NORTH MARIN WATER DISTRICT PROFILE

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Marin County Multi-Jurisdictional Hazard Mitigation Plan 2023

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ACKNOWLEDGEMENTS

The North Marin Water District 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 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 and district of the North Marin Water District more disaster resistant and sustainable.

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SECTION 1.0: INTRODUCTION

1.1 INTRODUCTION

The North Marin Water District Profile has been prepared in conjunction with the Marin County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), establishing an inter-jurisdictional process for the development and implementation of effective hazard mitigation strategies in association with identified hazards that pose real or potential threats to the North Marin Water District (NMWD).

1.2 PLANNING PROCESS

The majority of Marin County Operational Area (OA) 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 Marin County MJHMP Steering Committee and broader Planning Team approached the development of the Marin County 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 County Office of Emergency Management (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 own 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.

The Marin County OA is very different from most California Counties in that the populated portion of the County where the jurisdictions and district's planning areas are located has the same 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.

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 OA 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.

In addition to providing representation on the coordinated Marin County OA Multi-Jurisdictional Hazard Mitigation Plan Steering Committee, the North Marin Water District involved additional internal planning team members to support the broader planning process. The North Marin Water District jurisdictional representatives for the coordinated Marin County Multi-Jurisdictional

Hazard Mitigation Plans Steering Committee and the Planning Team Members are represented below.

1.2.1 Steering Committee Members (District Representatives)

Primary Point of Contact
Eric Miller, Asst. General Manager
Telephone: 415-897-4133
E-mail Address: emiller@nmwd.com

Alternate Point of Contact
Tim Fuette, Senior Engineer
Telephone: 415-761-8925
E-mail Address: tfuette@nmwd.com

This annex was developed by the primary point of contact with assistance from the members of the local mitigation planning team listed in Table 1 and Table 2.

Table 1: Local Hazard Mitigation Planning Team Members

Jurisdiction	Name	Title/ Department	Phone	Email
North Marin Water District	Eric Miller	Asst. General Manager	415-897-4133	emiller@nmwd.com
North Marin Water District	Robert Clark	Operations & Maintenance Superintendent	415-897-4133	rclark@nmwd.com
North Marin Water District	Anthony "Tony" Williams	General Manager	415-897-4133	twilliams@nmwd.com
North Marin Water District	Tim Fuette	Senior Engineer	415-761-8925	tfuette@nmwd.com

Table 1: Local Hazard Mitigation Planning Team Members

This 2023 Marin County Operational Area (OA) MJHMP is a comprehensive update of the 2018 Marin County OA MJHMP. The planning area and participating jurisdictions and organizations were defined to consist of unincorporated Marin County, five special districts, and the eleven incorporated jurisdictions to include the North Marin Water District. All participating jurisdictions and districts are within the geographical boundary of Marin County OA and have jurisdictional or district authority within this planning area.

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. 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.

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.

1.2.2 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.

1.2.3 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 Marin County and NMWD Steering Committee reached out to the following Local and Regional Agencies involved in hazard mitigation activities to invite them to participate in this planning process as a member of the Planning Team. These individuals work with Marin County and the NMWD communities and could provide subject matter expertise and relevant information to the planning process regarding the community history, hazard risk, vulnerability, and impact, mitigations efforts, community needs, demographics, and social vulnerability, economic concerns, ecology, and other

community services and needs.

The Marin County and NMWD Steering also 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, the NMWD and/or their interest as a neighboring jurisdiction, representatives from the following groups were invited to participate on the Planning Team:

Eighty-seven planning partners participated in this update, as listed in Table 2.

Table 2: 2023 MJHMP Local Planning Team Members

No.	Agency	Point of Contact	Title
1	Belvedere	Laurie Nilsen	Emergency Svs, Coord.
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	District Manager
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	OEM Director
20	Marin County	Hannah Tarling	Emergency Management Coordinator
21	Marin County	Chris Reilly	OEM Project Manager
22	Marin County	Woody Baker-Cohn	Senior Emergency Management Coordinator
23	Marin County	Leslie Lacko	Community Development Agency
24	Marin County	Hannah Lee	Senior Civil Engineer
25	Marin County	Felix Meneau	Project Mgr./ FCWCD
26	Marin County	Julia Elkin	Department of Public Works
27	Marin County	Beb Skye	Department of Public Works
28	Marin County	Scott Alber	Battalion Chief, Marin County Fire Dept.
29	Marin County	Lisa Santora	Deputy Public Health Officer, Marin Health & Human Services
30	Marin County	Koblick, Kathleen	Marin Health & Human Services
31	Marin County	Amber Davis	Public Health Preparedness
32	Mill Valley	Patrick Kelly	Department of Public Works

Table 2: 2023 MJHMP Local Planning Team Members			
No.	**Agency**	**Point of Contact**	**Title**
33	Mill Valley	Ahmed A Aly	Project Manager
34	Mill Valley	Jared Barrilleaux	Deputy Director of Engineering
35	Mill Valley	Daisy Allen	Senior Planner
36	Southern Marin Fire District	Tom Welch	Deputy Chief/South Marin Fire Dist.
37	Southern Marin Fire District	Marshall Nau	Fire Marshall/South Marin Fire Dist.
38	North Marin Water District	Eric Miller	Asst. General Manager
39	North Marin Water District	Robert Clark	Operations & Maint. Superintendent
40	North Marin Water District	Anthony Williams	General Manager
41	North Marin Water District	Tim Fuette	Senior Engineer
42	Novato	David Dammuller	Engineering Services Mgr.
43	Novato	Dave Jeffries	Consultant/JPSC
44	Ross	Richard Simonitch	Public Works Director
45	San Anselmo	Sean Condry	Public Works & Building Director
46	San Anselmo	Erica Freeman	Building Official
47	San Anselmo	Scott Schneider	Asst. PW Director
48	San Rafael	Quinn Gardner	Deputy Emergency Services Coord.
49	San Rafael	Cory Bytof	Sustainability
50	San Rafael	Joanna Kwok	Senior Civil Engineer
51	San Rafael	Kate Hagemann	Climate Adaptation & Resilience Planner
52	Sausalito	Andrew Davidson	Senior Engineer/ DPW
53	Sausalito	Kevin McGowan	Director of Public Works
54	Sausalito	Brandon Phipps	Planning Director
55	Tiburon	Sam Bonifacio	Assistant Planner
56	Tiburon	Dina Tasini	Director of Community Development
57	Tiburon	Laurie Nilsen	Emergency Services Coord.
Special Districts & Partner Agencies			
58	County of Marin Disability Access Program	Laney Davidson	Disability Access Manager/ ADA Coordinator
59	County of Marin Disability Access Program	Peter Mendoza	Disability Access Manager/ ADA Coordinator
60	Emergency Medical Services	Chris Le Baudour	EMS Authority
61	Fire Departments	Jason Weber	Fire Chiefs
62	Golden Gate Bridge, Highway & Transportation District	Daniel Rodriguez	Security, Emergency Management Specialist
63	Golden Gate Bridge, Highway & Transportation District	Dennis Mulligan	General Manager & CEO,
64	Marin City Climate Resilience and Health Justice	Terrie Green	Executive Director
65	Marin Center for Independent Living	Peter Mendoza	Director of Advocacy and Special Projects
66	Marin City Community Services District	Juanita Edwards	Interim General Manager
67	Marin County Community Development Agency	Leslie Lacko	Community Development Agency
68	Marin County Flood Control & Water Conservation District	Garry Lion	Advisory Board Member
69	Marin County Office of Education	Michael Grant	Director, Marin County Office of Education
70	Marin County Parks	Max Korten	General Manager and Director

Table 2: 2023 MJHMP Local Planning Team Members			
No.	**Agency**	**Point of Contact**	**Title**
71	PG&E	Mark Van Gorder	Government Affairs, North Bay
72	PG&E	Ron Karlen	PG&E Public Safety Specialist
73	Sonoma Marin Area Rail Transit (SMART)	Jennifer McGill	Chief of Police
74	Transportation Authority of Marin (TAM)	Anne Richmond	Executive Director
75	Willow Creek School	Itoco Garcia	Superintendent
	State Partners		
76	Cal OES – ESC	Sarah Finnigan	Cal OES Emergency Services Coordinator
77	Cal OES, Division of Safety of Dams	Danielle Jessup	Coordinator/ Dam Safety Planning Division
78	California Department of Public Health	Svetlana Smorodinsky	Disaster Epidemiologist/ Environmental & Occupational Emergency Preparedness Team
79	California Department of Public Health	Patrice Chamberlain	Health Program Specialist II
80	California Department of Water Resources	Julia Ekstrom, PhD	Supervisor, Urban Unit Water Use Efficiency Branch
81	Caltrans	Trang Hoang	Senior Transportation Engr/ Office of Advance Planning
82	Caltrans	Markus Lansdowne	Caltrans D4 Emergency Coordinator
	Federal Partners		
83	Army Corps of Engineers	Jessica Ludy	Flood Risk Management, Equity, and Environmental Justice
84	National Park Service	Stephen Kasierski	OneTam
85	US Coast Guard	LT Tony Solares	Sector SF Waterways Safety Branch
86	US Coast Guard	MST1 Brandon M. Ward	Emergency Management Specialist
87	US Coast Guard	LT William K. Harris	USCG SEC San Francisco

Table 2: 2023 MJHMP Planning Team Members

Several opportunities were provided for the groups listed above to participate in the North Marin Water District's 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 attending several videoconferencing meetings where hazard vulnerability and risk were discussed along with hazard mitigation strategies and actions. Planning Team members provided data and other applicable information directly as requested in meetings, emails, telephone calls, videoconferencing, worksheets, or through data contained on their websites or as maintained by their offices. This information was used to develop hazard vulnerability and risk profiles along with mitigation actions.

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.

Further as part of the public outreach process, all planning areas engaged in public outreach and education by providing information on their website or though press releases directing the public to the main Marin County OEM website that provided coordinated and detailed public information of the planning process and how the public could participate. All planning areas were invited to attend the public meetings and to review and comment on the plan prior to submittal to Cal OES and FEMA. Additional public outreach action is detailed in the 1.2.4 PUBLIC ENGAGEMENT section of this annex.

The following planning meetings were held with the planning team:

Table 3: North Marin Water District & Marin County 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

Table 3: North Marin Water District & Marin County MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
				• 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
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

Table 3: North Marin Water District & Marin County MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
				• Planning Process • Hazard Identification and Risk Assessment • Planning Goals and Objectives • Hazard Mitigation Projects • Community Input
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 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	• Presentation and review of the Draft Marin County OA MJHMP and Jurisdictional/District Annexes.

Table 3: North Marin Water District & Marin County MJHMP Planning Meetings				
No.	**Date**	**Attendees**	**Meeting**	**Planning Meeting Objectives**
			Emergency Management Website	• Opportunity for public comment and questions and answers.

Table 3: North Marin Water District & Marin County MJHMP Planning Meetings

1.2.4 Public Engagement

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. The Public Outreach efforts mirrored the Planning Team approach with a unified effort, led by the County OEM, involving all participating jurisdictions and districts. Public outreach for this plan update began at the beginning of the plan development process with a detailed press release informing the community of the purpose of the hazard mitigation planning process for the Marin County OA planning area and to invite the public to participate in the process.

Public involvement activities for this plan update were conducted by the County and all participating jurisdictions and districts and included press releases; website postings; a community survey; stakeholder and public meetings; 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.

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 OA MJHMP by establishing a framework with key actions for each step of the planning process. Elements of the equity approach included:

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 Marin County OEM Facebook account. After the meeting, Marin County OEM uploaded the recorded meeting to their website to allow the public on demand access to the meeting.

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 (ASL/CDI) interpretation, the ability for the Zoom videoconferencing attendee to activate subtitles in 29 different languages, and vision accessible PowerPoint slide.

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 citizens may make input as strategies and implementation actions change. Public meetings will continue to be held twice a year after the first and third MJHMP meetings. 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 citizenry is informed when deemed appropriate by the Steering Committee.

WEBSITE

At the beginning of the plan update process, Marin County OEM established a hazard mitigation website https://emergency.marincounty.org/pages/lhmp on behalf of all the planning areas to ensure consistent messaging and information, 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 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.

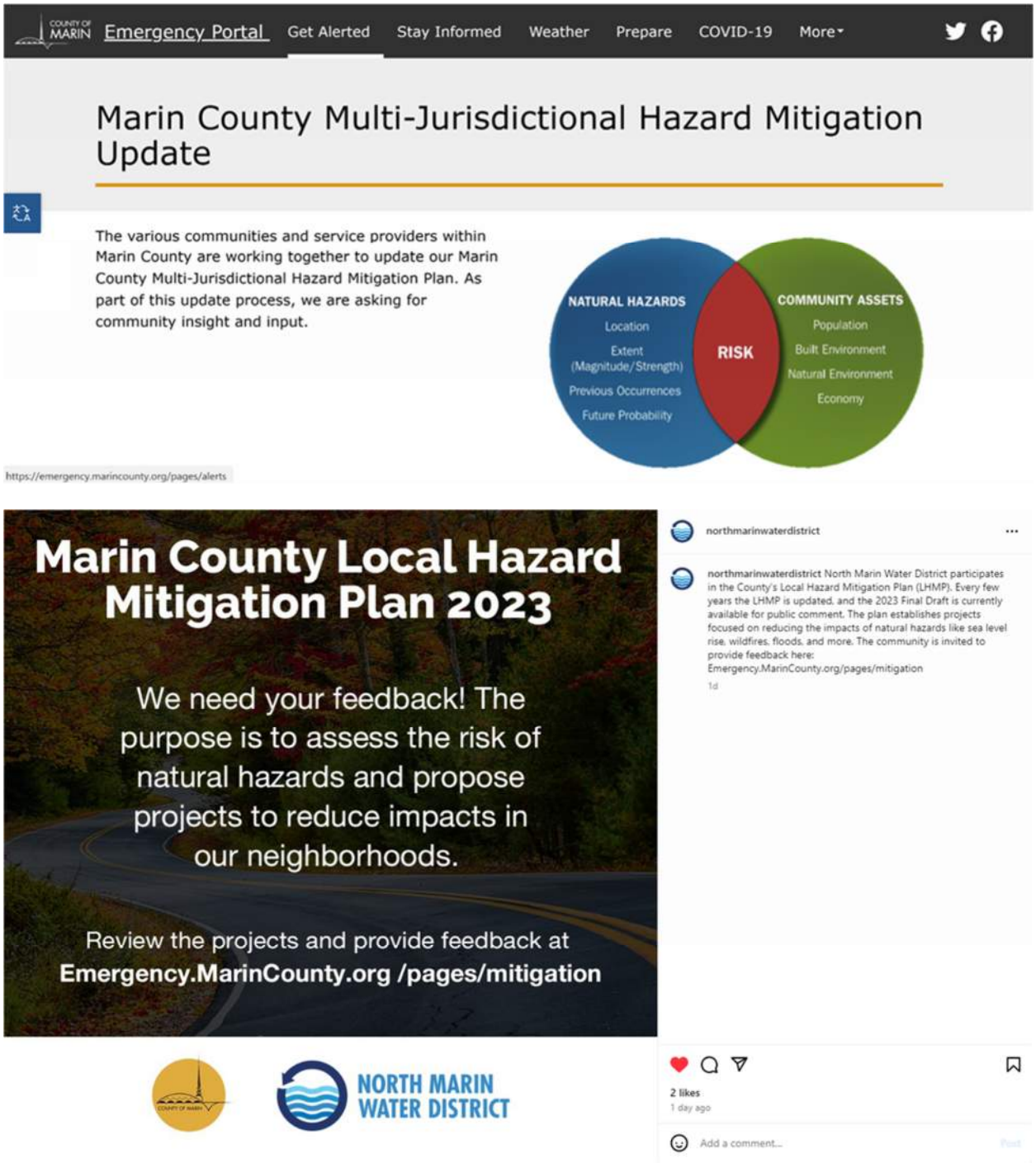


Figure 1: Marin County OEM MJHMP Website & NMWD Link

PUBLIC MEETINGS

Two separate Marin County 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 29 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 provide the URL link to the Survey Monkey website to complete the survey.

Figure 2: Marin County OEM MJHMP Public Town Hall Meeting

SOCIAL MEDIA

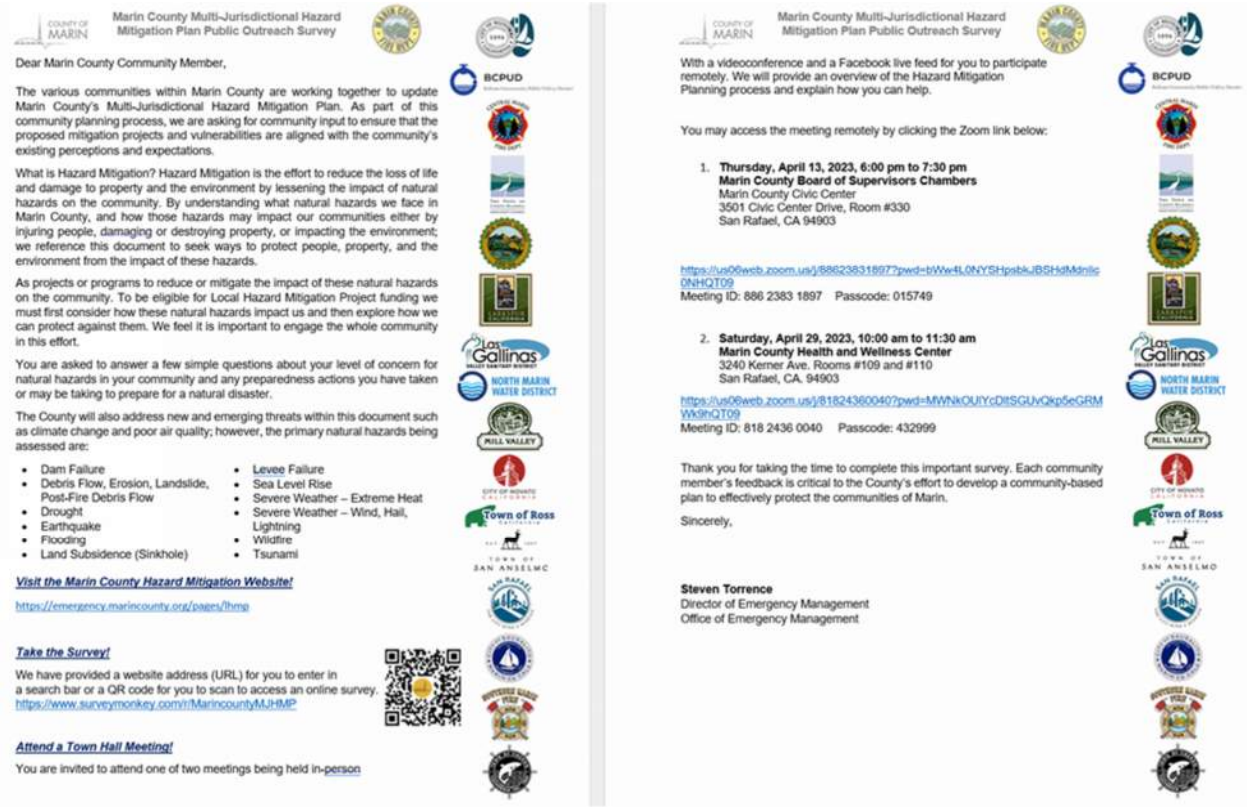
Marin County and its participating jurisdictions utilized several forms of social media to reach residents and customers. Information about the Hazard Mitigation Planning process was communicated to the public via Facebook, Twitter, and local access TV. Residents and customers were invited to complete 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 citizens are concerned about.
- Identify the best ways to communicate with the public.
- Determine the level of public support for different mitigation strategies.
- Understand the public's willingness to invest in hazard mitigation.

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 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 3: Hazard Mitigation Plan Public Outreach Press Release

SURVEY

A hazard mitigation plan survey (see Figure 4) 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 ten questions helped guide the Steering Committee in defining our hazards, and selecting goals, objectives, and mitigation strategies. The survey was 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 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 4: Hazard Mitigation Plan Survey

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.

After December 18, 2023, the various participating jurisdiction and district profiles remained on the Marin County OEM website for public comments. The NMWD had an additional social media and website postings for final public comment from December 18, 2023 until submission of the profile to Cal OES on February 12, 2024.

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 NMWD distributed press releases directing the community to the Marin County OEM website to review the draft plans. 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 revise the proposed hazard mitigation actions which resulted in the final list of hazard mitigation actions listed in 3.5 Hazard Mitigation Actions.

1.3 Overview and History

The North Marin Water District (NMWD) was formed in April of 1948 following voter approval under the State law known as the County Water District Law (Division 12 of the California Water Code). North Marin Water District is an independent special district governed by a five-member Board of Directors elected by division for four-year terms.

Prior to 1948, water service to the Novato area was provided by the Novato Water Company, a privately-owned public utility, operated for many years by the Cain family. In 1947, as Novato began to change and grow from a small agricultural community, Al Tresch acquired the water system. With about 500 customers the Novato Water Company began to experience serious water supply problems, since its existing wells were not producing sufficient high-quality water to meet its customers' needs.

In the fall of 1947, with the specter of limited water supply looming, the town leaders invited Marin Municipal Water District to a meeting to request that it extend its transmission line serving Hamilton Field to also serve the community of Novato. Marin Municipal turned down the request. A committee was then formed to advance the idea of purchasing the Novato Water

Company, developing a new source of water supply, and to upgrade and expand the system to meet the needs of the growing Novato community. The District was originally named North Marin County Water District. (In 1984, the word “County” was dropped from the name to eliminate any possible confusion as to whether or not the District was an agency of the County of Marin.)

1.4 Service Area

NMWD primarily serves the City of Novato and surrounding unincorporated areas in Marin County, encompassing approximately 20,750 active service connections serving approximately 24,100 dwelling units, as well as commercial, industrial and institutional customers. The NMWD service area covers 100 square miles. The estimated Novato Service Area population is 62,655. NMWD also provides service to several small improvement districts in the West Marin Service Area near the Pacific Ocean, via approximately 800 service connections.

The District has a unique territorial boundary (or boundaries as indicated) that includes: the Novato Water System that covers all of the City of Novato and surrounding unincorporated areas; the West Marin Water System that covers Point Reyes Station, Olema, Bear Valley, Silver Hills, Inverness Park and Paradise Ranch Estates; the Oceana Marin Wastewater System; and an area on the eastern side of Tomales Bay near Marshall that currently has no services available.

Figure 5: Map of the North Marin Water District
Source: Marin County OEM

Figure 6 illustrates the North Marin Water District service area in purple and the jurisdictional boundaries of the Cities of Novato and San Rafael in the black dashed lines.

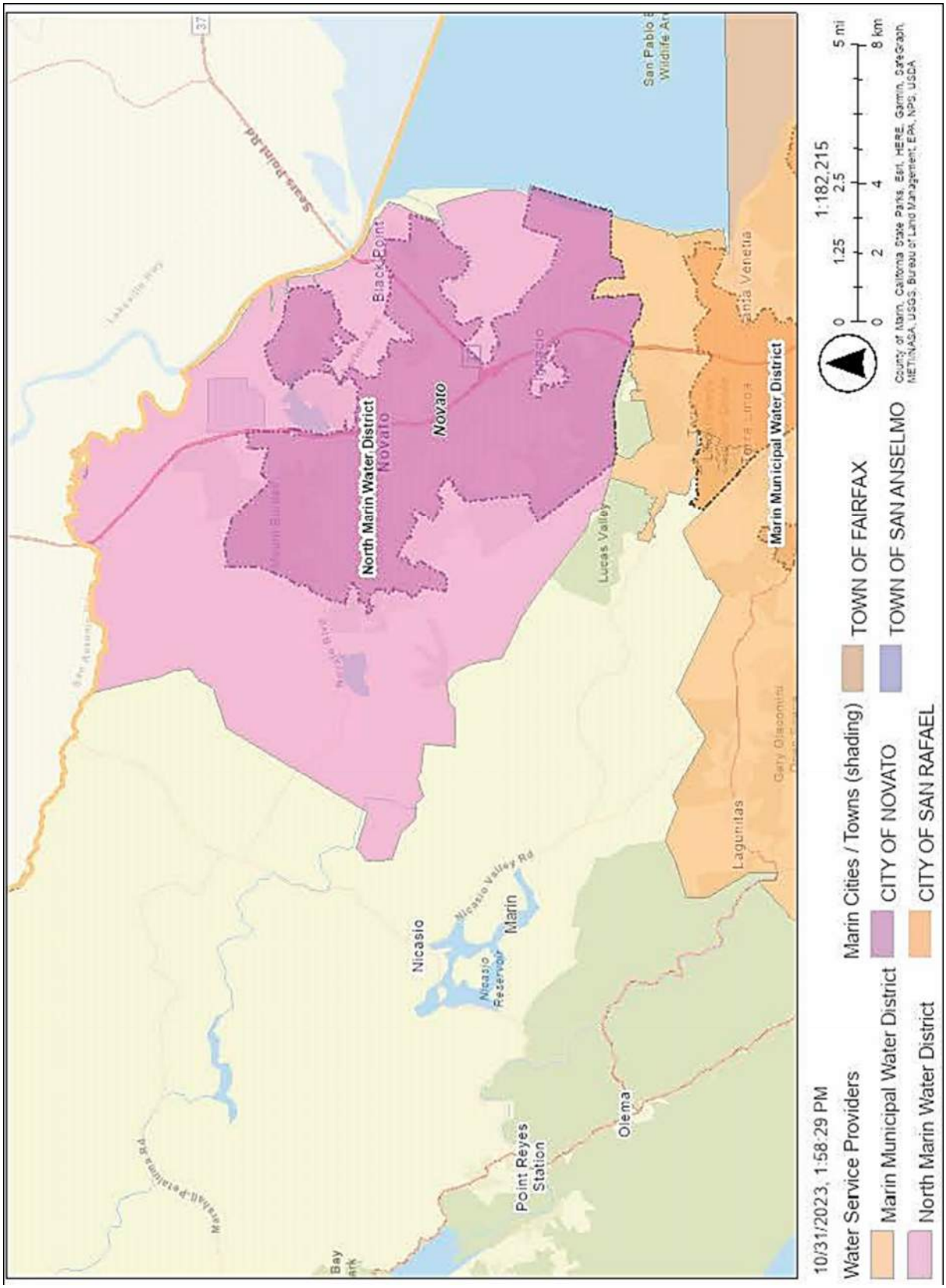


Figure 6: Map of the North Marin Water District and Jurisdictions
Source: Marin County OEM

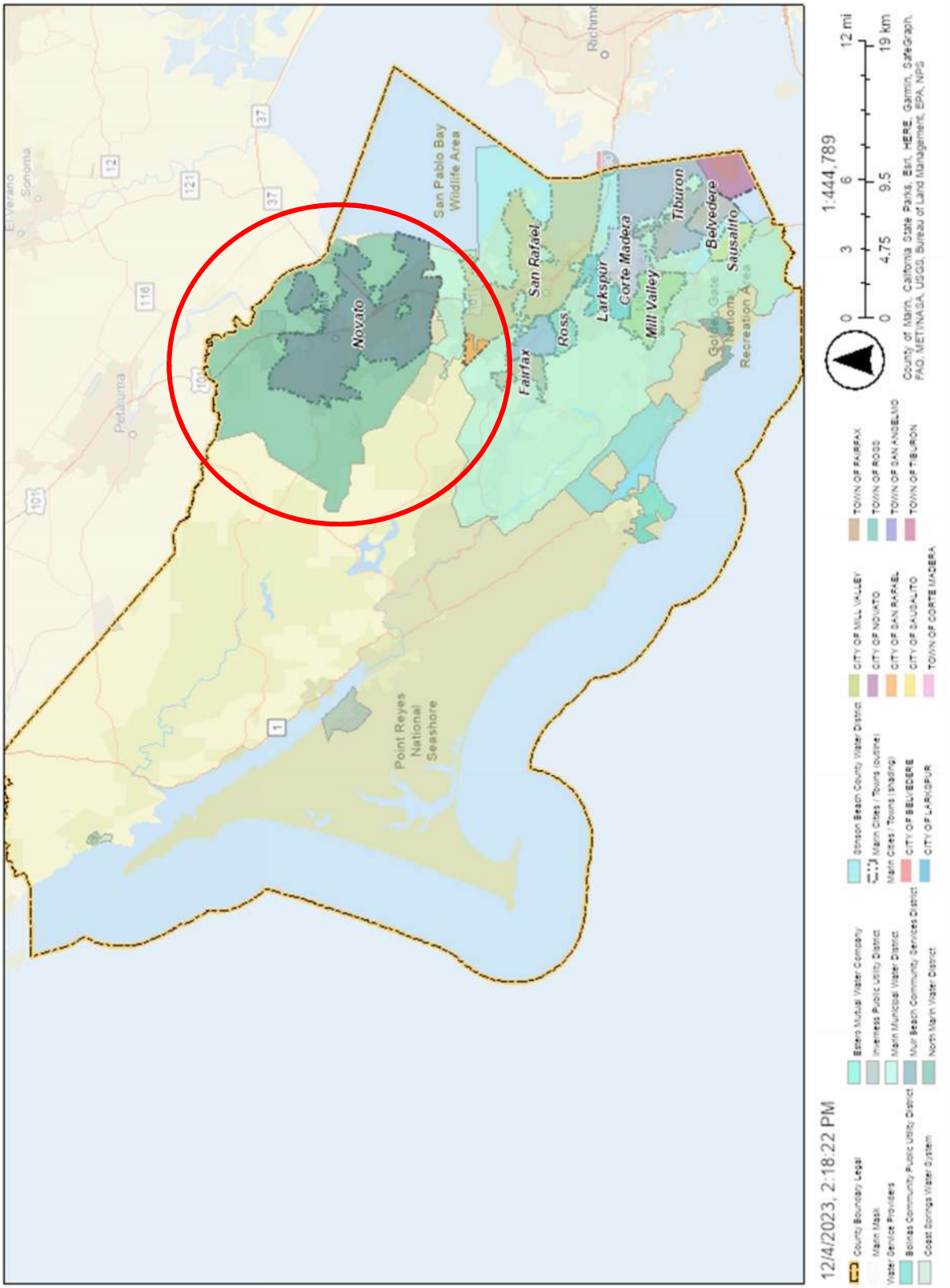


Figure 7: Map of the North Marin Water District within Marin County
Source: Marin County OEM

The North Marin Water District owns and operates Stafford Lake, Stafford Dam (DSOD Dam No. 88-0, National ID No. CA00321) and the associated treatment plant, which provides approximately 20% of Novato's water. The lake lies four miles west of downtown Novato and collects runoff from 8.3 square miles of watershed property located upstream at the upper tributary reaches of Novato Creek. Water from Stafford Lake is drawn by the intake tower and fed by gravity or by pumping (depending on the lake level) into the treatment plant located just below the dam. In addition to providing water supply for domestic needs and firefighting purposes, Stafford Dam provides flood protection for the greater Novato area. The Marin County Flood Control and Water Conservation District has partnered with NMWD to share in the cost of obtaining additional flood liability insurance. Stafford Dam (also known as the Novato Creek Dam) is approximately 71 feet tall with a crest length of 650 feet, is classified as an Extremely High Hazard Dam based on its size and potential for loss of life and property should the dam fail.

Water from the Russian River via connection to the Sonoma County Water Agency's aqueduct provides the remaining 80% of the Novato Service Area supply of water. This water originates from both the Eel River and the Russian River watersheds. The water supply for the West Marin Service Area is derived from groundwater from the Lagunitas Creek watershed.

NMWD maintains and operates approximately 340 miles of pipeline, 42 tanks totaling over 37 million gallons of storage, and associated pump stations, hydropneumatic systems, and regulator valves. NMWD sizes its storage tanks to meet operational, firefighting and emergency requirements. Storage requirements for both the Novato and West Marin Service Areas are updated on a 5-year cycle and are based in part on input provided by Novato Fire Protection District and Marin County Fire Department. NMWD evaluates water supply and consumer consumption on a 5-year cycle via its Urban Water Management Plan (UWMP) and associated Water Shortage Contingency Plan (WSCP) in accordance with state Department of Water Resources (DWR) guidelines and requirements.

Ensuring water quality and protecting public health is one of NMWD's primary goals. Water quality data is routinely collected throughout the distribution systems and at water sources.

1.4 Office of the General Manager & Administration

The General Manager is appointed by the Board of Directors to carry out the day-to-day activities of NMWD pursuant to the NMWD Regulations and Board Policies. The Manager has full responsibility for the maintenance, operation and construction of the NMWD water and wastewater systems and authority to determine employee duties to carry out these responsibilities. Refer to NMWD'S website https://nmwd.com/about/ for the most current organizational and administrative matters related to the Office of the General Manager

1.5 Financing

NMWD reports its activities as an Enterprise Fund under the broad category of funds called proprietary funds using the full accrual basis of accounting. Expenditures are tracked by department, with each department delineated by function and specific activity, to provide management and the Board with better cost control measures. At the end of each fiscal year, these costs are combined to arrive at the financial position and results of operations reflected in

NMWD's basic financial statements. For the latest NMWD financial statement, refer to https://nmwd.com/about/documents - NMWD Annual Comprehensive Financial Reports.

Fiscal year 2022 financial highlights include:

The District, on a consolidated basis, received 99% of budgeted operating revenue and expended 114% of budgeted operating expenditures, resulting in a net loss of $3.3 million. Four million (36%) of the Capital Improvement Project Budget was expended. The year ended with a cash balance of $44.7 million, an increase of $20 million from the prior year.

Novato potable water consumption decreased 20% from the prior fiscal year. Stafford Lake Water Treatment Plant produced 168MG, down 20% from the prior fiscal year. The net loss of $3.3 million exceeded the $34,000 budgeted net loss, and compares to a net income of $463,000 the prior fiscal year. Novato Water ended the fiscal year with a cash balance of $37.1 million. A 6% increase applicable to Novato Water customers was approved effective July 1, 2021.

The Novato Sanitary District and Las Gallinas Valley Sanitary District, along with the Deer Island Recycled Facility, combined to produce 252MG of Recycled Water, down 2% from the prior fiscal year. The fiscal year net income of $83,000 was greater than the $448,000 budgeted net loss and compares to a net loss of $52,000 the prior fiscal year. Recycled Water ended the fiscal year with a cash balance of $6.2 million. A 6% increase applicable to Recycled Water customers was approved effective July 1, 2021.

West Marin Water consumption was down 25% from the prior fiscal year. The $136,000 net loss compares to a budgeted net income of $165,000 and to a net loss of $8,000 from the prior fiscal year. West Marin Water ended the fiscal year with a cash balance of $793,000. A 6% increase applicable to West Marin Sewer customers was approved effective July 1, 2021.

Oceana Marin Sewer's net income of $48,000 compares to a budgeted net income of $92,000 and to net income of $48,000 from the prior fiscal year. Oceana Marin ended the year with a $485,000 cash balance. A 5% increase applicable to Oceana Marin Sewer customers was approved effective July 1, 2021.

1.5 Weather and Climate

The North Marin Water District and the City of Novato lie 30 feet above sea level. In the District and Novato, the summers are long, comfortable, arid, and mostly clear and the winters are short, cold, wet, and partly cloudy. Over the course of the year, the temperature typically varies from 41.8°F to 74.7°F and is rarely below 41°F or above 75°F. The difference in precipitation between the driest month and the wettest month is 5 inches. The annual rainfall is 18 inches. The month of highest relative humidity is February (79 %). The month with the lowest relative humidity is June (65 %). The month which sees the most rainfall is January. The driest month of the year is July.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	8.9 °C (48.1) °F	9.7 °C (49.5) °F	11 °C (51.8) °F	12.2 °C (53.9) °F	14.4 °C (57.9) °F	16.8 °C (62.2) °F	17.1 °C (62.8) °F	17.3 °C (63.1) °F	17.2 °C (63) °F	15.4 °C (59.7) °F	11.9 °C (53.3) °F	9.1 °C (48.5) °F
Min. Temperature °C (°F)	5.5 °C (41.8) °F	6.2 °C (43.1) °F	7.3 °C (45.1) °F	8.2 °C (46.8) °F	10.1 °C (50.1) °F	11.8 °C (53.3) °F	12.4 °C (54.4) °F	12.9 °C (55.2) °F	12.6 °C (54.7) °F	11.2 °C (52.1) °F	8.2 °C (46.7) °F	5.9 °C (42.6) °F
Max. Temperature °C (°F)	13.7 °C (56.7) °F	14.5 °C (58.1) °F	16 °C (60.8) °F	17.5 °C (63.4) °F	20 °C (68.1) °F	23.2 °C (73.8) °F	23.6 °C (74.5) °F	23.7 °C (74.7) °F	23.9 °C (75.1) °F	21.4 °C (70.6) °F	16.8 °C (62.3) °F	13.5 °C (56.2) °F
Precipitation / Rainfall mm (in)	118 (4)	124 (4)	88 (3)	41 (1)	22 (0)	5 (0)	1 (0)	2 (0)	2 (0)	25 (0)	58 (2)	114 (4)
Humidity(%)	78%	79%	76%	70%	68%	65%	70%	71%	68%	68%	74%	77%
Rainy days (d)	8	7	6	4	3	1	0	0	0	2	5	7
avg. Sun hours (hours)	5.7	6.4	7.8	9.4	10.0	10.6	9.3	8.5	8.7	7.8	6.7	5.6

Data: 1991 - 2021 Min. Temperature °C (°F), Max. Temperature °C (°F), Precipitation / Rainfall mm (in), Humidity, Rainy days. Data: 1999 - 2019: avg. Sun hours

Figure 8: The North Marin Water District Precipitation and Monthly Temperatures
Source: En.Climate-Data.org

1.6 Social Vulnerability and Risk

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.

For purposes of this plan the following National Risk Index (NRI) hazards are profiled in support of eight of the twelve Marin County MJHMP Hazards. NRI data was not available for Dam Failure, Land Subsidence, Levee Failure, or Sea Level Rise.

Table 4: NRI Hazards and Marin County MJHMP Hazards	
NRI Hazards	Marin County 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
Strong Wind	Severe Weather – Wind, Tornado

Table 4: NRI Hazards and Marin County MJHMP Hazards
Source: FEMA National Risk Index 2023

The National Risk Index leverages available source data for Expected Annual Loss 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 × 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.

The following Tables and Figures illustrates the NRI Hazard Type Risk Index and the Social Vulnerability Map for the North Marin Water District for the various Census Tracts within their service area.

Tables 5 - 9 illustrate the NRI Hazard Type Risk Index for the NMWD service area Census Tracts

Table 5: NRI Hazard Type Risk Index for Novato Census Tract 1022.03						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$2,722,258	Relatively High	Very High	1.35	$3,686,835	98.6
Riverine Flooding	$183,359	Relatively High	Very High	1.35	$248,329	92.9
Heat Wave	$8,084	Relatively High	Very High	1.35	$10,949	53.2
Tornado	$3,889	Relatively High	Very High	1.35	$5,267	12.6
Landslide	$2,470	Relatively High	Very High	1.35	$3,345	84.4
Strong Wind	$264	Relatively High	Very High	1.35	$357	11.5
Wildfire	$68	Relatively High	Very High	1.35	$92	35.4
Coastal Flooding	$0	Relatively High	Very High	1.35	$0	0
Drought	$0	Relatively High	Very High	1.35	$0	0
Tsunami	$0	Relatively High	Very High	1.35	$0	0

Table 5: NRI Hazard Type Risk Index for Novato Census Tract 1022.03
Source: FEMA National Risk Index 2023

Figures 9 - 13 illustrate the Social Vulnerability Maps for the NMWD service area Census Tracts.

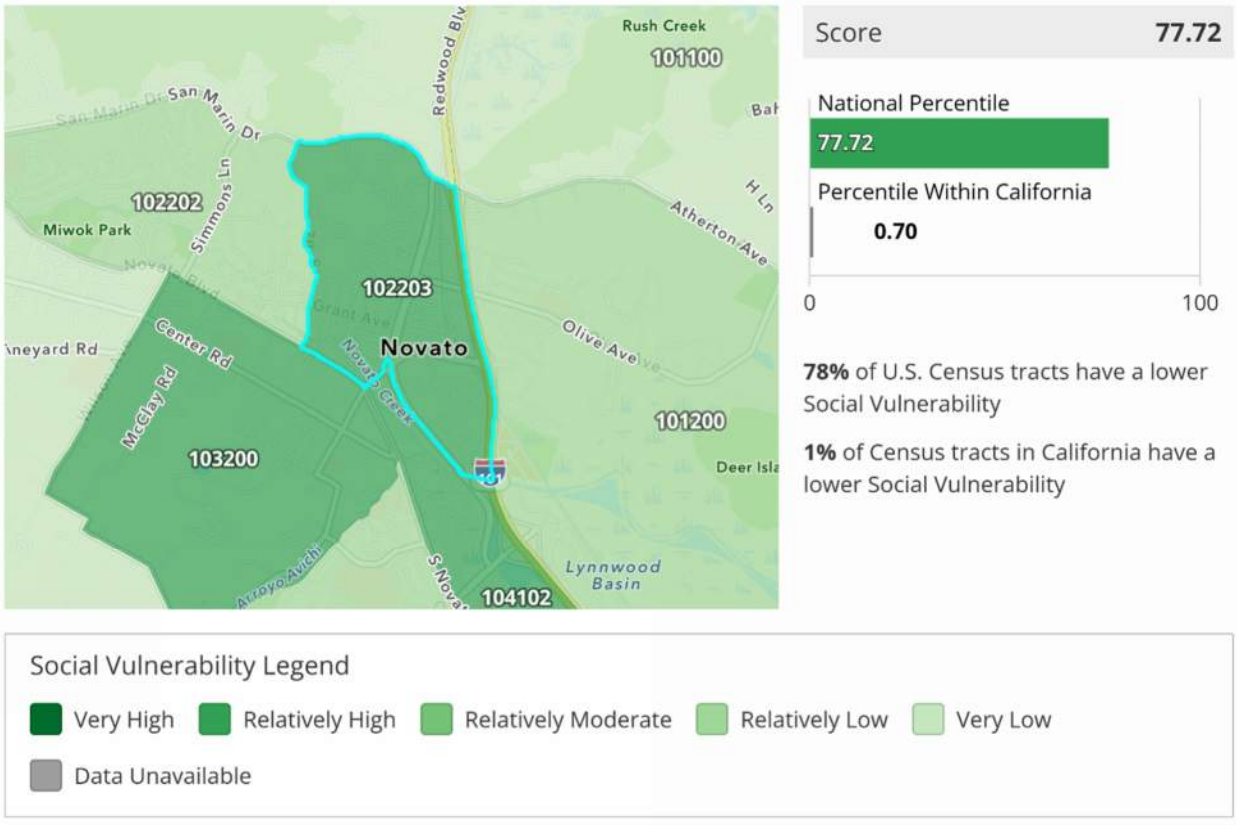


Figure 9: City of Novato Social Vulnerability Map Census Tract 1022.03
Source: FEMA National Risk Index 2023

Table 6: NRI Hazard Type Risk Index for Novato Census Tract 1032.00						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$1,889,584	Relatively High	Very High	1.37	$2,597,248	97.5
Riverine Flooding	$1,697,035	Relatively High	Very High	1.37	$2,332,588	99.4
Wildfire	$43,948	Relatively High	Very High	1.37	$60,407	91.9
Heat Wave	$10,500	Relatively High	Very High	1.37	$14,432	58.7
Tornado	$5,050	Relatively High	Very High	1.37	$6,941	16.8
Landslide	$3,209	Relatively High	Very High	1.37	$4,411	88.3
Strong Wind	$342	Relatively High	Very High	1.37	$471	13.8
Coastal Flooding	$0	Relatively High	Very High	1.37	$0	0
Drought	$0	Relatively High	Very High	1.37	$0	0
Tsunami	$0	Relatively High	Very High	1.37	$0	0

Table 6: NRI Hazard Type Risk Index for Novato Census Tract 1032.00
Source: FEMA National Risk Index 2023

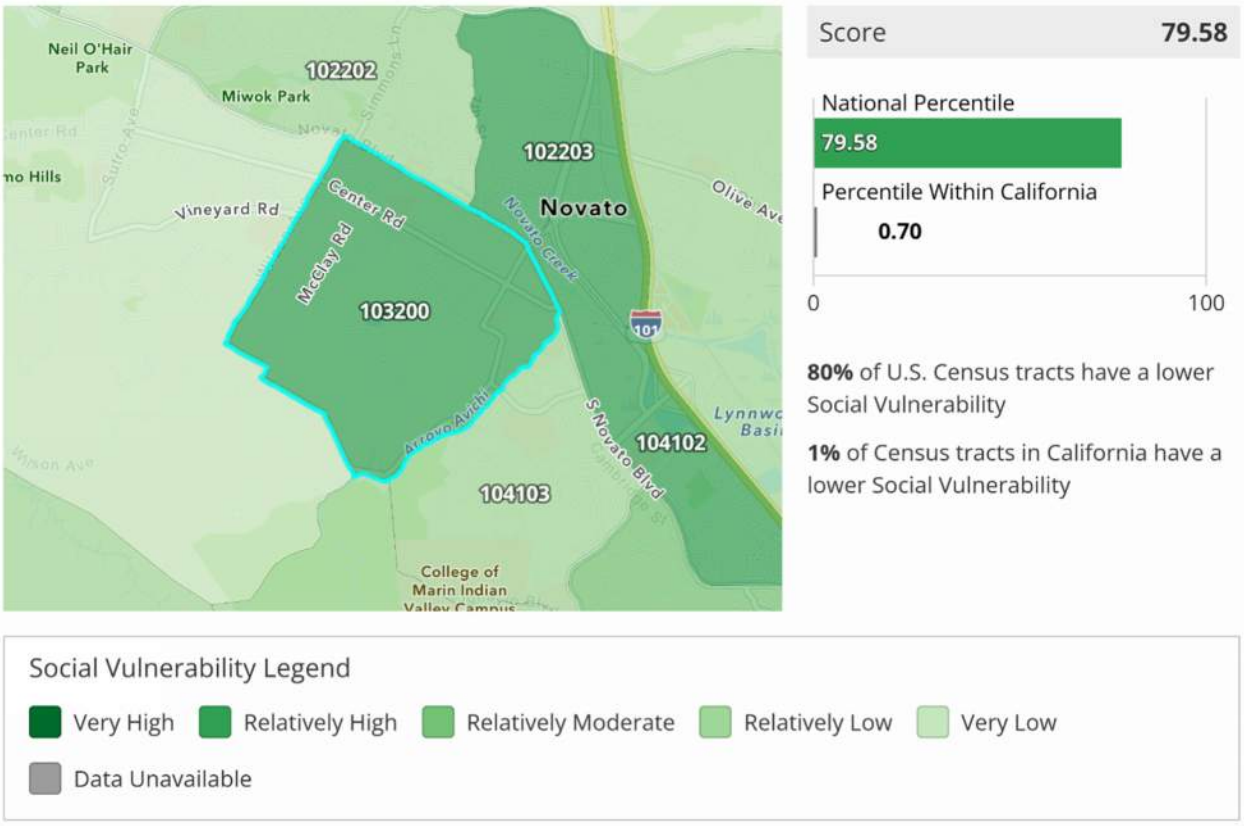


Figure 10: City of Novato Social Vulnerability Map Census Tract 10320.00
Source: FEMA National Risk Index 2023

Table 7: NRI Hazard Type Risk Index for Novato Census Tract 1012.00						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$2,569,756	Relatively Low	Very High	0.88	$2,272,662	96.8
Riverine Flooding	$154,980	Relatively Low	Very High	0.88	$137,063	88.1
Coastal Flooding	$64,204	Relatively Low	Very High	0.88	$56,781	95
Drought	$44,177	Relatively Low	Very High	0.88	$39,070	95.8
Heat Wave	$4,569	Relatively Low	Very High	0.88	$4,041	36.7
Wildfire	$4,251	Relatively Low	Very High	0.88	$3,760	79
Tornado	$3,094	Relatively Low	Very High	0.88	$2,736	6.3
Landslide	$2,521	Relatively Low	Very High	0.88	$2,230	77.9
Strong Wind	$168	Relatively Low	Very High	0.88	$148	6
Tsunami	$0	Relatively Low	Very High	0.88	$0	0

Table 7: NRI Hazard Type Risk Index for Novato Census Tract 1012.00
Source: FEMA National Risk Index 2023

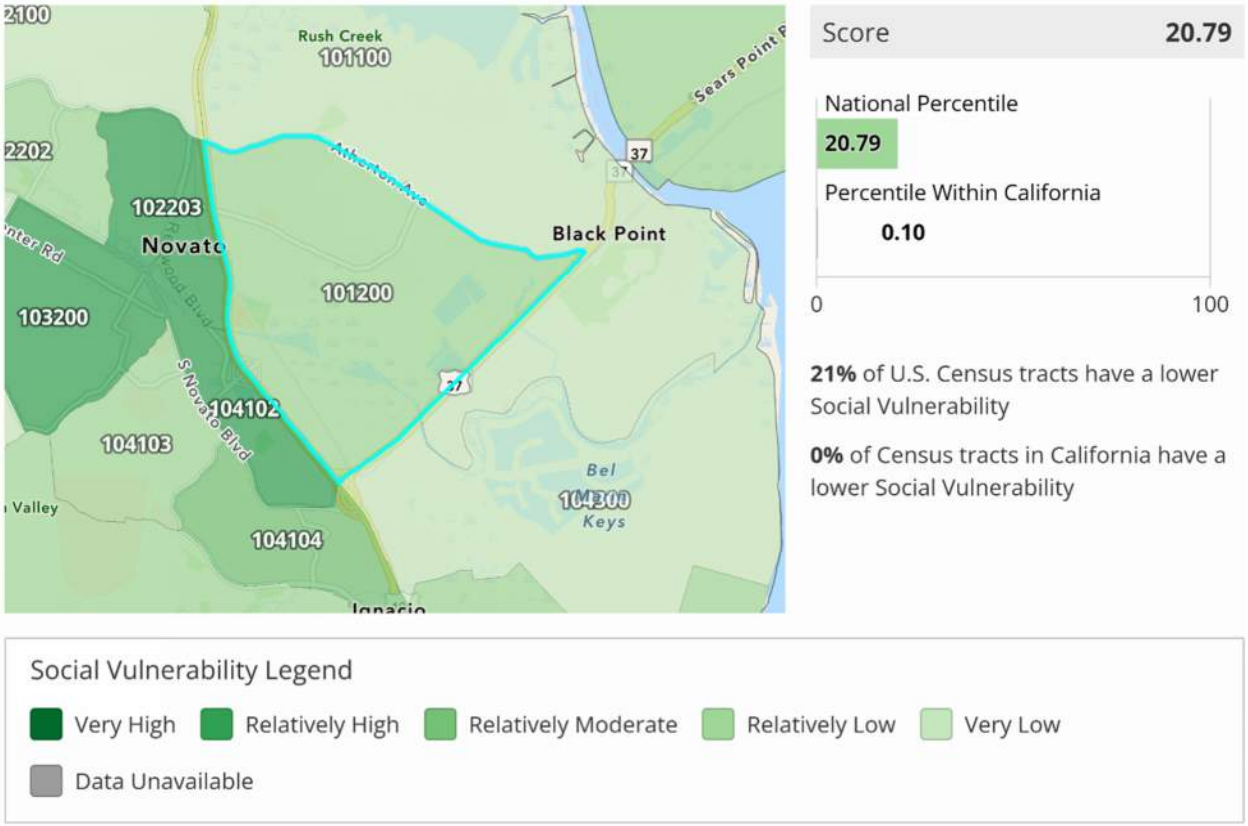


Figure 11: City of Novato Social Vulnerability Map Census Tract 1012.00
Source: FEMA National Risk Index 2023

Table 8: NRI Hazard Type Risk Index for Novato Census Tract 1022.02						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$1,255,306	Relatively Low	Very High	0.94	$1,177,508	92.4
Riverine Flooding	$375,636	Relatively Low	Very High	0.94	$352,356	94.9
Heat Wave	$9,379	Relatively Low	Very High	0.94	$8,798	49.2
Tornado	$3,991	Relatively Low	Very High	0.94	$3,744	8.7
Landslide	$3,696	Relatively Low	Very High	0.94	$3,467	85
Wildfire	$1,511	Relatively Low	Very High	0.94	$1,417	69.9
Strong Wind	$295	Relatively Low	Very High	0.94	$277	9.6
Coastal Flooding	$0	Relatively Low	Very High	0.94	$0	0
Drought	$0	Relatively Low	Very High	0.94	$0	0
Tsunami	$0	Relatively Low	Very High	0.94	$0	0

Table 8: NRI Hazard Type Risk Index for Novato Census Tract 1022.02
Source: FEMA National Risk Index 2023

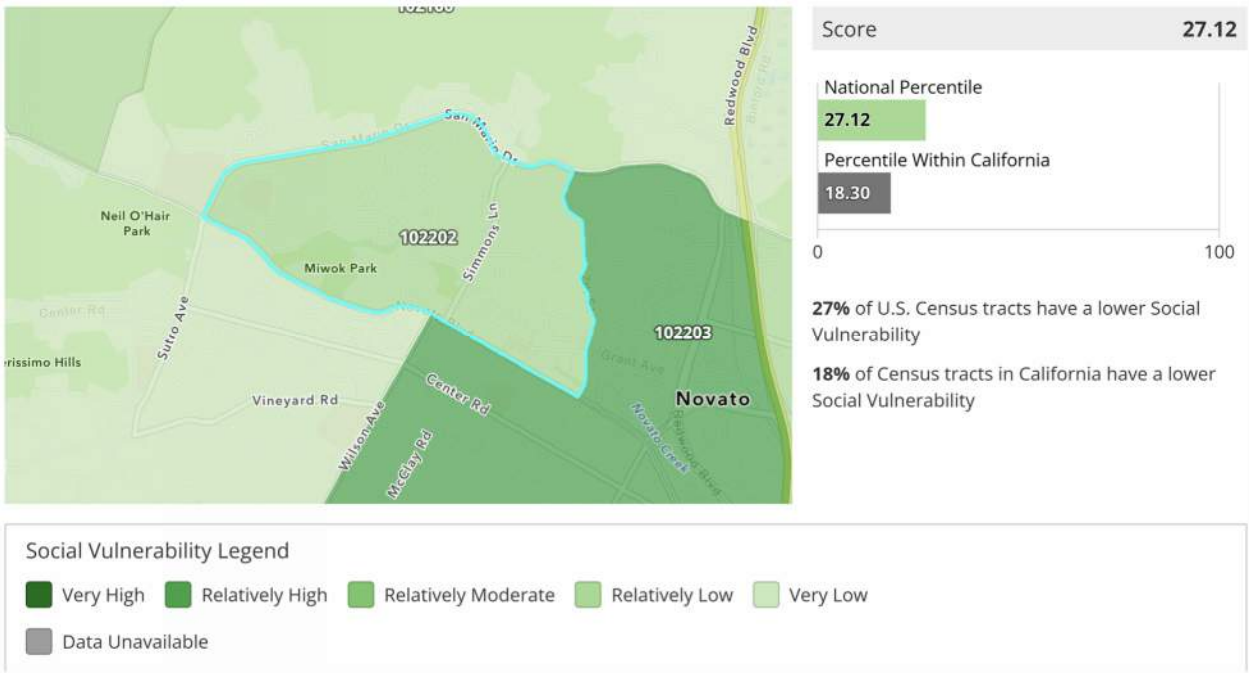


Figure 12: City of Novato Social Vulnerability Map Census Tract 1022.02
Source: FEMA National Risk Index 2023

Table 9: NRI Hazard Type Risk Index for Novato Census Tract 1041.02						
Hazard Type	**EAL Value**	**Social Vulnerability**	**Community Resilience**	**CRF**	**Risk Value**	**Score**
Earthquake	$1,540,791	Relatively High	Very High	1.19	$1,837,291	95.6
Riverine Flooding	$690,513	Relatively High	Very High	1.19	$823,391	98
Heat Wave	$8,314	Relatively High	Very High	1.19	$9,914	51.4
Coastal Flooding	$5,903	Relatively High	Very High	1.19	$7,038	88.3
Tornado	$3,151	Relatively High	Very High	1.19	$3,757	8.8
Landslide	$2,413	Relatively High	Very High	1.19	$2,878	82.1
Wildfire	$282	Relatively High	Very High	1.19	$337	49.7
Strong Wind	$254	Relatively High	Very High	1.19	$303	10.2
Drought	$0	Relatively High	Very High	1.19	$0	0

Table 9: NRI Hazard Type Risk Index for Novato Census Tract 1041.02
Source: FEMA National Risk Index 2023

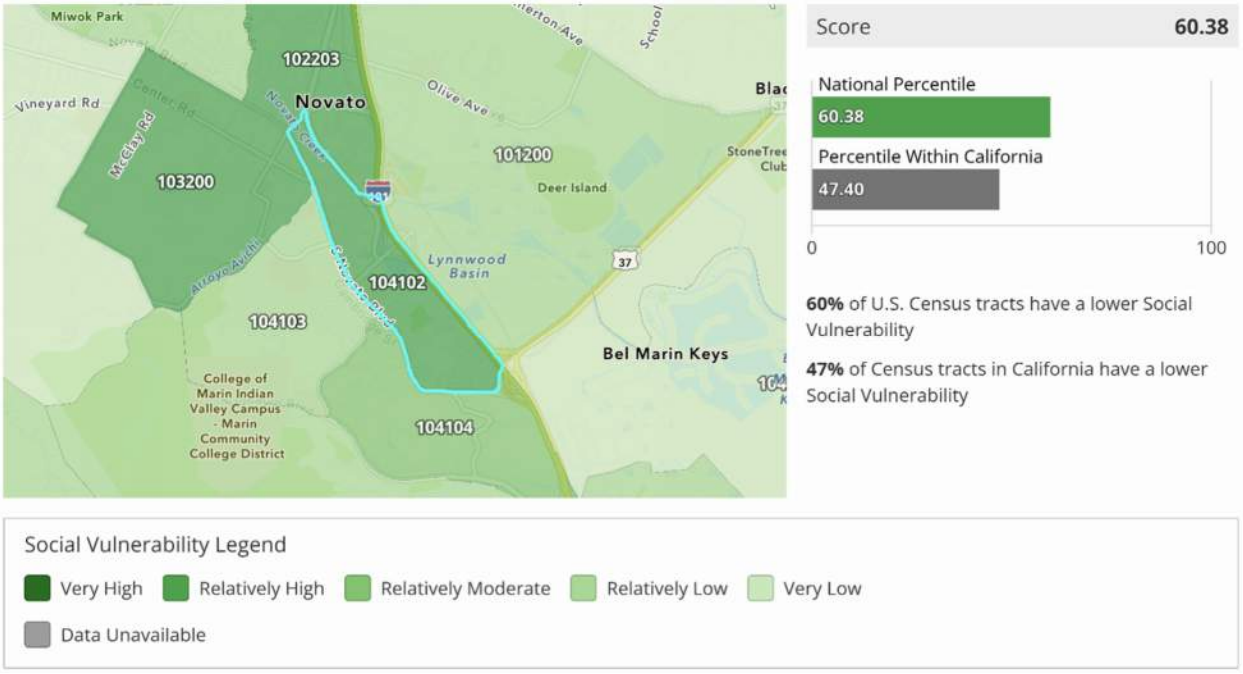


Figure 13: City of Novato Social Vulnerability Map Census Tract 1041.02
Source: FEMA National Risk Index 2023

Social Vulnerability in Marin County and the North Marin Water District

Most socially vulnerable residents in Marin County OA 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), 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, what the SVI is calculated from. 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, Social Vulnerability Index, 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.

Although, customers within the North Marin Water District reside within census tracts that have a Social Vulnerability Index of “Relatively High” to “Relatively Low”, the North Marin Water District’s ability to serve this community is limited to the potable water they provide. Their

influence may be realized during an emergency by ensuring the continued delivery of potable water which are considered a community lifeline. They may also work with these impacted customers to provide fee relief through local, state, and or federal programs where appropriate. The majority of socially vulnerable population services are provided through the county, state, and federal government or other non-governmental or volunteer agencies or organizations.

1.9 Critical Facilities

Novato

Stafford Lake – Local source provides 20-25% of North Marin's supply. Stafford Lake lies four miles west of downtown Novato and collects the runoff from 8.3 square miles of watershed land adjacent to the upper reaches of Novato Creek. The lake has a surface area of 230 acres and holds 4,450-acre feet or 1,450 million gallons (MG) of water. Water from Stafford Lake is fed into the Stafford Lake Water Treatment Plant, (located just below the dam) at a maximum rate of 6 million gallons per day. In FY 2021-22, 515.8 acre feet (168.1MG) of water was produced from the facility between July and October.

Russian River – Provides 75-80% of North Marin's annual supply. Russian River water originates from both the Eel River and the Russian River watersheds northeast of the City of Ukiah (Lake Mendocino) and west of Healdsburg (Lake Sonoma). The Coyote Dam at Lake Mendocino impounds the Eel River diversions and winter runoff from the local watershed. Warm Springs Dam at Lake Sonoma impounds winter runoff from the Dry Creek and Warm Springs local watersheds. Lakes Mendocino and Sonoma combined can store 367,500-acre feet to meet regional water supply needs, which totaled 46,200-acre feet in FY 2019 20. Releases from the lakes flow to a point about 10 miles upstream of Guerneville (see map on page 31 of this report), where six collector wells draw river water that has been filtered through 60 to 90 feet of natural sand and gravel to perforated pipes located at the bottom of each well. The thick layer of sand and gravel through which the water must pass before reaching the intake pipes provides a highly efficient, natural filtration process which, with chlorination treatment, produces a clear, potable, bacteria-free water. This water is then fed directly into the SCWA aqueduct system. In FY 21-22, North Marin received 5,797-acre feet (1,889MG) of Russian River water. North Marin has an agreement in place with SCWA to provide sufficient supply and meet Novato's current and future water supply needs. There continues to be competing interests for Russian River water, principally to protect steelhead and salmon listed as threatened or endangered species under the Endangered Species Act.

West Marin

Groundwater Wells – Local source provides 100% of North Marin's supply. Four active wells provide water for our West Marin customers: Coast Guard Well #2, Coast Guard Well #4, Gallagher Well No. 1, and Gallagher Well No. 2. In FY 21-22, 176.5-acre feet (57.5MG) of water was produced from a combination of the first three wells listed, as construction of the new Gallagher Well No. 2 was completed in October 2022 which added approximately 180,000 gallons per day to the water system.

The following list of facilities has been determined to be critical to the ability of the North Marin Water District to fulfill the requirements of its mission during an emergency:

Table 10: NMWD Critical Facilities in Fire and Flood Zone				
Category	Name	Address	Fire Severity Zone	Flood Zone
Critical Facilities				
District Building	NMWD Headquarters: Administration, Laboratory, and Corporation Yard	999 Rush Creek Place Novato, CA 94945	Moderate	500-year flood plain (Zone X)
District Building	Stafford Water Treatment Plant	3500 Novato Blvd. Novato, CA 94945	Moderate	n/a
District Building	Point Reyes Water Treatment Plant	101 Commodore Webster Dr. Point Reyes Station, CA 94956	Moderate	100-year flood plain (Zone AE)
High Potential Loss Facilities				
DAM	Novato Creek Dam	3500 Novato Blvd. Novato, CA 94945	Moderate	n/a
Critical Infrastructure				
Water	North Marin Aqueduct, 30”-42” water transmission pipeline	Linear utility –generally paralleling US 101	Various	n/a
Water	San Marin Pump Station	APN 125-411-25	High	n/a
Water	Lynwood Pump Station	Intersection of S. Novato Blvd & Sunset Parkway, Novato, CA 94945	Moderate	n/a
Water	Cherry Hill Pump Station	APN 143-421-33	High	n/a
Water	School Road Pump Station	Intersection of School Road & Sunset Trail, Novato, CA 94945	High	n/a
Water	Black Point @ Hwy 37 Regulating Station	Intersection of Harbor Drive & Hwy 37 Eastbound On-Ramp, Novato, CA 94945	High	AE
Water	Black Point @ Grandview Avenue Regulating Station	Intersection of Harbor Drive & Grandview Avenue, Novato, CA 94945	High	AE
Water	Coast Guard Wells (No. 2 & 4)	101 Commodore Webster Dr. Point Reyes Station, CA 94956	Moderate	AE
Water	Gallagher Well No. 1	APN 119-050-12	Moderate	AE
Water	Gallagher Well No. 2	APN 119-050-17	Moderate	AE
Water	Olema Pump Station	APN 166-220-10	Moderate	AE
Water	Bear Valley Pump Station	APN 166-350-10	Moderate	n/a
Water	Inverness Park Pump Station	APN 114-294-33	High	n/a
Water	Paradise Ranch Estates Pump Station No. 1	APN 114-111-19	Moderate	n/a
Water	Paradise Ranch Estates Pump Station No. 2	APN 114-100-89	High	n/a
Water	Paradise Ranch Estates Pump Station No. 3	APN 114-100-91	High	n/a
Water	Paradise Ranch Estates Tank No. 1	APN 114-111-19	Moderate	n/a
Water	Paradise Ranch Estates Tank No. 2	APN 114-100-89	High	n/a
Wastewater	Tahiti Way Lift Station	APN 100-261-47	Moderate	n/a
Wastewater	Oceana Marin Wastewater Storage and Treatment Ponds	APN 100-100-56	Moderate	n/a

Table 10: North Marin Water District Critical Facilities
Source: North Marin Water District

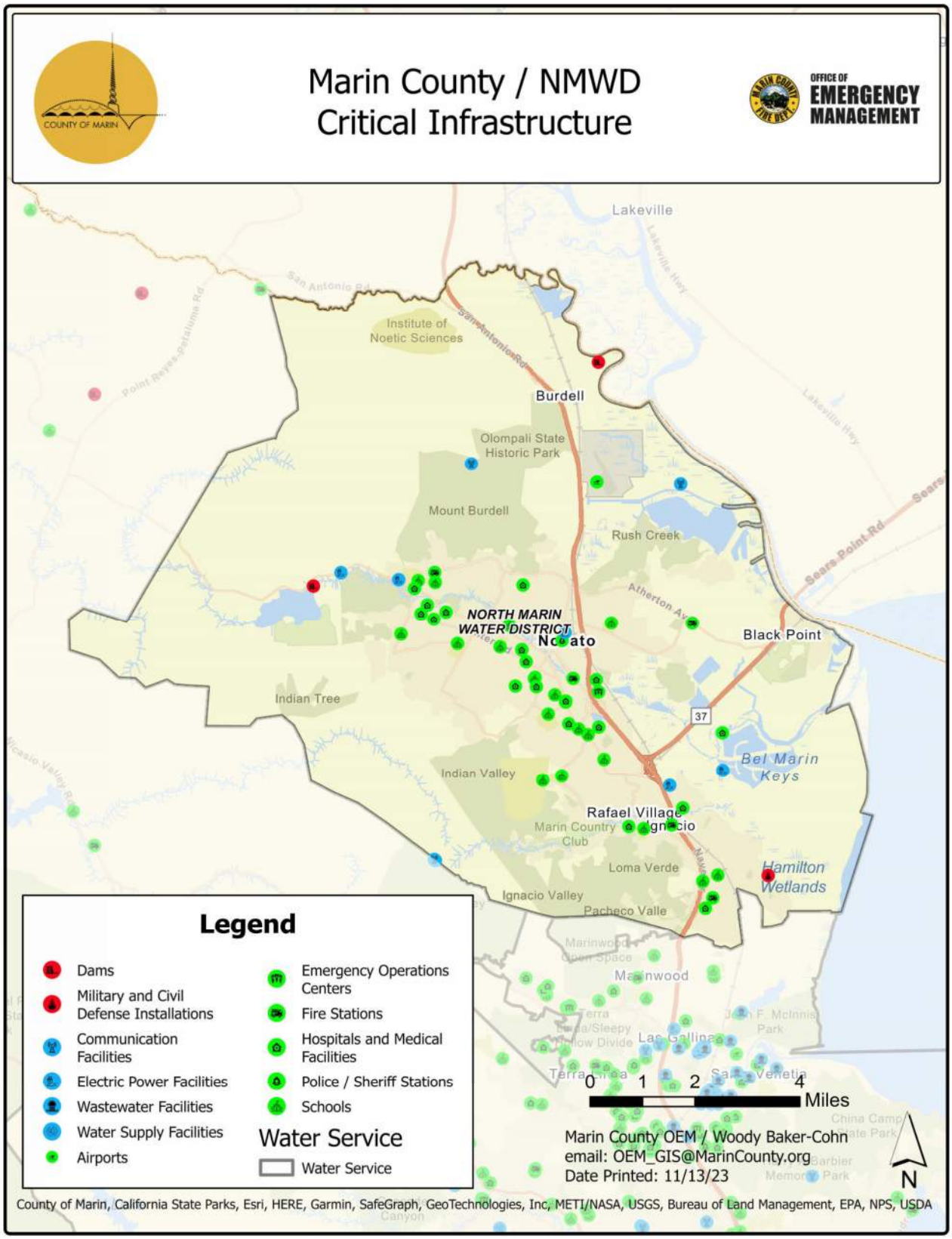


Figure 14: North Marin Water District Critical Facilities
Source: Marin County OEM

SECTION 2.0: HAZARD IDENTIFICATION AND RISK ASSESSMENT

The North Marin Water District identified hazards that affect the District and developed natural hazard profiles based upon the countywide risk assessment, past events and their impacts. Figure 15 shows the top hazards that the Jurisdiction is at risk from according to the hazard mitigation Steering Committee.

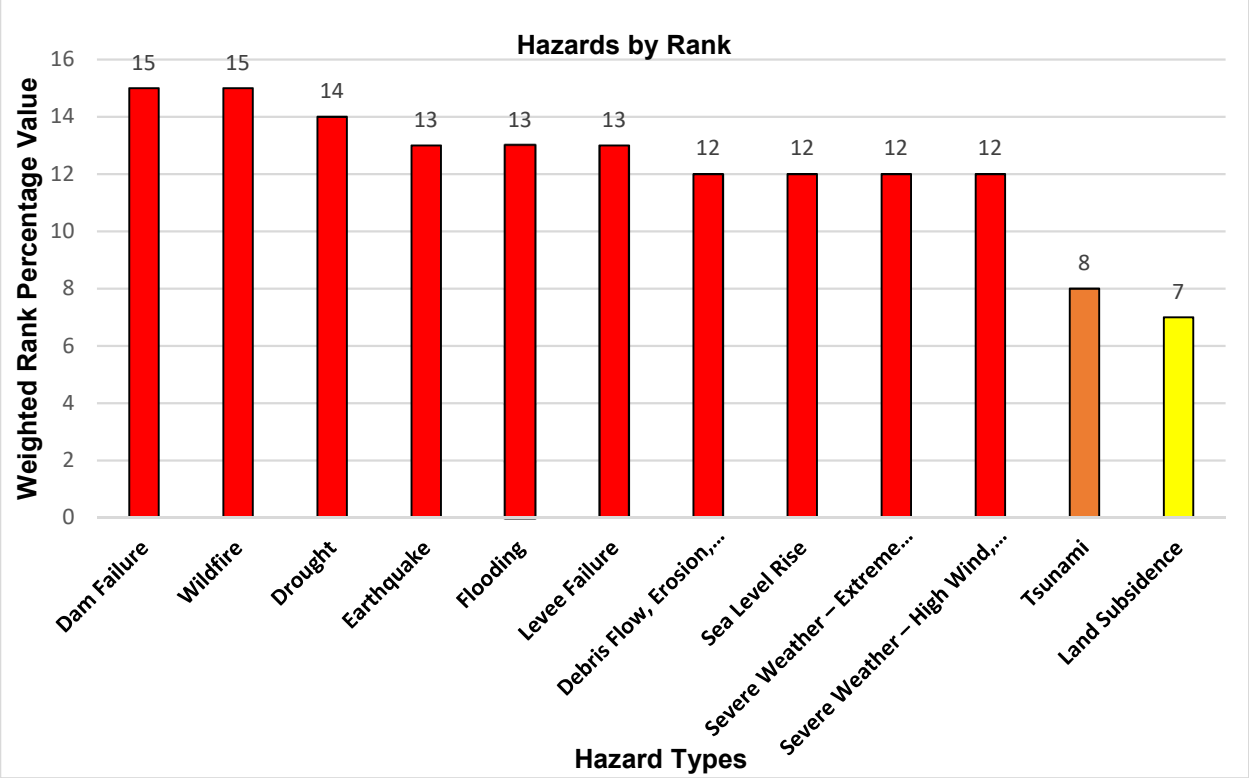


Figure 15: NMWD Risk Assessment – Planning Team Top Hazards

Figure 16: Risk Rank Categorization	
Risk Level	Risk Numerical Score
High Risk	**12 - 16**
Serious Risk	**8 - 11**
Moderate Risk	**4 - 7**
Low Risk	**1 - 3**

Figure 16: Hazard Risk Categorization

Each Marin County OA MJHMP participating jurisdiction and organization reviewed and approved the Top Hazards identified by the Planning Team. Each participating jurisdiction and district 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/ Likelihood of Future Events
- Geographic Extent
- Magnitude/ Severity
- Climate Change Influence
- Significance

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 11: Select Hazards 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
Tornado	Fujita Tornado Damage Scale	FO	F1, F2	F3	F4, F5

Table 11: Select Hazards Magnitude/ Severity Scale or Index

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.

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 IMPACTS AND RISKS

Source: Intergovernmental Panel on Climate Change, Headline Statements from the Summary for Policymakers, 2022

- 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.

FUTURE TRENDS/ IMPACTS

Source: Study Confirms Climate Models are Getting Future Warming Projections Right – Climate Change: Vital Signs of the Planet (nasa.gov)

Global Warming

- 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.
- 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.

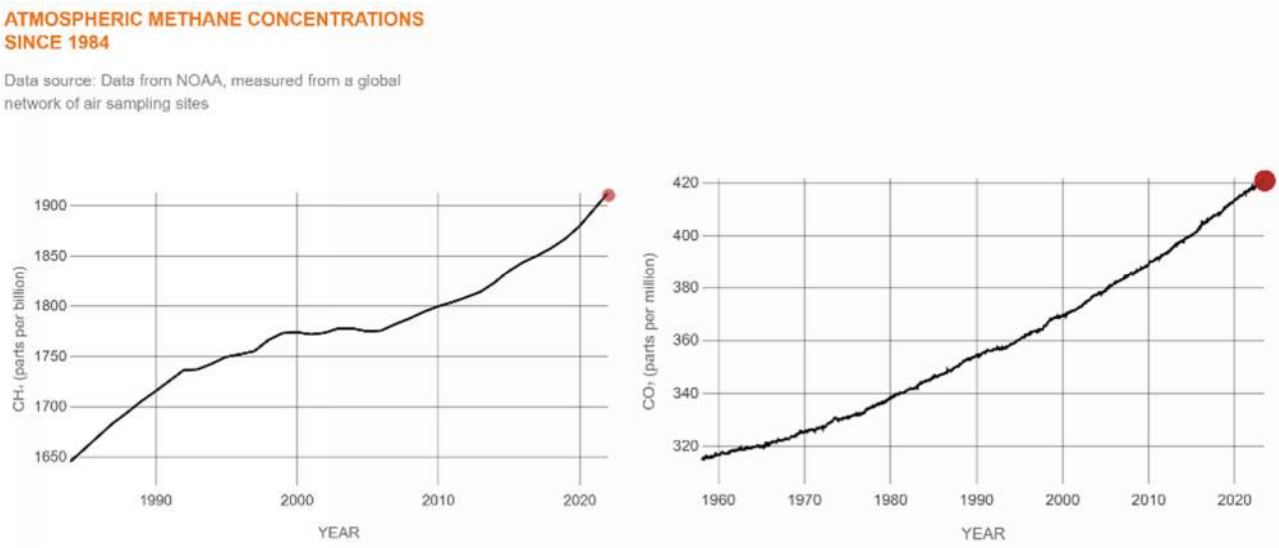


Figure 17: NASA Global Temperature Change CO2 Gas
Source: NASA Global Climate Change, 2022

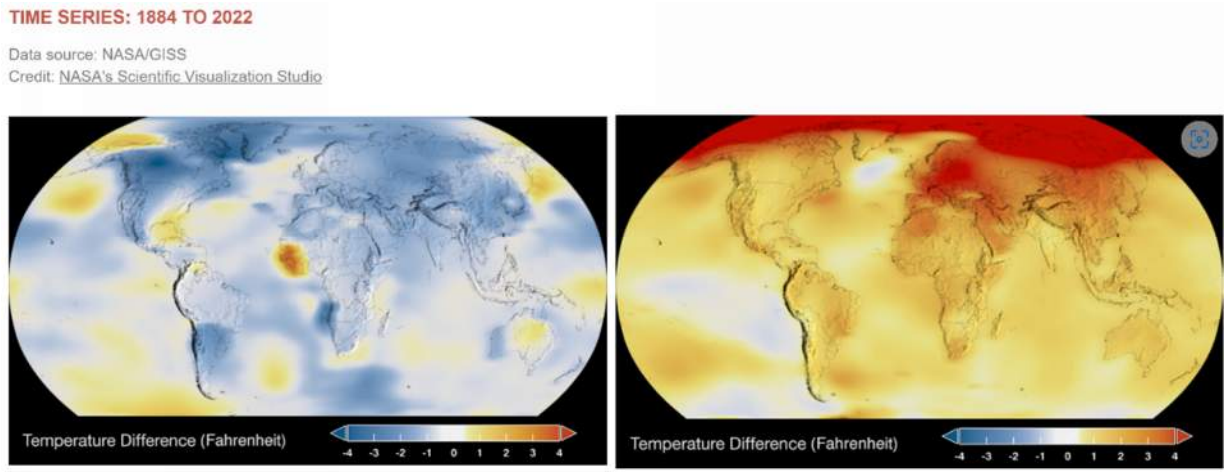


Figure 18: NASA Global Temperature Change 1884 to 2022
Source: NASA Global Climate Change, 2022

Drought

- A NASA-led study in 2022 concluded that 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 through at least 2022.

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 Level Likely to Rise 1 to 6.6 Feet by 2100.
- Global sea level has 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 if current projections hold. This change is expected to occur before mid-century.
- An indicator of changes in the Arctic sea ice minimum over time. Arctic sea ice extent both affects and is affected by global climate change.

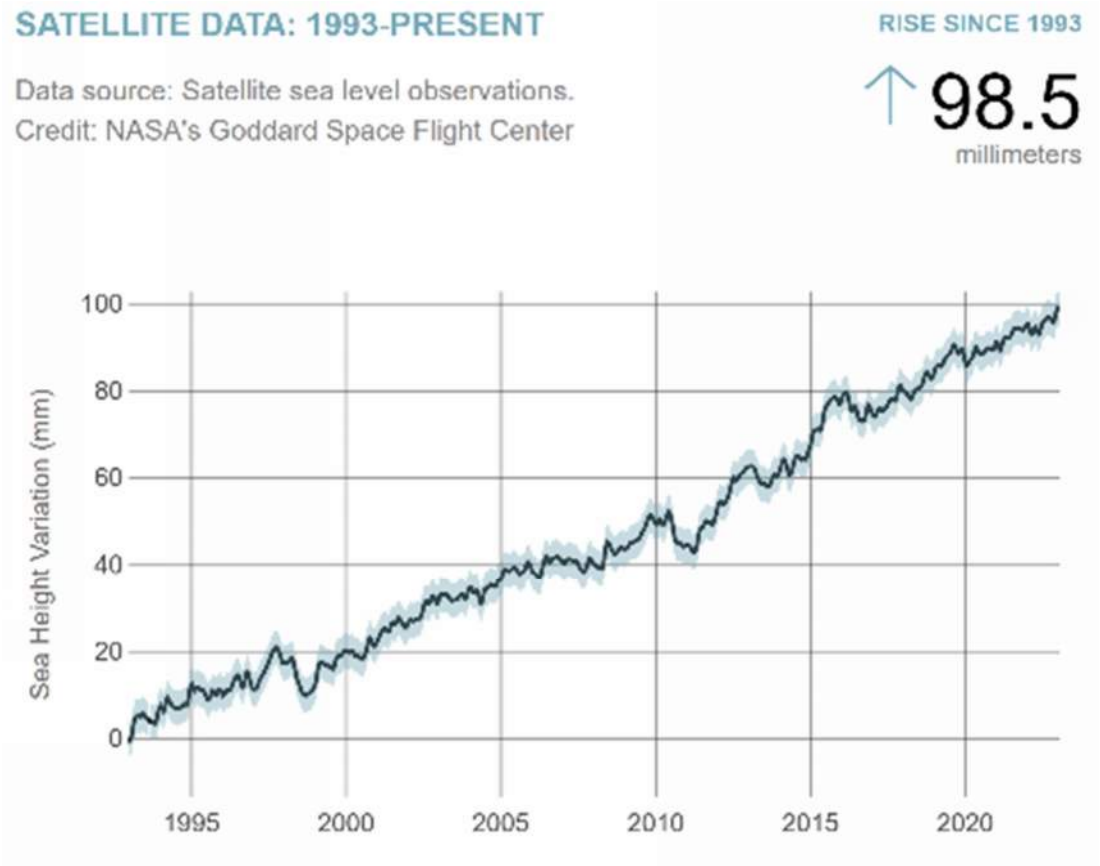


Figure 19: NASA Global Temperature Change Sea Level
Source: NASA Global Climate Change, 2022

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, increased intensity of rain fall may occur and may become 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.

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 OA MJHMP as a standalone hazard while addressing each of the other natural hazards. The Marin County OA 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.

Indicators of Climate Change in California

Source: 2022 Report: Indicators of Climate Change in California | OEHHA

- 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.

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).

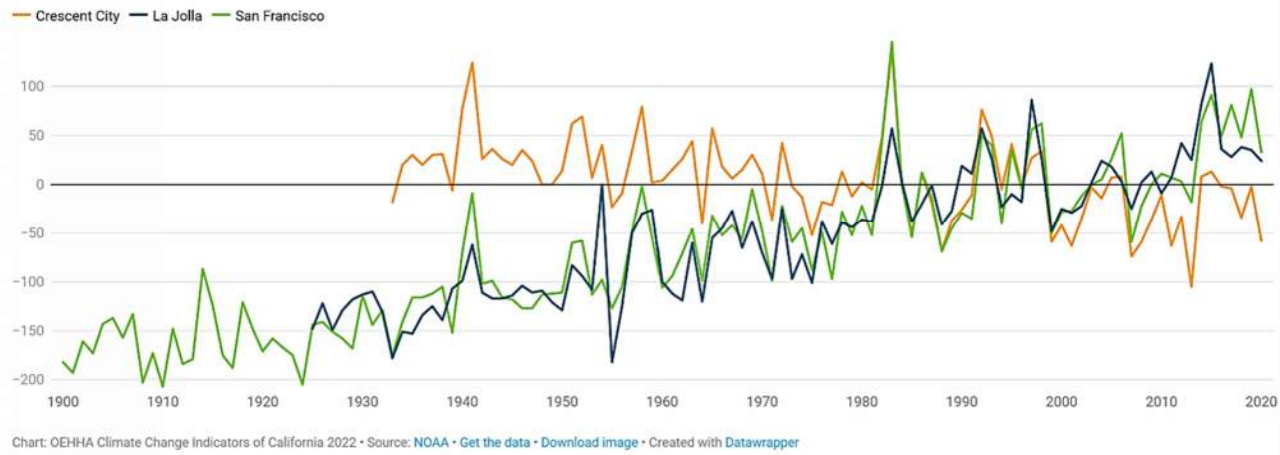


Figure 20: Annual Mean Sea Level Trends
Source: 2022 Report: Indicators of Climate Change in California | OEHHA

Climate Change in the Marin County Operational Area

Climate change is already having significant impacts across California. Temperatures are warming, heat waves are more frequent, 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. 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, and high tide events. 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 change 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 of Marin County jurisdictions, the County, and Marin County regional agencies, adapted a model Climate Action Plan (CAP) that is intended to support countywide implementation efforts and is currently being used to update additional climate action plans for other jurisdictions in Marin County. The CAP supports the Climate Action Plan for the unincorporated County, which was completed in 2020. The MCEP also collects data and report on progress in meeting each County jurisdictions' individual greenhouse gas emission targets. In June 2023, the County published the Greenhouse Gas Inventory for Unincorporated Community Emissions for the Year 2021. 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 initiatives

include Marin Clean Energy, Electrify Marin, the Marin Solar Project, the Marin Energy Watch Partnership, Resilient Neighborhoods, and Drawdown: Marin.

2.2 HAZARDS

Of the hazards profiled in the Marin County MJHMP, those noted in the table are specific for the North Marin Water District as per the planning team.

Table 12: NMWD Hazard Risk Assessment						
Hazard	Probability/ Likelihood of Future Events	Extent	Magnitude/ Severity	Climate Change Influence	Significance	Risk Score
Dam Failure	Unlikely	Extensive	Extreme	High	High	**15.00**
Debris Flow	Occasional	Significant	Moderate	High	Medium	**12.00**
Drought	Occasional	Extensive	Severe	High	Medium	**14.00**
Earthquake	Occasional	Extensive	Extreme	Low	Medium	**13.00**
Flooding	Occasional	Significant	Severe	High	Medium	**13.00**
Land Subsidence (Sinkhole)	Occasional	Negligible	Moderate	Medium	None	**7.00**
Levee Failure	Unlikely	Significant	Extreme	High	Medium	**13.00**
Sea Level Rise	Occasional	Significant	Moderate	High	Medium	**12.00**
Severe Weather – Extreme Heat	Likely	Extensive	Weak	Medium	Medium	**12.00**
Severe Weather – Wind, Tornado	Likely	Extensive	Weak	Medium	Medium	**12.00**
Tsunami	Unlikely	Negligible	Extreme	Low	Low	**8.00**
Wildfire	Occasional	Extensive	Extreme	Medium	High	**15.00**

Table 12: NMWD Hazard Risk Assessment
Source: North Marin Water District

Omitted Hazards

The North Marin Water District does not have any omitted hazards.

Table 13: County of Marin 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	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	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**

Table 13: County of Marin Hazard Risk Assessment
Source: Marin County

2.2.1 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, and homes. 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.

Table 14 shows all the dams in Marin County that could impact the Marin County Operational Area.

Table 14: 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	4,287	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 14: Dams in Marin County with Potential to Impact to the OA
Source: CalOES

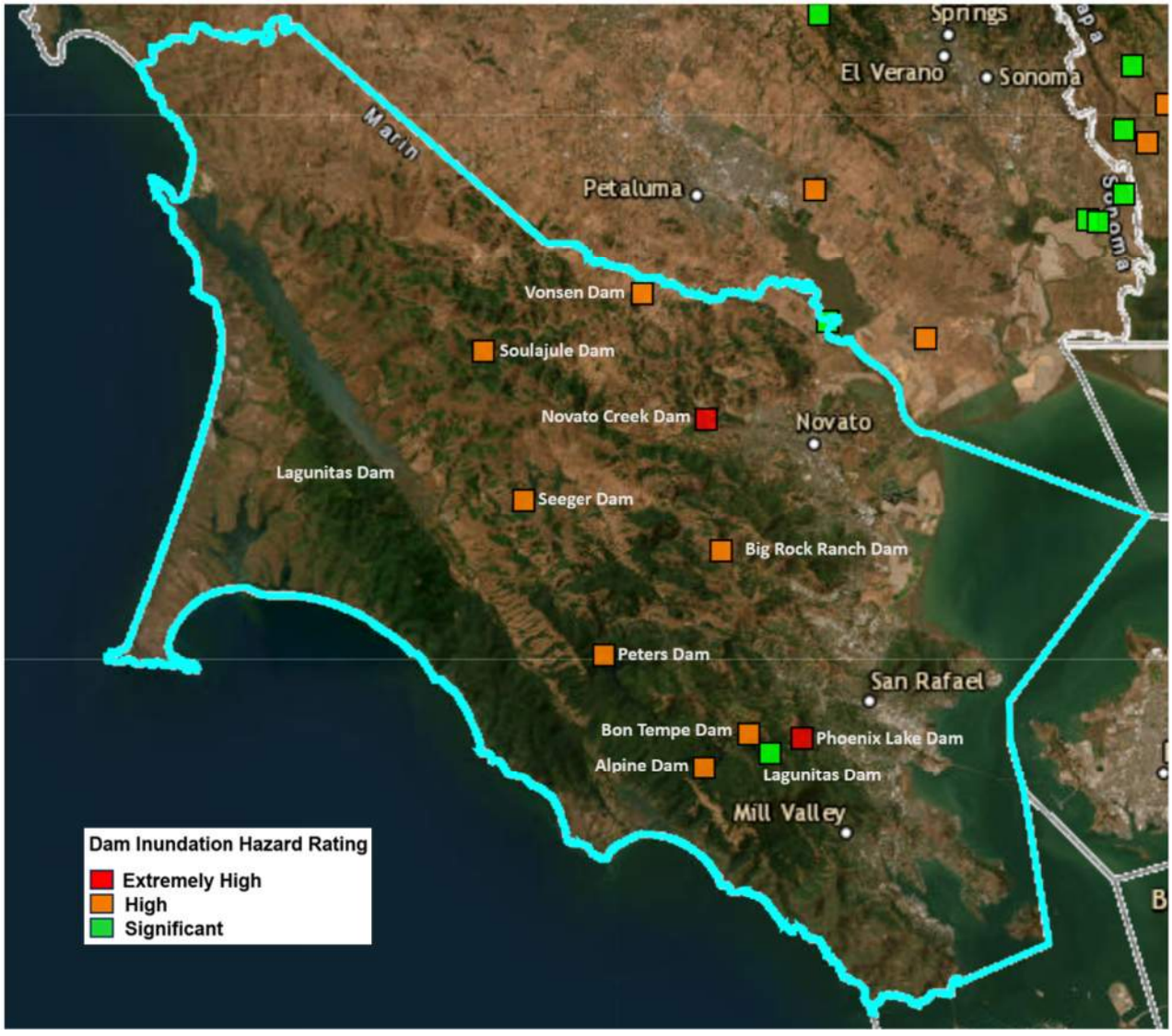


Figure 21: Dams in and around the Marin County OA
Source: Cal OES, Department of Water Resources, DSOD

Figure 22 illustrates the Dam Failure risk to Marin County.

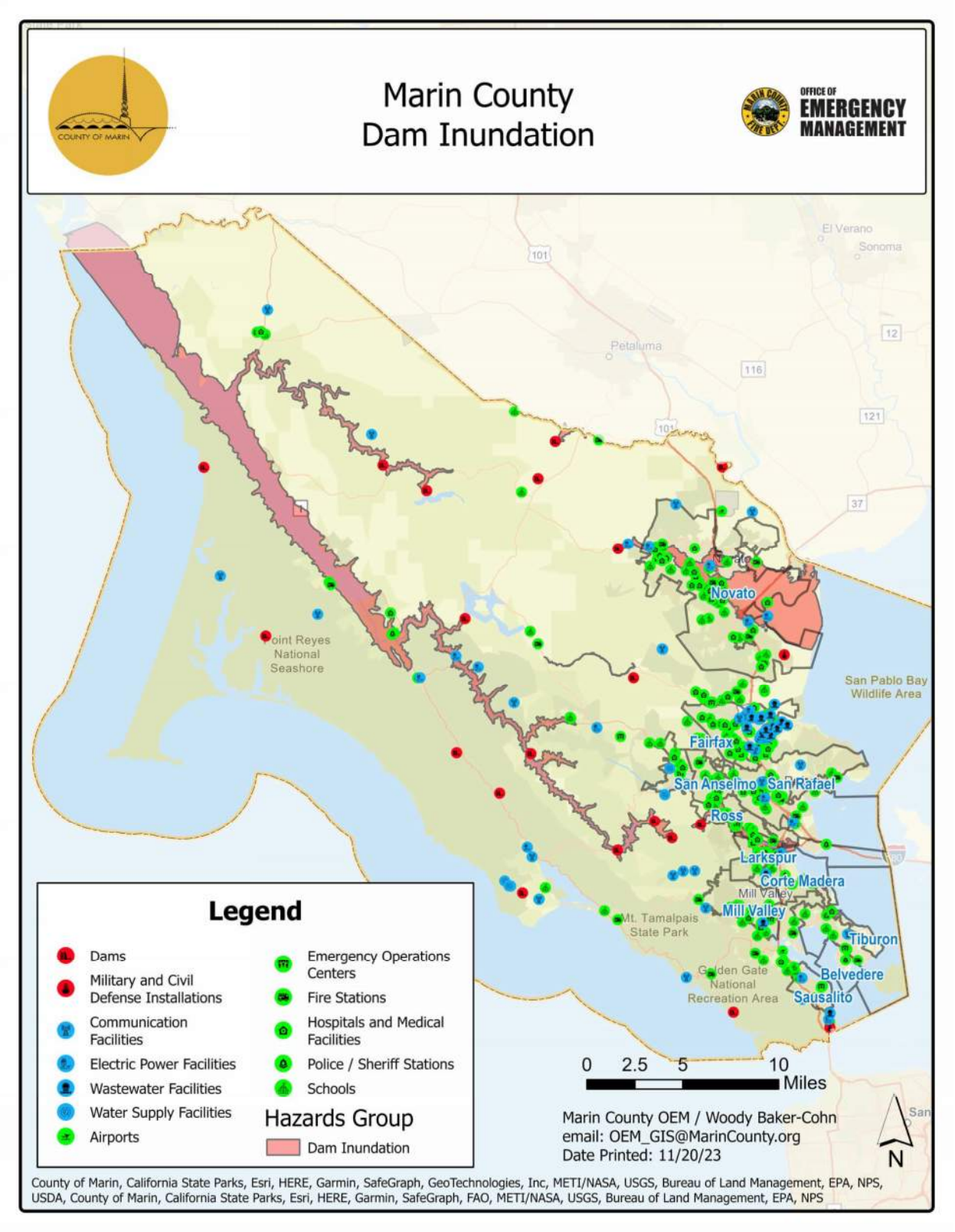


Figure 22: Marin County Dam Inundation Susceptibility to Critical Facilities
Source: Marin County OEM

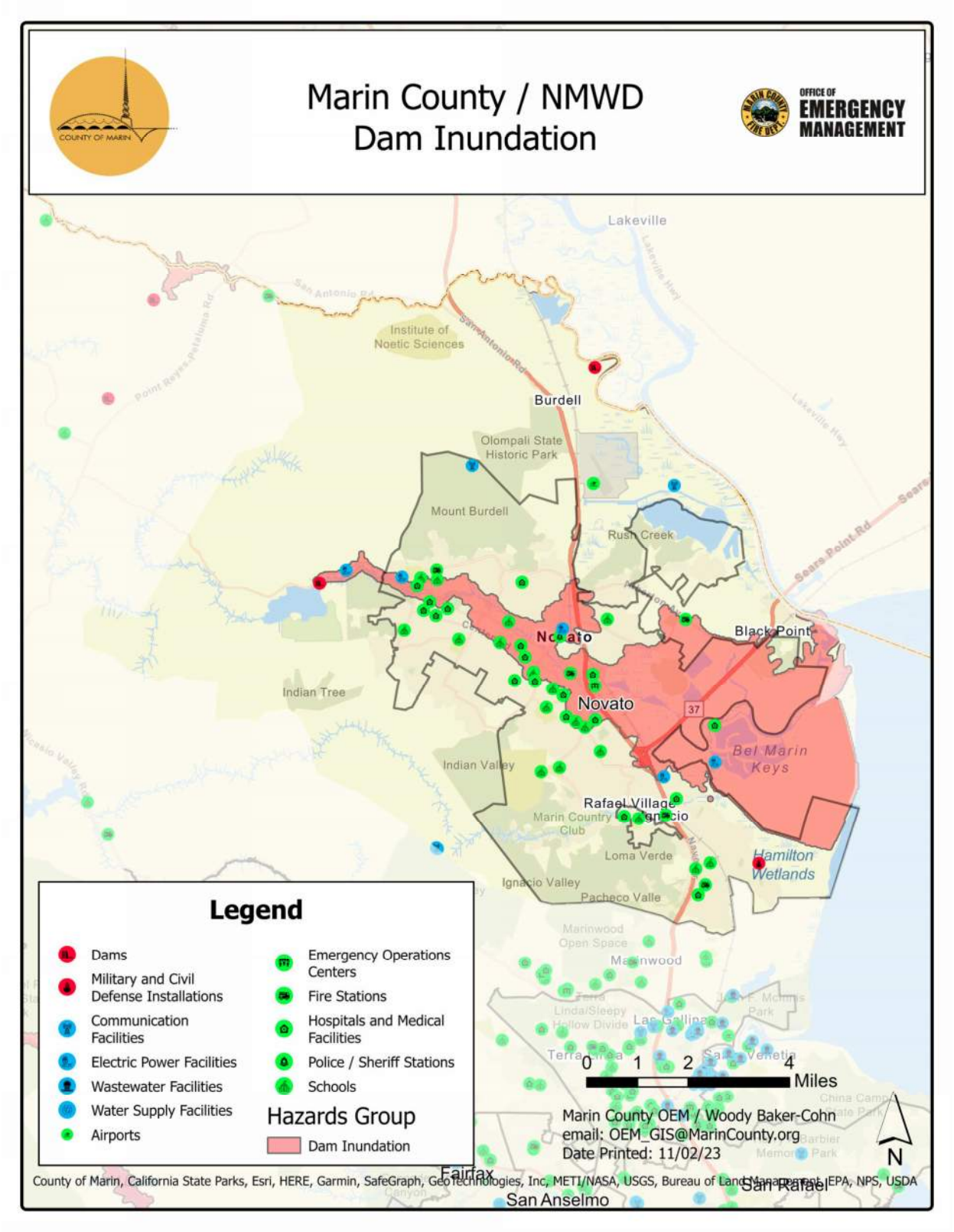


Figure 23: City of Novato Dam Inundation Critical Facilities and Infrastructure
Source: Marin County OEM

Novato Creek/ Stafford Dam

NMWD owns and operates Stafford Lake, Stafford Dam (DSOD Dam No. 88-0, National ID No. CA00321) and the associated treatment plant, which provides approximately 20% of Novato's water. The lake lies four miles west of downtown Novato and collects runoff from 8.3 square miles of watershed property located upstream at the upper tributary reaches of Novato Creek. Water from Stafford Lake is drawn by the intake tower and fed by gravity or by pumping (depending on the lake level) into the treatment plant located just below the dam.

In addition to providing water supply for domestic needs and firefighting purposes, Stafford Dam provides flood protection for the greater Novato area. The Marin County Flood Control and Water Conservation District has partnered with NMWD to share in the cost of obtaining additional flood liability insurance. Stafford Dam (also known as the Novato Creek Dam) is approximately 71 feet tall with a crest length of 650 feet, is classified as an Extremely High Hazard Dam based on its size and potential for loss of life and property should the dam fail.

Failure of the Novato Creek/Stafford Lake 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.

Figure 24: City of Novato - Nonato Creek Dam Inundation Impact
Source: California Department of Water Resources, DSOD

Stafford Lake has capacity of 4,287-acre feet of water that would cascade down Novato Creek through the unincorporated County into the City of Novato and Bel Marin Keys in the unincorporated County before emptying into San Pablo Bay in the event of a sunny-day dam failure. Parts of Ohair Park in the unincorporated County adjacent to the dam and along Novato Creek could be immediately inundated with up to ten feet of water. Novato is approximately 5,000 feet from the dam (see Figure 25). In up to two hours, water would overtop Novato Creek and could extend up to 500 feet on both sides of the creek, potentially inundating dozens of homes, part of the PG&E substation at Stafford, and part of San Marin High School and San Ramon Elementary School in up to ten feet of water in some areas. In two to five hours, water would continue overtopping Novato Creek extending down Novato Boulevard up to 1,000 feet of both sides of the road to the intersection of Diablo Avenue. Hundreds of homes, numerous commercial businesses and medical facilities, the Lu Sutton Elementary School and Our Lady of Loretto Elementary School lie in this area and could be inundated in up to eight feet of water. In the same amount of time, water would continue overtopping Novato Creek to the City boundary. This area includes most of the downtown commercial core of Novato where hundreds of homes, dozens of businesses and shopping centers, numerous medical facilities, the City of Novato Police Department and Town Hall, the Novato Fire Protection District Headquarters and primary Emergency Operations Center for the City, the Novato Fire Protection District #61, Lynwood Elementary School, Hill Middle School, the Marin Christian Academy and the PG&E substation at Novato could be inundated in up to ten feet of water in some areas. Water would also spread northward along Redwood Boulevard into North Novato in two to five hours where flood depths could be deepest, inundating dozens of homes and parts of Old Town in over ten feet of water in some places. The entire inundation area covers numerous major roads and highways in the City including Highway 101, Novato Boulevard and Redwood Boulevard which could hamper ingress and egress throughout much of central Novato. 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.

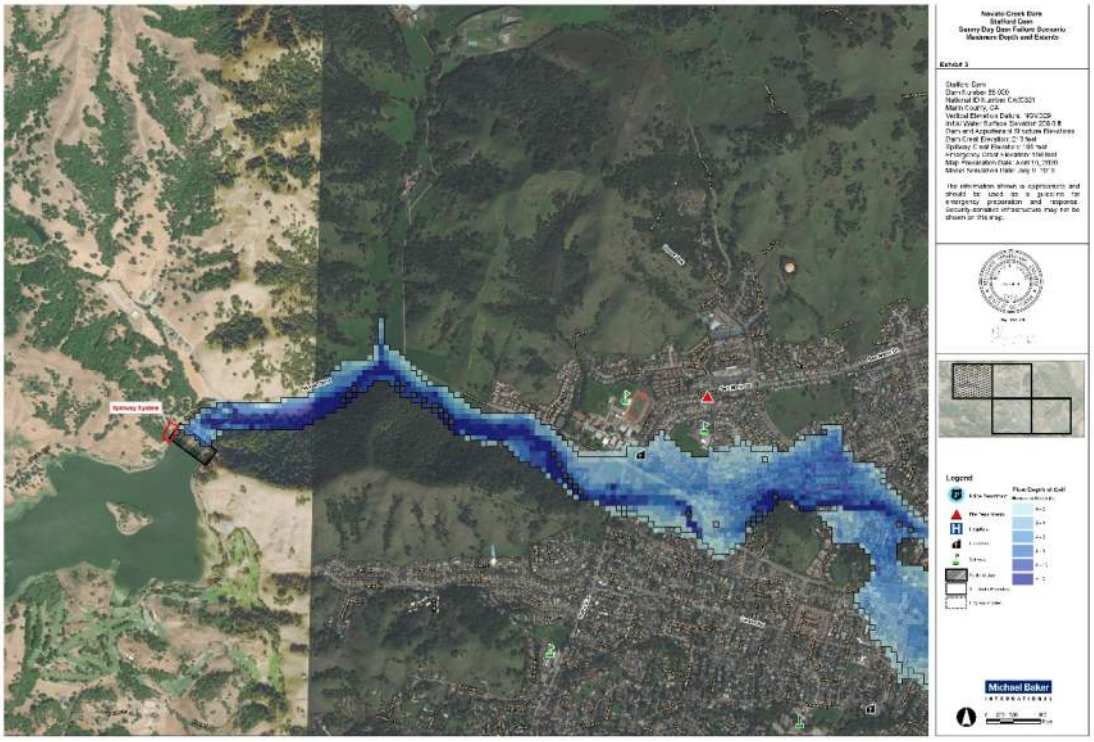


Figure 25: City of Novato - Novato Creek Dam Inundation Impact – West Novato
Source: California Department of Water Resources, DSOD

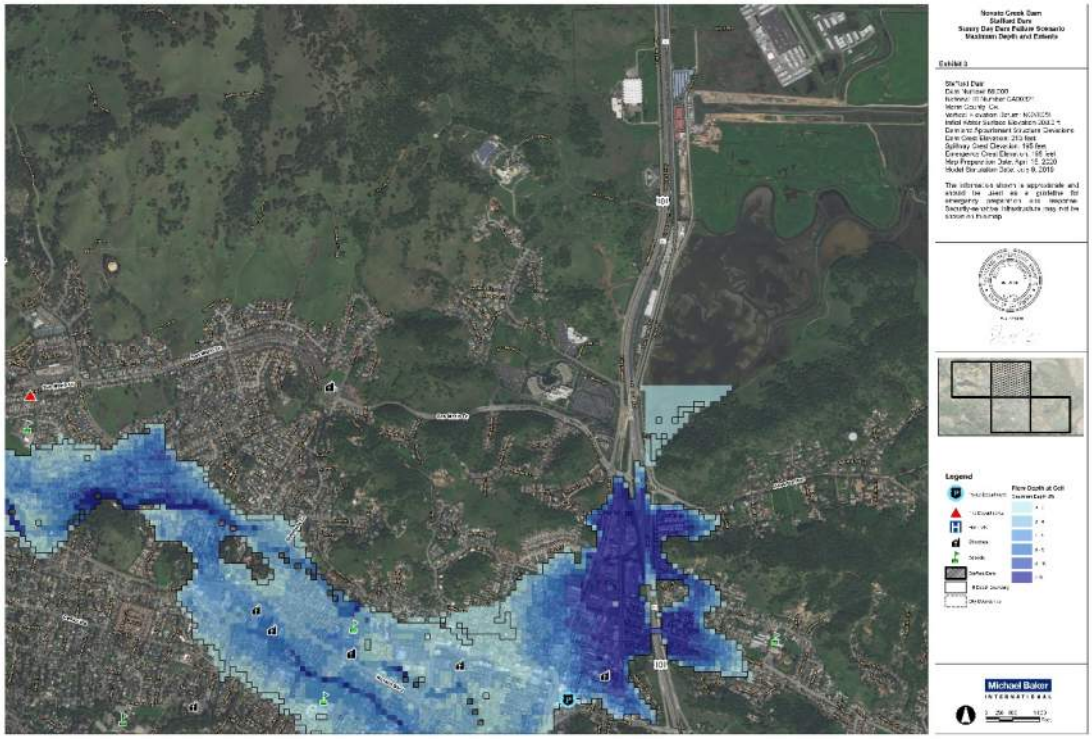


Figure 26: City of Novato - Novato Creek Dam Inundation Impact – North Novato
Source: California Department of Water Resources, DSOD

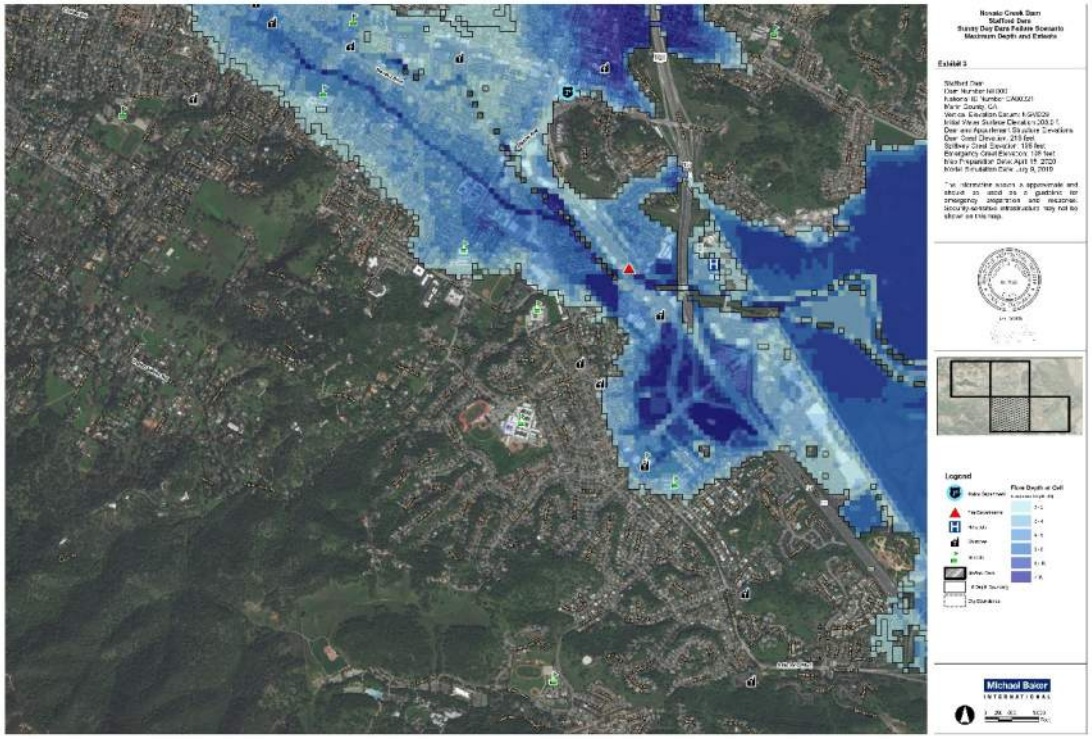


Figure 27: City of Novato - Novato Creek Dam Inundation Impact – Central Novato
Source: California Department of Water Resources, DSOD

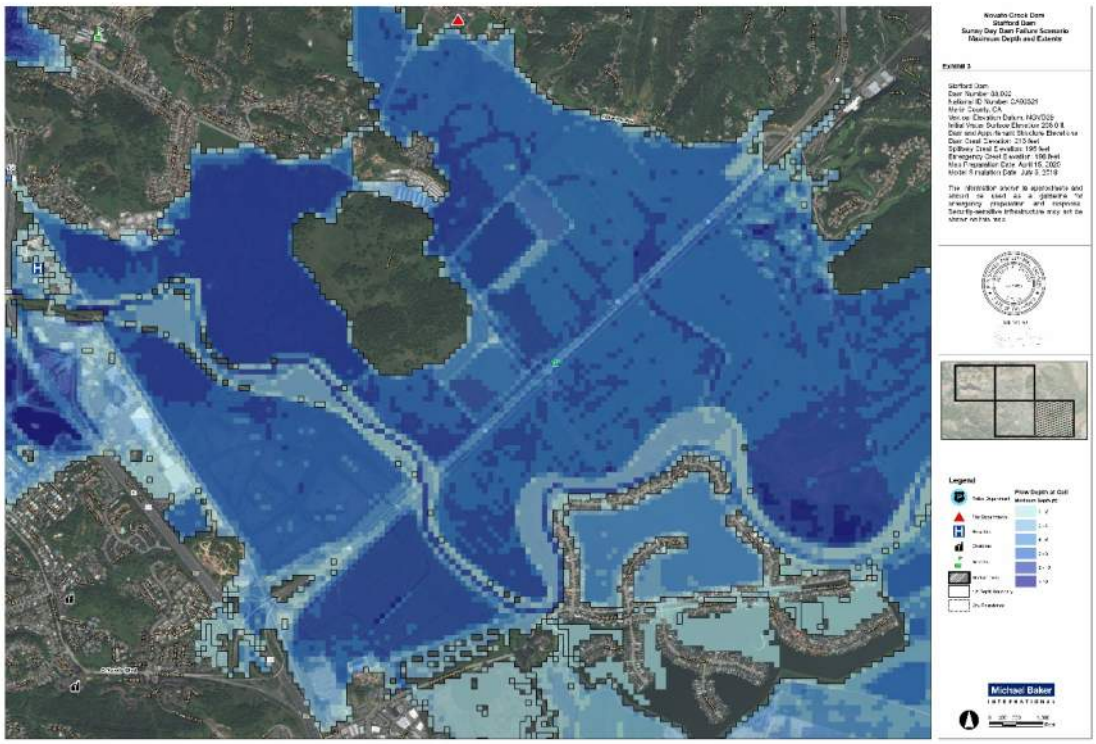


Figure 28: City of Novato - Novato Creek Dam Inundation Impact – East Novato
Source: California Department of Water Resources, DSOD

There is no record of a failure of any regulated dam located in the Marin County OA. On December 29, 2022, Phoenix Lake hit capacity after recent rains and the dam saw some spillover with no impacts.

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. This area includes part of the NMWD. Future development along Novato Creek and in the lowland areas of Novato and around the unincorporated communities of Bel Marin Keys and Black Point-Grenn Point could expose additional people and structures to risk of a dam failure.

2.2.2 Debris Flows

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.

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 29 shows landslide susceptibility classes.

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.

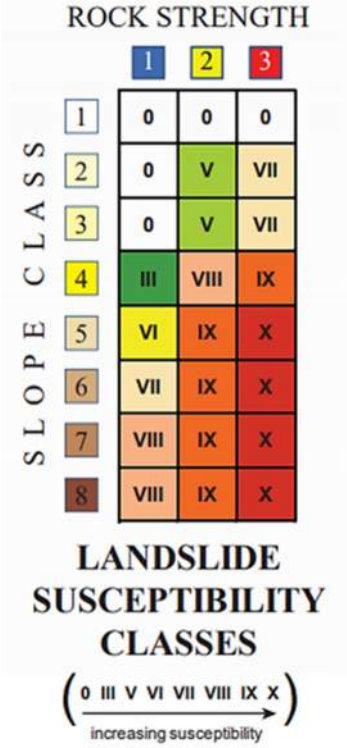


Figure 29: Landslide Susceptibility Classes
Source: USGS

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 30 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.

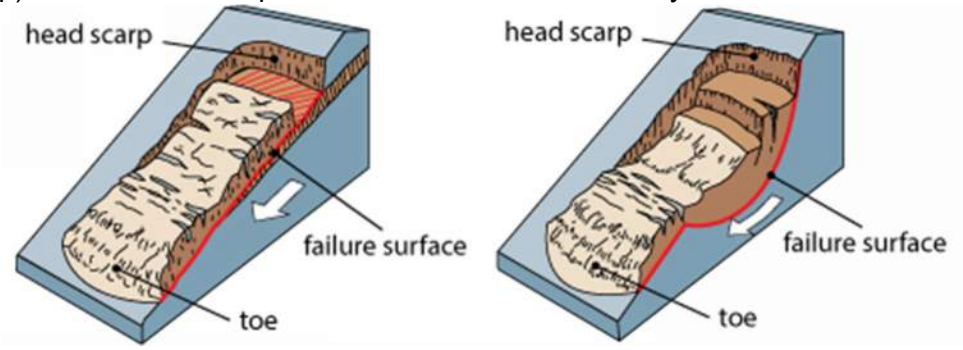


Figure 30: Mud Flow Areas
Source: Washington Department of Natural Resources

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.

A landslide in the NMWD service area would likely occur in steeper terrain areas due to higher susceptibility of hill-side slope material movement. These areas in the district include the northern and southern sides of the City of Novato and the unincorporated communities of Indian Valley, Loma Verde and Black Point-Green Point where the terrain is steeper and is more susceptible to movement of soil. These areas are primarily residential and consists of numerous winding streets and hillside homes that could be damaged or destroyed by a landslide. Residences in or on the fringes of open space areas including the Mount Burdell Open Space Preserve, Miwok Park, Cherry Hill, South Marin Park, the Indian Valley Preserve, the Rush Creek Open Space Preserve and Novato Heights have moderate to high susceptibility to a landslide. There are hundreds of residences in these areas. Of particular concern are

communities in southern Novato south of Novato Boulevard. A landslide impacting Ignacio Boulevard and/or Sunset Parkway could impact ingress and egress into communities in this area that are at high susceptibility of a landslide. Highway 101 also has high landslide susceptibility in this area near Pacheco Hill, and a landslide on the highway could cause significant transportation challenges that could impact the city. The College of Marin-Indian Valley Campus, the Loma Verde Elementary School, the Novato Station #65, the Good Shepherd Lutheran School, Novato High School and the Olive Elementary School all lie in areas of moderate to high landslide susceptibility. The main commercial areas of the city, including the downtown area, have little to no landslide susceptibility. The unincorporated community of Indian Valley has 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. The western side of the Black Point-Green 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 landslides.

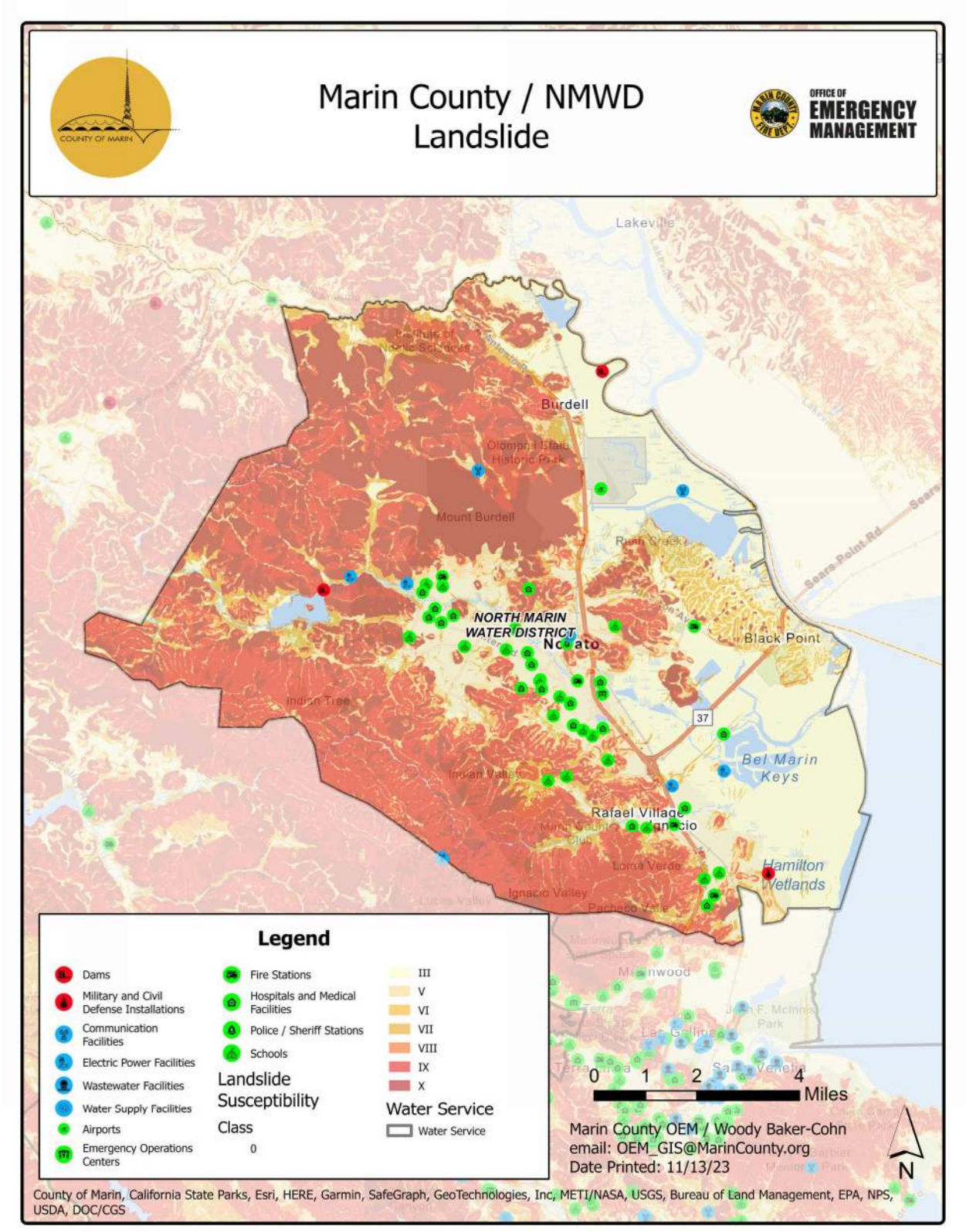


Figure 31: NMWD Debris Flow Critical Facilities and Infrastructure
Source: Marin County OEM

An earthquake has the potential to cause landslides throughout areas of landslide susceptibility. A wildfire and subsequent rain event could cause a landslide in any of the open spaces in and surrounding Novato, including in the Mount Burdell Open Space Preserve, Ohair Park, the Verissimo Hills Preserve, the Indian Tree Open Space Preserve, the Indian Valley Preserve, the Ignacio Valley Preserve, the Loma Verde Preserve and the Rush Creek Open Space Preserve. A debris flow down Novato Creek could impact the city with mud and water that damage bridges and other infrastructure.

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.

NMWD maintains and operates approximately 340 miles of pipeline, 42 tanks totaling over 37 million gallons of storage, and associated pump stations, hydropneumatic systems, and regulator valves. NMWD evaluates water supply and consumer consumption on a 5-year cycle via its Urban Water Management Plan (UWMP) and associated Water Shortage Contingency Plan (WSCP) in accordance with state Department of Water Resources (DWR) guidelines and requirements.

On 03/21/23, heavy rains caused a mudslide in Novato severely damaged and buckled a 100-foot section of Redwood Blvd. adjacent State Highway 101, forcing the closure of a nearby state park. The mudslide damaged a section of the NMWD potable water transmission main that is located below the frontage road of Redwood Boulevard, in the area of the mudslide.

Figure 32: Mudflow damage to Redwood Blvd. March 21, 2023
Source: Olompali State Historic Park

12/31/2005 - A mudslide came down on Pacheco Creek Drive, depositing over 2,000 cubic yards of mud and damaging several homes. Novato declared a state of emergency. Nobody was hurt, but mud poured into each home, forcing the residents to evacuate.

2/27/2017 – Heavy rain caused a landslide at Miwok Park along the southeast side of Novato Creek, destroying about 100 feet of a trail that connects the neighborhoods east and west of Miwok Park.

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)[1], 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. Further development of the residential areas of the NMWD including the City of Novato and the unincorporated communities of Indian Valley, Loma Verde and Black Point-Green Point that have a higher landslide susceptibility will expose more people and property to landslide risk. With increased wildfire potential as a result of climate change, more residents in NMWD could be susceptible to post-fire debris flows. This includes areas along Novato Creek, Arroyo San Jose and south of the Mount Burdell Open Space Preserve. 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.

[1] Landslide Sensitivity and Response to Precipitation Changes in Wet and Dry Climates. https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2022GL099499

2.2.3 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 its 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.

Drought can occur in the NMWD and have a profound effect on the delivery of potable water to the 62,655 population served by the district. Drought can reduce the available water in the Novato Creek/Stafford Lake Dam and other areas of the district reducing the available supply potable water to customers , which will also reduce revenue for the district which is used to operate the water delivery systems to these customers.

West Marin Water consumption was down 25% from the prior fiscal year. The $136,000 net loss compares to a budgeted net income of $165,000 and to a net loss of $8,000 from the prior fiscal year. NMWD evaluates water supply and consumer consumption on a 5-year cycle via its Urban Water Management Plan (UWMP) and associated Water Shortage Contingency Plan (WSCP) in accordance with state Department of Water Resources (DWR) guidelines and requirements.

Drought conditions throughout the District would also be felt in the mountainous areas where the risk of wildfire would increase, including in the City of Novato and in the unincorporated County communities of Indian Valley, Loma Verde and Black Point-Green Point. The wetland areas of Novato and the unincorporated Black Point-Green Point area, particularly the marshlands along San Francisco Bay, could become drier during prolonged period of drought and experience marshland fires that could impact local businesses and residences in the area. Dry trees in public spaces like Novato's City Park can become a safety hazard to the public due to falling limbs or the toppling of the tree itself.

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 including NMWD 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 and the NMWD, 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 including in the open spaces in and around NMWD. 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 including the NMWD service area in the unincorporated County and City of Novato where wildfires are more likely to occur. Drought also has the potential to dry out the marshlands along the shoreline of the NMWD, including in the unincorporated County and the City of Novato, increasing the chances of brush fires there. Future development in this area and in the mountainous areas of NMWD could expose people to drier summer conditions that could increase their vulnerability to wildfire. 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 including NMWD 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.

2.2.4 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 33).

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 33: Modified Mercalli Intensity Scale
Source: USGS

Figure 34 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 34: Mercalli Scale vs. Magnitude
Source: USGS

The extent of ground shaking also depends in large part on how soft the underlying soil is. Soft soils amplify ground shaking (see Figure 35). 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 35: Soil Types
Source: USGS

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.

An earthquake could occur anywhere in and around the NMWD, including the unincorporated County and the City of Novato, due to the number of active faults within and near Marin County. The NMWD is located directly between the San Andreas and Hayward faults. A moderate to extreme earthquake originating from either of these major faults or any of the other faults in the region could have major impacts on the infrastructure of the district.

NMWD maintains and operates approximately 340 miles of pipeline, 42 tanks totaling over 37 million gallons of storage, and associated pump stations, hydropneumatic systems, and regulator valves.

There is increased risk of shaking and liquefaction in the district from an earthquake, particularly in the central and eastern lowland areas where superficial deposits and fill are more prevalent.

Earthquake Shake Intensity

The colors on Figures 36 and 37 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.

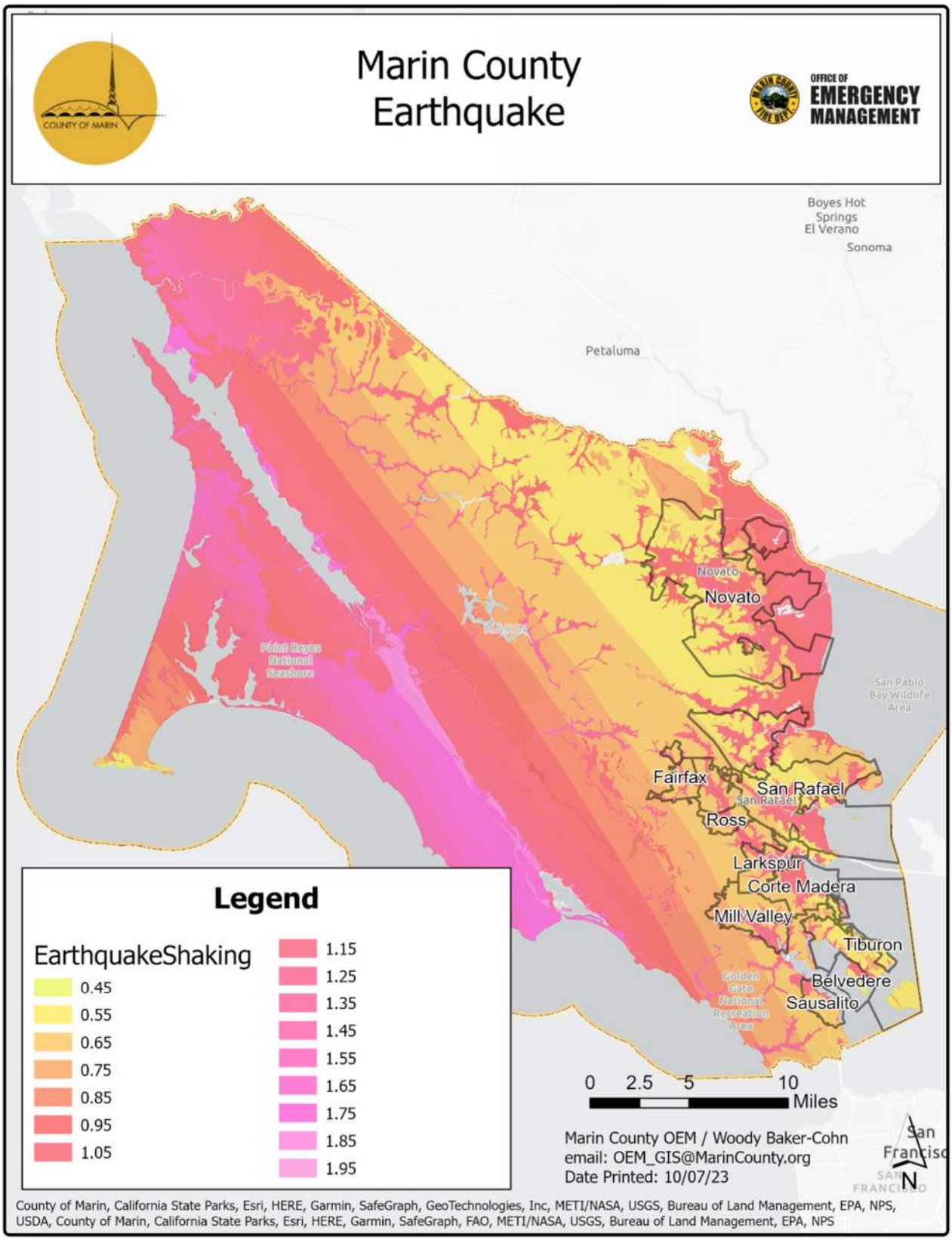


Figure 36: Marin County Earthquake Impact
Source: Marin County OEM

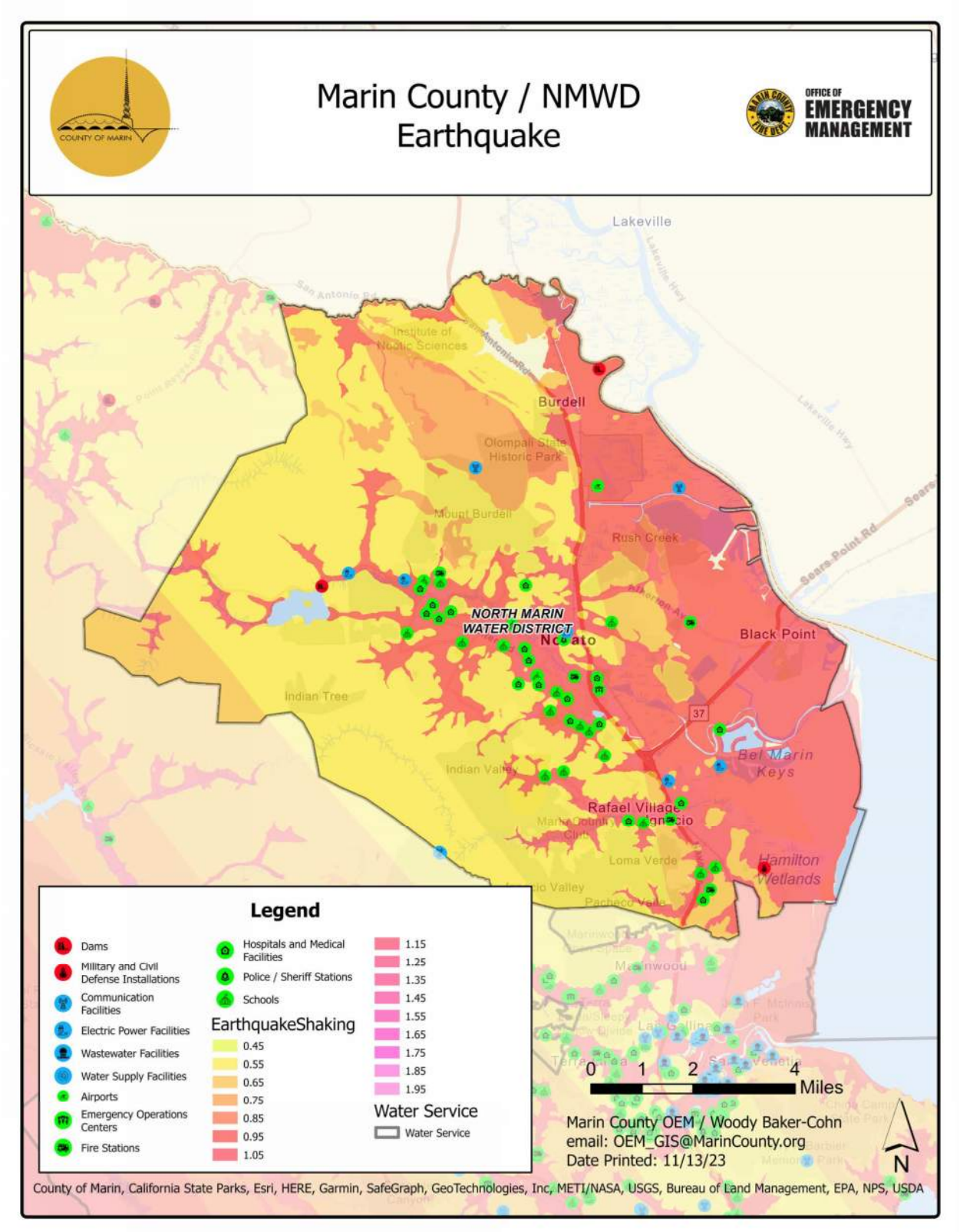


Figure 37: NMWD Earthquake Critical Facilities and Infrastructure
Source: Marin County OEM

A moderate to extreme earthquake originating from either of these major faults or any of the other faults in the region could have major impacts to the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point. There is increased risk of shaking and liquefaction in these areas from an earthquake, including in the central and eastern lowland areas of Novato and in the unincorporated communities of Bel Marin Keys and Black Point-Green Point where superficial deposits and fill are more prevalent. This area of Novato includes the primary commercial area of the city along the Highway 101 corridor, and numerous residential neighborhoods and commercial areas with schools and other critical facilities. All of the City's critical facilities with the exception of the Novato Fire Station #63 lie in an area of moderate earthquake shaking potential. The PG&E Substation at Hamilton Wetlands and the Novato Fire Station #62 in the unincorporated County also lie in an area of moderate earthquake shaking potential. Vulnerable structures include bridges and older buildings that have not undergone major seismic retrofitting. Utility infrastructure throughout the city and the unincorporated county in the NMWD could be impacted by an earthquake. Earthquakes could also cause landslides in the western areas of Novato with steeper terrain, causing damage to homes and roads as a result of shifting soils.

Marin County, including the Novato area, was sparsely populated at the time of the 1906 San Francisco Earthquake, and the effects across the County were relatively minimal. Likewise, the 1989 Loma Prieta Earthquake caused minimal impacts across Marin County as the epicenter of the quake was further south in Santa Cruz County. Smaller earthquakes with minimal to no impacts are routinely felt in Novato.

Climate Change and Future Development Considerations

There is no direct link between climate change and seismic activity that could impact the Marin County OA including NMWD, 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)[2], 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 including NMWD. 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. This includes the areas of the NMWD service area in the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point where the risk of subsidence and subsequent earthquake shaking are higher. Future development in these areas could expose more people and infrastructure to earthquake shaking as a result of climate change.

[2] An Enhanced Seismic Activity Observed Due to Climate Change: Preliminary Results from Alaska. https://iopscience.iop.org/article/10.1088/1755-1315/167/1/012018

2.2.5 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% 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 because 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 of rainfall and distribution of overland flow, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization and geomorphology. In the Marin County OA, riverine flooding can occur anytime from November through April and is largely caused by intense and continued rains, sometimes combined with snowmelt, increased discharges from upstream dams, and intense flow from tributary streams. These intense storms can overwhelm the local waterways as well as the integrity of flood control structures such as culverts and bridges. Flooding is more severe when antecedent rainfall has resulted in saturated soil 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 intense 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, causing 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 may be damaging to municipal infrastructure and private property.

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 soil saturation, extensive flooding and other impacts such as landslides. 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 38.

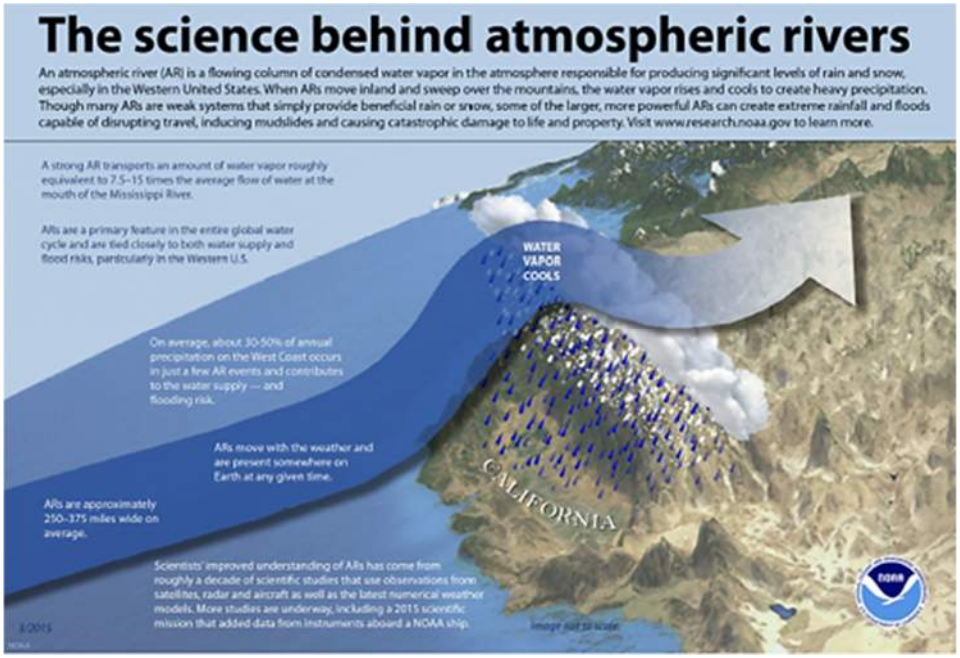


Figure 38: Diagram of an Atmospheric River Event
Source: NOAA

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.

Flooding in the NMWD, including in the unincorporated County and the City of Novato, generally results from a combination of high tides from San Pablo Bay and creek flooding from Novato Creek in low-lying areas. Most of the lowland areas in the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point are in the 100-year floodplain, with several areas in the 500-year floodplain.

The 100-year floodplain extends mostly along Novato Creek from Stafford Lake to San Pablo Bay, including a large area along Novato Boulevard for approximately two miles where hundreds of homes, numerous commercial buildings and shopping plazas, several medical facilities, Our Lady of Loretto School and Lynwood Elementary School could be susceptible to flooding. The 100-year floodplain also extends along some of the smaller tributaries in the City include parts of Warner Creek, Vineyard Creek, Wilson Creek, Arroyo Avichi Creek and Rush Creek. There are dozens of residences along these creeks that could be susceptible to flooding. The 100-year floodplain along Vineyard Creek extends through the middle of Sinaloa Middle School and the 100-year floodplain along Arroyo Avichi Creek runs along the edge of the Rancho Elementary School. Other areas with high flood danger include Ignacio and Arroyo San Jose, as well as the Bahia area. The area around Scottsdale Pond that includes a section of Highway 101 and the area north of Bel Marin Keys that includes several miles of State Route (SR) 37 lie in the 100-year floodplain and could be susceptible to flooding, which could cause transportation challenges for the city. The 500-year floodplain also follows Novato Creek for its length through most of the city and is interspersed with the 100-year floodplain. A large section of the 500-year floodplain lies north of downtown and extends along a mile of Redwood Boulevard, including the SMART railroad tracks which could be susceptible to flooding. The 500-year floodplain in Novato includes hundreds of homes, numerous commercial buildings and shopping plazas, Novato Fire Station #1, the PG&E substation at Novato and the Old Town area of downtown that could be susceptible to flooding. Most of downtown Novato, including the Novato Police Department and Novato City Hall, lie outside of the 100 and 500-year floodplains.

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.

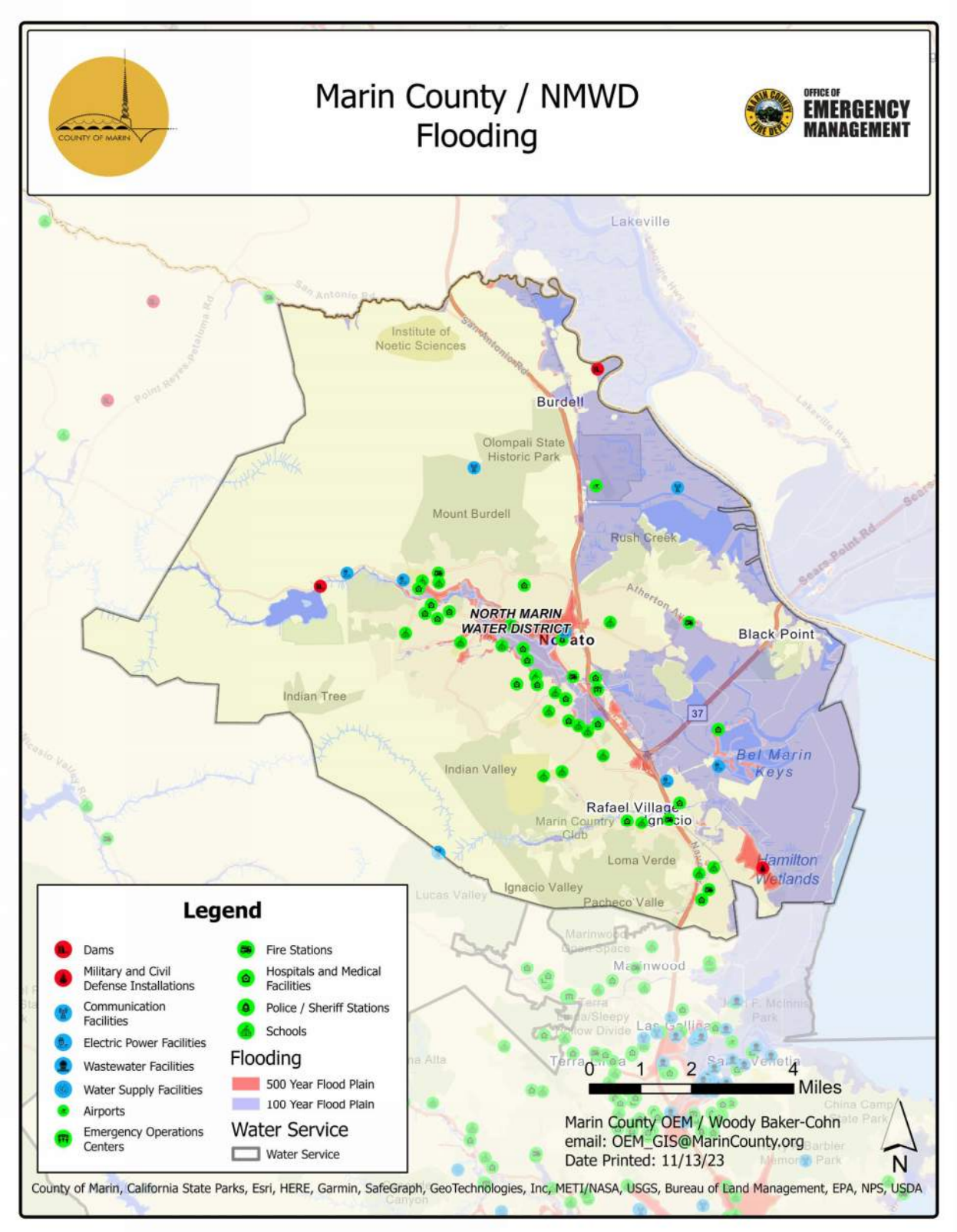


Figure 39: NMWD Flooding Critical Facilities and Infrastructure
Source: Marin County OEM

Table 15 shows the number of North Marin Water District critical facilities by flood zone.

Table 15: NMWD Critical Facilities by Flood Zone			
Category	Name	Address	Flood Zone
Critical Facilities			
District Building	NMWD Headquarters: Administration, Laboratory, and Corporation Yard	999 Rush Creek Place Novato, CA 94945	500-year flood plain (Zone X)
District Building	Stafford Water Treatment Plant	3500 Novato Blvd. Novato, CA 94945	n/a
District Building	Point Reyes Water Treatment Plant	101 Commodore Webster Dr. Point Reyes Station, CA 94956	100-year flood plain (Zone AE)
High Potential Loss Facilities			
DAM	Novato Creek Dam	3500 Novato Blvd. Novato, CA 94945	n/a
Critical Infrastructure			
Water	North Marin Aqueduct, 30"-42" water transmission pipeline	Linear utility –generally paralleling US 101	n/a
Water	San Marin Pump Station	APN 125-411-25	n/a
Water	Lynwood Pump Station	Intersection of S. Novato Blvd & Sunset Parkway, Novato, CA 94945	n/a
Water	Cherry Hill Pump Station	APN 143-421-33	n/a
Water	School Road Pump Station	Intersection of School Road & Sunset Trail, Novato, CA 94945	n/a
Water	Black Point @ Hwy 37 Regulating Station	Intersection of Harbor Drive & Hwy 37 Eastbound On-Ramp, Novato, CA 94945	AE
Water	Black Point @ Grandview Avenue Regulating Station	Intersection of Harbor Drive & Grandview Avenue, Novato, CA 94945	AE
Water	Coast Guard Wells (No. 2 & 4)	101 Commodore Webster Dr. Point Reyes Station, CA 94956	AE
Water	Gallagher Well No. 1	APN 119-050-12	AE
Water	Gallagher Well No. 2	APN 119-050-17	AE
Water	Olema Pump Station	APN 166-220-10	AE
Water	Bear Valley Pump Station	APN 166-350-10	n/a
Water	Inverness Park Pump Station	APN 114-294-33	n/a
Water	Paradise Ranch Estates Pump Station No. 1	APN 114-111-19	n/a
Water	Paradise Ranch Estates Pump Station No. 2	APN 114-100-89	n/a
Water	Paradise Ranch Estates Pump Station No. 3	APN 114-100-91	n/a
Water	Paradise Ranch Estates Tank No. 1	APN 114-111-19	n/a
Water	Paradise Ranch Estates Tank No. 2	APN 114-100-89	n/a
Wastewater	Tahiti Way Lift Station	APN 100-261-47	n/a
Wastewater	Oceana Marin Wastewater Storage and Treatment Ponds	APN 100-100-56	n/a

Table 15: North Marin Water District Critical Facilities in the Flood Zones
Source: Marin County/FEMA DFIRM

Floodwaters can be deep enough to drown people and move fast enough to sweep people and vehicles away, lift buildings off foundations, and carry debris that smashes into buildings and other property. Flood waters can cause significant erosion which can lead to slope instability, severely damaging transportation and utility infrastructure by undermining foundations or washing away pavement. If water levels rise high enough to get inside buildings, flooding can cause extensive damage to personal property and the structure itself. Flood events that develop very quickly are especially dangerous because there may be little advance warning. Flooding may occur when strong winds or tides result in a surge of seawater into areas that are above the normal high tide line. Tide elevations within San Pablo Bay have the potential to significantly impact the Novato storm drain system. Novato already sees flooding from king tides in San Pablo Bay and this is only expected to increase with sea level rise and climate change. A failure of the Stafford Lake/Novato Creek dam could contribute to flooding in the lowland areas the NMWD service area in the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point.

On 1/14/2023, a storm flooded SR-37 in Novato, including the U.S. 101 connector ramps. SR-37 had to close in both directions near Atherton Avenue for the weekend. The storm also flooded Armstrong Avenue.

On 2/14/2019, Novato police closed several streets and issued at least one shelter-in-place order in the City at Paper Mill Court due to flooding across the City in the midst of a severe winter storm. South Novato Boulevard between Nave and Lark courts, Simmons Lane from San Marin Drive to Lesse Lane and all of Commercial Boulevard were closed.

On 1/19/2019, a storm flooded the westbound lanes of SR-37 in Novato, causing a three-day partial closure of the road.

On 1/22/2017, a storm flooded three miles of SR-37 between Highway 101 and Atherton Avenue with five feet of water, closing it for three days.

On 12/11/2014, a storm flooded several neighborhoods in Novato, including on Garden Court and Chase Street. SR-37 flooded and the westbound lanes had to close.

On 12/31/2005-1/1/2005, a strong storm caused a mobile home park to flood with up to 4 feet of water, forcing the evacuation of about 100 stranded residents.

On 1/3-1/4/1982, torrential rains caused massive power outages, landslides, numerous injuries and over $14 million in damages throughout Novato. More than 9 inches of rain fell in 36 hours causing water to rush over Stafford Dam, ultimately flooding neighborhoods and roadways including Grant Avenue, Center Road and Novato Boulevard. Flooding shut down the railroad for nearly a month. Novato was declared a disaster area and was soon followed by the largest cleanup effort in the city's history.

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[3] found that the number of very intense precipitation

[3] Precipitation in a Warming World: Assessing Projected Hydro-Climate Changes in California and other Mediterranean Regaions. https://www.nature.com/articles/s41598-017-11285-y

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 including the NMWD. 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 including the NMWD 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 including the shoreline areas of the NMWD. Future development in these areas will expose more people and infrastructure to the effects of flooding. Development in the marshland area of the NMWD would expose additional people and infrastructure to flooding as marshlands act as a natural buffer to storm surge. Development in the marshland area of the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point would expose additional people and infrastructure in the NMWD service area to flooding as marshlands act as a natural buffer to storm surge. Development along Novato Creek, Arroyo San Jose, and other creeks in Novato in the 100 and 500-year floodplain would expose more people, structures and infrastructure including major roads in the NMWD service area to creek flooding and storm surge from Novato Creek as a result of climate change.

2.2.6 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 40 for a picture and description of how dissolution sinkholes form.

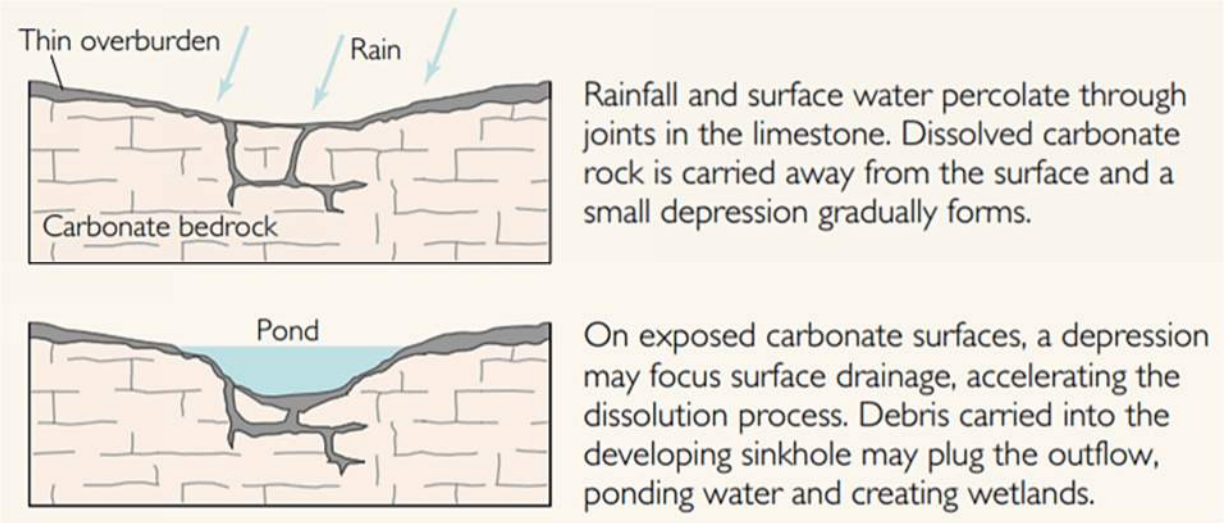


Figure 40: Dissolution Sinkhole Formation
Source: USGS

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 41 for a picture and description of how cover-subsidence sinkholes form.

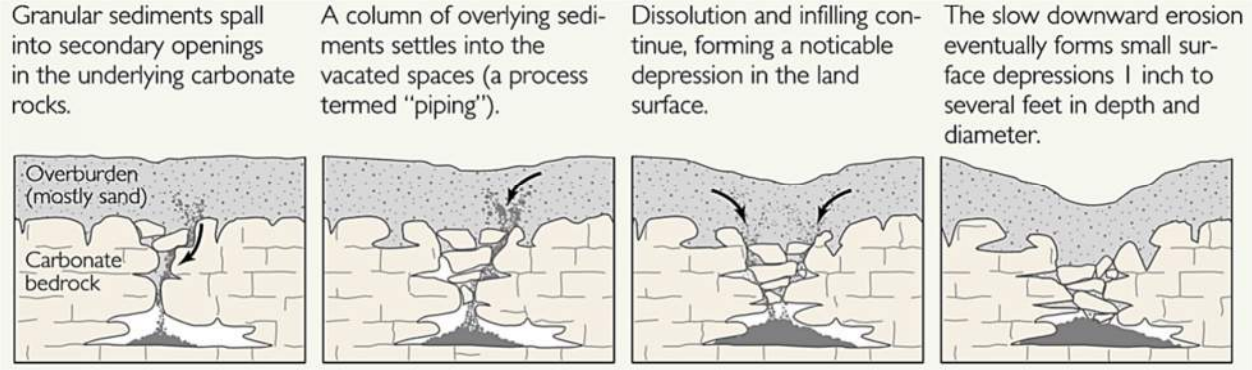


Figure 41: Cover-Subsidence Sinkhole Formation
Source: USGS

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 42 for a picture and description of how cover-collapse sinkholes form.

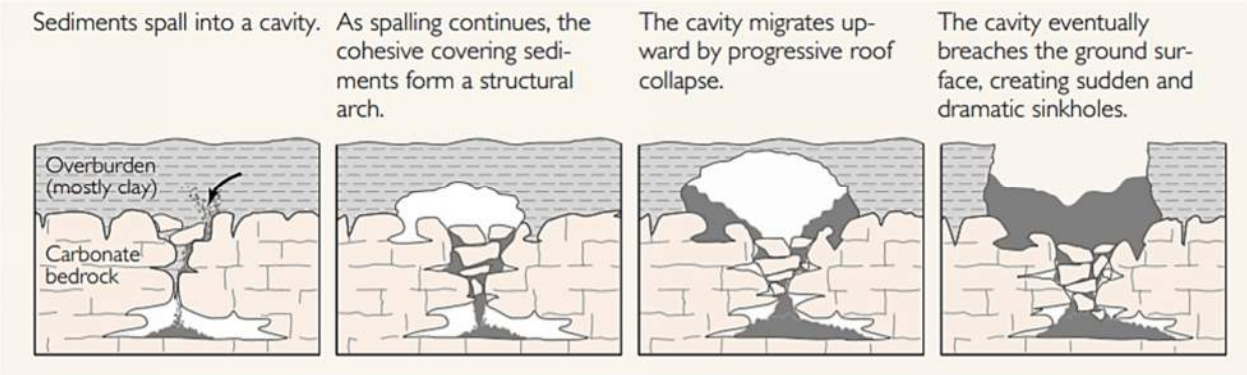


Figure 42: Cover-Collapse Sinkhole Formation
Source: USGS

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.

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 OA shoreline properties are the most exposed and vulnerable to subsidence. Land subsidence and sinkholes would most likely occur in the central and eastern lowland areas of the NMWD including the City of Novato and the unincorporated communities Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point where superficial deposits and fill are more prevalent. This includes the primary commercial area of the City of Novato along the Highway 101 corridor, and numerous residential neighborhoods with schools and other critical facilities. These areas could anticipate increased rates of subsidence as bay waters saturate the soil from below. Bel Marin Keys was built on bay fill and mud, and already experiences subsidence. Land subsidence could have numerous impacts for the district, including the settling of district facilities and infrastructure as well as the shifting of roadways and utility infrastructure that run through the district including in the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point. Transportation facilities along the OA's coastline are also vulnerable to subsidence. Increased subsidence could warp the buildings and runways at Marin County Airport in North Novato.

There have been no major sinkholes recorded in the district including the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-

Green Point, though sinkholes have occurred in neighboring jurisdictions including San Anselmo and San Rafael.

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 including the NMWD, land subsidence leads to higher sea levels and increased flood risk. The rate of land subsidence could increase across the Marin County OA including the lowland areas of the NMWD as a result of climate change. The impacts of land subsidence on infrastructure, including roads and underground utilities, in the NMWD could increase with future development in the lowland populated areas of the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point where land subsidence is more likely to occur.

2.2.7 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 43 shows a levee and the multiple ways it can fail.

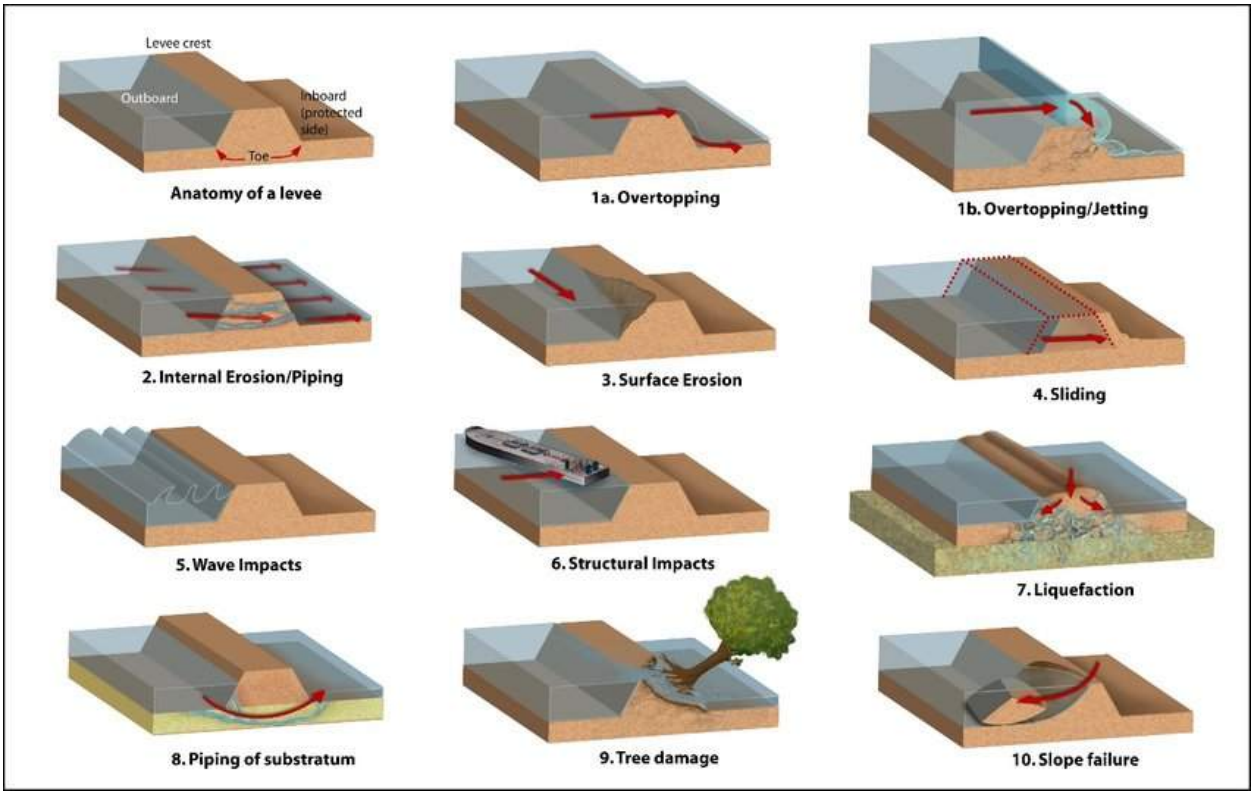


Figure 43: Levee Failure Mechanisms
Source: University of California

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.

The NMWD service area, including the City of Novato and the unincorporated County are protected by several levee systems, as shown in Figure 44.

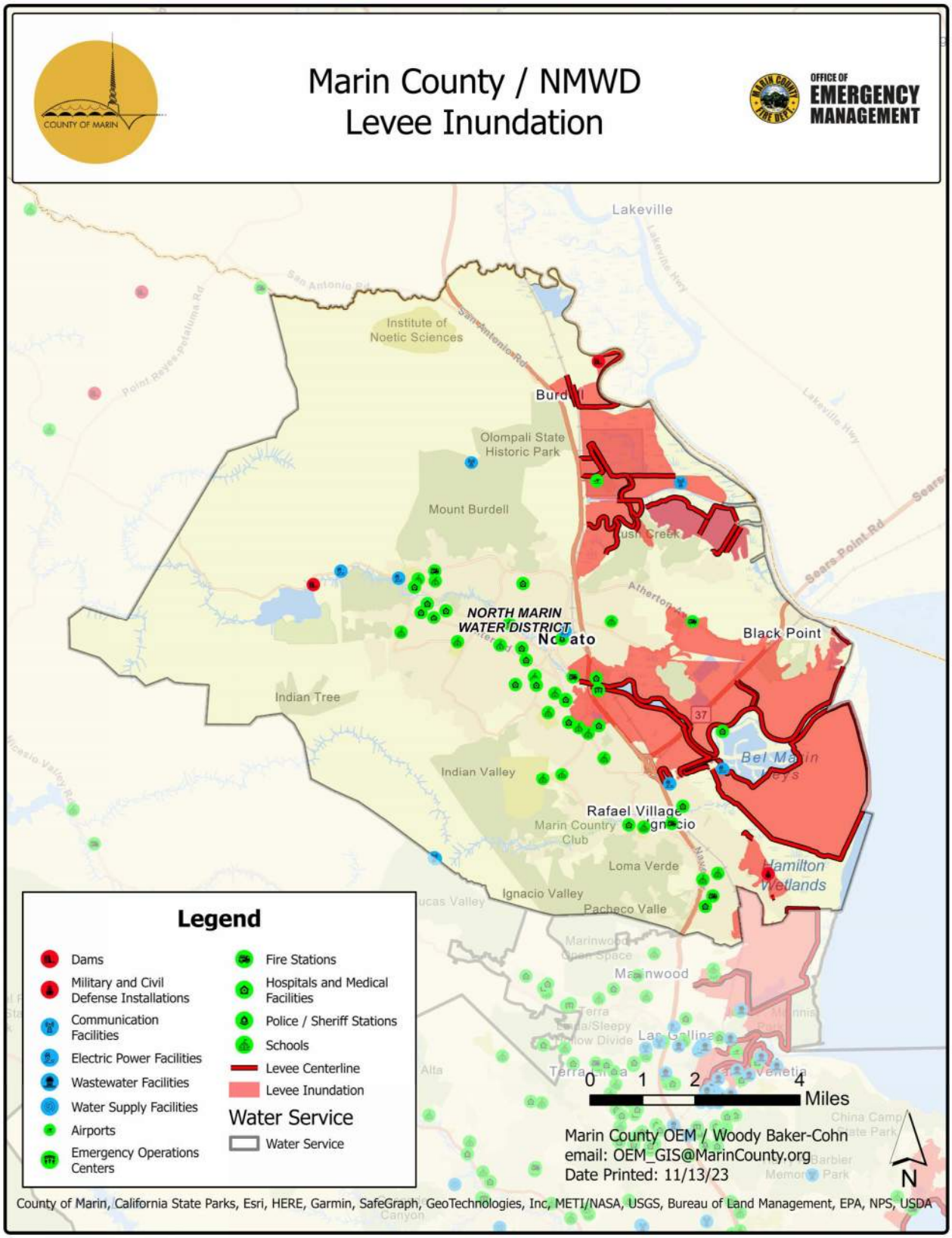


Figure 44: NMWD Levee Inundation Map
Source: Marin County OEM

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. Figures 45 and 46 show the levee systems and levee failure inundation areas around the Marin County Airport and North Marin.

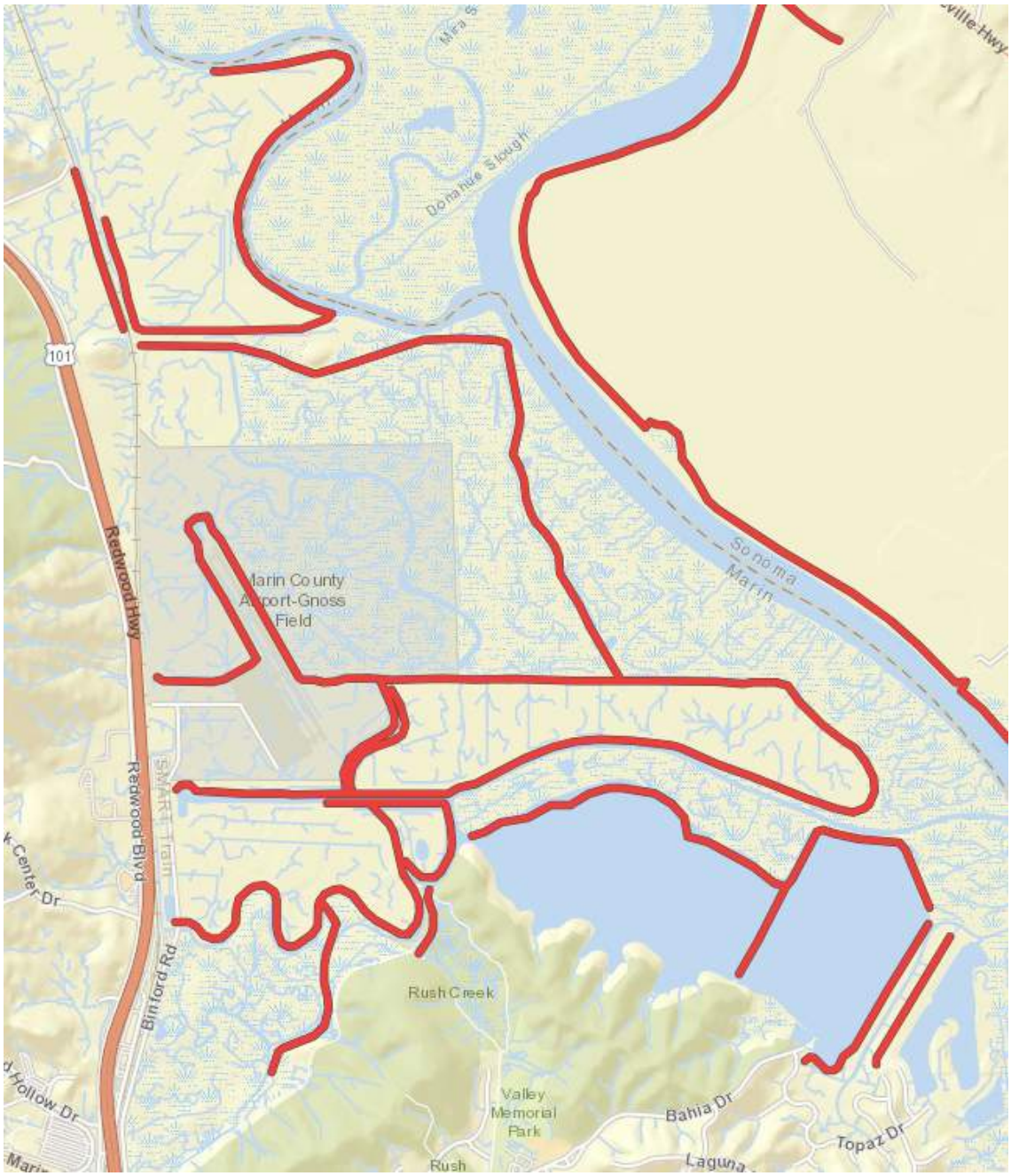


Figure 45: Levees Around the Marin County Airport
Source: U.S. Army Corps of Engineers

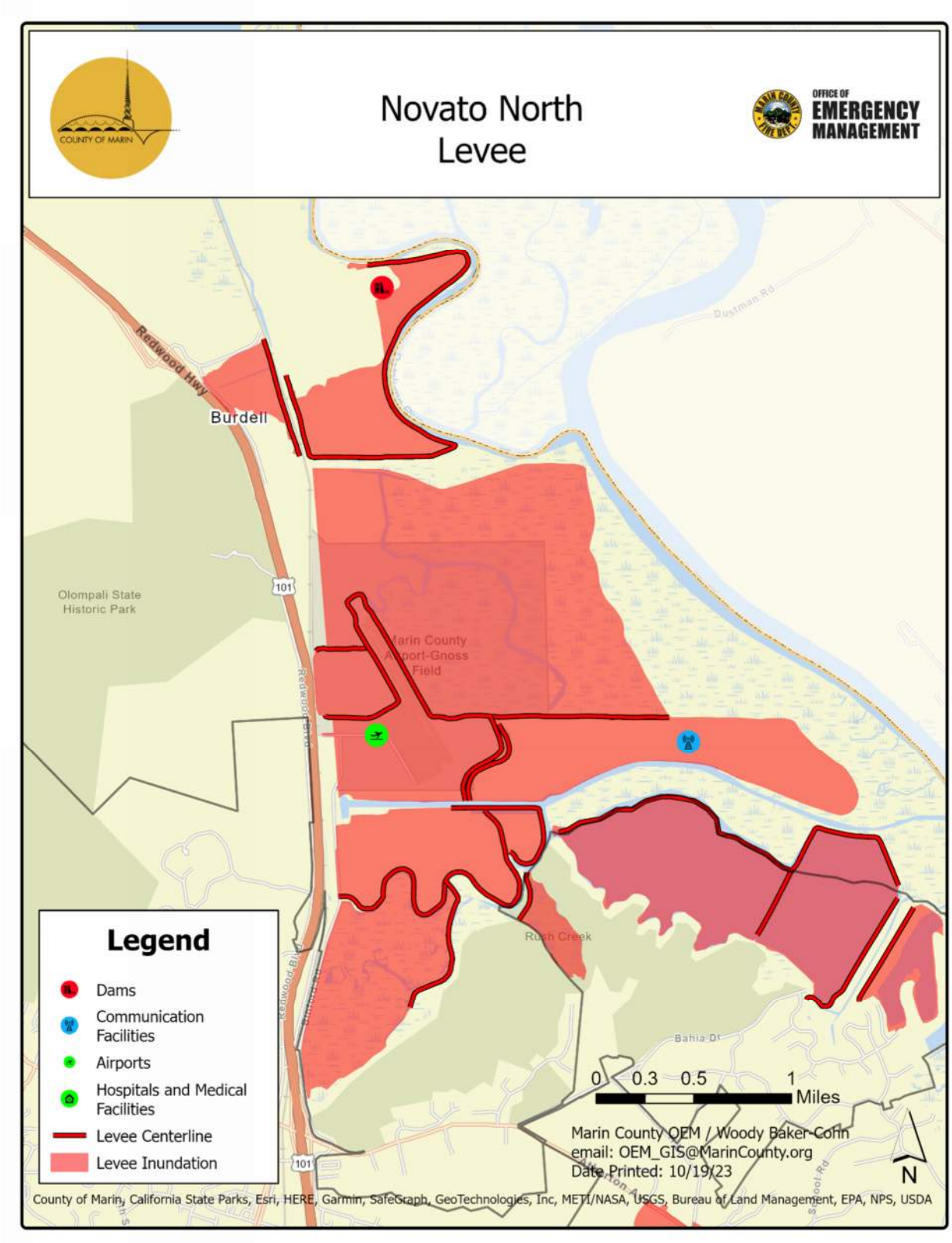


Figure 46: NMWD - Novato North Levee Inundation Map
Source: Marin County OEM

The City of Novato is protected by non-accredited levees along both sides of Novato Creek in the southern part of Novato near Bel Marin Key. The Novato Creek LB Upper Levee on the north side of the Creek is 2.11 miles long with no documented height. Approximately 1,468 people and 265 buildings with a property value of $361 million are at risk of a failure of the Novato Creek LB Upper Levee, including the Novato Community Hospital and part of Highway 101. The Novato Creek Levee on the south side of the Creek is 1.71 miles long with no documented height. Approximately 3,080 people and 214 buildings with a property value of $526 million are at risk of failure of the Novato Creek Levee, including several commercial areas and part of Highway 101. The Novato Creek RB Lower levee on the south side of the Creek is 1.1.7 miles long with no documented height. One building at the Ignacio Treatment Plant with a property value of $1.68 million is at risk from a failure of the Novato Creek RB Lower levee. The Novato Creek LB Lower Levee on the north side of the creek is 4.11 miles long with no documented height. Approximately 12 people and six buildings with a property value of $6.93 million are at risk of failure of the Novato Creek LB Lower levee. Marin County Levee 10 is a 1.04-mile-long levee with an undocumented height that primarily protects part of the Ignacio Treatment Plant. Marin County Levee 7 and Marin County Levee 3 are two unaccredited levees south of SR-37 on the east and west sides of a small tributary. Marin County Levee 7 is 0.53 miles long with no documented height. There is no risk to populations or property from failure of Marin County Levee 7. Marin County Levee 23 is 0.55 miles long with no documented height. Approximately three people and one building with a property value of $1.36 million is at risk of failure of the Marin County Levee 23. The Hamilton Levee along the Hamilton Wetlands is an accredited levee that is 1.09 miles long with 0.26 miles of embankment and no documented height. Approximately 1,786 people and 621 buildings with a property value of $470 million in the Hamilton neighborhood are at risk of failure of the Hamilton Levee. The Las Galinas Valley Sanitary District Levee is a non-accredited levee that is 3.63 miles long with no documented height. Approximately 19 people and nine buildings with a property value of $9.74 million are at risk of failure of the Las Galinas Valley Sanitary District Levee. The Novato Creek Levee Evaluation Project was created to evaluate the feasibility of increasing the level of flood protection for residences and businesses within Novato Creek's 100-year floodplain, and to work towards having the levees become FEMA accredited. A failure of any of the levees around Novato during a high rain event could cause flooding into residential neighborhoods and commercial areas of Novato, with property and infrastructure within the 100-year floodplain being most susceptible.

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 47 shows the Novato and Bel Marin Keys levee failure inundation area.

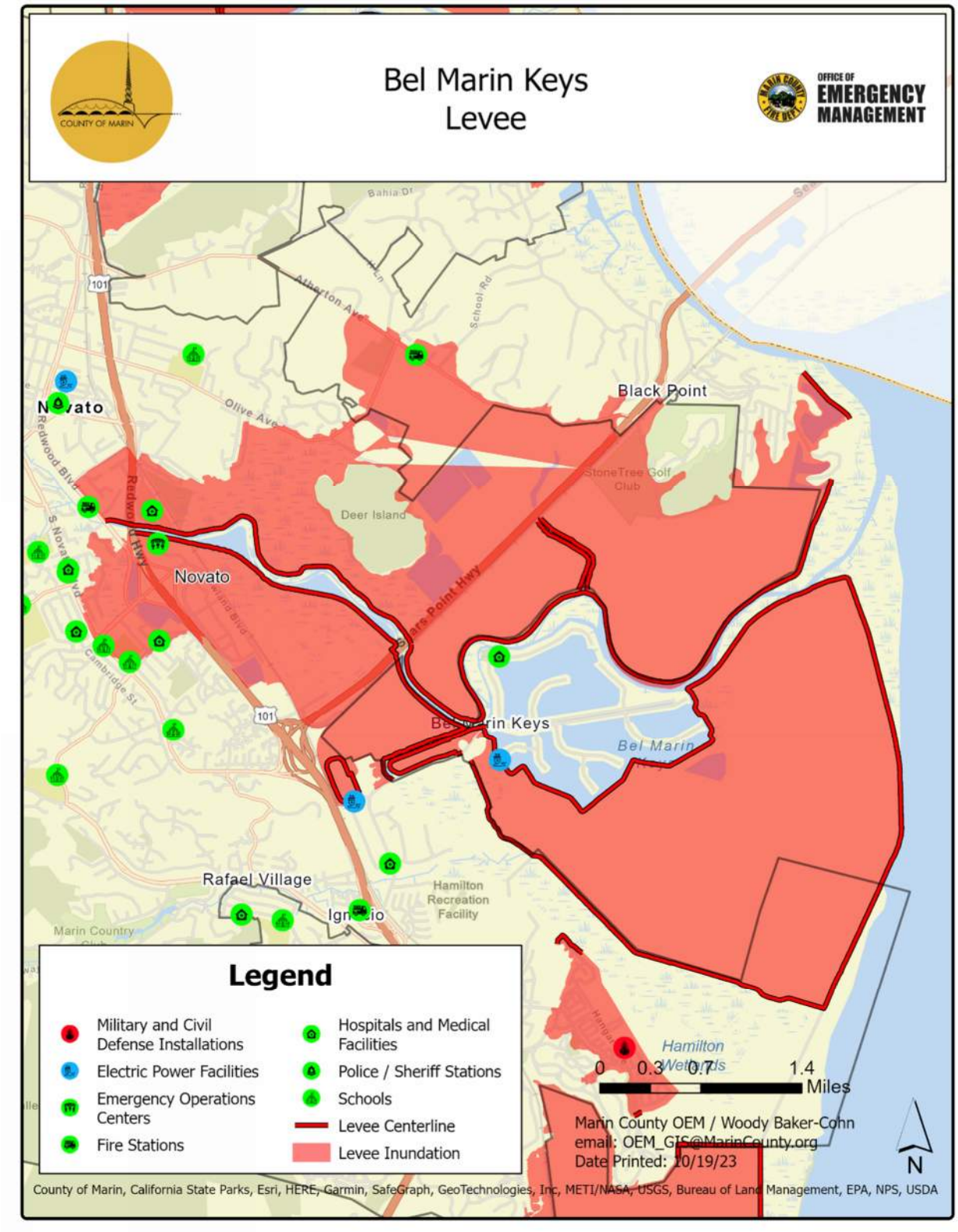


Figure 47: NMWD – Bel Marin Keys Levee Inundation Map
Source: Marin County OEM

On 2/14/2019, a levee was breached in two places near SR 37, washing out railroad tracks and threatening to inundate the roadway with water. A second levee near Pacheco Pond in the City of Novato was flowing over the top of the barrier, though the levee did not appear to have been breached. The largest breach, along Highway 37 and Harbor Drive, caused a swollen Novato Creek to spill over onto a field south of the highway.

On 12/31/2005-1/1/2006 a strong storm caused a levee breach behind Novato Community Hospital. Workers had to build a road out to the levee before they could begin repairs. The area being flooded was mostly wetlands and a park, and repairs were made before any homes were threatened.

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 including in the NMWD, increasing the potential for a levee failure. Rising seas will lead to increased stress on the levees around the Marin County OA shoreline including in the NMWD, particularly during a major tidal event and potential tsunami. As development increases in the populated areas of the NMWD protected by its levees, particularly along Novato Creek and around its marshlands, the potential for significant impacts to residents and infrastructure will only increase.

2.2.8 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 results 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).

There are areas within the NMWD service area including the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point that are at a lower elevation than many of the coastal areas in Marin County as shown in Figure 48. As such, these areas are particularly vulnerable to sea level rise and could experience between one and six feet of inundation as shown in Figure 49.

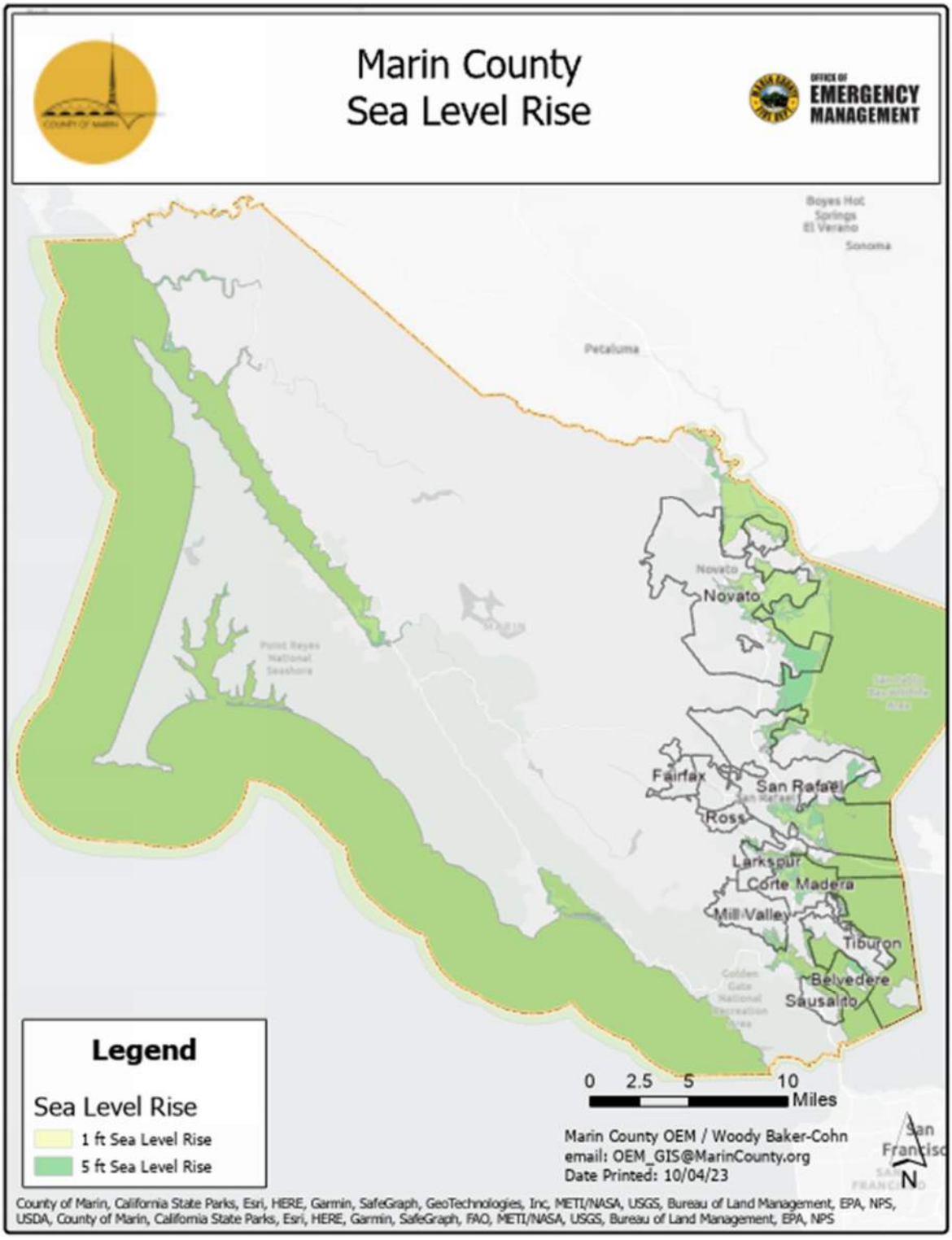


Figure 48: Marin County Sea Level Rise Impact
Source: Marin County OEM

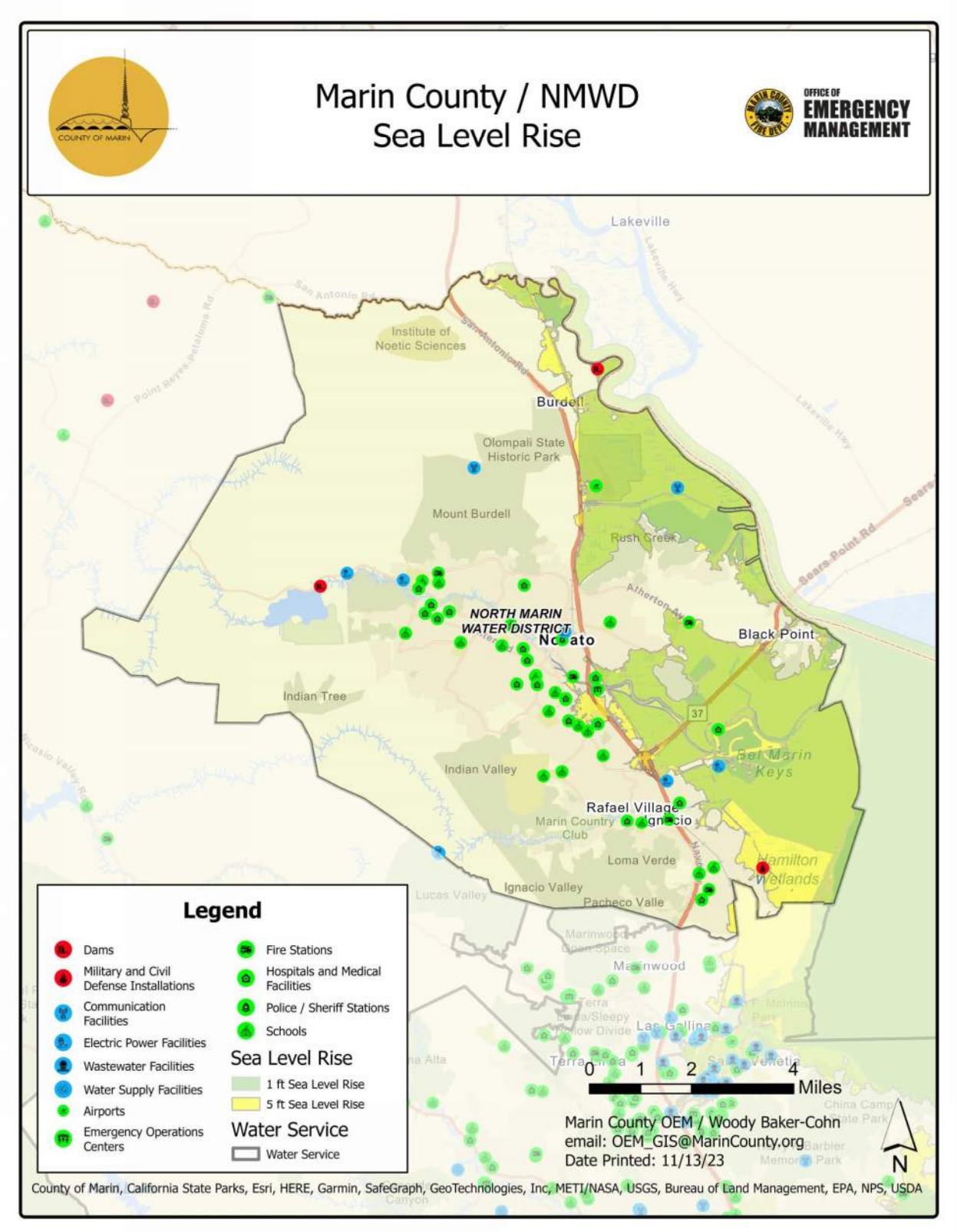


Figure 49: NMWD Sea Level Rise Impact on Critical Facilities
Source: Marin County OEM

The lowland areas in the City of Novato are particularly vulnerable to sea level rise and could experience between one and five feet of inundation. Development in the city is largely inland with a few buildings fronted by tidal marshes and the bay. Much of the community is fronted by unincorporated areas, managed stormwater, agricultural, utility, and marsh lands. These lands could buffer the city from San Pablo Bay for several decades; thus, the majority of assets may not experience saltwater flooding until the end of the century. A considerable number of parcels could flood, compromising their existing land uses and human activities. In addition, because of the city's size and the existence of several smaller neighborhoods, complex levee systems, and extensive marsh land, much of the impacted developed land is dispersed into pockets of flooding.

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). The following are key issues related to the City of Novato sea level rise and a 100-year storm surge:

- The Hamilton neighborhood could anticipate the FEMA certified levee overtopped in the long term. This would flood hundreds of homes and numerous professional workspaces.
- The Vintage Oaks Shopping Center could anticipate storm surge impacts in the medium term and tidal impacts in the long-term.
- Development east of US Highway 101 at the Bel Marin Keys and Rowland Boulevards.
- Buildings and marshes in Bahia, along Davidson Drive, and on Olive Avenue are vulnerable to sea level rise.
- SR 37 to Sonoma and Napa is vulnerable in the near-term in several locations along its route. This road provides access to several publicly accessible natural resource assets.
- Tidal and storm surge flooding could impair travel on US Highway 101 in the long-term.
- Sonoma Marin Area Regional Transit rail tracks could be vulnerable in the near-term. Train cars could also be damaged by saltwater exposure.
- The Novato Sanitary District wastewater treatment could expect long-term impacts to several critical buildings.
- The Novato Fire Station 62 is vulnerable in the medium-term, and flooded, in part, in the long term. In addition, the Fire Protection District and the Novato Professional Fire Fighter's Association office off Rowland Boulevard could be vulnerable.
- Most vulnerable parks are in Hamilton and are exposed in the long-term.
- Marsh lands are vulnerable in Hamilton, Deer Island and the surrounding diked baylands, and Bahia.

The most vulnerable assets are the wastewater treatment plant, SR 37, and Northern Marin Water District. In the long-term, the Hamilton neighborhood could also be vulnerable to levee overtopping. Due to Novato's inland development, very little of the community is directly impacted. Nevertheless, those dependent on the US Highway 101 corridor will be impacted. In addition, those who use the Novato Sanitary District treatment plant could experience wastewater disruptions.

The 2017 Marin Shoreline Sea Level Rise Vulnerably Assessment estimates that the City of Novato could anticipate impacts to over 51,000 people over 1,100 living units with $1 billion in assessed property value as a result of a 100-year sea level rise scenario and including storm surge. Structures throughout the city can become damaged extensively with their foundations compromised over time. Of particular concern are those structures and infrastructure that have not been elevated to projected sea level rise heights over the next century, including Highway 101 and SR 37 which could become more isolated due to sea level rise flooding. Sea level rise in the city has the potential to exacerbate inland flooding when a significant rain or tidal event occurs, pushing water from local creeks over their banks and into adjacent neighborhoods. Sea level rise can also cause increased subsidence along the city's shoreline, which may damage underground water and wastewater pipelines and disrupt services. The city's marshland would eventually turn into open water as a result of sea level rise, eliminating a natural barrier that protects the city from increased storm surge. The city would begin to experience seasonal, king tide, and storm surge flooding more frequently in the future.

The most vulnerable assets in the unincorporated County area of the NMWD from sea level rise in the medium-term are portions of Bel Marin Keys, which could face impacts. 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 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:

- 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.

In the near-term, tidal flooding at 10 inches of sea level rise with an additional 100-year storm surge would flood out and smaller public and private marinas and boat launches along the bay in Bel Marin Keys and Black Point, rendering them unusable. Storm surges can be powerful enough to damage and sink boats. Most concerning, however, is the potential inability of emergency professionals and vehicles to access people in or through flooded areas. Most levees south of the City of Novato could be overtopped as they are not designed to withstand this level of flooding.

In the medium-term, tidal flooding at 20 inches of sea level rise with an additional 100-year storm surge would cause pipelines under vulnerable roads and lateral pipes to vulnerable properties to become squeezed between rising groundwater and the confining roadway. This could cause pipes to bend and break and could even damage roadways. Impacts to the NMWD service area would impact water service in Bel Marin Keys and unincorporated County area around the City of 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, tidal flooding at 60 inches of sea level rise with an additional 100-year storm surge would cause roads to degrade more quickly, or if flood waters are deep enough, become impassable. Lane miles could be more than double this figure. 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 Novato Sanitary Wastewater Treatment Plants is a significant vulnerability that could arise, potentially disrupting hundreds of thousands of people. 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.

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. Sea level rise may push coastal habitats inland where possible, flooding tidal areas more frequently and inundating new inland areas with saltwater. On the bayside, the marshlands that buffer the shoreline communities from high tides and storm surges could begin to experience transitions in habitat. 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 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. Marin County OA populations in the NMWD 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.

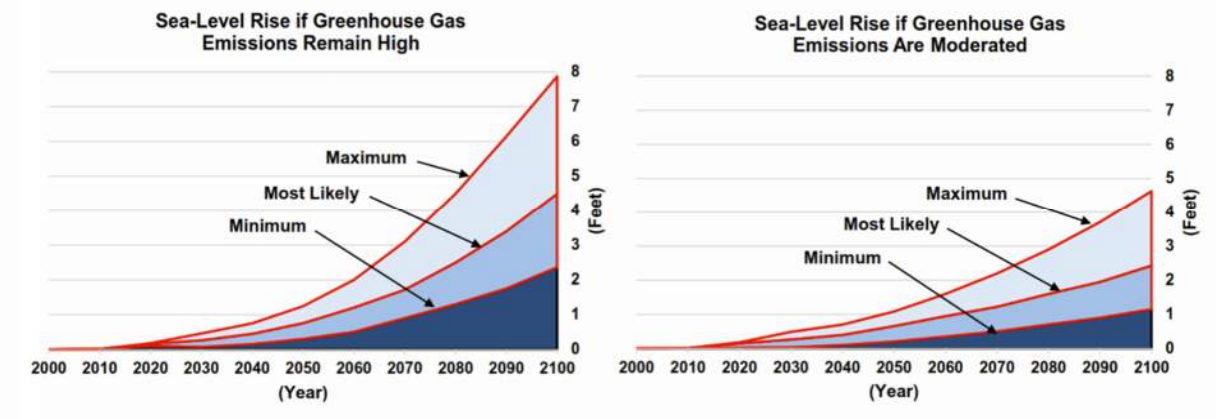


Figure 50: Projections of Sea Level Rise in the San Francisco Bay Area, 2000-2100
Source: 2019–2020 Marin County Civil Grand Jury, Climate Change: How Will Marin Adapt?

While the Marin County OA shoreline including around the NMWD 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 including the NMWD with increased tidal flooding and storm surge during severe weather events, and future development along the Marin County OA shoreline including around the NMWD 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 and lowland areas of the NMWD including the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point will put more people and property at risk from flooding as a result of sea level rise. Roads and utility infrastructure across the NMWD will continue to become inundated.

2.2.9 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 51):

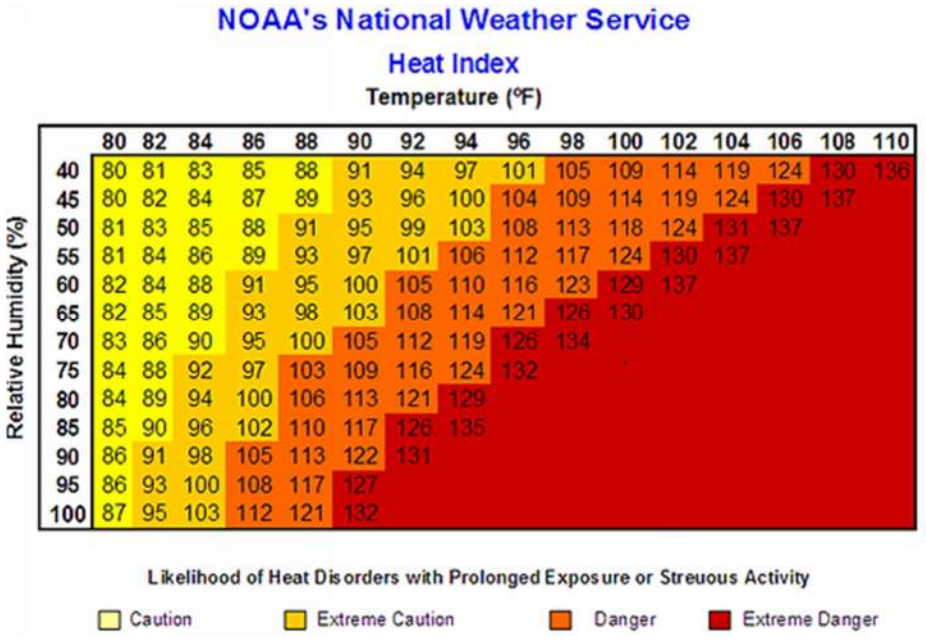


Figure 51: Heat Index
Source: NOAA

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.

Extreme heat has the potential to impact all areas of the NMWD, including the City of Novato and the unincorporated County, and would be felt more at lower elevations in the central areas of the district. Temperatures can feel warmer in this area due to the widespread presence of concrete and asphalt, which stores heat longer. Heat waves can cause power outages and can impact district employees who are exposed to high temperatures while working outside in the heat.

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. At the current rate, annual average temperatures in the Marin County OA 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.

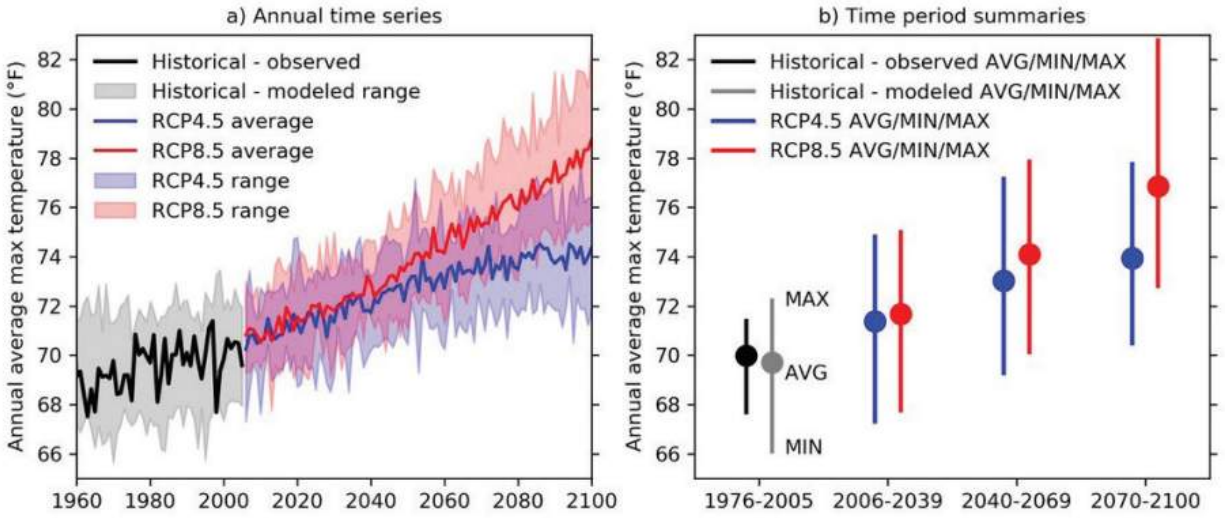


Figure 52: Annual Average Temperatures in the San Francisco Bay Area, 2000-2100
Source: California Climate Change Assessment (Fourth Edition)

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 including in the NMWD. There will be increased residential and business needs for cooling and addressing heat-related issues. These effects would primarily be felt in the lowland areas of the NMWD including the lowland areas of the City of Novato and the unincorporated communities of Bel Marin Keys, Indian Valley, Loma Verde and Black Point-Green Point where heat builds in developed areas. Heat waves also tax the energy grid. Future development in the Marin County OA including the NMWD 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 including the NMWD as conditions become hotter and drier. These effects will primarily be felt in the mountainous and marshlands areas of the NMWD where hotter and drier conditions are more apt to lead to wildfires. Future development near the many open spaces around the NMWD could expose more people and infrastructure to the threat of a major wildfire as a result of increasing temperatures.

2.2.10 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 53).

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 53: 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.

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 54) 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 54: 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 55: Waterspout Formation
Source: MarineInsights

All of the NMWD including the City of Novato and the unincorporated County is susceptible to storms and damage from wind and tornadoes, though the mountainous areas on the western side of the district have increased susceptibility due to a higher presence of trees. Drought can increase the susceptibility of trees toppling over in a high wind event. Fallen trees could damage homes and other facilities. Power lines could be impacted by fallen trees and wind,

causing power outages. Roadways could also become blocked by fallen trees, affecting the ability of residents to reach their homes.

On 3/14/2023 a strong storm with heavy winds caused a tree to fall onto a home in the City of Novato. There were no injuries.

On 12/16/2017 heavy winds knocked down a tree in the City of Novato, causing a power outage for 2,440 customers. A wind gust of 44 mph was recorded.

On 4/14/2009 high winds caused a tree to fall onto a power line on Pine Street in the City of Novato causing a small fire and knocking out power along the street.

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 and the NMWD. 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 in the NMWD 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 NMWD including in the mountainous residential areas throughout the City of Novato and the unincorporated communities of Indian Valley, Loma Verde and Black Point-Green Point will increase the effects of severe wind events.

2.2.11 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.

A tsunami experienced by the NMWD would most likely occur from an earthquake, the location of which would determine the amount of time that the tsunami waves would reach the district. Much of the eastern area of the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point are at a lower elevation and lie in a tsunami hazard area. The tsunami inundation zone in the City of Novato does not include any structures or populations. The two areas in the city in a tsunami inundation zone include the Hamilton Wetlands in southern Novato and the wetlands north of the Rush Creek Open Space Preserve. The Hamilton Levee protects the Hamilton neighborhood of the city from a tsunami and could be tested in a tsunami event. 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.

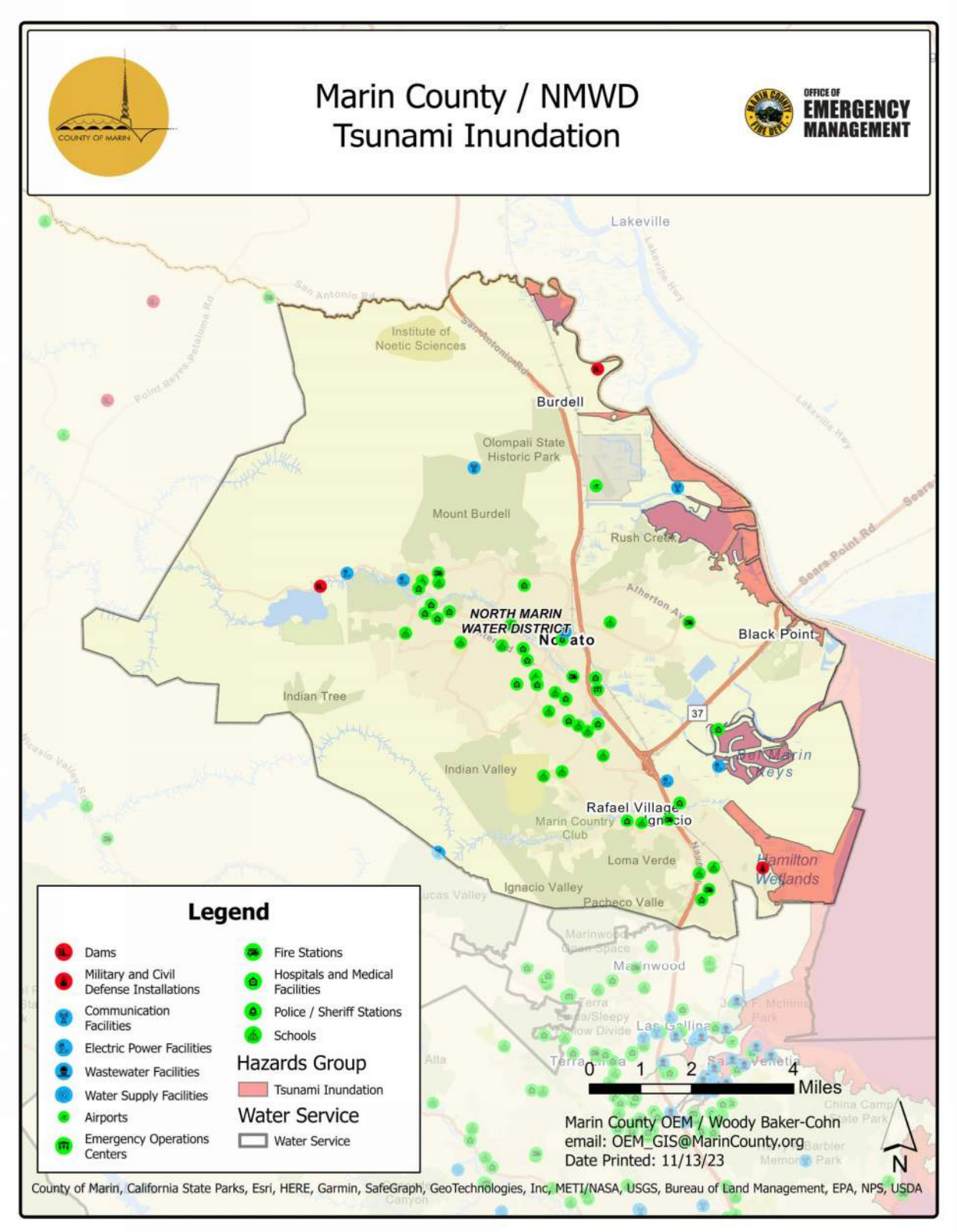


Figure 56: NMWD Tsunami Critical Facilities and Infrastructure
Source: Marin County OEM

The NMWD service area including the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point has never experienced a tsunami. Given its proximity to the San Francisco Bay, however, parts of the District are within a tsunami inundation zone and could potentially experience the impacts of one.

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 including the NMWD, where a large segment 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 district including the City of Novato and the unincorporated communities of Bel Marin Keys and Black Point-Green Point. This is particularly true along Novato Creek and around the marshland areas where additional storm surge as a result of a larger tsunami could cause greater impacts. Future development in these areas will expose more people and infrastructure to the effects of flooding in the district as tsunami inundation areas expand with climate change. Development in marshland in the district 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 along Novato Creek and along the marshlands and shoreline of the district as a result of high wave heights associated with a more significant tsunami.

2.2.12 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 or faster depending upon wind speed and ember distribution. 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.

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 and climate change. 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. The Marin County OA 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 dangerously high 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 depending upon the location of the incident. On federally owned land, or federal responsibility areas (FRA), fire protection is provided by the federal government, and 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 the Marin County OA, 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.

CAL FIRE contracts with MCFD to provide wildland fire protection and associated fire prevention activities for lands designated by the State Board of Forestry as SRA. 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 57 indicates the federal responsibility areas, state responsibility areas and local responsibility areas in the Marin County OA.

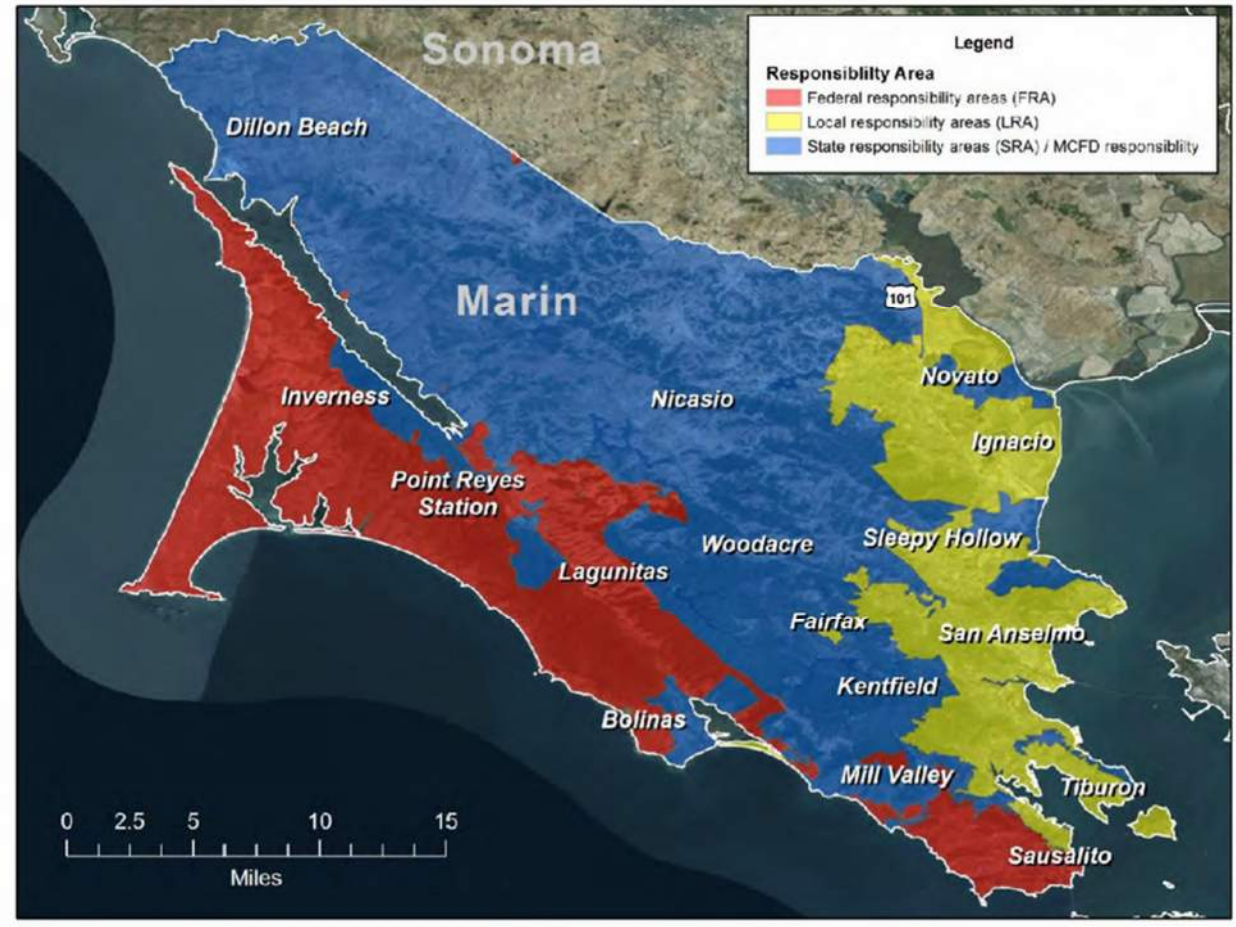


Figure 57: Federal, State and Local Responsibility Areas in the Marin County OA
Source: Marin Community Wildfire Protection Plan

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 (ECC) 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.

The Marin County OA 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 OA 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 the southern Marin County OA near the San Francisco Bay) with winds. The fog often penetrates into the inland valleys of the northern and central Marin County OA, 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 at times (15 to 25 mph), especially over the ridge tops and through northwest to southeast lying valleys, including San Geronimo/Ross, Hicks, Lucas Valleys, and Mill Valley and the Marin Headlands. 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 Central Valley 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), gusty and are often much faster over the mountains and ridge tops such as Mt. Tamalpais, Loma Alta, Marin Headlands 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 which were located in West Marin.

A few times per year in the summer and early fall, monsoonal flow from Mexico may bring 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, lightning from this type of weather pattern 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. Marin County's OA has significant changes in topography with steep vegetated slopes which can also add to the ability of the fuel to further expand a wildfire.

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 Marin Community Wildfire Protection Plan (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.

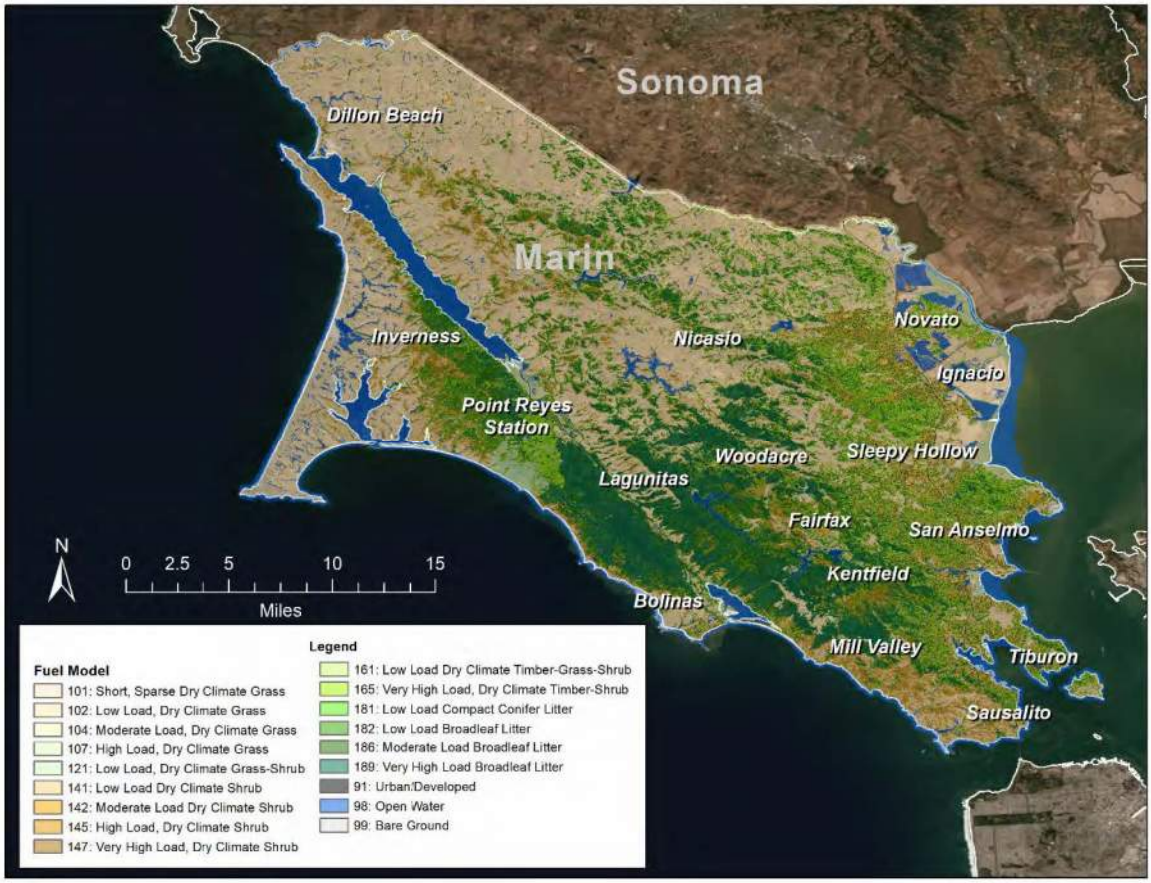


Figure 58: Fuel Model Map for the Marin County OA
Source: Unknown

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 nearby 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.

PG&E has also begun undergrounding several overhead transmission lines throughout California.

A wildfire in the NMWD would most likely occur in the areas of the district where there is more forested terrain, including around the City of Novato and in the unincorporated communities of Indian Valley, Loma Verde and Black Point-Green Point. These areas are primarily residential and consist of numerous winding streets and hillside homes that could be damaged or destroyed by wildfire. A wildfire could also occur in the marshland areas of the district including in the City of Novato and around the unincorporated communities of Bel Marin Keys and Black Point-Green Point. Of particular concern are those communities in the southern area of the City of Novato near the Indian Valley, Ignacio Valley, and Loma Verde Preserves that are located in a Very High FHSZ. There are hundreds of residences, the Novato High School, the San Jose Middle School, the Loma Verde Elementary School and the Hamilton Elementary School that lie in this area and could be susceptible to a wildfire. This area also has few major thoroughfares, which could impede evacuation in a wildlife. This area and the other areas surrounding the city including the Mount Burdell Open Space Preserve, Ohair Park, the Verissimo Hills Preserve, the Indian Tree Open Space Preserve and the Rush Creek Open Space Preserve are located in Moderate to High FHSZs. This area includes thousands of residences, numerous commercial buildings and medical facilities, San Marin High School, Pleasant Valley Elementary School, Hill Middle School, the College of Marin – Indian Valley Campus, the Good Shepherd Lutheran School, Olive Elementary School, Our Lady of Loretto School, Novato Fire Station #62, Novato Fire Station #63, Novato Fire Station #64 and Novato Fire Station #65 that could be susceptible to a wildfire. The unincorporated County in the District service area 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, lies in a Very High and High FHSZ and could have higher 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.

The NMWD maintains and operates approximately 340 miles of pipeline, 42 tanks totaling over 37 million gallons of storage, and associated pump stations, hydropneumatic systems, and regulator valves. The NMWD sizes its storage tanks to meet operational, firefighting and emergency requirements. Storage requirements for both the City of Novato and West Marin Service Areas are updated on a 5-year cycle and are based in part on input provided by Novato Fire Protection District and Marin County Fire Department. The NMWD evaluates water supply and consumer consumption on a 5-year cycle via its Urban Water Management Plan (UWMP) and associated Water Shortage Contingency Plan (WSCP) in accordance with state Department of Water Resources (DWR) guidelines and requirements.

All of the NMWD could be impacted by a Public Safety Power Shutoff (PSPS) event and/or suffer poor air quality from smoke as a result of a wildfire in Marin County or the surrounding region. As wildland areas around the district become drier due to climate change, the risk of a wildfire occurring and impacting the district will continue to increase. Brush fires in the district may increase over time as marshlands, parks, and other open spaces experience drier conditions.

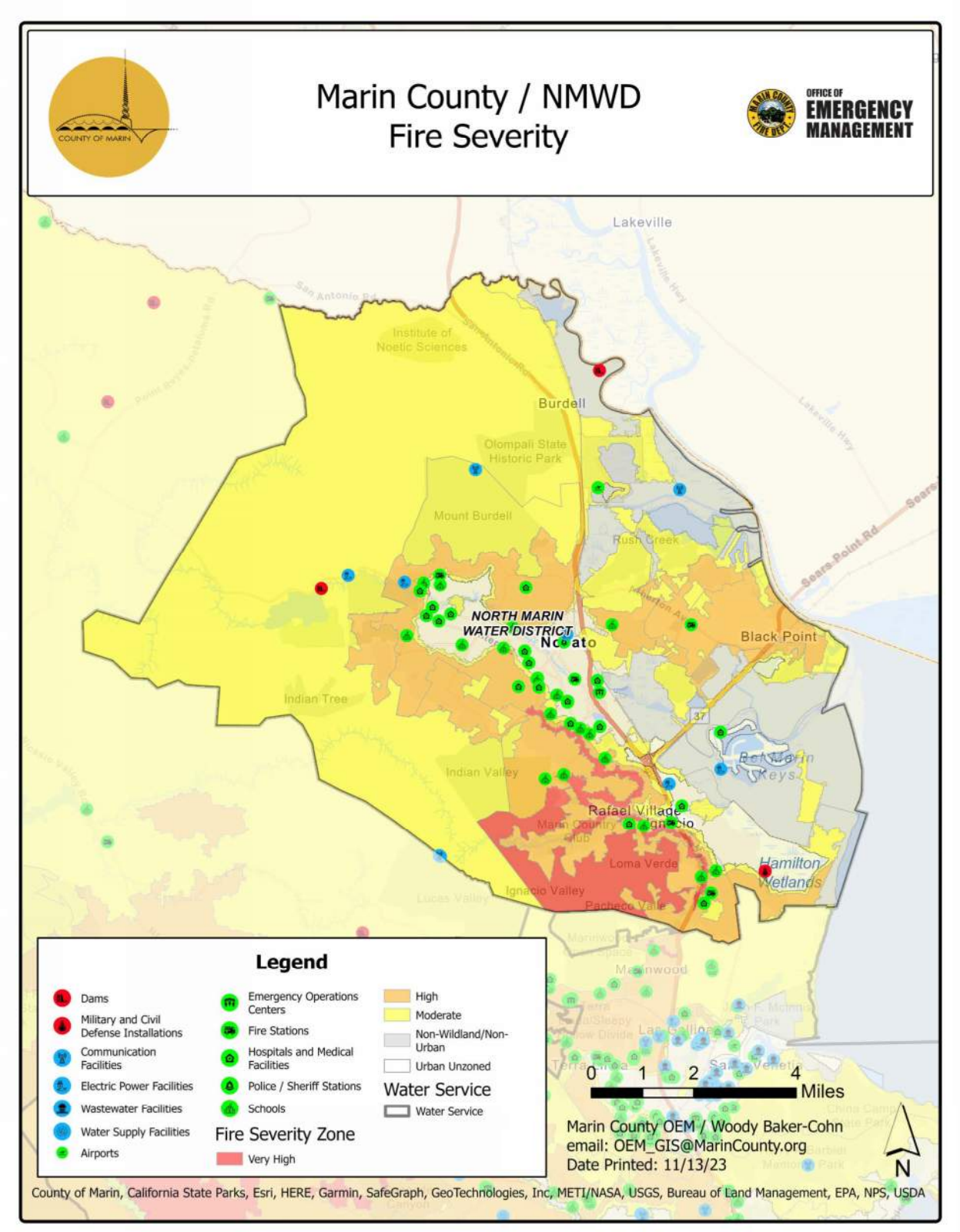


Figure 59: NMWD Wildfire Critical Facilities and Infrastructure
Source: Marin County OEM

The NMWD including the City of Novato and the unincorporated County has experienced a major 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.

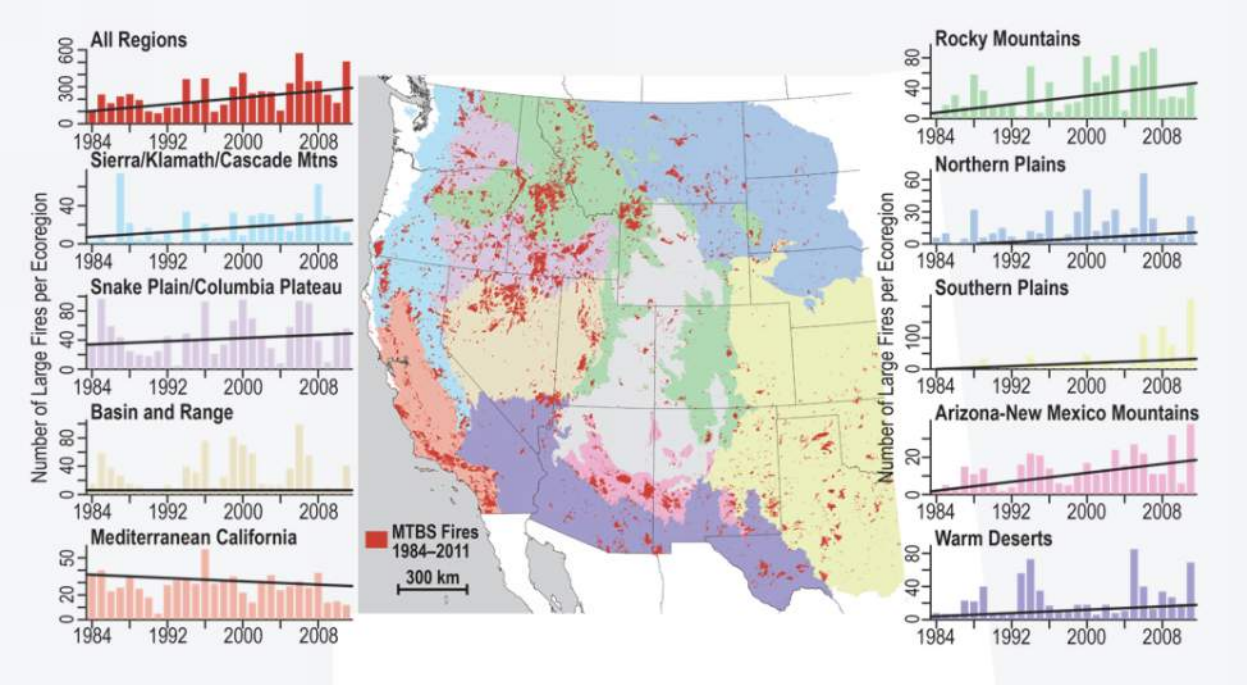


Figure 60: Trends in the Annual Number of Large Wildfires in the United States
Source: Fourth Climate Change Assessment, 01/04/23

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 including the NMWD 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, particularly in the open space areas around the NMWD. Future development in the WUI throughout the NMWD will expose more people and property to the impacts of a potentially significant wildfire. The growing number of people in the NMWD WUI can increase risk to life, property and public health as a result of a wildfire. Future development around the NMWD marshlands would expose more people to the effects of brush fires as the marshlands dry out in the summer due to climate change.

SECTION 3.0: MITIGATION STRATEGY

3.1 CHANGES IN DEVELOPMENT

In 2006 the Restructured Agreement for Water Supply with Sonoma County Water Agency (SCWA) was executed, authorizing SCWA to construct facilities to increase North Marin's water delivery entitlement to meet Novato's future needs consistent with community general plans in place. North Marin's aqueduct capacity entitlement in the Restructured Agreement is now 19.9 MGD. Also in 2006, reconstruction of the Stafford Water Treatment Plant concluded. At the time, the $16 million project was the largest ever undertaken in the District's history, and enables Stafford Lake water to meet anticipated future water quality standards.

North Marin constructed the Deer Island recycled water treatment facility in 2007 where highly-treated recycled water is produced and delivered to irrigate Stone Tree Golf Course. In cooperation with Novato Sanitary District, recycled water is also now produced and distributed to irrigate landscape in North Novato including the Fireman's Fund business park, Valley Memorial Park cemetery, Olive School playing fields and private and public landscape along the recycled water pipeline route.

North Marin also completed infrastructure improvements in coordination with Novato Sanitary District to produce and distribute recycled water for landscape irrigation in Central Novato which serves Novato Community Hospital, Vintage Oaks Shopping Center, Caltrans US101 right of way, Lynwood School playing fields and Marin Country Club Golf Course, plus private and public landscape along the recycled water pipeline route. In South Novato, North Marin worked with Las Gallinas Valley Sanitary District to deliver recycled water for landscape irrigation into the Hamilton Field area including Hamilton School playing fields, HOA common areas, and other public and private landscape along the recycled water pipeline route. Recycled water currently offsets approximately 10% of the annual potable water demand in Novato.

In the mid 2000's, as Caltrans planned its' Marin-Sonoma Narrows US101 highway widening project, North Marin began planning the Aqueduct Energy Efficiency Project. The AEEP, completed in 2015, enlarged 5 miles of the North Marin Aqueduct which was relocated due to the Caltrans project. The enlarged aqueduct enables continued Russian River Water delivery of up to 18 MGD by gravity and eliminates the need for the Kastania Pump station in South Petaluma, reducing energy costs and green-house gas emissions. Two-thirds of the $22M project cost was paid by Caltrans and one-half of North Marin's remaining share is paid by Marin Municipal Water District.

North Marin's water conservation efforts continue to be focused on reducing summer water demand, which is principally outdoor irrigation. The WaterLine newsletter is published in the spring and fall. The spring edition includes tips on how to reduce summer water demand and describes North Marin's current water conservation programs. North Marin has implemented tiered rates, known as the Conservation Incentive Rate (CIR), where single-family residential customers using over three times the typical summer use, and the Conservation Incentive Tier Rate (CITR), where single-family residential customers using more than one but less than three times the typical summer use, pay a surcharge on the rate to encourage water conservation. Water use restrictions for new development are stringent, requiring interior plumbing fixtures and appliances to meet high-efficiency standards.

North Marin also provides water service to the West Marin communities of Point Reyes Station, Olema, Bear Valley, Inverness Park, and Paradise Ranch Estates. The water supply for these communities comes from groundwater wells located adjacent to Lagunitas Creek. Two wells

are located behind the former Coast Guard Housing facility in Point Reyes Station, while another two wells are located about a mile and a half east of Point Reyes Station. This supply is of excellent quality but it requires treatment to remove iron and manganese which can affect the color of the water and result in staining. Treatment consists of adding an oxidant to precipitate the iron and manganese and then filtering the water through pressure filters which are capable of removing the iron and manganese and any excess oxidant. After filtration a small amount of chlorine is added to keep this water pure in the pipeline.

The West Marin water distribution system is small but complex, consisting of 13 different water storage tanks, 6 pump stations, 4 source water wells, and 1 water treatment plant. Development is scarce in these communities, so existing capacity is adequate to serve the current projected growth. Two of the 13 water storage tanks are redwood which represents a vulnerability to wildfire. The other 11 water storage tanks have been replaced with concrete or welded steel tanks.

3.2 Capability Assessment

The North Marin Water District did not participate in the 2018 MJHMP update. However, the strategies in which to support the overall District priorities are reflected in the sections below. Several actions were added to coincide with the priorities, progress in local mitigation efforts and changes in development.

Capabilities are the programs and polices currently in use 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 2018 capability assessments have been successfully incorporated into the North Marin Water District General Plan to include the Public Safety Element, Land Use Element, and Housing Element and the 2023 capability assessments will also be incorporated into the General Plan and these Elements. The capability assessment is divided into four sections: regulatory, administrative and technical, fiscal, and outreach and partnerships.

3.2.1 Regulatory Capabilities

The legal and regulatory capabilities include existing ordinances and codes that affect the District'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.

Opportunities for Enhancement

The 2023 Marin County OA MJHMP update provided the NMWD an opportunity to review and update the capabilities currently in place to mitigate hazards. This also provided an opportunity to identify where capabilities could be improved or enhanced. Specific opportunities could include:

- **Community Wildfire Protection Plan:** The District plans to take an active role in mitigation actions to enhance wildfire protection.
- **StormReady certification and Firewise Communities certification:** The District will consider participation in these programs.

Table 16: North Marin Water District 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?
Strategic Plan	Yes 2018	The Strategic Plan is NMWD's highest-level planning document. It represents the Board's direction for the future and the staff's work plan for implementing that direction. It identifies NMWD's mission, vision, and values, while providing a set of goals and objectives that becomes a framework for all decision making. The Strategic Plan is reviewed and updated approximately every 5 years. The Strategic Plan does not explicitly address hazards, but it is used to identify goals that often align with mitigating impacts of hazards.
5-Year Master Plan	Yes Varies	NMWD uses Master Plans for guiding decisions related to infrastructure maintenance, capacity improvements, and resiliency to hazards. NMWD has three separate Master Plans, one for each service area, 1) Novato, 2) West Marin, and 3) Oceana Marin. Each Master Plan is reviewed and updated approximately every 5 years. Projects identified in the Master Plans are high-level and are often intended to mitigate impacts from hazards, development, or address resiliency/redundancy in general.
Capital Improvements Plan (CIP)	Yes 2023	The CIP is a document the guides near-term decisions related to NMWD's capital assets. High-level projects identified in the Master Plans are programed into the CIP based on available funding. NMWD uses a 3-year planning horizon to develop the CIP, and the CIP is updated annually concurrent with the District's full budget cycle. The Board of Directors reviews and approves CIP funding on an annual basis, which supports implementation of projects that often mitigate impacts from hazards, development, or address resiliency/redundancy in general.
Local Emergency Operations Plan	Yes 2019	NMWD's Emergency Operations Plan (EOP) is District specific and its purpose is to provide a plan of action to respond to various emergencies and/or hazards that may involve District facilities. The EOP does not identify specific projects to mitigate impacts of hazards.
Local Water Supply Enhancement Study (LWES)	Yes 2022	The LWES was prepared with the intent of assisting NMWD in making informed and prudent decisions towards expanding the local water supply in the Novato service area. Although the LWSES does not explicitly address

		hazards, it identifies viable water alternatives which would inherently provide resiliency and redundancy that could mitigate impacts of certain hazards.
Building Code, Permitting, and Inspections	Y/N	Are codes adequately enforced?
Building Code	N	N/A
Building Code Effectiveness Grading Schedule (BCEGS) Score	N	N/A
Fire department ISO rating:	N	N/A
Site plan review requirements	N	N/A
Land Use Planning and Ordinances	Y/N	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
District Code	N	N/A
Zoning ordinance	N	N/A
Subdivision ordinance	N	N/A
Floodplain ordinance	N	N/A
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N	N/A
Flood insurance rate maps	N	N/A
Elevation Certificates	N	N/A
Acquisition of land for open space and public recreation uses	N	N/A
Erosion or sediment control program	N	N/A

Table 16: NMWD Legal and Regulatory Capabilities
Source: North Marin Water District

North Marin Water District Comprehensive Plan or Master Plan

North Marin Water District boundaries overlap unincorporated areas of Marin County and the City of Novato, both of which are required to have a General Plan or Master Plan per California Government Code 65300. Please see their respective General Plan or Master Plan for details.

Table 17: North Marin Water District Comprehensive Plan or Master Plan	
Goal/Policy/ Program	**Explanation**
Policy	NMWD is an independent special district governed by a five-member Board of Directors elected By-District for four-year terms.
Policy	NMWD is a public agency of the State of California established under the County Water District Law (Division 12 of the California Water Code). Policies and regulations have been adopted by the Board of Directors of NMWD pursuant to Water Code Section 31024 and establish the procedures under which NMWD operates, including the terms and conditions under which facilities will be installed and water will be supplied to users and the charges and rates for such service.

Table 17: NMWD Comprehensive Plan or Master Plan
Source: North Marin Water District

3.2.2 Administrative and Technical Capabilities

The administrative and technical capability identifies the District personnel responsible for activities related to mitigation and loss prevention. Many positions are full time and/or filled by the same person.

Table 18: North Marin Water District Administrative and Technical Capabilities		
Administrative	Yes/No	Is coordination effective?
Administration / Finance Department	Yes	The Administrative Department is comprised of the Administrative Services, Consumer Services, Finance and Information System. Consumer Services is responsible for managing water use data, responding to customer calls for service and assistance with their water services, creation and distribution of water bills, and answering customer questions regarding their bill or water use. Finance is responsible for general accounting and budgeting, payroll, purchasing, financial investments, risk management and information systems.
Construction / Maintenance	Yes	The Construction/Maintenance Department has a variety of duties, principally related to the installation, repair and replacement of water main pipelines, their appurtenances and performs all “underground” maintenance for the District. The Construction/Maintenance Department also assists other departments to upkeep structures, grounds, storage tanks and pumping facilities.
Operations / Maintenance	Yes	The Operations/Maintenance Department manages the supply, distribution and water quality for the City of Novato and the West Marin communities, and performs all “above-ground” maintenance for the District.
Mutual aid agreements	Yes	NMWD has mutual aid agreements with the City of Novato and the Novato Sanitary District for staff, equipment, and materials.

Technical	Yes/No	Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)		
Emergency Manager	Yes	NMWD has a Safety Manager on staff that serves in this role by definition. They lead the management team in emergency scenarios and coordinates with other local agencies as needed during emergencies.
Civil Engineer	Yes	NMWD has a Chief Engineer that oversees the Engineering Department and enforces District design and construction standards. They have training on emergency procedures and they coordinate with County and City officials as needed.
Engineer(s), project manager(s), technical staff, equipment operators, and maintenance and construction staff.	Yes	The Engineering Department consists of a small professional and technical staff that oversees the planning, permitting, design, construction and project management of water supply, treatment, transmission and distribution facilities necessary to serve NMWD's customers. Engineering functions for wastewater-related facilities are also provided by the Engineering Department to support the NMWD wastewater collection, treatment, and disposal system in Oceana Marin (Dillon Beach area).
Grant writing	No	NMWD does not have in-house staff with expertise in writing grant applications. NMWD has historically used consultant support for grant writing purposes.

Table 18: NMWD Administrative and Technical Capabilities
Source: **North Marin Water District**

3.2.3 Fiscal Capabilities

The fiscal capability assessment shows specific financial and budgetary tools available to the jurisdictions 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 19: North Marin Water District 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	Yes	The Board of Directors reviews and approves CIP funding on an annual basis, which supports implementation of projects that often mitigate impacts from hazards, development, or address resiliency/redundancy in general.
Fees for water, sewer, gas, or	Yes	NMWD's main source of revenue comes from rate payers

electric services		of the three different service areas. Rate revenue is used to fund District operations, maintenance, capital improvements, debt service, staff salaries and benefits, and various other expenses. When mitigation projects are identified in the various Master Plans and the Capital Improvement Plan, rate revenue can be adopted with the annual CIP budget to fund projects that have a hazard mitigation component.
Impact fees for new development	Yes	NMWD assesses Facility Reserve Charges (FRCs) to developments within the various service areas that need new or increased water use entitlement. FRC revenue can be used to fund future capital improvement projects that have a hazard mitigation component.
Incur debt through general obligation bonds and/or special tax bonds	Yes	NMWD has incurred debt through bonds that were used to fund larger capital improvement projects, some of which had a hazard mitigation component.
Federal funding programs	Yes	Federal grant program funding could be used to fund hazard mitigation projects, such as sea-level rise and drought contingency. Regional coordination through California Office of Emergency Services (Cal OES) was used to secure a federal grant through the Federal Emergency Management Authority's (FEMA) Hazard Mitigation Grant Program for a project to rehabilitate the District's Oceana Marin Wastewater Treatment and Storage Ponds
State funding programs	Yes	State grant program funding could be used to fund hazard mitigation projects, such as sea-level rise and drought contingency. Regional coordination through the Department of Water Resources (DWR) was used to secure a state grant through the State's Small Community Drought Relief Program for a project to drill a new well outside of the 100-year sea-level rise boundary in the District's west Marin service area.

Table 19: NMWD Fiscal Capabilities
Source: **North Marin Water District**

3.2.4 Community Outreach

The outreach and partnerships capability assessment shows outreach and public education programs available to the North Marin Water District and the North Marin Water District partnerships utilized to promote those programs.

Table 20: North Marin Water District Community Outreach		
Outreach and Partnerships	Yes/No	Could the program/organization help implement future mitigation activities?
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes	NMWD is committed to ongoing public education surrounding water conservation and water-waste reduction. The District has an active online presence through social media and provides frequent updates on the website.

Table 20: NMWD Community Outreach
Source: **North Marin Water District**

3.2.5 Participation in the National Flood Insurance Program

As a Special District the North Marin Water District does not participate in the national flood insurance program.

3.3 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

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
- Are 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.

3.4 Status of Previous Mitigation Actions

Table 21 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 21: NMWD Status of Previous Hazard Mitigation Actions

Action Number / Name	Completed	Ongoing	Not Started	Still Relevant	Included in Updated Action Plan
Stafford Dam (Novato Creek Dam) Mitigation – Upstream Face Armoring			X		X
Oceana Marin Force Main Replacement and Main Pump Station Upgrade/Relocation		X			X
Olema Domestic Water Pump Station Flood Protection			X		X
Eastern Marin County Creek Crossing Upgrades (Rush, Novato, Leveroni, Vineyard)			X		X
Oceana Marin Treatment and Storage Pond Repair		X			X
Oceana Marin Cliff-side Sewer Lining			X		X

Table 21: NMWD Status of Previous Hazard Mitigation Actions
Source: City of Novato

3.5 Hazard Mitigation Actions

The 2023 Marin County MJHMP was revised to reflect progress in local mitigation efforts. Mitigation projects were selected for each hazard and for the North Marin Water District 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 District Board of Directors 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.

Based on the hazard profiles, threat assessment, capabilities assessment, community survey results, discussions among the 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 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 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 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. 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 22 lists the Current Hazard Mitigation Actions for the North Marin Water District.

Table 22: North Marin Water District Current Hazard Mitigation Actions

No.	Mitigation Actions	Hazards Mitigated/ Goals Met	Jurisdiction/ Responsible Agency	New, Existing, Completed, Removed	Estimated Cost and Potential Funding Source	Timeline/ Priority	Comments/ Progress
NMWD-1	Encourage participation in Alert Marin and other community alert & warning systems to ensure the public is aware of any potential emergencies or risk.	All Hazards 1, 2, 3, 4, 5	North Marin Water District/ Marin County	New (2023)	Cost: General Funds	1 -2 Years/ High	
NMWD-2	Stafford Dam (Novato Creek Dam) Mitigation – Upstream Face Armoring	All Hazards 1, 2, 3, 4, 5	North Marin Water District	Existing (2018)	$1,000,000 (Rate Revenue, Federal and State Grants)	3-5 years Medium	Not started (identify and correct vulnerabilities along the upstream face of Stafford Dam)
NMWD-3	West Marin Water Supply Resiliency Project	All Hazards 1, 2, 4, 5	North Marin Water District	New (2023)	$2,000,000 (Federal and State Grants)	1-3 High	Not Started (identify and establish source(s) of additional water supply to enhance system redundancy)
NMWD-4	Novato Water System Enhanced Master Plan	All Hazards 1, 2, 3, 4, 5	North Marin Water District	New (2023)	$300,000-$500,000 (Rate Revenue)	1-15 High	Ongoing (A combination infrastructure and hazard mitigation plan, including seismic evaluations of all critical facilities, wildfire, flood hazards, etc.)
NMWD-5	West Marin Water System Enhanced Master Plan	All Hazards 1, 2, 3, 4, 5	North Marin Water District	New (2023)	$300,000-$500,000 (Rate Revenue)	1-15 High	Ongoing (A combination infrastructure and hazard mitigation plan, including seismic evaluations of all critical facilities, wildfire, flood hazards, etc.)
NMWD-6	Emergency Operations Plan (EOP) Update	All Hazards 1, 2, 3, 4, 5	North Marin Water District	New (2023)	Cost TBD (Rate Revenue)	1-3 High	Not Started (update to NMWD's 2019 EOP)
NMWD-7	Community and Individual Emergency Preparedness	All Hazards 1, 2, 3, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	1-3 High	Ongoing (circulate information and educate about risks associated with living within the inundation zone of Stafford Dam)
NMWD-8	Emergency Generator(s)	All Hazards 1, 2, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA,	1-5 High	Ongoing (secure funding for installation of permanent generators at critical District

					Private Local Grants		facilities such as HQ and backbone pump stations)
NMWD-9	Stafford Dam Mitigation – Remote Instrumentation including piezometers, inclinometers and accelerometers, weather station	Dam Failure/ 1,2,4, 5, 6	North Marin Water District	New (2023)	$1,000,000 (Rate Revenue, Federal and State Grants)	1-3 High	Not Started (install new technology to monitor ground water, seepage, movement within Stafford Dam to allow real-time information gathering)
NMWD-10	Educate Residents on Water Saving Techniques.	Drought/ 1, 2, 3, 4, 5	North Marin Water District	New (2023)	North Marin Water District	New	North Marin Water District
NMWD-11	Oceana Marin Force Main Replacement and Main Pump Station Upgrade/Relocation	Flooding/ 1, 2, 4, 5	North Marin Water District	Existing (2018)	$2,500,000 (Federal and State Grants)	1-5 years High	Ongoing (design phase underway for replacement of the first phase of the OM force main, no work started related to pump station upgrade)
NMWD-12	Olema Domestic Water Pump Station Flood Protection	Flooding/ 1, 2, 4, 5	North Marin Water District	Existing (2018)	$1,500,000 (Federal and State Grants)	3-5 years Medium	Not started (raise or relocate the Olema pump station out of the flood plain)
NMWD-13	Eastern Marin County Creek Crossing Upgrades (Rush, Novato, Leveroni, Vineyard)	Flooding/ 1, 2, 4, 5	North Marin Water District	Existing (2018)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	1-5 years Medium	Not started (identify vulnerabilities at creek crossings and design/implement appropriate changes to enhance resiliency to flooding & earthquake)
NMWD-14	Western Marin County Creek Crossing Upgrades (Olema, Lagunitas, Fish Hatchery, Haggerty Gulch, Silver Hills, Tomasini, and Bear Valley)	Flooding/ 1, 2, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	1-5 years Medium	Not started (identify vulnerabilities at creek crossings and design/implement appropriate changes to enhance resiliency to flooding & earthquake)
NMWD-15	Stafford Dam Mitigation – Spillway Hardening	Flooding/ 1, 2, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	3-5 years Medium	Not started (identify and correct vulnerabilities along the Stafford Dam spillway)
NMWD-16	Stafford Dam Enhancements – Spillway Adjustable Weir Gate	Flooding/ 1, 2, 4, 5	North Marin Water District	New (2023)	$1,250,000 (Rate Revenue)	1-3 years High	In Progress (Preliminary design underway for installation of an adjustable gate at the control notch of the Stafford Dam spillway)

NMWD-17	North Marin Water District Headquarters and Corporation Yard Flood Mitigation Project	Flooding/ 1, 2, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	3-5 years Medium	Not Started (identify and mitigate flooding of District HQ building from adjacent Rush Creek to allow operations during flood events)
NMWD-18	Wooden Tank Replacement – Paradise Ranch Estates Tanks No. 1 & 2	Wildfire/ 1, 2, 4, 5	North Marin Water District	New (2023)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	3-5 years Medium	Not Started (remove and replace two wooden tanks in the West Marin system with steel or concrete tanks)
NMWD-19	Oceana Marin Treatment and Storage Pond Repair	Severe Weather-Wind, Tornado/ 1, 2, 4, 5	North Marin Water District	Existing (2018)	$1,800,000 (FEMA HMGP)	2024 High	In Progress (Design complete, bidding Q3 2023, construction in 2024 to regrade and armor the banks of two ponds that serve the community's wastewater)
NMWD-20	Oceana Marin Cliff-side Sewer Lining	Severe Weather-Wind, Tornado/ 1, 2, 4, 5	North Marin Water District	Existing (2018)	Cost TBD: HMGP, BRIC, CDAA, Private Local Grants	3-5 years Medium	Not started (slip line sewer lines along the steep cliffs to prevent raw sewage spills into the ocean)

Table 22: NMWD Current Hazard Mitigation Actions

3.6 Progress in Local Mitigation Efforts

This plan has been created as a "living" document with input from the population and professionals within the North Marin Water District. 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 21 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.

The planning team for the North Marin Water District identified and prioritized the mitigation actions as detailed in Table 22, based on the risk assessment and in accordance with the process outline in Section 3, Mitigation Strategy, of the base plan. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included. General processes and information on plan implementation and maintenance of this LHMP by all participating jurisdictions is included in Section 4.0: Plan Review, Evaluation, and Implementation.

3.7 Plan Integration

For hazard mitigation planning, "integration" means that hazard mitigation information is used in other relevant planning mechanisms, such as master planning, strategic 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 the 2023 MJHMP will be used for further integration.

The planning team for the North Marin Water District will maintain this plan and will serve as a lead staff for grant project applications on District projects selected for application under the Hazard Mitigation Assistance grant programs.

An important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into town plans and mechanisms. Where possible the North Marin Water District will use existing plans and/or programs to implement hazard mitigation actions both directly within the District and through the coordinated efforts with the Cities and Towns they serve.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. As described in this plan's capability assessment, the North Marin Water District and the Cities and Towns they serve 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 Integration opportunities for the 2023 Marin County MJHMP:

District Master & Strategic Plans - Integrates hazard mitigation through the consideration of hazards most likely to impact the district.

District Emergency Action Plans – Integrates hazard mitigation through the consideration of the District's planned response to hazards most likely to impact the district.

District Dam Emergency Plans – Integrates hazard mitigation through the consideration of the District's planned response to an Emergency Dam incident most likely to impact the district or surrounding community.

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.

The successful implementation of this mitigation strategy will require 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.

3.8 Future Development Trends

Development within North Marin's service areas are managed through the Marin County and/or the City of Novato planning and development departments. North Marin participates in development efforts by reviewing applications and providing will-service notices during the planning phase. These will-serve notices acknowledge that North Marin is capable of providing water (or sanitary sewer) services to the proposed development.

North Marin's 2020 Urban Water Management Plan (Plan) incorporated estimated water use demands by applying projected population and employment growth rates. Additionally, the Plan incorporated planned developments within the District service areas, including new housing required per the Associate of Bay Area Government's (ABAG) Regional Housing Needs Allocation (RHNA) to verity that account growth projections consider all currently anticipated growth. Compliance with the ABAG RHNA is a requirement imposed on local government agencies (Cities and Counties) rather than utility providers and/or special districts.

North Marin's Plan indicates that the District has adequate supply and distribution capacity under normal water year conditions. However, the Plan also indicates that as soon as 2035, based on City and County development projections, North Marin will not have adequate supply and distribution capacity under "dry year" conditions. A dry year is defined as one with below average precipitation, which leads to lower water levels in local reservoirs and a reduction in available water supply. Most recently, North Marin experienced dry year conditions in three consecutive years, from 2020 to 2022.

SECTION 4.0: PLAN REVIEW, EVALUATION, AND IMPLEMENTATION

The strategies presented are deemed appropriate and effective by recommendation of the North Marin Water District.

4.1 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 MJHMP will be presented to local government for formal adoption. As appropriate, the adopted plan and accompanying North Marin Water District Community Profile will then be incorporated into local general plans for integration into organizational policy.

4.2 PLAN MONITORING

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 County and NMWD 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 NMWD is a participating member of the Marin Operational Area Hazard Mitigation Working Group. The NMWD Public Works Director will monitor and update the NMWD Annex to the Marin County OA MJHMP.

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.

4.3 Plan Evaluation

Upon approval and adoption by the NMWD, 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 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, including the NMWD, to evaluate the plan after each update meeting.

4.4 Plan Update

The NMWD General Manager will monitor and update the NMWD Annex to the Marin County OA MJHMP. During the five-year update cycle, the NMWD and the Marin County Office of Emergency Management will hold quarterly update meetings with the Marin Operational Area Hazard Mitigation Working Group and local stakeholders to discuss revisions to the plan and progress updates for the hazard mitigation actions. 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.

4.5 Record of Change

Date	Name / Organization	Change Description / Purpose	Page(s)
7/18/2024	Hannah Tarling Marin OEM	Added “Record of Change” section and table Update table of contents to include new section	140 6
7/18/2024	Hannah Tarling Marin OEM	Corrected acre feet capacity of Novato Creek / Stafford Lake reservoir	54

FIGURES AND TABLES

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ACRONYMS/ABBREVIATIONS

Acronym	Definition
ABAG	Association Bay Area of Governments
ADU	Accessory Dwelling Units
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
BCEGS	Building Code Effectiveness Grading Schedule
BCPUD	Bolinas Community Public Utility District
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
CA	California
CAC	Community Assistance Contact
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
CAV	Community Assistance Visit
CDAA	California Disaster Assistance Act
CDC	Centers for Disease Control and Prevention
CDI	Certified Deaf Interpreter
CEQA	California Environmental Quality Act
CERT	Community Emergency Response Team
CGS	California Geological Survey
CIP	Capital Improvement Plan
CIR	Conservation Incentive Rate
CITR	Conservation Incentive Tier Rate
CMFD	Central Marin Fire District
CMSA	Central Marin Sanitation 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
ECC	Emergency Command Center
EOC	Emergency Operation Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
EPC	Emergency Preparedness Commission
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

FOG	Fats, Oils, & Grease
FPA	Floodplain Administrator
FRA	Federal Responsibility Areas
FY	Fiscal Year
GGBHTD	Golden Gate Bridge, Highway and Transportation District
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
IPCC	Intergovernmental Panel on Climate Change
ISEPA	Identified Site Emergency Planning Application
JPA	Joint Powers Agreement
LCP	Local Coastal Program
LGVSD	Las Gallinas Valley Sanitary District
LHMP	Local Hazard Mitigation Plan
LOMA	Letters of Map Amendment
LOMR	Letters of Map Revision
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
MG	Million Gallons
MGD	Million Gallons Per Day
MHOAC	Medical/Health Operational Area Coordinator
MHW	Mean High Water
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MMI	Modified Mercalli Intensity
MMRC	Marin Medical Reserve Corps
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
NEPA	National Environmental Policy Act
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
NPDES	National Pollutant Discharge Elimination System
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
PUD	Public Utility District
PW	Public Works
RACES	Radio Amateur Civil Emergency Service
RAWS	Remote Automated Weather Stations
RCD	Resource Conservation District
RHNA	Regional Housing Needs Assessment
RTP	Regional Transportation Plan
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
SHSGP	State Homeland Security Grant Program
SMART	Sonoma Marin Area Rail Transit
SMCSD	Sausalito Marin City Sanitary District
SMFD	Southern Marin Fire District
SOD	Sudden Oak Death
SOX	Sulfur Oxides
SQL	Structured Query Language
SR	State Route
SRA	State Responsibility Areas
SSMP	Sewer System Management Plan
SVI	Social Vulnerability Index
TAM	Transportation Authority of Marin
TBD	To Be Determined
TENS	Telephone Emergency Notification System
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
UWMP	Urban Water Management Plan
VHFHSV	Very High Fire Severity Zone
VMP	Vegetation Management Plans
WC/ATWC	West Coast/Alaska Tsunami Warning Center
WHO	World Health Organization
WSCP	Water Shortage Contingency Plan
WUI	Wildland Urban Interface
WWTP	Waste Water Treatment Plant
XSS	Cross-Site Scripting