

## CHAPTER 4 - RISK ASSESSMENT OVERVIEW

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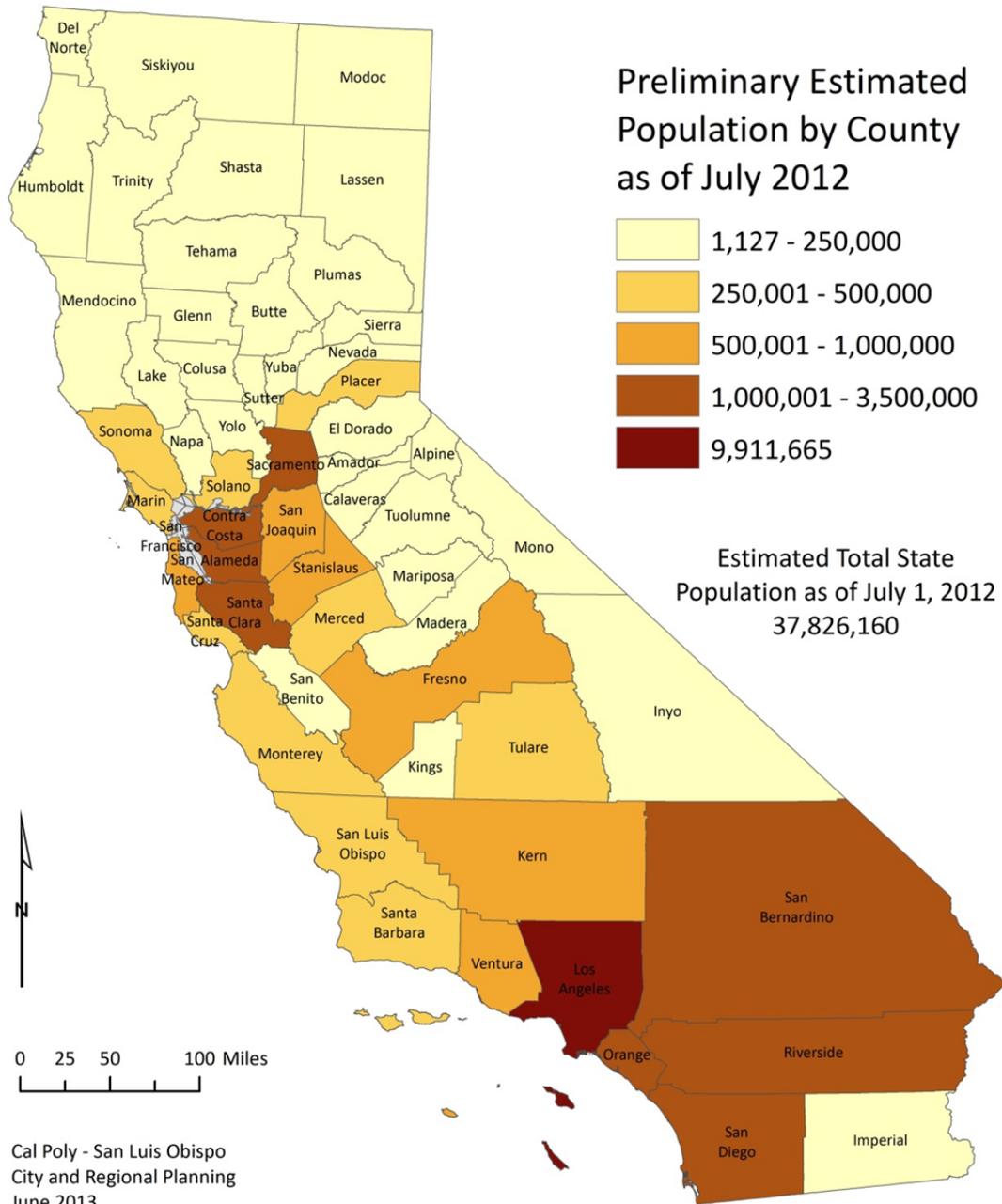
### **4.1 PROFILE OF ASSETS AT RISK**

California is an extraordinarily large, diverse, and complex state. With 12 percent of the U.S. population, it is culturally, ethnically, economically, ecologically, and politically diverse. Human, economic, and natural assets worthy of protection from natural and human-caused disasters include its people, economy, infrastructure, and environment. If it were a separate nation, it would have the eighth largest economy in the world. A catastrophic disaster could adversely affect the national and world economies. This confluence of demographic, economic, and environmental characteristics makes mitigating hazards in California both difficult and very important.

This chapter summarizes key elements conditioning the scale and complexity of the California’s mitigation challenge. For a more complete identification of California’s natural and anthropogenic hazards, see Chapters 5 and 6.

MAP 4.A: California Population by County

## California Population by County



Source: State of California, Department of Finance, E-2. California County Population Estimates and Components of Change by Year — July 1, 2010–2012

Created by: C. Scholdt (4.1--California Population by County.mxd)

Map 4.A shows population by county in five classifications. Counties with populations of one to 3.5 million inhabitants, shown in darker brown, are concentrated in the San Francisco Bay, Sacramento, and Southern California areas. Los Angeles County, shown in red, is in a class of its own with nearly 10 million people<sup>4</sup>.

<sup>4</sup> CA dept. of Finance July 1, 2012 <http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

## 4.1.1 POPULATION, ECONOMY AND INFRASTRUCTURE

### Population

California is the most populous state in the U.S., with a population of 37,826,160 as of July 1, 2012<sup>5</sup>. California leads the nation in population, employment, manufacturing, and agricultural output. Its 58 counties vary widely in land area, population, and growth.

Table 4.A identifies California’s top 10 counties in total population. Together, these counties represent 27,266,120 people, or 73 percent of the state’s population. Of this total, 20,440,233 people, or over half the state’s total population, live in the five southernmost counties (Los Angeles, San Diego, Orange, Riverside, and San Bernardino)<sup>6</sup>. Within these counties the 2009 to 2012 trends are for population increases in the inland counties and decreases in the coastal counties.

**Table 4.A: Top Ten Counties in Total Population, July 2012**

County	Total Population	2012 Rank	Population Change from 2009
Los Angeles	9,911,665	1	Decrease
San Diego	3,147,220	2	Decrease
Orange	3,071,933	3	Decrease
Riverside	2,244,399	4	Increase
San Bernardino	2,065,016	5	Increase
Santa Clara	1,828,597	6	Decrease
Alameda	1,540,790	7	Decrease
Sacramento	1,439,874	8	Decrease
Contra Costa	1,069,803	9	Decrease
Fresno	946,823	10	Decrease
Total Top 10	27,266,120		Decrease

*Increase in total population from 2009 to 2012*

Source: California Department of Finance, Report E-2:

<http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

### Diversity, Mobility, and Age

California’s current population is among the most diverse in the nation. Demographic characteristics tell an important story about the importance of mitigation to a state. California is one of four states (also including New Mexico, Texas, and Hawaii) where no single ethnic group represents a majority of the population. The historical influx of immigrants provides challenges for public outreach on disaster mitigation due to diversity of languages and cultures. Other demographic factors related to mitigation planning in California are the high mobility of the population<sup>7</sup>, age characteristics<sup>8</sup>, large Native-American populations, and people living with disabilities.

California’s population is continuing to become more diverse. The 2010 Census reported the racial and ethnic composition of California as 40 percent White not Hispanic, 38 percent Hispanic, 13 percent Asian, 6 percent Black, 1 percent American Indian, and 17 percent Other. According to the California Department of Finance, by 2013, the proportion of White not Hispanic and Hispanic will be equal, with the Hispanic population becoming the plurality in 2014. Continued population diversification presents a challenge for outreach and implementation regarding the state’s mitigation strategies. Hispanic and Asian populations, for example, include first-generation immigrants from many countries with heterogeneous cultures,

<sup>5</sup> Source: CA Department of Finance: <http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

<sup>6</sup> : <http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

<sup>7</sup> The average homeowner moves every seven years, and renters move more often, making educational outreach for mitigation difficult.

<sup>8</sup> The population of California is, on average, slightly younger than the rest of the nation.

languages, and disaster histories. Governments at all levels find it necessary to address related challenges, such as language, communications, trust of government, adherence to regulations, and extent of participation in mitigation-related community stakeholders groups.

In addition to being diverse, California's population is mobile. Statistics from the California Department of Real Estate indicate that the average homeowner in California relocates every seven years. Renters move much more frequently. The mobility of the population poses a challenge to continuously educating residents about the hazards and risks associated with their communities.

California faces an aging workforce, like the rest of the nation, together with loss of skilled workers due to retirement. In 2010, the California Department of Finance accounted for a total population of 4,271,542 over 65 years of age. In 2020, this age demographic is projected to increase to 6,052,716. This represents a substantially aging population who are more vulnerable to disasters. Residents over age 65 provide a challenge to mitigation by adding to the total number of persons in age groups more vulnerable and/or less able to respond to disasters. California also has a substantial population of 75+ year olds. In 2010, more than 1.5 million people 75 years and older lived in the 16 counties with 50,000 people or more. According to the California Department of Finance, in 2010 approximately 7 percent of the state was comprised of children younger than five years old. This proportion is expected to remain constant through 2020.

### **Native Americans**

California is home to more Native Americans than any other state in the country. Of the 561 federally recognized tribal governments in the United States, 109 have land or offices in California.

The 2010 U.S. Census reported 362,801 Native Americans in California, or approximately 1 percent of the state's population. Native Americans reside in all counties, with the smallest number of 44 and highest number of 72,828 in a single county. The top five counties for Native American population in order of magnitude were Los Angeles (72,828), San Diego (26,340), San Bernardino (22,689), Orange (18,132), and Riverside (23,710).

According to a 2011 California Disability Status Report by Cornell University, 18% of Native American between the ages of 21 to 64 reported having some type of disability.

The California Government Code (Sections 65352.3-65352.4) requires local governments to conduct meaningful consultation with California Native American tribes prior to adoption or amendment by a city or county government of its general plan. The purpose of the consultation is to protect cultural places on lands affected by the proposed general plan. For more information, see the California Native American Heritage Commission website at: [www.nahc.ca.gov/sp.html](http://www.nahc.ca.gov/sp.html)

### **People with Disabilities**

According to the Census Bureau's American Community Survey (ACS) for 2011, an estimated 3,749,792 people in California, or 10.1 percent of the non-institutional population, have some form of disability. One source ([www.disabilityplanningdata.com](http://www.disabilityplanningdata.com)), using ACS data, finds that 3,145,800 households, or 25.6 percent of all households in California, have at least one person with a disability. Table 4.B lists counties that have 100,000 or more households with members with a disability. Among these counties, the percentage of households with disabilities ranges from a low of 19.7 percent of total households (in Santa Clara County) to a high of 29.2 percent of total households (in Sacramento County).

**Table 4.B: California Counties with 100,000+ Disability Households, 2010**

County	Total Households in County	Households with Members with a Disability	% Households with Members with a Disability
Los Angeles	3,241,204	800,577	24.7%
San Diego	1,086,865	251,066	23.1%
Orange	992,781	201,535	20.3%
Riverside	686,260	182,545	26.6%
San Bernardino	611,618	174,923	28.6%
Sacramento	513,945	150,072	29.2%
Santa Clara	604,204	119,028	19.7%
<b>Total</b>	<b>7,736,877</b>	<b>1,880,061</b>	<b>24.3%</b>

Source: 2010 U.S. Census Profile of General Housing Characteristics Census Summary File 1

[http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC\\_10\\_SF1\\_SF1DP1&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_SF1DP1&prodType=table)

Local Disability Data for Planners: [http://www.disabilityplanningdata.com/site/state\\_household\\_table.php?state=california](http://www.disabilityplanningdata.com/site/state_household_table.php?state=california)

Additionally, an estimated 5.1 percent of the non-institutional population age 16 and over, have an “independent living difficulty,” and approximately 28 percent, of persons with a disability, live alone. Disabilities among the oldest and youngest age groups present special challenges for hazard mitigation as such persons are more vulnerable and/or less able to respond to disasters. One in four people between the ages of 65-74 will suffer some form of disability, increasing to 1 out of 2 for people 75 years and older.

A study published by the State Independent Living Council (SILC), “The Impact of Wildfires on People with Disabilities,” noted that people with disabilities were especially hard hit by the Southern California fires of 2003. It pointed out that since many people with disabilities need assistance with evacuation or may be unable to see approaching danger or hear announcements to evacuate, they are especially vulnerable to wildfires and other natural disasters. The report identified the following areas that are most challenging for the disabled community: preparation, notification, evacuation, sheltering and interim services, and recovery. For more information about SILC, see: [www.calsilc.org/](http://www.calsilc.org/)

Communities in states throughout the country, including California, wrestle with complex issues of how to effectively transport people with access and functional needs during critical incidents. To assist with this effort and to improve the ability for people with disabilities to maintain independence, health, and safety during disasters, Cal OES created the Office for Access and Functional Needs (OAFN). The purpose of OAFN is to identify the needs of people with disabilities before, during, and after a disaster and to integrate disability needs and resources into all aspects of emergency management systems. OAFN has released planning guidance and other relevant information to assist with this issue. For more information about OAFN, look for its link at the Cal OES web page: [www.caloes.ca.gov](http://www.caloes.ca.gov)

In addition to the creation of the Cal OES’s OAFN, the California Department of Social Services (CDSS) also initiated a planning effort by putting together a stakeholder group that included local, state, and federal government organizations, as well as various community based organizations (CBO) and private nonprofit (PNP) organizations to determine how people with disabilities and others with access and functional needs could be better supported in general population shelters.

The result of the stakeholder group process was the creation of the Functional Assessment Service Team (FAST) program. The purpose of the FAST program is to provide trained staff in general population shelters to conduct functional assessments of shelter residents. The assessments will evaluate the immediate needs that people with disabilities and others with access and functional needs may have when evacuated to emergency/disaster shelters. Once the needs have been assessed, the FAST member will initiate the appropriate resource request for the shelter resident. FAST members will be deployed to shelters when the resource is requested by the shelter manager and the members will remain in the shelters until it is determined that they are no longer needed. The CDSS administers the FAST program and works with

counties and cities to develop their FAST programs and incorporate the program into their local mass care and shelter plans. The CDSS also collaborates with the counties to bring the FAST program training to their communities.

For more information about the FAST program visit the following link on the CDSS website: <http://www.cdss.ca.gov/dis/PG1909.htm>

### **Estimated Animal Population**

There are approximately 19 million domestic animals in California, and countless millions of wild animals beyond that. About 50 percent of the homes in California have at least one dog or cat.

- There are nearly 7 million dogs in California.
- There are over 8 million cats in California.
- There are approximately 500,000 horses in California.
- California is the largest milk producing state in the nation – with more than 1.8 million dairy cows.
- California has about 800,000 sheep and goats.
- Food production --- more than 250 million broiler chickens, 280 million laying hens, and 620,000 beef cattle.

For more information on pet planning and preparedness, please visit: <http://www.calema.ca.gov/PlanningandPreparedness/Pages/Pet-Preparedness.aspx>

### **Economy**

As a result of its large population, productive industry, and large agricultural sector, California has the largest economy of any state in the nation. As noted earlier, if California were a separate nation, it would have, in 2012, the twelfth largest economy in the world. California's economy represents 13 percent of the U.S. gross domestic product. It is a highly diversified economy with jobs and businesses in many different industries.

As of September 2009, California had the largest labor market in the U.S. with 14.2 million non-farm jobs and 16 million total employed persons.<sup>9</sup> California's largest industries include trade, transportation, and utilities (2.7 million jobs); government (2.5 million jobs); and professional and business services (2.1 million jobs). California is strong in the manufacturing of electronic equipment, computers and related chips and software, machinery, transportation equipment, and metal products. The state is the nation's largest producer of agricultural products. It continues to be a major center for motion picture, television, film, and related entertainment industries. Tourism is another important source of income. Yet despite such economic strength, California has been hit hard by the recent economic recession. With an unemployment rate of 9.0 percent as of April 2013<sup>10</sup>, the number of people vulnerable to disasters due to economic distress remains high.

### **Infrastructure**

California has an extensive infrastructure system. Within California there are 7,000 miles of railroad track, 50,000 lane miles of state highways, 246 public-use airports/heliports, and 11 seaports to maintain and protect. California has the largest public education system in the world, including 23 campuses of the California State University (CSU) system, 10 campuses of the University of California (UC) system, and 109 community colleges within 72 districts, in addition to K-12 public and private schools. The State of California owns more than 20,000 buildings and leases space at more than 2,000 sites.

<sup>9</sup> [www.bls.gov/eag/eag.ca.htm](http://www.bls.gov/eag/eag.ca.htm)

<sup>10</sup> [www.bls.gov/eag/eag.ca.htm](http://www.bls.gov/eag/eag.ca.htm)

Critical infrastructure is essential to the state’s ability to provide assistance to its people for their everyday lives. Critical infrastructure such as transportation routes, utilities, government facilities, schools, and hospitals also provides the state with the capacity to respond to disasters. California’s resiliency (the ability to withstand, respond to, and recover from a disaster) strongly depends on its capacity to quickly restore the functioning of critical infrastructure and facilities after disasters. See Annex 3 Lifelines Infrastructure and Hazard Mitigation Planning.

## **4.1.2 NATURAL ENVIRONMENT**

### **Geography**

California has the third largest land area among the nation’s 50 states, with roughly 163,695 square miles. Its location and physical configuration make it vulnerable to many different hazards. For example, the state has over 1,100 miles of coastline, home to several major coastal cities – including San Francisco, Los Angeles, and San Diego – that are prone to flooding, tsunamis, and rising sea levels. Associated with much of the coastline are the northern and central coastal ranges which accommodate substantial terrain.

A key inland feature is the Central Valley, a huge, fertile valley bounded by the coastal mountain ranges to the west, the Sierra Nevada to the east, the Cascade Range to the north, and the Tehachapi Mountains to the south. Mountain-fed rivers irrigate the Central Valley. With dredging, a number of these rivers have become sufficiently large and deep that several inland cities, most notably Stockton, are harbor communities that can dock ocean-going vessels.

The Sierra Nevada range runs much of the length of California’s eastern border. Located in the Sierra Nevada are Mount Whitney, the highest peak in the continental U.S. at 14,495 feet, Yosemite National Park, and Lake Tahoe. To the east of the Sierra are the Owens Valley and Mono Lake, which are environmentally significant as habitat essential to birds. The south portion of the state has the Transverse Ranges, one of the few east-west trending ranges in the country; the Mojave Desert; and Death Valley, which contains the lowest point in North America (282 feet below sea level) and has the hottest recorded temperature in the U.S. (134 degrees).

### **Geology and Seismicity**

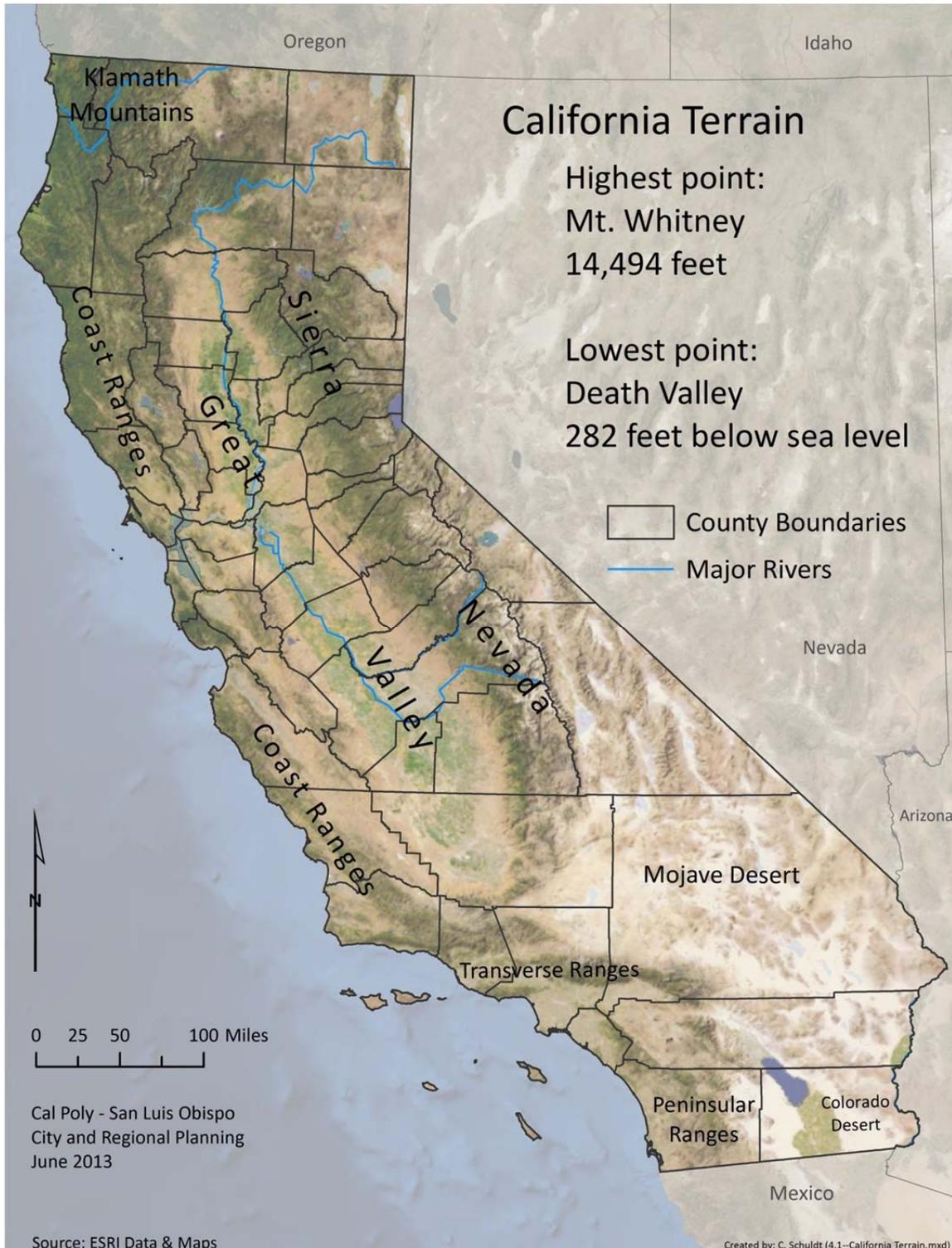
California has extensive seismic activity. It is more seismically active than all other states except Alaska, but California has more earthquake risk than all other states combined - seventy four percent of the country’s overall expected annualized losses (FEMA 366, 2000). It sits on the juncture of two major tectonic plates, the North America Plate and the Pacific Plate. The San Andreas Fault generally parallels the coast in a southeasterly direction, coming ashore near Eureka, passing west of San Francisco and east of Los Angeles into Mexico. Earthquakes have claimed the lives of more than 3,000 Californians in the past two centuries.

### **Watersheds and Terrain**

The Sacramento and San Joaquin rivers and their tributaries, which drain the Central Valley, form California’s principal river systems. The Sacramento, the longest river in the state, flows south for 377 miles to its junction with the San Joaquin. The Sacramento and San Joaquin rivers unite to form a large inland delta that drains into Suisun Bay, the eastern arm of San Francisco Bay. Development vulnerable to flooding continues to occur in floodplains associated with this extensive network of rivers.

Map 4.B identifies California’s major terrain features, including the Sierra Nevada and coastal ranges, the Central Valley, deserts, major rivers, and water bodies.

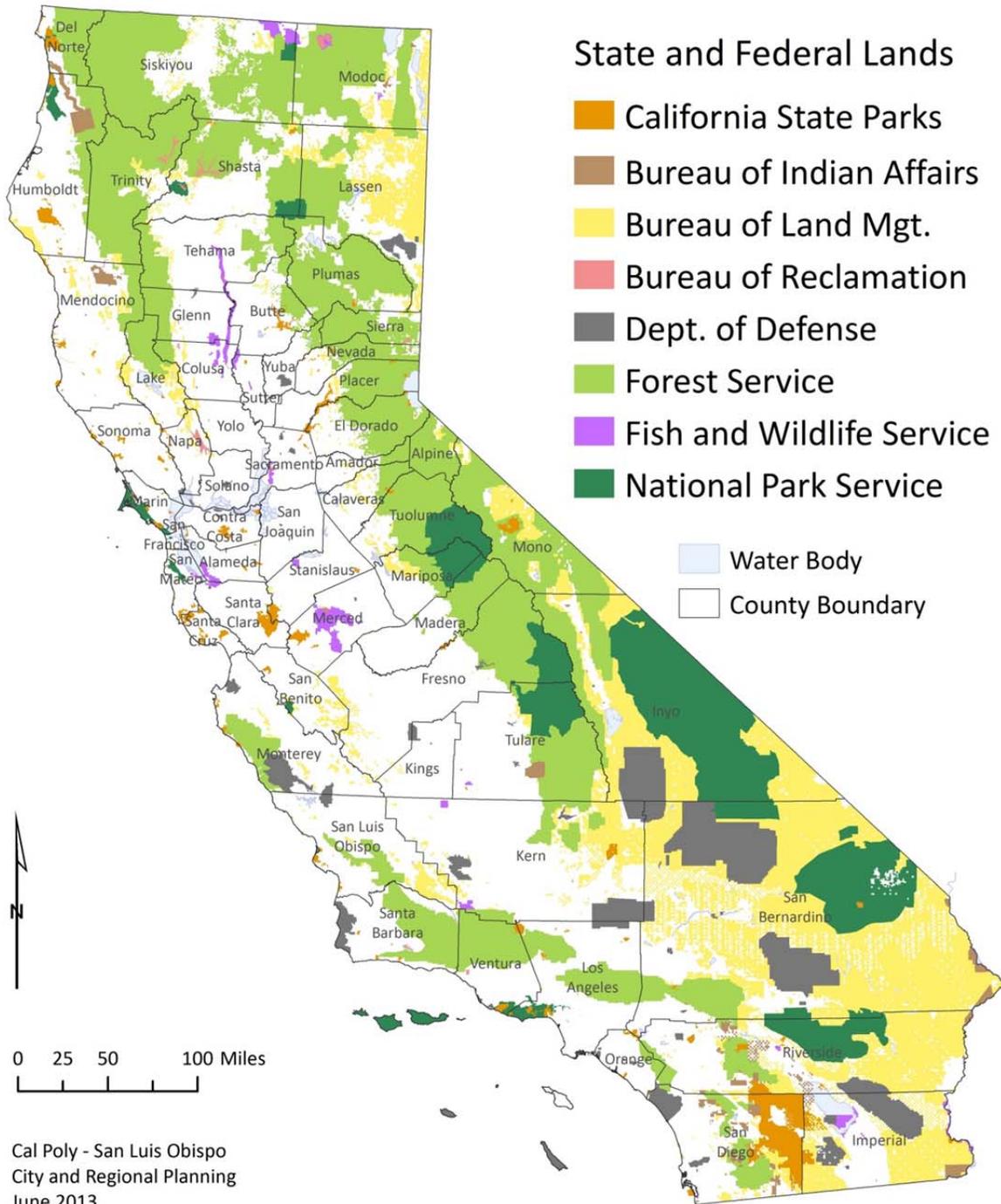
MAP 4.B: California Terrain



Map 4.B shows the general topography of California. This includes 1,100 miles of coastline. The Central Valley, labeled as "Great Valley" is a major topographic feature which collects major river run off from the Sierra Nevada Range and channels it though the Delta to the San Francisco Bay and out to the ocean.

MAP 4.C: Public Lands

## Public Lands



Source: U.S. National Atlas-USGS, 2008; ESRI; California State Parks, 2010

Created by: C. Schuldt (4.1--Public Lands.mxd)

Map 4.C shows a clear correlation between mountainous regions and public land holdings. (Online or download viewers can zoom in for a closer view of the information on this map.)

## Public Lands

Map 4.C shows California’s major public land areas. The largest category is U.S. Forest Service land, which covers 20.6 million acres. Other major public holdings include those of the Bureau of Land Management and National Park Service. Forest and range lands in and near these public holdings are subject to wildfire risk which is increasing due to climate change.

## Ecosystems

According to the California Climate Adaptation Strategy, California is one of the most biologically diverse regions of the world, with the most unique plant and animal species and greatest number of endangered species among all 50 states. Its wide biodiversity stems from its varied climate and assorted landscapes. Ecological communities include coastal ranges, coastal dunes, wetlands, rivers, lakes, streams, deserts, grasslands, chaparral, and inland, forested mountains among others. The vast number of endemic species here, combined with high level of threats to their persistence, makes California one of 25 biodiversity “hotspots” on earth.<sup>11</sup>

### 4.1.3 GROWTH PATTERNS AND TRENDS

#### Recent and Projected Growth Trends

From 2009 to 2012, California’s population grew by about 748,796 people, or 2 percent.<sup>12</sup> Table 4.C shows the top 10 counties in population growth from 2000 to 2012. Highest growth took place in the five most heavily populated Southern California counties. Growth in the top 10 counties totaled 2,755,075 people, or 75 percent of California’s total growth. By 2050, the population is expected to reach 50,365,074, roughly 12.5 million more people than presently reside in California.<sup>13</sup> Such an increase would be more than four times the amount of growth experienced in the past twelve years.

**Table 4.C: Top Ten Counties in Population Growth, 2000-2012**

County	Population Change, 2000 to 2012	2000-2012 Rank	2000-2009 Rank
Riverside	687,128	1	2
Los Angeles	367,682	2	1
San Bernardino	345,826	3	4
San Diego	318,846	4	3
Orange	218,040	5	5
Sacramento	209,373	6	6
Kern	191,149	7	8
Fresno	144,599	8	9
Santa Clara	141,182	9	7
San Joaquin	131,250	10	10
Total Top 10	2,755,075		

Source: California Department of Finance, Report E-2:  
<http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

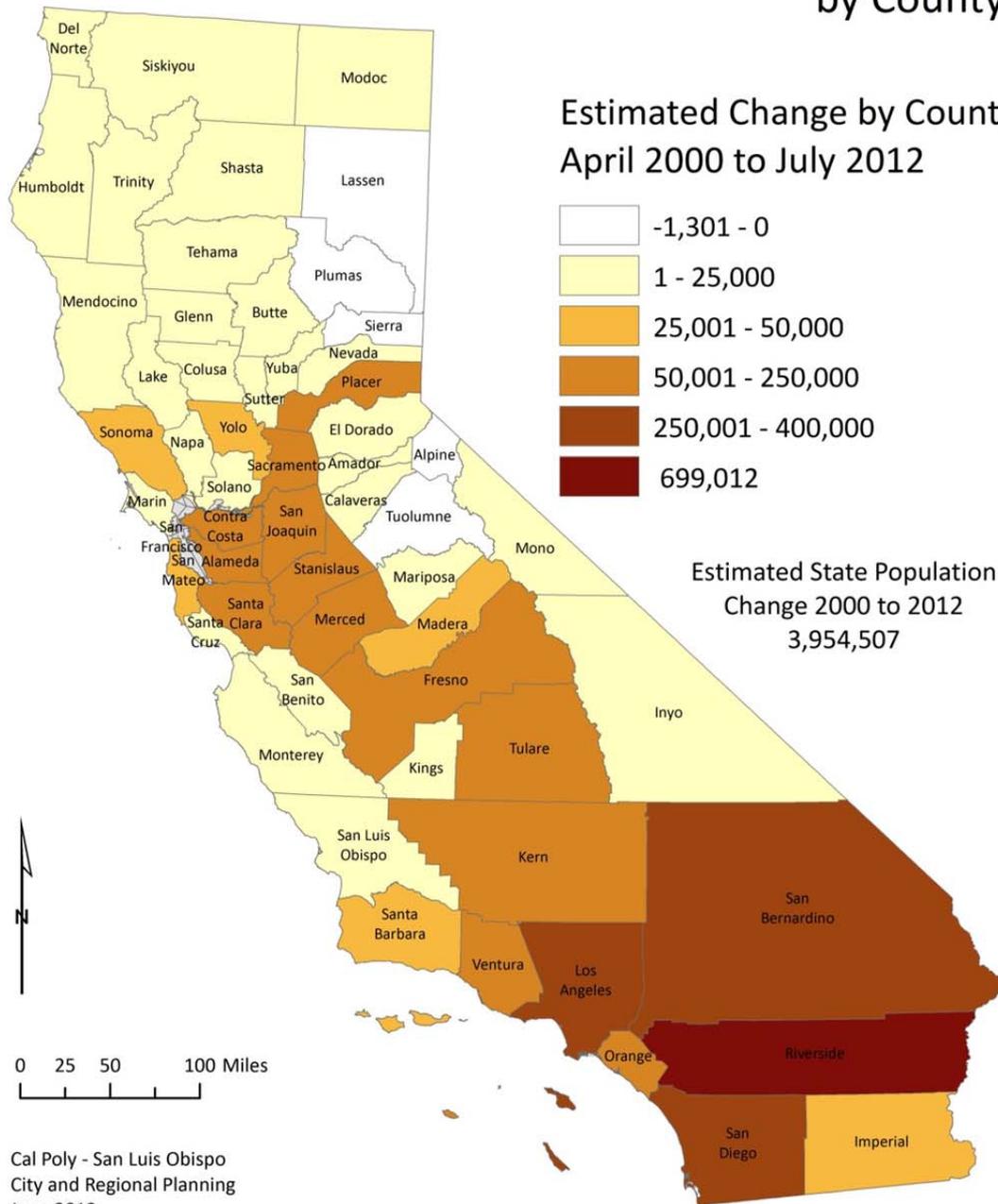
<sup>11</sup> Stein, Bruce A., Lynn S. Kutner, and Jonathan S. Adams (eds., 2000). Precious Heritage: The Status of Biodiversity in the United States. Oxford, UK: Oxford University Press

<sup>12</sup> <http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php>

<sup>13</sup> [www.dof.ca.gov/research/demographic/reports/estimates/e-2/2000-09/](http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/2000-09/)

MAP 4.D: California Population Change by County

## California Population Change by County



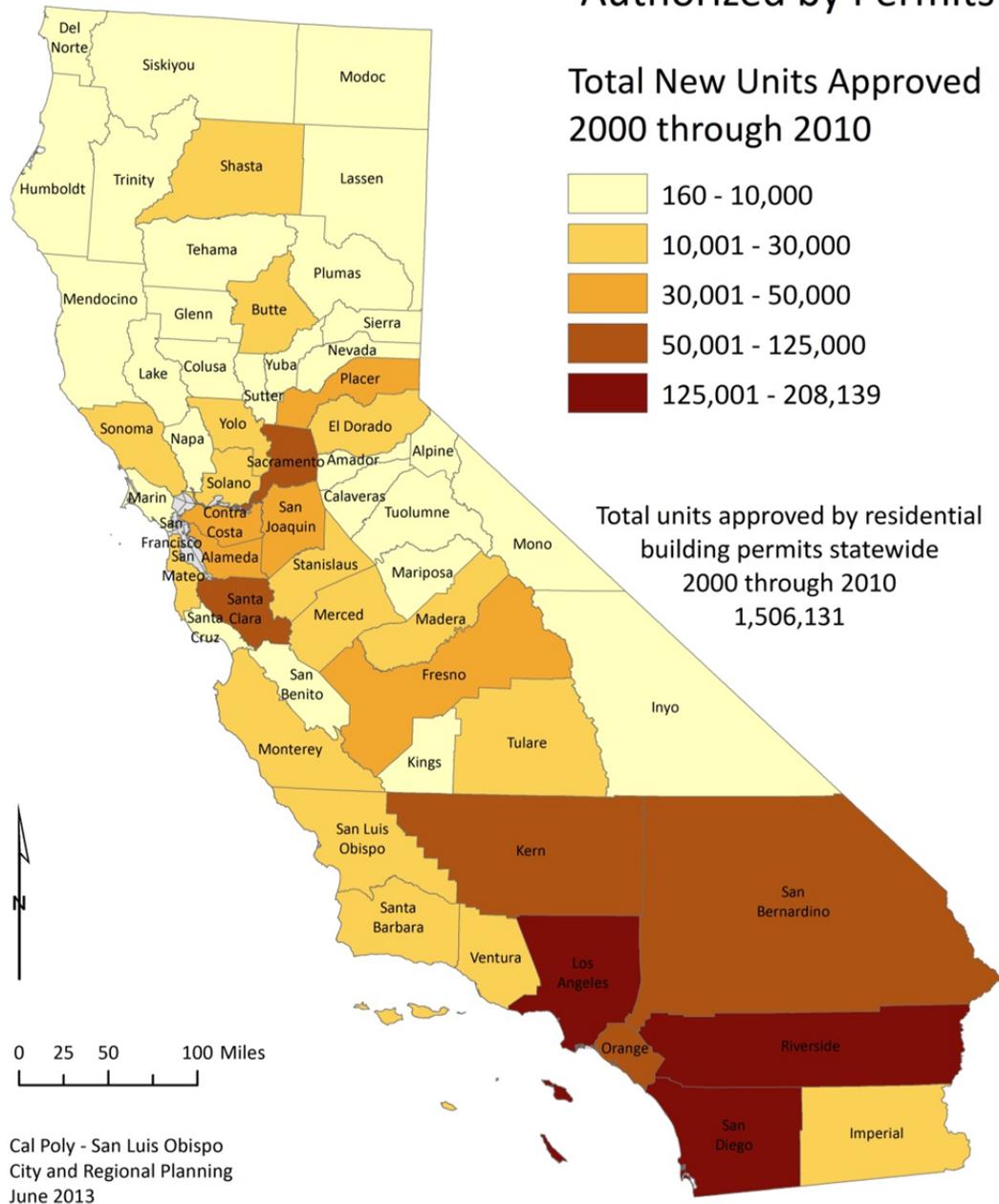
Source: State of California, Department of Finance, *E-2. California County Population Estimates and Components of Change by Year — July 1, 2010–2012, (December 2012)* and *Historical Census Populations of California, Counties, and Incorporated Cities, 1850-2010 (Rev. June 4, 2012)*

Created by: C. Schuidt (4.1–California Population Change by County.mxd)

Map 4.D shows that population growth from 2000 to 2012 has been concentrated largely in Southern California, Central Valley, San Francisco Bay, and Sacramento area counties.

MAP 4.E: California Residential Units Authorized by Permits

## California Residential Units Authorized by Permits



Source: State of California, Department of Finance, *California Statistical Abstract/ Table 1-6*, Rel. Jan. 2009, Revised/Provisional  
[Data provided by Construction Industry Research Board and Dept of Finance, Economic Research Unit]

Created by: C. Schuldt (4.1-Residential Units Authorized by Permits.mxd)

Map 4.E shows the ranges in additional dwelling units authorized by building permits. Most of the approved new units are in Southern California and the Sacramento area. Building codes and other state and local mitigation efforts help to minimize losses from future disasters. However, with climate change, increased severity of storms and prolonged droughts will increase vulnerability to flooding and wildfires.

## Implications of Growth

Growth patterns have a direct bearing on the impacts of hazards, risk, and vulnerability. It will be seen in Chapter 5 that rapid growth in Southern California counties, including Los Angeles, Orange, Riverside, and San Bernardino, has intensified high earthquake hazard exposure of large, vulnerable populations. The San Francisco Bay region constitutes 10 counties, roughly 20% of California’s Population, making this region’s earthquake and hazard vulnerability high. Also noted in Chapter 5 is exposure to high flood hazards in Central Valley counties and high wildfire hazards in the foothill and mountainous counties. Inland counties are replacing coastal counties as the leading growth areas.

## 4.2 CALIFORNIA’S DISASTER HISTORY

Federal regulations require each state to undertake a risk assessment of the hazards and vulnerabilities that affect it in order to provide a factual basis for developing a hazard mitigation strategy.

The following analysis of California’s disaster history provides a foundation for the risk assessment found in Chapters 5 and 6. Together those chapters identify emerging hazard, vulnerability, and risk issues, linking them to mitigation strategies and actions.

### 4.2.1 STATEWIDE DISASTER LOSS FINDINGS

Over the past six decades, disasters and corresponding losses have grown rapidly as has California’s population. Table 4.D shows overall increases in state emergency proclamations and federal disaster declarations from 1950 through 2012. The table also shows casualties and Cal EMA-administered disaster costs by decade, peaking in the 1990s due to the 1994 Northridge Earthquake. Figures for deaths and injuries are partial for the periods 2000-2009 and 2010-2012, and based on best available data.

**Table 4.D: Disasters and Losses by Time Phase, 1950 - 2012**

Year	State Emergency Proclamations <sup>a</sup>	Federal Disaster Declarations <sup>a</sup>	Deaths <sup>b</sup>	Injuries <sup>b</sup>	Cal OES-Administered Costs <sup>b, c</sup>
1950 – 1959	8	3	100	227	\$332,283,000
1960 – 1969	32	12	99	1,224	\$706,931,196
1970 – 1979	63	18	246	2,226	\$4,197,670,330
1980 – 1989	61	23	210	5,245	\$3,342,205,537
1990 – 1999	50	19	224	15,592	\$9,277,786,648
2000 – 2009	69	102	59	885	\$1,846,305,419
2010-2012	14	17	4	27	\$244,255,232
<b>Total</b>	<b>297</b>	<b>192</b>	<b>942</b>	<b>25,426</b>	<b>\$19,947,437,362</b>

Source: Cal OES database

<sup>a</sup> Through 2012.

<sup>b</sup> Information from 2000-2012 remains preliminary based on Incident Command System (ICS) Reporting and Cal EMA After Action Reviews

<sup>c</sup> Figures in this column show only certain post-disaster recovery costs, such as Individual and Public Assistance grants, which together reflect only a portion of total disaster costs. Disaster costs reflect actual estimates at the time of incidents not adjusted for inflation through normal means such as applying the Consumer Price Index to get equivalent values.

As discussed in Chapter 2, California’s leading mitigation goal is to significantly reduce life loss and injuries. Table 4.E (on the following page) provides an overall perspective on life loss and injury in relation to population growth for the period from 1950 to 2012. California’s population more than tripled from 1950 to 2012, while numbers of deaths remained within a relatively narrow range. Injuries have varied more widely. Over 11,000 injuries during the 1990s were due to the Northridge Earthquake.

MAP 4.F: State and Federal Declared Disasters, 1950-December 2012

State and Federal  
 Declared Disasters  
 1950 - December 2009



Source: Cal-OES

Created by:  
 K. Higgs

Map 4.F shows the pattern of California disasters since 1950. The largest numbers have occurred in Southern California in the state's most heavily populated counties.

**Table 4.E: Population and Disaster Deaths and Injuries by Time Phase, 1950 – 2012**

Year	State Population Beginning of Decade	Deaths	Injuries
1950 – 1959	10,586,000	100	227
1960 – 1969	15,717,000	99	1,224
1970 – 1979	19,953,000	246	2,226
1980 – 1989	23,668,000	210	5,245
1990 – 1999	29,760,000	224	15,592
2000 – 2009	33,872,000	59	885
2010 – 2012	37,253,956	4	27

Source: Cal OES database. At the time of this writing, "Death," and "Injuries," for information from 2000-2012 remains preliminary based on Incident Command System (ICS) Reporting and After Action Reviews; population from Counting California, UC Libraries

**Table 4.F: Disaster Incidents, Casualties, and Cost by Type, 1950 - 2012**

Disaster Type	Emergencies Through 2012	State Emergency Proclamations Though 2012	Federal Disaster Declarations Though 2012	Deaths Through 2012*	Injuries Through 2012*	Cal OES-Administered Costs Though 2012*
Fire	178	75	122	129	2,139	\$2,735,466,734
Flood	129	116	47	294	759	\$4,548,964,020
Earthquake	23	21	13	193	18,962	\$8,110,772,990
Agricultural	18	17	0	0	0	\$389,895,974
Freeze	9	8	4	0	0	\$1,017,890,620
Landslide	9	8	1	24	0	\$126,172,037
Economic	6	6	1	0	0	\$32,823,425
Civil Unrest	6	6	1	85	3,331	\$167,722,732
Drought	8	8	0	0	0	\$2,686,858,480
Hazardous Material	5	3	0	0	0	0
Wind	3	3	0	0	0	\$82,100
Air Disaster	2	2	0	232	2	0
Facility	2	2	0	0	0	\$654,897
Road Damage	3	3	0	0	0	\$462,986
Tsunami	3	3	2	13	1	\$49,617,379
Invasive Species	1	1	0	0	0	0
Storms	6	6	1	0	0	\$69,392,668
Tornado	1	1	0	0	0	0
Other	5	5	0	0	0	\$10,660,320
<b>Total</b>	<b>417</b>	<b>294</b>	<b>192</b>	<b>970</b>	<b>25,194</b>	<b>\$19,947,437,362</b>

Source: Cal OES database

\*\* Death and Injury estimates from 2003-2012 based on Incident Command System Reports and After Action Reviews. Administered Costs include obligated, but unspent expenditures in the case the incident remains open for Individual and Public Assistance grants.

Table 4.F identifies disaster incidents, casualties, and Cal OES costs by type. Cal OES has revised the database from which these summary tables were drawn during the preparation of the 2013 SHMP in an effort to continuously improve disaster history data. At the time of this writing, "Death," and "Injuries"

information from 2000-2012 remains preliminary based on Incident Command System (ICS) Reporting and After Action Reviews. These figures will be updated when data are available.

### **Need for Mitigation Focus on Potential Catastrophic Events**

Acknowledging that much of the state's population growth in the past 59 years has been in counties with high hazard exposure, these figures can be viewed as positive. Ongoing mitigation investments have helped limit what might otherwise have been higher loss totals for more common, small and moderate-sized disasters. It is important to recognize, however, that during this period there have been no catastrophic events like the 1906 San Francisco Earthquake. Catastrophic events are expected on longer time cycles than the many more "routine" disasters reported above. Thus, a major focus of mitigation efforts should be on the question of how to reduce losses from future catastrophic events.

For a detailed account of the data in the preceding tables, see Appendix M.

### **Need for Accurate Disaster Loss Data**

The preceding disaster emergency and loss data reflect a partial update of the Cal OES database since 2007. As noted previously, Cal OES is still in the process of completing the disaster loss data update from 2007 through 2009. However, it is important to recognize that its monetary loss data are limited to costs of federal grant programs administered by Cal OES, such as Individual and Household Assistance, Public Assistance, and Flood Mitigation Assistance grants, and thus are inadequate to reflect the true magnitude of losses experienced in these events.

To counteract this somewhat, the 2010 SHMP also uses disaster loss data from other sources, including the Spatial Hazard Events and Losses Database for the United States (SHELDUS)<sup>14</sup> and the Public Entity Risk Institute's (PERI) Presidential Disaster Declaration Site.<sup>15</sup> Because no single source provides all needed data, data from such databases need to be used carefully. Disaster loss databases vary widely in how data are compiled, how loss topics are defined, how data are updated, and what is included. For example, while SHELDUS is used because it tracks direct losses, it does not account for insured losses and may possibly over-estimate storm-related losses. PERI information is data is also included because it comes from FEMA. However PERI's loss data are available only for presidentially declared disasters, and not for state emergencies.

The preceding reflects the challenge of providing an accurate analysis of California's true long-term patterns of losses by type of disaster. It is clear from this that there is a need for a nationwide natural hazard loss database that would provide a comprehensive clearinghouse for disaster loss information by hazard type.<sup>16</sup>

## **4.2.2 PRIMARY SOURCES OF DISASTER LOSSES**

Table 4.F, which shows the pattern of emergencies, disasters, and associated losses by hazard types since 1950, when coupled with seismic knowledge, suggests the following findings:

1. Earthquakes occur less frequently than the other primary hazards causing disasters but account for the greatest combined losses (deaths, injuries, and damage costs)
2. Floods are the second most frequent disaster source and account for the second highest combined losses
3. Wildfires are the most frequent source of declared disasters and account for the third highest combined losses

<sup>14</sup> Hazards & Vulnerability Institute. The Spatial Hazard Events and Losses Database for the United States. Version 7.0 [Online Database]. Columbia, SC: University of South Carolina. 2009. Available from <http://www.sheldus.org>.

<sup>15</sup> Public Entity Risk Institute

<sup>16</sup> Gall, Melanie, Kevin A. Borden, and Susan L. Cutter. (2009). "When Do Losses Count? Six Fallacies of Natural Hazard Loss Data." American Meteorological Society 90(6). 2009. 799.

4. Earthquake costs exceeded wildfire costs by four times, using limited measures identified in these tables
5. Although floods have resulted in a greater number of total deaths during this period, earthquakes have accounted for the highest number of combined deaths and injuries
6. Earthquakes represent by far the greatest long term catastrophic disaster threat

From this analysis it is clear that these three hazards – earthquakes, fires, and floods – are predominant among the sources of disaster since 1950. Therefore, they are referred to in this risk assessment as “primary hazards.” Such findings also reflect the basis for past preparation of hazard-specific statewide mitigation plans for each primary hazard, and direct attention to risk assessments and mitigation measures identified in Chapter 5.

Earthquake hazard mitigation is particularly relevant to SHMP Goal 1 (Significantly reduce life loss and injuries) and SHMP Goal 2 (Minimize damage to structures and property), set forth in Chapter 2. In light of both the social and economic disruption caused by moderate-sized earthquakes, together with the significant potential for catastrophic disasters posed by earthquakes far greater in magnitude than those experienced since 1950, heightened attention is needed to mitigation strategies relating to this particular hazard.

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### **4.3 CRITERIA FOR HAZARDS, VULNERABILITY AND RISK ASSESSMENT**

The risk assessment in Chapters 5 and 6 identifies a hierarchical and functional classification of hazards based on stated hazard impact criteria. The hierarchy includes primary, secondary, and other hazards. For each of the primary and secondary hazards addressed in this SHMP, the risk assessment includes information identifying the following dimensions:

- Location within the state (i.e., geographic area affected)
- Previous occurrences within the state
- Probability of future events (i.e., chances of recurrence)

#### **4.3.1 HAZARD IMPACT CRITERIA**

The risk assessment encompasses a wide variety of hazards that can cause disasters. It has been organized on the basis of a series of hazard impact criteria:

- Levels of loss (life, structures and property, environment)
- Geographic extent
- Frequency and return periods
- Mitigation potential

#### **4.3.2 CLASSIFICATION SYSTEM: PRIMARY, SECONDARY AND OTHER HAZARDS**

The risk assessment is organized according to a hierarchy of primary, secondary, and other hazards.

Primary hazards include earthquakes, floods, and wildfires. These three are designated as primary hazards because:

- As discussed in Chapter 5, these three hazards have historically caused the greatest human, property, and/or monetary losses as well as economic, social, and environmental disruptions within the state
- Past major disaster events have led to the adoption of statewide plans for mitigation of these hazards, including the California Earthquake Loss Reduction Plan, State Flood Hazard Mitigation Plan, and California Fire Plan

- Together, these three hazards have the greatest potential to cause significant losses and disruptions in the future

Secondary hazards include levee failure, landslide, tsunamis, climate related impacts and volcanoes. These can be triggered by events involving primary hazards. Historically, secondary hazards have led to substantially lesser combined losses, as have other hazards.

For purposes of compliance with the Disaster Mitigation Act, as further specified by Interim Final Rule 44 CFR Section 206.401(c)(2)(i), the 2013 SHMP addresses in substantial detail the primary hazards of earthquakes, floods, and wildfires. Secondary, other, and additional hazards are addressed at a lesser level of detail due to their relatively fewer impacts, as identified in the preceding disaster history.

It is recognized that the preceding classification is provisional. It will change with time because the extent, intensity, and timing of meteorological changes associated with climate change are not yet well understood by the scientific community.

### **4.3.3 RISK ASSESSMENT COMPONENTS**

In addition to the classification of hazards, the risk assessment includes:

- A terminology section providing working definitions for key words such as hazard, vulnerability, and risk
- A GIS-based multi-hazard risk assessment in Chapter 5, which assesses risk exposure and social vulnerability to primary hazards by jurisdiction (counties), including sub-county patterns based on new raster-based analyses
- Observations regarding local vulnerability and potential loss drawn from the review of FEMA-approved Local Hazard Mitigation Plans in Annex 5
- Discussions of mitigation progress since 2010 covered initially in Chapters 1 through 3 and elaborated for each of the primary hazards evaluated in Chapter 5 and the other hazards described in Chapter 6

### **4.3.4 STANDARD RISK ASSESSMENT TEXT TEMPLATE CATEGORIES**

Throughout Chapters 5 and 6, an effort is made to use standard FEMA hazard and risk assessment criteria. For this reason, each primary, secondary, and additional hazard is addressed, to the extent possible given existing data sources, using the following descriptive categories:

- Identifying the hazard – what are its main characteristics?
- Profiling the hazard – where is it found, with what effects?
- Assessing state vulnerability and potential loss to the hazard – what kinds of populations and facilities are at risk?
- Assessing vulnerability by jurisdiction – which localities are most directly vulnerable to a particular hazard?
- Assessing local vulnerability and potential loss to the hazard – what are vulnerabilities and potential losses to that hazard within those localities?
- Identifying current hazard mitigation efforts – what is being done to mitigate hazards?

Within some sections of Chapter 5, for example in Section 5.2.4.1 (Earthquake Vulnerability and Mitigation of Buildings) and Section 5.2.4.2 (Vulnerability and Mitigation of Utilities and Transportation) certain of these categories are combined for key building inventories, addressing vulnerability, potential loss, and mitigation efforts in relation to particular structural types. An example is the discussion of unreinforced masonry (URM) in Chapter 5 in Section 5.2.4.1. This has been done because of the wide variety of

inventories of buildings and utilities vulnerable to earthquakes. In such instances, mitigation can best be discussed in relation to vulnerability issues related to the specific type of structure or facility.

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## 4.4 ESSENTIAL TERMINOLOGY

One of the difficulties in mitigation planning is confusion over the meaning of terms. Findings from previous Local Hazard Mitigation Plan reviews found that definitions of key terms varied substantially from plan to plan.

For this reason, special attention was given during the 2010 SHMP revision process to essential terminology used in the SHMP for the purpose of standardization. This standardization continues to be used in the 2013 SHMP. The following discussion identifies key terms, their working definitions, and their expanded meanings found in references consulted during exploration of this issue.

For purposes of the SHMP, the following working definitions are described briefly and, in some cases, accompanied by alternative definitions lending additional meaning from the law and natural hazards publications. One important source for these working definitions is a training handbook prepared by FEMA and the American Planning Association (APA).<sup>17</sup>

### 4.4.1 HAZARD, RISK, VULNERABILITY, DISASTER

Four key terms related to potential disaster threats and losses are hazard, risk, vulnerability, and disaster. Though often used interchangeably, each has its own distinct meaning and should be used with that distinction in mind to avoid confusion.

#### **Hazard**

The term “hazard” means an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss.

#### **Risk**

The term “risk” means the potential losses associated with a hazard, defined in terms of expected probability and frequency, exposure, and consequences.<sup>18</sup>

The International Organization of Standardization defines the term “risk” as the combination of the probability of an event and its consequences, where:

“Probability” is the extent to which an event is likely to occur

“Event” is the occurrence of a particular set of circumstances

“Consequences” are the outcome of an event<sup>19</sup>

#### **Vulnerability**

The term “vulnerability” can have varying meanings. From a structural perspective, it means susceptibility to damage given the inherent characteristics of a particular structure. Its broader meaning is the level of exposure of human life and property to damage from natural and human-made hazards.

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<sup>17</sup> “Planning for a Disaster-Resistant Community.” AICP Professional Development Workshop Handbook, APA 2007 National Conference in Philadelphia, Pennsylvania. April 2007.

<sup>18</sup> J. Schwab, K. C. Topping, C. C. Eadie, R. E. Deyle, and R. A. Smith. Planning for Post-Disaster Recovery and Reconstruction. American Planning Association, Planning Advisory Service, Report No. 483/484. 1998.

<sup>19</sup> International Organization for Standardization (ISO), Risk Management – Vocabulary – Guidelines for Use in Standards. ISO/IEC Guide 73ISO. Geneva, Switzerland: Central Secretariat. 2002.

Cutter, Boruff, and Shirley expand this definition with a discussion of social vulnerability, which they describe as partially the product of social inequalities—those social factors that influence or shape the susceptibility of various groups to harm, and govern their ability to respond. They assert that social vulnerability is also the product of place inequalities—those characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality, that contribute to the social vulnerability of places.<sup>20</sup>

Tierney expands on this vulnerability perspective, noting that disasters result not only from physical agents, but from a combination of three factors:

- (1) Disaster agent – whether a hurricane, earthquake, tornado, or some technological or human-induced event
- (2) Physical setting affected by the disaster, including:
  - (a) characteristics of the built environment (e.g., structures not built to survive the physical impact of the disaster agent); and
  - (b) environmental features that serve to either mitigate the effects of disasters or make them more severe (e.g., diminished wetlands that could have cushioned the impacts of Katrina);
- (3) Population vulnerability, a complex construct that includes such factors as:
  - (a) proximity to physical disaster impacts
  - (b) material resources (e.g., income and wealth)
  - (c) race, ethnicity, gender, age
  - (d) knowledge concerning recommended safety measures; and
  - (e) factors associated with social and cultural capital, such as routine involvement in social networks that can serve as conduits for information and mutual aid, as well as knowledge that enables community residents to interact successfully with mainstream societal institutions

Tierney also notes that human populations are also made vulnerable by steps their governments and institutions take (or fail to take) to protect them before and after disasters strike.<sup>21</sup>

## Disaster

The term “disaster” means a major detrimental impact of a hazard upon the population and the economic, social, and built environment of an affected area.

Note that a variety of other definitions of the term “disaster” are found in the natural hazards literature and the law, including the following:

...an event concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social disruption, such that all or some essential functions of the society or subdivision are impaired...<sup>22</sup>

...the occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society (or community)...<sup>23</sup>

For declaring a disaster at the federal level, the Stafford Act provides the following definition of the term “major disaster”:

<sup>20</sup> S. Cutter, B. Boruff, and W. L. Shirley. “Social Vulnerability to Environmental Hazards,” *Social Science Quarterly* 84 (1) 2003:242-261.

<sup>21</sup> K. Tierney. “Foreshadowing Katrina: Recent Sociological Contributions to Vulnerability Science.” *Contemporary Sociology: A Journal of Reviews* 35 (3), 2006:207-212.

<sup>22</sup> Charles Fritz. “Disaster,” in *Contemporary Social Problems*, R.K. Merton and R.A. Nisbet, eds. New York: Harcourt Press, 1961: pp. 651-694.

<sup>23</sup> A.W. Coburn, R. J. S. Spence, and A. Pomonis. *Vulnerability and Risk Assessment*. 2nd edition. Cambridge Architectural Research Limited, United Nations Disaster Management Training Programme. 1994.

...any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby...

The term “catastrophe” in the Stafford Act definition implies an event of a magnitude exceeding available local and state response and recovery resources. In more recent history, the term “catastrophic” has been redefined by events such as the 9/11 World Trade Center disaster and Hurricane Katrina to mean disasters large enough to stretch national resources.

### **Natural vs. Human-Caused Disasters**

The term “natural disaster” refers to destructive events involving natural forces such as droughts, earthquakes, floods, hurricanes, landslides, mudslides, storms, tornados, tsunamis, high or wind-driven waters, wildfires, and volcanic eruptions.

By contrast, “human-caused” disasters include acts of war and terrorism as well as disasters with a technological component such as dams and levee failures, nuclear accidents and radiological releases, major truck and rail transportation accidents, oil and other hazardous materials spills, and airplane crashes.

It is important to realize, however, that distinctions among natural, human-caused, and technological disasters are often artificial when taking into account the human decisions underlying settlement patterns that conflict with natural hazards. For example, Hurricane Katrina on the Gulf Coast was both a natural and human-caused disaster involving the construction of urban areas over time in naturally hazardous areas below sea level only partially protected by construction of inadequate levees. To the extent that disaster losses could be made preventable through mitigation, natural disasters can also be considered human-caused.

### **4.4.2 MITIGATION, PREPAREDNESS, RESPONSE, RECOVERY**

The terms mitigation, preparedness, response, and recovery are commonly referred to as the four basic functions of emergency management. They are referred to as “phases” because ideally they should occur in the order given. In the worst instances, response and recovery may be the only functions happening sequentially in the absence of mitigation and preparedness. Conversely, in the best instances, mitigation and preparedness are continuously occurring.

#### **Mitigation**

The term “mitigation” means sustained action taken to reduce or eliminate the long-term risk to human life and property from natural, human-caused, and technological hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery.

Mitigation is predicated on the principles that many losses are preventable through better community design and that each event should teach us how to reduce losses in the next disaster. Mitigation generally means reducing long-term risk from hazards to acceptable levels through predetermined measures accompanying physical development, such as strengthening structures to withstand earthquakes, prohibiting or limiting development in flood-prone areas, clearing defensible space around residences in wildland-urban interface (WUI) areas, or designing development away from areas of geological instability.

Mitigation is different from emergency preparedness. The latter concentrates on activities that make a person, place, or organization ready to respond to a disaster with emergency equipment, food, emergency shelter, and medicine.

### **Preparedness**

The term “preparedness” means making preparations before a disaster for what to do immediately after a disaster.

Examples of preparedness include developing pre-disaster plans and information regarding who to contact and where to go after a disaster; what food, equipment, and other emergency supplies to have ready and stored to enable quick action; what emergency communications measures should be available; how and where to evacuate people; and how to provide food, shelter, medical assistance, and basic services to disaster victims. It can also mean preparing for recovery, educating the public on personal and household preparedness, and practicing disaster drills.

Preparedness is sometimes confused with mitigation. However, it is distinguished from mitigation by its focus on immediate post-disaster action. Mitigation and preparedness go hand-in-hand. Where mitigation is insufficient to significantly reduce potential disaster losses, then preparedness becomes especially important. To the extent that time or financial resources preclude long-term mitigation of many hazards in the natural and social environment, then it becomes very important to undertake plans and actions to prepare for emergencies, making it easier to respond to and recover. This interdependency is fundamental to the SHMP.

### **Response**

The term “response” means actions taken to respond to the disaster, such as rescuing survivors, providing for mass evacuation, feeding and sheltering victims, and restoring communications.

### **Recovery**

The term “recovery” means restoring people’s lives and creating new opportunities for the future. It includes such actions as restoration of essential transportation, utilities, and other public services; repair of damaged facilities; provision of both temporary and replacement housing; restoration and improvement of the economy; and long-term reconstruction which improves the community.

## **4.4.3 SUSTAINABILITY AND RESILIENCE**

Two additional terms – sustainability and resilience – have come into the lexicon in the past several years. Emerging from a broader literature base, these terms are more difficult to define.

### **Sustainability**

Sustainability has come to be an over-arching concept within which disaster management takes place. A well-known definition of sustainability comes from the World Commission on Environment and Development which stated that sustainable development was that which meets the needs of the present without compromising the ability of future generations to meet their own needs.<sup>24</sup> This vision was articulated at a finer level by the National Commission on the Environment, which suggested sustainability is a strategy for improving the quality of life while preserving the environmental potential for the future, of living off interest rather than consuming natural capital.<sup>25</sup>

<sup>24</sup> World Commission on Environment and Development. 1987.

<sup>25</sup> National Commission on the Environment. 1993.

For purposes of this SHMP, the term “sustainability” adds to these previous definitions the idea of preservation of resources – physical, social, economic, environmental, historical, and cultural – for the benefit of future generations. Thus, a community is inherently unsustainable if its resources are destroyed or dramatically altered by disasters. Sustainable cities are those that both consume and preserve resources in a way that allows them to exist for a long period of time. One of the paths to sustainability is through investment in strong disaster mitigation.

## Resilience

The term “resilience” is commonly defined as the ability of a system to absorb shock and maintain its structure and functions with a minimum of loss. Further, a resilient system is one that can resume pre-event functionality in a relatively short time. Thus, a community is resilient when it maintains continuity and recovers quickly despite disasters.

This basic concept of resilience is expanded here to include two additional factors: 1) multiple geographic levels – cities, counties, regions, and the state; and 2) the capacity of a city, county, or state to adapt or transform itself during recovery to meet new challenges posed by changed conditions. The latter idea is captured in the commonly employed phrase “building back better.”

For purposes of this SHMP, the term “resilience” thus refers to the capacity of a community, region, or state to 1) survive a major disaster, 2) retain its essential structure and functions, and 3) adapt to post-disaster opportunities for transforming itself to meet new challenges.

Resilience should be seen as an element of sustainability. Disasters destroy resources, making communities *less* sustainable or unsustainable, whereas resilience helps to protect resources. Resilience can be developed not only through mitigation, but also through coordinated development and implementation of the other disaster management functions, including preparedness, response, and recovery.<sup>26</sup>

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## 4.5 AN EMERGING RISK FACTOR: CLIMATE CHANGE

An increasingly important factor affecting all four disaster management functions is climate change caused by global warming. Climate change reflects new uncertainties and factors shaping and conditioning hazard mitigation planning. It is addressed in this chapter as a factor intensifying impacts of many natural hazards described in Chapters 5 and 6.

Scientific studies have confirmed that release of greenhouse gases—such as carbon dioxide (CO<sub>2</sub>), methane, chlorofluorocarbons (CFCs), and nitrous oxide—is creating changes to the earth’s climate leading to a variety of negative effects. Impacts of meteorological changes have been under observation by risk management and natural hazards researchers for several decades.

Climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state’s infrastructure, water supplies, and natural resources.<sup>27</sup> The state has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing. Extreme weather events, such as heat waves, wildfires, droughts, and floods, are likely to be some of the earliest climate impacts experienced.<sup>28</sup>

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<sup>26</sup> Topping et al. “Building Local Capacity for Long-term Disaster Resilience.” Journal of Disaster Research. May 2010.

<sup>27</sup> California Natural Resources Agency. 2009 California Climate Adaptation Strategy: A Report to the Governor of the State of California in Response to Executive Order S-13-2008. p. 15.

<sup>28</sup> Ibid

In order to address these changes, California has developed a variety of laws, policies, and programs to both mitigate (or reduce) the emission of greenhouse gases into the atmosphere and adapt to the changes that will take place.

In the following sections, relevant state laws and policies are described, preliminary strategies for addressing climate change are outlined, and principles for incorporating climate change into state, local, and regional hazard mitigation planning are identified.

#### **4.5.1 CALIFORNIA’S CLIMATE CHANGE INITIATIVES**

California has been a leader in adopting initiatives to address climate change through the reduction of greenhouse gas emissions and response to risks associated with climate change. Although climate change is a global issue, actions taken by California can have far-reaching effects by encouraging other states, the federal government, and other countries to act. As the world’s fifteenth largest emitter of greenhouse gases from human activity and natural sources and with trillions of dollars of real estate at risk due to increasing climate-related hazards, California is uniquely positioned to act to reduce greenhouse gases and to adapt to climate change impacts.<sup>29</sup> The following summarizes the major initiatives of the state.

##### **Executive Order S-03-05 and Assembly Bill 32 – California Global Warming Solutions Act of 2006**

The initial push for greenhouse gas reduction was set in motion by Executive Order S-03-05 in 2005, which established climate change emission reduction targets for the state for the purpose of mitigating global warming. The executive order established greenhouse gas reduction targets as follows:

- By 2010, reduce emissions to 2000 emission levels
- By 2020, reduce emissions to 1990 emission levels
- By 2050, reduce emissions to 80 percent below 1990 levels

Subsequently, the California legislature passed and the Governor signed Assembly Bill (AB) 32, known as the California Global Warming Solutions Act of 2006. The law establishes a comprehensive program to achieve quantifiable, cost-effective reductions of greenhouse gases on a scheduled basis. It requires the California Air Resources Board (ARB) to develop regulations and market mechanisms that will ultimately reduce California's greenhouse gas emissions by 25 percent by 2020. Mandatory caps began in 2012 for significant sources. Specifically, AB 32 required the ARB, among other things, to:

- Establish a statewide greenhouse gas emissions cap for 2020, based on 1990 emissions by January 1, 2008
- Adopt mandatory reporting rules for significant sources of greenhouse gases by January 1, 2009
- Adopt a plan by January 1, 2009, indicating how emission reductions will be achieved from significant greenhouse gas sources via regulations, market mechanisms and other actions
- Adopt regulations by January 1, 2011 to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas, including provisions for using both market mechanisms and alternative compliance mechanisms

Measures similar to AB 32 have been adopted by many other states, with California leading the way. In response to an industry challenge to one of these state laws, the United States Supreme Court ruled that greenhouse gases should be considered pollutants. This decision emphasized the court’s view that the United States Environmental Protection Agency (EPA) has a responsibility to pass nationwide regulations governing such emissions. On December 7, 2009, the EPA finalized its finding under the Clean Air Act that

<sup>29</sup> California Natural Resources Agency. Final Statement of Reasons for Regulatory Action, Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB97. December 2009.

greenhouse gases in the atmosphere endanger both public health and the environment for current and future generations. The EPA also found that the combined emissions of greenhouse gases from motor vehicles engines are contributing to the buildup of greenhouse gases in the atmosphere and, thus, to the climate change problem. Ultimately, this finding paves the way for EPA regulation of greenhouse gas emissions.

Meanwhile, California is proceeding with implementation of AB 32 through related initiatives and programs described in the subsections that follow.

### **AB 32 Scoping Plan**

AB 32 required the California Air Resources Board (CARB), the lead agency for implementing AB 32, to develop a Scoping Plan outlining the state's strategy to achieve the 2020 greenhouse gas emissions reduction goals. On December 11, 2008, the RB adopted its Scoping Plan, setting forth a framework for future regulatory action on how California will achieve that goal through sector-by-sector regulation. The AB 32 Scoping Plan outlines a set of actions designed to reduce overall greenhouse gas emissions in California to 1990 levels by 2020 and proposes a comprehensive set of actions designed to reduce overall greenhouse gas emissions in California, improve the environment, reduce dependence on oil, diversify energy sources, save energy, create new jobs, and enhance public health. The Scoping Plan presents greenhouse gas emission reduction strategies that combine regulatory approaches, voluntary measures, fees, policies, and programs. Reduction strategies are expected to evolve as technologies advance and progress toward the state's goal is monitored.

### **Senate Bill 97 – CEQA Guidelines for Mitigation of Greenhouse Gas Emissions**

By enacting Senate Bill (SB) 97 in 2007, California's lawmakers expressly recognized the need to analyze greenhouse gas emissions as a part of the California Environmental Quality Act (CEQA) process. SB 97 required the Governor's Office of Planning and Research (OPR) to develop, and the Natural Resources Agency to adopt, amendments to the CEQA Guidelines addressing the analysis and mitigation of greenhouse gas emissions. Those CEQA Guidelines amendments clarified several points, including the following:

- Lead agencies must analyze the greenhouse gas emissions of proposed projects, and must reach a conclusion regarding the significance of those emissions. (See CEQA Guidelines Section 15064.4.)
- When a project's greenhouse gas emissions may be significant, lead agencies must consider a range of potential mitigation measures to reduce those emissions. (See CEQA Guidelines Section 15126.4(c).)
- Lead agencies must analyze potentially significant impacts associated with placing projects in hazardous locations, including locations potentially affected by climate change. (See CEQA Guidelines Section 15126.2(a).)
- Lead agencies may significantly streamline the analysis of greenhouse gases on a project level by using a programmatic greenhouse gas emissions reduction plan meeting certain criteria. (See CEQA Guidelines Section 15183.5(b).)
- CEQA mandates analysis of a proposed project's potential energy use (including transportation-related energy), sources of energy supply, and ways to reduce energy demand, including through the use of efficient transportation alternatives. (See CEQA Guidelines, Appendix F.)

### **SB 375 – Greenhouse Gas Emissions Reduction**

Enacted in October 2008, SB 375 further built on AB 32 by connecting the reduction of greenhouse gas emissions from cars and light trucks to regional and local land use and transportation planning. SB 375 asserts that "without improved land use and transportation policy, California will not be able to achieve the goals of AB 32." Accordingly, SB 375 has three goals: 1) to use the regional transportation planning process to help achieve AB 32 goals, 2) to use CEQA streamlining as an incentive to encourage residential

development projects that are consistent with regional plans that meet greenhouse gas emission reduction targets, and 3) to coordinate the regional housing needs allocation process with the regional transportation planning process.

SB 375 requires the California Air Resources Board (ARB) to establish greenhouse gas emission reduction targets for each region (as opposed to individual cities or households). Then each region's metropolitan planning organization (MPO) must create a Sustainable Communities Strategy (SCS) as part of the Regional Transportation Plan (RTP) that will meet the target for the region, or an Alternative Planning Strategy (APS) independent of the RTP describing why the targets cannot be met. No on-the-ground change is likely to be seen for several years, until after each MPO actually adopts the sustainable communities plan called for in the law.

### **SB 732 – Strategic Growth Council**

In September 2008, the Governor signed SB 732 creating the Strategic Growth Council (SGC). The SGC is a cabinet-level committee that is tasked with coordinating the activities of state agencies to:

- Improve air and water quality
- Protect natural resource and agriculture lands
- Increase the availability of affordable housing
- Improve infrastructure systems
- Promote public health
- Assist state and local entities in the planning of sustainable communities and meeting AB 32 goals

SB 732 gives the council authority to distribute Proposition 84 funds available for planning grants and incentives to encourage the development of regional and local land use plans designed to promote water conservation, reduce automobile use and fuel consumption, encourage greater infill and compact development, protect natural resources and agricultural lands, and increase adaptability to climate change. All projects and plans must be consistent with the state's planning priorities and reduce greenhouse gas emissions on a permanent basis consistent with AB 32 and any applicable regional plan. The planning grant criteria Priority Considerations award extra points for addressing climate change impacts on human and natural areas and adaptation planning to address these issues.

### **General Plan Guidelines**

Climate change has also been recognized by the Governor's Office of Planning and Research (OPR) as a factor to be considered in preparation of local general plans. OPR is in the process of updating the 2003 General Plan Guidelines, which provide guidance to cities and counties in the preparation of their local general plans. The next update will reflect legislative requirements enacted since 2003 and provide new guidance on addressing climate change, adaptation, and related issues. The current General Plan Guidelines require a safety element as one of seven mandatory elements in the general plan. The primary aim of the safety element is to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from fires, floods, earthquakes, landslides, and other hazards. Local agencies are encouraged by California law to adopt Local Hazard Mitigation Plans (LHMPs) as part of their general plan safety elements.<sup>30</sup> The LHMP must be consistent with the goals and objectives of both the local general plan and the SHMP. As such, the general plan and LHMP provide a local vehicle for implementation of the SHMP, including provisions dealing with climate change.

## **4.5.2 CLIMATE ADAPTATION: STATE EFFORTS TO PREPARE FOR CLIMATE RISKS**

In addition to leadership in greenhouse gas emissions reduction, California has also been a leader in efforts to prepare for and respond to climate risks, also known as adaptation.

<sup>30</sup> AB 2140 provides financial incentives for local agencies to adopt LHMPs as part of the safety elements of their general plans.

The people of California face escalating threats related to climate change, including extreme storm events, more frequent and severe wildfires, disruptions to water and energy delivery systems, disruptions to transportation systems, more frequent and severe heat waves and associated air quality issues, and the potential loss of species and habitats due to various climate related stressors. These climate impacts threaten not only public health and safety, but also billions of dollars of property and the economic livelihood of California.

Adjustments in natural or human systems can help reduce the potential harm from climate changes that are occurring or expected. As discussed above, the term “mitigation” can be associated with different meanings in the emergency management context and in the climate change context; “mitigation” in the climate change context generally refers to the reduction of greenhouse gases, while “mitigation” in the emergency management context refers to hazard mitigation activities that can be characterized as any action to reduce or eliminate the long-term risk to human life and property from natural or human-caused hazards. The term adaptation has been defined in the Intergovernmental Panel on Climate Change’s 4<sup>th</sup> Assessment Report as “initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change affects”.<sup>31</sup>

### **California Climate Adaptation Strategy**

Pursuant to Executive Order S-13-08, a multi-sectoral 2009 California Climate Adaptation Strategy (2009 CAS) was developed<sup>32</sup>. The 2009 CAS was based on best available science at the time and included recommendations to inform state decision makers in developing policies to prepare for climate impacts, reduce exposure and vulnerability, and build more resilient California communities. A First Year Progress Report was issued in 2010<sup>33</sup>.

In 2012, the state completed a Third California Climate Assessment (Third Assessment)<sup>34</sup>. The Third Assessment, supported by the prior Public Interest Energy Research (PIER) program administered by the California Energy Commission (CEC), began the work of examining expected climate impacts in specific regions in California (including parts of Southern California, the Central Valley, and the San Francisco Bay Area). The Third Assessment also included studies of climate impacts in specific sectors such as agriculture, water, energy and public health.

In order to augment previously identified strategies, and in light of advances in climate science and risk management options, the California Natural Resources Agency, in coordination with other state agencies and partners, is currently developing a 2013 update to the California Climate Adaptation Strategy (2013 Update). The 2013 update will include two additional sector chapters not previously included in the 2009 CAS; an energy chapter and an emergency management chapter.

Recognizing the very significant threat that climate change continues to pose to the health, safety, and economic well-being of California, the 2013 Update will be focused on identifying continued gaps and needs in efforts to prepare for climate impacts. There are still significant needs for funding and supporting authorities to advance the work of preparing for climate risks. Examples of progress to date are described below.

<sup>31</sup> IPCC 4th assessment definition [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg2/en/annexesglossary-a-d.html](http://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexesglossary-a-d.html)

<sup>32</sup> [http://resources.ca.gov/climate\\_adaptation/docs/Statewide\\_Adaptation\\_Strategy.pdf](http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf)

<sup>33</sup> <http://www.energy.ca.gov/2010publications/CNRA-1000-2010-010/CNRA-1000-2010-010.PDF>

<sup>34</sup> [http://climatechange.ca.gov/climate\\_action\\_team/reports/third\\_assessment/index.html](http://climatechange.ca.gov/climate_action_team/reports/third_assessment/index.html)

## Adaptation Progress and Resources

While the 2009 CAS, and the forthcoming 2013 CAS update, provide a comprehensive picture of California's continued needs with respect to preparing for climate impacts, more in-depth, sector specific guidance, policies and actions are also developing. State progress to date includes, but is not limited to, the following documents and other resources:

1. 2013 State of California Sea Level Rise Guidance Document ([http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013\\_SLR\\_Guidance\\_Update\\_FINAL1.pdf](http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf))
2. 2013 joint California Department of Water Resources (DWR) and National Oceanic and Atmospheric Association construction of four coastal observatories to improve flood watch and flood warning information that can be provided to local emergency responders (<http://www.water.ca.gov/news/newsreleases/2012/120312.pdf>)
3. 2013 California Department of Transportation release of "Addressing Climate Change Adaptation in Regional Transportation Plans - A Guide for California MPOs and RTPAs" ([http://www.dot.ca.gov/hq/tpp/offices/orip/climate\\_change/assessment.shtml](http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/assessment.shtml))
4. 2012 relaunch of the CAL FIRE wildfire preparedness website with added features and steps to assist homeowners in preparing for wildfires ([www.ReadyForWildfire.org](http://www.ReadyForWildfire.org))
5. 2012 California Department of Food and Agriculture launch of the Climate Change Consortium to help specialty crop growers prepare for climate impacts ([http://www.cdafa.ca.gov/egov/press\\_releases/Press\\_Release.asp?PRnum=12-029](http://www.cdafa.ca.gov/egov/press_releases/Press_Release.asp?PRnum=12-029))
6. 2012 DWR establishment of a Climate Change Technical Advisory Group on Water (<http://www.water.ca.gov/news/archive/index.cfm?yr=2012>)
7. 2012 California Department of Fish and Wildlife launch of the Climate College to promote climate literacy by providing open lectures on the fundamentals of climate science and providing tools and resources necessary to empower participants to better incorporate climate change into their professional responsibilities ([http://www.dfg.ca.gov/Climate\\_and\\_Energy/Climate\\_Change/Climate\\_College/](http://www.dfg.ca.gov/Climate_and_Energy/Climate_Change/Climate_College/))
8. 2012 State of California Extreme Heat Adaptation Interim Guidance ([http://www.climatechange.ca.gov/climate\\_action\\_team/reports/2012-08-31\\_Extreme\\_Heat\\_Adaptation\\_Interim\\_Guidance\\_Document.pdf](http://www.climatechange.ca.gov/climate_action_team/reports/2012-08-31_Extreme_Heat_Adaptation_Interim_Guidance_Document.pdf))
9. 2012 Climate Action for Health: Integrating Public Health into Climate Action Planning ([http://www.cdph.ca.gov/programs/CCDHP/Document/CAPS\\_and\\_Health\\_Published3-22-12.pdf](http://www.cdph.ca.gov/programs/CCDHP/Document/CAPS_and_Health_Published3-22-12.pdf))
10. 2012 Cool Pavements Bill ("AB 296") regarding materials that can be used to reduce extreme heat in urban areas ([http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab\\_0251-0300/ab\\_296\\_bill\\_20120927\\_chaptered.pdf](http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0251-0300/ab_296_bill_20120927_chaptered.pdf))
11. 2012 CEC public workshop on vulnerability of the California energy system to extreme weather events and climate change (the CEC's 2013 Integrated Energy Policy Report will include policy recommendations on this topic) ([http://www.energy.ca.gov/2013\\_energy\\_policy/index.html](http://www.energy.ca.gov/2013_energy_policy/index.html))
12. 2011 California Department of Transportation Guidance for Incorporating Sea Level Rise for Use in the Planning and Development of Project Initiation Documents ([http://www.dot.ca.gov/ser/downloads/sealevel/guide\\_incorp\\_slr.pdf](http://www.dot.ca.gov/ser/downloads/sealevel/guide_incorp_slr.pdf))

13. 2011 DWR, in cooperation with the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and Resources Legacy Fund, (<http://www.water.ca.gov/climatechange/CCHandbook.cfm>)
14. 2010 California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California (<http://www.dfg.ca.gov/habcon/connectivity/>)
15. 2013 Office of Environmental Health and Hazard Assessment Indicators of Climate Change in California (<http://oehha.ca.gov/multimedia/epic/climateindicators.html>)
16. 2011 Climate Change Handbook for Regional Water Planning developed cooperatively by Department of Water Resources, the U.S. Environmental Protection Agency, Resources Legacy Fund and the U.S. Army Corps of Engineers (<http://www.water.ca.gov/climatechange/CCHandbook.cfm>)

### **Additional Climate Adaptation Planning Resources**

In addition to the APG, four additional guidance documents from state agencies are intended to assist local governments in planning for climate change.

#### Adapting to Sea Level Rise: A Guide for California's Coastal Communities

Nicole Russell & Gary Griggs, University of California Santa Cruz

For the California Energy Commission--Public Interest Environmental Research Program

January 2012

[http://calost.org/pdf/announcements/Adapting%20to%20Sea%20Level%20Rise\\_N%20Russell\\_G%20Griggs\\_2012.pdf](http://calost.org/pdf/announcements/Adapting%20to%20Sea%20Level%20Rise_N%20Russell_G%20Griggs_2012.pdf)

#### Addressing Climate Change Adaptation in Regional Transportation Plans: A Guide for California MPOs and RTPAs

Cambridge Systematics. Prepared for the California Department of Transportation.

April 2013

[http://www.dot.ca.gov/hq/tpp/offices/orip/climate\\_change/documents/FR3\\_CA\\_Climate\\_Change\\_Adaptation\\_Guide\\_2013-02-26\\_.pdf](http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/documents/FR3_CA_Climate_Change_Adaptation_Guide_2013-02-26_.pdf)

#### Climate Action for Health: Integrating Public Health into Climate Action Planning

California Department of Public Health

February 2012

[http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS\\_and\\_Health\\_Published3-22-12.pdf](http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf)

#### Climate Change Handbook for Regional Water Planning

Prepared for US Environmental Protection Agency Region 9 and California Department of Water Resources  
November 2011

<http://www.water.ca.gov/climatechange/CCHandbook.cfm>

Progress on preparing for climate impacts in California is not limited to State efforts. As noted in the 2009 CAS, the federal government, tribes, local and regional governments, businesses, non-governmental organizations, and Californians all play an important role in preparing for climate impacts. The 2013 CAS Update will describe some of the successes of non-state entities and individuals, as well as a number of collaborative efforts. Continued cooperation and innovative solutions will be important in ensuring resilient California communities.

## Other Climate Change Resources

In 2010 the Pacific Council a membership-based international affairs organization headquartered in Los Angeles, published the report “Preparing for the Effects of Climate Change – A Strategy for California”. The report includes a set of guiding principles for use in making climate adaptation decisions in California. The principles, defined by the Pacific Council Task Force, strive to address both climate change challenges and stakeholder interests in light of best science available.

The Pacific Council’s guiding principles for all climate adaptation decisions are:

- Science-based policy
- Cost-effective actions
- Aligned incentives
- Public engagement
- Coordination of planning and public decision making

For more information on the report and guiding principles, please download the report from the Pacific Council’s website: <http://www.pacificcouncil.org/taskforcereports>

## Translating Climate Science into Actions to Prepare for Climate Impacts

### Cal-Adapt

In 2011, California launched Cal-Adapt, a web-based tool that allows users to see how climate is projected to change in local areas in California. The Cal-Adapt tool was developed by UC Berkeley’s Geospatial Innovation Facility (GIF) with funding and advisory oversight by the CEC’s Public Interest Energy Research (PIER) program, and advisory support from Google.org. The tool helps translate climate research from the scientific community into a format that is usable for local planning purposes. With continued funding support, Cal-Adapt can be maintained and enhanced so that it continues to serve as a central resource for those working on preparing for climate risks in California.

### California Climate Adaptation Planning Guide

In 2012, the state released the California Adaptation Planning Guide (APG), a set of four complementary documents that provide guidance to support communities in addressing the unavoidable consequences of climate change. The APG provides a step-by-step guide for local and regional governments to assess relevant climate impacts in their area and develop local climate action plans. The APG was designed to allow for flexibility in the commitment of time, money, and effort to suit the needs of the community. The APG was developed cooperatively by the California Natural Resources Agency, and California Emergency Management Agency (now Cal OES), with support from California Polytechnic State University–San Luis Obispo, and with funding through the Federal Emergency Management Agency and the California Energy Commission (CEC).

### CaLEAP Planning Tool

In 2012, the California Local Energy Assurance Planning (CaLEAP) web-based tool was launched (<https://caleap.icfwebservices.com/Plan/Overview>). CaLEAP is a CEC sponsored project to help local governments with preparations to make their communities more resilient in the face of disaster events that can interrupt energy supplies. The web-based tool was designed with local government end-users in mind. The tool is structured around CaLEAP methodologies, provides links and resources, can be used to identify needed materials, and can also act as a virtual office for planning teams in order to foster communication and coordination.

### Climate Change and Emergency Management

There is growing global recognition that experts in emergency management and experts in climate science and climate adaptation will benefit from collaborative efforts to share approaches, information, goals, viewpoints, and insights<sup>35</sup>. In California, this collaborative work has already begun, and the integration of climate impacts into emergency management efforts builds upon strengths and competencies that already exist in California’s emergency management agencies and departments. The 2007 SHMP first incorporated climate change and the topic has been expanded upon in subsequent SHMP updates.

Hazard mitigation in the context of a changing climate can take many different forms including, but not limited to:

- Construction of green infrastructure and other protective structures to address sea level rise
- Managed shoreline retreat
- Enhanced flood warning instrumentation
- Climate risk communication and education<sup>36</sup>
- Forest fire risk reduction through the removal of certain forest vegetation (or “fuels”)
- Defensible space clearance around homes and structures to reduce wildfire risk
- Building codes that require use of fire resistant building materials in areas prone to wildfire risk
- Promotion of sound land use practices
- Urban forestry and urban greening to address heat island effect
- Use of cool pavements to deal with urban heat island effect
- Use of state-of-art materials in new infrastructure to optimize resilience in light of expected climate impacts

Attention to the timing and spatial dimensions of hazard mitigation efforts is critical in the era of climate change. Some efforts to reduce risk in the short term, may actually increase exposure and vulnerability over the longer term. Climate considerations in hazard mitigation and other phases of emergency management will be more fully discussed in the emergency management chapter of the 2013 CAS Update. Climate considerations in hazard mitigation are also further discussed in Chapter 6 of this document.

### **4.5.3 LOCAL AND REGIONAL CLIMATE ADAPTATION PLANNING**

It is now clear that in coming decades natural disasters are broadly expected by members of the scientific community to intensify due to climate change. Emergency managers, planning agencies, private companies, and communities especially affected by climate change will be challenged to adapt their planning to take into account an increase in the type, extent, and intensity of natural hazards.

Disasters expected to be more widely experienced in the future include avalanches, coastal erosion, flooding, sea level rise, extreme heat, drought, landslides, severe weather and storms, and wildland fires. As suggested in Section 4.2.1, particular interest and priority should be given to those climate change impacts having the potential to escalate to catastrophic levels.

Local governments are mobilizing to create collaborative partnerships that address climate change at a local scale. The Alliance of Regional Collaboratives for Climate Adaptation (ARRCA) was developed in 2012 to help prepare California’s urban centers for the potential impacts of climate change including extreme events such as flooding, heat waves, and sea level rise. The Los Angeles Regional Collaborative for Climate

<sup>35</sup> See e.g. IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

<sup>36</sup> Climate risk communication and education can help shape choices that reduce climate risks by reducing exposure and vulnerability.

Adaptation and Sustainability (LARC) and the San Diego Climate Collaborative<sup>37</sup> are examples of localized efforts to create opportunities to share resources and leverage funding to implement climate adaptation planning.

#### **Progress Summary 4.A: California Climate Adaptation Planning Guide (APG)**

As noted above, the California Climate Adaptation Planning Guide (APG), a set of four complementary documents, provides guidance to support communities in addressing the unavoidable consequences of climate change. The APG introduces the basis for climate change adaptation planning and details a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development. The APG was developed to allow flexibility in the commitment of time, money, and scope.

The APG consists of the following four documents:

APG: Planning for Adaptive Communities – This document presents the basis for climate change adaptation planning and introduces a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development. All communities should start with this document.

APG: Defining Local and Regional Impacts – This supplemental document provides a more in-depth understanding of how climate change can affect a community. Seven “impact sectors” are included to support communities conducting a climate vulnerability assessment.

APG: Understanding Regional Characteristics – The impact of climate change varies across the state. This supplemental document identifies climate impact regions, including their environmental and socioeconomic characteristics.

APG: Identifying Adaptation Strategies – This supplemental document explores potential adaptation strategies that communities can use to meet adaptation needs. Adaptation strategies are categorized into the same impact sectors used in the APG: Defining Local and Regional Impacts document.

Communities seeking to understand their vulnerability to climate change and develop strategies to address the issue should refer to the APG:

[http://resources.ca.gov/climate\\_adaptation/local\\_government/adaptation\\_planning\\_guide.html](http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html)

### **Steps in Climate Adaptation Strategy Development**

The process of developing climate change adaptation strategies can vary from a short, initial qualitative process to a much more detailed, lengthy, comprehensive approach. Regardless of where a community falls in this spectrum, the basic steps are the same (see Figure 4.A).

#### Vulnerability Assessment

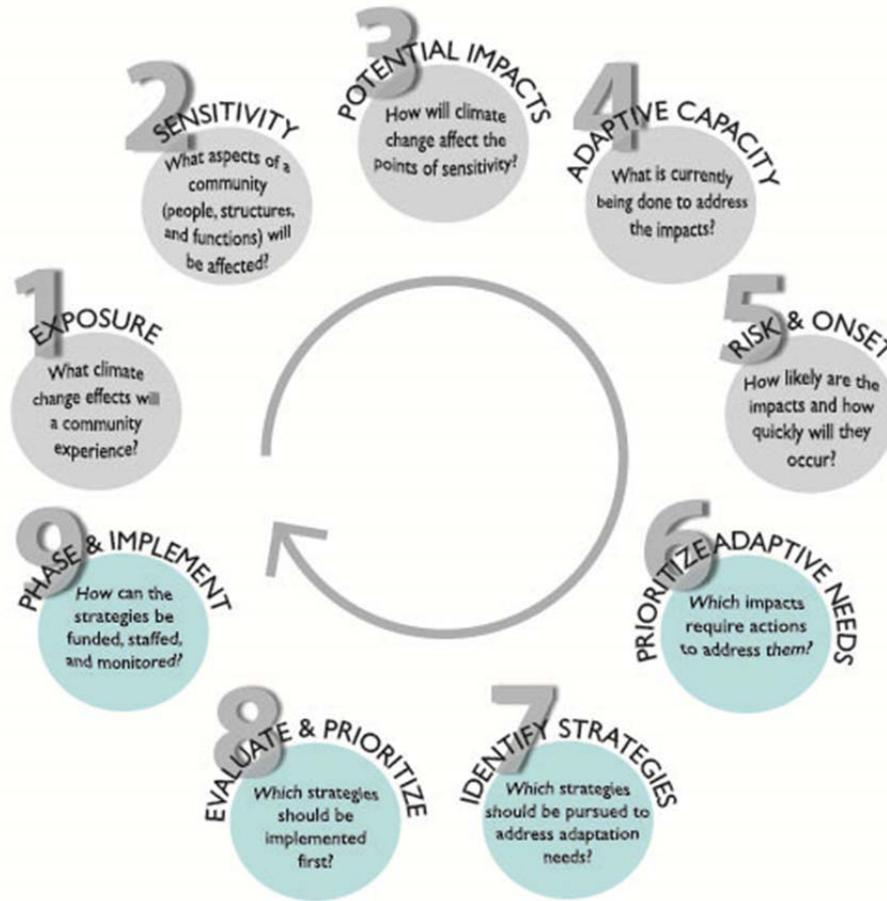
1. Exposure: Identify the climate change effects a community will experience
2. Sensitivity: Identify the key community structures, functions, and populations that are potentially susceptible to each climate change exposure
3. Potential Impacts: Analyze how the climate change exposure will affect the community structures, functions, and populations (impacts)
4. Adaptive Capacity: Evaluate the community’s current ability to address the projected impacts
5. Risk and Onset: Adjust the impact assessment to account for uncertainty, timing, and adaptive capacity

<sup>37</sup> <http://www.sdclimatecollaborative.org/overview/>

Adaptation Strategy Development

6. Prioritize Adaptive Needs: Based on the vulnerability assessment, set priorities for adaptation needs
7. Identify Strategies: Identify strategies to address the highest priority adaptation needs
8. Evaluate and Prioritize: Evaluate and rank strategies based on the projected onset of the impact, projected cost, co-benefits, and other feasibility factors
9. Phase and Implement: Develop an implementation plan that includes phasing of strategies and a monitoring system to assess effectiveness

**Figure 4.A: The Nine Steps in Adaptation Strategy Development**



Source: California APG: Defining Local and Regional Impacts

The gray steps are part of the vulnerability assessment (Steps 1-5) and the blue steps are adaptation strategy development (Steps 6-9).

**Progress Summary 4.B: Additional Local Climate Adaptation Guidance Sources**

**Progress as of 2013:** In the last two years, California state agencies have prepared five guidance documents (the APG, as well as the four documents discussed below) to assist local governments in planning and preparing for climate change. These documents assist local planners and managers in assessing risk, identifying at risk assets and populations, and developing climate adaptation policies and strategies. These documents were placed online for public use in late 2012.

## **4.6 MULTI-HAZARDS DEMONSTRATION PROJECT**

An effort to integrate science and disaster management at the federal level, the Multi-Hazards Demonstration Project was initiated by the United States Geological Survey (USGS) with a five-year, pilot project in 2006. The project's goal is to improve California's resiliency to earthquakes floods, wildfires, tsunamis, and other hazards. That goal is being accomplished by applying science to community decision making and emergency response, particularly through the use of a collaborative process and multi-hazard frameworks to create scenarios. The project is intended to help communities reduce their natural hazard threats by directing new and existing science toward identifying significant vulnerabilities and producing innovative hazard and risk communication products. These comprehensive and well-constructed "what-if" hazard scenarios are put to use in assessing and practicing mitigation preparedness, response, and recovery planning.

In January, 2012, this Southern California pilot project evolved into the national Science Application For Risk Reduction (SAFRR) project described in Section 4.6.3 below. (For more information regarding the ShakeOut, ARkStorm, and SAFRR projects described below, visit the USGS Multi-Hazards Demonstration Project website: <http://urbanearth.gps.caltech.edu/about/>)

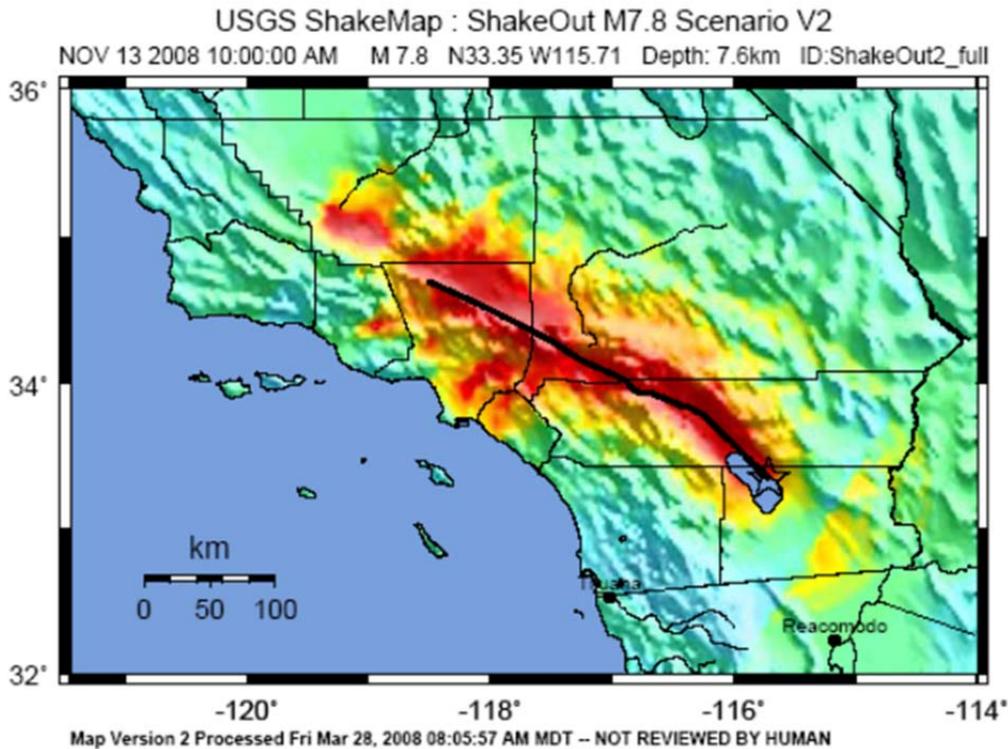
### **4.6.1 THE GREAT CALIFORNIA SHAKEOUT SCENARIO**

The ShakeOut Scenario, completed in May 2008 with hundreds of partners, was the first major product of the USGS Multi-Hazards Demonstration Project. This scenario designed a plausible large earthquake on the southern San Andreas Fault and then studied the effects of fault rupture and shaking as well as secondary hazards including liquefaction and landslides. The scenario considered direct physical impacts as well as long-term, social, cultural, and economic consequences.

Immediately after publication, it was clear that the ShakeOut Scenario made a difference. It encouraged new discoveries and applications in research fields as diverse as earthquake physics and disaster economics, broadening the foundation for future advances. Most importantly it inspired the largest ever participation in earthquake preparedness drills, among both the emergency response community and the general public, across the country and around the globe.

The first Great ShakeOut earthquake drill, based on the ShakeOut Scenario, was performed as part of the Golden Guardian exercise in California in 2008. Since then the drills have evolved into an annual statewide exercise which has led to improved preparedness though better understanding of possible disaster outcomes. For more information on the Great California Shakeout Drill Program, see Progress Summary 5.B in Chapter 5.

**MAP 4.G: Great ShakeOut Magnitude 7.8 Earthquake Scenario**



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC. (%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-85	85-124	>124
PEAK VEL. (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

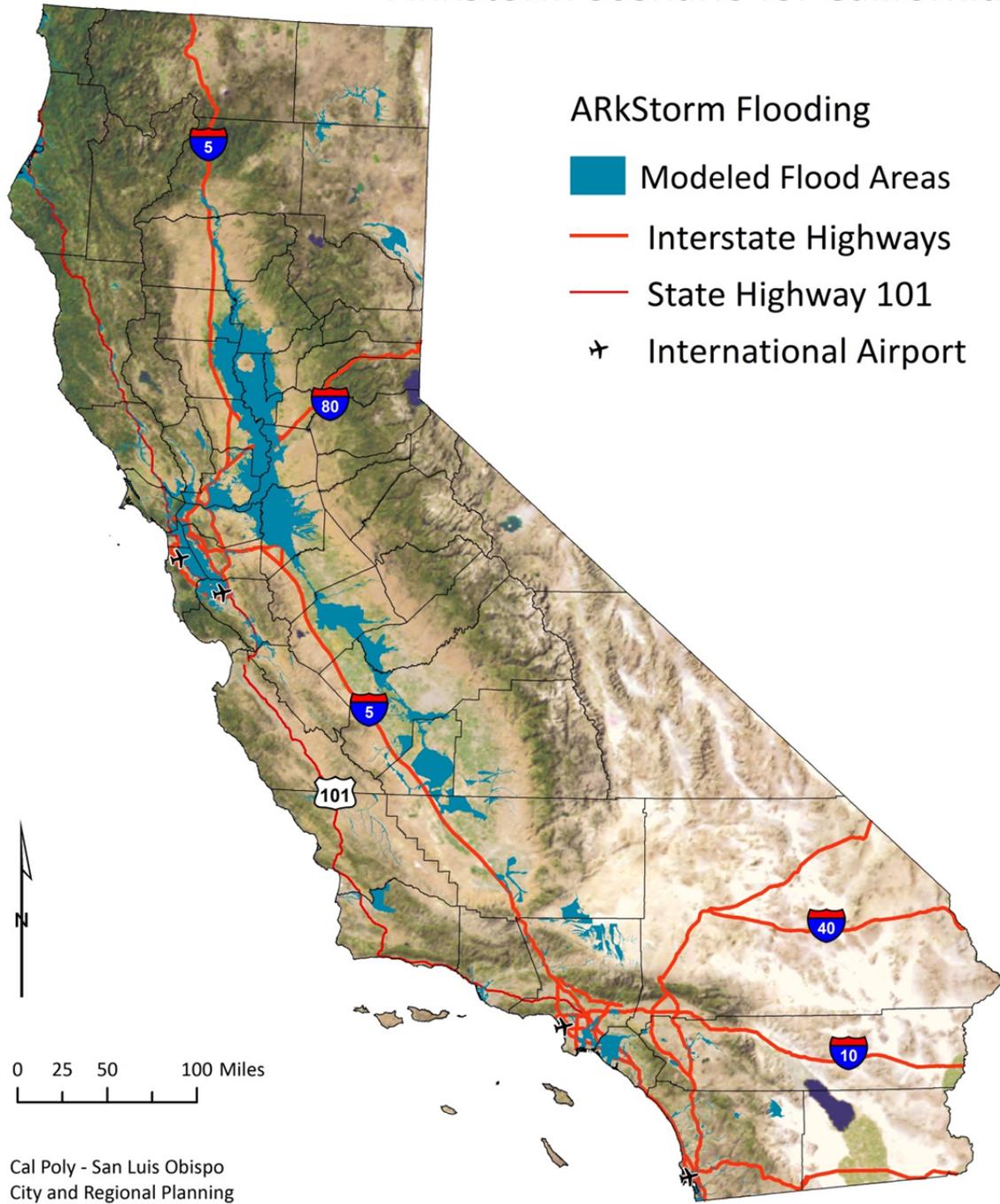
Map 4.G is a USGS “ShakeMap” created for the ShakeOut Scenario showing the geographic distribution of shaking levels on a Modified Mercalli Scale for a hypothetical magnitude 7.8 earthquake with a 200-mile fault rupture starting in the Salton Sea and progressing northward.

#### 4.6.2 ARKSTORM

The USGS Multi Hazards Demonstration Project’s (MHDP) second product called ARKStorm, addresses massive U.S. West Coast storms analogous to those that devastated California in 1861-1862. Scientific studies of offshore deposits in northern and southern California indicate that storms of this magnitude and larger have occurred about as often as large earthquakes on the southern San Andreas Fault. Such storms are projected to become more frequent and intense as a result of climate change.

MAP 4.H: Projected ARkStorm Flooding in California (Based on Modeled Scenario)

## ARkStorm Scenario for California

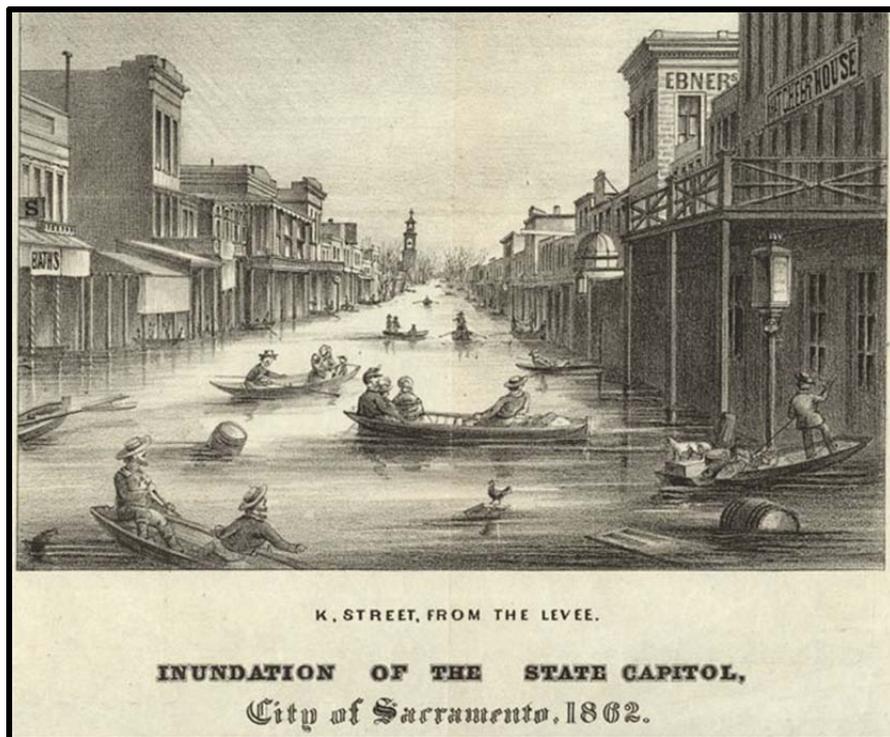


Sources: USGS ARkStorm

Created by: C. Schuldt (ARkStorm.mxd)

Map 4.H depicts an ARkStorm modeled scenario showing the potential for flooding in the Central Valley as the result of a large storm. (Online or download viewers can zoom in for a closer view of the information on this map.)

### Artist's Rendering of the 1861-1862 Winter Storms in Sacramento



This scientific effort resulted in a plausible flood hazard scenario to be used as a planning and preparation tool by hazard mitigation and emergency response agencies.

Cal OES intends to use the ARkStorm scenario in an upcoming Golden Guardian exercise.

#### **4.6.3 SCIENCE APPLICATION FOR RISK REDUCTION (SAFRR) TSUNAMI SCENARIO**

In January 2012, the Multi-Hazards Demonstration Project evolved into a permanent project known as Science Application for Risk Reduction (SAFRR) that has a similar mission and national purview. Under SAFRR's auspices, the USGS, National Oceanic and Atmospheric Administration (NOAA), California Geological Survey (CGS), and other entities have teamed to develop a Pacific Basin Tsunami Scenario. This scenario models inundation, currents, and scour to estimate the damage and necessary restoration of the built environment, as well as environmental, social, and economic impacts that would result from a large, hypothetical but plausible distant source tsunami affecting the west coast of the United States, including Alaska and Hawaii. The scenario focuses on ports, harbors and marinas. To avoid confusion in the Pacific Northwest where a Cascadia tsunami poses a much greater threat, the scenario restricts its focus to areas outside the Cascadia subduction zone.

Like the ShakeOut and ARkStorm disaster scenarios, the Pacific Basin Tsunami Scenario seeks to apply science to explain and understand the impacts of natural disasters, in this case, tsunamis. The tsunami scenario development began in January 2012 and will conclude in 2013.

## 4.7 THE NATIONAL PREPAREDNESS SYSTEM

A national initiative to integrate various prior and ongoing emergency management statutory and administrative directions from Congress and the President is embodied in Presidential Policy Directive (PPD) 8: National Preparedness which was released in March 2011. Its goal is to strengthen the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the nation. PPD-8 defines five mission areas—Prevention, Protection, Mitigation, Response, and Recovery—and mandates the development of a series of policy and planning documents to explain and guide the nation’s approach to ensuring and enhancing national preparedness.

### 4.7.1 THREAT AND HAZARD IDENTIFICATION AND RISK ASSESSMENT (THIRA)

The Threat and Hazard Identification and Risk Assessment (THIRA) is part of the overall National Preparedness System process derived from PPD-8, and builds on the National Preparedness Goal. THIRA is a tool that allows a jurisdiction to understand its threats and hazards as well as how the impacts may vary according to time of occurrence, season, location, and other community factors. This knowledge helps a jurisdiction establish informed and defensible capability targets. Each state must complete a THIRA each year as a condition of FEMA Homeland Security Grant Program funding. The ultimate outcome of the THIRA process is a set of capability targets.

The First Edition of the Threat and Hazard Identification Guide Comprehensive Preparedness Guide (CPG) 201 was published in April 2012. The annual State of California Threat and Hazard Identification and Risk Assessment is informed by the existing state emergency management plans and public and private stakeholders, and is conducted in accordance with CPG 201. This final THIRA document culminates in identifying preliminary State of California capability targets for the 31 core capabilities from the National Preparedness Goal. The entire CPG 201 is available on FEMA’s website: <http://www.fema.gov/national-preparedness>.

#### The THIRA Process

Basic elements of the THIRA process consist of five steps as defined in Comprehensive Preparedness Guide (CPG) 201:

- Step One: “Identify the Threats and Hazards of Concern,” assesses the various threats and hazards facing a community of any size.
- Step Two: “Give the Threats and Hazards Context,” assesses the vulnerability of the community to those hazards using varying time, season, location, and community factors.
- Step Three: “Examine the Core Capabilities Using the Threats and Hazards” estimates the consequences of those threats and hazards affecting the community.
- Step Four: “Set Capability Targets,” establishes capability targets through the lens of core capabilities.
- Step Five: “Apply the Results” captures the results of the THIRA process to set an informed foundation for planning and preparedness activities across prevention, protection, mitigation, response, and recovery.

In addition, Comprehensive Preparedness Guide (CPG) 201 Supplement 1: Toolkit provides templates for the actual THIRA submission product. The State of California completed these templates by using existing emergency response plans, subject matter expert elicitation and additional open source references in order to complete the first three steps of the THIRA.

The final THIRA product is the set of capability targets from Step Four of the CPG 201 THIRA process. The final THIRA product (Step Four) was submitted by uploading the completed templates to the State Preparedness Report (SPR) tool in the Preparedness Compliance Assessment System Tool (PrepCAST) portal so they could be used in the capability assessment process that leads to the SPR. The capability gaps inform

efforts, such as grant investment justifications, in order to address the gaps. Once they are submitted, FEMA Region IX will use the state, territory and tribal THIRAs and capability assessments to lead a regional gap analysis and capability development effort.

Step Five of the CPG 201 THIRA process (“Apply the Results”) is an ongoing effort to resolve capability gaps. In the capability assessment, states, territories, tribes, and urban areas eligible under the FY 2012 Urban Areas Security Initiative (UASI) grant program compare their capability targets from their THIRAs to their actual, assessed capabilities. The analysis then drives states, territories, tribes, and urban areas to determine their capability gaps.

### **THIRA Core Capability Targets**

Step Four in the THIRA process is to set capability targets. The greatest impact, coupled with desired outcomes, sets the target for each capability. The capability targets are based on the core capabilities which are grouped by mission areas: Prevention, Protection, Mitigation, Response and Recovery

Most relevant to this 2013 SHMP update are the mission areas of Mitigation and Response which include the following core capabilities:

#### Mitigation Mission Area Core Capabilities

- Community Resilience
- Long-Term Vulnerability Reduction
- Risk and Disaster Resilience
- Assessment of Threats and Hazard Identification

#### Response Mission Area Core Capabilities

- Critical Transportation
- Environmental Response/ Health and Safety
- Fatality Management Services
- Infrastructure Systems
- Mass Care Services
- Mass Search and Rescue Operations
- On-Scene Security and Protection
- Operational Communications
- Public and Private Services and Resources
- Public Health and Medical Services Situational Assessment

Planning, public information and warning and operational coordination are core capabilities common to all mission areas.

### **THIRA Submission to FEMA**

The State of California will apply the capability targets to the State Preparedness Report (SPR) capability assessment to ultimately define respective capability gaps. In order to meet FEMA’s submission requirements, both documents (the THIRA and SPR) are submitted via the FEMA Prep-Cast portal to the Department of Homeland Security. Once states, territories and participating tribes have submitted their respective THIRAs and capability assessments, FEMA Region IX will refine its THIRA and apply the results to identify and address the regional capability gaps. In future years THIRA will be based substantially on the refined assessments conducted by Region IX states to include California, territories, tribal nations, and Urban Area Security Initiative (UASI) communities. Using the THIRA results, jurisdictions will develop a strategy to allocate resources effectively to achieve capability targets and reduce risk.

#### 4.7.2 NATIONAL MITIGATION FRAMEWORK

Also part of the National Preparedness System is the National Mitigation Framework (NMF), which builds on the National Preparedness Goal. The National Mitigation Framework sets the strategy and doctrine for building, sustaining, and delivering the core capabilities for mitigation identified in the National Preparedness Goal. This framework considers the full spectrum of threats and hazards, including those that are natural, technological/accidental, and adversarial/human-caused.

The mission areas for the National Mitigation Framework are consistent with those of THIRA: Prevention, Protection, Mitigation, Response and Recovery. The framework provides the following definitions of the mission areas:

- Prevention: The capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism. As defined by PPD-8, the term “prevention” refers to preventing imminent threats.
- Protection: The capabilities necessary to secure the homeland against acts of terrorism and manmade or natural disasters.
- Mitigation: The capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- Response: The capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- Recovery: The capabilities necessary to assist communities affected by an incident to recover effectively.
- This framework establishes a common platform and forum for coordinating and addressing how the nation manages risk through mitigation capabilities. It describes mitigation roles across the whole community.

The National Mitigation Framework was published May 2013 and is available on FEMA’s website: <http://www.fema.gov/national-preparedness>.

PPD-8 and the National Mitigation Framework provide an emerging institutional backdrop for the federal and state laws, policies, and strategies presented previously in Chapter 3 as well as the detailed hazard and risk assessments described in the following Chapters 5 and 6.