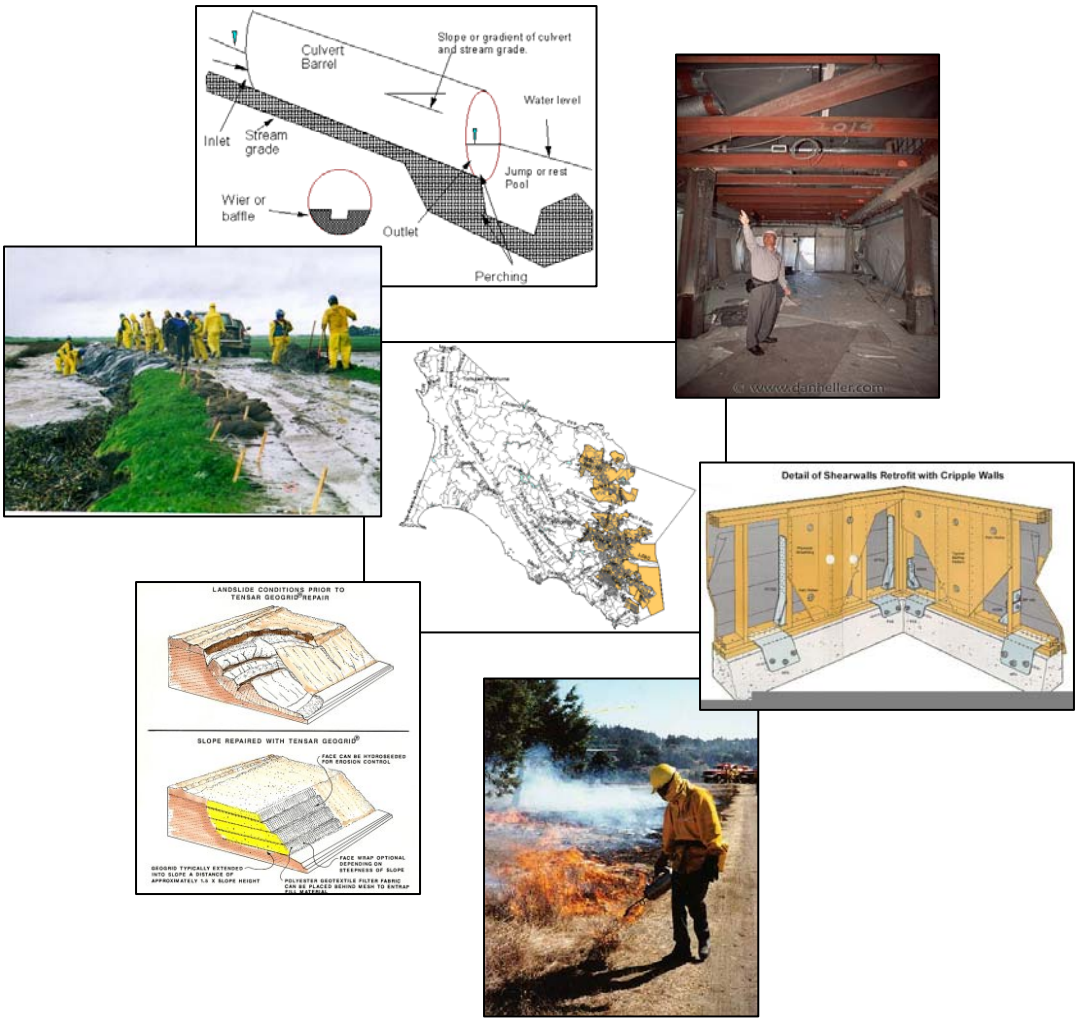
MARIN COUNTY OPERATIONAL AREA HAZARD MITIGATION PLAN



April 2006

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RESOLUTION NO. 2005-47

RESOLUTION OF THE MARIN COUNTY BOARD OF SUPERVISORS REAFFIRMING THE COUNTY OF MARIN'S COMMITMENT TO ITS OPERATIONAL AREA LOCAL HAZARD MITIGATION PLAN

WHEREAS, Marin County is subject to Earthquake, Fire, Flood, Terrorism, and other serious hazards; and

WHEREAS, Marin County faces a major problem during an emergency of the possibility of being isolated from the surrounding communities and any subsequent resources; and

WHEREAS, the County of Marin recognizes that disasters do not recognize city, county, or special district boundaries; and

WHEREAS, the County of Marin seeks to maintain and enhance both a disaster-resistant community by reducing the potential loss of life, property damage, and environmental degradation from natural disasters, while accelerating economic recovery from those disasters; and

WHEREAS, the County of Marin is committed to increasing the disaster resistance of the infrastructure, health, housing, economy, government services, education, environment, and land use systems in the County both in the incorporated and unincorporated areas; and

WHEREAS, the Federal Disaster Mitigation Act of 2000 requires all cities, counties, and special districts to have adopted a Local Hazard Mitigation Plan to receive disaster mitigation funding from FEMA; and

WHEREAS, the County of Marin has approved and adopted the Marin County Operational Area Local Hazard Mitigation Plan.

NOW, THEREFORE, BE IT RESOLVED that the County of Marin commits to continuing to take those actions and initiating further actions, as appropriate, as identified in the Marin County Operational Area Local Hazard Mitigation Plan in the Mitigation Planning and Goals Section.

PASSED AND ADOPTED at a regular meeting of the Board of Supervisors of the County of Marin held on this 26th day of April, 2005, by the following vote:

AYES: SUPERVISORS Charles McGlashan, Cynthia L. Murray, Harold C. Brown, Jr.

NOES: NONE

ABSENT: SUPERVISORS Susan L. Adams, Steve Kinsey

PRESIDENT, BOARD OF SUPERVISORS

ATTEST:

CLERK

Res. No. 2005-47
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- LHMP Announcements/Agendas/Meeting Notes
- LHMP meeting attendees/sign-in rosters

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EXECUTIVE SUMMARY

This Hazard Mitigation Plan is the product of a year long planning process undertaken by the Marin County Sheriff Office of Emergency Services. The purpose is to meet the requirements of the Disaster Mitigation Act of 2000 (DMA) - (Public Law 106-3900) and thereby maintain continued eligibility for certain Hazard Mitigation – or disaster loss reduction – programs from the Federal Emergency Management Agency (FEMA), now a part of the Department of Homeland Security. The Interim Final Rule published in the Federal Register on February 26, 2002 and October 1, 2002 established mitigation planning requirements for local governments.

State and Federal guidance also encourages mitigation planning to address man-made hazards including terrorism. This plan includes terrorism only broadly since mitigation for this hazard is addressed by other agencies operating at a higher level of security. The Marin County Local Hazard Mitigation Plan (LHMP) describes strategies for sustaining and building on current mitigation activities to ensure the future safety of lives, preservation of property, and protection of the environment during times of disaster.

Mitigation planning will improve the ability to recover after disaster. The LHMP is based on critical data with a focus on Hazard Identification, Vulnerability Analysis, and Mitigation Strategies, with a breakout of the major and minor hazards. The major hazards include significant risk detail. The minor hazards are less detailed, using a broader approach.

MARIN COUNTY OPERATIONAL AREA

Marin County is located on the central coast of California, north of the Golden Gate Bridge. It is part of the Governor's Office of Emergency Services Coastal Region.

Marin County covers 521 square miles with a population of over 250,000 in eleven incorporated cities and towns and the county's unincorporated area. Most of the population is located in the urban corridor located along the east-central part of the county, adjacent to Highway 101. Marin County plays a large part in the economy of the San Francisco Bay Area.

Marin County is surrounded by water on three sides: the Pacific Ocean on the west, the San Pablo Bay on the east and the San Francisco Bay on the south. It is adjacent to Sonoma County on the north.

Marin County is connected to its surrounding neighbors by bridges. The Golden Gate Bridge is to the south; the Richmond/San Rafael Bridge is to the east; State Highway 37 is to the north east (along the north part of San Pablo Bay across filled bay land); and Highway 101 is to the north (which narrows to a 4-lane uncontrolled road that transverses the Antonio Creek).

One of the major problems Marin County faces during any emergency is the possibility of being isolated from the surrounding communities and any resources or help.

PLANNING PROCESS

The process for the Marin County Operational Area Hazard Mitigation Plan follows the FEMA prescribed methodology, started in May 2004. Marin County OES staff took the lead by convening two committees, a County Stakeholders Committee and an Operational Area Stakeholders Committee representing planning efforts for multi-jurisdiction risk while defining local authority responsibilities. The various forums and meetings of these committee members defined the scope of the work for the Local Hazard Mitigation Plan to examine the recorded history of losses from natural hazards, and to analyze the future risks posed to the county by these hazards. The risk assessment portion of the plan was defined and specific recommendations for actions to mitigate future disaster losses were identified (*Section 2 – Hazard Mitigation*).

The members of the committees, county department heads, the Disaster Citizens Corps Council, and the Board of Supervisors will monitor the plan as it is amended, at least annually. Stakeholders will monitor progress on individual projects, will be solicited to provide periodic reports on project development, and will be instrumental in evaluating the goals and objectives for expected outcomes of mitigation projects.

Local Planning Mechanisms

This plan considers current Marin County planning mechanisms including existing capital improvement plans, zoning, building codes, agency forums, and comprehensive plans for purposes of mitigation projects and activities. Key components of major plans are integrated in this LHMP.

Marin Countywide Plan

The Marin Countywide Plan 2004, developed by the Marin County Community Development Agency, is a long range general plan that includes a significant section on environmental hazards addressing earthquake, fire, flooding and landslide threats. Community Development Agency public hearings conveyed concern for safety of lives and threats from the environment, extensively reflected in the Hazard Mitigation Plan. Marin County OES staff contributed to the content of the Countywide Plan addressing mitigation strategies for natural caused disasters, subject to various public hearings. This section provides an important reference and basis to the Marin County Hazard Mitigation Plan.

Marin County Fire Management Plan

The Marin County Fire Management Plan's overall goal is to save lives, protect the environment, and to reduce the total cost and losses from wild land fire. Its major components dealing with identifying assets at risk and mitigation strategies to reduce risks are integrated into the plan. Ongoing mitigation efforts include multi-agency and multi-jurisdictional coordinated efforts as described in the plan. Considered future projects for Community Wildfire Protection will be coordinated with LHMP/FEMA prescribed guidelines.

Marin Operational Area Emergency Operations Plan

The Marin County Operational Area Emergency Operations Plan (EOP) includes threat-specific annexes, such as annexes for Spontaneous Volunteers and Special Needs

Populations serving as a significant basis of reference for hazard mitigation and planning.

Other Planning Elements

Comments from the Marin County City Manager's Forum were noted and incorporated into planning activities. City Managers indicated that code references in the Hazard Mitigation Plan are critical and supported the operational area approach for planning due to multi-jurisdiction common hazard issues.

Notations from West Marin representatives – Bolinas, Point Reyes Station, Muir Beach, Stinson Beach – regarding Tsunami threat and concern about public awareness and education were incorporated into this plan.

Board of Supervisors' input concerning wetland restoration is an important consideration in the flood related section of the plan.

Two public media announced workshops were held in Central Marin and West Marin.

- Central Marin

Feedback regarding flood threats in the Kentfield and Ross areas due to large numbers of older homes that were built in low-lying creek areas reflected in the plan.

- West Marin

Coastal flooding combined with high wind, road closures, and wild land fire was noted at this meeting as primary concerns for coastal residents. Due to the rural environment, concerns about response to disaster for West Marin were recognized, including evacuation process and procedure. The Marin County Operational Emergency Operations Plan outlining SEMS utilization during disaster defines capabilities of overall emergency management for the entire county, including mitigation efforts occurring both before and after emergencies and disasters. Marin County OES models a highly effective Building Evacuation Procedure at the Civic Center facility as well as assists local jurisdictions with Building Evacuation Planning. The development of regional evacuation planning will include Marin County specific information.

STRATEGIES

Strategies for current, ongoing mitigation projects have defined elements and follow specific practices. Mitigation plan requirements to be incorporated into planning of projects follow basic current practices:

- Identify lead agency, stakeholders
- Define applicable policies, regulations, funding or practices
- Identify point of contact
- Conduct mitigation capability assessment
- Evaluate criteria for mitigation actions
- Apprise current elected officials/solicit support
- Evaluate alternative mitigation actions
- Identify how mitigation actions will be implemented
- Identify responsible parties and partners
- Identify funding sources

Current Priorities

Current priorities for the county include completing seismic retrofitting for county-owned structures, vegetation management, and flood control projects in several communities of the county. This plan identifies specific projects related to these priorities.

The seismic retrofitting will increase the level of safety during earthquake measuring larger than 7.2 on the Richter scale for the county's 2,500 employees and thousands of individuals who access county owned facilities each year. Plans for a potential Public Safety Building project near the current Marin Civic Center reflect mitigation in all areas of public safety and emergency management.

Vegetation management has included a special Fuel Crew Program to significantly reduce the fuel loading contributor to potential large wildland fires in the county.

A flood control plan for the Ross Valley area of the county is currently under analysis to avoid future recurrent flood damaged infrastructure.

For purposes of implementing potential future projects, planning teams will include building, zoning and code enforcement, councils of government, emergency management, public works, sanitation districts, housing, law and regional planning organizations as they apply. In the event of political implications, consultants may be utilized to ensure an objective evaluation of the effects of the program.

JURISDICTION VULNERABILITY- MAJOR AND MINOR HAZARDS

The planning team in Marin County primarily targeted its major hazards, Earthquake, Fire and Flood, with the intention of meeting FEMA's requirements for the DMA 2000. Specifics on past occurrences for major hazards are discussed in this plan.

The other hazards identified in this plan are addressed to meet State and Federal guidance that will encourage mitigation planning. Significantly less detail is provided for these hazards.

Earthquake - major

The major hazard, earthquake, with a significant seismic event could result in severe property damage to public and private infrastructure including electric distribution lines, telecommunications infrastructure, water, and gas lines.

The damage from a rupture generated by a magnitude of a 7.3 earthquake is predicted to cause large numbers of uninhabitable housing units in the county. Based on selected earthquake scenarios for the jurisdiction's vulnerability, ABAG predicts the following:

Earthquake Scenario	Predicted Uninhabitable Units
Northern Golden Gate San Andreas	2,988
Entire Bay Area San Andreas	3,495
Northern Hayward	1,653
Rodgers Creek	1,549

The median age of structures in Marin County is 41 years old. The County of Marin, by Ordinance No. 3354, has adopted California Building, Plumbing, Electrical and Mechanical Codes whereby no building or structures is erected, constructed, enlarged, improved, removed, or converted without a permit. Adherence to these codes currently allows the county to gather data on retrofitting and current building code compliance. It is important to note that this data continues to have limitations for assessing overall vulnerability in the county for all structures.

The county's topography includes large areas of steep slopes, adding to the vulnerability of earthquake induced disaster with the additional danger of landslide. Bluff erosion along the coastal areas also poses unique threats to coastal structures and roads during times of earthquake.

Fire - Major

The major hazard fire is threat to life, safety, rangeland, recreation, water and watershed, air quality, erosion, structures and wildlife.

Due to landscape and the wildland-urban interface, the Marin County population is extremely vulnerable and the threat is exceedingly high during summer and early fall months. Today's wildfires are very costly. The Mount Vision Fire of 1995 in West Marin is an example of a very damaging and costly fire.
Mount Vision Fire Costs:

- Extinguish Fire $ 6 million
- Structure Damage $ 23 million
- Repair – Utilities, Roads, Slopes $ 1.3 million

Currently total loss figures are difficult to calculate and predict. Fire departments alone cannot fix the problems. It will take cooperation from stakeholders to design mitigation strategies. The largest landowner within Marin County is the United States Government, which owns 80,233 acres with most of its acreage found in the Golden Gate National Recreation and Muir Woods Area.

Flood - Major

Flood, a major hazard threatening the county, particularly in numerous low-lying and coastal areas, continue to create numerous risks to people and the environment.

Flood and inundation hazard areas along the San Francisco Bay, San Pablo Bay, Tomales Bay, and the Pacific Ocean are a constant threat. Although restrictions for development in flood prone areas as they apply to the County's Floodplain Management Ordinance exist, recurring flooding occurs throughout the county due to the unpredictability of tides and heavy rainfall.

Other Hazards - Minor

Other hazards in Marin County include threats that provide limited historical data as a basis to assess vulnerability. This plan addresses Agriculture, Terrorism, Tsunami, and Landslides in addition to most common major hazards known within its jurisdiction. Landslides are generally associated with earthquake and flooding. Terrorism is the most difficult to predict and assess. Tsunami threat assessments are currently being developed, particularly for the immediate coastal and San Francisco Bay land areas. A

Tsunami Emergency Response Plan, currently being drafted by Marin County OES, provides a solid basis for response and mitigation planning.

During the first three to six weeks following a major disaster, emergency shelters for the displaced will become available for the general displaced population. Additional planning for the Special Needs Population is a critical need. Over fifteen percent of the total population in the county is categorized in the Disability Statistics, indicative of a substantial need for mitigation, specifically for this specific vulnerable population

NOTE: Consideration of the current median home price of nearly $1Million and the high cost of all buildings and infrastructure is a substantial factor in the increasing cost of damage due to all potential hazards.

Section 1: Risk Assessment - Major

NOTE: Unless otherwise cited, the primary source for hazard impacts is the Association of Bay Area Governments (ABAG). Because of independent rounding, subcategories in the tables of data may not add to totals.

As the impacts of the "major" threats – earthquake, wildfire, flood – are not completely developed, the Marin County planning team has reviewed the hazards identified based on past disasters and projected future impacts.

EARTHQUAKE

Faults and Probabilities

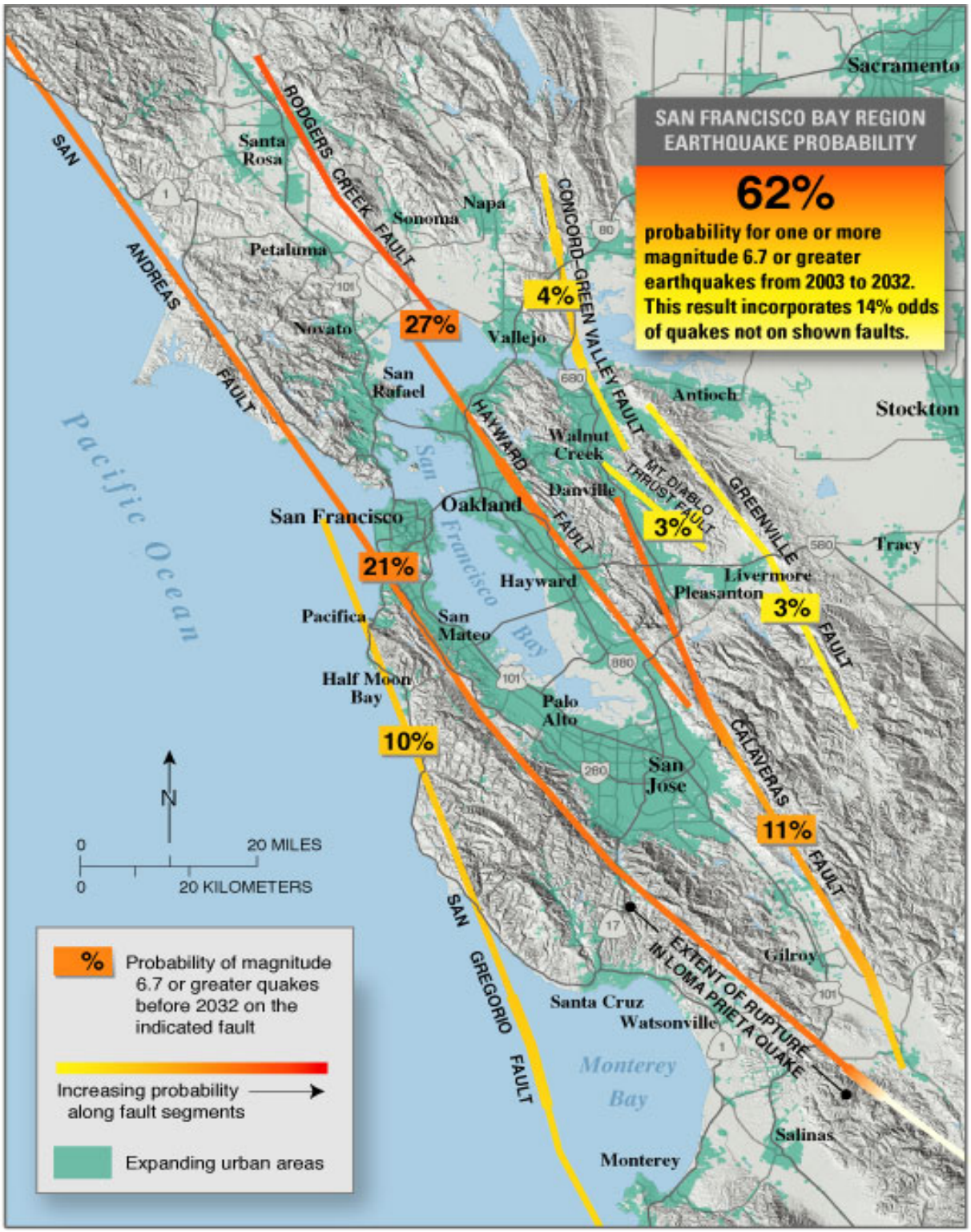
The San Andreas Fault traverses Marin County running north and south in the western quarter of the county. It enters Marin on the Pacific Coast near Bolinas, follows the path of Highway 1, and Tomales Bay, exiting Marin at sea just west of Dillon Beach. In addition, the eastern, more heavily populated part of Marin is less than ten miles from the northern section of the Hayward fault. The northern part of Marin is less than ten miles from the Rodgers Creek fault.

According to a 2003 study of earthquake probabilities prepared by the Working Group on California Earthquake Probabilities and published by the U.S. Geological Survey, the chances are 62% of a major (6.7 or greater magnitude) earthquake occurring in the Bay Area during the period of 2003 to 2032. For the San Andreas Fault, the probability is 11 percent. See San Francisco Bay Region Earthquake Probability diagram on next page.

The report further states that other faults in the area pose a major threat with potential magnitudes of 7.0 for the Rodgers Creek Fault and between 6.7 and 6.9 for the Hayward Fault. Potential slippage of the San Andreas fault could severely impact the county's coastal communities like Bolinas, Point Reyes Station, Stinson Beach and Muir Beach.

The impact of the Loma Prieta Earthquake on October 17, 1989 was most apparent in the northeast area of Santa Cruz. Depending on fault rupture location, a strong shaking such as this would cause severe damage within Marin County, including life-line damages. The Loma Prieta earthquake was not "the big one," which is a common reference to an event of magnitude around 8 or larger (such as the 1906 San Francisco quake). Earthquake aftershocks often occur with additional and unforeseen damage to our infrastructure.

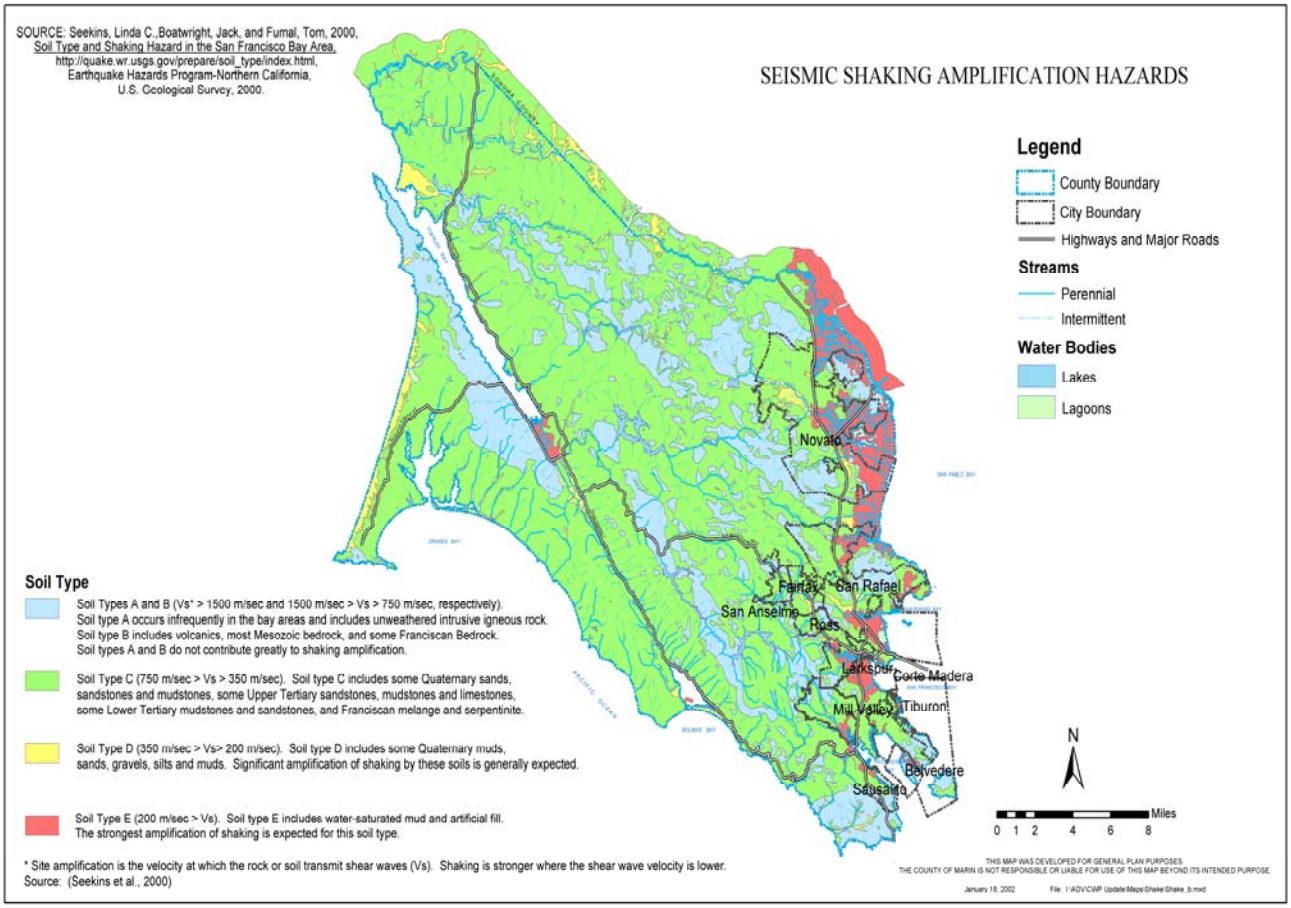
An earthquake occurring in or near these faults could result in significant deaths, casualties, damage to property and environment, and disruption of normal government and community services and activities. Ground failures (fissuring, settlement, and permanent horizontal and vertical shifting of the ground such as surface breaks caused by faulting) that often accompany earthquakes could cause significant damage to network infrastructure such as water, power, communication, and transportation lines in Marin County. These effects could be aggravated by secondary emergencies such as fires, flooding, tsunami, hazardous material spills, utility disruptions, landslides, automobile accidents, transportation emergencies and dam failures.


SAN FRANCISCO BAY REGION
EARTHQUAKE PROBABILITY
62%
probability for one or more magnitude 6.7 or greater earthquakes from 2003 to 2032. This result incorporates 14% odds of quakes not on shown faults.
Sacramento
Santa Rosa
Napa
Sonoma
Petaluma
Novato
Vallejo
San Rafael
Antioch
Stockton
Walnut Creek
Danville
Oakland
San Francisco
Hayward
Pleasanton
Livermore
Tracy
Pacifica
San Mateo
Half Moon Bay
Palo Alto
San Jose
Gilroy
Santa Cruz
Watsonville
Salinas
Monterey
Pacific Ocean
San Francisco Bay
Monterey Bay
SAN ANDREAS FAULT
RODGERS CREEK FAULT
CONCORD-GREEN VALLEY FAULT
HAYWARD FAULT
MT. DIABLO THRUST FAULT
GREENVILLE FAULT
CALAVERAS FAULT
SAN GREGORIO FAULT
EXTENT OF RUPTURE IN LOMA PRIETA QUAKE
27%
4%
21%
3%
3%
10%
11%
N
0
20 MILES
0
20 KILOMETERS
% Probability of magnitude 6.7 or greater quakes before 2032 on the indicated fault
Increasing probability along fault segments
Expanding urban areas

Marin County Earthquake History

The San Andreas Fault was the source of the 1906 earthquake with a magnitude of 7.8. Marin was sparsely inhabited at that time and experienced relatively moderate property loss and only two deaths. Although the epicenter was south of San Francisco, West Marin experienced some pronounced natural earthquake phenomena. This included a horizontal earth displacement of 21 feet near the head of Tomales Bay. On October 17,1989, a magnitude 7.1 earthquake occurred on the San Andreas Fault, the largest earthquake to occur in the San Francisco Bay Area since 1906.

Seismic Shaking Amplification Map



Profiling Earthquake Hazards

Ground shaking damage will vary from slight to intensive depending upon the magnitude of the earthquake and proximity to the epicenter. It is expected that a major earthquake on the Hayward fault could leave Marin County cut off from surface access; therefore movement within the county would be severely limited. Projections indicate up to 58 locations where roads could be impassible. In addition, outside resources would be focused on the more severely impacted East Bay communities.

Marin County owns and leases buildings considered to be "critical buildings" which include those that have architectural or historic distinction, cultural value critical to the recovery of our community, and are vital to the continuity of government functioning (including provision of social services). (*APPENDICES Reference Section #2:* Ground Shaking Tables, Building Log; Government Facilities Inventory Collection Forms)

- **Shaking Potential**

The majority of Marin County's single-family buildings with foundations to bedrock will perform well in a shake. Modern multi-story buildings with foundations to bedrock should not be subject to collapse, although some serious damage may occur. However, many heavier developed areas are built on soft alluvial soils or filled-in water ways. These soils will significantly increase the shaking effects and will account for the majority of damaged and destroyed structures, regardless of their proximity to the fault line.

Shaking Potential	Total Acres	Lowest	>>	>>>	>>>>	Highest
RESIDENTIAL (excluding mixed use):	30,229	251	0	18,692	8,036	3,250
1 unit/1-5 acre lot (Rural Residential)	11,148	89	0	6,539	3,661	859
1-3 units/acre (Not Mobile Home Parks)	8,719	95	0	5,829	1,924	871
3-8 units/acre (Not Mobile Home Parks)	8,213	59	0	5,122	1,959	1,072
>8 units/acre, Multifamily, Group Quarters	1,953	8	0	1,106	491	348
Mobile Home Parks	196	0	0	96	0	99
INDUSTRIAL (excluding mixed):	592	8	0	239	20	325
Salvage/Recycling, Mixture	592	8	0	239	20	325
TOTAL INFRASTRUCTURE:	10,149	80	0	5,361	2,410	2,298
TOTAL COMMERCIAL SERVICES (excluding mixed)	6,120	82	0	3,061	1,010	1,968
Subtotal-Commercial:	5,666	82	0	2,791	912	1,880
Retail/Wholesale	156	1	0	59	8	89
Research/Office	107	0	0	107	0	0
Other, Mixture or Unknown	5,402	81	0	2,625	905	1,791
Subtotal-Education:	54	0	0	36	14	3
Colleges/Universities	51	0	0	36	14	0
Subtotal-Hospitals and Health Care Facilities	256	0	0	156	75	25
Trauma Center Hospitals	49	0	0	29	1	19
State Prisons	207	0	0	127	75	6
Subtotal-Public Institutions:	144	0	0	77	7	59
Convention Centers	73	0	0	16	0	57
City Halls/County/Admin	55	0	0	52	0	2

Other-Community Centers and Libraries	9	0	0	2	7	0
TOTAL URBAN OPEN:	5,409	105	0	2,784	1,590	929
Golf Courses	1,083	0	0	576	424	83
Cemeteries	225	0	0	173	30	22
Parks	360	1	0	184	124	50
Vacant--Undeveloped	3,559	105	0	1,774	976	705
TOTAL AGRICULTURE:	8,379	108	0	4,203	1,007	3,061
Cropland and Pasture	8,293	108	0	4,169	996	3,020
Farmsteads and Inactive	77	0	0	34	12	32
TOTAL RANGELAND:	156,110	1,304	365	61,683	71,877	20,881
Herbaceous Range	141,325	1,182	347	56,746	64,413	18,638
Shrub and Brush	12,556	82	18	3,621	7,026	1,810
Mixed Range	2,229	41	0	1,317	438	433
TOTAL WETLANDS (Based on USGS Mapping):	3,760	213	3	764	1,150	1,630
Forested	329	7	0	72	142	108
Non-Forested	3,431	207	3	692	1,008	1,522
TOTAL FOREST LAND:	106,231	217	344	41,740	49,447	14,483
Deciduous	5,508	26	29	2,977	2,116	359
Evergreen	67,893	104	94	21,965	34,398	11,333
Mixed Forest	32,830	87	220	16,799	12,933	2,791
	======	======	======	======	======	======
	Total Acres	Lowest Potential	>>	>>>	>>>>	Highest Potential
TOTAL URBAN LAND:	52,784	541	0	30,198	13,066	8,980
TOTAL NON-URBAN LAND:	274,517	1,842	711	108,428	123,482	40,055
GRAND TOTAL:	327,302	2,382	711	138,626	136,547	49,034

- **Liquefaction Susceptibility**

Subsidence and differential settlement can occur along Bay Mud and Marshland areas of Marin, leading to damage of any structures sited on those lands. Many of these areas have been artificially filled over the years causing differential settlement. To date, most liquefaction hazard investigations have focused on assessing the risks to commercial buildings, homes, and other structures.

Liquefaction Susceptibility	Total Acres	Moderate	High	Very High
TOTAL RESIDENTIAL LAND (excluding mixed use):	30,229	2,249	3,445	1,624
1 unit/1-5 acre lot (Rural Residential)	11,148	574	483	121
1-3 units/acre (Not Mobile Home Parks)	8,719	505	923	371
3-8 units/acre (Not Mobile Home Parks)	8,213	976	1,526	801
>8 units/acre, Multifamily, Group Quarters	1,953	117	512	275
Mobile Home Parks	196	77	1	55
TOTAL INDUSTRIAL [excluding mixed]:	592	46	117	223
Salvage/Recycling, Mixture or Unknown	592	46	117	223
TOTAL MAJOR INFRASTRUCTURE:	10,149	1,176	2,159	1,507
Roads, Highway and Related Facilities	9,644	1,158	1,972	1,385
Airports	113	0	113	0
Ports	9	0	0	7
Infrastructure--Other, Unknown	383	18	73	115
TOTAL MILITARY:	286	0	32	176
General Military	286	0	32	176

TOTAL COMMERCIAL/SERVICES	6,120	731	1,712	1,243
Subtotal-Commercial:	5,666	646	1,664	1,130
Retail/Wholesale	156	38	33	64
Research/Office	107	85	0	0
Other, Mixture or Unknown	5,402	523	1,631	1,066
Subtotal-Education:	54	18	21	3
Elementary/Secondary	3	0	0	3
Colleges/Universities	51	18	21	0
Subtotal-Hospitals and Health Care Facilities	256	48	0	57
Trauma Center Hospitals	49	9	0	9
State Prisons	207	39	0	48
Subtotal-Public Institutions:	144	19	27	52
Convention Centers	73	19	5	48
City Halls/County Administration	55	0	10	4
Local Jails	8	0	8	0
Other-Community Centers/Libraries	9	0	4	0
TOTAL URBAN OPEN:	5,409	576	536	580
Golf Courses	1,083	310	41	140
Cemeteries	225	0	14	0
Parks	360	21	133	50
Vacant--Undeveloped	3,559	221	321	318
Mixed Urban Open, Including Parks	182	24	26	72
TOTAL AGRICULTURE:	8,379	666	3,285	106
Cropland and Pasture	8,293	658	3,259	102
Orchards/Groves/Vineyards	9	0	9	0
Farmsteads and Inactive	77	8	18	3
TOTAL RANGELAND:	156,110	11,367	7,488	1,998
Herbaceous Range	141,325	10,833	6,970	1,755
Shrub and Brush	12,556	436	340	127
Mixed Range	2,229	98	179	116
TOTAL WETLANDS (Based on USGS Mapping):	3,760	180	1,340	367
Forested	329	21	81	34
Non-Forested	3,431	160	1,259	334
Salt Evaporators	0	0	0	0
Wetlands--Unknown	0	0	0	0
TOTAL FOREST LAND:	106,231	1,855	1,208	413
Deciduous	5,508	189	103	41
Evergreen	67,893	568	546	91
Mixed Forest	32,830	1,098	559	282
TOTAL SPARSELY VEGETATED:	38	5	0	0
Mines/Quarries	38	5	0	0
	=========	=========	=========	=========
	Total Acres	Moderate	High	Very High
TOTAL URBAN LAND:	52,784	4,779	8,001	5,354
TOTAL NON-URBAN LAND:	274,517	14,074	13,321	2,884
GRAND TOTAL:	327,302	18,852	21,322	8,238

FIRE

NOTE: More detailed fire threat information is contained in the Marin County Community Fire Plan.

Wildfire

Marin's topography varies from relatively flat coastal tidelands, to Oak Savanna with rolling hills, to the steep brush covered slopes of Mount Tamalpais. Vegetation types vary from the Oak Savanna, to Dense Oak and Bay Tree woodlands, to dense groves of Coastal Redwood and Douglas Fir. Surrounded by water on three sides, combined with canyons and valleys, the county also enjoys a variety of micro-climates. This is evident in the summer months when Southern Marin may be shrouded in fog while the interior valleys are experiencing warmer temperatures.

Much of the county is characterized by canyons and narrow valleys surrounded and intermingled with steep, hilly terrain. This type of topography is susceptible to wildland fires that pose significant challenges to fire-fighting abilities.

Wind is a predominant factor in the spread of fire. Marin County has a characteristic north-west wind that originates from the Pacific Ocean and will frequently become a factor in fire suppression efforts. During the dry season, the county also experiences occasional strong northeast winds.

When a wildfire ignites in a high risk wildland/urban intermix area, the priority is life and property protection. The major wildland fire hazard risks for residential development are in Marin County's hilly areas, predominantly west of the Highway 101 corridor. Much of this area is characterized by steep slopes, poor fire access, inadequate water pressure and highly flammable vegetation.

Marin County Wildfire History

Wildfires are a natural and integral part of Marin County's ecosystem. Historical fire suppression practices extinguished fires in a timely manner. Now increased population has altered what was an occasional and beneficial natural occurrence into a frequently man-made event. Because of the massive build-up of fuel and the proximity of residences, any wildland fire has the potential to become a major inferno. Historical data reminds us that Marin County has not been a stranger to major wildfires.

September,1881 - William Pixley, while cleaning his land by burning brush in Corte Madera, set a fire that escaped his control, swept up the slopes of Mount Tamalpais and reportedly burned 65,000 acres before being controlled.

September, 1889 - The San Francisco Chronicle newspaper reported that "sparks from a passing train set fire to brush at the Corte Madera Depot. The fire soon spread and reached into heavy timber in the mountains where it raged fiercely."

October, 1890 - The Morning Oregonian newspaper reported that "for the past ten days a forest fire had been raging in the Coast Range Mountains between San Rafael and Bolinas, Marin County. Over 8,000 acres has burned and the fire is still burning in an easterly direction."

June, 1891 - The San Francisco Chronicle newspaper reported "A fire started in Bill William's Gulch at the base of Mount Tamalpais, swept the sides of the mountains in the dense woods area near Lagunitas and the Kent property, covering 12,000 acres."

September, 1904 - The Marin Journal newspaper reported "one of the most disastrous forest fires commenced on Bolinas Ridge behind the Hasbrouck property." Fanned by northerly winds, flames rushed westward over the ridge to numerous other ranches.

September 1923 - The largest fire in Marin County history burned 40,000 acres from Lucas Valley to Bolinas. The second largest fire occurred in 1936 and burned 4,000 acres.

July, 1929 - The fourth largest but most destructive fire in Marin history was the Mill Valley Fire. This burned 1,000 acres and destroyed 110 homes in Mill Valley. Damage was more than one million dollars.

October, 1995 - Mount Vision Fire burned more than 12,000 acres of Point Reyes National Seashore in West Marin County. The fire destroyed 48 homes.

1995 Mt. Vision Fire

Other Fire Concerns

Several other conditions contribute to Marin County's fire problem. During recent years, the fuels have been changing due to Sudden Oak Death. These changes include mostly dead, dry fuel on the ground. The diminished number of oak trees allows the forests to be increasingly dominated by more fire hazardous trees such as Bay and Laurel. This is compounded by light fuel type vegetation that have grown into the areas underneath the canopies of the dead trees.

Another type of vegetation that contributes to heavy fuel loading is Eucalyptus. Eucalyptus trees are found throughout the county. The trees and their leaves are highly flammable. Large groves exist around San Pedro Ridge and the slopes above Tamalpais Valley.

Hundreds of homes are located in box canyons covered with heavy fuels. Many of these areas have narrow roads, one lane access or only one way out. During a fire in this kind of area, evacuation is a serious concern. An example of this is the October, 1991 Oakland Hills Fire in Alameda County which started in a box canyon.

Several homes built prior to code changes (early 1990's) still have wood shake roofs that are highly combustible. Other homes are built into hillsides using stilt construction. Many of these homes can be destroyed when fire ignites at the base of a hill and travels upslope faster than fire engines can respond. As an example, since the year 2000, the City of Novato has experienced two fires that destroyed five structures at the cost of $1,355,173 (not including the cost of the land).

This photo depicts an example of streets that dead end in a box canyon. When the wind blows toward the end of box canyons, fire is forced to "chimney" through the canyon with very high intensities. Several areas throughout the county pose this type of problem.

Due to the age of many homes in Marin County, there are numerous older dwellings with wood shingle roofs.

Many homes throughout the county have several wood decks and are surrounded by highly flammable vegetation. During a fire, rising heat is trapped under the decks or other protrusions, jeopardizing the home.

Wildland - Urban Interface (WUI)

There are three main factors used to characterize the wildland-urban interface fire threat: topography, vegetation, and climate. Due to an abundance of these factors, Marin County is considered to have the greatest potential for a large wildland fire in California.

The Federal Register has defined the Wildland-Urban Interface (WUI) Community. The WUI is made up of both “interface” and “intermix” communities. In both communities, housing and development must meet or exceed a minimum density of one structure per 40 acres. Defining the two terms, “intermix” communities have more than 50% vegetation with more than one house per 40 acres. “Interface” communities are areas with housing in the vicinity of neighboring wildland vegetation. The California Fire Alliance (2001) defined “vicinity” as all areas within 1.5 miles of wildland vegetation covering at least one 1,325 acre Census block. These limitations were designed to ensure that areas surrounding small urban parks are not classified as interface WUI.

For large damaging fires to occur, three elements must be present. The components of the WUI triangle are structures, hazardous vegetation, and a weather event. While structures and vegetation are somewhat static, weather is an ever-changing phenomenon that is difficult to assess and predict. The two greatest factors concerning structure survivability are defensible space and building construction. Once a structure ignites, there is a high possibility additional structures will also burn due to radiant heat and ember lofting.

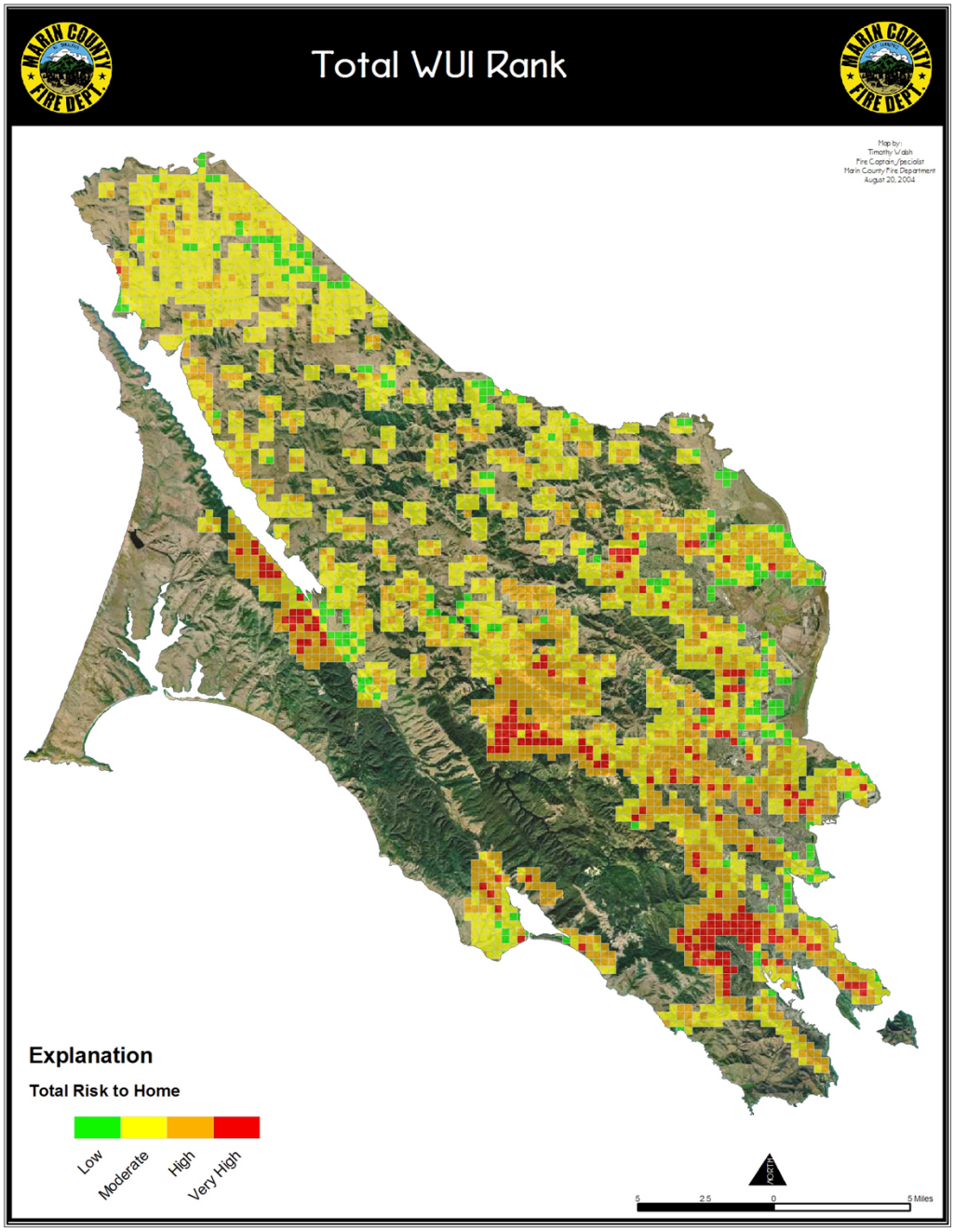
The WUI can be identified in areas where dwellings and vegetation exist at a certain mixture. If the density of housing is too high, the fire threat is not as great as in areas where the density is lower but interspersed with vegetation. It is at that point where the density of housing becomes critical in determining the nature of the WUI threat. See an example of a Density Map on the next page.

WUI Structure Density Map

A query was created to find parcels with a living unit. A point was placed in the center of each of the parcels meeting the query criteria (see WUI Rank Map next page). A computer program calculated the density of the points and determined structures per acre.

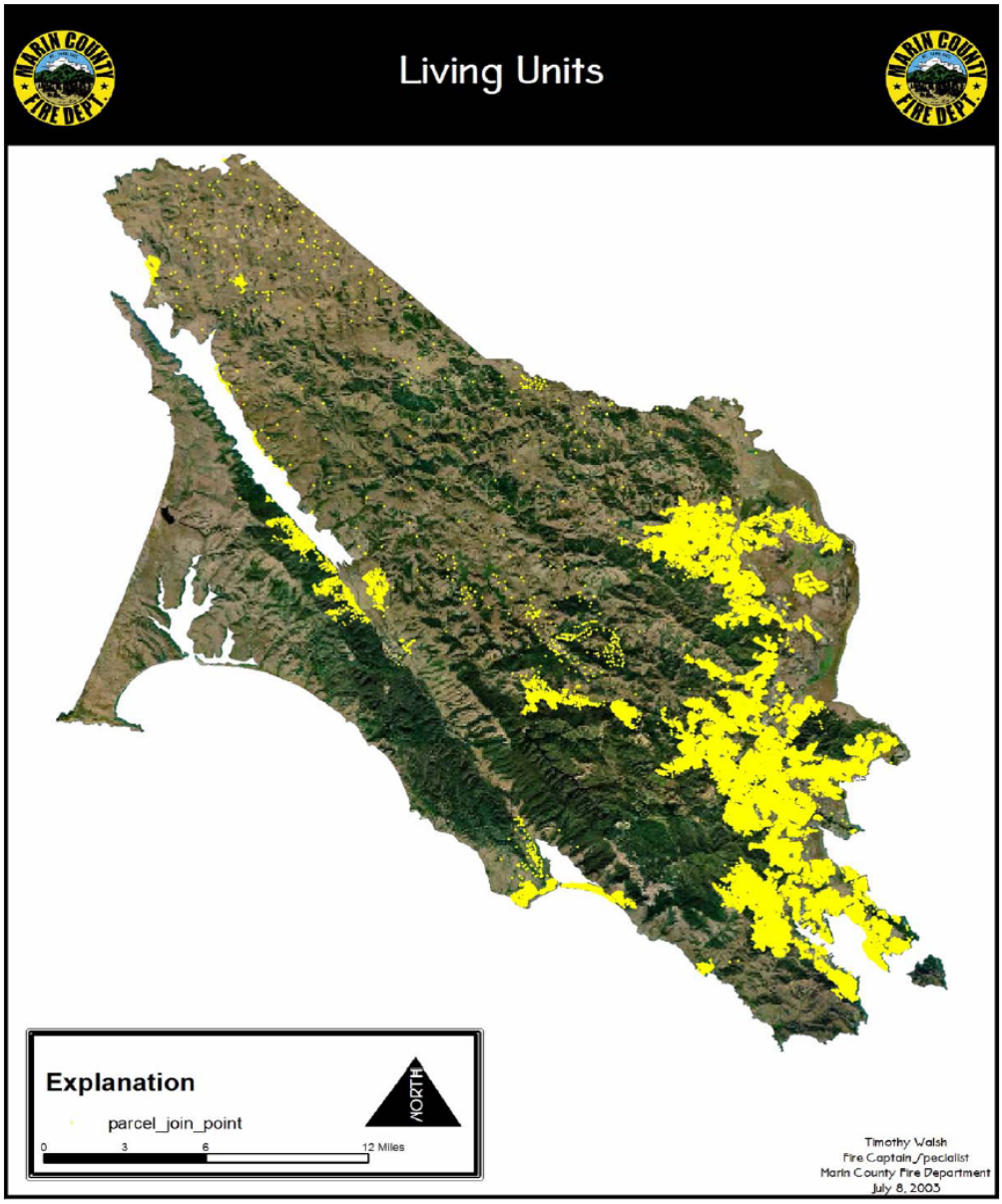
To determine structure density, a point (red dot) was placed in the center of each parcel. On small parcels, the spatial accuracy is very high but deteriorates as the size of the parcel increases. The image on this density map is of western Novato with Stafford Lake seen on the far left side of the image. In contrast to the Federal criteria of WUI (area greater than one house per 40 acres), a structure density of 1.75 homes per acre was chosen to delineate the WUI. Based on field experience, this number was chosen to define an area that represents the locations where the homes meet the wildland.

WUI Rank Map



Total Wildland Urban Interface Rank for Marin County was determined by a computer program calculating density of structures per acre, showing total risk to home on a scale of low to very high.

Living Units Density Map



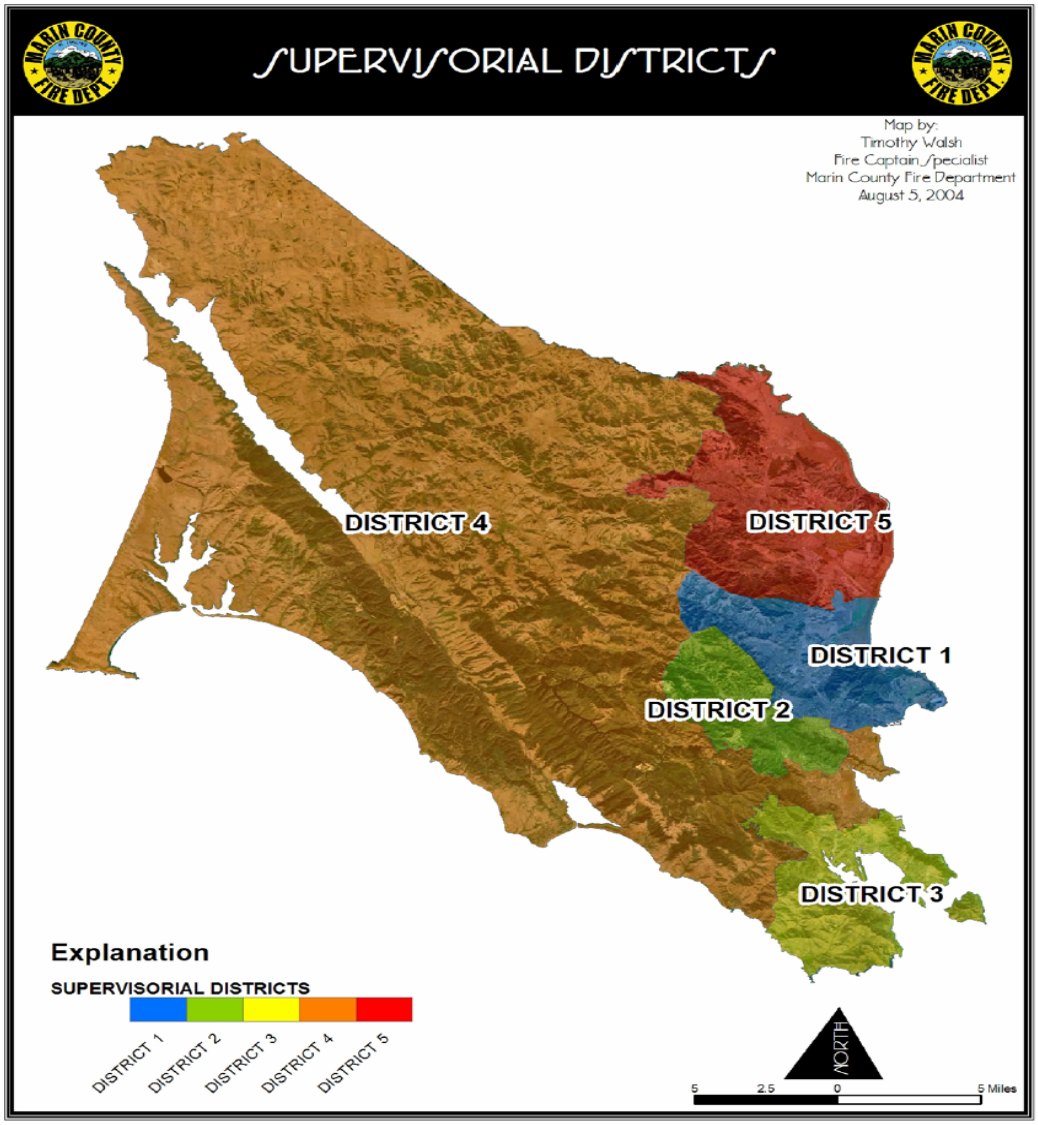
Structure Density Map depicting less than 1.75 homes per acre.

- **Assessing the Wildland/Urban Interface**

The county was divided into five geo-political zones that coincide with the Marin County Board of Supervisor's Districts (see Supervisorial Districts Map this page). They are referred to in this plan as Fire Management Zones. This was done to create a more manageable area for decision-making. The Supervisor Districts contain an average of approximately 15,800 living units each. See Table below.

Number of Living Units and Acres of each Supervisor District.

Supervisor District	Number of Living Units
One	15,379
Two	15,274
Three	17,429
Four	15,206
Five	15,871



- **Vegetation Management**

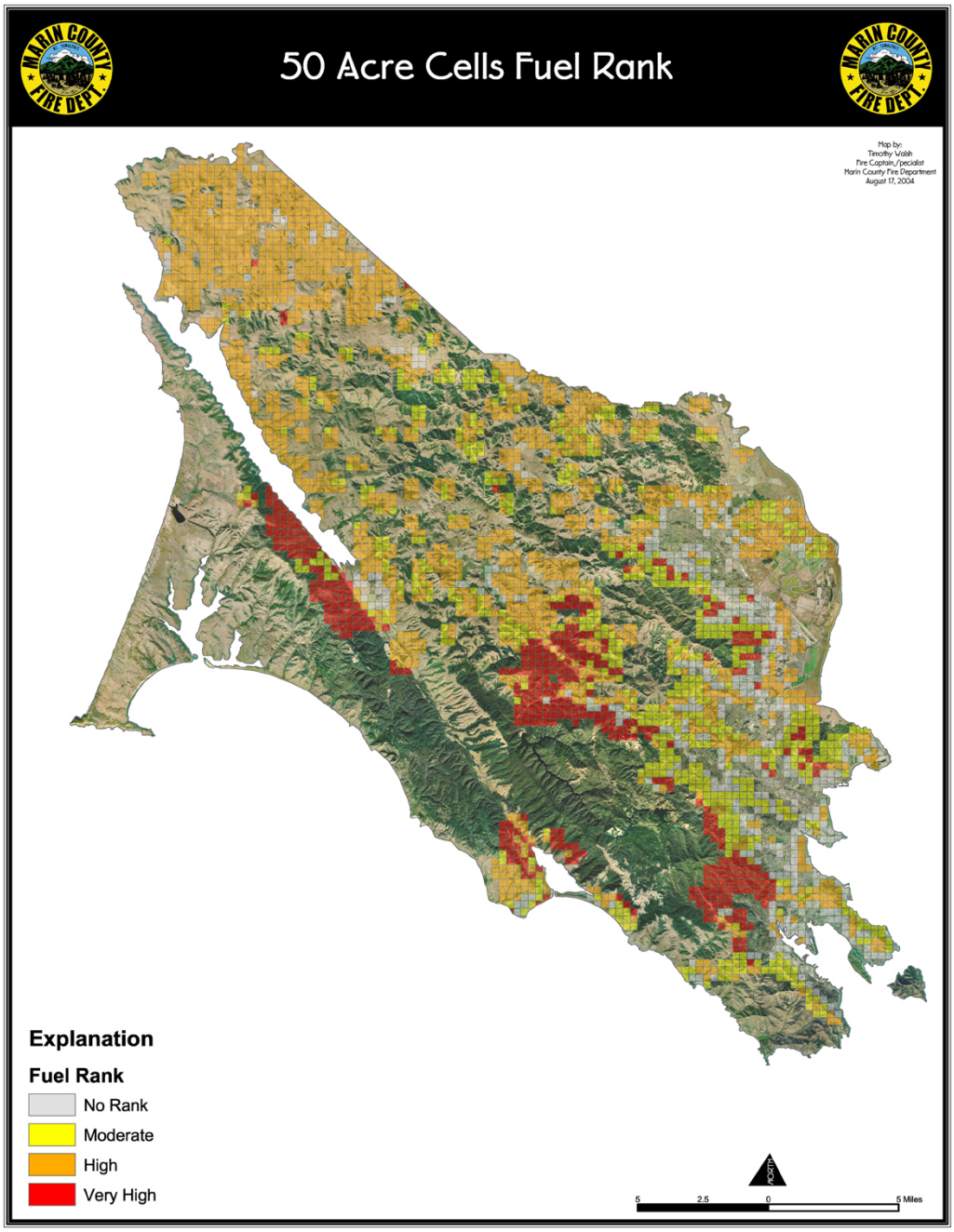
The Mount Tamalpais Area Vegetation Management Plan summarizes existing fire hazards in that area. Although the plan was prepared for the "Study Area" around Mount Tamalpais, this plan describes the dangers of vegetation found throughout the county:

> "The vegetation on the Study Area would support a catastrophic wildfire under severe weather conditions. Given the existing fuels on the Study Area, the lack of access due to overgrown fire roads and the distance from fire stations, steep and often inaccessible terrain, and the closeness of residential areas to the Study Area, a wildfire could burn thousands of acres and large numbers of structures. Fire departments would not be expected to control a wildfire under such conditions; the fire would ultimately be controlled when weather conditions changed. This would be similar to the occurrences of the 1991 East Bay Hills Fire."

To assess the vegetation, a fuel model ranking system was applied to develop a countywide fuel hazard ranking map. See Table below and Fuel Hazards Ranking Map on the next page.

Fuel Model	Description	Rank
1	Annual Grass	2
2	Valley Oak Woodland/Grass Understory	3
4	Mature Brush	3
5	Coastal Shrub	1
8	Oak/Bay/Madrone	2
9	Moderate Conifer	2
10	Heavy Conifer	3
28	Urban	Not Ranked
97	Agriculture	Not Ranked
98	Water	Not Ranked
99	Barren/Sand	Not Ranked

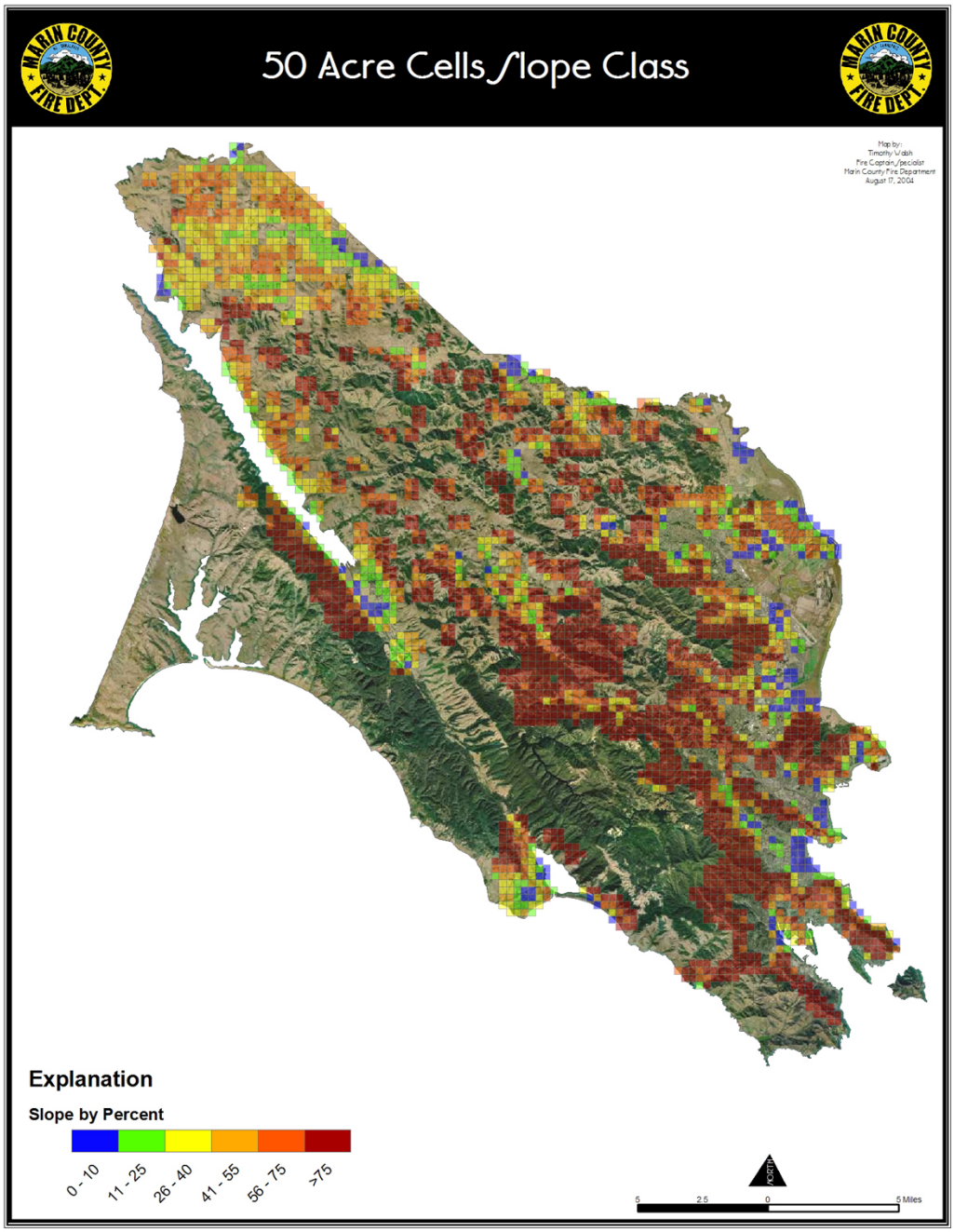
Fuel Hazards Ranking Map



This 50 Acre Grid Cell Map is ranked for Fuel Hazards.

- **Slope**

Slope is a measure of hillside steepness commonly expressed in percent. For example, a 1 percent slope means a rise of 1 foot in elevation for each 100 feet in horizontal distance. If all factors remain constant, fires will burn more rapidly on hillsides with steep slopes than on gradual slopes. Each 50 acre cell receives a ranking from 0 to 4.

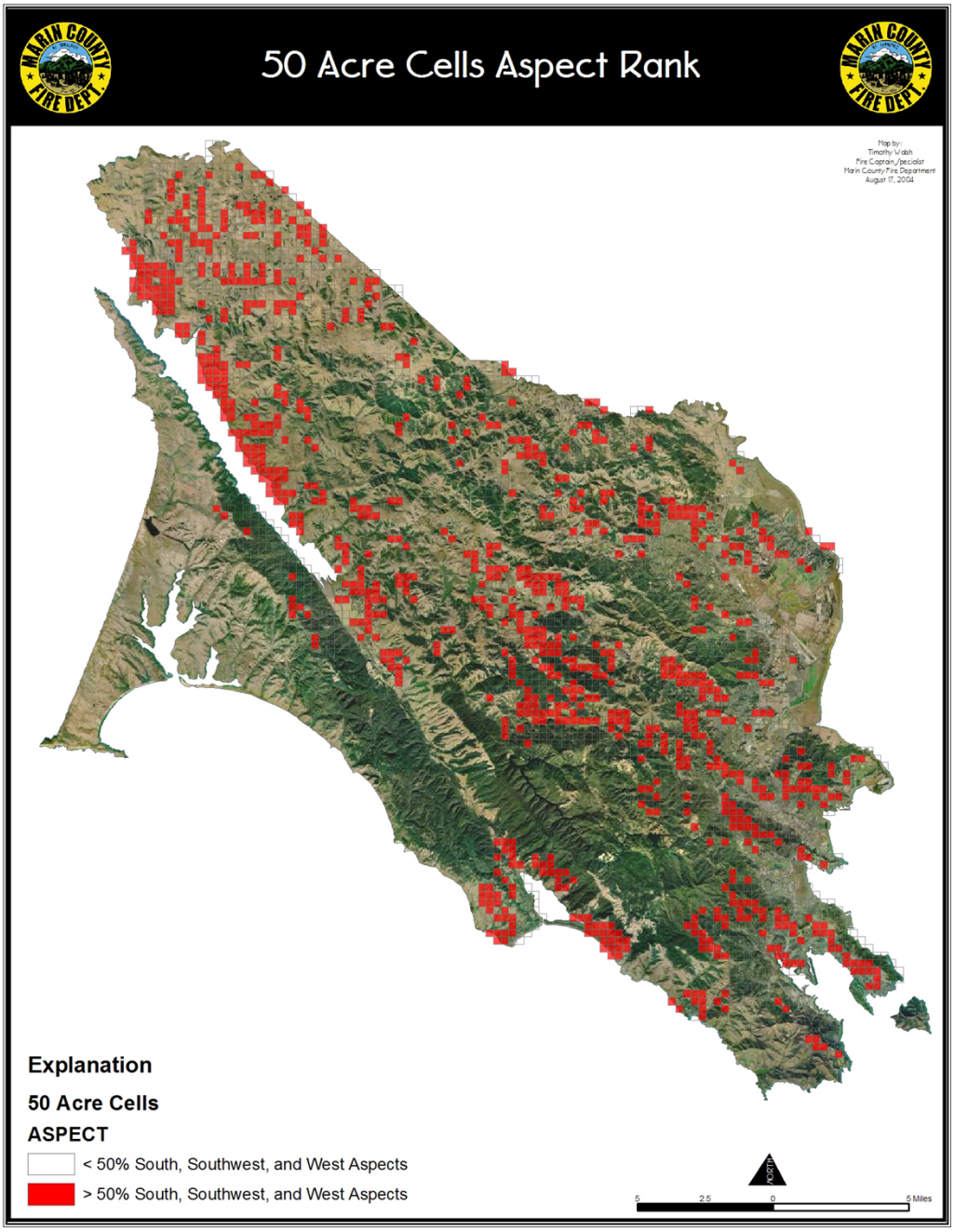


Slope Rankings: 0-10% = 0 11-25% = 1 26-40% = 2 41-60% = 3 >60% = 4

Aspect

Aspect is the direction each hillside faces. The fuel temperature on a southwest-facing slope will be significantly higher in the late afternoon because of the increased radiant solar energy received by fuels with these aspects.

Each 50-acre cell was assessed for south, southwest, and west facing aspects. If the cell had over 50 percent these aspects, it was given a rank of one.



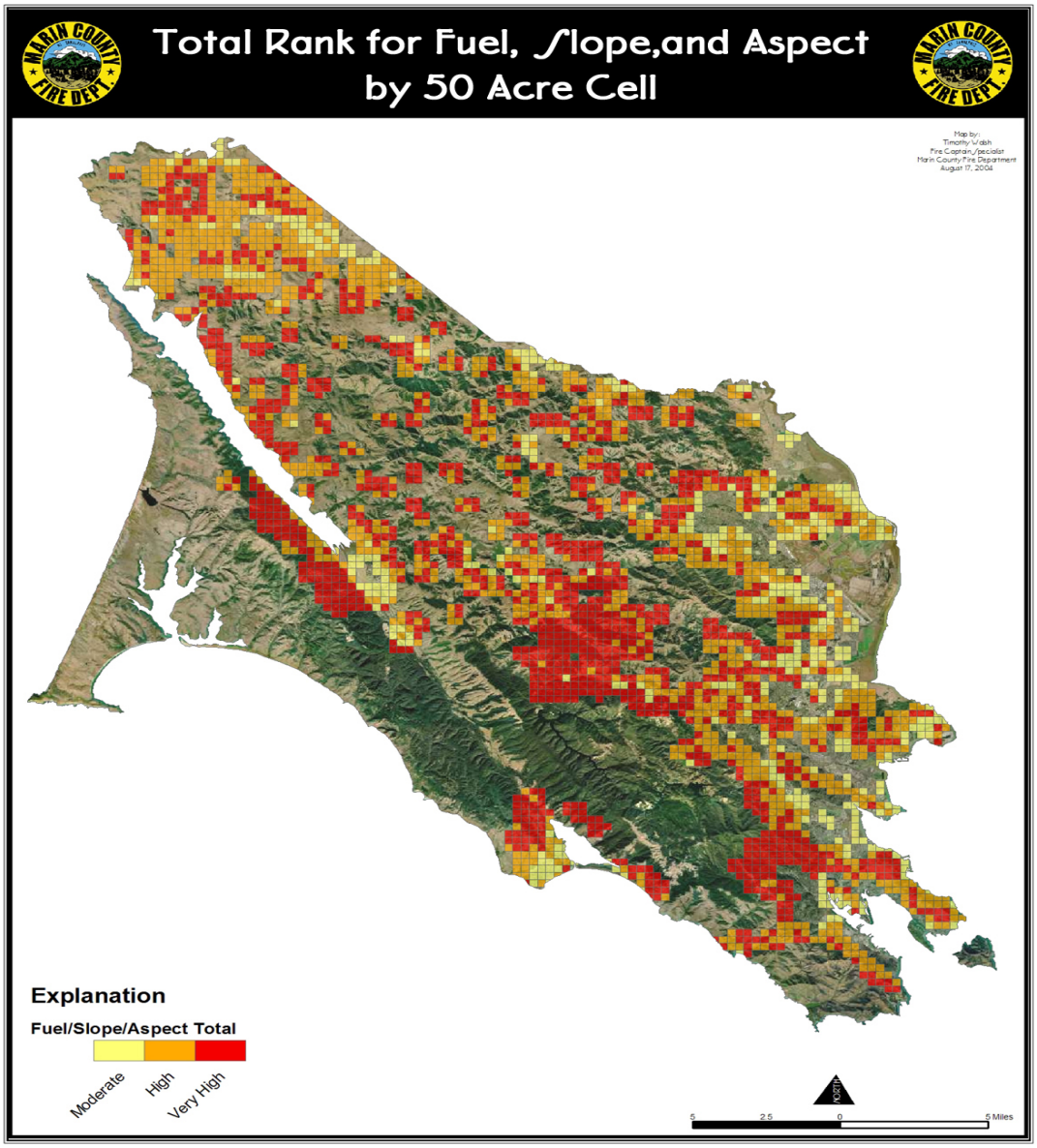
The red 50-acre cells have a least 50 percent of their slopes facing to the south, southwest, or west. This alignment with the sun results in vegetation that is closer to its ignition temperature with lower fuel moisture.

- **Total Hazard Rank**

To determine the Total Hazard Rank for each 50-acre cell, ranks were summed for fuel type, slope, and aspect.

Hazard Ranking Categories

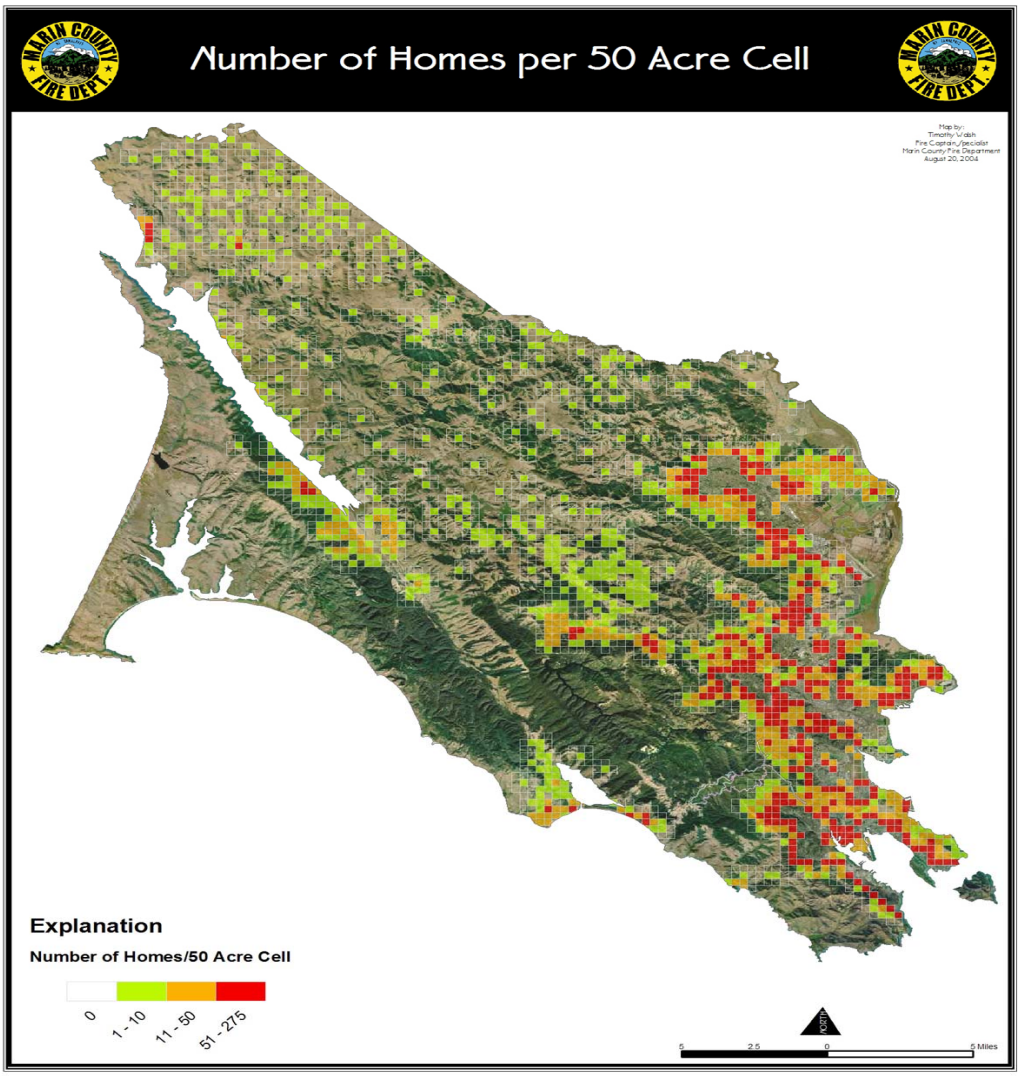
Summed Rank	Description
0-3	Moderate
4-6	High
7-8	Very High



- **Assets at Risk**

There are numerous factors that affect how vulnerable a structure is to a wildfire ignition. Roof composition, siding material, construction type and materials, slope, and defensible space are some general variables that affect structure survivability. For this analysis, the total hazard classification and housing density were used to define structure vulnerability. To define assets at risk, the number of homes that are near the fire hazard was calculated. Each 50-acre cell was assessed to determine the number of homes within each cell. A rank was assigned to each 50-acre cell based on housing density.

Number of Homes per 50 Acre Cell	Rank	Description
0	Not Ranked	Low
1-10 Homes	1	Moderate
11-50 Homes	2	High
> 50 Homes	3	Very High



Profiling Fire Threats

- **Wildland - Urban Interface Fire Threat**

The Wildland-Urban Interface, defined as the area where structures and other human development meet or intermingle with undeveloped wildland, creates an environment in which fire can move readily between structural and vegetation fuel.

Wildland Urban Interface Fire Threat	Total Acres	Within Threat Area
TOTAL RESIDENTIAL LAND (excluding mixed use):	30,229	23,254
1 unit/1-5 acre lot (Rural Residential)	11,148	7,768
1-3 units/acre (Not Mobile Home Parks)	8,719	6,797
3-8 units/acre (Not Mobile Home Parks)	8,213	6,854
>8 units/acre, Multifamily, Group Quarters	1,953	1,645
Mobile Home Parks	196	190
TOTAL INDUSTRIAL (excluding mixed):	592	323
TOTAL MAJOR INFRASTRUCTURE:	10,149	6,957
Roads, Highway and Related Facilities	9,644	6,774
Airports	113	21
Ports	9	0
Infrastructure--Other, Unknown	383	161
TOTAL MILITARY:	286	170
General Military	286	170
TOTAL COMMERCIAL/SERVICES (excluding mixed):	6,120	3,840
Subtotal-Commercial:	5,666	3,500
Retail/Wholesale	156	87
Research/Office	107	0
Other, Mixture or Unknown	5,402	3,413
Subtotal-Education:	54	51
Elementary/Secondary	3	0
Colleges/Universities	51	51
Subtotal-Hospitals and Health Care Facilities	256	190
Trauma Center Hospitals	49	30
State Prisons	207	160
Subtotal-Public Institutions:	144	100
Convention Centers	73	54
City Halls/County Administration	55	29
Local Jails	8	8
Other-Comm. Centers/Libraries	9	9
TOTAL URBAN OPEN:	5,409	3,883
Golf Courses	1,083	523
Cemeteries	225	121
Parks	360	240
Vacant--Undeveloped	3,559	2,858
Mixed Urban Open, Including Parks	182	142
TOTAL AGRICULTURE:	8,379	1,270
Cropland and Pasture	8,293	1,243
Orchards/Groves/Vineyards	9	0
Farmsteads and Inactive	77	27
TOTAL RANGELAND:	156,110	10,207
Herbaceous Range	141,325	7,785
Shrub and Brush	12,556	803
Mixed Range	2,229	1,619
TOTAL WETLANDS [Based on USGS Mapping]:	3,760	518
Forested	329	33

Non-Forested	3,431	486
TOTAL FOREST LAND:	106,231	7,512
Deciduous	5,508	457
Evergreen	67,893	4,720
Mixed Forest	32,830	2,335
TOTAL SPARSELY VEGETATED:	38	0
Mines/Quarries	38	0
	=========	=========
	Total Acres	Within Threat Area
TOTAL URBAN LAND:	52,784	38,428
TOTAL NON-URBAN LAND:	274,517	19,507
GRAND TOTAL:	327,302	57,935

- **Wildfire Threat**

Topography with steep, hilly terrain, canyons and narrow valleys is very susceptible to wildfire. Wind and dry seasonal weather patterns are added significant factors in the spread of wildfires.

Wildfire Threat	Total Acres	High	Very High	Extreme
TOTAL RESIDENTIAL LAND (excluding mixed use):	30,229	4,293	6,407	26
1 unit/1-5 acre lot (Rural Residential)	11,148	2,507	3,996	5
1-3 units/acre (Not Mobile Home Parks)	8,719	1,377	1,561	20
3-8 units/acre (Not Mobile Home Parks)	8,213	320	733	1
>8 units/acre, Multifamily, Group Quarters	1,953	70	117	0
Mobile Home Parks	196	20	0	0
TOTAL INDUSTRIAL [excluding mixed]:	592	27	1	0
Salvage/Recycling, Mixture or Unknown	592	27	1	0
TOTAL MAJOR INFRASTRUCTURE:	10,149	1,170	1,418	5
Roads, Highway and Related Facilities	9,644	1,106	1,353	5
Airports	113	8	0	0
Ports	9	0	0	0
Infrastructure--Other, Unknown	383	55	65	0
TOTAL MILITARY:	286	121	2	0
General Military	286	121	2	0
TOTAL COMMERCIAL/SERVICES (excluding mixed):	6,120	669	401	0
Subtotal-Commercial:	5,666	640	398	0
Retail/Wholesale	156	0	1	0
Research/Office	107	49	34	0
Comm. Outdoor Recreation	0	0	0	0
Other, Mixture or Unknown	5,402	591	363	0
Subtotal-Education:	54	0	3	0
Elementary/Secondary	3	0	0	0
Colleges/Universities	51	0	3	0
Subtotal-Hospitals and Health Care Facilities	256	26	0	0
Trauma Center Hospitals	49	1	0	0
State Prisons	207	25	0	0
Subtotal-Public Institutions:	144	2	0	0
Convention Centers	73	0	0	0
City Halls/County Administration	55	2	0	0

Local Jails	8	0	0	0
Other-Community Centers/Libraries	9	0	0	0
TOTAL URBAN OPEN:	5,409	1,103	1,179	15
Golf Courses	1,083	389	174	0
Cemeteries	225	63	42	0
Parks	360	10	58	0
Vacant--Undeveloped	3,559	613	897	15
Mixed Urban Open, Including Parks	182	27	7	0
TOTAL AGRICULTURE:	8,379	2,184	1,388	1
Cropland and Pasture	8,293	2,151	1,367	0
Orchards/Groves/Vineyards	9	0	0	0
Farmsteads and Inactive	77	33	21	1
TOTAL RANGELAND:	156,110	44,225	94,322	678
Herbaceous Range	141,325	40,963	85,978	177
Shrub and Brush	12,556	2,753	7,880	501
Mixed Range	2,229	509	465	0
TOTAL WETLANDS (Based on USGS Mapping):	3,760	1,084	1,280	23
Forested	329	102	136	0
Non-Forested	3,431	982	1,144	23
TOTAL FOREST LAND:	106,231	32,220	64,134	1,268
Deciduous	5,508	2,048	2,836	32
Evergreen	67,893	17,330	44,461	993
Mixed Forest	32,830	12,842	16,838	243
TOTAL SPARSELY VEGETATED:	38	29	6	0
	=========	=========	=========	=========
	Total Acres	High	Very High	Extreme
TOTAL URBAN LAND:	52,784	7,382	9,407	46
TOTAL NON-URBAN LAND:	274,517	79,742	161,131	1,971
GRAND TOTAL:	327,302	87,124	170,538	2,016

(*APPENDICES Reference Section #3:* Wild Fire Hazards Table, Government Facilities Inventory Collection Forms)

FLOOD

Types of Flooding

- **Waterways**

Floods are generally classed as either slow-rise or flash floods. Slow-rise floods may be preceded by limited warning time. Evacuation, sandbagging and other preventative measures for a slow-rise flood may lessen flood-related damage. Conversely, flash floods are difficult to prepare for due to extremely short warning time. Flash flood warnings usually require immediate action within the hour. Flood waters can cause road closures and sweep away objects and people.

Areas that experience occasional flooding are found in various locations throughout Marin County mainly affecting roads. The county's floods historically have caused road closures, landslides, debris flows, erosion, and sewer problems. Creeks often overflow in low lying areas when heavy rainfall is combined with high tide conditions.

- **Debris Flow**

In Marin County, flash flooding is not as critical a threat as is the debris flow including landslides caused by excessive rainfall that can cause serious damage.

- **Coastal Flooding**

Winter storms can generate heavy wave action along the coastal areas of Marin which, combined with high tides, can initiate flooding along the ocean and bay coastlines. Utilities in flood damaged buildings can result in gas leaks and electrical hazards. Resulting sewage and water line damage from floods are critical sanitation and health hazards.

- **High Tides**

Large volumes of water move into and out of San Francisco Bay as the tidal level of the Pacific Ocean just outside the Golden Gate changes each day. High astronomical tides over 7 feet are known to occur during winter storm weather causing flooding along the coast and impacting lands adjacent to Bay and River fronts.

Marin County Flood History

In recent history, the winter storms of 1970, 1973, 1982, 1983,1986,1998, 2005 and 2006 caused significant damage. Novato Creek in the northern part of the county historically caused damage to large numbers of homes in the 1960's until the Novato Flood Control Project was completed in the 1980's. Corte Madera Creek has had a history of flooding with the largest recorded flow in the winter of 1982 and more recently in December 2005 and January 2006, causing severe damage to the surrounding communities. Widespread localized flooding occurred in almost all areas of the County in this past winter storm. San Anselmo, Ross, Fairfax, and Mill Valley were the most heavily impacted. Power outages peaked at 10,000 customers in January. Nine schools closed due to mud, water and road damages and over 20 major roads were closed during the early part of the storm. Two levies in the Novato area were damaged. Over a thousand homes, apartments and businesses were damaged or destroyed. Listed below is a summary of cost for infrastructure losses:

Losses

- Public Sector:

Incorporated Areas & Special Districts	$ 15,291,500
Unincorporated Areas	$ 16,355,000
Total	$ 31,646,500

- Private Sector:

Homes, Business, etc - Incorporated Areas	$ 54,595,380
Homes, Business, etc - Unincorporated Areas	$ 8,595,000
	$ 63,190,380

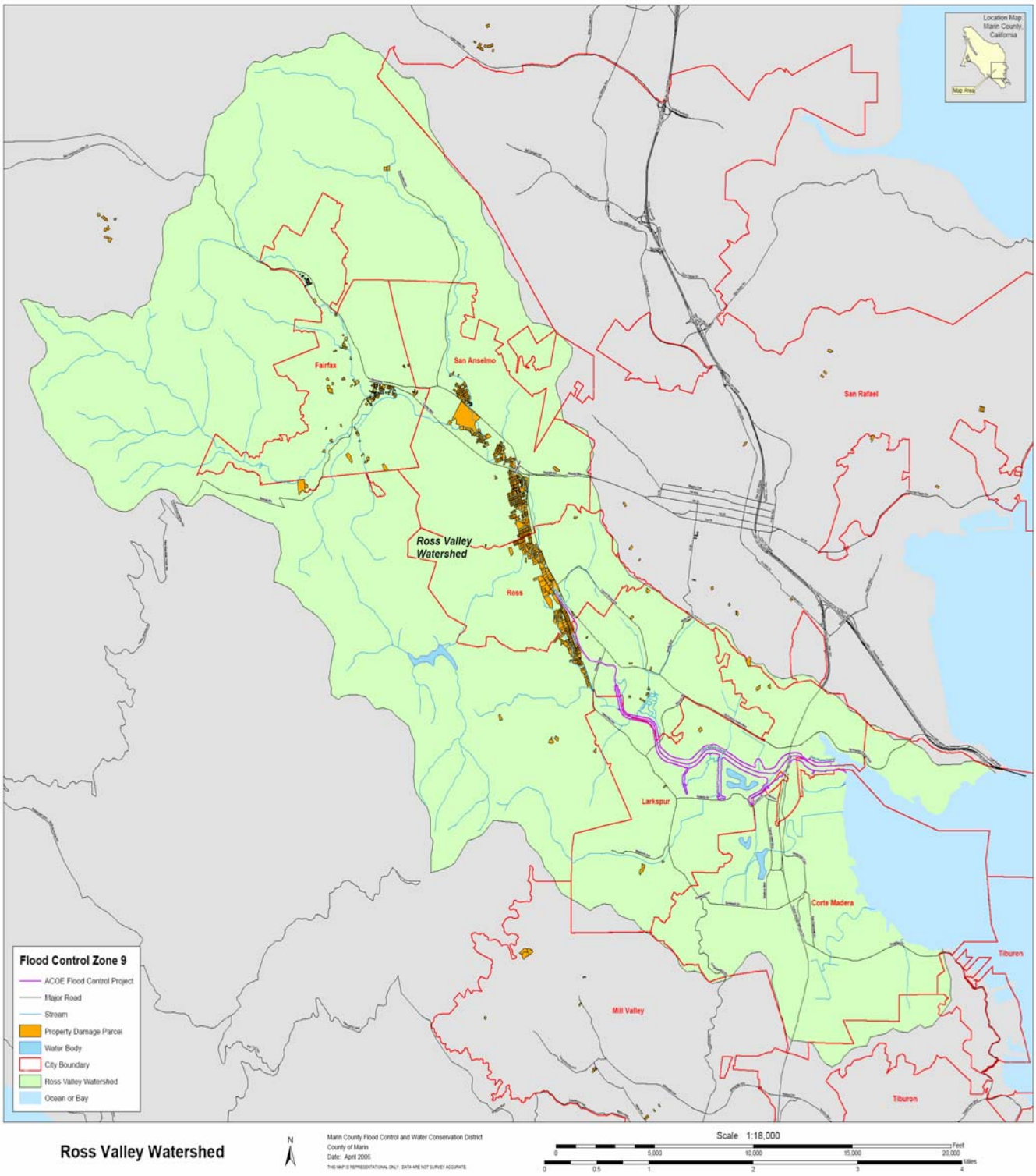
- Total $ 94,836,880

Although the current Corte Madera Creek Flood Control project is nearly complete (Unit 4 in the Town of Ross is yet to be constructed), flooding will still occur for storms greater than a 40-year recurrence flood event. Potentially all nine southerly and some centrally located communities of Marin County would be impacted. The north-east part of the county, densely populated around the floodplain zones, is threatened every winter and still experiences some damage during winter storms despite the completed Novato Creek Flood Control project. See Creek Map on page 33.

Flood of 1925: San Anselmo

Flood of 1982: San Anselmo

Flood of December 31, 2005: San Anselmo


Location Map: Marin County, California
Map Area
Fairfax
San Anselmo
San Rafael
Ross Valley Watershed
Ross
Larkspur
Corte Madera
Tiburon
Mill Valley
Tiburon
Flood Control Zone 9
ACOE Flood Control Project
Major Road
Stream
Property Damage Parcel
Water Body
City Boundary
Ross Valley Watershed
Ocean or Bay
Ross Valley Watershed
N
Marin County Flood Control and Water Conservation District
County of Marin
Date: April 2006
THIS MAP IS REPRESENTATIONAL ONLY. DATA ARE NOT SURVEY ACCURATE.
Scale 1:18,000
Feet
0
5,000
10,000
15,000
20,000
Miles
0
0.5
1
2
3
4

\Profiling Flood Hazard Events

- **FEMA Flood Zones**

The term “100-year flood” may be misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. The 100-year flood refers to the National Flood Insurance standard used by most Federal and State agencies. The various flood hazard zone designations are approximate methods that are based on base flood elevations or depths within each zone.

FEMA Flood Zones	Total Acres	100-yr Flood Plain (Q3 Zone A or V)	500-yr Flood Plain or Other Concern (Q3 Zone X500)
TOTAL RESIDENTIAL LAND (excluding mixed use):	30,229	2,032	1,069
1 unit/1-5 acre lot (Rural Residential)	11,148	292	63
1-3 units/acre (Not Mobile Home Parks)	8,719	573	179
3-8 units/acre (Not Mobile Home Parks)	8,213	845	514
>8 units/acre, Multifamily, Groups	1,953	271	279
Mobile Home Parks	196	51	33
TOTAL INDUSTRIAL [excluding mixed]:	592	190	114
Salvage/Recycling, Mixture or Unknown	592	190	114
TOTAL MAJOR INFRASTRUCTURE:	10,149	1,750	701
Roads, Highway and Related Facilities	9,644	1,514	674
Airports	113	113	0
Ports	9	1	4
Infrastructure--Other, Unknown	383	123	23
TOTAL MILITARY:	286	204	0
General Military	286	204	0
TOTAL COMMERCIAL/SERVICES	6,120	1,654	699
Subtotal-Commercial:	5,666	1,542	669
Retail/Wholesale	156	87	11
Research/Office	107	0	0
Other, Mixture or Unknown	5,402	1,454	658
Subtotal-Education:	54	19	8
Elementary/Secondary	3	3	0
Colleges/Universities	51	15	8
Subtotal-Hospitals/Health Care Facilities	256	21	0
Trauma Center Hospitals	49	6	0
State Prisons	207	16	0
Subtotal-Public Institutions:	144	72	21
Convention Centers	73	60	0
City Halls/County Administration	55	9	18
Local Jails	8	0	0
Other-Comm. Centers/Libraries	9	3	3
TOTAL URBAN OPEN:	5,409	627	310
Golf Courses	1,083	52	137
Cemeteries	225	42	0
Parks	360	103	17
Vacant--Undeveloped	3,559	363	144
Mixed Urban Open, Including Parks	182	65	11
TOTAL AGRICULTURE:	8,379	3,395	16

Cropland and Pasture	8,293	3,375	16
Orchards/Groves/Vineyards	9	9	0
Farmsteads and Inactive	77	11	0
TOTAL RANGELAND:	156,110	8,889	278
Herbaceous Range	141,325	8,108	150
Shrub and Brush	12,556	531	30
Mixed Range	2,229	250	97
TOTAL WETLANDS (USGS Mapping):	3,760	1,533	13
Forested	329	82	1
Non-Forested	3,431	1,451	12
TOTAL FOREST LAND:	106,231	1,283	49
Deciduous	5,508	192	2
Evergreen	67,893	588	32
Mixed Forest	32,830	503	14
TOTAL SPARSELY VEGETATED:	38	0	0
Mines/Quarries		0	0
	Total Acres	100-yr Flood Plain (Q3 Zone A or V)	500-yr Flood Plain or Other Concern (Q3 Zone X500)
TOTAL URBAN LAND:	52,784	6,457	2,893
TOTAL NON-URBAN LAND:	274,517	15,100	355
GRAND TOTAL:	327,302	21,558	3,248

- **Total Repetitive Flood Loss**

Marin County	Total	100-yr Flood Plain (Q3 Zone A or V)	500-yr Flood Plain or Other Concern (Q3 Zone X500)	Outside Flood Plain (Q3 Zone D or X)
Number of properties	149	124	6	19
Number of claims	398	335	13	50
Total claims	$4,972,054	$4,309,843	$128,720	$533,491
	=========	=========	=========	=========

Source: Association of Bay Area Governments, 2004.

Description: The Federal Emergency Management Agency (FEMA) insures properties against flooding losses in the Bay Area through the National Flood Insurance Program. Those properties that have had more than one insured flood loss are called repetitive loss properties and are summarized in this table.

- **FEMA Flood Insurance Rate Maps**

All printed panels of the FEMA Flood Insurance Rate Maps for the communities listed below are incorporated as part of the Marin County Local Hazard Mitigation Plan.

NFIP Community Numbers: Marin County

Community	Number
Belvedere	060429
Corte Madera	065023
Fairfax	060175
Larkspur	065040
Mill Valley	060177
Belvedere	060178
Ross	060179
San Anselmo	060180
San Rafael	065058
Sausalito	060182
Tiburon	060430
County of Marin	060173

Dam Failure Inundation

Dam inundation, or flooding which occurs as the result of structural failure of a dam, poses a serious threat to specific areas within the county. Although there is no history of major dam failure in the county, dams that could have serious impacts include: Alpine, Bone Tempe, Dolcini, Hagmaier North, Lagunitas, Lower Turney, Nicasio, Novato Creek, Peters, Phoenix Lake, Soulajule, Vonsen, and Walker Creek.

Dam Failure Inundation	Total Acres	Within Dam Inundation Area
TOTAL RESIDENTIAL LAND:	30,229	1,083
1 unit/1-5 acre lot (Rural Residential)	11,148	226
1-3 units/acre (Not Mobile Home Parks)	8,719	198
3-8 units/acre (Not Mobile Home Parks)	8,213	539
>8 units/acre, Multifamily, Group Quarters	1,953	119
Mobile Home Parks	196	2
TOTAL INDUSTRIAL:	592	5
Salvage/Recycling, Mixture or Unknown	592	5
TOTAL MAJOR INFRASTRUCTURE:	10,149	714
Roads, Highway and Related Facilities	9,644	671
Airports	113	0
Ports	9	8
Infrastructure--Other, Unknown	383	35
TOTAL MILITARY:	286	0
General Military	286	0
TOTAL COMMERCIAL/SERVICES:	6,120	503
Subtotal-Commercial:	5,666	457
Retail/Wholesale	156	0
Research/Office	107	0

Other, Mixture or Unknown	5,402	457
Subtotal-Education:	54	19
Elementary/Secondary	3	0
Colleges/Universities	51	19
Subtotal-Hospitals and Health Care Facilities	256	18
Trauma Center Hospitals	49	14
State Prisons	207	5
Subtotal-Public Institutions:	144	9
Convention Centers	73	0
City Halls/County Administration	55	0
Local Jails	8	0
Other-Comm. Centers/Libraries	9	9
TOTAL URBAN OPEN:	5,409	205
Golf Courses	1,083	10
Cemeteries	225	0
Parks	360	39
Vacant--Undeveloped	3,559	144
Mixed Urban Open, Including Parks	182	13
TOTAL AGRICULTURE:	8,379	391
Cropland and Pasture	8,293	386
Orchards/Groves/Vineyards	9	0
Farmsteads and Inactive	77	6
TOTAL RANGELAND:	156,110	1,683
Herbaceous Range	141,325	1,485
Shrub and Brush	12,556	121
Mixed Range	2,229	77
TOTAL WETLANDS [Based on USGS Mapping]:	3,760	372
Forested	329	16
Non-Forested	3,431	356
TOTAL FOREST LAND:	106,231	867
Deciduous	5,508	110
Evergreen	67,893	400
Mixed Forest	32,830	357
TOTAL SPARSELY VEGETATED:	38	0
Mines/Quarries	38	0
	=========	=========
	Total Acres	Within Dam Inundation Area
TOTAL URBAN LAND:	52,784	2,511
TOTAL NON-URBAN LAND:	274,517	3,314
GRAND TOTAL:	327,302	5,824

(APPENDICES Reference Section #4: Landslide, Dam Failure, County Storm Water Pump Stations)

OTHER HAZARDS - MINOR

Agriculture

Agriculture related hazards are primary concerns affecting environmental quality and the health and welfare of the Marin County population. Approximately 167,000 acres in Marin County are farms or ranches; this amounts to 50% of the total land in Marin. The average size of a farm in Marin is 588 acres. Agriculture in Marin contributes over $48 Million annually to the local economy. Drought is a known potential threat to the agriculture and vegetation of the county. Pesticide pollution is considered to be an imminent hazard.

In the year 2000, Marin County conducted 5,280 incoming plant quarantine inspections. Plants were monitored at Federal Express, UPS, nurseries, ethnic markets, aquatic supply stores and marble/tile/slate stores. Inspections were done on foreign wooden crates and pallets for wood boring insects. Eighty-two gypsy moth inspections of household goods from eastern states were conducted, as well as 1,010 Glassy-winged Sharp Shooter inspections on plant material from infested California counties. The county rejected 195 plant materials, and a total of 97 pests were intercepted. Of those, 11 pests were “Q” rated, 52 were “B” rated, and 34 were “C” or “D” rated.

Significant Pest Interceptions

Scientific Name	Common Name	Rating
Dasineura balsamicola	Balsam Fir Gall Midge Complex	B
Eulecanium kunoeuse	Kuno scale	B
Homalodisca coagulata	Glassy Winged Sharp Shooter	B
Orchidoplilus aterrimus	Orchid Weevil	Q
Pheidole megacephala	Big Headed Ant	Q
Technomyrmex albipes	An Ant	Q
Unknown A	Gall Wasp	Q

Q - rating: Serious - Quarantine Action
B - rating: Serious - County Action

Two types of pests of particular concern in Marin County include the Glassy-winged Sharp Shooter and the Gypsy Moth. The Glassy-winged Sharp Shooters are pests in California and that were first observed in the State in 1990. They are predominantly found in various parts of Southern California and San Joaquin Valley. Glassy-winged Sharp Shooters spread a variety of diseases, including Pierce’s Disease, which kills grapevines.

Gypsy moths also pose a threat to Marin County’s agriculture and vegetation. In July of 2000, two adult male gypsy moths were captured in a detection trap located on a property in Novato. Subsequently, gypsy moth detection trap density was increased to 25 per square mile over a four square-mile area surrounding this property. A door-to-door search was initiated after several additional gypsy moths were trapped in a localized area.

Terrorism

In addition to the natural and technological hazards we are most familiar with, people face threats of terrorism posed by extremist groups, individuals, and hostile governments. Terrorists can be domestic or foreign, and their threats to people, communities, and the nation range from isolated acts of terrorism to acts of war.

Terrorism is the use of force or violence against persons or property for the purpose of intimidation, coercion, or ransom. Terrorists often use violence and threats to create fear among the public, to try to convince people that their government is powerless to prevent acts of terrorism, and to get immediate publicity for their cause. Act of terrorism can range from threats to assassinations, kidnappings, airline hijackings, bombings, building explosions, mailing of dangerous materials, agro-terrorism, computer-based attacks, and the use of chemical, biological, and nuclear weapons – weapons of mass destruction (WMD)

Explosion, the most common type of terrorist attacks, has caused the most casualties and damage. Explosions cause building collapses and can cause fires, hazardous materials spills, and major communications breakdowns.

Weapons of Mass Destruction (WMD) events present different challenges than other incidents involving mass casualties. Weapons of Mass Destruction (WMD) events can Include attacks involving:

- Chemical Weapons
- Biological Weapons
- Radiological
- Nuclear Weapons
- Explosives

Chemical Weapons attacks utilize chemical agents that are poisonous vapors, aerosols, liquids, and solids that have toxic effects on people, animals, or plants. They can be released by bombs or sprayed from aircraft, boats, and vehicles. They can be used as a liquid to create a hazard to people and the environment. Some chemical agents may be odorless and tasteless. They can have an immediate or delayed effect.

Persons involved in a Biological Weapons attack, for example, may take days to develop symptoms and are therefore difficult to identify and control.

A Radiological attack would involve terrorists using radioactive materials employed in medicine, science and industry to produce a “dirty bomb” which would not cause mass destruction, but could disperse radiation over a wide area.

Nuclear Weapons, although least likely, present the most serious threat due to their profound physical impacts on people, buildings, infrastructure, and social systems. Radiation is a primary concern for those exposed and for their descendents.

High-value terrorism targets include military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, economic, and corporate centers.

Tsunami

Tsunami consists of waves generated by large disturbances of the sea floor 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; however are 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 quickly, before a warning is issued. Associated risks include flooding, contamination of drinking water, ruptured tanks or gas lines, and the loss of vital community infrastructure.

Prior to the tsunami of Indonesia this year, six tsunamis killed more than 350 people and damaged a half billion dollars of property in Hawaii, Alaska and the West Coast since 1946. The Alaskan earthquake of 1964, as a more recent example of our West Coast, generated tsunami waves affecting the entire California coastline and twelve lives were lost as a result and caused an estimated $17 Million in damage. *Marin County was not severely affected and there is no history of any significant damage caused by Tsunami.* The staggering statistics of the January, 2005 Tsunami crisis in the Indonesian districts -- over 30,000 deaths, many injuries, missing and hundreds of thousands people displaced -- cause us to take a much closer look at tsunami dangers.

2004 Tsunami: Indonesia

Some Marin County communities may be vulnerable because of the location and quality of the built environment. The principal exposure will be people, buildings, and infrastructure located in the low-lying potential inundation area. Especially at risk are visitors, hikers, campers, and non-residents who might be on the shore when the tsunami strikes. The State Office of Emergency Services expects to provide a tsunami inundation map for the Pacific Coast. Maps for the San Francisco Bay will not be available for several years.

Landslides

Landslides encompass a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on a very steep slope is the primary reason for a landslide, there are other contributing factors:

- Erosion by rivers or ocean waves create over-steepened slopes
- Rock and soil slopes are weakened through saturation by heavy rains
- Earthquakes create stresses that make weak slopes fail
- Earthquakes of magnitude 4.0 and greater have been known to trigger landslides
- Excess weight from accumulation of moisture

In Marin County, landslide movement is a serious hazard threat to the community's infrastructure. Landslides often move slowly and thus may not threaten life directly. When they do move - in response to such changes as increased water content, earthquake shaking, addition of load, or removal of down slope support - they deform or tilt the ground surface. The result can be destruction of foundations, offset of roads, and breaking of underground pipes.

The best predictor of where movement of slides might occur is knowing where they have happened in the past. A small proportion of them may become active in any one year with movements concentrated within all or part of the landside masses or around their edges.

During heavy rainfalls, excessive water consistently triggers mudslides in the county and have caused significant infrastructure damage during the floods of 1970, 1973, 1982, 1983, 1986, 1998, and January of 2005). Additionally, the potential for a significant earthquake increases the probable impact of landslide hazard threat throughout the county. Landslide movement can be divided into four different types:

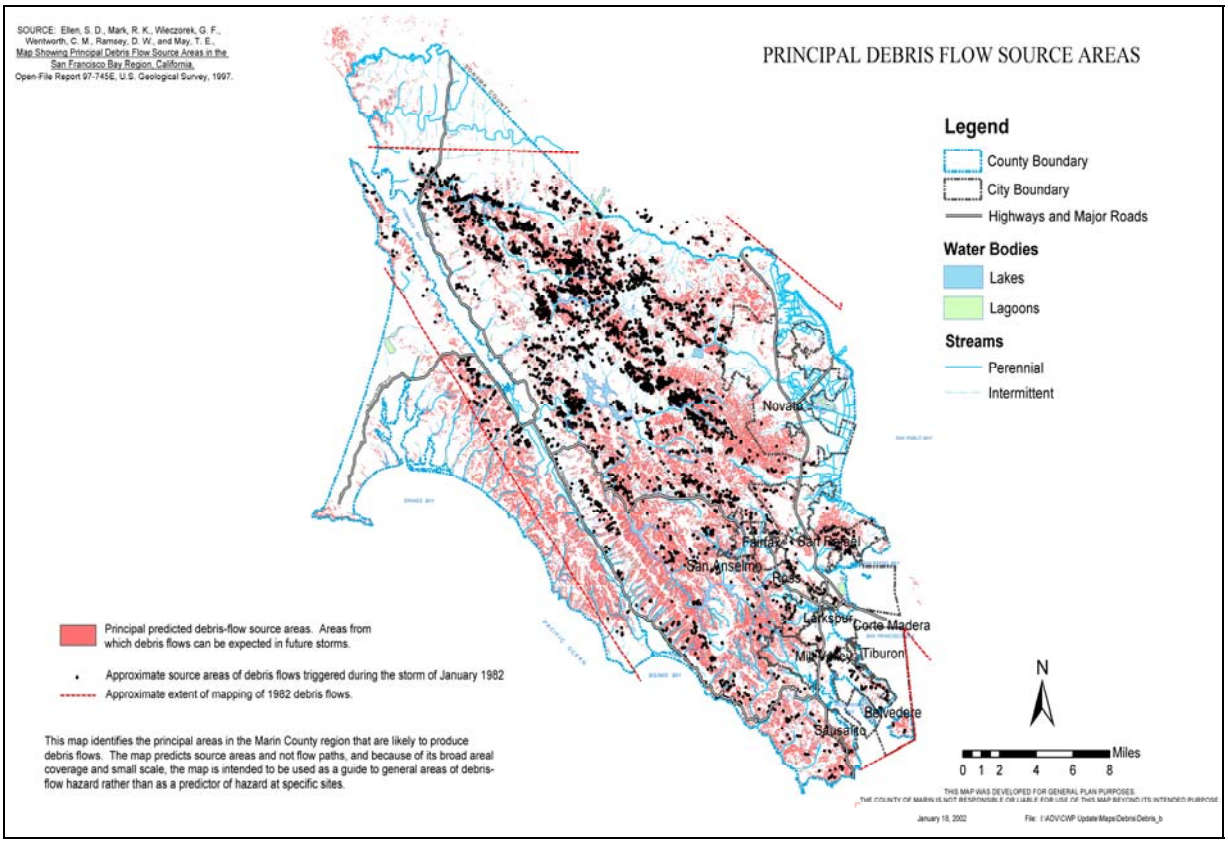
Lateral and Down-Slope movement of earth materials such as rock, soil, and/or artificial fill are a common type of slide. The term covers a broad category of events, including mudflows, mudslides, debris flows, rock falls, rock slides, debris slides, earth flows, and soil creep. Most losses from landslides occur in communities developed on sloping hillsides.

Lateral Spreads are usually associated with loose, sandy soils that involve lateral displacement of large, superficial blocks of soil as a result of liquefaction of a subsurface layer. Displacement occurs in response to the combination of gravitational forces generated by an earthquake. Lateral spreads commonly disrupt foundations of buildings, sever pipelines and other utilities.

Falls and Topples are movements in which masses of rock or other material fall from cliffs or other steep slopes. Earthquakes or saturated soil commonly trigger this type of movement.

Debris Flows are similar to slides but differ in the fact they are characterized by high water content and move similar to fluids. They usually occur in small, steep channels and are often mistaken for floods. See Principal Debris Flow Sources Area Map on the next page.

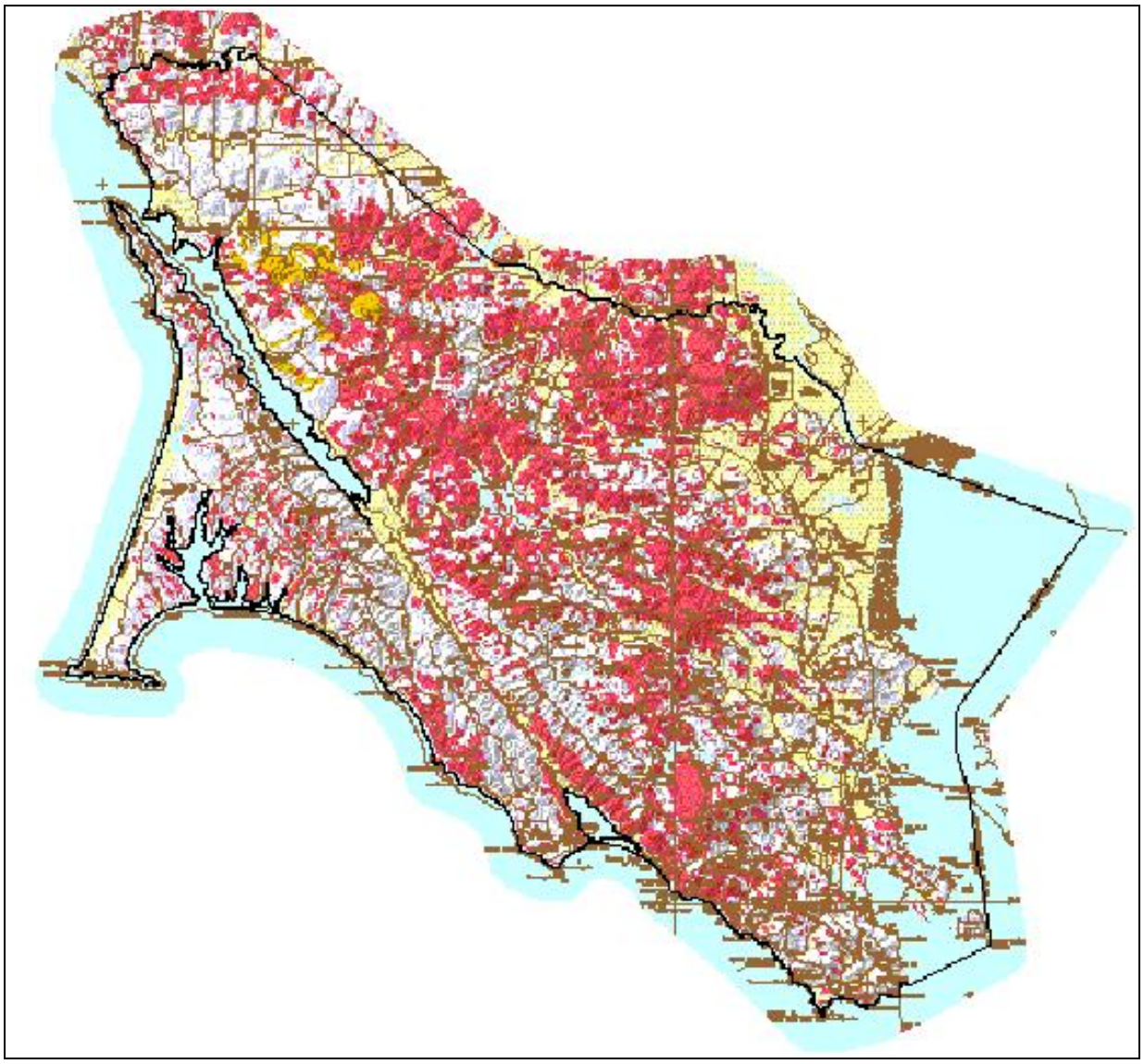
Principal Debris Flow Source Areas Map



During a severe winter storm such as the one which occurred in Marin County in 1982, thousands of debris avalanches and debris flows may be triggered in both rural and urban areas, smashing homes, blocking roads, severing utilities and water supply, and injuring or killing people.

NOTE: The hazards of earthquake-induced landslides and liquefaction for Marin County have not yet been mapped by the California Geological Survey. Therefore these hazards have not been assessed as completely as in other areas of the Bay Area.

Summary Distribution of Slides and Earth Flows in Marin County Map



Slides and Earth Flows in Marin County

- Red — Mostly Landslides – mapped landslides intervening areas typically narrower than 1500 feet and narrow borders around landslides.
- Orange — Many Landslides – consists of mapped landslides and more extensive intervening areas – defined by excluding mapped landslides.
- Grey — Few Landslides – contains few, if any, large mapped Landslides.
- Yellow — Flat Land – areas of gentle slope at low elevation that have little or no potential for formation of slumps, translational slides or earth flows.

Section 2: Hazard Mitigation

PLANNING AND GOALS

Overall Goal

The overall goals considered for hazard mitigation for Marin County are to maintain and enhance disaster resistant communities by reducing the potential loss of life, property damage, and environmental degradation from natural disasters, while accelerating economic recovery from those disasters.

Priority Goals

Mitigation programs and projects are ranked in priority based on evaluation by the Marin County planning team and the LHMP work group. Mitigation projects identified in this plan are based and ranked on the following priorities whereby the evaluation process included benefit/cost consideration:

1. Protect lives and property and the environment
2. Reduce future potential loss
3. Raise public awareness/education
4. Enhance emergency services including warning systems

Future goals and action items include:

1. Improve coordination within Marin County government
2. Revisit and re-evaluate risk assessments
3. Convene planning teams to review risk assessment
4. Convene working groups to review mitigation projects

Mitigation – General Considerations

Effective mitigation measures are based on an understanding of the risk faced by a community. Principal considerations included in this plan:

- Understand that natural hazards are ever-present, but catastrophic incidents are rare for individual localities.
- Use local vulnerability studies to design specific loss prevention measures and programs.
- Know that in the aftermath of major damaging events, people will frequently assign blame to those they believe are responsible for not taking precautionary actions.

Mitigation History of Success

Marin County has experienced success in past mitigation projects, two of which in recent years have significantly minimized the effects of disaster.

The White's Hill Slide Repair in 2001, a $5 million State and Federally funded project administered by the County, corrected the troublesome and hazardous slide on Sir Francis Drake Boulevard, one of West Marin's main thoroughfares. In addition to reducing and avoiding losses from slide hazards, White's Hill Bridge took into consideration the environmental surroundings of that area.

The 2005 Fairfax Storm Drainage Bond Construction Project successfully removed and replaced deteriorated storm sewer system pipe of over 1,000 feet. During the December 31st flood and the months of heavy rains to follow, this new drainage system avoided major damage to property and the environment.

HAZARD MITIGATION BY THREAT – MAJOR

Earthquake, Fire and Flood projects are identified and numbered according to importance within each hazard. A ranking system for all projects within the Major threat categories have been assigned a priority ranking based on the following information:

1) Frequency/History of events – It is clear that emergencies and disasters continue in the sense that it is recognized as an urgent need for comprehensive planning to prevent extensive damage from occurring again in the future. Tracking noticeable frequencies of the same kind of event necessitates an accelerated approach implementing strategically thought out mitigation projects.

2) Cost of losses recorded – The increase of funding required with each new emergency to replace structures, infrastructure and maintain environmental quality is a critical indicator that mitigation planning and projects are implemented to reduce cost of future disasters

3) Cost and length of time for recovery - The importance of planning ahead, planning strategically for mitigation so the cost and length of the recovery will be less severe is a key element for improving the ability to recover after disaster with less money spent on repeatedly replacing existing hazardous situations.

4) Environmental sustainability – Disaster resistance needs to further environmental sustainability, reduce pollution, strengthen agriculture resiliency, and avoid hazardous material releases in Marin County.

Priority Project Ranking

The priority ranks listed for each major project are identified as follows:

- **Very High –** To be adopted by the County immediately
- **High –** Existing with need to accelerate planning
- **Moderate –** To be adopted by the County when funding and resources allow
- **Under Study –** Under consideration and formal assessment/study
- **Existing** – Current project that may look at future funding for expanding

Earthquake

- **General**

One of the critical assessment tools is the Inventory of Buildings and Building Codes and Types which is crucial for ensuring current and future mitigation progress. Structures in Marin County built before 1970, when major seismic design changes were made to the building code, are especially vulnerable to ground shaking and liquefaction. Wood and frame buildings have an excellent record because of their lightness and flexibility. Some smaller wood framed buildings, however, lack properly designed and connected foundations and/or sufficient lateral bracing.

The Draft Marin Countywide Plan addresses the issue of safety from seismic and geological hazards that will protect people and property from risks associated with seismic activity and geologic conditions.
See Draft Marin Countywide Plan 2/04, Environmental Hazards 3-81 – 3-84 (Policies EH-2.1 – 2.2) - (*See APPENDICES Reference Section #1).*

- **Mitigation Projects**
  (Priority project ranking page 45)

Earthquake Mitigation Projects

Project	**Target Date**	**Assets Protected and Improved**	**Ranking/Priority Explanation**
1. Seismic Retrofit, County-owned buildings	TBD	People, Infrastructure, Assets, and Government services	**High** The existing program has accomplished retrofitting projects and is continuing to seek funding for those inventoried, retrofit-deficit structures to be seismically upgraded
2. Public Safety Building (potential)	2009	Emergency Services, Public Safety, Government services, enhanced Warning Systems, Training and Public Education	**Under Study** The concept of a highly efficient public safety building adjacent to the Marin County Civic Center government site has been under consideration since last year and is currently under formal assessment/study

Currently, the Marin County-owned structures which are considered seismically safe and compliant with current building codes – either recently retrofitted or constructed to meet current code – are the Civic Center Complex (Administration Hall of Justice and Jail) and the Public Safety Building in Marin City. These types of projects are funded through tax and bond measures. The numerous structures not yet seismically safe will be retrofitting projects which are generally funded through tax and bond measures; hazard mitigation grant money is also a consideration. Similar funding options are considerations for a new Public Safety Building currently being explored.

PROGRAM ASSESSMENT RESULTS

#1 Program/Project Description	**Seismic Retrofit of County-owned buildings not current to code (Civic Center Complex and Public Safety Building in Marin City are current code). (*See Building Log in Reference Section #2)***
Estimated Cost	**$10 Million**
Timeline/Schedule Years	**To be completed in the next 20 years Year 2035**
Responsible Department	**Capital Improvement/Building Administration**
Financing General Fund Grants Special	**Tax and Bond Measures General Funds Hazard Mitigation Grant Money**
Goal Addressed	**Comply with current seismic and retrofit codes/standards Public Safety**
Related Hazards Risks Addressed	**Fire, Landslide, Hazardous material**

#2 Program/Project Description	**Construction of new Public Safety Building (adjacent to the Civic Center Complex) to house Law Enforcement, the Communications Center, Office of Emergency Services, and Emergency Operation Center (EOC)**
Estimated Cost	**Not established**
Timeline/Schedule Years	**Engineering Design – 2006 (estimate) Construction – 2009 (estimate)**
Responsible Department	**Capital Improvement/Building Administration**
Financing General Fund Grants Special	**Tax and Bond Measures Hazard Mitigation Grant Funds**
Goal Addressed	**Increased Public Safety from all Hazards**
Related Hazards Risks Addressed	**Utilities, Building Safety, Warning Systems**

Fire

- **General**

A serious danger created by a seismic event is the indirect fire hazard. Disruption of gas and power lines would most likely result in fires. In hill areas where access is already restricted and vegetative conditions constitute a major fire hazard under normal conditions, the destruction of roads and water lines poses a major threat to life and property. Wooden tank ruptures and water main fractures can be expected, reducing or eliminating water pressure for firefighting and consumption.

The Marin County Fire Department maintains and annually grades over 120 miles of fire roads. It also makes recommendations to key stakeholders, such as the Marin County Open Space District, the California State Parks Service, and the Marin Municipal Water District, where grading and other fuel reduction projects will benefit the most. Using the Marin County Fire Community Fire Plan analysis, fire roads are being studied to insure ecological sustainability.

Controlled burns, fire thinning, fire and fuel breaks, and vegetation management generally reduce the intensity of the rate of spread of fire, thus reducing loss of life and property. National Fire Plan Grant Funding for Vegetation Management has been a source supporting these efforts over the last three years. The Marin County Fire Department also participates in all Homeland Security initiatives and was recently awarded grant funding for Community Outreach and Education projects. The Federal Bureau of Land Management grant funding has supported past projects such as the Pine Tree removal work in Mill Valley.

- **Codes**

Urban Wildland Interface (UWI) Code Adoption

The California Building Code (current version 2001 edition) governs virtually all buildings within the State of California. This code was adopted from the model code (1997 Uniform Building Code) and was amended by the various state agencies to increase fire and life safety. It contains necessary provisions for the construction of residences in most areas of the State.

Until recently, little comprehensive guidance has been available as how best to construct homes and projects in UWI areas - beyond the relatively brief treatment in Uniform Fire Code Appendix IIA - has been available. Exceptions to this have been local efforts in several of the Southern California Counties and occasional municipalities.

In 2003, the International Urban-Wildland Interface Code (UWIC) was published for the first time. While, this document provides significant information and guidance, underlying research to address specific pass/fail fire performance criteria for key groups is not available. Likewise, analysis of data describing conditions affecting the thousands of homes involved in the 2004 fires in Southern California was not available.

There are currently four codes/standards applicable to the Urban-Wildland Interface fire hazard. These are Public Resources Code Section 4291, the 2001 California Fire Code (which amends the 1997 Uniform Fire Code), National Fire Protection Association Standard 1144-Protection of Life and Property from Wildfire, and the International Urban-Wildland Interface Code. The 2001 California Building Code does not specifically address this hazard.

- **Mitigation Projects**
  (Priority project ranking page 45)

Fire Mitigation Projects

Project	Target Date	Assets Protected and Improved	Ranking/Priority Explanation
1. Fire break construction/maintenance	ongoing	Lives, property and the environment	**High** A new Fuel Crew Program in the county is currently funded through special county funds. The future of maintaining this program is dependent on other funding sources. Other funding will be sought.
2. Vegetation modification/fuel reduction	see table below for zone specific target dates	Lives, property and the environment	**High** The current Vegetation Management/fuel reduction program has target dates through the year of 2010 and will need to look at new funding sources outside of funding outlined in this plan
3. Public Education	ongoing	Emergency Services, Public Safety, Government services, enhanced Warning Systems	**Moderate** Existing program is looked at to be accelerated based on available funding

Listed below are fuel reduction mitigation projects priorities that are all generally ranked as high and is part of an ongoing process.

Fuel Reduction Mitigation Projects Priorities by Fire Management Zone (listed by zone)

Fire Management Zone	Project	Target Date	Assets Protected
1	San Pedro Ridge	2006-2008	Structures, Watershed, Recreation
1	Marinwood/Lucas Valley	TBD	Structures, Recreation
2	Kent Woodlands	Evergreen and Crown Road Sections Jan/Feb 2005. Continued 2006 - 2014	Structures, Watershed, Recreation
2	Phoenix Lake	TBD	Watershed, Recreation, Structures
2	Bald Mountain/Deer	Implementation Date TBD.	Structures,

	Park		Watershed, Recreation
2	Cascade Canyon Fairfax North	2007-2008	Structures, Watershed, Recreation
2	Tamarancho-Iron Springs	TBD	Structures, Watershed, Recreation
3	Mount Tamalpais	Communication Site March/April 2005 Continued 2006-2010	Public Safety Infrastructure, Structures, Watershed, Recreation
4	San Geronimo Valley	TBD	Structures, Watershed, Recreation
4	Rancho Santa Margarita	TBD	Structures
4	Wild Horse Valley	April 2005	Structures, Recreation
5	Pacheco Valley	TBD	Structures, Recreation
5	H-Ranch	TBD	Structures, Recreation
5	Indian Valley Campus	TBD	Structures

The County of Marin is in the process of adopting a code (Urban Wildland Interface Code) which will apply to those structures identified in the Marin County Community Fire Plan and/or by the local fire jurisdiction as being in a high wildland fire danger area.

The Marin County Community Fire Plan, managed by county fire administration, designates Fire Management Zones which correspond to County Supervisorial Districts. The fire plan has identified mitigation strategies and prioritized fire hazard reduction projects for each Fire Management Zone.

Flood

- **General**

The County of Marin participates in ongoing mitigation actions and proposed activities for flood prevention. Hydraulic analysis of runoff and drainage systems that can predict areas of insufficient capacity in the storm drain system is done on an as-needed basis, usually in conjunction with a development proposal or when a flood event indicates a flaw in the system.
The Marin County Flood Control and Water Conservation District manages eight Flood Control Zones

- Novato
- Mill Valley
- Bel Aire
- Stinson Beach
- San Rafael Meadows
- Santa Venetia
- Ross Valley
- Inverness

Within the Flood Control Zones that the District manages, there is an on-going effort to prepare residents for flooding from tides and storms. These efforts include public information and meetings with police, fire and public works staff to coordinate pre- and

post-disaster planning. Storm drainage projects to protect vulnerable properties are also a primary environmental mitigation activity in Marin County. The District utilizes crews from the Marin Conservation Corp overseen by the District staff members to carry out an annual Creek Maintenance Program in efforts to keep storm drains and creeks free of obstructions while retaining vegetation in the channel to allow for free flow of water.

County Code Chapters 11.08 and 23.18 enforces mitigation activities under provisions for creek protection, storm water management, and discharge control ordinances designed to keep watercourses free of obstructions and to protect drainage facilities.
To mitigate flooding by increasing stream flow and maintaining critical access and egress routes, all bridges in Marin County must be constructed so that the soffit (lowest point) is at least two feet above the 100-year water surface elevation. All "critical bridges" meet the County Code, Section 24.04.520(d) standard.
In areas of new development, utility systems are constructed so as to reduce or eliminate flood damage to the utility systems themselves due to the County Department of Public Works' assessments in the plan review stages.

The Flood Control District owns and operates three gauging stations along our Eastern Urban Corridor; one in the south (Mill Valley), one in the Central Marin (Kentfield/Ross) and one in the north (Novato) areas. All are both rain and water surface elevation gauges. Two new weather stations were recently installed in West Marin (not water surface gauges). For most effective mitigation, all five stations are automated and accessible to the public via the Internet. The District recognizes that a multi-agency approach is needed to mitigate flooding. This is carried out through the design of the various zones, which ignore jurisdictional boundaries, cities and otherwise. Those zones that include cities have City Council members on the Zone Advisory Boards and these meet at least annually. The directors of the County and the City Department of Public Works meet monthly. Any Capital Improvement Projects that might need coordination are identified at these meetings.

Hazardous materials stored in flood zones are elevated or protected from flood waters using effective methods – County Code Section 23.18.072 & 090**.** The Marin County Fire District Inspectors routinely assess storage of hazardous materials and actively mitigate safe storage.

The County Flood Control District provides an institutional mechanism to ensure that development proposals adjacent to floodways and in floodplains are referred to flood control districts for review and comment. The Department of Public Works' Land Use and Water Resources Division is directly linked to the District for plan review.

Floodplain management regulations for development in the floodplain and floodway areas are strictly enforced – County Code Chapter 23.09
New subdivisions are designed to reduce or eliminate flood damage by requiring rights-of-way laid out for the provision of approved sewer and drainage facilities, providing on-site detention facilities – Title 24 of the County Code.
Marin County recognizes the high value of preserving and protecting wetlands in floodplains. These wetlands absorb flood waters and toxics from runoff.
The District stockpiles sand and bags at various locations around the County of Marin for emergency use by residents and businesses during an event.

- **Mitigation Projects**
  (Priority project ranking page 45)

The County enforces the grading, erosion, and sedimentation requirements by prohibiting the discharge of concentrated storm water flows to mitigate pollution – County Code Sections 23.18.093, 24.04.625 & 627. The lead agency is Marin County Public Works for Flood Mitigation and related projects. Funding sources will include tax and bond measures and hazard mitigation funds are a consideration to mitigate severe winter storm results.

The Flood Control Zones are taxing entities which are receiving a portion of the State's Special District Fund, providing a somewhat reliable funding stream to construct and control facilities. Marin County has fifteen pump stations and several miles of levees and canals. The District applies for funding for flood control projects that have a high cost-benefit ratio to further mitigate threat of flooding. Hazard mitigation funding is considered for current projects under consideration.

Flood Mitigation Projects

Project	**Target Date**	**Assets Protected**	**Ranking Explanation**
1. Ross Valley Integrated Watershed Management Program	2006/2011	Potentially nine southern and central communities (people, infrastructure, assets and government services	**Very High** This program will be adopted by the County immediately. This fully coordinated effort will acquire community support and secure funding, and seek hazard mitigation funding.
2. Las Gallinas Creek Levee, Santa Venetia	TBD	Structures, Utilities, Transportation, Environment	**Moderate** Some existing new improvements have been made including a pump station. The need to accelerate planning and seek funding to restore the levee structure is needed. This project will be adopted by the County when funding and resources become available, including hazard mitigation funding
3. Marin County Flood Control & Water Conservation District (eight flood control zones) Public Education project	ongoing	Coordination for pre-and post-disaster planning with police, fire and public works staff	**Existing** Due to the Ross Valley Integrated Watershed Management Program Plans, increased public awareness and Community workshops will require funding
4. Marin County structure elevation program for Ross Valley, Novato, Santa Venetia, Mill Valley and Stinson Beach	2006/2011	Homes and businesses in special flood hazard zones which are or likely to be repetitive flood loss properties	**Very High** This program will be implemented upon receipt of Hazard Mitigation Grant funding.

PROGRAM ASSESSMENT RESULTS

#1 Program/Project Description	**Ross Valley Integrated Watershed Management Program – A comprehensive planning project. The entire Ross Valley is inter-connected via creeks and streams whereby this project will address the entire issue to resolve the chronic flooding in these parts of the county. This is a watershed-wide, multi-objective approach.**
Estimated Cost	**$3M - $5M**
Timeline/Schedule Years	**2006 – 2011**
Responsible Department	**Public Works/The Marin County Flood Control and Water Conservation District**
Financing General Fund Grants	**Tax and Bond Measures Hazard Mitigation Grant Money**
Goal Addressed	**Prevent recurring major damages to private and public infrastructure, environment and economy in affected communities**
Related Hazards Risks Addressed	**Landslides, hazardous material**
Reduction of Flood Risk	**Reduction of cost of flood insurance to property owners. Qualification for high rating under the Community Rating System of the National Flood Insurance Program.**

#2 Program/Project Description	**Las Gallinas Creek Levee Project, Santa Venetia (the levee located in the San Pablo Bay lands along Santa Venetia has deteriorated since it was created in 1983 and the tidal flooding threatens the entire residential areas in and around Santa Venetia. In addition to a new pump station completed last year, the restoration of the levee is a comprehensive plan.**
Estimated Cost	**$2M**
Timeline/Schedule Years	**Estimated 2007 - 20009**
Responsible Department	**Public Works**
Financing General Fund Grants Special	**Tax and Bond Measures (Water and Resources Development Act of 2005) Hazard Mitigation Grant Funds**
Goal Addressed	**Public Safety Structure Safety Traffic Safety**
Related Hazards Risks Addressed	**Landslides Liquefaction Roads/Traffic**

#3 Program/Project Description	**Marin County Flood Control & Water Conservation District (eight flood control zones) Public Education Project**
Estimated Cost	**$200,000**
Timeline/Schedule Years	**Estimated 2007**
Responsible Department	**Flood Control**
Financing General Fund Grants Special	**Hazard Mitigation Grant Funds**
Goal Addressed	**Public Awareness Public Readiness Coordinated Pre- and Post-disaster planning with public safety**
Related Hazards Risks Addressed	**Landslides Liquefaction Roads/Traffic**

#4 Program/Project Description	**Marin County structure elevation program for Ross Valley, Novato, Santa Venetia, Mill Valley and Stinson Beach communities which are in Marin County Flood Zones.**
Estimated Cost	**$10 – 15 million**
Timeline/Schedule Years	**Estimated 2006 – 2011 and on-going as funding is available**
Responsible Department	**Marin County Public Works will coordinate and administer the program in County unincorporated area and in incorporated communities which are in a Marin County Flood Control District Zone.**
Financing General Fund Grants Special	**FEMA Hazard Mitigation Grant funding Property owner contributions Marin County Flood Control staff**
Goal Addressed	**Repetitive flood loss property protection and avoidance of future damages.**
Related Hazards Risks Addressed	**Health and safety of residents and businesses in Special Flood Hazard areas.**

OTHER HAZARDS - MINOR

Agriculture

- **General**

Marin County's Department of Agriculture/Weights and Measures plays an important role in minimizing danger of contamination hazardous to the people who live and work in the area. The Integrated Pest Management (IPM) is an approach to pest control that is based on an understanding of a pest's life cycle and habits. IPM uses this information, combined with regular monitoring, to determine if and how to intervene for optimum pest control. IPM uses a number of different strategies, often at the same time, to control a pest. Because the goal of IPM is long-term pest control, emphasis is placed on preventing pests or eliminating their habitat. Treatments, if necessary, include mechanical and physical methods such as barriers, horticultural practices including proper plant care, and biological controls (bugs eating bugs). They are use as spot treatments and are chosen and timed to have the smallest negative impact on non-target organisms and the environment.

IPM is not only promoted in the Agriculture areas, but is successfully implemented in County Parks and Buildings and Schools where liquid and aerosol pesticide has been eliminated and replaced with reduced-risk products such as baits and traps.

Drought, though a potential problem in Marin County that can significantly affect agriculture, is not fully assessed.

- **Mitigation Strategies**

Mitigation efforts to reduce imported pests will continue to include routine inspection of suspected pest-infected shipment and material received in the county. Additionally, pest detection trapping eradicates residual pests that may not have been identified during inspections. The Marin County Agriculture Weights and Measures Division complies with the California Pesticide regulations and the Federal Food and Agriculture Codes (Fed. Code CFR#41).

To fully assess the potential drought in Marin County, planning will include working with ABAG and various water supply agencies on this issue.

The Agricultural Land Trust (MALT), founded in 1980 to preserve farmland in the county is a model for agricultural preservation efforts across the nation.

Terrorism

- **General**

Responsibility for terrorism has been separated into two phases: 1) incident response and crises management; and 2) consequence management. The lead agency for terrorist incident response and crisis management is the Federal Bureau of Investigation (FBI).

The Homeland Security Advisory System is a mechanism for disseminating information about the current risk of terrorist acts to federal, state and local authorities. The system

provides graduated warnings that mandate increasing security measures as the risk of an act of terrorism increases.

There are five levels of security warnings:

- Low - Green
- Guarded - blue
- Elevated - yellow
- High - orange
- Severe - red

- **Mitigation Strategies**

Because the primary mechanism for past terrorist incidents has been bombings, the primary focus of the State's s hazard mitigation strategy for terrorism is on mitigation measures that reduce risk from bomb blasts and nuclear, biological, and chemical attacks to critical facilities and populations. Examples of these strategies encouraged for implementation at local government levels include hardening of structures during construction and retrofitting, barriers and fencing around critical infrastructure, and adding redundant systems for fire protection, communications systems, information technology and utilities. Marin County participates in the Homeland Security and Urban Area Security Initiative Grant Programs which fund many mitigation activities.

The vague nature of the threat, the uncertainty regarding weapons, and the wide variety of potential targets make it difficult to identify specific mitigation projects. Marin County emphasizes, instead, the need to incorporate mitigation strategies in developing and refining operational procedures. The county participates in all Homeland Security initiatives including the Buffer Zone Protection Program. Marin County Office of Emergency Services provides coordination for the initiative for the operational area.

Mitigation Strategies

Explosions	- Evacuation Plan, supplies, training - Upgrade heating, ventilation and air conditioning system to filter contaminants - Shelter in Place supplies
Biological Weapons	- Installation of High Efficiency Particulate Ai(HEPA) filters furnaces - Plan for quarantine
Chemical Weapons	- Chemical decontamination device supplies - Medical Screening Capacity
Nuclear Weapons	- Indoor Shelters - Underground Shelters - Shelter in Place supplies - Evacuation Plan, supplies, training

Terrorism Mitigation Projects (potential)

Project	Target Date	Assets Protected
Security Enhancement, Marin Civic Center	TBD	Structures, Utilities
Public Safety Building	2009	Structures, Utilities

Tsunami

- **General**

The greatest threat associated with tsunami is the impact on coastal structure property and threat to human lives.

The State of California Coastal Management Program (CCMP) under the California Coastal Act requires cities and counties lying wholly or partly within the coastal zone to prepare a Local Coastal Plan (LC) that must be certified by the Coastal Commission as consistent with policies of the Coastal Act. (Public Resources Code, Division 20).

The U.S. National Tsunami Hazard Mitigation Program (NTHMP) is a State/Federal partnership created to reduce tsunami hazards along United States coastlines. NTHMP coordinates the efforts of five Pacific States including California. Focal points of future efforts include:

- The Tsunami Inundation Mapping Effort (TIME)
- Tsunami Warning Guidance for Tsunami Warning Centers
- Improve Seismic Networks
    - Installation of real-time broadband seismic stations
    - Telemetry upgrades to warning centers
    - Shortening information dissemination time to emergency services agencies
- Deploy Tsunami Detection Buoys
- Improve Statewide Coordination and Technical Support for Tsunami Warnings

The support of local populations for a variety of mitigation products and programs are essential for mitigation success. The strategic goal in developing “tsunami resilient” communities must have the following characteristics:

- Understanding of the nature of Tsunami hazards
- Having the tools needed to mitigate the Tsunami risk
- Dissemination of information about the Tsunami hazard
- Exchange of information with other at-risk-areas
- Institutionalized planning for a Tsunami disaster

Mitigation Strategies

- Establish and maintain communication capability with the Pacific Tsunami Warning Center via the California Warning Center
- Identify Tsunami Hazard Zones
- Identify and ensure accessible evacuation routes
- Coastal Management, integrate
    - Planning policies – land use considering hazard zones
    - Zoning policies – prohibit building at high risk
- Monitor need for seawall
- Utilize State OES tsunami inundation maps for Marin County when available

Landslides

- **General**

To mitigate landslides, specific planning and activities are designed to be ongoing. Evaluating the potential for earthquake induced landslides and identifying potential slope failures is critical. Long-term hazard reduction in Marin County focuses on reducing the frequency of landslides, reducing the likelihood that landslides will cause damage and minimizing damage when they do occur. Most of the ongoing landslide mitigation involves repair and reinforcement of failed slopes.

- **Mitigation Strategies**

For proposed projects, Marin County monitors and collects data for:

- Assessment of presence of existing landslides
- Quantitative evaluation of earthquake-induced landslide potential
- Engineering Geologic Investigations
- Stereoscopic aerial photographs made
- Topographic Maps collected and reviewed

Slope stability analysis by lead agency is performed. Basic considerations for any existing projects on proposed slopes that are determined to be unstable include appropriate mitigation methods, to be provided before the project is approved. In general this includes:

- Avoid the Failure Hazard
- Protect the site from the failure
- Reduce the hazard to an acceptable level

Efforts are being increased to reduce landslides and erosion in existing and future development by applying applicable State adopted Unified Building Codes and applicable standards found in the California Geological Survey Special Report – Guidelines for Evaluating and Mitigating Seismic Hazards in California.

PROJECT SUMMARY

Mitigation Programs and Projects

Action items identified as future mitigation programs and projects are evaluated and prioritized by Marin County planning team, the LHMP work group, utilizing the Benefit Cost Analysis specific to each project. The mitigation projects identified are within the definition of “hazard mitigation”, that is, “any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards”.

Section 3: Planning Reference

ASSOCIATION OF BAY AREA GOVERNMENT (ABAG)

Regional Planning

The Association of Bay Area Governments (ABAG) is a multi-county governmental coordinating agency which includes the nine Bay Area counties. ABAG is a significant resource for mapping and risk assessment information on the key threats facing the Bay Area Region.

Marin County Hazard Mitigation Planning is conducted in coordination with ABAG planning efforts. For planning purposes, Marin County utilizes various ABAG tools for hazard identification analysis, and risk assessment for government and critical facilities. ABAG received a grant from FEMA through the California Governor's Office of Emergency Services to prepare a multi-jurisdictional plan that fulfills the requirements of the Disaster Mitigation Act of 2000. ABAG was designated by the State and Federal governments as the official planning coordinating agency for the Bay Area cities and counties. ABAG has prepared an interim multi-jurisdictional plan for the region and will continue to work on this project until April, 2006. Cities and counties can adopt and use all or part of this multi-jurisdictional plan.

Parallel to, and in coordination with this effort, Marin County is utilizing the Operational Area approach for the eleven incorporated cities, towns, and special districts, facilitating communication and coordination for individual local planning efforts and the Pre-Disaster Mitigation Grant Competitive (PDM-C) program.

Local Government Coordination and Outreach

ABAG conducted series of forums, one in partnership with the Marin County Operational Area (OES) including county and city emergency managers, planning directors, public works directors, building officials, fire chiefs, and special district leadership to identify concerns, needs, timelines and parameters of planning and PDM-C Grant information.

Marin County OES staff assists local jurisdictions as appropriate with Hazard Mitigation Planning and will communicates and coordinates with stakeholders and provides information about the process, State and FEMA funding guidelines and resources. OES also plans to work with ABAG to develop specific information about the kind of level of damage to buildings, infrastructure, and critical facilities which might result from any of the hazards noted in this plan. ABAG will be conducting this effort in 2005 through early 2006. (See *APPENDICES Reference Section #6*: Planning Strategy)

MARIN COUNTY OPERATIONAL AREA

Operational Area Approach

Marin County's Operational Area approach emphasizes coordination of responsibilities that address common resources, mutual support and cooperation of all stakeholders and multi-agency commitment for some hazard mitigation projects will be required. However, jurisdictions' and special districts' risks, vulnerabilities and specific assessments require a plan tailored to each local authority. This method reflects the California Standardized Emergency Management (SEMS) organizational framework and also supports the Marin Countywide Plan 2004, "Environmental Hazards" Section. Cities, Towns and Special Districts develop individual plans and/or Hazard Mitigation Annexes identifying specific risks and mitigation projects.

Marin County Operational Area Stakeholders

Marin County Government

- Marin Community Development Agency
- Marin County Fire Department
- Marin County Health and Human Services Department
- Marin County Public Works/Flood Control
- Marin County Sheriff
- Marin County Sheriff's Office of Emergency Services

Cities/Towns

- City of Belvedere
- Town of Corte Madera
- Town of Fairfax
- City of Larkspur
- City of Mill Valley
- City of Novato
- City of San Rafael
- Town of Ross
- Town of San Anselmo
- City of Sausalito
- Town of Tiburon

Special Districts

- Community College District
- Central Marin Sanitation District
- Sausalito/Marin City Sanitary District

Many of the strategies for hazard mitigation exist as a part of the planning process through the Plan and Project Review actions, Building and Fire Code enforcement, and development of the Marin Countywide Plan. Newer potential projects, such as the proposed Marin County Public Safety Building, are included in this planning process.

The decision on priority was made based on a variety of criteria including technical and administrative feasibility, politically acceptability, socially appropriateness, legal conformity, economic soundness and not being harmful to the environment or our heritage.

Marin County will work to identify potential funding sources, including capital improvement budgets, bond issues, and federal or state grants.

Workshops/Public Involvement

The California Office of Emergency Services (OES) notified all potential stakeholders in the initial effort that promoted Local Hazard Mitigation Planning (LHMP).

Marin County OES utilized the Operational Area approach in support of LHMP to help facilitate the county's cities and special districts' planning efforts. Marin County OES has coordinated Local Hazard Mitigation Workshops, Stakeholders and Working Group Sessions. The cooperative planning process has included public participation, listening sessions, posting of the Draft Plan on the Marin County OES public website for comment, press releases and public workshops. (See A*PPENDICES Reference Section #5).*

Public Outreach Calendar of Events

May 20, 2004	LHMP presentation from Marin OES to County Public Works
May 27, 2004	Hazard Mitigation Workshop presented by State OES at Marin OES
June 17, 2004	Hazard Mitigation Planning Workshop/OEW-ABAG
July 22, 2004	Marin County City Manager's Forum presentation by Marin OES
August 26, 2004	LHMP stakeholder workgroup session by Marin OES
October 6, 2004	Public outreach at "Taming Natural Disasters" Conference by ABAG
March 10, 2005	Marin County Disaster Council presentation by Marin OES
March 17, 2005	LHMP review with Marin County Public Works Association
April 7, 2005	Press Release announcing LHMP
April 8, 2005	Posting of Draft LHMP on Marin County Website
April 13, 2005	Public Workshop – Central Marin County
April 14, 2005	Public Workshop – West Marin County
April 26, 2005	Marin County Board of Supervisor's Resolution to adopt LHMP
April 28, 2005	Submittal of LHMP to State OES/FEMA
April 11, 2006	LHMP stakeholder workgroup Hazard Mitigation Strategy Meeting

Marin OES Commitment

Marin County Sheriff's Office of Emergency Services (OES) assumed the lead role in drafting this Hazard Mitigation Plan and supporting the joint effort of participating cities, towns, and special districts in building a more disaster-resistant county. OES will continue to support stakeholder meetings that will move the identified mitigation projects forward. During this process, goals and objectives may be reviewed and adjusted based on improved data and/or changes of magnitude of risks. Additional risk assessment, refined benefit cost analysis, and resources required will be monitored by stakeholders. Stakeholders identified in this plan will evaluate the plan in response to technological and political changes or other significant events and monitor outcomes of projects as expected. Departments and agencies responsible for projects will be asked to provide annual reports on the progress of action items for purpose of formal review and update of plan. Public review opportunities will be provided as the plan is modified at public forums and/or the county website.

Major disasters affecting the community, legal changes, notices from ABAG and other triggers will be used in the monitoring process.