – Top Hazards Graphed 111
Figure 3.2: NASA Global Temperature Change CO2 Gas 113
Figure 3.3: NASA Global Temperature Change 1884 to 2022 113
Figure 3.4: NASA Global Temperature Change Sea Level 114
Figure 3.5: Human Health Impacts from Climate Change 115
Figure 3.6: Annual Mean Sea Level Trends 117
Figure 3.7: California Climate Impact Regions 118
Figure 3.8: Dams in and around the Marin County OA 124
Figure 3.9: Marin County Dam Inundation Susceptibility to Critical Facilities 125
Figure 3.10: Phoenix Lake Dam Inundation Area 127
Figure 3.11: Phoenix Lake Dam Inundation Area – Kentfield North 128
Figure 3.12: Phoenix Lake Dam Inundation Area – Kentfield South 129
Figure 3.13: Novato Creek/ Stafford Lake Dam Inundation Area 130
Figure 3.14: Novato Creek Dam Inundation Area – Green Point and Bel Marin Keys 131
Figure 3.15: Bon Tempe Dam Inundation Area 132

Figure 3.16: Bon Tempe Dam Inundation Area – Lagunitas-Forest Knolls-San Geronimo Area 133
Figure 3.17: Bon Tempe Dam Inundation Area – Point Reyes Station Area South 134
Figure 3.18: Bon Tempe Dam Inundation Area – Point Reyes Station Area North and Inverness 134
Figure 3.19: Peters Dam Inundation Area 135
Figure 3.20: Peters Dam Inundation Area – Lagunitas-Forest Knolls Area 136
Figure 3.21: Peters Dam Inundation Area – Point Reyes Station Area 137
Figure 3.22: Alpine Dam Inundation Area 138
Figure 3.23: Alpine Dam Inundation Area – Point Reyes Station 139
Figure 3.24: Lagunitas Dam Inundation Area 140
Figure 3.25: Seeger Dam Inundation Area 141
Figure 3.26: Seeger Dam Inundation Area – Point Reyes Station East 142
Figure 3.27: Seeger Dam Inundation Area – Point Reyes Station West 143
Figure 3.28: Big Rock Ranch Dam Inundation Area 144
Figure 3.29: Big Rock Ranch Dam Inundation Area East 145
Figure 3.30: Big Rock Ranch Dam Inundation Area West 146
Figure 3.31: Soulajule Dam Inundation Area 147
Figure 3.32: Soulajule Dam Inundation Area around Soulajule Dam 148
Figure 3.33: Soulajule Dam Inundation Area – Walker Creek at Highway 1 149
Figure 3.34: Soulajule Dam Inundation Area – Walker Creek at Highway 1 and Tomales Bay 149
Figure 3.35: Vonsen Dam Inundation Area 150
Figure 3.36: Vosen Dam Inundation Area 151
Figure 3.37: Landslide Susceptibility Classes 156
Figure 3.38: Mud Flow Areas 157
Figure 3.39: Landslide Susceptibility in the Marin County OA 158
Figure 3.40: Marin County Landslide Susceptibility for Critical Facilities Map 159
Figure 3.41: Landslide Susceptibility – Lagunitas, Forest Knolls, San Geronimo and Woodacre 160
Figure 3.42: Landslide Susceptibility – Nicasio and Tocoloma 160
Figure 3.43: Landslide Susceptibility – Olema and Point Reyes Station 161
Figure 3.44: Landslide Susceptibility – Inverness 161
Figure 3.45: Landslide Susceptibility – Dillon Beach and Tomales 162
Figure 3.46: Landslide Susceptibility – Dogtown, Bolinas and Stinson Beach 162
Figure 3.47: Landslide Susceptibility – Southern Marin County 163
Figure 3.48: Landslide Susceptibility – West Central Marin County 164
Figure 3.49: Landslide Susceptibility – Novato West 165
Figure 3.50: Landslide Susceptibility – West Central Marin County 166
Figure 3.51: Landslide Susceptibility – North Novato 167
Figure 3.52: Landslide Inventory in the Marin County OA 168
Figure 3.53: Damage in Inverness from the January 1982 Storm 169
Figure 3.54: January 1982 Highway 101 Mudslide in Marin County 169
Figure 3.55: February 2017 Landslide on Lucas Valley Road 170
Figure 3.56: March 2023 Mudslide in Marin County 171
Figure 3.57: U.S. Drought Monitor for California (2023) 177
Figure 3.58: U.S. Drought Monitor for California (2020) 178
Figure 3.59: U.S. Drought Monitor for California (2016) 179

Figure 3.60: Water Supply Conditions in California 2005-2018 179
Figure 3.61: Drought Impacts 181
Figure 3.62: 2022 Locations of Tree Mortality in the Marin County OA 182
Figure 3.63: Modified Mercalli Intensity Scale 185
Figure 3.64: Mercalli Scale vs. Magnitude 186
Figure 3.65: Soil Types 186
Figure 3.66: Earthquake Faults and Probability of Shaking in the Marin County OA 188
Figure 3.67: Marin County Earthquake Shaking Potential and Critical Facilities 189
Figure 3.68: Uniform California Earthquake Rupture Forecast Version 3 192
Figure 3.69: Population/Social Vulnerability to an Earthquake in California 195
Figure 3.70: Diagram of an Atmospheric River Event 198
Figure 3.71: FIRM Zones in the Marin County OA 199
Figure 3.72: The 100-year, 200-year and 500-year floodplains in the Marin County OA. 200
Figure 3.73: 100, 200, 500-Year Floodplains in the Marin County OA 201
Figure 3.74: 100-Year Floodplain – Lagunitas 202
Figure 3.75: 100-Year Floodplain – Forest Knolls Area 203
Figure 3.76: 100-Year Floodplain – San Geronimo Area 203
Figure 3.77: 100-Year Floodplain – Woodacre Area 204
Figure 3.78: 100-Year Floodplain – Tocoloma 204
Figure 3.79: 100-Year Floodplain – Nicasio 205
Figure 3.80: 100-Year Floodplain –Nicasio East 206
Figure 3.81: 100-Year Floodplain –Olema 206
Figure 3.82: 100-Year Floodplain – Point Reyes Station Area - South 207
Figure 3.83: 100-Year Floodplain – Point Reyes Station Area - North 208
Figure 3.84: 100-Year Floodplain – Inverness Park Area 209
Figure 3.85: 100-Year Floodplain – Inverness South 210
Figure 3.86: 100-Year Floodplain – Inverness 211
Figure 3.87: 100-Year Floodplain – Reynolds and Marconi Area 212
Figure 3.88: 100-Year Floodplain – Marshall Area 213
Figure 3.89: 100-Year Floodplain – Tomales Area 214
Figure 3.90: 100-Year Floodplain – Bolinas North 215
Figure 3.91: 100-Year and 500-Year Floodplain – Bolinas and Stinson Beach West 216
Figure 3.92: 100-Year and 500-Year Floodplain – Stinson Beach 217
Figure 3.93: 100-Year and 500-Year Floodplain – Muir Beach 218
Figure 3.94: 100-Year and 500-Year Floodplain – Tamalpais Valley Area 218
Figure 3.95: 100-Year and 500-Year Floodplain – Alto and Strawberry 219
Figure 3.96: 100-Year and 500-Year Floodplain – Kentfield and Greenbrae 220
Figure 3.97: 100-Year Floodplain – Marin City 221
Figure 3.98: 100-Year Floodplain – Lucas Valley and Marinwood 222
Figure 3.99: 100-Year Floodplain – Saint Vincent 223
Figure 3.100: 100-Year and 500-Year Floodplain – Santa Venetia Area 223
Figure 3.101: 100-Year and 500-Year Floodplain – San Pedro Hill Area 224
Figure 3.102: Novato Flooding - Marin County Landfill and Marin County airport 225
Figure 3.103: Flooding in San Rafael Area 226
Figure 3.104: 100-Year Floodplain – Bel Marin Keys 227
Figure 3.105: Stinson - Bolinas Area Flooding 228
Figure 3.106: Flood Control Zones in the Marin County OA 229

Figure 3.107: Damage in Inverness from 1982 Storm 231
Figure 3.108: Flooding in Marin City – 2019 Storm 232
Figure 3.109: Population/Social Vulnerability to Flooding in California 240
Figure 3.110: Dissolution Sinkhole Formation 241
Figure 3.111: Cover-Subsidence Sinkhole Formation 242
Figure 3.112: Cover-Collapse Sinkhole Formation 242
Figure 3.113: Land Subsidence in California 2007-2018 with Marin County Cutout 243
Figure 3.114: U.S. Rock types Susceptible to Water Dissolution 244
Figure 3.115: Levee Failure Mechanisms 247
Figure 3.116: Marin County Levee System 249
Figure 3.117: Levees in Tamalpais Valley 250
Figure 3.118: Levees in Strawberry 251
Figure 3.119: Tam Junction Levees 252
Figure 3.120: Levee in Kentfield 253
Figure 3.121: Greenbrae Levee System 254
Figure 3.122: McNears Sea Wall in the San Pedro Hill Area 255
Figure 3.123: Santa Venetia Levee in Santa Venetia 256
Figure 3.124: Marin Levee 33, Marin County Levees 33 and 24 and the Las Gallinas Valley Sanitary District Levee in St. Vincent 257
Figure 3.125: Santa Venetia Levee System 258
Figure 3.126: Bel Marin Keys Levee System 259
Figure 3.127: Levees Around the Marin County Airport 260
Figure 3.128: Novato North Levee System 261
Figure 3.129: Marin County Sea Level Rise Susceptibility to Critical Facilities 267
Figure 3.130: Average July Temperatures in California 268
Figure 3.131: Projections of Sea Level Rise in the San Francisco Bay Area, 2000-2100 275
Figure 3.132: Heat Index 276
Figure 3.133: Heat Disorders by Heat Index Level 277
Figure 3.134: Annual Average Temperatures in the San Francisco Bay Area, 2000-2100 281
Figure 3.135: Beaufort Wind Scale 282
Figure 3.136: Wind Zones in the US 283
Figure 3.137: Enhanced Fujita Scale 287
Figure 3.138: Waterspout Formation 288
Figure 3.139: Tsunami Inundation Zones in the Marin County OA 291
Figure 3.140: Tsunami Inundation Zone – Inverness Area 292
Figure 3.141: Tsunami Inundation Zone – Inverness 293
Figure 3.142: Tsunami Inundation Zone – South of Inverness 294
Figure 3.143: Tsunami Inundation Zone – Inverness Park and Point Reyes 295
Figure 3.144: Tsunami Inundation Zone – Reynolds and Marshall 296
Figure 3.145: Tsunami Inundation Zone – McDonald and Blakes Landing 297
Figure 3.146: Tsunami Inundation Zone – South of Tomales 298
Figure 3.147: Tsunami Inundation Zone – Dillon Beach Area 299
Figure 3.148: Tsunami Inundation Zone – Dillon Beach 300
Figure 3.149: Tsunami Inundation Zone – Bolinas Lagoon North 300
Figure 3.150: Tsunami Inundation Zone – Bolinas Area 301
Figure 3.151: Tsunami Inundation Zone – Bolinas Core 302
Figure 3.152: Tsunami Inundation Zone – Bolinas North 303

Figure 3.153: Tsunami Inundation Zone – Stinson Beach Area 303
Figure 3.154: Tsunami Inundation Zone – Stinson Beach 304
Figure 3.155: Tsunami Inundation Zone – Muir Beach 305
Figure 3.156: Tsunami Inundation Zone – Tamalpais Valley South 306
Figure 3.157: Tsunami Inundation Zone – Tamalpais Valley North 307
Figure 3.158: Tsunami Inundation Zone – Marin City 308
Figure 3.159: Tsunami Inundation Zone – Manzanita 308
Figure 3.160: Tsunami Inundation Zone – Strawberry South 309
Figure 3.161: Tsunami Inundation Zone – Unincorporated Tiburon Peninsula 310
Figure 3.162: Tsunami Inundation Zone – Paradise Cay 311
Figure 3.163: North Marin Tsunami Inundation Zones 312
Figure 3.164: Santa Venetia Tsunami Inundation Zones 313
Figure 3.165: Greenbrae Tsunami Inundation Zones 314
Figure 3.166: Richardson Bay Tsunami Inundation Zones 315
Figure 3.167: Tomales Bay Tsunami Inundation Zones 316
Figure 3.168: Bolinas – Stinson Tsunami Inundation Zones 317
Figure 3.169: Federal, State and Local Responsibility Areas in the Marin County OA 324
Figure 3.170: Fuel Model Map for the Marin County OA 328
Figure 3.171: Wildfire Ignition Points in the Marin County OA 331
Figure 3.172: WUI Boundary in the Marin County OA 332
Figure 3.173: Fire Hazard Severity Zones (FHSZ) in the Marin County OA 334
Figure 3.174: Marin County Wildfire Susceptibility to Critical Facilities 335
Figure 3.175: Fire Hazard Severity Zones – Lagunitas, Forest Knolls, San Geronimo and Woodacre 336
Figure 3.176: Fire Hazard Severity Zones –Woodacre 336
Figure 3.177: Fire Hazard Severity Zones –Woodacre Area 337
Figure 3.178: Fire Hazard Severity Zones – Nicasio 338
Figure 3.179: Fire Hazard Severity Zones – Tocoloma 339
Figure 3.180: Fire Hazard Severity Zones – Olema 340
Figure 3.181: Fire Hazard Severity Zones – Point Reyes Station 341
Figure 3.182: Fire Hazard Severity Zones – Inverness Park 342
Figure 3.183: Fire Hazard Severity Zones – Inverness 343
Figure 3.184: Fire Hazard Severity Zones – Inverness Area 344
Figure 3.185: Fire Hazard Severity Zones – Marconi/Marshall Area 345
Figure 3.186: Fire Hazard Severity Zones – McDonald/Blakes Landing Area 346
Figure 3.187: Fire Hazard Severity Zones – Tomales 347
Figure 3.188: Fire Hazard Severity Zones – Dillon Beach 348
Figure 3.189: Fire Hazard Severity Zones – Dogtown 349
Figure 3.190: Fire Hazard Severity Zones – Bolinas 350
Figure 3.191: Fire Hazard Severity Zones – Stinson Beach and Surrounding Area 351
Figure 3.192: Fire Hazard Severity Zones – Stinson Beach 351
Figure 3.193: Fire Hazard Severity Zones – Muir Beach 352
Figure 3.194: Fire Hazard Severity Zones – Tamalpais Valley and Marin City 353
Figure 3.195: Fire Hazard Severity Zone – Unincorporated Tiburon Peninsula and Paradise Cay 354
Figure 3.196: Fire Hazard Severity Zones – San Quentin 355
Figure 3.197: Fire Hazard Severity Zones – Lucas Valley and Marinwood 355

Figure 3.198: Fire Hazard Severity Zone – Bel Marin Keys and Loma Verde 356
Figure 3.199: Fire Hazard Severity Zone – San Antonio & Marin County Airport 357
Figure 3.200: Historic Wildfires in the Marin County OA 1919 - 1995 358
Figure 3.201: Historic Wildfires in the Marin County OA 1973 - 2020 359
Figure 3.202: 1995 Vision Fire 360
Figure 3.203: Population Density, Flame Length, and Rate of Spread for the Average Fire Season in the Marin County OA 365
Figure 3.204: Areas of Concern for the Average Fire Season in the Marin County OA 366
Figure 3.205: Areas of Concern for the Extreme Fire Season in the Marin County OA 367
Figure 3.206: WUI Boundary and Population Density in the Marin County OA 368
Figure 3.207: Trends in the Annual Number of Large Wildfires in the United States 372
Figure 3.208: Air Quality Index Concern Levels 376
Figure 3.209: Marin County OA Critical Infrastructure 377
Figure 3.210: Largest Oil Spills Affecting U.S. Waters 1969-2017 385
Figure 3.211: Marin County Covid-19 Hospitalizations 391
Figure 3.212: Marin County Covid-19 Hospitalizations by Demographics 391
Figure 3.213: Marin County Highways 393
Figure 3.214: SMART Commuter and Freight Line 396

TABLES

Table 1.1: Marin County Population Changes 1860-2020 26
Table 1.2: Marin County Estimated Jurisdictional Population 26
Table 1.3: Marin County Estimated Jurisdictional Population Change 2010-2020 27
Table 1.4: Marin County Population Age by Gender 2020 28
Table 1.5: Marin County Population by Race or Ethnicity 28
Table 1.6: Marin County Housing Stock 29
Table 1.7: Marin County Jurisdictional Housing Stock 31
Table 1.8: Historic Sites in Marin County 53
Table 1.9: NRI Risk Components and Factors 56
Table 1.10: NRI Hazards and Marin County OA MJHMP Hazards 57
Table 1.11: NRI Hazard Type Risk Index for Marin County 59
Table 1.12: NRI Highest-Risk Communities in Marin County 60
Table 1.13: Marin County Civilian Employed Population 16 Years and Over 67
Table 1.14: Marin County OA MJHMP Participants 2018 and 2023 69
Table 2.1: 2023 Marin OA MJHMP Participating Jurisdictions 76
Table 2.2: Marin County OA MJHMP Steering Committee Members 77
Table 2.3: Marin County OA MJHMP Preparative Consulting Planning Team Members 78
Table 2.4: Marin County OA MJHMP Planning Team Members 82
Table 2.5: Marin County OA MJHMP Planning Meetings 86
Table 3.1: Marin County OA MJHMP Hazard Identification and Comparison 101
Table 3.2: Marin County OA MJHMP Other Hazards Profiled 102
Table 3.3: State and Federal Declared Disasters in Marin County 104
Table 3.4: Marin County Hazard Risk Assessment 108
Table 3.5: Hazard Magnitude and Severity Scale 109

Table 3.6: Marin County Hazard Risk Assessment – Top Hazards Scored..... 110
Table 3.7: Hazard Ranked Dams in Marin County with Potential to Impact to the OA..... 123
Table 3.8: Marin County OA Hazard Risk Assessment – Dam Failure..... 153
Table 3.9: Marin County OA Hazard Risk Assessment – Debris Flow..... 173
Table 3.10: Marin County OA Hazard Risk Assessment – Drought..... 183
Table 3.11: Marin County OA Hazard Risk Assessment – Earthquake..... 193
Table 3.12: Marin County OA Hazard Risk Assessment – Flooding..... 236
Table 3.13: Marin County OA Hazard Risk Assessment – Land Subsidence..... 246
Table 3.14: Marin County OA Hazard Risk Assessment – Levee Failure..... 263
Table 3.15: Marin County OA Hazard Risk Assessment - Sea Level Rise..... 270
Table 3.16: Marin County OA Hazard Risk Assessment – Severe Weather, Extreme Heat..... 279
Table 3.17: Marin County OA Hazard Risk Assessment – Severe Weather; Wind..... 286
Table 3.18: Tornado Activity in the Marin County OA..... 288
Table 3.19: Marin County OA Hazard Risk Assessment - Tsunami..... 319
Table 3.20: Marin County OA Hazard Risk Assessment – Wildfire..... 363
Table 4.1: Unincorporated Marin County Future Growth Areas..... 401
Table 4.2: Marin County Legal and Regulatory Capabilities..... 406
Table 4.3: Marin County Goals and Policies..... 407
Table 4.4: Marin County Goals and Policies..... 411
Table 4.5: Marin County Fiscal Capabilities..... 413
Table 4.6: Marin County Community Outreach..... 414
Table 4.7: Participation in the National Flood Insurance Program (NFIP)..... 420
Table 4.8: Status of Previous Hazard Mitigation Actions..... 430
Table 4.9: Marin County Current Hazard Mitigation Actions..... 462

ACRONYMS

Acronym	Definition
ABAG	Association Bay Area of Governments
AQI	Air Quality Index
ARP	Address Resolution Protocol
ASL	American Sign Language
ATSDR	Agency for Toxic Substances and Disease Registry
BAAQMD	Bay Area Air Quality Management District
BCDC	Bay Conservation and Development Commission
BCPUD	Bolinas Community Public Utility District
BRIC	Building Resilient Infrastructure and Communities
CA	California
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	California Office of Emergency Services
CAP	Climate Action Plan
CASPER	Community Assessment for Public Health Emergency Response - California Department of Public Health
CDA	Community Development Agency
CDC	Centers for Disease Control and Prevention
CDI	Certified Deaf Interpreter
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CIP	Capital Improvement Plan
CMFD	Central Marin Fire District
CNRA	California Natural Resource Agency
CNRA	California Natural Resource Agency
CNRA	California Natural Resource Agency
CO	Carbon Monoxide
COVID-19	Coronavirus Disease 2019
COYL	Coyote Creek Left Bank Levee
CPUC	California Public Utilities Commission
CRF	Community Risk Factor
CRI	Community Resilience Index
CRS	Community Rating System

CRT	Community Response Team
CSA	County Service Area
C-SMART	Sea-level Marin Adaption Response Team
CWPP	Community Wildfire Protection Plan
DDoS	Distributed Denial of Service
DMA	Disaster Mitigation Act
DNS	Domain Name System
DOF	California Department of Finance
DoS	Denial-of-Service
DPW	Department of Public Works
DR	Disaster Relief
DSOD	Division of Safety of Dams - California Department of Water Resources
DWR	California Department of Water Resources
EAL	Expected Annual Loss
EAS	Emergency Alert System
EOC	Emergency Operation Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESHA	Environmentally Sensitive Habitat Areas
FD	Fire Department
FEMA	Federal Emergency Management Agency
FHSV	Fire Hazard Severity Zones
FIRM	Flood Insurance Rate Maps
FMA	Flood Mitigation Assistance
FMP	Flood Mitigation Plan
FPA	Floodplain Administrator
FRA	Federal Responsibility Areas
FY	Fiscal Year
GGNRA	Golden Gate National Recreation Area
GGNRA	Golden Gate National Recreation Area
GIS	Geographic Information System
Gov	Government
GPAC	General Plan Advisory Committee
H2S	Hydrogen Sulfide

HFHSZ	High Fire Severity Zone
HIRA	Hazard Identification and Risk Assessment
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HLR	Historic Loss Ratio
HMGP	Hazard Mitigation Grant Program
IoT	Internet of Things
IP	Intellectual Property
IPAWS	Integrated Public Alert and Warning System
ISEPA	Identified Site Emergency Planning Application
LCP	Local Coastal Program
LGVSD	Las Gallinas Valley Sanitary District
LHMP	Local Hazard Mitigation Plan
LRA	Local Responsibility Areas
LRAD	Long-Range Acoustic Device
LSAC	Levee Safety Action Classification
Marin IJ	Marin Independent Journal
MCEP	Marin Climate Energy Partnership
MCFD	Marin County Fire Department
MCOSD	Marin County Open Space District
MCPIO	Marin County Public Information Officers
MCSTOPP	Marin County Stormwater Pollution Prevention Program
MERA	Marin Emergency Radio Authority
MERS	Middle Eastern Respiratory Syndrome
MFHSZ	Moderate Fire Severity Zone
MHOAC	Medical/Health Operational Area Coordinator
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MMI	Modified Mercalli Intensity
MMWD	Marin Municipal Water District
MRZ	Mineral Resource Zones
MV2040	Mill Valley General Plan 2040
Mw Scale	Moment Magnitude Scale
MWPA	Marin Wildfire Prevention Authority
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center

NFDRS	National Fire Danger Rating System
NFIP	National Flood Insurance Program
NID	National Inventory of Dams
NIH	National Institute for Health
NMWD	North Marin Water District
NPR	Northwestern Pacific Railroad
NR	National Register of Historic Places
NRI	National Risk Index
NWS	National Weather Service
O3	Ozone
OA	Operational Area
OEM	Office of Emergency Management
OHP	Office of Historic Preservation
OWTA	On-Site Wastewater Treatment Systems
PD	Police Department
PG&E	Pacific Gas & Electric
PM10	Particulate Matter Less Than 10 Microns In Aerodynamic Diameter
PSPS	Public Safety Power shutoffs
PtH	Pass the hash
PW	Public Works
RAWS	Remote Automated Weather Stations
RCD	Resource Conservation District
RHNA	Regional Housing Needs Assessment
SASM	Sewerage Agency of Southern Marin
SFBRA	San Francisco Bay Restoration Authority
SFHA	Special Flood Hazard Area
SFHA	Special Flood Hazard Areas - FEMA
SFHA	Special Flood Hazard Area
SHMP	State Hazard Mitigation Plan
SMART	Sonoma Marin Area Rail Transit
SMFD	Southern Marin Fire District
SOX	Sulfur Oxides
SQL	Structured Query Language
SRA	State Responsibility Areas

SVI	Social Vulnerability Index
TAM	Transportation Authority of Marin
UCERF2	Uniform California Earthquake Rupture Forecast, Version 2
UCERF3	Uniform California Earthquake Rupture Forecast, Version 3
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
VHFHSV	Very High Fire Severity Zone
WC/ATWC	West Coast/Alaska Tsunami Warning Center
WHO	World Health Organization
WUI	Wildland Urban Interface
XSS	Cross-Site Scripting

APPENDIX A: ADOPTION LETTERS

RESOLUTION NO. 2024- 27

RESOLUTION OF THE MARIN COUNTY BOARD OF SUPERVISORS TO ADOPT THE 2024 MULTI JURISDICTIONAL LOCAL HAZARD MITIGATION PLAN

WHEREAS, natural hazards, such as earthquakes, floods, and wildfires, pose a significant threat to the residents and visitors of Marin County; and

WHEREAS, disasters start and end at the local level, it is the inherent responsibility of local government to lead hazard mitigation and the reduction of risk and vulnerability to hazards; and

WHEREAS, the County of Marin, in coordination with neighboring jurisdictions and special districts, produced the 2024 Marin Multi-Jurisdictional Local Hazard Mitigation Plan to provide a framework for hazard mitigation; and

WHEREAS, the County of Marin Board of Supervisors adopted a new Safety Element into the Countywide Plan in 2023 that incorporates by reference the 2024 Multijurisdictional Hazard Mitigation Plan by including the following language: "The Marin County Multi-Jurisdictional Local Hazard Mitigation Plan (MCM LHMP [now the MJHMP]) complies with all requirements set forth under Disaster Mitigation Act (DMA) 2000 and includes information also relevant to the Safety Element. Sections of the Safety Element are supplemented by the most recently adopted [MJHMP], which is incorporated by reference, as allowed by California Government Code Section 65302(g). The [MJHMP] presents environmental hazard analysis, describes important transportation and utility infrastructure at risk from environmental hazards, describes emergency evacuation systems, and mitigation actions to protect Marin County populations and infrastructure from environmental hazards."

NOW, THEREFORE, BE IT RESOLVED that the Marin County Board of Supervisors does herby adopt the 2024 Marin County Multi-Jurisdictional Local Hazard Mitigation Plan:

PASSED AND ADOPTED at a regular meeting of the Board of Supervisors of the County of Marin held on this 5 day of March 2024, by the following vote:

AYES:	SUPERVISORS	Dennis Rodoni, Stephanie Moulton-Peters, Eric Lucan, Katie Rice, Mary Sackett
NOES:	NONE	
ABSENT:	NONE	

DENNIS RODONI, PRESIDENT
BOARD OF SUPERVISORS

ATTEST:

Clerk

Resolution No. 2024-27
Page 1

OA-65

CITY of BELVEDERE
450 San Rafael Ave. • Belvedere, CA 94920-2336
Tel: 415/435-2611 • Fax: 415/435-8471
POLICE DEPARTMENT

December 1, 2022

Marin County Office of Emergency Services
1600 Los Gamos Drive
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the City of Belvedere is submitting this letter of commitment to confirm that the City of Belvedere has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the City of Belvedere, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The City of Belvedere understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;

BOLINAS COMMUNITY PUBLIC UTILITY DISTRICT

BCPUD BOX 390 270 ELM ROAD BOLINAS CALIFORNIA 94924 415 868 1224

September 23, 2022

Sheriff Jamie Scardina
Marin County Sheriff's Office
1600 Los Gamos Drive, #200
San Rafael, California 94903

Re: "Statement of Intent to Participate" as participating jurisdiction in Marin County Multi-Jurisdictional Local Hazard Mitigation Planning.

Sheriff Scardina:

In accordance with the Federal Emergency Management Agency ("FEMA")'s Local Mitigation Plans requirements, under 44 CFR §201.6, which specifically identify criteria that allow for multi-jurisdictional mitigation plans, the Bolinas Community Public Utility District ("BCPUD") is submitting this letter of intent to confirm that the BCPUD has agreed to participate in the Marin County Multi-jurisdictional Local Hazard Mitigation Planning ("MCM LHMP") effort.

Further, as a condition to participating in the mitigation planning; the BCPUD agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the County to complete the plan in conformance with FEMA requirements. The plan will comply with California AB 2140 through integration with the Marin Countywide Plan Safety Element and the municipalities' general plans. County staff on the MCM LHMP planning team are responsible for ensuring County compliance with AB 2140, and a representative of the BCPUD is responsible for ensuring compliance for its jurisdiction.

The BCPUD understands that it must engage in the following planning process, as more fully described in FEMA's *Local Mitigation Planning Handbook* (2013), including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.);
- Documentation of an effective process to maintain and implement the plan;
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan); and
- Documentation of participation in the NFIP, continued compliance with NFIP requirements, and address NFIP insured structures that have been repetitively damaged by floods.

Therefore, with a full understanding of the funding obligations incurred by an agreement between the

Letter to Sheriff Jamie Scardina
September 23, 2022
Page Two

Lead Jurisdiction and the Participating Jurisdiction, I, Jennifer Blackman, commit the BCPUD to the Marin County Multi-jurisdictional Local Hazard Mitigation Planning effort.

Executed this 23 day of September 2022.

Very truly yours,

Jennifer Blackman
General Manager

RESOLUTION NO. 03/2024

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF CORTE MADERA ADOPTING THE 2023 MULTI- JURISDICTIONAL LOCAL HAZARD MITIGATION PLAN AND TOWN OF CORTE MADERA ANNEX

WHEREAS, natural hazards, such as earthquakes, floods, and wildfires, pose a significant threat to the residents and visitors of the Town of Corte Madera; and

WHEREAS, disasters start and end at the local level, it is the inherent responsibility of local government to lead hazard mitigation and the reduction of risk and vulnerability to hazards; and

WHEREAS, the Town of Corte Madera, in coordination with neighboring jurisdictions and special districts, produced the Town of Corte Madera Annex to the 2023 Marin Multi-Jurisdictional Local Hazard Mitigation Plan (MJLHMP) to provide a framework for hazard mitigation.

NOW, THEREFORE, BE IT RESOLVED that based on the following findings and determinations and the record of these proceedings the Council of the Town of Corte Madera adopts the 2023 Multi-Jurisdictional Local Hazard Mitigation Plan and Town of Corte Madera Annex, included as Exhibit A and directs their implementation.

BE IT FURTHER RESOLVED that the Council of the Town of Corte Madera finds the following:

A. Adoption of the 2023 MJLHMP and Town of Corte Madera Annex are activities consistent with the goals and policies of the Corte Madera General Plan, and all Specific Plans in that the 2023 MJLHMP and Town of Corte Madera Annex provide updated data and mitigation strategies to address risk related to natural hazards; and

B. Adoption of the 2023 MJLHMP and Town of Corte Madera Annex would not be detrimental to the public interest, health, safety, convenience, or welfare of the Town in that these plans strive to improve and enhance public readiness for disaster and provide mitigation strategies; and

C. Adoption of the 2023 MJLHMP and Town of Corte Madera Annex, have been reviewed in accordance with the California Environmental Quality Act (CEQA) and are exempt from CEQA because they are 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 2023 MJLHMP and Town of Corte Madera Annex 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 2023 MJLHMP and Town of Corte Madera Annex are consistent with the Town of Corte Madera 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 2023 MJLHMP and Town of Corte Madera Annex will undergo additional CEQA review.

☼ ☼ ☼ ☼ ☼ ☼ ☼ ☼ ☼

I HEREBY CERTIFY that the foregoing resolution was duly and regularly adopted by the Town Council of Corte Madera at a regular meeting held on the 16th day of January 2024, by the following vote, to wit:

AYES:	Councilmembers: E. Beckman, F. Casissa, C. Lee, P. Ravasio, R. Thomas
NOES:	Councilmembers: - None -
ABSENT:	Councilmembers: - None -

APPROVED:

Eli H. Beckman, Mayor

ATTEST:

Lorena Barrera, Town Clerk

TOWN OF FAIRFAX
142 Bolinas Road, Fairfax, California 94930
(415) 453-1584 / Fax (415) 453-1618

December 5, 2022

Marin County Office of Emergency Services
Marin County Sheriff's Office
1600 Los Gamos Dr. #200
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Town of Fairfax is submitting this letter of commitment to confirm that the Town of Fairfax has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, Town of Fairfax, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The Town of Fairfax understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
Documentation of an effective process to maintain and implement the plan; and,
Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Fairfax Town Manager, commit the Town of Fairfax to the Marin County's Multi-jurisdictional Hazard Mitigation Planning effort.

This document is executed this 5th day of December, 2022.

Sincerely,

Heather Abrams
Town of Fairfax, Town Manager

City of Larkspur
400 Magnolia Avenue, Larkspur, California 94939
Telephone: (415) 927-5110 Fax: (415) 927-5022
Website: www.cityoflarkspur.org

March 28, 2023

Office of Emergency Management
Marin County Fire
1600 Los Gamos Drive
San Rafael, CA. 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the City of Larkspur is submitting this letter of commitment to confirm that the City of Larkspur has agreed to participate in the Marin County's Multi-Jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, City of Larkspur, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County Multi-Jurisdictional Hazard Mitigation Planning process to complete the plan in conformance with FEMA requirements.

The City of Larkspur understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include

relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-Jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, City Manager Dan Schwarz, commit the City of Larkspur to the Marin County Multi- Jurisdictional Hazard Mitigation Planning effort.

This document is executed this 28th day of March, 2023.

Dan Schwarz
City Manager

Las Gallinas VALLEY SANITARY DISTRICT

101 Lucas Valley Road, Suite 300
San Rafael, CA 94903
Tel.: 415-472-1734
Fax: 415-499-7715
www.LGVSD.org

MANAGEMENT TEAM
General Manager, Curtis Paxton
Plant Operations, Mel Liebmann
Collections/Safety/Maintenance, Greg Pease
Engineering, Michael P. Cortez
Administrative Services, Dale McDonald

DISTRICT BOARD
Megan Clark
Ronald Ford
Craig K. Murray
Judy Schriebman
Crystal J. Yezman

November 23, 2022

Marin County Office of Emergency Services
1600 Los Gamos Drive
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Las Gallinas Valley Sanitary District is submitting this letter of commitment to confirm that Las Gallinas Valley Sanitary District has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, Las Gallinas Valley Sanitary District, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

Las Gallinas Valley Sanitary District understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook. including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A

range of actions must be identified specific for each jurisdiction;

- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, *Curtis Paxton*, commit *Las Gallinas Valley Sanitary District* to the Marin County's Multi- jurisdictional Hazard Mitigation Planning effort.

This document is executed this 23rd day of November, 2022.

If you need further information or have any questions, please do not hesitate to contact our Administrative Services Manager, Dale McDonald at 415-526-1519.

Curtis Paxton
Las Gallinas Valley Sanitary District, General Manager

MILL VALLEY

November 29, 2022

Marin County Administrator's Office
3501 Civic Center Drive #325
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the City of Mill Valley is submitting this letter of commitment to confirm that the City of Mill Valley has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the City of Mill Valley, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The City of Mill Valley understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;

City of Mill Valley, 26 Corte Madera Avenue, Mill Valley, California 94941 • 415-388-4033

- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, *Todd Cusimano*, commit *the City of Mill Valley* to the Marin County's Multi-jurisdictional Hazard Mitigation Planning effort.

This document is executed this 29th day of November 29, 2022.

Todd Cusimano
City Manager
City of Mill Valley

NORTH MARIN WATER DISTRICT

999 Rush Creek Place
P.O. Box 146
Novato, CA 94948-0146

PHONE
415-897-4133

EMAIL
info@nmwd.com

WEB
www.nmwd.com

January 3, 2023

Marin County Administrator's Office
3501 Civic Center Drive #325
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-Jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the North Marin Water District is submitting this letter of commitment to confirm that North Marin Water District has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, North Marin Water District, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

North Marin Water District understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-Jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

DIRECTORS: JACK BAKER · KEN EICHSTAEDT · RICK FRAITES · MICHAEL JOLY · STEPHEN PETTERLE
OFFICERS: ANTHONY WILLIAMS, General Manager · TERRIE KEHOE, District Secretary · JULIE BLUE, Auditor-Controller · ERIC MILLER, Asst. GM/Chief Engineer

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, ***Anthony Williams, General Manager***, commit North Marin Water District to the Marin County's Multi-Jurisdictional Hazard Mitigation Planning effort.

This document is executed this 3rd day of January, 2023.

Sincerely,

Anthony Williams
General Manager
North Marin Water District

Attachment: NMWD Board of Directors Memo dated December 20, 2022

TW:edm
R:\NON JOB No ISSUES\Hazard Mitigation Plan\BOD Memos\2022 1220 - letter of commitment\Letter of Commitment to Marin County MJHMP.docx

CITY OF NOVATO
CALIFORNIA

December 15, 2022

Marin County Administrator's Office
3501 Civic Center Drive #325
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the **City of Novato** is submitting this letter of commitment to confirm that **City of Novato** has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, **City of Novato**, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

City of Novato understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook. including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A

922 MACHIN AVENUE, NOVATO, CA 94945 | PHONE: 415.899.8900 | NOVATO.ORG
Mayor Eric Lucan | Mayor Pro Tem Susan Wernick | Councilmembers Denise Athas • Pat Eklund • Mark Milberg
City Manager | Adam McGill

range of actions must be identified specific for each jurisdiction;

- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, ***Adam McGill, City Manager***, commit ***City of Novato*** to the Marin County's Multi- jurisdictional Hazard Mitigation Planning effort.

This document is executed this **15** day of December, 2022.

Adam McGill, City Manager
City of Novato

TOWN OF ROSS

February 6, 2023

Office of Emergency Management
Marin County Fire
1600 Los Gamos Drive
San Rafael, CA. 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allows for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Town of Ross is submitting this letter of commitment to confirm that Town of Ross agrees to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the Town of Ross agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The Town of Ross understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook. including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

P.O. BOX 320, ROSS, CA 94957-0320
415.453.1453 • FAX 415.453.1950
www.townofross.org

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Christa Johnson, Town Manager for the Town of Ross, does hereby acknowledge a commitment on behalf of the Town of Ross to participating in the Marin County's Multi- jurisdictional Hazard Mitigation Planning effort.

This document is executed this 6 day of February 2023.

Christa Johnson
Town Manager, Town of Ross

Steve Burdo
Mayor

Eileen Burke
Vice Mayor

Alexis Fineman
Council Member

Brian Colbert
Council Member

Tarrell Kullaway
Council Member

TOWN OF
SAN ANSELMO
EST. 1907

Town of San Anselmo
525 San Anselmo Avenue, San Anselmo, CA 94960-2682
(415) 258-4616
www.townofsananselmo.org

February 6, 2023

Office of Emergency Management
Marin County Fire
1600 Los Gamos Drive
San Rafael, CA. 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Town of San Anselmo is submitting this letter of commitment to confirm that the Town of San Anselmo has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

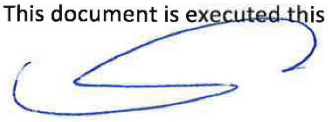
Furthermore, as a condition of participation in the mitigation planning, the Town of San Anselmo, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The Town of San Anselmo understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Dave Donery, the Town Manager, commit the Town of San Anselmo to the Marin County's Multi-jurisdictional Hazard Mitigation Planning effort.

This document is executed this 6th day of February, 2023.



Dave Donery, Town Manager
Town of San Anselmo

November 29, 2022

Marin County Administrator's Office
3501 Civic Center Drive #325
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the City of San Rafael is submitting this letter of commitment to confirm that the City of San Rafael has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the City of San Rafael, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The City of San Rafael understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook. including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending

meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and

- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Jim Schutz, commit the City of San Rafael to the Marin County's Multi- jurisdictional Hazard Mitigation Planning effort.

This document is executed this 29th day of November 2022.

Jim Schutz
City Manager

CITY OF SAN RAFAEL | 1400 FIFTH AVENUE, SAN RAFAEL, CALIFORNIA 94901 | CITYOFSANRAFAEL.ORG

Kate Colin, **Mayor** • Rachel Kertz, **Vice Mayor** • Maribeth Bushey, **Councilmember** • Eli Hill, **Councilmember** • Maika Llorens Gulati, **Councilmember**

DocuSign Envelope ID: 0B4CA582-DE1D-4BA9-81B3-C0970254E3EB

CITY OF SAUSALITO
Janelle Kellman, Mayor
Chris Zapata, City Manager
420 Litho Street, Sausalito, California 94965-1933
Telephone: 415-289-4100 ◦ WWW SAUSALITO.GOV

December 6, 2022

Marin County Office of Emergency Services
Marin County Sheriff's Office
1600 Los Gamos Dr. #200
San Rafael, CA 94903

File No.: 11.18.02

Re: Letter of Commitment
Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the City of Sausalito is submitting this letter of commitment to confirm that the City of Sausalito has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the City of Sausalito agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The City of Sausalito understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, City of

Administration: (415) 289-4167
Recreation: (415) 289-4189
FAX NUMBERS:
Community Development: (415) 339-2256
Public Works Engineering: (415) 339-2256
Library: (415) 331-7943
Public Works Maintenance: (415) 289-4138

DocuSign Envelope ID: 0B4CA582-DE1D-4BA9-81B3-C0970254E3EB

Sausalito City manager, commit the City of Sausalito to the Marin County's Multi-jurisdictional Hazard Mitigation Planning effort.

This document is executed this 6th day of December 2022.

Sincerely,
City of Sausalito

DocuSigned by:
75CB1AA4D9EF424...

Chris Zapata
City Manager

cc: Kevin McGowan, Public Works Director

Southern Marin Fire Protection District
Christian Tubbs, Fire Chief

28 Liberty Ship Way, STE 2800
Sausalito, California 94965
Phone: 415-388-8182 Fax: 415-388-8181

December 12, 2022

Marin County Office of Emergency Services
Marin County Sheriff's Office
1600 Los Gamos Dr. #200
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Southern Marin Fire Protection District is submitting this letter of commitment to confirm that Southern Marin Fire Protection District has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, Southern Marin Fire Protection District, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

Southern Marin Fire Protection District understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook, including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;
- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;

- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Chris Tubbs, Fire Chief, commit Southern Marin Fire Protection District to the Marin County's Multi- jurisdictional Hazard Mitigation Planning effort.

This document is executed this 12th day of December, 2022.

Chris Tubbs
Southern Marin Fire Protection District, Fire Chief

Town of Tiburon • 1505 Tiburon Boulevard • Tiburon, CA 94920 • P. 415.435.7373 F. 415.435.2438 • www.townoftiburon.org

Jon Welner
Mayor

Jack Ryan
Vice Mayor

Alice Fredericks
Councilmember

Noah Griffin
Councilmember

Holli Thier
Councilmember

Greg Chanis
Town Manager

November 30, 2022

Marin County Office of Emergency Services
1600 Los Gamos Drive
San Rafael, CA 94903

Re: Letter of Commitment as Participating Jurisdiction in Marin County Multi-jurisdictional Hazard Mitigation Planning

Dear State Hazard Mitigation Officer:

As the Federal Emergency Management Agency's (FEMA) Local Mitigation Plan requirements under 44 CFR §201.6 specifically identify criteria that allow for multi-jurisdictional mitigation plans and that many issues are better resolved by evaluating hazards more comprehensively by coordinating at the county, regional, or watershed level, the Town of Tiburon is submitting this letter of commitment to confirm that the Town of Tiburon has agreed to participate in the Marin County's Multi-jurisdictional Hazard Mitigation Planning.

Furthermore, as a condition of participation in the mitigation planning, the Town of Tiburon, agrees to meet the requirements for mitigation plans identified in 44 CFR §201.6 and to provide such cooperation as is necessary and in a timely manner to the Marin County to complete the plan in conformance with FEMA requirements.

The Town of Tiburon understands that it must engage in the following planning process, as more fully described in FEMA's Local Mitigation Planning Handbook. including, but not limited to:

- Identification of hazards unique to the jurisdiction and not addressed in the master planning document;

- The conduct of a vulnerability analysis and an identification of risks, where they differ from the general planning area;
- The formulation of mitigation goals responsive to public input and development of mitigation actions complementary to those goals. A range of actions must be identified specific for each jurisdiction;
- Demonstration that there has been proactively offered an opportunity for participation in the planning process by all community stakeholders (examples of participation include relevant involvement in any planning process, attending meetings, contributing research, data, or other information, commenting on drafts of the plan, etc.); and
- Documentation of an effective process to maintain and implement the plan; and,
- Formal adoption of the Multi-jurisdictional Hazard Mitigation Plan by the jurisdiction's governing body (each jurisdiction must officially adopt the plan).

Therefore, with a full understanding of the obligations incurred by participating in the FEMA hazard mitigation planning process as a participant in a multi-jurisdictional plan; I, Greg Chanis, Town Manager, commit the Town of Tiburon to the Marin County's Multi-jurisdictional Hazard Mitigation Planning effort.

This document is executed this 16 day of November 2022.

Greg Chanis

Town Manager, Town of Tiburon

(415) 435-7373

APPENDIX B: DOCUMENTATION OF THE PLANNING PROCESS

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plans
Project Kickoff Meeting

Steering Committee Meeting Agenda

October 26, 2022, from 10:00 am – 11:00 am

I. Welcome and Introductions
II. Hazard Mitigation and Emergency Management Overview
III. Plan Overview – Steps and Timeline
IV. Planning Process
V. Community Profiles
VI. Planning Goals and Objectives
VII. Hazard Identification and Risk Assessment
VIII. Status of the Current Hazard Mitigation Projects
IX. Identify New Hazard Mitigation Projects List
X. Planning Team
XI. Next Steps
XII. Questions & Concluding Remarks

Topic: **Marin County MJHMP Kick-off Steering Team Meeting**
Time: **Oct 26, 2022 10:00 AM** Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/88065994372?pwd=N3ZkdnR0bmlhQVErSUZXQVBiZFF3QT09
Meeting ID: **880 6599 4372**
Passcode: **848288**

Preparative Consulting
PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting

Steering Committee Meeting Sign-In Sheet

October 26, 2022, from 10:00 am – 11:00 am

Join Zoom Meeting
https://us06web.zoom.us/j/88065994372?pwd=N3ZkdnR0bmlhQVErSUZXQVBiZFF3QT09
Meeting ID: **880 6599 4372**
Passcode: **848288**

1. 10:24:27 From Paul Bockrath : Paul Bockrath, Preparative Consulting
2. 10:24:29 From Kate, San Rafael : Kate Hagemann, city of san Rafael
3. 10:24:44 From Beb : Beb Skye, Marin County DPW
4. 10:24:45 From Hannah Lee : Hannah Lee, Senior Civil Engineer, Marin County Flood Control & Water Conservation District
5. 10:24:52 From Leslie Lacko : Leslie Lacko | Marin County CDA
6. 10:24:55 From Rich Simonitch : Rich Simonitch Town of Ross
7. 10:24:57 From Scott Schneider : Scott Schneider, Asst. Public Works Director, Town of San Anselmo
8. 10:25:00 From Woody Baker-Cohn / Marin OES : Woody Baker-Cohn / Assistant Emergency Manager / Marin OES
9. 10:25:02 From Kevin McGowan, Sausalito DPW : Kevin McGowan, public works director from City of Sausalito is present.
10. 10:25:03 From Felix Meneau : Felix Meneau, Marin County DPW/Water Resources
11. 10:25:03 From Victoria LaMar-Haas, Cal OES : Victoria LaMar-Haas, Cal OES Local Mitigation Planning
12. 10:25:04 From Joanna K : Joanna Kwok, Senior Civil Engineer, City of San Rafael
13. 10:25:05 From Chris Good - Corte Madera : Chris Good, Senior Civil Engineer, Town of Corte Madera Public Works
14. 10:25:08 From Loren Umbertis, Town of Fairfax : Loren Umbertis, Public Works Director, Town of Fairfax
15. 10:25:11 From Jennifer Blackman : Jennifer Blackman, General Manager, Bolinas Community Public Utility District
16. 10:25:21 From Richard Diaz SRFD/OES : Richard Diaz - Community Disaster Preparedness Coordinator - City of San Rafael
17. 10:25:24 From David Block - Preparative : David Block, Preparative Consulting
18. 10:25:29 From mlockaby : Mark Lockaby Building Official Town of Fairfax
19. 10:25:32 From MCFD Staging User ipad iOS 11.2.1 HP34 (3)Tiger : Scott Alber, MCFD

PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting

20. 10:26:07 From Greg Pease - Las Gallias Valley Sanitary District : Greg Pease - Collection System/Maintenance/Safety Manager - Las Gallinas Valley Sanitary District
21. 10:45:22 From Chris Reilly : Chris Reilly, Emergency Services Manager, Marin County OES
22. 11:00:58 From Cory Bytof : Cory Bytof, City of San Rafael Sustainability
23. From David Dammuller, City of Novato Public Works
24. From Jared Peri, Cal OES Local Mitigation Planning

2023 Marin County
Multi-Jurisdictional Local Hazard Mitigation Plan
Hazard Meeting

Steering Committee Meeting Agenda

October 26, 2022, from 10:00 am – 11:00 am

I. Welcome and Introductions
II. Plan Overview – Steps and Timeline
III. Jurisdictional Points of Contact
IV. Jurisdictional Letter of Commitment
V. Identify Planning Team Members
VI. Hazard Identification and Risk Assessment
VII. Jurisdictional Profiles
VIII. Status of the Current Hazard Mitigation Projects
IX. Next Steps
X. Questions & Concluding Remarks

Topic: **Marin County MJHMP Steering Team Meeting**
Time: **November 9, 2022 10:00 AM** Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/83506781602?pwd=TThmN2d6NVNIVHdJRFBaQ0tzbHZlZz09
Meeting ID: **835 0678 1602**
Passcode: **747816**

One tap mobile
+16699006833,,83506781602#,,,,*747816# US (San Jose)
+14086380968,,83506781602#,,,,*747816# US (San Jose)

PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

Sign_n Sheet Marin Co. MJHMP Steering Committee Mtg 110922

10:02:55 From Paul Bockrath : Paul Bockrath, Preparative Consulting
10:03:14 From Tim Fuette (NMWD) : Tim Fuette, Senior Engineer, NMWD
10:03:15 From Loren Umbertis, Town of Fairfax : Loren Umbertis, Public Works Director, Town of Fairfax
10:03:17 From Leslie Lacko : Leslie Lacko | Marin County CDA
10:03:20 From Richard Diaz SRFD/OES : Richard Diaz, City of San Rafael
10:03:26 From Julia Elkin (she/her) | Marin County DPW : Julia Elkin, Marin County DPW
10:03:35 From Joanna K : Joanna Kwok, City of San Rafael, Senior Civil Engineer
10:03:38 From Jennifer Blackman : Jennifer Blackman, General Manager, Bolinas Community Public Utility District
10:03:45 From Dave Jeffries : David Jeffries, JPSC for City of Novato and Novato Fire District, Consultant
10:04:02 From Andrew Davidson : Andrew Davidson, City of Sausalito, Senior Engineer
10:04:08 From David -City of Novato : David Dammuller, Engineering Services Manager, City of Novato
10:04:19 From Greg Pease - Las Gallias Valley Sanitary District : Greg Pease, Collection System/Maintenance/Safety Manager, Las Gallinas Valley Sanitary District
10:04:27 From Eric Miller (NMWD) : Eric Miller, Assistant GM/Chief Engineer, North Marin Water District
10:04:54 From Richard Simonitch : Richard Simonitch, Public Works Director - Town of Ross
10:06:37 From Chris Reilly : Chris Reilly Marin OES
10:07:21 From Hannah Lee : Hannah Lee, Senior Civil Engineer, Marin County Flood Control & Water Conservation District
10:10:49 From Ahmed Aly Mill Valley : Ahmed Aly, Mill Valley Project Manager
10:13:01 From Felix Meneau : Felix Meneau, Capital Planning Project Manager - Marin County Flood Control & Water Conservation District
11:47:23 From Kevin McGowan, Sausalito DPW : Kevin McGowan, City of Sausalito
11:48:36 From Erica Freeman : Erica Freeman, Building Official Town of San Anselmo

2023 Marin County
Multi-Jurisdictional Local Hazard Mitigation Plan
Project Kickoff Meeting

Planning Team Meeting Agenda

December 6, 2022, from 10:00 am – 11:00 am

I. Welcome and Introductions
II. Hazard Mitigation and Emergency Management Overview
III. Plan Overview – Steps and Timeline
IV. Planning Process
V. Community Profiles
VI. Planning Goals and Objectives
VII. Hazard Identification and Risk Assessment
VIII. Status of the Current Hazard Mitigation Projects
IX. Identify New Hazard Mitigation Projects List
X. Planning Team
XI. Public Outreach
XII. Next Steps
XIII. Questions & Concluding Remarks

Topic: Marin County Hazard Mitigation Planning Team Kickoff Meeting
Time: Dec 6, 2022 10:00 AM Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/89164164111?pwd=ZDlkSlRtZStqbzVrRUFyYnpzbHJQUT09

Meeting ID: 891 6416 4111
Passcode: 279805
One tap mobile
+14086380968,,89164164111#,,,,*279805# US (San Jose)
+16694449171,,89164164111#,,,,*279805# US

Preparative Consulting | PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

MCM LHMP Planning Team Kickoff Meeting Sign In Sheet 120622

10:07:02 From Loren Umbertis, Town of Fairfax : Loren Umbertis, Public Works Director, Town of Fairfax
10:07:05 From Cory Bytof | City of San Rafael | he/him : Signing in: Cory Bytof, City of San Rafael, Sustainability Program
10:07:06 From Tim Fuette (NMWD) : Tim Fuette (NMWD)
10:07:17 From Woody Baker-Cohn / Marin OES : Woody Baker-Cohn / Asst EM / Marin OES/OEM
10:07:40 From Irene Borba - City of Belvedere : Irene Borba - Director of Planning & Building - City of Belvedere
10:07:40 From Richard Simonitch : Rich Simonitch, Town of Ross
10:07:44 From Dale McDonald : Dale McDonald / Las Gallinas Valley Sanitary District
10:07:47 From Richard Diaz : Signing in:
Richard Diaz
Office of Emergency Services
City of San Rafael
10:07:49 From Dave Jeffries : Dave Jeffries, City of Novato and Novato Fire District
10:07:56 From David Block : David Block, Preparative Consulting
10:08:04 From Kevin McGowan, Sausalito DPW : Signing in: Kevin McGowan, Public Works Director, City of Sausalito; kmcgowan@sausalito.gov
10:08:25 From Svetlana : Svetlana Smorodinsky, CA Department of Public Health
10:08:25 From Scott Schneider : Scott Schneider, Town of San Anselmo Public Works
10:08:33 From Eric Miller (NMWD) : Eric Miller, North Marin Water District
10:08:34 From Joanna Kwok : Joanna Kwok, City of San Rafael
10:08:38 From Erica Freeman, Building Official : Erica Freeman, Town of San Anselmo, Building Official
10:08:40 From RJ Suokko, Corte Madera : Signing in: RJ Suokko, Town of Corte Madera
10:08:42 From Tom Welch Mill Valley and SMFD Fire Department : Tom Welch - City of Mill Valley and Southern Marin Fire Protection District
10:08:42 From Jennifer Blackman : Jennifer Blackman, General Manager, Bolinas Community Public Utility District
10:08:48 From Stephen Marcotte : Stephen Marcotte - Bolinas Fire Protection District
10:08:48 From Patrick Kelly, City of Mill Valley : Patrick Kelly, Director of Planning & Building, City of Mill Valley
10:08:57 From David -City of Novato : David Dammuller, City of Novato
10:09:08 From Sam Bonifacio, Town of Tiburon : Samantha Bonifacio, Town of Tiburon (Assistant Planner)
10:09:17 From Ahmed Aly Mill Valley : Ahmed A Aly, P.E.
City of Mill Valley
Project Manager
415-384-4755
aaaly@cityofmillvalley.org

Twitter: @MillValleyDPW
10:09:39 From Laurie Nilsen : Laurie Nilsen, Emergency Services Coordinator, Belvedere and Tiburon -
10:24:05 From Tom Welch Mill Valley and SMFD Fire Department : Tom Welch Southern Marin Fire Protection District, Deputy Chief of Operations.
twelch@smfd.org.
11:16:40 From Cory Bytof | City of San Rafael | he/him : San Rafael City Schools
11:18:39 From Svetlana Smorodinsky CDPH : County of Marin Department of Health and Human Services

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan

Planning Team Meeting Agenda

March 7, 2023, from 9:00 am – 11:00 am

Planning Team Project Overview (9:00 am – 9:50 am)
(REQUIRED for Planning Team/OPTIONAL for Steering Committee)

I. Welcome and Introductions
II. Hazard Mitigation and Emergency Management Overview
III. Plan Overview – Steps and Timeline
IV. Community Overview
V. Planning Process
VI. Planning Goals and Objectives
VII. Hazard Identification and Risk Assessment
VIII. Stakeholders and Planning Team Identification

Meeting Break (9:50 am – 10:00 am)

Planning Team Meeting (10:00 am – 11:00 am)
(REQUIRED for Planning Team AND Steering Committee)

IX. Public Outreach
X. Planning Goals and Objectives
XI. Hazard Risk Ranking Worksheets
XII. Jurisdictional Profiles
XIII. Jurisdictional/ District Capability Assessment
XIV. 2018 Hazard Mitigation Project Status Update
XV. Next Steps
XVI. Questions & Concluding Remarks

Join Zoom Meeting
https://us06web.zoom.us/j/85488557965?pwd=cklySmNna0pCK0hQVjBhMlA0MlUyQT09

Meeting ID: 854 8855 7965
Passcode: 979049

One tap mobile
+16699006833,,85488557965#,,,,*979049# US (San Jose)
+14086380968,,85488557965#,,,,*979049# US (San Jose)

Preparative Consulting
PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

COUNTY OF MARIN

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Planning Team Meeting 030723 Sign-In

Marin County MJHMP Planning Meeting 030723

1. 09:05:0 From Greg Pease : Greg Pease, LGVSD Collections System/Maintenance/Safety Manager
2. 09:06:19 From Woody Baker-Cohn : Woody Baker-Cohn / Marin OEM / Asst EM
3. 09:09:30 From Chris Reilly : Chris Reilly, Marin County Fire OEM
4. 09:09:32 From Scott Alber : Scott Alber, MCFD
5. 09:09:47 From Andy : Andrew Davidson, City of Sausalito
6. 09:10:01 From Sarah Finnigan - Cal : Sarah Finnigan, Cal OES
7. 09:11:13 From DANIEL RODRIGUEZ : DANIEL RODRIGUEZ, Security, Emergency Management Specialist Golden Gate Bridge, Highway & Transportation District
8. 09:14:13 From Daisy Allen, Mill Valley : Daisy Allen, City of Mill Valley Planning
9. 09:15:34 From hannah lee : Hannah Lee, County of Marin DPW and Marin County Flood Control & Water Conservation District
10. 09:16:55 From Steven Torrence - Marin County OEM : Steven Torrence, Director of Emergency Management, Office of Emergency Management
11. 09:18:11 From Marshall Nau : Marshall Nau, Fire Inspector, Southern Marin Fire District
12. 09:54:55 From Daisy Allen, Mill Valley
13. 09:55:01 From Victoria LaMar-Haas, Cal OES : Victoria LaMar-Haas, Program Manager, Cal OES Local Mitigation Planning
14. 10:02:38 From David -City of Novato : David Dammuller, Engineering Services Manager, City of Novato
15. 10:03:48 From Dave Jeffries : Dave Jeffries, City of Novato
16. 10:03:54 From Scott Schneider : Scott Schneider, Town of San Anselmo
17. 10:04:19 From Tim Fuette (NMWD) : Tim Fuette, NMWD
18. 10:04:22 From Laurie Nilsen : Laurie Nilsen, Town of Tiburon & City of Belvedere OES
19. 10:04:34 From Sam Bonifacio- Tiburon Planning : Sam Bonifacio, Town of Tiburon
20. 10:04:42 From Julia Elkin (she/her), Marin County DPW : Julia Elkin, Marin County DPW
21. 10:04:51 From Jennifer Blackman : Jennifer Blackman, Bolinas Community Public Utility District
22. 10:06:46 From Markus Lansdowne - Caltrans D4 : Markus Lansdowne - Caltrans District 4 Emergency Operations Coordinator
23. 10:13:46 From Patrice Chamberlain- CDPH Enviro & Occ Health Emergency Prep
24. 10:45:15 From Leslie Lacko: Leslie Lacko, CDA, Marin County
25. 10:48:21 From Svetlana Smorodinsky: CDPH Disaster Epidemiologist/ Environmental & Occupational Emergency Preparedness Team

Additional Meeting Attendees

26. Amber Davis: Marin County Public Health
27. Chris LeBaudour: Marin County EMS Authority
28. Danielle Jessup: Cal OES Dam Safety Planning Division
29. Eric Goldman: Marin Water District
30. Jennifer McGill:
31. Jesse Sanchez:
32. Julie Ekstrom: CA. Dept. of Water Resources
33. Loren Umberis: Fairfax Public Works
34. Quinn Gardner: San Rafael
35. Rich Simonitch:
36. Richard Diaz: San Rafael FD
37. RJ Suokko: Corte Madera
38. Ahmed Aly: Mill Valley
39. Laney Davidson: Marin County

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan

Planning Team Meeting Agenda

April 4, 2023, from 10:00 am – 11:00 am

I. Welcome and Introductions
II. HMGP (DR-4683) Funding Timeline
III. Public Outreach
IV. Planning Goals and Objectives
V. Jurisdictional Hazard Vulnerability Maps
VI. Jurisdictional Profiles
VII. Jurisdictional/ District Capability Assessment
VIII. 2018 Hazard Mitigation Project Status Update
IX. Next Steps
X. Questions & Concluding Remarks

Topic: Marin County MJHMP Planning Team Meeting 040423
Time: Apr 4, 2023 10:00 AM Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/89624264855?pwd=VTNGV1VtUzgyVHVvNUMxRm9QL0ZRdz09

Meeting ID: 896 2426 4855
Passcode: 283612
One tap mobile
+16694449171,,89624264855#,,,,*283612# US
+16699006833,,89624264855#,,,,*283612# US (San Jose)

PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Planning Team Meeting 040423 Sign-In

Sign_in Sheet Marin County MJHMP Planning Meeting 040423

1. 10:01:52 From Paul Bockrath : Paul Bockrath, Preparative Consulting
2. 10:01:57 From Woody Baker-Cohn : Woody Baker-Cohn / Asst EM Marin OEM
3. 10:02:08 From Katherine Hagemann kate.hagemann@cityofsanrafael.org : kate Hagemann, city of san Rafael
4. 10:02:14 From Beb : Beb Skye, County of Marin
5. 10:02:16 From Loren Umbertis, Public Works Director : Loren Umbertis, Director of Public Works, town of Fairfax
6. 10:02:19 From Chris Good - Corte Madera : Chris Good - Town of Corte Madera/Sanitary District No. 2
7. 10:02:20 From Steven Torrence - Director Marin County OEM : Steven Torrence - OEM Director - County of Marin
8. 10:02:22 From Laurie Nilsen : Laurie Nilsen Belvedere and Tiburon Administrative and Emergency Services Coordinator
9. 10:02:23 From Jennifer Blackman : Jennifer Blackman, Bolinas Community Public Utility District
10. 10:02:31 From Kevin McGowan, Sausalito DPW : Kevin McGowan, City of Sausalito
11. 10:02:33 From Hannah Lee : Hannah Lee, Senior Civil Engineer, Marin County Department of Public Works and Flood Control & Marin County Water Conservation District
12. 10:02:34 From Sarah Finnigan - Cal OES : Sarah Finnigan, Cal OES, ESC
13. 10:02:39 From Jennifer McGill : Jennifer McGill, Sonoma-Marin Area Rail Transit District
14. 10:03:02 From Sam Bonifacio, Town of Tiburon : Sam Bonifacio, Assistant Planner with the Town of Tiburon
15. 10:03:53 From Marshall Nau : Marshall Nau- Southern Marin Fire District
16. 10:05:26 From Dale McDonald : Dale McDonald - LGVSD
17. 10:05:36 From Richard Simonitch : Richard Simonitch Town of Ross
18. 10:05:37 From Central Marin Fire : Matt Cobb - Central Marin Fire
19. 10:05:53 From Scott Alber : Scott Alber, MCFD
20. 10:06:24 From Erica Freeman : Erica Freeman, Town of San Anselmo
21. 10:06:40 From patrice : Patrice Chamberlain - CA Dept of Public Health, Enviro & Occupational Emergency Prep Team
22. 10:08:56 From Daisy Allen, City of Mill Valley : Daisy Allen, City of Mill Valley Planning
23. 10:09:23 From Leslie Lacko : Leslie Lacko, Marin County Community Development Agency
24. 10:10:14 From Quinn Gardner, San Rafael Dep Dir- Emergency Mgt (she/her) : Quinn Gardner, San Rafael

Additional Meeting Attendees

1. Amber Davis: Marin County Public Health
2. Ahmed Aly: Mill Valley
3. Daniel Rodriguez, Golden Gate Bridge, Highway & Transportation District
4. Manny Albano, San Rafael
5. Markus Lansdowne, Caltrans
6. Scott Schneider, San Anselmo

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan

Steering Committee Meeting Agenda

May 31, 2023, from 10:00 am – 11:30 am

I. Welcome and Introductions
II. HMGP (DR-4683) Funding Timeline
III. Public Outreach Status
IV. Jurisdictional Hazard Vulnerability Maps
V. OEM Overview of Hazard Maps and Marin Maps
VI. Marin Co. MJHMP Risk Assessment Tool Overview
VII. 2018 Hazard Mitigation Project Status Update
VIII. Hazard Working Groups
IX. Next Steps
X. Questions & Concluding Remarks

Topic: Marin County MJHMP Steering Committee Meeting 053123
Time: May 31, 2023 10:00 AM Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/88549237300?pwd=YjFzdXh2UW9mdDZEMkZiQlZiM0VaQT09

Meeting ID: 885 4923 7300
Passcode: 477919
One tap mobile
+16699006833,,88549237300#,,,,*477919# US (San Jose)
+14086380968,,88549237300#,,,,*477919# US (San Jose)

PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Steering Committee Meeting 053123 Sign-In

Sign_in Sheet Marin County MJHMP Planning Meeting 053123

Marin County MJHMP Steering Committee Meeting Chat 053123

10:02:50 From Paul Bockrath to Everyone:
Paul Bockrath, Preparative Consulting
10:03:45 From Woody Baker-Cohn to Everyone:
Woody Baker-Cohn / Marin OEM
10:03:46 From Rich Simonitch to Everyone:
Rich Simonitch, Town of Ross
10:03:49 From Erica Freeman, Town of San Anselmo to Everyone:
Erica Freeman, Town of San Anselmo
10:03:52 From Loren Umbertis, Public Works Director to Everyone:
Loren Umbertis, Town of Fairfax
10:03:56 From Beb to Everyone:
Beb Skye - County of Marin
10:03:58 From Dave Jeffries to Everyone:
Dave Jeffries - for City of Novato
10:03:59 From Julia Elkin | Marin County DPW to Everyone:
Julia Elkin, MarinCounty
10:04:04 From David -City of Novato to Everyone:
David Dammuller, City of Novato
10:04:05 From Daisy Allen to Everyone:
Daisy Allen, City of Mill Valley
10:04:15 From Chris Reilly to Everyone:
Chris Reilly, Marin County OEM
10:04:17 From Marshall Nau to Everyone:
Marshall Nau - Southern Marin Fire Protection District
10:04:17 From Greg Pease - Las Gallinas Valley Sanitary District to Everyone:
Greg Pease - Las Gallinas Valley Sanitary District
10:04:48 From Tim Fuette (NMWD) to Everyone:
Tim Fuette -NMWD
10:04:56 From Eric Miller - NMWD to Everyone:
Eric Miller - NMWD
10:04:56 From Scott Schneider to Everyone:
Scott Schneider, Town of San Anselmo
10:05:11 From Katherine Hagemann kate.hagemann@cityofsanrafael.org to Everyone:
Kate Hagemann - City of San Rafael
10:05:19 From Steven Torrence - Director Marin County OEM to Everyone:
Quinn Gardner - San Rafael
10:05:23 From Chris Good - Corte Madera to Everyone:
Chris Good - Town of Corte Madera
10:05:39 From Steven Torrence - Director Marin County OEM to Everyone:
Steven Torrence and Hannah Tarling- Marin County
10:05:43 From Leslie Lacko (she/her) | Marin Co to Everyone:
Leslie Lacko, Marin County CDA
10:06:20 From David Block to Everyone:
David Block, Preparative Consulting
10:08:54 From Joanna Kwok to Everyone:
Joanna Kwok, San Rafael
10:24:34 From hannah lee to Everyone:
Hannah Lee, Senior Civil Engineer, County of Marin and Marin County Flood Control & Water Conservation District

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan

Planning Team Meeting Agenda

June 27, 2023, from 10:00 am – 12:00 pm

I. Welcome and Introductions
II. HMGP (DR-4683) & BRIC Grant Funding Timeline
III. Public Outreach Status
IV. Jurisdictional Hazard Risk Assessment Tool
V. OEM Overview of Hazard Maps and Marin Maps
VI. Marin County Hazards over the Last 5-Years
VII. 2018 Hazard Mitigation Project Status Update
VIII. 2023 Hazard Mitigation Projects/Capital Improvement Projects
IX. Hazard Working Groups
X. Next Steps
XI. Questions & Concluding Remarks

Topic: Marin County MJHMP Planning Committee Meeting 062723
Time: Jun 27, 2023 10:00 AM Pacific Time (US and Canada)

Join Zoom Meeting
https://us06web.zoom.us/j/81005069903?pwd=eTM1N1dCSEtYdGNIYjcvT1cyL2U2Zz09

Meeting ID: 810 0506 9903
Passcode: 848497
One tap mobile
+16694449171,,81005069903#,,,,*848497# US
+16699006833,,81005069903#,,,,*848497# US (San Jose)

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Steering Committee Meeting 062723 Sign-In

Sign-In Sheet Marin County MJHMP Planning Meeting 062723

10:03:09 From Paul Bockrath to Everyone:
Paul Bockrath, Preparative Consulting
10:04:19 From Daisy Allen to Everyone:
Daisy Allen, Mill Valley Planning
10:04:20 From Woody Baker-Cohn to Everyone:
Woody Baker-Cohn / Marin OEM
10:04:21 From Rich Simonitch Town of Ross to Everyone:
Rich Simonitch, Town of Ross
10:04:23 From Loren Umbertis to Everyone:
Loren Umbertis, Town of Fairfax
10:04:25 From Kevin McGowan, Sausalito DPW to Everyone:
Kevin McGowan, City of Sausalito
10:04:29 From Tim Fuette (NMWD) to Everyone:
Tim Fuette, NMWD
10:04:31 From Julia Elkin | Marin County DPW to Everyone:
Julia Elkin, Marin County DPW
10:04:33 From Beb to Everyone:
Beb Skye, County of Marin
10:04:45 From Chris Good - Corte Madera to Everyone:
Chris Good - Corte Madera
10:04:54 From hannah lee to Everyone:
Hannah Lee, County of Marin Public Works and Marin County Flood Control & Water Conservation District
10:04:54 From brandon chapman to Everyone:
Brandon Chapman, Golden Gate Bridge, Highway, and Transit District
10:05:03 From David -City of Novato to Everyone:
David Dammuller, City of Novato
10:05:08 From Leslie Lacko (she/her) | Marin Co to Everyone:
Leslie Lacko
10:05:12 From Hannah Tarling, Marin OEM to Everyone:
Hannah Tarling, County of Marin
10:05:20 From Dale McDonald, LGVSD to Everyone:
Good morning from Las Gallinas
10:05:33 From Ezra Colman Central Marin Fire to Everyone:
Ezra Colman Central Marin Fire
10:05:49 From Scott Schneider to Everyone:
Scott Schneider, Town of San Anselmo
10:06:00 From Svet to Everyone:
Svetlana Smorodinsky CA Dept of Public Health
10:07:00 From Patrice Chamberlain | CDPH Environmental Emergency Prep to Everyone:
Patrice Chamberlain, CA Dept of Public Health
10:07:34 From Dale McDonald, LGVSD to Paul Bockrath(Direct Message):
Dale McDonald, Las Gallinas Valley Sanitary District
10:08:24 From Ruben Martin, Central Marin Fire Chief to Everyone:
Ruben Martin, Central Marin Fire

2023 Marin County
Multi-Jurisdictional Hazard Mitigation Plan

Planning Team Meeting Agenda

November 27, 2023, from 2:00 pm – 3:00 pm

I. Welcome and Introductions
II. Plan Overview – Steps and Timeline
III. Planning Process
IV. Hazard Identification
V. Jurisdictional and District Profiles
VI. Public Outreach Strategy
VII. Next Steps
VIII. Questions & Concluding Remarks

Topic: Marin County OA MJHMP Final Planning Meeting
Time: Nov 27, 2023, 02:00 PM Pacific Time (US and Canada)

https://us06web.zoom.us/j/89495636330?pwd=hCUbJ1LwrGAiWdlth8waxvhPLDHANz.1

Meeting ID: 894 9563 6330
Passcode: 571784

PO Box 143 Vacaville, CA 95696
(707) 685-2209 Preparative.org

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Final Planning Team Meeting 112723 Sign-In

Marin County OA MJHMP Final Planning Team Meeting Sign-In Sheet

14:03:56 From Paul Bockrath To Everyone:

Paul Bockrath, Preparative Consulting

14:05:04 From Woody Baker-Cohn To Everyone:

Woody Baker-Cohn

14:05:08 From Katherine Hagemann kate.hagemann@cityofsanrafael.org To Everyone:

Kate Hagemann, City of San Rafael

14:05:09 From Quinn Gardner To Everyone:

quinn gardner, city of san rafael

14:05:10 From Loren Umbertis To Everyone:

Loren Umbertis, Public Works Director, Town of Fairfax

14:05:14 From Daisy Allen, City of Mill Valley To Everyone:

Daisy Allen, City of Mill Valley

14:05:18 From Dale McDonald, LGVSD To Everyone:

Dale McDonald, LGVSD

14:05:18 From Marshall Nau To Everyone:

Marshall Nau

14:05:19 From David -City of Novato To Everyone:

David Dammuller, City of Novato

14:05:21 From Jennifer Blackman To Everyone:

Jennifer Blackman, General Manager, Bolinas Community Public Utility District

14:05:22 From iPhone To Everyone:

Joanna Kwok, City of San Rafael

14:05:22 From Dave Jeffries To Everyone:

David Jeffries, JPSC for City of Novato and Novato Fire District

14:05:22 From RJ Suokko, Corte Madera To Everyone:

RJ Suokko, Corte Madera

14:05:22 From Sam Bonifacio To Everyone:

Marin County Multi-Jurisdictional Hazard Mitigation Plan
Final Planning Team Meeting 112723 Sign-In

Samantha Bonifacio, Town of Tiburon

14:05:24 From Beb To Everyone:

Beb Skyte County of Marin DPW

14:05:32 From Erica Freeman To Everyone:

Erica Freeman, San Anselmo

14:05:34 From Marshall Nau To Everyone:

Marshall Nau - Southern Marin Fire District

14:05:35 From Patrice Chamberlain | CA Dept of Public Health To Everyone:

hi all! Patrice Chamberlain, CA Dept of Public Health

14:05:47 From Kevin McGowan, Sausalito DPW To Everyone:

Kevin McGowan, Sausalito DPW

14:05:50 From max korten To Everyone:

Max Korten, Marin County Parks

14:05:53 From Richard Simonitch To Everyone:

Richard Simonitch, Town of Ross

14:06:01 From Tim Fuette (NMWD) To Everyone:

Tim Fuette, NMWD

14:06:03 From Svetlana To Everyone:

Svetlana Smorodinsky, CDPH

14:06:13 From Laney Davidson To Everyone:

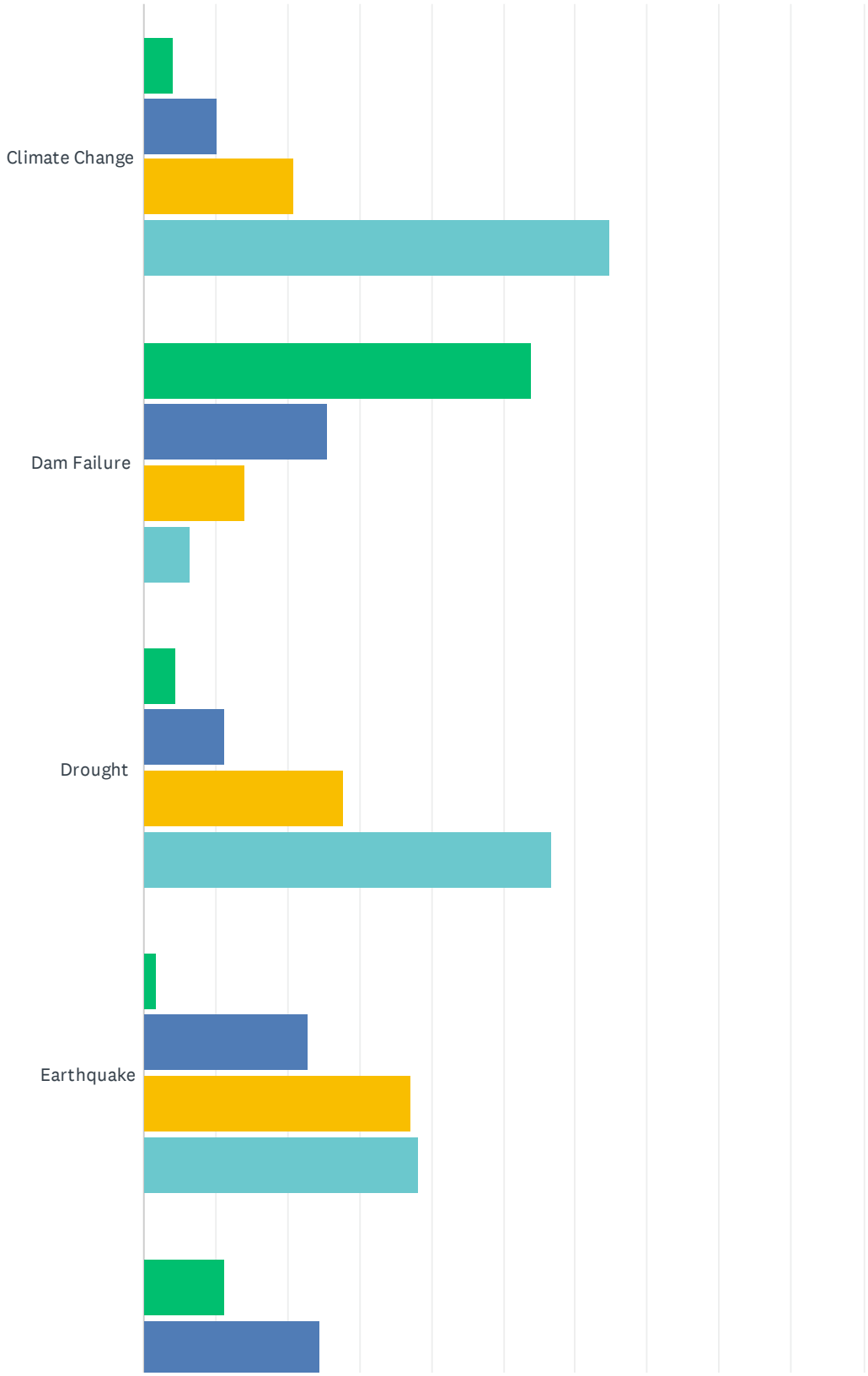
Laney Davidson, County of Marin Disability Access Manager

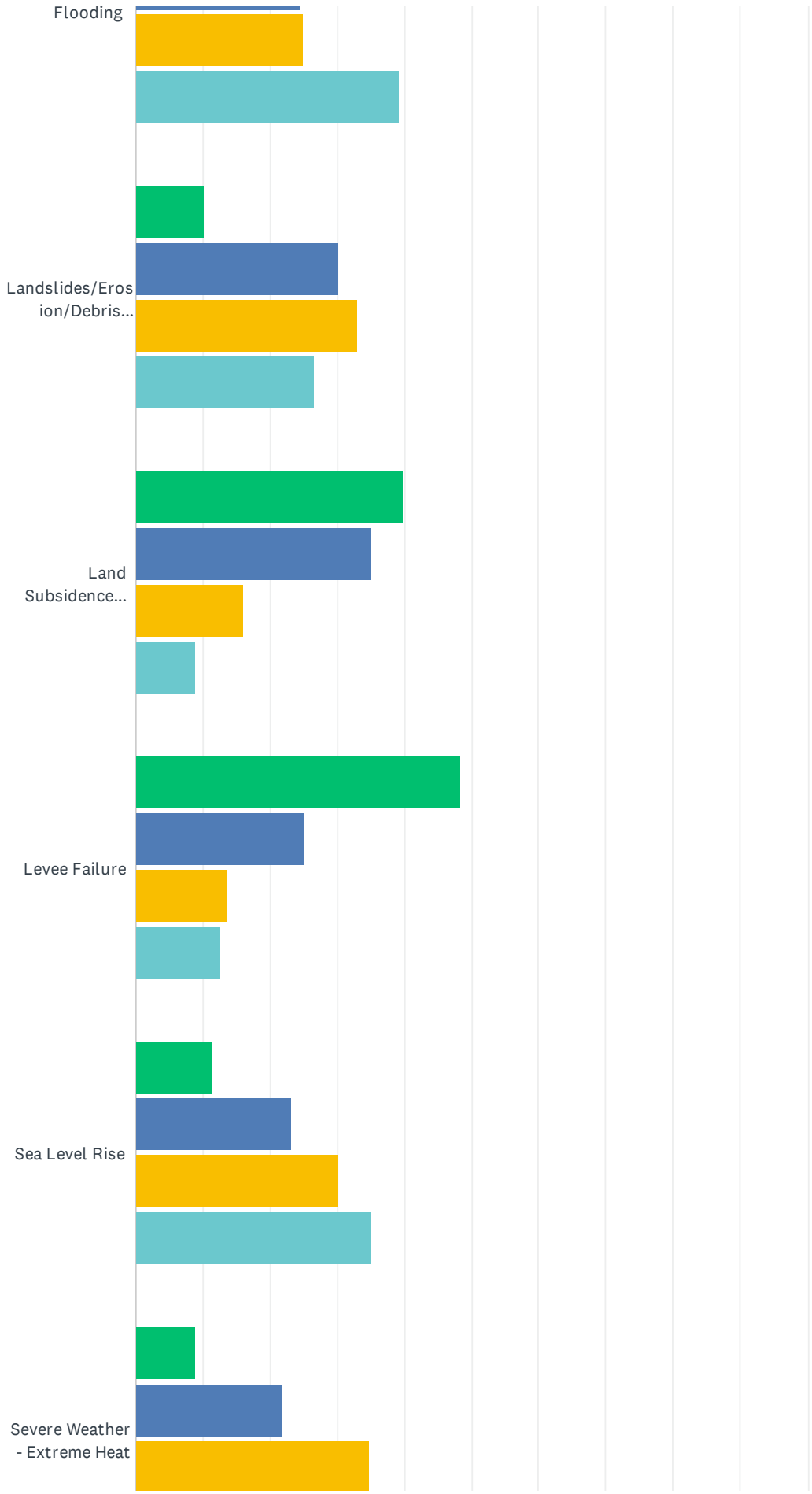
14:07:28 From Sarah Finnigan - Cal OES To Everyone:

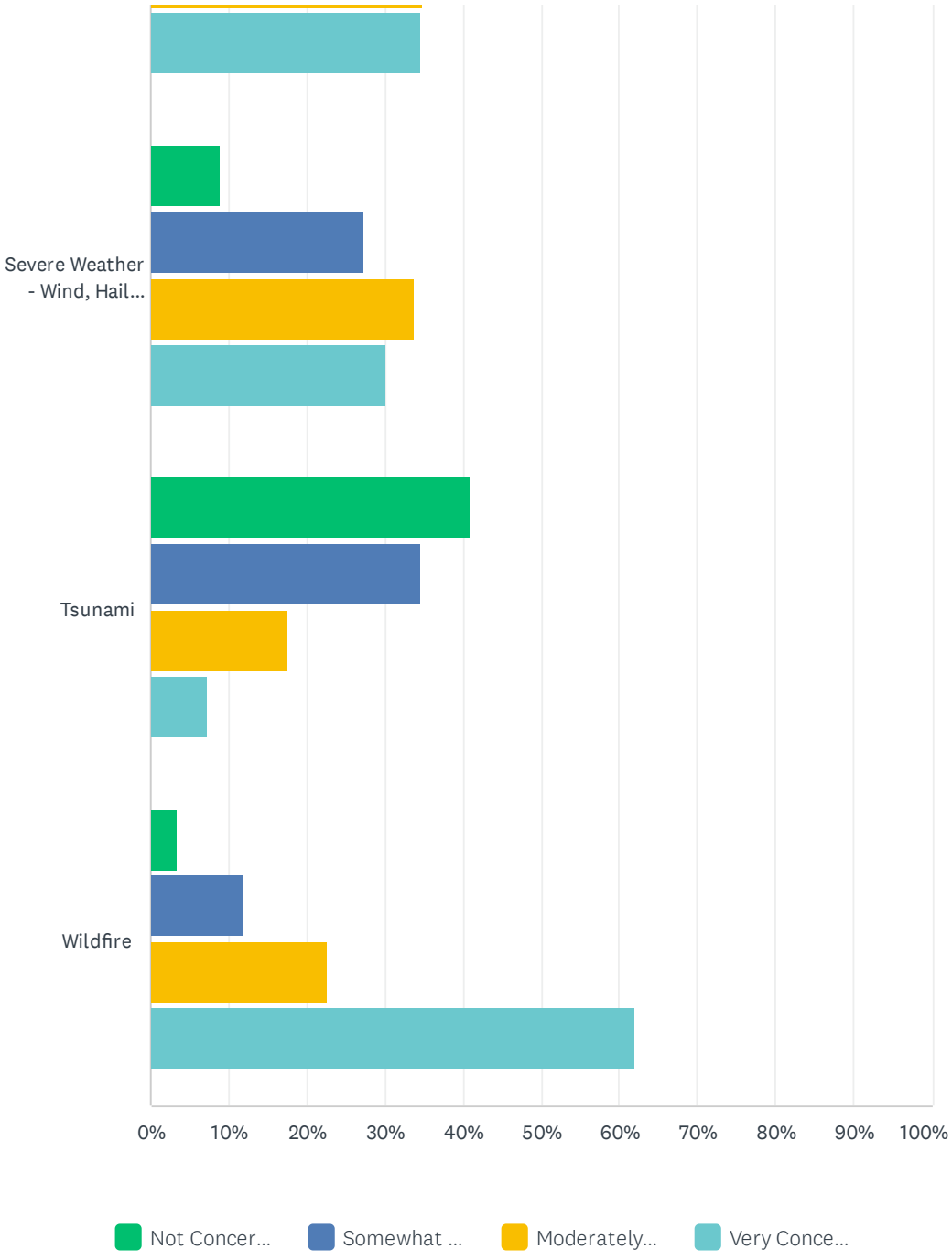
Sarah Finnigan, Cal OES

Q1 How concerned are you about the following Hazards in your community?

Answered: 293 Skipped: 0



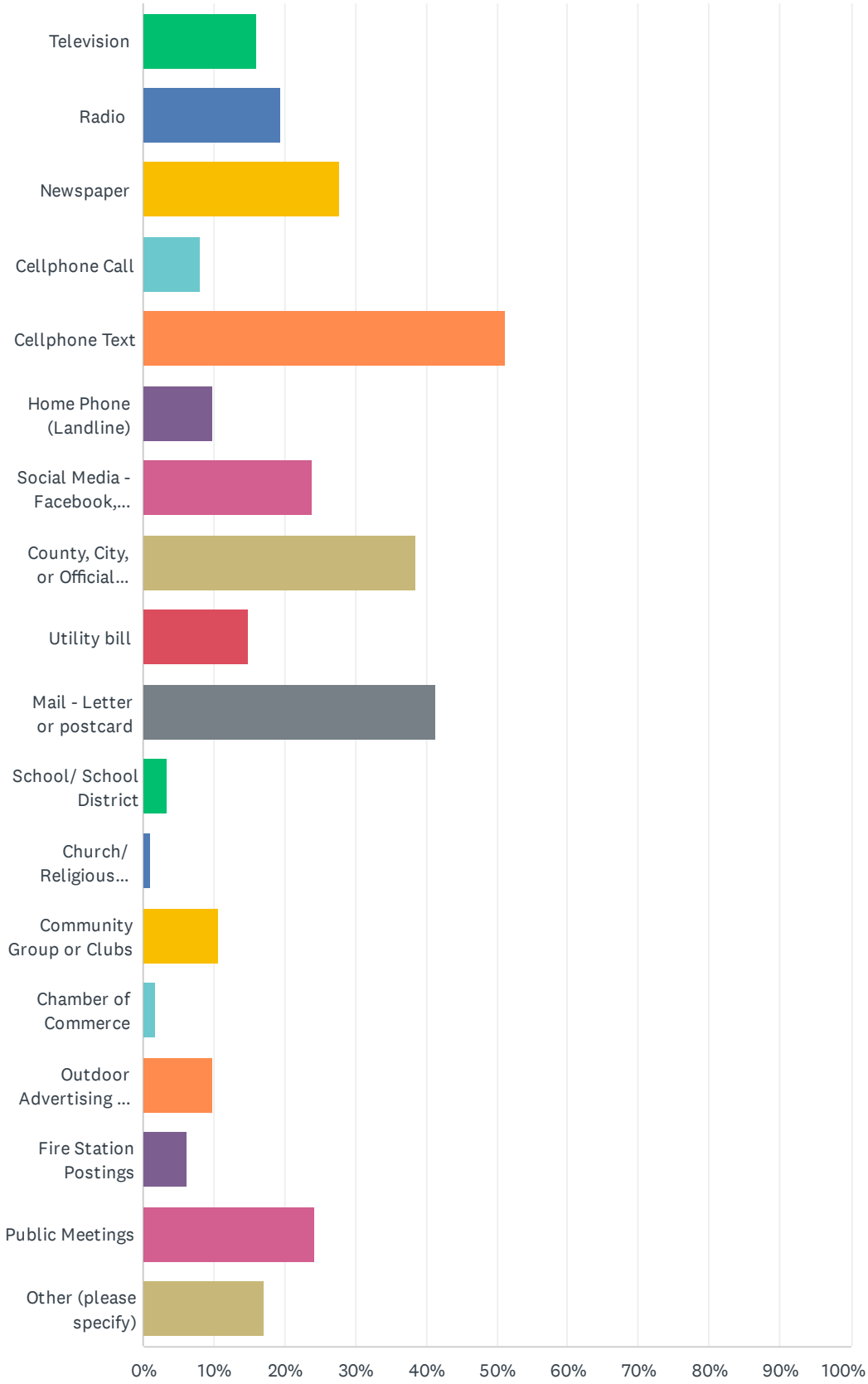

Flooding
Landslides/Erosion/Debris...
Land Subsidence...
Levee Failure
Sea Level Rise
Severe Weather - Extreme Heat


Severe Weather - Wind, Hail...
Tsunami
Wildfire
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Not Concer...
Somewhat ...
Moderately...
Very Conce...

	NOT CONCERNED	SOMEWHAT CONCERNED	MODERATELY CONCERNED	VERY CONCERNED	TOTAL
Climate Change	4.10% 12	10.24% 30	20.82% 61	64.85% 190	293
Dam Failure	53.92% 158	25.60% 75	13.99% 41	6.48% 19	293
Drought	4.44% 13	11.26% 33	27.65% 81	56.66% 166	293
Earthquake	1.71% 5	22.87% 67	37.20% 109	38.23% 112	293
Flooding	11.26% 33	24.57% 72	24.91% 73	39.25% 115	293
Landslides/Erosion/Debris Flows	10.24% 30	30.03% 88	33.11% 97	26.62% 78	293
Land Subsidence (Sinkhole)	39.93% 117	35.15% 103	16.04% 47	8.87% 26	293
Levee Failure	48.46% 142	25.26% 74	13.65% 40	12.63% 37	293
Sea Level Rise	11.60% 34	23.21% 68	30.03% 88	35.15% 103	293
Severe Weather - Extreme Heat	8.87% 26	21.84% 64	34.81% 102	34.47% 101	293
Severe Weather - Wind, Hail, Lighting	8.87% 26	27.30% 80	33.79% 99	30.03% 88	293
Tsunami	40.96% 120	34.47% 101	17.41% 51	7.17% 21	293
Wildfire	3.41% 10	11.95% 35	22.53% 66	62.12% 182	293

Q2 What is the best way for you to receive information about how to make your home and the people in your home safer from natural disasters?

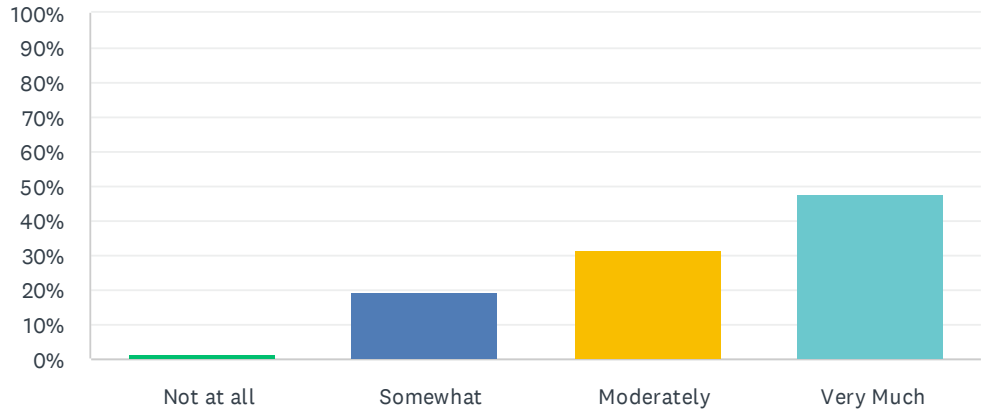
Answered: 293 Skipped: 0


Television
Radio
Newspaper
Cellphone Call
Cellphone Text
Home Phone (Landline)
Social Media - Facebook,...
County, City, or Official...
Utility bill
Mail - Letter or postcard
School/ School District
Church/ Religious...
Community Group or Clubs
Chamber of Commerce
Outdoor Advertising ...
Fire Station Postings
Public Meetings
Other (please specify)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
Television	16.04%	47
Radio	19.45%	57
Newspaper	27.65%	81
Cellphone Call	8.19%	24
Cellphone Text	51.19%	150
Home Phone (Landline)	9.90%	29
Social Media - Facebook, Twitter, Nextdoor	23.89%	70
County, City, or Official Government website	38.57%	113
Utility bill	15.02%	44
Mail - Letter or postcard	41.30%	121
School/ School District	3.41%	10
Church/ Religious Institution	1.02%	3
Community Group or Clubs	10.58%	31
Chamber of Commerce	1.71%	5
Outdoor Advertising - Billboards, Sandwich Boards, Bulletin Boards	9.90%	29
Fire Station Postings	6.14%	18
Public Meetings	24.23%	71
Other (please specify)	17.06%	50
Total Respondents: 293		

Q3 How concerned are you that a natural disaster could threaten your home or place of residence?

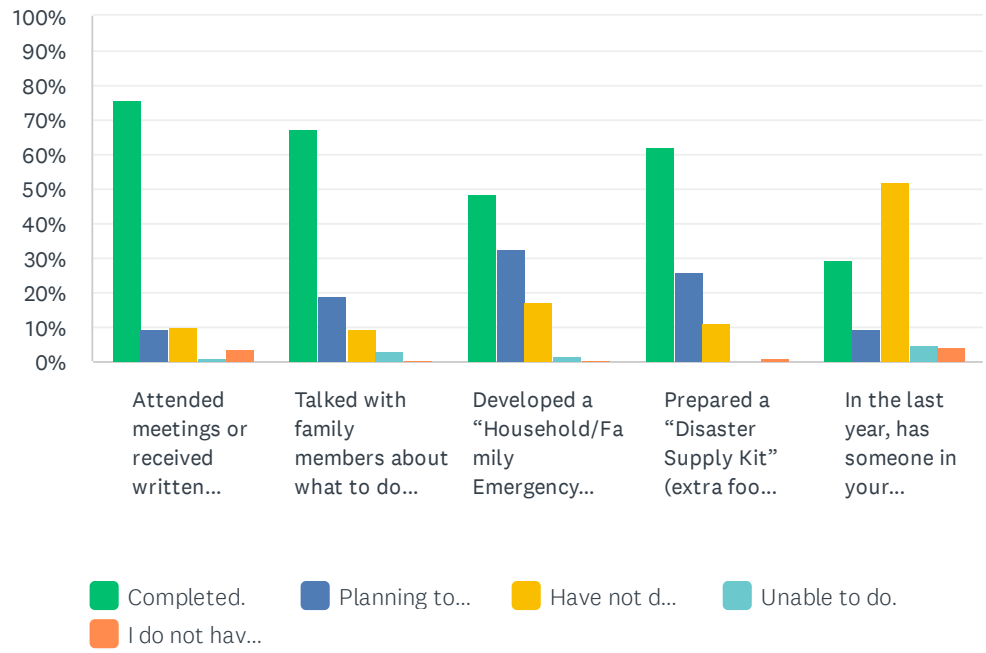
Answered: 293 Skipped: 0



ANSWER CHOICES	RESPONSES	
Not at all	1.37%	4
Somewhat	19.45%	57
Moderately	31.40%	92
Very Much	47.78%	140
TOTAL		293

Q4 In the following List, Please check those activities that you or someone in your household, Completed, Plan to do in the near future, Have not done, or are Unable to do. (Please check one answer per activity).

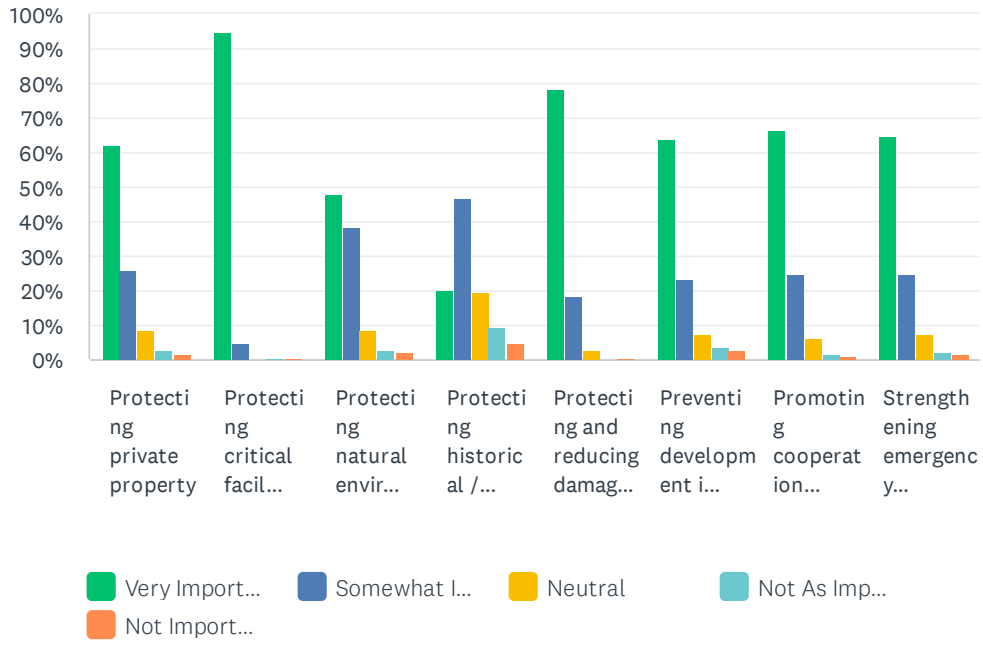
Answered: 293 Skipped: 0



	COMPLETED.	PLANNING TO DO.	HAVE NOT DONE.	UNABLE TO DO.	I DO NOT HAVE ENOUGH INFORMATION TO COMPLETE THIS TASK.	TOTAL	WEIGHTED AVERAGE
Attended meetings or received written information on natural disasters or emergency preparedness.	76.03% 222	9.59% 28	9.93% 29	1.03% 3	3.42% 10	292	1.46
Talked with family members about what to do in case of a disaster or emergency.	67.47% 195	19.03% 55	9.69% 28	3.11% 9	0.69% 2	289	1.51
Developed a "Household/Family Emergency Plan" in order to decide what everyone would do in the event of a disaster.	48.28% 140	32.76% 95	17.24% 50	1.38% 4	0.34% 1	290	1.73
Prepared a "Disaster Supply Kit" (extra food, water, batteries, medications, first aid, and other emergency supplies).	62.12% 182	25.94% 76	10.92% 32	0.00% 0	1.02% 3	293	1.52
In the last year, has someone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR).	29.27% 84	9.41% 27	52.26% 150	4.88% 14	4.18% 12	287	2.45

Q5 Natural disasters can have a significant impact on a community, but planning for these events can help lessen the impact. The following statements will help us determine community priorities in planning for these hazards. Please tell us how important each one is to you?

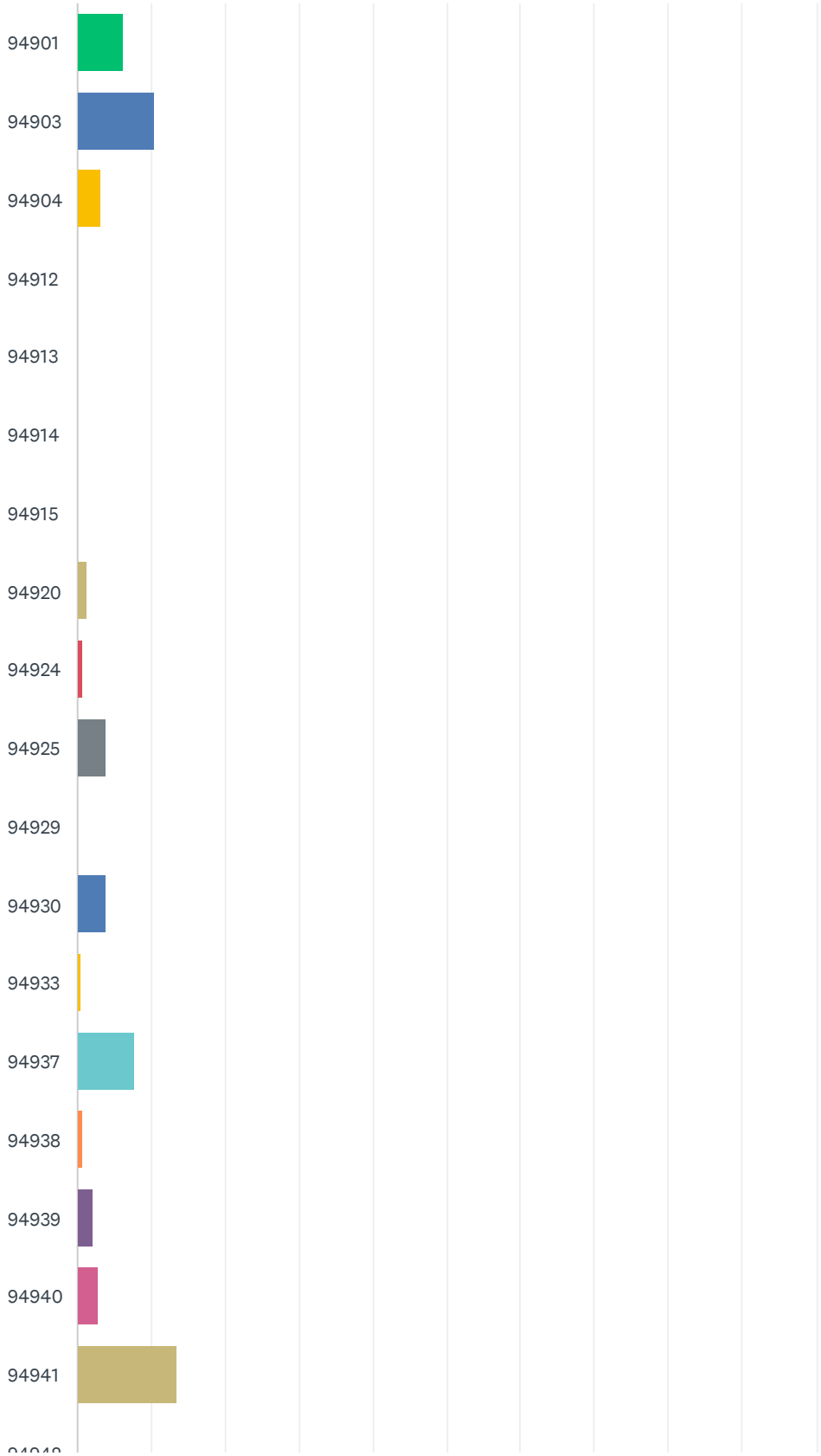
Answered: 293 Skipped: 0

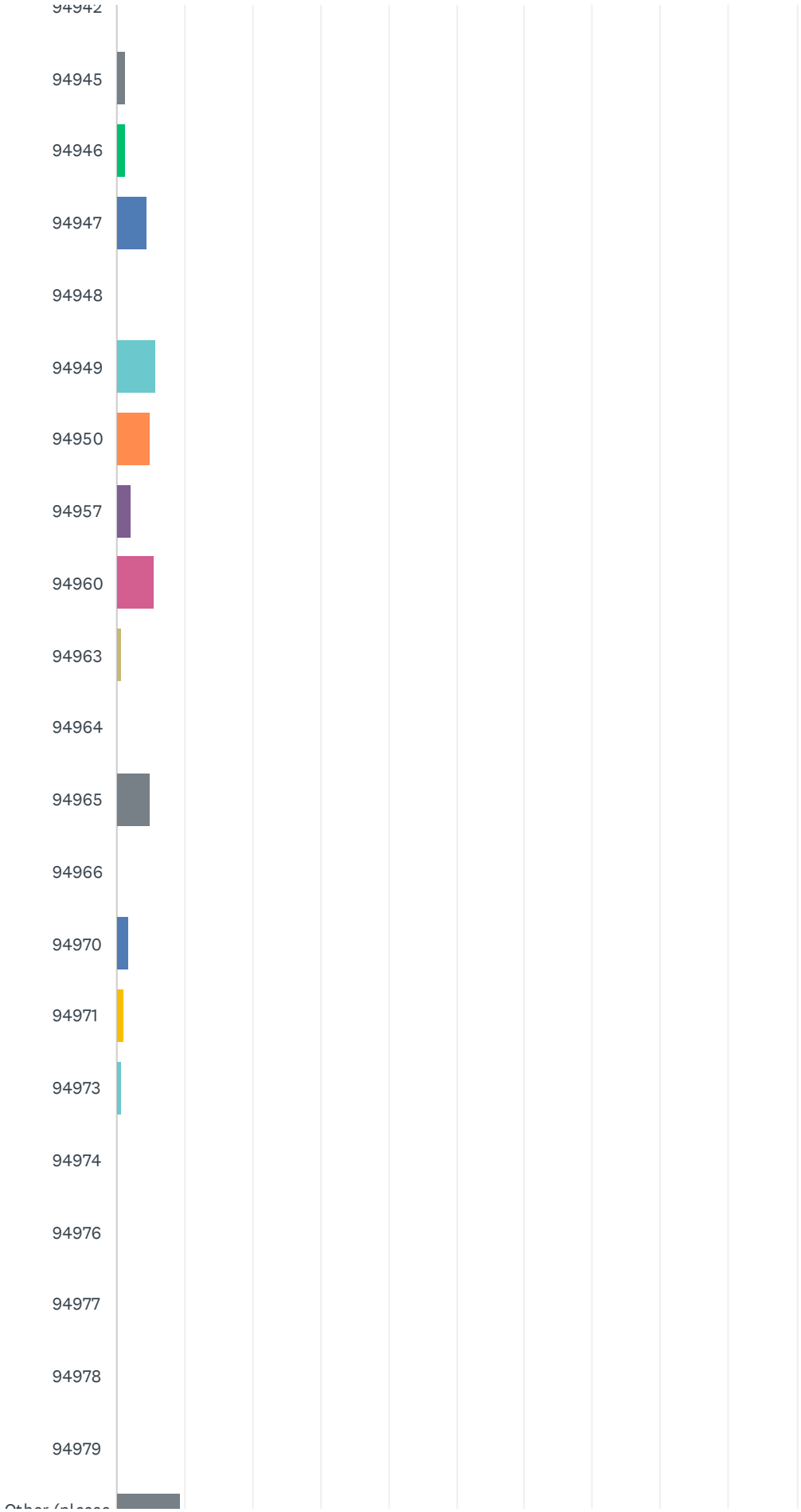


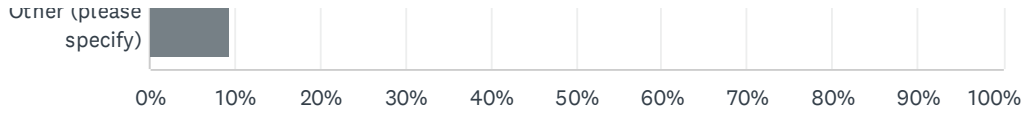
	VERY IMPORTANT	SOMEWHAT IMPORTANT	NEUTRAL	NOT AS IMPORTANT	NOT IMPORTANT	TOTAL	WEIGHTED AVERAGE
Protecting private property	61.94% 179	25.61% 74	8.30% 24	2.77% 8	1.38% 4	289	1.56
Protecting critical facilities (hospitals, transportation networks, fire stations)	94.54% 277	4.78% 14	0.00% 0	0.34% 1	0.34% 1	293	1.07
Protecting natural environment	48.12% 141	38.57% 113	8.53% 25	2.73% 8	2.05% 6	293	1.72
Protecting historical / cultural landmarks	20.00% 58	46.90% 136	19.31% 56	9.31% 27	4.48% 13	290	2.31
Protecting and reducing damage to utilities	78.35% 228	18.56% 54	2.75% 8	0.00% 0	0.34% 1	291	1.25
Preventing development in hazardous areas	63.57% 185	23.37% 68	7.22% 21	3.44% 10	2.41% 7	291	1.58
Promoting cooperation among public agencies, citizens, non-profit organizations and businesses	66.55% 195	24.57% 72	6.14% 18	1.71% 5	1.02% 3	293	1.46
Strengthening emergency services (police, fire, ambulance)	64.48% 187	24.48% 71	7.59% 22	2.07% 6	1.38% 4	290	1.51

Q6 Please provide your zip code

Answered: 290 Skipped: 3




94942
94945
94946
94947
94948
94949
94950
94957
94960
94963
94964
94965
94966
94970
94971
94973
94974
94976
94977
94978
94979


Other (please specify)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
94901	6.21%	18
94903	10.34%	30
94904	3.10%	9
94912	0.00%	0
94913	0.00%	0
94914	0.00%	0
94915	0.00%	0
94920	1.38%	4
94924	0.69%	2
94925	3.79%	11
94929	0.00%	0
94930	3.79%	11
94933	0.34%	1
94937	7.59%	22
94938	0.69%	2
94939	2.07%	6
94940	2.76%	8
94941	13.45%	39
94942	0.00%	0
94945	1.38%	4
94946	1.38%	4
94947	4.48%	13
94948	0.00%	0
94949	5.86%	17
94950	4.83%	14
94957	2.07%	6
94960	5.52%	16
94963	0.69%	2
94964	0.00%	0
94965	4.83%	14
94966	0.00%	0
94970	1.72%	5

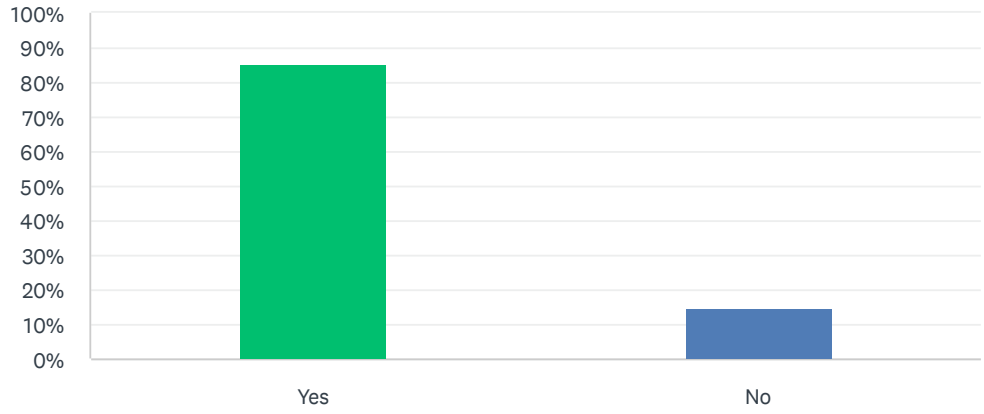
94971	1.03%	3
94973	0.69%	2
94974	0.00%	0
94976	0.00%	0
94977	0.00%	0
94978	0.00%	0
94979	0.00%	0
Other (please specify)	9.31%	27
TOTAL		290

Q7 Your City, Town, or Community Name

Answered: 290 Skipped: 3

Q8 Do you live within the limits of the specific City or Town listed in question #7?

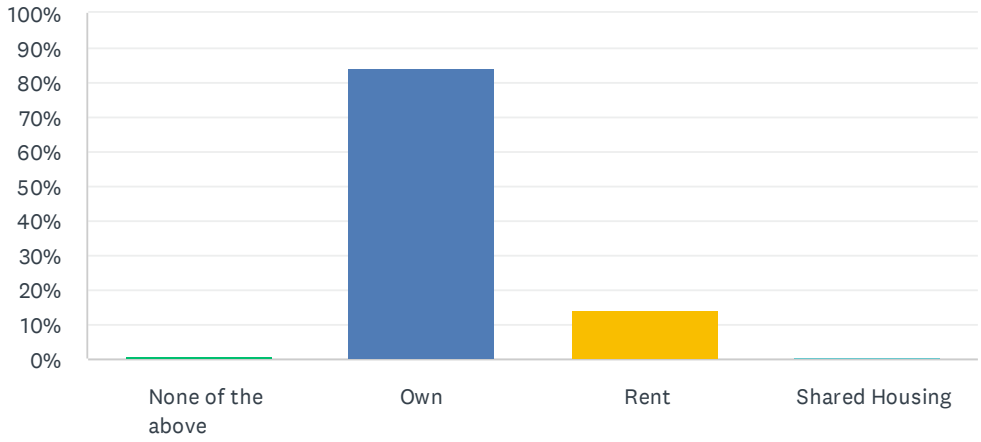
Answered: 287 Skipped: 6



ANSWER CHOICES	RESPONSES	
Yes	85.37%	245
No	14.63%	42
TOTAL		287

Q9 Do you own, rent or share a home?

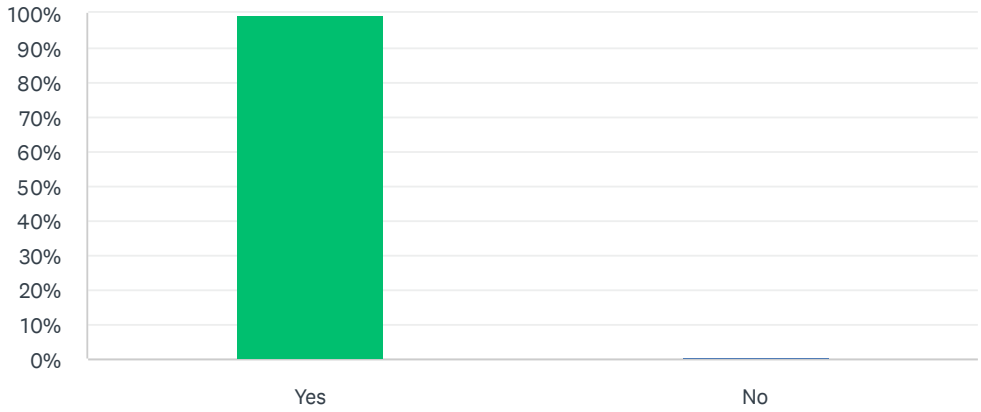
Answered: 290 Skipped: 3



ANSWER CHOICES	RESPONSES	
None of the above	1.03%	3
Own	84.14%	244
Rent	14.14%	41
Shared Housing	0.69%	2
TOTAL		290

Q10 Do you have internet access at your home?

Answered: 292 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	99.66%	291
No	0.34%	1
TOTAL		292

Public Outreach Survey Spanish

Encuesta del Plan Local de Mitigación de Riesgos Multi-Jurisdiccional del Condado de Marin en Español

1. ¿Qué tan preocupado está por los siguientes peligros en su comunidad?

	No preocupado	Algo preocupado	Moderadamente preocupado	Muy preocupado
Cambio climático	◯	◯	◯	◯
Falla de la presa	◯	◯	◯	◯
Sequía	◯	◯	◯	◯
Terremoto	◯	◯	◯	◯
Inundación	◯	◯	◯	◯
Deslizamientos de tierra/flujos de escombros	◯	◯	◯	◯
Falla del dique	◯	◯	◯	◯
Aumento del nivel del mar	◯	◯	◯	◯
Clima severo - Calor extremo	◯	◯	◯	◯
Clima severo - viento, granizo, iluminación	◯	◯	◯	◯
Hundimiento de la tierra (sumidero)	◯	◯	◯	◯
Tsunami	◯	◯	◯	◯
Wildfire (Fuego)	◯	◯	◯	◯

2. ¿Cuál es la mejor manera de recibir información sobre cómo hacer que su hogar y las personas en su hogar estén más seguros de los desastres naturales?

- [ ] Televisión
- [ ] Radio
- [ ] periódico
- [ ] Llamada de teléfono celular
- [ ] Aumento del nivel del mar
- [ ] Teléfono residencial (fijo)
- [ ] Redes sociales - Facebook, Twitter, Nextdoor
- [ ] Sitio web del condado, la ciudad o el gobierno oficial
- [ ] Factura
- [ ] Correo - Carta o postal
- [ ] Escuela / Distrito Escolar
- [ ] Iglesia / Institución religiosa
- [ ] Grupo comunitario o clubes
- [ ] Cámara de Comercio
- [ ] Publicidad exterior - vallas publicitarias, tableros de sándwiches, tablones de anuncios
- [ ] Publicaciones en la estación de bomberos
- [ ] Reuniones públicas
- [ ] Otro (especifíquese)

3. ¿Qué tan preocupado está de que un desastre natural pueda amenazar su hogar o lugar de residencia?

- ◯ De nada
- ◯ Algo
- ◯ Moderadamente
- ◯ Mucho

4. En la siguiente lista, verifique aquellas actividades que usted o alguien en su hogar, Completado, planea hacer en el futuro cercano, no ha hecho o no puede hacer. (Marque una respuesta por actividad).

	Completado	Plan para hacer	No hecho	No se puede hacer	No tengo suficiente información para completar esta tarea.
Asistió a reuniones o recibió información escrita sobre desastres naturales o preparación para emergencias.	○	○	○	○	○
Habló con los miembros de la familia sobre qué hacer en caso de un desastre o emergencia.	○	○	○	○	○
Desarrolló un "Plan de Emergencia para el Hogar / Familia" para decidir qué harían todos en caso de un desastre.	○	○	○	○	○
Preparó un "Kit de suministros para desastres" (alimentos adicionales, agua, baterías, medicamentos, primeros auxilios y otros suministros de emergencia).	○	○	○	○	○
En el último año, ¿alguien en su hogar ha recibido capacitación en primeros auxilios o reanimación cardiopulmonar (RCP)?	○	○	○	○	○

5. Los desastres naturales pueden tener un impacto significativo en una comunidad, pero la planificación de estos eventos puede ayudar a disminuir el impacto. Las siguientes declaraciones nos ayudarán a determinar las prioridades de la comunidad en la planificación de estos peligros. Por favor, díganos qué tan importante es cada uno para usted.

	Muy importante	Algo importante	Neutral	No es tan importante	No es importante
Protección de la propiedad privada	○	○	○	○	○
Protección de instalaciones críticas (hospitales, redes de transporte, estaciones de bomberos)	○	○	○	○	○
Protección del medio ambiente natural	○	○	○	○	○
Protección de monumentos históricos / culturales	○	○	○	○	○
Protección y reducción de daños a los servicios públicos	○	○	○	○	○
Prevención del desarrollo en zonas peligrosas	○	○	○	○	○
Promover la cooperación entre organismos públicos, ciudadanos, organizaciones sin ánimo de lucro y empresas	○	○	○	○	○
Fortalecimiento de los servicios de emergencia (policía, bomberos, ambulancia)	○	○	○	○	○

6. Por favor, proporcione su código postal

- ◯ 94901
- ◯ 94903
- ◯ 94904
- ◯ 94912
- ◯ 94913
- ◯ 94914
- ◯ 94915
- ◯ 94920
- ◯ 94924
- ◯ 94925
- ◯ 94929
- ◯ 94930
- ◯ 94933
- ◯ 94937
- ◯ 94938
- ◯ 94939
- ◯ 94940
- ◯ 94941
- ◯ 94942
- ◯ 94945
- ◯ 94946
- ◯ 94947
- ◯ 94948
- ◯ 94949
- ◯ 94950
- ◯ 94957
- ◯ 94960
- ◯ 94963
- ◯ 94964
- ◯ 94965
- ◯ 94966
- ◯ 94970
- ◯ 94971
- ◯ 94973
- ◯ 94974
- ◯ 94976
- ◯ 94977
- ◯ 94978
- ◯ 94979
- ◯ Otro (especifíquese)

7. El nombre de tu ciudad, pueblo o comunidad

8. \¿Vive dentro de los límites de la ciudad o pueblo específico mencionado en la pregunta # 7?

- ◯ Sí
- ◯ No

9. ¿Es propietario, alquila o comparte una casa?

- ◯ Poseer
- ◯ Alquilar
- ◯ Vivienda compartida

10. ¿Tienes acceso a Internet en tu casa?

- ◯ Sí
- ◯ No

Si tiene alguna pregunta sobre esta encuesta, envíe un correo electrónico a Mitigation@MarinCounty.org