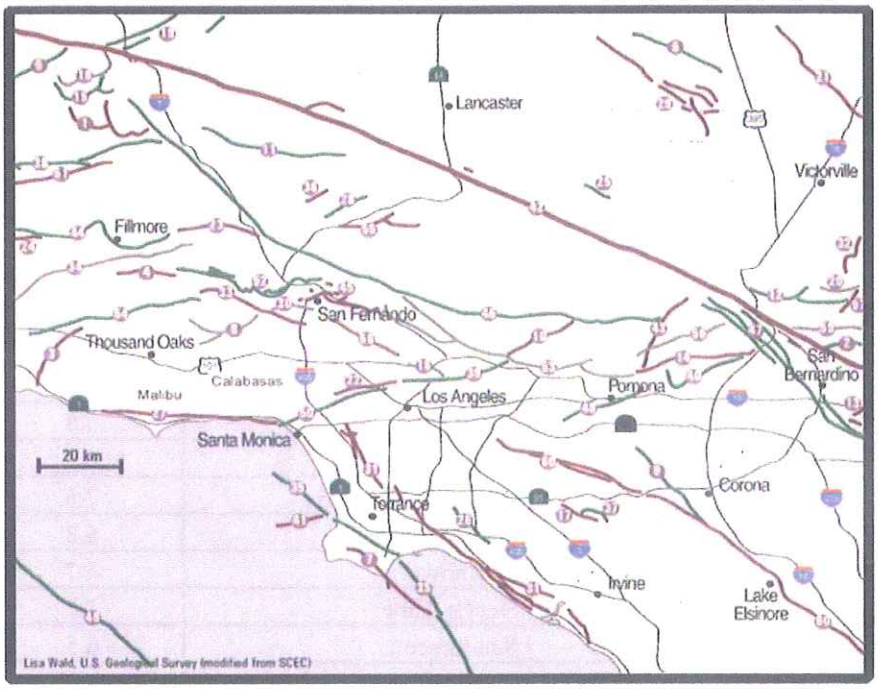
Causes and Characteristics of Earthquakes

Earthquake Faults In or Near the Las Virgenes-Malibu Region

There are multiple fault zones in proximity to the Las Virgenes-Malibu Region. Although the San Andreas Fault is capable of producing an earthquake with a magnitude greater than 8, there are multiple "lesser" faults that are in closer proximity and have the potential to inflict greater damage to the Las Virgenes-Malibu Region. For example, a magnitude M6.5 earthquake along the Chatsworth fault (less than a mile away) could result in more death and destruction than a "Great" quake on the San Andreas which is 40 miles away. The following map provides an overview of significant faults in the area.



Map 34: Earthquake Faults in the Greater Los Angeles / Ventura County Area

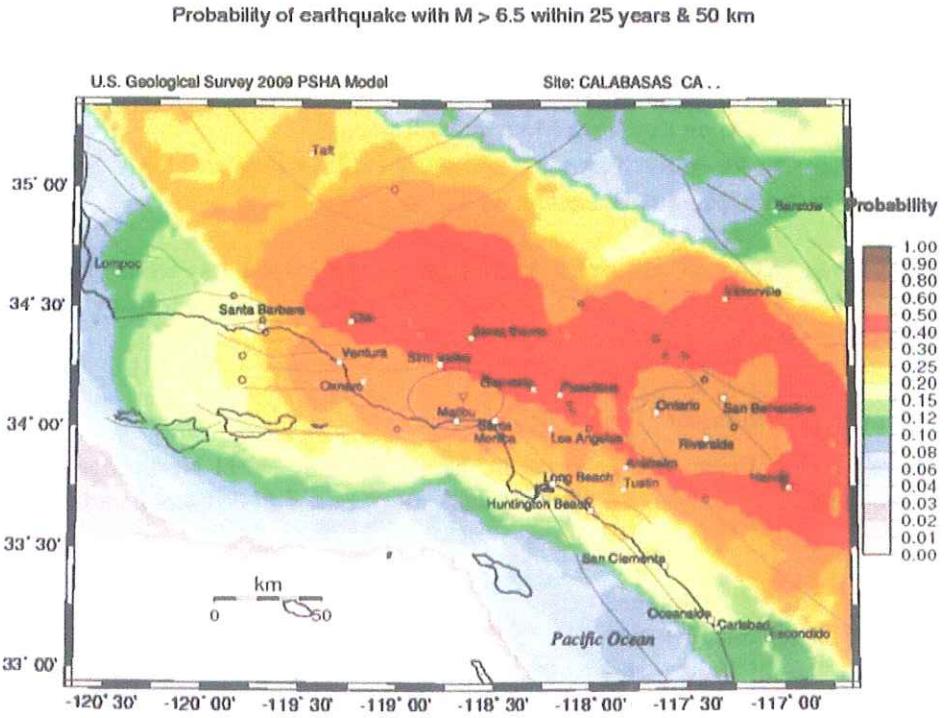
Fault Map Number	Fault Name	Potential Magnitude	Length	Distance to LVMCOG	Direction from the LVMCOG
8	Chatsworth	6.0-6.8	12.5 miles	1 mile	NE
22	Hollywood	5.8-6.5	9.4 miles	15 miles	E
27	Malibu Coast Fault	6.7	21.3 miles	0 miles	S
31	Newport/Inglewood	6.0-7.4	46.9 miles	15 miles	E
39	Raymond	6.0-7.0	16.3 miles	25 miles	E
42	San Andreas	6.8-8.0	750.0 miles	40 miles	NE
45	San Fernando	6.0-6.8	10.6 miles	15 miles	N
50	Santa Monica	6.6	15.0 miles	10 miles	SE
54	Simi-Santa Rosa	7.0	25.0 miles	10 miles	NW

Map 35: Major Faults Around the Las Virgenes-Malibu Region

SOURCE: U.S. Geological Survey and California Geological Survey, 2006, Quaternary fault and fold database for the United States, accessed 1/7/2010, from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/

Las Virgenes-Malibu Region Earthquake Probability

According to the U.S. Geological Survey earthquake Probabilistic Seismic Hazard Assessment (PSHA) model, there is a 30 to 40% chance that the Las Virgenes-Malibu Region will experience an earthquake of magnitude 6.5 or greater within the next 25 years.



Map 36: Southern California PHSA Model (USGS)

An earthquake of M6.5 or larger could cause a considerable number of casualties, as well as extensive damage to buildings, infrastructure, and critical facilities. The effects would be aggravated by aftershocks and secondary effects such as fire and landslides. In the event of a catastrophic earthquake, the capacity of the region to respond on its own would quickly become overwhelmed and assistance from surrounding municipalities, as well as the state and federal governments would be needed.

Furthermore, following a major earthquake:

- Extensive search and rescue operations would be required
- The demand for emergency medical care would increase
- Food and temporary shelter would have to be provided for displaced people

In addition, it is likely emergency operations would be hampered by the loss of critical infrastructure and roads, damage to critical facilities, disruption of utilities, and communications disruptions. During the recovery period, extensive efforts would be required to remove debris, clear roadways, demolish unsafe structures, restore public utilities, and provide continuing care for the affected population including temporary shelters for displaced people. Finally, secondary issues such as hazardous materials releases and civil unrest could further strain resources.

ShakeMap Scenarios

Predicted ground shaking patterns throughout southern California for hypothetical scenario earthquakes are available from the United States Geological Survey as part of their on-going "ShakeMap" program. These maps are provided in terms of Instrumental Intensity, which is essentially Modified Mercalli Intensity (MMI) estimated from instrumental ground motion recordings. The following scenarios depict strong ground shaking patterns for the 1994 Northridge Earthquake and three hypothetical scenario events:

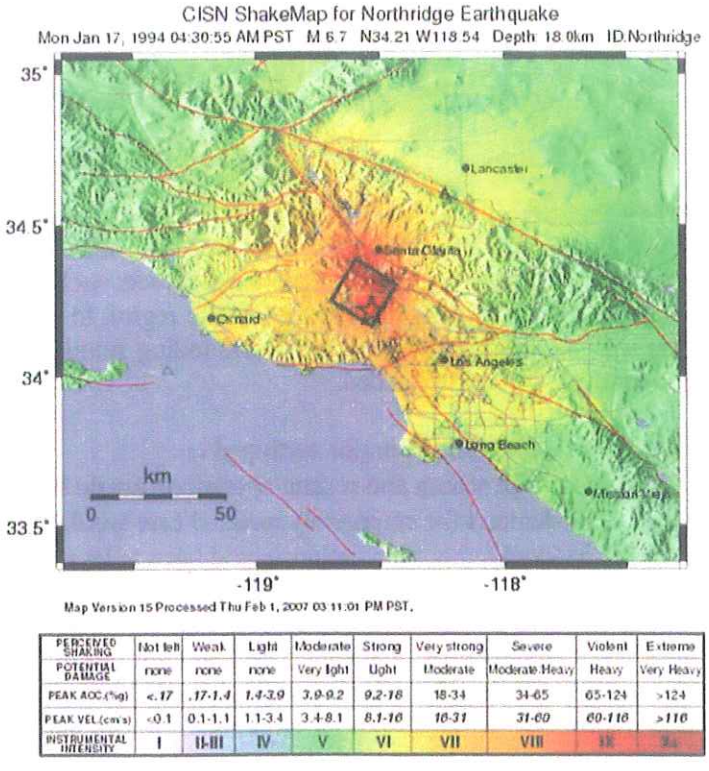
- M 6.7 1994 Northridge Earthquake
- M 6.6 Earthquake on the Santa Monica Fault Scenario
- M 6.9 Earthquake on the Newport-Inglewood Fault Scenario
- M 7.8 San Andreas Fault ShakeOut Scenario

Modeling various scenarios is useful in estimating the likely impact to local populations, infrastructure, and facilities. This information can be used to assist emergency managers and the public to better prepare for future events.

1994 Northridge Earthquake

The most recent significant seismic event in the area was the 1994 Northridge Earthquake. In terms of human impact, sixty people were killed, more than 7,000 injured, and 20,000 were left homeless.

The shaking heavily damaged communities throughout the San Fernando Valley, Simi Valley, and the areas north and west of Los Angeles. It is estimated that the event resulted in $20 billion in losses (USGS). More than 1,600 buildings were "red-tagged" as unsafe to enter and another 7,300 buildings were "yellow-tagged" and restricted to limited entry. Thousands of other structures experienced minor damage. The impact to local infrastructure included sink holes in local roads, damaged water lines, ruptured gas lines, electrical power outages, pipeline distribution system damage, and communications disruptions. Furthermore, seven major freeway bridges in the area collapsed and 170 were damaged - disrupting traffic in the Ventura-Los Angeles region for weeks following the earthquake.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate-Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Map 37: Northridge Earthquake ShakeMap

Santa Monica Fault Scenario

A M6.6 earthquake on the Santa Monica fault reflects a scenario that would result in Strong to Very Strong shaking in the Las Virgenes-Malibu Region with light to moderate potential damage.

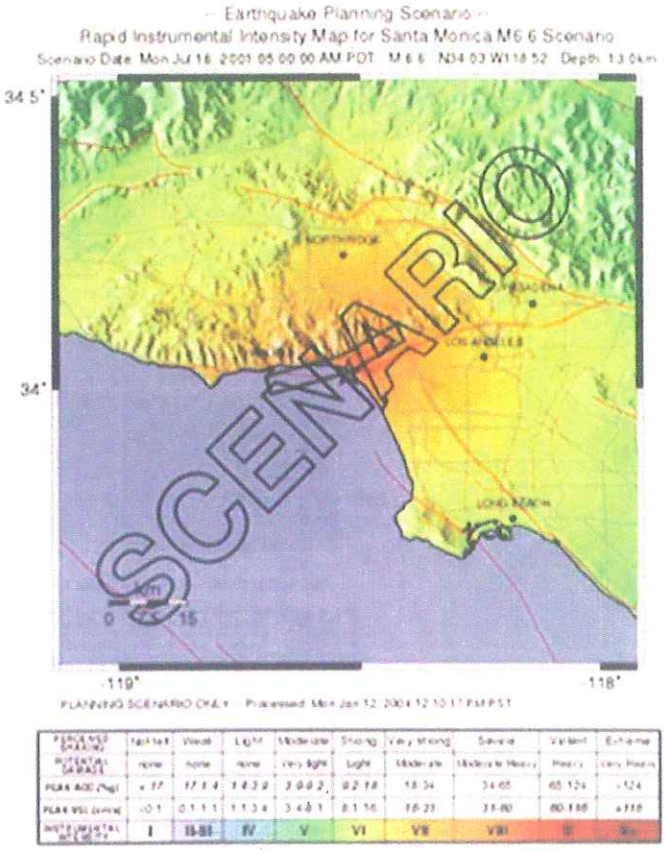
Newport-Inglewood Fault Scenario

A M6.9 earthquake on the Newport-Inglewood fault would result in parts of the Las Virgenes-Malibu Region experiencing very Strong to Severe shaking and potential damage could range from Moderate to Moderate/Heavy.

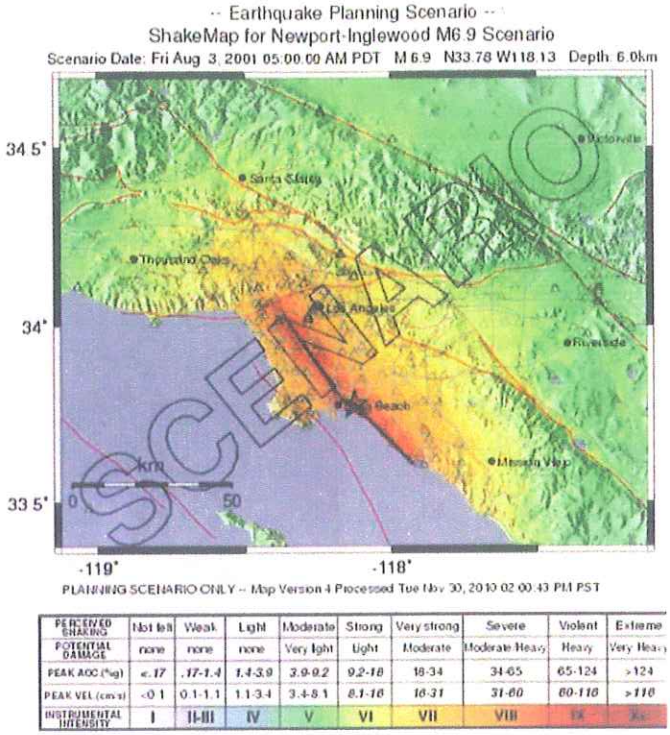
San Andreas Fault ShakeOut Scenario

A San Andreas earthquake has been used as the scenario for the annual ShakeOut Earthquake exercise and also serves a basis for statewide emergency response exercises.

Over 300 scientists, engineers, and others developed the San Andreas ShakeMap to study the likely consequences of a M7.8 earthquake on the San Andreas Fault. The scenario estimates over 1,800 deaths, 50,000 injuries, $200 billion in damages and other losses, and severe, long lasting disruptions with regional implications.

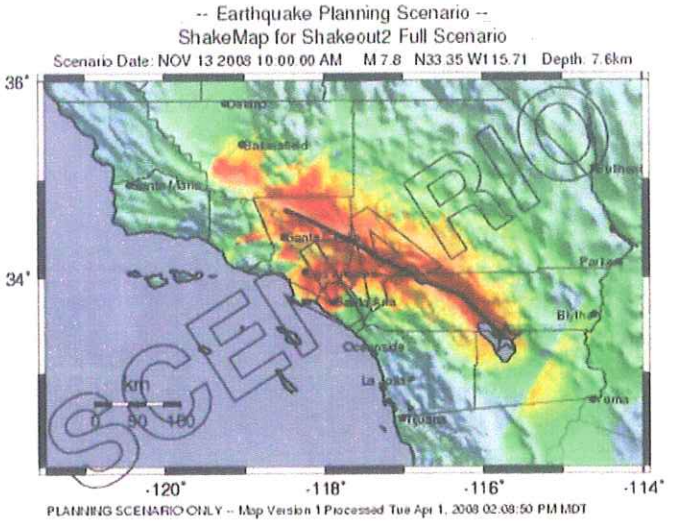


Map 38: Santa Monica Fault Scenario ShakeMap



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate-Heavy	Heavy	Very Heavy
PEAK ACC (%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Map 39: Newport-Inglewood Fault Scenario ShakeMap



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate-Heavy	Heavy	Very Heavy
PEAK ACC (%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Map 40: San Andreas Fault Scenario ShakeMap

Earthquake Hazard Identification

A major earthquake impacting the Las Virgenes-Malibu area will likely result in casualties, damage to structures, and disruptions to critical infrastructure (roads, bridges, lifelines, etc.). In addition, the long-term impact to the local economy can be significant. The examples listed below provide brief descriptions of the types of damage that can be anticipated.

Casualties

Collapsed structures or falling debris can kill or injure hundreds of people and trap others. Trained search and rescue teams will be needed to pull many of the injured from badly damaged or partially collapsed structures. However, it may take rescuers many hours, perhaps days after the earthquake to free trapped people.

Additionally, damage to the transportation infrastructure could impede emergency responders. Furthermore, hospitals may not be able to provide care to the injured due to overcrowding and damage to their facilities.

Structures

In most California communities (including areas in the Las Virgenes-Malibu Region) many buildings were built before 1993 when building codes were not as strict as after the 1994 Northridge Earthquake. In addition, retrofitting is not required except under certain conditions and can be expensive. Therefore, the number of buildings at risk in the Southern California area remains a concern.

Transportation Infrastructure

Residents in the Las Virgenes-Malibu Region commute frequently by automobiles and public transportation. An earthquake can greatly damage bridges, tunnels, roads, and freeways. Although Caltrans has retrofitted numerous freeway bridges in California, there are still some that are not retrofitted. The Federal Highway Administration requires that bridges listed on the National Bridge Inventory be inspected every 2 years.

The resulting disruption caused by a major earthquake can hamper emergency response efforts and the normal movement of people and goods. Life and commerce within the region is highly dependent on the transportation infrastructure and the economic recovery of the region depends on how quickly repairs are completed. Recovery would begin with inspectors from local and state transportation agencies evaluating damage and recommending closures, scheduling immediate repairs, and studying more extensive repairs and replacement.

Lifelines

Lifelines include water, natural gas, electric power generation and distribution systems, fuel pipelines, sewer, and telecommunications systems. Ground shaking and amplification can cause pipes to break, power and telephone lines to fall, and damage cell phone and radio towers. A disruption to lifelines will hamper rescue, recovery, and rebuilding efforts as well as interrupt the distribution of important information to the public. Examples include:

- Ground shaking and ground deformation can damage pipelines and may rip many apart. Further, if soils liquefy pipelines may float or move laterally with the blocks of soil displaced by lateral spreading.
- Water pumping stations and wells are dependent on electrical power that may be unavailable in the days following an event.
- Damage to sewage pipelines can result in waste spills and failures.
- Damage to natural gas lines can result in fires or explosions as well as service disruptions.
- Power used in the Las Virgenes-Malibu Region is transported via a system of high-voltage transmission lines. Electrical transmission lines (overhead lines, power poles, and underground utility conduits) and distribution facilities (substations) can be disrupted or damaged. Ground failures such as landslides could damage lines and may take months to repair depending on accessibility. In addition, large porcelain insulators, bushings, and transformers are vulnerable to moderate ground motions and damaged transformers may take months to replace. Redundancies built into the electrical grid should mitigate some of the impact; however a major earthquake will almost certainly disrupt the local electrical grid.
- Communications systems are vulnerable to overload in the minutes and hours following a major event. The communications infrastructure is comprised in part of hard-wired telephone and cable TV systems, microwave transmission stations, cellular telephone systems, and radio systems. Cellular systems are dependent on the hardwired connections between cell towers and land-based telephone systems. Hardwired systems and the cell phone infrastructure are owned and operated by private companies such as AT&T, Verizon, and Charter.

Fire

Downed power lines or broken gas pipelines can trigger fires. Furthermore, multiple fire emergencies may occur simultaneously. Major incidents will demand a larger share of resources and smaller fires may receive little or insufficient resources. Also, it may be more difficult for fire departments to respond to fire emergencies if fire stations suffer building damage. Finally, loss of electricity may cause pump failures resulting in a loss of water pressure in some communities, further hampering firefighting efforts.

Economy

Economic impacts include direct property damage, lost business output and productivity, business failures, business relocations, and a long term reduction in the economic base of the community. Damage to roads, bridges and buildings can impact the private sector's ability to conduct business as well as reduce consumer traffic. Consequently companies that experience only minimal physical loss could suffer significant customer and revenue loss. Small businesses are especially vulnerable since they generally have fewer resources and are less likely to have prepared or planned for such an event.

Estimated Impact of an Event

If a major or great earthquake were to occur, the consequences to local populations, employment, and housing will be significant. The table below provides the estimated impact of a disaster using a 10% loss baseline.

Category	Agoura Hills	Calabasas	Hidden Hills	Malibu	Westlake Village	Impact if a 10% Loss Occurs
Population	20,330	23,058	1,856	12,645	8,270	6,600
Total Employment	10,665	13,413	N/A	8,197	8,436	4,000
Total Housing Units	7,681	8,686	606	6,252	3,322	2,650
Median Home Value	$740,200	$962,700	More than $1,000,000	More than $1,000,000	More than $1,000,000	More than $2.6B

Table 109: Estimated Population and Economic Loss of an Earthquake

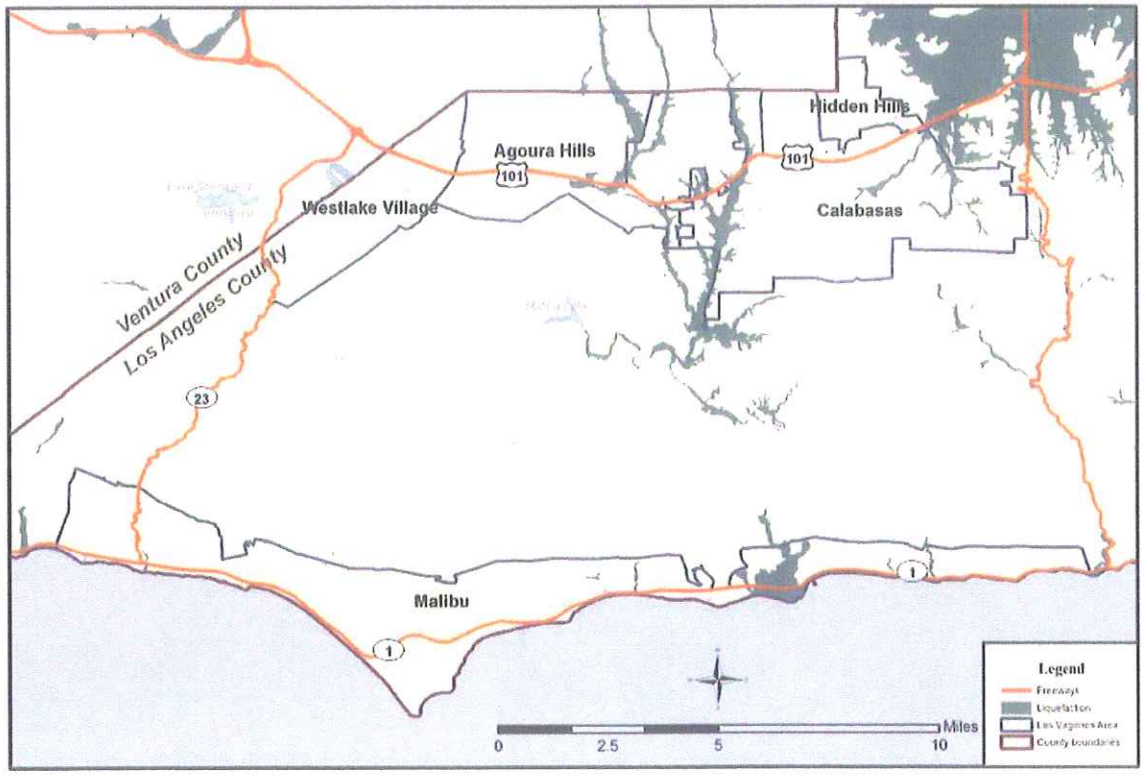
Based on a 10% loss projection, more than 6,600 people would be displaced or significantly impacted and more than 4,000 jobs could be lost (either temporarily or permanently). Also, more than 2,650 homes could be damaged or destroyed resulting in over $2.6 billion in losses (see Community Profile section for population, housing, and economic data).

Earthquake Vulnerabilities

Liquefaction

Buildings above liquefiable soils may settle or tip due to a loss of bearing capacity of the soil. Liquefaction occurs when soil grains in loose, saturated silty, sandy, or gravel soils attempt to rearrange themselves in a denser configuration when subjected to strong earthquake ground motions. The resulting increase in pressure of the water in the voids of the soil temporarily transforms the soil into a fluid, causing the soil to lose much of its strength. As the pore-water pressure builds, ground water and liquefied soil may find their way to the surface, creating sand boils on the ground surface. Several types of damaging ground failures can occur due to liquefaction including lateral spreading, ground settlement and sink holes.

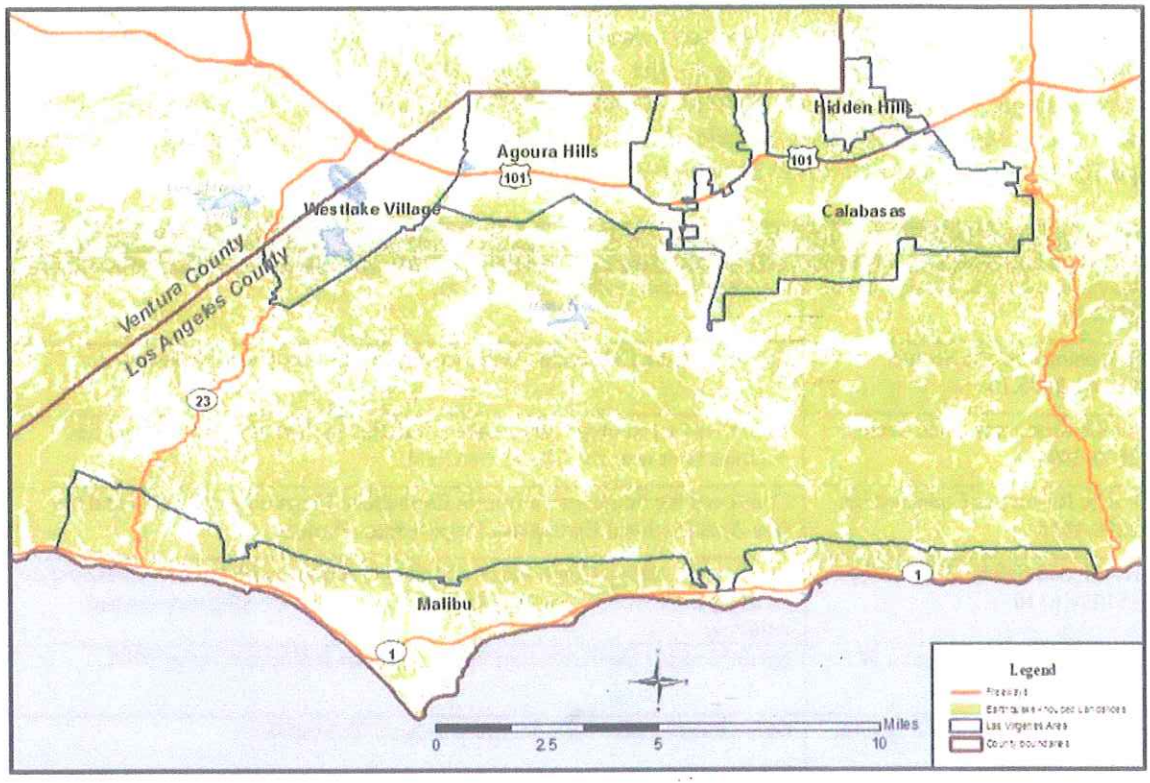
Lateral spreading occurs when the subsurface soil liquefies. Gravity and inertial forces from the earthquake cause the mass to move downslope. Lateral spreading can occur on very shallow slopes (nearly flat ground) and they can cause ground displacements ranging from inches to tens of feet. This type of movement can damage utilities and structures supported by shallow or deep foundations. In the Las Virgenes-Malibu Region portions of Calabasas, Agoura Hills, and Malibu are in liquefaction zones.



Map 41: Liquefaction Zones

Landslide

The severity of seismically induced landslides and related damage is dependent on the level of ground shaking and groundwater conditions at the time of the earthquake. The map below depicts areas prone to earthquake induced landslides.



Map 42: Potential Earthquake Induced Landslide Areas

California Earthquake Mitigation Legislation

Code Development

Earthquakes often result in revisions and improvements in building codes. The 1933 Long Beach Earthquake resulted in the Field Act, affecting school construction. The 1971 Sylmar Earthquake brought another set of increased structural standards. Similar re-evaluations occurred after the 1989 Loma Prieta and 1994 Northridge Earthquakes. These code changes have resulted in stronger and more earthquake resistant structures.

The Alquist-Priolo Special Studies Zone Act requires the State Geologist to delineate "special studies zones" along known faults in California. Cities and counties affected by the zones must regulate certain development "projects" within the zones. The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures (SOURCE: California Geological Survey).

The 1990 Seismic Hazards Mapping Act requires the California State Geologist to identify and map zones prone to seismically induced liquefaction, ground-shaking, landslides and other forms of ground failure resulting from earthquakes. The State Department of Conservation operates the Seismic Mapping Program for California.

The California Legislature has passed laws to strengthen the built environment and protect citizens. There are over 200 laws in the State Code related to earthquake safety. All new development within each of the individual cities within the Las Virgenes-Malibu Region comply with all current State and Los Angeles County Building Codes. The following table provides a partial list of California laws on earthquake safety.

Reference	Description
Government Code Section 8870-8870.95	Creates Seismic Safety Commission.
Government Code Section 8876.1-8876.10	Established the California Center for Earthquake Engineering Research.
Public Resources Code Section 2800-2804.6	Authorized a prototype earthquake prediction system along the central San Andreas fault near the City of Parkfield.
Public Resources Code Section 2810-2815	Continued the Southern California Earthquake Preparedness Project and the Bay Area Regional Earthquake Preparedness Project.
Health and Safety Code Section 16100-16110	The Seismic Safety Commission and State Architect will develop a state policy on acceptable levels of earthquake risk for new and existing state-owned buildings.
Government Code Section 8871-8871.5	Established the California Earthquake Hazards Reduction Act of 1986.
Health and Safety Code Section 130000-130025	Defined earthquake performance standards for hospitals.
Public Resources Code Section 2805-2808	Established the California Earthquake Education Project.
Government Code Section 8899.10-8899.16	Established the Earthquake Research Evaluation Conference.
Public Resources Code Section 2621-2630 2621.	Established the Alquist-Priolo Earthquake Fault Zoning Act.
Government Code Section 8878.50-8878.52 8878.50.	Created the Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990.
Education Code Section 35295-35297 35295.	Established emergency procedure systems in kindergarten through grade 12 in all the public or private schools.
Health and Safety Code Section 19160-19169	Established standards for seismic retrofitting of un-reinforced masonry buildings.
Health and Safety Code Section 1596.80-1596.879	Required all child day care facilities to include an Earthquake Preparedness Checklist as an attachment to their disaster plan.

Source: http://www.leginfo.ca.gov/calaw.html

Table 110: Partial List of California Laws on Earthquake Safety

Earthquake Mitigation Strategies

LVMCOG Mitigation Activities

The cities of Agoura Hills, Calabasas, Malibu and West Lake Village have implemented the Los Angeles Region Uniform Code Program (LARUCP) Seismic Zone 4 requirements. These are more restrictive standards than required by the State of California Building Code.

Agoura Hills

In order to minimize the adverse effects to residents, public and private property, and essential services caused by seismic and geologic hazards, the City of Agoura Hills has enacted the following policies:

- Enforcement of Building Code. Review all structures for compliance with the latest edition of the California Building Code (CBC). This code addresses all provisions associated with geologic and seismic regulations and the city requires the review of plans and inspection of all such structures considering the best management practices in site design and building construction methods.
- Geotechnical Investigations. Per City of Agoura Hill Building Code, any new structure could be subject to soils/geotechnical investigations and report to determine the potential for liquefaction, ground rupture, ground shaking, and soil bearing pressure in order to better design the structure for structural integrity.
- Slope Restrictions. Besides the hillside ordinance which has been in effect for years, and the regular CBC requirements, the City of Agoura Hills has more restrictive slope set back requirements. Slope failure repairs are subject to conditional use permit review with conditions for slope maintenance.
- Residential Footings. Due to the location of the City in relations with active faults, the City of Agoura Hills modified sections of the 2010 California Residential Code (CRC) in order to provide higher standards for residential buildings in case of a seismic event by requiring continuous footings and better concrete reinforcements.
- Retrofit Critical Facilities. Encourage the upgrade, retrofitting, and/or relocation of all existing critical facilities (e.g. schools, police stations, fire stations, and medical facilities) and other important public facilities that do not meet current building code standards and are within areas susceptible to seismic or geologic hazards.
- Emergency Preparedness. At the time of any natural disaster, including an earthquake, the City staff and its consultants are trained to facilitate rapid recovery.
- The City of Agoura Hills is very involved with International Code Council (ICC) and its local chapters, California Building Officials (CALBO), and the State Building Standard Commission for the adoption, and implementation of the Building Code and all the seismic safety regulations. Additionally, every 3 years during the Code adoption process, the City has adopted more restrictive requirements than those of the State.

The following table lists the 2010 California Building and Residential Codes (CBC and CRC) which were amended by the City of Agoura Hills in order to achieve better strengthening of structures in the community.

CA Building Code Section	Title
2010 CBC Sec. 1808.7	Footing on or Adjacent to Slopes
2010 CBC Sec. 1808.7.1	Building Clearance from Ascending Slope
2010 CBC Sec. 1808.7.2	Building Clearance from Descending Slope
2010 CRC Sec. R403.1.2	Continuous Footing in Seismic Design Categories D0, D1, D2
2010 CRC Sec. R403.1.3	Seismic Reinforcement
2010 CRC Sec. R403.1.5	Slope
2010 CRC Sec. R404.2	Wood Foundation Wall
2010 CRC Sec. R802.8	Lateral Support
2010 CBC Sec. 1808.7	Footing on or Adjacent to Slopes

Table 111: Partial List of Agoura Hills Building Codes

Calabasas

In order to minimize the adverse effects to residents, public and private property, and essential services caused by seismic and geologic hazards, the City of Calabasas has enacted the following policies:

- Incorporate adequate mitigation measures into proposed development projects to achieve an acceptable level of risk from potential seismic hazards resulting from ground motion or fault rupture.
- Emphasize prevention of physical and economic loss associated with earthquakes and other geologic disasters through early identification of potentially hazardous conditions prior to project approval.
- Facilitate rapid physical and economic recovery following an earthquake, geologic disaster or wildland fire through early investigation of the event and implementation of effective new standards for design of structures.
- Discourage development within potential landslide areas and areas with severe soils limitation as the City's preferred management strategy, and as a higher priority than attempting to implement engineering solutions.
- Where engineering solutions to slope stability constraints are required, implement landform grading programs so as to recreate a natural hillside appearance.
- Prior to approval of development projects within the liquefaction or landslide hazard zones or other areas identified by the City Engineer as having significant liquefaction and/or landslide hazards, require applicants to prepare site specific liquefaction and/or landslide studies and mitigation. Such studies shall be subject to review and approval by the City Engineer.

- In September 2010, the City of Calabasas amended its building codes to the California Building Code Standards which include Seismic design as of January 1, 2011.
- In March 2010, the City of Calabasas through the Department of Public Works published guidelines provide the minimum standards and recommended format for engineering geologic and geotechnical engineering reports submitted to the City of Calabasas.

Hidden Hills

The City of Hidden Hills has adopted the California Building Code which includes seismic design standards. Hidden Hills has included several mitigation requirements in the Hidden Hills Municipal Code under Title 5, Land Use and Development.

The Housing and Land Use Elements of the General Plan ensure that structures in Hidden Hills are of standard design and building materials, and are not subject to undue hazard based on their location. Hidden Hills has included several mitigation requirements under Title 5, Land Use and Develop. They are:

1. No building or grading permit shall be issued under the provisions of this Section when the Building Official finds that property outside the site of the proposed work could be damaged by activation or acceleration of a geologically hazardous condition and such activation or acceleration could be attributed to the proposed work on, or change in use of, the site for which the permit is requested. For the purpose of this subsection, geologically hazardous condition does not include the hazard of surface displacement due to earthquake faults.

2. Work requiring a building or grading permit by this Code is not permitted in an area determined by the City Engineer to be subject to hazard from landslide, settlement or slippage. These hazards include those from loose debris, slope wash and the potential for mud flows from natural slopes or graded slopes. For the purpose of this subsection, landslide, settlement or slippage does not include surface displacement due to the earthquake faults.

Malibu

The City of Malibu has a Safety Element section of its general plan, such planning is a proactive approach to earthquake planning. The City also implements a comprehensive Emergency Operations Plan and has developed a Mass Evacuation Plan.

The Goal is for the City of Malibu to create "A community that is free from all avoidable risks to safety, health, and welfare from natural and manmade hazards". With this goal in mind, Malibu has created S Policy 1.2.1: The City shall require development to provide for analyses of site safety related to potential hazards of fault rupture, earthquake ground shaking, liquefaction, and rock falls. This policy has numerous measures to support this policy.

Below are several measures that support the mitigation of damage due to earthquakes:

- **S Implementation Measure 39**: Develop and maintain a development geo-hazard database to incorporate findings from site specific and area hazard-related studies.
- **S Implementation Measure 40**: Adopt and update as appropriate maps of extreme fire danger areas, 100-year flood plains, landslide and debris flow danger, active and potentially active faults, tsunami, and any other hazard areas; and inform residents of those areas of risks and possible mitigation measures.
- **S Implementation Measure 41**: Require that all new construction be designed to be earthquake resistant to maximum probable earthquakes.
- **S Implementation Measure 42**: Apply all restrictions and investigation requirements mandated by the State under the Alquist-Priolo Special Studies Zones Act for faults classified as "active" to development on properties crossed by or adjacent to the Malibu Coast Fault.
- **S Implementation Measure 45**: Require that all critical use facilities (hospitals, police and fire stations) be earthquake resistant designed for the effects of a maximum credible earthquake.

Westlake Village

The Los Angeles County Department of Public Works oversees Westlake Village's Building and Safety Department. The Building and Safety Division is the enforcement, through the plan check and inspection process, of the Building, Plumbing, Mechanical, and Electrical Codes, as well as other local and State requirements relevant to the construction and occupancy of public and private structures. Some of the other pertinent State and local requirements enforced by Building and Safety include zoning requirements, general hazards mitigation, National Pollution Discharge Elimination System, Standard Urban Storm water Mitigation Plan, geology, disabled access, sound attenuation, energy conservation, and environmental protection.

Prior to development on certain soils such as thicker alluvium where liquefaction may occur, the City of Westlake Village requires a soils report. Additionally, if a hillside development is planned on an area located on sediments or volcanic rock, an engineering geology and soil investigation is required.

SECTION 7. WILDFIRE

The Nature of the Wildfire Threat

Fire is a natural part of the ecosystem in Southern California. However, wildfires present a substantial hazard to life and property in communities such as the Las Virgenes-Malibu Region that are built within or adjacent to hillsides and mountainous areas. Consequently there is a significant potential for losses due to fire in the Region (including wildland and urban fires). According to the California Division of Forestry and Fire Protection (CAL FIRE), for the years 2011 and 2010 the following fire season totals were reported in California (CAL FIRE jurisdiction fires):

Interval	Fires	Acres
January 1, 2011 through December 31, 2011	5,871	52,007
January 1, 2010 through December 31, 2010	4,014	31,298
5 year average (same interval)	5,908	238,846

Table 112: CAL FIRE Number of Fires and Acres Burned for 2010 and 2011

While the number of fires in 2011 and 2010 were less than average, Los Angeles County suffered a great deal of damage from wildfires in the three preceding years, 2007, 2008 and 2009. Recent major fire events include the 2009 Station Fire, the 2008 Sayre Fire, and the 2007 Ranch and Buckweed Fires.

Historical Record of Significant Fires

The following table provides examples of significant fires in Los Angeles County from 1993 to 2009.

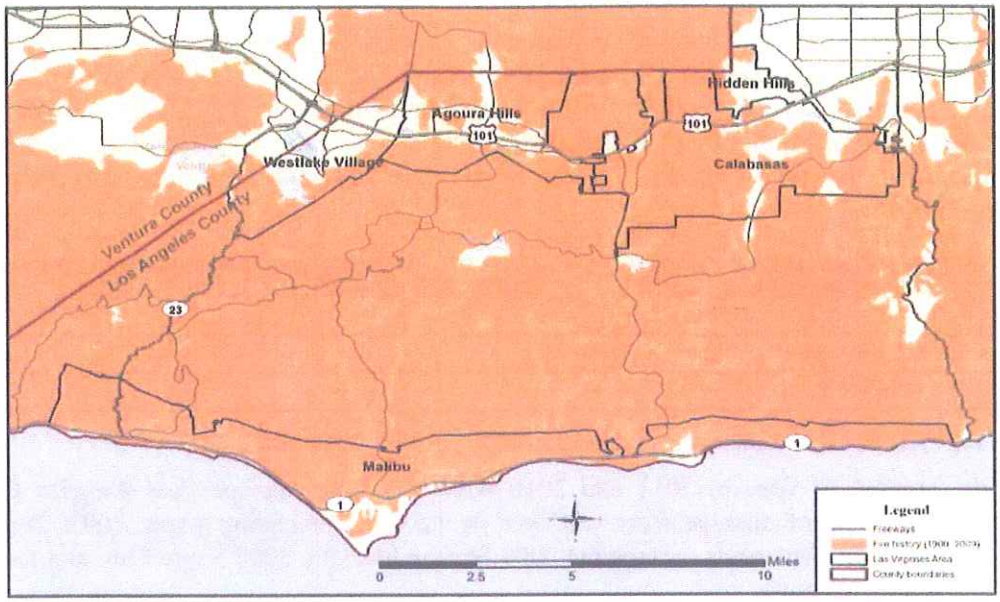
Fire Name	Start Date	Acres Burned	Structures Destroyed	Deaths
Station	Aug-2009	160,557	209	2
Sayre	Nov-2008	11,262	634	0
Ranch (Castaic/Piru)	Oct-2007	58,401	10	0
Buckweed	Oct-2007	38,356	63	0
Topanga	Nov-1993	18,000	323	3

Source: California Department of Forestry and Fire Prevention

Table 113: Los Angeles County Significant Fire Examples from 1993 to 2009

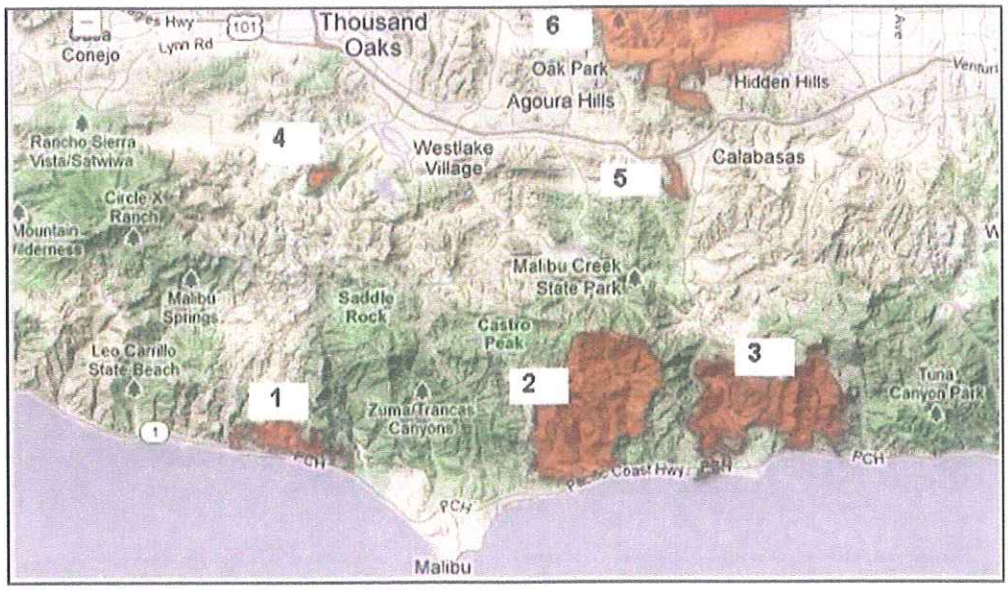
History of Fire Events in the Las Virgenes-Malibu Region

The Las Virgenes-Malibu COG Region has a long history of wildland fires. The map below depicts the fire history of the area from 1900 to 2009. Over the past 110 years nearly the entire Las Virgenes Malibu Region has been impacted by fire.



Map 43: Fire History In The Las Virgenes-Malibu Region

The map below depicts major fires since 2003 in the Las Virgenes-Malibu Region.



Source: Fresno Bee

Map 44: Major Fires Near or In the Las Virgenes-Malibu Region Since 2003

Map Location	Name	Year	Estimated Acres	Structure Loss
1	Pacific Fire	2003	806	0
2	Corral Fire	2007	4,708	53
3	Malibu Canyon Fire	2007	3,839	14
4	Sherwood Fire	2006	168	0
5	Lost Hills Fire	2008	167	0
6	Topanga Fire	2005	24,175	323

Table 114: Major Fires Near of In the Las Virgenes-Malibu Region

Causes and Characteristics of Wildfires

Southern California has two distinct areas of risk for wildland fire. First, the foothills and lower mountainous areas which are often covered with scrub brush or chaparral. Second, the higher elevation mountains which are contain large forest areas. In fact, the magnitude of the 2003 fires that struck Southern California were the result of three primary factors: (1) severe drought, accompanied by a series of storms that produced thousands of lightning strikes and windy conditions; (2) an infestation of bark beetles that has killed thousands of mature trees; and (3) the effects of wildfire suppression over the past century that led to a build-up of brush and small diameter trees in the forests.

Wildfire Hazard Identification

Urban/Wildland Interface Fires

The Las Virgenes-Malibu Region is like many Southern California communities that are challenged by the increasing number of houses being built on the urban/wildland interface. The National Wildland Coordinating Group defines urban/wildland interface as "the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel.

In terms of urban/wildland interface fires, there are three categories of concern:

- The classic urban/wildland interface exists where well-defined urban and suburban development presses up against open expanses of wildland areas;
- The mixed urban/wildland interface is characterized by isolated homes, subdivisions and small communities situated predominantly in wildland settings;
- Occluded urban/wildland interfaces exist where islands of wildland vegetation occur inside a largely urbanized area.

Very High Fire Hazard Severity Zones

For the purposes of describing the severity of fire hazard areas, the Los Angeles County Fire Department classifies areas according to criteria established in the State legislation commonly referred to as the "Bates Bill". The Bates Bill Process determines Very High Fire Hazard Severity Zones (VHFHSZs) in Local Responsibility Areas (LRAs).

In order to comply with the Bates Bill, the cities within the Las Virgenes-Malibu Region completed an evaluation of the following factors to determine the areas of the Region which would qualify as a Very High Wildland Fire Hazard Severity Zones.

- Fuel
- Topography
- Dwelling density
- Weather
- Infrastructure
- Fire codes and ordinances as they relate to brush issues

Each factor was given a value of 1-4 with a 4 being the highest danger rating. Any total score over 10 qualified the area as being one of VHFHSZ. Each of the three areas evaluated rated 10 or above with the highest area receiving a 12.

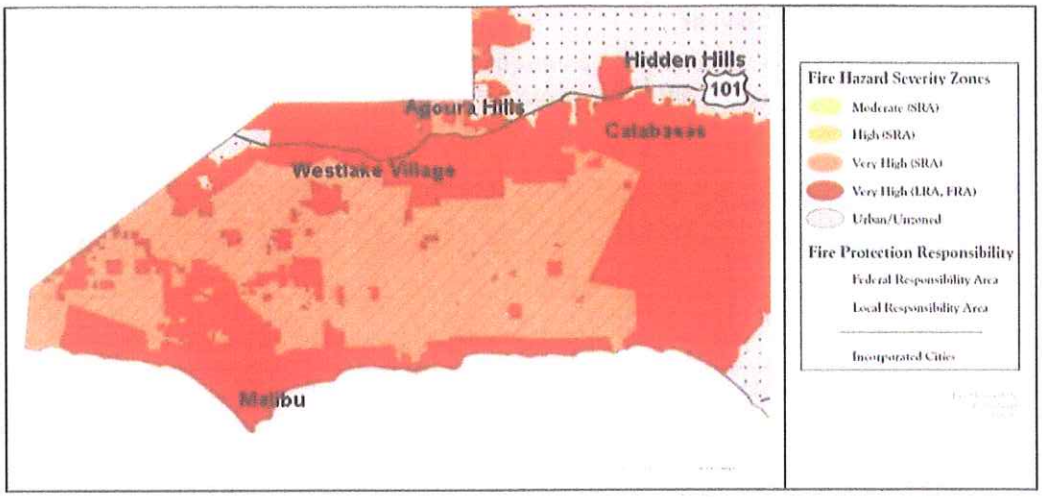
All five cities within the Las Virgenes-Malibu Region have been designated as VHFHSZs. Fire zone areas are rated on a scale of I – IV, with IV representing the most severe fire hazard zone. The Region contains both Zone III and Zone IV areas.

Identifying the hazard area as set forth above is the first step in assessing each city's vulnerability to wildland fires. Other key factors in assessing wildfire risk include:

- Ignition sources
- Building materials and design
- Community design
- Structural density
- Slope
- Vegetative fuel
- Fire occurrence
- Weather, as well as occurrences of drought

The Natural Hazard Disclosure Map on the following page depicts the two types of fire hazard areas referred to in legislation as disclosure items in real estate transactions. These areas are:

- Wildland Areas that may contain *substantial* forest fire risks and hazards (Wildland Areas)
- Very High Fire Hazard Severity Zones (VHFHSZ)



Map 45: Las Virgenes – Malibu Region Fire Map

Very High State Responsibility Areas (SRA)	The State Board of Forestry and Fire Protection classify areas in which the primary financial responsibility for preventing and suppressing fires is that of the state. These include: lands covered wholly or in part by timber, brush, undergrowth or grass, whether of commercial value or not; lands which protect the soil from erosion, retard run-off of water or accelerated percolation; lands used principally for range or forage purposes; lands not owned by the Federal government; and lands not incorporated. By Board regulations, unless specific circumstances dictate otherwise, lands are removed from SRA when housing densities average more than 3 units per acre over an area of 250 acres.
Very High Local Responsibility Areas (LRA)	Government Code 51175-89 directs the California Department of Forestry and Fire Protection (CAL FIRE) to identify areas of very high fire hazard severity zones within Local Responsibility Areas (LRA). Mapping of the areas, referred to as Very High Fire Hazard Severity Zones (VHFHSZ), is based on data and models of, potential fuels over a 30-50-year time horizon and their associated expected fire behavior, and expected burn probabilities to quantify the likelihood and nature of vegetation fire exposure (including firebrands) to buildings. Local Responsibility Area VHFHSZ maps were initially developed in the mid-1990s and are now being updated based on improved science, mapping techniques, and data. In late 2005 to be effective in 2008, the California Building Commission adopted California Building Code Chapter 7A requiring new buildings in VHFHSZs to use ignition resistant construction methods and materials. These new codes include provisions to improve the ignition resistance of buildings, especially from firebrands. The updated very high fire hazard severity zones will be used by building officials for new building permits in LRA. The updated zones will also be used to identify property whose owners must comply with natural hazards disclosure requirements at time of property sale and 100 foot defensible space clearance. It is likely that the fire hazard severity zones will be used for updates to the safety element of general plans.
Very High Federal Responsibility Areas (FRA)	The State and Federal Agencies jointly develop and review the Annual Operating Plan for the protection of Federal Responsibility Areas (FRA) located within State DPAs. As identified in the Annual Operating Plan, the State provides wildland fire protection at a level, which is most nearly equivalent to the wildland fire protection that would be provided directly by the Federal Agencies on FRA of equal hazard, risk, and value. Federal Agencies retain all land management responsibilities except for wildland fire protection on FRA within the area where the State has direct protection responsibility. This does not preclude the Federal Agencies from conducting fire prevention activities on these lands.

Estimated Impact of an Event

If a major wildfire were to occur, the consequences to local populations and housing in urban interface areas will be significant. The table below provides the estimated impact of a disaster using a 5% loss baseline.

Category	Agoura Hills	Calabasas	Hidden Hills	Malibu	Westlake Village	Impact if a 5% Loss Occurs
Population	20,330	23,058	1,856	12,645	8,270	3,300
Total Housing Units	7,681	8,686	606	6,252	3,322	1,325
Median Home Value	$740,200	$962,700	More than $1,000,000	More than $1,000,000	More than $1,000,000	More than $1.3B

Table 115: Estimated Population and Economic Loss of a Wildfire

Based on a 5% loss projection, more than 3,300 people would be displaced or significantly impacted and more than 1,325 homes could be damaged or destroyed resulting in over $1.3 billion in losses (see Community Profile section for population, housing, and economic data).

Wildfire Vulnerabilities

Base Hazard Factors

In order to determine the "base hazard factor" of specific wildfire hazard sites and interface areas, several factors must be taken into account. Categories used to assess the base hazard factor include:

- Topography (location, characteristics and
- Fuels
- Development (site/building construction and design, landscaping, defensible space, accessibility, etc.)
- Weather

Topography

Topography influences the movement of air, thereby directing a fire's course. In general, if the percentage of uphill slope doubles the rate of fire spread doubles. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Unfortunately, hillsides with hazardous topographic characteristics are also desirable, residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas. Numerous canyons, saddles, and ridges in the VHFHSZ will also contribute to erratic fire behavior due to the funnel and subsequent acceleration effect it will have on wind traveling through the area.

Fuels

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of

fuel and increases the fire's ability to spread. After decades of fire suppression "dog-hair" thickets have accumulated, which enable high intensity fires to flare and spread rapidly.

In addition, fuel is a key factor in wildfire behavior. Fuel is classified by volume and by type. Volume is described in terms of "fuel loading," or the amount of available vegetative fuel. In the Las Virgenes- Malibu Region, there are several types of fuel including a large amount of chaparral and woodland vegetation that is a catalyst for fire activity.

Like much of Southern California, chaparral is a primary fuel prevalent in the Las Virgenes-Malibu Region along with grasses, non-native vegetation and large trees such as junipers, palm, eucalyptus, pines, and locally prevalent oaks.

Added to this is the fact that a large percentage of the fuel beds in the Santa Monica Mountains contain dead and downed vegetation. This "die back" condition is due largely to drought conditions. These fuel beds are extremely receptive to ignition and spread of wildfires more quickly than live vegetation. This type of fuel mode is of particular concern when fires are wind driven, which can lead to short and long range spotting - which can affect the entire Region.

Development

Growth and development in scrubland and forested areas is increasing the number of structures in the Las Virgenes-Malibu interface areas. Wildfire has an effect on development, yet development can also influence wildfire. Owners often prefer homes that are private, have scenic views, are nestled in vegetation and use natural materials. There are many types of these homes within the Region that use vegetation as privacy barriers. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions make evacuation and firefighting difficult. Similarly, narrow and winding roads in these developed areas tend to make evacuation of civilians slow and difficult especially when fire resources are trying to gain access to the area utilizing the same roads.

Wildfire hazard areas are commonly identified in Regions of the urban/wildland interface. Ranges of the wildfire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control such as the surrounding fuel load, weather, topography, and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather and topography.

Within the cities in the Las Virgenes-Malibu Region, increased development in and adjacent to naturally vegetated areas exposes additional structures to potential wildland fires. With sound construction practices, sufficient water flows, brush clearance and provision of adequate access the risk can be reduced.

Weather

Weather patterns combined with certain geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible. This is a definite classification of the Las Virgenes-Malibu Region. Southern California is known for its lack of precipitation and its years of droughts.

High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The "Santa Ana" winds, which are heated by compression as they flow down to Southern California from Utah, create a particularly high risk, as they can rapidly spread what might otherwise be a small fire.

The Las Virgenes-Malibu Region experiences Santa Ana Wind conditions typically in the fall months. This poses a threat in two ways. A fire starting in the Las Virgenes-Malibu Region will spread rapidly and has the potential of overwhelming initial attack forces and destroying structures within minutes of ignition. A fire starting adjacent to the Las Virgenes-Malibu Region could quickly burn into the area either by direct flame contact or by fire brands being carried by the winds and spotting onto structures or combustible vegetation.

Wind bends the flames to pre-heat the fuel ahead and can carry fire brands up to a quarter mile or more ahead of the flame front. The majority of catastrophic fires that Southern California has experienced have occurred in the months of September, October, and November when Santa Ana Winds typically occur. Wind is considered to be the primary factor that influences fire spread. Furthermore, in the City of Malibu, severe wind gusts can occur through local canyons and valleys, propelling and increasing the intensity of wildfires.

Recent concerns about the effects of climate change (particularly drought) have contributed to concerns about wildfire vulnerability. Drought also leads to less frequent irrigation which can contribute to wildfires. For example, from 2007 to 2009 Southern California experienced drought conditions. This corresponds to the most recent years when significant wildfires have occurred.

The Threat of Urban Conflagration

An urban conflagration could start either as a result of a lightning strike, arson, human error, earthquake or other phenomenon. Possible scenarios include a fire in planned community that quickly spreads to nearby homes due to a combination of high winds and high temperatures.

Business structures are also at risk however this threat is mitigated by requirements for commercial sprinkler systems. Nevertheless, there is still a risk of widespread fire if local water supplies are disrupted due to extremely high demand, power outage, or line breaks (cause by an earthquake or other damage). Examples include high rise offices, large hotels, and retail centers.

Wildfire Mitigation Strategies

Federal Programs

The role of the federal land managing agencies in the wildland /urban interface is to reduce fuel hazards on the lands they administer; cooperate in prevention and education programs; provide technical and financial assistance; and develop agreements, partnerships and relationships with property owners, local protection agencies, states and other stakeholders. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.

Federal Emergency Management Agency (FEMA) Programs

FEMA is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland /urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments and provide for a greater understanding of FEMA programs at the federal, state and local levels.

Fire Suppression Assistance Grants

Fire Suppression Assistance Grants may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property as well as encourage the development and implementation of viable multi-hazard mitigation measures. The grant may include funds for equipment, supplies and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for fires. The grants are cost-shared with states. FEMA's Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues and the USFA's National Fire Academy provides training programs.

Hazard Mitigation Grant Program

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

National Wildland/Urban Interface Fire Protection Program

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association (WGA) can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

U.S. Forest Service

The U.S. Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on forest lands. The USFS is a cooperating agency and, while it has little to no jurisdiction in the lower valleys, it has an interest in preventing fires in the interface, as fires often burn up the hills and into the higher elevation US forest lands.

Los Angeles County Fire Department

First Responders

The Las Virgenes-Malibu Region is located in the Central Region, Division of the Los Angeles County Department. Battalion 5 of the LACoFD serves the Las Virgenes-Malibu Region with a total of 12 stations assigned to serve five cities and over 72,000 residents. The cities include Agoura Hills, Calabasas, Hidden Hills, Malibu, Westlake Village. Division VII and Battalion 5 headquarters are located at 3970 Carbon Canyon Rd., Malibu 90265.

Operating 9 divisions and 22 battalions, LACoFD answers approximately 300,000 emergency calls annually. The Department currently has 169 fire stations, 68 paramedic squads, 9 wildland fire suppression camps, 10 bulldozers, 9 helicopters, 23 Prevention Offices, 12 Forestry Units and numerous other response vehicles and facilities. It serves 58 incorporated cities, as well as the unincorporated areas of the County. Additionally, the Department has Planning, Information Management, Lifeguard, and Health Hazardous Materials Divisions which provide valuable services to the more than 4.1 million people who reside in the 1.2 million housing units located throughout the Department's 2,305 square mile area.

The LACoFD is one of six Contract Counties that maintain a contractual relationship with California Department of Forestry and utilizes the California Fire Plan within Los Angeles County as the primary wildland fire protection plan.

Other Agencies

It is important to work with other organizations and agencies to create a more comprehensive Hazard Mitigation Plan. There are numerous agencies with which Division VII of the LACoFD works closely, including but not limited to:

Political Entity	Jurisdiction
Los Angeles County Sheriff's Department	Local Government/ Law Enforcement
City of Los Angeles	Local Government/LRA Fire Protection
Ventura County Fire Department	LRA and SRA Fire Protection
National Park Service	Public Land Ownership, DPA Fire Protection
City of Agoura Hills	Contract
City of Hidden Hills	Contract
City of Malibu	Contract
City of Westlake Village	Contract
City of Calabasas	Contract
California State Parks	Public Land Ownership, SRA Fire Protection
Santa Monica Mountains Conservancy	Public Land Ownership, Recreational Use
Public Utility Companies	State/County
California Department of Forestry and Fire Protection	State/County

Table 116: Political Entities that Coordinate with the LACoFD to Mitigate the Threat of Fire

Fire Prevention Division

The Las Virgenes-Malibu area is part of the LACoFD Fire Prevention Central Region. Fire prevention and code enforcement in this area historically requires concentrated efforts related to water supplies for fire protection and vehicular access for fire apparatus. Geographic and terrain limitations as well as the lack of water supply in mountainous terrain present challenges that LAcoFD Inspectors review and inspect, often times providing alternative solutions for the owners/occupants to consider.

Special Operations Bureau

The Special Operations Bureau provides highly technical operational functions to County residents including Emergency Medical Services, Urban Search and Rescue, Hazardous Materials, Air Operations, Fire Camps for wildland firefighting, Heavy Equipment and central Dispatch.

Fire Prevention Programs

The Los Angeles County Fire Department manages an active effort in order to prevent the possibility of a wildfire occurring within the Las Virgenes-Malibu Region. The following list provides a sample of the programs, activities and practices.

Prescribed Burning
The health and condition of brush will determine the magnitude of wildfire. The LACoFD does practice prescribed burning. If fuels (slash, dry or dead vegetation, fallen limbs and branches) are allowed to accumulate over long periods of time without being methodically cleared, fire can move more quickly and destroy everything in its path. The results are more catastrophic than if the fuels are periodically eliminated. Prescribed burning is the most efficient method to remove these fuels.

Pre-Fire Management Plan
As a preventative measure, the LACoFD also implements a Pre-Fire Management Plan whose overall goal is to reduce the total cost and losses from wildland fires in California by protecting assets at risk through focused pre-fire management prescriptions and increased initial attacks.

Fuel Modification Plan
The Fuel Modification Plan is part of the Forestry Division of the LACoFD. This publication was prepared to establish a set of guidelines and landscape criteria for all new construction relating to fuel modification planning that will reduce the threat of fire in high hazard areas.

Vegetation Management Program
The Vegetation Management Program (VMP) is a cost-sharing program that focuses on the use of prescribed fire, mechanical, biological and chemical means for addressing wildland fire fuel hazards and other resource management issues on State Responsibility Area (SRA) and Local Responsibility Area (LRA) lands. The use of prescribed fire mimics natural processes, restores fire to its historic role in wildland ecosystems, and provides significant fire hazard reduction benefits that enhance public and firefighter safety.

The Los Angeles County Fire Department created the Vegetation Management Program in 1979 to develop strategies for responding to the growing fire hazard problem. These include:

- An ongoing effort to analyze the history of wildland fires in Los Angeles County
- Experimentation with different methods of reducing and removing fuels in fire prone areas
- Evaluation of the environmental impacts and effects of these practices

Brush Clearance Inspection Program

Mandated by the LA County Fire Code, all property owners in the region are presently required to maintain a firebreak around and adjacent to all buildings and structures by removing all flammable vegetation or other combustible growth for a minimum distance of 200 feet from the structure or to the property line, whichever is closer.

The Brush Clearance Program is a joint effort between the Los Angeles County Fire Department and the County of Los Angeles Department of Agricultural Commissioner/Weights and Measures, Weed Hazard and Pest Abatement Bureau (Weed Abatement Division). This unified enforcement legally declares both improved and unimproved properties a public nuisance, and where necessary, requires the clearance of hazardous vegetation. These measures create "Defensible Space" for effective fire protection of property, life and the environment. The Department's Brush Clearance Unit enforces the Fire Codes as it relates to brush clearance on improved parcels, coordinates inspections and compliance efforts with fire station personnel, and provides annual brush clearance training to fire station personnel.

Fire Retardant Foam

All the Los Angeles County Fire Department fire engines are equipped with fire retardant foam capability. This type of program demonstrates the value of pre-suppression and prevention efforts when combined with property owner support to mitigate hazards within the wildland/urban interface.

Fire Codes

Fire codes have been amended throughout the years to assist fire department personnel with wildland firefighting in the rural/urban interface zones. Building construction in these areas may have additional requirements for non-combustible construction components and water supplies. Inspectors assigned to these regional offices provide developers and homeowners with information for fire safe construction and fire protection systems.

Building Codes

All five Malibu-Las Virgenes COG cities are located within the Very High Fire Hazard Severity zone (VHFHSZ). Class A roofing material and one-hour rated exterior construction of structures is required by Fire and Building Codes.

Public Education and Involvement

The Fire Prevention Division within the Los Angeles County Fire Department (LACoFD) focuses on educating the community about the benefits of proper safety practices and identifying and eliminating all types of hazardous conditions, which pose a threat to life, the environment and property.

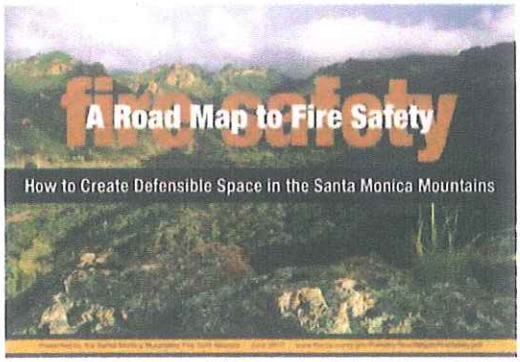
Ready Set Go!

The Los Angeles County Fire Department has published a personal wildfire action plan for residents living in the interface region called Ready Set Go! The plan describes the actions and tools necessary to successfully prepare for a wildfire. It gives guidance on retrofitting houses with fire-resistive features and describes how to create the necessary defensible space around the home. This publication also helps families prepare well ahead of time so that they are ready to quickly evacuate from an area endangered by a fast-approaching wildfire.

Additionally the County Fire Department makes a variety of Safety Handouts available on their website and at various fire stations in the Las Virgenes-Malibu Region. These documents include but are not limited to:

- Home Fire Safety Tips
- Brush Clearance Tips
- Exit Drills in the Home
- Storm Safety Guidelines
- Rolling Electric Outage Safety
- Link to Southern California Gas Company for safety tips on gas appliances

A Road Map to Fire Safety



The Santa Monica Mountains Fire Safety Alliance developed a booklet on how to create a defensible space for residents of the Santa Monica Mountains. *A Road Map to Fire Safety* includes fire hazard reduction guidance, FAIR Plan insurance material, environmental considerations, topography and vegetation facts, and fire prevention organization information. The booklet is distributed by the Los Angeles County Fire Department and each LVMCOG city in hardcopy and softcopy formats.

Community Education

The cities within the Las Virgenes-Malibu Region provide ongoing community education on fire hazards through the following programs:

- CERT (Citizen Emergency Response Team) training
- The City of Calabasas offers Calabasas Emergency Response Program (CERP) and Volunteers on Patrol program.
- The City of Malibu offers an Emergency Preparedness Program

- The City of Westlake offers a Disaster Response Team and a Volunteers in Policing program

The Las Virgenes-Malibu Regional cities along with the LACoFD educate the public in terms of fire and life Safety by providing the following special programs upon request. Fire Safety Education Programs that consist of the following:

- Local cable television education and informational programs are shown throughout the year, but most often during the months considered being fire season.
- Informational brochures have also been prepared and are distributed informing citizens about the need for evacuation plans and tips on home protection.

Connect-CTY and Alert LA County Emergency Mass Notification System

Residents of the Las Virgenes- Malibu COG participate in the *Connect*-CTY service (Blackboard Connect Inc.) which allows authorized civic leaders to create and rapidly disseminate time-sensitive messages to every telephone number stored in the notification database. With the *Connect*-CTY service, authorized users can send thousands of messages in minutes. Only authorized officials are allowed access to the system.

In addition, Los Angeles County has implemented an emergency mass notification system that will be used to contact County residents and businesses via recorded phone messages, text messages or e-mail messages in case of emergency. The system, called **Alert LA County**, will be used by the County's Emergency Operations Center to notify residents and businesses of emergencies or critical situations and provide information regarding necessary actions such as evacuations.

Alert LA County
Alert.lacounty.gov

BAER (Burned Area Emergency Rehabilitation)

The Los Angeles County Fire Department working in cooperation with the City of Malibu, Public Works and Conservation, surveys burned areas after wildfires in order to determine what mitigation efforts are necessary to avoid mudslides in the event of a large rainfall (ex. strategically placing K-rails to deter mudslides) and to begin re-vegetation.

LVCOG Mitigation Activities

All cities within the Las Virgenes-Malibu Council of Governments provide information regarding wildfire mitigation along with other emergency information on their websites. Wildfire mitigation planning advice can be downloaded or viewed online.

Agoura Hills

The City of Agoura Hills has implemented local fire codes to supplement County and State requirements. Additionally, during the code adoption process the City adopted more restrictive provisions by identifying the entire city boundary within the Very High Fire Hazard Severity Zone. This provision requires that all structures built in Agoura Hills meet the more restrictive sections of the code including the method and material used for construction (i.e. Roof, Deck, Patio, Eave materials, window types, etc.)

The City has agreement with the Los Angeles County Fire Department for all Fire Services including Fire Prevention. In addition to the fire suppression and LA County Fire Prevention reviews plans and inspects construction projects for brush clearance, fire sprinkler and access to

and around the project site. The City of Agoura Hills staff and its consultants are also trained and ready to assist its community for a fast recovery from all natural disasters including but not limited to fire. Codes Sections specific to Agoura Hills which were modified to provide better protection against fire, include:

Section	Title
2010 CBC Sec. 701A.2.1	Fire Severity Zone Established
2010 CBC Sec. 701A.3	Exception #5 – Roof Repair
2010 CBC Sec. 705A.2	Roof Covering
2010 CBC Sec. 711A	Additions and Alterations
2010 CBC Sec. 903.2	Fire Sprinklers – Where Required

Calabasas

The City of Calabasas has a program that grants free Healthy Oak permits. The intent of this program is to encourage proper maintenance of oak trees that may create a public safety hazard during a fire or windstorm event.

Hidden Hills

The City of Hidden Hills has an extensive fire prevention program. The City reviews each new development to ensure that structures are adequately separated and that fire retardant materials are used in construction. In addition, the Hidden Hills Municipal Code requires that property owners maintain right-of-way improvements and public works in a clean, hazard-free condition to ensure safety.

The following Hidden Hills building codes are implemented as preventative measures for loss of life and property because of a fire hazard event.

Section	Title
Section 1. Chapter 3 of Title 4	Fire Code

Malibu

Rambla Pacifico Alternative Access Project
This project (currently under construction) provides direct access from Rambla to Las Flores Canyon, greatly reducing the commute for Rambla residents and improving fire safety. Additionally, this project is providing alternative emergency routes in case of any hazard emergency.

Westlake Village

The Building and Safety Division of the Los Angeles County Department of Public Works serves under contract as the City's Building and Safety Department. Building and Safety is responsible for enforcing zoning restrictions and other regulations designed to reduce the threat of fire.

SECTION 8. WINDSTORM

The Nature of the Windstorm Threat

Severe windstorms pose a significant risk to life and property by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. High winds have the potential to cause damage to local homes and businesses from falling trees and debris. In addition, windstorms increase the risk of wildfire as the moisture content decreases in brush and vegetation on hillsides, especially in urban interface areas.

Causes and Characteristics of Windstorms in the Las Virgenes-Malibu Region

Windstorm events in the Las Virgenes-Malibu Region can be caused by short term, topographically influenced, high wind gusts as well as extended duration Santa Ana wind conditions. "Santa Ana Winds" typically occur between October and February. Santa Ana winds are characterized by strong dry offshore winds originating from the Great Basin and Upper Mojave Desert. Wind temperatures can range from extremely hot to cold. Damage can occur directly from the high wind speeds generated or from the secondary effects of very low humidity, which increases the threat of wildfires, particularly in the fire-prone chaparral country.

Windstorm Hazard Identification

Given the location and topography of the area, severe windstorms are a possibility. While the historic occurrence of these events on the Las Virgenes-Malibu Region has been minimal (when they occur) these events do pose a threat to life, property, utility delivery systems, infrastructure, and transportation. Furthermore, if a severe windstorm results in a prolonged utility disruption, it may be necessary to utilize private and public resources to aid in the care and sheltering of displaced residents. In addition, the economic impact of providing shelter, conducting repairs, and the disruption to local businesses can result in economic losses to the entire area. Finally, a severe windstorm can cause the loss of historic trees in the area and require the services of certified arborists.

The risk of trees falling is one of the more significant hazards resulting from high wind events. The leafy canopy and structural elements of a tree crown present a drag type barrier to winds. Trees naturally minimize wind drag through the re-orientation of leaves and through the independent motion of limbs and branches, thus reducing the transfer of uniform sway motion forces to the trunk. The Beaufort Wind Scale (BWS) specifically notes problems with trees as wind speeds increase. The BWS references the likelihood of whole tree motion as wind speeds exceed 32 miles per hour (MPH), twig breakage at 39 MPH and whole tree wind-throw as wind speeds exceed 55 MPH. The susceptibility of trees to wind-throw can be influenced by the general structural condition of the trees, the location of the trees in reference to wind patterns and the level and frequency of pruning maintenance.

The following chart depicts the Beaufort scale which is used to estimate wind strengths.

Beaufort Force	Speed (MPH)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air Ripples look like scales; No crests of foam - Smoke drift shows direction of wind, but wind vanes do not
2	4-7	Light Breeze - Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper; Small branches move
5	19-24	Fresh Breeze - Moderate, long waves; Many whitecaps; Some spray - Small trees with leaves begin to move
6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well-marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted; Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide small and medium sized ships; Sea covered with patches of white foam; Edges of wave crests blown into froth; Poor visibility - Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent – Widespread damage. Very rarely experienced on land.

Table 117: Beaufort Scale

Estimated Impact of an Event

If a severe windstorm were to occur, the consequences to local populations and housing could be significant. The table below provides the estimated impact of a disaster using a 1% loss baseline.

Category	Agoura Hills	Calabasas	Hidden Hills	Malibu	Westlake Village	Impact if a 1% Loss Occurs
Population	20,330	23,058	1,856	12,645	8,270	660
Total Housing Units	7,681	8,686	606	6,252	3,322	265
Median Home Value	$740,200	$962,700	More than $1,000,000	More than $1,000,000	More than $1,000,000	More than $265M

Table 118: Estimated Population and Economic Loss of a Windstorm

Based on a 1% loss projection, more than 660 people could be significantly impacted and more than 265 homes damaged resulting in over $265 million in losses (see Community Profile section for population, housing, and economic data).

Windstorm Vulnerabilities

Windstorms can result in damage to structures, disrupt utilities, and require emergency tree services (i.e. limb failures, clearance of private property trees fallen into roadways, etc.). In regards to wind related damage to structures; the Las Virgenes-Malibu Region has not experienced significant damage due to windstorms during the last decade. Nevertheless, the impact of a severe windstorm can be significant and mitigation planning can reduce losses if an event were to occur. Specific windstorm related issues are outlined below.

Life and Property

Detached tree limbs and building elements present a hazard to life and property as well as infrastructure. Furthermore, utility providers and emergency services can be overwhelmed during a major event. At risk populations include assisted care facilities and home-bound residents that are dependent on electrical power (see Utilities and Infrastructure section below). For example, in December 2011, the City of Pasadena, California experienced a severe windstorm with reported gusts near 100 MPH. The resulting power outages and debris impacted residents for weeks.

Utilities and Infrastructure

Windstorms can cause structural damage to buildings and other critical infrastructure. Overhead electrical and telephone lines are particularly vulnerable to damage from wind and debris as are microwave and satellite facilities. High winds commonly occur during winter storms and can cause trees to bend, sag, or fail (tree limbs or entire trees) which then come into contact with nearby power lines. Fallen trees can cause short-circuiting and conductor overloading. Wind-induced damage to the power system causes power outages to customers, incurs cost to make repairs, and in some cases can lead to ignitions that start wild land fires. In order to prepare for such events, Southern California Edison (SCE) has developed its own Hazard Mitigation Plan.

Transportation

Windblown debris, tree limbs and wind thrown trees can damage traffic control apparatus, block roadways, damage vehicles, and cause extreme traffic congestion - impeding emergency and vehicles and hampering repair efforts.

Increased Fire Threat

The Las Virgenes-Malibu Region is subject to Santa Ana Winds with regards to their impact on fire conditions. Winds can serve as a catalyst in the canyons to spread fire at a rapid rate. Prolonged winds during the warmer months of the year can decrease vegetation moisture levels and increase the ignition potential in dry underbrush. When urban/wildland interface fires occur, Santa Ana Wind conditions can drive flames and increase the spread speed and severity of the fire. This is a significant concern near homes, especially where brush clearance has been lax.

Windstorm Mitigation Strategies

Interagency Efforts

In the case of buildings and structures, the likelihood of structural element detachment is influenced by local building code requirements, the location of buildings in reference to wind patterns and in the level of maintenance and upkeep. In addition, one of the strongest and most widespread existing mitigation strategies pertains to tree clearance.

Currently, California State Law and LA County Fire Code requires utility companies to maintain specific clearances (depending on the type of voltage running through the line) between electric power lines and all vegetation (Fire Code section 325.1 Electrical Transmission Lines). Furthermore, homeowners are required to allow a utility company to comply with the law.

Failure to provide access to utility power lines can result in liability to the homeowner for damages or injuries resulting from a vegetation hazard. Many insurance companies do not cover these types of damages if the policy owner has refused to allow the hazard to be eliminated.

Continuous upgrades to engineering design criteria based on the latest industrial progress, geotechnical findings, and Code revisions are being conducted. For instance, Dynamic Shake Table Tests were recently made mandatory for certain equipment in addition to analytical design.

LVMCOG Mitigation Activities

Agoura Hills

In order to mitigate the impact of windstorms, the City of Agoura Hills tracks 8,000 trees that it maintains according to standards regarding public safety. Codes on tree pruning were recently reviewed and updated and new codes regarding tree maintenance were implemented.

In 2011 Agoura Hills signed a professional tree maintenance contract with West Coast Arborists Inc. to maintain all City owned trees. Since there is a great deal of individual attention required for adequate tree maintenance to ensure an increase in the health of city trees and enhance public safety this separate contract ensures that detailed maintenance logs and inventories are kept resulting in improved care, which can help reduce the City's liability. Under this new contract, every City owned tree is assessed every three years. Additionally, the City offers free hazardous oak tree pruning and removal permits and reduced fees for preventive oak tree pruning permits for potentially hazardous oak trees.

Calabasas

The Environmental Commission of the City of Calabasas among other duties is responsible for maintaining the Urban Forestry Master Plan and making recommendations to carry out the policies and goals of that plan. The Urban Forestry Master Plan includes the monitoring and maintenance of the city's tree population.

Additionally, the City has a program that grants free Healthy Oak Tree permits. The intent of this program is to encourage proper maintenance of privately owned oak trees in order to reduce safety hazards.

Hidden Hills

The Hidden Hills Community Association regularly trims trees on street and equestrian trail rights of way, as well as on common and community use properties.

Malibu

The City of Malibu has begun a citywide tree pruning program. In addition, the City is using aerial photographs to update their GIS and map every tree on public property.

Westlake Village

The City of Westlake Village has completed a census and assessment of all trees on public property. Hazardous trees were removed. The City is in the process of mapping all of its trees using a GIS program.

SECTION 9. LANDSLIDE

The Nature of the Landslide Threat

A landslide is defined as, the movement of a mass of rock, debris, or earth flow down a slope. Landslides are a type of "mass wasting" which denotes any down slope movement of soil and rock under the direct influence of gravity (FEMA).

The term "landslide" encompasses events such as rock falls, topples, slides, spreads, and flows. Landslides can be initiated by rainfall, earthquakes, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of these factors. Underwater landslides can also occur causing tidal waves and damage to coastal areas.

The size of a landslide normally depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

Landslides can be described as either: (1) rapidly moving (generally known as debris flows), and (2) slow moving. Rapidly moving landslides or debris flows present the greatest risk to human life. People living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Slow moving landslides can cause significant property damage but are less likely to result in serious human injuries (USGS).

Nationally, landslides cause 25 to 50 deaths each year. The best estimate of direct and indirect costs of landslide damage in the United States range between $1 billion and $2 billion annually (FEMA). As a seismically active region, California has had a significant number of locations impacted by landslides. In addition to the potential loss of life, landslides can result in private property damage, impact transportation corridors, break fuel and energy conduits, and disrupt communication facilities.

Within the Las Virgenes-Malibu Region there are areas that are susceptible to landslides due to slope instability, fire activity, rainfall and the geologic make-up of the area. Although all of the cities within the LVMCOG prohibit development in areas that may be prone to landslides, there are existing properties that may be susceptible to landslide activity.

Debris Flow

A debris or mud flow is a river of rock, earth and other materials, including vegetation that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows can have speeds on the order of 20 mile per hour, and can often move much faster (California Department of Conservation). This high rate of speed makes debris flows extremely dangerous to people and property in its path. In the event of a major landslide, debris flow can destroy roadway pavement and fill the storm drain catch basins. Any significant surface movement along streets will isolate residents and disrupt utilities in those areas. Although no significant debris flow resulting from landslide activity has been recorded in the Las Virgenes-Malibu Region, it remains a possibility.

Historical Record of Landslide Events

1994 Northridge Earthquake Landslide Related Impact

As a result of the magnitude 6.7 Northridge, California, earthquake, more than 11,000 landslides occurred over an area of 10,000 km^2. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. The earth movement destroyed dozens of homes, blocked roads, and damaged oil-field infrastructure. It also caused deaths from Coccidioidomycosis (Valley Fever), the spore of which was released from the soil and blown toward the coastal populated areas. The spore was released from the soil by the landslide activity.

History of Landslides in the Las Virgenes-Malibu Region

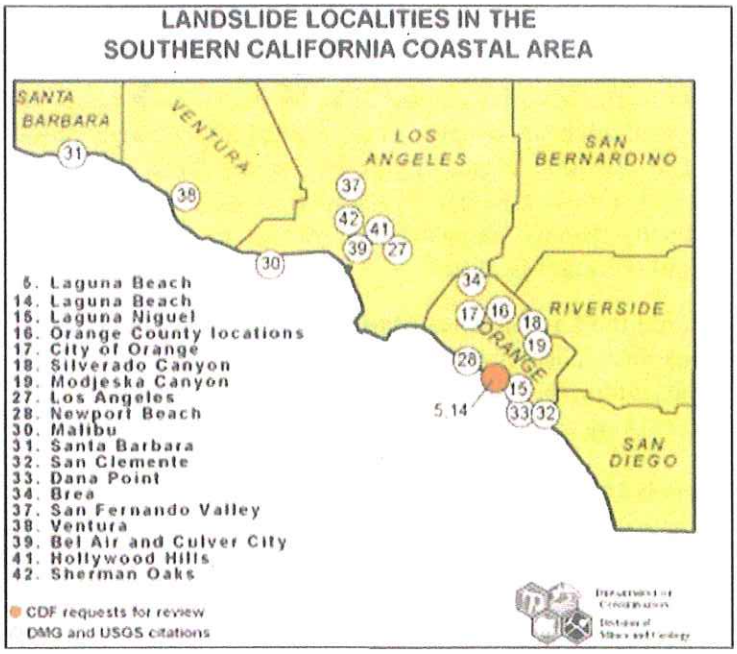
Several cities in the Las Virgenes-Malibu Region have experienced landslide events due to heavy rains or seismic events. Examples for the cities of Agoura Hills and Malibu are provided below.

Agoura Hills Landslides

Examples of landslide events in the City of Agoura Hills since 1990 include the Via Amistosa, Morrison Ranch, Liberty Canyon Slope Failure, Laura La Plante, Laro, and Chateau Park landslides. In 1999, Agoura Hills experienced the Kanan Slope Repair as a result of the El Nino storms of 1998.

Malibu Landslides

Landslide events in the City of Malibu have included the Calle del Barco, Kanan, Pacific Coast Highway, Las Flores, Love, and Malibu Road landslides. Due to the topography of the area, landslides in Malibu can severely disrupt transportation at a regional level. For example, Pacific Coast Highway is a heavily used transportation route and road closures due to landslides are a major concern. The *Landslide Localities in Southern California Coastal Area Map* depicts landslides along coastal areas in Southern California (1997-1998) including Malibu (Number 30). The summary on the next page describes a timeline of events in Malibu.



Map 46: Landslide Localities in the S. Calif. Coastal Area

Landslide Localities in Southern California Coastal Area

30. Malibu, Los Angeles County. On 12/06/97 homes in Malibu were damaged by waves and seacliff erosion. On 02/07 Malibu Canyon Road closed due to mudslides and rockfalls (Tan, 02/11). On 02/08 an ocean-eroded cliff buckled, causing one home to collapse and two others threatened. The homes along Broad Beach Road were undermined by high tides (Tan, 02/11). On 02/16 several houses along the beach of Malibu were damaged by the high surf and rainstorms (Tan, 02/19). On 02/23

Pacific Coast Highway, Topanga Canyon Boulevard, and Malibu Canyon Road were blocked by mudslides. A Union Pacific railroad trestle was undermined by the surging flows of the Ventura River and was not reopened to rail traffic for weeks (Tan, 03/05). On 02/24 in Malibu's Las Flores Canyon, officials called for evacuation of about a dozen homes because of unstable ground. Also, more mudslides on Pacific Coast Highway forced officials to close the local courthouse (Tan, 03/05). On 02/25 a 140-foot-long retaining wall partially collapsed, damaging two homes above the slide on Calle del Barco. The 20-year-wall, along a narrow road (Rambla Orienta) just above Pacific Coast Highway, began to give away during the evening of 02/24 (Tan, 03/05).

SOURCE: http://www.consrv.ca.gov/cgs/fwgp/ls_response/Pages/ls_la.aspx

Causes and Characteristics of Landslides

Landslide Events and Impacts

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produces conditions conducive to landslides and human activity further exacerbates landslide potential. Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials.

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. These rock falls are fast moving with materials free falling or bouncing down slopes. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they (along with climate) create landslide hazards. This is especially important with the demands placed on buildable land (particularly in urban areas) that increases the tendency to build on geologically marginal areas such as hillside lots.

Landslide Hazard Identification

Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flows, pipeline ruptures, and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events.

Natural Processes

Natural processes can cause landslides or re-activate historical landslide sites. Seismic tremors can trigger landslides on slopes with a history of landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on moderate slopes above steep streams and riverbanks.

Land Development, Grading, and Excavation

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and excavation can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content.

Drivers for hillside development include intensification of existing development on residential lots and expansion into undeveloped areas. Intensification consists of additional construction and modification of existing construction or the complete demolition and redevelopment of a residential lot.

Intensification expands developed pad areas into previously "natural" hill slope areas and often involves a corresponding increase in the size and volume of the onsite sewage disposal systems. Other human activities effecting landslides include: excavation, drainage modifications, groundwater alterations, and changes in vegetation and soil conditions.

Drainage and Groundwater Alterations

Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area; development that results in an increase in impervious surfaces impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides. Building Codes require drainage devices to dispose storm runoff away from hillside developments. Storm runoff is designed to be discharged into the storm drain system. Storm drain catch basins are normally maintained by Public Works Departments and are regularly cleaned to prevent any flooding or ponding.