STATE OF CALIFORNIA
MULTI-HAZARD MITIGATION PLAN

September 2004

State of California
Multi Hazard Mitigation Plan

Prepared By:

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State of California Multi-Hazard Mitigation Plan

Table of Contents

Chapter/Section **Page**

i. Summary of Tables & Figures 6
ii. Acknowledgements 11
iii. Summary 14

PART 1—INTRODUCTION

Chapter 1—The Planning Process 30
1.1 The Purpose of the Plan 31
1.2 The Planning Process 33
1.3 Coordination Among Agencies and Departments 36
1.4 Integration with Other Planning Efforts 41
1.5 Public Involvement 43

Chapter 2 – Adoption by the State 46

Chapter 3—State Profile 48
3.1 State Profile 48

PART 2—RISK ASSESSMENT

Chapter 4—Earthquake Risk Assessment 55
4.1 Identifying Earthquake Hazards 56
4.2 Profiling Earthquake Hazard Events 71
4.3 Assessing Vulnerability Inventories and Mitigation Progress by Jurisdiction and Type of Construction 77
4.3 Section 1 – Existing Buildings 79
4.3 Section 2 - Utilities and Transportation 101
4.4 Mitigation Measures for Earthquake Hazards 113
4.4 Section 1 - Historical Developments in Earthquake Mitigation 114
4.4 Section 2 - California Earthquake Loss Reduction Plan 119
4.5 Local Capability Assessment 126
4.6 Future Updates To This Plan 127

Chapter 5—Wildfire Risk Assessment 128
5.1 Identifying Fire Hazards 129
5.2 Profiling Fire Hazard Events 131
5.3 Assessing Fire Vulnerability and Losses by Jurisdiction 137
5.3 Section 1 – Fire Risks to Watershed Values 138
5.3 Section 2 – Fire Risks to Ecosystem Health 139
5.3 Section 3 – Fire Risks to Range Forage 143
5.3 Section 4 - Fire Risk to Timberlands and Woodlands 146

5.3 Section 5 - Fire Risk to Soils 149
5.3 Section 6 - Fire Risks to Riparian and Aquatic Habitats 151
5.3 Section 7 - Fire Risks to Recreation and Open Space 153
5.3 Section 8 – Fire Risks On Downstream Water Quality And Water Supply Infrastructure 154
5.4 Mitigation Measures for Fire Hazards 155
5.4 Section 1 – Wildfire and Human Development 156
5.4 Section 2 – The California Fire Plan 157
5.4 Section 3 - Pre-Fire Management Program to Reduce Wildfire Costs and Losses 161
5.4 Section 4 – Strategic Wildfire Planning 163
5.4 Section 5 – Governmental Partnership 165
5.4 Section 6 – Public Awareness and Education 169
5.4 Section 7 – Building Codes, Zoning, and Residential Flammable Vegetation Regulations 172

Chapter 6 - Flood Risk Assessment 174
6.1 Identifying Flood Hazards 175
6.2 Profiling Flood Hazard Events 177
6.3 Assessing Flood Vulnerability by Jurisdiction 189
6.4 Estimating Potential Flood Losses by Jurisdiction 194
6.5 Mitigation Measures for Flood Hazards 197

Chapter 7—Risk Assessment for Other Significant Hazards 212
7.1 Identifying Other Significant Hazards 213
7.2 Profiling Other Hazard Events 217
7.3 Assessing Other Hazard Vulnerabilities by Jurisdiction 230
7.4 Mitigation Measures for Other Hazards 234

Chapter 8 – Less Significant Hazards 240
8.1 Less Significant Hazards 240

PART 3—MITIGATION STRATEGY & FUNDING

Chapter 9—State Mitigation Strategy 248
9.1 Hazard Mitigation Goals 249
9.2 State Priorities 253
9.3 State Capability Assessment 258
9.4 Local Capability Assessment 263

Chapter 10—Funding Sources 272
10.1 Federal Funding Sources 273
10.2 State Funding Sources 282
10.3 Local Funding Sources 291
10.4 Alternative Funding Sources 292

PART 4—MITIGATION AWARENESS AND LOCAL PLANNING

Chapter 11 - Mitigation Education and Awareness 295
11.1 Mitigation Education and Awareness 295

Chapter 12—Local Mitigation Planning Coordination 297
12.1 Local Planning and Technical Assistance 298
12.2 Local Plan Integration 300
12.3 Prioritizing Local Assistance 301

Chapter 13 - Monitoring, Evaluating, and Updating the Plan 302
13.1 Updating the Plan 302

Chapter 14 - Estimating Potential Losses of State Facilities 304
14.1 Losses of State Facilities 304
14.2 Estimating Potential Losses by Jurisdiction 307

PART 5—APPENDICES

Glossary of Terms 312
Acronyms 315
Bibliography 317
Related Websites 328

i. Summary of Tables & Figures

Type	Number	Name	Page
Charts & Graphs	1.0	State Planning Timeline	N/A
	4.4.2A	CA Earthquake Loss Reduction Plan Elements And Initiatives	121
	5.1A	Wildfire Damage	129
	5.2A	Structure Loss From Wildfires	131
	5.3.2A	Fire-Related Risks To Ecosystems By Condition Class	143
	7.2A & B	Tracking Water Conditions	218
	7.2C	Hazardous Material Spills	225
Maps	iii.	States of Emergency	22
	4.1A	The Most Earthquake-Prone Areas In California	56
	4.1B	Shake Map	60
	4.2A	State Earthquake Disaster Proclamations	71
	4.3A	Levels Of Earthquake Hazards In California	77
	5.2A	Distribution Of Wildland-Urban Interface Housing Unit Density	133
	5.2B	State Wildland/Urban Interface Disaster Proclamations	134
	5.3.2A	Fire-Related Risks To Ecosystem Health As Measured By Condition Class	133
	5.3.3A	Potential Value Of Loss Expected Due To Wildland Fire Disrupting Grazing Activities	144
	6.1A	State Flood Disaster Proclamations	175
	6.2A	California Hydrologic Regions	177
	6.2B	Flood Types	186
	6.2C	Flood Zones	186
	6.2D	Tsunami Risk Zone	187
	6.3B	Flood Damage	191
	6.4A	NFIP Repetitive Losses	194
	6.4B	Storm and Flood Disasters Between 1955-2002	194
	7.1A	Civil Disturbances	212
	7.1B	Major California Dams	213
	7.1C	State Dam Disaster Proclamations	213

Continued on next page

i. Summary of Tables & Figures

Type	Number	Name	Page
Maps, Cont.	7.1D	State Drought Disaster Proclamations	213
	7.1E	Federal Freeze Disaster Declarations	213
	7.1F	Hazardous Materials Spills	213
	7.1G	State Agricultural Disaster Proclamations	214
	7.1H	Agricultural Disasters - Insect Pests	214
	7.1I	West Nile Virus	214
	7.1J	State Landslide Disaster Proclamations	214
	7.1K	Volcanoes & Calderas	215
	7.3A	Dam Zones	230
	7.3B	Landslide Risk Zones	230
	7.3C	Proximity of Volcanoes to Urban Areas	231
	7.3D	Volcanic Hazards	232
	14.1A	State Facilities in Earthquake Hazard Areas	304
	14.1B	State Facilities in Fire Hazard Areas	304
	14.1C	State Facilities in Flood Hazard Areas	305
Photos	4.1A	Loma Prieta Earthquake Damage	62
	4.1B	Surface Fault Rupture	64
	4.1C	Landslide	65
Tables	2.0	Declared California Disasters	53
	4.1A	The Modified Mercalli Intensity Scale	58
	4.2A	Earthquake Losses	72
	4.2B	Earthquake Scenarios Losses	74
	4.3A	Vulnerable California Populations	76
	4.3.1A	Earthquake Mitigation of Key Building Inventories	82
	4.3.1B	URM Buildings in California	84
	4.3.1C	Hospitals	85
	4.3.1D	Mitigation of Tilt-ups and Similar Buildings	93

Continued on next page

i. Summary of Tables & Figures

Type	Number	Name	Page
Tables, cont.	4.3.1E	Mitigation of Older Concrete Buildings	96
	4.3.1F	Seismic Gas Shutoff Valves	99
	4.3.2A	Mitigation Of Utilities And Transportation Systems	100
	4.4.2A	The Goals Of The California Earthquake Loss Reduction Plan By 2010	118
	4.4.2B	Critically Important Initiatives From The California Earthquake Loss Reduction Plan 2002-2006	119
	4.4.2C	Estimated Expenditures on Earthquake Mitigation	122
	4.4.2D	Selected Future State Seismic Hazard Mitigation Commitments	124
	4.4.2E	Selected Federal Seismic Hazard Mitigation Investments In California	124
	5.1A	Legislative Response to Fire Threat in California	129
	5.2A	Housing Unit Density Classes	132
	5.2B	California Fire Timeline & Statistics	132
	5.2C	Wildland Urban Interface By Density Class & Fire Threat	134
	5.2D	Housing Units In The Wildland Urban Interface By Density Class And Fire Threat	135
	5.3.2A	Condition Class Definitions	138
	5.3.2B	Summary Of Lands By Condition Class	139
	5.3.2C	Percentage Area Of Forests & Rangelands In Condition Classes 2 & 3	141
	5.3.3A	Loss Of Value Of Rangeland Forage Due To Wildfire	143
	5.3.4A	Percentage Of Timberland Area By Fire Threat Class	145
	5.3.4B	Percentage Of Hardwood Woodland Areas By Fire Threat Class	147
	5.3.5A	Statewide Distribution Of Post-Fire Erosion Risk Classes (Acres)	149
	5.4.5A	CDF WUI Grant Awards	167
	6.1A	Recent Flood Disasters	175
	6.2A	Delta Levee Break Disasters	186
	6.2B	Flood Types In California	186
	6.3A	Sample Flood Mapping Data	190
	6.3B	Flood Damage	191
	6.3C	PA Flood Damage	191

Continued on next page

i. Summary of Tables & Figures

Type	Number	Name	Page
Tables, cont.	6.3D	IA Flood Damage	191
	6.3E	Coordination With Local Communities	191
	6.3F	Repetitive Loss Communities	192
	6.4A	NFIP Repetitive Losses	194
	6.4B	Potential Flood Loss Areas	194
	6.5A	Theme 1: Better Understanding And Reducing Risks From Reasonably Foreseeable Flooding	202
	6.5B	Theme 2: Multi-Objective Management Approach For Floodplains	202
	6.5C	Theme 3: Local Assistance, Funding, & Legislation for Floodplain Management	203
	6.5D	Task Force Stakeholders	203
	6.5E	Federal Advisory Committee	203
	6.5F	FPCP-Approved Projects	205
	6.5G	Acquisition Projects	209
	6.5H	Elevations Projects	209
	6.5I	Acquisition/Elevation/Relocation Projects	209
	6.5J	Erosion Control Projects	209
	6.5K	Flood Control Projects	209
	6.5L	Communities With Completed FMPs and Have Received FMA Funds	210
	7.1A	Losses From Other Significant Hazard Types	212
	7.2A	Drought	219
	7.2B	Freeze	220
	7.2C	Agricultural and Health Risks From Insect Pests	221
	7.2D	Insect Infestations	221
	7.2E	Civil Disturbances	222
	7.3A	Volcanoes	231
	7.4A	Mitigation Measures	233
	8.1A	Airline Crashes	240
	8.1B	Four Levels of Nuclear Power Emergencies	243
	8.1C	Train Incidents/Derailments	246
	9.2A	Direct Mitigation Actions	252
	9.2B	Indirect Mitigation Actions	253
	9.4A	Unreinforced Masonry Retrofit Program Findings	267

Continued on next page

i. Summary of Tables & Figures

Type	Number	Name	Page
Tables, cont.	10.1A	Federal Homeland Security Funding Programs	279
	10.2A	Caltrans Funding	282
	10.2B	Community Development Block Grant Funding In California (Summary)	289
	12.1A	The Four Parts of Technical Assistance	298
	14.1A	Potential Loss of State Facilities From Earthquake Hazards	303
	14.1B	Fire Hazards	304
	14.1C	Flood Hazards	305
	14.2A	Estimated Risks and Potential Losses As Reported By All Counties	308
	14.2B	Estimated Risks and Potential Losses As Reported by Cities	308
	14.2C	Estimated Risks and Potential Losses As Reported by Special Districts	308
Other Doc-uments	1.0	Instructions On Using Hyperlinks In This Plan	29
	2.0	List of Assurances	46
	9.3A	Executive Order W-9-91	257
	12.1 A-O	LHMP Guidance Document	298

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Continued on next page

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iii. Summary

Using the Summary

This Summary provides a quick review of the key components of the State of California Multi-Hazard Mitigation Plan (Plan). Parts of this Summary are linked directly to related sections of the Plan—just click on the underlined text. For readers working with a hard copy, this Summary also includes page references to make it easier to find a given topic.

What is Hazard Mitigation?

44 Code of Federal Regulations, Subpart M, Section 206.401 defines hazard mitigation as, "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards."

For the purposes of this plan, hazards include both natural and man-made.

Purpose of the Plan

The State of California (State) is required to adopt a federally-approved State Multi-Hazard Mitigation Plan to be eligible for certain disaster assistance and mitigation funding. The overall intent of this Plan is to reduce or prevent injury and damage from hazards in the State. It identifies past and present mitigation activities, current policies and programs, and mitigation strategies for the future. This Plan also guides hazard mitigation activities by establishing hazard mitigation goals and objectives.

The Plan is a "living document" that will be reviewed and updated annually to reflect changing conditions and improved by new information, especially information on local planning activities.

The Plan:

- Documents statewide hazard mitigation planning in California
- Describes strategies and priorities for future mitigation activities
- Facilitates the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meets state and federal statutory and regulatory requirements
- Is an annex to the State Emergency Plan.

Continued on next page

iii. Summary

The Planning Process

The Plan is an evaluation the hazards California faces and the strategies, goals, and activities the state will pursue to address these hazards. OES implemented the state hazard mitigation planning process by:

- Inviting state agencies with key hazard mitigation roles to join the State Hazard Mitigation Team (SHMT) and become active participants in the development of this Plan
- Providing outreach, technical assistance, and education at the local regional, and tribal levels regarding both the state plan and the development and adoption of local plans
- Providing the public with the opportunity to review and comment on this Plan

Integrating Other Planning Efforts

A number of other state plans and documents were incorporated into this Plan, including:

- California Earthquake Loss Reduction Plan, prepared by the Seismic Safety Commission
- California Fire Plan, prepared by the California Department of Forestry and Fire Protection
- State of California Flood Hazard Mitigation Plan, prepared by the California Department of Water Resources

These plans are summarized below and are described in more detail in this Plan.

Continued on next page

iii. Summary

Federal Earthquake Disasters in California

The table below summarizes federally declared earthquake disasters in California since 1992.

Disaster #	Date	Number of Counties Affected	Number of Deaths	Damages
DR-943 Cape Mendocino	4/25/92 and 4/27/92	1	0	$48.2 million
DR-947 Big Bear - Landers	6/28/92	2	1	$91.1 million
DR-1008 Northridge	1/17/94	3	57	$40 billion+
DR-1342 Napa	9/3/00	1	Unknown	Unknown
DR-1505 San Simeon	12/22/03	2	Unknown	Unknown

Mitigation Plan for Seismic Hazards

The California Earthquake Loss Reduction Plan 2002-2006 is the state's mitigation plan for seismic hazards. Approved by the governor in 2002, it articulates the state's short- and long-term earthquake hazard mitigation priorities. The plan contains three overarching goals, eleven elements and 148 initiatives. About half of the initiatives are designed to continue indefinitely.

Key components of the California Earthquake Loss Reduction Plan include:

- Goals for 2010 (Table 4.4.2A)
- Critically Important Initiatives (Table 4.4.2B)
- Seismic Mitigation Cost Estimate and Funding Sources

Continued on next page

iii. Summary

Information about Seismic Hazards

For additional information about seismic hazards, vulnerability assessments, and mitigation measures, go to the following sections in the State Plan:

Section	Title	See Page
4.1	Identifying Earthquake Hazards	55
4.2	Profiling Earthquake Hazard Events	70
4.3	Assessing Vulnerability Inventories and Mitigation Progress by Jurisdiction and Type of Construction	76
4.4	Mitigation Measures for Earthquake Hazards	112
4.5	Local Capability Assessment	125
4.6	Future Needs for Improving This Plan	126

Federal Fire Disasters in California

The table below summarizes federally declared fire disasters in California since 1992.

Disaster #	Date	Number of Counties Affected	Number of Deaths	Damage
DR-958 Fires	8/29/92	2	0	$54,108,500
DR-1005 Southern CA Firestorms	10/28/93	6	4	Approx. $1 billion
DR-1498 October 2003 Fires	10/21/03-12/02/03	7	Unknown	Unknown

Continued on next page

iii. Summary

The California Fire Plan

The California Fire Plan is the state's roadmap for reducing the risk of wildfire. This forward-thinking plan calls for an innovative, proactive approach that includes stakeholders in identifying the risks that citizens face and appropriate community-based solutions that lessen the cost and damage from wildfires while improving public and firefighter safety and contributing to ecosystem health. The focus of this plan is local solutions for local problems.

The framework of the plan involves:

- Assessment of wildfire potential—fuels and weather
- The level of service—fire suppression success
- Assets at risk—life, property, air quality, water and watersheds, range, wildlife habitat, and timber

Wildfire Hazards in California

For additional information about wildfire hazards, vulnerability assessments, and mitigation measures, go to the following sections in the State Plan:

Section	Title	See Page
5.4.1	Wildfire and Human Development	155
5.4.2	The California Fire Plan	156
5.4.3	Pre-Fire Management Program to Reduce Wildfire Costs and Losses	160
5.4.4	Strategic Wildfire Planning	162
5.4.5	Governmental Partnership	164
5.4.6	Public Awareness and Education	168
5.4.7	Building Codes, Zoning, and Residential Flammable Vegetation Regulations	171

Continued on next page

iii. Summary

California's Flood History

California has a chronic and destructive flood history. While earthquakes tend to cause more extensive and costly damage, floods are noted for their persistence and effect on numerous communities (per 44CFR, go to glossary of terms for definition) during a single event. Of the 72 federally declared disasters in the state occurring between 1950 and 2000, 50 percent have been flood related.

While the "Great Flood" of 1861-62 may be unmatched in scope, the devastating effects of recent floods far exceed the damage of a century ago. Despite the construction of massive and relatively effective flood control projects, California remains highly vulnerable to flooding. A steady rise in population and the resulting development have contributed to an increased flood risk throughout the state.

Federal Flood Disasters in California

Between 1992 and 2002, every county in California was declared a federal disaster area at least once due to a flooding event. The counties of Los Angeles, Orange, and San Bernardino were declared federal flood disaster areas five times and sixteen other counties were declared disaster areas four times. The table below summarizes federally declared flood disasters in California since 1992:

Disaster #	Date	Number of Counties Affected	Number of Deaths	Damage
935-DR-CA	February 1992	6	5	$123.2 Million
979-DR-CA	January 1993	25	20	$600 Million
1044-DR-CA	January 1995	45	11	$741.4 Million
1046-DR-CA	February 1995	57	17	$1.1 Billion
1155-DR-CA	January 1997	48	8	$1.8 Billion
1203-DR-CA	February 1998	40	17	$550 Million

California Population in the Floodplain, by Jurisdiction

Nearly six percent of California's population (approximately 1,973,712 people) lives in a designated 100-year floodplain. The state's population is projected to increase by 40 percent through 2025, with 62 percent of the growth occurring in the Central Valley floodplain.

Continued on next page

iii. Summary

Repetitive Flood Damage

The repetitive nature of flood damage in California is of great concern. Areas flooded in the past continue to be inundated again and again. The desert community of Hesperia, in San Bernardino County, provides a classic example. Hesperia suffers repetitive flash flooding during both intense thunderstorms and winter storms. Such flooding occurred four times between 1991 and 1995. The frequent and devastating floods that occur on the Russian River in Sonoma County serve as another example. The county recorded thirteen flood events between 1995 and 2001—the most repetitive losses of any area in California. FEMA lists 801 repetitive loss properties in Sonoma County with $47.6 million in NFIP insurance claims between 1992 and 2002.

State Efforts

The state does the following to reduce repetitive flood losses:

- Works with FEMA to reduce NFIP claims by encouraging communities to participate in the FMA planning process and in developing FMA projects that address NFIP repetitive loss properties
- Works with communities to develop HMGP projects that address NFIP losses.
- Coordinates FMA and HMGP projects with communities to provide the greatest reduction of losses to the most vulnerable areas in the state

More Information about Flood Hazards

For more information about flooding in California, please go to the following sections of the State Plan:

Section	Title	Page
6.1	Identifying Flood Hazards	174
6.2	Profiling Flood Hazard Events	176
6.3	Assessing Flood Vulnerability by Jurisdiction	188
6.4	Estimating Potential Flood Losses by Jurisdiction	193
6.5	Mitigation Measures for Flood Hazards	196

Continued on next page

iii. Summary

Other Hazards in California

In addition to earthquakes, fires and floods, California faces a number of other hazards. The State of Emergency Map (below) identifies the types of major disasters and emergencies California has faced since 1950. The Plan profiles the most significant of these other hazards. These profiles discuss past hazards, the analysis used to determine the probability of future occurrences, the potential magnitude of future occurrences, and conditions that contribute to the vulnerability.

For additional information, refer to the following sections of the State Plan:

Drought
Freezes
Insect Pests
Avalanches
Civil Disturbances
Dam Failure
Hazardous Materials Spills
Landslides
Pollution
Terrorism
Volcanoes

State Multi-Hazard Mitigation Strategy

The hazard mitigation strategy for California is guided by a vision, a mission statement, and a set of goals.

Vision: A safe and resilient California through hazard mitigation

Mission: To integrate current laws and programs into a mitigation system that will guide the state in the reduction and prevention of injury and damage from natural and man-made hazards.

Goals:

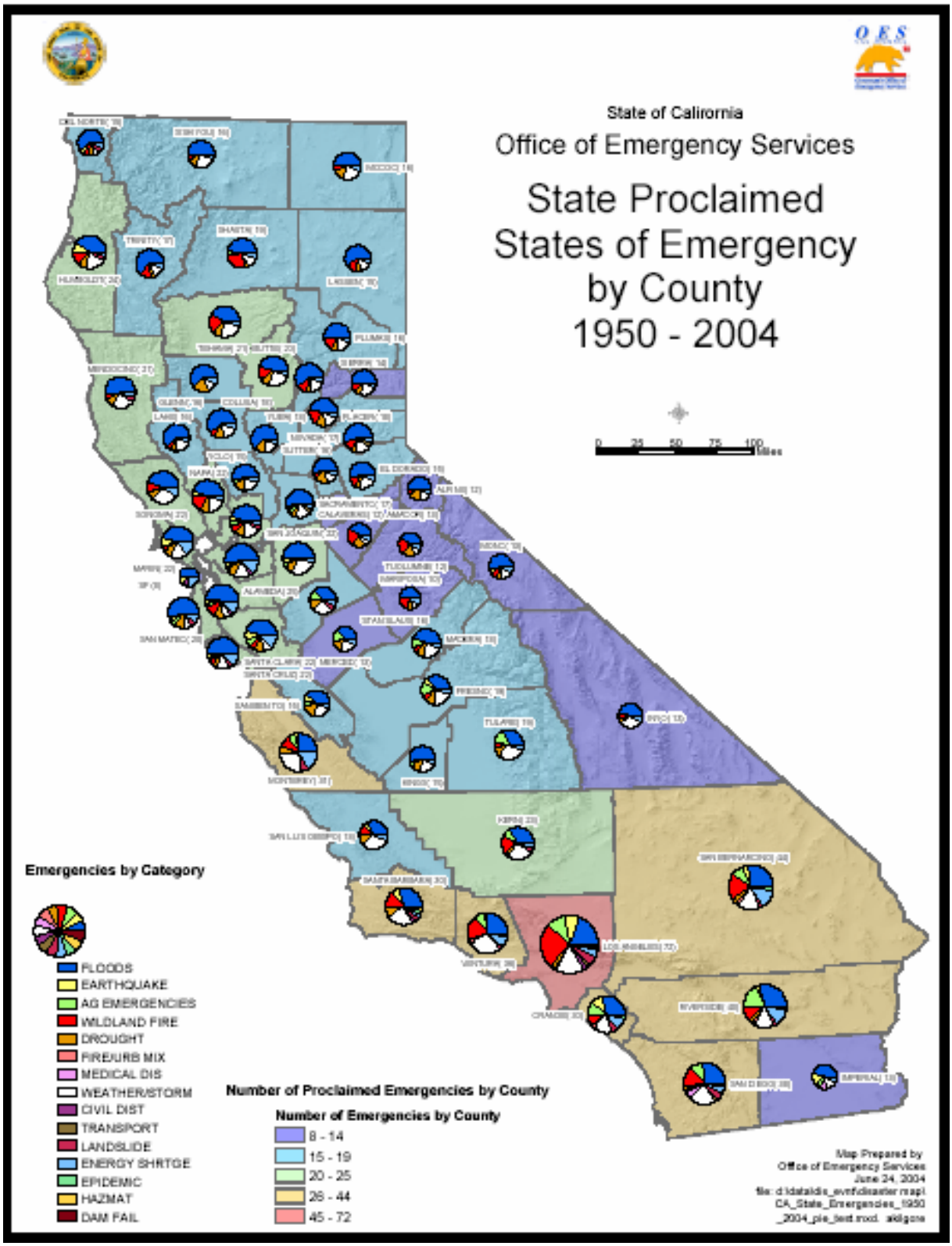
- Save Lives and Reduce Injuries
- Avoid Damages to Property
- Protect the Environment
- Promote Hazard Mitigation as an Integrated Policy

These goals and their associated objectives are described below.

Continued on next page

iii. Summary

Map iii - States of Emergency



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iii. Summary

Goal 1: Save Lives and Reduce Injuries

California is the most populated state in the country, with over 36 million residents. The sheer number of people can make emergency management activities a challenge. The challenge is further complicated by the distribution of population. The table below lists California's most populated counties and the number of state emergencies declared in each since 1970.

County	Population	Emergencies
Los Angeles	10, 103,000	68
Orange	3,017,000	28
San Diego	3,017,200	33
San Bernardino	1,886,400	39
Riverside	1,776,700	35
Santa Clara	1,731,400	20
Alameda	1,498,000	21

California's population is concentrated in areas where hazard risk is high. Wildland urban interface areas in San Bernardino, Riverside, Los Angeles and San Diego counties are magnets for both development and devastating fires. Flooding has historically been more prevalent in Southern California, where urban development contributes to a high amount of stormwater runoff. The San Francisco Bay Area and Southern California have both experienced large earthquakes since 1989.

Regardless of where Californians live, protecting their safety is one of the state's primary responsibilities. Many state and local laws have public safety of our citizens as their primary concern. Protecting lives is also the basis for emergency planning, response, and mitigation activities.

Consistent with one of the main responsibilities of state government, the mission of OES, and the OES Disaster Assistance Division's Strategic Plan, the primary goal of this State Multi-Hazard Mitigation Plan is the protection of the people of California.

Continued on next page

iii. Summary

Goal 1 Objectives

To achieve Goal 1, OES intends to:

- Continually improve the understanding of the location and potential impacts of natural hazards, the vulnerability of building types, and community development patterns and the measures needed to protect life safety
- Continually provide state and local agencies with updated information about hazards, vulnerabilities, and mitigation measures
- Ensure that all state codes and standards ensure the protection of life
- Ensure that all structures in the state meet minimum standards for life safety
- Ensure that all development in high-risk areas is protected by mitigation measures that provide for life safety.
- Identify and mitigate all imminent threats to life safety

Goal 2: Avoid Damages to Property

The Plan's stakeholders have agreed that strengthening building, mechanical, and fire codes is critical to protect lives and property and reduce seismic, fire and flood hazards. These codes help communities design and construct buildings that resist the forces of nature and ensure safety. The state's land use laws assist with this effort by requiring communities to keep buildings and development out of the most hazardous areas. It is essential that mitigation planning be incorporated into all land use planning activities at the local and state levels. This includes integrating mitigation efforts into all city and county general plans.

Earthquakes, floods, and other natural hazards disrupt the critical infrastructure of the state. Transportation routes, utilities, government facilities, and hospitals are critical to the state's ability to provide essential services. Retrofitting facilities by priority based on vulnerability will protect important buildings, occupants, and informational records.

The protection of property also includes the preservation of valuable operational data, historical information, and other non-structural assets. Stakeholders have been encouraged to incorporate mitigation activities into Continuity of Business and Continuity of Government plans at the local and state levels.

Continued on next page

iii. Summary

Goal 2 Objectives

To achieve Goal 2, OES intends to:

- Encourage safe development in high hazard areas
- Encourage property protection measures for all communities and structures located in hazard areas
- Reduce or eliminate all repetitive property losses due to flood, fire and earthquake
- Research, develop, and adopt cost-effective codes and standards to protect properties beyond the minimum of protecting life safety
- Establish a partnership among all levels of government and the business community to improve and implement methods to protect property

Goal 3: Protect the Environment

Californians place a strong emphasis on the quality of the physical environment. It is a primary reason why people live in California and why all levels of government and many organizations strive to conserve it.

Natural disasters not only destroy the man-made environment, but they can also adversely affect the physical environment. Dead and diseased trees create unhealthy forests and provide fuel for wildland fires that damage or eliminate habitat necessary to the survival of plants and wildlife. Flooding can adversely affect water quality in the rivers and streams that support fisheries and can also damage critical spawning habitat. Geologic hazards can result in landslides that can block streams and prevent fish migration. Debris from natural disasters can pollute the water, foul the land, and diminish air quality if not disposed of properly.

Goal 3 Objectives

To achieve Goal 3, OES intends to:

- Ensure that all mitigation projects are reviewed for compliance with all applicable environmental laws
- Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes
- Ensure that all state and local hazard mitigation planning reflect the goal of protecting the environment
- Develop and implement wildfire mitigation and watershed protection strategies that reduce losses to wildlife and habitat and protect water while also reducing damage to development
- Develop and distribute to state and local agencies maps of high-risk areas integrated with wildlife habitat areas

Continued on next page

iii. Summary

Goal 4: Promote Hazard Mitigation as an Integrated Policy

Currently the state and its communities have implemented hazard mitigation polices and measures in an ad hoc fashion. New mitigation policies, programs, and projects are often developed in response to the latest disaster. As the population of the state continues to grow in areas most susceptible to natural and man-caused hazards, comprehensive hazard mitigation is becoming more imperative. Planning and education are the best steps toward increased awareness and integration.

State and local hazard mitigation planning efforts are significant steps in broadening the understanding of the importance of mitigation. The law requiring local general plans that guide land use has proven to be useful in reducing the number and the severity of disasters. It will take time to see if the new hazard mitigation planning processes are as accepted and successful.

The state has already had success with education and awareness through programs addressing the three major natural hazards—fire, flood, and earthquakes. At three separate times of the year, OES, CSSC, the Department of Conservation, CDF, DWR, and the Department of Education join forces to hold special programs in schools and in communities to raise hazard awareness. In addition, OES annually sponsors the Disaster Resistant California (DRC) conference as a source of specialized mitigation training. The DRC provides a forum for businesses, academia, and government to share ideas, processes, success stories, and other information.

Goal 4 Objectives

To achieve Goal 4, OES intends to:

- Ensure that all communities in the state are covered by a Local Hazard Mitigation Plan
- Integrate hazard mitigation policies into local general plans
- Update the State Multi-Hazard Mitigation Plan annually to integrate local hazard mitigation plans and the results of disaster-and hazard-specific planning efforts
- Increase understanding of the importance of hazard mitigation among the general public and the business sector, stressing the benefits of reduced losses to life and property, the reduced cost of disaster recovery, and the increased benefit of the continuity of operations of business and government
- Strengthen the message of hazard mitigation in emergency management programs.

Continued on next page

iii. Summary

Planning Priorities

Based on the assessment of California's risks and vulnerabilities, the state has identified the following priorities for federal hazard mitigation funding:

- Protect lives and property at risk from imminent hazards created or exacerbated by disasters
- Protect vulnerable critical facilities and infrastructure in high hazard areas of the state
- Reduce repetitive losses
- Ensure that all communities are covered by an adopted local hazard mitigation plan. For the definition of communities go to the glossary of terms in the appendices.
- Improve understanding of natural hazards and the performance of hazard mitigation practices

Coordination of Local Hazard Mitigation Planning

In addition to state and federal codes and regulations and the expertise and assistance available through various state agencies, OES has instituted a multi-faceted Local Hazard Mitigation Planning Program (LHMP) in order to provide technical assistance to and track the progress and effectiveness of local government mitigation planning programs.

LHMP Program Objectives

The objectives of the LHMP Program are to:

- Integrate hazard mitigation activities in all pertinent local government programs
- Maximize the use of hazard mitigation resources, grants, and funds to reduce the impact of future disasters at the local level
- Maintain collaborative and cooperative relationships with local emergency managers, land use planners, and the scientific and technical communities involved in hazard mitigation
- Provide technical assistance and guidance to local governments to improve hazard risk assessments, mitigation project identification and analysis, and the development of local hazard mitigation plans
- Improve communications with stakeholders, legislators, and special interest groups involved in hazard mitigation
- Continue to enhance OES Regional and Operational Area capability and coordination
- Develop a statewide program of support for hazard identification and analysis and a risk-based approach to project identification, prioritization, and support for local governments

Continued on next page

iii. Summary

Prioritization of Mitigation Activities

The following criteria will be used to prioritize local hazard mitigation activities for funding:

- Percent of population at risk
- Frequency and likelihood of hazard
- Repetitive loss areas
- Small and impoverished communities
- Community planning resources available
- Types and percent of land areas at risk
- Development pressure rating
- Project urgency and cost benefit analysis
- Cost effectiveness of measure

Sources of Hazard Mitigation Funding

For further information about mitigation funding, please refer to the following sections of the State Plan:

Section	Title	Page
10.1	Federal Funding Sources	272
10.2	State Funding Sources	281
10.3	Local Funding Sources	290
10.4	Alternative Funding Sources	291

Plan Maintenance Process

Because the Plan is a living document that reflects ongoing hazard mitigation activities, the process of monitoring, evaluating, and updating it will be critical to the effectiveness of hazard mitigation in California. To facilitate the state hazard mitigation planning process, the Plan will be reviewed annually and any revisions will be provided to FEMA in the form of a written report.

State of California Multi-Hazard Mitigation Plan

PART 1—INTRODUCTION

How To Use This Plan

The State of California Multi-Hazard Mitigation Plan (Plan) contains information about the State's hazard mitigation efforts and programs. Some of this information is very detailed and all readers may not be interested in reviewing it. To provide readers with the option of accessing detailed information, the Plan includes "hyperlinks" (or links) to this information. Every link is underlined and in blue. Clicking on the link with your computer mouse will automatically take you to the information. We hope these links will create a user-friendly document that responds to the information needs of our readers. For more detailed information about the links, click Document 1.0 Instructions on Hyperlinks in the Plan.
If you are not viewing the Plan on a computer and are using a printed version, this additional source of information is included in Document 1.0 in the appendices.

In This Part

This part contains the following chapters.

Chapter	Title	Page
1	The Planning Process	30
2	Adoption by the State	46
3	State Profile	47

Chapter 1—The Planning Process

In This Chapter

This chapter contains the following topics.

Topic	Title	Page
1.1	The Purpose of the Plan	31
1.2	The Planning Process	33
1.3	Coordination Among Agencies	36
1.4	Integration with Other Planning Efforts	41
1.5	Public Involvement	43

1.1 The Purpose of the Plan

Introduction

The State of California is required to have a FEMA-approved Multi-Hazard Mitigation Plan (Plan) to be eligible for disaster recovery assistance and mitigation funding. This document fulfills FEMA requirements and provides direction and guidance on implementing hazard mitigation to state, local, and tribal governments. The Plan reflects California's cultural, societal, economic, and environmental values while also acknowledging the numerous regulatory and compliance issues facing government. It is intended to set the tone for the implementation of hazard mitigation practices that will build a safe and resilient California.

The goal of the Plan is to reduce or prevent injury and damage from hazards in California. It describes past and current hazard mitigation activities and philosophies and outlines future mitigation goals and strategies. The Plan provides guidance for hazard mitigation activities while cementing partnerships among local, state, and federal agencies in a formal written document. The Plan is a "living document" that will be reviewed annually and modified as necessary to reflect future changes and additional planning activities, especially at the local level.

The Plan:

- Documents statewide hazard mitigation system implemented in California
- Describes strategies and priorities for future mitigation activities
- Facilitates the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meets state and federal statutory and regulatory requirements
- Is an annex to the State Emergency Plan

Meeting Federal Requirements

This Plan meets the requirements for a standard state plan under Interim Final Rule 44 CFR 201.4, published by FEMA on February 28, 2002. Adoption of the Plan by the state and approval by FEMA qualifies California to obtain federal assistance for hazard mitigation and for the repair and replacement of infrastructure damaged in natural disasters.

Continued on next page

1.1 The Purpose of the Plan

What is Hazard Mitigation?

44 Code of Federal Regulations, Subpart M, Section 206.401 defines hazard mitigation as, "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards."

For the purposes of this plan, hazards include both natural and man-made.

Plan Development Process

While the Governor's Office of Emergency Services (OES) has lead responsibility for the development and maintenance of the State Multi-Hazard Mitigation Plan, the document was produced in collaboration with multiple state agencies. A State Hazard Mitigation Team (SHMT) met regularly starting in August 2003 to develop the statewide strategies, priorities, and goals that are the core of the Plan. The SHMT is truly the "owner" of the Plan, while OES is its steward.

1.2 The Planning Process

Introduction

Hazard mitigation planning is a dynamic process built on realistic assessments of past and present information that engages multiple partners to anticipate future hazards and provide meaningful strategies to address possible impacts and identified needs.

The hazard mitigation planning process involves:

- Organizing resources
- Assessing risks
- Developing mitigation strategies, goals, and priorities
- Adopting a plan
- Implementing the plan
- Monitoring progress
- Revising the plan as necessary

Various local, state, and federal agencies, tribal governments, businesses, non-profit organizations, and others are involved in hazard mitigation planning efforts in California. Many mitigation planning efforts and groups in the state are collaborative and coordinated by multiple agencies. Examples include the California Fire Alliance, the Floodplain Management Task Force, the Drought Task Force, and the Sacramento-San Joaquin River Basins Comprehensive Study. These cooperative efforts served as models for the development of this Plan.

Role of OES

The primary roles of OES in terms of this Plan are to:

- Ensure that the Plan meets FEMA requirements and is approved by FEMA
- Coordinate the continued development of the Plan, including coordination of the State Hazard Mitigation Team, and local and federal agencies
- Administer FEMA hazard mitigation grant programs, including HMGP, PDM, FMA, and FMAG
- Provide ample opportunity for public involvement in the development of the Plan (see Topic 1.5 for more information)

Continued on next page

1.2 The Planning Process

OES Implementation

This Plan outlines California state government's understanding and evaluation of the hazards the state faces and the strategies, goals, and activities it will pursue to address them. Although this is the state's first formal multi-hazard mitigation plan, California has been successfully implementing hazard mitigation programs for 16 years. Since 1986, the state has completed 558 mitigation projects, expending more than $455 million to reduce or eliminate the long-term risks to life and property from hazard events.

OES has implemented the state multi-hazard mitigation planning process by:

- Inviting state agencies with key hazard mitigation roles to join the SHMT and become active participants in the development of this Plan
- Providing outreach, technical assistance, and education at the local regional, and tribal levels regarding both the Plan and the development and adoption of local plans
- Providing the public with the opportunity to review and comment on the Plan

Hazard-Specific Planning Documents

California already has a number of hazard-specific mitigation plans in place that have been approved by FEMA, including the:

- California Earthquake Loss Reduction Plan
- California Fire Plan
- State Flood Hazard Mitigation Plan

California Earthquake Loss Reduction Plan

The California Seismic Safety Commission (CSSC) prepared the California Earthquake Loss Reduction Plan to fulfill the requirements of the California Earthquake Hazards Reduction Act of 1986 (Government Code §8870, et seq.). Numerous organizations and individuals participated in the development of the plan, which reflects the state of the art in seismic hazard mitigation techniques and is used as a tool to evaluate potential initiatives to reduce the impact of future earthquakes.

Continued on next page

1.2 The Planning Process

California Fire Plan

The California Fire Plan describes the state's priorities for wildfire hazard mitigation. Required by state law, the plan defines a framework for the systematic assessment of existing wildland fire protection services, identifies high-risk and high-value areas that are potential locations for costly and disastrous wildfires, ranks these areas by relative risk for wildfires, and describes available mechanisms to reduce future costs and losses from fire events. The California Board of Forestry and Fire Protection and the California Department of Forestry and Fire Protection (CDF) developed the plan jointly with significant input from all levels of government, the business community, non-profit organizations, and the public.

State Flood Hazard Mitigation Plan

The State Flood Hazard Mitigation Plan was developed through a multi-agency collaborative effort that involved all levels of government, the private sector, and other stakeholders. The plan identifies high flood hazard areas and outlines mitigation strategies to address the flood risk. FEMA initially approved the plan in 1996 on the condition that the state complete community profiles and state agency capability assessments. These two additional sections were approved by FEMA in 1997.

1.3 Coordination Among Agencies and Departments

Overview

While OES coordinates statewide hazard mitigation activities in California, many specific mitigation efforts are part of programs administered by other state agencies, including:

- Seismic Safety Commission (CSSC)
- Department of Forestry and Fire Protection (CDF)
- Department of Water Resources (DWR)
- Governor's Office of Planning and Research (OPR)
- California Geological Survey (CGS)
- Department of Housing and Community Development (HCD)

W-9-91 and the Administrative Order

One of the important elements of The Governor's Executive Order W-9-91 is the ability of the Director of OES to assign specific emergency functions to state agencies through administrative orders. On September 12, 2000, the Governor Gray Davis sent a letter to Agency Secretaries initiating the updating of all administrative orders relate to emergency management. OES began contacting and updating the administrative orders of all state agencies and departments. For the first time, hazard mitigation was included in the administrative orders. The standard hazard mitigation provisions included in the administrative order are:

52. Identify, document, and when practical, implement those activities that potentially could reduce or lessen the impact of an emergency.
53. Establish hazard mitigation as an integral element in operations and program delivery as appropriate.
54. During a Presidential declaration of a major disaster, participate in the hazard mitigation planning process.

It is Executive Order W-9-91 and the Administrative Orders that are the foundation of State Hazard Mitigation Team (SHMT) and state agency coordination in the field of hazard mitigation. These administrative orders are operation until superceded.

Continued on next page

1.3 Coordination Among Agencies and Departments

State Hazard Mitigation Team (SHMT)

The SHMT is comprised of agencies that have primary responsibility for specific state-mandated hazard mitigation activities. The SHMT was essential in the development of this document and will play a key role in ensuring that the Plan is maintained and updated. SHMT goals are to:

- Meet at least quarterly
- Coordinate a review of all state agencies' hazard mitigation roles
- Review legislative initiatives and actively work on the development of a sustainable State Hazard Mitigation Program
- Report (each member) on their agency's progress toward achieving goals, any ongoing projects, changes in the hazard environment, and new opportunities made available through advancements in technology and knowledge or through completed work
- Review the Plan
- Review the most recent work in hazard mitigation to keep up to date on significant changes
- Review new technologies and advancements in knowledge
- Recommend updates to the Plan

The Role of the California Seismic Safety Commission (CSSC)

The primary role of the California Seismic Safety Commission (CSSC) is to set goals and priorities for earthquake safety. The commission also drafts and promotes legislation to enhance seismic safety. It is composed of representatives from various state, local, and private entities, with consultants and contributors representing a broader spectrum of interests, including federal agencies.

Continued on next page

1.3 Coordination Among Agencies and Departments

The Role of the California Department of Forestry and Fire Protection (CDF)

The California Department of Forestry and Fire Protection (CDF) protects the people of the state from fires, responds to emergencies, and protects and enhances forest, range, and watershed values that provide social, economic and environmental benefits. CDF responds to an average of 6,300 wildfires and more than 286,000 non-wildfire emergencies each year. The department oversees a wide range of programs and activities to promote fire prevention and fire loss mitigation, including the Fire Safe and Firewise programs, cooperative fire protection initiatives, code enforcement, land use/wildfire protection planning, hazardous fuel reduction, forest stewardship, forest and rangeland research, and citizen involvement. CDF works closely with numerous partners, including local governments through contractual fire protection agreements and federal agencies through the California Wildfire Coordinating Group and the California Fire Alliance, and participates in many taskforces and working groups initiated through the authority of other agencies.

The Role of the Department of Water Resources (DWR)

The Department of Water Resources (DWR) coordinates with various agencies, including FEMA and USACE, to mitigate flood impacts in California. DWR is the State coordinating agency for the National Flood Insurance Program (NFIP), FEMA's floodplain management program. The department is also a member of the CALFED Bay-Delta Program, which is developing and implementing a long-term comprehensive plan to restore ecological health and improve water management in San Francisco Bay and the Sacramento-San Joaquin Delta.

After the floods of the 1990s, DWR began coordinating several multi-agency efforts, including the Sacramento-San Joaquin River Basins Comprehensive Study (Comp Study) and the Floodplain Management Task Force. The Comp Study, which is jointly led by the California Board of Reclamation and USACE, has made significant new recommendations about how to mitigate potential floods and ecosystem losses. The Floodplain Management Task Force has made numerous recommendations to guide floodplain management decisions.

Continued on next page

1.3 Coordination Among Agencies and Departments

The Role of the Governor's Office of Planning and Research (OPR)

Among other duties, the Governor's Office of Planning and Research (OPR) provides guidance to local governments in the preparation of their general plans. Every city and county in the state must prepare a general plan to guide development. The plan must include a safety element, the goal of which is to reduce the potential risk of death, injury, property damage, and economic and social dislocation due to hazards such as floods, wildfires, and earthquakes. OPR also operates the State Clearinghouse, which coordinates state agency review of environmental documents prepared pursuant to the California Environmental Quality Act (CEQA). The Clearinghouse will coordinate the state agency review of this draft Plan.

The Role of the Center for Collaborative Policy

To help initiate a greater level of interagency coordination in the development of the Plan, OES contracted with the Center for Collaborative Policy, a joint program of California State University, Sacramento and the McGeorge School of Law, to provide facilitation and other services. The funds for this contract were provided through California's PDM 2002 grant. Among other things, the Center facilitated SHMT meetings.

The Role of the California Geological Survey (CGS)

The California Geological Survey (CGS) develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources. In terms of hazard assessment, CGS is responsible for identifying and mapping geologic hazards and estimating the potential consequences and the likelihood of occurrence of various hazard events.

The Role of the Department Of Housing And Community Development (HCD)

As California's principal housing agency, the mission of the Department of Housing and Community Development (HCD) is to provide leadership, policies, and programs to expand and preserve safe and affordable housing opportunities and promote strong communities for all Californians.

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1.3 Coordination Among Agencies and Departments

OES Local Hazard Mitigation Planning Program

Through OES, the state has started a program to promote and support local hazard mitigation planning and local participation in the state hazard mitigation planning process. Through the Local Hazard Mitigation Planning Program, local grassroots organizations, public and private agencies, and the general public will be able to participate in the state hazard mitigation planning process by participating in workshops and forums on Local Hazard Mitigation Plans (LHMP).

1.4 Integration with Other Planning Efforts

Introduction

Various state agencies have been delegated planning responsibilities through state law or by executive order. The hazard mitigation planning process provides an opportunity to incorporate hazard mitigation into these other ongoing planning efforts. The vision for this Plan is to both integrate and enhance all state planning efforts. Where specific hazards are not dealt with in other state documents, this Plan presents original research and analysis.

The Foundation for Multi-Hazard Mitigation Planning in California

Hazard mitigation has been an ongoing effort in California for many years. However, due to the frequency and intensity of natural disasters in California and various statutory and regulatory mandates, mitigation efforts have tended to occur in a decentralized manner. The state has undertaken particularly significant mitigation efforts for the California's three major disaster types: earthquakes, fires and floods. The state plans covering these three areas, the California Fire Plan, the California Earthquake Loss Reduction Plan, and the State Flood Hazard Mitigation Plan, form the foundation for this integrated multi-hazard mitigation Plan.

All three of these plans were developed through collaborative processes that involved multiple stakeholders, including local, state, and federal agencies, non-profit organizations, and the public. These processes served as a model for the development of this document. The three plans also include information on state and local risk that formed the foundation for the risk assessment in this Plan.

Continued on next page

1.4 Integration with Other Planning Efforts

Other Planning Efforts

OES and the SHMT reviewed and incorporated elements from numerous plans and documents in the development of this Plan, including:

- California Earthquake Loss Reduction Plan
- California Fire Plan
- State Flood Hazard Mitigation Plan
- General Plan Guidelines
- Sacramento-San Joaquin River Basins Comprehensive Study
- Recommendations of the California Floodplain Management Task Force
- Local hazard mitigation plans
- OPR technical advice publications
- Hazardous materials plans
- Integrated Watershed Planning Principles
- Drought Task Force Report
- OES Terrorism Plan

Integration of the HMGP, FMA, And PDM Programs

OES will coordinate the planning requirements of the HMGP, FMA, and PDM programs to promote multi-hazard mitigation planning by local governments. Project grants funded through these programs will be based upon priorities identified in this Plan.

Incorporation of Hazard Mitigation into General Plans

OES is working with OPR to incorporate information on hazard mitigation planning into the *General Plan Guidelines*, which provides guidance to California cities and counties in the preparation of their general plans. Additionally, OPR, OES, CDF, and the Regional Council of Rural Counties (RCRC) have developed a guidance document for incorporating wildland fire hazard mitigation language into general plans The document, *Fire Hazard Planning*, is part of OPR's General Plan Technical Advice Series and can be downloaded at www.opr.ca.gov/publications/PDFs/Fire_Hazard_Planning-Final_Report.pdf. OPR, CDF, and OES are also providing outreach to local jurisdictions on wildfire mitigation planning through the federal Firewise Communities workshops and the California Fire Safe Communities program.

1.5 Public Involvement

Introduction

OES, working with the SHMT, developed the following proposed public participation process.

The Public Involvement Process

The proposed process for public involvement in the state hazard mitigation planning process includes:

- Promotion of the draft Plan by the SHMT
- Public workshops/listening sessions
- Distribution of the draft Plan by CD to local government and state agency stakeholders
- Posting the draft Plan on the OES website for comment
- Press releases and public notices announcing the availability of the Plan

Tools to Support the Public Process

The following tools were developed to support all elements of the public participation process:

- State Multi-Hazard Mitigation Plan CD
- Post card announcing the availability of the draft Plan
- Public Notices
- PowerPoint presentation on the Plan
- Page on OES website dedicated to the Plan

State Hazard Mitigation Team (SHMT) Promotion of the Plan

Members of the SHMT will give presentations on the Plan at workshops and conferences sponsored by their own agencies and other organizations as opportunities permit.

Workshop/ Listening Sessions

OES hosted workshops/listening sessions on the Plan in the Bay Area, Southern California, and Sacramento. The purpose of these workshops was to present hazard and vulnerability information and to gather stakeholder input.

Distribution of the Draft Plan on CD

Upon request, the Draft Plan was distributed to city and county governments, state agency stakeholders, interested groups, and individuals for comment.

Continued on next page

1.5 Public Involvement

OES Website

OES posted the Draft Plan on its website and invited comments. Reviewers were able to submit comments directly from the website.

Postcard Announcement

OES distributed over 7,000 postcards that announced the availability of the Plan. The postcards were mailed to cities and counties, special districts, state and federal agencies, and interested groups.

OES Public Notices

OES published 18 public notices in newspapers serving most medium to large cities to announce the availability of the draft Plan.

State Hazard Mitigation Web Portal

OES and the Resources Agency are creating a State Hazard Mitigation Web Portal as a one-stop shop for all things dealing with hazard mitigation. The portal will be an ongoing way for the public to participate in the state hazard mitigation planning process. One of the first things that will be available on the portal is the final version of this Plan. The portal will also include a comment/request form that will allow individuals to communicate directly with state hazard mitigation staff on a wide range of mitigation topics.

Timeline for Public Involvment

The timeline for the public involvement process is as follows:

Activity	Date
Develop tools	March-June, 2004
Hold workshops in: • Southern California • Bay Area • Disaster Resistant California (DRC) conference in Sacramento	 March, 2004 April, 2004 May 3-5, 2004
Submit plan to the State Clearinghouse, which will coordinate review by state agencies	July 1, 2004
Begin 45-day public review period	July 1, 2004
End public & state agency review period	August 16, 2004
Review and revise Plan	July-August 2004
Submit final Plan to FEMA	September 1, 2004

Continued on next page

1.5 Public Involvement

Summary of the Public Comment Period

The public comment period for the State Multi-Hazard Mitigation Plan commenced July 1, 2004. The plan and appendices were made available on the State Plan web page of the OES website, as were electronic forms to send comments and make requests for a CD or hard copy of the plan. The final totals are as follows:

- The web page received 1,915 hits during the period between July 1 and August 15.
- OES distributed 85 CDs and three hard copies of the plan
- OES received multiple comments from six people.

State of California Multi-Hazard Mitigation Plan

Chapter 2 – Adoption by the State

Plan Adoption

The State of California Multi-Hazard Mitigation Plan (Plan) is a comprehensive description of the State's commitment to reduce or eliminate the impacts of disasters. This Plan is coordinated and maintained by the Governor's Office of Emergency Services but is the culmination of input and recommendations from numerous stakeholders from local, state and federal government agencies, private business and organizations.

In adopting this Plan, the State of California agrees to comply with all applicable state and federal statutes and regulations (see Document 2.0 - List of Assurances) and will update the plan at least every three years. The Plan will be amended to reflect new or revised state and federal statutes and regulations. Future amendments will also reflect changes to State organization or policy as appropriate.

The Director of the Governor's Office of Emergency Services by virtue of the Emergency Services Act, Executive Order W-9-91, and the Administrative Orders is an appropriate body. State agencies are committed through Executive Order W-9-91 and the Administrative Orders to adhere to the plan.

I, _____, as Director of the Governor's Office of Emergency Services and Governor's Authorized Representative do hereby formally adopt this Multi-Hazard Mitigation Plan on this the _____day in the month of _____in the year 2004.

Chapter 3—State Profile

3.1 State Profile

Introduction

California is a tremendously diverse and dynamic state. Its diversity is reflected in its landscape, population, culture, and economy. It is home to both the country's lowest point (Death Valley) and highest point outside of Alaska (Mount Whitney). It has more national parks and forests than any other state and is home to the country's only remaining stand of giant Sequoias. The state has the fifth largest economy in the world and leads the nation in volume of annual construction and manufacturing and in the value of annual farm output. It has more people, automobiles, and civil aircraft than any other state in the nation.

California's Physical Geography

With an area of 158,869 square miles, California is the third largest state in the country. It is a land of tremendous geographic diversity, with many striking natural features. The state's 1,100 miles of coastline is home to several major cities, including San Francisco, Los Angeles, and San Diego. Down its center lies the Central Valley, a huge, fertile valley bound by the coastal mountain ranges in the west, the Sierra Nevada to the east, the Cascade Range in the north, and the Tehachapi Mountains in the south. Mountain-fed rivers naturally irrigate the Central Valley. With dredging, a number of these rivers have become sufficiently large and deep so that several inland cities, most notably Stockton, are harbor communities. The capital, Sacramento, is in the north-central portion of the Central Valley.

The Sierra Nevada range runs much of the length of California's eastern border. Located in the Sierras 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 Sierras 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 at 282 feet below sea level contains the lowest point in North America and at 134 degrees has the hottest recorded temperature in the U.S.

Continued on next page

3.1 State Profile

California's Rivers and Lakes

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 from its source at the base of Mount Shasta in the southern Cascade Mountains to its junction with the San Joaquin. The Pit River is the longest tributary of the Sacramento, although shorter tributaries, such as the Feather and American rivers, carry larger volumes of water. The San Joaquin River rises in the Sierra Nevada near Yosemite National Park and flows north for 350 miles before joining the Sacramento River. The Sacramento and San Joaquin rivers unite to form a large inland delta that drains to Suisun Bay, the eastern arm of San Francisco Bay. Numerous mountain streams descend from the Sierra Nevada to join the two rivers.

The rivers of California's Coast Ranges are relatively short, except for the 250-mile Klamath River, which rises in Oregon and flows through the northwestern portion of the state. The Salinas River rises in the Coast Ranges and flows northwest through a broad fertile valley to Monterey Bay. The major river in southern California is the Colorado, which follows the Arizona-California state line before flowing into the Gulf of California, in Mexico.

California has several thousand lakes, most of which are small. The largest is the Salton Sea, a salty lake in the southeast corner of the state that lies 233 feet below sea level and covers 364 square miles. Lake Tahoe, high in the Sierra Nevada on the California-Nevada state line, is one of the deepest lakes in the United States and covers 191 square miles.

The damming of rivers has created numerous other lakes. These include Folsom Reservoir on the American River, Lake Oroville on the Feather River, and Pine Flat Reservoir on the Kings River, all in the Sierra Nevada, and Clair Engle Lake on the Trinity River in the Klamath Mountains. Shasta Lake, behind Shasta Dam on the upper Sacramento River, is the largest reservoir in the state, and along with Clair Engle and Whiskeytown Lakes, forms one of the largest national recreation areas in the nation.

Continued on next page

3.1 State Profile

California's Climate

Climates in California vary depending on latitude, elevation, and proximity to the coast. Most of the state has rainy winters and dry summers. The influence of the ocean generally creates cooler summers and warmer winters along the coast, along with summer fog. Moving east, communities experience hotter summers and colder winters. Winds from the ocean carry moisture to the northern parts of the state, which generally receive more rainfall than the south. California's mountain ranges influence the climate as well; moisture-laden air from the west cools as it ascends the mountains, dropping moisture. Some of the rainiest parts of the state are west-facing mountain slopes.

High desert climates are found east of the Sierra Nevada and the Transverse and Peninsular ranges of southern California. The low deserts east of the southern California mountains, including the Imperial and Coachella valleys and the lower Colorado River basin, are part of the Sonora Desert, with hot summers and mild winters. The higher elevation deserts of eastern California, including the Mojave Desert, the Owens Valley, and the Modoc Plateau, are part of the Great Basin region and experience hot summers and cold winters.

California's Tectonic Plates

California sits on two major tectonic plates, the North America Plate and the Pacific Plate. The Pacific Plate is currently moving north, scraping along the edge of the North American Plate. The frequently violent interactions of these two plates are responsible for most of California's rugged geologic features. As magma seeped up from the subduction zone between the two plates, a massive pool of granite was created that slowly cooled, forming batholiths. These batholiths have been rising, pushing upwards along faults that run along the edge of the Sierra Nevada. This violent upward movement was demonstrated in 1872, when a massive earthquake near Lone Pine caused upward thrusts of 20 feet or more.

The infamous San Andreas fault is a lateral strike-slip fault that begins along the north coast of California, passes adjacent to San Francisco, runs east of Los Angeles, and branches into Mexico. As the two plates slide past one another, tension builds and potential energy is stored until something gives, releasing massive amounts of energy in the form of an earthquake. Earthquakes have claimed the lives of more than 3000 Californians in the past two centuries. The San Andreas is not the only active fault in California. The state is laced with numerous faults that can cause earthquakes.

Continued on next page

3.1 State Profile

California's Economy

California's economy is the fifth largest in the world and the largest of any state by far, representing 13 percent of U.S. gross domestic product. It is a highly diversified economy, with jobs and businesses in many different industries. The service, finance, insurance, and real estate industries account for about half of the state's total gross product.

The state is the nation's top agricultural producer and leads the nation in the production of fruits and vegetables, including carrots, lettuce, onions, broccoli, tomatoes, strawberries, and almonds. The state's most valuable crops are grapes, cotton, flowers, and oranges. Dairy products, in which California also leads the nation, account for the largest share of farm income in the state. The state also contributes a major share of the nation's domestic wine production.

Since World War II, manufacturing of electronic equipment, computers and related chips and software, machinery, transportation equipment, and metal products has increased enormously in California. Many high-tech companies and small low-tech companies thrive in Southern California in what is said to be the largest manufacturing belt in the country. The leading producer of semiconductors and software development, the area near San Jose is generally referred to as Silicon Valley.

California continues to be a major center for motion picture, television, film, and related entertainment industries. Tourism as another important source of income for the state.

California's Forest Lands

Forests cover 40 percent of California's land area. California usually ranks third in the nation in terms of timber and lumber output. Lumbering is the chief economic activity in the Sierra Nevada and in northwestern California. About two-fifths of the forestland in the state is classified as commercial forest. The United States Forest Service manages more than half of these commercial forests

The most densely forested areas are the Klamath Mountains, the Coast Ranges north of San Francisco, and the Sierra Nevada. Tree growth is heaviest on the wet, westward-facing slopes. The coast redwood grows in dense forests on the lower mountain slopes along the coast between the Santa Lucia Range south of Monterey Bay and the Oregon state line. Redwoods in California grow in pure stands and also with Douglas fir, canoe cedar, and Port Orford cedar. Douglas fir predominates the slopes immediately above the

Continued on next page

3.1 State Profile

California's Forest Lands, (continued)

redwood areas. Further inland the Douglas fir forests give way to a more open forest of deciduous trees, such as tan oak madrone, Oregon maple, California bay tree, and several species of oak. In the Klamath Mountains and Coast Ranges above 5,000 feet, ponderosa pine predominates.

The giant Sequoia grows in groves at somewhat higher elevations along the western slopes of the Sierra Nevada in what is known as the yellow pine belt. The yellow, or ponderosa, pine is the most valuable commercial conifer logged in the Sierra, and thrives at elevations between 3,000 to 8,000 feet. Above the pine forests are stands of red fir and Jeffrey pine. They give way above 9,000 feet to Lodgepole pine, Engelmann spruce, and other firs.

South of San Francisco and on the low mountain slopes of the Central Valley, grasslands, mixed evergreens and broadleaf species and areas of shrub growth predominate. The golden poppy, the state flower, grows abundantly in the Central Valley. Grasses and sedges also form meadows above 11,500 feet, the timberline, in the Sierra Nevada. The mixed evergreen and broadleaved woodlands occupy the low western slopes of the Sierra Nevada and extensive areas in the Coast Ranges inland from the coast. These relatively open woodlands include oak, pine, and juniper. Large areas of the uplands along the southern coast are covered with chaparral, a low, and in places almost impenetrable, shrub growth of manzanita, mountain mahogany, California scrub oak, chamise, buckbrush, and other evergreen species. The lower western slopes of the Sierra Nevada are covered partly with chaparral.

The 18 national forests in California cover about 20.6 million acres. Within the national forests are a number of wilderness areas and wildlife refuges. Los Padres National Forest, the largest national forest wholly within the state, covers 1,700,000 acres in western California. Most of the other larger national forests in California lie in the northern and northeastern parts of the state. Shasta-Trinity national forest, in northern California, lies in a volcanic area and includes Mount Shasta. The Six Rivers National Forest, noted for its groves of redwoods, can be found in the northern coastal uplands. Along California's eastern border are the Plumas, Tahoe, El Dorado, Stanislaus, and Inyo national forests. Sierra National Forest, in the Sierra Nevada region, preserves stands of giant Sequoias.

Continued on next page

3.1 State Profile

California's Demographics

California's population is approximately 35 million and is expected to grow to nearly 44 million by 2020 and nearly 55 million by 2050. Two-thirds of the state's population currently lives south of Bakersfield.

California is the most ethnically diverse state in country, with no majority ethnic group. The population is:

- 46.8 percent White
- 33.2 percent Hispanic
- 11.1 percent Asian
- 6.2 percent Black
- 0.4 percent American Indian/Alaskan Native
- 0.7 percent Hawaiian/Pacific Islander

California is home to more Native Americans than any other state in the country. Of the 562 federal recognized tribal governments in the United States, 106 are in California. The state has 109 reservations and rancherias in 33 counties.

In addition to being diverse, the population is dynamic. 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 educating residents about the hazards and risks associated with their communities.

State of California Multi-Hazard Mitigation Plan

PART 2—RISK ASSESSMENT

Introduction

Federal regulations require that states undertake a risk assessment of the hazards and vulnerabilities that affect them as part of the hazard mitigation planning process to provide a factual basis for developing a mitigation strategy. The risk assessment process helps to prioritize jurisdictions and geographic areas to receive funding and technical assistance for conducting more detailed local risk and vulnerability assessments.

Table 2.0 Declared California Disasters

The attached table lists all state emergency proclamations and federal emergency and disaster declarations in California since 1950.

Click here or go to Table 2.0 in the Appendices.

Why Hazards Were Included in This Assessment

This risk assessment focuses on a number of different hazards, which were included because:

- They have historically caused significant human and/or monetary losses
- Past events have led to the development of hazard mitigation recommendations
- They have the potential to cause significant human and/or monetary losses in the future.

In This Part

This part contains the following chapters.

Chapter	Title	Page
4	Earthquake Risk Assessment	54
5	Wildfire Risk Assessment	127
6	Flood Risk Assessment	173
7	Risk Assessment for Other Significant Hazards	211
8	Risk Assessment for Less Significant Hazards	239

Chapter 4—Earthquake Risk Assessment

In This Chapter

This chapter contains the following topics.

Topic	Title	Page
4.1	Identifying Earthquake Hazards	55
4.2	Profiling Earthquake Hazard Events	70
4.3	Assessing Vulnerability Inventories and Mitigation Progress by Jurisdiction and Type of Construction	76
4.4	Mitigation Measures for Earthquake Hazards	112
4.5	Local Capability Assessment	125
4.6	Future Needs for Improving This Plan	126

4.1 Identifying Earthquake Hazards

Causes of Earthquakes: Plate Tectonics

California always has been seismically active because it sits on the boundary between two of the earth's tectonic plates. Most of the state - everything east of the San Andreas Fault - is on the North American Plate. Monterey, Santa Barbara, Los Angeles, and San Diego are on the Pacific Plate, which is constantly moving northwest past the North American Plate. The relative rate of movement is about two inches (50 millimeters) per year. Although the San Andreas Fault is considered the boundary between the two plates, some of the motion (also known as slip) is taken up on faults as far away as central Utah. In California, about forty millimeters per year of the slip occurs on the faults of the San Andreas system, and about ten millimeters per year occurs in the Mojave Desert and in the Basin and Range area east of the Sierra Nevada on a fault system known as the eastern California shear zone.

The constant motion of the plates causes stress in the brittle upper crust of the earth. These tectonic stresses build as the rocks are gradually deformed. The rock deformation, or strain, is stored in the rocks as elastic strain energy. When the strength of the rock is exceeded, rupture occurs along a fault. The rocks on opposite sides of the fault slide past each other as they spring back into a relaxed position. The strain energy is released partly as heat and partly as elastic waves called seismic waves. The passage of these seismic waves produces the ground shaking in earthquakes.

California has thousands of recognized faults, hundreds of which have names, but only some are known to be active and pose significant hazards. As was mentioned above, the motion between the Pacific and North American plates occurs primarily on the faults of the San Andreas system and the eastern California shear zone. Other faults have much lower rates of movement and correspondingly longer times between significant earthquakes.

Faults are more likely to have future earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve the accumulating tectonic stresses. Geologists classify faults by their relative hazards. "Active" faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). In contrast, "potentially active" faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on

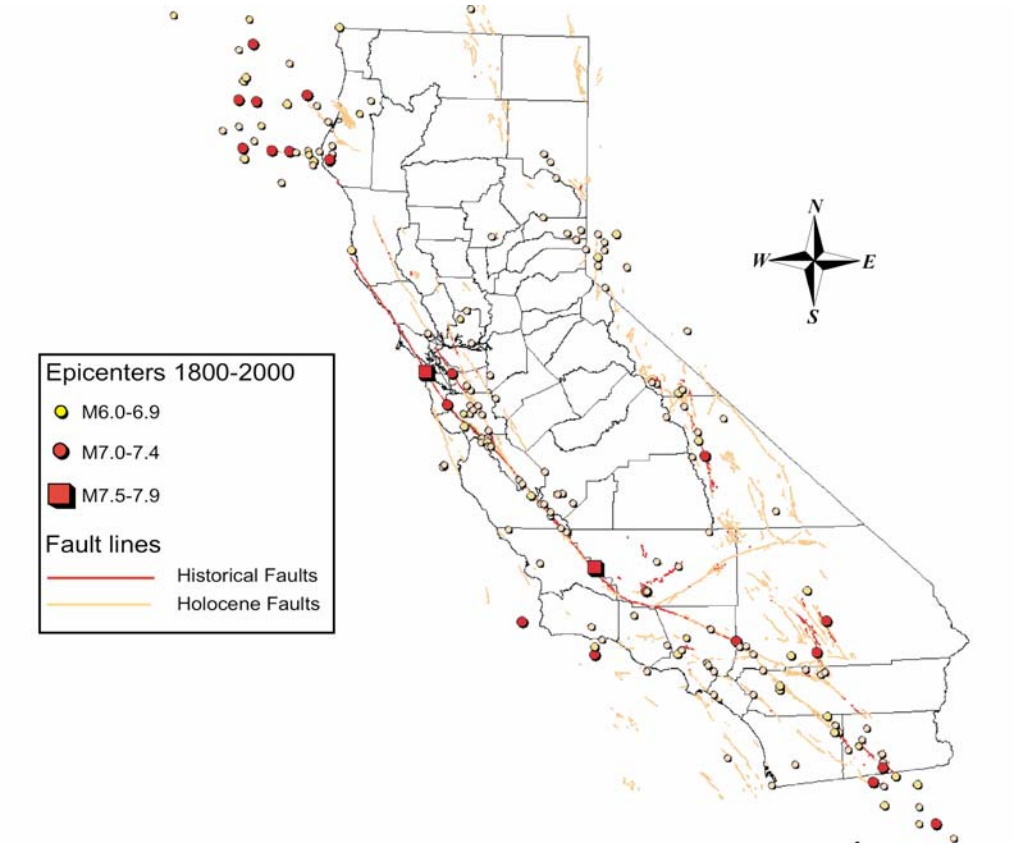
Continued on next page

4.1 Identifying Earthquake Hazards

Causes of Earthquakes: Plate Tectonics (continued)

geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

Map 4.1A The Most Earthquake-Prone Areas in California



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4.1 Identifying Earthquake Hazards

Earthquake Hazards: Shaking

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales. One of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology. The most commonly used scale today is the Moment Magnitude (Mw) Scale. Moment magnitude is related to the total area of the fault that ruptured and the amount of offset (displacement) across the fault. It is a more uniform measure of the energy released during an earthquake.

The other commonly used measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. In general, it decreases with distance from the source of an earthquake, but it may be increased or decreased by a number of factors. The California Strong Motion Instrumentation Program (CSMIP) records the intensity of shaking on the ground and in structures during earthquakes through a statewide network of strong motion instruments called the California Integrated Seismic Network (CISN). The measurements are used immediately after an event to assist in emergency response by agencies like OES.

Continued on next page

4.1 Identifying Earthquake Hazards

Table 4.1A The Modified Mercalli Intensity Scale

Shaking intensity is often described using the Modified Mercalli Intensity Scale, which rates an earthquake's effects based on human observation. While an earthquake has only one magnitude it may have many intensity values, which will generally decrease with distance from the epicenter. The table below lists the Mercalli Scale's various intensity levels.

Intensity	Effects
I	Not felt except by a very few who are favorably situated.
II	Felt by persons at rest, on upper floors, or favorably placed.
III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing vehicles rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.
V	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).
VII	Difficult to stand. Noticed by drivers of vehicles. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII	Steering of vehicles is affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

Continued on next page

4.1 Identifying Earthquake Hazards

The Modified Mercalli Intensity Scale (continued)

Intensity	Effects
IX	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.
XI	Rails bent greatly. Underground pipelines completely out of service.
XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Earthquake "ShakeMaps"

Earthquake shaking is measured by instruments called accelerographs that are triggered by the onset of shaking and record levels of ground motion at strong motion stations throughout the state operated by the California Integrated Seismic Network (CISN). CISN includes stations operated by the California Geological Survey (CGS), the U.S. Geological Survey (USGS), the California Institute of Technology, and UC Berkeley. The CGS and the USGS rapidly convert the data from the accelerographs into "ShakeMaps" that show the distribution of earthquake shaking. ShakeMaps are used by emergency responders to evaluate the extent and variation of shaking within the area affected by an earthquake and to send resources to the areas that most likely sustained heavy damage. The maps also help identify vulnerabilities, which is useful in pre-disaster mitigation planning.

ShakeMaps, which are based on actual measured motions, are a major step forward in guiding emergency response to earthquakes. Areas of as-yet limited spacing distribution of strong motion stations still require estimation or interpolation, which can unnecessarily reduce accuracy. USGS and CGS produce their maps in addition to the intensity map, to guide response for specific types of structures (short, small structures versus tall, long structures).

Continued on next page

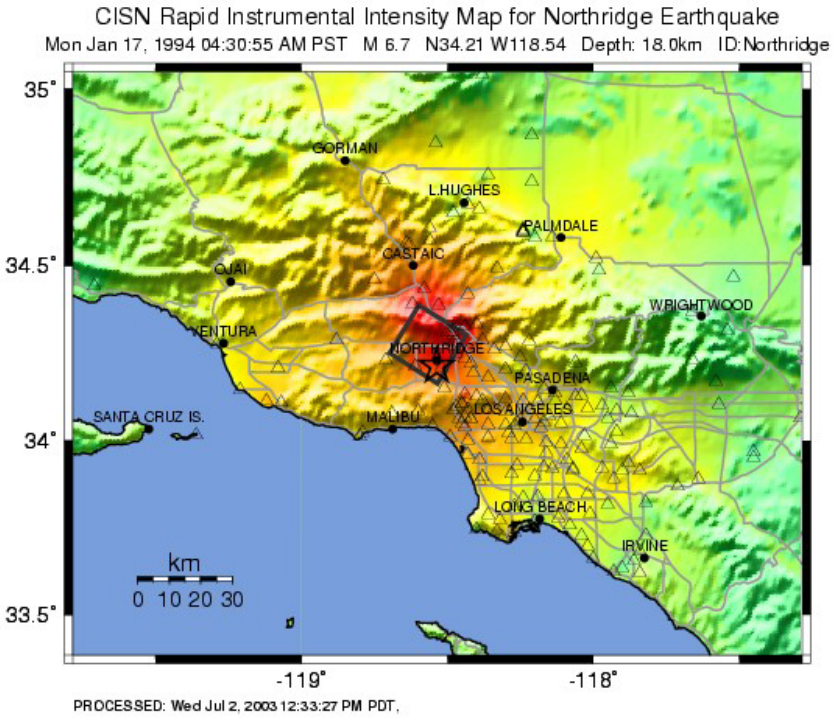
4.1 Identifying Earthquake Hazards

Earthquake "ShakeMaps" (continued)

CGS and USGS also use ground motion data in modeling ground shaking patterns to be expected in future earthquakes. The potential for earthquake shaking at any place can be related to the potential for earthquakes on the surrounding faults and the ground motion from potential earthquakes. Integrating all of the potential for ground motion produces a map showing the long-term seismic hazard.

Map 4.1B Shake Map

ShakeMaps, such as this one for the 1994 Northridge earthquake, show the distribution of strong ground shaking and can be used to focus emergency response efforts.



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

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4.1 Identifying Earthquake Hazards

Amplification of Seismic Shaking

Although seismic waves radiate from their source like ripples on a pond, the radiation is not uniform due to the complex nature of an earthquake rupture, the different paths the waves follow through the earth, and the different rock and soil layers near the earth's surface. Large earthquakes begin to rupture at their hypocenter deep in the earth and the fault ruptures outward from that point. Because the speed of an earthquake rupture on a fault is similar to the speed of seismic waves, waves closer to the epicenter can be compounded by waves from farther along the rupture, creating a pulse of very strong seismic waves that move~~s~~ along the fault in the direction of the fault rupture. Seismic waves may also be modified as they travel through the earth's crust. Shaking from the 1989 Loma Prieta earthquake was concentrated to the north, toward San Francisco and Oakland, possibly due to the reflection of seismic waves off the base of the earth's crust.

As seismic waves approach the ground surface, they commonly enter areas of loose soils where the waves travel more slowly. As the waves slow down, their amplitude increases, resulting in larger waves with frequencies that are more likely to damage structures. Waves can also be trapped within soft sediments between the ground surface and deep, hard basement rocks, their destructive energy multiplying as they bounce back and forth, producing much greater shaking at the ground surface. CGS and USGS recorded large ground waves at many locations during both the Loma Prieta earthquake and the 1994 Northridge earthquake.

Unexpectedly large ground waves and their resulting damage may be produced from a relatively distant earthquake. Shaking from the 1999 Hector Mine earthquake in the Mojave Desert produced waves with amplitudes of up to 15 cm in the Los Angeles basin, more than 200 kilometers from the epicenter. While there was little damage from the Hector Mine earthquake, other large earthquakes have caused damage in distant places. For example, Nevada's 1954 Dixie Valley earthquake damaged critical facilities in Sacramento due to water sloshing.

Continued on next page

4.1 Identifying Earthquake Hazards

Photo 4.1A Loma Prieta Earthquake Damage

The photo below shows damage in the Marina District of San Francisco from the 1989 Loma Prieta earthquake. The damage was increased because the shaking was amplified as it passed through the earth's crust and entered the soft sediments near the earth's surface.

Photo by John Nakata, USGS

Mitigation of Seismic Shaking Hazards

Seismic shaking, which caused over 98 percent of the losses in the Loma Prieta Earthquake, has long been recognized as the main threat to structures during earthquakes. To mitigate this hazard, building codes have been steadily improved over the past 80 years as understanding of seismic shaking has improved based on strong motion data gathered by CGS and USGS. Current California building codes include provisions for considering the potential shaking from earthquakes, including stronger shaking near faults and amplification by soft soils. The building code has been the main mitigation tool for seismic shaking in most buildings, although hospitals, schools, and other critical facilities are subject to additional mitigation measures, as will be discussed below.

Continued on next page

4.1 Identifying Earthquake Hazards

Earthquake Hazards: Ground Failure

Fissuring, settlement, and permanent horizontal and vertical shifting of the ground often accompany large earthquakes. Although not as pervasive or as costly as the shaking itself, these ground failures can significantly increase damage and under certain circumstances can be the dominant cause of damage. The majority of damage from the 1964 Alaskan Earthquake was attributed to the extensive ground failures that accompanied the event. Studies after the 1994 Northridge Earthquake showed that when ground failure was involved, damage to residential dwellings was three to four times greater than average shake damage. Because of their geographic extent, network infrastructures such as water, power, communication, and transportation lines are particularly vulnerable to ground failures.

Fault Rupture

The sudden sliding of one part of the earth's crust past another releases the vast store of elastic energy in the rocks as an earthquake. The resulting fracture is known as a fault, while the sliding movement of earth on either side of a fault is called fault rupture. Fault rupture begins below the ground surface at the earthquake hypocenter, typically between three and ten miles below the ground surface in California. If an earthquake is large enough, the fault rupture will actually travel all the way to the ground surface, wreaking havoc on structures built across its path. Recent large earthquakes in Turkey and Taiwan have shown that few structures built across the surface traces of faults can withstand the large displacement that occurs during an earthquake.

Continued on next page

4.1 Identifying Earthquake Hazards

Photo 4.1B Surface Fault Rupture

The photograph below illustrates a surface fault rupture from the 1992 Landers Earthquake. This fault rupture, located in the Mojave desert, disrupted roads and damaged homes.

Liquefaction

In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during the intense shaking. One common type of failure occurs when soft, water-saturated soil settles, causing the water to eject sediment particles as it works its way to the ground surface. This phenomenon, known as liquefaction, turns the soil into a fluid, causing it to lose the ability to support buildings and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. Alameda Naval Air Station runways and Port of Oakland equipment suffered damage from liquefaction during the 1989 Loma Prieta Earthquake.

Continued on next page

4.1 Identifying Earthquake Hazards

Landslides

Landslides are the result of the down-slope movement of unstable hillside materials under the influence of weathering and gravity over time. Strength of rock and soil, steepness of slope, and weight of the hillside material all play an important role in the stability of hillside areas. Weathering and absorption of water can weaken slopes, while the added weight of saturated materials or overlying construction can increase the chances of slope failure. Sudden failure can be triggered by heavy rainfall, excavation of weak slopes, and earthquake shaking, among other factors. Because landslides occur often without earthquakes, landslide hazards are discussed in a separate section of this Plan and are only briefly mentioned here as a secondary hazard associated with earthquakes.

Photo 4.1C Landslide

Ground shaking from the 1994 Northridge earthquake triggered damaging landslides, including this one in the Pacific Palisades area of Los Angeles.

Continued on next page

4.1 Identifying Earthquake Hazards

Mitigation of Ground Failure

Because the safety and stability of buildings, bridges, and other engineered structures depends on strong, stable foundations, catastrophic ground failures of the type discussed here must be avoided by choosing safe construction sites or by reducing risk through prudent civil engineering practice. The latter includes constructing appropriate foundation systems and modifying unstable ground to increase stability through grading, compacting, or reinforcing soils. Experience has repeatedly shown that use of these methods in design and construction can greatly reduce damage and loss during earthquakes.

The 1971 San Fernando Earthquake was caused by rupture along the San Fernando fault that resulted in total loss to many structures built across its path. That event clearly demonstrated that active faults must be avoided when constructing new buildings and led to passage of the Alquist-Priolo Earthquake Fault Zoning Act of 1972. The Act prohibits the construction of buildings for human occupancy across active faults in California. Similarly, the extensive damage caused by secondary ground failures during the 1989 Loma Prieta Earthquake focused attention on landslides and liquefaction and led to the Seismic Hazards Mapping Act, which increases construction standards at sites where ground failures during earthquakes are likely.

Ground Failure Hazard Zones

Where and when to mitigate ground failure hazards is facilitated by seismic hazard zone maps and earthquake fault zone maps. These maps identify where such hazards are more likely to occur based on analyses of faults, soils, topography, groundwater, and the potential for earthquake shaking sufficiently strong to trigger landslide and liquefaction. Both types of maps are based on the concept of “special study zones” and are used to identify locations where specially adapted construction standards are necessary for public safety and welfare. Local planning and building departments must use such maps as a screening tool to identify when to undertake detailed geotechnical or fault investigations in order to validate the level of hazard suspected at proposed development sites. A city or county can only issue a construction permit in hazard areas when the developer agrees on an appropriate level of mitigation against landslides or liquefaction, or when selected building sites are offset from active fault traces (usually at least 50 feet).

California disclosure laws require that sellers inform buyers if a property for sale is located within an earthquake fault zone or a seismic hazard zone. The Alquist-Priolo Earthquake Fault Zoning Act has been in effect for 30 years and over 5000 miles of active fault are now zoned throughout the state. The

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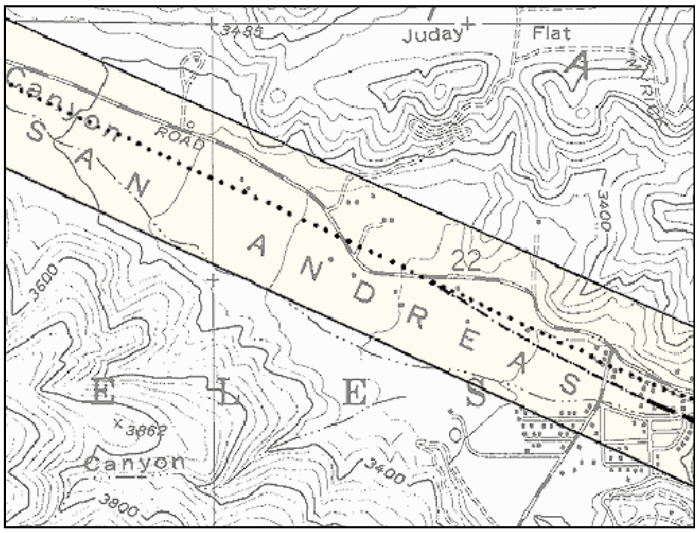
4.1 Identifying Earthquake Hazards

Ground Failure Hazard Zones (continued)



Earthquake Fault Zone along a portion of the San Andreas Fault

Seismic Hazards Mapping Act has been in effect for over 10 years and more than 4000 square miles of land have been zoned in Los Angeles, Ventura, and Orange counties and in portions of the San Francisco Bay Area. The area zoned under the Seismic Hazards Mapping Act encompasses over 165 incorporated cities having a total population of more than 12 million and an average annual volume of new construction over $10 billion. Two hundred high-risk cities remain to be zoned, representing a total population of about nine million and an average annual construction volume of over $13 billion.

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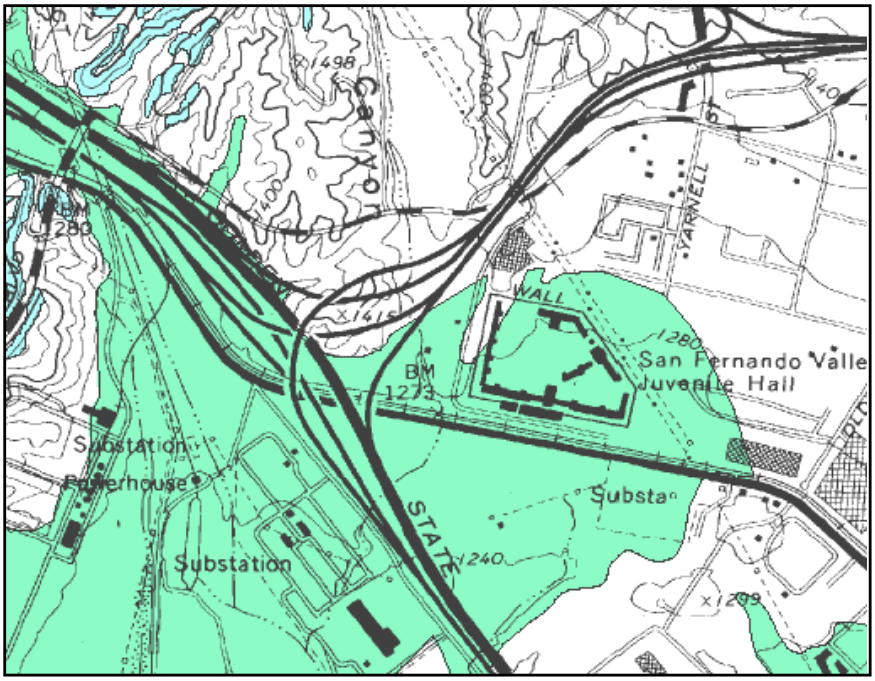
4.1 Identifying Earthquake Hazards

Ground Failure Hazard Zones (continued)



Seismic Hazard Zones in the Newhall area of the northern San Fernando Valley (blue areas are landslides and green areas are liquefaction).

Earthquake Hazards: Tsunami

Tsunamis are large waves caused by sudden disturbances in the ocean, usually on the ocean floor. (Seiches are similar large waves in lakes) They are commonly caused by fault rupture on the ocean floor or by underwater landslides. There are two types of tsunamis—local and distant. Local tsunamis are more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types.

Continued on next page

4.1 Identifying Earthquake Hazards

Earthquake Hazards: Tsunami (continued)

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 100 feet in height when they approach a shallow shoreline, causing severe damage to coastal development. In 1997, a large tsunami triggered by a magnitude seven (M7) earthquake killed more than 3,500 people in Papua, New Guinea. The 1964 Alaskan Earthquake produced a tsunami that killed thirteen people and caused over $10 million in damage in northern California; damage and losses were even greater in Hawaii. Recent studies of the continental shelf off the California coast indicate a potential for underwater landslides capable of generating damaging tsunamis that could threaten coastal communities.

Similar to tsunamis are large water splash waves caused by landslides landing in water bodies. Such a wave was responsible for the 1963 Vaiont, Italy, dam disaster, where a water wave rose 300 feet above a dam, flooding villages below and killing 2,600 people. In 1958, an M8 earthquake in Alaska caused a landslide that produced a similar wave in Lituya Bay that reached 1,720 feet up the adjacent mountain slope.

Mitigation of Tsunami and Seiche Hazards

Tsunamis cannot be prevented, but early warning and evacuation can dramatically reduce their threat to human safety. Modern warning networks can sense tsunamis hundreds, or even thousands, of miles from their location of impact and issue warnings to potentially threatened communities. Such warning systems, coupled with well-designed evacuation plans, can remove people from harm's way. Federal and state programs to educate local emergency response agencies and the public and to develop safe evacuation routes with appropriate signage are currently underway.

Life and property loss from tsunamis and seiches can also be reduced by limiting development along low-lying coasts and designing structures to allow swift water to flow around, through, or underneath without causing collapse.

4.2 Profiling Earthquake Hazard Events

Introduction

This section summarizes major earthquakes in California and their related damages and losses.

Recent Earthquake Events

Earthquakes large enough to cause moderate damage to structures—those of M5.5 or larger—occur three to four times a year. The 1987 Whittier Narrows earthquakes (M6), caused by a buried thrust fault, caused hundreds of millions of dollars in property damage. Most recently, the San Simeon Earthquake (M6.5) hit an area six miles northeast of San Simeon on December 22, 2003. As of March 17, 2004, FEMA had approved over $20.1 million in aid for recovery from this event. An average of once every two to three years, a strong earthquake (M6 to M6.9) strikes somewhere in the state. An earthquake of this size, such as the 1994 Northridge Earthquake (M6.7) or the 1983 Coalinga Earthquake (M6.5), is capable of causing major damage if the epicenter is near a densely populated area. Major earthquakes (M7 to 7.9) occur in California about once every ten years.

Two recent major earthquakes, the 1992 Landers Earthquake (M7.3) and the 1999 Hector Mine Earthquake (M7.1) caused extensive surface fault rupture but relatively little damage because they occurred in lightly populated areas of the Mojave Desert. In contrast, earthquakes of smaller magnitude but in densely populated areas, such as the 1989 Loma Prieta Earthquake (M6.9), have caused extensive damage over large areas.

The two largest earthquakes in California, the 1857 Fort Tejon Earthquake and the famous 1906 San Francisco Earthquake were similar in magnitude (M7.9 and M7.8) and resulted from movement along the San Andreas Fault. Earthquakes of this size (M7.7 to M7.9) can cause more extensive damage over a larger area than the M7.1 to M7.4 earthquakes that have struck California in recent decades.

Although a great earthquake (M8 or greater) has never been officially recorded in California, evidence suggests that one occurred in the early eighteenth century. Native American oral histories, tree-ring studies, geological studies that show the uplift or subsidence of large areas of coastal land, and records of a tsunami that struck Japan and cannot be correlated with an earthquake anywhere else around the Pacific indicate that an M9 earthquake occurred in January 1700 on the Cascadia Subduction Zone, extending north from Cape Mendocino in Northern California to British Columbia. An earthquake of this size is similar to the one that struck Alaska in 1964 and is capable of extensive damage over a very broad region.

Continued on next page

4.2 Profiling Earthquake Hazard Events

Recent Earthquake Losses

As shown in Table 4.2A below, earthquakes have caused significant losses in California over the past thirty years. The average annual loss (AAL) between 1970 and 1999 was about $1.9 billion in direct property damage (in 2000 dollars). However, 70 to 80 percent of that loss was from the Northridge Earthquake alone. Thus, past earthquakes may not provide a realistic estimate of future earthquakes' effects. Large earthquakes in lightly populated regions, such as Landers and Hector Mine, show the potential earthquake shaking from major earthquakes, while moderate earthquakes in populated areas, particularly Northridge, give a sense of California's vulnerability to earthquake shaking. A major earthquake near one of California's urban centers could cause unprecedented losses. Indirect losses, such as from unemployment and business interruption, could be more than double direct losses.

Map 4.2A State Earthquake Disaster Proclamations

The map below illustrates state earthquake proclamations between 1950 and 2003.

Click here to view the map or go to Map 4.2A in the Appendices.

Continued on next page

4.2 Profiling Earthquake Hazard Events

Table 4.2A Earthquake Losses

The table below shows reported direct losses from major and strong earthquakes in California since 1971.

Earthquake	Date	Magnitude	Direct Losses (1)	Deaths (4)	Injuries (4)
San Fernando	Feb. 9, 1971	6.6	$2,200 (2)	58	2000
Imperial Valley	Oct. 15, 1979	6.5	$70 (2)	0	91
Coalinga	May 2, 1983	6.4	$18 (2)	1	47
Whittier Narrows	Oct. 1, 1987	6.0	$522 (3)	9	200+
Loma Prieta	Oct. 17, 1989	6.9	$10,000 (4)	63	3757
Cape Mendocino	Apr. 25, 1992	7.0	$80 (3)	0	356
Landers/ Big Bear	June 28, 1992	7.3	$120 (3)	1	402
Northridge	Jan. 17, 1994	6.7	$46,000 (2)	57	11,846
Hector Mine	Oct. 16, 1999	7.1	Minor	0	11
San Simeon	Dec. 22, 2003	6.5	Undetermined	2	46

(1) Estimate in millions of 2000 dollars
(2) Estimate from FEMA (1997)
(2) Estimate from U.S. Office of Technology Assessment
(3) Estimate from National Research Council (1994)
(4) Estimate from OES
(5) Estimate from CSSC

Potential Earthquakes

On the basis of research conducted since the 1989 Loma Prieta earthquake, USGS and other scientists have concluded that there is a 62 percent probability that at least one earthquake of M6.7 or greater, capable of causing widespread damage, will strike the San Francisco Bay Area before 2032. Similarly, research coordinated by the Southern California Earthquake Center (SCEC) in 1995 concluded that there is an 80 to 90 percent probability that an earthquake of M7.0 or greater will hit Southern California before 2024. Major quakes could occur in any part of these two highly urbanized and rapidly growing regions. The probability that a major quake will hit in some part of California in the next thirty years is over 95 percent.

Continued on next page

4.2 Profiling Earthquake Hazard Events

Estimating Losses from Future Earthquakes

With HAZUS, a standardized methodology and GIS modeling software developed by FEMA, it has become possible in recent years to estimate losses from future earthquakes in California. By combining ShakeMaps with a statewide computerized inventory of population and buildings using HAZUS, CGS has estimated casualty and damage losses from various potential earthquakes for the two largest metropolitan regions of the state. Results are summarized in Table 4.2B below. CGS used the 1990 census as the basis for estimating the building inventory. Growth in California since 1990 means that the loss estimates are likely low. Potential losses to other to other types of property, including transportation systems, lifelines, and utilities, which CGS did not estimate, could be several times greater than losses to buildings.

The accuracy of ShakeMaps and the resulting HAZUS estimates are strongly dependent on recorded ground motion. Therefore, places with too few instruments have the potential for significant discrepancies between estimated and actual ground motions. The California Integrated Seismic Network and the federal Advanced National Seismic System have been working together to fund and install additional seismic instruments. Both programs are funded less that what is required to meet project objectives. Instrumentation is still sparse in some areas of the state, including the epicentral regions of the 2000 Napa and 2003 San Simeon earthquakes.

4.2 Profiling Earthquake Hazard Events

Table 4.2B - Earthquake Scenario Losses

The table below describes potential earthquakes and their associated losses for Northern and Southern California.

Potential Earthquake Scenarios	M	Projected Building Damage in Millions
Northern California		
San Andreas Fault: Repeat of the 1906 San Francisco Earthquake	7.9	$54,000
San Andreas Fault: Santa Cruz + Peninsula + North Coast segments	7.8	$50,000
San Andreas Fault: Santa Cruz + Peninsula segments	7.4	$30,000
San Andreas Fault: Santa Cruz segment	7.0	$5,900
San Andreas Fault: Peninsula segment	7.2	$24,000
Southern Hayward: Repeat of the 1868 Earthquake	6.7	$15,000
Northern Hayward	6.5	$9,000
Southern Hayward + Northern Hayward	6.9	$23,000
Rodgers Creek	7.0	$8,000
Southern Calaveras + Central Calaveras	6.4	$3,200
Northern Calaveras	6.8	$10,000
Southern + Central + Northern Calaveras	6.9	$13,000
Concord	6.2	$2,800
Green Valley	6.5	$3,200
Concord + Green Valley	6.7	$6,800
San Gregorio	7.4	$15,000

Continued on next page

4.2 Profiling Earthquake Hazard Events

Table 4.2B - Earthquake Scenario Losses (continued)

Potential Earthquake Scenarios	M	Projected Building Damage in Millions
Southern California		
Puente Hills fault	7.1	$69,000
Newport-Inglewood	6.9	$49,000
Palos Verdes	7.1	$30,000
Whittier Fault	6.8	$29,000
Verdugo Fault	6.7	$24,000
San Andreas Fault: Southern Rupture	7.4	$18,000
San Andreas Fault: Repeat of the 1857 Earthquake	7.8	$17,000
Santa Monica	6.6	$17,000
Raymond Fault	6.5	$17,000
San Joaquin Hills	6.6	$15,000
Rose Canyon	6.9	$14,000
San Jacinto	6.7	$7,000
Elsinore Fault	6.8	$4,000

4.3 Assessing Vulnerability Inventories and Mitigation Progress by Jurisdiction and Type of Construction

Introduction

This section summarizes the size and vulnerability of major types of existing development, how the vulnerabilities can be mitigated, and what information the state currently has about mitigation progress.

Determining Vulnerability

Earthquake vulnerability is primarily based upon population and the built environment. Urban areas in high hazard zones tend to be the most vulnerable, while uninhabited areas generally are less vulnerable. CGS and USGS have done considerable work using GIS technology to identify populations in seismic hazard zones. This topic discusses the number of individuals that reside in the high seismic hazard zone in each California county and includes a sample of GIS mapping. In future editions of this Plan this section will be supplemented with information from local hazard mitigation plans.

Table 4.3A Vulnerable California Populations

The attached table summarizes the percentage of each California county's population residing in the seismic hazard zone. In 17 counties, more than 90 percent of the population lives in the 40 percent g peak ground acceleration or higher seismic hazard zone. These 17 counties are home to 19 million people, or 55 percent of the state's population. Statewide, approximately 22 million people live in the 40 percent g or higher seismic hazard zone.

Click here to view the table or go to Table 4.3A in the Appendices.

Statewide Earthquake Loss Potential

Unfortunately, the number and variations of all potential earthquakes are so large that it is not possible to develop scenarios for all of them, nor would it be possible to prioritize them by importance if they were developed. To get an idea of the overall scope of the risk of losses from earthquakes and to determine which areas are most vulnerable, CGS uses an alternate approach based on probabilistic seismic hazard analysis (PSHA), which considers all possible earthquakes on all of the possible sources. Using this approach, CGS estimates an expected direct annual loss in California of about $2.2 billion. This is approximately 0.14 percent of the $1.6 trillion total value of the building inventory in the HAZUS database. Indirect losses, such as unemployment, loss of market share to other regions or countries, and other economic effects could be as much as twice the direct losses.

Continued on next page

4.3 Assessing Vulnerability Inventories and Mitigation Progress by Jurisdiction and Type of Construction

Map 4.3A Levels of Earthquake Hazards in California

The attached map shows the various levels of earthquake hazards in California and their locations.

Click here to view the map or go to Map 4.3A in the Appendices.

In This Topic

Due to the size and complexity of this topic, it has been broken down into two sections. This topic contains the following sections.

Section	Title	Page
4.3.1	Existing Buildings	78
4.3.2	Utilities and Transportation	100

4.3 Section 1 – Existing Buildings

Existing Buildings – General Overview

Compared to other earthquake vulnerabilities, buildings pose the largest risk to life, injury, property and economic welfare. California has approximately 12 million buildings, with an average of 2.7 occupants per building. Approximately 95 percent are low rise (one to three stories), five percent are medium rise (four to seven stories), and 0.03 percent are high rise buildings (eight or more stories) *(ATC 13, Jones et al).* Observations after earthquakes indicate that building safety is most often compromised by poor quality in design and construction, inadequate maintenance, a lack of code enforcement at the time of original construction, and improper alterations to the original building. *(Turning Loss to Gain, CSSC 95-01)*

A less common cause of damage is the poor performance of older buildings built to earlier seismic codes. Approximately 15 percent of California's buildings were constructed before 1933, when explicit requirements for earthquakes first began to be incorporated into building codes and when the state first required local governments to create building departments and issue permits. About 20 percent of California's buildings were constructed before 1940, when the first significant strong motion recording was made in El Centro. About 45 percent of the state's buildings were constructed before the Structural Engineers Association of California's first statewide consensus on recommended earthquake provisions were published in 1960. About 65 percent were built before the mid- to late-1970s, when significant improvements to lateral force requirements began to be enforced throughout the state. California did not have uniform adoption of the same edition of model codes in every jurisdiction until the early 1990s. Thus, well over half of all existing buildings in California are built to earlier standards that in many cases can result in inadequate earthquake performance.

Damage due to ground shaking produces over 98 percent of all building losses in typical earthquakes. In addition, buildings are also vulnerable to ground displacements associated with primary fault rupture, liquefaction, differential settlement, and landslides. Inundations from tsunamis seiches, and dam failures can also be major sources of loss to buildings.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Building Earthquake Losses

The most effective single element in mitigating earthquake losses to buildings is the consistent application of a modern set of design and construction standards, such as those incorporated in modern building codes. The codes are updated regularly to include the most effective design and construction measures that have been found by testing and research or observed in recent earthquakes to reduce building damage and losses. Local government building departments using a relatively modern code, such as the 1997 Uniform Building Code, regulate the vast majority of buildings. Exceptions include acute care hospitals, public K-14 schools, and state-owned buildings, which are regulated by state agencies in accordance with an even more stringent set of building code provisions that are incorporated in the 2002 California Building Code.

For new buildings, state and local governments enforce the California Building Standards Code (CBSC) that includes earthquake safety provisions from the 1997 Edition of the Uniform Building Code with enhancements for hospitals, public schools, and essential services buildings. Since this code is now outdated, the state enacted twenty emergency earthquake safety amendments that are applicable to state-owned buildings in 2003. The California Building standards Commission encourages local governments and other agencies to adopt these amendments.

A small percentage of older buildings have been strengthened or "retrofitted" to improve their resistance to earthquake shaking. Observations after recent earthquakes suggest that retrofitted buildings on the whole perform noticeably better than similar buildings that have not been retrofitted (*ATC 31, 1992, CSSC 94-06, WJE 1994*). However, in many respects their performance has been mixed. Less than five percent of California's existing buildings have been structurally retrofitted; the actual number has not been determined.

California has adopted retrofit standards for un-reinforced masonry (URM) buildings, hospitals, public schools, and state-owned buildings. The state has not formally recognized retrofit standards for other existing buildings. The CBSC allows retrofits of any nature provided that they make existing buildings no less safe. The 2003 International Existing Building Code is available for use at the discretion of regulatory agencies. It includes a compilation of seismic evaluation and retrofit guidelines and standards for un-reinforced masonry, tilt-up, wood frame dwelling, and older concrete buildings, including federal guidelines such as FEMA 356.A separate California Historical Building Code contains seismic safety provisions for evaluating, rehabilitating, and altering historical buildings.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Building Earthquake Losses (continued)

Mitigation measures for ground displacement include strengthening foundations, locating new facilities to avoid sites with the potential for large displacements during earthquakes, and modifying soils below foundations.

The state has not formally recognized seismic evaluation standards for other existing buildings. However, a new national evaluation standard is now available (ASCE 31-02).

Mitigation of Earthquake Losses in Nonstructural Systems and Building Contents

California did not begin to regulate the earthquake safety of nonstructural systems and heavy contents in buildings, such as water heaters, ceilings, light fixtures, and heating equipment, until the 1970s. Buildings built before the 1970s and newer buildings that were not regulated and that have unbraced systems can be made safer with retrofit projects. FEMA offers guidelines for the evaluation and retrofit of building contents and nonstructural building systems (FEMA 74). These retrofits can significantly reduce the risks of injuries and business interruption from earthquakes and are often feasible at very low costs. OES offers guidelines are for evaluating and retrofitting nonstructural falling hazards common to schools at www.oes.ca.gov.

Water heater bracing kits that are certified for use by the State Architect are available at most hardware stores. The State Architect also offers strapping instructions at www.dsa.dgs.ca.gov/Publications/default.htm. Bracing can prevent fires and serious water damage caused by toppled water heaters.

Continued on next page

4.3 Section 1 – Existing Buildings

Fire Following an Earthquake

One of the greatest potential hazards after an earthquake is fire. Fires following the 1906 San Francisco Earthquake, the 1923 Tokyo Earthquake, and the 1995 Kobe Earthquake caused extensive damage and killed thousands. Fires that follow earthquakes fall into two basic categories:

- **Category One**: Fires that follow immediately after an earthquake. Fires can occur when power lines are fused, broken and the resulting arcing comes into contact with combustible fuel. Water heaters, stoves and lighting fixtures/lamps are dislodged and come into contact with combustible fuel. Natural gas mains, lines and service are severed and the released gas finds a source of ignition. Combustible liquids can leak and find a source of ignition.

- **Category Two**: Fires that are delayed following an earthquake and that are generally human caused or preventable incidents. An example is fire caused by the restoration of electricity to an area not properly checked and secured. Lamps that were on when an earthquake hit may have been dislodged by the earthquake onto combustible material. When power is restored, heating can occur, followed by ignition. Arcing of downed power lines can also ignite combustibles. Additionally, inexperienced people can start fires by trying to relight gas pilots.

Mitigation for the prevention of natural gas system leakage has, in some areas, included the localized upgrading of natural gas pipelines and automatic seismic shut-off switches, which cut off natural gas to customers. It is critical that restoration of gas service following an earthquake be coordinated through the local gas utility and the fire department to ensure that service is not restored until minimum safety requirements are met on the distribution side of the gas meter. Restoration of gas and electrical services for areas known or suspected to have sustained damage may not be restored until the utilities and the fire department are prepared to have service restored.

An additional fire mitigation technique is the use of seismic pressure wave-triggered automatic garage door openers and alarms on fire stations. These devices help ensure that firefighters and fire equipment are not trapped in damaged fire stations following earthquakes.

Continued on next page

4.3 Section 1 – Existing Buildings

Sub-Inventories of Existing Buildings

The following building types are discussed in the text that follows:

- Unreinforced Masonry (URM) Buildings
- Hospitals
- Locally Regulated Essential Services Facilities
- State-Regulated Essential Services Buildings
- Other State-Owned Normal Occupancy Facilities
- State Criminal Justice Buildings
- State-Owned Health Services
- K-12 Public Schools
- Community Colleges
- Public Universities
- Tilt-Ups
- Single-Family Wood Frame Dwellings
- Multi-Unit Wood Frame Residential Buildings
- Locally Regulated Non-Ductile Concrete Buildings
- Steel Frame Buildings
- Seismic Gas Shutoff Valves
- High-Rise Buildings
- Mobile Homes

Table 4.3.1A - Earthquake Mitigation of Key Building Inventories

The following table is titled, "Draft Overall Progress Toward Earthquake Mitigation of Key Building Inventories in California." It summarizes the progress in making some of these types of buildings safer.

Click here to view the table or go to Table 4.3.1A in the Appendices.

Locally Regulated Unreinforced Masonry Buildings

Unreinforced masonry (URM) buildings are made of brick, stone, or other types of masonry and have no reinforcing steel to keep them from falling down in earthquakes. Most URM buildings have features that can threaten lives during earthquakes. These include parapets, walls, and roofs that are poorly connected to each other. When earthquakes occur, inadequate connections in these buildings can allow masonry to fall. Floors and roofs can collapse, placing occupants and passersby in harm's way.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of URM Buildings

The risk to life from URM buildings can be significantly reduced by the regulation of alterations to existing buildings and seismic retrofits. California has prohibited the construction of new URM buildings since 1933. However, many older URM buildings still remain in use today in California's historic, commercial, and industrial districts.

In 1986, California passed a law requiring local governments in high seismic regions nearest active faults (Seismic Zone 4) to inventory their URM buildings, establish a risk reduction program, and report to the CSSC. Ninety-one percent of the jurisdictions affected by the URM law comply with its provisions. State government buildings are exempt from the URM law but are partially addressed by other laws and regulations.

In 1990, there were an estimated 30,000 URM buildings statewide; approximately 26,000 were located in Seismic Zone 4, with the remainder in Seismic Zone 3. Ninety-eight percent of the URM buildings in Seismic Zone 4 (284 jurisdictions) have been inventoried. Statewide, URM buildings average 10,000 square feet of floor area and retrofits costs range from $10 to $150 per square foot. The following is a summary of their status:

Number	Status	%
16,761	Mitigated	66
13,303	Retrofitted to various standards	52
8,685	Retrofitted to the UCBC	34
4,618	Retrofitted to other standards	18
3,458	Demolished	14
8,754	Unretrofitted	34

Source: Status of the Unreinforced Masonry Building Law, SSC 2003-03. For a description of the types of occupancy in URM buildings, see Appendix B in Status of the Unreinforced Masonry Building Law, 1995, SSC 95-05, www.seismic.ca.gov/sscpub.htm

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of URM Buildings (continued)

The state adopted retrofit standards for URM buildings in the 1997 edition of the Uniform Code for Building Conservation, Appendix Chapter 1 (Title 24, Part 10, of the California Building Standards Code). Of California's cities and counties (about 600), 169 have adopted some form of these standards. The retrofit standards should be updated because the International Code Council has updated the code with several new improvements. The most current edition was published in the 2003 International Existing Building Code.

Table 4.3.1B – URM Buildings in California

Click here to view the table or go to Table 4.3.1B in the Appendices.

Continued on next page

4.3 Section 1 – Existing Buildings

Table 4.3.1C Hospitals

Since 1973, hospitals have been required to be built to higher standards than other buildings so that they can be reoccupied after major earthquakes. However, most hospitals built before 1973 still remain in service, some of which pose risks to life or are not expected to be available for occupation after future earthquakes.

The Office of Statewide Health Planning and Development (OSHPD) requires hospital owners to survey the earthquake vulnerability of their buildings as summarized in the table below. Structural Performance Category (SPC) 1 is the most vulnerable ranking for buildings. Many SPC 1 hospitals pose significant collapse risks. SPC 5 hospitals pose the least structural risk. Similarly, rankings for Nonstructural Performance Categories (NPC) range from 1 (most vulnerable) to 5 (least vulnerable).

Type	Category	Number of Buildings	%	Vulnerability
Structural Performance (SPC)	SPC-1	975	39	Most Vulnerable
	SPC-2	211	8	
	SPC-3	291	12	
	SPC-4	672	27	
	SPC-5	323	13	Least Vulnerable
SPC not reported	N/A	35	1	N/A
Non-Structural Performance (NPC)	NPC-1	1,807	72	Most Vulnerable
	NPC-2	430	17	
	NPC-3	63	3	
	NPC-4	143	6	
	NPC-5	15	1	Least Vulnerable
NPC not reported	N/A	49	2	N/A

Source: Hospital Seismic Performance Ratings, OSHPD, April 2001. For more information visit www.oshpd.ca.gov.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Hospital Buildings

Senate Bill 1953 (SB 1953), enacted in 1994 after the Northridge Earthquake, expanded the scope of the 1973 Alquist Hospital Seismic Safety Act. SB 1953 required the retrofit of all critical nonstructural components in surgery and emergency medical rooms by 2002. The law also requires that by 2008, all hospital buildings built before 1973 be replaced or retrofitted so that they can reliably survive earthquakes without collapsing or posing threats of significant loss of life. It further mandates that all existing hospitals be seismically evaluated and retrofitted, if needed, by 2030, so that they are reasonably capable of providing services to the public after disasters. SB 1953 applies to all acute care facilities (including those built after 1973) and affects approximately 2,500 buildings across 475 hospital facilities. State-owned hospitals are exempt from SB 1953.

OSHPD has adopted and enforces regulations for the seismic evaluation and retrofit of existing hospital buildings (SB 1953 Regulations and Division VI-R, Title 24, Part 2) that are applicable to all existing urgent care hospitals.

Locally Regulated Essential Services Facilities

California has no statewide inventory of locally regulated essential services facilities, including fire, police, ambulance, and emergency communication facilities. Most of these facilities were built prior to 1986, before state standards began to require enhanced seismic safety, and are not expected to be reliably functional after a severe earthquake, delaying emergency response and in some cases posing significant risks to life. DGS estimates that there are approximately 450 fire stations, 400 emergency operations centers, and 450 police stations throughout California.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Locally Regulated Essential Services Buildings

To mitigate the risk of earthquakes to locally regulated essential services facilities, California enacted the Essential Services Buildings Seismic Safety Act in 1986. Pursuant to the Act, the Division of the State Architect within DGS adopted regulations that apply to the construction of all new essential services buildings (California Code of Regulations, Title 24, Part 1, §4-201 to §4-222). There are no statewide regulations for evaluating and retrofitting locally regulated essential services buildings that existed prior to 1986, except for unreinforced masonry buildings in some jurisdictions. Some local governments and state agencies have voluntarily retrofitted or replaced their vulnerable buildings.

In 1990, the state passed the Earthquake Safety and Public Buildings Rehabilitation Bond Act (Proposition 122). Up to $50 million was allocated for the seismic retrofit of essential services facilities. As of 2000, 147 retrofit projects totaling $46 million were underway. Approximately 70 fire stations, 12 emergency operations centers, and 9 police stations completed retrofits by 2000. Many local governments and special districts have retrofitted their essential services buildings with local funds.

State-Regulated Essential Services Buildings

California has no statewide inventory of state-regulated essential services facilities, including fire, police, ambulance, and emergency communication facilities. Most of these facilities were built before state standards began to require enhanced seismic safety and are not expected to be reliably functional after earthquakes, delaying emergency response and in some cases posing significant risks to life. Key state agencies owning essential services facilities include:

- CDF
- CalTrans
- CHP
- DWR
- CNG

Continued on next page

4.3 Section 1 – Existing Buildings

Other State-Owned Normal Occupancy Facilities

California has an asset management program for non-university buildings that maintains an inventory of approximately 17,000 buildings with a total of almost 90 million square feet of space. Proposition 122 of 1990 included $250 million for the identification and seismic retrofit of deficient state-owned buildings.

Mitigation of Other State-Owned Normal Occupancy Facilities

As of 2003, 70 state-owned buildings had been retrofitted and an additional 76 retrofits were in progress. Combined with other funding, as of 2003 this total effort provided $262 million in seismic safety improvements in buildings owned or occupied by 13 state agencies.

In 1990, CSSC estimated the average seismic retrofit cost for state buildings at $45 per square foot. In 1999, DGS' Real Estate Services Division estimated the cost for retrofitting all state buildings as $0.84 to $1.7 billion.

In 2002, the state began a program to transfer facility funding and operations for county courthouses to the Judicial Council. Seismic evaluations are required as part of the negotiation between the counties and the state.

For existing buildings owned by the state, the CBSC adopted regulations (Division VI-R, Title 24, Part 2) that are applicable to state building seismic evaluations and retrofits. This portion of the regulations needs updating to the most current edition in the 2003 International Existing Building Code.

Mitigation of State-Regulated Essential Services Buildings

California enacted the Essential Services Buildings Seismic Safety Act of 1986 and DSA adopted regulations that apply to all new construction (Title 24, Part 1). For existing essential services buildings owned by the state, the CBSC adopted regulations (Division VI-R, Title 24, Part 2) that apply to building seismic evaluations and retrofits.

4.3 Section 1 – Existing Buildings

State Criminal Justice Buildings

A 1979-1980 renovation and planning study funded by the Department of Corrections included seismic evaluations and identification of remedial actions for major state prison buildings. Since then, some prisons have been retrofitted in conjunction with other planned modernization projects. Together the Department of Corrections, the Department of Justice, and the California Youth Authority own:

- 33 prisons
- 38 correctional conservation camps
- 11 youthful offender institutions
- 12 crime laboratories

Mitigation of State Criminal Justice Buildings

CBSC has adopted regulations (Division VI-R, Title 24, Part 2, CCR) for the seismic evaluation and retrofit of state criminal justice buildings.

State-Owned Health Services

The state manages seismic risk in its health care facilities through DGS, CDHS, and DDS. The state owns:

- Four mental health hospitals with 4 million square feet of space
- Five developmental centers 5 million square feet of space
- Two public health laboratories

Mitigation of State-Owned Health Services Buildings

The state's acute care hospitals are exempt from the Alquist Hospital Seismic Safety Act. However, the state remains responsible for the public's seismic safety in these facilities. For state-owned buildings, the CBSC has adopted regulations (Division VI-R, Title 24, Part 2) that are applicable to seismic evaluations and retrofits.

Continued on next page

4.3 Section 1 – Existing Buildings

K-12 Public Schools

Since 1933, public schools have been constructed in accordance with the Field Act, which requires thorough reviews of construction plans, strict inspections, and quality control. By 1977, nearly all public schools that were built before the Field Act had either been retrofitted or were no longer being used for instructional purposes. The Field Act did not begin to regulate nonstructural systems and building contents in schools until the 1970s. Many schools, particularly older public schools contain falling hazards that can injure occupants.

In 2002, the Division of the State Architect released a survey of early Field Act buildings that were constructed to regulations that, for certain types of construction, are no longer considered to provide reliable life safety. Survey results include:

- 70,000 Field Act building construction projects overall
- Approximately 40,000 buildings with 470 million square feet of space
- Buildings built before 1933 were either removed from use or retrofitted by 1976
- About 16,000 of the state's current Field Act buildings were constructed prior to 1978, when major changes were made to Field Act regulations
- 9,659 buildings (92 million square feet of space) with non-wood construction
- 2,122 Category 1 Buildings (expected to perform well and achieve life safety)
- 7,537 Category 2 buildings (not expected to perform as well as Category 1 Buildings and require more seismic evaluations)
- DSA anticipates needing $4.7 billion to evaluate and retrofit Category 2 buildings to meet a damage control and life safety performance objective

Source: Seismic Safety Inventory of California Public Schools, Division of the State Architect, Department of General Services, November 15, 2002

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Public School Buildings

California has adopted the Field Act and its regulations for new construction in the California Building Standards Code. For existing K-12 public schools and community colleges, DSA recently adopted emergency seismic evaluation and retrofit regulations (Division VI-R, Title 24, Part 2) that are applicable to public school buildings and conversions of non-Field Act buildings to public school use. Several older school districts throughout the state have or are currently retrofitting early Field Act schools.

The HMGP identified non-structural mitigation as a priority for schools and essential facilities following the 1994 Northridge Earthquake. OES offers guidelines for the retrofit of building contents and nonstructural building systems such as ceilings, light fixtures, and mechanical equipment (Guide and Checklist for Nonstructural Earthquake Hazards in California Schools, available at www.oes.ca.gov).

Community Colleges

Community Colleges also must comply with the Field Act. In 2000, the Community Colleges Chancellor's office funded a rapid seismic evaluation of buildings constructed to early Field Act standards. The survey found that the community college system has 20 district offices, 108 campuses, 54 off-campus centers, 4,366 buildings overall, and 52.2 million square feet of space. Of the total buildings, 1,600 were given a rapid seismic evaluation to identify retrofit needs that are now integrated into future capital outlay plans.

Public Universities

The University of California (UC) and California State University (CSU) systems together have 192 primary and satellite campuses and 10,000 buildings with 138 million square feet of space Since the early 1970s, UC has been evaluating and retrofitting buildings on its campuses. The system has ranked the seismic safety of its major buildings from "good" to "very poor" and has embarked on capital outlay programs to retrofit those that are ranked "poor" or "very poor." In the early 1990s, CSU initiated a similar program. As of 2003, CSU had evaluated 1,364 major facilities, identified 145 as potentially hazardous, and required further evaluation and retrofits in many cases. Most of facilities identified as hazardous now have retrofit projects undergoing design or construction or completed. The greatest vulnerability aspects of public universities are the potential for loss of life, research, and educational functions, and damage to state property.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Public University Buildings

For existing public university buildings owned by CSU and UC, the CBSC has adopted regulations (Division VI-R, Title 24, Part 2, CCR) that are applicable to their seismic evaluations and retrofits.

For the UC Berkeley Campus alone, the SAFER program estimates a need of $1.2 billion to address life safety retrofits over 20 to 30 years.

The San Jose State University Engineering Department has provided model non-structural mitigation techniques for laboratories.

The Disaster Resistant Universities Program

In the last decade, disasters have affected university and college campuses with high frequency, sometimes causing death and injury and always resulting in monetary losses and disruptions in teaching, research, and public service. Damage to buildings and infrastructure and interruption of the institutional mission result in significant losses that can be measured by faculty and student departures, decreases in research funding, and increases in insurance premiums. These losses could have been substantially reduced or eliminated through comprehensive pre-disaster planning and mitigation actions.

Building A Disaster Resistant University is both a how-to guide and a distillation of the experiences of six universities and colleges across the country that have been working to become more disaster-resistant. The guide, that can be downloaded at *www.fema.gov/fima/dru.shtm*, provides basic information designed for institutions just getting started as well as concrete suggestions for institutions that have already begun to take steps towards becoming more disaster resistant.

The SAFER Program

The Seismic Action Plan for Facilities Enhancement and Renewal at UC Berkeley is known as the SAFER Program. According to program's website, "The review was undertaken and the action plan developed with one goal: to do all we can to improve the safety of the campus in the event of a major earthquake on the nearby Hayward Fault. Our number one priority is the protection of the life and safety of students, faculty and staff." For more information, visit www.berkeley.edu/news/extras/1997/SAFER/index.html.

Continued on next page

4.3 Section 1 – Existing Buildings

Tilt-Ups

Tilt-up buildings are typically one- or two-story buildings constructed of concrete walls that are tilted into place and connected to wood or steel roofs. If the connections between the walls and roofs are weak, the walls can pull away from roofs and collapse during ground shaking. There is no statewide inventory of tilt-up buildings. However, a 1991 estimate suggested that there were approximately 57,000 throughout the state (EQE, 1991). Forty percent of these were built prior to 1976, after which building codes began to require stronger wall-to-roof connections. Many tilt-up buildings have been constructed in the past decade, generally to more current construction standards. Additional enhancements to the building code for new tilt-up construction were adopted in 1997.

The average building size for older tilt-up buildings is 30,000 square feet. Average retrofit costs are $5 per square foot. Much of California's light industrial and commercial properties are tilt-up buildings or buildings with reinforced masonry or concrete walls with vulnerabilities in connections between walls, roofs, and floors. These buildings pose significant risks of casualties and losses in business continuity and market share from earthquake damage.

Current retrofit provisions are available in Appendix Chapter 2 of the International Existing Building Code or FEMA 356. Additionally, state law encourages the disclosure earthquake weaknesses in commercial properties at the time of sale. See Chapter 11 for more information.

Table 4.3.1D Mitigation of Tilt-Ups and Similar Buildings

The following jurisdictions have adopted retrofit programs for tilt-up buildings:

Jurisdiction	# of Buildings	Program Type
Los Angeles	2,618	Mandatory Retrofit
Los Angeles County & Contract Cities	N/A	Mandatory Retrofit
Fullerton	220	Mandatory Retrofit
Hayward	130	Voluntary Retrofit
La Palma	N/A	Mandatory Retrofit
Brisbane	N/A	Voluntary Retrofit

Continued on next page

4.3 Section 1 – Existing Buildings

Single-Family Wood Frame Dwellings

There is no statewide inventory of single-family wood-frame dwellings, but approximately 1.5 million single-family dwellings were built in California before 1960 when jurisdictions began to require adequately braced walls. Homes can slide or fall off their foundations if not adequately anchored and braced.

A 1999 survey by the Association of Bay Area Governments (ABAG) determined that two percent to 38 percent of all Bay Area homes were retrofitted to variable levels in different jurisdictions. The average retrofit rate was well below 10 percent. Similarly, the California Earthquake Authority has surveyed its policyholders and found that about 6 percent have retrofitted their homes.

The primary risk posed by single-family wood frame buildings is the potential for loss of housing and property after earthquakes. In addition, poorly braced homes on steep hillsides that can slide down hills and present significant threats to life. Falling chimneys can also cause casualties and damage.

Mitigation of Single-Family Wood Frame Dwellings

The following cities have voluntary dwelling retrofit programs:

- Los Angeles (also adopted hillside dwelling retrofit ordinance)
- Berkeley
- San Leandro
- Oakland
- Santa Barbara

The most current retrofit provisions are available in Appendix Chapter 3 of the International Existing Building Code. Additionally, state law requires the disclosure of typical earthquake weaknesses in homes at the time of sale. See Chapter 11 for more information.

Continued on next page

4.3 Section 1 – Existing Buildings

Multi-Unit Wood Frame Residential Buildings

There is no statewide inventory of multi-unit wood frame residential buildings. However, approximately 360,000 buildings can be inferred from local inventories available from select cities as summarized in the tables below. A significant numbers—perhaps half—of all apartments and condominiums have parking at the lower levels, which can create earthquake vulnerabilities. These buildings can collapse and cause casualties and property loss and be rendered uninhabitable after earthquakes. Up to 84 percent of the loss of housing in a Hayward earthquake scenario is expected to occur in multifamily residential buildings *(ABAG 1999).*

The estimated numbers of apartment buildings statewide are as follows:

- 360,000 total buildings
- 280,000 apartment buildings in Zone 4
- 140,000 soft story in Zone 4 (50 percent estimated)
- An average of 16 units per building

Sources: Department of Finance Demographics Unit at www.dof.ca.gov and City of Los Angeles estimates of 40,000 buildings with 50 percent soft story

Mitigation of Multi-Unit Residential Buildings with Soft, Weak, Open Fronts

The following jurisdictions have voluntary retrofit programs for apartments:

- Los Angeles
- Fremont

The most current retrofit provisions are available in Appendix Chapter 4 of the International Existing Building Code or FEMA 356.

Continued on next page

4.3 Section 1 – Existing Buildings

Locally Regulated Non-Ductile Concrete Buildings

There is no statewide inventory of concrete buildings. However, an approximate figure of 40,000 buildings can be inferred from local inventories. These buildings, particularly older ones with high numbers of occupants, can collapse and kill hundreds. This type of building is the fastest growing cause of earthquake losses around the world (Coburn, 2002). California instituted changes in building codes in the mid-1970s that were intended to stem losses in newer buildings constructed to later standards. However, the great majority of these buildings constructed before the mid-1970s have not been evaluated or retrofitted.

The most current retrofit provisions are available in FEMA 356, ATC 40 as revised, and Appendix Chapter 5 of the International Existing Building Code.

Source: 14,000 buildings extrapolated from a Los Angeles County Assessor's Database summary by EQE 11-5-97

Table 4.3.1E Mitigation of Older Concrete Buildings

The following jurisdictions have retrofit programs for non-ductile concrete buildings:

Jurisdiction	Buildings	Type of Program
Long Beach	Non-bearing URM, including non-ductile concrete with URM	Mandatory Retrofit
Los Angeles	N/A	Voluntary Strengthening
Fremont	City Hall	Voluntary Strengthening
Palo Alto	49 buildings	Voluntary Strengthening
Petaluma	5 buildings	Partial Strengthening

Continued on next page

4.3 Section 1 – Existing Buildings

Repair of Steel Frame Buildings

After the Northridge Earthquake, the City of Los Angeles enacted an ordinance that required the repair of existing damaged steel frame buildings. Many of these buildings were restored to their pre-earthquake conditions and are likely to suffer similar or worse damage in future earthquakes. Elsewhere in the state no surveys of such buildings exist, although several similarly damaged buildings were discovered in the Bay Area years after the 1989 Loma Prieta Earthquake. The state has since changed its building code for constructing new buildings with this type of framing. There are no efforts in the state to require retrofits or enact post-disaster repair provisions.

Much of California's corporate, finance, legal and insurance commerce occurs within these buildings. The potential for loss of market share in the economy from the closure of these buildings due to nonstructural damage is significant. The risk to life is smaller than with other vulnerable building types.

Mitigation of Steel Frame Buildings

The cities of Los Angeles and Santa Monica have post-earthquake repair ordinances. Los Angeles required owners to remove the finishes from joints in 242 buildings and repair the ones that were cracked.

The most current recommended evaluation and retrofit provisions are in FEMA 350 to FEMA 353 and in the American Institute of Steel Construction Seismic Provisions. See www.atc.org and www.aisc.org for more information.

High Rise Buildings

There is no statewide inventory of high-rise buildings. Only approximately 0.03 percent of all buildings in the state have eight or more stories. However, much of California's corporate, finance, legal, and insurance commerce takes place in these buildings. The potential for loss of market share in the economy from the closure of these buildings after earthquakes due to nonstructural damage is significant. The Council on Tall Buildings and Urban Habitat maintains an inventory of high-rise buildings at www.ctbuh.org.

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation in High Rise Buildings

Guidelines are available for the retrofit of building contents and nonstructural building systems, such as ceilings, light fixtures and mechanical equipment (FEMA 74). Structural retrofits can be accomplished using FEMA 356 or the International Existing Building Code.

Mobilehomes

California has approximately 473,000 mobilehomes. HCD regulates installations and alterations to mobilehomes in approximately 3600 of the state's 5800 mobile home parks. Local governments have enforcement jurisdiction over the remaining parks, as well as over all manufactured home installations outside of parks. In 1974, HCD began to require engineered tie-down devices for wind loads in excess of 15 pounds per square foot for singlewide homes. However, most homes are multi-wide or in regions of lower wind speed and are exempt from this requirement. Most homes installed prior to 1994 are not attached to their foundations or otherwise braced to resist earthquake loads.

Numerous studies have determined that the performance of pre-1994 mobilehomes in California earthquakes is significantly worse than that of conventional wood-frame dwellings. The primary earthquake weaknesses are the temporary foundations on which such homes are commonly placed. Homes on inadequate foundations can shift and fall several feet in earthquakes, severing gas lines. Doors can become stuck, trapping occupants and creating serious threats to life in events with fires *(SSC 95-01, Turning Loss to Gain*).

Mitigation of Mobilehomes

In 1981, the state began to regulate the design and construction of optional Earthquake Resistant Bracing Systems that can be installed under existing mobilehomes at the owners' discretion. Since 1994, the state has required that new or relocated mobilehomes be braced to resist earthquakes in one of three ways:

- Conventional foundation systems similar to wood frame dwellings
- Engineered tie-down systems
- Earthquake-resistant bracing systems

Continued on next page

4.3 Section 1 – Existing Buildings

Mitigation of Natural Gas Systems in Buildings

The CSSC has developed guidance for local governments for mitigating natural gas systems in buildings, titled Improving Natural Gas Safety in Earthquakes *(SSC 02-03).* The most cost effective mitigation method is training the public to know when and how to manually shut off existing gas valves.

Table 4.3.1F Seismic Gas Shutoff Valves

The following local governments have adopted mandatory seismic gas shutoff valve ordinances:

Jurisdiction	Ordinance Number(s)	Year(s)
Los Angeles	171874	1995, 1998, 2002
Martinez	1269	1999
Contra Costa County	2000-11	2000
Richmond	32-00	2000
Alameda County	0-2001-54 & 0-2001-55	2001
Marin County	3322	2001
Hercules	9-2.09	2001
West Hollywood	01-592	2001

4.3 Section 2 - Utilities and Transportation

Introduction

Due to the extensive nature of utility and transportation infrastructure in California, utilities will be discussed first and will be followed by a summary of transportation systems. Utilities include

- Electric transmission systems
- Electric power plants (hydroelectric and fossil fuel)
- Electric distribution systems
- Water supply pipelines (potable and non-potable)
- Water treatment systems
- Wastewater collection systems
- Natural gas and oil supply pipelines
- Telecommunication systems

Table 4.3.2A Mitigation of Utilities and Transportation Systems

The table below summarizes the overall progress towards earthquake mitigation of key utilities and transportation systems.

Inventory Category	Number of Miles	Geo-located	Mitigation Program	Seismic Evaluation	Mitigation Progress	Responsible State Agencies
Utilities	31,720 miles	Yes	◓	◓	◓	CEC, PUC, Cal EPA, California Independent System Operator (ISO), DWR
Ports and Harbors	10	Yes	◓	◓	◓	State Lands Commission, Coastal Commission
Highways	50,000 miles	Yes	◕	◕	◕	Caltrans
Railways	7,000 miles	Yes	○	○	○	PUC
Bridges-State	2,194	Yes	●	◕	◕	Caltrans
Bridges-Local	1,211	Yes	◓	◔	○	Caltrans
Dams	1200+	Yes	●	●	◕	DWR

● Most nearly completed, needs updating ◕ nearly completed ◓ halfway completed
◔ Partially completed, needs significant work ○ begun

Continued on next page

4.3 Section 2 - Utilities and Transportation

General Observations on Utilities And Transportation Systems

In addition to various laws, ordinances, regulations, standards and guidelines, construction activities for utilities and transportation systems must abide by the California Environmental Quality Act (CEQA). If a utility or transportation activity is considered a "project" under CEQA, then the owner of the proposed project must either obtain an exemption from the requirements or use CEQA guidelines to see if their project may pose an impact on the environment. This includes following a checklist to determine if there may be an impact on the environment from a seismic hazard. If the answer is yes, then the owner is required to address questions about seismic hazard assessment and possible mitigation. If the answer is no, then the owner is not required under CEQA to address seismic hazard assessment or mitigation, but may be required by a local ordinance, law, or standard, or their insurance company, to address seismic hazard issues.

There is no comprehensive database for seismic hazard assessment or mitigation of utilities as a group or as just a particular type of utility. However, various groups have collected data on the performance of utilities and transportation systems during and after earthquakes in California and elsewhere. The data collection and analysis effort has been applied on an irregular level to various utility components. This is primarily due to the fact that a great deal of California's utility infrastructure has been in existence since before the 1971 San Fernando earthquake. As new standards and guidelines have been developed, utilities have been using new data and design techniques to assess seismic hazards for power plants, electrical transmission and distribution systems, natural gas pipelines, water supply lines (including canals and aqueducts), and dams for new projects and seismic retrofit projects.

CalTrans and local governments have also been retrofitting bridges using new design techniques and new standards and guidelines. Data regarding locally owned transportation retrofit activities is not monitored in California. However, several facilities are known to have taken action for seismic hazard mitigation including ports and airports.

Continued on next page

4.3 Section 2 - Utilities and Transportation

General Observations Of Utilities And Transportation Systems, (Continued)

Experience gained after assessing earthquake performance of utilities and transportation systems points to the following:

Various degrees of damage affect the functionality of utilities, roads, bridges, ports, or airports. The extent of damage is related to the severity of the seismic hazard at the facilities in question, the quality of the soils or rock at and adjacent to the site, the design criteria used in building the facilities, and the age and condition of the facilities. Those facilities of high quality construction and built on good performing soil or rock tend to perform better than those built on poorly performing soils.

Typical building codes for utilities and transportation system focus on the preventing the loss of lives and reducing property damage but do not guarantee that the facility will remain functional after an earthquake. Fault rupture has caused breakage of pipes and offsets in the foundations of electrical power towers, roads, and buildings.

A matrix of guidelines and standards for improving the performance of lifelines and transportation systems during and after disasters has been produced by the American Lifelines Alliance. The matrix can be viewed at www.americanlifelinealliance.org. (Click the matrix button on the left side of the index page.)

Electrical Utilities

California has 31,721 miles of electric transmission lines and up to double that amount for the electric distribution system. In addition California has 188 operational power plants varying in size from 50 megawatts to over 2,000 megawatts, generating a total of up to 53,700 megawatts *(CEC Power Plant Data Base, Summer 2003).* California also imports, to various degrees throughout the year, electric power from outside of the state. No complete seismic hazard mitigation inventory for electrical power generation, transmission and distribution exists in California. This is due to the lack of a requirement and funding for such a task, and the fact that either private companies or investor-owned utilities own the majority of electric power generation and transmission. However, several assessments of electric power generation, transmission and distribution systems have been performed following California earthquakes, as well as, earthquakes in Japan and elsewhere *(See Schiff 1999).*

Continued on next page

4.3 Section 2 - Utilities and Transportation

Electrical Utilities, (Continued)

The greatest aspect for vulnerability is from strong ground shaking. This tends to occur in high voltage substations or switchyards due to two reasons:

1. Substations and switchyards tend to be key facilities in the ability of a distribution or transmission system to reroute power around or to areas affected by earthquakes; and,
2. Some high voltage substation and switchyard equipment is relatively brittle.

The amount of recorded substation and switchyard damage after the 1971 San Fernando earthquake, the 1986 Palm Springs earthquake, and the 1994 Northridge earthquake highlights these two vulnerabilities. The ground motion hazard is generally the greatest hazard overall. In regions struck by earthquakes, it can be likely that vulnerable electric power equipment is in the area of strong ground shaking. Conversely, strong ground shaking occurs in areas where there are earthquakes. Earthquake shaking can cause electrical lines to slap together, causing the lines to catch fire. In California significant seismic hazard mitigation research has been conducted by electric utilities and by researchers through organizations such as the Pacific Earthquake Engineering Research Center. Mitigation research products are making their way into new construction, purchasing, and siting decisions for all aspects of the electric utility industry in California.

Other vulnerable aspects of electrical transmission distribution and generation facilities include:

- Landslides that can damage electric transmission or distribution towers, substations, or switchyards.
- Ground deformation such as subsidence or liquefaction that can cause a misalignment in the power train of an electric power plant. Typically such problems can be mitigated by careful assessment of the potential for on-site liquefaction or subsidence and the proper design of foundations.

Continued on next page

4.3 Section 2 - Utilities and Transportation

Interdependency on Electric Power

Key aspects of vulnerability is the potential for loss of electrical power in:

- Natural gas pipelines, including compressor and pumping stations
- Oil transmission pipelines and pumping stations
- Oil, natural gas, or water storage facilities
- Water supply systems and pumping stations, and
- Waste water treatment and disposal systems.

All these systems rely on electric power, so when disrupted, services are interrupted. In some cases automatic shut-off valves and emergency power systems such as diesel generators have reduced this risk. Ground waves move at speed of sound – electronic signals travel at the speed of light providing an opportunity for smart valve intervention.

Pipeline Networks- Natural Gas, Oil, and Water

California is reported to have 11,600 miles of natural gas transmission pipeline (CEC, 2003). No complete seismic hazard mitigation inventory for pipeline networks exists in California. However, several regional utilities have assessed their natural gas pipe works with respect to seismic hazard. An incomplete seismic hazard inventory is due to the lack of a requirement and funding for such a task, and because utilities and private companies own most of the pipeline systems. Municipalities, special jurisdictions, and the State also own pipelines.

Pipelines subjected to significant displacement may develop leaks or breaks. This may be caused by ground deformation or by strong ground shaking. Ground deformation may include fault rupture as well as landslides, liquefaction or subsidence. Typical mitigation measures to offset this vulnerability include assessing siting requirements, flexible couplings, and aboveground fault crossings. Mitigation for fault crossings may also be accomplished by making pipes flexible enough and pipe supports big enough to allow pipelines to move to accommodate the anticipated ground displacements without rupture. Mitigating of areas prone to landslides prior to installation, or rerouting of pipelines around areas prone to land sliding are possible.

Ground deformation can cause significant damage to older pipe works made of cast iron or clay. At the end of 2003, there are several natural gas and water supply pipeline replacement projects underway in California. These projects tend to focus on replacing older pipes, valves, and pumps in an effort to maintain the reliability and to modernize their systems.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Water Supply, Waste Water Treatment, and Disposal Systems

Water filtration plants and wastewater treatment facilities are often located in areas subject to severe ground shaking and liquefaction, flooding, or tsunami inundation. Damage to water filtration plants can result in disruptions of clean water supplies. Damage to waste water treatment facilities or their intake pipe works or effluent disposal systems can result in immediate serious public health hazards.

Loss of power can also lead to discharges of partially treated or untreated effluent into waterways or the ocean. One mitigation technique to prevent an effluent discharge due to the loss of power is to include back up power at such plants to keep facilities operational.

Dams, Reservoirs, Canals, and Levees

California utilizes over 1,200 dams and thousands of miles of levees to meet its water supply, conveyance, and flood protection demands. The greatest weakness of this system is liquefaction-induced failures caused by strong ground shaking. *(Torres, et al., 2000)*

During the 1971 Sylmar earthquake the Lower San Fernando Dam, which is upstream from a heavily populated area, was severely damaged from liquefaction. The dam condition was an issue of concern for potential breech and inundation of the community. The dam, though heavily damaged, was not breeched and no dam failure induced flooding occurred. Later, another dam and a reservoir were built upstream from the Lower San Fernando Dam. The San Fernando Dam, which was being used only for flood control purposes, was damaged again during the 1994 Northridge earthquake.

Several other dams have experienced damage during earthquakes. DWR Division of Safety of Dams has been working with dam owners to periodically assess the safety of dams in their jurisdictions and several dam owners have rehabilitated their dams.

Earthquake instrumentation of dams was begun after the 1971 Sylmar earthquake, and though the effort continues with strong motion instrumentation projects in CGS and DWR, less that 45 dams currently have adequate instrumentation. Modern adequate instrumentation can provide the data to assist rapid assessment of the state of health of a dam after a significant earthquake.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Dams, Reservoirs, Canals, and Levees (continued)

The Sacramento-San Joaquin Delta contains levees critical for delivering irrigation water to 3 million acres, and drinking water to over 23 million people. A failure in one of the Delta levees in 1972 interrupted the State and Federal water supply systems and required approximately 500,000 acre-feet of fresh water to restore export water to acceptable quality *(Senate Hearings on the 1972 Levee Failure at Andrus-Brannan Islands).* Recent studies indicate the levees in the Delta are susceptible to significant damage in a near-field seismic event. CALFED's "Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees" report of April 2000 concludes that 3 to 10 failures are likely to occur on critical Delta levees during a 100-year earthquake. These failures would likely stop the export of Delta water until water quality is restored. Aside from the potential impact to water delivery to southern California, the encroachment of brackish or seawater into the delta could have significant environmental impact on salt-sensitive species. The San Joaquin Delta also has many fuel storage facilities and oil and gas pipelines located within the region. These lines may fail during a seismic event and cause large scale spills that will also inhibit the export of Delta water and severely impact one of the nation's largest natural salt water habitats.

Two major seismic hazard mitigation efforts include the East Side Reservoir Project in Riverside County and the Olivehain Dam in San Diego County. The East Side Reservoir Project includes canals, pipeworks, a new dam, and reservoir intended to provide water to a large portion of the Los Angeles metropolitan region for up to six months should an earthquake take the California Aqueduct out of service. The Olivehain Dam and reservoir is intended to provide San Diego with water should there be interruptions of water from the Colorado River after earthquakes.

Other Vulnerabilities

Observations of damage from California earthquakes have also shown that ground shaking may be locally attenuated but then be amplified farther away. Such was the case for the Hector Mine earthquake when an oil storage tank near Wilmington (over 100 miles away) was damaged and minimal or no damage was observed in cities between the epicenter and the tank. Ground shaking may also damage aboveground pipelines and their support framing.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Petrochemical Facilities Including Oil Refineries and Liquefied Natural Gas Facilities

California has several petrochemical facilities, which include

- Oil refineries
- Oil storage facilities
- Gasoline storage facilities
- Liquefied natural gas facilities, and
- Marine oil terminals.

There is no statewide inventory of seismic hazard mitigation activities of petrochemical facilities. There are two seismic hazard guidelines for petrochemical facilities. These are

- *Guidelines for Seismic Evaluation and Design of Petrochemical Facilities* by the American Society of Civil Engineers; and
- *Marine Oil Terminal Engineering and Maintenance Standards* by the California State Lands Commission Marine Facilities Division.

Both guidelines contain general seismic hazard assessment and mitigation for design information.

The *Guidelines for Seismic Evaluation and Design of Petrochemical Facilities* provides information for engineers to develop project specific seismic hazard mitigation designs and also contains information for emergency contingency planning, post-earthquake damage assessment and seismic retrofit design.

The Marine Oil Terminal Engineering and Maintenance Standards are in alignment with Seismic Design Guidelines for Port Structures, which were published by the International Navigation Association in 2001. The NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA Publication No. 368) is also being revised. Once revised FEMA 368 is anticipated to include seismic hazards guidelines for ports. The guidelines are to be equivalent to the guidelines published by the State Lands Commission for marine oil terminals.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Solid Waste Disposal Systems (Municipal and Hazardous Waste Landfills)

There is no inventory of municipal or hazard waste landfill seismic hazard mitigation activities. However, there are over 200 municipal and hazardous waste landfills in California. During the siting, permitting or closure process a landfill owner may be required to submit a stability analysis for the liner and/or final cover systems. The purpose of the liners and the final cover is to prevent the uncontrolled release of leachate or landfill gas (a gas that is made up mainly of methane) from the landfill. This may vary from a simple analysis for flat slopes to a sophisticated seismic hazard assessment and slope stability analysis.

In general, the greatest vulnerability for landfills with respect to seismic hazards may be the damage to the final cover or the landfill gas collection and control system caused by ground deformation (in this case the deformation of the landfill). Another significant vulnerability of landfills is the loss of electrical power to run leachate collection and control systems and landfill gas collection and control systems.

Transportation Systems

Transportation systems are generally broken down into the following categories:

- Highways (including freeways)
- Bridges
- County or City Roadways
- Railways
- Ports and Harbors (including airports).

California has approximately 50,000 lane miles of highways. There are an unknown amount of lane miles of county and city roadways since there is no single database that includes all the roadways in the State.

There are 12,000 state and 12,000 local bridges *(CalTrans 2001).* 2,194 state bridges were determined to need seismic retrofitting; as of 2003, all but 12 have been retrofitted. 1,100 local bridges were determined to need seismic retrofitting. As of 2001, 500 of these have been retrofitted.

There are also seven state-owned toll bridges that have been determined to require seismic hazard mitigation. As of July 2001, the retrofitting of two bridges have been completed.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Transportation Systems, (Continued)

Fault ruptures and strong ground shaking, as evidenced in the Kocaeli, Turkey and Chi-Chi, Taiwan earthquakes, are key concerns. A third hazard is the potential for landslides blocking tunnels or mountain roadways. CalTrans research engineers, designers, construction, and maintenance staff are addressing all three issues.

Roadways and bridge approaches with minor deformation might be acceptable for limited use, while similar degrees of deformation for airport runways may not be acceptable. Ground deformation may also affect harbors and ports by changing the alignments of tracks for large cranes.

Strong ground shaking causes more damage over a larger area than fault rupture. This is because damage from surface rupture is confined typically along the fault. Earthquake induced landsliding and liquefaction may also be localized and not necessarily cover an area as extensive as strong ground shaking.

CalTrans, working with the CGS Strong Motion Instrumentation Program, embarked on an important bridge instrumentation effort after their Loma Prieta earthquake. Over 60 bridges currently have strong motion instrumentation, and the 7 major toll bridges are also slated for full instrumentation. After an earthquake, the data from this instrumentation will provide key information about the necessity for detailed inspection by CalTrans to establish whether the structure should be closed for repair. Although this is a small percentage of the total number of bridges, the instrumentation can be a very important part of event response and recovery.

There are approximately 7,000 miles of railroad track in California *(CPUC 2002).* A significant number of track-miles are vulnerable to landslides, liquefaction, fault rupture, and settlement. The greatest vulnerability that trains have from seismic hazards is from strong ground shaking, causing trains to derail, followed by ground deformation causing bending or breaking of railroad track and damage to railroad bridges. The American Railway Engineering and Maintenance-of-Way Association *(2003 Manual for Railway Engineering)* has developed recommended practices for the design and maintenance of railroad bridges, embankments, culverts, tunnels, and other components for improved performance during and after earthquakes. In addition, CGS has guidelines that are applicable to railways and similar projects for assessing and mitigating seismic hazards. This document is the *Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, 1997.*

Continued on next page

4.3 Section 2 – Utilities and Transportation

Ports and Harbors

There is no systematic integrated database or inventory on seismic hazard assessment or mitigation for ports and harbors in California. However, most of the large ports and harbors have initiated some sort of seismic hazard study for various projects in recent years.

Ground deformation is a significant vulnerability in various ports and harbors since significant piers and quays are built out of dredge tailings or fill. Landfills do not typically perform well in large earthquakes as evidenced by damage to man-made ground in the Marina District of San Francisco and in Kobe, Japan. Ground deformation on landfills at ports and harbors can affect harbors and ports by changing the alignments of tracks for large cranes used to load or off load cargo ships. Such deformation may occur from lateral spreading, liquefaction, dynamic compaction, or secondary ground rupture. After the 1989 Loma Prieta Earthquake, some of the Oakland Airport's runways experienced severe ground deformation. This damage impacted airport operations.

Depending on the location and geometry and depth of the port or harbor it may be susceptible to a tsunami or seiche. To date, California has had only one series of tsunamis that significantly damaged a port or harbor. That event was a series of tsunamis that hit the Port of Crescent City after the M9.2 earthquake in Alaska on March 26, 1964.

The American Society of Civil Engineers has created *Seismic Guidelines for Ports.* The guidelines provide generalized information for assessing seismic hazards for use in developing seismic hazard mitigation design criteria. The guidelines are based on observations of the performance of ports and harbors after earthquakes around the world. Several ports and harbors have also conducted seismic hazard mitigation projects.

Continued on next page

4.3 Section 2 – Utilities and Transportation

Communication Systems

California has no seismic hazard inventory for its communication systems. However, there is a guideline for the improvement of their performance during earthquakes titled *Methods of Achieving Improved Seismic Performance of Communications Systems (Tang and Schiff, 1996).*

The greatest vulnerability of communication systems depends on what communications aspects are under consideration. For example, strong ground shaking tends to affect switches and other aboveground components more than liquefaction. However, liquefaction may affect belowground conduits more than shaking.

In prior strong urban earthquakes, there has been little damage to cellular telephone or internet systems. However, their use has grown exponentially since the 1994 Northridge Earthquake. Their typical vulnerabilities stem from the loss of electrical power and from surges in customer use potentially swamping the capacity of the systems.

The seismic vulnerability of radio and television communication systems is typically from the loss of power and shaking damage to unsecured equipment.

4.4 Mitigation Measures for Earthquake Hazards

Introduction

From 1990 through June of 2003, Californians spent in excess of $19 billion on seismic hazard mitigation activities (CSSC, 2003). This is an indicator of the level of effort to mitigate seismic hazards and reduce life and property loss after earthquakes. Additional loss mitigation is provided by approximately $10 billion in earthquake insurance currently in place. One of the more significant mitigation activities that cannot be assigned a specific cost is mitigation by hazard avoidance. A good example is the requirement that buildings and facilities in California no longer be built over ground rupture traces of active faults.

In This Topic

Due to the size and complexity of this topic, it has been broken down into two sections. This topic contains the following sections.

Section	Title	Page
4.4.1	Historical Developments in Earthquake Mitigation	113
4.4.2	California Earthquake Loss Reduction Plan	118

4.4 Section 1 - Historical Developments in Earthquake Mitigation

Dam Safety Act	After the 1928 collapse of the Saint Francis Dam in Ventura County killed more than 450 people, in 1929 California passed the Dam Safety Act to regulate the construction and maintenance of all non-federal dams. Following 1963 collapse of the Baldwin Hills Dam in Southern California, the state expanded its jurisdiction to both new and existing off-stream storage facilities. DWR's Division of Safety of Dams administers the Dam Safety Act and periodically inspects dams to ensure their safety. Fees paid by dam owners fund the Division's work.
Field Act	In 1933, one month after the Long Beach Earthquake destroyed 70 schools, seriously damaged 120 others, and caused minor damaged to 300 more, California passed the Field Act to ensure seismic safety in new public schools. The Act establishes regulations for the design and construction of K-12 and community college buildings. The Division of the State Architect within DGS enforces the Field Act.
Riley Act	Following the 1933 Long Beach Earthquake, the state also passed the Riley Act, which requires local governments to have building departments that issue permits for new construction and alterations to existing structures and conduct inspections. Permit fees paid by building owners generally fund the work of local building departments. The Act also set minimum seismic safety requirements that have since been incorporated into all building codes.
Hospital Safety Act	The loss of emergency functions and hospital collapses due to the 1971 San Fernando Earthquake prompted passage of the Hospital Seismic Safety Act of 1973. This Act regulates the design, construction, and alteration of hospitals for the protection of life and property and so that they will remain functional after disasters. OSHPD enforces this Act.

Continued on next page

4.4 Section 1 - Historical Developments in Earthquake Mitigation

Strong Motion Instrument Act

The state passed the Strong Motion Instrumentation Act in 1972 in response to the extensive damage to buildings and bridges caused by the 1971 San Fernando Earthquake. The earthquake highlighted the need for more data on strong ground shaking during earthquakes and on the response of structures to the shaking. The Act established a statewide network of strong motion instruments to gather vital earthquake data for the engineering and scientific communities. Data obtained from the strong motion instruments is used to recommend changes to building codes, assist local governments in the development of their general plans, and help emergency response personnel in the event of a disaster.

Alquist-Priolo Earthquake Fault Zoning Act

The state passed the Alquist-Priolo Earthquake Fault Zoning Act in 1972 to mitigate the hazard of surface faulting to structures built for human occupancy. The law was another response to the 1971 San Fernando Earthquake, which produced extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. Before issuing building permits, cities and counties must require a geologic investigation to ensure that proposed buildings will not be constructed across active faults. Proposed building sites must be evaluated by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault.

Seismic Safety Commission Act

The 1971 San Fernando Earthquake highlighted weaknesses in California's earthquake risk management policies. To address these weaknesses, in 1975 the state legislature created the independent California Seismic Safety Commission (CSSC) to provide a consistent earthquake policy framework for the state. The mission of CSSC is "to provide decision makers and the general public with cost-effective recommendations to reduce earthquake losses and expedite recovery from damaging earthquakes." The commission is also responsible for implementing the California Earthquake Hazards Reduction Act, which requires CSSC to "prepare and administer a program setting forth priorities, funding sources, amounts, schedules, and other resources needed to reduce statewide earthquake hazards."

Continued on next page

4.4 Section 1 - Historical Developments in Earthquake Mitigation

California Earthquake Hazards Reduction Act	After the 1985 Mexico City Earthquake, in 1986 California passed the Earthquake Hazards Reduction Act, which called for a coordinated state program to implement new and expanded activities to significantly reduce earthquake threat. The program is coordinated by CSSC, which is required to specify priorities, funding sources and amounts, schedules, and other resources. Although historically funded by the state general fund, since the 2003-2004 fiscal year, the program was funded by fees imposed on property insurance companies.
Un-reinforced Masonry Building Law	In response to the 1983 Coalinga Earthquake, in 1986 the state legislature enacted the Un-reinforced Masonry Building Law, which requires local governments in high seismic regions of California to inventory un-reinforced masonry buildings, establish mitigation programs, and report progress to the CSSC. As of 2003, 251 local governments have established programs and 16,761 buildings have either been retrofitted or demolished. Cities and counties rely on a variety of funding sources, including building permit fees, to pay for these programs. Some local programs offer financial, planning, and zoning incentives to building owners for retrofit. The CSSC periodically reports on the progress made by local programs in a publication entitled *Status of the Un-reinforced Masonry Building Law,* most recently in 2003.
Essential Services Building Seismic Safety Act	Also in response to the 1985 Mexico City earthquake, in 1986 the state passed the Essential Services Building Seismic Safety Act to require enhanced regulatory oversight by local governments during the design and construction of new essential service facilities, such as fire and police stations and emergency communications and operations facilities. The Division of the State Architect within DGS enforces this Act.

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4.4 Section 1 - Historical Developments in Earthquake Mitigation

Bridge Seismic Retrofit Program	Since the 1971 San Fernando Earthquake, CalTrans has been authorized to seismically retrofit vulnerable state and local bridges. Phase 1 consisted of retrofitting 1,039 state-owned single- and multiple-column bridges at a cost of $815 million. Phase 2 consisted of retrofitting the remaining 1,364 multiple-column state bridges at a cost of approximately $2 billion. Approximately $1.5 billion is being spent to replace major non-toll bridges and $4.6 billion for major toll bridge retrofits and replacements. Replacement costs include significant non-seismic upgrades. Costs for retrofitting 1,212 locally owned bridges are expected to be approximately $1 billion. Funds come from the State Transportation Improvement Fund, the State Highway Account, FEMA public assistance, sales tax increments, and gasoline taxes.
Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990 (Prop 122)	Proposition 122 was passed by voters in June 1990 after the 1989 Loma Prieta earthquake revealed vulnerabilities to state-owned and essential services buildings. The bond measure authorized the state to issue $300 million in general obligation bonds for the seismic retrofit of state and local government buildings ($250 million for state-owned buildings and $50 million for partial financing of local government essential services facilities). The Seismic and Special Programs Section of DGS' Real Estate Services Division administers Proposition 122 grant programs.
Seismic Hazards Mapping Act	The Seismic Hazards Mapping Act, passed in 1990, directs the Department of Conservation to identify and map areas prone to liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the Act is to reduce the threat to public safety and to minimize the loss of life and property by identifying and mitigating these seismic hazards. The Act requires geotechnical investigations to identify hazards and formulate mitigation measures before permitting most developments within mapped Zones of Required Investigation.

Continued on next page

4.4 Section 1 - Historical Developments in Earthquake Mitigation

Hospital Seismic Retrofit and Replacement Program	The state legislature passed Senate Bill 1953 after the 1994 Northridge earthquake revealed vulnerabilities in older hospitals. The law requires hospitals to undertake nonstructural retrofits of emergency and surgical rooms by 2002, collapse-avoidance retrofits by 2008, and achieve full compliance with the Alquist Hospital Seismic Safety Act by 2030. OSHPD enforces this Act.
Marine Oil Terminal Program	After the 1994 Northridge Earthquake, the State Lands Commission received a hazard mitigation grant from FEMA to develop standards for the evaluation, retrofit, and maintenance of new and existing marine oil terminals. In 2003, the Commission issued its proposed regulations and plans to hold hearings prior to their consideration for adoption. The proposed regulations would help limit the potential and size of oil releases after earthquakes and tsunamis by requiring upgrades of older terminals. Fees to be paid by marine oil terminal owners would fund the state's oversight of this program.
Early History of California's Earthquake Loss Reduction Programs	CSSC issued its first comprehensive earthquake hazard mitigation plan, *Guiding Action: Goals and Policies to Strengthen Earthquake Safety in California,* in 1979. The commission prepared a strategic seismic safety program and financing plan in 1982, *Earthquake Hazards Management: An Action Plan for California*. After the passage of the California Earthquake Hazard Reduction Act of 1986, CSSC prepared *California at Risk,* a series of comprehensive five-year programs for earthquake mitigation.

4.4 Section 2 - California Earthquake Loss Reduction Plan

Introduction

California's mitigation plan for seismic hazards, the California Earthquake Loss Reduction Plan, was last updated and signed by the governor in 2002. The plan articulates the state's priorities for earthquake hazard mitigation. It contains three overarching goals, eleven elements, and 148 initiatives, half of which are designed to continue indefinitely.

Excerpts from the Plan

Key parts of the California Earthquake Loss Reduction Plan include:

- Goals for 2010 (Table 4.4.2A)
- Critically Important Initiatives (Table 4.4.2B)
- Cost Estimates for Seismic Hazard Mitigation

Below are excerpts from these key parts of the plan.

Table 4.4.2A Goals for 2010

The table below describes the California Earthquake Loss Reduction Plan's goals to be achieved by 2010.

Goal	Description
Advancement in Learning About Earthquakes	Applicable and effective research in geoscience, engineering, and social sciences about earthquakes, including techniques for mitigating their effects, will be the basis of California's mitigation strategies. The full spectrum of educational opportunities and communication strategies will effectively transfer that knowledge to the policy makers, the professions, and the public.
Advancement in Building for Earthquakes	Public policy affecting the design and retrofit of vulnerable existing structures will encourage cost-effective mitigation. The design and construction of all new structures will be based on higher performance standards that increase reliable levels of protection for both the lives and property of its citizens, and will ensure continued strength in the California economy.
Advancement in Living with Earthquakes	Preparedness and emergency response systems will effectively minimize the pain and suffering from potentially disastrous earthquakes. Both short- and long-term efforts to accomplish personal and economic recovery will significantly reduce the impact. Californians will be better prepared to understand, respond, and recover.

Continued on next page

4.4 Section 2 - California Earthquake Loss Reduction Plan

Table 4.4.2B Critically Important Initiatives

The California Earthquake Loss Reduction Plan has eleven elements: Geosciences, Research and Technology, Education and Information, Economics, Land Use, Existing Buildings, New Buildings, Utilities and Transportation, Preparedness, Emergency Response and Recovery. Each element has a series of related initiatives, which are divided into three categories: critically important, very important, and important. The table below describes the critically important initiatives.

Initiative	Description	Approximate Time to Accomplish
1.1.1	Geosciences: Ensure efficient, accurate, and reliable completion of the statewide Seismic Hazard Mapping Program for California's high-risk developed and developing areas. Utilize independent review and acceptance of appropriate procedures to compile the data and construct the maps. Include end users and others affected as part of the independent review.	10 Years
2.1.1	Research & Technology: Support and co-fund California-based seismic research programs funded by federal agencies or the private sector.	Ongoing
3.2.1	Education & Information: Develop educational approaches and tools in seismic hazard mitigation including earthquake fundamentals, seismic hazards identification, safety information about potentially hazardous building contents, workplace safety, emergency plans, and risk assessment techniques and tools for those responsible for facilities operation and management.	5 Years
4.1.1	Economics: Develop economic models and real case studies that demonstrate the cost-effectiveness of specific design, construction, and retrofit methods based on increased levels of property, contents, functionality, and tax base protection. Make those findings available to policymakers and to lending, insuring, and taxing agencies.	3-5 Years
5.1.1	Land Use: Require geotechnical and geological reports addressing seismic hazards for all subdivisions pending completion and adoption of mapping under the Seismic Hazards Mapping Act for any jurisdictional area.	2 Years
6.1.1	Existing Buildings: Encourage economic incentives, such as improved mortgage terms, reduced insurance rates, and positive tax benefits, for upgrading structural and non-structural elements in buildings.	10 Years

Continued on next page

4.4 Section 2 - California Earthquake Loss Reduction Plan

Table 4.4.2B Critically Important Initiatives (continued)

Initiative	Description	Approximate time to Accomplish
6.4.3	Existing Buildings: Identify and prioritize all seismically vulnerable public and private buildings. Establish a mitigation plan to reduce the risk posed by those buildings, including structural and non-structural elements, equipment and contents. The most vulnerable and the most essential buildings should be addressed as the highest priority.	10 Years
7.3.1	New Buildings: Amend statute to allow California to adopt seismic-specific amendments to national model building codes that meet the specific needs of the state and that apply to all State and local jurisdictions.	2 Years
8.4.3	Utilities & Transportation: Identify potentially vulnerable public and private utility systems including electric, gas, oil, water, and communication. Upgrade vulnerable systems to ensure the operation and timely restoration of essential systems to reasonable levels of service.	5 Years
9.4.1	Preparedness: Require compliance with the Standardized Emergency Management System (SEMS). Ensure school and district boards and administrators develop and implement school emergency plans and staff training as required by the current Education Code.	3-5 Years
10.1.1	Emergency Response: Provide interoperable upgraded regional and local emergency communications, including: 1) mutual-aid channels for police, fire, and emergency medical services; 2) regional emergency communications councils with authority to establish regional standards for emergency communication; and 3) response and recovery public broadcast channels for the public.	3 Years
11.2.1	Recovery: Establish plans for accommodating large displaced populations on an interim basis by using military facilities, publicly owned parks and recreational facilities, manufactured housing, and other appropriate options	5 years

NOTE: For information on other initiatives see the California Earthquake Loss Reduction Plan at www.seismic.ca.gov.

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4.4 Section 2 - California Earthquake Loss Reduction Plan

Cost Estimates for Seismic Hazard Mitigation

The total amount of seismic hazard mitigation and risk management by insurance is not known. However, a recent survey by CSSC revealed that from 1990 to 2002, Californians spent over $575 billion on construction and alterations. Roughly $19 billion of that, or just over three percent, was for seismic hazard mitigation, an average of just over $1.5 billion per year. Seismic hazard mitigation costs for individual projects ranged from zero (no seismic hazard mitigation required or done) to 100 percent (the project was done only to mitigate a seismic hazard-related risk) of a project's total cost. In the same time period, Californians spent $10 billion on earthquake insurance for residences.

Chart 4.4.2A California Earthquake Loss Reduction Plan Elements and Initiatives

The attached chart illustrates the progress of California Earthquake Loss Reduction Plan elements and initiatives.

Click here to view the chart or go to Chart 4.4.2A in the Appendices.

Continued on next page

4.4 Section 2 - California Earthquake Loss Reduction Plan

Table 4.4.2C Estimated Expenditures on Earthquake Mitigation

The table below summarizes the dollar amount spent on selected earthquake mitigation in California from 1990 through 2002.

Program or Project	Amount Spent in Millions
CalTrans Bridge Retrofit, Replacement, and Toll Bridge Program	$3,248
Bridge Retrofit by Local Governments	$1,000
CalTrans Earthquake Research	$52
Proposition 122 State Building Retrofits	$223.5
Local Government Essential Services Building Retrofits	$45.4
Technology Development	$3
AB 300 Public School Survey	$.5
Alquist Act Hospital Evaluation and Retrofit Program	$11
OES/DSA Nonstructural Pamphlet for Schools	$.05
OES Hazard Mitigation Program (HMGP)	$70
Division of the State Architect K-12 School Seismic Hazard and Retrofit/Design	$1,550
Community College Seismic Evaluation Survey	$.9
UC Berkeley SAFER Program	$250
CSU Seismic Retrofit Program	$300
UC Seismic Retrofit Program	$300
Department of Insurance Retrofit Grants Program	$6.4
Pacific Earthquake Engineering Research Center	$20
PUC/CEC Earthquake Research	$5.5
TriNet/CISN	$13.8
DWR Levee Study in the Delta	$2.3
State Lands Commission Marine Oil Terminal Project	$.1
OES New State Operations Center	$26.5
DWR:	
• Seismic Instrument Operation	$6
• Water Project Review	$7
• Division of Safety of Dams	$5
OPR	$225
PUC	$.6

Continued on next page

Table 4.4.2C Estimated Expenditures on Earthquake Mitigation (Continued)

Programs and Projects	$ in Millions
CSSC	$10
Seismic Hazard Mapping Program	$32
UC Seismographic Station and Research Center	$23
BART Retrofit Program	$28
CEA Mitigation Program	$5
Strong Motion Instrument Program	$45
Hospital Seismic Hazard Mitigation 1989-2002 (all California Hospitals)	$7,120
City of Los Angeles ATC 50 Residential Grading Plan	$1
San Francisco Bond Measure for URM Retrofits	$350
URM Building Seismic Retrofits	$1,730
San Francisco Community Action Plan for Seismic Safety	$.7
Los Angeles Historic Property Contracts Retrofit Program	$2.5
East Side Reservoir Project (Los Angeles)	$2,000
Local Match for FEMA Post-Northridge Earthquake Seismic Hazard Mitigation	$249.7
Total	$18,970.6

NOTE: Due to rounding, table may not add.

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4.4 Section 2 - California Earthquake Loss Reduction Plan

Table 4.4.2D Selected Future State Seismic Hazard Mitigation Commitments

The table below summarizes some of California's future mitigation funding commitments through 2030. All of these projects are currently being developed or are under construction.

Projects Underway or Obligated	Millions Obligated
SB 1953 Hospitals Seismic Hazard Compliance (to be paid by hospital owners)	$23,800*
Proposition 47 School Construction and Modernization Seismic Hazard Assessment and Retrofit	$735
PG&E Projects	$2,175
San Diego County Water Authority	$827
San Francisco PUC	$3,600
EBMUD Retrofit Program	$189
East Bay Bridge Span Replacement Project	$2,900
Carquinez Straights Bridge Replacement Project	$480
San Rafael Bridge Seismic Retrofit Project	$484
State Water Project	$30
Total	$35,220

*Denotes projected expenses from 2002 through 2030.

Table 4.4.2E Selected Federal Seismic Hazard Mitigation Investments in California

The table below identifies the amount of federal funding supplied to the state for earthquake mitigation between 1990 and 2003. One of the major mitigation successes funded in cooperation with the federal government has been CGS' Seismic Hazard Mapping Program. This effort has been ongoing since the passage of the Seismic Hazards Mapping Act in 1990.

Principal Funding Sources	Amount Spent in Millions
FEMA Post-Northridge Earthquake (includes $11 million in Seismic Hazard Mapping funds)	$760
USGS	$300
National Science Foundation	$75
Federal Highway Funds (Seismic hazard mitigation)	$940
Total	$2,075

4.5 Local Capability Assessment

Local Capability Assessment

CSSC has developed a progress chart of earthquake mitigation in jurisdictions in high seismic areas of California (Zone 4). The chart lists cities and counties that have adopted mitigation programs for unreinforced masonry buildings, tilt-ups, wood frame dwellings, and apartments building, and also lists financial incentives. For more information, see *Building Mitigation Progress in California's Jurisdictions* at www.seismic.ca.gov

4.6 Future Updates To This Plan

Future Updates

This portion of the Plan was compiled with existing resources through the cooperative efforts of CGS and CSSC. The following are recommended for future updates to this Plan:

- Develop and maintain a Living Earthquake Risk Model with enhanced samples of inventories or actual inventories reflecting their specific vulnerabilities
- Expand efforts to track statewide mitigation progress by governments and the private sector, particularly local government regulatory efforts to identify and mitigate geologic hazards

Chapter 5—Wildfire Risk Assessment

In This Chapter

This chapter contains the following topics.

Topic	Title	Page
5.1	Identifying Fire Hazards	128
5.2	Profiling Fire Hazard Events	130
5.3	Assessing Fire Vulnerability by Jurisdiction	136
5.4	Mitigation Measures for Fire Hazards	154

5.1 Identifying Fire Hazards

Introduction

In California, the state's diverse ecosystems significantly influence the threat of fire and its associated risks. Fire has played an integral in shaping the state's landscape and natural resources over the millennia. Understanding this past helps predict future fire behavior and assess threats to natural resources and urban improvements.

History of Fire in California

In terms of assessing the ecological role of fire, experts typically view the pre-settlement period (prior to 1700) as the time when the "natural" fire regime standard developed. During this period, both lightening and people were responsible for causing fires. As was common for indigenous peoples throughout the world, California's Native Americans historically set fires to alter plant and animal populations, facilitate the collection of desirable species, and protect their villages from uncontrolled fire. While broad climate changes are partially responsible for significant variations in fire over time, Native Americans have been present in the state long enough to exert their own evolutionary force on fire patterns, supplementing and altering the long-term influences of lightning fires.

Beginning first with Spanish missionaries, then with trappers and miners, and finally with westward expansion due to the railroads, the settlement period (after 1700) saw significant changes in land use. Livestock grazing, water and timber utilization, farming, mining, and other human activities altered vegetation and brought new fire sources. Changes in fire regimes greatly accelerated after the 1850s, as large influxes of settlers dramatically altered the landscape (Leiberg, 1902). Early photographs depicting settlement activities show the extent and nature of these changes (Gruell, 2001).

Starting in the early 1900s and accelerating after the formation of the USFS and the State Division of Forestry (now CDF), organized fire suppression came to define the modern era of fire management in California. Today, land use changes, population growth, development, fire suppression methods, and variations in climate continue to influence the nature and size of fires and how they interact with the natural environment.

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5.1 Identifying Fire Hazards

The Challenge of Wildfire

Fire is an integral component of many of California's ecosystems. However, uncontrolled wildfires are costly, putting lives and property at risk and compromising watersheds, open space, timber, range, recreational opportunities, wildlife habitats, endangered species, historic and cultural assets, wild and scenic rivers, other scenic assets, and local economies. The challenge is how to manage fires across California's diverse ecosystems to reduce both costs and losses.

On average, 10,000 wildfires burn half a million acres on an annual basis in California. While the actual number of acres burned fluctuates considerably from year to year, one trend that has remained constant for over a decade is the rise in wildfire-related financial losses. From 1947 to 1990, the dollar damages (in 2001 dollars) to structures and other resources in State Responsibility Areas (SRAs) exceeded $100 million only once. Between 1990 and 2001, losses exceeded $100 million five times.

Chart 5.1A Wildfire Damage

The attached chart summarizes wildfire damage in SRAs from 1947 to 2001 in acres and dollars.

Click here to view the chart or go the Chart 5.1A in the Appendices.

Table 5.1A Legislative Response to Fire Threat in California

The attached table provides a chronological account of California's legislative response to fire threat.

Click here to view the table or go to Table 5.1A in the Appendices.

CDF's Goal

CDF's goal for wildland fire protection is to contain 95 percent of fires at ten acres or less. Statewide, approximately 97 percent of all vegetation fires are contained within the first few hours after they are reported. The remaining 3 percent either move too quickly or are too intense for available fire suppression resources to handle. Multiple large fires can quickly draw down the pool of fire suppression resources, making it more difficult to bring the fires under control.

5.2 Profiling Fire Hazard Events

Introduction

This section analyzes how wildfire affects California's biological, physical, economic, and social assets. Specifically, the section focuses on fire risks to:

- People and property
- Watersheds
- Ecosystem function and health
- Range forage
- Timberlands
- Soils

The term "risk" refers to the potential damage or loss to a specific asset. Risk from the same fire for one resource may be fundamentally different than for another resource. Analyzing fire risk involves two components: the probability of a fire event occurring and the potential of such an event to cause change (Bachman and Allgower, 1999). The chance of a wildfire occurring is measured using an index of "expected fire frequency." The potential of a fire event to cause change is based on the measure of "potential fire behavior." Together, these two measures comprise the "fire threat." All of these measures are part of the *California Fire Plan* and are described in greater detail in *The Changing California: Forest and Range 2003 Assessment*, available at www.frap.cdf.ca.gov/assessment2003

Fire Risks to People and Property

Fire poses significant risk to the people of California and their homes, as evidenced by an increasing trend in structure loss from wildland fires (Martin and Sapsis, 1994, Figure 1). The risk is predominantly associated with Wildland-Urban Interface (WUI) areas. WUI is a general term that applies to development interspersed or adjacent to landscapes that support wildland fire. WUI areas have been a major focus of CDF's fire management strategy since at least 1972. The diversity of WUI settings and disagreement about alternative mitigation strategies led to confusion and different methods of defining and mapping WUI areas. The work presented here is an attempt to provide an integrated analysis of WUI issues for statewide and regional assessment regarding local land use planning and pre-fire project development.

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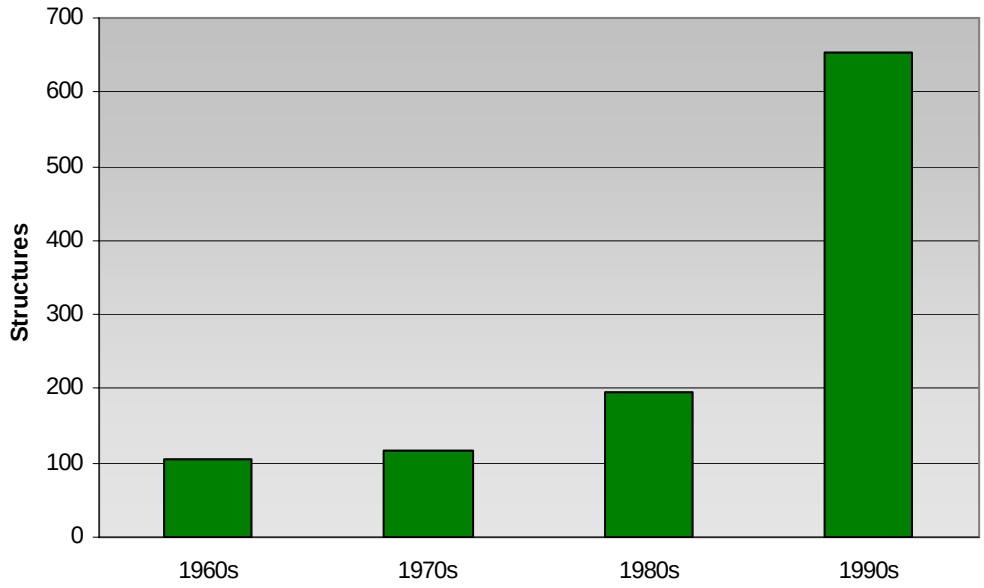
5.2 Profiling Fire Hazard Events

Chart 5.2A Structure Loss from Wildfires

The following chart summarizes the mean annual structure loss from wildfire by decade from 1960 to 1999.



Defining Wildland-Urban Interface Areas

The California Fire Plan formalizes much of the work that has been done on assessing the threat of wildfire in California's WUI areas. CDF's work in this area also helped in the development of the National Fire Plan.

CDF has developed an estimate of fire risk in WUI areas that is consistent with National Fire Plan methods but is more refined in terms of both mapping extent and quantification of risk. Within California, both wildfire risk and asset characteristics can vary in the same area. To account for these multiple combinations, CDF uses spatial data to distinguish fire-related characteristics from assets and applies spatial rules for determining relative risk of loss (see www.frap.cdf.ca.gov/assessment2003). Terms such as high, very high, and extreme indicate threat levels, with extreme being the highest level. CDF uses this information to create a GIS map of fire threats, then superimposes on this map a spatial representation of housing unit density based on 2000 census data. Housing unit density is classified into the categories, and all classes other than wildlands are considered as potential WUI (see Table 5.2A below).

Continued on next page

5.2 Profiling Fire Hazard Events

Table 5.2A Housing Unit Density Classes

The table below describes housing density classes in California for areas exposed to significant fire risk. All classes other than wildland are considered WUI.

Source: *FRAP, 2003 Assessment*

Class	Description
Wildland	Less than one housing unit per twenty acres
Rural	From one housing unit per five acres to one housing unit per twenty acres
Interface	From one housing unit per acre to one housing unit per five acres
Urban	Greater than one housing unit per acre

Table 5.2B - California Fire Timeline & Statistics

The attached table summarizes deaths and structural damage/destruction from fires in California between 1929 and 2003.

Click here to view the table or go to Table 5.2B in the Appendices.

The Tunnel Fire (Oakland Hills Fire)

The Tunnel Fire ignited on October 20, 1991 in the Oakland Hills north of the Caldecott Tunnel in an upscale residential area of large homes perched on hillsides, some on very steep slopes, and landscaped with abundant shrubbery and trees. The area had seen fires before, including one in 1923 in the nearby Berkeley Hills that burned into Berkeley and destroyed more than 600 homes in one hour, and one in September of 1970 in the same neighborhood as the Tunnel Fire that burned 200 acres and destroyed thirty-seven homes. This sort of repetitive fire occurrence and structure loss in a given area is not uncommon in California, where weather and fuel conditions often combine to create a cyclical potential for major fire losses.

With structure loss five times greater and loss of life twice as great as any previously recorded wildfire in California, the Tunnel Fire became the baseline for discussing fire loss potential in the state.

Continued on next page

5.2 Profiling Fire Hazard Events

The 2003 Southern California Wildfires

The most recent fire disaster in California (as of August 2004) was the Southern California Wildfires event. This event consisted of 13 fires that burned a total of 750,043 acres and claimed 22 lives between October 21, 2004 and November 4, 2004. Affected counties were Los Angeles, Riverside, San Bernardino, San Diego, and Ventura. As of February 3, 2004, federal and state officials have approved more than $218 million to help residents, business owners, local government agencies, and non-profit organizations recover from these wildfires and prepare for future disasters.

Source: California Fire Siege 2003—The Story, USFS and CDF

Map 5.2A – Distribution of WUI Housing Unit Density

The map below illustrates the distribution of WUI housing unit density classes in California for areas exposed to significant fire risk.

Click here to view the map or go to Map 5.2A in the appendices.

Housing unit density provides a good measure for asset value, population density, and level of community infrastructure at risk to fire damage. All other things being equal, an area labeled urban is likely to have more asset/social value than a rural area of equal size. One limitation of this approach is that areas of less than one housing unit per twenty acres do not show up as areas of significant community value.

The density data does a reasonably good job of showing the locations and spatial concentrations of residential structures. However, it is also necessary to show how the threat to assets varies according to both the relative threat of wildfire and the barriers to the spread of wildfire. This was done through a series of steps that account for significant barriers to fire spread, such as natural land features or land uses that act as natural barriers/fire modifiers (see www.frap.cdf.ca.gov/assessment2003).

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5.2 Profiling Fire Hazard Events

Table 5.2C WUI by Density Class & Fire Threat

The table below lists a statewide summary of acres in the WUI by proximate threat class.

Density class	Total acres	WUI By Fire Threat Class				
		Extreme	Very High	High	Moderate	None
Rural	3,126,844	459,507	1,733,775	392,808	475,188	65,564
Interface	1,322,621	249,996	722,877	176,144	156,197	17,406
Urban	3,391,217	209,799	909,622	609,386	1,608,606	53,802
Total	7,840,682	919,302	3,366,274	1,178,338	2,239,991	136,772

Source: *FRAP, 2003 Assessment*

Map 5.2B State WUI Interface Disaster Proclamations

The map below illustrates state WUI fire disasters between 1950 and 1997.

Click here to view the map or go to Map 5.2B in the Appendices.

Relative Fire Threat by Acreage and Housing Density

A total of 7.8 million acres are developed at densities considered to meet the WUI criteria. Of this total, 920,000 acres are exposed to an Extreme Fire Threat, 3.4 million acres to a Very High threat, and an additional 1.2 million acres to a High threat. If we consider all WUI lands with threat levels greater than Moderate to be at significant risk to damage from fire, the total area at significant risk is 5.5 million acres, or 59 percent of the total WUI area. The density breakdown of this group shows that 1.7 million acres (32 percent) of the WUI at risk are Urban, 1.2 million acres (21 percent) are Interface, and the remaining 2.6 million acres (47 percent) are Rural.

The distribution of housing units in WUI, by housing unit density classes that are exposed to High or greater fire threat, is shown in Table 5.2E below. As expected, while the majority of areas considered WUI are low-density rural areas, when viewed in terms of assets at risk, most housing assets are concentrated in urbanized areas. Of the 4.9 million homes exposed to High or greater fire threat, 4.1 million homes (84 percent) are in the Urban density class. The dominant density/threat class is the Urban/Very High threat class, comprising 2.1 million homes.

Continued on next page

5.2 Profiling Fire Hazard Events

Table 5.2D Housing Units by Density Class and Fire Threat

The table below summarizes the total number of housing units in WUI areas as of 2000.

Source: *FRAP, 2003 Assessment*

Density class	Total housing units	Housing Units by Fire Threat Class				
		Extreme	Very High	High	Moderate	None
Rural	323,284	49,167	178,491	41,793	47,842	5,989
Interface	597,498	109,892	316,246	83,347	80,000	8,012
Urban	10,886,540	380,220	2,131,667	1,624,185	6,627,360	123,104
Total	11,807,323	539,279	2,626,404	1,749,325	6,755,202	137,105

5.3 Assessing Fire Vulnerability and Losses by Jurisdiction

In This Topic

Due to the size and complexity of this topic, it has been broken down into eight sections. This topic contains the following sections.

Section	Title	See Page
1	Fire Risks to Watershed Values	137
2	Fire Risks to Ecosystem Health	138
3	Fire Risks to Range Forage	142
4	Fire Risks to Timberlands and Woodlands	145
5	Fire Risks to Soils	148
6	Fire Risks to Riparian and Aquatic Habitats	150
7	Fire Risks to Recreation and Open Space	152
8	Fire Risks to Downstream Water Quality And Water Supply Infrastructure	153

5.3 Section 1 – Fire Risks to Watershed Values

Fire's Effect on Water and Watersheds

Fires can have significant adverse effects on watershed lands, watercourses, and water quality. Large, hot fires cause serious, immediate damage from which a watershed can take decades to recover. By burning off vegetation and exposing mineral soil, fire impairs the ability of a watershed to hold soil in place and to trap sediment before it enters stream systems. Loss of vegetation also means less water being absorbed by plants, causing a short-term increase in the quantity and the delivery rate of water entering streams. This can have significant effects downstream from the site of a fire. In the wrong place at the wrong time, such as with the fire-flood cycle commonly experienced in Southern California. This increased runoff and its large sediment load can cause costly damage to downstream assets such as homes, roads, debris basins, and other infrastructure. It can also result in the loss of human life when at-risk residents are not evacuated.

Increased sediment levels can overwhelm stream systems by filling in deep pools and other niches used by fish and other aquatic species, causing flooding and deposition in riparian habitats, damaging small-scale and large-scale municipal water supply facilities, and even destroying structures. Over time, the cost of controlling erosion from wildfires has risen at a much faster rate than wildfire acreage. This is primarily due to the increasing value of downstream uses of high-quality water runoff. The Forest Service spent $48 million in the 1990s on post-fire soil-erosion compared to only $20 million in the 1970s (Robichaud, 2000). Municipal water districts spend far more than the Forest Service to address damages to storage, pumping, conveyance, and groundwater recharge facilities. In many areas, water districts have also increased expenditures to address the post-fire degradation in water quality.

5.3 Section 2 – Fire Risks to Ecosystem Health

Fire-Associated Risks to Ecosystems in the National Fire Plan

As part of the ongoing national strategy to protect ecosystems from degradation, loss of diversity, and possible loss or conversion, a classification system was developed to assess fire-related risk to basic ecological health. A coarse-scale assessment of this measure, termed "Condition Class," was conducted for the lower 48 states in support of the initial policy development for the National Fire Plan (Hardy et al., 2001; Schmidt et al., 2002; USFS, 1999). The process continues to be refined, to better meet the needs of local and regional efforts to reduce risks to ecosystem health and stability, while maintaining a centralized and consistent approach nationwide (Hann, 2002).

Table 5.3.2A Condition Class Definitions

The table below lists the definitions used to assess fire risks to ecosystem health. Lands are assigned one of three levels indicating the relative risk to the ecosystem.

	Low Condition Class 1	**Moderate Condition Class 2**	**High Condition Class 3**
Departure From Natural Regimes	None, minimal	Moderate	High
Vegetation Composition, Structure, Fuels	Similar	Moderately altered	Significantly different
Fire Behavior, Severity, Pattern	Similar	Uncharacteristic	Highly uncharacteristic
Disturbance Agents, Native Species, Hydrologic Functions	Within natural range of variation	Outside historical range of variation	Substantially outside historical range of variation
Increased Smoke Production	Low	Moderate	High

Source: *FRAP, 2003 Assessment*

Continued on next page

5.3 Section 2 – Fire Risks to Ecosystem Health

Map 5.3.2A Fire-Related Risks to Ecosystem Health as Measured by Condition Class

Condition classes are based on current vegetation type and structure—as defined by California Wildlife Habitat Relationship type, size, and density (see Habitat Diversity)—and the unique combination of expected fire frequency and potential fire behavior. The distribution of condition classes throughout California is shown on the attached map.

Click here to view the map or go to Map 5.3.2A in the Appendices.

Source: *FRAP, 2003 Assessment*

Table 5.3.2B Summary of Lands by Condition Class

The table below provides a summary of lands in California by condition class.

Condition Class	Acres	Percent
1 (Low)	43,764,634	43
2 (Moderate)	19,908,640	20
3 (High)	17,172,956	17
Non-wildland	20,044,612	20

Source: *FRAP, 2003 Assessment*

Continued on next page

5.3 Section 2 – Fire Risks to Ecosystem Health

Ecological Risk from Fire

Roughly 37 million acres in California are ecologically at risk from fire, with 17 million acres high risk (Table 5.3.2B). The areas at risk span diverse ecosystems, ranging from pine forests in the Klamath/North Coast to coastal sage scrub communities along the South Coast. Numerous areas of the state are dominated by ecosystems at risk from wildfire. The only area without significant widespread ecosystems at risk is the southeastern desert region, where fire has and continues to be a relatively rare phenomenon.

A regional assessment of fire risk to ecosystems compares the total area in the Moderate and High Condition Classes to the total area of forest and rangeland. This regional summary also reveals the diverse types of habitats that fire threatens across California. Several of the forest bioregions have over 60 percent of their land base in Moderate or High Condition Classes (Table 5.3.2C, below). In these areas, vegetation structures and fire frequencies deviate from historical levels and pose High or Moderate risk to ecosystem health. Table 5.3.2C also shows the High risk typically associated with changed fire regimes in the South Coast. The Modoc region, dominated by sagebrush steppe and the pervasive influence of exotic annual grasses, has largely lost its basic ecological integrity, and future fires would only exacerbate the problem. Similarly, the forested area of the Klamath/North Coast and Sierra regions are at risk due to unnaturally severe fires, where post-fire succession may result in loss of forested cover for decades without active reforestation efforts.

Continued on next page

5.3 Section 2 – Fire Risks to Ecosystem Health

Table 5.3.2C Percentage Area of Forests & Rangelands in Condition Classes 2 & 3

The table below summarizes the percentage area of forests and rangelands in California in Condition Classes 2 and 3 (Moderate and High) and habitats with large proportions of area in Condition Classes 2 and 3.

Source: *FRAP, 2003 Assessment*

Bioregion	Percentage	Habitats with large proportions of Condition Classes 2 and 3
Bay Area/Delta	42	Mixed Conifer
Central Coast	51	Sagebrush; Grassland
Colorado Desert	5	Sagebrush; Grassland
Klamath/North Coast	68	Klamath Mixed Conifer
Modoc	86	Sagebrush; Grassland
Mojave	6	Sagebrush; Grassland
Sacramento Valley	29	Ponderosa Pine
San Joaquin Valley	13	Sierran Mixed Conifer
Sierra	68	Ponderosa Pine
South Coast	70	Coastal Sage Scrub

5.3 Section 3 – Fire Risks to Range Forage

Introduction

Range forage represents an important economic resource to the ranchers of California. When fire consumes standing crops, it is a significant short-term loss. The loss is then compounded because rangelands must rest after fire—often for one to two full growing seasons—to allow for recovery.

Range Value

FRAP used the California Fire Plan Assets at Risk analysis to form the basis of range forage valuation (1996). This work combined estimates of forage production and replacement feed costs with assumptions of duration of rest from active grazing. For each acre of unique range (vegetation) type, region, and ownership class, productivity was assessed as carrying capacity and expressed in Animal Unit Months—a standard measure of range forage. The potential loss of value from wildfire was based on the cost of replacement feed for 2.5 seasons, assuming that half of the current year forage would be directly lost in the fire, and that rangelands would require two years of rest for recovery of range condition. Actual costs of replacement feed were based on estimates for a mixture of oat-hay and alfalfa. From this analysis, the Fire and Resource Assessment Program (FRAP) determined that the average loss from one acre of rangeland burning is $24, with average costs per unique land type ranging from a low of $4 to a high of $54.

Estimated Range Forage Losses as a Function of Fire Frequency

Range value at risk is not significantly affected by fire behavior. If the rangeland burns, the forage is lost and risk is realized. For a given area of rangeland, the more pressing concern regarding fire risk is the expected rate of fire occurrence. Higher probability of fire increases the risk of fire, causing the loss in range forage value.

FRAP used expected fire frequency to model the annual probability of a fire burning a particular piece of rangeland. The expected annual loss in dollars was then calculated as the product of the probability of a fire occurring, the replacement forage cost (as calculated above), and the regional forage utilization coefficients, which estimate the amount of regional forage actually used by domestic livestock.

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5.3 Section 3 – Fire Risks to Range Forage

Chart 5.3.3A Fire-Related Risks to Range Forage

The figure below illustrates how FRAP measured fire-related risks to range forage.

Using this calculation, FRAP found that of the $138 million dollars of value ascribed to rangeland forage annually, a total of $2.5 million is estimated to be lost due to wildfire.

Table 5.3.3A Loss of Value of Rangeland Forage Due to Wildfire

The table below summarizes the annual loss of value to rangeland forage from wildfires in nominal dollars.

Bioregion	Rangeland Loss
Bay Area/Delta	$184,308
Colorado Desert	$12,271
Modoc	$229,642
Mojave	$37,839
North Coast/Klamath	$315,271
Sacramento Valley	$158,098
San Joaquin Valley	$114,992
Sierra	$478,680
Central Coast	$662,739
South Coast	$331,781
Total	$2,525,620

Source: *FRAP, 2003 Assessment*

Continued on next page

5.3 Section 3 – Fire Risks to Range Forage

Map 5.3.3A Potential Value of Loss Expected Due to Wildland Fire Disrupting Grazing Activities

The attached map illustrates the potential annual value of loss expected due to wildland fire disrupting grazing activities, assuming lands under forage utilization in dollars per acre.

Click here to view the map or go to Map 5.3.3A in the Appendices.

Source: *FRAP, 2003 Assessment*

5.3 Section 4 - Fire Risk to Timberlands and Woodlands

Fire Risk to Timberlands

Timberlands, defined as conifer-dominated habitat types that likely support 20 cubic feet of volume growth per year and are not in reserved status (see Forest Land Base), are a significant economic resource in California and are the primary economic base in some rural areas. Fire can pose significant risk to timber assets through direct loss from combustion, mortality of growing stock, and fire-induced susceptibility to insect, pathogen, and decay mechanisms. The actual loss of timber value associated with a given fire event is a function of tree structure, fire severity, and post-fire salvage opportunity.

FRAP presents risk to timberlands using the fire threat class. Roughly three-quarters of California's timberland faces a high fire threat or greater, and over half of these lands have very high or extreme fire threat conditions (see Table 5.3.3A below). Only about one-fifth of California's timberlands face a moderate fire threat, where expected losses to timber assets are likely to be low. While some of the standing timber value can be salvaged following a wildfire, much of California's timber assets are exposed to significant risk from wildland fire.

Table 5.3.4A – Percentage of Timberland Area by Fire Threat Class

The table below shows the percentage of fire threat across the roughly 17 million acres of timberland statewide.

Threat	%
None assigned	1
Moderate	21
High	37
Very High	40
Extreme	1

Source: *FRAP, 2003 Assessment*

Continued on next page

5.3 Section 4 - Fire Risk to Timberlands and Woodlands

Fire Risk to Woodlands

California's extensive distribution of woodland vegetation, especially hardwood woodlands, provide key habitat for many species. The risk of habitat loss associated with fire in woodland areas is highly variable, due both to varying habitat quality and the unique fuel and vegetation response characteristics of specific areas. Habitat characteristics such as tree canopy height and closure, presence or absence of a developed shrub understory, and occurrence of special habitat elements—such as snags and downed logs—are important determinants of habitat quality for many species. There is little information on the role the structural characteristics of hardwood woodlands play in determining the level and value of associated wildlife use (Tietje et al., 1997). Consequently, it is difficult to reliably assess the effects of fire as a habitat-altering agent in hardwood areas. As recently as 2002, California researchers were unaware of any published research related to the effects of prescribed fire on California oak woodland habitats and associated wildlife species (Vreeland and Tietje, 2002).

In general, fire influences on hardwood woodland habitat suitability are specific to animal and plant species, and are determined by fire intensity and frequency as an influence on landscape patterns of habitat. This includes such things as presence or absence of a shrub understory, post-fire oak resprouting ability, and amount of canopy cover present. Over the longer-term, fire frequency and intensity influences the presence and composition of understory species, young tree recruitment to the woodland stand, and ecosystem sustainability. Sapling recruitment may also be adversely influenced indirectly by fire induced population increases of certain wildlife that browse or otherwise damage saplings (Swiecki and Bernhardt 2002). A light to moderately intense prescribed fire (flame heights less than one meter) recently conducted in mixed blue oak/coast live oak woodland in California's central coast region, resulted in no observed change in the relative abundance of small mammals, breeding birds, amphibians, or reptiles. Prescribed fire of this intensity was considered potentially beneficial by reducing competition from exotic annual grasses and stimulating shrub and tree vigor (Vreeland and Tietje 2002).

Habitat alteration that results in sparse to moderate levels of canopy closure may create conditions that support higher levels of biological diversity in some types of hardwood woodland. The California Wildlife Habitat Relationships System provides one tool to evaluate the effects of change in habitat use and value to terrestrial vertebrates, as a result of altered habitat structural conditions. Hardwood woodland habitat types such as blue oak,

Continued on next page

5.3 Section 4 - Fire Risk to Timberlands and Woodlands

Fire Risk to Woodlands (continued)

coastal oak, and valley oak support the greatest number of species that find optimal breeding habitat when canopy closure conditions are from sparse to moderate (10 to 60 percent).

Roughly two-thirds of California's hardwood woodlands are exposed to Very High or Extreme fire threat. While many areas may respond favorably to wildland fire, initial changes in the post-fire environment may cause temporary habitat loss and species dislocation.

Table 5.3.4B Percentage of Hardwood Woodland Areas by Fire Threat Class

The table below summarizes the percentage distribution of fire threat classes in hardwood woodlands in California.

Threat	%
None assigned	3
Moderate	7
High	25
Very High	64
Extreme	2

Source: *FRAP, 2003 Assessment*

5.3 Section 5 - Fire Risk to Soils

Introduction

Fire presents a significant risk to soil, especially in denuded watersheds, through accelerated erosion potential in the immediate post-fire environment, particularly when subjected to severe rainstorms prior to any vegetation recovery (Wells et al., 1979). FRAP has developed a statewide risk assessment based on the expected marginal increase in surface erosion from a potential fire.

Fire Effects on Soil and Sediment Delivery

Erosion is a natural process that occurs across a watershed at varying rates, depending on soils, geology, slope, vegetation, and precipitation. The intensity of a fire and the subsequent removal of vegetative cover increases the potential rate of soil erosion and new sediment sources. Wildfires affect surface erosion in a watershed by altering detachment, transport, and deposition of soil particles. Most wildfires create a patchwork of burned areas that vary in severity. Severely burned areas suffer increased erosion due to loss of the protective forest floor layer and creation of water-repellent soil conditions that can cause flooding, downstream sedimentation, and threats to human life and property.

The effects of fire on soil resources are dependent on the intensity of the fire and are induced by soil heating and by removal of the protective cover of vegetation, litter, and duff. The magnitude of soil heating depends on fuel loading, fuel moisture content, fuel distribution, rate of combustion, soil texture, soil moisture content, and other factors. The movement of heat into the soil depends upon the peak temperature of the fire and how long the heat is present. Because fuels are not evenly distributed around a site, a single fire will cause varying levels of soil heating. The highest soil temperatures occur where fuel consumption is greatest and where the duration of burning is longest. Fires in forested areas often cause high soil temperatures due to heavy fuel accumulation. In contrast, rangelands fires are often shorter in duration and cause less soil heating because of their comparatively light fuel load.

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5.3 Section 5 - Fire Risk to Soils

Factors Used to Model Fire Risks to Soil

FRAP used a modified form of the universal soil loss equation (Wischmeier and Smith, 1978) to predict potential soil loss from fire across California. The model characterizes the influence of vegetation and other environmental factors on soil erosion using inputs such as soil and precipitation data, topography, and vegetation cover. The main determining factor in predicting potential soil loss is changes to vegetation cover resulting from fire. These changes approximate the increase in surface erosion from future wildfire burning under both current fuel conditions and severe fire weather.

The model predicted that approximately 29 million acres in California would exhibit high or very high levels of surface erosion following wildfire (see Table 5.3.4A below). An additional 35 million acres are expected to experience moderate levels of surface erosion, likely due to limited severity of wildfire on vegetation cover and intrinsic low-erosion physical settings, such as gentle terrain, cohesive soils, or moderate storm intensity. For the 37 million acres of flat terrain, the model predicts no surface erosion.

Table 5.3.5A Statewide Distribution of Post-Fire Erosion Risk Classes (Acres)

The table below summarizes the statewide distribution of post-fire erosion risk classes in acres.

Erosion Class	Acres	Percent
None	36,965,529	37
Moderate	34,827,443	35
High	24,644,072	24
Very High	4,003,522	04
Total	100,440,566	100

Source: *FRAP, 2003 Assessment*

5.3 Section 6 - Fire Risks to Riparian and Aquatic Habitats

Introduction

Wildfire can produce a wide range of water quality and aquatic habitat outcomes, from beneficial to catastrophic. Wildfire outcomes are determined by weather, fuels, terrain, and to a lesser extent, suppression efforts. Large wildfires pose the greatest risk to water quality and riparian habitat.

If a wildfire encounters fuel levels that have been reduced through prescribed burning and/or mechanical means, there is a good chance the fire would produce conditions more favorable to maintaining good water quality and aquatic habitat. Highly destructive fires are thus minimized.

The Effects of Quick, Cool Fires on Water Quality, and Aquatic and Riparian Habitats

Quick, cool and spotty fires tend to maintain water quality and aquatic habitat. These fires leave a mosaic of burned and unburned vegetation. Riparian vegetation often remains largely intact, due to the higher moisture content of the vegetation and soils. The lower temperatures and shorter fire-residence times mean that soils can still absorb precipitation. The spottiness of these fires means some soil cover is retained. The retention of live "overstory" vegetation means more soil cover would soon be added in the form of fallen leaves, needles, and twigs. These favorable conditions result in:

- Little or no post-fire increases in erosion and stream sedimentation
- No significant increases in stream water temperatures during critical periods
- The short-term possibility of slightly higher dry-season stream flows (base flows) in some situations, due to reduced evapotranspiration upslope
- Little or no increase in flood flows
- Greatly diminished risk of future catastrophic wildfires, due to reduced fuel hazards.

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5.3 Section 6 - Fire Risks to Riparian and Aquatic Habitats

The Effects of Slow, Hot Fires on Water Quality, and Aquatic and Riparian Habitats

Fires that burn slow and hot—consuming most, if not all, of the vegetation and fuels—can catastrophically damage water quality and aquatic habitat. These fires leave large areas with essentially no live vegetation. Riparian vegetation is often killed or consumed. The high fire temperatures and long fire-residence times bake some soils so severely they repel water, rather than allowing it to rapidly infiltrate. Coarse-grained soils are particularly susceptible to this condition, which results in essentially 100% runoff and high rates of surface erosion. These fires consume most of the existing soil cover and kill the overstory vegetation that would produce new soil cover before the next storm season. Loss of trees leads to loss of root tensile strength, which in some situations can trigger shallow landslides. These unfavorable conditions result in:

- Greatly accelerated post-fire erosion and increased stream sediment
- Potentially significant increases in stream water temperatures during critical periods due to loss of riparian vegetation
- The possibility of lower dry-season stream surface flows, due to surface streamflow being converted to subsurface flow by increased bedload depths
- Increased flood potential due to more debris entrained in flood flows, adding bulk and causing backwater problems, and also due also to higher runoff rates in the case of small to medium floods
- High probability this destructive cycle would be repeated in a few decades, as a thick stand of even-age vegetation grows back

Fires' Effects on Aquatic Habitat

Fire can also dramatically affect aquatic habitat. Increased erosion and sediment deposition can result in channel aggradation (i.e. wider, shallower channels), filling of pools that provide important fish habitat, increased turbidity that makes it harder for fish to find food and can damage gills, and changes in water chemistry.

5.3 Section 7 - Fire Risks to Recreation and Open Space

Fire Risks to Recreation and Open Space

After a wildfire, significant alteration of watershed lands and the associated stream systems is noticeable for periods varying from a few years to decades. In the short term, the presence of partially burnt vegetation reduces recreational and open space values. Fires can also destroy campgrounds, trails, bridges, and other recreational facilities within the area. Increased amounts of downstream sedimentation may significantly affect streams and lakes, which tend to be the most heavily used spots within larger recreational areas.

As the vegetation grows back and damaged recreational infrastructures are replaced, the recreational and open space values would increase. However, it may take decades before vegetation types such as mature forests return to their pre-burn character. Grasslands and shrublands, on the other hand, can return to their pre-burn character within a decade. The recovery of riparian areas depends on the level of alteration caused by the increased sediment delivery and the restoration of the site through normal hydrologic cycles of in-stream downcutting and deposition.

5.3 Section 8 – Fire Risks On Downstream Water Quality And Water Supply Infrastructure

Fire's Affect on Water Quality

Wildfires can potentially affect water quality through increased sedimentation and increased turbidity, and through increases in nutrient loadings. Concentration of nutrients (phosphorous and nitrogen) are increased from burned vegetation and delivered to streams through surface runoff. Stream temperatures often increase after fire occurs, typically through the removal of overhead protective vegetation. Elevated stream temperatures are detrimental to most cold-water fish species.

Fire's Affect on Water Infrastructure

Water delivery systems may be dramatically affected by fire. With the exception of the North Coast, most watersheds in California have extensive downstream water supply infrastructures serving rural residents, larger municipalities and agricultural users. Increased sediment can decrease storage capacity in dams and reservoirs. For example, the Denver Water Board lost an estimated $20 million worth of storage capacity in Strontia Springs Reservoir following the 1996 Buffalo Creek wildfire.

Mitigating the Downstream Damages of the 2003 Fires

The Santa Ana Watershed Project Authority estimates needing to spend more than $40 million per year, for a number of years, to mitigate the downstream damages of the 2003 fires in the upper watershed of the Santa Ana River (SAWPA 2004). The largest component would go towards mitigating the damage to water quality from the heavy salt load in the runoff. The removal of sediment from conveyance structures, recharge facilities, and wetlands represents the second largest component. Water agencies, including SAWPA, are increasingly looking at upstream investments that could be more cost-effective than after the fact mitigation efforts.

5.4 Mitigation Measures for Fire Hazards

Introduction

Once thought of as a seasonal hazard, wildfires are an almost everyday occurrence in California. However, much of the state's approach to dealing with wildfire is still seasonal in nature. Flammable expanses of brush, diseased timberland, overstocked forests, hot and dry summers, extreme topography, intense fire weather wind events, summer lightning storms, and human acts all contribute to California's wildfire threat.

In This Topic

Due to the size and complexity of the topic, it has been broken down into seven sections. This topic contains the following sections.

Section	Title	Page
1	Wildfire and Human Development	155
2	The California Fire Plan	156
3	Pre-Fire Management Program to Reduce Wildfire Costs and Losses	160
4	Strategic Wildfire Planning	162
5	Governmental Partnership	164
6	Public Awareness and Education	168
7	Building Codes, Zoning, and Residential Flammable Vegetation Regulations	171

5.4 Section 1 – Wildfire and Human Development

Introduction

Wildfire and human development have always been in conflict. Wildfire is a natural part of our environment and human development in wildlands is an accepted practice. This inherent conflict requires careful management in order to reduce or eliminate losses to life, property, and resources from wildfires. Some past management practices have failed to address the comprehensive nature of the human/wildfire conflict and have exacerbated conditions that can lead to more damaging fires. One example is wildfire suppression without aggressive management of hazardous fuels. Another is wildfire suppression without performance-based fire-resistant construction standards or fire-safe development requirements. Daily actions and decisions often fail to consider wildfire risks and the potential for resulting losses.

Managing the Human/Wildfire Conflict

Managing the human/wildfire conflict requires a commitment of resources and a focused mitigation plan over the long term. The approach must be system-wide and include the following:

- An informed, educated public that takes responsibility for its own decisions relating to wildfire protection
- An effective wildfire suppression program
- An aggressive hazardous fuels management program
- Land use policies and standards that protect life, property, and resource protection
- Construction and property standards that provide defensible space

5.4 Section 2 – The California Fire Plan

The California Fire Plan

The overall goal of the California Fire Plan is to reduce total costs and losses from wildland fire by protecting at-risk assets through focused pre-fire management efforts and increased initial attack success. To view the plan, go to www.fire.ca.gov/FireEmergencyResponse/FirePlan/pdf/fireplan.pdf.

California Fire Plan Objectives

The plan has five objectives:

Objective	Description
1	To create wildfire protection zones that reduce the risks to citizens and firefighters.
2	To assess all wildlands, not just the state responsibility areas (SRAs). Analyses will include all wildland fire service providers—federal, state, and local government, and private. The analysis will identify high risk, high value areas, and develop information on and determine who is responsible, who is responding, and who is paying for wildland fire emergencies.
3	To identify and analyze key policy issues and develop recommendations for changes in public policy. Analysis will include alternatives to reduce total costs and losses by increasing fire protection system effectiveness.
4	To have a strong fiscal policy focus and monitor the wildland fire protection system in fiscal terms. This will include all public and private expenditures and economic losses.
5	To translate the analyses into public policies.

Continued on next page

5.4 Section 2 – The California Fire Plan

California Fire Plan Framework

The California Fire Plan (Fire Plan) lists five major components as the basis of an ongoing fire planning process to monitor and assess California's wildland fire environment:

	Component	Description
1	Wildfire Protection Zones	A key product of the Fire Plan is the development of wildfire safety zones to reduce citizen and firefighter risks from future large wildfires.
2	Initial Attack Success	The Fire Plan defines an assessment process for measuring the level of service provided by the fire protection system for wildland fire. This measure can be used to assess CDF's ability to provide an equal level of protection to lands of similar type, as required by Public Resources Code §4130. This measurement is the percentage of fires that are successfully controlled before unacceptable costs are incurred. Knowledge of the level of service will help define the risk to wildfire damage faced by public and private assets in the wildlands.
3	Assets Protected	The Fire Plan will establish a methodology for defining assets protected and their degree of risk from wildfire. The assets addressed in the plan are citizen and firefighter safety, watersheds and water, timber, wildlife and habitat (including rare and endangered species), unique areas (scenic, cultural, and historic), recreation, range, structures, air quality. Stakeholders, including national, state, local, and private agencies, interest groups, will be identified for each asset at risk. The assessment will define the areas where assets are at risk from wildfire, enabling fire service managers and stakeholders to set priorities for pre-fire management project work.

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5.4 Section 2 – The California Fire Plan

Fire Plan Framework (continued)

#	Component	Description
4	Pre-Fire Management	This aspect focuses on system analysis methods that assess alternatives to protect assets from unacceptable risk of wildland fire damage. Projects include a combination of fuels reduction, ignition management, fire-safe engineering activities, and forest health to protect public and private assets. The priority for projects will be based on asset owners and other stakeholders' input and support. Pre-fire management prescriptions designed to protect these assets will also identify who benefits and who should share in the project costs.
5	Fiscal Framework	The State Board of Forestry and CDF are developing a fiscal framework for assessing and monitoring annual and long-term changes in California's wildland fire protection systems. State, local, and federal wildland fire protection agencies, along with the private sector, have evolved into an interdependent system of pre-fire management and suppression forces. As a result, a change to budgeted levels of service of any of the entities directly affects the others and the services delivered to the public. Monitoring system changes through this fiscal framework will allow the Board and CDF to address public policy issues that maximize the efficiency of local, state, and federal firefighting resources.

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5.4 Section 2 – The California Fire Plan

California Fire Plan Framework

The framework of the Fire Plan consists of:

- Identifying those areas of concentrated assets and high risk for state, federal, and local officials and for the public
- Allowing CDF to create a more efficient fire protection system focused on meaningful solutions for identified problem areas
- Providing citizens with an opportunity to identify public and private assets to carry out projects necessary to protect these assets
- Identifying where cost-effective pre-fire management investments can be made to reduce taxpayer costs and citizen losses from wildfires before they occur
- Encouraging an integrated intergovernmental approach to reducing costs and losses
- Enabling policymakers and the public to focus on what can be done to reduce future costs and losses from wildfires

5.4 Section 3 - Pre-Fire Management Program to Reduce Wildfire Costs and Losses

Findings

1. Suppression of fire in California's Mediterranean climate has significantly altered the ecosystem and increased both losses from major fires and fire protection costs. Historical fire suppression has increased:
    - Periods between fires
    - Volumes of fuel per acre
    - Fire intensities
    - Fire damage and losses
    - Fire suppression difficulties
    - Total taxpayer costs and losses
2. With continued fire suppression in wildland areas, fuel volumes per acre will continue to increase, unless a substantial long-term program of fuel reduction is implemented.
3. Fuel loading problems are occurring in federal and state responsibility areas, as well as in local responsibility areas—such as wildlands within city limits.
4. Increased dead and dying vegetation due to drought, volumes of drier fuel per acre, and acres with vegetation fuel ladders are all contributing to the increased size and severity of fires, resulting in greater costs and losses.
5. To address the long-term trends of increased fuel loading and population growth, CDF is implementing a pre-fire management initiative that combines existing vegetation management, fire prevention, and engineering programs into a coordinated effort with the objectives of reducing fire hazards, improving the effectiveness of ignition management, and reducing losses and costs to California's Wildland Fire Protection System.
6. Pre-fire management can help reduce the overall emissions caused by wildland fires. Based on the annual average acres burned by wildfire from 1985 to 1994, wildfire generates almost 600,000 tons of air pollutants per year.
7. There are tradeoffs between taxpayer investments in pre-fire management and related state and federal emergency fund expenditures for fire disasters, ecological and natural resource losses, private citizen losses, and safety problems for civilians and firefighters during wildland fires.
8. With more people and structures in the wildlands, more lives, property, and ecological, economic, and natural resource assets are at risk.

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5.4 Section 3 - Pre-Fire Management Program to Reduce Wildfire Costs and Losses

Findings (continued)

9. The public must understand the risks involved. Agencies have not adequately communicated those risks. Wildland homeowners may often feel a false sense of security by believing that fire protection organizations, fire insurance coverage, and fire prevention requirements eliminate risk from wildfire.

Recommend-ations

CDF developed a pre-fire management initiative for State Responsibility Areas and provides technical assistance to help local governments develop pre-fire management programs on local responsibility areas. The State Board of Forestry should encourage federal agencies to increase pre-fire management efforts on their lands and participate in joint efforts in the wildland intermix.

To reduce the wildland fire protection costs, the following are recommended:

- Develop wildfire protection zones and fire hazard mitigation measures, including ignition-resistant building standards, are needed as part of the local government planning and land-use decisions on permitting developments in wildland areas
- Create a pre-fire management database to provide more definitive risk assessment information to the public and the insurance industry, code officials, building industry and local fire jurisdictions
- Establish comprehensive wildfire protection zones
- Improve building construction materials for wildland structures
- Provide insurers and homeowners with information on reducing risks.
- Support equitable insurance ratings for wildland structures

5.4 Section 4 – Strategic Wildfire Planning

FRAP Assessments and Local Fire Management Plans

Since the 1970s, FRAP has conducted periodic assessments of California's forests and rangelands. The third assessment, in 1995, focused on wildfires. Published as the California Fire Plan in 1996, its goal was "to reduce total costs and losses from wildland fire in California by protecting assets at risk through focused pre-fire management prescriptions and increasing initial attack success." The plan defined a framework for:

- Assessing level of service in wildland areas
- Identifying assets to be protected and their degree of risk from wildfire
- Setting pre-fire management priorities to reduce costs and losses
- Developing a model for financial responsibility

Some counties with CDF fire suppression forces are developing fire management plans that address the same issues. The plans are developed through collaborative processes, with Fire Safe Councils taking a lead role.

The Planning Process

The California Fire Plan is a unique strategic wildland fire planning process, utilizing computer modeling to identify highest hazard and highest risk areas that are targeted for fire loss mitigation activities. The Plan:

- Utilizes state of the art technology and fire science modeling to assess planning elements
- Requires local stakeholder input and validation of assessments
- Uses computer modeling to develop federally required "Communities at Risk" list for National Fire Plan grant allocation
- Promotes community involvement to develop local solutions for local problems
- Is recognized nationally for innovativeness and success

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5.4 Section 4 – Strategic Wildfire Planning

Community Involvement

Development in California has led to high-risk WUI communities amid the states fire dependant landscapes. The resulting increased demand for fire services in the WUI can be effectively met with a proactive, community based response. The solution to the state's wildfire crisis lies in creating proactive communities that can withstand wildfire and work with wildfire agencies to reduce flammable fuels that contribute to catastrophic wildfires. For residents and business owners, being in California means learning to prepare for and live with wildfires.

The key to the success of the Fire Plan is community involvement. The Fire Plan is created at the local level to address local problems and identify and implement local solutions. Local community-based Fire Safe Councils are actively involved in developing community awareness, creating community fire protection plans, and implementing critical pre-fire management projects throughout the state.

Utilizing the combined expertise, resources, and communication channels of its members, the Fire Safe Council fulfills its mission to preserve California's natural and manmade resources by mobilizing all Californians to make their homes, neighborhoods, and communities fire safe.

California Fire Safe Council facts:

- More than 100 Fire Safe Councils are active statewide
- Comprised of homeowners, business owners, insurance and real estate representatives, public utilities, and many others
- Involved in 300 community based fire defense projects
- Have secured $13 million of grant funded projects
- Is duplicated nationally
- Recognized by the National Association of State Foresters, National Academy of Public Administrators, and Western Governors Association

5.4 Section 5 – Governmental Partnership

California Fire Alliance

Leading the coordination of wildfire risk mitigation is the California Fire Alliance (Alliance). Started in 1997, the Alliance was formed as a way to coordinate the pre-fire management efforts of its member agencies—CDF, USFS, the California Fire Safe Council, BIA, BLM, OES, the Los Angeles County Fire Department, NPS, and USFWS. The Alliance coordinates its monthly meetings with those of the Fire Safe Council meetings, and the directors of the member agencies meet several times each year to discuss and reach consensus on California wildfire prevention and fire loss mitigation strategies.

The Alliance is a forum for sharing information so that its member agencies can make decisions and operate pre-fire management programs in a coordinated, integrated fashion. Pre-fire management programs include such things as efforts aimed at creating defensible space, fire safe landscaping, fuel breaks, and forest management involving both prescribed fire and mechanical thinning. The Alliance and the State's Fire Safe Councils provide an efficient organizational structure for mobilizing wildfire risk mitigation activities. The Alliance provides a single point of contact between the local Fire Safe Councils and its member agencies, while in turn the local councils provide the Alliance with a single point of contact for coordination with individual communities.

Four Fire Alliance Strategies

The Alliance focuses its efforts on four strategies to deal with the WUI issues in California. These strategies are:

1. Work with communities with wildfire risk to develop community-based planning leadership and facilitate the development of community fire loss mitigation plans.
2. Assist communities in developing fire loss mitigation plans, educational tools, and projects to reduce the threat of wildfire losses on public and private lands.
3. Develop a universal information and education outreach plan to increase awareness of wildland fire protection program opportunities that are available to communities at risk.
4. Work in a collaborative fashion to develop, modify, and maintain a comprehensive list of communities at risk for California.

Continued on next page

5.4 Section 5 – Governmental Partnership

Alliance Accomplish-ments

The Alliance has accomplished the following:

- Provided support for community land use planning and fire protection planning needs
- Sponsored regional firewise community workshops statewide to promote community fire planning
- Sponsored community and county level fire planning teams
- Implemented an interagency wildfire prevention media campaign and educational events
- Implemented a "clearinghouse" for wildfire mitigation grant applicants
- Publicly shared pre-fire project data to develop additional collaborative hazardous fuels projects
- Created a nationally recognized model for collaboration that is used by the National Wildland Fire Leadership Council

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5.4 Section 5 – Governmental Partnership

Vegetation Management Program

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

- Significantly reduce damages from wildfire, floods, and accelerated erosion
- Increase the productivity of range and forest lands
- Increase water yields
- Improve wildlife and fish habitat
- Improve air quality and protect irreplaceable soil resources

Under the VMP, private landowners may contract with CDF to conduct prescribed burns, with the state assuming up to 90 percent of the cost based on the degree of benefit to the public. CDF personnel inspect, prescribe, and prepare the site and perform the burn on a cost-share basis. Implementation of VMP projects is the responsibility of individual CDF units. Units select projects based on fit with the unit's priority areas (those identified through the Unit Fire Plan) and value to the unit. The VMP typically treats about 40,000 acres each year.

The program started in 1981 as a way to deal with unmanaged, shrub-covered lands, which can lead to disastrous, uncontrollable wildfires. CDF has identified approximately five million acres of highly hazardous shrub-covered land throughout the state. Prescribed burning remains the most cost-effective and environmentally sound method of reducing fire risk on these lands and achieving the VMP's other objectives. In the program's first five years, burns were completed on more than 200,000 acres. All VMP projects involve the development of a land management plan, many of which use the Coordinated Resource Management Planning approach due to multiple ownerships issues. Air quality considerations related to the burning are addressed by a smoke management plan.

Continued on next page

5.4 Section 5 – Governmental Partnership

Pre-Fire Grant Projects

Through various programs, CDF continues to participate in hazardous fuels reduction projects. Through the Conservation Camp program, inmate, ward, and Conservation Corps fire crews construct and maintain strategic fuel breaks, reduce roadside fuels, and contribute significantly to CDF's pre-fire mission in numerous ways. Funding for this work traditionally comes from the state general fund in the form of daily operating funds. Those that benefit from this work are limited in what they can offer CDF in terms of reimbursement for work related expenses. With the deployment of the National Fire Plan, Congress set aside pre-fire grant funds for ten years to assist the states in reducing the huge backlog of flammable vegetation that exists throughout the nation. Beginning in 2001, federal funds were directed to state projects with awards being determined through a competitive process.

Table 5.4.5A Wildland Urban Interface Grant Awards

The Bureau of Land Management dedicates a portion of its hazardous fuels funds to projects sponsored by community-based organizations. The following table reflects grant funding since 2001.

Click here to view the table or go to Table 5.4.5A in the Appendices.

5.4 Section 6 – Public Awareness and Education

Firewise Community Workshops, Phase 1

The California Fire Alliance sponsored nine Regional Firewise Community Workshops throughout the state. Community-based organizations were invited to bid for one of the Firewise Community Workshops. The workshops brought together a diversity of professionals, community leaders, and citizen stakeholders to learn how to use the collaborative FIREWISE Community planning process and effectively transfer the knowledge and techniques to their own communities and jurisdictions, regardless of community size and complexity of issues.

Workshop Goals

Workshop goals included identifying ways to:

- Improve safety in the WUI by learning to share the responsibility
- Create and nurture local partnerships for improved decisions in communities
- Encourage the integration of firewise concepts into community and disaster mitigation planning

Workshop Participants

Participants included:

- Local government planners
- Insurance professionals
- Resource Conservation Districts
- Fire Safe Council members
- Elected officials
- Business owners
- Emergency planners
- Homebuilders
- Interested citizens
- Developers
- Architects
- Contractors
- Realtors
- Fire departments
- Landscapers

About the Workshops

The workshops, which drew more than 1,000 participants, were tailored to California's specific needs, with sessions on the safety element of city and county general plans, multi-hazard mitigation planning, landscape fuels analysis and project planning, and model WUI codes. Attendees learned firsthand the complexities involved in building safer communities, subdivisions, and homes and left more prepared for the inevitable effects of unwanted wildland fire.

Continued on next page

5.4 Section 6 – Public Awareness and Education

Firewise Community Workshops, Phase 2

In California and throughout the nation, a number of communities have started developing community fire protection plans. However, many California communities do not have the resources to begin their own planning process. The California Fire Alliance offers these communities direct assistance in the development and implementation of wildland fire protection plans. Establishing a support program to assist communities with planning was a logical next step after the first phase of Firewise Community Workshops and fulfills the Alliance's goal of facilitating the development of community-level fire plans.

Through the Alliance, regional consultants provide support to nearly 100 communities as they begin the development of their fire plans. The consultants provide each planning team with:

- Initial training
- A link to specialized data and local, federal, and state planning resources
- Facilitation in the planning process until the team can establish its own identity and organization
- Consultation and mentoring as they continue the planning process

National Model Template

The framework developed for the planning teams is available as a model template for use nationwide. The template includes:

- A planning team agenda and timeline
- A component addressing administrative, organizational, and technical support needs
- Planning team training that uses existing off-the-shelf material
- Identification of support resources
- A process for developing planning team and project goals and objectives

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5.4 Section 6 – Public Awareness and Education

Community Fire Planning Framework	Sponsored by the California Fire Alliance, the Community Fire Planning Framework is a template to help guide communities and/or local Fire Safe Councils in the development of DMA 2000-compliant local fire hazard mitigation plans. It can serve as a catalyst to bring together citizens, government, and other experts in a collaborative process to create a strategic community fire mitigation plan. The components of the planning framework can be used in their entirety or tailored to the needs of a particular community. The framework includes a comprehensive list of planning topics and resources to assist the planning team in getting started.
Basic Fire Plan Template	An associated document, the Basic Fire Plan Template, is far less comprehensive and is designed to help communities and/or local Fire Safe Councils identify and prioritize projects and begin plan implementation.

5.4 Section 7 – Building Codes, Zoning, and Residential Flammable Vegetation Regulations

Introduction

Since the 1960s, the state and local governments in California have enacted numerous laws related to protecting communities from wildfire. Many of the laws focus on either roofing or vegetation, the two major factors that affect structure loss during wildland fires. In many cases, these laws were passed immediately following a major fire, repealed later, sometimes re-enacted, and so on. Roofing regulations in WUI communities, such as Berkeley and Los Angeles, have histories of this sort due to recurring fires alternating with pressure from private-sector interest groups. Today, state law requires Class A roofs in areas designated as having a severe fire hazard and Class B roofs are required in all other parts of the state.

California's residential flammable vegetation regulations began with legislation following the 1961 Bel Air Fire that destroyed nearly 500 structures. Now codified in Public Resources Code §4291, the law requires a minimum of 30 feet of clearance around structures in SRAs. Additional clearing of up to 100 feet may be required in the most severe conditions. Numerous local jurisdictions have adopted more stringent standards.

Natural Hazard Disclosures (NHDs) in real estate transactions have been required for wildland fire hazards since 1990, but were not widely used until the late 1990s. NHDs are required in Very High Fire Hazard Severity Zones (VHFHSZs) in LRAs and in all areas of state responsibility fire protection, regardless of fire hazard.

Fire hazard rating and fire severity zoning have been a part of the WUI toolbox in California for decades. The need to adopt an effective zoning method is significant for both fire protection costs and insuring homes in high fire hazard areas. California uses the Fire Hazard Severity Zone process as required by statute. In addition to vegetation management, fire hazard zones are subject to various requirements for fire safe construction, emergency access and egress, and water supply.

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5.4 Section 7 – Building Codes, Zoning, and Residential Flammable Vegetation Regulations

Local General Plans and the Safety Element

California law requires each city and county to adopt a general plan "for the physical development of the city or county, and any land outside its boundaries which…bears relation to its planning" (Government Code §65300). The general plan is the "constitution" for all local development. It expresses the community's goals and embodies public policy relative to the distribution of future land uses, both public and private. The general plan must contain seven mandatory elements—land use, housing circulation, conservation, open space, noise, and safety. Although WUI issues could be addressed in almost any of the mandatory elements, the most logical place for them is the safety element.

The goal of the safety element is to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from hazards such as fires, floods, earthquakes, and landslides. Within the safety element local jurisdictions must address fire safe standards, including evacuation routes, water supplies, road widths, and clearance around structures. Although this information has been required to be included in general plans since 1974, compliance is not universal (OSFM, 1999).

In 2002, OPR provided specific guidance for incorporating fire issues in the general plan in a publication entitled *Fire Hazard Planning*, which is part of the General Plan Technical Advice Series. The document can be downloaded at www.opr.ca.gov/publications/PDFs/Fire_Hazard_Planning-Final_Report.pdf. The purpose of the document is to help local jurisdictions develop effective general plan policies related to fire hazard mitigation and to help Fire Safe Councils, concerned citizens, and other interested parties develop fire plans that contain policies can easily be integrated into local general plans.

Fire Hazard Planning encourages a collaborative approach to hazard mitigation planning that links local mitigation efforts with local land use decision-making and that involves state and local government agencies, elected officials, local planners, community members, non-profit organizations, fire districts, and others. This approach maximizes community safety and can help link planning and funding decisions. The publication of *Fire Hazard Planning* was OPR's first step in developing a larger guidance toolkit for incorporating multi-hazard mitigation planning policies into the general plan and associated local prevention, response, and mitigation plans.

Chapter 6 - Flood Risk Assessment

In This Chapter

This chapter covers the following topics:

Topic	Title	See Page
6.1	Identifying Flood Hazards	173
6.2	Profiling Flood Hazard Events	176
6.3	Assessing Flood Vulnerability by Jurisdiction	188
6.4	Estimating Potential Flood Losses by Jurisdiction	193
6.5	Mitigation Measures For Flood Hazards	196

6.1 Identifying Flood Hazards

California's Flood History

California has a chronic and destructive flood history. Of seventy-two federally declared disasters in the state between 1950 and 2000, half were flood related.

While the "Great Flood" of 1861-62 may be unmatched in scope, the devastating effects of recent floods far exceed the damage of a century ago. Despite the construction of massive and relatively effective flood control projects, California remains vulnerable to flooding. A steady rise in population and accompanying development contribute to increased flood risks throughout the state.

Repetitive Flood Damage

The repetitive nature of flood damage causes the greatest concern. Areas flooded in the past continue to be inundated again and again. The desert community of Hesperia, in San Bernardino County, provides a classic example. Hesperia suffers repetitive flash flooding during both intense thunderstorms and winter storms. Such flooding occurred four times between 1991 and 1995. The frequent and devastating floods that occur on the Russian River in Sonoma County serve as another example. The county recorded thirteen flood events between 1995 and 2001, the most repetitive losses of any area in California. FEMA lists 801 repetitive loss properties in Sonoma County with $47.6 million in NFIP insurance claims between 1992 and 2002.

Federal Flood Disasters in California

Between 1992 and 2002, every county in California was declared a federal disaster area at least once for a flooding event. The counties of Los Angeles, Orange, and San Bernardino were declared federal flood disaster areas five times, and sixteen other counties were declared disaster areas four times.

Continued on next page

6.1 Identifying Flood Hazards

Table 6.1A Recent Flood Disasters

The table below describes federally declared flood disasters in California since 1990.

Disaster #	Date	Scope (# of Counties)	# of Deaths	Damage in $
935-DR-CA	February 1992	6	5	$123.2 Million
979-DR-CA	January 1993	25	20	$600 Million
1044-DR-CA	January 1995	45	11	$741.4 Million
1046-DR-CA	February 1995	57	17	$1.1 Billion
1155-DR-CA	January 1997	48	8	$1.8 Billion
1203-DR-CA	February 1998	40	17	$550 Million

Source: OES, *Origins and Development—A Chronology 1917-1999*

Map 6.1A State Flood Disaster Proclamations

The attached map illustrates state of emergency proclamations for floods in California between 1950 and1997.

Click here to view the map or go to Map 6.1A in the Appendices.

6.2 Profiling Flood Hazard Events

Introduction

In California, planning for flood mitigation poses many challenges. Mitigation strategies need to account for multiple climatological patterns, geographical diversity, a wide variety of flood types, and a large population.

Climatology

Disparate climatological patterns present challenges to flood mitigation planning in California, including:

- El Nino conditions
- La Nina conditions
- Santa Ana conditions
- Drought
- Desert monsoons
- Northwest coastal conditions
- Tropical storms
- Gulf of Alaska storms
- "Pineapple Express" patterns

Hydrologic Regions

Disparate hydrologic regions present further challenges to flood mitigation planning in California. California has ten hydrologic regions:

- North Coast
- San Francisco Bay
- Central Coast
- South Coast
- North Lahonton
- South Lahonton
- Colorado River-Desert
- Sacramento River
- San Joaquin
- Tulare Lake

Continued on next page

6.2 Profiling Flood Hazard Events

Map 6.2A California's Hydrologic Regions

The attached map illustrates the hydrologic regions of California.

Click here to view the map or go to Map 6.2A in the Appendices.

About the North Coast Region

The North Coast hydrologic region runs along the Pacific Coast from the California-Oregon border to the mouth of the Russian River. On its eastern border, the region runs from the middle of Modoc County through the Trinity, Shasta, Tehama, Glenn, and Lake county lines, then bisects the southeast portion of Mendocino County and the northeast portion of Sonoma County.

Major streams and tributaries in the North Coast Region include:

- Smith River
- Klamath River and its tributaries: Trinity, Salmon, Scott, Shasta, and Lost rivers
- Mad River
- Van Duzen River
- Eel River
- Mattole River
- Noyo River
- Navarro River
- Gualala River

Flood History of the North Coast Region

This region is sparsely populated, with the majority of settlement in the Humboldt Bay area. The area receives larger rain totals than any other region and experiences some of the State's most spectacular and devastating flood events. Tsunamis are a threat along the coastline, as evidenced by one caused by the 1964 Alaskan earthquake that killed twelve and caused $10 million in property damage in the Humboldt Bay area. The typical type of flooding that occurs in this area is represented by the 1964 late winter storms that caused $213 million in property damage.

Continued on next page

6.2 Profiling Flood Hazard Events

About the San Francisco Bay Region

The San Francisco Bay hydrologic region extends along the north central coast and encompasses most of the Bay Area counties. The reaches to just north of Ukiah in Mendocino County, south to the Coyote Creek watershed in Santa Clara County, and inland to just east of the Sacramento-San Joaquin Delta.

Major stream systems in the region include:

- Russian River
- Dry Creek
- Big Sulphur Creek
- Petaluma River
- Napa River
- Walnut Creek
- Alameda Creek
- Guadalupe River
- Coyote Creek
- San Gregorio Creek
- Pescadero Creek

Flood History of the San Francisco Bay Region

The area around San Francisco Bay is heavily populated and the entire region is marked by hills, river valleys such as those along the Russian River, and marshlands. The region is most vulnerable to classic stream flooding, landslides, and some urban flooding. Flooding along the coastal and bay shorelines can be severe when winter storms coincide with high tides. Sonoma County, most of which is located in this region, records the most NFIP repetitive losses of any area in California. FEMA NFIP lists 801 repetitive loss properties in Sonoma County with $47,679,914 in insurance claims between 1992 and 2002. Most of these properties are located along the Russian River.

Continued on next page

6.2 Profiling Flood Hazard Events

About the Central Coast Region

The Central Coast hydrologic region reaches from Ano Nuevo Point in San Mateo County down the Pacific Ocean to near the crest of the coast range in Santa Barbara County. The region is mountainous with very narrow strips of flat coastal plain. Generally, the mountain streams and rivers in this area run directly into the Pacific Ocean and lack significant delta areas.

Major stream systems in the Central Coast Region include:

- San Lorenzo River
- Pajaro River
- Salinas River, including tributaries of the Nacimiento River, San Antonio River, and Arroyo Seco
- Carmel River
- Santa Maria River
- Big Sur River
- Santa Ynez River

Flood History of the Central Coast Region

This region includes major agricultural areas and urban centers and is characterized by stream flooding and slides. A typical flooding event occurred in the coastal community of Cambria in San Luis Obispo County in January 1995. The west end of the community suffered extensive damage, with many businesses and homes flooded up to their rooflines.

Continued on next page

6.2 Profiling Flood Hazard Events

About the South Coast Region

The South Coast hydrologic region extends up from the U.S.-Mexico border to the Tehachapi, San Bernardino, San Gabriel, and San Jacinto mountains. Nearly one-third of the area is coastal plain.

Major stream systems in the South Coast region include:

- Calleguas Creek Basin
- Malibu and Santa Monica Bay streams
- Ventura River
- Santa Clara River
- Los Angeles River
- San Gabriel River
- Santa Ana River
- Santa Margarita River
- San Luis Rey River
- San Dieguito River
- San Diego River
- Sweetwater River
- Otay-Tijuana River

Flood History of the South Coast Region

This region contains major urban centers, including the counties of Los Angeles, Orange, and San Diego. Much of the flooding is sudden and severe, resulting in massive slides, debris flows, and mudflows. Typical of the flooding that occurs in this area were the 1969 winter storms that killed forty-seven and resulted in $300 million in property damage. During these storms, an alluvial flood and debris flow on Deer Creek in San Bernardino County killed eleven. Normally Deer Creek is dry and is not considered a special flood hazard area on the National FIRMs. However, the region has experienced tremendous population growth since 1969 and the area of the Deer Creek alluvial fan is now home to several public schools and Ontario International Airport.

Continued on next page

6.2 Profiling Flood Hazard Events

About the North Lahontan Region

The North Lahontan hydrologic region lies in the extreme northwest portion of the state. It is bounded by the Sierra Nevada, Cascade, and Warner mountain ranges on the west and the Nevada border on the east and runs south to Bridgeport in Mono County. Lake Tahoe is located in the center of the region.

All streams in the region terminate in lakes or playas because they have no outlet to the ocean. These include the:

- Susan River, including the tributary of Piute Creek
- Truckee River
- Carson River
- Walker River

Flood History of the North Lahontan Region

This region is sparsely settled with the exceptions of the communities around Lake Tahoe and the City of Susanville. It experiences flooding from winter rainstorms, snowmelt, and intense late spring and early fall thunderstorms. During the January 1997 floods, the Walker River overflowed its banks and flooded the communities of Walker and Colville. The river supports an alluvial fan that runs through these communities.

About the South Lahontan Region

The South Lahontan hydrologic region is nestled between the Sierra Nevada, San Bernardino, and San Gabriel mountains, the Nevada state line, the Mono Lake Valley, and the Northern Colorado Desert. The region is relatively dry and contains the following streams and rivers:

- Mojave River
- Big Rock Creek
- Little Rock Wash
- Amargosa River
- Owens River
- Bishop Creek

Continued on next page

6.2 Profiling Flood Hazard Events

Flood History of the South Lahontan Region

Despite its generally dry conditions, this sparsely populated region experiences periodic winter storms and thunderstorms that often result in flash floods. Under storm conditions, the region's generally dry stream systems pose a significant threat. The Mojave River runs through three growing San Bernardino county communities: Hesperia, Victorville, and Barstow. The desert community of Hesperia is located at the base of an alluvial fan that forms the headwaters for the Mojave River. This area experiences significant flood damage during both winter storms and summer monsoon events. Examples of the flooding are the 1982 winter storms that killed thirty-three and caused $274 million in property damage and the 1983 summer storms that killed three and caused $35 million in damage in Inyo, Riverside, and San Bernardino counties.

About the Colorado River-Desert Region

The dominant hydrologic features of this region are the Colorado River, which forms its eastern boundary, and the Salton Sea, which lies just shy of its western boundary, which is marked by the San Bernardino and San Jacinto mountains. The region is also bounded by the U.S.-Mexico border to the south and the South Lahontan region to the north.

In addition to the Colorado River and Salton Sea, the region contains:

- Whitewater River
- New River
- Alamo River

Flood History of the Colorado River-Desert Region

This is a mostly sparsely populated agricultural region that experiences irregular flooding. However, both common winter storm events and tropical flows from Mexico's Pacific Coast can bring massive rainstorms and flash floods. During the summer months, monsoonal flows come up over the mainland of Mexico. Typical of this type of event was the June 1982 Colorado River Flood, which caused $4.6 million in property damage. The flood destroyed thirty-two homes and damaged an additional 114 homes and thirteen businesses. The 1983 summer storms, highlighted in the South Lahontan profile above, also affected this area.

Continued on next page

6.2 Profiling Flood Hazard Events

About the Sacramento River Region

The Sacramento River hydrologic region includes the northern half of the Central Valley. The Sacramento River drains through the Sacramento-San Joaquin Delta and is bounded by the Sierra-Nevada Mountains, the Coast Range, the Cascade Range, and the Trinity Mountains. This is a major agricultural area, with the Sacramento metropolitan area comprising the largest concentration of population.

Major streams and many smaller creeks are tributaries to the Sacramento River, including:

- Pit River
- McCloud River
- Feather River
- American River
- Yuba River
- Bear River
- Cow Creek
- Cottonwood Creek
- Battle Creek
- Cache Creek
- Putah Creek

Flood History of the Sacramento River Region

Flooding in this region is predominantly caused by runoff from either major winter storm events or snowmelt. While massive dams and levee systems have significantly reduced this region's historic flood problems, the area remains vulnerable to flooding along small streams due to levee failures and in urban drain areas dependent upon pumping stations. This region includes portions of the Sacramento-San Joaquin Delta, which is addressed separately at the end of the region profiles. Flooding from a 1950 event killed nine and caused $32 million in damage throughout both the Sacramento River and San Joaquin regions.

Continued on next page

6.2 Profiling Flood Hazard Events

About the San Joaquin Region

The San Joaquin hydrologic region encompasses the middle portion of the Central Valley bounded by the Sierra Nevada Mountains, the Coast Range, the divide between the American and Consumnes river watersheds, and the divide between the San Joaquin and Kings river watersheds. The region also includes portions of the Sacramento-San Joaquin Delta, although that area is described separately in this Plan.

Many major streams flow to the San Joaquin River through the Delta, including:

- Consumnes River
- Dry Creek
- Mokelumne River
- Calaveras River
- Littlejohn Creek
- Stanislaus River
- Tuolumne River
- Merced River
- Bear River
- Owens River
- Mariposa Creek
- Chowchilla River
- Fresno River
- Los Banos Creek
- San Luis Orestimba Creek
- Marsh Creek
- Arroyo Pasajero (a seasonal arroyo)

Flood History of the San Joaquin Region

Although predominantly agricultural, this region has experienced increased urbanization in recent years and is subject to flooding from winter storm events and snowmelt. Flooding occurred in this region during the 1969 storms, as highlighted above in the description of the South Coast region.

Continued on next page

6.2 Profiling Flood Hazard Events

About the Tulare Lake Region

The Tulare Lake hydrologic region comprises the extreme southern portion of the Central Valley. It is defined by the Sierra Nevada Mountains, the divide between the San Joaquin and Kings rivers, the Coast Range, and the Tehachapi Mountains.

Rivers in this region include:

- Kings River
- Kaweah River
- Tule River
- Kern River

Flood History of the Tulare Lake Region

The Kaweah, Tule, Kern, and Kings rivers all historically drained into the Tulare Lake bed. Through the late 1800s, Tulare Lake was of substantial size during wet periods, although its level fluctuated. A number of small reclamation districts were established in the area in the early 1900s that, over the years, built levees and reclaimed the more than 200,000-acre lakebed for agriculture.

Though now predominantly agricultural, this region contains the large urban centers of Fresno and Bakersfield. It is subject to flooding from winter storms and snow runoff. Typical of the type of events that occur were the 1969 heavy snow runoff, the 1986 flooding event, and the 1997 snow melt/flooding events.

The Delta

The Sacramento-San Joaquin Delta has its own unique features and challenges and deserves its own description. More than 40 percent of the state's land drains into the Delta, a distinctive area that is managed with the involvement of local, state, and federal entities. The islands protected by the Delta's extensive levee systems are virtually all subject to flooding and have experienced numerous disasters in the past. The causes of levee failures are varied and repairing them is costly. There are numerous state and federal programs aimed at providing safety in this region. Most recently, the USACE and the Reclamation Board sponsored the CALFED Bay-Delta Authority and the Sacramento and San Joaquin River Basins Comprehensive Study.

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6.2 Profiling Flood Hazard Events

Table 6.2A Delta Levee Break Disasters

The table below summarizes recent levee break disasters in the Sacramento, San Joaquin, and Tulare hydrologic regions. Other levee damages occurred in the Delta during other disaster events, including significant damage from events in 1986 and 1997.

Year	Event	County	Property Damage in Millions
1972	Andrus Island Levee Break	Sacramento	$23.7
1980	Holland and Webb Islands Levee Breaks	Contra Costa, Sacramento, San Joaquin	$17.4
1980	Jones Tract Levee Break	San Joaquin	$21.5
1982	McDonald Island Levee Break	San Joaquin	$11.6
2004	Jones Tract Levee Break	San Joaquin	$57.9

Table 6.2B Flood Types in California

California is subject to a variety of flood hazard types that occur in the various hydrologic regions with varying degrees of frequency. The attached table lists flood types in California and the problems associated with each type.

Click here to view the map or go to Table 6.2B in the Appendices.

Map 6.2B Flood Types

The attached map shows the dominant flood types in California and where they occur.

Click here to view the map or go to Map 6.2B in the Appendices.

Map 6.2C Flood Zones

The attached map shows NFIP 100-year flood zones (the darkest shaded areas). Properties in the 100-year flood zone with federally insured mortgages must be insured through the NFIP.

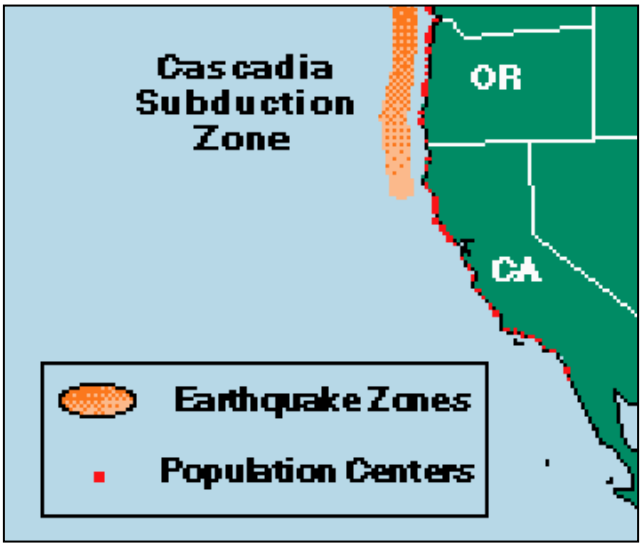
Click here to view the map or go to Map 6.2C in the Appendices.

Continued on next page

6.2 Profiling Flood Hazard Events

Map 6.2D Tsunami Risk Zone

Tsunamis, caused by earthquakes or undersea landslides, threaten California's west coast, especially in northern California. There are two types of tsunamis—local and distant. Although local tsunamis represent the more immediate threat, allowing at-risk populations only a few minutes to find safety, California is vulnerable to and must plan for both tsunami types.



Source: *Tsunami Hazard Mitigation - A Report to the Senate Appropriations Committee,* Prepared by National Oceanic and Atmospheric Administration Pacific Marine Environmental Laboratory, Seattle, Washington, March 31, 1995. www.pmel.noaa.gov/ ~bernard/ senatec.html

6.3 Assessing Flood Vulnerability by Jurisdiction

Geographic Diversity

California's geographic diversity represents a difficult challenge to planning for flood mitigation. No single approach can ensure protection given the extreme geographic variances from place to place.

California has:

- The highest and lowest points in the contiguous United States—Mt. Whitney at 14,495 feet above sea level and Death Valley at 282 feet below sea level. These two points are separated by just 100 miles.
- Some of the highest and lowest daily temperature in the U.S., recorded in Death Valley and Truckee, respectively.
- A mismatch between water supply and population centers. Approximately two-thirds of the state's water resources are in the northern half of the state, while two-thirds of the state's population resides in the southern half of the state.
- A 1,100-mile-long coastline.
- 2,407 square miles of inland water surface.
- 172,000 miles of rivers, with 70,000 miles of rivers downstream from dams.
- Prominent coastal and inland mountain ranges, including the Sierra Nevada and the Sutter Buttes, which is the smallest of any mountain range.
- The Central Valley, the largest inland valley in the U.S. and the source of a majority of the nation's food supply.
- The largest county in the country (20,154-square-mile San Bernardino County).
- Interfacing urban and wildland regions, particularly along the coastal and inland mountain ranges.
- Extensive and highly varied deserts.

Floodplain Mapping

The federal government started regulatory floodplain mapping on a nationwide basis in the late 1960s. FEMA has now mapped over 15,000 miles of stream systems using both detailed and approximate study methods. This represents less then 10 percent of all the streams in California. These figures do not include the coastline or alluvial fans.

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6.3 Assessing Flood Vulnerability by Jurisdiction

Floodplain Mapping Needs

"Compounding current floodplain management issues, over the next 25 years California is expected to have about a 14 million increase in population. The demand for development will put a heavy load on the remaining floodplains that are not mapped. It is currently estimated that about one-third of California's stream reaches are or will be experiencing development pressures within the next 25-year period. This results in approximately 35,000 miles of unmapped streams that still need floodplain mapping."

Source: DWR website at www.water.ca.gov

Identification of Pertinent Flood Hazard Areas

California intends to identify all pertinent flood hazard areas within the next ten years. Because generating detailed studies of all potentially developable areas would be cost prohibitive within the foreseeable future, the state will use approximate assessments to map 100-year "awareness floodplains" for both riverine and alluvial fan conditions.

Floodplain Mapping Website

As mapping studies are completed, they will be provided to communities and posted to the Awareness Mapping website at www.fpm.water.ca.gov/mapping/awareness_mapping.html.

The website is designed to provide communities and individual citizens with an additional tool for understanding potential flood hazards not currently mapped as regulated floodplains by FEMA.

Continued on next page

6.3 Assessing Flood Vulnerability by Jurisdiction

Table 6.3A Sample Flood Mapping Data

The table below provides a sample of the data included with the DWR maps. This data is for Ventura County.

AWARENESS FLOODPLAIN MAPPING FOR VENTURA COUNTY	
Hydrology	Drainage area was computed by HEC-GeoHMS procedure with the USGS DEM, ranging from 0.5 to 5.4 square miles; Mean annual precipitation was 18 to 22.5 inches, extracted from the digitized "Mean Annual Precipitation in the California Region" prepared by Rantz (1969); 100-yr maximum peak discharge was estimated with the USGS multiple-regression procedure (WRI 77-21, Waananen and Crippen) specific to the South Coast Region. Discharges range from 269 to 2689 cubic feet per second.
Hydraulics	Floodplain footprint was primarily developed by HEC-RAS / HEC-GeoRAS with the USGS DEM; alternative method includes the following: The main channel slope was estimated from the USGS DEM, ranging from 0.15 to 0.06 ft/ft; Water Surface Elevation was estimated by normal depth calculation.
Field Assessment	Floodplain footprints were field checked where streams were accessible; Manning's values were estimated during field assessment and used for final HEC-RAS / HEC-GeoRAS models and normal depth calculations.

Source: www.fpm.water.ca.gov/mapping/southern_dist/ventura/ventura_metadata.html

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6.3 Assessing Flood Vulnerability by Jurisdiction

Other Sources of Floodplain Maps

Other sources of flood maps include:

- Dam inundation maps
- GIS maps using FEMA FIRM data and other data sources

Local communities can use these tools for future development and hazard mitigation planning.

Table 6.3B & Map 6.3B Flood Damage

The attached table and map summarize flood damage by county.

Click here to view the table or go to Table 6.3B in the Appendices.

Click here to view the map or go to Map 6.3B in the Appendices.

Table 6.3C PA Flood Damage

The attached table summarizes PA flood damage by county.

Click here to view the table or go to Table 6.3C in the appendices.

Table 6.3D IA Flood Damage

The attached table summarizes IA flood damage by county.

Click here to view the table or go to Table 6.3D in the Appendices.

Table 6.3E Coordination with Local Communities

Communities that participate in the NFIP CRS program identify their vulnerability to flood hazards through their CRS plans. The attached table identifies communities participating in the NFIP CRS program for DR-1203 in 1998.

Click here to view the table or go to Table 6.3E in the Appendices.

California's Role in the FMA Program

The state participates in FEMA's FMA program by assisting repetitive loss (RL) communities in developing flood mitigation plans. FEMA provides California with a list of its top RL communities on an annual basis.

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6.3 Assessing Flood Vulnerability by Jurisdiction

Flood Hazard Vulnerability

FEMA, in coordination with the state, identifies the California's top RL communities, which account for 84 percent of the state's total NFIP losses. These areas are considered the most vulnerable to flooding. Roughly half of the NFIP losses in California are not located in Special Flood Hazard Areas (SFHAs).

Community Rating System Participation

Of the top California RL communities, less than half participate in the CRS program. The state encourages all RL communities to participate in the CRS program. Of all California communities within the NFIP, only 10 percent participate in the CRS program. California's CRS communities save a total of $8.7 million per year on flood insurance premiums.

For more information, go to *http://training.fema.gov/EMIWeb/CRS/index.htm*

State Efforts

The state seeks to reduce repetitive flood losses by:

- Working with FEMA to reduce NFIP claims by encouraging communities to participate in the FMA planning process and in developing FMA projects that address NFIP repetitive loss properties.
- Working with communities to develop HMGP projects that address NFIP losses.
- Coordinating FMA and HMGP projects with communities to provide the greatest reduction of losses to the most vulnerable areas in the state.

Table 6.3F Repetitive Loss Communities

The attached table lists the communities with the most repetitive losses in California during the past ten years in rank order from 1 to 36. The list is in descending order by the number of NFIP insurance claims paid in the state. Repetitive losses are one of many means of determining state vulnerability to flooding.

Click here to view the table or go to Table 6.3F in the Appendices.

6.4 Estimating Potential Flood Losses by Jurisdiction

California Population in Floodplains, by Jurisdiction

Approximately 5.8 percent (1,973,712 people) of the California population lives in a designated 100-year floodplain. The state's population is projected to increase by 40 percent through 2025, with 62 percent of the growth occurring in the Central Valley floodplain.

Table 6.4A lists, on a county-by-county basis, the total California population living in a floodplain as of 1998. The table was developed using GIS technology by overlaying the most recent census data on the FIRM.

IA Claims

Table 6.4A lists, as a percentage of total claims, the number of claims made by individuals in California for federal assistance during federal flood disaster declarations over the past ten years. The percentages illustrate where the most significant amount of flood damage occurs within California on a county-by-county basis. IA flood damage claims include both residential and small business flood damage sites where either state or federal assistance was requested. These figures can be used to project where flood damage is likely to occur in the future unless mitigation measures are performed.

Repetitive Damage vs. Repetitive Loss

Repetitive damage refers to those properties damaged more than once from a flood event, whether or not the property is located in a SFHA or carries NFIP insurance.

Repetitive loss (RL) refers to those properties insured by the NFIP that were damaged more than once from a flood event and for which a claim was filed against the NFIP insurance.

Repetitive Loss Claims

The number of repetitive NFIP claims is listed in Table 6.4A on a county-by-county basis for both the unincorporated areas of the counties and as a total that includes both the unincorporated and incorporated areas of the counties. The NFIP RL claims represent only a small percentage of the total IA flood damage sites as indicated by comparing this table with Table 6.3D in the Flood Hazard Vulnerability Section (6.3) of this Plan.

Continued on next page

6.4 Estimating Potential Flood Losses by Jurisdiction

Table 6.4A & Map 6.4A NFIP Repetitive Losses

The attached table and map identify federal disaster declarations for flood damage as of 1998.

A majority of NFIP flood loss claims occur during flood events that do not rise to the level of a federal disaster declaration; only 7.3 percent of all IA flood damage occurs in the 100-year floodplain. Over 90 percent of IA flood damage claims occur in twenty of California's fifty-eight counties.

While RL claims are not included in the IA flood damage claims, RL properties only account for 3 percent of the total IA flood damage claims (7,503 RL losses out of 252,091 IA claims). OES provided the IA flood damage claim data and FEMA Region IX provided the NFIP RL data.

Click here to view the table or go to Table 6.4A in the Appendices.

Click here to view the map or go to Map 6.4A in the Appendices.

Map 6.4B Storm and Flood Disasters between 1955 & 2002

The attached map shows storm and flood disasters by county and frequency between 1955 and 2002.

Click here to view the map or go to Map 6.4B in the Appendices.

Table 6.4B Potential Flood Loss Areas

The attached table identifies where potential flood losses are most likely to occur on a county-by-county basis given the total IA flood damage claims during presidential disaster declarations over the past ten years

Given the flood data available for California, it is evident that living outside of a designated 100-year floodplain does not guarantee protection from flood damage.

OES is currently quantifying flood damage using IA dollar figures and is using HAZUS data for future flood loss estimations. Accurate data is not currently available to project or to estimate IA losses in dollars for future flood events in California.

Click here to view the table or go to Table 6.4B in the Appendices.

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6.4 Estimating Potential Flood Losses by Jurisdiction

Public Facilities

Table 6.4A indicates the number of public agencies that applied for flood disaster recovery funds during federal flood disaster declarations between 1992 and 2002. The data is shown on a county-by-county basis. The table also lists total damage to public facilities in dollars and percentages of the total flood damage in the state by county.

Table 6.4B ranks California counties in terms of total eligible flood damage to public facilities for flood disaster declarations from 1992 to 2002.

Flood Recovery Funds Statistics

A variety of information can be extrapolated from Table 6.4A and Table 6.4B, including the following:

- Nearly 75 percent of the eligible flood disaster recovery funds awarded to public entities during the past ten years went to twenty of California's fifty-eight counties.
- The average dollar amount per county for PA flood disaster recovery funds during the past ten years for the top twenty counties was $21,881,472 (a total of $437,629,456 for 20 counties).
- The average dollar amount per county for PA flood disaster recovery funds during the past ten years for all fifty-eight California counties was $10,234,687 (a total of $593,611,817 for 58 counties).
- The average annual dollar amount for repairing public facilities after a federal flood disaster declaration in California over the past ten years was. $59,361,182.

6.5 Mitigation Measures for Flood Hazards

Using Levees for Flood Control

Levees were introduced into California in the Sacramento area in the mid 19th century, providing relief from flooding. As the population increased, so did the proliferation of flood-control structures. To this day, levees serve to control floodwaters in the Central Valley, the 450-mile long, 50-mile wide basin that supplies a majority of the nation's food supply.

The Central Valley Project

The federal Emergency Relief Appropriations Act, passed in 1935, authorized expenditures of funds for various types of public works projects, including water conservation and irrigation. The Central Valley Project (CVP), a series of dams, reservoirs, and canals in California's San Joaquin Valley, was first established under this authority. The federal Flood Control Act of 1936 formally authorized funds for the CVP by name.

Over the years, the CVP has been reauthorized numerous times and its purpose expanded through various federal statutes. A 1940 law broadened the project's purpose to include navigation improvements, flood control, and energy development purposes. In 1949, Folsom Dam and Folsom Reservoir were added to the CVP. A 1950 law declared that the purpose of the project is to improve navigation, regulate the flow of the San Joaquin and Sacramento Rivers, flood control, irrigation, and electric power. A 1954 law declared the use of water for fish and wildlife as an additional purpose of the project. It also provided authority and conditions for delivery of water to the grasslands areas of the San Joaquin Valley for waterfowl purposes as stipulated in a 1950 DOI report entitled *Waterfowl Conservation in the Lower San Joaquin Valley, Its Relationship to the Grasslands and the Central Valley Project*.

A 1978 statute amended the 1954 law to guarantee the delivery of 3000 acre-feet of water each fall and 4000 acre-feet of water each summer, when available, and authorized construction of a water delivery system to deliver water to federal waterfowl refuges in the San Joaquin Valley. Finally, a 1992 law included provisions to protect, restore, and enhance fish and wildlife and their habitats in the Central Valley and the Trinity River Basin. Objectives include addressing the effects of the CVP on fish and wildlife resources and achieving a "reasonable balance among competing" water uses.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

About the SWP

The California State Water Project (SWP) is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. Its main purpose is to store water and distribute it to twenty-nine urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. Of the contracted water supply, 70 percent goes to urban users and 30 percent goes to agricultural users. Maintained and operated by DWR, the SWP makes deliveries to two-thirds of California's population. Another purpose of the SWP is to improve water quality in the Sacramento-San Joaquin Delta, control Feather River floodwaters, provide recreation, and enhance fish and wildlife. For more information on the SWP, go to www.owe.water.ca.gov/swp.

Early State Flood Hazard Mitigation Planning Efforts

On February 9, 1983, President Reagan assessed the damage from severe storms, flooding, high tides, and wave action in numerous parts of California, and declared a major disaster under provisions of the Federal Disaster Relief Act of 1974. The FEMA Region IX Interagency Flood Hazard Mitigation Team prepared a Federal Interagency Flood Hazard Mitigation Report for the disaster dated March 11, 1983. Supplement 1 to that report, dated March 24, 1983, made specific recommendations and provided a framework for the subsequent development of the first State Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta.

In February 1986, torrential rains drenched much of California and caused flooding statewide. On February 21, 1986, President Reagan again determined that damage levels warranted a major disaster declaration. OES developed a second mitigation plan that directly responded to the FEMA-State Disaster Assistance Agreement for the 1986 storms disaster, which required that a mitigation plan be submitted to FEMA within 180 days of a presidential disaster declaration.

The 1986 plan was based on the first mitigation plan that was developed after the 1983 winter storms. The 1986 plan was organized into three sections. Section 1 discussed the major origins of floods in California and the programs and capabilities of the fourteen state agencies with flood-related responsibilities, and recommended hazard mitigation measures. Section 2 presented a separate hazard mitigation plan that addressed events and mitigation activities particular to the Sacramento-San Joaquin Delta. Section 3 contained hazard mitigation plans for specific cities and counties.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

1983 and 1986 Flood Plans

Jurisdictions that submitted local plans during the 1983 and 1986 flood events were:

- City of Clearlake
- Lake County
- City of Lakeport
- Marin County
- Napa County
- City of Napa
- City of Petaluma
- City of Roseville
- Sacramento County
- City of Sacramento
- Santa Cruz County
- Sonoma County
- Yuba County

1996 State Flood Hazard Mitigation Plan

In 1996, FEMA approved the State of California Flood Hazard Mitigation Plan, which was developed in response to two federally declared disasters: the 1995 winter storms and the 1995 late winter storms. Over twenty state agencies and regulatory bodies participated in the development of the plan.

Strategies of the 1996 State Flood Hazard Mitigation Plan

The 1996 plan covered the entire state and promoted the following three strategies:

1. Consider watersheds as singular units. Watershed management must emphasize the need for multi-agency involvement regardless of jurisdictional boundaries.
2. Stress adequate floodplain management through:
   - Avoiding risks in the floodplain.
   - Minimizing the effects of those risks when they cannot be avoided.
   - Mitigating the effects of damage when it occurs.
   - Accomplishing the above in such a way that diminishes negative environmental impacts.
3. Emphasize nonstructural over structural mitigation when feasible. For example, the enactment of codes and standards requiring structures to be elevated above the 100-year flood level rather than construction of diversion channels or levees.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Recommend-ations of the 1996 State Flood Hazard Mitigation Plan

The 1996 flood plan produced ten recommendations:

- Promote a cause-and-effect approach to streams and watersheds in developing flood hazard mitigation measures.
- Control future development in floodplains and flood prone areas by promoting the establishment and enforcement of zoning regulations, codes and standards, permitting regulations, and effective planning at the state and local levels. This includes development on bluffs and hillsides and in coastal zones.
- Promote the acquisition or elevation of existing properties located in the floodplain that are vulnerable to repetitive damage.
- Implement other flood control measures where acquisitions, elevations, or other nonstructural measures are not feasible. This includes the improvement or installation of levees, culverts, and channels.
- Ensure that citizens receive information on storm-related hazards affecting their communities, and on the practices necessary to diminish their vulnerability through public education.
- Assist local governments by endorsing effective regulation and maintenance practices for private flood control facilities.
- Work with local floodplain managers to promote participation in and ensure compliance with the NFIP and to update the FIRM for their communities.
- Work with the DWR and regional and local entities to document historic flood patterns across the state's watersheds.
- Ensure OES participation in existing interagency groups (or establish such groups as necessary) to improve the awareness and adequate implementation of effective mitigation actions.
- Create an inventory/database on flood vulnerability and risk, the status of floodplain management, and mitigation practices at the state and local level.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Completion of the 1996 State Flood Hazard Mitigation Plan

On January 30, 1997, FEMA conditionally approved Phase I of the State Flood Hazard Mitigation Plan, subject to the completion of Phase II. This work was completed on July 30 1998 and approved by FEMA on September 3, 1998. Phase II included:

- Assurances that the activities, programs, and policies of all state agencies related to hazard evaluation, vulnerability, and mitigation would be coordinated and contribute to the overall lessening or avoiding of vulnerability to natural hazards.
- Integration of local government risk analyses and mitigation planning efforts into the State Flood Hazard Mitigation Plan.

Flood Mitigation Planning Today

Flood hazard mitigation is a continuing year-round effort in California. While past plans were prepared in a post-flood mode, local communities and state agencies are encouraged to prepare pre-flood hazard mitigation plans that identify ways to reduce damage caused by flooding.

The FEAT Report

In January 1997, a declared flood disaster event caused over $1.8 billion in damage across 48 counties. In response to the disaster, the governor created the Flood Emergency Action Team (FEAT) by executive order. The FEAT was tasked with developing a report to assess the damage from the disaster, develop a plan for repairs, evaluate agency responses, and make recommendations for improvements. One of the recommendations was to assist communities in preparing floodplain management/flood hazard mitigation plans. The report also recommended a large number of mitigation projects and called for a comprehensive study of flood control in the Central Valley. In response, the USACE and the State Reclamation Board released the *Sacramento and San Joaquin River Basins Comprehensive Study* on December 20, 2002.

To access the FEAT report, go to
http://rubicon.water.ca.gov/FEATReport120.fdr/featindex.html

Continued on next page

6.5 Mitigation Measures for Flood Hazards

The California Floodplain Management Task Force

In 2000, the Governor Gray Davis signed Assembly Bill 1147, which recommended the creation of the California Floodplain Management Task Force (Task Force). In February 2002, the Governor Davis tasked DWR with convening the Task Force. The Task Force focused on the intent of Assembly Bill 1147, which stated: "the Legislature finds and declares that the impacts of flooding can be reduced through better coordination of floodplain management decisions. It is the intent of the Legislature that the Governor establishes a floodplain management task force with broad membership from the local, state, and federal governments and stakeholders with an interest in flood control. If the task force is established, it is the intent of the Legislature that it examine specific issues related to state and local floodplain management, including, but not limited to, features that substantially reduce potential flood damage, and make recommendations for more effective statewide floodplain management policies."

For more information, go to www.fpm.water.ca.gov.

Roles of the Task Force

The newly formed Task Force sought to recommend floodplain management strategies designed to reduce flood losses and maximize the benefits of floodplains. It found that existing programs are not adequate to accomplish these goals, and that for many Californians time is of the essence. The members moved forward with an understanding that failure to take action could result in loss of life; increased economic, agricultural, and property losses; and environmental decline or lack of ecosystem restoration opportunities.

The Task Force identified the need for California to comply with the NFIP. It also developed recommendations for improving floodplain management by adopting best management practices and integrating multi-objective management approaches. A draft floodplain management executive order was promulgated in an effort to foster compliance with NFIP.

In developing their recommendations, the Task Force considered an array of previously identified options drawn from thirty-nine reports on the subject as well as other resources, including:

- *Flood Emergency Action Team Report* (FEAT Report)
- *Sharing the Challenge—Floodplain Management into the 21st Century* (the Galloway Report)
- Government agency publications, books, published papers, and websites
- Specific recommendations from stakeholders

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6.5 Mitigation Measures for Flood Hazards

Recommendations of the Task Force

The Task Force convened more than 30 small group meetings and six public plenary sessions between April and December of 2002 to seek consensus on the recommendations presented in its report. The recommendations represent three basic themes:

1. Better Understanding and Reducing Risks from Reasonably Foreseeable Flooding (Table 6.5A)
2. Multi-Objective Management Approach for Floodplains (Table 6.5B)
3. Local Assistance, Funding, and Legislation for Floodplain Management (Table 6.5C)

The Floodplain Management Task Force's final report was published on December 12, 2002 and can be viewed at http://fpmtaskforce.water.ca.gov.

Table 6.5A Theme 1. Better Understanding and Reducing Risks from Reasonably Foreseeable Flooding

Local, state, and federal agencies should consider the risk to life and property from reasonably foreseeable floods when making their land use and floodplain management decisions. To do this effectively, decision-makers need better tools and information and specific methods to comply with the federal NFIP.

Click here to view the table or go to Table 6.5A in the Appendices.

Table 6.5B Theme 2. Multi-Objective Management Approach for Floodplains

State, local, and federal agencies should implement multi-objective floodplain management on a watershed basis. Where feasible, projects should provide adequate protection for natural, recreational, residential, business, economic, agricultural, and cultural resources and protect water quality and supply.

Click here to view the table or go to Table 6.5B in the Appendices.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Table 6.5C Theme 3: Local Assistance, Funding, and Legislation for Floodplain Management

DWR should identify and actively pursue funding opportunities, technical assistance to local governments and other organizations, and legislative proposals to implement Task Force recommendations and ensure successful floodplain management, recognizing that local governments have the primary responsibility and authority for land use decisions.

Click here to view the table or go to Table 6.5C in the Appendices.

Table 6.5D Task Force Stakeholders

The attached table contains a list of the local and state agencies on the Task Force.

Click here to view the table or go to Table 6.5D in the Appendices.

Table 6.5E Federal Advisory Committee

The following is a list of members of the Federal Advisory Committee to the Task Force:

Name/Title	Organization
Cynthia McKenzie	FEMA Region IX
Jack Eldridge	FEMA Region IX
Ray Lenaburg	FEMA Region IX
Rebecca Lent	National Marine Fisheries Service
Mark Charlton	USACE
Mary Butterwick	USEPA Region 9
Shanna W. Draheim	USEPA Region 9
Wayne Nastri	USEPA Region 9
Michael Hoover	USFWS

Source: California Flood Task Force, http://fpmtaskforce.water.ca.gov

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6.5 Mitigation Measures for Flood Hazards

Floodplain Mitigation Programs

Floodplain mitigation programs include:

- The Flood Protection Corridor Program (FPCP)
- Urban Streams Grant Program
- Coastal Resources Grant Program
- HMGP
- FMA Program

The Flood Protection Corridor Program (FPCP)

The FPCP was established when California voters passed Proposition 13, the "Safe Drinking Water, Watershed Protection and Flood Protection Act," in March of 2000. The FPCP authorized bond sales of $70 million for primarily nonstructural flood management projects that include wildlife habitat enhancement and/or agricultural land preservation. Of the $70 million, approximately $5 million was for educational programs and administrative costs and another $5 million was earmarked for the City of Santee, leaving approximately $60 million for flood corridor protection projects throughout the state.

Any local agency or nonprofit organization with interest in flood management issues is eligible to sponsor projects under FPCP that seek to acquire, restore, enhance, and protect real property for the purposes of flood control protection and agricultural land preservation and/or wildlife habitat protection. Sponsoring agencies or organizations that meet the criteria can partner with other types of agencies and organizations as necessary to ensure diverse funding sources and necessary expertise on the project team.

For more information, go to www.dfm.water.ca.gov/fpcp/index.cfm.

FPCP Progress to Date

In response to outreach efforts begun in the spring of 2000, DWR reviewed direct expenditure project opportunities for the FPCP. Of the eleven projects that qualified for direct expenditure, five were recommended for approval based upon state interest and a significant contribution to flood protection, wildlife habitat enhancement, and/or agricultural land conservation. The cost for these five projects is approximately $27 million.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Table 6.5F FPCP Approved Projects

The attached table shows approved FPCP projects.

Click here to view the table or go to Table 6.5F in the Appendices.

Fundable Activities in the FPCP

Fundable activities under the FPCP include:

- Non-structural flood damage reduction projects within flood corridors
- Acquisition of real property or easements in a floodplain
- Setting back existing flood control levees or strengthening or modifying existing levees in conjunction with levee setbacks
- Preserving or enhancing flood-compatible agricultural use of real property
- Preserving or enhancing wildlife values of real property through restoration of habitat compatible with seasonal flooding
- Repairing breaches in the flood control systems, water diversion facilities, or flood control facilities damaged by a project developed pursuant to Chapter 5, Article 2.5 of the Clean Water, Watershed Protection and Flood Protection Act of 2000
- Establishing a trust fund for up to 20 percent of the money paid for acquisitions to generate interest in maintaining the acquired lands
- Paying the costs associated with the administration of projects

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Urban Streams Grant Program

The Urban Streams Restoration Program seeks to assist communities in reducing damage from floods and stream bank and watershed instability while restoring the environmental and aesthetic values of streams, and to encourage stewardship and maintenance of streams by the community. Funds can be used to:

- Restore watersheds
- Reduce property damage
- Renovate town centers

Since 1985, the program has provided over 170 grants ranging from $1,000 to $200,000 to communities throughout California. Program funding increased from $2 million in the 2000-2001 fiscal year to $10 million in the 2001-2002 fiscal year. Because of the increased funding, DWR amended the regulations for the program, including raising the grant cap from $200,000 to $1 million per project. This change allows DWR to provide funds for larger, more complex stream restoration and flood management work in addition to funding smaller projects.

Source: www.watershedrestoration.water.ca.gov/urbanstreams

Urban Streams Grant Program Project Types

Projects funded under the Urban Streams Grant Program include:

- Stream cleanups
- Bank stabilization projects
- Re-vegetation efforts
- Daylighting of culverted creeks
- Re-contouring of channels to improve floodplain function
- Occasional acquisition of strategic floodplain properties or easements

For more detailed information on the many projects that have been funded through this program, visit http://endeavor.des.ucdavis.edu/nrpi, the website for the University of California, Davis' Natural Resource Project Inventory.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

About the San Lorenzo River Flood Control Program

Under the San Lorenzo River Flood Control Program, the City of Santa Cruz received $2 million in funding to cover the state share of costs for flood management projects to improve the level of flood protection in the Santa Cruz region.

About the Arroyo Pasajero Watershed Program

Under the Arroyo Pasajero Watershed Program, the state allocated $5 million projects designed to improve flood protection for State Highway Route 269 north of the City of Huron or to improve flood control for the California Aqueduct near the Arroyo Pasajero crossing.

Coastal Resources Grant Program

Part B grants under the Coastal Resources Grant Program fund projects to help coastal cities and counties effectively exercise their responsibility for improving the management of the state's coastal resources. Only those jurisdictions with Local Coastal Programs approved by the California Coastal Commission are eligible to apply for grant funding.

For more information contact:

The Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814
(916) 653-5656

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Types of Coastal Resources Grant Program Expenditures

The types of expenditures eligible for funding through Part B grants include:

- Coastal Habitat Protection
- Projects that provide for the protection of wetlands, floodplains, estuaries, beaches, dunes, and fish and wildlife and their habitat within coastal areas
- Protection of life and property
- Projects that minimize the loss of life and property in coastal flood-prone, storm surge, geologic hazard, and erosion prone areas
- Protection of recreational resources
- Projects that provide public access to the coast for recreational purposes, to acquire coastal view sheds, and to preserve, maintain, and restore historic, cultural, and aesthetic coastal sites
- Protection of coastal economic resources
- Projects that facilitate siting major facilities along the coast related to fisheries, recreation, ports, and other coastal-dependent commercial uses
- Projects that promote other coastal management improvements that are determined by the secretary of the Resources Agency to be consistent with the state's coastal management program

HMGP

The Hazard Mitigation Grant Program (HMGP) assists state and local governments in implementing hazard mitigation measures after a major disaster declaration. States may receive up to 7.5 percent of the total estimated eligible Stafford Act disaster assistance. Up to 7 percent of the state’s HMGP funds may be used for the development of mitigation plans. FEMA can then provide up to 75 percent funding for eligible project costs.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

HMGP Projects

During the past ten years, local government and state agencies requested $377,608,766 in flood mitigation projects from the HMGP and received a total of $137,307,925. The table below lists HMGP projects in five categories:

- Acquisition
- Elevation
- Acquisition/Elevation/Relocation
- Erosion Control
- Flood Control

Tables 6.5 G-K HMGP Projects

The attached tables list HMGP flood projects in California. Click on the links below to view the tables or go to the Appendices.

Table 6.5G – Acquisition Projects
Table 6.5H – Elevation Projects
Table 6.5I – Acquisition/Elevation/Relocation Projects
Table 6.5J – Erosion Control Projects
Table 6.5K – Flood Control Projects

FMA Program

The Flood Mitigation Assistance (FMA) program assists states and local communities in implementing flood hazard mitigation measures before a major disaster occurs. The program targets NFIP communities with numerous repetitive loss structures. The program offers two types of grants to local communities: planning and project grants. A community must have a FEMA-approved Floodplain Management Plan (FMP) to be eligible for FMA grant funding.

A community has two years to develop an FMP and three years to complete a project with FMA funds. Eligible communities may apply for up to $50,000 in FMA planning funds once in a five-year period. The total planning grant funding made available in any fiscal year to any state, including all communities located in the State, cannot exceed $300,000. Project grant funding during any five-year period cannot exceed $10 million to any state or $3.3 million to any eligible community. States also receive technical assistance grants to administer the FMA program. The total assistance grants in any fiscal year during a five-year period cannot exceed $20 million.

Continued on next page

6.5 Mitigation Measures for Flood Hazards

Table 6.5L Communities That Completed FMPs and Received FMA Funds

From 1997 to 2002, California received FMA planning and project grant funds totaling $6,296,645.

The following communities completed FMPs and/or received FMA grant funding:

Community	Received or is awaiting FEMA approval of FMP	Received FMA project funding	Received FMA funding to develop FMP
City of Clearlake	X	X	
City of Los Angeles	X	X	
City of Malibu	X	X	
Monterey County	X	X	
City of Napa	X	X	
Sacramento County	X	X	
Santa Cruz County	X	X	
City of Roseville	X		
Lake County	X		
San Luis Obispo County	X		
City of Milpitas	X		
Yuba County	X		
City of Laguna Beach			X
City of Lakeport			X
Tehama County			X
Ventura County			X

State of California Multi-Hazard Mitigation Plan

Chapter 7—Risk Assessment for Other Significant Hazards

Introduction

This part discusses other hazards in California. The profiles include past hazards, the analysis used to determine how probable future occurrences are, the magnitude of these occurrences, and what conditions in the hazard areas that contribute to the vulnerability.

The more significant hazards include:

Avalanche
Drought
Freezes
Insect Pests
Civil Disturbances
Dam Failure
Hazardous Materials Spills
Landslides
Pollution
Terrorism
Volcanoes

In This Chapter

This chapter contains the following topics.

Topic	Title	Page
7.1	Identifying Other Significant Hazards	212
7.2	Profiling Other Hazard Events	216
7.3	Assessing Other Hazard Vulnerabilities by Jurisdiction	229
7.4	Mitigation Measures for Other Hazards	233

7.1 Identifying Other Significant Hazards

Table 7.1A - Losses from Other Significant Hazard Types

The table below summarizes losses from significant hazard events other than fires, floods, and earthquakes in California from 1950 to 1997, except where indicated by *.

Hazard	Deaths	Injuries	Damage in millions	Counties Affected
Avalanche	15	N/A	N/A	16
Civil Disturbances	53	2457	$800.3	5
Dam Failure	3	N/A	N/A	1
Drought	0	0	$2,644.0	55
Freeze	0	0	$1,006.6	66 (†)
Hazardous Materials	0	300	$38.0	4
Insect Pests	12*	0	$142.6	18
Landslides	17	0	$42.8	9
Pollution	Pollution does not usually cause immediate damage, but is a long-term health & environmental issue.			All
Volcanoes	No volcano eruptions since 1917			N/A

(†) Some counties were affected multiple times.

* West Nile Virus-related fatalities as of September 7, 2004 in California in the counties of Los Angeles, Orange, San Bernardino, and Riverside.

Avalanche

Avalanches occur in the steep mountainous areas of the state that receive significant amounts of snow. Avalanches are weather related threats to communities, residents, and visitors to the high mountain areas of the state. Avalanches have caused property damage and loss of life. Significant events have damaged or destroyed ski resorts at Mt. Shasta and Lake Tahoe. Avalanches have also blocked and damaged roadways. Avalanches pose a threat in the Sierra Nevadas on the eastern side of the state and the Cascade Range in the north.

Map 7.1A Civil Disturbances

The attached map illustrates civil disturbance proclamations in California.

Click here to view the map or go to Map 7.1A in the Appendices.

Continued on next page

7.1 Identifying Other Significant Hazards

Map 7.1B Major California Dams

The attached map illustrates the locations of major dams in California.

Click here to view the map or go to Map 7.1B in the Appendices.

Map 7.1C State Dam Disaster Proclamations

The attached map illustrates state proclamations for dam failure between 1950 and 1997.

Click here to view the map or go to Map 7.1C in the Appendices.

Map 7.1D State Drought Disaster Proclamations

The attached map illustrates state drought disaster proclamations between 1950 and 1997.

Click here to view the map or go to Map 7.1D in the Appendices.

Map 7.1E Federal Freeze Disaster Declarations

The attached map illustrates the locations of freeze disasters and other federally declared disasters in California from 1991 through 2003.

Click here to view the map or go to Map 7.1E in the Appendices.

Map 7.1F Hazardous Materials

The attached map shows the number of hazardous materials spills that occurred in each county between January 1, 2002 and August 23, 2002. The map reveals that the Northern California counties of Sacramento, Marin, and San Francisco, and the Southern California counties of Kern, Los Angeles, San Bernardino, Orange, Riverside, and San Diego have the highest incidence of such spills.

Click here to view the map or go to Map 7.1F in the Appendices.

Source: OES Hazardous Spill Report database. Map design: Randy Fortner

Continued on next page

7.1 Identifying Other Significant Hazards

Map 7.1G State Agricultural Disaster Proclamations

The attached map illustrates state agricultural disaster proclamations between 1950 and 1997.

Click here to view the map or go to Map 7.1G in the Appendices.

Map 7.1H Insect Pests

The attached map illustrates the types and numbers of insect disasters that have occurred in each county from 1950 – 2004.

Click here to view the map or go to Map 7.1H in the Appendices.

Map 7.1I - West Nile Virus

By August of 2004, there were 45 human cases of West Nile Virus infection in California. These occurred in San Bernardino County (26), Riverside County (8), Los Angeles County (8), Imperial County (1), Kern County (1), and Orange County (1). The cases in Imperial and Kern counties are the first human cases in these counties in 2004. Of the 45 cases, 21 are classified as West Nile fever, 18 are classified as West Nile neuroinvasive disease, and five are of unknown status. Two of these cases were initially detected in asymptomatic individuals through screening done at blood banks-one of these individuals later became symptomatic.

Click here to view the map or go to Map 7.1I in the Appendices.

Map 7.1J State Landslide Disaster Proclamations

The attached map illustrates state proclamations for landslide disasters between 1950 and 1997.

Click here to view the map or go to Map 7.1J in the Appendices.

Continued on next page

7.1 Identifying Other Significant Hazards

Air & Water Pollution

Although as a single event air pollution is less significant than flood, fire, or earthquake, cumulatively it is much more hazardous to the health of large numbers of Californians.

Maps 7.1K Volcanoes & Calderas

The attached map illustrates the locations of volcanoes and calderas in California.

Click here to view the map or go to Map 7.1K in the Appendices.

Source:
http://vulcan.wr.usgs.gov/Volcanoes/WesternUSA/Maps/map_west_coast_volcanoes.html

7.2 Profiling Other Hazard Events

Drought

Drought is a gradual phenomenon. One dry year does not normally constitute a drought in California, but rather serves as a reminder of the need to plan for droughts. California's extensive system of water supply infrastructure - reservoirs, groundwater basins, and interregional conveyance facilities - generally mitigates the effects of short-term dry periods for most water users.

Droughts exceeding three years are relatively rare in Northern California, the source of much of the state's water supply. The 1929-1934 drought established the criteria commonly used in designing storage capacity and yield for large Northern California reservoirs. The driest single year in California's measured hydrologic history is 1977. California's most recent multi-year drought was 1987-1992.

Source: Preparing for California's Next Drought—Changes Since 1987-92, Department of Water Resources, July 2000.

The 1995-1997 Drought

From November 1975 through November 1977, California experienced one of its most severe droughts. Although people in most areas of the state are accustomed to almost no precipitation during the growing season (April to October), they expect it in the winter. In 1976 and 1977, the winters brought only one-half and one-third of normal precipitation, respectively, leading to the state's fourth and first driest years on record. Most surface storage reservoirs were substantially drained in 1976, leading to widespread water shortages when 1977 turned out to be even drier.

Source: Preparing for California's Next Drought—Changes Since 1987-92, Department of Water Resources, July 2000.

Continued on next page

7.2 Profiling Other Hazard Events

1987-1992 Drought

From 1987 to 1992 California again experienced a serious drought due to low precipitation and run-off levels. The hardest hit region was the Central Coast, roughly from San Jose to Ventura. For the Central Coast and central Sierra Nevada, 1987 to 1990 is the driest period on record.

In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered, recreational use of lakes and rivers decreased, forestry losses and fires increased, and hydroelectric power production decreased.

In February 1991, DWR and OES surveyed drought conditions in all 58 California counties and found five main problems:

- Extremely dry rangeland
- Irrigated agriculture with severe surface water shortage and low or no groundwater
- Widespread rural areas where individual and community supplies were going dry
- Urban area rationing at 25 to 50 percent
- Environmental impacts

After four drought years and three winter months of meager precipitation, California's water prospects looked bleak at the start of 1991. Storage in major reservoirs had dropped to 54 percent of average, the lowest since 1977, a record dry year. Other supply systems were suffering more major shortages. The shortages led to stringent water rationing and severe cutbacks in agricultural production (including threats to survival of permanent crops such as trees and vines). Fish and wildlife resources were in critical shape as well. Not since the 1928-34 drought had there been such a prolonged dry period.

Continued on next page

7.2 Profiling Other Hazard Events

1987-1992 Drought (continued)

Water was so scarce that most suppliers doubted the SWP and the CVP would be able to provide minimum carryover storage as a hedge against yet another dry year. In February 1991, the governor established the Drought Action Team. This team almost immediately created an emergency drought water bank to develop a supply for four critical needs:

- Municipal and industrial uses
- Agricultural uses
- Protection of fish and wildlife
- Carryover storage for 1992

The large-scale transfer program, which involved over 800,000 acre feet of water, was implemented in less than 100 days with the help and commitment of the entire water community and established important links between state agencies and local water interests and local government for future programs.

Source: Preparing for California's Next Drought – Changes Since 1987-92, Department of Water Resources, July 2000

Charts 7.2A & 7.2B Tracking Water Conditions

Chart A describes water conditions in California between 1989 and 2000 and Chart B describes water conditions between 1999 and 2003. The charts illustrate the cyclical nature of weather patterns in California. Snow pack and precipitation increased between 1993 and 1997, began decreasing in 1998, and began to show signs of recovery in 2002.

Click here to view the charts or go to Charts 7.2 A and 7.2B in the Appendices.

Source: http://cdec.water.ca.gov/snow/bulletin120

Continued on next page

7.2 Profiling Other Hazard Events

Table 7.2A Drought

The table below summarizes California droughts since 1972. The 1976-77 and the 1987-92 droughts were among the worst in California history. So far, the 2000s have had less significant droughts, but based on the information in this table, as well as the trends illustrated by the following chart, another serious drought is likely to occur in this decade or the next.

Year	Number of Incidents	Jurisdictions Affected	Crop Damage
1972	1	Glenn, San Benito, Santa Clara	$8 million
1976-1977	1	Alpine, Calaveras, Colusa, Fresno, Glenn, Madera, Merced, San Diego, San Joaquin, Solano, Stanislaus, Sutter, Tuolumne, Alameda, Butte, Contra Costa, Kings, Los Angeles, Riverside, San Luis Obispo, Tulare, Yolo, Amador, Monterey, Napa, Nevada, San Benito, San Bernardino, Tehama, San Mateo, Marin	$2.67 billion
1988	1	Madera County location emergency was ratified every two weeks through 1991	N/A
1990	2	Santa Barbara City and County	0
1991	1	Alameda, Alpine, Colusa, Fresno, City of Orange Cove, Glenn, Kern, Kings, Lake, Madera, Marin, Mendocino, Monterey, Placer, Santa Barbara, City of Santa Barbara, Shasta, Siskiyou, Solano, Sonoma, Sutter, Tehama, Tulare, Tuolumne, and Yuba. Many of these emergencies continued through 1992	USDA-nationwide: $995 million for 1990-91 crop loss. Additional, $775 million in emergency funds for 1990-92 crop losses.
2001	5	Del Norte, Modoc, Siskiyou, Inyo, Humboldt, Kern, Los Angeles, Ventura, Mono, Lassen, Plumas, San Bernardino, Santa Barbara, Sierra, Shasta, Trinity	N/A
2002	3	Alpine, Amador, Calaveras, Imperial, Modoc, Nevada, Orange, Placer, Riverside, San Bernardino, Sierra, Stanislaus	$12,100

Sources:

- *OES Individual Assistance Section, 2001 & 2002 SBA Declarations/USDA Designations database*
- *OES Origins and Development—A Chronology 1917-1999*

Continued on next page

7.2 Profiling Other Hazard Events

Table 7.2B Freeze

Although infrequent, freezes can severely affect California agriculture. The table below summarizes freeze disasters since 1950.

Year	Number of Incidents	Counties Affected	Crop Damage
1969	1	San Diego	$10 million
1972	2	Colusa, El Dorado, Fresno, Kern, Kings, Lake, Madera, Merced, Modoc, Nevada, Placer, San Benito, San Joaquin, Santa Clara, Stanislaus, Siskiyou, Tehama, Tulare	$113.5 million
1973	1	Alameda, Contra Costa	$8-$10 million
1990	1	Alameda, Butte, Colusa, Fresno, Glenn, Imperial, Kern, Los Angeles, Madera, Marin, Merced, Mendocino, Monterey, Napa, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tulare, Ventura, Yolo, Yuba	$852.4 million
1998-99	1	Fresno, Kern, Kings, Madera, Merced, Monterey, Tulare, Ventura	N/A
2001	3	Butte, Colusa, Fresno, Glenn, Madera, Mariposa, Merced, Plumas, Sutter, Tehama, Tuolumne, Yuba	N/A
2002	5	Butte, Colusa, Glenn, Lake, Marin, Mendocino, Napa, Orange, Riverside, Sacramento, Shasta, Sonoma, Tehama, Trinity	N/A

Sources:

- *OES Individual Assistance Section – 2001 & 2002 SBA Declarations/ USDA Designations database*
- *OES Origins and Development – A Chronology 1917-1999*

Continued on next page

7.2 Profiling Other Hazard Events

Table 7.2C Agricultural and Health Risks from Insect Pests

California is at risk from many insects that, under the right circumstances, can cause severe economic, environmental, or physical harm. The table below profiles the insects that are of concern to California.

Source: www.cdfa.ca.gov/phpps/pdep/insect_pests_and_diseases.htm

Dangerous to	Insects
Plants and Crops	Asian longhorn beetle, Caribbean fruit fly, glassy-winged sharp shooter, guava fruit fly, gypsy moth, Japanese beetle, Mediterranean fruit fly, melon fruit fly, Mexican fruit fly, olive fruit fly, oriental fruit fly, bark beetle
Humans	Africanized honeybee, mosquito
Both	Red imported fire ant

Table 7.2D Insect Infestations

The table below summarizes insect infestations that have occurred in California since 1950.

Type of Insect	Number of Incidents	Counties Affected	Crop Damage
Mediterranean Fruit Fly	7	Contra Costa, Los Angeles, Orange, Riverside, San Benito, San Bernardino, San Mateo, Santa Clara, Santa Cruz, Stanislaus, Ventura	$22 million
Mexican Fruit Fly	2	Los Angeles, San Diego	None—damage mitigated
Sweet Potato Whitefly	1	Imperial, Riverside	$12.7 million
Bark Beetle	1	San Bernardino, Riverside, San Diego	N/A

Continued on next page

7.2 Profiling Other Hazard Events

West Nile Virus

By August of 2004, there were a total of 45 human cases of West Nile Virus infection in California. These occurred in San Bernardino County (26), Riverside County (8), Los Angeles County (8), Imperial County (1), Kern County (1), and Orange County (1). The cases in Imperial and Kern counties are the first human cases in these counties in 2004. Of the 45 cases, 21 are classified as West Nile fever, 18 are classified as West Nile neuroinvasive disease, and five are of unknown status. Two of these cases were initially detected in asymptomatic individuals through screening done at blood banks- one of these individuals later became symptomatic.

Source: http://www.westnile.ca.gov/

Table 7.2E Civil Disturbances

As summarized in the table below, there have been several significant civil disturbances in California since 1950. These disturbances have all taken place in metropolitan areas.

Source: OES Origins and Development—A Chronology 1917-1999

Disturbance	Location	Date	Deaths	Injuries	Damage
Watts	South Central Los Angeles	1965	32	874	$45 million
Berkeley	City of Berkeley	1964	0	20	N/A
San Francisco	City & Co. of SF	1966	U/A	42	N/A
Burning of Bank of American	Santa Barbara	1969	0	12+	$275,000-$300,000
Rodney King Riot	City of Los Angeles	1992	53	2300	N/A

Dam Failure

Dam failure is the uncontrolled release of impounded water from behind a dam. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, and terrorism can all cause a dam to fail. Dam failure causes downstream flooding that can affect life and property.

Continued on next page

7.2 Profiling Other Hazard Events

Historic Dam Failures in California

California has had about 45 failures of non-federal dams. The failures occurred for a variety of reasons, the most common being overtopping. Other reasons include specific shortcomings in the dams themselves or an inadequate assessment of surrounding geomorphologic characteristics.

California's first notable dam failure was in 1883 in Sierra County, while the most recent failure occurred in 1965. The most catastrophic event was the failure of William Mulholland's infamous St. Francis Dam, which failed in 1928 and killed an estimated 450 people, only slightly fewer then the 1906 San Francisco earthquake. The actual number of dead from the St. Francis Dam failure was likely substantially higher. San Francisquito Canyon, which was flooded in the event, was home to hundreds of transients and illegal immigrants who were never accounted for in the death totals.

Continued on next page

7.2 Profiling Other Hazard Events

Dam Safety Legislation

Since 1929, the state has supervised all non-federal dams in California to prevent failure for the purpose of safeguarding life and protecting property. Supervision is carried out through the state's Dam Safety Program under the jurisdiction of DWR. The legislation requiring state supervision was passed in response to the St. Francis Dam failure and concerns about the potential risks to the general populace from a number of water storage dams. The law requires:

- Examination and approval or repair of dams completed prior to August 14, 1929, the effective date of the statute
- Approval of plans and specifications for and supervision of construction of new dams and the enlargement, alteration, repair, or removal of existing dams
- Supervision of maintenance and operation of all dams under the state's jurisdiction

The 1963 failure of the Baldwin Hills Dam in Southern California led the Legislature to amend the California Water Code to include within state jurisdiction both new and existing off-stream storage facilities.

Dams and reservoirs subject to state supervision are defined in California Water Code §6002 through §6004, with exemptions defined in §6004 and §6025. In administering the Dam Safety Program, DWR must comply with the provisions of CEQA. As such, all formal dam approval and revocation actions must be preceded by appropriate environmental documentation.

In 1972, Congress moved to reduce the hazards from the 28,000 non-federal dams in the country by passing Public Law 92-367, the National Dam Inspection Act. With the passage of this law, Congress authorized the USACE to inventory dams located in the United States. The action was spurred by two disastrous earthen dam failures during the year, in West Virginia and South Dakota that caused a total of 300 deaths.

The Water Resources Development Act of 1986 (P.L 99-662) authorized USACE to maintain and periodically publish an updated National Inventory of Dams (NID). The Water Resources Development Act of 1996 (P.L. 104-303), Section 215, re-authorized periodic updates of the NID by USACE.

Continued on next page

7.2 Profiling Other Hazard Events

Chart 7.2C Hazardous Material Spills

Hazardous materials are everywhere and are accidentally released or spilled many times during any given day. The attached chart lists the most common sites for spills in California based on an analysis of 173 reports for spills occurring between October 9 and October 17, 2002.

Click here to view the chart or go to Chart 7.2C in the Appendices.

Landslide Risk to California

California's proliferation of mountains and hills puts it at high risk for landslides. Any slope of 15 degrees or greater is susceptible to mud or landslides.

Air Pollution in California

Air pollution is a continuing problem in California, with the largest concentration of pollution in the highest populated air basins: the San Francisco Bay Area, the San Joaquin Valley, the Sacramento Valley, San Diego, and the South Coast. Pollutants include smog, soot, and toxic air contaminants (TACs). *(Source: Toxic Beginnings—Cancer Risks to Children from California's Air Pollution, National Environmental Trust)*

However, toxic emissions in California are on the decline. The table below shows the average quantities of emissions in tons per day since 1975. In 2000, average statewide emissions of nitrogen oxide (NOx) dropped to 51 percent of those in 1975, reactive organic gasses (ROG) dropped to 36 percent, and carbon monoxide (CO) dropped to 30 percent. Only Particulate Matter (PM10, less than or equal to 10 microns) has increased since 1975.

Statewide Emissions (tons/day, annual average)								
	1975	1980	1985	1990	1995	2000	2005	2010
NO_x	4762	5050	4939	4901	4133	3523	2962	2462
ROG	6408	6210	5737	4595	3755	3117	2592	2331
PM_{10}	1813	1983	1985	2254	2221	2313	2447	2601
CO	38285	36315	34625	29631	22876	17937	14052	11423

Source:
/www.arb.ca.gov/adam/cgibin/db2www/ozonereport_ytd.d2w/start#down

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7.2 Profiling Other Hazard Events

About Terrorism

Terrorism is defined in 28 CFR Section 0.85) as "…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."

Since September 11, 2001, terrorism has become a fact of life for all Americans. Planning for response to potential terrorist incidents has long been part of California's Emergency Preparedness Planning effort. California provides a target-rich environment for terrorists, with many facilities and venues and an easy place to hide in California's diverse population. Effective hazard mitigation that reduces risk to terrorism must be based upon technical expert information and analysis of actual terrorist events.

Source: Terrorism in the United States 1999, www.usdoj.gov

Terrorism Risk

"The threat of terrorism comes from domestic and international terrorists. The Federal Bureau of Investigation further divides the domestic terrorism threat by orientation. These orientations are: Right Wing, Left Wing, and Special Interest. The international terrorism threat can also be divided into four groups; state sponsors, formal terrorist organizations, loosely affiliated extremists, and rogue elements."[1]

Responsibility for terrorism has been separated into two phases: incident response and crises management; and consequence management. The lead federal agency for terrorist incident response and crisis management is the FBI. The lead federal agency for consequence management is FEMA.[2]

Many terrorist events have occurred in California, most recently the attempted attack on the Suburban Propane tanks in Elk Grove in 1999. Worldwide there were 457 incidents or planned acts during the period from 1980 to 1999. Of these, 135 were international, and 322 domestic terrorism. The majority of these incidents (321) have been bombings."[3] However, there is also a concern for the potential of Weapons of Mass Destruction (WMD) use in future terrorist events. The use of WMDs increases the potential for mass casualties and damage.

Continued on next page

7.2 Profiling Other Hazard Events

Terrorism Risk (continued)

One of the special considerations in dealing with the terrorist threat is that it is difficult to predict. One must know the minds and capabilities of various terrorists and terrorist groups. These are characteristics terrorist organizations strive to conceal. Because all terrorists are not the same, the calculation is even more difficult. Two things are clear from the perspective of hazard mitigation. The most often used weapon of terrorists is bombs, and the greatest potential for loss is from WMDs.

Because of the dynamic nature of the terrorist threat and the open nature of California society, all jurisdictions within California are vulnerable to terrorist attack.

Sources:

- *CONPLAN, United States Government Interagency Domestic Terrorism Concept of Operations, January 2001*
- *Terrorism in the United States 1999, U.S. Department of Justice, Federal Bureau of Investigation, page 41*

Biological & Chemical Terrorism

The use of biological agents, such as anthrax and smallpox, and chemical agents in terrorism is of concern in the United States. However, biological terrorism may not be a major threat. According to the Chemical and Biological Weapons Non-proliferation Project, Henry L. Stimson Center, there are several reasons why terrorists have refrained from and may well continue to avoid poison gas and germ agents. These include:

- Moral objections by terrorists to use these agents
- The possibility that these materials may jeopardize their own health
- Effects of use would be delayed
- Materials are difficult to obtain and use
- The possibility of offending potential supporters and group members
- Severe retaliation by governments.

It is clear that terrorists continue to prefer showy displays of appalling destruction, and want to be identified as the perpetrators of this destruction. Therefore, when combined with the fact that terrorists can still attempt to achieve their goals using conventional weapons, these reasons make biological or chemical attacks unattractive options.

Source: Ataxia—The Chemical and Biological Terrorism Thread and the U.S. Response by Amy Smithson, Director of the Chemical and Biological Weapons Nonproliferation Project, Chapter 2, page 25

Continued on next page

7.2 Profiling Other Hazard Events

Active Volcanoes

Mount Shasta "has erupted, on the average, at least once per 800 years during the last 10,000 years, and about once per 600 years during the last 4,500 years."

Source: http://vulcan.wr.usgs.gov/Volcanoes/Shasta/Hazards

The Long Valley Caldera and Mono-Inyo Craters volcanic chain "has a long history of geologic activity that includes both earthquakes and volcanic eruptions. This activity is likely to continue long into the future."

Source: http://lvo.wr.usgs.gov/zones/index.html#ashfall

7.3 Assessing Other Hazard Vulnerabilities by Jurisdiction

Agricultural – Droughts, Freezes, and Insect Infestations

Agricultural issues most dramatically affect farmers and farm workers. Unlike most other hazards, which produce graphic images of destruction, agricultural hazards appear less disastrous in the eyes of the general public. Luckily, none of California's agricultural disasters have caused widespread food shortages resulting in massive starvation or famine. However, these hazards can have a major economic impact on farmers, farm workers, packers, and shippers of agricultural products. They can also cause significant increases in food prices to the consumer due to shortages.

West Nile Virus Vulnerabilities

By August 2004, the concern about West Nile Virus (WNV) has become big news in California. The counties currently most affected by WNV include Riverside, San Bernardino, Imperial, Los Angeles, Orange, Kern, Fresno, and Stanislaus. However, mosquitoes infected with the virus can occur anywhere in the state.

The following table shows West Nile Virus Activity in California as of August 2004. Click here to view the table or go to Table 7.3A in the appendices.

Source: California Department of Health Services at http://www.westnile.ca.gov/

Avalanches in Alpine County

Alpine County, located along the crest of the Sierra Nevada mountains, has a history of avalanches. The county's avalanche season extends from the first major snowfalls of late fall until the last of the snow melts in the spring.

Those areas of substantial avalanche danger are clearly known and usually avoided. The areas in the county's downhill ski resorts and along the state highways are carefully administered to drastically reduce avalanche-causing conditions. The greatest impact avalanches have on the county is to its transportation infrastructure.

Civil Disturbances

Civil disturbances can occur almost anywhere. However, the most significant ones in California have historically taken place in large urban centers. Deaths and injuries occurred to individuals who were in or around the disturbances while they were happening. Damage was caused by thrown objects, fires, and looting.

Continued on next page

7.3 Assessing Other Hazard Vulnerabilities by Jurisdiction

Dams and Reservoirs in State Jurisdiction

California Water Code §6000 through §6000 identifies the dams and reservoirs that are under state jurisdiction. Dams and reservoirs owned by the federal government are not subject to state jurisdiction except as otherwise provided by federal law. There are approximately 45 federally owned dams in California. For information on these dams visit: www.usbr.gov/dataweb/html/cadams.html

Map 7.3A Dam Zone Map

The attached map shows the number of dams in each county in California. Los Angeles County leads the state with 104 and Modoc County is second with 79 dams. Del Norte County has no dams.

Click here to view the map or go to Map 7.3A in the Appendices.

Source: State Summary 2/01, Robert Mead, OES Planning Assistance
Map design: Randy Fortner

Dam Failures in California

There are 1483 dams in California. Since of 1950 there have been only nine dam failures. Overtopping caused two of the failures, and the others were caused by seepage or leaks. One failure resulted in three deaths because the leak turned into a washout.

Landslides

Landslides can occur in areas with a slope of 15 percent or more. Neighborhoods and businesses located on or below bluffs and hills are especially vulnerable to landslides.

For more information on California landslides, go to the California Geological Surveys website at www.consrv.ca.gov/cgs and click on "Landslides."

Map 7.3B Landslide Risk Zones

The map below illustrates areas of California that have either experienced landslides or are considered susceptible.

Click here to view the map or go to Map 7.3B in the Appendices.

Source: USGS landslide website at
http://landslides.usgs.gov/html_files/landslides/nationalmap/national.html

Continued on next page

7.3 Assessing Other Hazard Vulnerabilities by Jurisdiction

Power Shortage Risks

The 2000-2001 California electricity crisis brought to light many critical issues surrounding the state's power generation and distribution system, including its dependency on out-of-state resources. Although California has implemented effective energy conservation programs, the state continues to experience both population growth and weather cycles that contribute to a heavy demand for power.

Hydro-generation provides approximately 25 percent of California's electric power, with the balance coming from fossil fuels, nuclear, and green sources. As experienced in 2000 and 2001, blackouts can occur due to losses in transmission or generation and/or extremely severe temperatures that lead to heavy electric power consumption.

Table 7.3A Volcanoes

Populations living near volcanoes are most vulnerable to volcanic eruptions and lava flows, although volcanic ash can travel and affect populations many miles away. While there are about 20 volcanic locations in California, only a few are active and pose a threat. The table below identifies the active volcanoes in California and those areas most vulnerable to eruption and/or ash.

Volcano	Vulnerable Jurisdictions
Medicine Lake	Modoc County and the southeastern corner of Siskyou County
Mount Shasta	Shasta and Trinity counties
Lassen Peak	Lassen County
Long Valley Caldera	Inyo and Mono counties and the northeastern corner of Fresno County

Map 7.3C Proximity of Active and Potentially Active Volcanoes to Urban Areas

The map below shows active and potentially active volcanoes in California and their proximity to urban centers.

Click here to view the map or go to Map 7.3C in the Appendices.

Source: http://pubs.usgs.gov/gip/volcus/page16.html

Continued on next page

7.3 Assessing Other Hazard Vulnerabilities by Jurisdiction

Map 7.3D Volcanic Hazards

The map below illustrates volcanic hazards based on activity in the last 15,000 years**.** Areas in blue or purple show regions at greater or lesser risk of local volcanic activity, including lava flows, ashfall, lahars (volcanic mudflows), and debris avalanches. Areas in pink show regions at risk of receiving five or more centimeters of ashfall from large or very large explosive eruptions, originating at the volcanic centers shown in blue.

Click here to view the map or go to Map 7.3D in the Appendices.

Source: http://www.usgs.gov/themes/map2.html

7.4 Mitigation Measures for Other Hazards

Table 7.4A Mitigation Measures

The table below identifies mitigation measures identified in other state hazard mitigation planning documents and by emergency management experts. This list is provided as guidance to organizations that are considering how to mitigate hazards in their jurisdictions.

Hazard Type	Mitigation Measures
Drought	Drought is an economic hazard. The following measures cannot prevent drought, but can reduce crop damage and losses due to drought: • Drought plan • Water management • Land management • Crop management *Source: Defending Against Drought, available at www.nrcs.usda.gov/feature/highlights/drought.html*
Freeze	Freeze damage is another economic hazard. Mitigation measures for frost include: • Warning systems • Selective planting • Crop insurance • Frost-fighting equipment • Biological ice nucleation *Source: Mitigation Strategy Report, FEMA-DR-1267-CA, The California Freeze of 1998, FEMA Region IX Mitigation Division*
Insect Pests	Agricultural pests are an economic hazard and, in some cases, a physical danger. Mitigation for pests should include an integrated pest management strategy. *Source: www.ipm.ucdavis.edu/GENERAL/tools.html*

Continued on next page

7.4 Mitigation Measures for Other Hazards

Table 7.4A Mitigation Measures continued

Hazard Type	Mitigation Measures
Avalanches	• Artificial release (1) • Mechanical compaction (1) • Defense structures (2) • Forecasting (1 & 2) • Public education (2) *(1)* Source: Commission on Engineering and Technical Systems (CETS), Snow Avalanche Hazards and Mitigation in the United States (1990) *http://books.nap.edu/books/0309043352/html/44.html#pagetop* *(2)* Dulci Bosma, Christine Williams, Becky Cookman, Michigan Technological University, Snow Avalanches: Hazard Planning and Avoidance at *http://www.geo.mtu.edu/department/classes/ge404/avalanche/avalindex.html*
Civil Disturbances	Special events planning such as using highly visible police presence.

Continued on next page

7.4 Mitigation Measures for Other Hazards

Table 7.4A Mitigation Measures continued

Hazard Type	Mitigation Measures
Hazardous Materials Releases	Fixed Facilities: • Process Hazard Management (PHM) through Cal OSHA • Policies and procedures, hazard communication, and training • Placarding and labeling of containers • Hazard assessment • Security • Process and equipment maintenance • Mitigating techniques—flares, showers, mists, containment vessels, failsafe devices • Use of inherently safer alternative products • Emergency plans and coordination • Response procedures Transported: • Placards and labeling of containers • Proper container established for material type • Random inspections of transporters • Safe handling policies and procedures • Hazard communications • Training for handlers • Permitting • Transportation flow studies, e.g., restricting HAZMAT transportation over certain routes.

Continued on next page

7.4 Mitigation Measures for Other Hazards

Mitigation Measures, (Continued)

Hazard Type	Mitigation Measures
Landslides	• Geologic report review • Hazard abatement districts • Relocation or acquisition of at-risk residential properties • Preliminary soil slip susceptibility • National landslide hazard program
Terrorism	Because the primary mechanism for past terrorist incidents has been bombings and because of the potential for mass casualties from a WMD terrorist event, the primary focus of the state's hazard mitigation strategy for terrorism is on mitigation measures that reduce risk from bomb blast and nuclear, biological, and chemical attacks to critical state facilities and population. Measures include: Hardening (construction/retrofitting) • Relocation/retrofitting of air intakes • Ventilation system upgrade/retrofit • Protect tower bases of bridges • Seismic retrofitting • Upgrade/retrofit water main system • Blast guard window film/glazing, frames • Egress improvements Barriers and Fencing • Fencing around air intakes • Fencing around fuel supply • Vehicle barriers, bollards, popup gates, hydraulic barriers • Waterfront security system • Perimeter fencing Redundant systems • Fire protection system • Communications systems • Information technology • Utility (Gas/Heat/Water) • Utility (Electric)

Continued on next page

7.4 Mitigation Measures for Other Hazards

Mitigation Measures, (Continued)

Hazard Type	Mitigation Measures
Terrorism, continued	Security Measures • Security systems/early warning systems • Warning and alarms systems directly related to system protection/shut down • Smart utility management systems on all critical services. Planning/Studies • Telecommunications plans • IT disaster recovery plans • Business continuity/resumption plans • Intelligence gathering and sharing • Threat, vulnerability, and risk assessments • Evacuation plans • Site security planning HM Plan/Service Continuity Plan Seismic Study • Retrofitting • Interior lighting • Exterior lighting • Staging areas Secure Access & Entry Points • Card swipe system • Magnetometer • Metal detectors • Surveillance cameras & closed circuit TVs • Personnel detection equipment • Vehicle detection equipment • Radar systems • Building access system • Motion detectors • Replacing door locks and keys

Continued on next page

7.4 Mitigation Measures for Other Hazards

Mitigation Measures, (Continued)

Hazard Type	Mitigation Measures
Terrorism, continued	IT systems • Security management system • Building access system • Employee identification system • Coding protocol for sensitive records.

How These Measures Contribute to the Overall Strategy

These above-listed measures are already being used in many communities and situations and have proven effective in reducing or eliminating hazard risk. Each of these measures directly meets an objective stated in the state's Hazard Mitigation Strategy.

Chapter 8 – Less Significant Hazards

8.1 Less Significant Hazards

Introduction

Other hazards have occurred than those profiled in earlier in the Plan. Although most of these hazards can and do happen, they are less likely to result in a federal disaster declaration due to their individual magnitude or frequency of occurrence.

However, because all of these hazards have happened in recent history, and because California is at risk to these hazards, they are discussed below. These include:

- Airline crashes
- Computer breaches
- Hurricanes
- Nuclear power incidents
- Tornadoes
- Train Derailments

Table 8.1A - Airline Crashes

Airline crashes are listed as a less significant hazard because individually they are less likely to result in a state or federal disaster declaration. However, OES recognizes the severity of these incidents as they often lead to deaths and injuries.

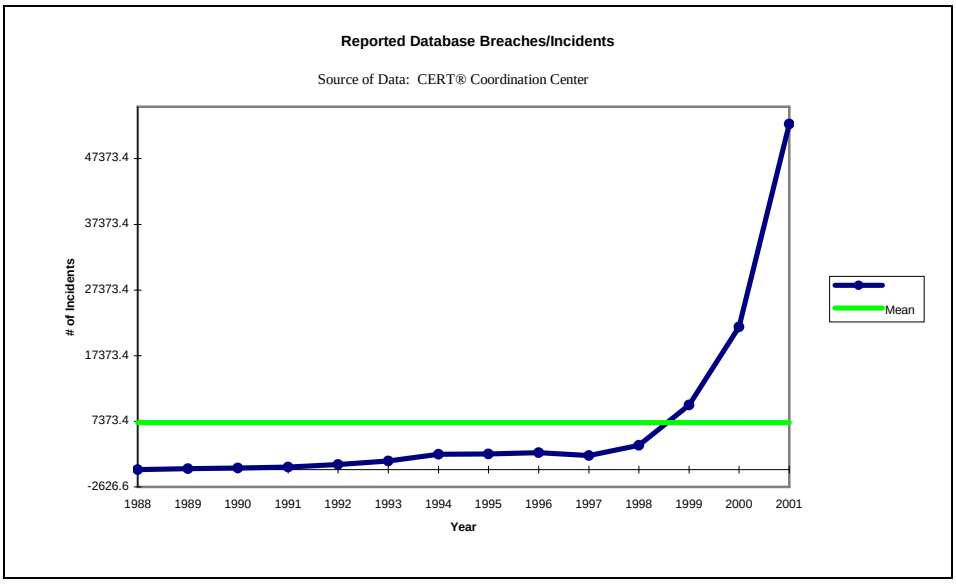
Airline(s)/Flight	Location	Airline(s)/Flight	Location
South West 1455	Burbank	Swift Air Lines, Inc.	Marina Del Rey
Phoenix Air 35A	Fresno	Pacific Southwest Airlines	San Diego
USAIR 1493/Skywest 5569	Los Angeles	Continental Airlines	Los Angeles
Bell	Alamo	Jet Aviation, Ltd.	Palm Springs
North Star/Cessna	Oakland	Mercer Airlines	Van Nuys
Aero naves De Mexico/Piper	Cerritos	Golden West Airlines	Whittier
China Airlines	San Francisco	Sierra Pacific Airlines	Bishop
Western Helicopters	Valencia	Trans World Airlines	Los Angeles
McDonell Douglas Corp.	Edwards AFB	Spectrum Air, Inc.	Sacramento
Air California 336	Orange County	Trans World Airlines	San Francisco

Continued on next page

8.1 Less Significant Hazards

Computer Breaches

Computer breach incidents have risen sharply since the 1980s. These include viruses, worms, Trojan horses, break–ins, and other damaging breaches. Whereas only six incidents were reported in 1988, the number rose gradually during the late 1980s and 1990s, they made a sharp rise beginning in 1998, and have risen exponentially since. To date, there have been over 142,500 computer breaches.



Data Source for chart: CERT Coordination Center at http://www.cert.org/stats/cert_stats.html

Continued on next page

8.1 Less Significant Hazards

Hurricanes

California is at very low risk of hurricanes, although it is possible for one to threaten the southern California coast. (*Source: The Weather Channel* [*http://www.weather.com/encyclopedia/tropical/climo.html*](http://www.weather.com/encyclopedia/tropical/climo.html))

No hurricanes have hit California in recorded history because tropical storm winds generally blow from east to west, but California is affected by heavy rain resulting from tropical winds that blow north from Mexico and become colder by the time they hit California. *(Source: The USA TODAY Weather Book by Jack Williams)*
(Source: USA Today website [*http://www.usatoday.com/weather/whpacg.htm*](http://www.usatoday.com/weather/whpacg.htm)*)*

Continued on next page

8.1 Less Significant Hazards

Nuclear Power Plant Hazards

There are two operating nuclear power plants (NPP) in California, Diablo Canyon Power Plant in San Luis Obispo County, and San Onofre Nuclear Generating Station in San Diego County. Two other nuclear power plants, Humboldt Bay and Rancho Seco, are not operational, but have spent fuel stored on-site.

State and local governments having jurisdiction within ten miles of an operating nuclear power plant must plan, train, and conduct emergency exercises annually in accordance with federal regulations. Detailed emergency plans are maintained by each affected agency.

Four Emergency Classification Levels (ECLs) have been established in federal regulations to characterize the severity of the emergency and the response actions required. The ECLs must be used as the foundation for emergency response planning, training and exercises. ECLs are described in the table below.

As part of the planning basis, affected agencies must establish emergency planning zones (EPZs), which is an approximate ten-mile radius drawn around each plant site. The exact EPZ size is established to provide for substantial reduction in early severe health effects in the event of a worst-case core melt accident.

To date, there have been no deaths or injuries resulting from a nuclear emergency event at a California nuclear power plant. For this reason they are classified as a less significant hazard.

Table 8.1B - Four levels of NPP emergencies

The table below describes the four levels of NPP emergencies.

Emergency Classification Levels	ECL Description and Purpose	Populations Effected	Occurrences
Notification of Unusual Event	Issued when events have occurred that potentially could degrade the level of plant safety. No radioactive releases requiring emergency response are expected.	On site only	Average 1-2 per year.

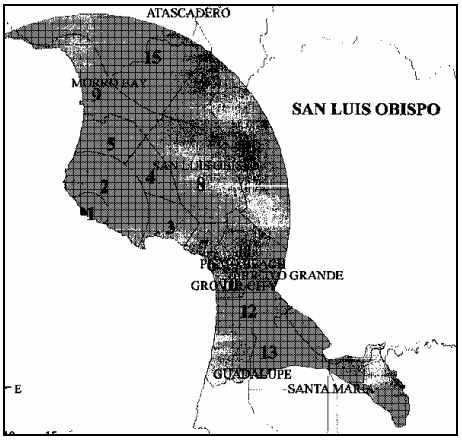
Continued on next page

8.1 Less Significant Hazards

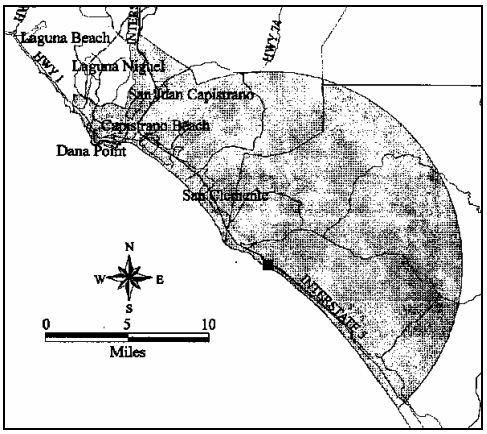
Table 8.1B - Four levels of NPP emergencies (continued)

Emergency Classification Levels	ECL Description and Purpose	Populations Effected	Occurrences
Alert	Issued when events have occurred that involves a substantial degradation of plant safety. Any radioactive releases are expected to be a fraction of federal exposure guidelines requiring protective actions.	On site only	1 (SONGS, March 1999)
Site Area Emergency	Issued when events have occurred that involve the failure of major plant functions needed to protect the public. Radioactive releases are not expected to exceed federal exposure guidelines at the site boundary.	Site area, schools, beaches, & transient populations within the EPZ.	0
General Emergency	Issued when events have occurred that involve substantial core degradation or loss of containment integrity. Radioactive releases are expected to exceed federal exposure guidelines.	Designated areas within the (EPZ)	0

Nuclear Power Plant EPZs



EPZ for the Diablo Canyon NPP



EPZ for SONGS

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8.1 Less Significant Hazards

Nuclear Power Plant Planning & Regulation

The Nuclear Regulator Commission (NRC) regulates the operation of nuclear power plants in the Unites States. The NRC is responsible for ensuring that the NPPs in California are safe from hazards such as earthquakes and fires, as well as hazards from hostile sources such as terrorism. FEMA evaluates the ability of local and state governments to protect the public in the event of a nuclear power plant emergency.

Due to strict regulation of nuclear power plants in the United States, significant nuclear power incidents that can cause harm to the public have low probability of occurrence, and none have occurred in California.

Tornadoes

While California does have tornadoes, it is relatively low-risk compared to states in the Midwestern and Southern United States (see the map below). *Source: The Weather Channel* *http://www.weather.com/encyclopedia/tornado/climo.html*

Since 1950, 292 tornadoes have occurred in 42 counties in California, resulting in 103 injuries. However, no deaths have occurred, and none of the California tornadoes since 1950 have been over F2 on the Fujita Scale (see Table 8.1 in the appendices). Of these 292 tornadoes, only eight percent reached F2, whereas 53 percent were at F0, the least severe type and 39percent reached F1. No major tornadoes (those of F3-F6) have occurred after 1880 in California. The biggest risks of tornadoes in California include light to moderate damage to homes, destruction of mobile homes, and injuries caused by light object projectiles during F2 scale tornadoes. In the 52 years between 1950 and 2002, the average occurrence of an F2 scale tornado has been approximately once every 2.36 years.

Source: The Tornado Project *http://www.tornadoproject.com*

Continued on next page

8.1 Less Significant Hazards

Table 8.1C - Train Incidents/ Derailments

Train derailments are so localized that the incidents themselves would not constitute a disaster. However, if there are volatile or flammable substances on the train and the train is in a highly populated or densely forested area, death, injuries, damage to homes, or forest fires could occur.

There have been 14 train accidents affecting 12 communities since 1950.

Incident	Location
Metrolink collision	Glendale
Southern Pacific collision	Beaumont
Union Pacific derailment	Kelso
Freight train derailment	Cajon
Atchison, Topeka, & Santa Fe/Union Pacific collision	Cajon
Atchison, Topeka, & Santa Fe/ATSF collision	Corona
Amtrak passenger train collision	Stockton
Southern Pacific derailment	San Bernardino
Southern Pacific derailment	West Surf
Union Pacific collision	Kelso
Western Pacific derailment	Hayward
Southern Pacific collision	Thousand Palms
Southern Pacific collision	Tracy
Two Southern Pacific trains collision	Indio

PART 3—MITIGATION STRATEGY & FUNDING

In This Part

This part contains the following chapters.

Chapter	Title	See Page
9	State Mitigation Strategy	247
10	Funding Sources	271

State of California Multi-Hazard Mitigation Plan

Chapter 9—State Mitigation Strategy

Overview

This hazard mitigation strategy for California describes actions that are guided by a vision of a safe and resilient California. The communities and businesses of the state have developed and grown in the dynamic environment of flood, fire, earthquake, and other natural events. The state's history or natural disasters has led to numerous laws, regulations, programs, and policies aimed at protecting infrastructure, housing, businesses, government, and the public. Because of a continually increasing demand for limited hazard mitigation resources, the state must continually improve its approach to hazard mitigation. This Plan describes a statewide strategic approach to mitigation that integrates current laws, policies, and programs.

As detailed in Chapter 1 of this Plan, this mitigation strategy, including the vision, mission, goals, and objectives, was developed with extensive input from and coordination with stakeholders from state and local agencies, businesses, non-profit organizations, and the public. As objectives and goals are attained, these same participants will be included in the development of new goals and objectives through a review and approval process with the State Hazard Mitigation Team (SHMT).

This strategy identifies goals; provide a summary of current state and federal laws, policies, and programs that address achieving the goals; and lists the goals, objectives, and initiatives from other plans that have been integrated into this Plan. The strategy also explains the state's current priorities and how those priorities relate to the goals.

Vision

A safe and resilient California through hazard mitigation.

Mission

To integrate current laws and programs into a mitigation system that will guide the state in the reduction and prevention of injury and damage from hazards.

In This Chapter

This chapter contains the following topics.

Topic	Title	See Page
9.1	Hazard Mitigation Goals	248
9.2	State Priorities	252
9.3	State Capability Assessment	257
9.4	Local Capability Assessment	262

9.1 Hazard Mitigation Goals

Goals

1. Save lives and reduce injuries
2. Avoid damages to property
3. Protect the environment
4. Promote hazard mitigation as an integrated policy

Goal 1: Save Lives and Reduce Injuries

California is the most populated state in the country with over 36 million residents. The sheer number of people can make emergency management activities a challenge. The challenge is further complicated by the distribution of population. The table below lists California's most populated counties and the number of state emergencies declared in each since 1970.

County	Population	Emergencies
Los Angeles	10,103,000	68
Orange	3,017,300	28
San Diego	3,017,200	33
San Bernardino	1,886,500	39
Riverside	1,776,700	35
Santa Clara	1,731,400	20
Alameda	1,498,000	21

Note: Population totals based on California Department of Finance estimates

California's population is concentrated in areas where hazard risk is high. Wildland urban interface areas in San Bernardino, Riverside, Los Angeles and San Diego counties are magnets for both development and devastating fires. Flooding has historically been more prevalent in Southern California, where urban development contributes to a high amount of stormwater runoff. The San Francisco Bay Area and Southern California have both experienced large earthquakes since 1989.

Regardless of where Californians live, protecting their safety is one of the state's primary responsibilities. Many state and local laws have public safety of our citizens as their primary concern. Protecting lives is also the basis for emergency planning, response, and mitigation activities.

Consistent with one of the main responsibilities of state government, the mission of OES, and the OES Disaster Assistance Division's Strategic Plan, the primary goal of this State Multi-Hazard Mitigation Plan is the protection of the people of California.

Continued on next page

9.1 Hazard Mitigation Goals

Goal 1 Objectives

- Continually improve the understanding of the location and potential impacts of natural hazards, the vulnerability of building types, and community development patterns and the measures needed to protect life safety
- Continually provide state and local agencies with updated information about hazards, vulnerabilities, and mitigation measures
- Ensure that all state codes and standards ensure the protection of life
- Ensure that all structures in the state meet minimum standards for life safety
- Ensure that all development in high-risk areas is protected by mitigation measures that provide for life safety.
- Identify and mitigate all imminent threats to life safety

Goal 2: Avoid Damages to Property

The Plan's stakeholders agreed that the strengthening of building, mechanical, and fire codes is critical to the protection of property and life and the reduction of seismic risk, fire and flood hazards. These codes help communities design and construct buildings that resist the forces of nature and ensure safety. The state's land use laws assist with this effort by requiring communities to keep buildings and development out of the most hazardous areas. It is essential that mitigation planning be incorporated into all land use planning activities at the local and state levels. This includes integrating mitigation efforts into all city and county general plans.

Earthquakes, floods, and other natural hazards can disrupt critical infrastructure of the state. Transportation routes, utilities, government facilities, hospitals, etc., are essential to the State's ability to provide assistance to the people of California. In addition, retrofitting facilities by priority based on vulnerability will protect important buildings, occupants, and informational records.

The protection of property also includes the preservation of valuable operational data, historical information, and other non-structural assets. The stakeholders have encouraged the incorporation of mitigation activities into Continuity of Business and Continuity of Government Operations plans and the local and state levels.

Continued on next page

9.1 Hazard Mitigation Goals

Goal 2 Objectives

- Discourage development in high hazard areas
- Encourage property protection measures for all communities and structures located in hazard areas
- Reduce or eliminate all repetitive property losses due to flood, fire and earthquake
- Research, develop, and adopt cost-effective codes and standards to protect properties beyond the minimum of protecting life safety
- Establish a partnership among all levels of government and the business community to improve and implement methods to protect property

Goal 3: Protect the Environment

Californians place a strong emphasis on the quality of the physical environment. It is a primary reason why people live in California and why all levels of government and many organizations strive to conserve it.

Natural disasters not only destroy the man-made environment, but they can also adversely affect the physical environment. Dead and diseased trees create unhealthy forests and provide fuel for wildland fires that damage or eliminate habitat necessary to the survival of plants and wildlife. Flooding can adversely affect water quality in the rivers and streams that support fisheries and can also damage critical spawning habitat. Geologic hazards can result in landslides that can block streams and prevent fish migration. Debris from natural disasters can pollute the water, foul the land, and diminish air quality if not disposed of properly.

Goal 3 Objectives

- Ensure that all mitigation projects are reviewed for compliance with all applicable environmental laws
- Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes
- Ensure that all state and local hazard mitigation planning reflect the goal of protecting the environment
- Develop and implement wildfire mitigation and watershed protection strategies that reduce losses to wildlife and habitat and protect water while also reducing damage to development
- Develop and distribute to state and local agencies maps of high-risk areas integrated with wildlife habitat areas

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9.1 Hazard Mitigation Goals

Goal 4: Promote Hazard Mitigation as an Integrated Policy

Currently the state and its communities have implemented hazard mitigation polices and measures in an ad hoc fashion. New mitigation policies, programs, and projects are often developed in response to the latest disaster. As the population of the state continues to grow in areas most susceptible to natural and man-caused hazards, comprehensive hazard mitigation is becoming more imperative. Planning and education are the best steps toward increased awareness and integration.

State and local hazard mitigation planning efforts are significant steps in broadening the understanding of the importance of mitigation. The law requiring local general plans that guide land use has proven to be useful in reducing the number and the severity of disasters. It will take time to see if the new hazard mitigation planning processes are as accepted and successful.

The state has already had success with education and awareness through programs addressing the three major natural hazards—fire, flood, and earthquakes. At three separate times of the year, OES, CSSC, the Department of Conservation, CDF, DWR, and the Department of Education join forces to hold special programs in schools and in communities to raise hazard awareness. In addition, OES annually sponsors the Disaster Resistant California (DRC) conference as a source of specialized mitigation training. The DRC provides a forum for businesses, academia, and government to share ideas, processes, success stories, and other information.

Goal 4 Objectives

- Ensure that all communities in the state are covered by a Local Hazard Mitigation Plan
- Integrate hazard mitigation policies into local general plans
- Update the State Multi-Hazard Mitigation Plan annually to integrate local hazard mitigation plans and the results of disaster-and hazard-specific planning efforts
- Increase understanding of the importance of hazard mitigation among the general public and the business sector, stressing the benefits of reduced losses to life and property, the reduced cost of disaster recovery, and the increased benefit of the continuity of operations of business and government
- Strengthen the message of hazard mitigation in disaster preparedness programs

9.2 State Priorities

Overview Of Mitigation Actions

Actions taken to mitigate hazards can either be direct or indirect. Direct actions are those that actually protect life, property and the environment. Indirect actions are those that require prompting or encouraging communities, businesses and individuals to take direct action to reduce risk.

Direct Mitigation Actions

The actions that directly provide protection include:

- Restricting property use -- limiting or avoiding the development on and use of restricted property examples include not building on known faults or in floodways
- Improving survivability of structures and their contents—These are measures that strengthen structures to resist destructive forces of natural or man caused events. These measures are part of the initial construction of facilities or added as a "retrofit". Examples include base-isolation of the foundation of a building for better performance during an earthquake, elevating houses to prevent flooding, strapping water heaters to the wall and using tile roofing to reduce fire threat
- Building protective measures—These measures keep destructive forces away from communities or structures. Examples include levees, drainage channels and firebreaks.

Table 9.2A – Direct Mitigation Actions

Table 9.2A shows the relationship of the types of direct actions that are currently used to the major hazards of the state.

Click here to view the table, or go to Table 9.2A in the appendices.

Indirect Mitigation Actions

Indirect actions include:

- Mandates—these are laws and regulations that include codes and standards, zoning laws, laws and policies specifying or encouraging mitigation actions or discouraging risky actions. These actions also include the enforcement of the mandates
- Plans—these are documents adopted by governing bodies with descriptions of actions and varying degrees of commitment to those actions. Examples include Hazard Mitigation Plans, Local General Plans
- Education and awareness programs—these are programs that are intended to persuade people to voluntarily behave in a manner that reduces chances of loss. These programs can either have targeted or general audiences

Continued on next page

9.2 State Priorities

Indirect Mitigation Actions (continued)

- Research and development—these are efforts supported by either public or private funding that improve understanding of hazards, vulnerabilities and mitigation.

Table 9.2B – Indirect Mitigation Actions

Table 9.2B shows the relationship between the indirect actions and the direct actions. Also, mandates and plans can lead to further mandates and plans as well as educational programs and research and development efforts.

Click here to view the table or go to Table 9.2B in the appendices.

State Mitigation Actions

The state acts both directly and indirectly; however most mitigation in the state is a result of mandates, plans and special reports. There are a number of state laws and programs that require, guide and oversee mitigation to be done by local agencies, businesses and private citizens. For more information, go to Chapter 4.4 Section 1 and Chapter 4.5.

There are also mandates that direct state agencies to protect state owned or controlled property. The state protects critical facilities such as the State Water Project, the state university systems, the state park systems, state owned and maintained highways and bridges, and the facilities owned or operated by the Department of General Services. A list of those facilities is contained in the Inventory of State Facilities. For more information, go to Chapter 14.1.

Setting Priorities for Actions

Because of the probability and severity of the multiple risks that are faced by the state, California is forced to continually address a number of hazards and vulnerabilities. There is no prioritization of hazards in the state. What is a priority is reflected by the order of goals in this plan: the protection of lives, the protection of property, and the protection of the environment.

There is a pattern of policy development in the state. After all large disasters there are studies that make recommendations followed by administrative, then legislative actions. The issue of greatest concern is improving the protection to life safety, followed by the protecting developed property and the environment. The result three important lines of mitigation policy for earthquake, flood, and fire. The priority for actions is reflected in the laws that have been passed. These actions are identified in the chapters in the plan

Continued on next page

9.2 State Priorities

Setting Priorities for Actions (continued)

describing the strategies to address the significant hazards. For more information, go to Chapter 4.4, Chapter 5.4, Chapter 6.5, and Chapter 7.2.

The actions that are a result of state legislation or a Governor's executive orders are the highest priorities. Any actions recommended identified in agency strategic plans or in reports are a lesser priority.

Federal mandates are also a priority. The allocation for the distribution of federal funding is based on the federal requirements and any state priorities must be addressed within those requirements.

The allocation of state resources to the actions is also the responsibility of the Governor and legislature through the state budget process. This process of resource allocation is ultimately the process for setting priorities.

Priorities for the use of Hazard Mitigation Funding from the Federal Emergency Management Agency

OES is responsible for distributing the mitigation funds from FEMA. The priorities for distributing the funds are as follows:

1. Ensuring communities are eligible for federal programs by supporting Local multi-hazard mitigation planning (to the extent allowed by the federal program)
2. Protect lives and property at risk from imminent hazards created or exacerbated by disasters
3. Protect vulnerable critical facilities and infrastructure in high hazard areas of the state
4. Reduce repetitive losses
5. Ensure that all communities are covered by an adopted local hazard mitigation plan
6. Improve understanding of natural hazards and the performance of hazard mitigation practices

Ensuring Community Eligibility for Federal Programs

FEMA provides states with Hazard Mitigation grant funding from three programs: the Hazard Mitigation Grant Program described under the Robert T. Stafford Act, the Pre Disaster Mitigation Program described in the Disaster Mitigation Act of 2000 and the Flood Mitigation Assistance Program described in the National Flood Insurance Act of 1968. Each of these programs requires approved projects to be consistent with locally developed plans, be cost effective and be effective long-term mitigation. Also each program allows some funding to be available for developing local hazard mitigation plans.

Continued on next page

9.2 State Priorities

Protect Lives and Property at Risk from Imminent Hazards

After disasters, affected communities can be threatened by imminent hazards related to the initial disaster event. The experience from the October 2003 fires in Southern California is a clear example. The fires destroyed vegetation and changed the absorption characteristics of the soils on the slopes above many communities. Subsequent winter storms caused floods, mudflows, and landslides that added to the destruction from the fire. Aftershocks, landslides, and fires can follow from earthquakes, while the aftermath of a major flood might include landslides and increased vulnerability to future flooding.

Recovery efforts after a disaster have several sources of funding. Some of those sources can help in abating or mitigating hazards. The process for making HMGP funds available usually takes 90 to 180 days. That time is used to identify sources of funding and the projects for which the funding can be used. This assures that funding will be used in a complementary fashion without duplicating use.

Funding projects that will mitigate imminent hazards is highly cost effective and assists in critical efforts to help communities recover from disasters. It is anticipated that not all such projects will be identified in local hazard mitigation plans. Establishing this priority provides guidance for locals to build in the flexibility to identify critical mitigation needs that may arise from a disaster when there is no time to update a local plan.

Protect Critical Facilities and Infrastructure In High Hazard Areas

The next most important priority for federal funding is to help with protecting critical facilities and infrastructure. Though the state and many communities have ongoing capital improvement programs, there is still an almost overwhelming need to retrofit, replace, protect, or relocate facilities and infrastructure important to the state's communities that are at risk from hazards. It is anticipated that the local hazard mitigation plans will provide a list of projects falling in this category. Those projects located in the high hazard zones will generally be more cost effective than those that are not. Examples of needed mitigation include facilities located in floodplains, within 2400 meters of an extreme threat of fire, on active faults, in liquefaction zones, and on or near landslides and unstable soil areas.

Continued on next page

9.2 State Priorities

Reduce Repetitive Losses	Areas of repetitive loss are high priorities for hazard mitigation funding. Repetitive losses are a drain on community, state, and national disaster management resources and are very cost effective to mitigate. The current national priority is the reduction of repetitive flood losses because these translate into a loss to the National Flood Insurance Program (NFIP). California has numerous areas of repetitive flood loss. Additionally, many areas of the state experience repetitive losses from wildfire.
Ensure That All Communities Are Covered by an Adopted Local Hazard Mitigation Plan	Because of the history of disasters throughout California, ensuring that all communities are covered by a local hazard mitigation plan is a priority. Such plans are necessary to receive federal financial assistance for hazard mitigation.
Improve Understanding of Natural Hazards and Mitigation Practices	State agencies and many of the state's universities are researching the behavior of natural events and improved methods for research. There is also considerable research devoted to improving disaster-resistant building materials and practices. This research is critical to improving building standards and practices.

9.3 State Capability Assessment

Structure of California State Government

To understand the state's capability in implementing hazard mitigation, it is important to understand the political underpinnings of the California state government. While California cities and counties are separate autonomous subdivisions of state government, it is state law, policies and programs that have a large influence on local land use and hazard mitigation activities.

State law is the foundation for local planning in California. The California Government Code (Sections 65000 et seq.) contains many of the laws regulating land use planning including the general plan, specific plans, subdivisions, and zoning. However, the state is seldom directly involved in local land use and development decisions; these have been delegated to the city councils and county boards of supervisors. Local decision makers adopt their own land use policies based upon the state laws and approve individual land development projects based on these policies.

California Pre- and Post-Disaster Hazard Management Policies

California has numerous laws, regulations, and other policy documents that detail the state's policies as related to hazard management. Below is a list of these laws and programs, sorted by hazard, which forms the state's overall hazard management policies. Many of these laws and programs are described in greater detail elsewhere in the plan. Links are provided to make it easier to access more detailed information.

California's Policies and Programs

General Policies:

- State law for general plans, Government Code §65300
- General Plan Guidelines – Page 169
- State of California Emergency Plan – located at http://www.oes.ca.gov/OEShomeP.nsf/All/CA+Emergency+Plan/$file/CEP.pdf
- 2000 California Building Code – Page 76
- California Historical Building Code – Page 76
- Executive Order W-9-91 (Document 9.3A)
- Emergency Services Act
- The California Disaster Assistance Act
- California Environmental Quality Act, Disclosure of Potential Hazards

Continued on next page

9.3 State Capability Assessment

California's Policies and Programs (continued)

Seismic policies – Please refer to Chapter 4.4:

- Dam Safety Act
- Field Act
- Riley Act
- Hospital Safety Act
- Strong Motion Instrumentation Act
- Alquist-Priolo Earthquake Fault Zoning Act
- Seismic Safety Commission Act
- California Earthquake Hazard Reduction Act
- Unreinforced Masonry Building Act
- Essential Services Building Seismic Safety Act
- Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990
- Seismic Hazards Mapping Act
- California Earthquake Loss Reduction Plan

Fire Hazard Management Policies:

- Public Resources Code 4291
- California Fire Plan
- Natural Hazard Disclosure requirements
- Governor's Blue Ribbon Fire Commission
- The following laws are available in Table 5.1A
  - Organic Act
  - Zoning and development laws
  - Clarke-McNary Act
  - California Land Conservation Act
  - Housing Act
  - Z'berg Nejedly Forest Practice Act
  - Forest Improvement Act
  - SB 1972 – Campbell
  - SB 78 – Ayala
  - SB 799 – Mello
  - AB 1812 – Cortese
  - SB 1075 – Rogers
  - AB 337 – Bates
  - AB 3819 – Brown
  - AB 747 – Brown
  - AB 1195 – Torlakson
  - AB 6X and 1195
  - AB 423
  - AB 1216

Continued on next page

9.3 State Capability Assessment

California's Policies and Programs (continued)

Flood Hazard Management Policies
- Cobey–Alquist Flood Plan Management Act
- AB 1147, Page 198
- Water Code 128
- Flood Emergency Action Team Report
- Executive Order B-30-77

General Hazard Management Programs
- State participation in federal mitigation programs such as the FNIP, HMGP, FMA, and CalFED

Seismic Hazard Programs
- Seismic Hazard Zone Mapping
- Bridge Seismic Retrofit Program
- Hospital Seismic Retrofit and Replacement Program
- Marine Oil Terminal Program
- California At Risk Five-Year program
- Safety Assessment Volunteer Program
- California Strong Motion Instrumentation Program (CSMIP)
- California Integrated Seismic Network (CISN)

Fire Hazard Programs
- California Fire Alliance
- Vegetation Management Program
- Fire Hazard Planning Program
- Participation in the federal FireWise communities program
- Fire Safe Council

Flood Hazard Programs
- Levee Inspection Program
- State participation in the NFIP
- State/federal Flood Response Center
- California Data Exchange Center
- Dam Safety Program
- State Water Project
- Flood Awareness Mapping
- Flood Protection Corridor Program (FPCP)
- Urban Streams Grant Program
- Coastal Resources Grant Program

Continued on next page

9.3 State Capability Assessment

State of California Implementation Capabilities

The State of California has a history of successfully implementing hazard mitigation through a process of legislation, program development, and program and project implementation. This history demonstrates the state's enhanced capability to implement state-level hazard mitigation programs that are effective and, in many ways state-of-the-art, hazard mitigation programs such as CDF's Fire Planning Framework, which as become a national template for fire planning.

Examples of the state's capability are the Bridge Seismic Retrofit program that has been highly successful. Over four billion dollars was spent retrofitting bridges throughout the state. The Vegetation management Program, which funds local fuel load reduction efforts by local governments, treats about 40,000 acres each year. The Flood Protection Corridor Program (FPCP) provided $70 million dollars for primarily non-structural flood management projects that include wildlife habitat enhancement and/or agricultural land preservation.

Evaluation of State Capabilities

The state's efforts at implementing hazard management can be viewed from three perspectives:

1. State legislation
2. State-level implementation
3. Local level implementation of state priorities

1. State Legislation

Legislation related to hazard mitigation has been, for the most part, hazard specific and effective. Most legislation is the result of disaster events in which specific vulnerabilities were highlighted. These laws include:

- Dam Safety Act
- Field Act
- Alquist-Priolo Act
- AB 337 - Bates
- AB 3819 – Brown
- AB 1216
- Unreinforced masonry Building Law, and
- Essential Services Building Seismic Safety Act
- PRC §2589 Seismic Hazards Mapping Act

Continued on next page

9.3 State Capability Assessment

1. State Legislation (continued)	Many of the state's legislative efforts have come as recommendations from special commissions that were formed following a disaster. The most recent examples of these commissions are the Flood Emergency Action Team from the 1990's and the recent Governor's Blue Ribbon Fire Commission. The legislative aspect of California's approach to hazard mitigation is responsive, focused, and effective.
2. State-Level Implementation	Implementing state-level hazard mitigation has also been an effective part of the state's approach to hazard mitigation. The state has expended billions of dollars on seismic, fire, and flood hazard mitigation. Some of these efforts are the State Water Project, the Bridge Retrofit Program, and several fire hazard management programs. This aspect of the state's hazard mitigation approach is also effective.
3. Local Level Implementation Of State Priorities	The state's efforts at implementing hazard mitigation at the local level are the most complicated. State laws that strengthen building codes and standards have been effective and explain why California has experienced far less damage (especially in earthquakes) than other areas of the work that experience similar disasters. But each law is unique, and depending on how strictly it is written, implementation is sometimes delegated to local governments. Encouraging local governments to initiate hazard mitigation efforts on their own is more difficult. California is currently experiencing severe budget challenges and funding is scarce for activities that don't appear to have an immediate need. But a major area of opportunity for California to realize the benefits of hazard mitigation is in local government-initiated and -implemented hazard mitigation. This is why one of the state's hazard mitigation priorities is to "ensure that all communities are covered by an adopted local hazard mitigation plan."

9.4 Local Capability Assessment

Introduction

California has developed a number of comprehensive and effective local pre- and post-disaster mitigation policies, programs, codes, standards, and capabilities.

California Vision

The California vision for a statewide hazard mitigation planning program includes the implementation of a statewide, multi-faceted, local hazard mitigation planning program.

Authority

44 CFR Parts 201 and 206 require that the state mitigation strategy include a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

The Legal Underpinnings of Local Government Hazard Mitigation Activities

State law is the foundation for local planning in California. There are approximately 575 incorporated cities and counties in California. State law requires each of these jurisdictions adopt "a comprehensive, long-term general plan for [its] physical development." Through the general plans, local jurisdictions document official decisions and future strategies regarding the location of housing, business, industry, roads, parks, and other land uses, protection of the public from environmental hazards, and conservation of natural resources. Within the general plan there are many opportunities for local agencies to identify plan for, and mitigate local hazardous conditions such as flood, fire, and geologic events. The legislative body of each city (the city council) and county (the board of supervisors) adopts zoning, subdivision and other ordinances to regulate land use and to implement the policies of its general plan.

Cities and counties are distinct and independent political entities. Each city and county formally adopts its own general plan and develops regulations for implementing the decisions contain within. There is no requirement that adjoining cities ore cities and counties have identical, or even similar, plans and ordinances.

Special districts with taxing authority can be also formed to address hazard issues such as fire protection, geologic hazard abatement, and flood control.

Continued on next page

9.4 Local Capability Assessment

The Legal Underpinnings of Local Government Hazard Mitigation Activities (continued)

The California Special Districts Association describes special districts in the following way: "Special districts are a form of local government created by a local community to meet a specific need. Inadequate tax bases and competing demands for existing taxes make it hard for cities and counties to provide all the services their citizens desires. When residents or landowners want new services or higher levels of existing services, they can form a district to pay for and administer them."(1) The ability of local communities to create special districts provides local communities a significant capability to address hazard concerns.

Cities and counties can also form special districts and Joint Power Authorities to address specific and multiple issues. Examples of these special districts and Joint Power Authorities are the Sacramento Area Flood Control Agency (SAFCA) http://www.safca.org, and the Association of Bay Area Governments (ABAG) – a joint powers authority http://www.abag.ca.gov.

Another local mechanism for hazard mitigation is the emergence of conservancies. These conservation organizations can become landholders with the goal of preserving the natural environment, which may also have hazard mitigation benefits. For example, land with flood or geologic hazard issues may be kept out of development through the purchase of the land for open space or through the purchase of the land's development rights. Since its founding in 1958, the Nature Conservancy has worked on more than 100 projects and preserves in California. Many mature projects and preserves, however, are now managed by other organizations – for example, local conservation organizations or appropriate public agencies."(2)

(1) From the California Special Districts Association website at http://www.csda.net/spcldist.htm
(2) The nature Conservancy website, http://nature.org/wherewework/northamerica/states/california/preserves/

Continued on next page

9.4 Local Capability Assessment

State Actions That Support The Development Of Local Capacity

OES, through its Local Hazard Mitigation Planning (LHMP) Program, assists local governments in identifying those measures most effective for hazard mitigation. The LHMP Program has held workshops and assists local communities in developing their hazard mitigation plans.

The state supports the development of effective hazard mitigation policies at the local level through model ordinances such as the Model Floodplain Management Ordinance, available at www.fpm.water.ca.gov. The state requires local governments to adopt certain building standards, as does the Alquist-Priolo Earthquake Hazard Act. The natural Hazard Disclosure Act also supports hazard mitigation in local communities.

The state, through its various agencies, also works with local governments to enhance local hazard mitigation efforts. CDF works closely with local governments in the development of mitigation policies that impact state responsibility areas for fire protection. DWR works with FEMA and local governments in administration of the NFIP. OES works closely with local governments in developing emergency plans.

Local Government Policies

The first local agency to adopt a seismic safety building code was the city of Santa Barbara, not long after it was rocked by a quake on June 29, 1925.[3] At the time of the writing of this plan, few local hazard mitigation plans have been forwarded to the state to review to identify specific local government hazard mitigation policies. Below are local hazard mitigation policies that reflect some of California's local government policies:

- 169 communities have adopted some form of the URM retrofit standards
- The cities of Los Angeles and Santa Monica have post-earthquake repair ordinances.
- Each community that volunteers to participate in the NFIP (97% participation in California) must have floodplain management requirements compliant with NFIP regulations.
- The City of Napa Municipal Code, Title 17 Zoning Ordinance
- Many California communities have adopted optional general plan elements that deal with hazard mitigation issues such as 27 communities with an optional emergency element, 44 communities with an optional flood control element, 39 communities with an optional fire element, and 119 communities with an optional seismic element. [4]

Continued on next page

9.4 Local Capability Assessment

Local Government Policies (continued)

- Several local governments have adopted mandatory seismic gas shutoff valve ordinances.

(3) A History of the California Seismic Safety Commission, "Living Where The Earth Shakes," 1975-2000, SSC 2000-04 December 2000, Sacramento, *http://www.seismic.ca.gov/pub/CSSC_HISTORY.pdf*

(4) The California Planner's Book of Lists, 2004, Sacramento, Ca, *http://www.opr.ca.gov/planning/PDFs/2004%20BOL%20for%20the%20web.pdf*

Local Government Programs

The state is still receiving local hazard mitigation plans from local agencies that are participating in the state's Local Hazard Mitigation Planning Program. Below is a list of those programs that have been identified in local hazard mitigation plans and by state agencies:

- Local programs implementing the unreinforced masonry retrofit standards
- U.C. Berkeley Safer Program
- Fire Safe Councils
- Local participation in the NFIP program
- San Lorenzo Flood Control program
- Berkeley Retrofit Rebate Program
- Sonoma and Marin Counties Open Space Acquisition Programs
- Napa River Flood Control Project of 1998 (also known as Proposition A)
- San Francisco City Hall Restoration Bond Fund
- Regional Flood Control project in Placer County at http://www.placer.ca.gov/news/2004/6-17-04-flood-control-project.htm

Continued on next page

9.4 Local Capability Assessment

Capability of Local Government

In the current budgetary environment most local governments are faced with serious financial shortfalls. But it is clear that communities that make a commitment to community safety through hazard mitigation are able to propose, develop and implement hazard mitigation strategies.

Many California communities have participated in the federal hazard mitigation grant program and the flood mitigation assistance program. These communities understand the value of hazard mitigation. It is expected that as the state's Local Hazard Mitigation Planning program matures, more communities will participate which will increase the capability of local communities to plan, develop, and implement effective hazard mitigation strategies.

Effectiveness Of Local Hazard Mitigation Policies, Programs, And Capabilities

The overall effectiveness of the locally-based hazard mitigation programs can be seen in the results of disasters over the years. California is arguably the most disaster-prone state in the nation with a combination of significant hazards and the nation's largest population. Contrasting the results of like events nationwide and worldwide demonstrates the state's effectiveness in minimizing losses. The new Local Hazard Mitigation Planning Program creates a new opportunity for further analysis. However, most local hazard mitigation plans are still in development. Review of these plans will be integral to a more complete analysis of the effectiveness of local hazard mitigation strategies.

Continued on next page

9.4 Local Capability Assessment

Table 9.4A - Unreinforced masonry Retrofit Program Findings

The California Seismic Safety Commission has reviewed local unreinforced masonry retrofit programs and found that some programs are more effective than others. The table below summarizes their findings.

Program Type	Summary
Mandatory Strengthening	These programs require owners to strengthen or otherwise reduce risks in their buildings within times prescribed by each local government. Time schedules vary and generally depend on the number of occupants. Programs are based on the City of Los Angeles' Division 88 ordinance (LA, 1981) which is also the historic basis for the Uniform Code For Building Conservation Appendix Chapter 1 (ICBO, 2001) and the Seismic Safety Commission's Recommended Model Ordinance (CSSC, 1995). Triggers for the Model Ordinance were developed in 1991 in cooperation with the California Building Officials. This is the most effective program type.
Voluntary Strengthening	These programs establish seismic retrofit standards and require owners to evaluate the seismic risks in their buildings. Owners then write publicly available letters to their local governments indicating when they intend to retrofit (CSSC, 1990). This type of program is somewhat more effective than "Notification Only" (see next program type).
Notification Only	Local governments write letters to owners stating that their building type has been known to perform poorly in earthquakes. This is typically the least effective type of program. Most jurisdictions have adopted more comprehensive measures than this.
Other	Variations of the above with unique requirements and effectiveness. Some cities, for example, require owners to post placards on URM buildings that warn occupants and passersby of earthquake risks. In general, placarding (1) has not proven to be an effective motivation for owners to retrofit (CSSC, 1995).

Source of table: Excerpt from CSSC 2003 Report," Status of the Unreinforced Masonry Building Law"

(1) From the California Special Districts Association website, http://www.csda.net/spcldis.htm

Continued on next page

9.4 Local Capability Assessment

Table 9.4A - Unreinforced masonry Retrofit Program Findings (continued)

Where communities have not developed a hazard mitigation plan the effectiveness of mitigation is difficult to guage. Where communities make the commitment to develop and implement hazard mitigation strategies, hazard mitigation is effective. Examples of the communities are City of Napa and City of Oakland.

As local hazard mitigation plans are forwarded for review, an inventory of local policies, programs, and pabilities will be developed. In future updates, the state will be able to analyze the effectiveness of local mitigation efforts. Calfironia will include this analysis in annual updates.

California Land Use Planning Codes and Standards

California's planning codes and standards include the following requirements and declarations:

- Every city and county in the state must adopt a general plan for the physical development of the county or city and any land outside its boundaries that bears relation to its planning. The general plan must cover a local jurisdiction's entire planning area and address the broad range of issues associated with the city's or county's development.
- The state legislature has declared that "decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan."
- The legislature has further declared that the state's land is an exhaustible resource, not just a commodity, and is essential to the economy, environment, and general wellbeing of the people of California.

Continued on next page

9.4 Local Capability Assessment

The Role of the Local General Plan

The role of a local government's general plan is to act as a "constitution" for future development. The general plan bridges the gap between a community's values, visions, and goals and physical development actions, such as the subdivision of land and public works projects. Information found in the general plan underlies most local land use decisions. In counties and general law cities, zoning and specific plans are required to conform to the general plan. Local LHMPs will also have to conform to the general plan.

The 2003 *General Plan Guidelines*, prepared by OPR, emphasize viewing a local general plan in its regional context. OPR encourages local governments to approach planning issues, including issues that affect mitigation planning, from beyond the artificial boundaries of a city or county whenever the affects of those issues transcend those boundaries. Wildfire, flooding, and air pollution are examples of hazards that could extend across jurisdictional boundaries.

The Role of OPR

The role of OPR is not to regulate local government planning, but to provide city and counties with planning assistance and resources. OPR prepares numerous publications on a variety of planning topics and provides advice and assistance to local planners by phone and e-mail. Additionally, OPR maintains a database on the status of city and county general plans and posts the information at www.calpin.ca.gov.

Other OPR roles include:

- Providing research staff to the Governor on planning issues
- Conducting comprehensive statewide planning
- Facilitating interagency coordination at the state level
- Coordinating state agency review of environmental documents prepared pursuant to CEQA

Continued on next page

9.4 Local Capability Assessment

Codes and Standards Enforcement

Codes and standards are usually enforced by building inspectors, or in extreme cases by law enforcement. Code enforcement agencies arbitrate disputes concerning portions of facilities involved in repairs or upgrades and are tasked with making final decisions on such matters.

Definition of Enforcement Agency

According to California Health and Safety Code §16006, the "enforcement agency means the agency of a city, city and county, or county responsible for building safety within its jurisdiction. The office of the State Architect is the enforcement agency for state-owned facilities or facilities leased by the state." The Division of the State Architect (DSA), within DGS, is also the review agency for the design and construction of school facilities in California.

Post-Disaster Building Inspections

After a disaster, inspections are often necessary to determine if buildings are still safe to occupy. In California, the responsible enforcement agency sends out inspectors to review damaged buildings. These buildings are tagged with a colored placard posted on the building exterior and visible from the street. The color coding is as follows:

- Green—safe to occupy
- Yellow—safe only for limited use by occupants
- Red—the building is unsafe and entry is not permitted

State of California Multi-Hazard Mitigation Plan

Chapter 10—Funding Sources

Introduction

Because the state has been subject to a wide variety of disasters, there are many programs that address hazard mitigation through the improvement or replacement of infrastructure. In addition, there has been an increase in programs that reduce hazards through actions that do not result in the creation or improvement of infrastructure, such as the purchase of conservation easements. This chapter describes the various funding sources used in California.

In This Chapter

This chapter contains the following topics.

Topic	Title	See Page
10.1	Federal Funding Sources	272
10.2	State Funding Sources	281
10.3	Local Funding Sources	290
10.4	Alternative Funding Sources	291

10.1 Federal Funding Sources

Current Federal Funding Sources

There are numerous federal sources of funding for hazard mitigation projects, including:

- FEMA
- HUD
- USACE
- SBA
- USDA
- NRCS
- NOAA
- Federal Homeland Security Grants
- BLM

FEMA Grant Programs

FEMA has three programs for funding hazard mitigation projects:

- HMGP
- FMA
- PDM

About the Hazard Mitigation Grant Program (HMGP)

HMGP is authorized under Section 404 of the Stafford Act. The program provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. These funds are only available in states following a presidential disaster declaration. Eligible applicants include state and local governments, Native American tribes or other tribal organizations, and certain private non-profit organizations. Eligible projects must be cost-effective. Funding in California is administered through OES. Approximately $932 million in grant funds have been made available since the 1989 Loma Prieta Earthquake.

Continued on next page

10.1 Federal Funding Sources

About the Flood Mitigation Assistance Program (FMA)

FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. Grants are available for planning, projects, and technical assistance. States are encouraged to prioritize grant applications that include repetitive loss properties identified in their RL Strategy. Funding in California is administered through OES. NFIP RL communities can apply for planning funds and RL communities with a FEMA-approved FMP are eligible to apply for project funding.

Projects may include elevation, relocation, or demolition of insured structures; acquisition of insured structures and property; dry flood-proofing of insured structures; minor localized structural projects that are not fundable by state and other federal programs, such as erosion control and drainage improvements; and beach nourishment activities, such as the planting of dune grass.

About the Pre-Disaster Mitigation Program (PDM)

PDM, administered in California by OES, was created when the Disaster Mitigation Act of 2000 amended the Stafford Act to provide a funding mechanism that is not dependent on a presidential disaster declaration. Of the $25 million appropriated in fiscal year 2002 nationwide, California received approximately $1 million. The majority of these funds were spent on the development of this Plan. The PDM program for fiscal year 2003 was split into two different grants: planning and competitive. Of the $150 million appropriated the entire nation, for 2003, California received $6,219,837.44 for state and local governments for planning and projects.

Continued on next page

10.1 Federal Funding Sources

Department of Housing and Urban Development (HUD) Community Development Block Grant Program	HUD's Community Development Block Grant Program (CBDG) can be used to fund hazard mitigation projects. CDBG is one of the largest federal grant programs. Each year, funds are made available to economically disadvantaged entitlement communities. A separate component of CDBG, the State CDBG Program, provides program funds directly to states, which they then allocate among typically rural localities that do not participate in the entitlement program. Detailed information about CDBG funding is located in the State Funding section later in this chapter.
U.S. Army Corps of Engineers (USACE)	USACE provides funding for flood control projects, including $86 million nationwide in fiscal year 2003.
U.S. Small Business Administration (SBA) Funding	The SBA's Disaster Division may provide funds in its disaster home and business loans for mitigation measures. The Disaster Division also funds hazard mitigation projects through Pre-Disaster Mitigation Loans. The Pre-Disaster Loan program is a five-year pilot program authorized by statute in 1999 that allows the SBA to make low-interest, fixed rate loans to small businesses for the purpose of implementing mitigation measures to protect their property from disaster-related damage. The program was funded at a level of $15 million for each of the five fiscal years from 2000 through 2004.
United States Department of Agriculture (USDA) Programs	The USDA has three programs that can provide funding for hazard mitigation projects: • Rural Development/Community Facilities Guarantee • Community Facilities Direct Loans • Community Facilities Direct Grants • Volunteer Fire Assistance
About Rural Development/ Community Facilities Guarantee	This program provides an incentive for commercial lending that will develop essential community facilities, such as fire stations, police stations, and other public buildings.

Continued on next page

10.1 Federal Funding Sources

About Community Facilities Direct Loans	This program provides loans for essential community facilities to unincorporated areas and cities with a population of less than 20,000. Loans range from $100,000 to $6,000,000
About Community Facilities Direct Grants	This program provides grants to develop essential community facilities for those applicants who cannot qualify for a loan. Eligible applicants are unincorporated areas and cities with a population of less than 20,000. The average size of a grant is $30,000.
About Volunteer Fire Assistance	This program provides funding for organizing, training, and equipping volunteer/rural fire districts. Assistance is available only to communities with a population under 10,000, but groups of smaller communities may join together in a combined effort to service more than 10,000 people. Total funds available vary by fiscal year, but the maximum award is $20,000 and the minimum award is $500.
The Natural Resources Conservation Service (NRCS)	The NRCS has four programs that can provide funding for hazard mitigation projects: • Conservation Reserve Program (CRP) • Environmental Quality Incentives Program • Small Watershed Program and Flood Prevention Program • Emergency Watershed Protection Program
About the Conservation Reserve Program (CRP)	The CRP is a voluntary program that offers long-term rental payments and cost-share assistance to establish long-term resource-conserving cover on environmentally sensitive cropland or, in some cases, marginal pastureland. Protective cover reduces soil erosion, improves water quality, and enhances or establishes wildlife habitat. Increased rental payments are available on certain land areas (e.g., land within a wellhead protection area may receive an additional 10 percent payment). Annual rental payments to each participant may be provided up to $50,000 per fiscal year for up to 50 percent of the cost for establishing cover and incentive payments can be made for wetland hydrology restoration equal to 25 percent of the cost of restoration.

Continued on next page

10.1 Federal Funding Sources

About the Environmental Quality Incentives Program (EQIP)

The EQIP was established to provide a single voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. Nationally, it provides technical, financial, and educational assistance; half of its funding targets livestock-related natural resource concerns and the other half targets more general conservation priorities. EQIP is available primarily in priority areas where there are significant natural resource concerns and objectives. Eligible applicants include non-federal landowners (including Native American tribes) engaged in livestock operations or agricultural production. Eligible land includes cropland, rangeland, pasture, forestland, and other farm and ranch lands.

About the Small Watershed Program and Flood Prevention Program

The purpose of the Small Watershed Program is to assist federal, state, and local agencies, local government sponsors, tribal governments, and program participants to protect watersheds from damage caused by erosion, floodwater, and sediment, to conserve and develop water and land resources, and solve natural resource and related economic problems on a watershed basis. The program empowers local people or decision makers, builds partnerships, and requires local and state funding contribution. Both technical and financial assistance are available.

Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance. The focus of these plans is to identify solutions that use land treatment and nonstructural measures to solve resource problems.
Watershed plans involving an estimated federal contribution in excess of $5,000,000 for construction, or construction of any single structure having a capacity in excess of 2,500 acre feet, require Congressional committee approval. Other plans are approved administratively. After approval, technical and financial assistance can be provided for installation of works of improvement specified in the plans.

Project sponsors are provided assistance in installing planned land treatment measures. Surveys and investigations are made and detailed designs, specifications, and engineering cost estimates are prepared for construction of structural measures. Areas where sponsors need to obtain land rights, easements, and rights-of-way are delineated. Technical assistance is also furnished to landowners and operators to accelerate planning and application of needed conservation measures on their individual land units.

Continued on next page

10.1 Federal Funding Sources

About the Emergency Watershed Protection (EWP) Program

The purpose of the EWP is to undertake emergency measures, including the purchase of floodplain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or any other natural occurrence is causing or has caused a sudden impairment of the watershed. It is not necessary for a national emergency to be declared for an area to be eligible for assistance. The program objective is to assist sponsors and individuals in implementing emergency measures to relieve imminent hazards to life and property created by a natural disaster. Activities include providing financial and technical assistance to remove debris from streams, protect destabilized stream banks, establish cover on critically eroding lands, repairing conservation practices, and the purchase of floodplain. The program is designed for installation of recovery measures.

Source: NRCS website, http://www.nrcs.usda.gov/programs/ and Catalog of Federal Funding Sources for Watershed Protection, http://www.epa.gov/owow/watershed/wacademy/fund.html

National Oceanic and Atmosphere Administration (NOAA) Programs

NOAA has two programs for funding hazard mitigation projects. These are

Coastal Services Center Cooperative Agreements
Coastal Zone Management Administration/Implementation Awards

Continued on next page

10.1 Federal Funding Sources

Coastal Services Center Cooperative Agreements

Cooperative agreements may be used only to implement and enhance the states' approved Coastal Zone Management programs. Ten to 20 percent of Section 306 funds are available annually to develop new program requirements under Section 309 in the areas of:

- Coastal wetlands management and protection
- Natural hazards management
- Public access improvements
- Reduction of marine debris
- Assessment of cumulative and secondary impacts of coastal growth and development
- Special area management planning
- Ocean resource planning, and
- Citing of coastal energy and government facilities.

Coastal Zone Management Administration/ Implementation Awards

This program assists states in implementing and enhancing Coastal Zone Management programs that have been approved by the Secretary of Commerce. Funds are available for projects in areas such as coastal wetlands management and protection, natural hazards management, public access improvements, reduction of marine debris, assessment of impacts of coastal growth and development, special area management planning, regional management issues, and demonstration projects with potential to improve coastal zone management. Two types of grants are available: Formula grants, which require a non-federal match, and Program Enhancement grants, which require no match.

Source: NOAA Website, http://www.noaa.gov and Catalog of Federal Funding Sources for Watershed Protection, http://www.epa.gov/owow/watershed/wacademy/fund.html

Continued on next page

10.1 Federal Funding Sources

Federal Homeland Security Grants

Beginning in fiscal year 2002, several grant programs have become available to fight terrorism. FEMA, the Department of Justice, Department of Heath Human Services, and the Department of Transportation will be administering these funds. Many of these programs relate to preparedness and response activities and not mitigation. However, they have been included in this document because they are new and have significant relevance to the current situation. In addition, these programs could evolve as time goes on.

A Federal Homeland Security Funding table describing these funding programs follows.

Table 10.1A - Federal Homeland Security Funding Programs

The following table summarizes funding programs for homeland security.

Click here to view the table or go to Table 10.1A in the Appendices.

Continued on next page

10.1 Federal Funding Sources

Federal Programs in the California Fire Alliance Resource Guide

The California Fire Alliance has identified several funding sources local governments can use to support fire hazard mitigation efforts, including:

- Volunteer Fire Assistance
- State Fire Assistance (SFA)
- State Fire Assistance (SFA) – Wildland Urban Interface (WUI)
- Economic Action Program
- Community Protection/Community Assistance to CDF and Contract Counties
- Community Protection/Community Assistance to Non-Profit Groups
- Rural Fire Department Assistance
- Community Protection/ Community Assistance Initiative
- Rural Fire Assistance
- Payments to States and Counties
- Assistance to Firefighters Grant program
- HMGP

Bureau of Land Management (BLM) Programs

The BLM funds Firewise Community Workshops through CDF with National Fire Plan funds. For information on Firewise workshops, visit www.firewise.org/communities.

10.2 State Funding Sources

Current State Funding Sources

There are several sources of state funding for hazard mitigation projects, including:

- Caltrans
- Commerce and Economic Development Program
- Proposition 13
- Proposition 50
- WRCB
- DWR
- CDI

California Department of Transportation (CalTrans)

Since the 1971 San Fernando earthquake struck the Los Angeles area, CalTrans has been seismically retrofitting bridges throughout the state. Initially, the Caltrans retrofit program consisted of restraining sections of 1,262 bridges with steel cable. This work was completed in 1989. The current seismic retrofit program is divided into two phases. Phase 1 identified 1,039 bridges for strengthening after the Loma Prieta quake with a total estimated cost of $812 million. Phase 2 identified an additional 1,364 bridges following the 1994 Northridge earthquake. The cost of retrofitting Phase 2 bridges is estimated at $1.05 billion.

A total of 1,114 city- and county-owned bridges have been identified as candidates for seismic retrofit. CalTrans is the lead agency for 794 of these bridges and various local governments are the lead agency on the remaining bridges.

Continued on next page

10.2 State Funding Sources

Table 10.2A – Caltrans Funding

The table below summarizes the Caltrans Bridge Retrofit Program.

Program	Cost
Toll-Bridge Retrofit Program	$2,500,000,000
Phase 1 Bridge Retrofit	$ 812,000,000
Phase 2 Bridge Retrofit	$1,050,000,000
Total	$4,362,000,000

Proposition 192, a bond measure passed in March 1976, provided $2 billion for bridge retrofit. Additional funding from the bridge retrofit program comes from the tax on motor vehicle fuel. This includes $650 million for retrofitting seven of the state's toll bridges and more than 1,000 other structures identified for strengthening after the 1994 Northridge Earthquake.

Commerce and Economic Development Program

The Commerce and Economic Development Program administers two programs that may provide funding for hazard mitigation projects:

- Infrastructure State Revolving Fund Program
- Rural Economic Development Infrastructure Program

Infrastructure State Revolving Fund (ISRF) Program

The Infrastructure State Revolving Fund Program (ISRF) provides low-cost financing to public agencies for a wide variety of infrastructure projects. Loans are available in amounts ranging from $250,000 to $10,000,000 with loan terms of up to 30 years. Eligible applicants include any subdivision of a local government, including cities, counties, redevelopment agencies, special districts, assessment districts, joint powers authorities and non-profit corporations formed on behalf of a local government. Flood control is an eligible project type.

Rural Economic Development Infrastructure Program (REDIP)

The Rural Economic Development Infrastructure Program (REDIP) program provides loans to eligible public entities for water treatment and supply facilities and flood control projects. There is a limit of $2 million per project.

Continued on next page

10.2 State Funding Sources

Proposition 13

Proposition 13, passed by state voters in March 2000, was a $1.97 billion bond measure to finance a variety of projects and programs for safe drinking water, clean water, water conservation, and flood protection. The flood protection component of Proposition 13 provided funding for a number of hazard mitigation projects and programs, including:

- Floodplain mapping
- Flood protection corridors
- Flood control subventions
- Urban stream restoration
- Capital Area flood protection
- San Lorenzo River flood control
- Yuba Feather flood protection
- Arroyo Pasajero watershed projects
- Watershed protection
- Water and watershed education
- River protection
- Southern California integrated watershed project
- Lake Elsinore and San Jacinto watershed projects
- Coastal watershed salmon habitat projects.

Although some of the programs and projects above have an insurance, water quality, or environmental focus, they all have hazard mitigation components. Subsequent bonds have continued to fund the Urban Streams Renewal Program and other mitigation projects.

Additionally, the City of Santee received a $5 million grant from Proposition 13 to protect streets and highways from flooding. DWR acted as the pass-through agency.

Continued on next page

10.2 State Funding Sources

Proposition 50

Prop 50 funds a variety of water projects including development of river parkways; improved security for state, local and regional water systems.

Eligible applicants include:

- Municipalities
- Local agencies
- Educational institutions
- Non-profit organizations
- Indian tribes
- State agencies
- Federal agencies

Eligible projects include:

- Building local community capacity to assess and effectively manage watersheds that affect the Bay Delta system
- Development or refinement of watershed assessments and plans
- Design, development and implementation of specific watershed conservation, maintenance, and restoration actions.

Funding Caps are $5 million for projects and a minimum of $250,000. $100,000 for planning projects with a $100,000 minimum. WRCB administers this program.

California Water Resources Control Board

The Water Resources Control Board has four programs for funding hazard mitigation projects:

- Clean Water State Revolving Fund (SRF) Program
- Watershed Protection Program
- Southern California Integrated Watershed Program
- Lake Elsinore and San Jacinto Watershed Program

Continued on next page

10.2 State Funding Sources

Clean Water State Revolving Fund (SRF) Program	This program provides low-interest loans for the construction of publicly owned wastewater treatment and water reclamation facilities, implementation of non-point source and storm water pollution control activities, and estuary enhancement activities. Loans are available for municipalities, non-profit organizations, and private parties. The program is capitalized by grants from US EPA that require a 20 percent state match.
Watershed Protection Program	This program provides grants to municipalities, local agencies, or non-profit organizations to develop local watershed management plans and/or implement projects consistent with watershed plans. A maximum of $200,000 is available for each local watershed plan and a maximum of $5,000,000 is available for individual projects. Sixty percent of the funds are allocated to projects in Los Angeles, Orange, Riverside, Ventura, San Bernardino, and San Diego Counties. Forty percent of the funds are allocated to projects in the remaining counties. A total of $90 million is allocated for the program, $35 million of which is set aside for grants to small communities.
About the Southern California Integrated Watershed Program	This program provides local assistance to the Santa Ana Watershed Project Authority for projects in the Santa Ana watershed, such as basin water banking, contaminant and salt removal, removal of non-native plants, the creation of wetlands, programs for water conservation, efficiency and storm water management, planning and implementation of a flood control program to protect agricultural operations and adjacent property, and to assist in abating the effects of waste discharges into the water supply. A total of $235 million is allocated to this program.
About the Lake Elsinore and San Jacinto Watershed Program	This program will provide $15 million in local funding for watershed management and flood control projects consistent with the Lake Elsinore Management Plan that preserve agricultural land, protect wildlife habitat, protect and enhance recreation resources, and improve lake water quality.

Continued on next page

10.2 State Funding Sources

Department of Water Resources (DWR)

DWR has nine programs that may provide funding for hazard mitigation projects:

- Urban Streams Restoration Program
- Flood Protection Corridor Program
- Yuba Feather Flood Protection Program
- Bay-Delta Multipurpose Water Management Program
- Infrastructure Rehabilitation Program
- Capital Area Flood Protection Program
- Floodplain Mapping
- Flood Control Subventions Program

About the Urban Streams Restoration Program

This is a competitive grant program to promote effective low-cost flood control projects, including stream clearance and flood mitigation and clean-up activities. Funds are available to public agencies, nonprofit organizations, and local community groups. All public agencies must have a partnership with a non-profit citizens group to receive funding. Individual projects are limited to a maximum of $1 million.

About the Flood Protection Corridor Program

This is a competitive grant program for flood protection projects, including the acquisition of real property and the acquisition of easements from willing sellers. Funds are available to public agencies, non-profit organizations, and DWR.

About the Yuba Feather Flood Protection Program

This program provides competitive grants for flood protection projects along the Yuba and Feather Rivers and their tributaries and along the Colusa Drain and its tributaries. Grants are available to public agencies. A total of $90 million was authorized for the program.

Continued on next page

10.2 State Funding Sources

About the Bay-Delta Multipurpose Water Management Program	DWR provides competitive grants and funding for specific projects aimed at achieving CALFED's goal of achieving long-term solutions to fish and wildlife, water supply reliability, flood control, and water quality problems in the Bay-Delta. Funding is available to federal, state, and local public agencies.
About the Infrastructure Rehabilitation Program	DWR provides competitive grants for feasibility studies and cost-effective construction projects for the replacement of water distribution and storage infrastructure. Construction grants of up to $5 million are available to economically disadvantaged public agencies and mutual water companies. Feasibility study grants of up to $100,000 are also available. Applicants must demonstrate water losses or that the system is in imminent danger of failure. Funds from this program have been used to replace elevated water tanks that do not meet seismic standards.
About the Capital Area Flood Protection Program	This project pays for the state's share of the non-federal costs of flood management projects that improve flood protection in the Sacramento region. Approximately $20 million was authorized directly to the Sacramento Area Flood Control Agency.
About the Floodplain Mapping Program	DWR committed $2.5 million for a continuing mapping program to assist local land use planning efforts in order to avoid or reduce future flood risks and damage.
Flood Control Subventions Program	DWR's Division of Flood Management provides financial assistance to local agencies cooperating in the construction of federal flood control projects. For more information, visit www.fcpsubventions.water.ca.gov.
California Department of Insurance (CDI)	CDI has two programs for funding hazard mitigation projects: • Earthquake Retrofit Program • Low Interest Retrofit Loan Program

Continued on next page

10.2 State Funding Sources

About the Earthquake Retrofit Program

California Department of Insurance is currently offering a limited number of earthquake retrofit grants to low- and moderate-income homeowners in Contra Costa, San Mateo, Santa Clara, Orange, Imperial, and Riverside counties. For more information, visit www.insurance.ca.gov/docs/EGL.htm.

About the Low Interest Retrofit Loan Program

This program offered low-interest loans for earthquake retrofits to qualified borrowers in Alameda, Contra Costa, Humboldt, Imperial, Los Angeles, Mendocino, Orange, Riverside, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, and Santa Cruz counties.

About the State Community Development Block Grant (CDBG) Program

This program, administered by HCD, funds housing, economic development, public works, community facilities, and public service activities serving lower-income people in small, typically rural, communities. State and federal regulations restrict distribution of state CDBG funds to non-entitlement jurisdictions, including cities with populations under 50,000 and counties with populations under 200,000 in the unincorporated area. These are jurisdictions that do not participate in the HUD Entitlement CDBG program. State regulations dictate the method of fund distribution to eligible jurisdictions, including ratings and rankings for most of the funds.

CDBG grants are provided to jurisdictions to a combined maximum amount of $800,000 per year and must principally benefit lower-income persons and households, except under an amendment as described in the following paragraph. In addition to the $800,000 limit, jurisdictions may be able to access one or both of the following special state CDBG funds: The Native American Set-Aside Fund to assist non-federally recognized Native American communities and the Colonias Set-Aside Fund to assist communities near the U.S.-Mexican border.

State regulations allow the amendment of an existing grant to fund an otherwise CDBG-eligible replacement project or activity in an area proclaimed by the Governor as either a “state of emergency” or a “local emergency” as defined in Government Code §8558.

Continued on next page

10.2 State Funding Sources

California CDBG Program, Planning and Technical Assistance Grants

This program funds studies and plans for the same types of activities and for the same eligible jurisdictions noted in the above section, "About the State Community Development Block Grant Program." Grants are provided on a first-come, first-served basis in amounts up to $70,000 per year, including $35,000 for economic development planning and $35,000 to plan for any of the other eligible activities. HCD administers the program and offers two funding cycles per year.

Table 10.2B State CDBG Funding

The table below summarizes state Community Development Block Grant (CDBG) funding from fiscal year 2000 through fiscal year 2003. It is assumed that funding levels will remain about the same in future years.

Fiscal Year	Total Dollars
2000	$44,280,000
2001	$46,070,000
2002	$43,788,000
2003	$48,899,805

10.3 Local Funding Sources

Examples of Current Local Funding Sources

Examples of local funding sources for mitigation measures include:

- Berkeley Retrofit Rebate Program
- Sonoma and Marin Counties Open Space Acquisition Programs
- Napa River Flood Control Project of 1998 (also known as Proposition A)
- San Francisco City Hall Restoration Bond Fund

About the Berkeley Retrofit Rebate Program

This program is a local government program offering financial incentives for recently purchased properties in the City of Berkeley. The program applies to new retrofits and retrofit upgrades. It is funded by the transfer tax assessed on property transfers in Berkeley and includes both a rebate of one-half percent of the purchase price of a house if the funds are to be used for retrofit projects and a waiver of permit fees for retrofit projects. Funds must be used within one year of purchasing the home.

About the Sonoma and Marin Counties Open Space Acquisition Programs

Sonoma and Marin counties have undertaken aggressive open space acquisition programs implemented by special districts established for such purposes.

About the Napa River Flood Control Project of 1998

The Napa River Flood Control Project (also known as Proposition A) was approved by Napa County voters in March 1998. The project does not rely on any single approach, but combines several different types of mitigation. Over two hundred separate parcels will be affected in whole or in part by the project, which is the largest public works project in Napa County's history.

About the San Francisco City Hall Retrofit Bond Fund

San Francisco raised more than $300 million in bond funds for the retrofit and restoration of its City Hall after the 1989 Loma Prieta Earthquake.

10.4 Alternative Funding Sources

Combined Funding Approaches

Projects in California are commonly carried out by combining funding from one or more state agency, state and local agencies, federal and state agencies, or a combination of all three. These approaches have been both informal and formal.

California Financing Coordinating Committee (CFCC)

CFCC was created in 1998 to better facilitate cooperative funding agreements between state and federal agencies. CFCC offers coordinated and streamlined access to infrastructure financing for California's local communities. CFCC members provide potential borrowers and grant recipients with an efficient and effective infrastructure funding mechanism. Members include the California Infrastructure and Economic Development Bank (I-Bank), HCD, SWRCB, DWR, DHS, and USDA.

Mitigation Opportunities During Scheduled Infrastructure Improvements

California has a history of incorporating mitigation into scheduled infrastructure improvements. State regulations require that whenever a state-owned structure is retrofitted, repaired, or modified and the total construction costs exceed 25 percent of the total replacement cost, the structure be brought up to current minimum seismic standards. For non-state-owned buildings, the local enforcing agency determines mitigation requirements.

Private Funding Sources

Millions of dollars are donated through corporate programs every year for disaster relief efforts nationwide and overseas. Unfortunately, corporate programs to fund disaster mitigation are not as prevalent as disaster relief efforts. More often, the private sector is involved in public/private partnerships and non-profit/private partnerships. Some examples of these partnerships are outlined below.

Public Private Partnership (PPP) 2000

The PPP 2000 was a cooperative effort among government agencies, private companies, and the Institute for Business and Home Safety to work on reducing natural disaster losses. The goal of PPP 2000 was to “seek new and innovative opportunities for government and nonprofit, private sector organizations to work together to reduce vulnerability to and losses from natural hazards in communities across the nation.” The partnership included the 19 agencies comprising the Subcommittee on Natural Disaster Reduction (SNDR), which is part of the National Science and Technology Council’s Committee on the Environment and Natural Resources.

Continued on next page

10.4 Alternative Funding Sources

Non-Profit/ Government Partnerships

Land purchases in California have been carried out in cooperation with non-profit agencies. For example, DWR provided $30 million in funding for The Nature Conservancy to purchase island property in the Sacramento-San Joaquin Delta. The effort had the joint benefits of water supply, flood control, and habitat conservation.

The Trust for Public Land, The Nature Conservancy, and the Conservation Fund are all helping communities throughout the country to develop local and regional plans for systems of open space.

In 1998, the David and Lucille Packard Foundation began a five-year, $175 million program called the Conserving California Landscapes Initiative to protect open space, farmland, and wildlife habitat in the Sierra Nevada, Central Valley, and Central Coast regions. As of November 2000, this program has protected over 327,000 acres of land. In April 2001, the foundation granted $50 million to the Peninsula Open Space Trust to help conserve 20,000 acres in San Mateo County that are believed to be the only undeveloped coastline next to a major metropolitan area remaining in the world.

USDA Rural Development/ Community Facilities Guarantee

The USDA Rural Development/Community Facilities Guarantee provides an incentive for commercial lending that will develop essential community facilities.

PART 4—MITIGATION AWARENESS AND LOCAL PLANNING

In This Part

This part contains the following chapters.

Chapter	Topic	Page
11	Mitigation Education and Awareness	294
12	Local Mitigation Planning Coordination	296
13	Plan Maintenance	301
14	Estimating Potential Loss of State Facilities	303

Chapter 11 - Mitigation Education and Awareness

11.1 Mitigation Education and Awareness

Disaster Resistant California (DRC) Conferences

The Governor's Office of Emergency Services (OES) sponsors an annual conference called Disaster Resistant California (DRC), which offers an exciting and highly dynamic exploration of risk reduction, homeland security, planning, preparedness, response, and recovery through plenary panels, workshops, and professional development courses. Focusing on the importance of disaster resistant communities, the conference's presentations, displays, and demonstrations emphasize successful systems, technologies, and strategies for implementing hazard mitigation measures and programs. In 2004, the conference for the first time included various technical demonstrations and special listening sessions, including two sessions on the Draft Plan.

Each year, DRC attracts a variety of emergency management professionals, local and state government representatives, and private business partners to share ideas, technology, and resources for risk reduction. Based upon the principles set forth by FEMA's Project Impact Program, the conference focuses on the integral role that community-based mitigation strategies play in reducing the vulnerability of individual communities in building a safer future for California. In addition, DRC strengthens and supports partnerships between private business and public entities by sharing success stories and hosting technological demonstration sessions. Also in the spirit of the Project Impact program, DRC recognizes those California communities that have demonstrated a commitment to hazard mitigation and that have made significant strides toward making their individual jurisdictions disaster resistant.

DRC offers a variety of plenary, breakout, training, and networking opportunities demonstrating best practices and offering invaluable tools for today's emergency management environment. Sessions include presentations from local, state, and federal authorities and nationally known experts. The conference has also welcomed several international delegations—from Japan, China, Taiwan, Turkey, Iran, Ecuador, and Panama—to share their knowledge, experiences, ideas and innovations in emergency management with California communities and businesses.

Continued on next page

11.1 Mitigation Education and Awareness

Mitigation Education and Marketing (MEAM)

OES uses the MEAM concept to travel to meetings of local business organizations, such as Rotary and Lions clubs, to promote mitigation, discuss future changes and opportunities involving hazard mitigation programs, and explain how attendees can help using their unique position within the community. The MEAM display debuted at the first DRC conference and uses mixed media such as photos, videos, and written materials to promote the idea of public-private partnership.

Mitigation Education Resources

Below are some public information resources on hazard mitigation.

Resource	Comments
Homeowner's Guide to Earthquake Safety	State law requires sellers of homes built before 1960 to provide a copy of the *Homeowner's Guide to Earthquake Safety* to buyers along with a disclosure form identifying any earthquake weaknesses in the home. The guide is California's best selling earthquake safety document. It was developed and is maintained by CSSC.
Commercial Property Owner's Guide to Earthquake Safety	State law encourages sellers of commercial property built before 1975 with tiltup, concrete, or masonry walls to provide buyers with a copy of the *Commercial Property Owner's Guide to Earthquake Safety* and fill out a form to disclose any earthquake weaknesses in the property. The guide was developed and is maintained by CSSC.
Seismic Retrofit Practices Improvement Program	The following publications are available from the CSSC for assisting and educating building owners about seismic retrofitting: • *Earthquake Risk Management: Mitigation Success Stories* (CSSC 99-05) • *Are You Prepared? A Guide for Decision-Makers* (CSSC99-06) • *Earthquake Risk Management: A Toolkit for Decision-Makers* (CSSC 99-04) • *Built to Resist Earthquakes: The Path to Quality Seismic Design and Construction for Architects, Engineers, and Inspectors* (CSSC 99-03)

State of California Multi-Hazard Mitigation Plan

Chapter 12—Local Mitigation Planning Coordination

Introduction

This chapter describes the state's local hazard mitigation planning support efforts as required by 44 CFR 201. It also describes the state's process for incorporating local planning efforts into the State Multi-Hazard Mitigation Plan and prioritizing assistance to local jurisdictions.

In this chapter

This chapter contains the following topics.

Topic	Title	Page
12.1	Local Planning and Technical Assistance	297
12.2	Local Plan Integration	299
12.3	Prioritizing Local Assistance	300

12.1 Local Planning and Technical Assistance

Introduction

44 CFR 201 requires a description of the state's process to support, through funding and technical assistance, the development of local hazard mitigation plans.

California Local Hazard Mitigation Planning (LHMP) Program

The Local Hazard Mitigation Program (LHMP), administered by OES' Hazard Mitigation Section (HMS), offers technical assistance to local government mitigation planning programs and tracks their progress and effectiveness. Its purpose is to support and assist local governments in the development of local hazard mitigation plans (LHMPs). The program provides local governments with information on integrating hazard identification, risk assessment, risk management, and loss prevention into a comprehensive approach to hazard mitigation and helps them identify cost-effective mitigation measures and projects.

Goal of the LHMP Program

The overall goal of the LHMP Program is for all local governments in California to have FEMA-approved LHMPs. Local governments must have an approved plan by this date to be eligible for certain mitigation programs authorized under the Stafford Act.

Objectives of the LHMP Program

The objectives of the LHMP Program are to:

- Integrate hazard mitigation activities in all pertinent local government programs
- Maximize the use of hazard mitigation resources, grants, and funds to reduce the impact of future disasters at the local level
- Maintain collaborative and cooperative relationships with local emergency managers, land use planners, and the scientific and technical communities involved in hazard mitigation
- Provide technical assistance and guidance to local governments to improve hazard risk assessments, mitigation project identification and analysis, and the development of local hazard mitigation plans
- Improve communications with stakeholders, legislators, and special interest groups involved in hazard mitigation
- Continue to enhance OES Regional and Operational Area capability and coordination
- Develop a statewide program of support for hazard identification and analysis and a risk-based approach to project identification, prioritization, and support for local governments

Continued on next page

12.1 Local Planning and Technical Assistance

Document 12.1 A-M LHMP Guidance Document

Click the links below to view portions of the LHMP Guidance Document or go to Document 12.1 in the Appendices.

12.1A – Region Map
12.1B – Part 1 Cover
12.1C – Part 1
12.1D – Part 2 Cover
12.1E – Part 2
12.1F – Part 2, Section 1
12.1G – Pat 2, Section 2
12.1H – Part 2, Section 3
12.1I – Part 2, Section 4
12.1J – Part 2, Section 5
12.1K – Part 2, Section 6
12.1L – Part 2, Section 7
12.1M – Part 2, Section 8
12.1N – Additional Information on Environmental Rules for Local Governments

Table 12.1A The Four Parts of Technical Assistance

The table below describes the four parts pf the technical assistance program the state has developed to assist local governments in developing LHMPs.

Part	Function
1	Identify and communicate with local governments to promote local hazard evaluation and mitigation planning and to assist in developing local hazard mitigation plans.
2	Provide technical assistance, guidance, resources, and tools to local governments for all aspects of local hazard mitigation planning.
3	Provide specialized training and exercises to state agency staff and local governments concerning local hazard mitigation planning and the LHMP Program.
4	Maintain an ongoing project tracking system to track the hazard mitigation actions, plans, and projects of local governments.

12.2 Local Plan Integration

Introduction

44 CFR 201 requires the state to establish a process and timeframe by which LHMPs will be reviewed, coordinated, and linked to the Plan.

Integrating LHMPs

Upon submission of an LHMP, HMS staff will review the plan within 21 days for:

- Compliance with 44 CFR 201.6 using FEMA LHMP guidance documents
- Consistency with state mitigation goals and objectives
- Local hazards
- Local capability assessment
- Local mitigation measures and activities

Once a LHMP is approved by FEMA, HMS staff will forward a recommendation to the state hazard mitigation officer (SHMO) to update the Plan if the LHMP identifies new hazards, project types, or significant information not already included in the state Plan. In addition, all FEMA-approved LHMPs will become part of the Plan as attachments.

12.3 Prioritizing Local Assistance

Introduction

44 CFR 201 requires the state to develop criteria for prioritizing planning and project grant funding to communities and local jurisdictions under available funding programs.

Developing a Cost-Beneficial Hazard Mitigation Program

California is dedicated to developing a cost-beneficial statewide hazard mitigation program. The program will provide technical assistance and funding for hazard mitigation projects that reflect the diverse hazards and risks found in California. The state will recommend funding projects or activities that meet the State's priorities.

Prioritization Criteria

The following criteria have been proposed for prioritizing mitigation activities for funding:

- Percent of population at risk
- Frequency and likelihood of hazard
- Repetitive loss areas
- Small and impoverished communities
- Community planning resources available
- Types and percent of land areas at risk
- Development pressure rating
- Project urgency and cost benefit analysis
- Cost effectiveness of measure

Prioritization of Non-Planning Grants

The first priority for California is the development of hazard mitigation plans by local governments as identified in Chapter 9.2. For local governments that already have FEMA approved local hazard mitigation plans a principal criterion for prioritizing funding for non-planning grants will be the extent to which benefits are maximized according to a cost-benefit review of proposed projects and their associated costs.

Chapter 13 - Monitoring, Evaluating, and Updating the Plan

13.1 Updating the Plan

Introduction

Because the Plan is a living document that reflects the state's ongoing hazard mitigation activities, the process of monitoring, evaluating, and updating it will be critical to the effectiveness of hazard mitigation in the state.

The SHMO has the responsibility for maintaining, evaluating, and updating the Plan. OES staff will support the SHMO as directed. The SHMT will play a pivotal role in providing input, direction, and guidance. The SHMO will review and recommend for approval any plan updates proposed by the SHMT. The Plan will be updated at least every three years.

The SHMO

Under 44 CFR 201.2, the SHMO state's primary point of contact with FEMA, other federal agencies, and local governments for mitigation planning and implementation of mitigation programs and activities required under the Stafford Act. Currently, the SHMO is the OES Hazard Mitigation Section (HMS) chief. The HMS administers hazard mitigation grant programs authorized under the Stafford Act—HMGP, PDM, and FMA—and other grant programs as directed. The section also oversees state and local hazard mitigation planning programs undertaken to meet the requirements of the Stafford Act.

Criteria For Plan Revision

Recommendation for Plan revisions will be based on the following criteria:

- New technologies
- New information
- Significant changes in the landscape due to implementation of hazard mitigation projects
- Changes in federal or state laws, regulations, or policies

Continued on next page

13.1 Updating the Plan

Monitoring Hazard Mitigation Projects

OES staff will monitor the implementation of hazard mitigation projects, programs, and initiatives. Staff will report to the SHMO and the SHMT on the progress made towards plan goals and objectives and will track the following specific events:

- Hazard events, including federally declared disasters
- FEMA approval of local hazard mitigation plans
- Advances in knowledge or understanding of hazards
- Changes in federal, state, and local legislation
- Performance of mitigation projects during hazard events

Reviewing Progress

OES staff will produce a State Plan Report for review by the SHMT and the SHMO at least quarterly. The report will examine the progress toward achieving goals and evaluate implementation activities.

Chapter 14 - Estimating Potential Losses of State Facilities

14.1 Losses of State Facilities

Introduction

Using the State inventory list provided by DGS, OES has estimated the potential dollar losses of state owned and operated facilities from hazard events using building square footages and DGS estimates of building replacement costs per square foot.

Table 14.1A Potential Loss of State Facilities from Earthquake Hazards

The 40 percent peak ground acceleration (PGA) zone is considered the high seismic hazard zone. The state owns 9,250 buildings in the 40 percent PSI or greater zone. These buildings account for 92,921,038 square feet of space and have a replacement cost of $30,663,942,540. The State also leases 860 buildings in the 40 percent PSI or greater zone with 6,472,445 total square feet of space.

There are 2,499 State-owned buildings for which the PGA zone has not been determined, accounting for 48,860,903 square feet of space with a replacement cost of $16,124,097,990. The state also leases 2,566 structures awaiting a PGA zone determination, accounting for 5,137,978 square feet of space.

PGA %	Number of State-Owned Buildings	Total Square Footage	Total Replacement Cost	Number of State-Leased Buildings	Total Square Footage
80-176	751	10,678,089	$3,523,769,370	84	418,398
70-79	1,426	11,773,760	$3,885,340,800	167	1,322,449
60-69	1,322	18,169,111	$5,995,806,630	173	1,385,431
50-59	2,817	30,586,215	$10,093,450,950	220	1,573,404
40-49	2,934	25,713,863	$8,485,574,790	216	1,772,763
30-39	4,162	24,644,382	$8,132,668,500	179	1,140,942
20-29	3,374	47,263,450	$15,596,938,500	576	8,812,614
10-19	1,562	12,343,920	$4,073,493,600	274	3,712,927
0-9	1,376	4,970,263	$1,640,186,790	19	57,819
No data	2,499	48,860,903	$16,124,097,990	2,566	5,137,978

Continued on next page

14.1 Losses of State Facilities

Map 14.1A State Facilities in Earthquake Hazard Areas

The map below shows State buildings located in earthquake hazard areas.

Click here to view the map or go to Map 14.1A in the Appendices.

Potential Loss of State Facilities from Fire Hazards

The State owns 447 structures with a total square footage 3,283,137 within extreme fire risk areas (Zone 4). Assuming a $330-per-square-foot replacement cost (including contents), there is a potential for over $1 billion in losses from fire. The State leases three buildings within Zone 4 with a total square footage of 13,489 square feet.

2,308 State-owned structures with a total square footage 18,247,267 and a replacement cost of over $6 billion are located in the very high fire risk area (Zone 3). The State leases 429,938 square feet in 78 structures in Zone 3.

The State owns 1,847 structures with a total square footage of 26,578,924 in Zone 2, the high fire risk area, and leases an additional 735 structures with 11,597,918 square feet of space in this zone.

Table 14.1B – Fire Hazards

The table below summarizes the number of State buildings in high fire hazard zones and the square footage of those buildings. The table also gives an estimate of the value of those buildings.

# in Zone 4	Sq. Ft.	$ at Risk in Millions	# in Zone 3	Sq. Ft.	$ at Risk in Millions	# in Zone 2	Sq. Ft.	$ at Risk in Millions
447	3,283,137	1,083	2,308	18,247,267	6022	1,847	26,578,924	7,973.7
3	13,489	4.5	78	429,938	142	735	11,597,918	8771
450	3,296,626	989	2,386	18,677,205	6163	2,582	38,176,842	12,598

Map 14.1B – State Facilities in Fire Hazard Areas

The following map shows the locations of State buildings in fire hazard areas.

Click here to view the map or go to Map 14.1B in the Appendices.

Continued on next page

14.1 Losses of State Facilities

Potential Loss of State Facilities from Flood Hazards

The State owns 2,189 building with a total square footage of 26,839,975 and a replacement value of almost $9 billion (assuming a $330-per-square-foot replacement cost) that are located in the 100-year flood zone. The State leases another 409 buildings with a total a square footage of 7,346,941 in this zone.

In addition, the State owns 631 facilities with 5,162,462 square feet of space and a replacement cost of over $1.7 billion and leases 261 buildings with a total square footage 3,189 in the 500-year flood zone.

Table 14.1C - Flood Hazards

The table below summarizes the number of State buildings in high flood hazard zones and the square footage of those buildings. The table also gives an estimate of the value of those buildings.

FIRM 100	Sq. Ft.	$ at Risk in Millions		FIRM 500	Sq. Ft.	$ at Risk in Millions
Zone A				Zone X		
2,189	26,839,975	8,857		631	5,162,462	1,704
409	7,346,941	2,424		261	3,189	1
2,598	34,186,916	11,281		892	5,165,651	1,705

Map 14.1C State Facilities in Flood Hazard Areas

The following map shows the locations of State buildings in high flood hazard areas.

Click here to view the map or go to Map 14.1C in the Appendices.

14.2 Estimating Potential Losses by Jurisdiction

Introduction

Drawing on local experience, historical review, and information provided by both the State and Federal Emergency Management agencies, local governments throughout California have begun to identify and profile their natural hazards, estimate risk to their communities, and to analyze potential losses to vulnerable structures as well as other vulnerabilities.

How the State Supports Local Risk Assessment

State government departments support local governments in the development of local risk assessments by providing the resources and technical expertise needed to estimate risk and analyze losses. Through state legislation many state agencies have been tasked to determine vulnerability to hazards (the basis for estimating losses) on a local level. An example is the Bates Bill, AB 337.

Assembly Bill 337

AB 337 requires state agencies to support local governments in the following ways:

- Very High Fire Hazard Severity Zones Identification
- The Seismic Hazards Mapping Act
- National Flood Insurance Program (NFIP)
- Interim Final Rule (IFR)
- FEMA's State Hazard Mitigation Plan Guidance Document

Identification of Very High Fire Hazard Severity Zones

The California Department of Forestry and Fire Protection, in cooperation with local fire authorities, is required to identify areas of Very High Fire Hazard Severity Zones in the Local Responsibility Areas (LRA) of California.

The Seismic Hazards Mapping Act

The Act requires the State Geologist to identify areas of high seismic hazard, such as surface fault rupture, liquefaction, and earthquake induced landslide, on a local scale, Cities and counties must regulate certain development projects in these areas.

Continued on next page

14.2 Estimating Potential Losses by Jurisdiction

National Flood Insurance Program	The Department of Water Resource's administration of the NFIP program is designed to support the development of local flood risk assessments among other goals. It is clear that local risk assessments are not produced in a vacuum, but are the result of a collaborative effort between state and local governments.
Interim Final Rule	The IFR, which implemented DMA 2000, requires states to incorporate the findings of local jurisdiction loss estimates in the State plan. It requires, in part, that "[The State risk assessment shall include an] overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in the local risk assessments as well as the State risk assessment." In addition the IFR indicates that the State Plan should ". . . describe the distribution of losses across the State and should include specific reference to quantifying losses to local critical facilities."
State Hazard Mitigation Plan Guidance Document	FEMA's guidance document for developing the State Hazard Mitigation Plan recommends the following: "Although the Rule requires that States only analyze losses to structures, States are highly encouraged to analyze the potential economic and human impact each hazard would have statewide."
OES's Recommend-ation	OES proposes a series of tables to represent the estimated risk to population and the estimated losses to critical facilities, commercial, residential and other described losses, by counties, cities and special districts. The information will be used to compare and improve State estimates, and to review/revise the State's mitigation goals and priorities. Additionally, the information will serve as a quality check for statewide information that has been developed, by State agencies, to provide an estimated total state loss for each loss category and associated hazard.

Continued on next page

14.2 Estimating Potential Losses by Jurisdiction

Samples of the Tables (Tables 14.2A – C)

The proposed tables will be completed and updated as more information is collected and reported by California counties, cities, and special districts. The Interim Final Rule (IFR) does contain an element for local governments to " estimate potential dollar losses to vulnerable structures, "However, a “Needs Improvement” score on this requirement would not preclude a local mitigation plan from being approved by FEMA (at this time). Due to this allowance in the quantity and quality of local potential loss information, and due to the fact that information on potential losses, to other than "facilities," was not required by the IFR, the collection of this information could represent a multi-year effort, by OES.

Click the following hyperlinks to view sample tables, or go to Table 14.2A, Table 14.2B, and Table 14.2C in the Appendices.

Minimizing Time Required to Collect Information

Two possible approaches are under consideration by OES to minimize the time required to efficiently collect local potential loss information from local governments:

1. Include the potential loss categories listed below on the Local Hazard Mitigation Plan Review Crosswalk, under the FEMA allowed section for "Additional State Requirements."

2. Ensure that the local plan development and review database, which is under development by OES as a primary method of obtaining information, from local governments, for "integration" into the State Hazard Mitigation Plan, includes these categories of information for "on line" update by all local governments which are developing local hazard mitigation plans.

In addition to deciding on the method for collecting information from local governments in each of the potential loss categories, OES must decide the method of estimating. FEMA's guide has suggested that the following methodologies be used for the flood hazard for several of the data collection categories. OES will define all data collection categories for each identified hazard in their local plans prior to asking local governments to include this data.

Continued on next page

14.2 Estimating Potential Losses by Jurisdiction

Examples from the FEMA guidance

The following is an example of a local risk assessment using the FEMA guidance. Note: This method is not an accurate measure of vulnerability because depth of flooding for each structure in the floodplain was not assessed:

> Because Allwater County has not yet submitted a plan that estimates losses to residential, commercial, and critical facilities, all figures for this county were estimated by multiplying the percentage of structures in the floodplain (50% of all structures) with County economic data included in State demographic and tax information.
>
> Estimated Residential Losses = 50% x number of residences x median housing value.
>
> Estimated Commercial Losses = 50% x number of businesses x median building value x median business revenue.
>
> Estimated Critical Facilities = 50% x number of police and fire stations, hospitals, schools x median estimated losses to critical facilities of all other counties.

It should be noted that the information collected for estimated risk and potential losses will be collected by hazard identified, for all local governments reporting that they are subject to a particular hazard.

A review of the information included in local plans that have been submitted for State review, demonstrates the need to be very specific about the potential loss information requested. In some cases, such as Tuolumne and Alpine Counties, information has been reported concerning the severity and cost of past hazard events, but not the "potential" loss to the jurisdiction for each identified hazard. It should be noted that due to the deficiencies in reporting described above, a review of the plans currently submitted, indicate that local governments are not reporting the information needed to complete these proposed tables.

State of California Multi-Hazard Mitigation Plan

PART 5—APPENDICES

In This Part

This part contains the following appendices.

Topic	Page
Glossary of Terms	311
Acronyms	314
Bibliography	316
Related Websites	327

Glossary of Terms

Glossary of Terms

The following table defines many of the terms used in this document.

Term	Definition
Active Fault	A fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.
Annexation	The addition of territory to an existing city.
Community	Per 44CFR, Subchapter D, Section 201.1, "any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments, regional or interstate government entity, or agency or instrumentality of local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity." (See also Local Government)
Critical Facilities	Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals. *Source: FEMA 386-2*
Critical Habitat	The critical habitat for listed species consists of: 1. The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the Act, on which are found those physical or biological features (constituent elements) a. Essential to the conservation of the species, and b. Which may require special management considerations or protection 2. Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Act, upon a determination by the Secretary that such areas are essential for the conservation of the species. *Source: ESA §3 (5)(A). Designated critical habitats are described in 50 CFR §17 and §226.*
Endangered Species	Any species that is in danger of extinction throughout all or a significant portion of its range. *Source: ESA §3(6)*
Essential Services Building	Any building, including buildings designed and constructed, for public agencies used, or designed to be used, or any building a portion of which is used or designed to be used, as a fire station, police station, emergency operations center, California Highway Patrol office, sheriff's office, or emergency communication dispatch center. *Source: California Health and Safety Code §16007*
Fire Regime	The pattern and variability of fire occurrence and its effect on vegetation. It is usually expressed or classified based on both fire frequency and the general severity of the effects on the dominant life forms present. *Source: Kilgore 1973*
General Law Cities	Cities that follow the general laws of the state. This is in comparison to charter cities, which follow their own constitutions as well as some of the general laws of the state.

Continued on next page

Glossary of Terms

Hazard Mitigation	Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. *Source: 44 Code of Federal Regulations, Subpart M, Section 206.401*
Incorporation	The creation of a new city.
Listed Species	Any species of fish, wildlife or plant that has been determined to be endangered or threatened under section 4 of the Act. *Source: 50 CFR §402.02*
Local Government	Per 44CFR, Subchapter D, Section 201.1, "any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments, regional or interstate government entity, or agency or instrumentality of local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity." (See also Community)
Mitigation Education and Marketing (MEAM)	A program within the OES Hazard Mitigation Section that was developed to promote the mitigation message of prevention, help state and local jurisdictions and the public recognize hazards, and emphasize effective planning.
Section 4	The section of the Endangered Species Act of 1973, as amended, outlining procedures and criteria for: • Identifying and listing threatened and endangered species • Identifying, designating, and revising critical habitat • Developing and revising recovery plans • Monitoring species removed from the list of threatened or endangered species
Section 7	The section of the Endangered Species Act of 1973, as amended, outlining procedures for interagency cooperation to conserve federally listed species and designated critical habitats. Section 7(a)(1) requires federal agencies to use their authorities to further the conservation of listed species. Section 7(a)(2) requires Federal agencies to consult with the Services to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. Other paragraphs of this section establish the requirement to conduct conferences on proposed species; allow applicants to initiate early consultation; and require FWS and NMFS to prepare biological opinions and issue incidental take statements. Section 7 also establishes procedures for seeking exemptions from the requirements of section 7(a)(2) from the Endangered Species Committee.

Continued on next page

Glossary of Terms

Term	Definition
Section 9	The section of the Endangered Species Act of 1973, as amended, that prohibits the taking of endangered species of fish and wildlife. Additional prohibitions include: • Import or export of endangered species or products made from endangered species • Interstate or foreign commerce in listed species or their products • Possession of unlawfully taken endangered species
Section 10	The section of the Endangered Species Act of 1973, as amended, that provides exceptions to Section 9 prohibitions. The exceptions most relevant to Section 7 consultations are takings allowed by two kinds of permits issued by the National Fish and Wildlife Service and the National Marine Fisheries Service: scientific take permits and incidental take permits. The Services can issue permits to take listed species for scientific purposes, or to enhance the propagation or survival of listed species. The Services can also issue permits to take listed species incidental to otherwise legal activity.
State Responsibility Area (SRA)	State Responsibility Areas include those lands that are: • Covered wholly or in part by forests or by trees producing or capable of producing forest products • Covered wholly or in part by timber, brush, undergrowth, or grass, whether of commercial value or not, which protect the soil from excessive erosion, retard runoff of water or accelerate water percolation, if such lands are sources of water which is available for irrigation or for domestic or industrial use • In areas principally used or useful for range or forage purposes and are contiguous to the lands described above State Responsibility Areas do not include those lands that are: • Owned or controlled by the federal government or any agency of the federal government • Within the exterior boundaries of any city, except a city and county with a population of less than 25,000 if, at the time the city and county government is established, the county contains no municipal corporations • Located within the state but do not come within any of the classes specifically described as being included

Acronyms

Acronyms

The following table lists all acronyms used in this document.

Acronym	Meaning
ABAG	Association of Bay Area Governments
ARB	Air Resources Board
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CGS	California Geological Survey
Cal EPA	California Environmental Protection Agency
CalTrans	California Department of Transportation
CBSC	California Building Standards Commission
CDBG	Community Development Block Grant
CDF	California Department of Forestry and Fire Protection
CDHS	California Department of Health Services
CDI	California Department of Insurance
CFR	Code of Federal Regulations
CGS	California Geological Survey
CHP	California Highway Patrol
CISN	California Integrated Seismic Network
CNG	California National Guard
CRS	Community Rating System
CSSC	California Seismic Safety Commission
DFG	State Department of Fish and Game
DGS	State Department of General Services
DWR	Department of Water Resources
FEAT	Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FMP	Floodplain Management Plan
FRAP	Fire and Resource Assessment Program
GIS	Geographic Information System
HCD	California Department of Housing and Community Development
HMGP	Hazard Mitigation Grant Program
HUD	Housing and Urban Development
IA	Individual Assistance
LHMP	Local Hazard Mitigation Plan

Continued on next page

Acronyms

Acronym	Meaning
MEAM	Mitigation Education And Marketing
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	National Resources Conservation Service
OES	Governor's Office of Emergency Services
OPR	Governor's Office of Planning and Research
OSHPD	Office of Statewide Health Planning and Development
PA	Public Assistance
PDM	Pre-Disaster Mitigation Program
PUC	Public Utilities Commission
SBA	Small Business Administration
SEMS	Standardized Emergency Management System
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
US EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOAD	National Voluntary Organizations Active in Disasters
WGA	Western Governors' Association
WRCB	State Water Resources Control Board

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Chapter 12

44 Code of Federal Regulations

Chapter 13

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Chapter 14

No sources for this chapter.

Related Websites

Websites Directory

OES and the SHMT consulted the following websites in the development of this document. This list of websites was compiled as of July 1, 2004. During plan updates, this information will be revised as necessary. These are listed in alphabetical order.

Agency	Website Address
Air Resources Board	www.arb.ca.gov
Bureau of Indian Affairs	www.doi.gov/bureau-indian-affairs
Department of Forestry and Fire Protection	http://www.fire.ca.gov/php/index.php
Department of Conservation	www.consrv.ca.gov
Department of Food and Agriculture	http://www.cdfa.ca.gov/
Department of Housing and Community Development	www.hcd.ca.gov
Department of Insurance	http://www.insurance.ca.gov/docs/index.html
Department of Water Resources	www.water.ca.gov
Energy Commission	www.energy.ca.gov
Environmental Protection Agency	www.epa.gov
Federal Emergency Management Agency	www.fema.gov
Fire and Resource Assessment Program	http://frap.cdf.ca.gov
Firewise Communities	www.firewise.org/communities
Governor's Office of Emergency Services	www.oes.ca.gov
Governor's Office of Planning & Research	www.opr.ca.gov
National Oceanic & Atmospheric Administration	www.noaa.gov
Natural Hazards Center	www.colorado.edu/hazards
Natural Resource Project Inventory	http://endeavor.des.ucdavis.edu/nrpi
Pacific Marine Environmental Laboratory	www.pmel.noaa.gov
Seismic Safety Commission	www.seismic.ca.gov
Statewide Integrated Pest Management Program	www.ipm.ucdavis.edu

Continued on next page

Related Websites

Agency	Website Address
U.S. Army Corps of Engineers	www.usace.army.mil
U.S. Department of Justice	www.usdoj.gov
U.S. Geological Survey	www.usgs.gov
University of California, Davis	www.ucdavis.edu
USA Today Weather	http://asp.usatoday.com/weather/weatherfront.aspx?POE=HFTABWEA
The Weather Channel	www.weather.com
California West Nile Virus Surveillance Information Center	http://www.westnile.ca.gov/