COUNTY OF SAN MATEO

HAZARD VULNERABILITY ASSESSMENT

APPENDIX TO THE EMERGENCY OPERATIONS PLAN

(HAZARD + RISK = VULNERABILITY)

San Mateo County Sheriff's Office
Homeland Security Division
Office of Emergency Services

JANUARY 2, 2015

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GENERAL

San Mateo County has the potential for experiencing a variety of natural and technological disasters. In recent years, the County has experienced several events such as earthquakes, floods, storms, and hazardous material incidents.

San Mateo County, with its varying topography; mix of semi-urban and rural areas; and growing permanent, seasonal, and recreational population, is subject to a wide variety of negative impacts from various hazards and threats. Local hazards can be categorized as either natural or technological/man-made events. While the local climate changes slowly, the technological/man-made environment can change rapidly.

Some hazardous events occur almost annually, while other events may not happen for decades. Additionally, not every hazardous event occurs with notable damage or loss of life. For this reason, we have chosen to assess hazards by comparing the frequency of the hazard with the potential resulting impact (Exhibit 2-1).

EXHIBIT -1:

High Probability Low Impact	High Probability Moderate Impact	High Probability High Impact
Moderate Probability Low Impact	Moderate Probability Moderate Impact	Moderate Probability High Impact
Low Probability Low Impact	Low Probability Moderate Impact	Low Probability High Impact

The following threat summaries are the product of a historical, meteorological, geographical, geological, and visual assessment of San Mateo County. Natural and technological risks are described in gross terms for the San Francisco Bay Area with specific references to San Mateo County, when appropriate. No magnitude of importance is implied by the order of listing and this list is not meant to be all inclusive. Exhibit 2-2 lists the threats to public health and safety covered in this document which include:

EXHIBIT -2: SAN FRANCISCO BAY AREA THREATS TO PUBLIC HEALTH AND SAFETY

Natural Threats	Man-Made/Technological Threats
▪ Drought ▪ Earthquake ▪ Extreme Heat ▪ Flood ▪ Landslide ▪ Pandemic and Epidemic ▪ Tsunami ▪ Wildland Urban Interface Fire	▪ Hazardous Materials Incident ▪ Dam Failure ▪ Terrorism ▪ Transportation Accident

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SAN MATEO COUNTY PROFILE

San Mateo County is located on the western coast of California, immediately south of the City and County of San Francisco. It is bordered to the south by Santa Clara and Santa Cruz Counties, to the east by San Francisco Bay and Alameda County, and to the west by the Pacific Ocean. The Santa Cruz mountain range, running along the central axis of the County, separates the coastside from the bayside.

Dry, mild summers and moist, cool winters characterize the climate. The monthly temperature mean in August varies from the coastside, at 58 degrees Fahrenheit (^{o}F) to 65^{o}F on the bayside, while the January mean is near 50^{o}F on both sides. Precipitation averages are 24 inches and 20 inches for the coastside and bayside, respectively. Approximately 90% of the precipitation occurs during the 6-month period from November through April.

San Mateo County has a total area of 741 square miles, of which 449 square miles are land and 292 square miles are water. There are eight basic landforms in San Mateo County: ocean beach, coastal terrace, coastal foothills, mountains, upper valley, bayside foothills, bayside plains, and bayside marsh and mud flats. Elevations range from sea level to a maximum elevation of 2,572 feet above mean sea level at Long Ridge Hill.

As of 2013, the County was home to approximately 747,373 residents. Approximately 91% of the residents live in the 20 incorporated cities and 9% reside in unincorporated communities and areas. San Mateo County is the fourteenth most populous among California's 58 counties.

The County is home to the second largest airport in California and the only deep-water port in the southern part of San Francisco Bay. Each day, thousands of people board three major mass transit systems that serve the County: Bay Area Rapid Transit (BART), Caltrain and SamTrans. The network of roads includes: freeways linking the County to San Francisco and Silicon Valley, two bridges to the East Bay, and rural roads that wind through farmland and redwood forests. Since the days the Spanish built El Camino Real, efficient transportation has played a critical role in the economy and culture of the Peninsula.

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HAZARD 1: DAM FAILURE

Low Probability
High Impact

Definition

Dam failures are catastrophic events characterized by the sudden, rapid, and uncontrolled release of impounded water.[1]

Types

Dam failures occur for various reasons. Failures may be caused by structural deficiencies in the dam itself, lack of maintenance and repair, or the gradual weakening of the dam through the normal aging processes. Major storms and associated runoff, earthquakes, slope failures, or a terrorism event can also cause dam failure.

The most common cause of dam failure is overtopping, when the water behind the dam flows over the face of the dam and erodes the structure.

Probability

No quantitative probability information exists for the Bay Area dam failure hazard. When a dam is known to have a failure potential, the water level is reduced to allow for partial collapse without catastrophic loss of water, as required by the California Department of Water Resources, Division of Safety of Dams (DSOD). For example, in 2001 the DSOD restricted the Calaveras Reservoir to approximately 30% of its original capacity to avoid a catastrophic release of water until the deficiencies are corrected. This decrease in capacity reduced the probability of failure resulting in damage to near zero.[2]

Location, Extent, and Vulnerability

In 1972, California implemented Government Code § 8589.5 requiring dam owners to develop maps depicting inundation areas that might be affected by dam failure. The law required that each map be produced only once, without any requirements for updating. Further, the scenario used to create the maps restricted the results to a worst case situation that does not fit the historical evidence of dam failure.

The maps were developed using engineering hydrology principals and represent the best estimate of where the water would flow from complete dam failed of a full reservoir. The inundation pathway is based on completely emptying the reservoir and does not include run-off from storms. Had the maps been developed more recently, different assumptions and map-making methods would have been used. In addition, dam inundation maps do not indicate the depth of inundation and may represent only an inch of water in some inundation areas.

Development downstream of dams, and upgrades to older dams have altered the inundation area, but the law does not require dam owners to update these maps and no new information is available on inundation areas. These maps still provide an estimate of the general location and extent of dam failure inundation areas.[3] These maps are on file with the Office of Emergency Services and have been used to produce plans for notification of downstream areas.

According to these maps, 13 dams in San Mateo County have been identified as large enough to endanger lives and property in the event of a major uncontrolled release or catastrophic failure (see Exhibit 2-5 Dam Failure Inundation Area). Eleven of these dams are large enough and located in areas that a failure would endanger a sizeable population. The flood plain that would result from a catastrophic failure of each of these eleven dams

has been mapped by the owner of the dam. All of these dams are inspected at least annually by the DSOD, and more frequently by their owners and operators.

EXHIBIT -3: SAN MATEO COUNTY DAMS WITH POTENTIAL TO ENDANGER LIVES AND PROPERTY

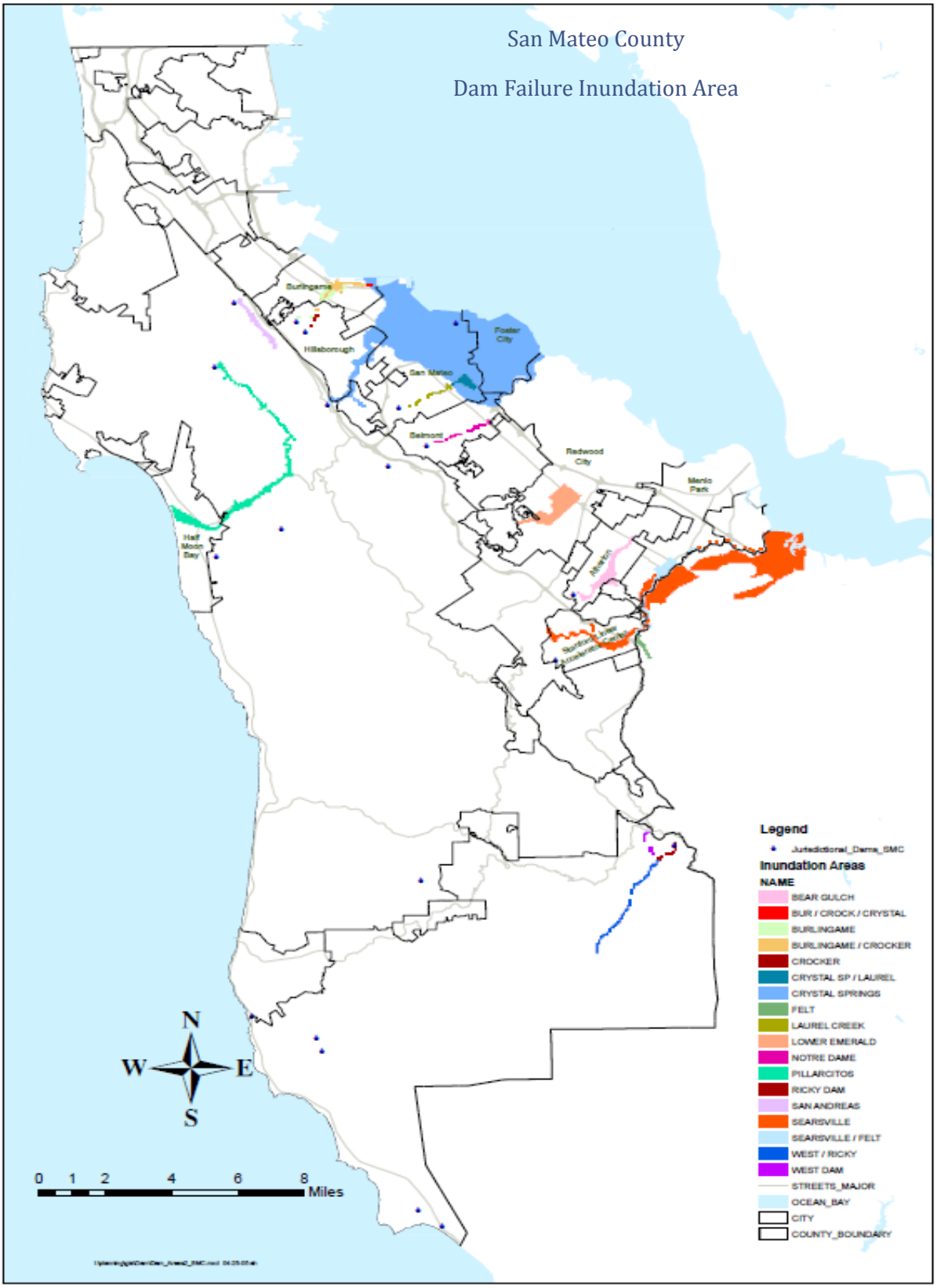
Dam	Owner	Height (Feet)	Capacity (Acre-Feet)
Bear Gulch	Cal Water Svc	61	672
Spencer Lake	Hillsborough	87	73
Crocker	Hillsborough	45	22
Lower Crystal Spring	SF PUC Water Dept.	140	57,910
Emerald Lake	Emerald Lake CC	57	45
Felt Lake	Stanford University	67	900
Johnston	Peninsula Open Space Trust	31	30
Laurel	San Mateo	40	55
Notre Dame	Belmont	51	120
Pilarcitos	SF PUC Water Dept.	103	3,100
Rickey/West	Mid-Peninsula Open Space District	64	47
San Andreas	SF PUC Water Dept.	107	19,027
Searsville	Stanford University	68	952

Six smaller dams in San Mateo County have been exempted from the inundation mapping and dam failure planning requirements of the State Dam Safety Act. All of these dams are inspected periodically by the DSOD.

EXHIBIT -4: EXEMPTED SAN MATEO COUNTY DAMS

Dam	Owner	Height (Feet)	Capacity (Acre-Feet)
Bean Hollow 2-3	Lake Lucerne Mutual Water Company	40	1,361
Canada Road	CalTrans	52	74
Coastways	Mary DeFremery Atkins	46	100
Green Oak No. 1	Capitola Berry Farms	39	322
Pomponio Ranch	Ann Bowers	63	256
Lake Lucerne	Lake Lucerne Mutual Water Company	21	455

EXHIBIT-5: DAM FAILURE INUNDATION AREA



Source: San Mateo County 2005

Dam failure inundation area and exposure of existing land use is as follows:

- Of the 286,193 acres of land in San Mateo County, 10,732 acres (3.75%) are in areas mapped as dam failure inundation areas.
- 9,600 acres (3.35%) of urban land are in the dam failure inundation area, versus 1,132 acres (0.4%) of non-urban land.
- Of the 10,732 acres within the dam failure inundation area, 4,506 acres (41.99%) are residential use, and 24 acres (0.22%) are mixed commercial-industrial complexes.[4]

Lower Crystal Springs Dam Failure

The Lower Crystal Springs Dam is the largest of the dams that affects San Mateo County. Constructed in 1888, this gravity dam was built on the San Mateo Creek. The dam impounds water to form the Lower Crystal Springs Reservoir. The reservoir is a water supply for San Francisco and most cities within San Mateo County. Despite its location directly on the San Andreas Fault, the dam has survived both the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake.

The DSOD reviews and inspects the dams for potential failure due to a major seismic event. According to the most recent report, the DSOD indicates that the dam is structurally safe and will perform without failure. In 2010 the Lower Crystal Springs Dam was evaluated for the effects of an 8.3 magnitude earthquake (on the Richter scale). Based on this evaluation, it was determined the potential for dam failure would be low. If events caused a failure of the dam, the area of potential inundation is shown in Exhibit 2-1 below.[5]

Lower Crystal Springs Dam Upgrade Project

In 1983, the DSOD mandated the maximum allowable water surface elevation of the Lower Crystal Spring Dam reservoir be lowered by 8 feet until completion of hydraulic upgrades to the dam's spill capacity. This lower maximum operating elevation reduces the reservoir's storage capacity by 16%, a reduction of 2.6 billion gallons of water.

The San Francisco Public Utilities Commission, in conjunction with the County of San Mateo, will be conducting significant upgrades to Lower Crystal Springs Dam and the bridge that passes over the dam between fall 2010 and spring 2015.

The purpose of the Lower Crystal Springs Dam Improvements Project is to comply with these DSOD requirements and thereby restore the maximum storage capacity of the reservoir. The project involves widening the spillway, raising the parapet wall, and replacing the stilling basin with a new, larger facility.

Past Occurrences

While dams have failed elsewhere, there is no history of dam failure in the Bay Area.

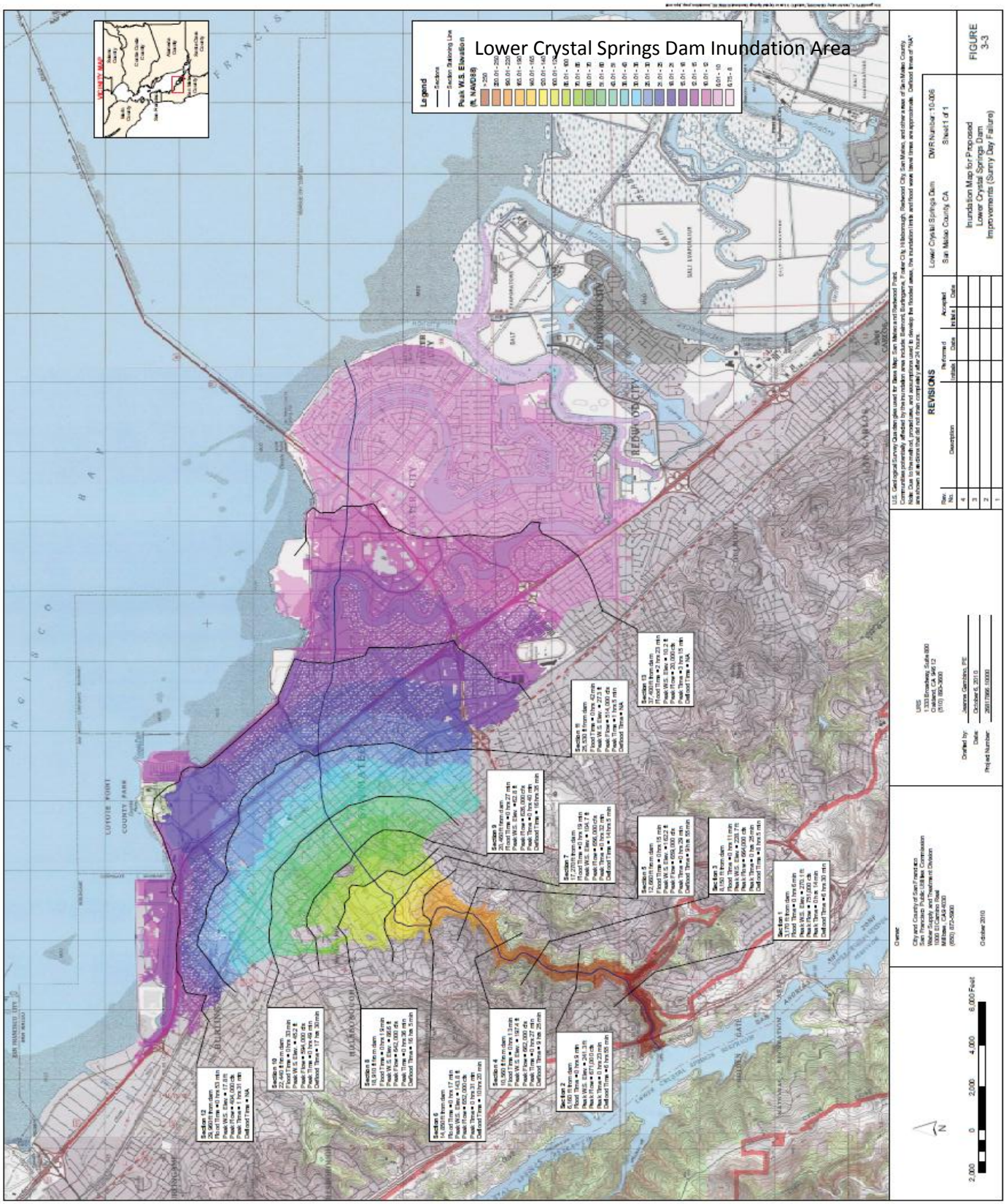


EXHIBIT-6:

Source: SFPUC 2010

Impact

Although a complete dam failure is unlikely, the impact from any catastrophic failure would be similar to a flash flood. Lives could be lost. Injuries from debris being carried by the flood are likely. Depending on the quantity of water, the force could destroy buildings, electrical power transmission infrastructure, bridges, and roadways.

The environmental impact of the failure of small dams will probably only impact a small portion of the environment downstream. The scouring action of a large quantity of water may destroy all vegetation in its path. A large dam may completely destroy forested areas. Like any flash flood, a dam failure would likely kill any wildlife caught in the flow.

HAZARD 2: DROUGHT

Definition

Moderate Probability
Moderate Impact

Drought is defined as a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area.

In simpler terms, a drought is a period of unusually dry weather that persists long enough to cause serious problems such a crop damage, extreme fire hazard, and/or water supply shortages. The severity of the drought depends upon the degree of moisture deficiency, duration, and size of the affected area.[6]

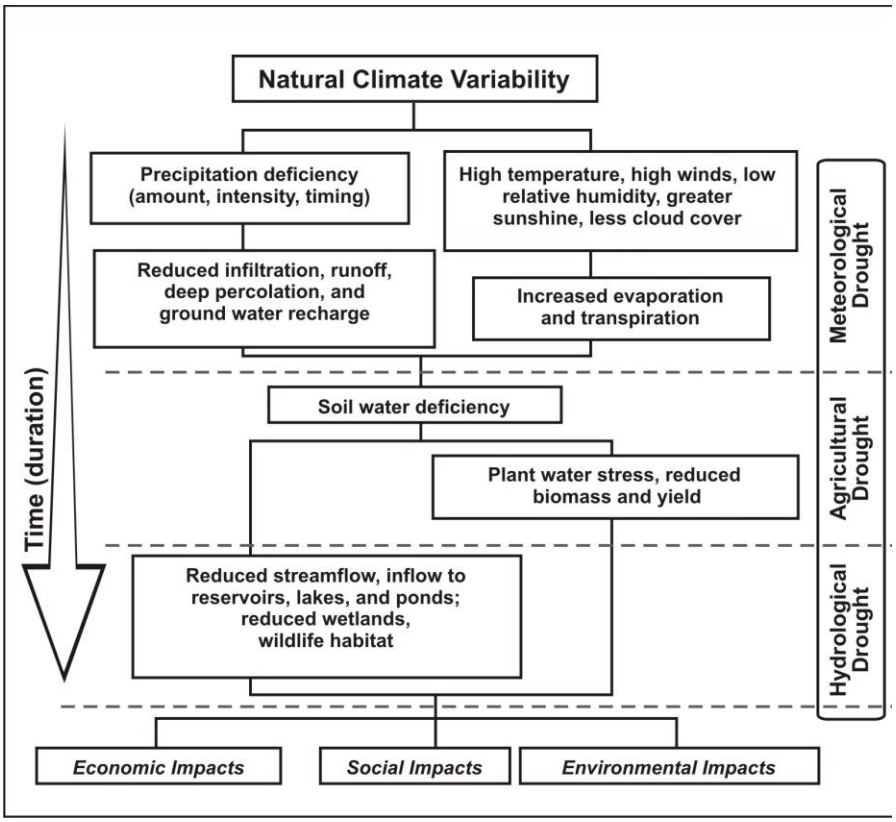


EXHIBIT-7: SEQUENCE OF DROUGHT IMPACTS

Source: National Drought Mitigation Center, University of Nebraska-Lincoln

Types

Because of the wide range of drought definitions available, 'drought' has been grouped into four main categories or types: (1) meteorological drought, (2) agricultural drought, (3) hydrological drought, and (4) socioeconomic drought. The first three categories measure drought as a physical phenomenon and the last category measures drought in terms of supply and demand, tracking the effects of water shortfall through socioeconomic systems. This process is illustrated in Exhibit 2-7.[7]

Meteorological Drought

This type of drought is characterized as precipitation's departure from normal over a period of time. These definitions are usually region-specific, and presumably based on a thorough understanding of regional climatology. Meteorological measurements are the first indicators of drought.

Agricultural Drought

This type of drought is characterized as not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought, but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.

Hydrological Drought

This type of drought is characterized by the deficiencies in surface and subsurface water supplies (i.e. stream flow, reservoir and lake levers, and groundwater). There is a time lag between the lack of rain and decreasing

quantities of water in streams, rivers, lakes, and reservoirs; therefore, hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels.

Socioeconomic Drought

This type of drought is characterized as the occurrence when physical water shortage starts to affect people, individually and collectively. In more abstract terms, most socioeconomic definitions of drought are associated with the supply and demand of an economic good such as water, food grains, fish, or hydroelectric power.

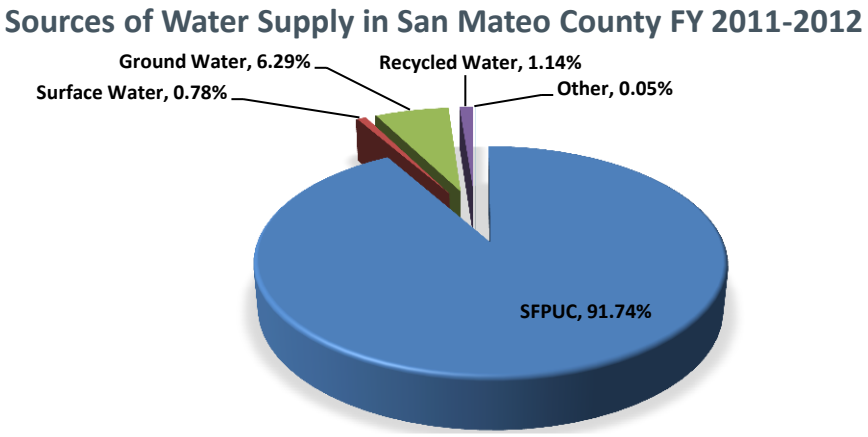
Probability

There is also no current data on the probability of drought that would be comparable to the USGS effort on earthquakes in the region, or the way 100-year flood maps are created.[8]

Location, Extent and Vulnerability

As San Mateo County's population and business community continues to grow, so does the demand for water. The County has limited local water sources and relies heavily on the San Francisco Public Utilities Commission's (SFPUC) regional water system. The SFPUC system obtains 85% of its water from Sierra Nevada snowmelt, stored in the Hetch-Hetchy reservoir in Yosemite National Park. The remaining 15% comes from local Bay Area watersheds. San Mateo County gets approximately 92% of its water from SFPUC and approximately 8% from surface, ground, and recycled water (see Exhibits 2-8 and 2-9).

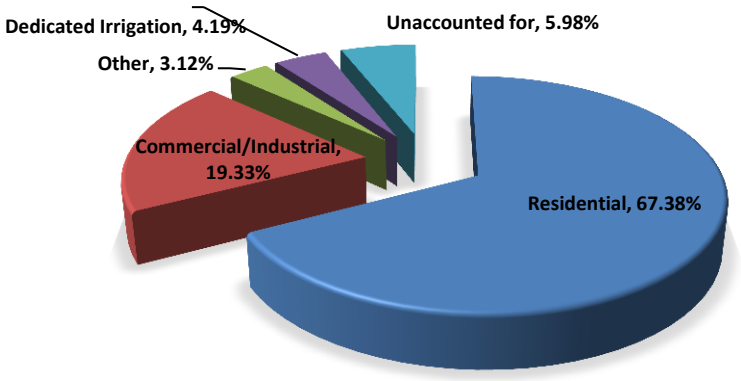
EXHIBIT-8:



Source: Bay Area Water Supply & Conservation Agency 2011-2012

EXHIBIT-9:

Water Use by Class of Customer in San Mateo County FY 2011-2012



Source: Bay Area Water Supply & Conservation Agency 2011-2012

Drought can impact the entire Bay Area, not just one particular county or a few cities. Shortages in precipitation in the Sierra Nevada may have a more pronounced impact on water supply in the region than a meteorological drought in the Bay Area itself.

California's statewide and region wide water infrastructure greatly enhances the state's drought resilience by providing capability for water transfers and exchanges. Lessons learned from past droughts, and from disasters such as earthquakes and wildfires, have fostered water system interconnections between the state's major water utility operators.[9]

The 2002 *Hetch-Hetchy Water and the Bay Area Economy* report presents the importance of water to the region and the potential impacts of drought and population growth. The report notes that based on conditions during the 1986 to 1992 drought period, SFPUC has determined that the maximum quantity of water it can reliably deliver to its customer base is 239 million gallons per day (mgd). However, actual demand in 2000 to 2001 was nearly 260 mgd, and 265 mgd in 2013. It is generally understood that the SFPUC system is operating in excess of its assured supply capacity and approaching its actual delivery capacity.

The 2007 report by the Pacific Institute on Water Demand Projections indicates that the total water demand will increase by 14%, or 33 million mgd, between 2001 and 2030.[10]

Most Bay Area water districts develop long-term water supply and management plans, including urban water shortage contingency analyses.

Climate Change

Climate change has the potential to make drought events more common in the west, including in California. Long-term climate forecast models suggest that a warming planet will lead to changes in precipitation distribution and more frequent and severe drought in some parts of the country, particularly the western U.S. In addition, the 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report indicates that it is very likely that hot extremes and heat waves will become more frequent as the earth warms. These events will have implications for the frequency and severity of future drought occurrence. Extreme heat creates conditions more conducive for evaporation of moisture from the ground, thereby increasing the possibility of drought.

Past Occurrences

The drought of 1976 to 1977 was the worst in the State's recent history due to the driest (1977) and fourth driest (1976) years on record. Statewide, California's average annual rainfall is 200 million acre-feet. In 1977, precipitation totaled only 90 million acre-feet, or 45% of average.[11] This drought left California with dangerously low reservoir and groundwater levels. Of the state's 58 counties, 47 declared emergencies and economic losses related to agriculture totaled $2.4 billion in 1977 and estimated $500 million in 1976.[12] Losses to urban and industrial areas were considered minimal.[13]

February 27, 2009 – the Governor proclaimed a state of emergency due to a statewide drought. Much of the state experienced the driest spring on record (Spring 2008). The drought lasted three years with below-average rainfall, low snowmelt runoff, and the largest court-ordered water restriction in state history.

January 17, 2014 – the Governor proclaimed a state of emergency due to a statewide drought. Water years 2012 and 2013 were dry statewide, and 2013 was the driest year on record in the state.

January 31, 2014 – SFPUC officially asked all customers of the Hetch Hetchy Regional Water System to voluntarily restrict water consumption. The goal is to reduce system-wide usage by 10%. The request applies to all residential, commercial, industrial, municipal, and wholesale customers that receive water from the Hetch Hetchy Regional Water System.

Although February 2014 storms brought much needed rain and snow to Northern California, it did little to address the dearth of precipitation over the past few years. Precipitation at Hetch Hetchy, as of March 2014, is still only 34.7% of normal annual precipitation. Snowpack levels at Hetch Hetchy increased by 10% due to the February 2014 storms but are still only 32% of median April 1 snowpack conditions. Bay Area watersheds, as of March 2014, have only received 33% of normal annual precipitation.[14]

Impacts

The impact of drought on the County follows a sequence of events that begins with relatively minor effects and as time progresses, gets much worse, leading to major environmental degradation. This can eventually lead either directly or indirectly (such as with a fire) to major changes in the local ecosystems within the County.

A severe, prolonged drought will impact the agricultural and industrial bases as well as the population within the County. Economic impacts become apparent progressing from a meteorological drought to an agricultural drought. Crops are damaged due to lack of water. As crops are damaged, farmers lose money, and the consumers, who rely on these crops, either for jobs or part of their regular diet, begin to feel the effects.

Damaged crops may lead to a decrease in food quality as well as quantity, thus increasing food importation. This results in higher costs for the distributors and consumers.

Industries within the County that rely on a large supply of water for manufacturing goods could have a similar predicament as water supplies dwindle. These effects may include cutting back some processes and laying off workers with obvious consequences.

HAZARD 3: EARTHQUAKES

Definition

Moderate Probability
High Impact

An earthquake is a naturally induced shaking of the ground. It is caused by an abrupt shift of rock along a fracture in the earth's crust called a fault. Within seconds, an earthquake releases stress that has slowly accumulated within the rock. Sometimes the release occurs near the surface and sometimes it comes from deep within the crust.

General Situation

San Mateo County is in the heart of 'Earthquake Country'. Located within or near San Mateo County are several known active and potentially active earthquake faults. These include the San Andreas and the Hayward faults.

The San Andreas Fault

The San Andreas Fault is the best known earthquake fault system in the United States and a major element of California geology, running roughly 810 miles through California. The fault runs directly through San Mateo County in a north-south direction.

The Hayward Fault

The Hayward Fault runs parallel to, and east of, the San Andreas Fault. It extends from San Jose, about 74 miles northward along the base of the East Bay Hills, to San Pablo Bay. The largest quake in recorded history along the Hayward Fault occurred in 1868, with an estimated magnitude of 7.0. The Hayward Fault is capable of generating a magnitude 7.5 quake. Many scientists believe that the Hayward Fault is connected to the Calaveras Fault to the south, the Rodgers Creek Fault to the north, and the Maacama Fault still farther north. If that is the case, the longer fault system could produce a larger earthquake.[15]

The San Gregorio Fault

The San Gregorio Fault is an active earthquake fault located off the coast of Northern California. The southern end of the fault is in southern Monterey Bay, and the northern end is about 20 km northwest of San Francisco, near Bolinas Bay, where the San Gregorio intersects the San Andreas Fault. Most of the San Gregorio fault trace is located offshore beneath the waters of Monterey Bay, Half Moon Bay, and the Pacific Ocean, though it cuts across land near Point Año Nuevo and Pillar Point. The San Gregorio Fault is part of a system of coastal faults which run roughly parallel to the San Andreas

Probability

Scientists have indicated that there is a 63% chance of a major earthquake (magnitude 6.7 or greater) in the Bay Area within the next 30 years.[16] While research by the U.S. Geological Survey (USGS) has provided more reliable probability information for future Bay Area earthquakes than for any other area of the country, it has a wide error range – plus or minus 22%[17]. Smaller earthquakes are more likely to occur and can still produce significant damage over localized areas.

Location, Extent and Vulnerability

Earthquakes directly and indirectly affect all of San Mateo County. Exhibit 2-12 illustrates the earthquake risk in the County and region, showing the location of the various faults that affect the Bay Area.

While the entire County experiences shaking during earthquakes, areas of liquefaction experience even greater shaking. Exhibit 2-13 illustrates the location and extent of San Mateo County's seismic hazard based on areas of liquefaction. As illustrated, areas with the greatest susceptibility to liquefaction are generally underlain by soft soils, mud (along the Bay margin), and artificial fill.

Ground Shaking

Ground shaking is both a hazard created by earthquakes and the trigger for other hazards, such as liquefaction and landslides. Ground shaking describes the vibration of the ground during an earthquake. The intensity of the ground shaking and the resultant damages are determined by the magnitude of the earthquake, distance from the epicenter, and characteristics of surface geology. Most earthquake damage results from the shaking caused by seismic waves passing beneath buildings, roads, and other structures. This hazard is the primary cause of the collapse of buildings and other structures.

Liquefaction

When the ground liquefies in an earthquake, it behaves much like liquid. Liquefaction is a phenomenon involving the loss of shear strength of a soil. Soft soils or human-made fills can subside or experience liquefaction. Liquefaction commonly causes lack of support for structures located on the liquefiable soils. Ground failures may form, such as ground cracking or boils from layers of sand sometimes located a number of meters under the surface.

Liquefaction causes structural damage to buildings, bridges, and roads, as well as damage to underground pipes. Areas with the greatest susceptibility to liquefaction are generally underlain by soft soils, mud (along the Bay margin), and artificial fill. The extensive urban development of lowlands and landfill around San Francisco Bay is especially vulnerable, and liquefaction in many of these areas will intensify the damage to structures erected on them. Neighborhoods built on landfill will experience significant liquefaction-related damage.[18]

Fault Rupture

Fault rupture describes the phenomena where ground on opposite sides of the earthquake fault is displaced in opposite directions, either vertically or horizontally. Displacement ranges from inches to several feet. Structures crossing a fault rupture can collapse or may be rendered unusable due to sudden misalignment of roads, pipelines, water, wastewater, or electrical and telecommunications utilities. Damage from fault rupture can occur where the San Andreas Fault is closely surrounded by structures and other development.

Landslides

Landslides occur on steep slopes. Loss of strength in sensitive soils can also cause landslides and other ground failures; see Landslide Hazard on page 30.

Dam Failure

Dam failure is also possible during an earthquake. Likely causes are either a fracture of the retention wall or the failure of the soils under the structure; see Dam Failure Hazard on page 4.

Tsunamis and Seiches

Vertical displacement, co-seismic subsidence, or earthquake-induced landslides can all cause tsunamis and seiches; see Tsunami / Wave Event Hazard on page 45.

Past Occurrences

April 18, 1906 – San Francisco Earthquake, Magnitude 7.9

March 22, 1957 – Daly City Earthquake, Magnitude 5.3

October 17, 1989 – Loma Prieta Earthquake, Magnitude 6.9

Impacts

A 7.9 magnitude earthquake on the northern portion of the San Andreas Fault lasting 40 to 60 seconds would result in serious damage in San Mateo County.

The specific information presented below provides detailed estimates of potential earthquake losses in San Mateo County. The data is extracted from the following documents:

- San Francisco Bay Area Earthquake Readiness Response: Concept of Operations Plan, September 23, 2008
- San Francisco Bay Area Catastrophic Earthquake Incident Scenario, September 20, 2007

Freeways and Major Highways

Extensive damage to the transportation infrastructure will affect the delivery of resources and the ability of first responders to: access locations of fires and civil unrest, conduct search and rescue, complete transportation assessments, establish ingress and egress routes, initiate evacuation operations, and provide security.[19]

Expected impacts to surface transportation infrastructure is summarized as follows:

- All major bridges and approaches will be closed for inspection in the days following the earthquake.
- All approaches to the San Mateo and Dumbarton Bridges cross highly liquefiable soils and are expected to suffer surface damage and connection failure. Traffic will be forced onto Highways 880 and 101, which will already be restricted to traffic due to damage and inspection.
- Damage/closure of State Route 1 due to landslides.
- Highway 280 is parallel to the fault source and will likely suffer severe damage at raised bridges, due to collapsed foundations, and along cliffs susceptible to landslide.
- Fault rupture and accompanying landslides may close Highway 92 to Half Moon Bay, impacting a major ingress/egress from coastside to bayside.
- Highway 101 may suffer damage from fault rupture and/or liquefaction.

Airports

San Francisco International Airport (SFO) is expected to sustain significant damage. Airport operations, including commercial runways, lighting, terminal facilities, control towers, terminal buildings, cargo handling facilities, and access roads will likely be damaged and could be inoperable for 60 days or more. Initially, the airports will be available only to small, fixed-wing and rotary aircraft. Air operational capability for large, fixed-wing aircraft may be restored within one week, but many of the fueling, servicing, and cargo-handling facilities will not be operational for a longer period of time. Passenger operations may be delayed for 15 days or more. The runways at the airport are expected to be serviceable in a relatively short period of time, possibly less than one week.

Half Moon Bay Airport may suffer damage due to shaking and experience power and communication disruptions. This airport is less likely to suffer closure of service roads and may serve as a point of delivery for emergency supplies to the coastside.[20]

Ports

The land on which the Ports of Oakland, San Francisco, and Redwood City are located is subject to lateral spreading, where subsurface soil liquefies and gravity and earthquake forces cause the land mass to move downward. Ground displacements of several feet are expected to damage structures such as cranes, along the edge of piers. Collapse of the cranes will cause additional structural damage to port facilities and require complex debris removal efforts. All piers in the Bay Area will initially suffer prolonged power loss and damage to truck and rail access routes.[21]

Railroads

Commuter/freight rail lines from San Jose to San Francisco could be closed for weeks due to displacement of rails caused by expected fault ruptures in the areas parallel to the San Andreas Fault.

The rails of Caltrain, which carries commuters from San Mateo County to San Francisco, are vulnerable to the same ground failure risk that threatens Highway 101 and cannot be relied upon to relieve the increased commuter traffic needs that will result from impacts to the highway.[22]

The Bay Area Rapid Transit (BART) system is vulnerable to earthquakes and could suffer rail displacement and collapse of underground tunnels. Portions of BART could be out of service for over two years in a major earthquake. [23]

Communications

The buildings and equipment of telecommunications systems owned by the private sector have been strengthened since the 1989 Loma Prieta earthquake, with special emphasis on redundancy and power backup. The regional communication infrastructure in the Bay Area is highly diverse and incorporates a number of statewide communication systems.[24]

An overload of post-earthquake calls in the region will make communicating by phone difficult. Carriers will block the calls coming into the region to relieve circuit overloading. Outbound calls, as well as text messaging, are more likely to be available. Customers located in areas subject to severe ground shaking and high probability of ground failure may lose land-based connections to the telephone system. Access for repairs in those areas will be a challenge, due to roadway destruction. The cellular phone system relies on the integrity of antennas that are mostly located on building tops. Cell phone calls typically connect to the same landline systems that will be hampered by the expected overload of calls. The region's telecommunications companies will prioritize calls to allow emergency responders to communicate by phone.[25]

Water

EXHIBIT-10:

Total number of households without potable water after the scenario event is as follows:					
Area	Total Number of Households	Hours/Days after Scenario Event			
		E+24 Hours	E+72 Hours	E+7 Days	E+30 Days
San Mateo County	268,000	236,900	234,300	228,100	149,700
Bay Area Region	2,923,200	1,841,100	1,769,200	1,649,400	914,900
Source: HAZUS 2009. The estimates were adjusted, by county, for population increases since 2000.					

Electrical Power

EXHIBIT-11:

Total number of households without electricity after the scenario event is as follows:					
Area	Total Number of Households	Hours/Days after Scenario Event			
		E+24 Hours	E+72 Hours	E+7 Days	E+30 Days
San Mateo County	268,000	100,100	62,800	27,900	6,800
Bay Area Region	2,923,200	492,200	308,400	139,000	34,300
Source: HAZUS analysis 2009. The estimates are adjusted for population increase since the year 2000.					

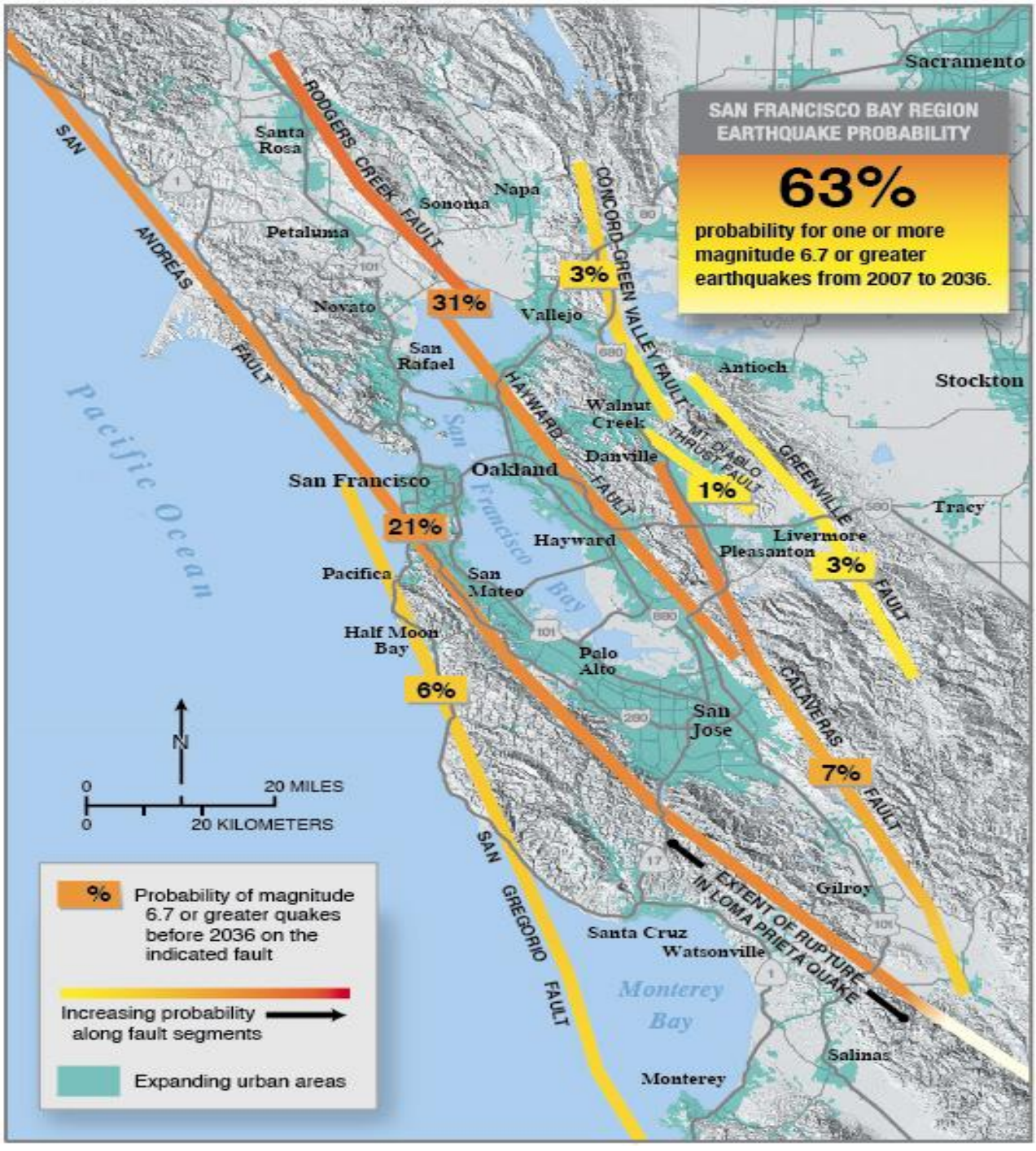
Wastewater

Sewer pipes, as large as 10 feet in diameter, form the backbone of the wastewater transport system. These interceptors run along the margins of the Bay in areas of liquefiable soils. The interceptors will suffer major damage following an earthquake. Loss of electrical power will render pumping plants unusable, causing sewage backups and spills through the street access holes, posing potential public health concerns. Open trenches may be necessary to carry sewage for short distances. Sewer pipeline breaks may cause "sinkholes" that undermine roads and buildings.[26]

Natural Gas and Liquid Fuels

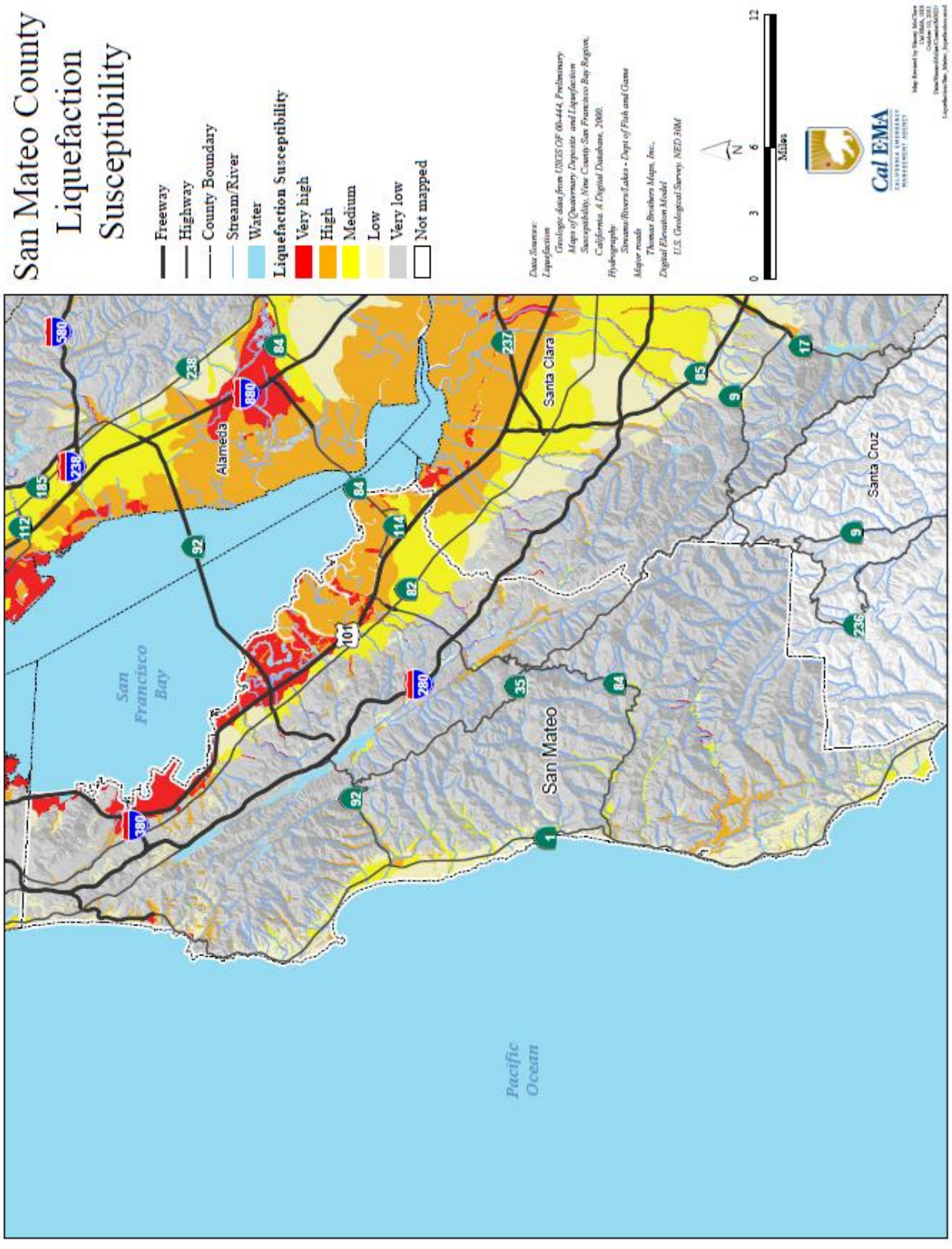
Pacific Gas & Electric (PG&E) is the provider of natural gas in the Bay Area. The main natural gas pipelines and facilities near major faults in the region have been retrofitted and severe damage is not anticipated. However, the network of pipes beneath city streets is expected to suffer damage from ground failure. Hundreds of breaks in mains, valves, and service connections will occur from an earthquake. Broken gas mains could fuel street fires. Structural fires will occur as a result of broken service connections. Restoration of service to customers could take as long as two months because individual connections will need to be inspected and appliances relighted. Most gas shutoffs are expected to be initiated by cautious customers. Natural gas pipelines tend to follow the major highway systems from San Francisco, down to San Jose, and up along the shore of the East Bay. Emergency response and restoration of highway sections vulnerable to ground shaking will be complicated by subsequent gas line failures in the same damaged areas. Trucks deliver most liquid fuel to retail stations, using the region's vulnerable highway systems. Damage to roads will delay transportation of fuel for distribution to the general public.[27]

EXHIBIT-12: FAULT MAP



Source: USGA 2008

EXHIBIT-13:



Source: Cal OES 2011

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HAZARD 4: EXTREME HEAT

Definition

Low Probability
Low Impact

According to the National Weather Service, extreme heat occurs when the temperature reaches extremely high levels or when the combination of heat and humidity causes the air to become oppressive and stifling. Generally, extreme heat is considered to be 10 degrees above the normal temperature over an extended period of time.

A credible forecast that shows the high likelihood of three or more successive days with a heat index above 104 degrees, and night time low temperatures above 75 degrees, would prompt an "Excessive Heat Watch" four days prior to the expected onset of the hot weather, or an "Excessive Heat Warning" three or fewer days prior to the expected onset. This is considered a yellow alert level, and prompts the Department of Public Health to notify all Towns and Cities of the impending threat using California Health Alert Network (CAHAN), the SMC Alert notification system, and any other system of notification that is appropriate.

Types

During heat or extreme heat, local National Weather Service offices can issue heat-related messages as conditions warrant, including:

- **Excessive Heat Outlook**: when the potential exists for an excessive heat event in the next 3 to 7 days. An outlook is used to indicate that a heat event may develop. It is intended to provide information to those who need considerable lead time to prepare for the event, such as public utilities, emergency management personnel, and public health officials.
- **Excessive Heat Watch**: when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain. It is intended to provide enough lead time so those who need to set their plans in motion can do so. Relevant plans include established individual community excessive heat event mitigation plans.
- **Excessive Heat Warning/Advisory**: when an excessive heat event is expected in the next 36 hours. These warnings are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurrence. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions than a warning. An advisory alerts the population that conditions may cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

Probability

According to National Oceanic and Atmospheric Administration's (NOAA) Climate Summary Report for the Redwood City Weather Station, maximum daily temperatures in excess of 90 degrees occurred 557 times between 1982 and 2012. Based on this data, San Mateo County can expect to experience temperatures in excess of 90 degrees approximately 19 days a year.

Location, Extent, and Vulnerability

When an extreme heat event occurs, it affects all of San Mateo County.

Many residents lack efficient cooling systems in their homes or businesses and are unaware how to protect themselves. The difference between the normal temperature and the elevated temperature dictates the real

impact the heat has on the individual. Since the area normally has fairly mild temperatures, the population can feel stressed at lower temperatures than many other places, especially if the increase in temperature happens suddenly.

Warmer average summer temperatures experienced in cities and rural areas across the United States have led to premature death among certain vulnerable populations, including the elderly, young, poor, cognitively or physically impaired, and chronic disease populations (for example hypertension and diabetes). The most vulnerable people in San Mateo County tend to be the elderly.

Past Occurrences

June 2000 – Heat wave with high temperatures over 100 degrees, resulting in five deaths.

July 2006 – Heat wave with high temperatures over 100 degrees.

Impact

Increasing temperatures can pose a serious threat to public health. The 2006 heat wave led to over 140 deaths in California directly attributable to heat exposure. This does not account for the loss of life that was due to complications of other illnesses exacerbated by heat events. Certain populations—such as the elderly, infants, homeless and young children—are especially vulnerable to these impacts. Higher temperatures can also decrease the water supply through increased evaporation rates and increased irrigation demand. Finally, temperature increases can lead to an increased incidence of wildfires.

HAZARD 5: FLOODING

Definition

Moderate Probability
Moderate Impact

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from either the overflow of inland or tidal waters, or from an unusual and rapid accumulation or runoff of surface waters from any source.

Types

San Mateo County's flood hazards are divided into three types: rural, urban, and tidal flooding.

Rural Flooding

The risk of flooding in the rural area is dependent on several variables: (1) the amount and intensity of annual rainfall in each watershed; (2) the width and topographic setting of the floodplains of the major streams; (3) the degree to which flood control improvements have been made; and, most importantly, (4) the amount of development that is located within known floodplains.

The unincorporated rural areas of San Mateo County contain 21 major watersheds. All but two of these watersheds drain to the Pacific Ocean. Only the Crystal Springs and San Francisquito Watersheds drain to the San Francisco Bay. In the rural area, the major streams are almost completely in undisturbed natural conditions.

Compared to neighboring Bay Area counties, the rural portion of San Mateo County receives abundant annual rainfall. In effect, the rural mountainous areas act as a "rain trap". Average rainfall in the rural area ranges from more than 45 inches per year in the Skyline Ridge area to over 30 inches per year in most of the South Coast watersheds west of Skyline. By comparison, Redwood City, located on the east side of the Skyline Ridge, averages around 19 inches per year.

During years of average rainfall and relatively mild storm systems, the natural stream channels of the rural watersheds are adequate to drain runoff. However, in years of abnormally high rainfall or unusually severe storms, disastrous flooding can occur. Runoff during such conditions cascades rapidly down the narrow stream channels of the mountainous areas. The strong velocity of flood waters during these times can carry debris for long distances, block stream channels, and create areas of severe localized flooding.[28]

Urban Flooding

In the urban portion of the County, the problem of directing storm runoff from the mountains to the San Francisco Bay has been addressed through various flood control districts. Improvements have included installation of culverts and bridges, construction of levees, various methods of channel alteration, or installation of underground storm drains.

The solution to the flood hazard problem in the urban areas can create certain hazardous situations. When natural stream channels are altered and vegetation is removed, the velocity of the storm runoff increases because it can more efficiently flow toward the Bay. This can create hazards to those who might accidentally fall into the creek, particularly young children.

Urban areas can also experience debris blockage in creek channels. In many areas, residential neighborhoods border directly on creek channels. These areas could be spot flooded if the channels are not clear. Additionally, decaying flood-deposited garbage or other organic material could create health hazards in the aftermath of a flood.[29]

Tidal Flooding

The hazards of tidal flooding in county areas proximate to San Francisco Bay have been mitigated to some degree by the series of levees. The levees were constructed for salt evaporation ponds in the southeast portion of the County and for flood protection in the north and central portions of the County. Generally, these levees would not withstand the flood intensities of the 100-year base flood.[30]

Probability

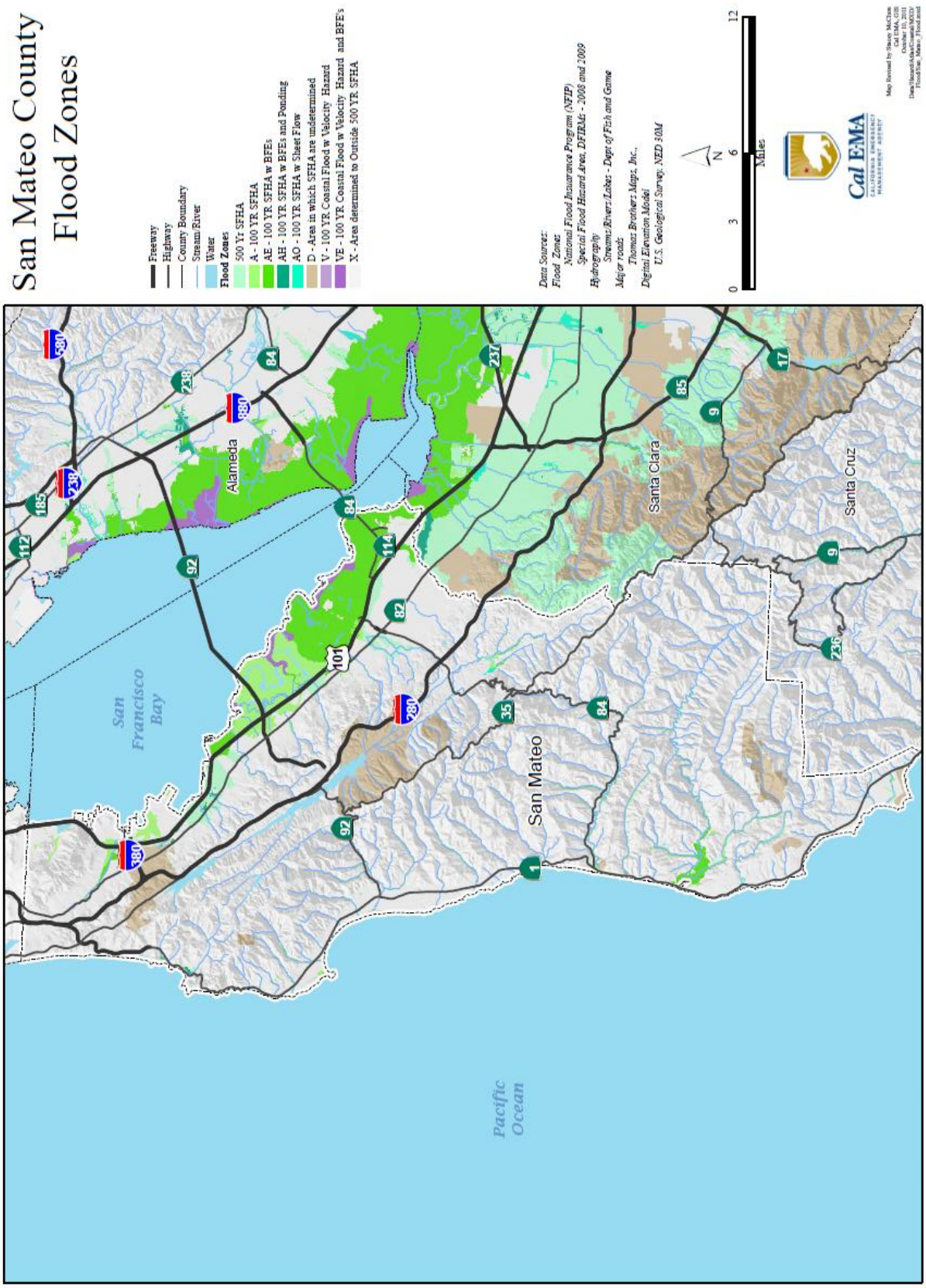
The Federal Emergency Management Agency (FEMA) has mapped flooding hazards in the County's low-lying areas. These flood hazard maps have built-in probability information including the 100-year and the 500-year floodplains.[31]

Location, Extent, and Past Occurrences

San Mateo County contains 34 watersheds. The watersheds are relatively small and they drain to the Pacific Ocean or to the San Francisco Bay. Exhibit 2-13 illustrates the flood prone areas of San Mateo County.

Flooding within the 100- and 500-year flood zones in the County directly effects less 5% of total land area and approximately 1.5% urban land flooding within the 100-year flood zone.[32]

EXHIBIT-14:



Source: Cal OES 2011

San Francisquito Creek

San Francisquito Creek courses through Portola Valley, and the Cities of Woodside, Menlo Park, Palo Alto, and East Palo Alto. The creek and its Los Trancos Creek tributary define the boundary between San Mateo and Santa Clara Counties. The San Francisquito Creek watershed encompasses an area of approximately 45 square miles. Most of the watershed lies in the Santa Cruz Mountains and Bay Foothills northwest of Palo Alto; the remaining 7.5 square miles lie on the San Francisquito alluvial fan near the San Francisco Bay.[33]

According to the 2012 Flood Insurance Study for San Mateo County, there is a 1% annual chance floodflow in San Francisquito Creek is contained in the channel in East Palo Alto. However, tidal flooding from the San Francisco Bay circumvents the incomplete levee system near the Bay and causes flooding in the residential area adjacent to San Francisquito Creek on the east side of the city.

San Francisquito Creek overflows at two locations within the City of Menlo Park. The overflow travels eastward toward the Bay along streets leading away from the creek channel. At the Bayshore Freeway, this shallow flooding crosses into the county area and continues to flow toward the Bay. There are no other spills from San Francisquito Creek into the county area. However, tidal flooding from the Bay during the 1% annual chance flood can possibly overtop the levee system in the City of East Palo Alto and cause flooding in the residential area adjacent to San Francisquito Creek. Flooding has occurred in this area as a result of inadequate or nonexistent storm water facilities causing local storm waters to be trapped in the area.

Historically there have been multiple floods along the San Francisquito Creek, most recently in December 2012. The largest flood in recorded history along the San Francisquito Creek occurred on February 3, 1998. More than 1,700 homes and businesses were impacted, resulting in $28 million in damages. Significant damages were also caused by flooding in 1955, 1958, and 1995, along with high water erosion events in 1978, 1980, and 1982.[34]

Pescadero and Butano Creeks

Pescadero and Butano Creeks are located in a classic river valley formed by the joining of two large drainages. Each creek has a well-defined channel that meanders through a broad floodplain bounded by hills on either side of the valley. This broad floodplain has little gradient and, therefore, is inundated by overflows from Pescadero Creek and the joining flows of Butano Creek. Most of the Town of Pescadero is built in this floodplain and is inundated during floods. The U.S. Army Corps of Engineers (USACE) estimated $352,000 in damages in Pescadero caused by the December 1955 flooding of roads, bridges, and 15 homes. This estimate includes costs associated with rescue and emergency efforts.

The 1998 flood event brought record floods to this watershed. Over 6 inches of rain fell over two days with a peak flow of 10,600 cubic feet per second (cfs) at the USGS gauge on Pescadero Creek. High water marks taken after the flood show a flood elevation of 14.6 feet just downstream of the Pescadero Creek Road Bridge.

Colma Creek

Colma Creek has historically been a source of flooding in South San Francisco. In 1964, the Colma Creek Flood Control Zone was created to alleviate flooding in South San Francisco. A number of improvements have been made on Colma Creek by the Flood Control Zone. These improvements have been designed to accommodate a 2% annual event with an adequate amount of freeboard. However, during a 1% annual chance flood event, flooding would still occur as a result of the remaining inadequate structures and channel capacities.

Watersheds Affecting Burlingame

The City of Burlingame has experienced significant historical flooding from a number of watersheds. In 2009, Burlingame residents approved an annual storm drain fee to fund a capital improvement program to improve the City's storm drain system. Some of the projects include replacing or upgrading the City's aging storm drain pipelines, pump stations, and culverts, as well as improving catch basins and creek embankments. As a result of implementing a number of flood improvement projects, flooding in Burlingame has been and continues to be greatly reduced.

Impacts

Once flooding begins, personnel will be needed to assist in: rescuing persons trapped by floodwater, securing utilities, evacuating residents, moving equipment, cordoning off flooded areas, and controlling traffic. These actions may overtax local agencies, and additional personnel and resources may be needed.

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HAZARD 6: HAZARDOUS MATERIALS

Definition

Low Probability
Moderate Impact

Hazardous materials are substances that because of their chemical, physical, or biological properties, pose a potential risk to life, health, environment, or property when not properly contained. A hazardous materials incident is the potential release of the material from its container into the local environment.

Types

Hazardous materials include materials that are explosive, flammable, combustible, corrosive, reactive, poisonous, biological, or radioactive. They can be solid, liquid, or gaseous.

Hazardous materials incidents may be generated from a fixed site, a transportation (highway, rail, maritime, air) related accident/release, or a pipeline transportation. Not included here are terrorist incidents or radioactive releases from a fixed nuclear facility (FNF). Hazardous materials use, in terrorist activities, is covered in the Terrorism section.

Hazardous materials are classified into four groups of chemicals under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986. These are:

1. **Extremely Hazardous Substances (EHS) –** Includes approximately 366 chemicals. These chemicals have acutely toxic properties. These hazardous materials pose the greatest risk for causing catastrophic emergencies.
2. **Hazardous Substances –** Includes approximately 720 chemicals.
3. **Hazardous Chemicals –** Inventories and material safety data sheets for these chemicals must be submitted if they are present at the chemical facility in certain amounts.
4. **Toxic Chemicals –** Includes 325 chemicals. Chemicals or chemical categories that appear on the list because of their chronic or long-term toxicity.

Probabilities

It is difficult to predict the probability of hazardous material events due to multiple sources (trains, trucks, boats, airplanes, fix sites, pipelines, etc.) along with the magnitude of various hazardous materials.

Location, Extent, and Vulnerability

Releases of EHS can occur during transport and from fixed facilities. Transportation-related releases are generally more troublesome because they can occur anywhere, including close to human populations, critical facilities, or sensitive environmental areas. Transportation-related EHS releases are also more difficult to mitigate due to the variability of locations and distance from response resources.

A hazardous material incident is most likely to occur within the County's industrial areas, and along land and water transportation corridors. Trucks and vessels that use these transportation corridors commonly carry a variety of hazardous materials, including gasoline, other petroleum products, and other chemicals known to cause human health problems.

The northern part of the County is home to a number of biotech companies, which increases the vulnerability for hazardous material incidents.

The bayside portions of the County from Brisbane to Menlo Park contain a number of fixed facilities that use hazardous materials. These industries include semi-conductor and related devices, and biological research activities. The coastside sections of the County are primarily rural - most of this area is forested or agricultural. There are concentrations of pesticides and related substances in the agricultural areas.

Hazardous materials incident history in the County shows most problems occurring in the Brisbane/South San Francisco/San Francisco Airport area in the northeast, and in the Belmont to Menlo Park area in the southeast. These bayside areas have substantial suburban development with a significant population at risk should a serious release occur. These sections also overlie a large groundwater basin.

Road, Rail, and Pipeline Spill Potential

There are four major highways in the County that carry large quantities of hazardous materials: State Route 1, which runs north - south along the western edge of the County; Interstate 280, which runs north - south through the center of the County along the San Andreas Fault; Highway 101, which runs north - south along the eastern edge of the County; and State Route 92 which bisects the other three roads as it runs east - west at mid-county.

Highway 101 is the most heavily traveled truck route and is the most frequent location of hazardous materials spills occurring on major roads in the County.

The Union Pacific railroad right of way parallels Highway 101 through the heavily populated eastern side of the County. Cargo of electronics, fabricated metals, plastics, precision machinery, agricultural chemicals, construction materials, rock/sand/gravel aggregates, and other hazardous materials are also shipped over the rail lines.

Natural gas pipelines also run north - south along the eastern bayshore. Truck, rail, and pipeline transfer facilities are concentrated in this region, and are involved in considerable hazardous materials handling.

Past Occurrences

October 1973 – A resident found a desk-sized metal container in a vacant lot in Belmont and decided it would make a nice barbeque. While using it as a barbeque, it began releasing a strange gas and the resident called the Belmont Fire Department. As a result, 27 firefighters were hospitalized for exposure to a now banned chemical known as methyl bromide.

October 17, 1989 – The Loma Prieta Earthquake caused damage throughout the County and Bay Area. Kelly-Moore paint warehouses were damaged, spilling latex paint and solvents into San Carlos Creek which flows into the Bay.

April 11, 2000 – A fuel tank truck overturned at the Tunnel Road onramp to northbound Highway 101, spilling its load of 7,000 gallons of diesel fuel on the freeway and shoulder. This coincided with the opening of Pac Bell Park in San Francisco, causing significant traffic congestion.

November 7, 2007 – The largest oil spill event in the Bay Area in recent history occurred when a container ship struck a pier bumper at the western span of the Bay Bridge, causing 58,000 gallons of bunker fuel to be released into the Bay. Oiled and dead wildlife, oil slicks, and oil globs were reported around the Bay and the Pacific coastline.

January 29, 2008, 2:00 PM – A car collided with a gasoline tanker on northbound Highway 101 in Redwood City, spilling 8,000 gallons of fuel on the freeway and nearby wetlands. This closed the freeway in both directions for several hours and caused massive traffic congestion on the San Francisco Peninsula and bridges.

August 28, 2009 – Columbus Manufacturing Inc. in South San Francisco released 200 pounds of anhydrous ammonia into the air affecting hundreds of people and hospitalizing more than a dozen people.

September 9, 2010 – The San Bruno pipeline explosion occurred when a natural gas pipeline owned by PG&E exploded in flames in the Crestmoor residential neighborhood, resulting in 8 fatalities and 58 injuries. The explosion and the resulting fire leveled 35 houses and damaged many more.

Impacts

An incident of bulk hazardous materials could result in fire, explosion, toxic cloud, or direct contamination of people and property. The effects may involve a local site or many square miles. Health problems may be immediate, such as corrosive effects on skin and lungs, or may be delayed, such as the development of cancer. Damage to property could range from immediate destruction by explosion to permanent contamination by a persistent hazardous substances in the environment.

The cleanup and recovery from a hazardous materials incident is very time consuming and costly. It is possible that a spill in the County could enter storm drains and waterways before it could be contained. Ecological damage to the area could be substantial.

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HAZARD 7: LANDSLIDES

Definition

Low Probability
Low Impact

The term landslide refers to the downward movement of masses of rock and soil. Landslides in this area are for the most part masses of soil ranging, in volume, from a few cubic feet to many cubic yards. The rate of travel of a slide can range from a few inches per month to many feet per second, depending on slope, material, and water content. Landslides can be initiated by storms, earthquakes, fires, erosion, and by human modification of the land.

Types

Slides

Although many types of mass movements are included in the general term "landslide", the more restrictive use of the term refers only to mass movements, where there is a distinct zone of weakness that separates the slide material from more stable underlying material. The two major types of slides are rotational slides and translational slides.[35]

Rotational slide – This is a slide in which the surface of rupture is curved concavely upward and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide.

Translational slide – In this type of slide, the landslide mass moves along a roughly planar surface with little rotation or backward tilting. A block slide is a translational slide in which the moving mass consists of a single unit or a few closely related units that move downslope as a relatively coherent mass.

Flows

Debris Flow – A debris flow is a soil flow where the majority of the materials are coarse-grained (fine sand to boulder size particles) and non-cohesive. Debris flows are most often triggered by intense rainfall following a period of less intense precipitation, or by rapid snow melt. High water pressures cause the soil and weathered rock to rapidly lose strength and flow downslope. Debris flows can move very rapidly, at rates ranging from cubic yards per hour to cubic yards per second, and travel relatively long distances, making them a significant threat to life and property.

Debris flows commonly begin as a slide of a shallow mass of soil and weathered rock. Their most distinctive landform is the scar left by the original shallow slide. The path of the debris flow may be marked by a small drainage that has been stripped of vegetation. The debris flow may not leave any deposit if it flows directly into a larger creek and is immediately eroded away. Many debris flow deposits are ephemeral, but in some cases successive debris flows may deposit material in the same area thereby forming a debris fan which resembles a small, steep alluvial fan.[36]

Earth Flow – An earth flow is a specific type of soil flow landslide where the majority of the soil materials are fine-grained (silt and clay) and cohesive. The material strength is low through much of the slide mass, and movement occurs on many discontinuous shear surfaces throughout the landslide mass. This movement along numerous internal slide planes disrupts the landslide mass leading to cumulative movement that resembles the flow of a viscous liquid characterized by a lumpy, or “hummocky” slope morphology. The lower parts of an earth flow usually bulge outward and are steeper than adjacent slopes.

Earth flows commonly occur on moderately steep slopes. Slope gradients are commonly 10% to 30%, although steeper slopes may be found in headscarp and toe areas.

Earth flows typically are initiated by periods of prolonged rainfall and sometimes do not initiate until well after a storm or the rainy season has passed. They are characteristically slow moving, in the inch per day range, and may continue to move for a period of days to weeks after initiating.

Probability

Estimating the probability of landslides is too complex for the scope of this document. In general, landslides are most likely to occur during periods of higher than average rainfall or El Niño winter storms. In addition, the ground must be saturated prior to the onset of a major storm for significant landsliding to occur.

Location, Extent, and Vulnerability

In general, landslides are most likely during periods of higher than average rainfall or El Niño winter storms. In addition, the ground must be saturated prior to the onset of a major storm for a significant landslide to occur. There is no way to estimate the scale of individual landslides in terms of size or extent based on maps, or to assign specific probabilities to these areas in terms of the likelihood of future landslides[37].

Slides and earth flows can pose a serious hazard to property in the hillside terrain of San Mateo County. They tend to move slowly and thus rarely threaten life directly. When landslides occur in response to such changes as increased water content, earthquake shaking, additional development, or removal of downslope support – they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, and breaking of underground pipes within and along the margins of the landslide, as well as overriding of property and structures downslope.[38]

The best available predictor of where movement of slides and earthflows might occur is the distribution of past movements. These landslides can be recognized from their distinctive topographic shapes, which can persist in the landscape for thousands of years. Most of the landslides recognizable in this fashion range in size from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. Some small portion of them may become active in any one year, with movements concentrated within all or part of the landslides masses or around their edges.[39]

Exhibit 2-14 provides a summary of the distribution of landslides evident in San Mateo County. The summary map provides a basis for initial evaluation of areas of vulnerable to slumps, translational slides, and earth flows in the County.[40]

There are many potential landslide sites within the County. Many threaten key highways. Some jurisdictions may be directly affected or simply isolated from a landslide. Over 92% of the areas vulnerable to landslides are located within the unincorporated areas of the County.

Exposure of existing land use in a landslide area is as follows:

- Of the 286,193 acres of land in San Mateo County, 65,794 acres (22.99%) are vulnerable to landslides. Of those 65,794 acres, 60,837 acres (92.46%) are located in unincorporated areas while 4,957 acres (7.53%) are located in incorporated areas of the County.
- 8,752 acres (3.06%) of urban land and 57,042 acres (19.93%) of non-urban land are vulnerable to landslides.

- Of the 65,794 acres vulnerable to landslides, 6,522 acres (9.91%) are residential lands, 88 acres (0.13%) are mixed commercial-industrial complexes, 33,356 acres (50.7%) are forest land, 2,482 acres (3.77%) are agricultural land, and 21,008 acres (31.93%) are rangeland.
- Of the 3,182 miles of roads in San Mateo County, 293 miles (9.2%) are vulnerable to landslides. Categorically, 4 miles (0.13%) are located on an interstate highway, 21 miles (0.55%) are on a primary US/State highway, 32 miles (1.0%) are on a secondary State/County highway, 212 miles (6.7%) are on local roads, and 23 miles (0.7%) are on miscellaneous roads.[41]

Past Occurrences

January 4, 1982 – An extraordinarily intense storm saturated many areas, triggering hundreds of small to major landslides in the County. The majority of these landslides occurred in steep sections of the western and northern parts of the County, mostly in sparsely populated areas. In Pacifica, three children were killed when a strip of the hillside behind their home slid hundreds of feet, destroying two homes. Millions of dollars in property damage were attributed to landslides throughout the County.

1998 Landslides caused by El Niño Storms – Landslides caused an estimated minimum of $55 million damage to public and private property in San Mateo County as a consequence of 1998 winter storms. Hundreds of hillslope failures occurred throughout the County, most during the week of February 2. The most common types of damaging failures were earthflows and earth slumps, leading to $38 million of damages in La Honda, Moss Beach, Pacifica, Daly City, and Portola Valley. The pre-existing Polhemus landslide (earth slump) in San Mateo was reactivated. Earth slumps involved in shoreline retreat in the Daly City, Pacifica, Tunitas Creek, and Moss Beach (Half Moon Bay area) are included in this assessment.

Highway 1 at Devils Slide has also been closed by slides in the past. In 1995 and 2006 slides resulted in extended closures. The new Tom Lantos Tunnel opened in March 2013 to allow Highway 1 to by-pass Devils Slide.

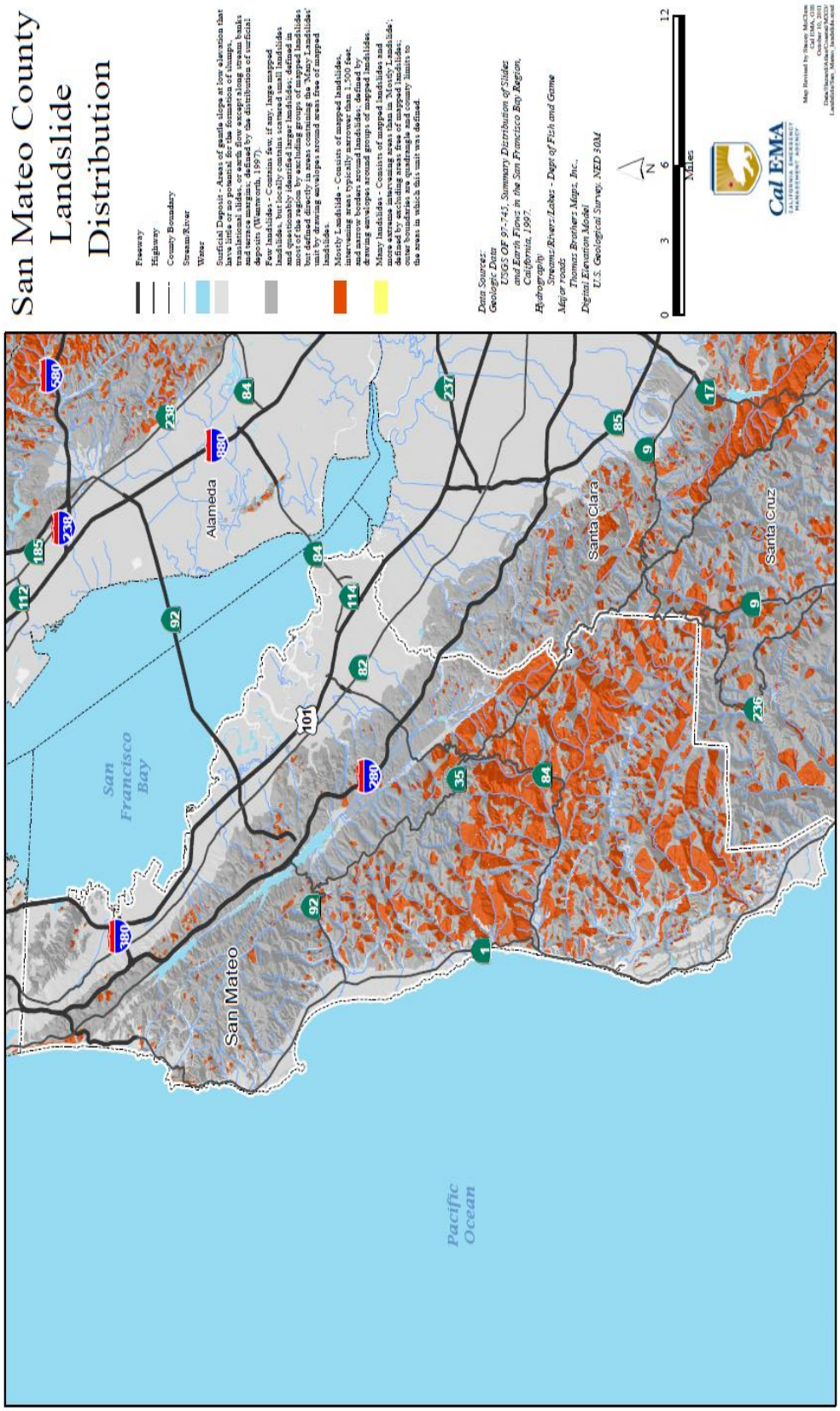
Damage from debris flows especially affected the southwestern part of the county, which includes the Tunitas Creek, San Gregorio, and Pescadero watersheds. Debris flows were widespread and abundant on natural slopes west of Skyline Ridge. Debris flows were present, but rare, on natural slopes east of Skyline Ridge and were observed in the Alpine Road, Crystal Springs, San Bruno Mountain, and Point San Pedro areas, and along the extent of the County's coastal sea cliffs.[42]

Impact

Landslides can result in the disruption of roads, water, sewer, gas, electric and phone lines, as well as serious damage to public and private property. The loss of life in such an occurrence is a major concern.

Due to the probable locations of the landslide vulnerability being located in the less populated/developed incorporated areas of the county, landslides will have little effect on the developed property. However, in the more developed areas, there is a danger of roads being impassable, damaged, buried, or in some cases swept away. Private property is vulnerable to similar risks. While many of the landslides will not be large enough to affect a large numbers of homes or businesses, landslides could affect individual parcels of private property. As witnessed in 1982, the landslide in Pacifica destroyed two homes and killed three children.

EXHIBIT-15:



Source: Cal OES 2011

HAZARD 8: PANDEMIC AND EPIDEMIC

Moderate Probability
High Impact

Definition

The Center for Disease Control (CDC) defines an epidemic as an occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time. A pandemic is defined as an epidemic occurring worldwide, or over a very wide area, crossing international boundaries, and usually affecting a large number of people.[43]

Many potential devastating diseases are spread through physical contact, ingestion, inhalation, and insects. Airborne diseases and those spread through physical contact pose higher risks to the community because they are difficult to control. Diseases such as influenza, pertussis, tuberculosis, and meningitis are all spread through these methods and pose a threat to all communities. Health agencies closely monitor diseases with the potential to cause an epidemic and seek to develop immunizations.

Types

Several characteristics of pandemic or epidemic differentiate these hazards from other public health emergencies. First, an epidemic or pandemic has the potential to infect large numbers of people, which could easily overwhelm the health care system not only within the county or the region, but also in the entire state or country. A pandemic outbreak could also jeopardize essential community services by causing high levels of absenteeism in critical positions in the every workforce. It is likely that vaccines against a new virus would not be available for six to eight months following the arrival of the virus in the United States. Basic public services such as health care, law enforcement, fire and emergency response, communications, transportation, and utilities could all be disrupted or severely lessened. Finally, the pandemic, unlike other public health emergencies, could last for several weeks or months.

The best known types of pandemics are pandemic flus. These have been some of the deadliest pandemics in history. It is estimated that the 1918 flu pandemic killed over 50 million people worldwide. The latest example of a worldwide pandemic is the H1N1 swine flu. This flu strain is a recombination of swine, human and bird flu genes. Initial cases appeared in Veracruz, Mexico in spring 2009. Spreading through the population, it next moved to the United States and then eventually worldwide. Symptoms were mild for a large percentage of the population; however those with compromised immune systems, pregnant women, or very young children had a more intense reaction than the general population.

Seasonal flu epidemics are a recurring phenomenon that migrate around the world. The flu virus tends to mutate, allowing it to continuously re-infect the population. In the United States, annual flu respiratory infections range from 5 to 15%.

Probability

There have been four flu pandemics in the past 100 years, with three of them being in the last 60 years. This produces a recurrence rate for pandemic flu of 25 years or less.

Location, Extent, and Vulnerability

Epidemics and pandemics have in the past affected the entire County. They will continue to do so in the future. To what extent they infect the public depends on their ease of transmittal. How serious the disease is to the

individual depends on a number of factors including age, general health, life style, occupation, and other factors.

In 2009 and 2010, the H1N1 swine flu pandemic caused widespread infection, but the virus killed relatively few people. A far more lethal pandemic occurred in 1918 to 1920, when the Spanish flu infected 500 million worldwide, and killed 50 million people, including 675,000 in the U.S.[44] A similar pandemic, assuming an infection rate of 35% and a mortality rate of 2%, would cause over 250,000 infections and 5,000 deaths in San Mateo County. Economic losses could be staggering.

Past Occurrences

Pandemics and epidemics have plagued humans for thousands of years. As human populations began to congregate in cities, the potential for large-scale epidemics grew. As this process continued and trade between the various population centers increased, so did the potential for disease to spread, leading to the potential for pandemics. Today with the mobile population, individuals can be in North America one day, in Europe the next, and in Asia the next. This increases the ability for opportunistic diseases to migrate through the world population rapidly.

Recent Pandemics have included:

- 1918 to 1920 Spanish Influenza (worldwide)
- 1957 to 1958 Asian Influenza
- 1961 to 1970s 7th Cholera Pandemic
- 1968 to 1969 Hong Kong Influenza
- 2009 to 2010 Swine Flu

Impact

Seasonal flu causes considerable economic hardship due to lost productivity, high medical costs and lost wages. In addition to the economic hardships above, with a pandemic the need for social distancing and isolation will lead to further temporary decrease in the financial condition of the community. In the United States the economic impact of a pandemic could range from $71 to $167 billion a year.[45]

Depending on the severity of the epidemic or pandemic there could be problems with continuity of operations and the delivery of services. As staff stays home due to illness or to care for others, the ability of the County, other jurisdictions, and businesses, to maintain delivery of services could be severely limited.

With epidemics and pandemics no area is immune to the spread of the disease. The impact on people is acute illness. Depending on the specific disease contracted, there may be symptoms that include respiratory problems, vomiting, diarrhea, sore muscles, joint pain, weakness, spitting up blood, coma, or death.

A significant surge in the need for additional health care resources is expected during an epidemic or pandemic. A serious shortage of health care facilities, equipment, pharmaceuticals, and personnel is predicted. Essential health care supplies might not be available during a pandemic, because health care systems maintain their supply chains with just-in-time operations, and approximately 80% of supplies, including drugs, come from foreign suppliers, which might not be functioning during a pandemic.[46]

Pandemic influenza will affect many regions simultaneously and therefore outside resources may be unavailable.

HAZARD 9: TERRORISM

Definition

Low Probability
High Impact

Terrorism is a broad term that describes the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. As defined by the United States Federal Bureau of Investigation (FBI), terrorism is the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population or any segment thereof, in the furtherance of political or social objectives.

Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based); and the use of chemical, biological, nuclear, and radiological weapons.

Terrorists often use threats to create fear among the public and to try to convince citizens that their government is powerless to protect them. The effects of terrorism may include, but are not limited to, casualties, structural damage to buildings and infrastructure, financial services and banking, and disruptions in basic services such as electricity, water supply, public transportation, communications and healthcare.

Types

Title 18 USC § 2331 defines "international terrorism" and "domestic terrorism" for purposes of Chapter 113B of the Code, entitled "Terrorism":

Domestic Terrorism – means activities with the following characteristics:

- Involve acts dangerous to human life that violate federal or state law;
- Appear intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination. or kidnapping; and
- Occur primarily within the territorial jurisdiction of the U.S.[47]

International Terrorism – means activities with the following characteristics:

- Involve violent acts or acts dangerous to human life that violate federal or state law;
- Appear to be intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping; and
- Occur primarily outside the territorial jurisdiction of the U.S., or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to intimidate or coerce, or the locale in which their perpetrators operate or seek asylum.[48]

Cyber-Terrorism – is the convergence of cyberspace and terrorism. It refers to the unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. To qualify as cyber-terrorism, an attack should result in violence against persons or property, or at least cause enough harm to generate fear. Attacks that lead to death or bodily injury, explosions, or severe economic loss are all examples of cyber-terrorist related activities. Attacks against elements of a government's critical infrastructure could also be classified as acts of cyber-terrorism depending on the impact of such an event.[49]

Weapon of Mass Destruction (WMD) – is defined by the FBI as "any explosive or incendiary device, as defined in *Title 18 USC § 921*, as a bomb, grenade rocket, missile, mine, or other device with a charge of more than four ounces." A WMD is further defined in *Title 18 USC §2332a* as "any weapon designed or intended to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals or their precursors." In addition, a WMD can be classified as "any weapon involving a biological agent or any weapon designed to release radiation or radioactivity at a level dangerous to human life."[50]

Probability

The probability of future terrorist attacks is unknown.

Location, Extent, and Vulnerability

The extent of future terrorist attacks is unknown. Communities vulnerable to terrorist incidents are those that have high visibility or are internationally known and those communities containing highly visible targets. These critical facilities, sites, systems, or special events are usually located near high-volume transportation routes with multiple access points. These facilities include:

- Government office buildings, courthouses, schools, hospitals, and shopping malls
- Dams, water reservoirs, and the power distribution network
- Military bases
- Railroads, interstate highways, tunnels, airports, ferries, bridges, seaports, and hazardous materials pipelines
- Sport stadiums, concert venues, convention centers, theatres, parks, and casinos
- Financial institutions and banks
- Historical landmarks and monuments
- Scientific research facilities, museums, and institutes of higher learning
- Special events, parades, religious services, festivals, and celebrations

These critical facilities, sites, and special events become even more appealing as potential terrorist targets during visits by high profile personalities and dignitaries.

Past Occurrences

To date, San Mateo County has never experienced a terrorist incident.

Nationally, the past decade has seen a number of well publicized terrorist incidents and attempts in the U.S. The most notorious event is the 9-11 attack on the World Trade Center and the Pentagon.

Impact

Terrorist incidents by their nature purposely attempt to impact the health (physical or mental) of the target population. Small individual events like a cross burning in a victim's yard are meant to cause mental anguish and to force a reaction like moving. Large scale events like the 9-11 attacks are meant to cause as much physical damage, death, injury and terror as possible. People in the area attacked can be killed or injured. Survivors may develop mental problems, or contract long term physical ailments, as happened to many of the survivors of the 9-11 attacks on the World Trade Center and the victims of the 2001 anthrax attack.

First responders at the scene of a terrorist incident will be exposed to the same health and safety factors as those who survived the initial attack. In many cases the exposure could be prolonged for responders who assist in the extended rescue and cleanup activities, possibly leading to a high rate of either physical or mental

illness. This was the case for those responding to the World Trade Center attack who then scoured the debris pile, in some cases for weeks.

Impacts on the persons directly affected by a terrorist attack will vary depending on the type of incident. In the event of a radioactive dirty bomb or a nuclear device, there could be long-term radiation related illnesses. These can range from acute radiation sickness leading to death in a few days to weeks, to the long-term development of cancer or other radiation diseases. If the attack is conventional explosives, there will be traumatic injuries and burns. If the attack is with a biological agent the result will depend on the agent. However, it is likely that all these events will cause a number of deaths and probably long-term ill effects for those impacted. If the attack is with a chemical agent, there could be burns, inhalation problems, or various types of poisoning.

Another risk to first responders arriving at the scene of a terrorist incident is the possibility of a secondary device. In many cases terrorists set up a secondary device for the sole purpose of killing and wounding those who come to rescue the injured. In response many organizations now train their responders not to enter the scene until the 'all clear' is given by those trained to evaluate it for secondary devices.

A cyber-attack's impact will depend on the targeted infrastructure. Since each piece of infrastructure has a different result if attacked, the consequences will be different. An attack that shuts down the traffic signals within the County will have a different impact than an attack that changes the switches on train tracks or erases the bank balances of companies and individuals throughout the United States.

The damage to facilities and the infrastructure is frequently the goal of many terrorist incidents. While many of today's terrorist incidents aim at maximum human casualties, much of this can be obtained by destroying the facilities or infrastructure being used by those citizens.

The impact on property, facilities, infrastructure and healthcare surge is strongly correlated with the focus of the attack, the material used in the attack, and any protective measures the facility has taken ahead of time. A chemical bomb next to a government building will have a very different impact than a cyber-attack that shuts down an air traffic control tower at a major airport, or the detonation of a small nuclear device in a major port.

One of the key things, that many terrorists focus on, in the twenty-first century, is the financial impact their operations have on the targeted organization or country. They have become aware that not only can they hurt a society or group by a direct attack on its members, but that striking at the economic underpinnings of a society or organization can destroy it just as effectively.

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HAZARD 10: TRANSPORTATION ACCIDENT

Moderate Probability
Moderate Impact

Definition

Transportation accidents as used in this assessment include accidents involving road, rail, and air within San Mateo County.

Types

Minor accidents between a low number of motor vehicles, or an accident involving a small private plane are not included in this definition unless there is some defining characteristic that makes them stand out. Instead, accidents must involve a number of vehicles, and/or include a large number of casualties, or create some other problem that must be resolved by the first responders in the County. Hazardous materials are covered in more detail in the Hazardous Materials section. Therefore, this section mentions it as contributing factor but will not emphasize it.

Probability

Small transportation incidents are a daily occurrence in San Mateo County. Large scale incidents that threaten the health and safety of a large number of citizens are rare.

Due to the wide variations among the type and magnitude of transportation accidents, there is no formal way to estimate the probability of these events within the scope of this document.

Location, Extent, and Vulnerability

Transportation accidents exemplify a hazard with a large number of low-impact events and a small number of high-impact events. Every year more than 40,000 people die in transportation accidents in the United States. The vast majority of these are the result of traffic accidents. Of the traffic deaths, most occur on highways and rural roads. While individual accidents are not large incidents, they have a large cumulative impact. Many programs and regulations have been established to improve safety. The means to handle the most frequent incidents fall well within the scope of daily operations of local government. Occasionally larger incidents occur that have a bigger, more lasting impact on the community and challenge the response capabilities of local government.

Major Airplane Crash

A plane or jet crash in San Mateo County could cause serious damage and life loss requiring an immediate and coordinated response by various law enforcement, fire, and emergency medical services. In the case of a downed aircraft, the size and speed of the airframe, and highly flammable fuel magnify the emergency response services required.

The numbers of people killed and injured from an aircraft accident is dependent on the location of the crash and the way the plane impacts the ground. If the crash occurs in a populated area, the time of day affects the numbers of persons injured or killed on the ground.

Law enforcement efforts in a major crash would focus on cordoning off the impacted location, maintaining open traffic lanes for emergency vehicles, and keeping curious citizens at a safe distance from the incident. Firefighting resources would be charged with fire containment, search and rescue, patient triage and treatment. EMS would be responsible for additional patient triage, treatment and transportation to area

hospitals. Depending on local arrangements, the local response agencies will effect a unified command organization. Mobile command and communication centers would be established as needed.

San Francisco International Airport

SFO is the seventh busiest international airport in the United States and twenty-second busiest in the world. SFO is owned by the City and County of San Francisco and operated in San Mateo County. The airport is located in the northeastern quadrant of San Mateo County. Aircraft landing at SFO usually make their approaches to Runway 28 by flying west up the Bay. Exceptions to this practice occur when weather fronts are moving through the area. When winds are from the south, aircraft approach from Oakland/Alameda to Runway 19. With winds out of the north, aircraft approach much like a typical Runway 28 landing up to Coyote Point where they turn left towards San Mateo. Prior to the ridgeline the aircraft turn right 180 degrees flying over the City of Millbrae to a Runway 01 landing. Most departures have the aircraft using Runway 01 to the north. Most of the heavy aircraft departures take off from SFO flying west over San Bruno, South San Francisco, Pacifica, and Daly City in what has been referred to as the Gap departure.

Two factors related to the airport departures should be noted. The majority of heavy overseas flights leaving SFO use the Gap Departure route. The shoreline is used when heavy westerly winds do not permit Runway 01 departures and fog does not reduce visibility of San Bruno Mountain.

The Gap Departure is used by flights from SFO approximately 30% of the time (65,000 to 70,000 flights/year).

The Gap, as it traverses San Bruno, South San Francisco, Pacifica, and Daly City, is 1.2 miles wide and 5.8 miles in length. This aircraft flight path encompasses the entire Serramonte neighborhood of southern Daly City, central San Bruno, and South San Francisco, with resident population of approximately 45,000 people. These neighborhoods are characterized by single-family residential houses with about sixteen units per acre. Multi-family units are scattered throughout the planning area and are constructed at 20 to 25 units per acre. Several large regional shopping centers are also located within the Gap.

Due to the close proximity of dwelling units and high density of the urbanized area, a downed jet liner could cause a large number of fatalities and serious injuries. Since the homes are typically located within six feet of each other, the number of units immediately impacted would be high and the risk of fire spreading would be significant.

While the above scenario would dictate a quick and multi-jurisdictional response, the probability of such an event is low. According to national studies of airport accidents involving large aircraft, the vast majority of airliner accidents occur either immediately before landing or within 1,000 yards of take-off.

Trucking Incident

The main transportation arteries through San Mateo County are Highway 101 and Interstate 280. These routes are heavily used throughout the day and night and the control of vehicular traffic in and around the affected area of a multi-casualty or hazardous materials incident will be the primary problem at any time.

A major truck incident that occurs in a heavily-populated industrial area or residential area can result in considerable loss of life and property. Potential hazards could include overturned tank trailers, direct impact either into a residence or industrial building, or cutting into the normal flow of traffic.

In many areas there are few, if any, good alternate routes. During commute hours, the problem will be severely compounded. It will be essential to expedite the flow of essential emergency response vehicles through the area and divert nonessential traffic. In a major accident, it is not uncommon for these roads to close for most of a day to support rescue, recovery and accident investigation activities.

In a major disaster, increased reliance on goods and equipment being trucked into the County combined with restricted or damaged roads could result in a greater chance for a major accident.

Railroad Incident

San Mateo County is served daily by Caltrain and BART for passenger service and by Union Pacific Railroad for freight transportation. Freight trains operate daily along nearly the entire length of the Caltrain corridor, and make up less than 5% of train traffic on the San Francisco Peninsula. The freight trains move mostly at night, when Caltrain traffic is less frequent.

A major train derailment that occurs in a heavily populated industrial area can result in considerable loss of life and property. As a train leaves its track, it can no longer be controlled. Potential hazards could include overturned rail cars, hazardous materials incidents, and impact from railcar, cargo, and truck assemblies into an industrial building, home, or roadway traffic.

Train accidents could be caused by derailment, an accident with a pedestrian, an accident with a vehicle at a grade crossing, a collision with another train, or an explosion or fire in or near the train. Any hazardous materials carried as freight or in another impacted vehicle could substantially complicate response actions and require monitoring until all debris is removed.

Numerous agencies, from local emergency response resources to federal agencies charged with investigating the incident, would respond to the scene. Traffic control and resource management will be difficult but essential to maintain. Schools near the site may be isolated or evacuated immediately.

Past Occurrences

Major Plane Crash

July 6, 2013 – Asiana Airlines Flight 214 crashed after hitting the seawall short of the runway on approach at SFO resulting in three fatalities and 181 injuries. 304 people survived the crash.

Trucking Incident

April 11, 2000 – A fuel tanker overturned at the Tunnel Road onramp to northbound Highway 101 spilling its load of 7,000 gallons of diesel fuel on the freeway and shoulder. This coincided with the opening of Pac Bell Park in San Francisco causing significant traffic congestion.

January 29, 2008, 2:00 PM – A car collided with a gasoline tanker on northbound Highway 101 in Redwood City spilling its load of 8,000 gallons of fuel on the freeway and nearby wetlands. This closed the freeway in both directions for several hours and caused massive traffic congestion on the San Francisco Peninsula and bridges.

BART

Three minor train derailments have occurred in the Bay Area in the last 20 years; however, no derailments have occurred in San Mateo County.

Caltrain and Union Pacific

No derailments or major crashes have occurred in San Mateo County.

Impacts

The impacts of a major transportation accident, while varying depending on the type of accident and vehicles involved, will have a number of similar factors. Differences between them are discussed as necessary.

The potential for injury and death are the major impacts from all types of transportation accidents. Traumatic injury and possible burns are the primary results. For the survivors of a major incident with numerous fatalities and injuries, post-traumatic stress can be a lingering problem.

The threats to the health and safety of personnel responding to the scene of transportation accidents depend on the environmental factors associated with each incident. Threats include: hazardous chemicals, fire, explosion, and in water rescues, drowning and hypothermia.

Trucking Incident: Most road or highway transportation incidents will result in very little damage to facilities, infrastructure, or property. This is due to the limited or localized nature of any highway accident. The relative minor damage caused by impact may be aggravated by any fire or chemical spill that is created by the accident.

A highway incident should not impact the delivery of services or the continuity of operations for any jurisdiction for more than a short period of time. Rerouting for all major routes is a standard operating procedure that happens frequently.

Train Crash/Derailment: Rail transportation events, localized like road events, can cause considerably more damage to property, facilities and infrastructure. Any piece of property or facility in close proximity to the tracks has the potential of being damaged or destroyed. The most likely item of infrastructure damaged will be the rail tracks. This is compounded by any fire or chemical spill that is created by the accident.

Transportation delays are likely to occur, especially for commuter Caltrain and BART passengers.

Major Air Crash: The crash of any aircraft can damage or destroy any property, facility, or piece of infrastructure that it hits. The area in which an aviation accident occurs will influence the impact of the disaster on the County. If an aircraft goes down in an industrial or residential area the number of fatalities may increase and the danger of fire is enhanced. If the accident occurs during peak traffic periods, the responding agencies may have problems reaching the area or transporting the injured out of the area. An accident in a large open area could also present a problem. With airplane wreckage scattered over a large area, crowd control could be difficult, especially if there is easy access to the area. Such a circumstance could easily overtax the responding police forces.

When a commercial airliner crashes, the fire service will bear the burden of the immediate effects; however, while the effects are often intense they are usually of short duration.

There are other emergency elements impacted by an aircraft accident. Area hospitals could be flooded with injured persons and blood banks could receive large orders for blood. Emergency medical service (EMS) providers would be impacted with a surge in victim treatment and transport to area hospitals while still responding to 911 medical calls. Law enforcement agencies may experience challenges establishing an

effective crowd/traffic control. International flights may have many non-English speakers who will require translation services both at the scene and at hospitals. All responding agencies and disciplines have to establish effective unified command operations. Establishment of a temporary morgue would be required.

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HAZARD 11: TSUNAMI / WAVE EVENT

Low Probability
Low Impact

Definition

A tsunami is a series of waves generated in a body of water by a rapid disturbance along the seafloor that vertically displaces the water. Subduction earthquakes at plate boundaries and underwater landslides are the causes of a tsunami.

A single tsunami event may involve a series of waves, known as a train, of varying heights. In open water, tsunamis have long time lapses (from minutes to hours) before the next wave top passes a point. A tsunami wavelength can extend up to several hundred miles. The actual height of a tsunami wave in open water is generally only 1 to 3 feet and is often unnoticeable. The tsunami wave can travel across the ocean at over 500 miles per hour. As the wave approaches land, the sea shallows and the wave no longer travels as quickly, and begins to "pile up" as the wave-front becomes steeper and taller. Therefore, the wave can increase to a height of 90 feet or more as it approaches landfall.

Seiches are oscillating waves in an enclosed or partly-enclosed body of water, caused by earthquakes or landslides which displace part of the water body.

Types

Local Source Tsunami

A local-source tsunami is an event which can cause destruction up to 600 miles from the source. Also known as a near-shore tsunami, the first wave could arrive on shore within minutes after a significant earthquake or undersea landslide. In San Mateo County such an event would most likely be caused by an earthquake-induced submarine landslide or from an earthquake in the Cascadia Subduction Zone north of Cape Mendocino.

Distant Source Tsunami

A tsunami caused by a very large earthquake elsewhere on the Pacific Rim could reach the California coast between 4 to 15 hours after the earthquake. The Alaska-Aleutians Subduction Zone is an example of a distant source that has caused destructive tsunamis in California.[51]

Probability

It is not sufficient to estimate the probability of future tsunamis simply based on past occurrences. Because tsunamis are rare there is not enough data in the historical record to adequately derive a return period.

Location, Extent, and Vulnerability

Tsunamis:

California, the Pacific Coast, as well as the Bay Area are all at risk from tsunamis.

The San Mateo County coastline extends 55 miles and consists of several residential and agricultural communities. The

EXHIBIT-16: APRIL 1, 1946, HALF MOON BAY AFTER TSUNAMI FLOODING

Source: NOAA/NGDC by Howard Anderson

greatest potential damage from a tsunami would occur in Pillar Point Harbor, Half Moon Bay, El Granada, Pescadero, Princeton-by-the-sea, and Pacifica. (see Exhibits 2-17, 2-18, and 2-19)

Along the bayside of San Mateo County there is a possibility of inundation. The inundation line represents the maximum considered tsunami runup from a number of extreme, yet realistic, tsunami sources. (Exhibit 2-16)

Seiches:

Lakes and other enclosed bodies of water could be affected by a seiche. Four bodies of water in San Mateo County are believed to be large enough to pose significant seiche potential: Upper Crystal Springs Reservoir; Lower Crystal Springs Reservoir; San Andreas Lake; and Pilarcitos Lake. If an earthquake similar in magnitude to the 1906 earthquake were to occur at a time when these water bodies were at the high water mark, seiches could top the spillways by several feet and cause major inundation downstream.

Past Occurrences

Notable distant tsunamis that have impacted California include:

April 1, 1946 – A magnitude 8.8 earthquake in the Aleutian Islands generated a tsunami that caused damage along the coast of California, including flooding over 1000-feet inland in Half Moon Bay (see Figure 2-15).

March 28, 1964 – Twelve people were killed in California when a tsunami was generated by a magnitude 9.2 earthquake off the coast of Alaska. However, only minimal damage to boats in Half Moon Bay was reported.

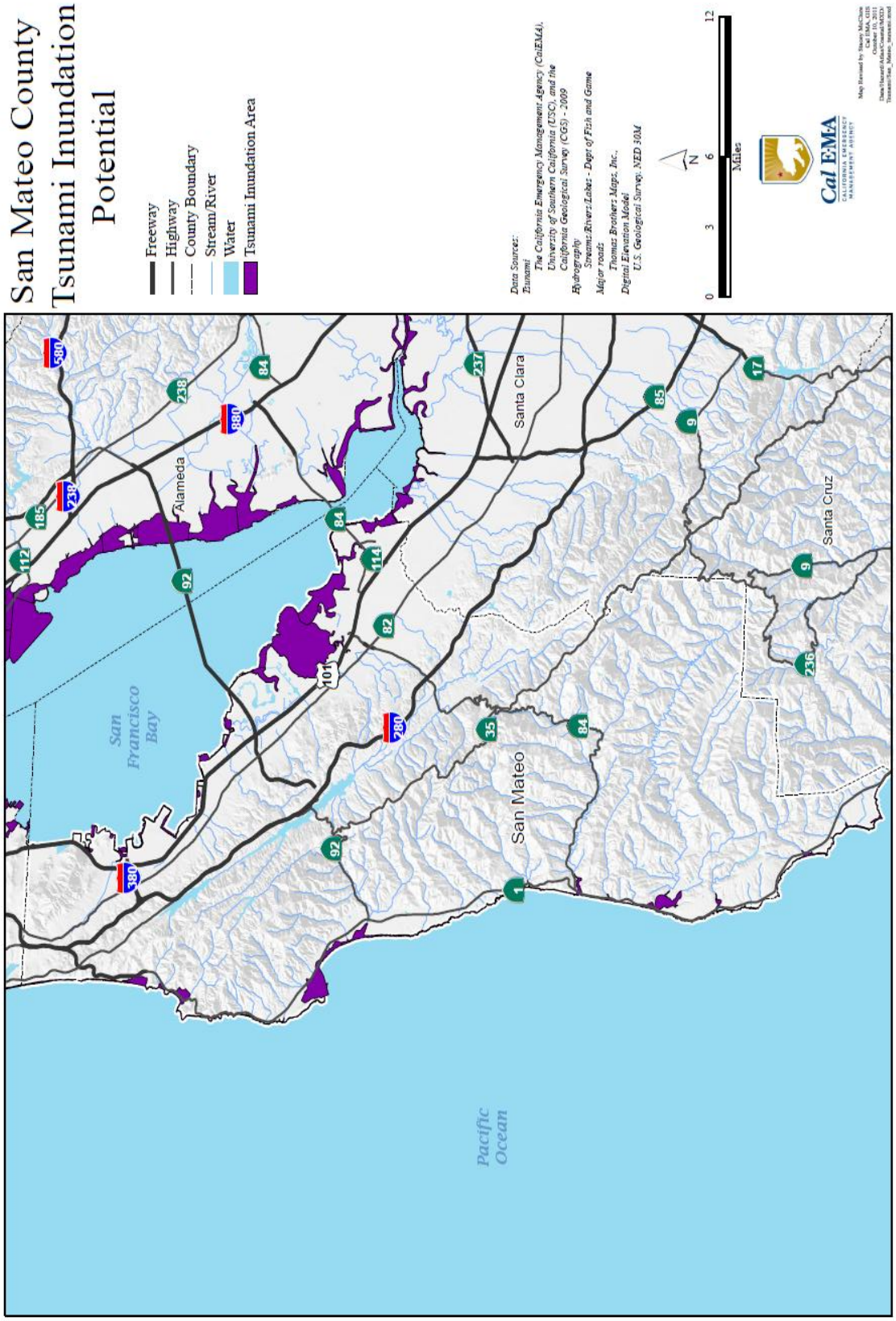
March 11, 2011 – A magnitude 9.0 earthquake in the Tohoku region of Japan produced a moderate amplitude tsunami in California. Although it did not generate significant flooding in California, strong tsunami currents caused one death and over $50 million in damages to 27 harbors statewide including Pillar Point, with the most significant damage occurring in Crescent City and Santa Cruz.

Impact

A significant tsunami can cause a wide variety of direct and indirect impacts. The potential impacts include:

- Evacuation
- Loss of life (human and animal)
- Mass injuries
- Damage to docks, piers, boats, and ships
- Destruction of homes and businesses from the impact of waves and debris, flooding, buildings floating off foundations and scouring as water recedes
- Disruption of utilities and communications systems
- Damaged or destroyed roadways and bridges
- Hazardous material spills
- Fires
- Transportation accidents
- Damage and disruption of ecologically sensitive areas
- Disruption of the economy (especially tourism and fishing industries)

EXHIBIT-17:

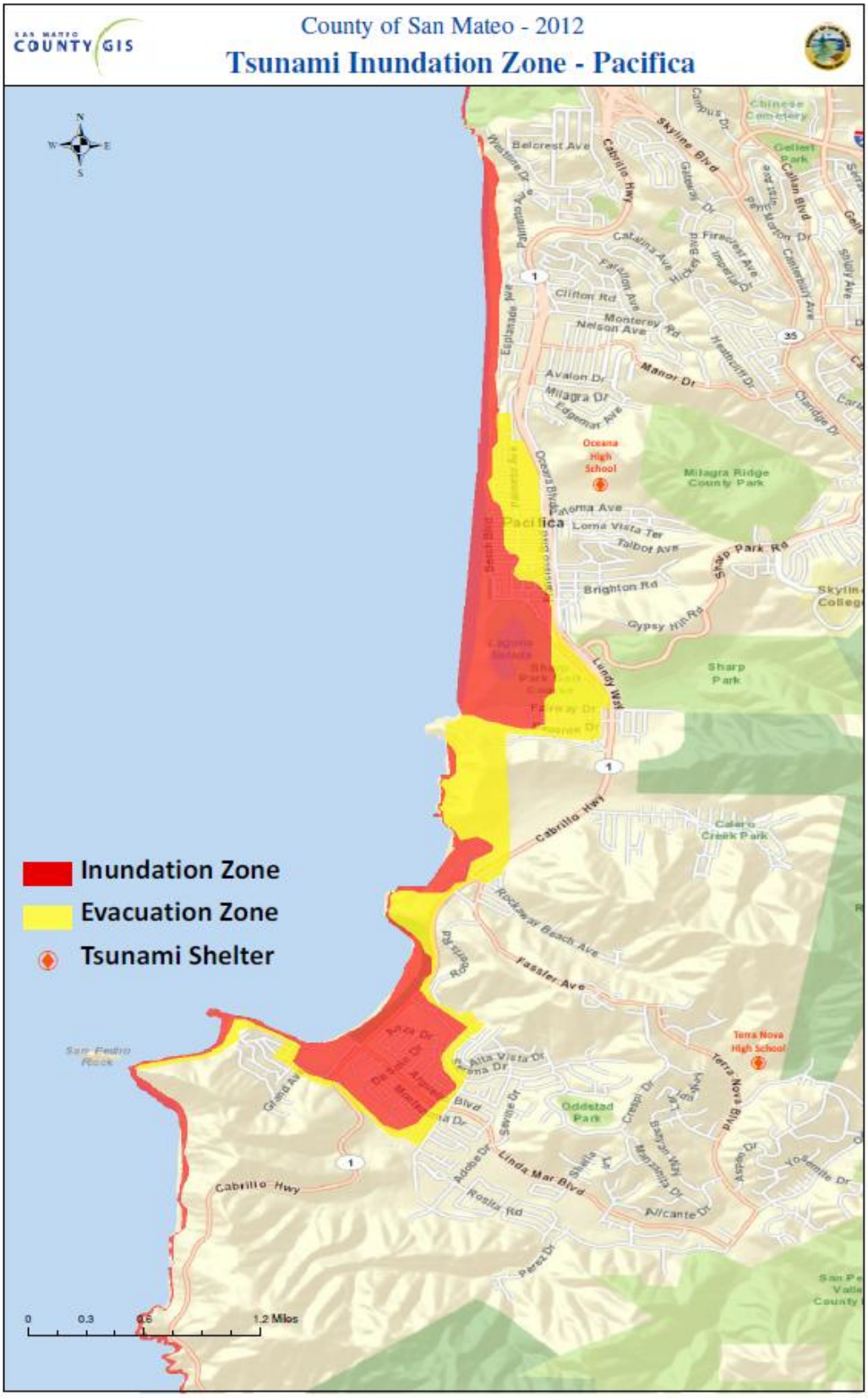


Source: Cal OES 2011

EXHIBIT-18:

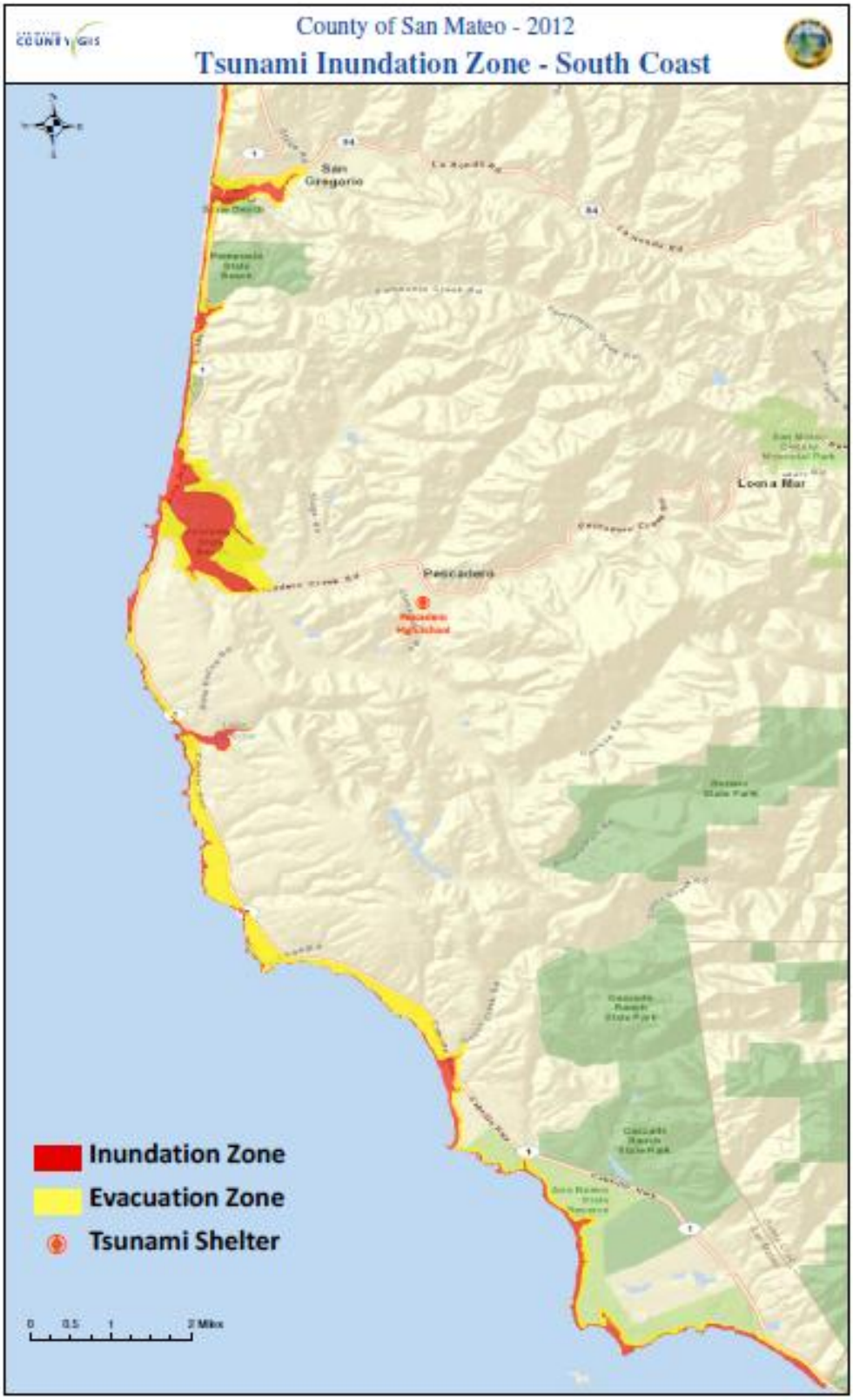
Source: San Mateo County 2012

EXHIBIT-19:



Source: San Mateo County 2012

EXHIBIT-20:



Source: San Mateo County 2012

HAZARD 12: WILDLAND URBAN INTERFACE FIRE

Definition

Moderate Probability
Moderate Impact

A wildland urban interface (WUI) is any area where structures and other human developments meet or intermingle with wildland vegetative fuels – the shrubs, trees and grasses. These plants and wildland areas have evolved over time to burn.[52] There are numerous locations within San Mateo County where structural developments meet and intermingle with the wildland areas. This condition gives rise to the possibility of WUI fires, especially when weather conditions are dry and fuels are abundant.

Types

WUI fires can occur naturally, ignited by heat from the sun, a lightning strike, or as a result of human carelessness. Heat waves, droughts, and cyclical climate changes such as El Niño can also have a dramatic effect on the risk of wildfires. More than 80% of wildfires are caused by people.

Secondary events such as erosion, landslides, and flash floods often occur in areas which have been affected by wildland fires.

Naturally Occurring Fires

Naturally occurring interface fires, especially those caused by heat or lightning are rare.

Man-made Fires

Man-made interface fires, stemming from people's carelessness and lack of fire knowledge, are common causes of interface fires. Major causes include arson, campfires, discarding lit cigarettes, improperly burning of debris, and children playing with fire.

Probability

Due to multiple variables including cause, weather, and location, there is no formal way to estimate the probability of a WUI within the scope of this document.

Location, Extent, and Vulnerability

San Mateo and Santa Cruz Counties are conducive to periodic large wildfire events due to local topography, fuels (forest, chaparral, grasslands) and certain weather conditions. Each year, state, local, and volunteer departments throughout the region respond to numerous wildfires. The vast majority of these wildfires are less than one acre. The reasons for this include early identification and reporting, large fire suppression responses (by both local and state agencies), generally unfavorable fuels and fire weather, and air support. Effective fire suppression over the past 100 years has led to uncharacteristically high fuel loads. When ignitions occur during unfavorable weather, in areas with poor access, fires can rapidly increase to an unmanageable size prior to fire crew's arrival.[53]

Exhibit 2-20 illustrates the location and extent of communities within San Mateo County with wildland fire threats. Communities located in the natural vegetation of the County's foothills and coastal mountains are in WUI and are inherently at risk from wildfires.

There has been increasing public pressure to preserve local natural features since the 1970s. This philosophy has influenced the management of parks, open space, and private land holding. Subdivision and home

developments on rural lands prone to fire hazards result in an ever-increasing land base that is often void of disturbance, whether by wildfire or resource harvesting. In many instances, the resulting landscape is overgrown with a variety of species in a variety of different age classes. The increased number of homes and proximity to flammable landscapes can be a potentially dangerous situation in the event of a fire.[54]

Exposure of existing land use to WUI is as follows:

- Of the 286,193 acres of land in San Mateo County, 70,882 acres (24.77%) are vulnerable to WUI.
- 55,980 acres (19.56%) of urban land are vulnerable to WUI.
- Of the 70,882 acres vulnerable to WUI in the County, 32,198 acres (45.42%) are residential land, 2,042 acres (2.88%) are mixed commercial-industrial complexes, 5,886 acres (8.30%) are forest land, 1,655 acres (2.33%) are agricultural land, and 6,590 acres (9.30%) are rangeland.[55]

Exposure of existing land use to wildfires is as follows:

- Of the 286,193 acres of land in San Mateo County, 101,042 acres (35.31%) are classified as having a high vulnerability to wildfires, and 51,197 acres (17.89%) are classified as very high vulnerability.
- Of the 101,042 acres of high vulnerability, 6,682 acres (6.61%) are residential land, 172 acres (0.17%) are mixed commercial-industrial complexes, 58,267 acres (57.67%) are forest land, 4,054 acres (4.1%) are agricultural land, and 27,326 acres (27.04%) are rangeland.
- Of the 51,197 acres of very high vulnerability, 4,531 acres (8.85%) are residential land, 159 acres (0.31%) are mixed commercial-industrial complexes, 18,843 acres (36.80%) are forest land, 2,926 acres (5.72%) are agricultural land, and 22,686 acres (44.31%) are rangeland.[56]

Past Occurrences

San Mateo County does not have a significant WUI fire history. In the late 1950s to the mid-1960s there were a number of relatively large fires. The largest fire was in 1962 and consumed over 3,000 acres. Since then, fires have been kept relatively small.

1962 – Two fires totaling 3,200 and 240 acres occurred near the southern county line.

1962 – A 1,300-acre fire occurred in the Skylonda area

1995 – A 20-acre wildfire occurred along Highway 35

2001 – A 54-acre wildfire occurred along Highway 35

2008 – A 100+ acre wildfire occurred on San Bruno Mountain

There have been reports of large wildland fires occurring prior to 1960; however, accurate locations have not been identified.

San Mateo County has not seen much significant fire activity since the early 1960s. The reasons for the lack of fire activity in the past 40 to 50 years may be attributed to a few reasons, including weather, changes in forest management, extended fire regimes, aggressive firefighting, and other reasons. Regardless the reason, the fact remains, wildfires will occur.[57]

Impact

The health and safety of persons in the affected area at the time of the fire could be deeply compromised. Burns, smoke inhalation, psychological trauma, and death are potential impacts on the population living, working, or visiting the impacted area.

The impacts to responding personnel include burns, trauma, smoke inhalation, psychological trauma and death. Injury and death can occur from equipment failure or not wearing the proper equipment. They can occur from falling snags, burnover, or even a bulldozer rolling over on steep terrain.

Within the geographic area covered by a WUI fire there could be damage to the facilities and infrastructure. The fires throughout the western states present year-to-year images of the destruction possible. San Mateo County can expect private property, public facilities, equipment, and infrastructure to have major damage or in some cases total loss from a WUI fire.

WUI fires can become hot enough to burn asphalt, which can render the roads impassable for more than just a few days. Utility poles and wires can be destroyed. Industrial, commercial and residential structures can be destroyed. Cars, trucks, busses, and equipment caught in the path of a fire can be a total loss.

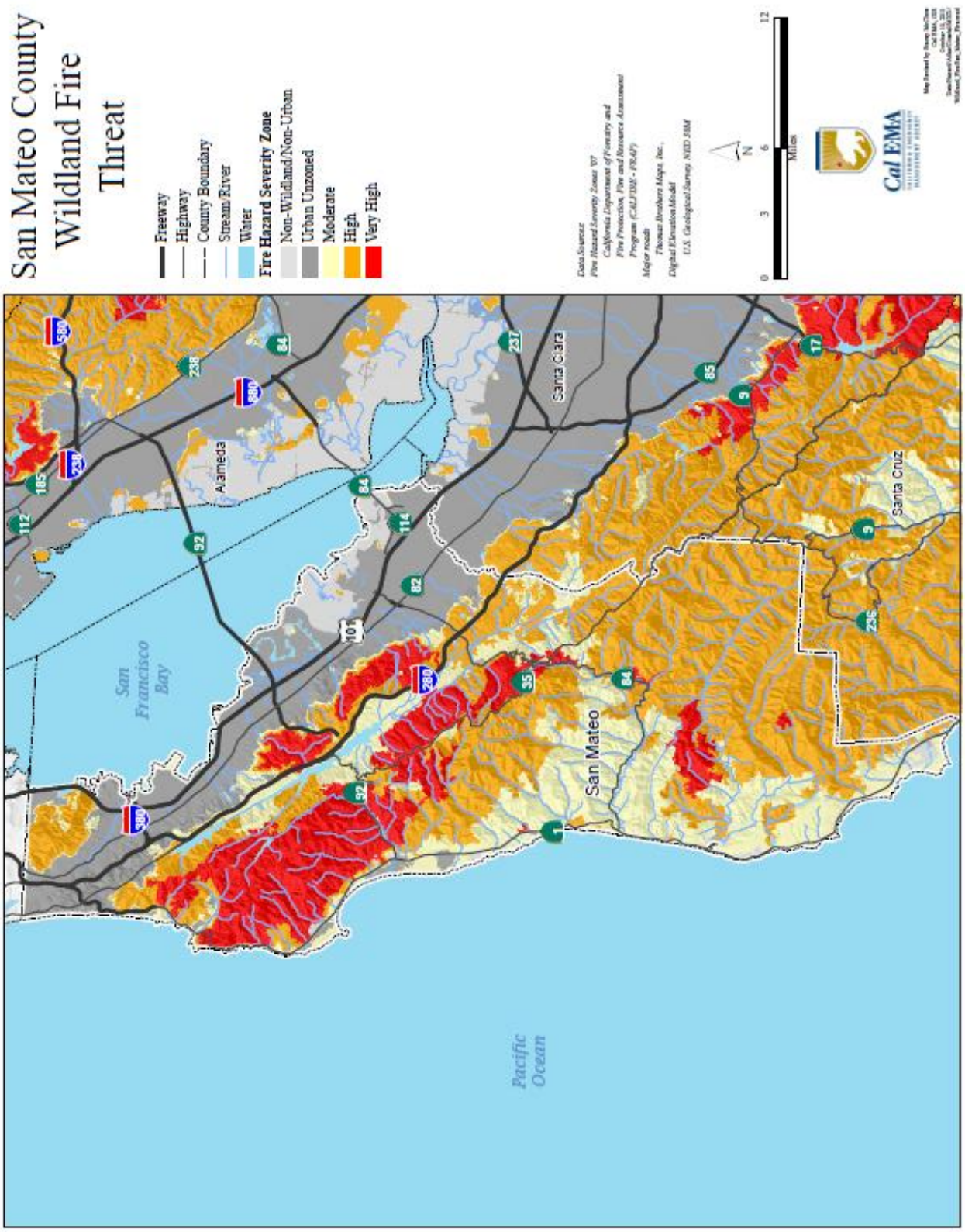
Environmental impacts from a major wildfire can be extreme, and may be exacerbated even further if the fire becomes a WUI.

Normal environmental damage includes deforestation, death of animals, pollution of streams and rivers from burnt material, increased erosion and later on, landslides. This damage may take decades to reverse. If the fire happens in an area of old-growth forest, which may have been in existence for hundreds of years, it could take centuries for the environment to regain its original form and biodiversity.

Not everything about fire damage is detrimental. The environmental effects and the destruction of the forest creates areas for colonization by new plants and animals. These burned areas allow sunlight to reach the ground. Plants that have not been able to survive or be established in heavily shaded understories common in old growth forests can thrive. As they do so, they will attract animals that thrive on them. Over time, the remnants of the original forest will encroach on the open area and it will once again return to forest.

With a fire that affects the interface between the forest and the developed areas of the County, there is the problem of further pollution including the burning of materials. The burning of construction materials, tires, the rupturing of oil, gas or other hazardous materials tanks, and the distribution of firefighting chemicals across the landscape are all hazards associated with WUI fires.

EXHIBIT-21:



Source: Cal OES 2011

ENDNOTES

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