COUNTY OF MONTEREY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

VOLUME 1

March 2022

Carmel-by-the-Sea
Gonzales
King City
Monterey
Salinas
Seaside
Del Rey Oaks
Greenfield
Marina
Pacific Grove
Sand City
Soledad
Carmel Area Wastewater District
Monterey County Water Resources Agency
Monterey One Water
Monterey Regional Waste Management District
Moss Landing Harbor District

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ACKNOWLEDGMENTS

The Monterey County Multi-Jurisdictional Hazard Mitigation Plan update was made possible through the dedicated efforts of each participating jurisdiction, stakeholders, members of the public, and the Monterey County Office of Emergency Services. The development of this plan would not have been possible without the dedication and commitment of the Hazard Mitigation Plan Steering Committee.

Participating jurisdictions include:

Monterey County
City of Carmel-by-the-Sea
City of Del Rey Oaks
City of Gonzales
City of Greenfield
City of King
City of Marina
City of Monterey
City of Pacific Grove
City of Salinas
City of Sand City
City of Seaside
City of Soledad
Monterey County Water Resources Agency
Carmel Area Wastewater District
Monterey One Water
Monterey Regional Waste Management District
Moss Landing Harbor District

Special thanks to the following partners who helped make this project possible:

Federal Emergency Management Agency (FEMA)
California Governor's Office of Emergency Services (Cal OES)
Monterey County Information Technology Department

The citizens of Monterey County are commended for their participation in the outreach strategy. This outreach success will set the course for the successful implementation of this plan during the next performance period.

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While this Volume, **Volume 1,** address the entire geographic area of Monterey County and all participating jurisdictions holistically, **Volume 2** of the Monterey County Multi-Jurisdictional Hazard Mitigation Plan contains the Jurisdictional Annexes for each participating jurisdiction.

A Unincorporated County of Monterey (and Monterey County Water Resources Agency)

B City of Carmel-by-the-Sea

C City of Del Rey Oaks

D City of Gonzales

E City of Greenfield

F City of King

G City of Marina

H City of Monterey

I City of Pacific Grove

J City of Salinas

K City of Sand City

L City of Seaside

M City of Soledad

N Carmel Area Wastewater District

O Monterey One Water

P Monterey Regional Waste Management District

Q Moss Landing Harbor District

ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
AMBAG	Association of Monterey Bay Area Governments
APG	Adaptation Planning Guide
APN	Assessor Parcel Numbers
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	California Governor's Office of Emergency Services
Cal-Am Water	California-American Water Company
CalARP	California Accidental Release Prevention Program
Caltrans	California Department of Transportation
CAWD	Carmel Area Wastewater District
CCR	California Code of Regulations
CDAA	California Disaster Assistance Act
CDBG	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CERV	Community Emergency Response Volunteers
CFR	Code of Federal Regulations
CGS	California Geological Survey
CHP	California Highway Patrol
CIP	Capital Improvement Plan
CoSMoS	USGS Coastal Storm Modeling System
County	Monterey County
COVID-19	Coronavirus Disease 2019
CRS	Community Rating System
CSUMB	California State University, Monterey Bay
DFIRM	Digital Flood Insurance Rate Map
DHS	Department of Homeland Security
DMA	Disaster Mitigation Act of 2000
DSOD	California Division of Safety of Dams
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EEW	Earthquake Early Warning
EOP	Emergency Operations Plan
EPA	US Environmental Protection Agency

ACRONYMS AND ABBREVIATIONS

ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHSZ	Fire Hazard Severity Zones
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance Program
FMAG	Fire Management Assistance Grant
FMMP	Farmland Mapping and Monitoring Program
FPD	Fire Protection District
FRA	Federal Responsibility Area
FRAP	Fire and Resource Assessment Program
GIS	Geographic Information System
HHPD	High Hazard Potential Dams
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
IBC	International Building Code
JPA	Joint Powers Authority
LHMP	Local Hazard Mitigation Plan
LRA	Local Responsibility Area
M1W	Monterey One Water
MBARI	Monterey Bay Aquarium Research Institute
MBNMS	Monterey Bay National Marine Sanctuary
MCI	Multiple Casualty Incident
MCOE	Monterey County Office of Education
MCWRA	Monterey County Water Resources Agency
MHHW	Mean Higher High Water
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MM	Modified Mercalli Scale
MPRPD	Monterey Peninsula Regional Park District
MPWMD	Monterey Peninsula Water Management District
MRWMD	Monterey Regional Waste Management District
MST	Monterey-Salinas Transit
NCRIC	Northern California Regional Intelligence Center
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NIMS	National Incident Management System

ACRONYMS AND ABBREVIATIONS

NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NTWC	National Tsunami Warning Center
NWS	National Weather Service
OES	Monterey County Office of Emergency Services
OPC	Ocean Protection Council
OPR	Governor's Office of Planning and Research
PBCSD	Pebble Beach Community Services District
PG&E	Pacific Gas and Electric
PGA	Peak Ground Acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PSPS	Public Safety Power Shut-off
RCDMC	Resources Conservation District of Monterey County
RCP	Representative Concentration Pathways
RL	Repetitive Loss
RWQCB	Regional Water Quality Control Boards
SARS	Severe Acute Respiratory Syndrome
SB	Senate Bill
SBA	Small Business Administration
SFHA	Special Flood Hazard Area
SGMA	Sustainable Groundwater Management Act
SHMP	State Hazard Mitigation Plan
SRA	State Responsibility Area
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
Steering Committee	Multi-Jurisdictional Hazard Mitigation Steering Committee
UBC	Uniform Building Code
URM	Unreinforced Masonry
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USFS	US Forest Service
USGS	US Geological Survey
WHO	World Health Organization
WMD	Weapons of Mass Destruction
WUI	Wildland Urban Interface

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EXECUTIVE SUMMARY

HAZARD MITIGATION OVERVIEW

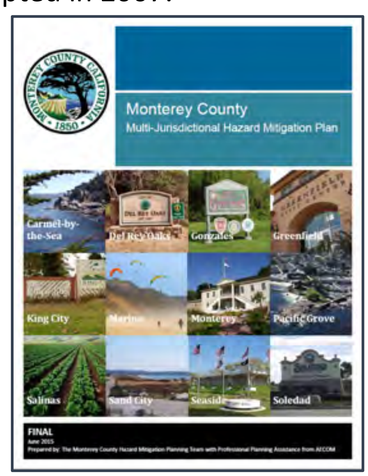
Monterey County is vulnerable to a wide range of natural and manmade hazards. These hazards can threaten the life and safety of residents and visitors and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life. While the threats from hazard events may never be fully eliminated, there is much we can do to lessen their potential impact on our communities. By minimizing the damaging impacts of hazards upon our built environment, we can prevent such events from resulting in disasters. The concept and practice of reducing risks to people and property from known hazards is called hazard mitigation.

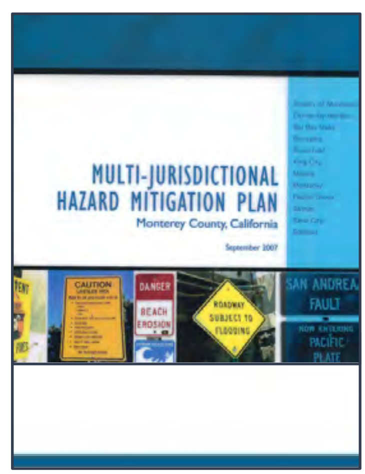
Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to alleviate the death, injury, and property damage that can result from a disaster. Monterey County and a partnership of local governments within the County have developed a hazard mitigation plan to reduce risks from natural disasters in the Monterey County Operational Area—defined as the unincorporated county and incorporated jurisdictions within the geographical boundaries of the County. The plan complies with federal and state hazard mitigation planning requirements to establish eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs.

UPDATING THE MONTEREY COUNTY PLAN

This plan is a comprehensive update of the 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan, which covered the unincorporated county, 12 municipalities and 2 special purpose districts. FEMA approved the 2016 plan on March 7, 2016, and it expired on March 7, 2021, the current update meets federal requirements for updating hazard mitigation plans on a five-year cycle. It represents the third iteration of the Monterey County Multi-Jurisdictional Hazard Mitigation Plan, which was initially adopted in 2007.

This Plan was prepared in coordination with FEMA and the California Office of Emergency Services (Cal OES) to ensure that it meets all applicable federal and state requirements. This includes conformance with FEMA's latest Local Mitigation Planning Handbook (released March 2013) and Local Mitigation Plan Review Guide (released October 2011).





GUIDING PRINCIPLE

The following guiding principle was created and agreed upon by the participants to represent the overall intended outcome of the Plan:

Reduce the risk to life and property in Monterey County in an efficient and effective manner by decreasing the long-term vulnerability from hazards through coordinated planning, partnerships, capacity building, and implementation of effective risk reduction measures.

SCOPE AND AUTHORITY

The Monterey County Multi-Jurisdictional Hazard Mitigation Plan geographically covers the entire area of Monterey County and has multiple participating jurisdictions. This includes Monterey County, 12 incorporated municipalities, and 5 special districts, hereinafter referred to as "participating jurisdictions."

- Unincorporated Monterey County
- Monterey County Water Resources Agency (MCWRA) (Included with unincorporated Monterey County)
- City of Carmel-by-the-Sea
- City of Del Rey Oaks
- City of Gonzales
- City of Greenfield
- City of King
- City of Marina
- City of Monterey
- City of Pacific Grove
- City of Salinas
- City of Sand City
- City of Seaside
- City of Soledad
- Carmel Area Wastewater District (CAWD)
- Monterey Regional Waste Management District (MRWMD)
- Monterey One Water (M1W)
- Moss Landing Harbor District

Representatives from each participating jurisdiction formed a core planning team, referred to as the Steering Committee, in order to drive the development of the plan update. The Steering Committee was at the core of the MJHMP planning process and was integral to ensuring its success, its implementation, and its future maintenance. The Plan addresses those hazards determined to be of primary or secondary concern to each jurisdiction, as documented in the risk assessment portion of this Plan. Other hazards that pose a low risk or are otherwise omitted from this Plan will continue to be evaluated during future plan updates, but they may not be fully addressed until they are determined to be of primary or secondary concern to Monterey County. Individual entities are still able to, and are encouraged to, continue to address, and plan for those other hazards as may be appropriate within their jurisdictions.

This Plan must be adopted by all participating jurisdictions in accordance with the authority and police powers granted to local governments under Article 11 of the California Constitution. This Plan was developed in accordance with current federal rules and regulations governing local hazard mitigation plans. The Plan shall be monitored and updated on a routine basis to maintain compliance with the following legislation: Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (Public Law 106-390) and by FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201.

PLAN STRUCTURE

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole County.

Volume 1 includes the federally required elements of a hazard mitigation plan for all participating jurisdictions. This includes the description of the planning process, public involvement strategy, hazard risk assessments, countywide mitigation actions, and a plan maintenance strategy. Since this is a multi-jurisdictional plan, **Volume 1** addresses the entirety of Monterey County, which includes all participating jurisdictions and the entire geographic boundary of the County.

Volume 2 contains the Jurisdictional Annexes, which detail the hazard mitigation planning elements specific to each participating jurisdiction in the Monterey County MJHMP Update and includes all federally required jurisdiction-specific elements for each participating jurisdiction. Each annex is not intended to be a standalone document, but annexes to, supplements, and incorporates by reference the information contained in **Volume 1** of the Plan. As such, all information in **Volume 1**, including the planning process and other procedural requirements and planning elements apply to and were met by each participating jurisdiction. The Annexes provide additional information specific to each participating jurisdiction, with a focus on providing additional details on the risk assessment and mitigation strategy.

All participating jurisdictions will adopt Volume 1 in its entirety and their own jurisdiction-specific annex in Volume 2.

RISK ASSESSMENT

Risk assessment is the process of measuring the potential loss of life resulting from natural hazards, as well as personal injury, economic injury, and property damage, in order to determine the vulnerability of people, buildings, infrastructure, and the environment to natural hazards. For this update, risk assessment models were enhanced with new data and technologies that have become available since 2016. The Steering Committee used the risk assessment to rank risk and to gauge the potential impacts of each hazard of concern in the Operational Area. The risk assessment included the following:

- Hazard identification and profiling
- Assessment of the impacts on physical, social, environmental, and economic assets
- Identification of particular areas of vulnerability
- Estimates of the cost of potential damage.

Based on the risk assessment, hazards were ranked for the risk they pose to the overall Operational Area.

Ranking	Hazard	Degree of Risk
1	Drought & Water Shortage	High
2	Earthquake	Substantial
3	Pandemic	Substantial
4	Wildfire	Substantial
5	Epidemic	Substantial
6	Cyber-Attack	Substantial
7	Utility Interruption/ PSPS	Substantial
8	Localized Stormwater Flooding	Substantial
9	Severe Winter Storms	Substantial
10	Water Contamination	Moderate
11	Windstorms	Moderate
12	Hazardous Materials Incident	Moderate
13	Agricultural Emergencies	Moderate
14	Riverine Flooding	Moderate
15	Sea Level Rise	Moderate
16	Slope Failure	Moderate
17	Flash Flood	Moderate
18	Extreme Heat	Moderate
19	Coastal Flooding	Moderate
20	Coastal Erosion	Moderate
21	Targeted Violence	Possible
22	Invasive Species	Possible
23	Terrorism	Possible
24	Dam Failure	Possible
25	Extreme Cold & Freeze	Possible
26	Mass Migration	Possible
27	Tsunami	Possible
28	Levee Failure	Possible

MITIGATION GOALS

The Steering Committee reviewed and updated the goals from the 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan and confirmed a set of goals. The Steering Committee and planning partners established the following goals for the plan update:

Goal #1	Minimize risk and vulnerability of Monterey County to hazards and protect lives and prevent losses to property, public health, economy, and the environment.
Goal #2	Increase the resilience of infrastructure and critical facilities and reduce long-term vulnerabilities of existing and future critical facilities, property, infrastructure, and high hazard potential dams due to natural hazards.
Goal #3	Build and support capacity to enable local government and the public to prepare for, respond to, and recover from the impact of natural hazards.
Goal #4	Encourage the development and implementation of long-term, cost-effective, and environmentally sound mitigation projects.
Goal #5	Promote and implement hazard mitigation policies and projects that are consistent with state, regional, and local climate action, and adaptation goals.
Goal #6	Inform the public on the risk from hazards of concern and increase awareness, preparation, mitigation, response, and recovery activities to promote public safety.
Goal #7	Enhance codes and their enforcement where feasible, so that new construction can withstand the impacts of known hazards and to lessen the impact of development on the environment’s ability to absorb the impact of natural hazards.
Goal #8	Consider the impacts of known hazards in all planning mechanisms that address current and future land uses within the County.
Goal #9	Establish a partnership among all levels of government and the business community to improve and implement methods to protect property.
Goal #10	Encourage hazard mitigation measures that promote and enhance natural processes and minimize adverse impacts on the ecosystem.

HAZARD PROBLEM STATEMENTS

As part of the planning process, the Steering Committee and planning partners identified key vulnerabilities and hazards of concerns applicable to the entire County. Hazard Problem Statements helped the Steering Committee identify common issues and weaknesses, determine appropriate mitigation strategies, and understand the realm of resources needed for mitigation. The update process resulted in the identification of unique hazard problem statements by individual planning partners, as presented in **Volume 2** of this plan.

In addition, the Steering Committee and planning partners identified countywide problem statements. The Countywide Hazard Problem Statements were based on the risk assessments, the risk prioritization process, the vulnerability analysis, and local knowledge, as well as the jurisdiction specific problem statements and community and stakeholder input.

Countywide Hazard Problem Statements are identified below:

Drought & Water Shortage

In Monterey County, water supply is extremely limited during non-drought years. As such, droughts are a serious threat in the County and could have devastating impacts on the agricultural industry, a major economic driver and job provider. Additionally, prolonged periods of drought can reduce water available for residential users and increase water prices. Governing authorities have been established to limit water use and protect water supply. Procurement of water credits/rights may limit new development necessary to meet increasing housing demands. Periods of drought also lead to increased pumping of groundwater wells, which can exacerbate sea water intrusion into the aquifer, increase land subsidence risks, and effect water quality. Contamination of drinking water, though unlikely, could be catastrophic. Drought conditions are likely to increase in future climate change scenarios.

Earthquake

Monterey County has several fault systems, including three major active faults: The San Andreas Fault, the Palo Colorado-San Gregorio Fault, and the Monterey Bay-Tularcitos Fault. Due to the location of population centers and building history in the County, any large earthquake will likely have significant impacts on people, property, and critical infrastructure including water systems, telecommunications infrastructure, roads, bridges, healthcare systems, and utilities. Damages and debris could isolate large populations from these critical lifelines. Older unreinforced-masonry structures in the County are particularly vulnerable to earthquake risk. An earthquake can also produce cascading impacts due to urban conflagration, wildfires, seiches, landslides, tsunamis, dam failure, and levee failure.

Pandemic/ Epidemic

The whole population of Monterey County is vulnerable to disease. The impacts of the COVID-19 Pandemic on the County have demonstrated the catastrophic risks that can be associated with large-scale disease outbreaks. Critical healthcare systems can become overwhelmed, limiting access to life-saving medical services. Continuity of government due to impacted workforces can result in limitations to essential government services. Disease outbreaks can place a disproportionate burden on the County's most vulnerable populations. Additionally, due to the large number of transient populations, such as tourists and migrant farmworkers, eradication of any new disease outbreak can be difficult without significant impacts to industry and the local economy.

Wildfire

California, and subsequently Monterey County, is in cycle of extreme heat, drought, and fire, all amplified by climate change. Wildfires are a natural part of the California environment; however, fire behavior has increased in frequency, size, and impact from longer wildfire "seasons." Deferred vegetation management and population sprawl in the wildland urban interface and intermix, have increased probability and impact of wildfires. Sudden oak death and invasive species have created unhealthy forests. Large wildfires, such as the 2020 Wildfires in Monterey County, can cause housing inventories to become significantly limited thus increasing the demand on the housing market; additionally, many property owners have been unable to obtain or retain fire insurance at an affordable price or at all. Pre-existing water supply challenges in the County can lead to limited water available for fire suppression.

Cyber-Attack

Nearly every aspect of life in Monterey County is dependent on systems and resources connected and managed through computer systems. Cyber-attacks can have catastrophic impacts on the ability of government, public and private entities to access banking, electricity, water, telecommunications, transportation, and other information systems necessary for survival. Due to the tightly coupled nature of technological system and critical lifelines, any failure of service continuity could cost lives.

Utility Interruption/ PSPS

Heat-related equipment failures and electrical infrastructure igniting wildfires has resulted in unintentional and intentional rolling blackouts and power shutoffs throughout the County. Public Safety/ Utility Initiated Power Shut Offs to prevent wildfire ignition can have notably significant impacts due to the length of disruption time, limited efficacy of the strategy, and the effect on first responder capabilities. Extreme and prolonged heatwaves across the state increase the demand for use of the aging electrical grid, significantly depleting electricity reserves resulting in blackouts. Heatwaves are expected to increase in intensity and magnitude due to climate change, which will likely exacerbate this problem. Traditional energy sources increase climate change risk and are failing more consistently, but energy alternative technology cannot meet current nighttime demand.

Additionally, Monterey County has limited microgrids and reliance on the macro-grid makes the County vulnerable to rolling and prolonged power outages. Over the last decade Monterey County residents have begun adjusting to the increasing unreliability of macro utilities. Loss of power for more than a few hours can result in large economic losses, specifically related to food and agriculture. More vulnerable populations in isolated areas or who rely on medical devices are at increased risk during prolonged power outages.

Localized Stormwater Flooding

Localized flooding has the potential to significantly impact people, property, and critical infrastructure in the County. Undersized and aging drainage infrastructure, deferred maintenance, increased run-off due to drought conditions, the built environment, and trends in precipitation and weather can all increase the risk of localized stormwater flooding. Climate change is likely to exacerbate the intensity and magnitude of precipitation events, increasing the risk associated with localized stormwater flooding causing drainage infrastructure to be undersized in increasingly more common events.

Additionally, unhoused residents living in stormwater drainage areas can lead to increasing flood risk due to accumulated debris and trash, which can complicate both flood response and mitigation activities.

Severe Winter Storms

Severe winter storms have been increasing in intensity, magnitude, and severity in Monterey County and are associated with a variety of hazards in this Plan. Severe winter storms and heavy rain can have significant impacts including flash flooding, localized stormwater flooding, mudslides, and landslides. Secondary hazards can cause immobility and loss of utilities. Roads may become impassable due to flooding, downed trees, or landslides. Power lines may be downed due to high winds, and services such as water or telecommunications infrastructure may not be able to operate without power.

Stormwater runoff from heavy rains can also impair water quality by washing pollutants into water bodies. Severe winter storms can also cause large storm surge and wave action along the coastline, flooding low lying areas and causing dramatic erosion. Coastal bluff and cliff failure due to erosion can create hazardous conditions due to roadway collapse, undermined home foundations and damage to utilities. Additionally, future sea level rise scenarios are likely to exacerbate coastal and inland flood risks during winter storms.

Road Infrastructure

The occurrence of any hazard profiled in this Plan in combination with aging and limited road infrastructure can result in limited egress of evacuees and minimal ingress of first responders. Roadways can be compromised in severe weather incidents, further limiting road capacity. Road infrastructure is not developing at a rate commensurate with the rate that population and housing is expanding. Further, the topography of the County limits where new roads can be built.

MITIGATION ACTION PLAN

The Steering Committee and planning partners selected a range of appropriate mitigation actions to work towards achieving the goals set forth in this plan update, in addition to reducing risks identified in the problem statements. Mitigation actions presented in this update are activities designed to reduce or eliminate losses resulting from hazards. The update process resulted in the identification of mitigation actions for implementation by individual planning partners, as presented in **Volume 2** of this plan.

The Steering Committee reviewed the catalogs of hazard mitigation alternatives and selected area-wide actions to be included in a hazard mitigation action plan. The selection of area-wide actions was based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives. The countywide hazard mitigation action plan was designed to benefit the whole partnership. The countywide Hazard Mitigation Action Plan includes the following mitigation actions:

Hazard	Mitigation Action
Drought	Provide public information on water conservation and assess the potential for community-wide water conservation programs.
Earthquake	Provide information on earthquake risk and preparedness to the public. Continue to adopt and implement current earthquake building standards and upgrade, remove, or replace unreinforced masonry buildings, as feasible.
Pandemic/ Epidemic	Provide unified information to the public regarding personal protective measures and mitigating strategies in accordance with CDC guidelines. Implement public health measures in government facilities.
Wildfire	Continue to collaborate across the operational area with all jurisdictions with fire protection and suppression responsibility on wildfire mitigation efforts.
Cyber-Attack	Seek to increase redundancy in IT infrastructure, implement protective cyber-security measures, and train staff on common cyber-attack methods.
Utility Interruption	Encourage the development of and use of microgrids and the hardening of utility of infrastructure, where possible. Provide backup generators for critical infrastructure and facilities.
Localized Stormwater Flooding	Maintain good standing in the National Flood Insurance Program and encourage coordination on drainage system maintenance.
Severe Winter Storms	Maintain StormReady and TsunamiReady certification, as applicable.
Climate Change	Support, encourage, and implement, when feasible, countywide climate action, adaptation, and resiliency initiatives.
All Hazards	Incorporate and make consistent other planning documents with appropriate goals, policies, and objectives to address hazards identified within the Multi-Jurisdictional Hazard Mitigation Plan.

IMPLEMENTATION

The Steering Committee developed a plan implementation and maintenance strategy that includes annual progress reporting, a strategy for continued public involvement, a commitment to plan integration with other relevant plans and programs, and a commitment to actively maintain the plan over the performance period. Full implementation of the recommendations of this plan will require time and resources. The measure of the plan's success will be its ability to adapt to changing conditions. The planning partners will assume responsibility for adopting the recommendations of this plan and committing resources toward implementation. The framework established by this plan commits all planning partners to pursue actions when the benefits of a project exceed its costs. The planning partnership developed this plan with extensive public input and support to help ensure the plan's success.

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PART A: PLANNING AND COMMUNITY PROFILE

THIS PART PROVIDES AN OVERVIEW OF THE MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN, THE PLANNING PROCESS, AND COMMUNITY OF MONTEREY COUNTY. IT CONSISTS OF THE FOLLOWING SECTIONS:

1. INTRODUCTION
2. PLANNING PROFILE
3. COMMUNITY PROFILE

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1. INTRODUCTION

Disasters can cause loss of life, damage buildings and infrastructure, and have devastating consequences for a community's economic, social, and environmental well-being. Nationwide, federal, state, and local governments spend billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. This only partially reflects the true cost of disasters because additional expenses are incurred by insurance companies, nongovernmental organizations, non-profits, and individuals, which are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be reduced or even eliminated.

Hazard mitigation reduces disaster losses and damages. The term "hazard mitigation" is defined as sustained action or strategy taken to reduce or eliminate the long-term risk to human life and property from hazards. After disasters, repairs and reconstruction often are completed in such a way as to simply restore damaged property to pre-disaster conditions. These efforts may return property and infrastructure to "the norm," but the replication of pre-disaster conditions may result in a repetitive cycle of damage and reconstruction. Hazard mitigation planning can break this repetitive cycle by reducing vulnerability to hazards through smart construction and proper planning of future development and critical infrastructure.

Mitigation activities can be developed, planned, and implemented before or after a disaster occurs. Hazard mitigation activities involve long- and short-term actions and include planning efforts, policy changes, programs, studies, improvement projects, and other steps to reduce the impacts of hazards. Implementing fuel reduction around buildings within high wildfire risk areas, outreach programs that increase risk awareness, projects to protect critical facilities, and the removal of structures from flood hazard areas are all examples of mitigation actions. Local mitigation actions and concepts can also be incorporated into land use plans and building codes. Proactive mitigation policies and actions help reduce risk and create safer, more disaster resilient communities. Mitigation is an investment in the future safety and sustainability of Monterey County.

Monterey County and participating jurisdictions have prepared this update to the Monterey County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), which was originally approved by the California Governor's Office of Emergency Services (Cal OES) and the Federal Emergency Management Agency (FEMA) in 2007 and updated in 2016. The plan in its current form reflects a comprehensive update in 2021. The purpose of this plan is to guide hazard mitigation planning in Monterey County in order to better protect the people and property from the effects of hazard events.

This plan demonstrates the commitment of each participating jurisdiction to reducing risks from hazards through mitigation and serves as a tool to direct resources to achieve optimum results with available administrative, technical, and financial resources. The plan will help guide and coordinate mitigation activities throughout Monterey County. This plan was also developed to ensure Monterey County and participating jurisdictions' continued eligibility for certain federal disaster assistance, specifically the FEMA Hazard Mitigation Assistance (HMA) grants, including the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC), and Flood Mitigation Assistance Program (FMA).

1.1 HAZARD MITIGATION PLANNING

Mitigation is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. The hazard mitigation plan provides an assessment of hazards, vulnerabilities, and risks prevalent in Monterey County and how those hazards may affect participating jurisdictions differently based upon proximities to hazards.

Mitigation actions are identified based on that risk assessment and the participation of a wide range of stakeholders and the public in the planning process. The mitigation strategy presented in this plan responds to the identified vulnerabilities within each community and provides actions to achieve the greatest risk reduction based upon available resources.

1.1.1 REGULATORY FRAMEWORK

For many years, federal disaster funding focused on relief and recovery after disasters occurred, with limited funding for hazard mitigation planning. The purpose of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 100-707), as amended by the Disaster

Mitigation Act of 2000 (Public Law 106-390), is to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters.

The Disaster Mitigation Act (DMA 2000) shifted the federal emphasis toward planning for disasters before they occur and requires proactive pre-disaster planning as a condition of receiving certain federal financial assistance under the Stafford Act. Regulations developed to fulfill the Disaster Mitigation Act's requirements are included in Title 44 of the Code of Federal Regulations (44 CFR). The Disaster Mitigation Act encourages state and local authorities to work together on pre-disaster planning and to assist local governments in accurately assessing mitigation needs, resulting in faster allocation of funding and more cost-effective risk reduction projects under FEMA's Hazard Mitigation Assistance program.

The Disaster Mitigation Act requires the plan be updated every five years to remain in compliance with federal mitigation grant conditions. Grant compliance is contingent on meeting the plan update requirements that are contained in 44 CFR. Jurisdictions that allow a plan to expire are not able to pursue funding under the Stafford Act for which a current hazard mitigation plan is a prerequisite.

Federal regulations require a plan for monitoring, evaluating, and updating hazard mitigation plans. The plan update process provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies over time.

1.1.2 BENEFITS OF MITIGATION PLANNING

All citizens and businesses of Monterey County are the ultimate beneficiaries of hazard mitigation planning. This Plan seeks to reduce risk for those who live in, work in, and visit the County and provides a viable planning framework for all foreseeable hazards that may impact the County. Benefits of mitigation planning include:

- Identifying actions for risk reduction that are agreed upon by stakeholders and the public.
- Focusing resources on the greatest risks and vulnerabilities.
- Building partnerships by involving citizens, organizations, and businesses.
- Increasing education and awareness of threats and hazards, as well as their risks.
- Communicating priorities to State and Federal officials.
- Aligning risk reduction with other community objectives.

1.2 PURPOSE OF PLANNING AND THE PLAN UPDATE

The Monterey County Multi-Jurisdictional Hazard Mitigation Plan identifies resources, information, and strategies for reducing risk from hazards. Monterey County and the local jurisdictions that participated as planning partners initiated this planning effort for several key reasons. Monterey County has significant exposure to numerous hazards that have led to injuries and loss of life, in addition to millions of dollars in past damages. The planning partners want to be proactive in preparing for the probable impacts of hazards. Finally, limited local resources make it difficult to implement proactive risk-reduction measures. Federal and state financial assistance is paramount to successful hazard mitigation in the County. Elements and strategies in the MJHMP were selected because they best meet the needs of the planning partners and their citizens. The resources and background information in the plan are applicable countywide, and the Plan's goals and recommendations can lay the groundwork for the development and implementation of local mitigation activities and partnerships.

As a DMA 2000 requirement, the plan must be updated every five years to remain in compliance with federal mitigation grant conditions. Monterey County first prepared a hazard mitigation plan in compliance with the Disaster Mitigation Act in 2007. The 2016 update to the Monterey County Multi-Jurisdictional Hazard Mitigation Plan was prepared by Monterey County Office of Emergency Services (OES) and AECOM. This plan is the update to the previous iterations of the plan and was updated with funding support from a FEMA Hazard Mitigation Grant Program Planning Grant (DR-4382-PL0025).

1.2.1 OBJECTIVES OF THE PLAN UPDATE

The 2021 update to the Monterey County Multi-Jurisdictional Hazard Mitigation Plan will help guide and coordinate mitigation activities and was developed to meet the following objectives:

- Meet or exceed the requirements of the Disaster Mitigation Act the and the 2015 California legislation requiring the incorporation of climate adaptation strategies into hazard mitigation planning (SB 379).
- Meet the needs of each planning partner as well as state and federal requirements.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Create a risk and vulnerability assessment that focuses on local hazards of concern.
- Identify a comprehensive and integrated mitigation strategy for long term risk reduction.
- Meet the planning requirements of FEMA's Community Rating System (CRS) program, allowing planning partners that participate in the CRS program to maintain or enhance their classifications.
- Coordinate existing plans and programs so that high-priority projects to mitigate possible disaster impacts are funded and implemented.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the County.

1.2.2 PARTICIPATING JURISDICTIONS

The County prepared this update in partnership with local municipalities and special districts. One of the benefits multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities.

Any local government or non-profit agency with the ability to regulate building or infrastructure development or maintenance may participate in the planning process. However, to obtain FEMA approval, each of the local jurisdictions must meet all FEMA planning requirements outlined in 44 CFR Section 201.6.

The Monterey County Multi-Jurisdictional Hazard Mitigation Plan geographically covers the entire area of Monterey County and has multiple participating jurisdictions. A planning partnership was formed to develop and steer the content in this plan. This partnership consists of participating jurisdictions and Monterey County stakeholders. Partners worked together to create the goals, objectives, mitigation strategies, and implementation methods to reduce risk.

The following municipal jurisdictions have elected to become annexes of this plan update:

- Unincorporated Monterey County (and Monterey County Water Resources Agency)
- City of Carmel-by-the-Sea
- City of Del Rey Oaks
- City of Gonzales
- City of Greenfield
- City of King
- City of Marina
- City of Monterey
- City of Pacific Grove
- City of Salinas
- City of Sand City
- City of Seaside
- City of Soledad

Additionally, the following special districts have elected to become annexes of this plan update:

- Monterey County Water Resources Agency (MCWRA) (in unincorporated annex)
- Carmel Area Wastewater District (CAWD)
- Monterey Regional Waste Management District (MRWMD)
- Monterey One Water (M1W)
- Moss Landing Harbor District

All jurisdictions listed above participated in and were annexes to the 2016 Monterey County MJHMP, with the exception of the Monterey Regional Waste Management District (MRWMD) and the Moss Landing Harbor District, which are new to the 2022 Plan.

1.3 CONTENTS OF THE PLAN

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole County.

Volume 1: Countywide Hazard Mitigation Plan

Volume 1 includes the federally required elements of a hazard mitigation plan for all participating jurisdictions. This includes the description of the planning process, public involvement strategy, hazard risk assessments, countywide mitigation actions, and a plan maintenance strategy. Since this is a multi-jurisdictional plan, **Volume 1** addresses the entirety of Monterey County, which includes all participating jurisdictions and the entire geographic boundary of the County. **Volume 1** includes the following appendices:

- Appendix 1: Plan Adoption Resolutions from Planning Partners
- Appendix 2: Plan Progress Report Template

Volume 2: Jurisdictional Annexes

Volume 2 contains the Jurisdictional Annexes, which detail the hazard mitigation planning elements specific to each participating jurisdiction in the Monterey County MJHMP Update and includes all federally required jurisdiction-specific elements for each participating jurisdiction. Each annex is not intended to be a standalone document, but annexes to, supplements, and incorporates by reference the information contained in **Volume 1** of the Plan. As such, all information in **Volume 1**, including the planning process and other procedural requirements and planning elements apply to and were met by each participating jurisdiction. The Annexes provide additional information specific to each participating jurisdiction, with a focus on providing additional details on the risk assessment and mitigation strategy. Jurisdictional Annexes in **Volume 2** are organized in the following order:

A Unincorporated County of Monterey (and Monterey County Water Resources Agency)
B City of Carmel-by-the-Sea
C City of Del Rey Oaks
D City of Gonzales
E City of Greenfield
F City of King
G City of Marina
H City of Monterey
I City of Pacific Grove
J City of Salinas
K City of Sand City
L City of Seaside
M City of Soledad
N Carmel Area Wastewater District
O Monterey One Water
P Monterey Regional Waste Management District
Q Moss Landing Harbor District

All participating jurisdictions will adopt **Volume 1** in its entirety and their own jurisdiction-specific annex in **Volume 2**. It should also be noted that the Monterey County Water Resources Agency as a dependent special district is covered under the Unincorporated Monterey County Annex. The Agency participated extensively in both the Steering Committee and the unincorporated County Hazard Mitigation Planning Team. The Plan will also be adopted by the Monterey County Water Resources Agency Board, in addition to its adoption by the Monterey County Board of Supervisors.

1.3.1 WHAT'S NEW?

In 2016, the County met all approval requirements from the DMA and officially adopted an update to the 2007 MJHMP. The 2016 Monterey County MJHMP contained descriptions of their planning processes, risk assessments of identified hazards, and mitigation strategies for reducing the risk and vulnerability from these hazards. Since the approval of the 2016 MJHMP by Cal OES and FEMA, progress has been made by the County and the participating jurisdictions on implementation of the mitigation strategies. As part of the update process, a thorough review and update of the 2016 MJHMP was conducted to ensure that this update reflects current community conditions and priorities in order to realign the updated mitigation strategy for the next five-year planning period.

Also, to be noted, **Section 8**, *Plan Maintenance* of the 2016 MJHMP and **Section 22**, *Plan Implementation and Maintenance*, of this MJHMP update identify key questions to be considered as criteria for assessing the effectiveness and appropriateness of the Plan during future plan updates. Questions include:

- Do the goals address current and expected conditions?
- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the Plan?
- Are there implementation problems, such as technical, political, legal, or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did the jurisdictions, agencies, and other partners participate in the plan implementation process as proposed?

Plan Reorganization

For this Plan update, a new plan organization was used. The hazard section was reorganized, combining Hazard Analysis and Vulnerability Analysis sections from the previous plan by hazard. This allowed for a simpler document flow, which allows the reader to gain a full picture of the risk of any given hazard profiled in this plan in one individual section.

Changes in Development

Hazard mitigation plan updates must be revised to reflect changes in development within the planning area during the previous performance period (44 CFR Section 201.6(d)(3)). The plan must describe changes in development in hazard-prone areas that increased or decreased vulnerability for each jurisdiction since the last plan was approved. The intent of this requirement is to ensure that the mitigation strategy continues to address the risk and vulnerability of existing and potential development and takes into consideration possible future conditions that could impact vulnerability.

Monterey County experienced a 5.8% increase in population between 2010 and 2020. Participating jurisdictions have adopted general plans that govern land use decisions and policymaking, as well as building codes and specialty ordinances based on state and federal mandates. This plan update assumes that some new development triggered by the increase in population occurred in hazard areas. Because all such new development would have been regulated pursuant to local programs and codes, it is assumed that vulnerability did not increase even if exposure did. Specific land use and development trends for each participating jurisdiction are included in their respective Annex in **Volume 2**. Risk assessments included update information on development in order to assess current exposure accurately.

New Hazards and Risk Assessment Methodology

The risk assessments for each identified hazard were updated. This included reworking the hazard profile, adding new hazard event occurrences, redoing the entire vulnerability analysis to add additional items, and updating the vulnerability assessment based on more recent hazard data as well as using the most current parcel and assessor data for the existing built environment to develop loss estimates.

The County strengthened this plan by using new research methods and information systems. Geographic Information Systems (GIS) mapping and updated critical infrastructure inventories provided the County the tools to develop more comprehensive data sets than those in the 2016 MJHMP. The FEMA National Risk Index was also used to enhance the risk assessment. The National Risk Index incorporates physical and social vulnerability data to identify communities more at-risk to the adverse impacts of natural hazards. The National Risk Index is a high quality, comprehensive data set that identifies a community’s risk to natural hazards.

The 2016 MJHMP addressed the following hazards: agricultural emergencies coastal erosion, dam failure, earthquake, flood (including coastal storm), a hazardous materials event, landslide, tsunami, wildfire, and windstorm. As part of the plan update process new hazards of concern were identified and included in this update. Some hazards were reorganized or expanded to include additional sub-hazards. New hazards and changes include:

- Levee Failure added to Dam Failure
- Land Subsidence added to Earthquake Section
- Flooding was expanded to also include Localized Stormwater Flooding and Flash Floods
- Landslide was renamed to Slope Failure to encompass a broader range of slope-based hazards
- Severe Weather added as a new section which included Windstorm in addition to Severe Winter Storms, Extreme Cold & Freeze, and Extreme Heat

- Public Health Hazards added and includes Pandemic and Epidemic
- Human Caused Hazards added and includes Cyber-Attack, Targeted Violence, Terrorism, and Mass Migration
- Utility Interruption added, including PSPS and Space Weather
- The 2016 MJHMP described the anticipated effects of climate change on all hazards, as applicable, and for this update Climate Change risk analysis was expanded and combined into its own Section
- Sea Level Rise was moved under the new Climate Change Section

Mitigation Actions

The 2016 mitigation actions were reviewed and have been changed, updated, and revised to reflect new priorities in this MJHMP. During this MJHMP update process, each of the 2016 mitigation actions were examined for relevancy and the potential for future implementation and then evaluated for potential follow-up. Some mitigation actions developed during the 2016 MJHMP effort are an inherent part of the MJHMP update process or were not detailed enough for implementation at a local jurisdiction level, and thus were not included in this update. The County has made significant changes to other 2016 Mitigation Actions because of the updated risk assessment and implementation strategy, to include more detail, or to update based on current mitigation practices.

During this MJHMP update process, the Steering Committee also decided to add countywide mitigation actions. These countywide actions were based on the highest rated hazards of concern the identified problem statements across the operational area. They were included in order to provide a high-level countywide mitigation strategy.

Mitigation Success Stories

The 2016 Monterey County MJHMP guiding principle, goals, objectives, and mitigation actions have been implemented through various ongoing projects, plans, and programs. The planning partners have made improvements toward reducing natural hazard risks to life and property, with significant risk reduction efforts for floodplain management, flood damage prevention, and fire hazard reduction. Throughout the hazard sections of the Plan, mitigation success stories were added in order to reflect on risk reduction successes that have occurred over the previous planning period. Mitigation success stories discussed in the Plan include:

- Section 5: Mitigating the Impact of the COVID-19 Pandemic to Farmworkers
- Section 7: San Clemente Dam Removal
- Section 10: Severe Repetitive Loss Property Elevation
- Section 10: Salinas River Stream Maintenance Program
- Section 14: City of Salinas Free Tree Program
- Section 15: Rain Rocks Shed/ Pitkin's Curve Bridge
- Section 18: Monterey Fire Defensible Space Inspection Program
- Section 19: City of Gonzales Growing Green

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2. PLANNING PROFILE

This section describes each stage of the planning process used to develop the Monterey County Multi-Jurisdictional Hazard Mitigation Plan. The planning process provides a framework for document development and follows the FEMA recommended steps as enumerated in federal regulation and outlined below.

FEMA recommends 4 major planning steps:

- Step 1: Organize Resources
- Step 2: Assess Risk
- Step 3: Develop a Mitigation Strategy
- Step 4: Adopt and Implement the Plan

This MJHMP is a community-driven, living document. The planning process itself is as important as the resulting plan because it encourages communities to integrate mitigation with day-to-day decision making. This section describes each stage of the planning process.

Multi-Jurisdictional Planning Process

Multi-jurisdiction hazard mitigation planning offers many benefits, such as increased coordination and efficiency in planning and implementation efforts. At the same time, each jurisdiction has specific hazards and specific mitigation actions that must be addressed individually. The MJHMP balances the benefits of a comprehensive, coordinated approach to hazard mitigation with the specific realities of individual participating jurisdictions.

Volume 2 of this MJHMP documents each jurisdiction's hazard mitigation planning process and resources. Each participating jurisdiction individually followed the same planning process as the countywide plan for their respective annex. ***Volume 2*** provides each participating jurisdiction's stand-alone annex.

2.1 PLANNING TIMELINE

The planning process began in April of 2019. The original intention was to start public outreach and the content update in January of 2020. Milestones and tasks affiliated with the FEMA planning steps set the original anticipated closeout date for March 2022. Planning efforts were suspended for approximately 12 months due to several moderate to catastrophic disasters in Monterey County in 2020 and 2021. These large events included the COVID-19 Pandemic, the 2020 River Fire, the 2020 Carmel Fire, the 2020 Dolan Fire, subsequent recovery efforts, and the 2021 Atmospheric River/Post-Fire Flood Flows.

After being suspended, the planning and update process resumed in March 2021, with an anticipated closeout date of July 2023. *Table 2-1* outlines the key milestones in the process.

Table 2-1
MJHMP Planning Timeline

Planning Stage	Start Date	End Date
Public Outreach	May 2019	February 2021
Planning Process	May 2019	March 2020
Planning and Update Process Suspended	March 2020	March 2021
Planning Process (Continued)	March 2021	January 2022
Update Process	March 2021	January 2022
Plan Review	February 2022	June 2022
Plan Adoption and Approval	July 2022	July 2023

2.1.1 THE STEERING COMMITTEE

In line with the first step of the recommended planning process, organizing resources, a Steering Committee was developed. Monterey County OES opened this planning effort to all eligible local governments and special districts within the County. Each jurisdiction wishing to join the planning partnership was asked to provide a designated a point of contact for the jurisdiction who would serve as the jurisdiction's Steering Committee representative, as well as confirm the jurisdiction's commitment to the process and understanding of expectations.

The Steering Committee was comprised of representatives from all participating jurisdictions who worked together to develop the MJHMP. Each jurisdiction's Steering Committee representative was also the lead for their respective Jurisdictional Hazard Mitigation Plan Stakeholder Team.

The Steering Committee was at the core of the MJHMP planning process and was integral to ensuring its success, its implementation, and its future maintenance. Members of the Steering Committee, listed in *Table 2-2*, represented jurisdictional leads from each planning partner.

Table 2-2
2022 MJHMP Steering Committee Members

Name	Agency/Jurisdiction	Title
Barbara Buikema	Carmel Area Wastewater District	General Manager
Paul Tomasi	City of Carmel-by-the-Sea	Police Chief
Chris Bourquin	City of Del Rey Oaks	Police Commander
Jeff Hoyne	City of Del Rey Oaks	Police Chief
Jason Muscio	City of Gonzales	Fire Chief
Jim Langborg	City of Greenfield	Fire Chief
Doreen Liberto	City of King	Community Development Director
Steve Adams	City of King	City Manager
Doug McCoun	City of Marina	Fire Chief
Gaudenz Panholzer	City of Monterey	Fire Chief
Alyson Hunter	City of Pacific Grove	Senior Planner
Skylar Thompson	City of Salinas	Fire Chief
Brian Ferrante	City of Sand City	Police Chief
Dave Nava	City of Seaside	Division Chief
Mary Gutierrez	City of Seaside	Fire Chief
George Nunez	City of Soledad	Fire Chief
John Dugan	Monterey County Housing and Community Development	Deputy Director of Land Use and Community Development
Kelsey Scanlon	Monterey County Office of Emergency Services	Emergency Services Planner
Jennifer Bodensteiner	Monterey County Water Resources Agency	Associate Hydrologist
Sarah Stevens	Monterey One Water	Compliance Analyst
David Ramirez	Monterey Regional Waste Management District	Senior Engineer
Tommy Razzeca	Moss Landing Harbor District	General Manager/ Harbormaster

The Steering Committee met throughout the development of the MJHMP update to discuss the MJHMP, its progress, and key planning elements. *Table 2-3* provides an overview of those meetings, including dates and topics discussed.

Agendas for all Steering Committee Meetings are included in **Appendix 3**.

Table 2-3
Steering Committee Meeting Schedule

Meeting	Date	Topics Discussed
Kick-Off Meeting	May 22, 2019	• Overview of Hazard Mitigation • Solicit Planning Partners • Plan Expectations and Timeline
Planning Meeting #1	January 22, 2020	• Hazard Mitigation Overview • Overview of Planning Process • Roles, Responsibilities, and Tasks • Public Outreach Strategy • Information Requirements
Planning Meeting #2	February 19, 2020	• Planning Process Schedule • Public Outreach Strategy • Community Profile Review • Information Requirements
Planning Meeting #3	March 2020	• Cancelled Due to COVID-19
Planning Meeting #4	April 2020	• Cancelled Due to COVID-19
Planning Meeting #5	May 2020	• Cancelled Due to COVID-19
Planning Meeting #6	July 15, 2020	• Progress Update • COVID-19 Restrictions • Timeline Changes
Planning Meeting #7	August 2021	• Cancelled Due to COVID-19
Planning Meeting #8	April 15, 2021	• Planning Process Timeline Update • Plan Reorganization and Hazard List • Upcoming Public Meetings and Survey • Jurisdiction Information Requirements
Planning Meeting #9	May 21, 2021	• Jurisdiction-Specific Planning Meetings • Information on Jurisdiction Annexes • Threat Hazard Risk Assessment
Planning Meeting #10	September 21, 2021	• Countywide Mitigation Strategy • Threat Hazard Risk Assessment Results • Countywide Mitigation Actions • Plan Maintenance Strategy • Jurisdiction Annexes Overview

Review and Incorporation of Existing Documents

The Steering Committee and the Monterey County OES Team reviewed and incorporated existing plans, studies, reports, and technical information in the formation of this MJHMP. Those documents are referenced throughout the hazard sections and are examined more closely in **Section 20**, *Capability Assessment*.

2.1.2 STAKEHOLDER ENGAGEMENT

Per 44 CFR Section 201.6(b)(2), the planning process included an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved.

In order to gather input from stakeholders on the risks and hazards facing Monterey County, the Threat Hazard Identification and Risk Assessment (THIRA) Survey, described in more detail in **Section 4**, *Risk Assessment Methods*, was sent out to neighboring communities, local and regional agencies, agencies that regulate development, businesses, academia, and other private and non-profit interests. Results from the survey were included with the rest of the Steering Committee and Jurisdiction results in the Countywide THIRA.

The agencies from whom stakeholders were invited to participate includes:

- American Red Cross
- American Water Works
- Association of Monterey Bay Area Governments (AMBAG)
- Big Sur Fire Brigade
- Cachagua Fire
- California American Water Company
- California Department of Fish and Wildlife
- California Department of Forestry and Fire Protection (CAL FIRE)
- California Department of Transportation (Caltrans)
- California Governor's Office of Emergency Services (Cal OES)
- California Highway Patrol (CHP)
- California State Parks
- California State University, Monterey Bay (CSUMB)
- Carmel Valley Recreation and Park District
- Castroville Community Services District
- Center for Ocean Solutions
- Central Coast Community Energy
- Central Coast Wetlands Group
- Community Emergency Response Volunteers (CERV) of the Monterey Peninsula
- Cypress Fire Protection District

- Elkhorn Slough National Reserve
- Gonzales Rural Fire Protection District
- Hartnell Community College
- Marina Coast Water District
- Mid Coast Fire Brigade
- Monterey Bay Aquarium Research Institute (MBARI)
- Monterey Bay Sanctuary Foundation
- Monterey County Office of Education
- Monterey County Regional Fire Protection District
- Monterey Peninsula Regional Park District (MPRPD)
- Monterey Peninsula Unified School District
- Monterey Regional Fire
- Monterey-Salinas Transit (MST)
- National Weather Service (NWS)
- Natural Resources Conservation Service (NRCS)
- Naval Postgraduate School
- North County Fire Protection District
- North County Recreation and Park District
- Pacific Gas & Electric (PG&E)
- Pajaro/Sunny Mesa Community Services District
- Pebble Beach Community Services District
- Resources Conservation District of Monterey County (RCDMC)
- Salinas Valley State Prison.
- San Ardo California Water District
- San Benito County
- San Lucas County Water District
- San Luis Obispo County
- Santa Cruz Country
- Santa Lucia Community Services District
- Soledad-Mission Recreation District
- SPCA for Monterey County
- Spreckels Community Services District
- The Nature Conservancy
- United Way Monterey County
- US Army Garrison- Presidio of Monterey
- US Army Garrison-Fort Hunter Liggett
- US Environmental Protection Agency (EPA)
- US Forest Service - Los Padres National Forest

2.1.3 JURISDICTION SPECIFIC PLANNING EFFORTS

Each jurisdiction conducted internal planning efforts with their individual jurisdiction planning teams to update their specific Annexes. These efforts were led by the Local Jurisdiction Lead who served as that jurisdiction's Steering Committee representatives. Each Jurisdictions respective Steering Committee representative established their own Jurisdiction Hazard Mitigation Plan Stakeholder Team. Jurisdiction-specific Stakeholder Teams included, as applicable, those deemed relevant for local hazard mitigation and disaster risk reduction efforts and often included representatives from the following departments: City Management, Economic Development, Fire Department, Floodplain Administration, IT, Parks & Recreation, Community Development, Police Department, and Public Works. Details on the members of each Jurisdiction Hazard Mitigation Plan Stakeholder Team is included in **Volume 2**.

Each participating jurisdiction held at least one Jurisdiction Hazard Mitigation Planning Meeting. At these meetings, the respective Hazard Mitigation Plan Stakeholder Team discussed hazard vulnerabilities, reviewed previous problem statements and mitigation strategies, and discussed their action plan. Each jurisdiction went through a risk ranking process using the Threat Hazard Risk Assessment (THIRA) Survey. This process is described in more detail in Section 4.4, *Hazard Prioritization and Risk Ranking*. Jurisdiction specific planning meetings are listed in *Table 2-4.*

Table 2-4
Jurisdiction-Specific Planning Meetings

Jurisdiction	Meeting Date	Location
City of Pacific Grove	May 5, 2021	Virtual
City of Carmel-by-the-Sea	June 15, 2021	Virtual
City of King	June 22, 2021	Virtual
City of Seaside	June 28, 2021	Virtual
City of Salinas	July 13, 2021	City of Salinas City Hall
City of Monterey	July 19, 2021	Virtual
Monterey One Water (MW1)	July 28, 2021	Regional Treatment Plant
Carmel Area Wastewater District (CAWD)	August 2, 2021	CAWD Offices
City of Soledad	August 18, 2021	City of Soledad City Hall
City of Sand City	August 24, 2021	City of Sand City City Hall
Unincorporated Monterey County	August 30, 2021	Virtual
City of Marina	August 31, 2021	Virtual
City of Gonzales	September 15, 2021	City of Gonzales Police Station
City of Del Rey Oaks	September 21, 2021	City of Del Rey Oaks City Hall
City of Greenfield	September 23, 2021	Virtual
Monterey Regional Waste Management District (MRWMD)	September 23, 2021	MRWMD Offices
Moss Landing Harbor District	September 27, 2021	Moss Landing Harbor
City of Salinas	October 5, 2021	City of Salinas City Hall

2.2 PUBLIC ENGAGEMENT

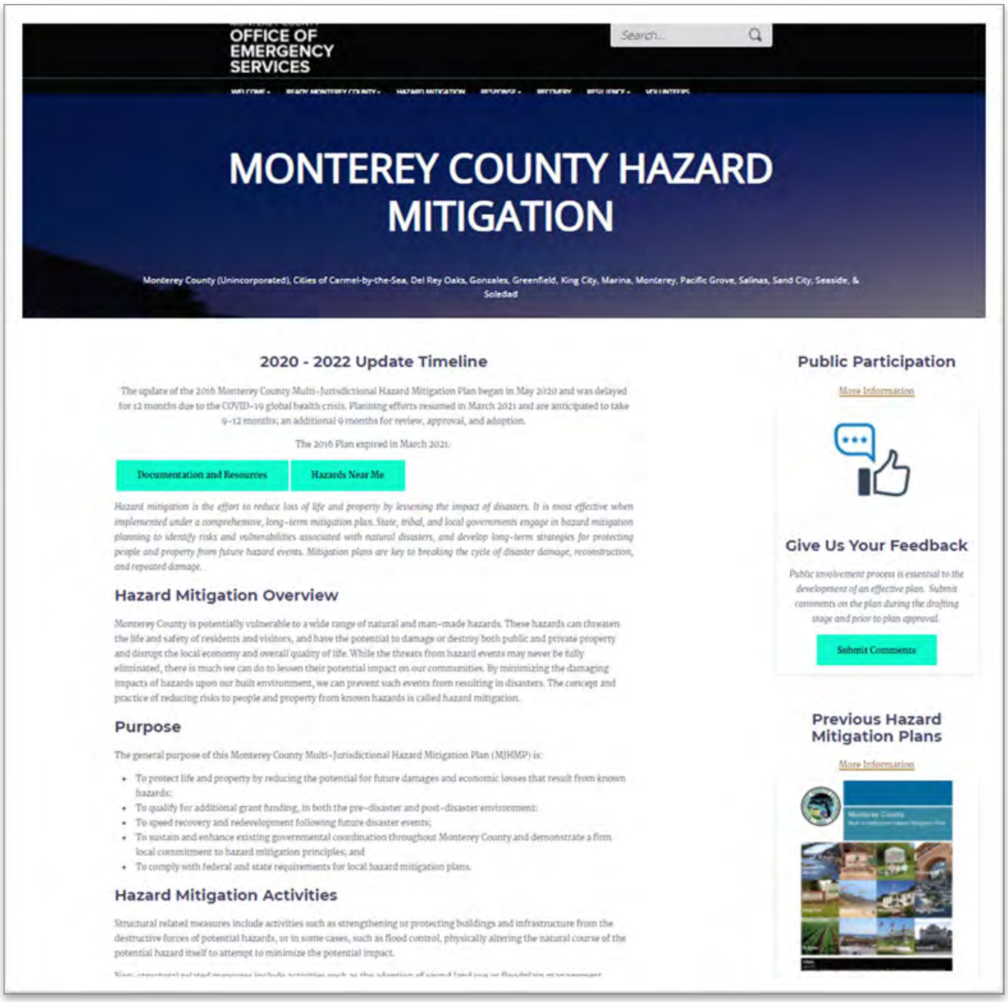
Broad public participation in the planning process helps ensure that diverse points of view are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The public involvement strategy used for this plan update introduced the concept of mitigation to the public and provided the Steering Committee with feedback to use in developing the plan.

Public outreach was a critical element of the plan update process, as Monterey County includes a broad range of communities with diverse citizenry, concerns, and needs. A plan that reflects the community's values and priorities is likely to have greater legitimacy and "buy-in" and greater success in implementing mitigation actions and projects to reduce risk. The public outreach strategy maximized involvement throughout the planning process.

Public stakeholders were given many opportunities to provide comment during all phases of the update process. The strategy for involving the public in this plan was a multi-pronged approach utilizing a dedicated website, a Community Survey, 7 Public Forums, and Public Presentations. Presentations were provided in Spanish upon request. The website and Survey were translated in Spanish to accommodate Spanish speaking community members.

2.2.1 WEBSITE

At the beginning of the plan development process, a website was created to keep the public posted on plan development milestones and to solicit relevant input. The site's address was publicized at all public meetings. Each planning partner established a link to this site on its own agency website. Information on the plan development process, the Steering Committee, the Survey, and drafts of the plan was made available to the public on the site throughout the process. Monterey County OES intends to keep the website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.



2.2.2 SURVEY

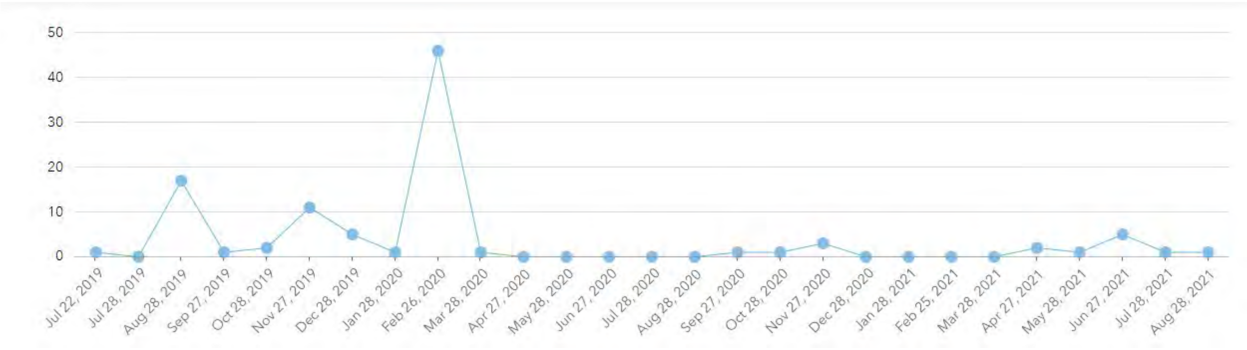
A hazard mitigation survey was developed, in both English and Spanish, by the planning team with guidance from the Steering Committee. The survey provided an opportunity for residents to share opinions regarding hazard mitigation and participate in the plan update process. The survey consisted of 30 questions and was made available on the hazard mitigation plan website and advertised throughout the course of the planning process. The survey was used to:

- Gauge the public's perception of risk and identify what citizens are concerned about.
- Identify the best ways to communicate with the public.
- Determine the level of public support for different mitigation strategies.
- Understand the public's willingness to invest in hazard mitigation.

The survey was open for public participation from July 22, 2019, to August 28, 2021, and 100 completed surveys were submitted.

Data suggests a direct correlation between public outreach efforts and survey participation as seen in *Figure 2-1.*

Figure 2-1
Survey Responses to Date



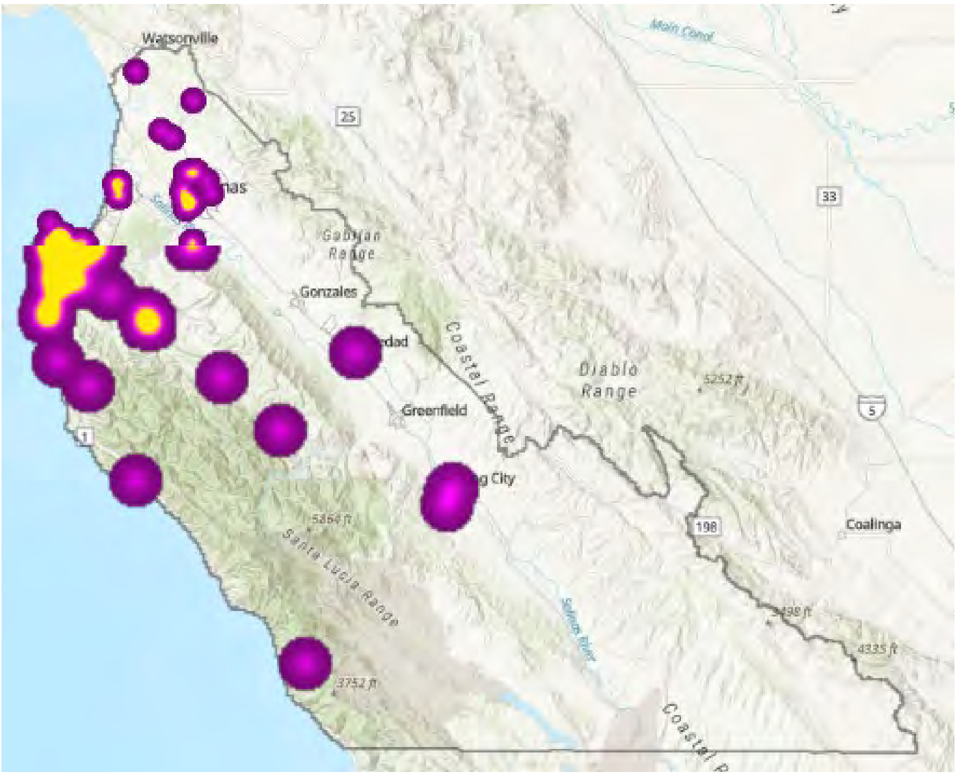
Survey respondents represented a broad range of geographical areas. *Table 2-5* summarizes the geographic diversity of respondents and *Figure 2-2* shows a heat map of respondents.

Table 2-5
Public Survey Respondents by Location

Jurisdiction	# of Respondents
City of Carmel by The Sea	1
City of Del Rey Oaks	2
City of Gonzales	0
City of Greenfield	0
City of King City	1
City of Marina	5
City of Monterey	27
City of Pacific Grove	5
City of Salinas	12
City of Sand City	0
City of Seaside	0
City of Soledad	1
Incorporated Jurisdiction Respondents Subtotal	**54**
Unincorporated Area- Big Sur	8
Unincorporated Area-Carmel	5
Unincorporated Area- Carmel Valley	9
Unincorporated Area - Salinas/River Rd	2
Unincorporated Area - North County	4
Unincorporated Area - Other	1
Unincorporated Area Respondents Subtotal	**29**
Other*	17
Total Respondents	**100**

*Respondents identified locations outside of County or did not identify their locations.

Figure 2-2
Heat Map of Public Survey Respondents Locations



Results of the survey were used to support the creation of the Countywide Hazard Mitigation Problem Statements and the Countywide Hazard Mitigation Action Matrix.

Approximately 74% of survey participants indicated they had experienced or been impacted by a natural hazard or disaster. The most common hazards respondents had experienced or been impacted by were flooding (25 respondents), earthquakes (24 respondents), wildfires (23 respondents), and windstorms (19 respondents). Survey participants were most concerned about agricultural emergencies, earthquakes, and climate change.

Participants also ranked which community assets were most vulnerable to natural hazards. Community assets were ranked by vulnerability in the following order:

1. Infrastructure: Damage or loss of roads, bridges, utilities, schools, etc.
2. People: Loss of life and/or injuries
3. Environmental: Damage, contamination or loss of forests, wetlands, waterways, etc.
4. Governmental: Ability to maintain order and continue providing public services, etc.
5. Economic: Business interruptions or closures, job losses, agricultural losses, etc.
6. Cultural/Historic: Damage or loss of libraries, museums, historic properties, etc.

In terms of mitigation activities, 81% of respondents felt natural systems protection was very important to pursue, 77% felt educations and awareness programs were very important to pursue, 73% felt local plans and regulations were very important to pursue, and 71% felt structure and infrastructure projects were very important to pursue.

The highest priority mitigation actions included: Strengthen infrastructure such as roads, bridges, water/wastewater and electric power supply facilities (83 respondents); Develop climate adaptation plans, policies or projects to minimize potential negative impacts from climate change (68 respondents); Enhance or restore the capacity of natural features (dunes, floodplains, wetlands) to absorb impacts of natural hazards (61 respondents); Strengthen critical public facilities such as police, fire, schools and hospitals (60 respondents); and Provide better public information about hazard risks and available mitigation measures (59 respondents).

The lowest priority mitigation actions included: Protect cultural and/or historic resources such as monuments, museums, historic landmarks, etc. (18 respondents); Assist vulnerable property owners with securing funding for mitigation projects (35 respondents); and acquire vulnerable properties from willing sellers, remove or relocate existing structures and maintain as open space (23 respondents).

Full survey results are available upon request.

2.2.3 COMMUNITY FORUMS

Monterey County OES held 7 Community Forums, geographically dispersed by Supervisorial District, in order to capture a wide range of community input on the update to the MJHMP. *Table 2-6* lists the community forums that occurred.

Table 2-6
Hazard Mitigation Community Forums on the 2022 MJHMP

District	Date	Location
District 1	January 8, 2020	Ag Commissioner’s Office
District 2	January 6, 2020	Castroville Library
District 3	January 15, 2020	San Antonio Valley Community Center
District 3	January 17, 2020	Arroyo Seco Fire District Station #32
District 4	January 9, 2020	Marina Library
District 5	January 16, 2020	Big Sur Lodge Conference Room
District 5	January 22, 2020	Discovery Center at Palo Corona Regional Park

In order to assess the community’s perception of hazard risk, during the community forums, an interactive activity was conducted. The activity was offered in both English and Spanish. Community members voted with stickers to answers questions on the importance of various community assets and their level of concern on different hazards. First, in order to understand the importance of various community assets, community forum participants indicated how important various community assets were to them. Community assets was defined as features, characteristics, or resources that either make a community unique or allow it to function.

Table 2-7 summarizes the results from all community forums on the answer to the question: How important are each of the following community assets to you? The results indicate that over 90% of community members that responded considered Electric Power and Gas Facilities, Emergency Operations Centers, Hospital and Medical Facilities, Major Roads and Bridges, and Water and Wastewater Utilities to be very important.

Table 2-7
Community Forums Interactive Activity Results: Community Assets

Community Asset	Percent of Respondents				
	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Airports	13.3%	66.7%	13.3%	0.0%	6.7%
Colleges/Universities	50.0%	28.6%	7.1%	14.3%	0.0%
Day Care Facilities	30.0%	40.0%	30.0%	0.0%	0.0%
Elder Care Facilities	64.3%	14.3%	21.4%	0.0%	0.0%
Electric Power and Gas Facilities	95.7%	0.0%	4.3%	0.0%	0.0%
Emergency Operations Centers	93.3%	6.7%	0.0%	0.0%	0.0%
Emergency Shelters	87.5%	12.5%	0.0%	0.0%	0.0%
Farms and Agricultural Facilities	38.5%	46.2%	7.7%	7.7%	0.0%
Fire Stations and EMS Facilities	80.0%	20.0%	0.0%	0.0%	0.0%
Government Buildings	25.0%	37.5%	37.5%	0.0%	0.0%
Historic Buildings	41.7%	25.0%	25.0%	8.3%	0.0%
Hospital and Medical Facilities	92.3%	7.7%	0.0%	0.0%	0.0%
Major Roads and Bridges	92.6%	7.4%	0.0%	0.0%	0.0%
Major Employers	28.6%	42.9%	28.6%	0.0%	0.0%
Military Facilities	14.3%	57.1%	14.3%	14.3%	0.0%
Natural Resources	85.7%	14.3%	0.0%	0.0%	0.0%
Parks and Recreational Areas	78.6%	21.4%	0.0%	0.0%	0.0%
Police Stations	84.6%	15.4%	0.0%	0.0%	0.0%
Port and Marine Facilities	62.5%	25.0%	0.0%	12.5%	0.0%
Schools (K-12)	68.8%	25.0%	6.3%	0.0%	0.0%
Small Businesses	54.5%	45.5%	0.0%	0.0%	0.0%
Water and Wastewater Utilities	92.3%	7.7%	0.0%	0.0%	0.0%

Next, in order to understand the community's perception of hazard risk, community forum participants indicated how concerned they were about various hazards.

Table 2-8 summarizes the results from all community meetings on the answer to the question: How concerned are you about the possibility of your community being impacted by each of these hazards?

Table 2-8
Community Forums Interactive Activity Results: Hazard Concern

Hazard	Percent of Respondents		
	Very Concerned	Somewhat Concerned	Not Concerned
Agricultural Emergency	73.9%	26.1%	0.0%
Coastal Erosion	70.0%	30.0%	0.0%
Dam Failure	55.6%	27.8%	16.7%
Earthquake	78.6%	21.4%	0.0%
Flood	80.0%	20.0%	0.0%
Hazardous Materials Incident	62.5%	25.0%	12.5%
Landslide / Debris Flow	69.4%	22.2%	8.3%
Sea Level Rise	64.7%	29.4%	5.9%
Tsunami	61.1%	22.2%	16.7%
Wildland Fire	73.1%	23.1%	3.8%
Windstorm	37.5%	58.3%	4.2%

2.2.4 PUBLIC PRESENTATIONS

In order to inform the public about the plan, public presentations were held. Presentations helped educate the public about existing hazards and mitigation strategies and allowed the public to provide feedback on the MJHMP. Public presentations are listed in *Table 2-9*.

Table 2-9
Public Presentations of the 2022 MJHMP Update

Public Presentation	Date
Monterey County Board of Supervisors	Tuesday, April 2, 2019
Monterey County Disaster Council	Wednesday, April 24, 2019
Monterey County Disaster Council Meeting	Wednesday, October 30, 2019
City of Gonzales City Council Meeting Presentation	Monday, November 18, 2019
City of Pacific Grove City Council Meeting Presentation	Wednesday, February 19, 2020
City of Sand City City Council Meeting Presentation	Tuesday, March 3, 2020
City of King City Council Meeting Presentation	Tuesday, August 25, 2020
City of Greenfield City Council Meeting Presentation	Tuesday, September 22, 2020
City of Monterey City Council Meeting Presentation	Tuesday, October 6, 2020
Monterey County Disaster Council Meeting	Wednesday, October 28, 2020
Carmel-by-the-Sea Climate Change Committee Meeting	Thursday, November 19, 2020
City of Marina City Council Meeting Presentation	Tuesday, May 18 2021
City of Carmel-by-the-Sea City Council Presentation	Tuesday, June 1, 2021
City of Seaside City Council Meeting Presentation	Thursday, June 3, 2021
Monterey Regional Waste Management District Board	Friday, June 18, 2021
City of Soledad City Council Meeting Presentation	Wednesday, July 21, 2021
City of Salinas City Council Meeting Presentation	Tuesday, August 10, 2021
City of Del Rey Oaks City Council Meeting Presentation	Tuesday, September 28, 2021
Moss Landing Harbor District Board Presentation	Wednesday, September 29, 2021

2.3 ASSESS THE RISK

In accordance with FEMA requirements, the Steering Committee identified and prioritized the hazards affecting both the County as a whole and each participating jurisdiction individually. It also assessed the vulnerability to those hazards. Results from this risk assessment aided in the subsequent identification of appropriate mitigation actions. While the process is described below, the substance of this risk assessment is detailed in **Section 4**, *Risk Assessment Methods*.

Identify and Profile Hazards

Based on a review of past hazard events, existing plans, reports, and other technical studies, data, and information, the Steering Committee determined what regional hazards could affect the County. The Steering Committee completed a screening and prioritization processes to determine priority hazards to be assessed. A risk assessment finalized the prioritization process by ranking hazards according to the impact and threat to the whole County in **Volume 1** and each participating jurisdiction in **Volume 2**.

Assess Vulnerabilities

Assessing vulnerabilities exposes the unique characteristics of individual hazards and begins the process of narrowing down which areas within the County are vulnerable to specific hazard events. The vulnerability assessment involved a subjective assessment, in addition to a GIS overlaying method for examining vulnerabilities in-depth. The identified hazards varied depending on the geographic make-up of, priorities of, and services provided by the participating jurisdictions. Using these methods, planning partners estimated vulnerable populations, infrastructure, and potential losses from hazards.

2.4 DEVELOP A MITIGATION STRATEGY

This plan provides an explicit strategy and blueprint for reducing potential losses identified in the risk assessment based on existing authorities, policies, programs and resources, and participating jurisdictions' abilities to expand on and improve these existing tools. MJHMP development included identifying goals, assessing existing capabilities, reviewing the 2016 MJHMP goals, and identifying new mitigation actions. The MJHMP was prepared in accordance with requirements from DMA 2000 and the California Governor's Office of Planning and Research (OPR) and FEMA's HMP guidance. The process is described below; the substance of the mitigation strategy is detailed in **Section 21,** *Mitigation Strategy***,** for the whole County and within **Volume 2** for each participating jurisdiction.

Identify Goals

The Steering Committee reviewed the 2016 MJHMP goals and determined their current validity, consistent with FEMA requirements. The goals were updated to meet the current hazard environments and to be consistent with the changing policies and goals of participating jurisdictions. The goals are presented in **Section 21,** *Mitigation Strategy***.**

Develop Capabilities Assessment

A capabilities assessment is a comprehensive review of participating jurisdictions' capabilities and tools to implement the mitigation actions in the MJHMP. The Steering Committee and individual jurisdiction Planning Teams identified technical, financial, and administrative capabilities to implement mitigation actions, as detailed in **Section 20,** *Capability Assessment,* and in **Volume 2** for each participating jurisdiction.

Identify Hazard Problem Statements

The Steering Committee and individual jurisdiction Planning Teams developed mitigation actions, as both planning activities and projects, to address problems that could originate from hazards identified in the risk assessment, in line with identified capability of each jurisdiction. Mitigation actions were created first by developing problem statements for prioritized hazards. Hazard Problem Statements are located at the conclusion of each hazard section, in **Section 21**, *Mitigation Strategy,* and in **Volume 2** for each individual jurisdiction.

Identify Mitigation Actions

As part of the MJHMP planning process, the Steering Committee and individual jurisdiction Planning Teams reviewed and analyzed the status of the mitigation actions identified in the 2016 MJHMP. The status of mitigation actions included in the 2016 MJHMP that were either completed or deleted during the plan update process is included in **Volume 2** in the respective annexes of each jurisdiction who were included in the prior plan. Once the 2016 actions were reviewed, the Steering Committee and individual jurisdiction Planning Teams then worked to identify and develop new mitigation actions with implementation elements. Additional detail on these mitigation actions is provided in **Section 21,** *Mitigation Strategy,* and in **Volume 2** for each individual jurisdiction.

2.5 ADOPT AND IMPLEMENT THE PLAN

Once the risk assessment and mitigation strategy were completed, information, data, and associated narratives were compiled into the MJHMP. **Section 1.3.1**, *What's New?*, provides detailed information on new and updated elements of the MJHMP.

Plan Review and Revision

Once the Draft MJHMP Update was completed, a public and government review period was established for official review and revision. Public comments were accepted, reviewed, and incorporated into this update. Applicable comments from the public have been received and addressed prior to submitting to FEMA and Cal OES. Steering Committee Members, Operational Area stakeholders, and partners were provided a 60-day review period prior to the public review and comment period. This was announced at the Monterey County Operational Area Disaster Council meeting on October 27, 2021.

A 30-day public comment period, from February 10 to March 10, 2022, gave the public an opportunity to comment on the draft plan update prior to its submittal to Cal OES. The principal avenue for public comment on the draft plan was the website established for this plan update. Comments received on the draft plan are available upon request. All comments were reviewed by the Steering Committee and incorporated into the draft plan as appropriate.

Plan Approval and Submittal

On behalf of all participating jurisdictions, Monterey County Office of Emergency Services submitted the Plan for Cal OES and FEMA Review on March 11, 2022. The 2022 Monterey County MJHMP received Approval Pending Adoption from FEMA on June 14, 2022.

Plan Adoption

Upon receiving the notice of Approval Pending Adoption, all participating jurisdictions seeking plan approval are required to adopt the plan. The plan approval date remains the same regardless of the independent participating jurisdictions adoption dates.

Table 2-10
Jurisdiction Plan Adoption Dates

Annex Letter	Agency/Jurisdiction	Adoption Date
A	Unincorporated County of Monterey	
A	Monterey County Water Resources Agency	
B	City of Carmel-by-the-Sea	
C	City of Del Rey Oaks	
D	City of Gonzales	
E	City of Greenfield	
F	City of King	
G	City of Marina	
H	City of Monterey	
I	City of Pacific Grove	
J	City of Salinas	
K	City of Sand City	
L	City of Seaside	
M	City of Soledad	
N	Carmel Area Wastewater District	
O	Monterey One Water	
P	Monterey Regional Waste Management District	
Q	Moss Landing Harbor District	

Upon receiving the record of adoption from the State, FEMA will issue an official approval letter stating which jurisdictions have adopted and are approved and eligible for FEMA Hazard Mitigation Assistance programs. The approval letter and date are generated with the first jurisdiction adopting the plan. The Monterey County MJHMP was approved on DATE and expires on DATE.

Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is its implementation and success under FEMA's grant programs. This MJHMP has been assembled to reduce the risk of natural hazards, and also to meet the requirements of the DMA 2000 and maintain eligibility under FEMA's Hazard Mitigation Assistance (HMA) grant programs. FEMA administers three programs that provide funding for local agencies with approved mitigation plans:

- Hazard Mitigation Grant Program (HMGP), which assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration.
- Building Resilient Infrastructure and Communities (BRIC), which provides funds for hazard mitigation planning and projects on an annual basis.
- Flood Mitigation Assistance (FMA), which provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.

Plan Maintenance

The County will update and monitor this plan in accordance with all FEMA requirements in order maintain eligibility for FEMA HMA. Evaluation and revision procedures for this plan are detailed in **Section 22,** *Plan Implementation and Maintenance*. **Section 22** includes the measures Monterey County and planning partners will take to ensure the MJHMP's continuous long-term implementation, including MJHMP monitoring, reporting, evaluation, maintenance, and updating.

3. COMMUNITY PROFILE

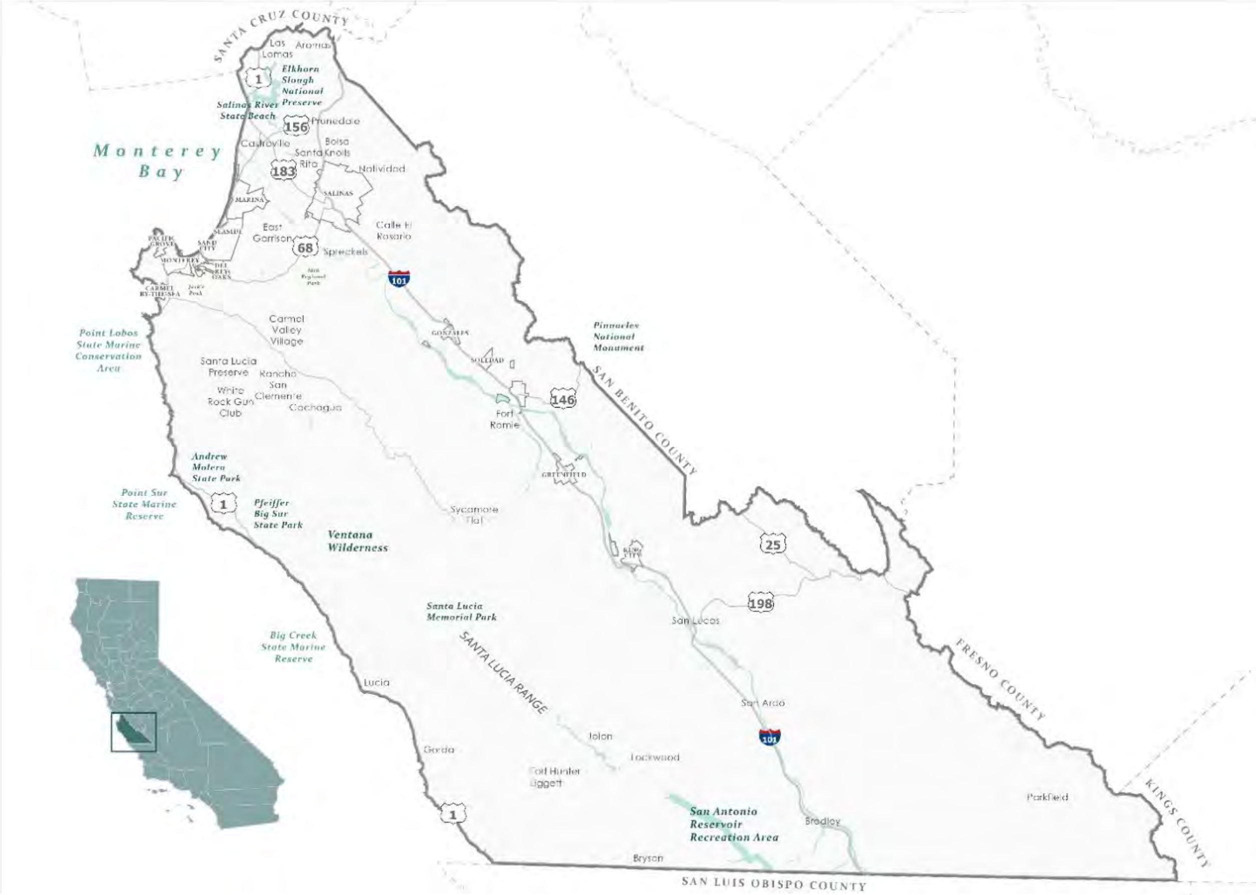
Monterey County is situated on California's central coast, south of San Francisco and north of Los Angeles. Monterey County is known to the world for its majestic coastlines including Big Sur, the Monterey Peninsula, and the Monterey Bay, as well as the agriculturally rich Salinas Valley, known as the “Salad Bowl of the World.” It is also home to Pinnacles National Park near the City of Soledad, the Monterey Bay Aquarium, and the site of a Monarch butterfly preserve in the City of Pacific Grove.

3.1 LOCATION, GEOGRAPHY, AND CLIMATE

Monterey County is located on the Pacific Ocean on the north-central coast of California. The County is bordered by Santa Cruz County to the North, San Benito, Fresno, and King Counties to the East, San Luis Obispo County to the South, and the Pacific Ocean to the West. The County is 110 miles south of San Francisco and 320 miles north of Los Angeles.

Monterey County, one of the largest in California, covers 3,771 square miles, of which 13% is water, and contains nearly 100 miles of coastline. Elevation within the County ranges from sea level to 5,862 feet at Junipero Serra Peak, which is located 12 miles inland in the Santa Lucia Range. Prominent land features in the County include two major northwest-southeast trending mountain ranges—the Santa Lucia Range along the coast, and the Gabilan Range along the eastern border of the County, both of which are part of the Pacific Coast Range. Between the Santa Lucia and Gabilan mountain ranges lies the Salinas Valley; and at the center of the Valley flows the Salinas River, the largest river on California’s Central Coast.

Figure 3-1
Map of Monterey County



The Santa Lucia Range stretches approximately 100 miles from just south of Carmel to a point north of the San Luis Obispo County line. The steepest slope in the contiguous United States occurs within the Coast Range at Cone Peak, ranging from sea level to 5,155 feet in a distance of just three miles. The Big Sur coastline is known for its steep slopes, jagged peaks, and narrow coastal canyons. Offshore the steep ridges of the Santa Lucia Mountains fall sharply beneath the Pacific Ocean. 50 miles offshore, the Pacific Ocean reaches a depth of 12,000 feet. Two deep submarine canyons, the Sur Submarine Canyon, and the Partington Submarine Canyon, cut into the continental shelf near the Big Sur coast, and eventually merge to become one of the deepest submarine canyons on earth.

On the eastern side of the Santa Lucia Range, the mountain slopes descend abruptly down to the Salinas Valley, which rises in altitude from sea level at the Monterey Bay to approximately 400 feet near Bradley. The Valley is 130 miles long and is famous for its productive soils.

The Gabilan Mountains, like the Santa Lucia Mountains, are composed of granite and metamorphic rocks and are similarly characterized by steep slopes and complex drainage patterns. The Gabilan Mountains, located further inland however, are drier than the Santa Lucia

Mountains. At the northern end of the Monterey County lies the Pajaro River. Much of north County land is cultivated with agricultural crops. The coastal area of North County contains wide sandy beaches and the primary commercial fishing harbor for the entire County.

Monterey County includes 12 incorporated cities and 16 unincorporated areas; of which Salinas, the County seat, is the largest municipality. The cities can be generally grouped into two classifications (valley and coastal):

Valley Cities: Gonzales, Greenfield, King City, Salinas (Monterey County seat), and Soledad.

Coastal Cities: Carmel, Del Rey Oaks, Marina, Monterey, Pacific Grove, Sand City, and Seaside.

California Highway 101 bisects the County providing easy access to all Salinas Valley cities and the Monterey Peninsula, while Highway 1 offers scenic views of the California coast.

The climate in Monterey County is considered Mediterranean, with dry summers, rainy winters, and moderate temperatures year-round, with an average rainfall of about 19 inches per year. Precipitation in the region falls mainly between November and April. Large variations exist in rainfall amounts between coastal and inland areas, as well as from year to year and from sea level to altitude along the coast.

3.2 HISTORY

Before the European colonization, the Monterey area had been inhabited for over 8,000 years. Indigenous peoples lived in the valleys and near the seaside and the area was inhabited by three major native groups: the Costanoan (Ohlone), Esselen, and Salinan groups. The Salinan Indigenous Americans lived in southern region of the County and had about 3,500-4,000 members. The Esselen Indigenous Americans had several hundred members and resided on the northwest coast of the County. The Costanoan (Ohlone) group was the largest in the area with around 7,000 people, occupying Monterey Peninsula and northern region of the County.

Spanish explorers first sailed past the Monterey coast in the mid-1500s but did not land in the Monterey Bay until the early 1600s. In 1542, Juan Rodriguez Cabrillo discovered the bay he named "*la Bahia de los Pinos*," the Bay of Pines, but not venture ashore. By the late 1500s, New Spain's concerns were focused on the Pacific, in particular, the threat of English piracy against Spain's Manila galleons. With a view toward finding a port to protect and supply the galleons, Sebastian Vizcaino laid claim to the bay in 1602, when he named it, the *Bahia de Monte Rey*, or Monterey Bay, in honor of Gaspar de Zuniga y Acevedo, Conde de Monterrey, the Viceroy of New Spain. The word itself is composed of the "*monte*" and "*rey*," which literally means "king of the mountain" in Spanish. Spanish settlement in the region though did not occur for another 167 years. It would not be until 1769, when New Spain, fearing the advancement of the Russians, planned an expedition into California to establish a military foothold and a mission. On June 3, 1770, Captain Gaspar de Portola, and Franciscan Father Junipero Serra founded the Presidio of Monterey and the Mission de San Carolos Borromeo de Monterey at Monterey Bay.

In 1774, the small, rudimentary presidio was named the capital of the Californias, both Alta and Baja, upper and lower. And, in 1778 it was named the capital of Spanish Alta California.

Spanish settlers began developing catholic missions, or religious outposts, within the County and used the Salinas Valley for range lands. Franciscan missionaries also began constructing missions in the late 1700s, establishing missions in Monterey (1770, then moved to Carmel in 1771), in the San Antonio River Valley (1771) along the eastern side of the Santa Lucia Mountains, and in Soledad (1791). This began a period of forced conversions of Indigenous Americans to Catholicism and the disintegration of traditional Indigenous life. Natives were decimated by introduced European diseases, particularly whooping cough, and measles, and by violence in the missions and declining birth rates. In 1826, after Mexico's secession from Spain, the governor of Alta California emancipated the remaining natives from the missions. A small number of their descendants still live in the region.

Monterey was an important port and military position, for Spain, becoming the political and cultural Capital of Alta California in 1775. Spain established a formal pueblo government in the region that went into effect in 1794. By 1800, most settlers in the area lived in the Presidio or at the mission in Carmel, while a few had moved out to ranches south of Salinas. Slowly, settlers began moving into the Salinas Valley and developing ranches centered around cattle. The region remained a military outpost for most of Spanish rule. Spanish occupation of the Monterey County region significantly expanded grasslands, especially in the Salinas Valley, to support an economy based primarily on cattle grazing. The Spanish also introduced a number of important crops to the region, including wine grapes, olives, apples, and pear trees.

In 1822, following the Mexican War of Independence, California became a province of Mexico. Monterey remained the capital of Alta California during the 20-year period of Mexican rule. Under Mexican rule, with the secularization of the missions, the Californios, the descendants of the original Spanish colonists, secured vast land grants and expanded the cattle and hide trade. The boundaries of the original ranchos serve to a large extent as today's property boundaries within the region, particularly on larger tracts of agricultural and ranching lands. Mexico lifted the strict trading regulations the Spanish had enforced, and Monterey became California's main port of entry. British, American, and South American trading vessels flocked to the coastal port. The official Custom House at Monterey opened to foreign ships, transforming the old Spanish provincial capital into an international port.

Tensions between the US and Mexico rapidly deteriorated in the 1840s as American expansionists eagerly eyed land to the west, including the lush northern Mexican province of California. Indeed, in 1842, a US naval fleet, incorrectly believing war had broken out, seized Monterey. Monterey was returned the next day, but the episode only added to the uneasiness between Mexico and the US. In the mid-1800s, during the Mexican American war, the Presidio of Monterey was taken over by the US military. In July 1846, Commodore John Drake Sloat's troops officially raised the American flag over the Custom House, setting the stage for California to become part of the US. Sloat established the first American fort in California to protect the harbor. Following the Mexican American War, the Treaty of Guadalupe Hidalgo, signed in February 1848, formally ceded Alta California, which included Monterey County, to the United States. US Navy Captain Walter Colton was appointed Monterey's first American Alcalde or Chief Magistrate of the Monterey district in 1846. He impaneled the first jury in California, co-founded the first newspaper in California, was one of the founders of the first public library in California, and raised funds to build Colton Hall, the first and largest public building in California, as a town hall and school. In 1849, the new building became the site of the convention to establish a constitution for American California.

Settlement of Monterey County following its entry into the US, was at first concentrated around the establishments of earlier settlers. As ranchos were subdivided and settlers applied for preemption to public lands, clustered farms appeared in the canyon mouths that opened on to the Salinas Valley. The discovery of gold in the Sierra Nevada foothills in 1849 brought droves of homesteaders to the County, and as the best parcels in Monterey and the Salinas Valley became occupied, homesteading spread to the rugged Big Sur coast. Many of the first American settlers were cattlemen like the Spanish before them, and sheep were raised in large numbers, both in the Salinas Valley and in the hills of the Big Sur coast. Grazing eventually gave way to irrigated agriculture. The gold rush sparked the development of the Southern Pacific railroad and, as the railroad system grew in late 1800s, so did the Salinas Valley population.

David Jacks, a controversial figure in Monterey history, involved himself in the settlement of Mexican land claims in Monterey. In 1853 the Pueblo of Monterey contracted Delos Ashley to help legalize its title to some 30,000 acres of land. Ashley billed the city $1,000 for his services and when they could not pay, he suggested the city auction some of its land. Ashley and Jacks were the only two bidders and purchased the entire tract for $1002.50, which included what is now the cities of Monterey, Pacific Grove, Seaside, and Del Rey Oaks along with the Del Monte Forest, and Fort Ord. The sale was controversial, and the city filed suit against Jack claiming the sale was illegitimate. The case eventually reached the US Supreme Court in 1903, which ruled in favor of Jack. Jack embarked on what appears to have been an almost obsessive taste for land acquisition. Piece by piece he added to his holdings through mortgage and tax sales and other shrewd practices. As a result, of Jack's shrewd business practices, animosity toward him ran high. At his height Jack was said to own around 100,000 acres of Monterey County land.

The gold rush created a cattle boom, which ended with major flooding in 1862, shifting the use of land from ranching to dry farming of grains. By 1870, commercial agriculture was well underway in the Salinas Valley. A major drought in 1863 and 1864 essentially wiped out the cattle industry, and grain production became the County's principal agricultural activity. Sugar beet cultivation and dairying began to replace grain farming by 1897. In 1874, the first railroad was established, the Monterey and Salinas Valley Railroad, shipping grain, fish, and other goods. Soon, the narrow gauge was overtaken by the Southern Pacific Railroad. The extension of the Southern Pacific Railroad from Pajaro to Salinas, along with improved irrigation systems, refrigerated freight cars, and other innovations in technology, encouraged increasingly intensive row crop cultivation and set the stage for the Salinas Valley to become one of the most productive agricultural regions in the world.

The wealth of sea life around the Monterey Peninsula, from migrating whales to abalone and squid, also attracted settlers to the region. By 1853, Chinese settlers had established a vibrant fishing village, making the Monterey villages unique in early Chinese immigration to California. The Chinese would continue their livelihood, despite fire and hardships. They were joined on the Bay by Portuguese whalers from the Azores who found a lucrative and dangerous livelihood in shore whaling.

The sugar beet industry in Monterey County was the first type of intensive farming to bring changes that would profoundly affect land use, labor, and settlement. In 1897, Claus Spreckels began a sugar beet industry in Monterey County. The success of the industry was dependent on contracted growers and a large body of low-wage laborers. These needs had a tremendous effect on tenancy and colonization of agricultural lands in the County, and greatly influenced the ethnic makeup of the Salinas Valley. The operations in Monterey County did not experience gradual growth but were put in place in the form of a fully planned town and plant, with company owned farms scattered from Salinas to King City. Spreckels did most of the pioneer work in irrigation technology in the County, paving the way for more efficient use of the seasonally scarce water supply that had hindered intensive farming efforts up to this time. Beets, however, were eventually replaced by row crops which had a higher value per acre.

David Jacks sold a large tract of land between Carmel and Pacific Grove to the Pacific Improvement Company, a company controlled by the so-called "Big Four" California railroad barons. Railroad pioneer Charles Crocker sought to create a destination for the railroad, the Hotel Del Monte with gardens, polo fields, a racetrack, and a seventeen-mile leisure road to the Del Monte’s Pebble Beach. The hotel opened in 1880 and was immediately dubbed the “The World's Most Elegant Seaside Resort.” Hotel Del Monte was the catalyst for Monterey's modern-day tourism industry and at its peak encompassed 20,000-acres spread across the Monterey Peninsula. The Hotel Del Monte was requisitioned by the Navy at the beginning of World War II and in 1947, the resort was sold to the federal government.

Following the Spanish-American War, the need for more bases on the West Coast prompted the Army to establish the Monterey Military Reservation on the same site as the, the old fort on Presidio Hill (the American Presidio in contrast to the Royal Presidio located east of Old Town). In 1904, it was renamed the Presidio of Monterey in honor of the original Spanish and Mexican presidio. From 1902 onward the mission of the Presidio changed from 19th century coastal defense to instruction and training, which it continues today as the home of the Defense Language Institute. The 1900s were a time of military growth for Monterey County with Fort Ord’s creation in Seaside during World War I and Camp Roberts development in South County during World War II. However, in recent history, base closures have resulted in reductions of military presence in the County, and the reuse of major portions of the former Fort Ord.

A phenomenal expansion in lettuce production took place starting in 1920, and by 1930 lettuce accounted for almost half the gross returns to the County from farm products. The resulting increase in total farm income was reflected in a substantial growth in population. The need for seasonal field labor was firmly established with the shift to intensive single crop production. By 1930, a permanent shift in agricultural production to corporate owners and large operators who packed and shipped as well as grew the crop had taken place in the County. During the late 1930s and 40s the Salinas Valley witnessed a significant boom in agricultural production due to the development of farming infrastructure in the region. This led to a higher demand for labor that was satisfied due to the influx of farmworkers from Mexico during World War II, through the “Bracero” program. During and after the Dust Bowl, the Salinas Valley received thousands of displaced workers from the South and Midwest. Displaced workers led to a vast increase in agricultural productivity. The commercial farming sector of the Dust Bowl era forms the backdrop for several John Steinbeck novels.

In the early 1900s, the Monterey Bay began to attract the interest of commercial fish processors. In 1900, the first sardine cannery opened, adjacent to the Monterey Wharf and in 1902, the first fish packing and canning operation on Cannery Row. In 1903, Frank Booth took over the sardine cannery and would hire a Norwegian fisheries expert, Knut Hovden, to mechanize the canning process. Hovden would go on to revolutionize the canning industry and successfully operated the largest and longest operating cannery. By the 1940s, nineteen fully operating canneries harvested over 250,000 tons per season on "Cannery Row,” making Monterey the “Sardine Capital of the World.” In the late 1940s the sardine harvests diminished year by year signaling the end of the industry. The Monterey Bay Aquarium opened in 1984 at the old Hovden cannery site. Designated in 1992 as the Monterey Bay National Marine Sanctuary, an enormous federally protected marine area of California's central coast was created, centered on Monterey Bay.

3.3 POPULATION AND DEMOGRAPHICS

According to the 2020 Census, Monterey County has a population of 439,035 people. About 80% of the countywide population resides in the 12 incorporated municipalities, which consist of only 2% of the County’s total land area.

Salinas represents the largest city in Monterey County with over 163,542 residents. The cities of Marina, Soledad, Monterey, and Seaside form the second largest group in population ranging from 22,359 to 33,366 residents each. The smallest cities include Sand City, Del Rey Oaks Carmel-by-the-Sea and Gonzales with populations ranging from 325 to 8,647. The population for the unincorporated areas of the County is 104,482. The largest communities in the unincorporated County are Prunedale (18,885 residents), Castroville (7,515 residents), Carmel Valley Village (4,524 residents), and the Del Monte Forest (4204 residents). Since the 2010 Census the population of Monterey County has increased 6%. The largest population growth occurred in Greenfield (16%), Marina (13%), Salinas (9%), and Monterey (9%).

Table 3-1 lists the total land area, population, percentage change in population since 2010, and population density (in persons/per square mile) for each jurisdiction.

Table 3-1
Total Land Area and Population in Monterey County

Jurisdiction	Land Area (Square Miles)	Population (2020)	Population Density	Population (2010)	Percent Change
Incorporated Cities	**67.06**	**334,553**	**4,988.9**	**314,844**	**6%**
Carmel-by-the-Sea	1.08	3,220	2,981.5	3,722	-13%
Del Rey Oaks	0.48	1,592	3,316.7	1,624	-2%
Gonzales	1.92	8,647	4,503.6	8,187	6%
Greenfield	2.14	18,937	8,849.1	16,330	16%
King City	3.84	13,332	3,471.9	12,874	4%
Marina	8.88	22,359	2,517.9	19,718	13%
Monterey	8.47	30,218	3,567.7	27,810	9%
Pacific Grove	2.86	15,090	5,276.2	15,041	0%
Salinas	23.18	163,542	7,055.3	150,441	9%
Sand City	0.56	325	580.4	334	-3%
Seaside	9.24	32,366	3,502.8	33,025	-2%
Soledad	4.41	24,925	5,651.9	25,738	-3%
Unincorporated Areas	**3,213**	**104,482**	**32.5**	**100,213**	**4%**
Aromas	4.75	2,708	570.1	1,358	99%
Boronda	0.55	1,760	3,200	1,710	3%
Bradley	0.09	69	766.7	93	-26%
Carmel Valley Village	19.20	4,524	235.6	4,407	3%
Castroville	1.06	7,515	7,089.6	6,481	16%
Chualar	0.63	1,185	1,881.0	1,190	0%
Del Monte Forest	10.65	4,204	394.7	4,514	-7%
Elkhorn	4.83	1,588	328.8	1,565	1%
Las Lomas	1.04	3,046	2,928.8	3,024	1%
Lockwood	10.91	368	33.7	379	-3%
Moss Landing	0.60	237	395.0	204	16%
Pajaro	0.93	2,882	3,098.9	3,070	-6%
Pine Canyon	3.34	1,871	560.2	1,822	3%
Prunedale	46.20	18,885	408.8	17,560	8%
San Ardo	0.45	392	871.1	517	-24%
San Lucas	0.39	324	830.8	269	20%
Spreckels	0.12	692	5,766.7	673	3%
Other Unincorporated	3,107	52,232	16.8	51,377	2%
Total	**3,280**	**439,035**	**133.9**	**415,057**	**6%**

Source: US Census Bureau, 2020 Census & 2010 Census

Monterey County's population growth has been fairly constant for the past 30 years, increasing steadily since the 1980s. Population projections for Monterey County ranging from 2030 to 2060, according to the California Department of Finance, are: 464,124 (2030); 477,265 (2040); 481,305 (2050); and 476,734 (2060). [1]

3.3.1 DEMOGRAPHICS

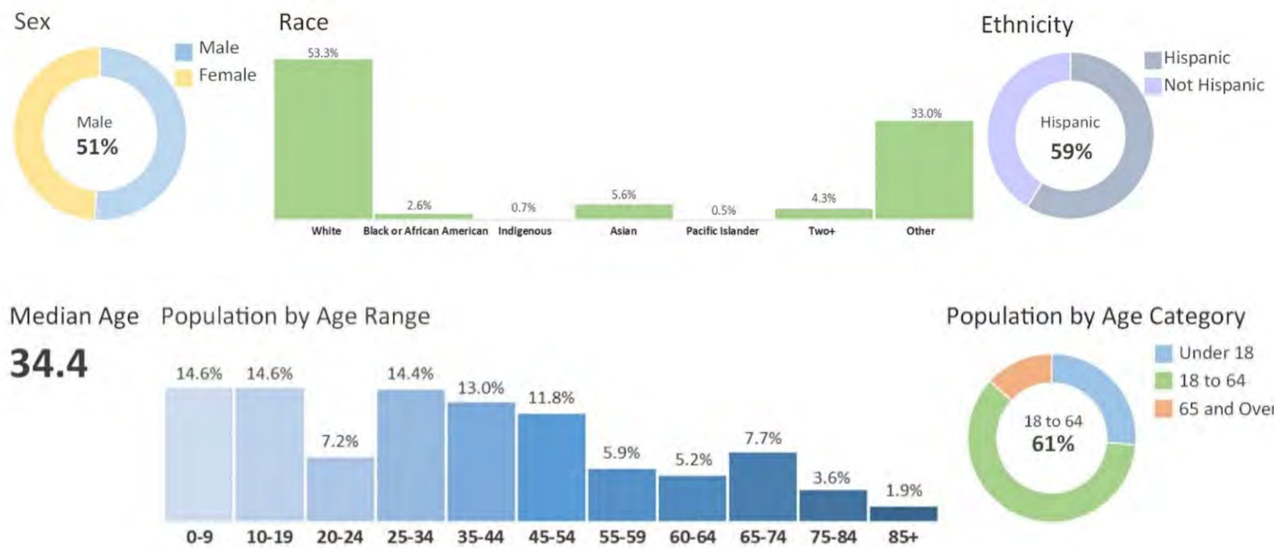
Note: Since full 2020 Census Data was not available at the time of this plan, the remainder of the section summarizes the most up-to-date information for Monterey County according to the 2015-2019 American Community Survey (ACS) performed by the US Census Bureau, except where noted.

The median age of Monterey County residents is 34.4 years. Monterey County's population is relatively young with 50.8% of residents under the age of 34. The next largest age group consists of adults between the ages of 35-59 comprising 30.7% of the population. Older adults ages 60+ make up about 13% of the population.

The gender makeup of the county is 51% male and 49% female. The racial makeup is approximately 53.3% White, 5.6% Asian, 2.6% Black or African American, 0.7% American Indian or Alaskan Native, and 0.5% Native Hawaiian and other Pacific Islander, and 4.3% from two or more races. Hispanic or Latino of any race makes up 58.7% of the county population.

Figure 3-2 summarizes the demographics of the population of Monterey County.

Figure 3-2
Monterey County Demographics



[1] California Department of Finance, Population Projections

There are approximately 127,155 households in Monterey County with an average household size of 3.3 persons. Married couples make up 52.5% of households and cohabiting couple comprise 7.8% of households. 15.3% of households have a male householder and 24.4% have a female householder, with no spouse/partner present.

78% of Monterey County residents are US citizens, which is lower than the national average of 93% and the state average of 87%. In 2017, the percentage of US citizens in Monterey County was 77.4%, meaning that the rate of citizenship has been increasing. Immigrants comprise about 30% of the total population, and at 21%, Monterey County has the highest percentage of non-citizens of any county in California. The County's immigrant population, including undocumented immigrants, is a critical component of the local labor force, especially for the agriculture, and hospitality industries.

3.3.2 INCOME

Per capita income in Monterey County continues to be at the low end of the spectrum in comparison to the statewide average and nearby counties. In 2019, the County had a per capita personal income of $30,073 and a median household income of $71,015 annually. 81.9% of households received earnings exclusive of social security and retirement income, with an average income amount of $91,308. 30% of households received Social Security with the average income amount of $19,147 and 17.6% of households received retirement income with the average income of $37,254. These income sources are not mutually exclusive; that is, some households received income from more than one source.

3.3.3 EDUCATION

The education system in Monterey County primarily consists of a public school system headed by the Monterey County Office of Education (MCOE). MCOE was established more than 150 years ago by California's Constitution and supports 24 school districts, two community colleges, and a state university. Data from the California Department of Education[2] indicates that in Monterey County, 2019-20 enrollment in K-12 Public Schools was 77,387. After experiencing continuous declines in enrollment growth, the County's K-12 enrollment began growing steadily in 2009 and has grown by 6.7% since then. However, in 2020 enrollment declined by 0.7% from the previous year. Between 2019 and 2020, Monterey County's high school graduation rate increased from 83.5% to 84.5%. In 2017-18, the college going rate was 67.7% compared to the State's rate of 65.2%.

Higher Education and Research Institutions

Approximately 71.5% of people 25 years and over in Monterey County have graduated from high school and 24.7% had a bachelor's degree or higher.

[2] California Department of Education, DataQuest

Monterey County is home to a range of institutions of higher learning, both public and private, large, and small, general, and highly focused institutions, particularly related to marine research. The higher education and research institutions located in the County contribute to the local economy, directly employing more than 15,000 faculty, staff, and researchers. Institutions in the County include:

- Brandman University
- Cabrillo College
- California Department of Fish & Wildlife (CDFW) Marine Region
- California State University, Monterey Bay
- Central Coast College
- Defense Language Institute, Foreign Language Center
- Defense Manpower Data Center
- Elkhorn Slough National Estuarine Research Reserve
- Fleet Numerical Meteorology and Oceanography Center, US Navy
- Golden Gate University
- Hartnell College
- Hopkins Marine Station of Stanford University
- Middlebury Institute of International Studies at Monterey
- Monterey Bay Aquarium
- Monterey Bay Aquarium Research Institute (MBARI)
- Monterey College of Law
- Monterey Bay National Marine Sanctuary
- Monterey Peninsula College
- Moss Landing Marine Lab, California State University (7 campuses)
- Pacific Fisheries Environmental Laboratory (NOAA)
- Panetta Institute for Public Policy
- National Weather Service (NOAA)
- Naval Postgraduate School
- Naval Research Laboratory
- US Geological Survey (USGS), Pacific Science Center
- University of California, Santa Cruz (UCSC)

3.4 HOUSING

Of the approximately 141,820 housing units in Monterey County, an estimated 90% are occupied, and 10% are vacant. Of the total housing units, 69% are in single-unit structures, 27% are in multi-unit structures, and 5% are mobile homes. 23.5% of housing units were built since 1990, and 28% were built prior to 1960. Of all occupied housing units, about 50% were moved into since 2010. Of the 127,155 occupied housing units, 51%, 64,900 units are owner-occupied and 49%, 62,255 units are renter occupied. This percentage of owner-occupation is lower than the national average of 64%, but similar to the state average of 54.8%. *Table 3-2* shows the ownership percentage in Monterey County compared its parent and neighboring geographies.

Table 3-2
Home Ownership in Monterey County Compared to Other Jurisdictions

Jurisdiction	Owner-Occupied	Renter-Occupied
Monterey County, California	51%	49%
United States	64%	36%
California	54.8%	45.2%
Fresno County, California	53.3%	46.7%
Kings County, California	52.3%	47.7%
San Benito County, California	63.7%	36.3%
San Luis Obispo County, California	61.6%	38.4%
Santa Cruz County, California	60.1%	39.9%

Source: 2015-2019 American Community Survey 5-Year Date Profile

The median housing value of owner-occupied units is $516,600 and 67% of owner-occupied units had a mortgage. The median monthly housing costs for mortgaged owners was $2,265 and $593 for non-mortgaged owners, 31% of owners with mortgages and 12% of owners without mortgages spent 35% or more of household income on housing costs. The median gross rent in the County was $1,495 and 44.5% of renters spent 35% or more of household income on rent. About 88.2% of County residents were living in the same residence one year earlier. 5.8% of people had moved during the past year from another residence in the County, 3.3% from another county in California, 1.9% from another state, and 0.8% from abroad.

Geographic Mobility

Monterey County is connected to the north and south by US Highway 101 and State Route 1 and is connected to the Central Valley by State Routes 156 and 198. State Route 68 connects Salinas with the Monterey Peninsula and State Route 145 provides access to the Pinnacles National Recreation Area. The Monterey Peninsula Airport provides regular flights to San Francisco, Los Angeles, Phoenix, Denver, and Las Vegas. Four carriers currently provide service from Monterey and provide 40 flights in and out daily. AMTRAK serves Monterey County daily north and south with a station in Salinas. The County is also served by Greyhound Bus Lines.

3.5 LOCAL ECONOMY

Monterey County's economy is primarily based upon tourism in the coastal regions and agriculture in the Salinas Valley. In 2019, The total GDP in Monterey County was approximately $24.5 billion. Of the sectors in Monterey County, Agriculture, Forestry, Fishing and Hunting contributed the largest portion of GDP, almost $5 billion. The next-largest contributions came from Real Estate and Rental and Leasing, about $3 billion, Public Administration, about $2.1 billion, and Health Care and Social Assistance, about $2 billion.

Agriculture

Monterey County is one of the nation's top agricultural producers. Agriculture is the County's largest sector in terms of economic output and employment. As such, it represents a vital link to both the County's cultural past and competitive future. Agriculture touches nearly every facet of life in Monterey County. From lettuce in the Salinas Valley, artichokes in Castroville, berries in north Monterey County, or vineyards in the Carmel Valley, agriculture shapes County life. Monterey County is known as "The Salad Bowl of the World" and crops grown in the County supply large percentages of total national pounds produced each year: 61% of leaf lettuce, 57% of celery, 56% of head lettuce, 48% of broccoli, 38% of spinach, 30% of cauliflower, 28% of strawberries, and 3.6% of wine grapes. Monterey County farmers are among the most productive and efficient in the world, growing more than 150 crops. [3]

In 2019, Monterey County agriculture accounted for a production value of over $4.4 billion, which was 3.6% over the previous year. Agriculture contributes a total of $11.7 billion in economic output. The $11.7 billion in economic output consists of $7.4 billion in direct economic output and $4.3 billion in additional economic output in the form of multiplier effects, over $31 million per day. Local agriculture accounts for more than 63,921 jobs in Monterey County with 57,503 being direct employees and 6,417 additional jobs made possible through expenditures by agricultural companies and their employees. One in five jobs in Monterey County directly attributable to the agricultural industry. [4]

Tourism & Hospitality

Monterey County has long been a tourist destination attracting nearly 4.6 million visitors annually. The County has a worldwide reputation with widely recognized destinations such as Big Sur, Pebble Beach, Carmel-by-the-Sea, and Monterey – and attractions such as Monterey Bay Aquarium, National Steinbeck Center, 17-Mile Drive, Cannery Row, Fisherman's Wharf, Pinnacles National Park, and the Monterey Wine Country. Tourism spending accounts for approximately $3 billion annually, supporting 27,000 jobs and generating $153 million in local tax revenue. [5] Visitors enjoy a wide variety of recreational activities including golf, beaches, scuba diving, sailing, kayaking, whale watching, fishing, camping, horseback riding, skydiving, hiking, biking, art galleries, exhibits, music, and theatre. Nearly 300 special events take place in Monterey County annually, including AT&T Pebble Beach Pro-Am Golf Tournament, Monterey Jazz Festival, races at WeatherTech Raceway Laguna Seca, Concours d'Elegance, Big Sur Marathon and other food, wine, cultural and family festivals.

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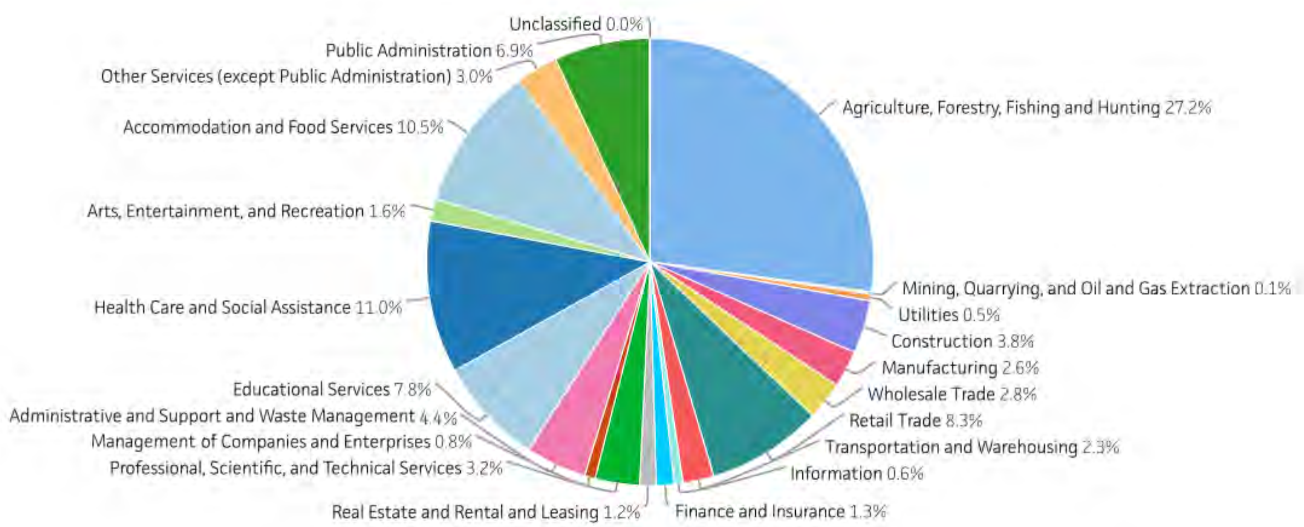
[3] Facts, Figures & FAQs, Monterey County Farm Bureau
[4] Economic Contributions of Monterey County Agriculture, Agricultural Commissioner's Office (June 2020)
[5] 2020-2021 Annual Report, Monterey County Convention & Visitors Bureau

3.6 EMPLOYMENT

Monterey County's civilian labor force includes approximately 197,404 persons, or about 45% of the County's total population. 76.4% of the civilian workforce is private wage and salary workers; 15.2% are government workers; and 8.1% are self-employed in their own businesses. Monterey County's annual unemployment rate in 2020 was 10.8%. The most common industries in Monterey County, by number of employees, are Agriculture, Forestry, Fishing, Mining & Hunting (55,033 workers), Health Care & Social Assistance (22,297 workers), and Accommodation & Food Services (21,287 workers). Compared to other counties, Monterey County, has an unusually high number of Agriculture, Forestry, Fishing & Hunting industry (20x higher than expected). Sectors with the highest average wages per worker are Utilities ($123,326), Mining, Quarrying, and Oil and Gas Extraction ($103,601), and Finance and Insurance ($87,368).[6] *Figure 3-3* shows the breakdown of the labor force by industry.

Figure 3-3
Monterey County Labor Force Breakdown, By Industry



Source: Monterey County Workforce Development Board

Compared to the national average, Monterey County has an unusually high number of residents working in Farming, Fishing, & Forestry Occupations (32 times higher than expected), Building & Grounds Cleaning & Maintenance Occupations, and Food Preparation & Serving Related Occupations.

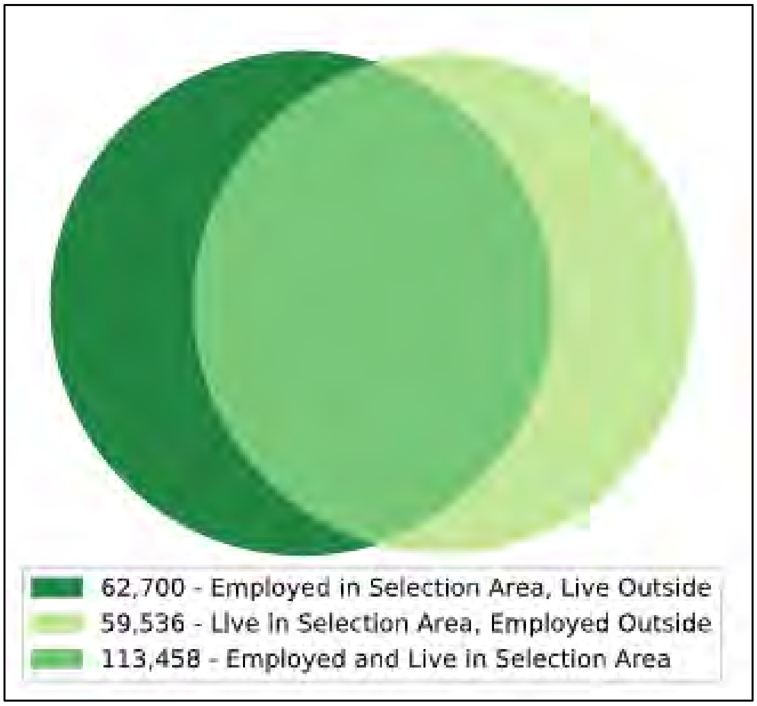
According to the State of California Employment Development Department's Labor Market Division, Monterey County's local economic strength lies in occupations that generally pay lower wages, explaining why the per capita income levels are relatively low compared to nearby counties. In Monterey County, 18% of the labor force consists of occupations in Farming,

[6] Economic Overview: Monterey County, Monterey County Workforce Development Board (November 30, 2020)

Fishing, and Forestry. In the first quarter of 2020, the mean hourly wage was $15.46 per hour. The second highest occupational category is Office and Administrative Support, accounting for 10% of the workforce with a mean wage of $22.36 per hour. Food Preparation and Serving-Related occupations represent the third largest share of Monterey County's employment, with 10% and a mean wage of $15.37 per hour. The top three occupations in Monterey County represent 38% of all employment.

Monterey County continues its efforts to attract more highly skilled jobs to the local economy by encouraging its residents to seek higher educational opportunities that will in turn create a more highly skilled labor force. Occupations in with the highest average wages per worker are Healthcare Practitioners and Technical Occupations ($121,200), Management Occupations ($119,400), and Legal Occupations ($116,500). Inflow/Outflow job data from 2018 indicates the majority of employees (113,458) live and work in Monterey County. *Figure 3-4* summarizes inflow/outflow job data for Monterey County.

Figure 3-4
Inflow/Outflow Job Counts in 2018 for Monterey County



Source: United States Census Bureau, Job-to-Job Flows (J2J)

Recent forecasts suggest that agriculture will continue to provide the greatest number of new jobs, but post-secondary education and specialized business services, both key components of the expanding technology sector of the County, will show the highest percentage growth over the next several years. *Table 3-3* summarizes projected change in number of jobs in 2026 based on occupation from a 2016 baseline.

Table 3-3
Projected Change in Occupation in Monterey County

Occupation	2016 Employment	2026 Employment	Percent Change
Management Occupations	14,280	15,920	+11.5%
Business & Financial Operations Occupations	5,520	6,020	+9.1%
Computer & Mathematical Occupations	2,080	2,310	+11.1%
Architecture & Engineering Occupations	1,150	1,270	+10.4%
Life, Physical & Social Science Occupations	1,620	1,760	+8.6%
Community & Social Service Occupations	2,230	2,590	+16.1%
Legal Occupations	890	970	+9%
Education, Training & Library Occupations	13,240	15,130	+14.3%
Arts, Design, Entertainment, Sports, & Media Occupations	2,350	2,570	+9.4%
Healthcare Practitioners & Technical Occupations	6,990	8,310	+18.9%
Healthcare Support Occupations	3,050	3,630	+19%
Protective Service Occupations	4,450	270	-4%
Food Preparation & Serving Related Occupations	17,200	19,340	+12.4%
Building/Grounds Cleaning & Maintenance Occupations	7,970	8,970	+12.5%
Personal Care & Service Occupations	8,260	10,520	+27.4%
Sales & Related Occupations	16,080	16,840	+4.7%
Office & Administrative Support Occupations	20,990	21,710	+3.4%
Farming, Fishing & Forestry Occupations	45,580	55,590	+22%
Construction & Extraction Occupations	6,340	7,420	+17%
Installation, Maintenance & Repair Occupations	6,870	7,490	+9%
Production Occupations	5,200	5,590	+7.5%
Transportation & Material Moving Occupations	11,120	12,560	+12.9%
Total	203,460	226,780	

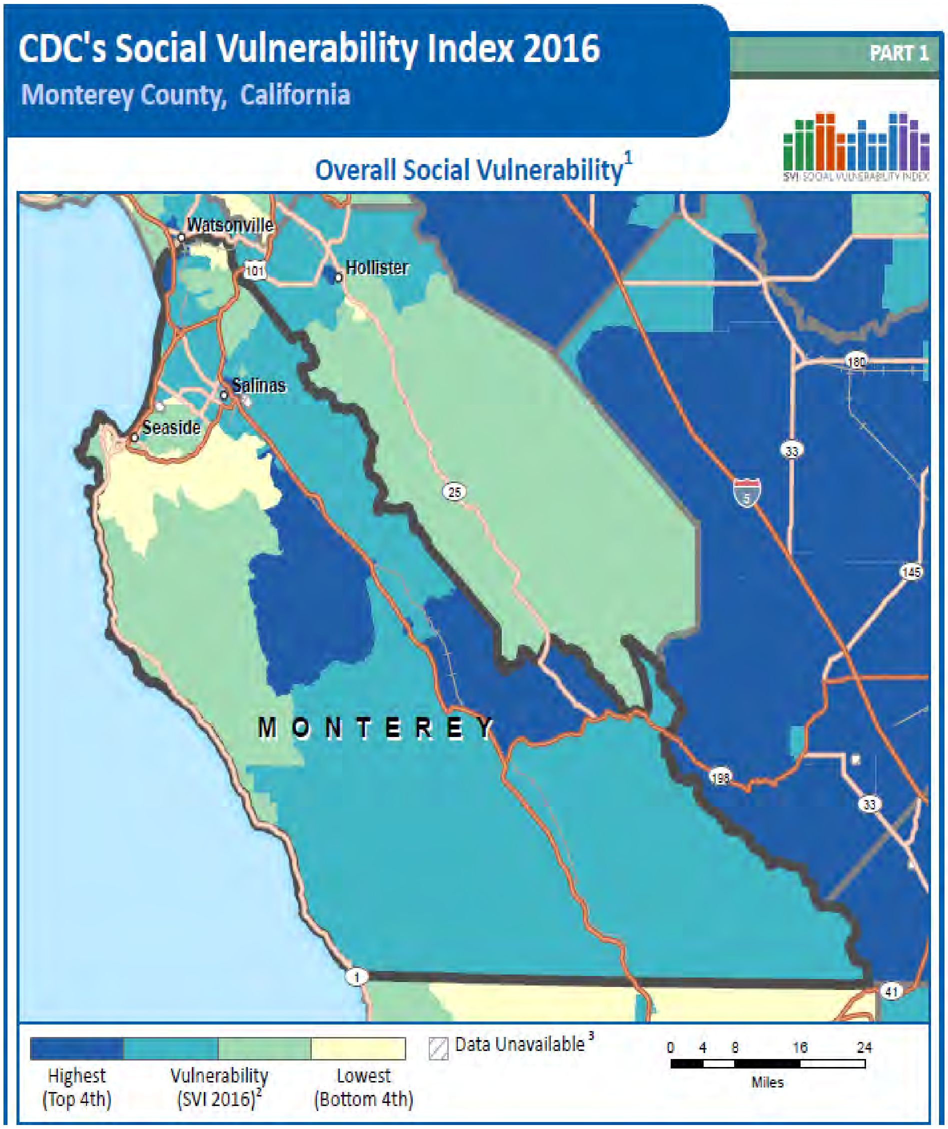
Source: California Employment Development Department

3.7 SOCIAL VULNERABILITY

Social vulnerability refers to the resilience of communities when confronted by external stresses, including natural or human-caused disasters. Characteristics of a population can serve as an important gauge of everything from evacuation compliance to successful long-term recovery, therefore reducing social vulnerability can decrease both human suffering and economic loss. Geographic patterns of potential population vulnerability to disaster can be used to inform mitigation, preparedness, response, and recovery. Considering social vulnerability is an important step in establishing a Whole Community approach to emergency management and hazard mitigation.

Hazard exposure alone does not fully explain disaster resilience; characteristics including age, ethnicity, race, income, household structure, language, employment, home & car ownership, health, population density, insurance, and citizenship, can also impact how well a person manages hazard risks. For the purposes of this plan, the CDC's Social Vulnerability Index (2016), was used to assess the vulnerability of the community. The Index uses US Census data to determine the social vulnerability of census tracts. The Index ranks each tract on 15 social factors, including poverty, lack of vehicle access, and crowded housing. Each tract receives an overall ranking. *Figure 3-5* shows overall Social Vulnerability by census tract in the County.

Figure 3-5
Overall Social Vulnerability in Monterey County



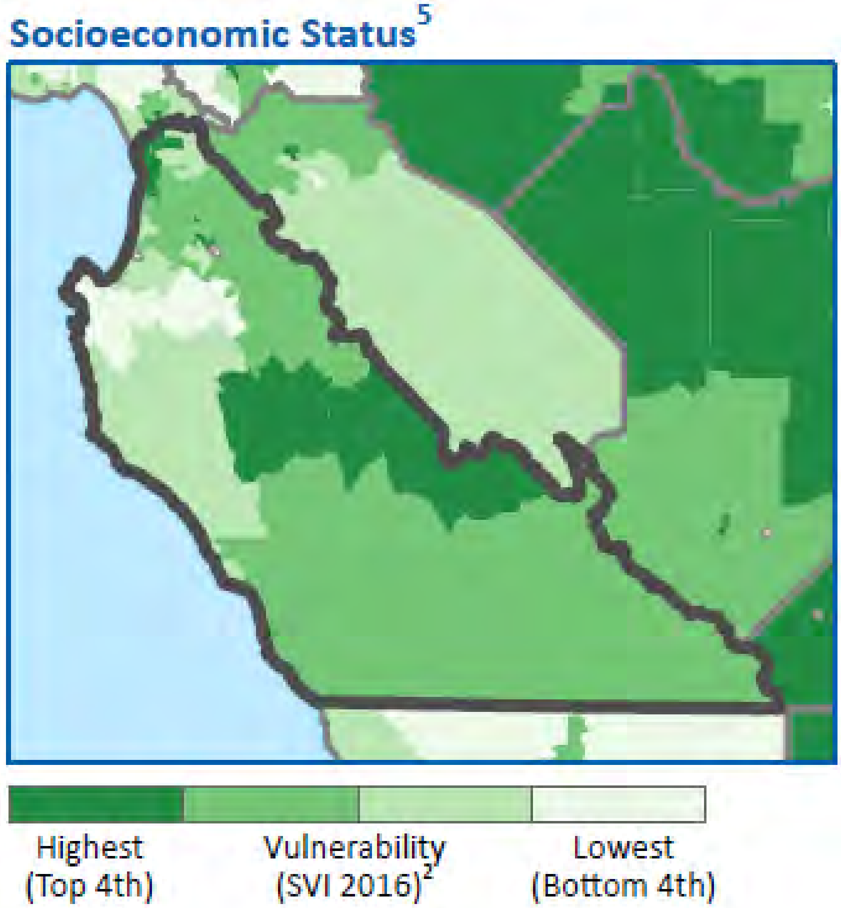
The index also groups tracts into four related themes and ranks them by theme. The four themes used by the CDC Social Vulnerability Index include:

- Socioeconomic Status
- Household Composition and Disability
- Minority Status and Language
- Housing Type and Transportation

3.7.1 SOCIOECONOMIC STATUS

The Socioeconomic Status Theme consists of income, poverty, employment, and education variables. Economically disadvantaged populations are disproportionately affected by disasters and are less likely to have the income or assets needed to prepare for a possible disaster, respond to, or to recover after a disaster. Although the monetary value of their property may be less than that of other households, it likely represents a larger proportion of total household assets. For these households, lost property is proportionately more expensive to replace, especially without homeowner's or renter's insurance. *Figure 3-6* shows overall ranking by census tract on the Social Vulnerability Index Socioeconomic Status Theme in Monterey County.

Figure 3-6
CDC Social Vulnerability Index: Socioeconomic Status in Monterey County



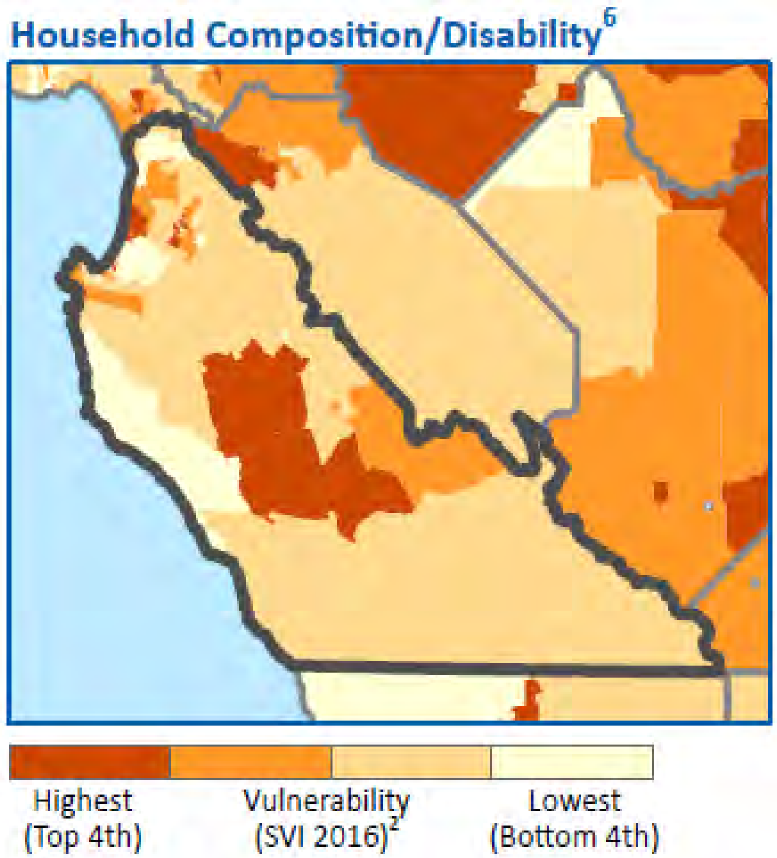
Approximately 13.1% of people in the County are in poverty; about the same rate as California (13.4%) and the in US (13.1%). 9.6% of families are below the poverty line. 19.4% of children under 18 are below the poverty level, compared with 8% of people 65 years old and over. The largest demographic living in poverty is Females, with no spouse and a child under 18 (35%). The most common racial or ethnic group living below the poverty line in the County is Hispanic, followed by White and Other.

Approximately, 2% of residents received cash public assistance benefits, averaging $4,533 annually. Monterey County has the highest yearly enrollment when compared to its neighboring counties (1,915 participants in 2018-2019) in CalWORKS, which provides financial assistance to families. About 7% of residents received Supplemental Nutrition Assistance Program (SNAP) benefits. Monterey County has 18,961 househsholds participating, in CalFresh, which supplements the food budget of low-income households to meet their nutritional needs.

3.7.2 HOUSEHOLD COMPOSITION AND DISABILITY

The Household Composition and Disability Theme is composed of age, single parenting, and disability variables. Household composition is defined here to include dependent children less than 18 years of age, persons aged 65 years and older, and single-parent households. Also included are people with disabilities. People in any of these categories are likelier to require financial support, transportation, medical care, or assistance during disasters. Children and elders are the most vulnerable groups in disasters. Children, especially younger children, cannot protect themselves during a disaster because they lack the needed resources and knowledge to effectively cope with the situation. *Figure 3-7* shows overall ranking by census tract on the CDC Social Vulnerability Index Household Composition and Disability Theme in Monterey County.

Figure 3-7
CDC Social Vulnerability Index: Household Composition and Disability in Monterey County



An estimated 8.8% of residents in Monterey County has a disability. 30.6% of residents 65 years of age and older had a disability. *Table 3-4* summarizes the percentage of the population in Monterey County who have a disability by age group and type of disability.

Table 3-4
Percent of Noninstitutionalized Monterey County Residents with a Disability by Age Group

Type of Disability	Under 18	18 to 64 Years	65+ Years	Total
With a hearing difficulty	0.5%	1.4%	13.1%	2.7%
With a vision difficulty	0.6%	1.4%	4.8%	1.6%
With a cognitive difficulty	3.0%	2.8%	8.2%	3.6%
With an ambulatory difficulty	0.6%	2.9%	18.7%	4.7%
With a self-care difficulty	1.0%	1.3%	8.2%	2.2%
With an independent living difficulty	n/a	2.5%	13.2%	4.5%
Total Persons with Disabilities	3.1%	6.6%	30.6%	8.8%

Additionally, many residents suffer from a chronic health condition. *Table 3-5* summarize age-adjusted prevalence rates from chronic conditions in Monterey County.

Table 3-5
Prevalence of Chronic Health Conditions of Adults Aged 18 and Over [7]

Health Condition	Age-Adjusted Prevalence Rate
Arthritis	21.6%
High Blood Pressure	28.8%
Cancer[1]	5.7%
Asthma	9.2%
Coronary Heart Disease	6%
Chronic Obstructive Pulmonary Disease	6%
Diabetes	10.8%
High Cholesterol[2]	29.6%
Chronic Kidney Disease	3.1%

[1]Excludes skin cancer
[2]Among adults who have been screened in the past 5 years
Source: Centers for Disease Control, PLACES: Local Data for Better Health, County Data, 2020

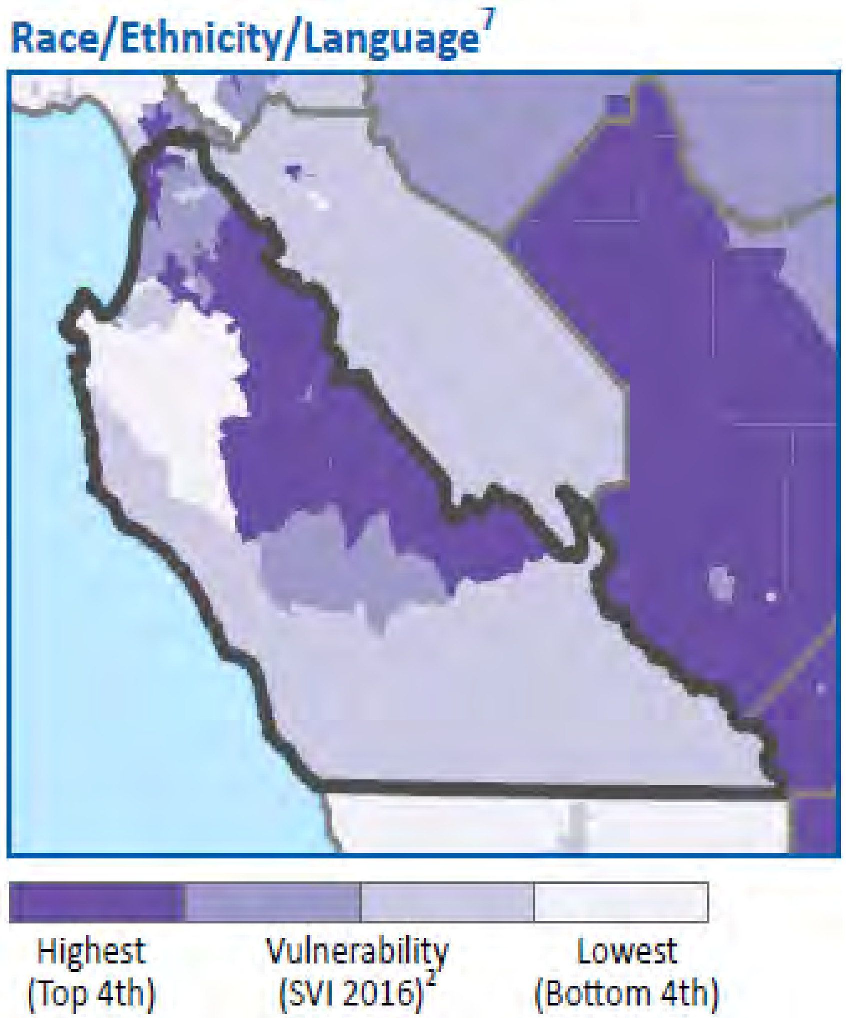
3.7.3 MINORITY STATUS AND LANGUAGE

The Minority Status and Language Theme is composed of race, ethnicity, and English language proficiency variables. The social and economic marginalization of certain racial and ethnic groups has rendered these populations more vulnerable at all stages of disaster. African Americans; Native Americans; and populations of Asian, Pacific Islander, or Hispanic origin are correlated with higher vulnerability rates. In recent decades, the numbers of persons immigrating to the United States from Latin America and Asia have substantially increased. Many immigrants are not fluent in English, and literacy rates for some groups are lower. To the

[7] Centers for Disease Control, PLACES: Local Data for Better Health, County Data, 2020

degree that immigrants have limited English proficiency, disaster communication is made increasingly difficult. *Figure 3-8* shows overall ranking by census tract on the CDC Social Vulnerability Index Minority Status and Language Theme in Monterey County.

Figure 3-8
CDC Social Vulnerability Index: Minority Status and Language Theme in Monterey County



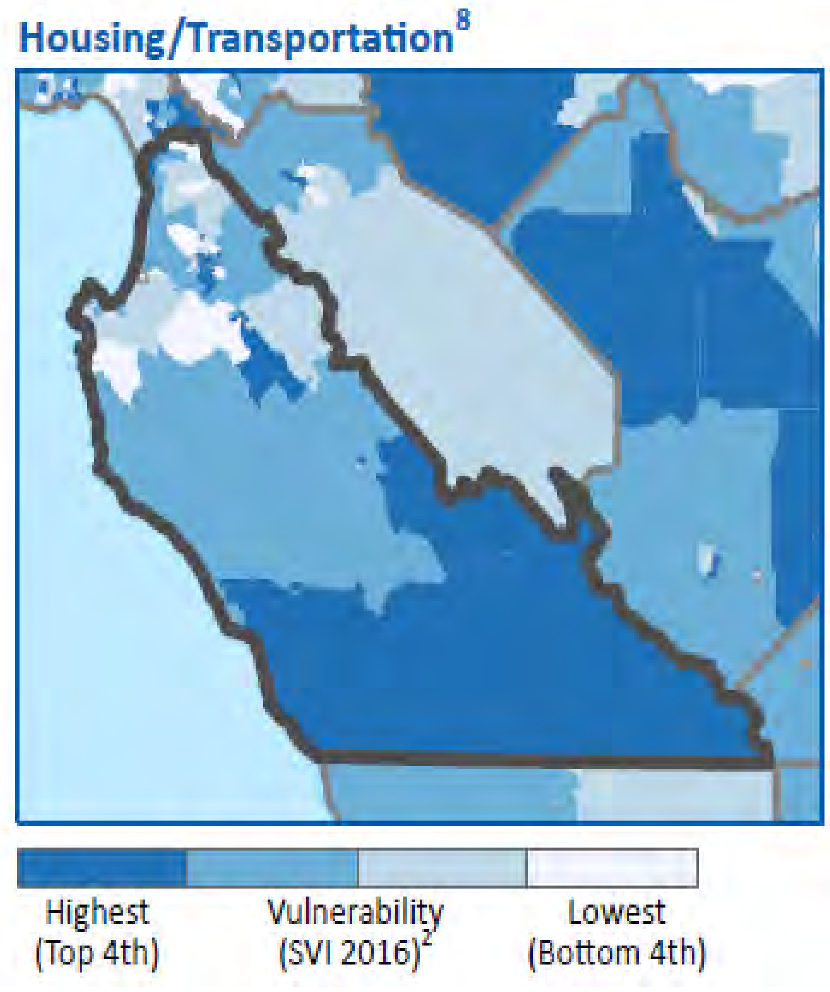
As of 2015, data from the Department of Justice indicates that 109,286 people, 28.2% of residents in Monterey County have limited English proficiency. 91% of the population with limited English proficiency speak Spanish. The next most common language spoken was Tagalog, account for 2.1% of the limited English proficiency population.

3.7.4 HOUSING AND TRANSPORTATION

The Housing and Transportation Theme is composed of housing structure, crowding, and vehicle access variables. Housing quality is an important factor in evaluating disaster vulnerability. It is closely tied to personal wealth; that is, poor people often live in more poorly constructed houses or mobile homes that are especially vulnerable to strong storms or earthquakes. Populations residing in group quarters such as college dormitories, farm workers' dormitories, psychiatric institutions, and prisons also present special concerns during evacuation. Residents of nursing homes and long-term care facilities are especially vulnerable because of their need for specific and limited resources.

On average, farmworker incomes are less than half of the area median household income. Some housing requirements can pose a particular challenge to farmworkers. For example, farmworkers may have difficulty establishing good credit or demonstrating long-term residency, both of which are often standard requirements in the private rental-housing market. Substandard and structurally deficient conditions are common in farmworker housing; conditions that are often worsened by crowding or lack of affordability. The lack of an adequate, affordable housing supply forces farmworkers to live in overcrowded and unsafe housing or to seek housing in garages or other substandard structures that sometimes do not provide basic shelter or sanitation. *Figure 3-9* shows overall ranking by census tract on the CDC Social Vulnerability Index Housing and Transportation Theme in Monterey County.

Figure 3-9
CDC Social Vulnerability Index: Housing and Transportation Theme in Monterey County



Homeless populations are also vulnerable during disasters. As of the last comprehensive count in 2019[8], there were 2,422 homeless people in Monterey County. As homeless populations can be difficult to count accurately this number is most likely underestimated. Most of the homeless population, 76% is unsheltered, spending their nights outdoors, primarily in the streets or parks (22%), in their vehicle (19%), or in a tent (18%). Men (65%) are disproportionately represented in the County's homeless population, as are Black/African American residents (25% of the homeless population, 3% of the County population). Over half of homeless survey respondents, 58%, have at least one disabling condition. 44% suffer from depression, 45% abuse drugs or alcohol, 27% have physical disabilities, 25% suffer from chronic health problems, and 23% have post-traumatic stress disorder.

3.8 LAND USE AND DEVELOPMENT TRENDS

Monterey County has a total area of 3,771 square miles, of which 13% is water. As seen in *Table 3-6*, Land cover data indicates that the largest land use in Monterey County is shrubland, followed by grasslands and forest land. The majority of developed land consists of low-intensity development.

Table 3-6
Land Cover Monterey County: 2018 Statistics

Land Cover Type[1]	Percent
Crops[2]	5.3%
Forest[3]	22.3%
Wetlands	1.5%
High Intensity Developed	0.6%
Low Intensity Developed	5.6%
Grassland	24.9%
Shrubland	35.4%
Fallow	2.7%
Barren	1.7%

Source: CalLands, UC Agriculture and Natural Resources (2018)
[1] Percentages recalculated based on acreage to exclude water
[2] All crop categories combined (Alfalfa & hay, corn, cotton, fruit trees, grain crops, grapes, other tree crops, rice, tomatoes, vegetables & fruits, walnuts, winter wheat)
[3] Includes deciduous, evergreen, and mixed forest

The County and its municipal planning partners all adopt General Plans, which serve as blueprints for establishing long-range development policies, as directed with California's General Planning Law. Decisions on land use will be governed by these plans. This hazard mitigation plan will work together with the General Plans to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area. A

[8] Monterey County Homeless Census & Survey Comprehensive Report (2019)

General Plan provides a basis for private development proposals and public projects to remain consistent with existing city, regional and state policies. The General Plan is designed to help the County and participating jurisdictions address issues related to land use, circulation(traffic), housing, open space, conservation, noise, and safety. The Land Use portion of the plan helps guide the County and participating jurisdictions in determining the location of future development(s), to include possible future annexations for municipal jurisdictions. The Safety Element of the General Plan serves to decrease risk of impact from natural hazards.
Past development that most led to the highest increases in hazard vulnerability in the County happened many decades and even more than a century ago. The County and other participating jurisdictions are well aware of areas of increased hazard risk related to older development. More recently, development in the last few decades has occurred with less hazard risk because of existing overlay of Federal, State, and local regulations.

The Association of Monterey Bay Area Governments (AMBAG) estimates that to house the region's expected population growth by 2040, an increase of approximately 24,000 housing units is needed in Monterey County. A large amount of the growth is expected to occur in South County and in the Cities of Marina and Seaside.[9] Future development may become constrained due to limited water sources, poor water quality, and geologic (landslide), fire, flood, and seismic hazards. In addition to local challenges, infrastructure problems affect entire regions. All planning partners reviewed their General Plans under the capability assessments undertaken for this hazard mitigation plan. Deficiencies revealed by these reviews are identified as mitigation actions to decrease risks to move beyond past trends. Moreover, while past development has occurred in hazard areas to some degree, increasing hazard risks, development standards and performance measures, often times incorporated into specific plans, policy plans, and master plans, are employed to reduce risk. These development standards are continually improving and will continue to strengthen into the future.

The Safe Growth Survey,[10] a technique recommended by organizations such as the American Planning Association (APA) and FEMA,[11] was used to evaluate the extent to which each local jurisdiction in Monterey County is positioned to grow safely relative to its natural hazards. The survey was used to gain an understanding of individual jurisdiction's land use and devolvement trends and how various comprehensive plans, capital improvement plans, and zoning and subdivision ordinances may allow growth in hazardous areas. The Safe Growth Survey was used as part of the 2013-2014 MJHMP Plan update, which allowed the survey results to be compared over time, in order to measure progress. The results indicate that municipal jurisdictions in the County are continuing to maintain the level of safe growth established in 2016. More information on the Safe Growth Survey is included in **Section 20.2**, *Safe Growth Survey.* Specific

[9] 2018 Regional Growth Forecast, Association of Monterey Bay Area Governments (June 2018)
[10] Safe Growth Audits, David R. Godschalk, FAICP (October 2009)
[11] Local Mitigation Planning Handbook, *Worksheet 4.2: Safe Growth Audit*, FEMA (March 2013)

land use and development trends, along with the Safe Growth Survey results for each participating municipal jurisdiction are included in their respective Annex in **Volume 2**.

Water Availability

In the coastal regions of California, access to water is a barrier to new development. Access to water is a primary constraint to development on the Monterey Peninsula. Water is supplied to most of the Monterey Peninsula through wells in Carmel Valley, dams, and a well drawing from the Seaside Aquifer. However, since 2020 a portion of the Monterey Peninsula's potable water supply has come from indirect potable reuse via the Pure Water Monterey Groundwater Replenishment Project, an effort lead by Monterey One Water. The Monterey Peninsula Water Management District has established water allocations for jurisdictions within its district and communities have distributed most of the available allocations. As a result, new development must either provide another water source such as a well or enter a waitlist for future allocations.

Fort Ord Reuse

Fort Ord was a major US Army base which closed in 1994. The former Fort Ord Military Base is located on the California coastline near the Monterey Peninsula consisting of 45 square miles and covering over 28,000 acres of land. The Fort Ord Reuse Authority (FORA), a large multi-governmental body composed of elected officials at the local, state, and federal levels, was created by the California State Legislature in 1994 with the legislatively mandated mission of overseeing replacement land use, removing physical barriers to reuse, financing and constructing major components of the required infrastructure and protecting identified environmental reserves.

The property was divided among the City of Seaside, City of Marina, and unincorporated Monterey County. This reuse has resulted in the expanding of the cities of Marina, Del Rey Oaks, and Seaside, and adding area to be developed by Monterey County. 69% of the total acreage has been dedicated to recreational/open space. About 1,000 acres were used to create the Fort Ord Dunes State Park and approximately 15,000 acres were dedicated by President Obama for the Fort Ord National Monument. The Fort Ord National Monument consists of nearly 23 square miles of undeveloped natural wildlands and is open to the public and managed by the US Department of the Interior, Bureau of Land Management.

Many other areas have been converted from military to civilian land uses under the direction of FORA. While many old military buildings and infrastructure remain abandoned, many others have been demolished. Notable developments include the cleanup of Army munitions from thousands of acres of land, the California State University Monterey Bay (CSUMB) campus, the UC-Santa Cruz Monterey Bay Education, Science and Technology Center (MBEST), the Veterans Transition Center, residential subdivisions, shopping centers, health clinics, new military facilities, and a nature preserve. FORA legislatively terminated on June 30, 2020. The responsibility for the area and undeveloped land now falls to the individual jurisdictions of Seaside, Marina, Del Rey Oaks, Marina Coast Water District, and the Monterey County.

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PART B: HAZARD PROFILES AND RISK ASSESSMENT

THIS PART IDENTIFIES, PROFILES, AND ASSESSES THE HAZARDS THAT COULD AFFECT MONTEREY COUNTY. IT CONSISTS OF THE FOLLOWING SECTIONS:

4. RISK ASSESSMENT METHODS
5. AGRICULTURAL EMERGENCIES
6. COASTAL EROSION
7. DAM & LEVEE FAILURE
8. DROUGHT
9. EARTHQUAKE
10. FLOODING
11. HAZARDOUS MATERIALS INCIDENT
12. HUMAN CAUSED HAZARDS
13. PUBLIC HEALTH HAZARDS
14. SEVERE WEATHER
15. SLOPE FAILURE
16. TSUNAMI
17. UTILITY INTERRUPTION
18. WILDFIRE
19. CLIMATE CHANGE

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4. RISK ASSESSMENT METHODS

As defined by the Federal Emergency Management Agency (FEMA), risk is the potential for damage, loss, or other impacts created by the interaction of hazards with community assets. The risk assessment process measures the potential loss to a community, including loss of life, personal injury, property damage, and economic injury resulting from a hazard event. This information provides a framework for a community to develop and prioritize mitigation strategies and plans to help reduce both the risk and vulnerability from future hazard events.

The *FEMA Local Mitigation Planning Handbook* identifies four steps for conducting a risk assessment:

1. Identify & Describe Hazards
2. Identify Community Assets
3. Analyze Risks
4. Summarize Vulnerability

The risk assessment for this hazard mitigation plan update evaluates the risk of hazards prevalent in Monterey County and meets requirements of the Disaster Mitigation Act and 44 CFR, Section 201.6(c)(2).

4.1 HAZARD IDENTIFICATION

The first step in the planning process was to identify the threats and hazards of concern in Monterey County, based on a combination of experience, forecasting, subject matter expertise, and other available resources. This supported the development of a list of threats and hazards that could affect the community. Hazards were categorized as follows:

- Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis, and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought, and wildfires), meteorological (cyclones and storms/wave surges), or biological (disease epidemics and insect/animal plagues).
- Technological hazards are generally accidental or result from events with unintended consequences (for example, an accidental hazardous materials release).
- Human Caused Hazards result from the intentional actions of an adversary, such as a threatened or actual terrorism, chemical attack, biological attack, or cyber incident.

The Steering Committee considered the full range of hazards that could affect the County and then listed hazards that present the greatest concern. The process incorporated a review of state and local hazard planning documents, as well as information on the frequency of, magnitude of, and costs associated with hazards that have struck or could strike the County. Anecdotal information regarding natural hazards and the perceived vulnerability of the County's assets to them was also used. *Table 4-1* summarizes the hazards of concern this plan will address.

Table 4-1
Hazards of Concern

Hazard	Reason for Inclusion
Agricultural Emergencies	Agriculture is an economic driver in the County and is at risk to many hazards such as insects, weeds, wildfire, and severe weather.
Coastal Erosion	Parts of the County are located on the Ocean and are subject to erosion risk. Coastal erosion can create hazardous conditions, threatens dune habitat, and poses a threat to the agriculture and tourism industries. Sea level rise is likely to exacerbate erosion risk.
Dam & Levee Failure	Several large and aging dams are in the County, in addition to many miles of levees. Dam failure can be catastrophic to all life and property downstream.
Drought	Droughts are a serious threat and could have devastating impacts on agriculture. Previous droughts have caused major economic damage to the agricultural industry and prolonged periods of drought can reduce water availability and increase water prices.
Earthquake	Several active faults, including the San Andreas Fault, run through the County. Due to the location of population centers and building history, any earthquake will likely have significant impacts on people, property, and critical infrastructure. An earthquake could also trigger other natural hazard events such as dam failures and landslides, which could severely impact the County.

Table 4-1
Hazards of Concern

Hazard	Reason for Inclusion
Flooding	Flooding is a major hazard and is associated with many of the largest and most damaging historical hazard events. The history of flooding is associated with coastal storms, heavy rainfall, flash flooding, and run-off. Increased impervious surfaces, the channelization of streams, and increased development in floodplains has resulted in intensified flood flows and more property and lives at risk.
Coastal Flooding	Coastal flooding is generally associated with winter storms, high tides, and strong winds and is a significant hazard on the coastline.
Riverine Flooding	Riverine flooding, notably along the Salinas, Carmel, and Pajaro Rivers, has caused damage in the County.
Flash Flooding	Flash flooding occurs quickly with little to no warning and can cause serious damage in the County.
Localized Stormwater Flooding	Drainage systems in the County have a finite capacity and prolonged heavy rainfall has contributed to flooding in more urbanized areas.
Hazardous Materials Incidents	The County contains large industrial facilities, major transportation routes, agricultural operations, harbors, pipelines, and oil fields, all of which have the potential to cause a hazardous materials release.
Human Caused-Hazards	Although not required, human-caused hazards were included since preparation for them involves many of the same resources as a natural hazard. The likelihood of these hazard is greater than that of several of the natural hazards identified in this Plan.
Cyber-Attack	The spectrum of cyber-risks is limitless, with threats having a wide range of effects. Cyber-attacks can originate from any computer in the world and effect any system that is connected to the Internet.
Targeted Violence	Mass-casualty incidents (MCIs) and active shooters can cause loss of life serious injuries, and associated property damage.
Terrorism	Terrorism can cause loss of life, widespread illness and injury, the destruction of property, the displacement of large numbers of people, and devastating economic losses.
Mass Migration	Population migration of large scales can lead to resource pressures and can exacerbate existing instability.
Public Health Hazards	All of the County is susceptible to public health hazards. A large disease outbreak could have devastating effects on the population. Health hazards can also have large economic effects and complicate response efforts to other natural hazard events.
Epidemic	Due to increased air travel and growing population, the probability and threat of a communicable disease outbreak is growing.
Pandemic	While the probability of a major infectious disease pandemic is relatively low, it can have catastrophic social and economic consequences, as seen during the COVID-19 pandemic.

Table 4-1
Hazards of Concern

Hazard	Reason for Inclusion
Severe Weather	Severe weather has previously caused damage in Monterey County. Due to the size of the County and changes in elevation and climate, weather conditions and their impacts can vary greatly. Severe weather events are also associated with a variety of secondary hazards, which have the potential to greatly impact the County.
Severe Winter Storms	Severe winter storms have caused damage in the County and can lead to immobility and loss of utilities. Heavy rain can have significant impacts, including flash flooding and mudslides.
Extreme Cold & Freeze	Extreme cold and freeze events have impacted the County. Freeze can have a devastating effect on agriculture. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening.
Windstorms	Windstorms are a frequent problem in the County and have been associated with injuries and fatalities. Windstorms can topple trees and cause damage to utilities and critical facilities.
Extreme Heat	Extreme heat has caused fatalities in the County and is associated with a variety of health-related issues.
Sea Level Rise	Rising sea levels will increase the likelihood and intensity of floods., as well as lead to increased coastal and fluvial flooding, increased tidal inundation, coastal erosion, tsunami inundation, seawater intrusion, and worsened storm surge. (Profiled in Climate Change)
Slope Failure	The County is vulnerable to slope instability, especially after prolonged rainfalls and in areas recently burned by wildfires. Slope failure is a common occurrence and has caused damage to homes, public facilities, and roads. In Big Sur, landslides have caused millions of dollars in damage and have led to lengthy closures of Highway 1.
Tsunami	Several areas of the County are located in mapped tsunami inundation zones. Tsunamis are a threat to life and property.
Utility Interruption	Equipment failures and electrical infrastructure igniting wildfires has resulted in blackouts and power shutoffs throughout the County. Loss of power for more than a few hours can result in large economic losses and have large effects on vulnerable populations.
Space Weather	Space weather can cause damage to critical infrastructure, especially the electric grid. The effects can be far-reaching, as virtually all infrastructure and services depend on the electric power grid.
Wildfire	The geography, terrain, weather patterns and vegetation in the County provide ideal conditions for recurring wildfires and rapid spread. Past wildfires have caused damage to critical infrastructure, property, and the environment, and have led to injuries and loss of life. The County is likely to face a wildfire threat each and every year and can expect a large fire to occur every few years.

In addition to the hazards listed above, climate change was assessed as both a hazard and as exacerbating other hazards profiled in this Plan. Sea level rise risk is profiled within the climate change section, in addition to the increased risk of the following hazards:

- *Agricultural Emergencies*- The Salinas Valley is one of the most vulnerable agricultural regions to climate change. The amounts, forms, and distribution of precipitation, as well as the increased frequency and intensity of climate extremes, will affect water availability as well as pests, crop yields, and the length of the growing season.
- *Dam & Levee Failure*- Dams and levees are designed partly based on assumptions about a river's flow behavior. Changes in weather patterns can have significant effects on the behavior of rivers and these changes could conceivably cause a dam or levee to lose some or all of its designed margin of safety.
- *Drought*- With a warmer climate, droughts could become more frequent, more severe, and longer lasting, thereby increasing their impact on the County.
- *Earthquake*- The impacts of global climate change on earthquake probability are unknown, but secondary impacts of earthquakes could be magnified by climate change.
- *Flooding*- Climate change is likely to exacerbate the intensity and magnitude of precipitation events, increasing the risk associated with flooding. High frequency flood events in particular will likely increase with a changing climate.
- *Human-Caused Hazards*- Climate change could lead to increases in violence and cause increases in climate induced migration.
- *Public Health Hazards*- Rising temperatures and more extreme drought events could lead to increases in heat-related illness, as well as vector-borne and infectious diseases.
- *Severe Weather*- Extreme heat waves are likely to increase in probability due to climate change. Atmospheric river events, the dominant driver of locally extreme rainfall events and associated flooding, are expected to increase under projected climate change.
- *Slope Failure*- Climate change will likely affect storm patterns, the occurrence and duration of droughts, and the probability of wildfire, which are all factors that would increase the probability of landslide occurrence.
- *Tsunami*- It is unclear if climate change would increase the frequency of tsunamis, but when a tsunami occurs the effects of climate change could lead to more destructive waves and inundation areas would likely reach further than current mapping indicates.
- *Wildfire*- Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels.

Excluded Hazards

Other hazards were noted by the Steering Committee and the public to potentially consider in the MJHMP update. Some of these hazards have the potential to do damage or harm but were determined to not have a significant enough effect, so they are not profiled further; in some cases, they are currently addressed in other planning mechanisms or have had limited historic impacts. *Table 4-2* lists the hazards excluded from this Plan.

Table 4-2
Excluded Hazards

Hazard Type	Explanation
Avalanche	Monterey County is not located in area prone to frequent or significant snowfall.
Blizzard	Monterey County is not located in area prone to frequent or significant snowfall.
Cyclone	No historic events have occurred in Monterey County.
Ice Storm	The County does not reach temperatures low enough with enough frequency for an ice storm to pose a major threat.
Limnic Eruption	No historic events have occurred in Monterey County.
Civil Unrest	This is a risk in Monterey County but is more appropriately dealt with in other planning mechanisms.
Expansive Soils	No historic events have occurred in Monterey County.
Glacier Movement/ Collapse	There are no glaciers in Monterey County.
Human-Wildlife Conflicts	This is a risk in Monterey County but is more appropriately dealt with in other planning mechanisms.
Hurricane	No significant historic events have occurred in the County.
Maritime Incidents	This is a risk in Monterey County but is more appropriately dealt with in other planning mechanisms.
Plane Crash	This is a risk in Monterey County but is more appropriately dealt with in other planning mechanisms.
Sinkholes	No significant historic events have occurred in the County.
Supply Chain Interruptions	This is a risk in Monterey County but is more appropriately dealt with in other planning mechanisms.
Volcano	Due to distance from volcanoes and the limited chance of an eruption, this hazard was not identified as a priority.

4.1.1 DISASTER DECLARATION HISTORY

One important consideration in identifying and prioritizing hazards is past major hazard events, especially those that triggered federal, state, or local disaster declarations. Most available information on major past hazard events comes from past disaster declarations. If a local government determines effects of an emergency are beyond the capability of local resources to mitigate effectively, the local government may proclaim a local emergency. Pursuant to *California Government Code Section 8680.9*, a local emergency is a condition of extreme peril to persons or property proclaimed as such by the governing body of the local agency affected by a natural or manmade disaster. The purpose of a local emergency proclamation is to provide extraordinary police powers, immunity for emergency actions, authorize issuance of orders and regulations, activate pre-established emergency provisions, and is a prerequisite for requesting state or federal assistance.

Pursuant to *California Government Code Section 8625*, the Governor may proclaim a State of Emergency in an area affected by a disaster, when he is requested to do so by the governing body of the local agency affected, or he finds the local authority is inadequate to cope with the emergency. The California Disaster Assistance Act (CDAA) provides state financial assistance for recovery efforts to local governments after a state disaster has been declared.

If the severity and magnitude of an event surpasses the ability of the local and state government to respond and recover, the Governor can request federal assistance. Based on the Governor's request, the President may declare that a major disaster or emergency exists, thus activating an array of Federal programs to assist in the response and recovery effort. There are two types of disaster declarations provided for in the Stafford Act: Emergency Declarations and Major Disaster Declarations. Both declaration types authorize the President to provide supplemental federal disaster assistance. However, the event related to the disaster declaration and type and amount of assistance differ.

- **Emergency Declarations**: An Emergency Declaration can be declared for any occasion or instance when the President determines federal assistance is needed. Emergency Declarations supplement State and local efforts in providing emergency services, or to lessen or avert the threat of a catastrophe in any part of the US. The total amount of assistance provided for a single emergency may not exceed $5 million.
- **Major Declaration**: The President can declare a Major Disaster Declaration for any natural event, including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President believes has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond. A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work.

Not all programs, however, are activated for every disaster. The determination of which programs are authorized is based the types of assistance specified and, on the needs, identified during Preliminary Damage Assessments. FEMA disaster assistance programs are as follows:

- **Individual Assistance**: Assistance to individuals and households
- **Public Assistance:** Assistance to state and local governments for emergency work and the repair or replacement of disaster damaged facilities
- **Hazard Mitigation Assistance**: Assistance to state and local governments for actions taken to prevent or reduce long term risk to life and property from natural hazards.

Additionally, the Disaster Mitigation Act of 2000 authorized the Fire Management Assistance Grant (FMAG) program, which provides for the mitigation, management, and control of fires that threaten such destruction as would constitute a major disaster. The purpose of FMAG is to provide supplemental federal assistance to states and local government to fight fires burning on public (non-federal) or privately owned forest or grassland. A Local or State fire agency must request an FMAG through the Cal OES Fire and Rescue Branch or the California State Warning Center while the fire is burning uncontrolled. The federal government may also issue a disaster declaration through the US Department of Agriculture (USDA), and the Small Business Administration (SBA). The SBA can make federally subsidized loans to repair or replace homes, personal property or businesses that sustained damages not covered by insurance. The Secretary of Agriculture is authorized can declare a disaster to make emergency loans available to producers suffering losses in declared counties and in counties that are contiguous to a designated county.

As summarized in *Table 4-3*, since 1990, Monterey County has experienced a total of 55 emergencies, resulting in a local, state, or federal disaster declaration, 14 of which were major federally declared disasters. This information, coupled with local historical and anecdotal information, helped inform the hazard identification process.

Table 4-3
Disaster Proclamations and Declarations (1990-2021)

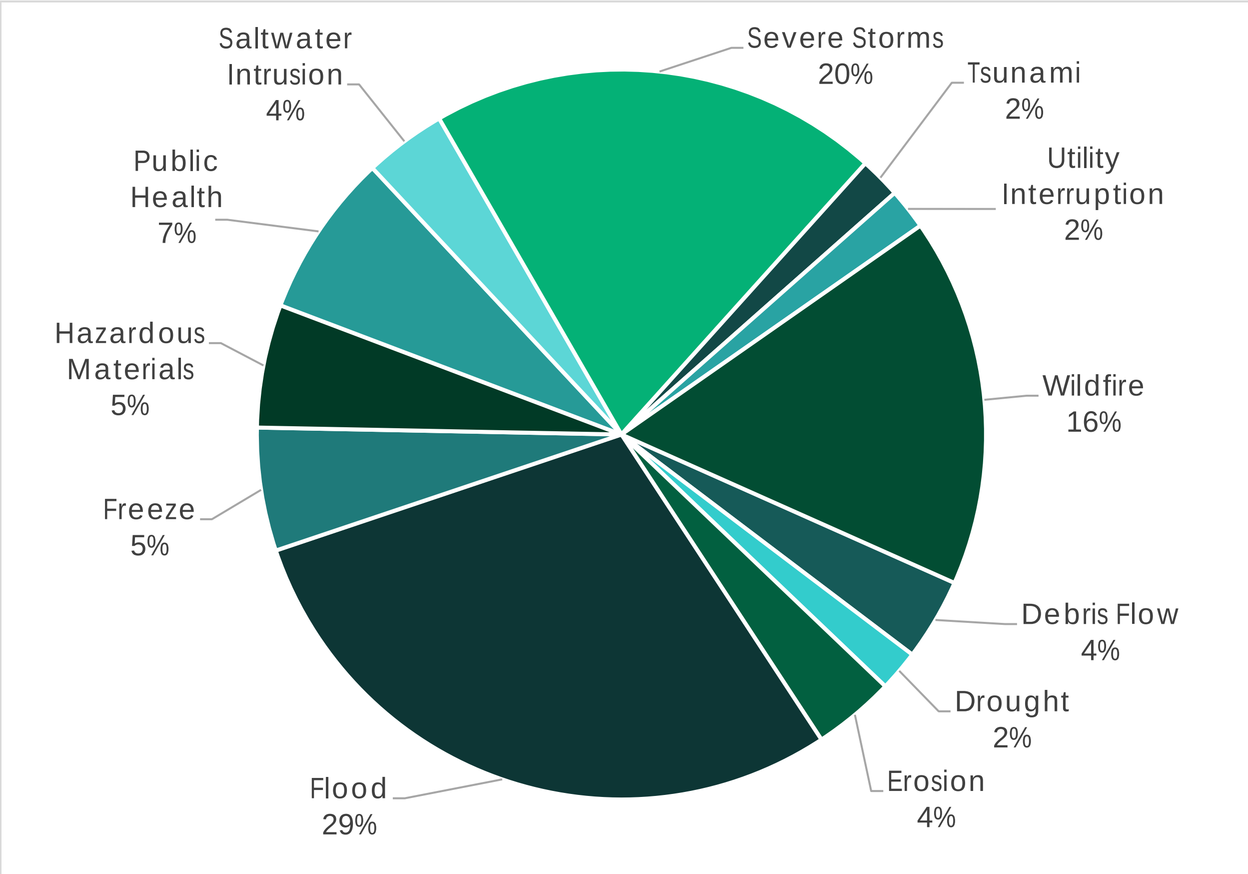
Year	Declaration Type	Incident Type	Description	FEMA #	CDAA #	Local #
2021	State and Local Emergency	Drought	Drought		2021	21-189
2021	State and Local Emergency	Severe Storms	Severe Winter Storms, Flooding, Mudslides, and Erosion		2021	21-033
2020	Major Disaster	Wildfire	August 2020 Wildfires	DR-4558	2020-06	
2020	Local Emergency	Wildfire	Dolan Fire			20-283
2020	Fire Management	Wildfire	Carmel Fire	FM-5333	2020-06	
2020	Fire Management	Wildfire	River Fire	FM-5329	2020-06	20-277
2020	Local Emergency	Flood	Salinas River Lagoon Flooding			20-309
2020	Major Disaster	Public Health	COVID-19 Pandemic	DR-4482	2020-01	20-060
2019	Local Emergency	Flood	Carmel River & Lagoon Flooding			19-016
2019	State and Local Emergency	Flood	Atmospheric River, Chualar Flash Flood, and Carmel River Flooding		2020-05	19-943
2019	Local Emergency	Utility Interruption	Public Safety Power Shutoff			19-383
2019	Major Disaster	Severe Storms	Late February 2019 Storms	DR-4434	2019-03	
2019	State and Local Emergency	Severe Storms	Mid-February 2019 Atmospheric River		2019-02	19-077
2019	Local Emergency	Flood	Salinas River Lagoon Flooding			19-022
2017	Major Disaster	Severe Storms	February 2017 Winter Storms	DR-4308	2017-03	17-045
2017	Major Disaster	Severe Storms	January 2017 Winter Storms	DR-4301	2017-01	17-008
2017	Local Emergency	Flood	Salinas River Lagoon Flooding			16-005
2016	Local Emergency	Erosion	Emergency Infrastructure Repair			16-089
2016	Local Emergency	Flood	Emergency Infrastructure Repair			16-324
2016	Fire Management	Wildfire	Soberanes Fire	FM-5137		16-206

Table 4-3
Disaster Proclamations and Declarations (1990-2021)

Year	Declaration Type	Incident Type	Description	FEMA #	CDAA #	Local #
2016	Local Emergency	Severe Storms	Severe Winter Storms			16-084
2015	Local Emergency	Saltwater Intrusion	Saltwater Intrusion and Inundation at Moro Cojo Slough			15-122
2015	Local Emergency	Wildfire	Tassajara Fire			15-253
2014	Local Emergency	Saltwater Intrusion	Saltwater Intrusion and Inundation at Moro Cojo Slough			14-299
2014	Local Emergency	Wildfire	Pfeiffer Fire			14-003
2012	Local Emergency	Flood	Salinas River Lagoon Flooding			12-386
2012	Local Emergency	Flood	Carmel River & Lagoon Flooding			12-027
2011	Major Disaster	Tsunami	March 2011 California Tsunami	DR-1968	2011-02	
2011	Local Emergency	Debris Flow	Highway 1 Failure and Closure			11-075
2010	Local Emergency	Flood	Carmel River & Lagoon Flooding			10-083
2010	Local Emergency	Flood	Carmel River & Lagoon Flooding			10-006
2009	Local Emergency	Public Health	Influenza A (H1N1) Virus Infection			09-319
2009	State and Local Emergency	Wildfire	Gloria Fire		2009-06	09-376
2009	Local Emergency	Hazmat	Dayton Fire Explosion and Hazardous Material Incident			09-741
2009	Local Emergency	Flood	Salinas River Lagoon Flooding			09-172
2009	Local Emergency	Debris Flow	Basin Complex Burn Scar Debris Flow			09-147
2009	Local Emergency	Flood	Carmel River & Lagoon Flooding			09-148
2009	Local Emergency	Public Health	Human Immunodeficiency Virus			09-129
2008	Fire Management	Wildfire	Indians and Basin Complex Fires	FM-2781	2008-02	08-244
2008	Local Emergency	Hazmat	Emergency Asbestos Remediation			08-234
2007	Major Disaster	Freeze	Severe Freeze	DR-1689	2007-02	
2007	Local Emergency	Flood	Carmel River & Lagoon Flooding			07-309
2006	Local Emergency	Hazmat	Emergency Asbestos Remediation			06-267
2006	Local Emergency	Flood	Severe Winter Storms			06-006
2005	Local Emergency	Erosion	Road Erosion on Scenic Road			05-118
2005	Local Emergency	Flood	Carmel River & Lagoon Flooding			05-085
2004	Local Emergency	Severe Storms	Severe Winter Storms			04-058
2003	Local Emergency	Public Health	Human Immunodeficiency Virus			03-034
1999	Major Disaster	Freeze	Severe Freeze	DR-1267	98-02	
1998	Major Disaster	Severe Storms	El Nino '98 Winter Storms	DR-1203	98-01	
1997	Major Disaster	Severe Storms	Severe Winter Storms,	DR-1155	97-01	
1995	Major Disaster	Severe Storms	1995 Late Winter Storms	DR-1046	95-03	
1995	Major Disaster	Severe Storms	1995 Winter Storms	DR-1044	95-01	
1993	Major Disaster	Flood	1993 Winter Storms	DR-979	93-01	
1991	Major Disaster	Freeze	Severe Freeze	DR-894		

As seen in *Figure 4-1*, the top three hazards resulting in a declaration of any kind are Flooding (29%), Severe Storms (20%), and Wildfires (16%).

Figure 4-1
Historical Declared Hazard Events in Monterey County by Hazard Type (1990-2021)



4.1.2 EOC ACTIVATIONS

The County maintains a list of Emergency Operations Center (EOC) activations. As seen from the list of EOC Activations, winter storms, wildfires, flooding, and utility outages were the most common hazards requiring activation of the EOC. EOC activations from 2006 to present include:

- 2022 Tsunami
- 2021 Willow Fire
- 2019 PSPS Event
- 2017 Pajaro Sewage Spill
- 2016 Soberanes Fire
- 2015 Tassajara Fire
- 2014 Drought
- 2009 Mudslide
- 2008 Basin Complex Fire
- 2021 Car Week
- 2020 Wildfires
- 2019 Chualar Flood
- 2016 Winter Storms
- 2016 Phone Outage
- 2014 Winter Storms
- 2014 Debris Flows
- 2009 H1N1 Influenza
- 2006 Soledad MCI
- 2021 Winter Storms
- 2020 COVID-19
- 2017 Winter Storms
- 2016 Chimney Fire
- 2015 Power Outage
- 2014 Natividad Water Issue
- 2013 Pfeffer Fire
- 2009 Dayton Hazmat Incident
- 2008 Winter Storms

4.2 HAZARD PROFILES

The hazards identified in *Table 4-1 Hazards of Concern*, were profiled individually in identified sections. These profiles set the stage for the risk assessment, where exposure and vulnerability are quantified for each of the identified hazards. Each hazard is profiled in the following format:

Hazard Overview: This section gives a description of the hazard and includes definitions and background, scientific, and regulatory information, as applicable.

Hazard History: This section contains information on previous occurrences of the hazard in the County. Historical hazard information is helpful in estimating the likelihood of future events and predicting potential impacts. When data was available, the extent of the impacts, such as fatalities, injuries, building and infrastructure damages, and loss of services, were included.

Location: This section includes information on the geographic location of areas affected by the hazard in Monterey County. Generally, maps were used to illustrate location for many of the hazards. National, state, and County databases were reviewed to locate available spatially based data relevant to this planning effort.

Maps were produced using Geographic Information System (GIS) to show the spatial extent and location of hazards when such datasets were available. These maps are included in the hazard chapters of this plan. When mapping was not available or deemed not the most appropriate way to identify the location, narrative description was used. Some hazards affect the entire County uniformly, in which case specific location or extent was not identified.

Frequency: This section describes the frequency and likelihood of future occurrences of the hazard. The frequency and likelihood of the hazard occurring in the future and can be described in a variety of ways. Where possible, frequency was calculated based on existing data. Hazard likelihood was compared using the following general descriptions:

- *Unlikely*: Less than 1% chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.
- *Occasional*: Between 1 and 10% chance of occurrence in the next year or has a recurrence interval of 11 to 100 years.
- *Likely*: Between 10 and 100% chance of occurrence in next year or has a recurrence interval of 10 years or less.
- *Highly Likely*: Near 100% chance of occurrence in next year or happens every year.

Severity: Severity, or extent, is defined as the strength or magnitude of a hazard. Depending on the hazard, the severity was described in a combination of ways including:

- The value on an established scientific scale or measurement system
- Other measures of magnitude, such as water depth or wind speed
- The duration of hazard events

Warning Time: This section describes the warning time and speed of onset for the hazard.

Secondary Hazards: This section seeks to examine the vulnerabilities of hazard events beyond the individual hazard. Often another hazard occurs as a secondary hazard, such as an earthquake causing a landslide or tsunami or a wildfire. Other events are compounded by outside factors, such as wildfire evacuations occurring during Public Safety Power Shutoff (PSPS) events. This section was included to highlight compounding hazard risks by highlighting secondary hazards and local conditions that accelerate impacts.

4.3 RISK ASSESSMENT METHODOLOGY

The Risk Assessment measures the potential impact on life, property, critical infrastructure, the environment, and the economy resulting from the hazards profiled. The intent of the Risk Assessment is to identify the qualitative and quantitative vulnerabilities of the community to the greatest extent possible given available data. The Risk Assessment increases understanding of hazard impacts to the community and provides a foundation to develop and prioritize mitigation actions. In turn, mitigation actions reduce damage from natural disasters through increased preparedness and focus resources to areas of greatest vulnerability.

This section provides an overview of the methods used for the risk assessments for each hazard identified. Vulnerabilities to each hazard were assessed in a two-step process. First, population, critical facilities, county parcels, and structures were inventoried to develop a “lay of the land.” Then, those inventories were utilized in calculating estimated exposure and damage from hazards at various levels of severity.

The Risk Assessment utilized geospatial data along with local knowledge of past events. Geospatial data was essential in determining population and assets exposed to hazards and was conducted if a natural hazard has a spatial footprint that could be analyzed against the locations of people and assets.

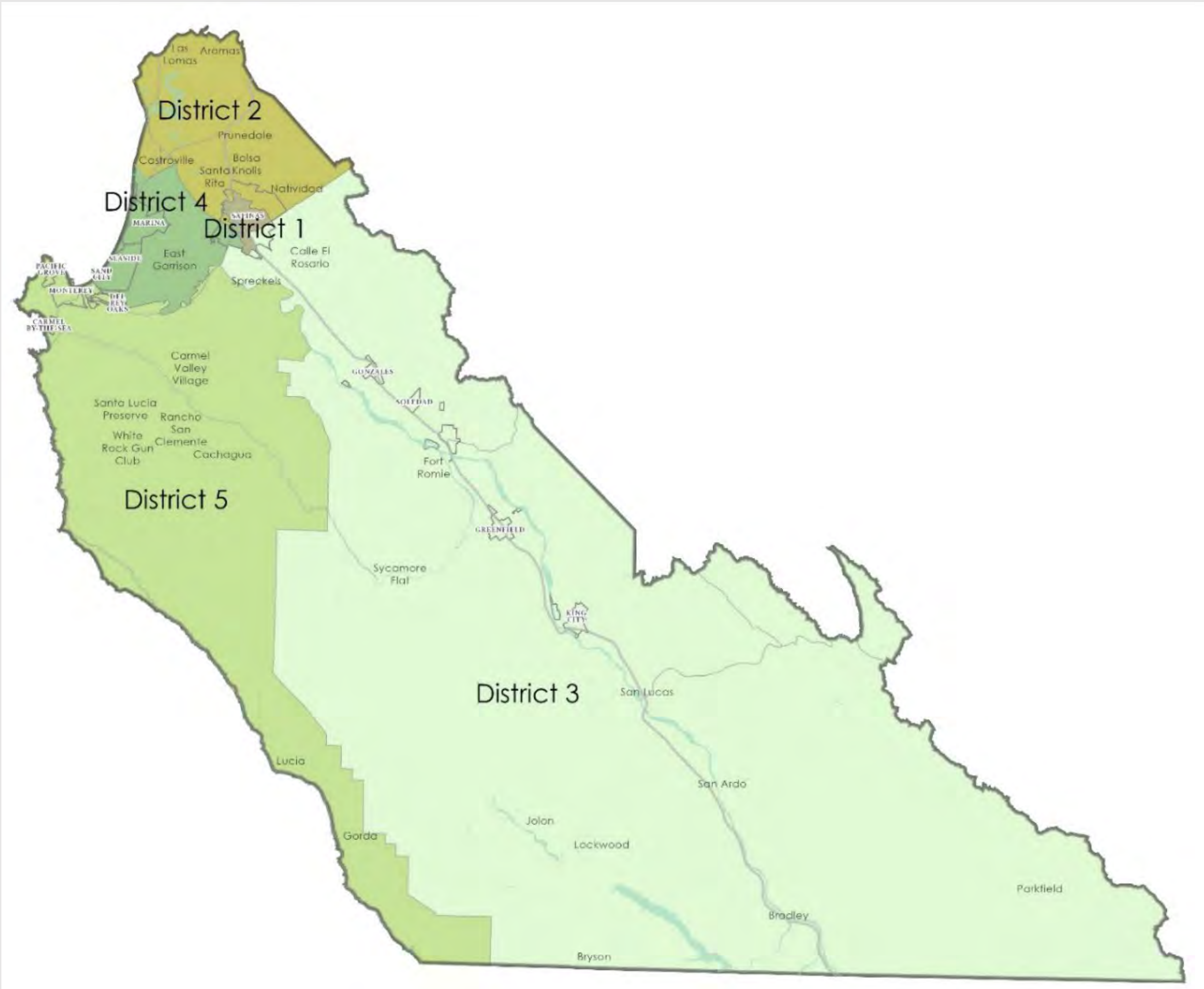
4.3.1 POPULATION AND ASSET INVENTORY

In order to describe the risk posed by each hazard, it was important to first understand the total population and assets at risk. The population and asset inventories provided a baseline to measure the significance of hazard events and vulnerability to those events.

Supervisorial Districts and Political Subdivisions

For the purposes of Countywide analysis, the 2010 Supervisorial Districts were used to conceptualize the geographic distribution of population and property. *Figure 4-2* shows the geographic location of each Supervisorial Districts in Monterey County.

Figure 4-2
2010 Monterey County Supervisorial Districts



Supervisorial Districts in Monterey County include the following geographic areas:

District 1 is geographically the smallest supervisorial district in Monterey County and is entirely within the city limits of the city of Salinas.

District 2 is the northernmost supervisorial district in Monterey County, the 2nd District includes the communities of Boronda, Castroville, Las Lomas, Moss Landing, Pajaro, Prunedale, Royal Oaks, the northern neighborhoods of the city of Salinas, and those portions of the community of Aromas that are located within Monterey County.

District 3 covers the majority of the Salinas Valley and southern Monterey County, extending to its border with San Luis Obispo County. The district includes the unincorporated communities of Spreckels, Chualar, Jolon, the eastern portion of the city of Salinas, and the cities of Gonzales, Greenfield, Soledad, and King City. Additionally, it includes the military installations at Fort Hunter Liggett and Camp Roberts, as well as portions of the Los Padres National Forest.

District 4 includes the southwest portion of the city of Salinas, the cities of Del Rey Oaks, Marina, Seaside, Sand City, and the former military installation at Fort Ord.

District 5 is geographically the largest of the five districts and covers most of the Monterey Peninsula and southern coastline of the County down to the southern border with San Luis Obispo County. The 5th District includes the cities of Carmel-by-the-Sea, Monterey, and Pacific Grove, the unincorporated communities of Carmel Valley Village, Big Sur, Pebble Beach, San Benancio, Corral de Tierra, and Jamesburg. Additionally, it includes the military installations at the Presidio of Monterey, the Defense Language Institute, and the Naval Postgraduate School, as well as the Ventana Wilderness area of the Los Padres National Forest.

Population

Each natural hazard affects County residents differently depending on the location of the hazard and the population density where the hazard event could occur. Risk assessments presented in this section summarize the population exposure for each natural hazard if available.

To produce the hazard-specific risk assessments, first the population near each hazard was determined. Population estimates were derived from 2010 Census information. Census blocks were used to determine the population exposed to the hazards.

Parcel Value Inventory

Monterey County Assessor’s data was used to develop both residential and non-residential values exposed to hazards. Residential and nonresidential parcels were identified using Assessor's Land Use Codes.

The Parcel Value Inventory includes total assessed value of the land and of any structures on the land. These elements are combined because, in the event of a disaster, the value of the infrastructure or improvements to the land is usually the focus and the land itself is not a total loss. Each hazard profile outlines predicted impacts to this Inventory based on each hazard’s geographic extent.

The Monterey County Parcel and Population Inventory is summarized in *Table 4-4.*

Table 4-4
Monterey County Parcel and Population Inventory

Jurisdiction	Population	Residential		Non-Residential	
		Count	Value ($)	Count	Value ($)
Carmel-by-the-Sea	3,460	2,489	$4,071,156,577	888	$691,544,498
Del Rey Oaks	1,000	584	$276,553,256	144	$55,959,358
Gonzales	6,758	1,303	$437,053,854	479	$193,034,179
Greenfield	13,299	2,574	$749,316,532	585	$176,076,227
King City	10,970	1,874	$552,522,904	898	$284,138,790
Marina	18,939	3,603	$2,163,216,447	1,388	$582,115,264
Monterey	26,998	6,533	$4,016,887,152	5,671	$2,661,097,840
Pacific Grove	15,030	4,798	$3,545,159,214	1,763	$441,654,454
Salinas	133,018	23,032	$9,261,979,929	9,025	$3,159,440,145
Sand City	324	157	$32,386,952	644	$320,490,499
Seaside	28,456	5,461	$2,345,735,210	2,159	$481,073,182
Soledad	22,713	2769	$1,049,529,544	703	$147,123,893
Supervisorial District					
District 1	74,822	9,872	$3,434,995,377	4,619	$1,674,390,014
District 2	73,812	16,226	$7,225,922,676	8,558	$2,369,919,832
District 3	76,581	12,949	$4,353,858,958	10,695	$5,609,556,661
District 4	71,735	15,072	$7,553,619,336	7,009	$2,506,288,306
District 5	81,657	29,599	$32,363,271,436	14,367	$6,397,430,508

Critical Facilities and Infrastructure

Critical facilities and Infrastructure were of particular concern when conducting the Risk Assessment. A critical facility is a structure or other improvement that, because of its function, size, service area, or uniqueness, has the potential to cause disruption of vital socioeconomic activities if it is destroyed, damaged, or functionally impaired. Critical facility points include police stations, fire stations, hospitals, elder care facilities, day care facilities, buildings containing hazardous materials, schools, transportation infrastructure, utilities, and government buildings. Critical lifelines include communication, electric power, liquid fuel, natural gas, and transportation routes.

A critical infrastructure spatial database was developed to translate critical facilities information into georeferenced points and lines. The critical facilities inventory was developed from a variety of sources, including County, City, State, Federal, and industry datasets.

Table 4-5 lists critical infrastructure data sources. All data sources have a level of accuracy acceptable for planning purposes. Due to the sensitivity of this information, a detailed list of facilities is not provided. The risk assessment for each hazard qualitatively discusses critical facilities with regard to that hazard.

Table 4-5
Critical Infrastructure and Assets Data Sources

Critical Facilities and Assets	Source
Emergency Operation Centers, Fire Stations, Police Stations, Schools, Airports, Electric Power Facilities, Landfills, Military Facilities, Large Public Facilities	2015 Monterey County Local Hazard Mitigation Plan, data reviewed and updated by County OES, PG&E
Hospitals and Medical Care Facilities	Monterey County GIS, PG&E
Dams	US Army Corps of Engineers National Inventory of Dams
Harbors	Monterey County GIS
Hazardous Material Facilities	Monterey County GIS: Underground Tanks, Cal ARP Facility
Transportation Infrastructure- Roads, Highways, Bridges, and Railroads	Monterey County GIS
Communications Facilities	Monterey County GIS, PG&E
Water and Wastewater Infrastructure	Monterey County GIS, M1W provided GIS layer of collection system including conveyance pipelines and pump stations
Rain Gauges	Monterey Water Resources Agency
Stormwater Infrastructure	Monterey County GIS
Oil Wells	California Department of Conservation, Geologic Energy Management Division's (CalGEM) Well Finder (WellSTAR)

4.3.2 HAZARD EXPOSURE

The asset and population inventory information were then used to generate specific exposure and damage estimations based on the severity of specific hazard events. “Exposure” of assets and population refers to the total counts of parcels, people, facilities, and assets within the County in which a hazard event may occur.

A natural hazards overlay was developed to reflect the combination of many known natural hazard spatial footprints. The spatial overlay method enables summarization of building values, parcel counts, population exposure, and critical facility exposure within a hazard’s geographic extents.

In Monterey County, coastal erosion, dam failure, levee failure, hazardous materials incidents, earthquake liquefaction, flooding, slope failure, sea level rise, tsunami, and wildfire have identifiable geographic extents and corresponding spatial information about each hazard.

Table 4-6 summarizes the data sources used for each of these hazards.

Table 4-6
Hazard Exposure Data

Hazard	Data Source	Severity and Exposure
Coastal Erosion	USGS Coastal Storm Modeling System (CoSMoS), Central California Projections of Coastal Cliff Retreat and Shoreline Change due to 21st Century Sea Level Rise	To determine exposure, the Hold the Line Management Scenario was used for both coastal cliff retreat and shoreline change. For shoreline change, Continued Nourishment Management Scenario, in addition to modeling which forced Sea Level Rise in 2100 at 200 cm. Based on OPC High Risk Aversion Guidance, the following sea level rise levels were chosen: 25 cm Sea Level Rise (2030, near future risk; 75 cm Sea Level Rise (2060); and 200 cm Sea Level Rise (2100).
Dam Failure	• *Nacimiento*- Monterey County GIS • *San Antonio*- Monterey County GIS • *Forest Lake Dam*- Pebble Beach Community Services District • *Los Padres Dam*- CA DOSD	Exposure risk was based on the following: • *Nacimiento*- Spillway Failure, Dam Failure • *San Antonio*- Spillway Failure, Dam Failure • *Forest Lake Dam*- 4 Failure Scenarios • *Los Padres Dam*- Inundation area
Levee Failure	Army Corp of Engineers National Levee Database	Leveed Areas was used to determine exposure risk.
Hazardous Materials Incident	*Mobile*- US Dept of Transportation, National Transportation Atlas Database *Fixed*-Monterey County Hazardous Materials Plan (2019)	Based on guidelines in the US Department of Transportation's Emergency Response, the recommended buffer distance or "protective action distance" of one mile was used, around mobile and fixed facilities to determine exposure risk.
Earthquake Liquefaction	Monterey County GIS	High and moderate liquefaction potential areas used to determine exposure risk.
Flooding	FEMA FIRM (2018)	100-year and 500-year floodplain used to determine exposure risk.
Slope Failure	Earthquake Induced Landslide Risk, Monterey County 2010 General Plan	High and moderate earthquake induced landslide potential areas used to determine exposure risk, in addition to data from the FEMA National Risk Index.
Sea Level Rise	National Oceanic and Atmospheric Administration (NOAA), Sea Level Rise Data	Based on OPC High Risk Aversion Guidance, the following sea level rise levels were chosen: 1 ft Sea Level Rise (2030); 3 ft Sea Level Rise (2060); and 7 ft Sea Level Rise (2100) to determine exposure.

Table 4-6
Hazard Exposure Data

Hazard	Data Source	Severity and Exposure
Tsunami	California Geological Survey, Tsunami Inundation Maps, Monterey County Tsunami Hazard Areas (2021)	Tsunami Inundation Zone used to determine exposure risk.
Wildfire	CALFIRE Fire Threat	Statewide GIS layer in raster format of fire threat, which combines expected fire frequency with potential fire behavior to create 4 threat classes. Very High, High, and Moderate Threat Zones were considered areas exposed to wildfire risk.

FEMA National Risk Index

The FEMA National Risk Index was also used to enhance the risk assessment. The National Risk Index incorporates physical and social vulnerability data to identify communities more at-risk to the adverse impacts of natural hazards. The National Risk Index is a high quality, comprehensive data set that identifies a community's risk to natural hazards.

Community risk in the National Risk Index is a combination of several factors, including the expected annual dollar loss related to building value, crop, or population, due to a natural hazard; social vulnerability, which measures how social groups respond to the adverse impacts of natural hazards; and community resilience, which is the community's ability to recover from a natural disaster.

4.3.3 HAZARD VULNERABILITY

Included in the risk assessment was a consideration of hazard vulnerability. Vulnerability is the characteristics of community assets that make them susceptible to damage from a given hazard. The vulnerability of people, property, critical infrastructure, the environment, and the economy is discussed within each respective risk assessment section for each hazard.

Vulnerability was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Additionally, vulnerability was assessed qualitatively using local knowledge.

Environmental Impacts

Monterey County has many important environmental assets and natural resources. These resources are critical to community identity and quality of life and support the economy through agriculture, tourism and recreation, and a variety of other ecosystem services, such as clean air and water. Hazards profiled in this Plan can have impacts on the natural environment and are discussed qualitatively in this section.

The natural environment also provides protective functions that reduce hazard impacts and increase resiliency. For instance, wetlands and riparian areas help absorb flood waters, soils and landscaping contribute to stormwater management, and vegetation provides erosion control and reduces runoff. Conservation of environmental assets may present opportunities to meet mitigation and other community objectives, such as protecting sensitive habitat, developing parks and trails, or contributing to the economy.

Economic Impacts

After a disaster, economic resiliency drives recovery. Monterey County has a variety of specific economic drivers that are important to understand when planning to reduce the impacts of hazards and disasters to the local economy. Depending on the hazard, economic impacts in this section were described in terms of indirect losses, such as functional downtime and loss of employment wages, and in terms of the impact to primary economic sectors

4.3.4 LIMITATIONS

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- Missing data on value of structure or land
- Population assessed based on census blocks, which differs from physical residents in a hazard area
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents has to prepare for a specific hazard event
- The uncertain spatial accuracy of a variety of the data used to assess hazard exposure
- Lack of a standardized model for assessing sea level rise impacts. Multiple models provide multiple results. Not all models were run in the development of the sea level rise analysis.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, Monterey County will collect additional data to assist in estimating potential losses associated with other hazards.

4.4 HAZARD PRIORITIZATION AND RISK RANKING

FEMA requires all hazard mitigation planning partners to have jurisdiction-specific mitigation actions based on local risk, vulnerability, and community priorities. This plan included a risk ranking protocol for each planning partner, in which "risk" was calculated by adding the extent of hazard, the likelihood of future occurrence, the severity, and the impact on people, property and the economy.

The risk ranking was used to identify mitigation actions for hazards. The risk ranking at the planning partner scale was used to inform the action plan development process for each partner. Planning partners were directed to identify mitigation actions addressing hazards that, at a minimum, had a "high" risk ranking. Actions that address hazards with a substantial, moderate, possible, slight, negligible hazard ranking are considered optional by this planning process. The following Countywide risk ranking was prepared by the planning team. The results are used in establishing mitigation priorities.

Each participating jurisdiction also completed the hazard prioritization process specifically for the hazards applicable to their jurisdiction, and this important initial stage informed the rest of the planning process for each jurisdiction. Individual hazard prioritization matrices are available in **Volume 2** of this MJHMP.

4.4.1 THREAT HAZARD RISK ASSESSMENT SURVEY

The risk ranking process was conducted using the Threat Hazard Risk Assessment Survey. All stakeholders took the Threat Hazard Risk Assessment Survey. The purpose was both the gauge perceived risk and to rank and prioritize the hazards. The survey assisted in the creation of a risk matrix, in order to compare hazards and rank which pose the greatest risk. Based on the survey each identified hazard was given a rank based on geographic extent, likelihood of future occurrences, magnitude, and impacts

The score for each variable by hazard was calculated using a weighted average of all survey responses. Variables were then summed to create results for each Individual jurisdiction (summarized in **Volume 2**). For the Countywide THIRA overall jurisdiction risk ranking scores by hazard for likelihood, magnitude, and impact were used and weighted by population in the jurisdiction (as a percentage of the total County population).

Municipal jurisdictions scores comprised 75% of the total score per variable, participating special district scores compromised 15% of the total score (weighted by population served), and stakeholder scores (collected as described in *Stakeholder Engagement*) comprised 10% of the total score. Geographic extent which was weighted by land area (as a percentage of the total County land area). The risk index was helpful tool to compare multiple hazards, but it is not a complete risk assessment and is supplementary to the more detailed risk analysis provided in each hazard chapter.

Variables

Variables were based on the hazard profiles as described above and, on the FEMA, Local Mitigation Planning Handbook. The following variables, questions, and guidance shaped the ranking on the matrices:

Geographic Extent: What geographic area is affected by this hazard?

1. Negligible: No known or negligible geographic extent
2. Limited: Less than 10% of Planning Area
3. Significant: 10-50% of Planning Area
4. Extensive: 50-100% of Planning Area

Likelihood of Future Occurrences: What is the likelihood of a hazard event occurring in a given year?

1. Unlikely: Less than 1% chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.
2. Occasional: Between 1 and 10% chance of occurrence in the next year or has a recurrence interval of 11 to 100 years.
3. Likely: Between 10 and 100% chance of occurrence in next year or has a recurrence interval of 10 years or less.
4. Highly Likely: Near 100% chance of occurrence in next year or happens every year.

Magnitude/ Severity: What is the expected magnitude and severity of the hazard event based on historic events or future probability?

1. Negligible: Less than 10% of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries treatable with first aid
2. Limited:10-25% of property severely damaged; shutdown of facilities for more than a week; and/or injuries treatable do not result in permanent disability
3. Critical: 25-50% of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
4. Catastrophic: More than 50% of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths

Impact: In terms of injuries, damage, or death, would you anticipate impacts to be negligible, limited, critical, or catastrophic when a significant hazard event occurs?

1. Negligible: no meaningful impact
2. Limited: minimal potential impact
3. Critical: moderate potential impact
4. Catastrophic: widespread potential impact

4.4.2 RANKING METHODOLOGY

To determine the rank, each variable was weighted on a scale from 1-4, or negligible/ unlikely to extensive/ highly likely/ catastrophic. The score for each variable by hazard was calculated using a weighted average of all survey responses. Scores on each variable were added together to determine a score between 1 and 16.

Figure 4-3 demonstrates how individual variable scores were added together to create a total score, associated with a relative degree of risk.

Figure 4-3
Risk Ranking Score Matrix by Variable

		Geographic Extent 1	Geographic Extent 2	Geographic Extent 3	Geographic Extent 4		
Likelihood	1	4	6	8	10	1	Magnitude/ Severity
	2	6	8	10	12	2	
	3	8	10	12	14	3	
	4	10	12	14	16	4	
		Impact 1	Impact 2	Impact 3	Impact 4		

Each score was associated with a qualitative degree of risk ranking from Negligible (a score between 1 and 4) to Very High (a score between 14.1 and 16). As described below in *Table 4-7*

Table 4-7
Degree of Risk Scores

Degree of Risk	Values
Very High	14.1-16
High	12.1-14
Substantial	10.1-12
Moderate	8.1-10
Possible	6.1-8
Slight	4.1-6
Negligible	1-4

4.4.3 RESULTS

As discussed above, each participating also ranked hazards for its own area. *Table 4-8* summarizes the number of times a ranking of very high, high, substantial, moderate, possible, and slight was assigned by a participating jurisdiction based on the numerical ratings that each jurisdiction assigned each hazard. The results indicate the following general patterns:

- The only hazards to receive any very high-risk rankings were drought and water shortage, earthquake, epidemic, pandemic, sea level rise, and severe winter storms.
- Drought and water shortage followed by wildfire were the most commonly ranked as high risk. 50% of participating jurisdictions ranked drought as high risk.
- Earthquake, followed by utility interruption, and localized stormwater flooding were the most commonly ranked as substantial risk hazards. 67% of participating jurisdictions ranked earthquake as a substantial risk.

- Flash flood was the most commonly ranked moderate risk hazard, followed by terrorism and then, cyber-attack, hazardous materials incident, and riverine flooding.
- Extreme cold and freeze, extreme heat, and mass migration were the most commonly ranked as a possible risk.
- Extreme cold and freeze, mass migration, and slope failure were the most commonly ranked as slight risks. Levee failure was the most commonly unranked hazard.

Table 4-8
Number of Participating Jurisdiction Assigning a Given Ranking to a Hazard

Hazard	Number of Jurisdictions Assigning Ranking to Hazard						
	Very High	High	Substantial	Moderate	Possible	Slight	Unranked/ Negligible
Agricultural Emergencies	0	2	5	2	0	3	6
Coastal Erosion	0	3	4	4	0	1	6
Coastal Flooding	0	2	4	2	4	0	6
Cyber-Attack	0	5	4	7	2	0	0
Dam Failure	0	0	1	4	5	2	6
Drought & Water Shortage	1	9	5	0	1	1	1
Earthquake	1	3	12	2	0	0	0
Epidemic	1	4	6	5	1	1	0
Extreme Cold & Freeze	0	0	1	3	7	4	3
Extreme Heat	0	0	2	6	7	0	3
Flash Flood	0	0	3	9	3	1	2
Hazardous Materials Incident	0	1	4	7	5	1	0
Invasive Species	0	0	2	6	3	3	4
Levee Failure	0	0	2	1	3	4	8
Localized Stormwater Flooding	0	0	7	6	4	1	0
Mass Migration	0	0	1	0	7	4	6
Pandemic	1	5	7	1	3	1	0
Riverine Flooding	0	0	3	7	5	2	1
Sea Level Rise	1	4	4	1	1	1	6
Severe Winter Storms	1	2	4	6	3	1	1
Slope Failure	0	0	4	5	4	4	0
Targeted Violence	0	0	3	6	5	2	0
Terrorism	0	1	2	8	3	3	0
Tsunami	0	3	2	4	2	0	0
Utility Interruption/ PSPS	0	3	8	6	1	0	0
Water Contamination	0	2	5	6	3	1	0
Wildfire	0	7	2	3	2	2	0
Windstorms	0	2	6	4	4	1	0

Specific jurisdictional results are included in **Volume 2** of this Plan. Based on the jurisdictional results and the methodology described above, a countywide Threat Hazard Identification Risk Assessment matrix was created. *Table 4-9* summarizes the results of the countywide THIRA.

Table 4-9
Countywide Threat Hazard Identification Risk Assessment (THIRA)

Hazard	Geographic Extent	Likelihood of Occurrence	Magnitude/ Severity	Impact	Total *Out of 16*	Degree of Risk
Agricultural Emergencies	2.6	2.1	2.2	2.3	9.1	Moderate
Coastal Erosion	2.5	1.9	1.8	1.8	8.0	Moderate
Coastal Flooding	2.6	1.8	1.9	1.9	8.2	Moderate
Cyber-Attack	2.3	2.6	2.7	2.9	10.5	Substantial
Dam Failure	2.7	1.2	1.2	1.8	6.9	Possible
Drought & Water Shortage	3.1	3.0	3.0	3.1	12.3	High
Earthquake	2.9	2.9	3.1	3.1	11.9	Substantial
Epidemic	2.6	2.5	2.8	2.7	10.7	Substantial
Extreme Cold & Freeze	2.0	1.6	1.6	1.6	6.7	Possible
Extreme Heat	2.8	2.0	1.7	1.8	8.2	Moderate
Flash Flood	2.4	1.9	2.0	2.1	8.4	Moderate
Hazardous Materials Incident	1.8	2.4	2.5	2.5	9.2	Moderate
Invasive Species	2.5	1.7	1.7	1.7	7.7	Possible
Levee Failure	2.4	1.2	1.0	1.4	6.1	Possible
Localized Stormwater Flooding	2.8	2.6	2.4	2.4	10.2	Substantial
Mass Migration	2.0	1.4	1.4	1.4	6.3	Possible
Pandemic	2.9	2.5	2.9	2.9	11.2	Substantial
Riverine Flooding	2.3	2.1	2.1	2.1	8.6	Moderate
Sea Level Rise	2.6	1.9	2.1	2.0	8.6	Moderate
Severe Winter Storms	2.7	2.5	2.5	2.5	10.1	Substantial
Slope Failure	2.5	1.9	2.0	2.0	8.5	Moderate
Targeted Violence	1.8	1.9	2.1	2.2	7.9	Possible
Terrorism	1.8	1.6	2.1	2.1	7.5	Possible
Tsunami	2.1	1.2	1.4	1.4	6.1	Possible
Utility Interruption/ PSPS	2.4	2.7	2.5	2.6	10.2	Substantial
Water Contamination	2.6	2.0	2.5	2.5	9.6	Moderate
Wildfire	3.2	2.4	2.6	2.6	10.8	Substantial
Windstorms	2.3	2.4	2.3	2.3	9.3	Moderate

Based on the THIRA results, *Table 4-10* shows the hazard ranking for all hazard considered in the plan update.

Table 4-10
Countywide Hazard Risk Ranking

Ranking	Hazard	Total	Degree of Risk
1	Drought & Water Shortage	12.3	High
2	Earthquake	11.9	Substantial
3	Pandemic	11.2	Substantial
4	Wildfire	10.8	Substantial
5	Epidemic	10.7	Substantial
6	Cyber-Attack	10.5	Substantial
7	Utility Interruption/ PSPS	10.2	Substantial
8	Localized Stormwater Flooding	10.2	Substantial
9	Severe Winter Storms	10.1	Substantial
10	Water Contamination	9.6	Moderate
11	Windstorms	9.3	Moderate
12	Hazardous Materials Incident	9.2	Moderate
13	Agricultural Emergencies	9.1	Moderate
14	Riverine Flooding	8.6	Moderate
15	Sea Level Rise	8.6	Moderate
16	Slope Failure	8.5	Moderate
17	Flash Flood	8.4	Moderate
18	Extreme Heat	8.2	Moderate
19	Coastal Flooding	8.2	Moderate
20	Coastal Erosion	8.0	Moderate
21	Targeted Violence	7.9	Possible
22	Invasive Species	7.7	Possible
23	Terrorism	7.5	Possible
24	Dam Failure	6.9	Possible
25	Extreme Cold & Freeze	6.7	Possible
26	Mass Migration	6.3	Possible
27	Tsunami	6.1	Possible
28	Levee Failure	6.1	Possible

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5. AGRICULTURAL EMERGENCIES

5.1 OVERVIEW

Agriculture is the backbone of Monterey County's economy. Agriculture has always been an integral part of the County and has continually grown and changed along with the County. The soils and climate in the region make the County an ideal area to sustain a wide variety of agricultural endeavors. Agriculture in Monterey County is a mosaic of farmland intermingled with other uses in a rural setting. This land provides marketable products, open space, wildlife habitat, watershed benefits, and an aesthetic environment.

For purposes of this plan, an agricultural emergency is any type of unintentional event that threatens human health and the economic stability of the agricultural industry in Monterey County. This primarily includes any event or threat that has the ability to cause widespread losses of crops, livestock, and farm property. Agricultural losses occur on an annual basis and are usually associated with severe weather events, heavy rains, floods, heat, freeze, drought, fires, crop and livestock disease, insects, and noxious weeds.

5.1.1 NATURAL DISASTERS & SEVERE WEATHER

According to the US Department of Agriculture (USDA), every year natural disasters, such as droughts, earthquakes, extreme heat and cold, floods, fires, earthquakes, hail, landslides, and tornadoes, challenge agricultural production. Because agriculture relies on the weather, climate, and water availability to thrive, it is easily impacted by natural events and disasters. Agricultural impacts from natural events and disasters most commonly include contamination of water bodies, loss of harvest or livestock, increased susceptibility to disease, and destruction of irrigation systems and other agricultural infrastructure. These impacts can have long lasting effects on agricultural production including crops, forest growth, and arable lands, which require time to mature. These types of events may also include accidental threats related to the release of hazardous materials and/or explosive hazards, which can not only cause agricultural losses but also directly affect human health.

More in-depth risk assessments for *Drought* (**Section 8**), *Flooding* (**Section 10**), *Hazardous (***Section 11**), *Severe Weather*(**Section 14**), and *Wildfire*(**Section 18**) are included in this plan. As they all pose a potential agricultural hazard they are discussed briefly in this section.

5.1.2 PESTS, WEEDS, AND DISEASES

Pest and diseases are a critical threat due to their potential to cause economic and human health disasters. The Monterey County Office of the Agricultural Commissioner has active programs in place to monitor, detect, quarantine, eradicate, and manage pest and disease threats to Monterey County's agricultural sector.

Insect pest 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 for consumers due to shortages. The primary pests of concern include:

- Mediterranean Fruit Fly
- Glassy-Winged Sharpshooter
- Gypsy Moth
- Asian Citrus Psyllid
- Oriental Fruit Fly
- Melon Fruit Fly
- Japanese Beetle
- Mexican Fruit Fly
- Light Brown Apple Moth
- European Grapevine Moth

These pests have a wide host range and are difficult and costly to manage once established.

Noxious weeds, defined as any plant that is liable to be troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate, are also of concern. Weeds of concern in Monterey County include:

- Fertile Capeweed
- French Broom
- Cape Ivy
- Arundo
- Pampas Grass
- Purple Pampas Grass
- Sticky Eupatorium
- Yellowstar-thistle
- Veldt Grass
- Taurian Thistle
- Puna Grass
- Skeletonweed
- Scotch Thistle

The rich soils and moderate climate of Monterey County make it an ideal place for invasive weed species to colonize. Invasive weeds are generally able to out-compete local native plant species for water and space because they are more prolific, have more vigorous growth, and lack predators that would otherwise help to keep them in check. They degrade habitat for other wildlife, domestic animals, recreation, and other land use activities. The agricultural industry is particularly affected by weeds.

Noxious weeds have been introduced in Monterey County by a variety of means. An absence of natural controls, combined with the aggressive growth characteristics and unpalatability of many of these weeds, allows these weeds to dominate and replace more desirable native vegetation. Negative effects of weeds include the following:

- Loss of wildlife habitat and reduced wildlife numbers
- Loss of native plant species
- Reduced livestock grazing capacity
- Increased soil erosion and topsoil loss
- Diminished water quality and fish habitat
- Reduced cropland and farmland production
- Reduced land value and sale potential

The consequences of agricultural disasters to the County include ruined plant crops, dead livestock, ruined feed and agricultural equipment, monetary loss, job loss, and possible multi-year effects (i.e., trees might not produce if damaged, loss of markets, food shortages, increased prices, possible spread of disease to people, and loss or contamination of animal products). When these hazards cause a mass die-off of livestock, other issues occur that include the disposal of animals, depopulation of affected herds, decontamination, and resource problems. In addition, insect pests and diseases such as bark beetles, Sudden Oak Death, and Pitch Canker in trees can destroy large expanses of forest and woodland, increasing the fuel load and contributing to greater fire risk. Overall, any type of severe agricultural disaster can have significant economic impacts on both the agricultural community and the entire County.

5.2 HAZARD PROFILE

5.2.1 HISTORY

Monterey County has experienced numerous agricultural-related disasters of varying magnitudes. The County received Presidential Major Disaster Declarations for severe freezing and crop damages in 2007, 1999, and 1991, and for a severe drought emergency in 1977. Major agricultural losses have also occurred following many of the other presidentially declared major disasters for Monterey County. For instance, it is estimated that the 1995 flood disaster resulted in $240 million in losses to crop production in the Salinas Valley.

Over the past 10 years, the US Department of Agriculture has declared 27 agricultural disasters in Monterey County, which are listed in *Table 5-1*. USDA Disaster Declarations make emergency loan assistance available to eligible family farmers to cover physical and production losses.

Table 5-1
USDA Agricultural Disaster Designations in Monterey County (2012-2021)

Designation Number	Disaster Type	Crop Disaster Year
S4916	Drought	2021
S4467	Drought	2019
S4656	Excessive Rain	2019
S4657	Excessive Rain and Hail	2019
S4350	Freeze	2018
S4460	Drought	2018
S4144	Drought	2017
S4163	Drought	2017
S3952	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2016
S4003	Rain and Wind	2016
S4164	Severe Weather, Excessive Rainfall and High Winds	2016
S3784	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2015
S3943	Drought	2015
S3626	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3637	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3626	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3637	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3743	Drought	2014
S3491	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3497	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3504	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3547	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3569	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3268	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2012
S3320	Hailstorm, Rain, and Cold Temperatures	2012
S3379	Drought	2012
S3452	Drought	2012

Source: United States Department of Agriculture (USDA), Disaster Designation Information

The most common cause of these disasters over the past several years have been, in order of frequency: drought, high winds, excessive heat, wildland fire, insects, excessive rain, and freezing temperatures. There has been an estimated $15.3 million in crop damages for Monterey County since 1996. Approximately $7 million is associated with severe freezing temperatures in 2007, about $7 million was attributed to wildfire events, and nearly $2 million to flood events.

The impact of the COVID-19 pandemic on California agricultural businesses was severe, unprecedented, and will continue to affect the industry for the coming years. Impacts occurred across four main sectors: consumer demand (retail, export, and food service), agricultural supply chain (transportation, packing, storage), producers (crops, dairy, nursery, and meat), and input suppliers (workers, crop protection, materials).

The Monterey County Agricultural Commissioner's Office conducted a survey of agricultural producers, which indicated significant losses particularly among growers providing fresh produce to the foodservice sector. The closing of schools and the cancellation of most conferences and travel resulted in the cancellation of contracts for fresh produce. Approximately 20% of County growers responded to the survey and of those responding to the survey, 38% reported losses. A total of 2,093 acres were reported as a loss or not planted. [12] Additionally, Agriculture work sites, shared worker housing, congested housing, and shared worker transportation vehicles presented unique challenges for preventing the spread of COVID-19.

The wildfires of 2020 presented yet another set of emergencies for Monterey County agriculture. The wildfire smoke created a hazard for farmworkers. Prior to the wildfires, the Agricultural Commissioner's Office had started distributing N95 respirators to pesticide applicators. When the first wildfire struck, the N95 respirators were redirected to protect farmworkers from the wildfire smoke. The losses from the 2020 wildfires occurred primarily to wine grapes and strawberries and were estimated at $74,586,292.[1]

Mitigation Success Story
Mitigating the Impact of the COVID-19 Pandemic to Farmworkers

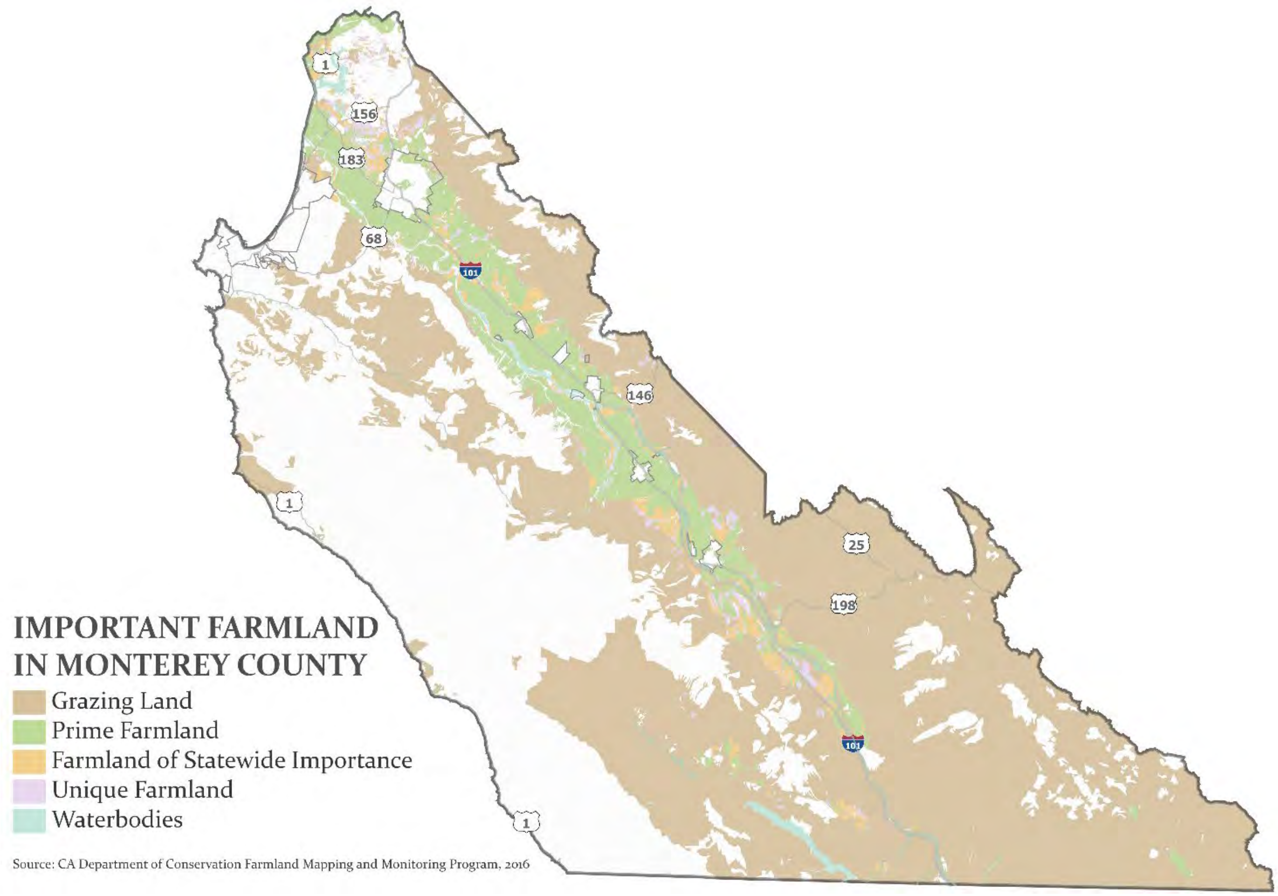
Staff from the Agricultural Commissioner's Office worked to distribute surgical masks face coverings, and other protective equipment directly to farmworkers and through community-based organizations, growers, and farm labor contractors. The Ag Commissioner's Office distributed thousands of COVID-19 informational cards to farmworkers. The Spanish language wallet-sized cards listed symptoms of COVID-19, along with information about where farmworkers could receive free medical attention, food, and childcare. They also partnered with several community groups to create a public service announcement in Spanish and Mixtec, speaking directly to farmworkers about the actions they could take to protect themselves, their families, and the community from COVID-19. Isolation housing was provided to those farmworkers either diagnosed or exposed to COVID-19 through a unique grower-led program which ultimately became the model for the state's program implemented much later in the pandemic, called Housing for Harvest.

[12] Monterey County Ag Community Shows Resilience, Henry S. Gonzales, Monterey County Agricultural Commissioner, April 24, 2021

5.2.1 LOCATION

Agricultural hazards occur throughout the County where lands are used for farming and grazing. The County has large swaths of agricultural lands. According to the California Department of Conservation's Farmland Mapping and Monitoring Program (FMPP), the County has about 165,000 acres of prime farmland, 44,500 acres of farmland of statewide importance, 26,500 acres of unique farmland, and over 1 million acres of grazing land. The map below shows the locations of valuable farmland in the County.

Figure 5-1
Important Farmland in Monterey County



While most agricultural land is located in the unincorporated County and cities may not be directly affected, they are indirectly affected economically when agricultural losses occur.

5.2.2 FREQUENCY

Agriculture in the County is at risk to many hazards: insects, weeds, wildfire, severe weather, as well as downturns in commodity prices. Each of these has a different likelihood, duration, and speed of onset. Some, such as freeze, can have a short onset and a short duration. Drought can have a long onset and long duration. Insects and weeds can have short or long onset, and short or long durations.

All agricultural losses can have a significant impact on affected communities. As long as severe weather events, insects, and weeds continue to be an ongoing concern, the potential for annual agricultural losses remains.

5.2.3 SEVERITY

The potential severity of agricultural emergencies in Monterey County can perhaps best be quantified by the exposure of production value. Crop values vary from year to year based on production, market, and weather conditions, but according to the Economic Contributions of Monterey County Agriculture Report the economic contribution of Monterey County agriculture is about $11.7 billion annually. This consists of $7.4 billion in combined, direct output from production and processing, plus $4.3 billion in multiplier effects. Nearly one out of every five jobs in the County are related to agriculture which supports 57,503 jobs directly and an additional 6,417 jobs indirectly. [13]

Crops grown in Monterey County supply large percentages of total national pounds produced each year: 61% of leaf lettuce, 57% of celery, 56% of head lettuce, 48% of broccoli, 38% of spinach, 30% of cauliflower, 28% of strawberries, and 3.6% of wine grapes. [14] Therefore, a significant agricultural hazard has the potential to severely affect the economy of the entire County and could have widespread effects on food availability in the rest of the Country.

5.2.4 WARNING TIME

Identifying the presence of insects and pests in agricultural lands is the most important step in warning for an agriculture disaster. Once identified, preventing the insects and pests from establishing a population is critical. Communication between farmers to warn each other of the presence of invasive pests and insects so that appropriate measures can be taken to prevent them from establishing a population and negatively impacting crops.

5.3 SECONDARY HAZARDS

The most significant secondary hazard associated with an agriculture disaster is wildfire. Severe infestation of pests and disease in agricultural lands can cause crops to die, creating increased fuel for wildfire. Agricultural lands are open areas with a mix of grasses, shrubs, trees, and crops that, if dried out or dead, could easily ignite and either start or contribute to a wildfire.

Additionally, Ample scientific evidence shows that crops, orchards, grasslands, and other agricultural areas can help protect people and property from wildfires. Agricultural belts around urban areas are especially helpful, where they reduce the fuel load, disrupt advancing fires, and facilitate firefighting efforts. For more information on wildfire risk in Monterey County, refer to **Section 18**, *Wildfire*.

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[13] Monterey County Agricultural Commissioner, 2020, Economic Contributions of Monterey County Agriculture
[14] Monterey County Farm Bureau

5.4 RISK ASSESSMENT

5.4.1 POPULATION

Agricultural disasters pose a serious threat to the local economy and populations directly employed by the agriculture industry. An agricultural disaster has the potential to greatly impact the Monterey County economy, people employed in the agriculture industry, and their families. As noted previously, nearly one out of every five jobs in the County are related to agriculture which supports 57,503 jobs directly and an additional 6,417 jobs indirectly,[15] therefore agricultural emergencies can have a deep impact on the population of Monterey County if it leads to a reduction in jobs.

An agriculture disaster can also pose a threat to human health. Mosquitos carry harmful disease and can transmit diseases to the population. The Africanized honeybee also presents a threat to the population, not because of their sting but because of their aggressive response to a disturbance. The Africanized honeybee will swarm and attach for long periods in the event of a disturbance to their nests.

5.4.2 PROPERTY

All agricultural crops are threatened by and exposed to severe weather events, heavy rains, floods, heat, freeze, drought, fires, crop and livestock disease, insects, and noxious weeds.

Table 5-2 summarizes gross production value of key crop types in Monterey County in 2020 and 2019 as a proxy for crop value threatened by hazards in the County.

Table 5-2
Gross Production Value of Crops in Monterey County

Category	2020	2019
Vegetable Crops	$2,524,608,000	$3,099,088,000
Fruits & Nuts	$1,124,737,000	$1,028,146,000
Livestock & Poultry	$110,891,000	$110,580,000
Nursery Crops	$119,836,000	$143,979,000
Field Crops	$25,481,000	$24,554,000
Seed Crops & Apiary	$4,582,000	$3,645,000
Total	$3,910,135,000	$4,409,992,000

Source: Monterey County Agricultural Commissioner

Table 5-2 also demonstrates the impact of the COVID-19 pandemic and 2020 wildfires on crop production. Major increases and decreases in crop production for 2020 include:

[15] Monterey County Agricultural Commissioner, 2020, Economic Contributions of Monterey County Agriculture

- Vegetable Crops saw a decrease in value of $574,480,000 to $2,524,608,000.
- Fruit and Nut Crops saw an increase of $96,591,000 to $1,124,737,000. (The Fruits and Nuts category without including Wine Grapes values, saw an increase of $176,696,000 or nearly 21%, to $1,018,746,000 due in part to the increase in value of strawberries.)
- Wine Grapes saw a significant decrease of 43% or $80,105,000 to reach a total for red and white varietals of $105,991,000 partly due to effects of wildfires, the COVID-19 pandemic, a decrease in production and average price per ton.
- Nursery Crops suffered a decrease of 16.8% or $24,143,000 due to reduced acreage, production, and prices once again favoring an increase in imports and demand for cannabis greenhouse production

All agricultural land is threatened by and exposed to severe weather events, heavy rains, floods, heat, freeze, drought, fires, crop and livestock disease, insects, and noxious weeds.

Table 5-3 summarizes the number of acres and value of important agricultural land by type.

Table 5-3
Value of Agricultural Land in Monterey County

Supervisorial District	Prime Farmland		Farmland of Statewide Importance	
	Acres	Value	Acres	Value
District 1	491	$70,953,097	5	$1,768,087
District 2	19,181	$804,422,513	8,741	$635,499,149
District 3	127,881	$3,516,483,171	33,727	$1,876,893,765
District 4	13,635	$381,699,801	1,382	$189,266,984
District 5	4,297	$230,007,594	649	$86,547,025
Total	**165,485**	**$5,003,566,176**	**44,505**	**$2,789,975,010**
Supervisorial District	**Unique Farmland**		**Grazing Land**	
	Acres	**Value**	**Acres**	**Value**
District 1	24	$51,485,685	0	$0
District 2	8,163	$714,501,131	21,829	$463,542,869
District 3	16,995	$2,212,880,829	937,186	$3,319,092,070
District 4	244	$170,856,593	8,417	$169,830,424
District 5	927	$162,943,833	96,117	$2,630,183,802
Total	**26,353**	**$3,312,668,071**	**1,063,549**	**$6,582,649,165**

Agricultural land value exposed to wildfire and flood risk was assessed for this plan. Agricultural land exposed wildfire risk was assessed using CAL FIRE Fire Hazard Severity Zones.

Table 5-4 summarizes acres and values of Prime Farmland in Fire Hazard Severity Zones.

Table 5-4
Prime Farmland Exposed to Wildfire Risk by Fire Hazard Severity Zone

Supervisorial District	Very High		High		Moderate	
	Acres	Value	Acres	Value	Acres	Value
District 1	0	$0	0	$0	0	$0
District 2	14	$12,577,575	191	$43,685,766	481	$66,884,478
District 3	315	$91,087,807	3455	$337,096,616	15,763	$903,926,268
District 4	2	$1,120,394	0	$0	0	$0
District 5	43	$47,386,924	250	$35,805,582	741	$33,058,223
Total	375	$152,172,700	3,896	$416,587,964	16,985	$1,003,868,969

Table 5-5 summarizes acres and values of Farmland of Statewide Importance in Fire Hazard Severity Zones.

Table 5-5
Farmland of Statewide Importance Exposed to Wildfire Risk by Fire Hazard Severity Zone

Supervisorial District	Very High		High		Moderate	
	Acres	Value	Acres	Value	Acres	Value
District 1	0	$0	0	$0	0	$0
District 2	16	$2,781,112	459	$70,633,137	304	$79,151,933
District 3	3	$9,242,779	1,285	$234,072,137	9,340	$384,329,143
District 4	0	$1,210,897	0	$0	0	$0
District 5	17	$25,691,776	218	$6,278,334	8	$6,278,334
Total	37	$38,926,564	1,963	$310,983,608	9,652	$469,759,410

Table 5-6 summarizes acres and values of Unique Farmland in Fire Hazard Severity Zones.

Table 5-6
Unique Farmland Exposed to Wildfire Risk by Fire Hazard Severity Zone

Supervisorial District	Very High		High		Moderate	
	Acres	Value	Acres	Value	Acres	Value
District 1	0	$0	0	$0	0	$0
District 2	53	$13,722,249	1,267	$152,429,770	787	$83,181,508
District 3	203	$89,991,097	3,571	$432,711,859	6,003	$617,457,668
District 4	2	$2,511,838	0	$0	0	$0
District 5	100	$26,134,030	174	$58,265,936	444	$27,945,919
Total	358	$132,359,214	5,012	$643,407,565	7,234	$728,585,095

Table 5-7 summarizes acres and values of Grazing Land in Fire Hazard Severity Zones.

Table 5-7
Grazing Land Exposed to Wildfire Risk by Fire Hazard Severity Zone

Supervisorial District	Very High		High		Moderate	
	Acres	Value	Acres	Value	Acres	Value
District 1	0	$0	0	$0	0	$0
District 2	9,760	$51,763,441	7,053	$146,479,709	2,488	$69,632,969
District 3	103,883	$354,760,669	547,587	$1,444,195,814	131,137	$1,258,200,102
District 4	182	$5,416,285	0	$0	0	$0
District 5	35,477	$1,777,052,329	57,070	$1,172,818,716	2,652	$50,503,125
Total	149,301	$2,188,992,724	611,710	$2,763,494,239	136,277	$1,378,336,196

Agricultural land exposed flood risk was assessed using the FEMA 100-year floodplain. *Table 5-8* summarizes acres and values of Prime Farmland in the 100-year floodplain.

Table 5-8
Prime Farmland Exposed to Flood Hazard Risk

Supervisorial District	100-Year Floodplain	
	Acres	Value
District 1	421	$9,816,487
District 2	7,102	$408,922,260
District 3	20,507	$1,317,258,937
District 4	7,121	$269,820,865
District 5	2,290	$104,670,375
Total	37,441	$2,110,488,924

Table 5-9 summarizes acres and values of Farmland of Statewide Importance in the 100-year floodplain.

Table 5-9
Farmland of Statewide Importance Exposed to Flood Hazard Risk

Supervisorial District	100-Year Floodplain	
	Acres	Value
District 1	0	$0
District 2	320	$158,964,554
District 3	28,707	$811,603,587
District 4	2,457	$141,858,306
District 5	669	$49,773,190
Total	32,152	$1,162,199,637

Table 5-10 summarizes acres and values of Unique Farmland in the 100-year floodplain.

Table-10
Unique Farmland Exposed to Flood Hazard Risk

Supervisorial District	100-Year Floodplain	
	Acres	Value
District 1	4	$6,466,951
District 2	1,514	$294,890,372
District 3	2,467	$729,573,350
District 4	181	$106,480,197
District 5	195	$62,998,558
Total	4,362	$1,200,409,428

Table 5-11 summarizes acres and values of Grazing Land in the 100-year floodplain.

Table 5-11
Grazing Land Exposed to Flood Hazard Risk

Supervisorial District	100-Year Floodplain	
	Acres	Value
District 1	0	$0
District 2	1,126	$161,714,843
District 3	39,624	$1,145,728,172
District 4	229	$40,332,494
District 5	1,215	$190,067,361
Total	42,193	$1,537,842,870

5.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities, as defined in this plan, will not be affected by an agriculture disaster.

5.4.4 ENVIRONMENT

Agricultural lands in Monterey County provide a wide variety of ecosystem services that could be threatened by an agricultural hazard including:

- Wildlife Habitat: Providing food, water, shelter, and space to support resident and transient wildlife, especially through riparian areas and perennial vegetation.
- Soil Structure, Formation and Fertility: Sustaining healthy soils, the foundation of all life, by managing them in ways that not only support plant growth, but also reduce erosion, prevent landslides, suppress pathogens, sequester carbon, and purify water.
- Water Cycling: Maintaining or improving soil moisture and water storage, while minimizing runoff, through cover crops, tillage, residue management, and dozens of related practices.

- Pest Control: Controlling pests and weeds through many management practices that support their natural enemies, such as raptors, beneficial insects, and other wildlife.
- Pollination Services: Supporting agricultural production and healthy ecosystems by providing nesting habitat and floral resources for wild pollinators.
- Nutrient Cycling: Managing plant nutrients and soil in ways that help store, transform, and cycle important nutrients in the soil, such as carbon, nitrogen, and phosphorus.
- Biodiversity Conservation: Promoting ecosystem productivity, beauty, pest control, and other benefits by managing on-farm streams, trees, shrubs, wetlands, and cropped areas in ways that support diverse plants and animals.
- Atmospheric Gas & Climate Regulation: Reducing greenhouse gas levels through practices that make farm operations more energy efficient, and by building capacity to store carbon.
- Water Quality: Improving and protecting water quality through vegetative buffers, stream bank protection, prescribed grazing, grassed waterways, and other management practices.
- Wildfire Protection: Crops, orchards, grasslands, and other agricultural areas can help protect people and property from wildfires.

While calculating the true value of ecosystem services is quite difficult, there are some methods to try to capture this value. The 2020 Economic Contributions of Monterey County Agriculture Report estimated the value of ecosystem services provided by agricultural lands ranges from $4.7 billion to $10.9 billion, with rangelands delivering the highest value.

5.4.5 ECONOMIC IMPACT

As noted above, agriculture is an important pillar of the Monterey County economy with an economic contribution of about $11.7 billion annually. The agricultural industry also contributions significantly to local tax revenue. Including production and local processing, and after subtracting significant subsidies, estimate indicate agriculture's net tax contribution in the County in 2018 at $61.9 million to $122.7 million. This included excise, sales, and property taxes, as well as fees, licenses, and permits (but not income taxes).[16] Therefore, the potential economic impact associated with agricultural hazards is quite high.

Any of the hazards discussed in this chapter can deal a damaging blow to the agricultural industry. When combined, they can undermine not just an individual operation, but the entire industry. One way to reduce the economic risk to the agricultural industry is emphasize product diversification. To assess crop diversification in the County, the Monterey County Agricultural Commissioner used the Shannon-Weaver Index. Created in 1949 for military code breaking, the Shannon Weaver index is widely used by economists, ecologists, and others interested in quantifying diversity.

[16] Monterey County Agricultural Commissioner, 2020, Economic Contributions of Monterey County Agriculture

Over the past decade, Monterey County has consistently produced thirty-five major commodities. The relative contribution of individual commodities varied during the period analyzed from 0.25% of the county's total farm gate value (the minimum threshold in the analysis) to 35.4% of the county total. At first glance, Monterey County's resulting index of 0.61 seems near the middle of the 0.00 to 1.00 range. But the Shannon-Weaver formula includes a logarithmic function, which complicates interpretation. The 0.61 index is quite high compared to the twenty other California counties analyzed in the study. The index likely suggests exceptional protection from economic shocks. Validating the extent of this protection would require more detailed analysis, but these preliminary results indicate that Monterey County agricultural production is both diverse and well distributed across types.[5]

5.5 FUTURE TRENDS IN DEVELOPMENT

Possible future strategies to address influences on insect pests and diseases might include:

- Inventory and monitor invasive species that threaten crops
- Downscale climate change data to allow informed decisions on biodiversity planning by farmers and rural communities
- Strengthen the dissemination of knowledge, appropriate technologies, and tools to improve management practices related to agricultural biodiversity and ecosystem services

5.6 ISSUES

Key issues related to agricultural emergencies in Monterey County include:

- Large amounts of agricultural land in the Salinas Valley are below sea level and could become at risk due to future sea level rise.
- In Monterey County, water supply is extremely limited during non-drought years. As such, droughts are a serious threat in the County and could have devastating impacts on the agricultural industry, a major economic driver and job provider.
- The agricultural industry is a major driver of the local economy and any major impacts to it, could have a major effect on the community.
- Much of the agricultural water supply in Monterey County is susceptible to seawater intrusion.

6. COASTAL EROSION

6.1 OVERVIEW

Coastal erosion refers to the natural geological process resulting in loss of sand, sediment, vegetation, or soil on beaches, dunes, bluffs, or cliffs along the coast. It is a natural process, caused by waves, winds, tides, storms, and the movement of tectonic plates, but its effects can be exacerbated by human activity. Coastal erosion takes place both gradually over decades, caused by multiyear impacts and long-term climatic change such as sea level rise, lack of sediment supply, subsidence, or long-term human factors such as the construction of shore protection structures and dams, and rapidly, as with landslides or severe storms. Coastal erosion processes are complex and depend on a number of factors such as geologic formation, groundwater seepage, and exposure to wave energy. The Monterey County coastline is variable in terms of geologic composition and exposure to high tides, wave energy and related erosion. Sections of the coast exhibit a variety of backshore landforms including wide sand and cobble beaches backed by cliffs, sandy beaches backed by sand dunes, secluded and undeveloped pocket beaches, rocky intertidal areas, rocky bluffs, loosely consolidated bluffs, and large sea cliffs. Due to these various backshore types along the shoreline, erosion characteristics also vary significantly.

Chronic Versus Episodic Erosion

Coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. Coastal erosion is classified as either episodic or chronic. Episodic erosion consists of the shore and backshore adjustment that results from short duration, high intensity meteorological and oceanic storm events. This type of event response results in shore adjustment and happens during a single storm or during a series of closely spaced storm events within a storm season. Chronic erosion is associated with slow, gradual shoreline adjustment associated with sea-level rise, land subsidence, changes in sediment supply which result from watershed modifications or dam building, and decadal adjustments in rainfall and runoff associated with climate change.

Human alteration of the shoreline can influence long and short-term erosion rates. One of the major causes of beach erosion is the construction of dams and other structures along creeks and rivers that trap sediment and prevent it from reaching the ocean. This deprives the shoreline of the material that would replenish beach sand supplies. Coastal structures such as groins, jetties, seawalls, and breakwaters can also cause increased erosion. Shoreline structures eliminate the natural wave run-up and sand deposition processes and can increase reflected wave action and currents at the waterline. The increased wave action can cause localized scour both in front of and behind structures and prevent the settlement of suspended sediment. This can result in a rapid loss of beach sand in down-current beaches. Seawalls are often used to protect sea cliffs from eroding wave action. These structures, however, can reflect wave energy to strip protective beach sand at an accelerated rate. This may ultimately result in increased sea cliff erosion rates, particularly at sections of coastline adjacent to the seawall.

6.1.1 SAND MINING IN MONTEREY COUNTY

On average, the coastline of southern Monterey Bay is the most erosive shore in California due to a long history of sand mining.[17] Southern Monterey Bay has a long history of sand mining operations and from 1906 to 1990, was the most intensively mined shoreline in the US.[18] As many as six sand mines, which includes the current CEMEX Lapis Plant, were active at various times over the past century in the City of Marina and City of Sand City. The CEMEX Lapis sand mine located in Marina, was the last coastal sand mine in the US, until its closure at the end of 2020. The plant produced an estimated 200,000 to 300,000 cubic yards of sand a year, enough to fill up to 30,000 dump trucks. The sand mine operated for years without permits from the state, claiming that its operations pre-date state laws such as the 1976 Coastal Act. The mine officially stopped operations on Dec. 31, 2020.

6.1.2 TYPES OF COASTAL EROSION

Beach and Dune Erosion

Beach and dune erosion occur through high wave run-up during high tides and increased wave energy that carry sand away from the shoreline. Beach and dune erosion may occur gradually over time as beaches naturally accrete and erode, resulting in mild changes in the shoreline and volume of sand present on the beach. Energetic coastal storms and particularly strong El Niño

[17] USGS, 2006, National Assessment of Shoreline Change, Part 3.
[18] Sand mining impacts on long-term dune erosion in southern Monterey Bay

events potentially result in the abrupt loss of large quantities of sediment and increased landward retreat of the shoreline.

Cliffs and Bluff Erosion

Bluff and cliff recession is the most visible aspect of coastal erosion because of the dramatic change it causes to the landscape. As a result, this aspect of coastal erosion usually receives the most attention. Coastal bluff erosion occurs in the form of irreversible landward retreat of coastal bluffs and cliffs. Historical bluff erosion has been episodic in nature with rates that vary throughout Monterey County due to the composition of coastline bluff rock formations and vulnerability to wave interaction with the cliffs.

Rising tides, currents, and waves directed at the base of the bluff cause the erosion of relatively non-resistant rock. As a bluff erodes, the top edge moves landward. This is a natural process that becomes a hazard as it threatens structures or other developed property, infrastructure, as well as recreational trails and public coastal access. The retreat of the bluffs threatens waterfront residences, businesses, and public facilities, eventually rendering them uninhabitable or unusable.

6.2 HAZARD PROFILE

6.2.1 HISTORY

Coastal erosion within Monterey County has primarily occurred during periods of intense wave action coinciding with high tides and coastal storms. El Niño events have produced large waves that have stripped volumes of sand from Monterey Bay, leaving the beaches, dunes, and cliffs exposed to high tides and wave attack.

As a result of the 1982–1983 El Niño events, approximately 20 to 40 feet of the marine terraces by Scenic Drive in Carmel fell into the sea. The 1997–1998 El Niño winter storm event, led to large amounts of dune erosion in the vicinity of Fort Ord (43-foot retreat) and the city of Marina (50-foot retreat). During both El Niño events, several extremely steep cliffs (100% slope) near Big Sur failed because of increased wave attack.

The 2017 Winter Storms resulted in a significant erosion in the Big Sur area, ultimately resulting in major infrastructure failures in Palo Colorado, Mud Creek, Paul’s Slide, and Pfeiffer Canyon Bridge. Coastal erosion coupled with extreme wave action during the 2016-17 El Nino led to the exposure of M1W's land/ocean outfall junction structure. Earthquakes have also caused the Monterey cliffs to erode. The October 17, 1989, Loma Prieta Earthquake produced several isolated cliff failures throughout the County.

Some areas have seen particularly dramatic shoreline retreat. For example, At Fort Ord, a football field existed on the dune between Stillwell Hall and the ocean in 1944. After the field eroded into the ocean, rock rubble was placed in front of Stillwell Hall in 1978 and again in 1985 to stop erosion, but even after sand mining ceased, extreme recession continued to occur at the flanks of the rubble. Up to 46 feet of recession occurred during the 1997–98 El Niño winter just to the north of Stillwell Hall. Close to 380 feet of retreat occurred over a 70-year period. The area still experiences erosion close to 6 feet per year. [19]

Historic Erosion Rates

Historic average beach and dune erosion in Southern Monterey Bay (from Moss Landing to Pacific Grove) is approximately 2.6 feet a year and higher than any other region in the state. Historically, the highest dune erosion rates have occurred in the Fort Ord area (7 feet annually) and Marina (4.5 feet annually) because of wave refraction patterns that produce larger waves. Long-term historic erosion rates in this area have been variable.

Historic average erosion rates for Southern Monterey Bay are summarized in *Table 6-1.*

Table 6-1
Estimated Historic Long-term Average Erosion Rates (ft/year) in Southern Monterey Bay

Location	Thornton et al. (2006)		Hapke et al. (2006)	
	1940-1984	*1985-2005*	*1910-2002*	*1970-2002*
Moss Landing			+1.2	-1.7
Salinas River			+3.7	0
Marina State Beach	-1.0	-4.7	-1.4 to -2.0	-3.1 to -5.2
Stilwell Hall (Fort Ord)	-5.2 to -6.2		-2.5 to -3.7	-3.7 to -6.6
Sand City	-3.9 to -6.4	-2.7	-1.4	-3.7 to -6.2
Monterey Beach Resort	-2.4	-0.9	-1.4	-3.0
Del Monte Beach	-2.0	-0.4		

Rocky cliffs and marine terraces located along Monterey Peninsula from Pacific Grove to Carmel have shown very little erosion over the past several years, with some locations which consist of granite showing virtually no change over a 50-year time span. [20] The granite cliffs around the entire Monterey Peninsula erode at rates of about 3.3 inches per year. [21] While long-term average erosion in this area is quite low, some years have seen a severe winter storm or series of storms result in 3 to 8 ft of erosion. [22]

Steep cliffs within Monterey County are located along the Big Sur coast, where the rugged Santa Lucia Mountains descend abruptly into the Pacific Ocean. Cliff retreat within this area average about 7 inches per year; however, failure rates can be much greater in weakened, fractured, or faulted areas. [23]

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[19] USGS, 2006, National Assessment of Shoreline Change, Part 3.
[20] Living with the California Coast, 1985
[21] USGS, 2007, National Assessment of Shoreline Change, Part 4.
[22] Haro, Kasunich & Associates, 2016, Coastal Bluff Protection Analysis and Geotechnical Investigation for City of Pacific Grove Public Works Department.
[23] USGS, 2004, Map Showing Coastal Cliff Retreat Rates Along the Big Sur Coast.

6.2.2 LOCATION

Coastal erosion is an ongoing process that is difficult to measure but can be seen in various areas along the coastline. Dune and cliff erosion rates vary significantly throughout the County due to geological composition and the physical forces acting on the coastline; therefore, actual erosion and shoreline retreat distance will not be uniform throughout the county.

Coastal erosion is likely across the entire coastline of Monterey County at varying rates. Based on historic erosion rates, Southern Monterey Bay, from Moss Landing to Pacific Grove, is likely to experience the highest rates and largest impacts due to future erosion. While the granite cliffs of the Monterey Peninsula and Big Sur Coast are eroding at a slower rate, they are still vulnerable to erosion during large storm events.

6.2.3 FREQUENCY

Average rates of historic beach and cliff erosion and shoreline retreat and are expected to continue and accelerate, but future erosion rates are difficult to project due to variable coastal processes and uncertainty in sea level rise projections. Increased frequency of coastal storms and wave run-up due to sea level rise increases the irreversible bluff erosion and cliff collapse that may occur.

The entirety of the Monterey County coastline has shown a shift towards increased erosion in the more recent time period. In the Southern Monterey Bay region, the net average retreat rate more than doubles from the long-term (7.8 inches per year) to short-term net retreat of 24 inches per year. In addition, the percent of the coast experiencing erosion increased by 36%.[24]

Similar trends have been noticed in the Carmel and Big Sur regions, with net long-term average shoreline change rate being close to undetectable, with a maximum rate of 31 inches per year measured at the southern end of Carmel River State Beach. Short-term erosion occurred along 65% of the coast, with the maximum of 67 inches per year measured at Carmel River State Beach and Carmel City Beach. This indicates that this region is becoming became more erosional from the long-term to the short-term.[25]

Actual future rates of erosion are relative to future coastal processes and difficult to project with certainty. Projected rates of erosion are naturally varied and will likely accelerate by 2100; thus, most erosion will occur towards the end of the century. Over the next 50 years, sea level rise in Monterey Bay is predicted to increase coastal erosion 20-25% over historic erosion rates. In the 50-100-year timeframe, erosion rates are projected to increase 40-50% over historic rates.[26] In the Big Sur region, 5 feet of sea-level rise will expose 2.5 square miles of cliffs and 1.9

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[24] USGS, 2007, National Assessment of Shoreline Change, Part 4.

[25] USGS, 2006, National Assessment of Shoreline Change, Part 3.

[26] Association of Monterey Bay Area Governments (AMBAG), 2008, Coastal Regional Sediment Management Plan for Southern Monterey Bay.

square miles of dunes to erosion, leading to average cliff retreats rates of 121 feet and average dune erosion rates of 590 feet. [27]

6.2.4 SEVERITY

Coastal erosion can range from gradual wearing a way of coastal land at inches per year to more significant, catastrophic events that can result in bluff failures involving several hundred cubic yards of material.

The most dramatic erosion often occurs during storms, particularly because the highest energy waves are generated under storm conditions. Although coastal erosion can occur with any annual winter storm, damage is more likely to occur during El Niño events. Ocean storms that have some amount of coastal impact can be expected every year. El Niño events occur about every 2 to 7 years and typically last 16 to 18 months.

Cliff erosion can result in permanent and significant alterations of coastal geology that can expose landward development and resources to additional coastal threats. Large sections of the county coastline, especially those with rocky headlands or sea cliffs, are not vulnerable to flooding, but are highly susceptible to erosion.

6.2.5 WARNING TIME

As discussed previously, coastal erosion can be classified as either episodic or chronic. Episodic erosion consists of the shore and backshore adjustment that results from short duration, high intensity meteorological and oceanic storm events. Meteorologists can often predict the likelihood of a severe weather event. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. Chronic erosion is associated with slow, gradual shoreline adjustment. Chronic erosion hazards occur slowly but can have significant property or health consequences. The identification of this hazard generally takes site-specific analysis to determine the erosion rates, site soil, geologic properties, and what mitigation is most relevant and prudent for the site. For this type of hazard, warning time is long.

6.3 SECONDARY HAZARDS

Coastal erosion can cause several types of secondary effects. Erosion can destabilize roads, the foundations of structures, and utility lines. It can also cause damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat. Erosion can exacerbate landslide risk, as relentless erosion by ocean waves, creates extreme topography, making areas highly susceptible to landslides. Erosion also exacerbates flood risk, destroying important coastal dunes and cliffs, which provide key flood control benefits.

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[27] Pacific Institute, California Climate Change Center, 2009, [The impacts of sea-level rise on the California coast](#).

6.4 RISK ASSESSMENT

USGS Coastal Storm Modeling System (CoSMoS), Central California Projections of Coastal Cliff Retreat and Shoreline Change due to 21st Century Sea Level Rise data was used for this risk assessment. For cliff retreat modeling an end of century (2100) forced sea level rise amount of 200 cm was used based on Ocean Protection Council (OPC) High Risk Aversion Guidance. For shoreline change, winter erosion uncertainty modeling was used to capture the degree of uncertainty associated with future shoreline erosion. Hold the Line scenario modeling was chosen for both types of erosion. Three sea level rise levels (25 cm, 75 cm, and 200 cm) were used to represent planning horizons based on OPC Sea Level Rise Projections for the Monterey Tide Gauge. 25 cm of sea level rise represents near term (2030) risk, 75 cm represent mid-term (2060) risk, and 200 cm represent long-term (2100) risk.

6.4.1 POPULATION

Table 6-2 and *Table 6-3* indicates the population in the County exposed to coastal cliff and shoreline erosion risk, respectively.

Table 6-2
Population Exposed to Coastal Cliff Erosion Risk in Monterey County

Supervisorial District	Sea Level Rise Scenario		
	25 CM	75 CM	200 CM
District 1	0	0	0
District 2	0	0	0
District 3	0	0	0
District 4	0	0	0
District 5	1,027	1,642	1,932
Total	1,027	1,642	1,932

Table 6-3
Population Exposed to Shoreline Erosion Risk in Monterey County

Supervisorial District	Sea Level Rise Scenario		
	25 CM	75 CM	200 CM
District 1	0	0	0
District 2	32	32	32
District 3	0	0	0
District 4	34	34	34
District 5	423	147	147
Total	489	213	213

Bluff and cliff failure due to erosion can create hazardous conditions due to roadway collapse, undermined foundations, and damage to utilities. Isolated communities are vulnerable to the impacts, where roadway failure can limit access to basic services for months at a time.

6.4.2 PROPERTY

Table 6-3 and *Table 6-4* indicates the residential property in the County exposed to coastal cliff and shoreline erosion risk, respectively.

Table 6-4
Residential Property Exposed to Coastal Cliff Erosion Risk

Supervisorial District	Sea Level Rise Scenario					
	25 CM		75 CM		200 CM	
	#	Value	#	Value	#	Value
District 1	0	0	0	0	0	0
District 2	0	$0	0	$0	0	$0
District 3	0	$0	0	$0	0	$0
District 4	0	$0	0	$0	0	$0
District 5	206	$1,183,367,352	226	$1,244,106,508	253	$1,323,971,611
Total	206	$1,183,367,352	226	$1,244,106,508	253	$1,323,971,611

Table 6-5
Residential Property Exposed to Shoreline Erosion Risk

Supervisorial District	Sea Level Rise Scenario					
	25 CM		75 CM		200 CM	
	#	Value	#	Value	#	Value
District 1	0	0	0	0	0	0
District 2	0	$0	0	$0	0	$0
District 3	0	$0	0	$0	0	$0
District 4	0	$0	0	$0	0	$0
District 5	4	$3,099,857	4	$3,099,857	4	$3,099,857
Total	4	$3,099,857	4	$3,099,857	4	$3,099,857

Table 6-6 and *Table 6-7* indicates the non-residential property in the County exposed to coastal cliff and shoreline erosion risk, respectively.

Table 6-6
Non-Residential Property Exposed to Coastal Cliff Erosion Risk

Supervisorial District	Sea Level Rise Scenario					
	25 CM		75 CM		200 CM	
	#	Value	#	Value	#	Value
District 1	0	0	0	0	0	0
District 2	0	$0	0	$0	0	$0
District 3	0	$0	0	$0	0	$0
District 4	0	$0	0	$0	0	$0
District 5	226	$221,988,454	227	$223,536,860	248	$240,099,182
Total	226	$221,988,454	227	$223,536,860	248	$240,099,182

Table 6-7
Non-Residential Property Exposed to Shoreline Erosion Risk

Supervisorial District	Sea Level Rise Scenario					
	25 CM		75 CM		200 CM	
	#	Value	#	Value	#	Value
District 1	0	0	0	0	0	0
District 2	3	$0	2	$0	1	$0
District 3	0	$0	0	$0	0	$0
District 4	0	$122,851,855	32	$122,851,855	27	$116,279,109
District 5	21	$73,218,711	20	$73,218,711	21	$73,729,302
Total	24	$196,070,566	54	$196,070,566	49	$190,008,411

Property vulnerable to coastal erosion, generally includes low-lying coastal structures and those built close to the edge of eroding bluffs. Coastal erosion impacts on coastal property are dependent on several factors including the elevation and composition of the shoreline (i.e., wide sandy beach versus a rocky intertidal beach fronting coastal bluffs).

6.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities that are vulnerable to coastal erosion may include transportation and wastewater treatment and water supply infrastructure. Regional and local-serving public and utility infrastructure vulnerable to coastal erosion include roads, bridges, railroad lines and crossings, wastewater treatment plants, culverts, water lines, communication line and towers, stormwater outlets, bike lanes, bike facilities, and fiber optic lines. The Seaside Pump Station, the Monterey Interceptor Pipeline between the Seaside Pump Station and Wharf II, and M1W's land/ocean outfall junction structure are all critical facilities identified at high to moderate risk from coastal erosion.

Coastal erosion will have long-lasting impacts on the Monterey Bay region's transportation infrastructure, threatening over 50 miles of highway, roads, and rail throughout the region including Highway 1.[28] *Table 6-8* summarizes transportation infrastructure exposed to both costal cliff and shoreline erosion risk in the County.

Table 6-8
Transportation Infrastructure Exposed to Coastal Cliff and Shoreline Erosion Risk

Transportation Infrastructure	1 ft Sea Level Rise (2030)	3 ft Sea Level Rise (2060)	7 ft Sea Level Rise (2100)
Highway/Freeway (Miles)	0	0	0
Major Road (Miles)	71	88	89
Local (Miles)	1	3	8
Railroad (Miles)	0	0	0

[28] Pacific Institute, California Climate Change Center, 2009, The impacts of sea-level rise on the California coast.

6.4.4 ENVIRONMENT

Natural features such as dune fields and coastal cliffs exist over much of the County coastline that are subject to irreversible beach and bluff erosion. A transition between the land and the sea, the shoreline is a critical habitat for nutrient cycling and supports a diversity of invertebrate fauna, surf zone fishes, shorebirds, marine mammals, and plant species, including a Federally Threatened species, such as the Western Snowy Plover.

Sandy beaches and dunes also provide important services to human communities, such as flood protection, serving as barriers to landward shoreline retreat and providing a natural protective buffer against coastal flooding. Normal erosion of coastal dunes provides a significant sediment source for beaches. Sandy beaches also are a significant source of aesthetic, recreational, and economic value to human communities. For example, the Marina sand dunes are breathtaking examples of old dunes covered in coastal scrub and native dune vegetation. Loss of sandy beach and dune habitats would have large environmental effects on Monterey County.

6.4.5 ECONOMIC IMPACT

Tourism is a major economic driver in Monterey County, and future coastal erosion could threaten popular beaches and recreational facilities. Coastal erosion could affect vertical and lateral beach access points, which would prevent residents and visitors from accessing the beach and may increase the risk of injuries. Beach tourism is important to the County' economy and generates significant revenue as many visitors rent hotels or other accommodations, dine out or shop at area stores. Visitor-serving areas such as those on the Monterey Peninsula and in Big Sur include local businesses and hotels that benefit the local economy. These businesses depend on tourism, and cities and communities within the County benefit from sales tax revenues. Disruption of these areas due to impacts of coastal erosion could decrease economic activity and affect the local economy. Future coastal beach and bluff erosion in the County may also negatively impact coastal businesses and households and decrease coastal real estate opportunities.

Coastal bluff and cliff failure due to coastal erosion can create hazardous conditions due to roadway collapse, undermined home foundations, and damage to utilities. Natural resources with recreational and economic value may also be adversely affected. This risk is notable in the Big Sur area, where roadway failure can limit access to recreational areas for months at a time.

The County supports some of the largest dune habitats in the State, which are vulnerable to damages from erosion. As this vulnerability increases over time, damages may impact the economy of the area and impact viable coastal land uses. Dune erosion along the Monterey Bay is likely to exacerbate the risk of flooding in the lower Salinas Valley. This could increase the risk of flooding on agricultural land and threaten a major economic driver. Coastal storms can also lead to erosion impacts and severe flooding and inundation of economically important infrastructure such as harbors and buildings related to commercial and recreational fisheries.

6.5 FUTURE TRENDS IN DEVELOPMENT

Land use and development along the County's shoreline is governed by the California Coastal Act. Regulations under the Coastal Act are typically administered by the County and local cities through adopted Local Coastal Plans (LCP), overseen by the California Coastal Commission. The County and each incorporated city's certified Local Coastal Plans govern land use planning and development permitting. Monterey County has four LCP segments: North County, Del Monte Forest, Carmel Area, and Big Sur Coast, which guides development in unincorporated areas. There are also three areas of deferred certification in the County, at Fort Ord Dunes State Park, Mal Paso Beach, and Yankee Point. Each city along the Coast also as a certified Local Coastal Plan which governs land use and permitting with the coastal areas of the cities.

6.6 ISSUES

Key issues associated with coastal erosion in Monterey County include:

- The risk of costal erosion to critically important dune habitat.
- The economic risk of coastal erosion on the two largest economic drivers in the County: agriculture and tourism.
- The cumulative and compounding risk of coastal erosion along with severe winter storms, large storm surge, and wave action along the coastline is likely to lead to more dramatic erosion and exacerbate flooding in low lying areas.
- Coastal bluff and cliff failure due to erosion can create hazardous conditions due to roadway collapse, bridge failure, undermined home foundations, and damage to utilities. This can lead to immobility and loss of utilities.
- Future sea level rise scenarios are likely to exacerbate coastal erosion risks, but a high degree of uncertainty exists on the future risk.

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7. DAM AND LEVEE FAILURE

7.1 OVERVIEW

7.1.1 DAM FAILURE

A dam is an artificial barrier that stops or restricts the flow of water. Dams are built for a variety of uses including flood protection, power generation, agriculture, water supply, and recreation. A dam failure is usually the result of the age of the structure, inadequate spillway capacity, or structural damage caused by an earthquake or flood. Dam failures typically occur when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion (piping) through the dam or foundation occurs. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-filled water that rushes downstream, damaging anything in its path. Improper design, improper maintenance, negligent operation, and/or failure of upstream dams on the same waterway can also cause or contribute to dam failure.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, and homes. Electric generating facilities and transmission lines could also be damaged and affect life support systems in communities outside the immediate hazard area. Associated water supply, water quality and health concerns could also be an issue. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

7.1.2 LEVEE FAILURE

Levees are man-made structures, usually earthen embankments, designed and constructed to contain, control, or divert a flow of water in order to protect land from peak flood levels or to protect land that is below sea level. Levees reinforce the banks of streams and help prevent flooding by containing higher flow events to the channel. By confining the flow to a narrower steam channel, levees can also increase the speed of the water. Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or dam failure. Levees reduce, not eliminate, the risk to individuals and structures located behind them.

A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning. When a levee system fails or is overtopped, severe flood damage can occur due to increased water surface elevation associated with levees and the resulting increase in water velocity.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals, such as the California ground squirrel, the salt marsh harvest mouse, or the western burrowing owl can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure. No levee provides protection from events for which it was not designed, and levees require maintenance to continue to provide the level of protection they were designed and built to offer.

7.1.3 REGULATORY OVERSIGHT

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of most dams in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure in order to protect lives and property of the public.

The National Dam Safety Program is a partnership among the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA's leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchases of needed equipment. FEMA has also expanded existing and initiated new training programs. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most of the dams in the United States.

California Division of Safety of Dams

California's Division of Safety of Dams (DSOD), a division of the Department of Water Resources (DWR), monitors dam safety at the state level. Dams regulated by the DSOD are more than 25 feet in height and hold back more than 15 acre-feet of water or are more than 6 feet in height and hold more than 50 acre-feet of water. DSOD assigns hazard ratings to large dams within the State. Dams are classified in four categories based on the potential hazard to life and property:

- **Extremely High Hazard** – Expected to cause considerable loss of human life or would result in an inundation area with a population of 1,000 or more.
- **High Hazard** – Expected to cause loss of at least one human life.
- **Significant Hazard** – No probable loss of human life but can cause economic loss, environmental damage, impacts to critical facilities, or other significant impacts.
- **Low Hazard** – No probable loss of human life and low economic and environmental losses. Losses are expected to be principally limited to the owner's property.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with many federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate potential dam safety problems, complaints about constructing and operating a project, safety concerns related to natural disasters, and issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet. FERC monitors seismic research and applies it in performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management.

US Army Corps of Engineers Dam Safety Program

The US Army Corps of Engineers is responsible for safety inspections of some federal and nonfederal dams in the US that meet the size and storage limitations specified in the National Dam Safety Act. They have inventoried such dams and surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of the dams.

US Army Corps of Engineers and FEMA Levee Oversight

The Army Corp and FEMA have differing roles and responsibilities related to levees. The Corps addresses operation and maintenance, risk communication, risk management, and risk reduction issues as part of its responsibilities under the Levee Safety Program. FEMA addresses mapping and floodplain management issues related to levees, and it accredits levees as meeting requirements set forth by the National Flood Insurance Program.

Depending on the levee system, the Corps and FEMA may be involved with a levee sponsor and community independently or jointly. The two agencies' long-term goals are similar: to reduce risk and lessen the devastating consequences of flooding. Army Corps and FEMA partnering activities related to levees include the following:

- Joint meetings with levee sponsors and other stakeholders
- Integration of levee information into the National Levee Database
- State Silver Jackets teams
- Sharing of levee information
- Targeted task forces to improve program alignment.

Coordination between the Corps and FEMA on levees is now standard within many of each agency's policies and practices. Over the past several years, both agencies coordinated policies where appropriate; jointly participated in meetings with stakeholders; and participated in many multiagency efforts, such as the National Committee on Levee Safety, the Federal Interagency Floodplain Management Task Force, and the Silver Jackets Program, which brings together state, federal, tribal, and local agencies to learn from each other and apply their knowledge to reduce risk from hazards.

National Committee on Levee Safety

Congress created the National Committee on Levee Safety to develop recommendations for a national levee safety program. The Committee notes that when combined, aging levees, increased development in the floodplain, and increasing frequency of flooding due to climate change, point to an overall increase in the risk of flooding due to levee overtopping or failure. The Committee seeks to use an integrated approach to creating reliable levee systems and protecting people and property from floods. The Committee is made up of representatives from the Army Corps, FEMA, state, regional, and local agencies, and the private sector and has been working toward this goal since October 2008.

7.1.4 DAMS IN MONTEREY COUNTY

The following dams are located in or have inundation zones in Monterey County:

Table 7-1
Dams in or Owned by Monterey County*

Facility Name	Water Course	Owner	Dam Type	Downstream Hazard	Condition
San Antonio	San Antonio River	Monterey County Water Resources Agency	Earthen Embankment	Extremely High	Fair
Los Padres	Carmel River	California American Water	Earthen Embankment	Extremely High	Satisfactory
Pacific Grove	Pacific Ocean	California American Water	Earthen Embankment	Low	Satisfactory
Forest Lake	Off stream	Pebble Beach Community Services District	Earthen Embankment	Extremely High	Satisfactory
Black Rock Creek	Black Rock Creek	Private	Earth and Rock	Low	Satisfactory
Silacci	Unnamed	Private	Earthen Embankment	Significant	Fair
Nacimiento[1]	Nacimiento River	Monterey County Water Resources Agency	Earthen Embankment	Extremely High	Satisfactory

*Excludes Federally owned Dams
[1]Located in San Luis Obispo County
Source: Division of Safety of Dams, Dams Within Jurisdiction of the State of California

For the purposes of this Plan, the Nacimiento, San Antonio, Forest Lake, and Los Padres dams will be discussed in more detail as they pose an Extremely High downstream hazard and are considered by FEMA as High Hazard Potential Dams (HHPD).

Nacimiento Dam

Nacimiento Dam and its reservoir, the Nacimiento Reservoir, are located in northern San Luis Obispo County, about 20 miles from the coast, in central California. This earth-filled dam was completed in 1957.When the reservoir is full (elevation 800 feet), it has a maximum storage capacity of 377,900 acre-feet, is 18 miles long, and has about 165 miles of shoreline. The maximum elevation during flood stage is 825 feet, with a maximum temporary capacity of 538,000 acre-feet and a temporary surface area of 7,149 acres. Nacimiento Dam is under the jurisdiction of the DWR DSOD and the FERC. The FERC has jurisdiction over the project due to the existence of the hydroelectric plant. Nacimiento Dam was constructed and is owned by the

Monterey County Water Resources Agency (MCWRA). It serves as a flood control, water conservation, and recreation facility.

For the purposes of this plan, the following relevant plans, and studies specific to the Nacimiento Dam were reviewed:

- Nacimiento Dam EAP; WRA Rev #3 12/17/2021
- Nacimiento Dam Spillway Condition Assessment Report; GEI 2018
- Nacimiento Dam construction documentation
- Nacimiento Dam periodic inspection reports
- Nacimiento Dam FERC Part 12D Potential Failure Mode Analysis Reports
- Nacimiento Dam FERC Part 12D Safety Inspection Reports
- Nacimiento Dam Seismic Stability Review Report; GEI 2005
- Nacimiento Dam Safety Surveillance and Monitoring Reports
- Probable Maximum Flood Hydrology Report for Nacimiento Reservoir and Supplements; GEI 2001, 2003, and 2004

San Antonio Dam

San Antonio Dam and its reservoir, the San Antonio Reservoir, are located in southern Monterey County, about 16 miles northwest of Paso Robles, in central California. This earth-filled dam was completed in 1967. When the reservoir is full (elevation 780 feet), it has a maximum storage capacity of 335,000 acre-feet, is 16 miles long, and has about 100 miles of shoreline. The maximum elevation during flood stage is 802 feet, with a maximum temporary capacity of about 477,000 acre-feet and a temporary surface area of about 7,500 acres. San Antonio Dam is under the jurisdiction of the DSOD. Like Nacimiento Dam, San Antonio Dam was constructed and is owned by the MCWRA. It serves as a flood control, water conservation, and recreation facility.

For the purposes of this plan, the following relevant plans, and studies specific to the San Antonio Dam were reviewed:

- San Antonio Dam Spillway Condition Assessment Report; GEI 2018
- San Antonio Dam construction documentation
- San Antonio Dam periodic inspection reports
- San Antonio Dam Performance Evaluation Reports
- San Antonio Dam Seismic Analysis Report; Bechtel 1970
- Probable Maximum Flood Hydrology Report for San Antonio Reservoir; GEI 1999

Forest Lake Dam

The Forest Lake Dam, and its reservoir, the Forest Lake Reservoir, is in the Pebble Beach area in the Del Monte Forest. In December 1998, the Pebble Beach Community Services District (PBCSD) purchased the Forest Lake Reservoir from California-American Water Company (Cal-Am). Following the purchase, the reservoir was rehabilitated, including new improvements to meet the DSOD requirements. During winter months, when there is excess production at the Carmel Area Wastewater District's treatment plant, the reservoir is filled with recycled water. Stored recycled water is then used during summer months when the irrigation demands exceed the production, thereby further reducing the use of potable water. The rehabilitation of the reservoir started in 2005 and completed in 2006. In 2009, outlet structure of the reservoir was modified to increase the storage capacity from 105 million gallons to 115 million gallons.

Los Padres Dam

The Los Padres Dam, built in 1949 along the Carmel River, is located 25 miles upstream from the ocean. The dam is a rock and earth-filled dam which is as high as a thirteen-story building; its base is as thick as a football field and has an overall crest measurement of 680 feet. The dam is owned and operated by California-American Water Company (Cal-Am) and serves as a flood control and water conservation facility. The reservoir has a 3,200-acre feet of storage capacity. The Los Padres Reservoir is steadily filling with sediment, as the pervasively fractured granitic and metamorphic rock underlying the Carmel River watershed is easily eroded.

Sediment loads may greatly increase when fires reduce vegetation cover and are followed by large rainfall events, as occurred after the 1977 Marble Cone Fire that produced catastrophic debris flows. The Monterey Peninsula Water Management District (MPWMD) has undertaken several studies that fully evaluate the various options available for Los Padres Dam. The studies include consideration of dam removal and the development of new location for water storage "off-mainstem" of the Carmel River. This alternative was determined to best meet the long-term needs of water supply, instream flows, and fish passage within the watershed and represented the most effective means of maximizing beneficial use of the basin's available hydrology.

7.1.5 LEVEES IN MONTEREY COUNTY

Monterey County contains about 52 linear miles of levees. Most levees in the County are privately owned agricultural levees. *Table 7-2* summarizes levee miles by waterway.

Table 7-2
Miles of Levee in Monterey County by Waterbody

Waterbody	Miles of Levee
Bennett Slough	0.9
Carmel River	2.1
Elkhorn Slough	5.6
Moro Cojo Slough	4.3
Pajaro River	9.2
Salinas River	29.6
Total	**51.7**

Source: US Army Corp of Engineers, National Levee Database

Pajaro River Levee

The Pajaro River is located in Santa Cruz and Monterey County with the River being the approximate County line. The Pajaro River Levee System was built as a federal flood control project, authorized by Section 10 of the Flood Control Act of December 1944. The Army Corps of Engineers designed and constructed the levees and associated system components within the Pajaro River Basin in the late 1940s. The project was built to reduce flood risk to the City of Watsonville, the town of Pajaro and surrounding areas by reducing flooding over the channel banks. The project primarily consists of earthen levees, with a low flow channel. The low flow channel varies in elevation but is typically about 25 feet below the levee crest elevation.

The left (southern) bank of the Pajaro Levee system is located in Monterey County and extends from the Pacific Ocean to Murphy Road. The town of Pajaro is located behind the left bank levee. The levee maintenance agency for the left bank is the MCWRA. MCWRA has an emergency plan that identifies critical stages of the river and the related actions that the Office of Emergency Services takes such as declaring an emergency and mobilizing emergency responders. The MCWRA also has an ALERT system that monitors river levels whenever significant storms approach the area.

The right (northern) bank of the Pajaro River Levee system is owned/operated by the Santa Cruz County Flood Control and Water Conservation District – Zone 7. Santa Cruz County, Zone 7, and the City of Watsonville have an Emergency Action Plan. The County can monitor stream gages and when a critical water level is reached, alert the public through a reverse 911 system. The County also has an evacuation plan that covers a range of disasters and an ALERT Storm System.

Carmel River Levees

Levees have been constructed by private interests on the Carmel River from State Highway 1 upstream approximately 4,000 feet on the north bank, and from 3,000 feet upstream of the mouth to 10,000 feet upstream of the mouth on the south bank. These levees are not adequate to hold the 100-year flood.

7.2 HAZARD PROFILE

7.2.1 HISTORY

Dam Failure

There is no record of any damages, fatalities, or injuries associated with dam failure in the Monterey County. However, water has been released over the Nacimiento Dam spillway crest five times (1958, 1969, 1983, 2011, and 2017) over the last 63 years, and the San Antonio Dam spillway crest three times (1982, 1983, and 2006) over the past 55 years.

The state's most recent dam emergency occurred in February 2017 when the Oroville Dam in Butte County was on the verge of overflow. The dam's concrete spillway was damaged by erosion and a massive hole developed. The auxiliary spillway was used to prevent overtopping of the dam, and it experienced erosion problems also. Evacuation orders were issued in advance of a potential large uncontrolled release of water from Lake Oroville, but such a release did not occur. After this incident, state officials ordered that the flood-control spillways of 93 dams be re-inspected for potential geologic, structural, or performance issues that could jeopardize their ability to safely pass a flood event.

Levee Failure

In March 1995, a 10–20-year storm event, caused a breach in the Pajaro levee approximately 3 miles upstream of the town of Pajaro. The drainage system in the flat town could not adequately discharge the stormwater runoff in the streets. This resulted in mass evacuations and damage to private property. All residences (600+) and businesses in Pajaro were damaged and 2,500 people were evacuated.

Several locations along the Pajaro Levee were damaged and had to be repaired after the 1989 Loma Prieta earthquake causing damage to roads and property. An atmospheric river event in January of 2017 caused a levee breach along the Carmel River near Paso Hondo in Carmel Valley Village, impacting 20 to 30 homes.

7.2.2 LOCATION

Dam Failure

A dam failure is possible at any dam in Monterey County. The most likely location of a damaging levee failure would be at dams classified as having extremely high downstream hazard, which as previously mentioned includes the Nacimiento, San Antonio, Forest Lake, and Los Padres Dams.

The Nacimiento, San Antonio, and Los Padres Dams are older and are the most likely locations of a dam failure.

Mitigation Success Story
San Clemente Dam Removal

The San Clemente Dam was a large concrete dam located about 18 miles from the Ocean on the Carmel River. Over time the reservoir became increasingly sedimented and no longer served as a water source. The dam posed a safety concern and could have failed in the event of a large earthquake or flood.

1921	San Clemente Dam Built
1991	Dam declared seismically unsafe by the DOSD
1999	Carmel River listed as one of North America's most endangered rivers
2007	Studies confirm feasibility of dam removal option to bring dam into compliance with safety standards
2009	Dam removal and river re-route project chosen
2011	Preliminary designs completed and project approved by CPUC
2013	Construction begins
2015	San Clemente Dam Removed

Due to safety and environmental concerns, the CA Coastal Conservancy, NOAA, and California American Water decided to re-route the river and remove the dam. As of 2019, the Carmel River is returning to its wild state and the fish population is rebounding. At the time, this was the largest dam removal project in California history.

All three dams and reservoirs are inspected annually by the DSOD to ensure that they are in good operating condition. Nacimiento receives an additional annual inspection from FERC. Both Nacimiento and San Antonio receive periodic inspections by Water Resource Agency staff. These dam safety programs reduce risk associated with the dams but do not eliminate the possibility of a dam failure. During the winter, temporary flood storage is provided in flood pools in Nacimiento and San Antonio reservoirs.

Along the Los Padres Dams, excess water can be released through transmission pipes, valves, and spillway systems. However, use of the dam spillways for flood control releases would most likely occur during severe winter storms, when the dams and reservoirs are receiving increased inflow. Damage from a dam failure is most likely to occur in mapped dam failure inundation zones. Shown in *Figure 7-1* is the dam failure inundation zones for a spillway or full dam failure at the Nacimiento Dam.

Figure 7-1
Nacimiento Dam Failure Inundation Zone

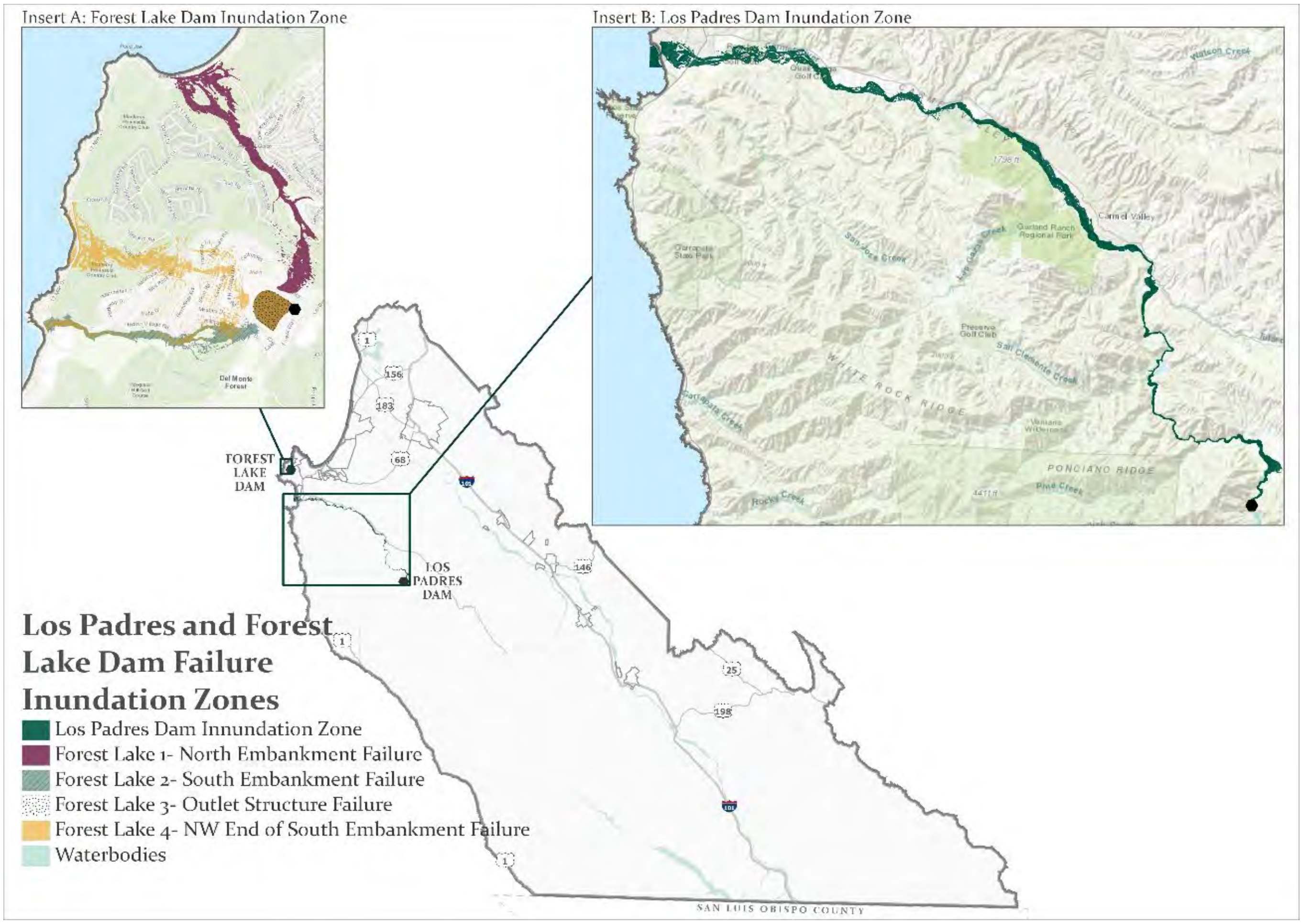
As of April 2019, the San Antonio Dam spillway has been identified to have significant foundation and structural deficiencies such that the spillway is in poor condition and unsafe for use under high flow conditions. Major rehabilitation or full replacement of the spillway will be needed to ensure the safe performance of the spillway under significant flows up to the maximum design outflow. The California Department of Water Resources, Division of Safety of Dams requires the San Antonio dam spillway be restored to full function by November 1, 2024.

Shown in *Figure 7-2* is the dam failure inundation zones for a spillway or full dam failure at the San Antonio Dam.

Figure 7-2
San Antonio Dam Failure Inundation Zone

The inundation zones for both the Los Padres Dam and the Forest Lake Dam are mapped in *Figure 7-3*.

Figure 7-3
Los Padres and Forest Lake Dam Failure Inundation Zones



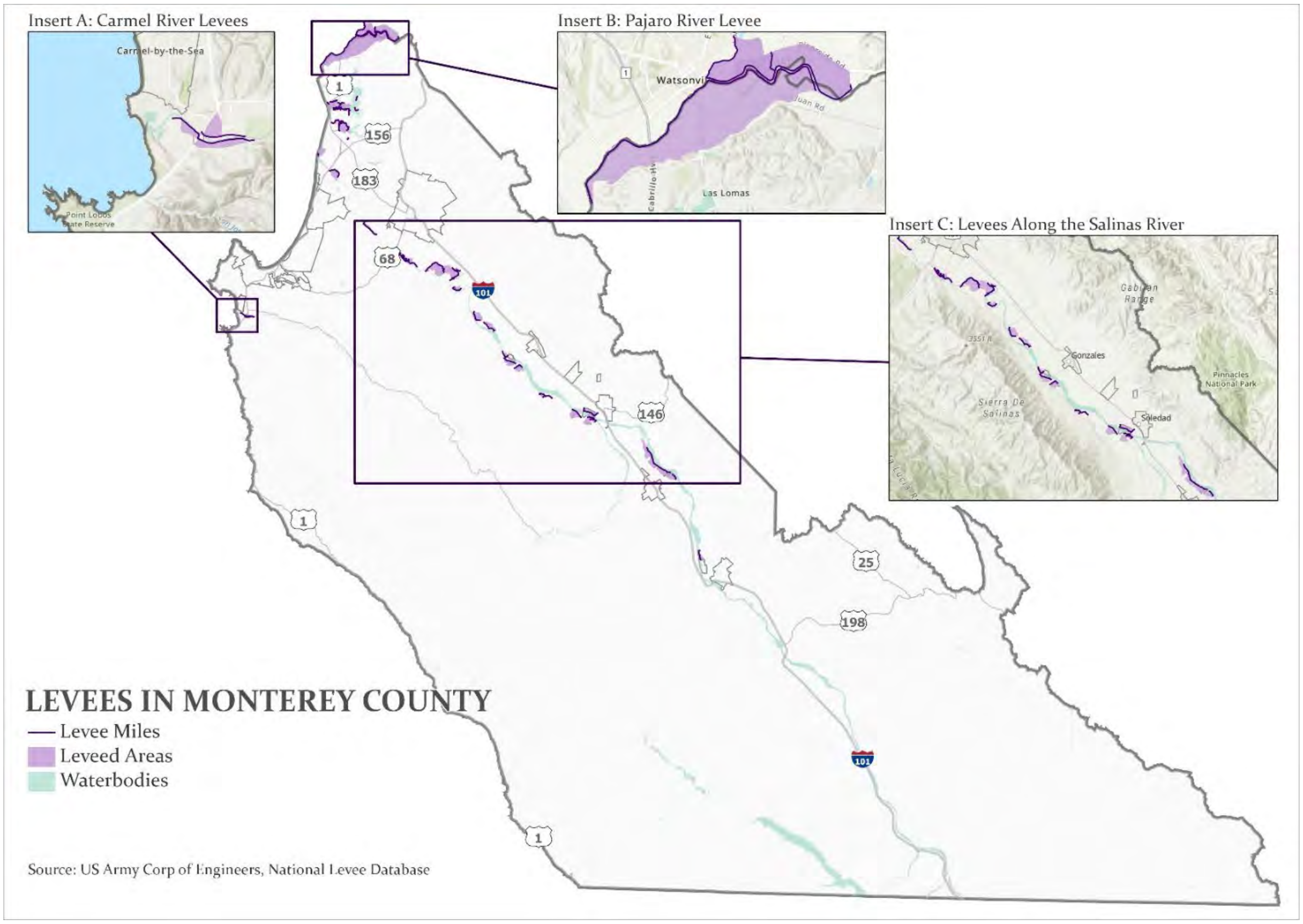
Levee Failure

A levee failure is possible along any levee in Monterey County. The most likely location of a damaging levee failure would be at the Carmel River Levees, the Pajaro River Levee, or at one of the many levees along the Salinas River.

For the NFIP, FEMA only recognizes levee systems that meet minimum design, operation, and maintenance standards. Therefore, there is a possibility that unaccredited levees exist in Monterey County, which do not meet FEMA standards and that could be a location of a levee failure. Since information is not available on the locations of such levees, risk associated with unaccredited levees is beyond the scope of this plan.

Levee miles and leveed area in Monterey County is shown in *Figure 7-4*.

Figure 7-4
Levees in Monterey County



7.2.3 FREQUENCY

Dam Failure

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. Although the recent Oroville event raised public concern about dam failure, the probability of such failures remains low in today's regulatory environment.

All dams face a "residual risk" of failure, which represents the risk that conditions may exceed those for which the dam was designed. For example, dams may be designed to withstand a probable maximum precipitation, defined as the theoretically, greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location at a certain time of the year. The chance of occurrence of a precipitation event of a greater magnitude than that represents residual risk for such dams. This in turn represents a theoretical probability of future occurrence for a dam failure event, though the probability of an event exceeding the assumed maximum is not generally calculated as part of dam design.

Levee Failure

Levee failure probabilities are considered to be higher than dam failure probabilities because levees are often exposed to more adverse conditions associated with high velocity flood flows, such as erosion and scour. Many levees are designed to overtop in high flow conditions; such overtopping is referred to as design failure.

7.2.4 SEVERITY

Dam Failure

Dam failure can be catastrophic to all life and property downstream. The US Army Corps of Engineers developed the classification system shown in *Table 7-3* for the hazard potential of dam failures.

Table 7-3
US Army Corps of Engineers Dam Hazard Potential Classification

Hazard Category	Direct Loss of Life	Lifeline & Property Losses	Environmental Losses
Low	None expected	No disruption of services; Loss of isolated buildings, agricultural lands, and equipment	Minimal incremental damage
Significant	None expected	Disruption of essential facilities and access; major loss of public and private facilities	Major mitigation required
High	Probable. One or more expected	Disruption of essential facilities and access; Extensive loss of public and private facilities	Extensive or impossible to mitigate

The Army Corps has classified the Forest Lake, Los Padres, San Antonio, and Nacimiento Dams as High Hazard [29] Dam inundation maps show that the greatest risk from dam failure is in Carmel Valley, where failure of the Los Padres would cause inundation of urbanized areas and alter the riparian corridor. Dam failure in Salinas Valley would also be significant, whether caused by the failure of San Antonio or Nacimiento Reservoir. Studies reveal that either failure would overflow the 100-year floodplain in Salinas Valley. However, the risk would predominately be to agricultural land.

Levee Failure

In the event of a levee failure, floodwaters may ultimately inundate the protected area landward of the levee. The extent of inundation is dependent on the flooding intensity. Failure of a levee during a 1% annual chance flood will inundate the 100-year floodplain previously

[29] US Army Corp of Engineers, National Inventory of Dams

protected by the levee. Residential and commercial buildings nearest the levee overtopping or breach location will suffer the most damage from the initial embankment failure flood wave. Landward buildings will be damaged by inundation.

One major risk for the Pajaro River levee is of a breach before water flows over the levee (overtopping). This breach is associated with seepage (water leaking through the levee) and resulting erosion of the levee slope. The other major risk is from overtopping (water flowing over the levee) which also results in levee erosion and the potential for a breach. If a breach occurs, water could flood the town of Pajaro and surrounding agricultural lands rapidly, leading to significant economic damage and potential loss of life. While these conditions are possible, they are not certain to take place during a flood event. The past evacuations and flood events have increased community awareness and reduced the likelihood for life loss through the implementation of the notification and evacuation plans.

7.2.5 WARNING TIME

Dam Failure

Warning time for dam failure varies depending on the cause of the failure, the size of the dam and volume of water retained, and the location of the dam. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. All dams of concern in Monterey County are earthen dams, which do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. The time of breach formation ranges from a few minutes to a few hours.

The number of people to be alerted and evacuated in the event of impending dam failure can vary widely. A major factor to consider is the initial flow in the river when the failure occurs. The initial flow is normally very low on all the rivers between May and October. During the winter, the initial flow is much higher. This wide variation in initial flow has a significant impact on the areas that must be evacuated.

Levee Failure

Warning time for levee failures depends on the cause of the failure. A levee failure caused by structural failure can be sudden and occur with little to no warning. If heavy rains are impacting a levee system, communities located in the immediate danger zone can be evacuated before a failure occurs. If the levee failure is caused by overtopping, the community may or may not be able to recognize the impending failure and evacuate. If a levee failure occurs suddenly, evacuation may not be possible.

7.3 SECONDARY HAZARDS

Dam and levee failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards are landslides, bank erosion, and destruction of downstream habitat. Levee failures can also cause environmental incidents due to hazardous materials releases when floodwaters infiltrate facilities that store these types of materials.

Additionally, dam failure may worsen the severity of a drought by releasing water that might have been used as a potable water source. A failure of the Nacimiento or San Antonio dam could affect water availability for downstream agricultural users. If the dams were to fail or otherwise be unable to provide regular water releases, it would affect the ability of growers to exercise their right to those surface waters for supplementing recycled water and could cause a corresponding increase in groundwater usage.

7.4 RISK ASSESSMENT

For the purposes of this risk assessment, dam failure risk was assessed for the dams that are classified as High Hazard by the Army Corps of Engineers, which includes the Nacimiento, San Antonio, Forest Lake, and Los Padres Dams. Inundation zone data for the Nacimiento and San Antonio dams were provided by MCWRA. Inundation data for the Forest Lake Dam were provided by the Pebble Beach Community Services District. Inundation data for the Los Padres Dam were from the DWR DSOD California Dam Inundation Map data.

Data on levee location, leveed area, and population and property exposed to levee failure risk were from the US Army Corp of Engineers, National Levee Database. Leveed Area, which is defined as the estimated area of a floodplain from which flood water is excluded by the levee system, was used to determine the population and property exposed to levee failure.

7.4.1 POPULATION

Dam Failure

All residents in a dam failure inundation zone would be exposed to the risk of a dam failure. Population exposed to a failure of the Nacimiento Dam is summarized in *Table 7-4*.

Table 7-4
Population Exposed to Dam Failure in Monterey County- Nacimiento Dam

Supervisorial District	Spillway Failure	Dam Failure
District 1	0	0
District 2	4,391	6,876
District 3	3,779	7,427
District 4	1,493	11,372
District 5	2,690	3,091
Total	12,353	28,766

Population exposed to a failure of the San Antonio Dam is summarized in *Table 7-5*.

Table 7-5
Population Exposed to Dam Failure in Monterey County- San Antonio Dam

Supervisorial District	Spillway Failure	Dam Failure
District 1	0	0
District 2	2,509	5,757
District 3	1,024	7,742
District 4	174	9,318
District 5	66	3,090
Total	3,773	25,907

A failure of the Los Padres Dam would impact a population of 5,784, all located in Monterey County Supervisorial District 5, in the Carmel Valley area.

Population exposed to a failure of the Forest Lake Dam is summarized in *Table 7-6*. Impacts are not summarized by Supervisorial District, as all impacts would occur in Monterey County Supervisorial District 5 in the Pebble Beach community.

Table 7-6
Population Exposed to Dam Failure in Monterey County- Forest Lake Dam

Scenario	Population
Scenario 1- North Embankment Failure	302
Scenario 2- South Embankment Failure	403
Scenario 3- Outlet Structure Failure	23
Scenario 4- NW End of South Embankment Failure	834

The potential for loss of life is affected by the capacity and number of evacuation routes available to those living in potential inundation areas. Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area.

The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system.

Levee Failure

Those living in an area protected by a levee would be exposed to levee failure risk in the event of a levee failure event.

Table 7-7 summarizes population exposed to levee failure risk by water body in Monterey County.

Table 7-7
Population Exposed to Levee Failure in Monterey County by Waterbody

Waterbody	Miles of Levee	Population
Bennett Slough	0.9	6
Carmel River	2.1	633
Elkhorn Slough	5.6	0
Moro Cojo Slough	4.3	0
Pajaro River	9.2	3,597
Salinas River	29.6	23
Total	**51.7**	**4,259**

Source: US Army Corp of Engineers, National Levee Database

A failure of the left (southern) bank of the Pajaro levee would threaten the population of the town of Pajaro, which includes a population of 2,700 to 3,600 people who are located within the floodplain with the higher number of populations at night. There is also potential for loss of life from levee breaching.

Similar to dam failure, vulnerable populations are all populations in a leveed area that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system. Homeless encampments are sometimes located along levees and those populations would be immediately vulnerable if a levee were to fail.

7.4.2 PROPERTY

Dam Failure

All property in a dam failure inundation zone would be exposed to the risk of a dam failure. Residential property exposed to a failure of the Nacimiento Dam is summarized by failure type in *Table 7-8*. Non-residential property exposed to a failure of the Nacimiento Dam is summarized by failure type in *Table 7-9.*

Table 7-8
Residential Property Exposed to Dam Failure in Monterey County- Nacimiento Dam

Supervisorial District	Spillway Failure		Dam Failure	
	#	Value	#	Value
District 1	0	$0	0	$0
District 2	102	$64,518,030	547	$215,959,574
District 3	350	$111,015,165	930	$296,389,365
District 4	18	$7,953,691	2,449	$1,085,984,861
District 5	18	$6,264,905	201	$119,647,543
Total	488	$189,751,791	4,127	$1,717,981,343

Table 7-9
Non-Residential Property Exposed to Dam Failure in Monterey County- Nacimiento Dam

Supervisorial District	Spillway Failure		Dam Failure	
	#	Value	#	Value
District 1	0	$0	0	$0
District 2	1,573	$284,272,763	1,739	$359,562,190
District 3	601	$1,046,736,191	1,237	$1,913,669,147
District 4	212	$318,310,350	1,081	$652,433,746
District 5	81	$75,470,973	149	$97,208,521
Total	2,467	$1,724,790,277	4,206	$3,022,873,604

Residential and non-residential property exposed to a failure of the San Antonio Dam is summarized by failure type in *Table 7-10* and *Table 7-11*, respectively.

Table 7-10
Residential Property Exposed to Dam Failure in Monterey County- San Antonio Dam

Supervisorial District	Spillway Failure		Dam Failure	
	#	Value	#	Value
District 1	0	$0	0	$0
District 2	25	$14,955,579	356	$160,541,542
District 3	27	$3,896,226	862	$290,548,892
District 4	6	$1,878,279	1,829	$817,783,466
District 5	5	$1,925,278	270	$158,562,338
Total	63	$22,655,362	3,317	$1,427,436,238

Table 7-11
Non-Residential Property Exposed to Dam Failure in Monterey County- San Antonio Dam

Supervisorial District	Spillway Failure		Dam Failure	
	#	Value	#	Value
District 1	0	$0	121	$81,861,626
District 2	1,365	$163,566,067	1,709	$344,429,789
District 3	458	$708,840,660	1,226	$1,603,644,752
District 4	84	$156,648,583	883	$570,421,330
District 5	47	$60,066,878	164	$99,018,359
Total	1,954	$1,089,122,188	4,103	$2,699,375,856

A failure of the Los Padres Dam would impact 943 residential properties, valued at $779,795,548 and 419 non-residential properties, valued at $196,382,343. All impacted property would be in Monterey County Supervisorial District 5, in the Carmel Valley area.

Residential property exposed to a failure of the Forest Lake Dam by failure type is summarized in *Table 7-12.* Non-residential property exposed to a failure of the Forest Lake Dam by failure type is summarized in *Table 7-13.* Impacts are not summarized by Supervisorial District, as all impacts would occur in Supervisorial District 5 in the Pebble Beach community.

Table 7-12
Residential Property Exposed to Dam Failure in Monterey County- Forest Lake Dam

Scenario	Number	Value
Scenario 1- North Embankment Failure	38	$47,663,347
Scenario 2- South Embankment Failure	48	$54,833,015
Scenario 3- Outlet Structure Failure	0	$0
Scenario 4- NW End of South Embankment Failure	266	$356,389,582

Table 7-13
Non-Residential Property Exposed to Dam Failure in Monterey County- Forest Lake Dam

Scenario	Number	Value
Scenario 1- North Embankment Failure	12	$97,873,581
Scenario 2- South Embankment Failure	16	$62,584,773
Scenario 3- Outlet Structure Failure	0	$0
Scenario 4- NW End of South Embankment Failure	52	$77,207,153

Vulnerable properties are those closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are near where the dam waters would collect. Properties in the dam inundation zone that are built to NFIP minimum construction standards may have some level of protection against dam inundation, depending on the velocity and elevation of the inundation waters. These properties also are more likely to have flood insurance.

Levee Failure

Any property in an area protected by a levee would be exposed to levee failure risk in the event of a levee failure event. *Table 7-14* summarizes land area behind levees, as well as structures and property value exposed to levee failure risk by water body in Monterey County.

Table 7-14
Property Exposed to Levee Failure in Monterey County by Waterbody

Waterbody	Miles of Levee	Leveed Area in Square Miles	Structures	Property Value
Bennett Slough	0.9	0.35	1	$544,000
Carmel River	2.1	0.17	111	$258,000,000
Elkhorn Slough	5.6	0.62	0	$0
Moro Cojo Slough	4.3	0.87	0	$0
Pajaro River	9.2	5.97	811	$481,000,000
Salinas River	29.6	8.51	8	$55,501,000
Total	**51.7**	**16.49**	**931**	**$795,045,000**

Source: US Army Corp of Engineers, National Levee Database

The southern bank of the Pajaro levee reduces flood risk for agricultural areas and the town of Pajaro which sits within the floodplain. There is potential for high economic damages if a levee breach occurs and 800 structures at risk of flooding. While not all land protected by levee is agricultural, much of the 16.49 square miles of the land protected by levees in Monterey County is likely agricultural. Therefore, a levee failure could threaten important agricultural value.

7.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Dam Failure

Transportation routes have the potential to be destroyed due to dam failure. This includes all roads, railroads, and bridges in the path of the dam inundation. Notably, Highway 101 would be at risk if the Nacimiento or San Antonio Dam were to fail. Carmel Valley Road would be at risk due to a failure of the Los Padres Dam.

Transportation routes vulnerable to dam inundation have the potential to be wiped out and could create isolation issues. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge.

Utilities such as overhead power lines, cable and phone lines could also be at risk if any dam were to fail. Loss of these utilities could create additional isolation issues for the inundation areas. *Table 7-15* summarizes critical infrastructure identified as vulnerable to dam failure risk.

Table 7-15
Critical Infrastructure Exposed to Dam Failure Risk in Monterey County

Critical Infrastructure Type	Nacimiento		San Antonio		Forest Lake (Scenarios)				Los Padres
	Dam Failure	Spillway Failure	Dam Failure	Spillway Failure	1	2	3	4	
Facilities									
Emergency Response	4	0	1	0	0	0	0	0	0
Fire Station	3	0	1	0	0	0	0	0	1
Police Station	2	0	2	0	0	0	0	0	0
Medical Facilities	4	0	4	0	0	0	0	0	2
Military Facility	0	0	0	0	0	0	0	0	0
Large Public Facility	0	0	0	0	0	0	0	0	0
Educational Facilities	12	0	6	0	0	0	0	0	1
Power Plant	1	0	1	0	0	0	0	0	0
Water & Wastewater	32	14	28	2	0	0	0	0	21
Stormwater Facilities	9	5	7	0	0	0	0	0	0
Government Facilities	14	2	12	0	0	0	0	0	1
Communication Facilities	80	24	64	9	2	2	2	2	6
Rain Gauges	9	3	7	3	0	0	0	0	1

Table 7-15
Critical Infrastructure Exposed to Dam Failure Risk in Monterey County

Critical Infrastructure Type	Nacimiento		San Antonio		Forest Lake (Scenarios)				Los Padres
	Dam Failure	Spillway Failure	Dam Failure	Spillway Failure	1	2	3	4	
Hazardous Materials									
Active or Idle Oil Well	1,050	811	955	100	0	0	0	0	0
Landfill	0	0	0	0	0	0	0	0	0
Underground Tank	6	1	3	0	0	0	0	0	0
Cal ARP Facility	8	3	7	0	0	0	0	0	1
Transportation									
Airport	1	0	0	0	0	0	0	0	0
Bridge	28	21	26	11	0	0	0	0	7
Harbor	1	1	1	1	0	0	0	0	0
Highway (Miles)	96	42	63	8	0	0	0	0	0
Major Road (Miles)	109	38	111	15	0	0	0	0	0.7
Local Road (Miles)	159	57	133	10	3	2	0	4	25
Railroad (Miles)	45	11	46	2	0	0	0	0	0

Levee Failure

A failure of the left bank of the Pajaro levee could threaten critical infrastructure in the town of Pajaro, which includes a middle school, PG&E distribution lines, and industrial sites.

7.4.4 ENVIRONMENT

The environment would be exposed to a number of risks in the event of dam failure or levee failure event. The inundation could introduce many foreign elements into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals, especially endangered species such as steelhead.

7.4.5 ECONOMIC IMPACT

Dam and levee failure would likely impact Monterey County's agricultural economy. When a dam fails or a levee is breached, soil and crop damages in the flooded bottomland areas that impact agricultural management capacities and crop productivity. Breached levees appreciably impact freshwater resources, damage crops and livestock, destroy homes, schools, businesses, and wild species habitat, among other vital, sensitive areas. Levee failure often leads to oil and petroleum contamination of freshwater resources, particularly in dense residential, agricultural, and commercial areas protected by levee systems that depend upon such water resources for drinking, irrigation, and industrial uses.

7.5 FUTURE TRENDS IN DEVELOPMENT

Most of the areas vulnerable to the more severe impacts from dam and levee failure intersect the mapped flood hazard areas. Flood-related policies in the general plans of participating jurisdictions will help to reduce the risk associated with dam and levee failure for all future development. Flooding due to a dam or levee failure could exceed the special flood hazard areas regulated through local floodplain ordinances, and therefore the County and participating jurisdictions should still consider this hazard when permitting development in mapped dam inundation zones and downstream of high hazard and significant hazard dams. Low hazard dams could become significant or high hazard dams if development occurs below them.

7.6 ISSUES

The most significant issue associated with dam and levee failure involves the properties and populations in the inundation zones. Flooding as a result of a dam or levee failure would significantly impact these areas. There is often limited warning time for dam or levee failures. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam and levee failure hazards include the following:

- Dam and levee infrastructure may require repair and improvement to withstand climate change impacts.
- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.
- Mapping for federally regulated dams is already required and available; however, mapping for nonfederal-regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federal-regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

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8. DROUGHT

8.1 OVERVIEW

Drought is a significant decrease in water supply relative to what is typical in a given location. It is a normal phase in the climate cycle of most regions, originating from a deficiency of precipitation over an extended period of time, usually a season or more. This leads to a water shortage for some activity, group, or environmental sector. High temperatures, high winds, and low humidity can worsen drought conditions, and can make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

Droughts are frequently classified as one of the four types: meteorological, agricultural, hydrological, or socioeconomic. Meteorological droughts are typically defined by the level of “dryness” when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts (when the amount of moisture in soil does not meet the needs of a particular crop). Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socioeconomic drought is the result of water shortages that affect people and limit the ability to supply water-dependent products in the marketplace.

Droughts cause public health and safety impacts, as well as economic and environmental impacts. Public health and safety impacts are primarily associated with catastrophic wildfire risks and drinking water shortage risks for small water systems in rural areas and private residential wells. Drought impacts are felt first by people most dependent on annual rainfall –

such as ranchers using dryland range or rural residents relying on wells in low-yield rock formations.

Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline. At times, drought may also cause community-wide impacts because of acute water shortages (regulatory use restrictions, drinking water supply, and seawater intrusion). The magnitude of such impact's correlates directly with local groundwater supplies, reservoir storage, and development densities. Drought conditions can also contribute to or exacerbate extreme heat concerns, particularly with regard to elderly populations.

8.1.1 DROUGHT IN CALIFORNIA

Most of California's precipitation comes from storms moving across the Pacific Ocean. The path followed by the storms is determined by the position of an atmospheric high-pressure belt that normally shifts southward during the winter, allowing low pressure systems to move into the State. On average, 75% of California's annual precipitation occurs between November and March, with 50% occurring between December and February. A persistent Pacific high-pressure zone over California in mid-winter signals a tendency for a dry water year.

A typical water year produces about 100 inches of rainfall over the North Coast, 50 inches of precipitation (combination of rain and snow) over the Northern Sierra, 18 inches in the Sacramento area, and 13 inches to 23 inches in the planning area. In extremely dry years, these annual totals can fall to as little as one half, or even one third of these amounts. The Sierra Nevada snowpack serves as the primary agent for replenishing water in the San Francisco Bay area, including Monterey County, and for much of the State of California. A reduction in spring snowpack runoff, whether due to drier winters or to increasing temperatures leading to more rain than snow, can increase risk of summer or fall water shortages throughout the region.

8.1.2 DROUGHT CONDITIONS

The US Drought Monitor (USDM) uses a five-category system to label the severity of droughts. Drought categories show experts' assessments of conditions related to dryness and drought including observations of how much water is available in streams, lakes, and soils compared to usual for the same time of year. Drought is classified into five categories:

D0 - Abnormally Dry
D1 - Moderate Drought
D2 - Severe Drought
D3 - Extreme Drought
D4 - Exceptional Drought

Since no two states experience the same set of impacts during a drought. USDM has developed tables of impacts reported during past droughts in each state for each level of drought on the US Drought Monitor. Impacts by drought category for California are listed in *Table 8-1.*

Table 8-1
Drought Impacts by USDM Drought Category in California

D0	Soil is dry; irrigation delivery begins early; Dryland crop germination is stunted
	Active fire season begins
	Winter resort visitation is low; snowpack is minimal
D1	Dryland pasture growth is stunted; producers give supplemental feed to cattle
	Landscaping and gardens need irrigation earlier; wildlife patterns begin to change
	Stock ponds and creeks are lower than usual
D2	Grazing land is inadequate; Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase
	Producers increase water efficiency methods and drought-resistant crops
	Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff
	Wine country tourism increases; lake- and river-based tourism declines
	Water temperature increases, programs to divert water to protect fish begin River flows decrease; reservoir levels are low, and banks are exposed
D3	Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains; Orchard removal and well drilling company business increase
	Fruit trees bud early; producers begin irrigating in the winter
	Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive
	Fire season lasts year-round; fires occur in wet parts of state; burn bans implemented
	Low river levels impede fish migration and cause lower survival rates
	Wildlife encroaches on developed areas; little native food and water is available for bears, which hibernate less
	Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are exceptionally low; water theft occurs
	Wells and aquifer levels decrease; homeowners drill new wells
	Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase
	Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted
D4	Fields are left fallow; orchards are removed; vegetable yields are low
	Fire season is very costly; number of fires and area burned are extensive
	Fish rescue begins; forest mortality is high; wetlands dry up; survival of native plants and animals is low; wildlife death is widespread; algae blooms appear
	Policy change, agriculture unemployment is high, food aid is needed
	Poor air quality affects health, greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise
	Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water quality is poor
	Water prices are extremely high; wells are dry, more, and deeper wells are drilled

8.1.3 LOCAL WATER SUPPLY AND WATER SHORTAGE

Monterey County is isolated from State and Federal water supplies and must rely solely on its local water resources, historically, groundwater and surface water from watersheds with negligible influence from snowpack. The Monterey County Water Resources Agency manages two large reservoirs: San Antonio and Nacimiento. The Monterey Peninsula depends on two water sources: the Carmel River, which drains a 255-square-mile watershed and runs 36 miles from its source in the Santa Lucia mountains to the sea; and the Seaside Basin, which is recharged by local rain, and which underlies the City of Seaside as well as parts of the former Fort Ord and Highway 68 corridor.

Groundwater is the major source of water for many water users in more rural areas of Monterey County with the exception of residents along the Big Sur coast, who depend entirely on surface water and shallow wells for their water supply, and of residents in an area near Greenfield in the Salinas Valley, who have a diversion from the Arroyo Seco River.

High demands on water resources during severe drought can limit water supply. During critically dry years, the California State Water Resources Control Board can mandate water conservation by water users and agencies to address statewide water shortages. *Table 8-2* lists State Drought Management Program stages mandated to water right holders.

Table 8-2
State Drought Management Program

Drought Stage	State Mandated Customer Demand Reduction	Rate Impacts
Stage 0 or 1	<10%	Normal rates
Stage 2	10 to 15%	Normal rates; Drought surcharge
Stage 3	15 to 20%	Normal rates; Drought surcharge
Stage 4	>20%	Normal rates, Drought surcharge

Several efforts are also underway to provide recycled water and reduce the risk seawater intrusion. The Pure Water Monterey Groundwater Replenishment Project (PWM/GWR) replenishes the Seaside Basin with an average of 3500 acre-feet/year of advanced purified recycled water which is injected to the Basin via a series of shallow and deep injection wells. The recycled water mixes with native groundwater and is stored for later potable water supply.

The Salinas Valley Reclamation Project (SVRP) provides recycled water to growers in the Salinas Valley. The distribution portion of the system, known as the Castroville Seawater Intrusion Project (CISP), delivers water through 45 miles of pipeline to 12,000 acres of farmland in the northern Salinas Valley nearly year-round. While SVRP does not produce potable water, it does help agricultural users in the CSIP area reduce their reliance on the 180- and 400-foot aquifers, which are the source of potable water supply for several communities including Castroville and the City of Salinas.

8.2 HAZARD PROFILE

8.2.1 HISTORY

The California Department of Water Resources has state hydrologic data back to the early 1900s. The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920, 1922 to 1924, and 1928 to 1934. Since then, a number of prolonged periods of drought occurred in California, all of which impacted Monterey County to some degree.

1976 to 1977 Drought: California had one of its most severe droughts due to lack of rainfall during the winters of 1976 and 1977. 1977 was the driest period on record in California, with the previous winter recorded as the fourth driest in California's hydrological history. The cumulative impact led to widespread water shortages and severe water conservation measures throughout the state. Only 37% of the average Sacramento Valley runoff was received, with just 6.6 million acre-feet recorded. Over $2.6 billion in crop damage was recorded in 31 counties. FEMA declared a drought emergency (Declaration 3023-EM) on January 20, 1977, for 58 California counties.

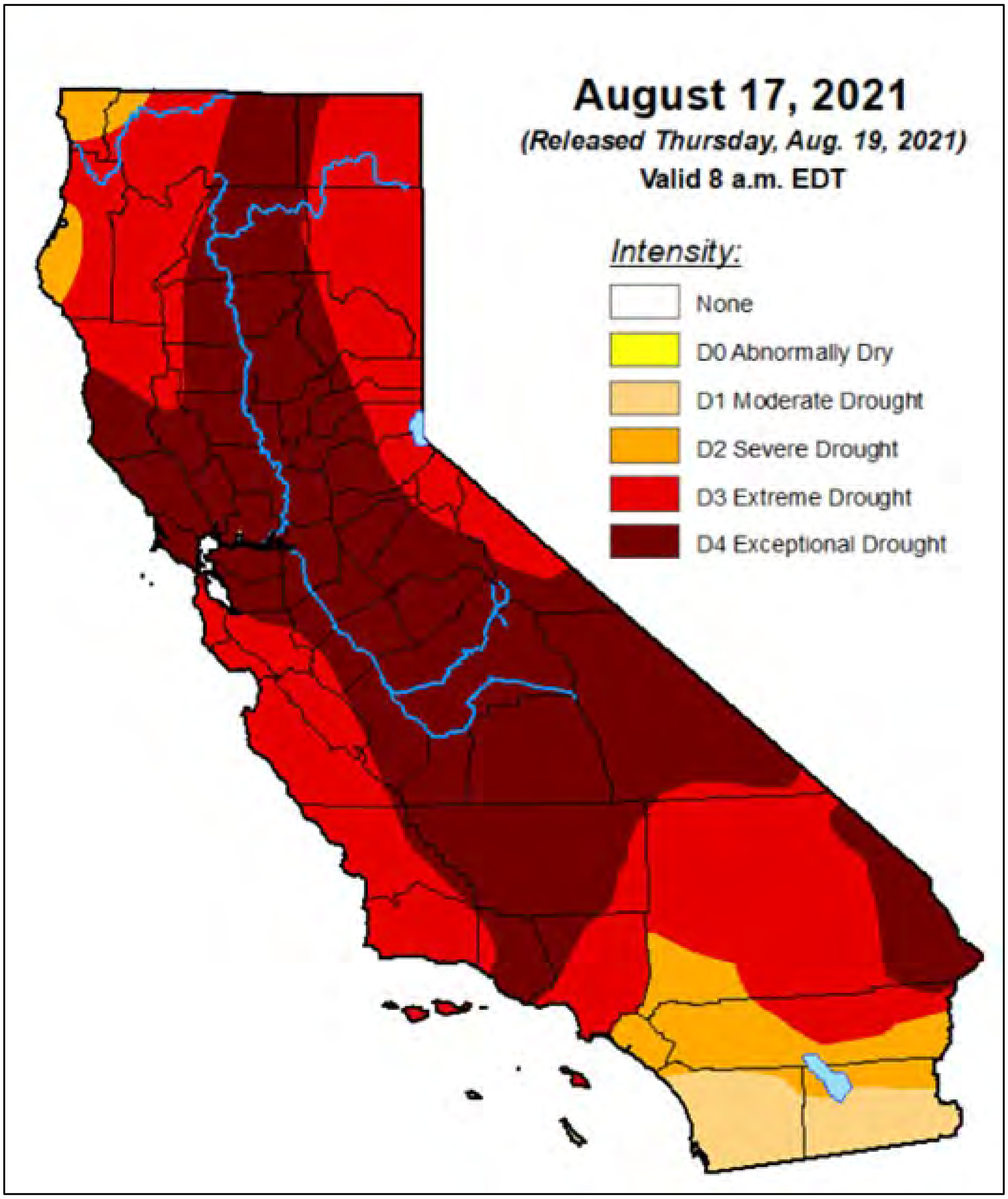
1987 to 1992 Drought: California received precipitation well below average levels for four consecutive years. While the Central Coast was most affected, the Sierra Nevadas in Northern California and the Central Valley counties were also affected. During this drought, only 56% of average runoff for the Sacramento Valley was received, totaling just 10 million acre-feet. In 1991, the State Water Project sharply decreased deliveries to water suppliers. By February 1991, all 58 counties in California were experiencing drought conditions. Urban areas as well as agricultural areas were impacted.

2007 to 2009 Drought: The governor issued an executive order that proclaimed a statewide drought emergency on June 4, 2008, after spring 2008 was the driest spring on record, with low snowmelt runoff. On February 27, 2009, the governor proclaimed a state of emergency for the entire state as severe drought conditions continued. The largest court-ordered water restriction in state history (at the time) was imposed.

2012 to 2016 Drought: The most recent major drought in California set several records for the state and was one of the most severe droughts on record. On January 17, 2014, Governor Jerry Brown declared a statewide drought emergency in response to California's driest year on record, with nearly 99% of the state considered abnormally dry or worse, and almost two-thirds of the state (including Monterey County) in extreme drought conditions. In the State of Emergency declaration, Governor Brown directed state officials to assist farmers and communities that are economically impacted by dry conditions. The Governor also directed state agencies to use less water and hire more firefighters and initiated a greatly expanded water conservation public awareness campaign. On April 2, 2017, Governor Brown lifted the drought emergency, but declared that California must continue water conservation efforts.

2021 Drought: On July 8, 2021, Governor Gavin Newsom declared a drought emergency in Monterey County along with 8 other Counties. This declaration was an expansion of the May 10, 2021, drought declaration**,** with 50 of California's 58 counties now included in the drought emergency declaration. Drought conditions in California as of August 17, 2021, are shown in *Figure 8-1*.

Figure 8-1
US Drought Monitor, Drought Conditions as of August 17, 2021



Source: The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.

The US Department of Agriculture (USDA) declares agriculture-related disasters for losses resulting from drought, flood, fire, freeze, tornadoes, pest infestation, and other natural disasters. Between 2012 and 2021, the period for which data was available, Monterey County was included in 21 USDA disaster declaration in relation to drought, listed in *Table 8-3*.

Table 8-3
USDA Agricultural Disaster Designations in Monterey County (2012-2021)

Designation Number	Disaster Type	Crop Disaster Year
S4958	Drought	2021
S4969	Drought	2021
S4916	Drought	2021
S4467	Drought	2019
S4460	Drought	2018
S4144	Drought	2017
S4163	Drought	2017
S3952	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2016
S3784	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2015
S3943	Drought	2015
S3626	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3637	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3626	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3637	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2014
S3743	Drought	2014
S3491	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3497	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3504	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3547	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3569	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2013
S3268	Drought, High Winds, Wildfire, Excessive Heat, and Insects	2012
S3379	Drought	2012
S3452	Drought	2012

Source: United States Department of Agriculture (USDA), Disaster Designation Information, Last updated August 20, 2021

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the US. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public, members of the media, and staff of government agencies.

The Drought Impact Reporter found that Monterey County was affected by 111 impacts from droughts from January 2012 through November 2021 in the following categories (note that some impacts have been assigned to more than one category).[30]

59 Relief, Response & Restrictions Impacts

57 Water Supply & Quality Impacts

35 Agriculture Impacts

31 Society & Public Health Impacts

22 Plants & Wildlife Impacts

19 Fire Impacts

7 Tourism & Recreation Impacts

6 Business & Industry Impacts

5 Energy Impacts

8.2.2 LOCATION

Drought is a regional phenomenon with the potential to impact the entire population of Monterey County directly or indirectly, be it from water restrictions, higher water and food prices, reduced air or water quality, or restricted access to recreational areas. No portion of the County is immune from drought conditions. However, the most significant financial losses are likely to occur in areas that are primarily agricultural.

Lack of winter snowfall in the mountains can eventually lead to agricultural impacts due to decreased stream flows. Droughts of just a few weeks during critical periods of plant development can have disastrous effects on agriculture production. Reduced reservoir storage from decreased runoff in the mountains can lead to water shortages. Droughts that occur in populated areas may not have direct effects to the residents but may increase the threat of wildfire in the wildland urban interface areas.

8.2.3 FREQUENCY

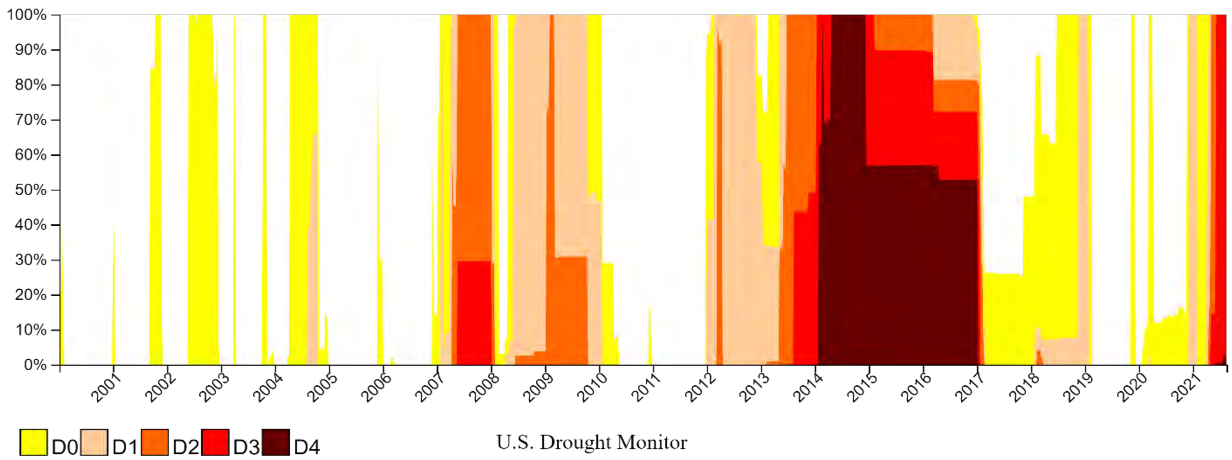
Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the

[30] Drought Impact Reporter, National Drought Mitigation Center

precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

According to historical data prepared by the National Drought Mitigation Center, Monterey County, has experienced some level of drought almost every year during the past 20 years. Time series data by percentage area in drought conditions in Monterey County from the US Drought Monitor[31] is shown in *Figure 8-2*. Therefore, droughts likely are likely to occur frequently in Monterey County at varied severities in the future.

Figure 8-2
Monterey County Percentage Area Drought Conditions



8.2.4 SEVERITY

Drought can have a widespread impact on the environment and the economy, although it typically does not result in loss of life or damage to property. The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Unlike most disasters, droughts normally occur slowly but last a long time. Drought can have severe impacts in Monterey County's water resources, which are already over-stretched by the demands of a growing agriculture economy and population.

The agricultural sector clearly demonstrates the site-specific nature of drought impacts. Agricultural drought impacts are normally felt earliest by those relying on unmanaged water supplies: entities carrying out dryland grazing and non-irrigated crop production, usually grain crops. Impacts to irrigated agriculture depend on the source and nature of the irrigation water supply, whether it be local groundwater, local surface water, or imported surface water, and

[31] Time Series Data, US Drought Monitor

any water rights or contractual provisions that may be associated with the source. The extent to which producers may mitigate water shortage impacts depends on multiple factors but is heavily influenced by economic considerations. Factors involved in making decisions about mitigating irrigation water shortages include availability and costs of pumping groundwater, price of alternative surface water sources, capital investments associated with maintaining permanent plantings, and status of international crop markets.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate, and in many cases, groundwater is more heavily relied upon during periods of drought due to a reduction in surface water availability. This can lead to a reduction in groundwater levels, decreases in water quality, and problems such as reduced pumping capacity or wells going dry. Long term drought conditions in the County could lead to increased groundwater mining in the Deep Aquifers. Reduced replenishment of groundwater also affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

8.2.5 WARNING TIME

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

Scientists currently do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long a drought will last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

8.3 SECONDARY HAZARDS

Drought is often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well. For more information on heat risk in Monterey County, refer to *Severe Weather* in **Section 14**.

8.3.1 SEAWATER INTRUSION

Droughts can cause and exacerbate seawater intrusion in Monterey Bay area. Drought conditions can lead to increases in groundwater pumping, including potential pumping from deep aquifers, and this loss of groundwater increases seawater intrusion. According to the 2015 Urban Water Management Plan for the Salinas District, the annual non-drought overdraft of the Salinas Valley Groundwater Basin is estimated to be approximately 45,300 AF per year. During droughts, the annual overdraft can escalate to between 150,000 to 300,000 AF per year. As a result of this consistent overdraft, groundwater levels in the Salinas Valley Groundwater Basin have dropped below sea level, allowing seawater to intrude from Monterey Bay into aquifers located 180 and 400 feet below ground surface. While basin overdraft conditions are expected to improve by the year 2030 due to water reclamation efforts, recent groundwater modeling from the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM) predicted seawater intrusion to continue to worsen, though at a decreased rate.

8.3.2 WILDFIRE

A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to wildfire ignition as the duration of the drought extends. For more information on wildfire risk in Monterey County, refer to *Wildfire* in **Section 18**.

8.3.3 DEBRIS FLOWS

Post-fire vegetation recovery on burn scars is necessary for winter-storm slope stability. Drought conditions may slow the vegetation recovery rates on burn scars causing a higher debris flow likelihood for a longer period following a wildfire. For more information on debris flow risk in Monterey County, refer to *Slope Failure* in **Section 15**.

8.4 RISK ASSESSMENT

The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Population/Social Impacts: These impacts affect people’s health and safety. Social impacts include public safety, health, conflicts between people when there is not enough water to go around, and changes in lifestyle.
- Economic Impacts: These impacts of drought cost people (or businesses) money, farmers’ crops are destroyed; low water supply necessitates spending on irrigation or to drill new wells; businesses that sell boats and fishing equipment may not be able to sell their goods.
- Environmental Impacts: Plants and animals depend on water. When a drought occurs, their food supply can shrink, and their habitat can be damaged.

8.4.1 POPULATION AND SOCIAL IMPACTS

The entire population of Monterey County is vulnerable to drought events. Drought can affect people's health and safety, including health problems related to low water flows, poor water quality, or dust. Drought also is often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion. Other possible impacts include recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and hygiene; compromised food and nutrition; and increased incidence of illness and disease.

Water shortages can affect access to safe, affordable water, with substantial impacts on low-income families and communities burdened with environmental pollution. Disadvantaged communities in areas in the Central Coast region, such as the City of Salinas, were highly affected by water shortages during the 2011-2016 drought and another extend period of drought would likely disproportionality affect low-income communities. Drought changes also exacerbated affordability concerns for low-income households

8.4.2 ECONOMIC IMPACT

Drought causes the most significant economic impacts on industries that use water or depend on water for their business, most notably, agriculture and related sectors (forestry, fisheries, and waterborne activities), power plants and oil refineries. In addition to losses in yields in crop and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. Drought can lead to other losses because so many sectors are affected- losses that include reduced income for farmers and reduced business for retailers and others who provide goods and services to farmers. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products may also increase as supplies decrease. Although most businesses will still be operational, they may be affected aesthetically—especially the recreation and tourism industry. Moreover, droughts within another area could affect food supply/price of food for residents within the County.

Monterey County's agricultural sector is particularly vulnerable to drought conditions, with consequences that directly relate to the water available for irrigation purposes. Heat conditions associated with drought exacerbate agricultural irrigation demands when water levels are at their lowest. Reduction in precipitation coupled with heat stress can adversely impact crop production. In the Salinas Valley, agricultural water is made available from groundwater sources that are recharged by the Salinas River, which relies on water releases from the Nacimiento, and San Antonio reservoirs as controlled by MCWRA. Since 1990, growers in the Castroville Seawater Intrusion Project (CSIP) distribution system area have utilized tertiary-treated recycled water produced by M1W in partnership with MCWRA to irrigate their crops. In 2006, M1W and MCWRA added the Salinas River Diversion Facility (SRDF), which supplies recycled water to 12,000 acres of productive farmland. The SRDF relies upon water from the upstream Reservoirs to operate, providing Salinas River flows to supplement recycled water and further reduce groundwater pumping in the 180- and 400-foot aquifers of the Salinas Valley Groundwater Basin. During years when the SRDF is non-operational due to drought, a corresponding increase in groundwater pumping in CSIP region has been observed.

8.4.3 ENVIRONMENTAL IMPACT

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

8.5 FUTURE TRENDS IN DEVELOPMENT

Land use planning is directed by general plans adopted under California's General Planning Law. Municipal planning partners are encouraged to establish general plans with policies to deal with issues of water supply and protection of water resources. These plans increase capability at the local municipal level to protect future development from impacts of drought. All planning partners reviewed their general plans under the capability assessments undertaken for this hazard mitigation plan. Deficiencies revealed by these reviews are identified as mitigation actions to increase capability to deal with future trends in development.

8.6 ISSUES

- The probability of increased drought frequencies and durations due to climate change.
- The promotion of active water conservation even during non-drought periods.
- Application of alternative techniques (groundwater recharge, continued/expanded water reclamation, local capture and reuse, desalination, and transfer) to stabilize and offset water supply shortfalls.
- Regular occurrence of drought or multiyear droughts that may limit the County's ability to successfully recover from or prepare for more occurrences.
- The impact of prolonged drought conditions on Monterey County's agricultural industry, a key economic driver in the County.
- Severe drought could have serious impacts on water quality.
- Increased groundwater pumping during drought years exacerbating seawater intrusion.
- A severe drought would result in drier fuels which could create increased wildfire risk. Lack of water due to drought could also impede firefighting capabilities.

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9. EARTHQUAKE

9.1 OVERVIEW

An earthquake is a sudden motion or trembling caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break, and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds. Earthquakes usually occur without warning and, after just a few seconds, can cause massive structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, gas, communication, and transportation. The effects of an earthquake can be felt far beyond the site of its occurrence. The degree of damage depends on many interrelated factors. Among these are: the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surface deposits or bedrock, degree of consolidation of surface deposits, presence of high groundwater, topography, and the design, type, and quality of building construction.

9.1.1 EARTHQUAKE GEOLOGY

The Earth's crust, which is the rigid outermost shell of the planet, is broken into seven or eight major tectonic plates and many minor plates. Where the plates meet, they move in one of three ways: convergent (two plates moving together), divergent (two plates moving apart), or transform (two plates moving parallel to one another). Earthquakes, volcanic activity, mountain building, and oceanic trench formation occur along plate boundaries.

Subduction is a geological process that takes place at convergent boundaries of tectonic plate, in which one plate moves under another. Regions where this process occurs are known as subduction zones, and they have the potential to generate highly damaging earthquakes. The transform (parallel) movement of tectonic plates against one another creates stresses that 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 more relaxed position. The strain energy is released partly as heat and partly as elastic waves called seismic waves. The passage of seismic waves produces the ground shaking in earthquakes.

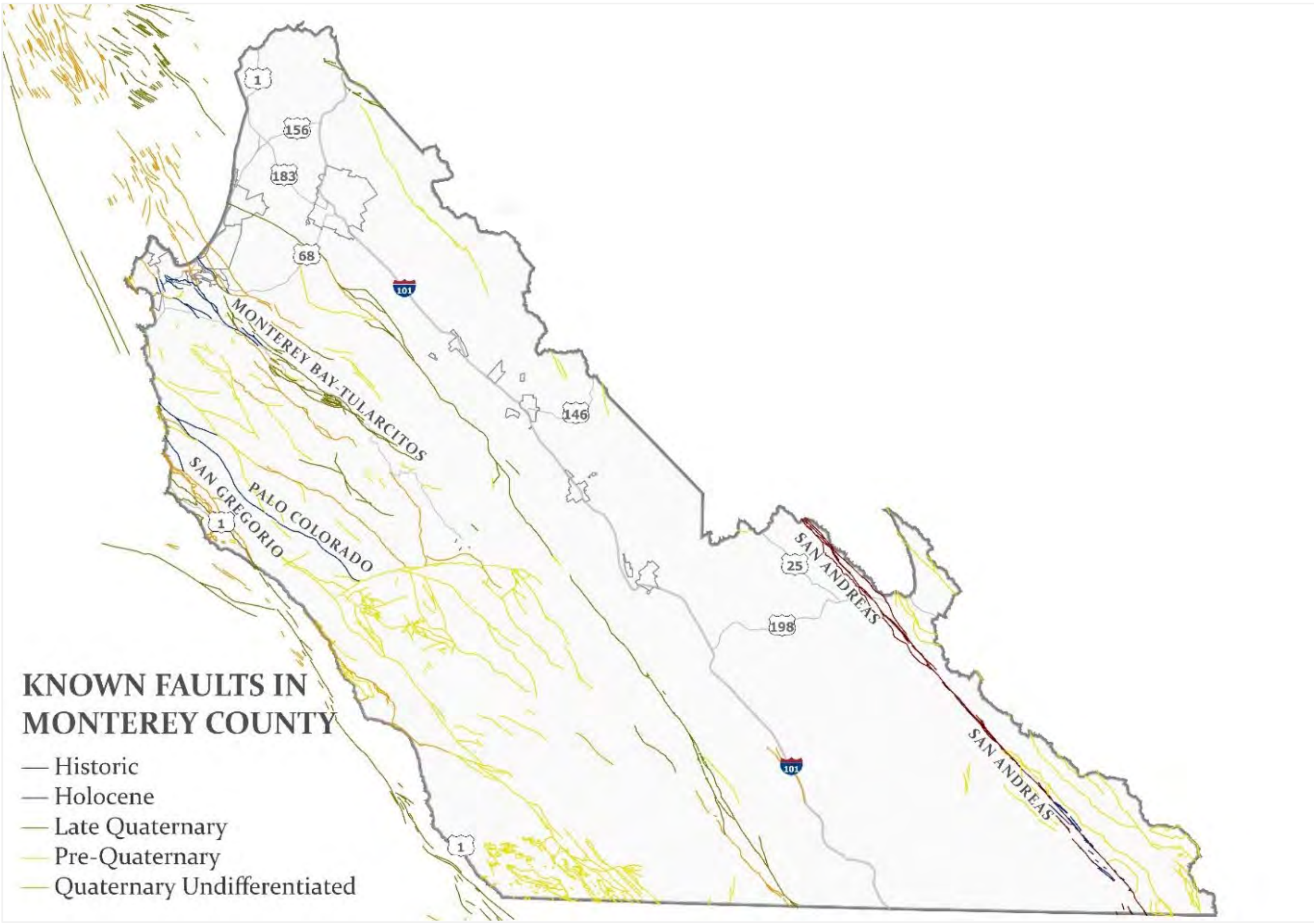
Monterey County lies within the California Coast Ranges, a region dominated by active tectonic movement of the North American Plate, east of the San Andreas Fault, and the Pacific Plate to the west. Regional tectonic forces generate an estimated relative motion between the North American and Pacific plates of approximately 2 inches per year. Over time, these forces have created the varied mountainous, valley, and fault-bound blocks seen in the County today.

Geologists have found that earthquakes tend to reoccur along faults, which are zones of weakness in the earth’s crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all stress has been relieved. Another earthquake could still occur. In fact, relieving stress along one part of a fault may increase it in another part. Therefore, faults are mapped to determine earthquake hazards. In California, a system has been developed by the California Geological Survey (CGS) and US Geological Survey (USGS) to assess the activity of faults. CGS categorizes faults based on the age of last displacement, as defined below:

- Historic faults have ruptured during historic time (approximately the last 200 years) and are associated with either a recorded earthquake with surface rupture, measurable surface displacement along a fault in the absence of notable earthquakes (e.g., aseismic creep), or displaced survey lines.
- Holocene age faults have ruptured within the past 11,000 years, as demonstrated by geomorphic or stratigraphic evidence of displacement of Holocene deposits or geomorphic features.
- Late Quaternary age faults have ruptured within approximately the last 700,000 years, as demonstrated by geologic and geomorphic evidence of displacement of Late Quaternary deposits or geomorphic features. This category may include younger faults that lack deposits by which to differentiate younger displacements.
- Quaternary age faults show evidence of surface rupture younger than approximately 1.6 million years ago.
- Pre-Quaternary age faults lack recognized evidence of Quaternary displacement or show evidence of no displacement during Quaternary time. Also included in this category are known faults for which detailed studies have not determined fault activity, and those faults identified only in preliminary mapping.

The classification of "active" is applied to historic and Holocene age faults; "potentially active" is applied to Quaternary and late Quaternary age faults; and "inactive" is applied to pre-Quaternary age faults. These classifications are not meant to imply that inactive faults will not rupture, only that they have not been shown to have ruptured for some time and the probability of fault rupture is low. Known faults in the County by age are shown in *Figure 9-1*.

Figure 9-1
Known Faults in Monterey County by Age



9.1.2 EARTHQUAKE CLASSIFICATIONS

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

The most common method for measuring earthquakes is magnitude, which measures the strength of earthquakes. An earthquake's magnitude is a measure of the energy released at the source of the earthquake and is related to the total area of the fault that ruptured, the amount of displacement across the fault, and the actual location of the energy release inside the earth. The Richter scale measures magnitude of earthquakes based on the amplitude of the largest energy wave released by the earthquake. Richter scale readings are suitable for smaller earthquakes; however, because it is a logarithmic scale, the scale does not clearly distinguish the magnitude of large earthquakes above a certain level.

Therefore, while the Richter scale is the most well-known measurement for earthquake magnitude, the majority of scientists currently use the Moment Magnitude (Mw) Scale to measure magnitude. As shown in *Table 9-1*, there are seven earthquake magnitude classes, ranging from great to micro. A magnitude class of great can cause tremendous damage to infrastructure, compared to a micro class, which results in minor damage to infrastructure.

Table 9-1
Earthquake Magnitude Classes (Moment Magnitude Scale)

Magnitude Class	Magnitude Range	Description
Great	Magnitude > 8	Tremendous Damage
Major	7 ≤ Magnitude < 7.9	Widespread Heavy Damage
Strong	6 ≤ Magnitude < 6.9	Severe Damage
Moderate	5 ≤ Magnitude < 5.9	Considerable Damage
Light	4 ≤ Magnitude < 4.9	Moderate Damage
Minor	3 ≤ Magnitude < 3.9	Rarely Causes Damage
Micro	Magnitude < 3	Minor Damage

Intensity

Although an earthquake has only one magnitude, it can have many intensities. The effects of an earthquake in a particular location are measured by intensity. Intensity at a given site is a function of earthquake magnitude, increasing as magnitude increases; distance from the causative fault, decreasing as distance increases; and underlying site geology, generally increasing in areas with weak, unconsolidated materials. Earthquake intensity decreases with increasing distance from the epicenter of the earthquake.

The Modified Mercalli Intensity value assigned to a specific site after an earthquake is a more meaningful measure of severity to the nonscientist than magnitude because intensity refers to the effects experienced at that place. The lower numbers on the intensity scale generally deal with the how the earthquake is felt by people, while the higher numbers are based on observed structural damage.

Table 9-2 provides an overview of the Modified Mercalli Intensity scale.

Table 9-2
Modified Mercalli Intensity Level Descriptions

Intensity	Shaking	Description/ Damage
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt by only a few persons at rest, especially on upper floors of building. Delicately suspended objects may swing.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. Disturbances of trees, poles, and other tall objects sometimes noticed.
VI	Strong	Felt by all, many frightened. Many objects fall from shelves. Some heavy furniture moved; a few instances of fallen plaster, broken windows, and damaged chimneys. Damage slight. Some fall of tree limbs, isolated rockfalls and landslides, and isolated liquefaction.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Tree damage, rockfalls, landslides, and liquefaction are more severe and widespread with increasing intensity.
VIII	Severe	Many find it difficult to stand. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monument walls, and heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving in cars disturbed.
IX	Violent	Some forcibly thrown to the ground. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Extreme	Some well-built structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Railway lines bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud.

9.1.3 GROUND MOTION

Earthquake hazard assessment is also based on expected ground motion. The ground experiences acceleration as it shakes during an earthquake. The peak ground acceleration (PGA) is the largest acceleration recorded by a monitoring station during an earthquake. PGA is a measure of how hard the earth shakes in a given geographic area and is expressed as a percentage of the acceleration due to gravity. Horizontal and vertical PGA varies with soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity. Earthquake hazard assessment involves estimating the annual probability that certain ground motion accelerations will be exceeded, and then summing the annual probabilities over a time period of interest.

Maps of earthquake shaking hazards provide information for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes.

Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. Buildings, bridges, highways, and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damage and disruption. PGA values are directly related to these lateral forces that could damage “short period structures” such as single-family dwellings. Longer-period response components determine the lateral forces that damage larger structures with longer natural periods such as apartment buildings, factories, high-rises, and bridges. *Table 9-3* lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

Table 9-3
Modified Mercalli Scale and Peak Ground Acceleration

Modified Mercalli Scale	Perceived Shaking	Potential Structural Damage		Estimated PGA (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	< 0.17%
II-III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X - XII	Extreme	Very Heavy	Very Heavy	> 124%

9.1.4 LIQUEFACTION

The impact of an earthquake on structures is a function of ground shaking, distance from the source of the quake, and liquefaction, an effect of an earthquake in which soils lose their shear strength and behave as liquid, damaging structures that derive their support from the soil. Liquefaction involves loose sandy soil with a high-water content that undermines the ground's ability to solidly support building structures during an earthquake. Liquefaction occurs when ground shaking causes the mechanical properties of some fine grained, saturated soils to liquefy and act as a fluid (liquefaction). It is the result of a sudden loss of soil strength due to a rapid increase in soil pore water pressures caused by ground shaking. In order for liquefaction to occur, three general geotechnical characteristics should be present:

- Ground water should be present within the potentially liquefiable zone
- The potentially liquefiable zone should be granular and meet a specific range in grain-size distribution
- The potentially liquefiable zone should be of low relative density. If those criteria are present and strong ground motion occurs, then those soils could liquefy, depending upon the intensity and duration of the strong ground motion.

Liquefaction that produces surface effects generally occurs in the upper 40 to 50 feet of the soil column, although the phenomenon can occur deeper than 100 feet. The duration of ground shaking is also an important factor in causing liquefaction to occur. The larger the earthquake magnitude, and the longer the duration of strong ground shaking, the greater the potential there is for liquefaction to occur.

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. *Table 9-4* summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 9-4
NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/ Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	<180
F	Special Study Soils- liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick	

9.2 HAZARD PROFILE

9.2.1 HISTORY

Earthquakes tend to reoccur where they have struck before. The central California coast has a history of damaging earthquakes, primarily associated with the San Andreas fault, which runs through the southeastern portion of the County for about 30 miles. There have also been a number of 5.0 to 6.5 earthquakes on other faults which have affected large portions of the region. The County has experienced 429 earthquakes since 1900 and 67 earthquakes since 2000 of 4.0 magnitude or higher. *Table 9-5* summarizes the year, epicenter, and magnitude of major earthquakes (6.0 magnitude or more) that have affected the County since 1850.

Table 9-5
Monterey County Earthquakes, Magnitude 6.0+ (1838-Present)

Date	Magnitude	Location
2004	6.0	Parkfield
2003	6.5	San Simenon
1989	6.9	Loma Prieta
1984	6.1	Morgan Hill
1983	6.5	Coalinga
1952	6.2	Monterey Bay
1966	6.6	Parkfield
1934	6.0	Parkfield
1926	6.3	Monterey Bay
1922	6.5	Parkfield
1906	7.8	San Francisco
1901	6.4	Parkfield
1857	7.9	Parkfield

The approximate 7.9 Fort Tejon earthquake of 1857 was one of the largest earthquakes ever recorded in the US and the largest in California history. It originated in Parkfield in Monterey County and caused a surface rupture scar of about 225 miles in length along the San Andreas Fault to the Cajon Pass northwest of San Bernardino. Yet, despite the immense scale of this quake, only two people were reported killed by the effects of the shock. The fact that only two lives were lost was primarily due to the fact that in 1857 California was sparsely populated, especially in the regions of strongest shaking. Were the Fort Tejon shock to happen today, the damage would easily run into the billions of dollars, and the loss of life would likely be substantial.

In 1906, the 7.8. magnitude San Francisco Earthquake caused severe damage. The Salinas River bottom lands were severely ruptured, fissured, and otherwise deformed. The Spreckels Sugar Mill, situated on the banks of the river, suffered more severely probably than any other steel structure in the State. Other damage from the 1906 earthquake included destruction of the wharf at Moss Landing and destruction of the Hotel Del Monte in Monterey.

On October 17, 1989, the Loma Prieta earthquake occurred in neighboring Santa Cruz County. The earthquake lasted only 10 to 15 seconds but was a 6.9 magnitude. In Moss Landing, liquefaction destroyed a causeway, damaged the bridge linking the Moss Landing spit to the mainland and cracked the paved road on Paul's Island.[32] A section of Highway 1 through Monterey, a bridge carrying Highway 1 over the Salinas River, and the Salinas River rail bridge suffered damage. In the Old Town Salinas historical district, unreinforced masonry buildings were partially destroyed. The 2004 6.0 magnitude Parkfield earthquake caused only minor damage but was long-anticipated event on the San Andreas fault and is the world’s best recorded earthquake to date.

9.2.2 LOCATION

Monterey County is located in a region of high seismicity with numerous local faults, as shown below. The primary seismic hazard for the County is potential ground shaking from these faults. Major faults in Monterey County are described below and mapped by slip rate in *Figure 9-2.*

San Andreas Fault

The San Andreas Fault runs through the southeastern portion of the County for approximately 30 miles and poses the single greatest seismic hazard to the County. To the north and south of the County, the fault appears to be currently locked with no detectable movement. Between these locked sections, within the County, the San Andreas Fault creeps (slips aseismically).

From San Juan Bautista to Parkfield, the creeping section produces numerous small to moderate (mostly magnitude 6.0 and smaller) earthquakes but no large ones. The stretch of the fault between Parkfield and Gold Hill defines a transition zone between the creeping and locked behavior of the fault. The slip rate of the San Andreas fault is Greater than 5.0 mm/year.

Palo Colorado-San Gregorio Fault

The Palo Colorado-San Gregorio Fault zone connects the Palo Colorado Fault near Point Sur, south of Monterey, with the San Gregorio Fault near Point Ano Nuevo in Santa Cruz County. It is a right-lateral strike-slip fault zone oriented generally north-south consisting of two or more parallel and fairly continuous fault segments that extend at least 60 miles. The slip rate of the San Gregorio–Palo Colorado fault is between 1.0 and 5.0 mm/year.

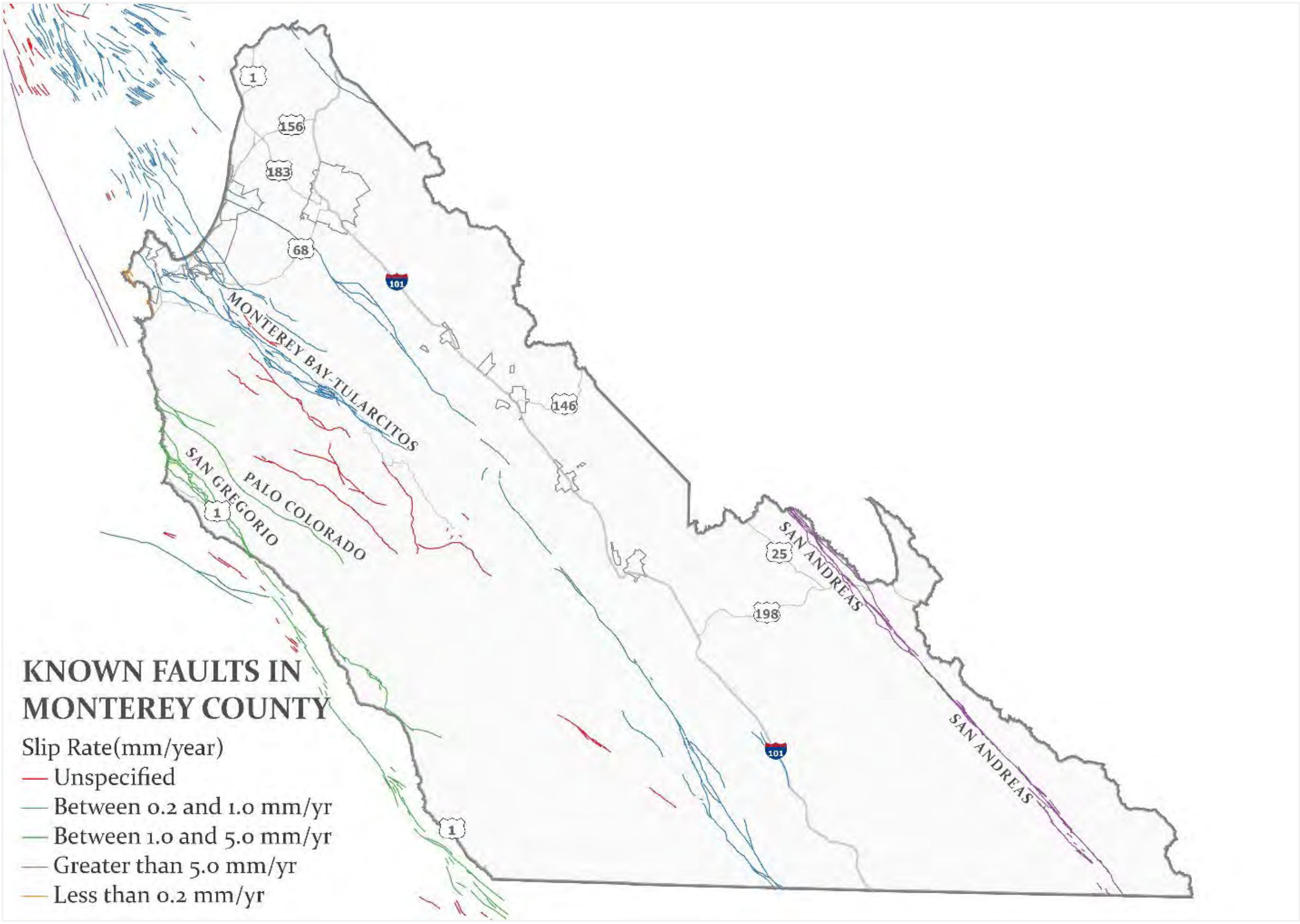
Monterey Bay-Tularcitos Fault

The Monterey Bay-Tularcitos Fault zone lies seaward of the city of Seaside, extending northwesterly to the Pacific Ocean. It is composed of short, discontinuous parallel fault segments ranging from 3 to 9 miles in length.

[32] USGS

The Monterey Bay Fault–Tularcitos zone is either truncated or merges with the San Gregorio fault segment of the Palo Colorado–San Gregorio Fault zone. The slip rate of the Monterey Bay-Tularcitos fault is between 0.2 and 1.0 mm/year.

Figure 9-2
Known Faults in Monterey County by Slip Rate

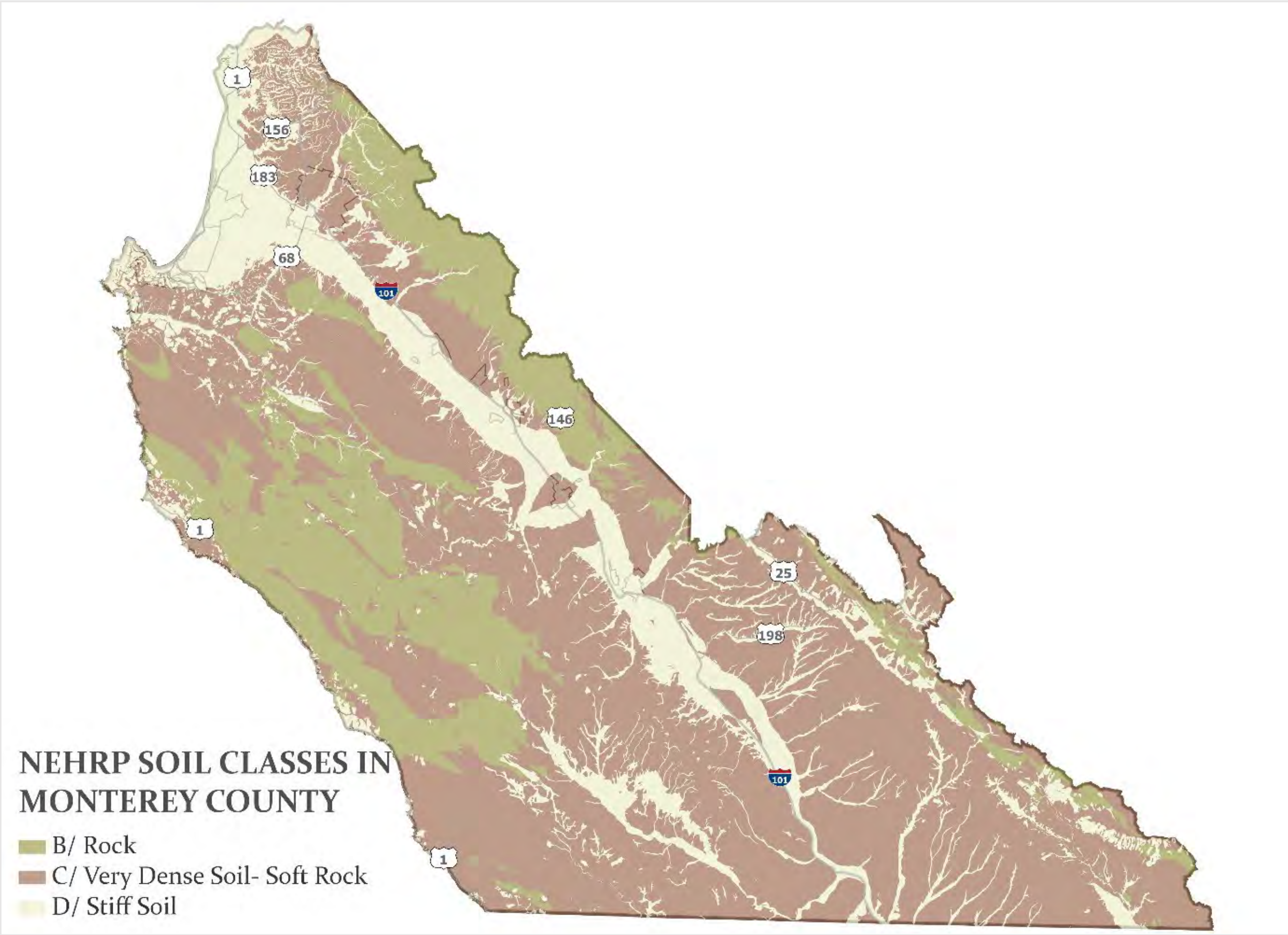


NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. *Table 9-4* summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F.

As shown in *Figure 9-3*, based on soil type, the location of the most extreme earthquake damage in Monterey County would likely be in some areas of the Monterey Peninsula, areas along the Monterey Bay, and in the Salinas Valley. These areas generally include the largest population centers in the County, and therefore are areas of high concern for earthquake risk reduction.

Figure 9-3
NEHRP Soil Classes in Monterey County



9.2.3 FREQUENCY

California experiences hundreds of earthquakes each year, most with minimal damage and magnitudes below 3.0 on the Richter Scale. Earthquakes that cause moderate damage to structures occur several times a year. According to the California State Hazard Mitigation Plan, earthquakes large enough to cause moderate damage to structures—those of Magnitude 5.5 or larger—occur three to four times a year statewide. Strong earthquakes of Magnitude 6 to 6.9 strike on an average of once every two to three years. Major earthquakes of Magnitude 7 to 7.9 occur in California about once every 10 years. According to the USGS, in the next 30 years, California has a 99.7% chance of a magnitude 6.7 or larger earthquake

Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 150-year intervals on the southern segment of the San Andreas Fault (south of Parkfield). As the last large earthquake on the southern San Andreas Fault segment occurred in 1857, that section of the fault is considered a likely location for an earthquake within the next few decades. The northern segment of the fault (north of San Juan Baustista) has a slightly lower potential for a great earthquake, as only about 100 years have passed since the 1906 earthquake. The USGS estimates there is a 72% probability (or likelihood) of at least one earthquake of magnitude 6.7 or greater striking somewhere in the greater San Francisco Bay region before 2043. [33] The 30-year probability of an M ≥ 6.7 earthquake on the northern segment of the San Andreas Fault is 21%.

The San Gregorio–Palo Colorado Fault zone has a 10% probability of a magnitude 6.7 or greater earthquake by 2032. The Calaveras-Paicines Fault, which does not run directly through Monterey County, could also be the location of a major earthquake, which would affect the County. The probability of experiencing a Magnitude 6.7 or greater earthquake along the Calaveras Fault in the next 30 years is 26%.

However, as noted above, Monterey County experiences several small detectable earthquakes every year. Also, moderate-sized, potentially damaging earthquakes could occur in this area at any time.

9.2.4 SEVERITY

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking at any specified location. The intensity of earthquake shaking lessens with distance from the earthquake epicenter. Magnitude represents the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of the earthquake waves recorded on instrument.

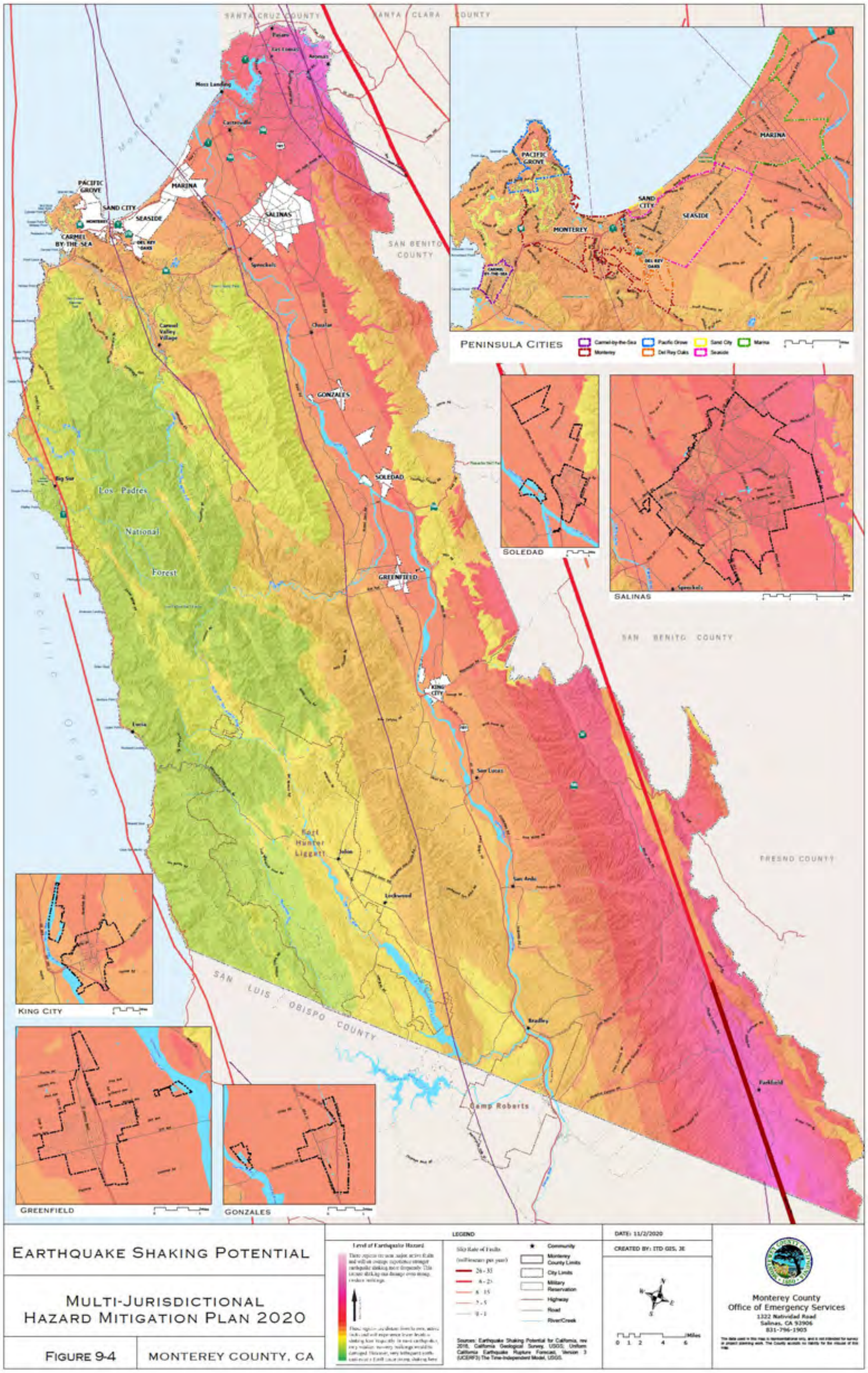
The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically)

USGS ground motion maps, based on current information about fault zones, show the PGA that has a certain probability of being exceeded in a 50-year period. Mapping of ground shaking potential was used to assess the risk of earthquakes. the hazard from ground shaking is most severe in areas near the San Andreas Fault and in the unconsolidated alluvial areas of the County such as the Salinas and Carmel Valleys.

Earthquake shaking potential in Monterey County is shown in *Figure 9-4*.

[33] USGS, Earthquake Outlook for the San Francisco Bay Region 2014–2043

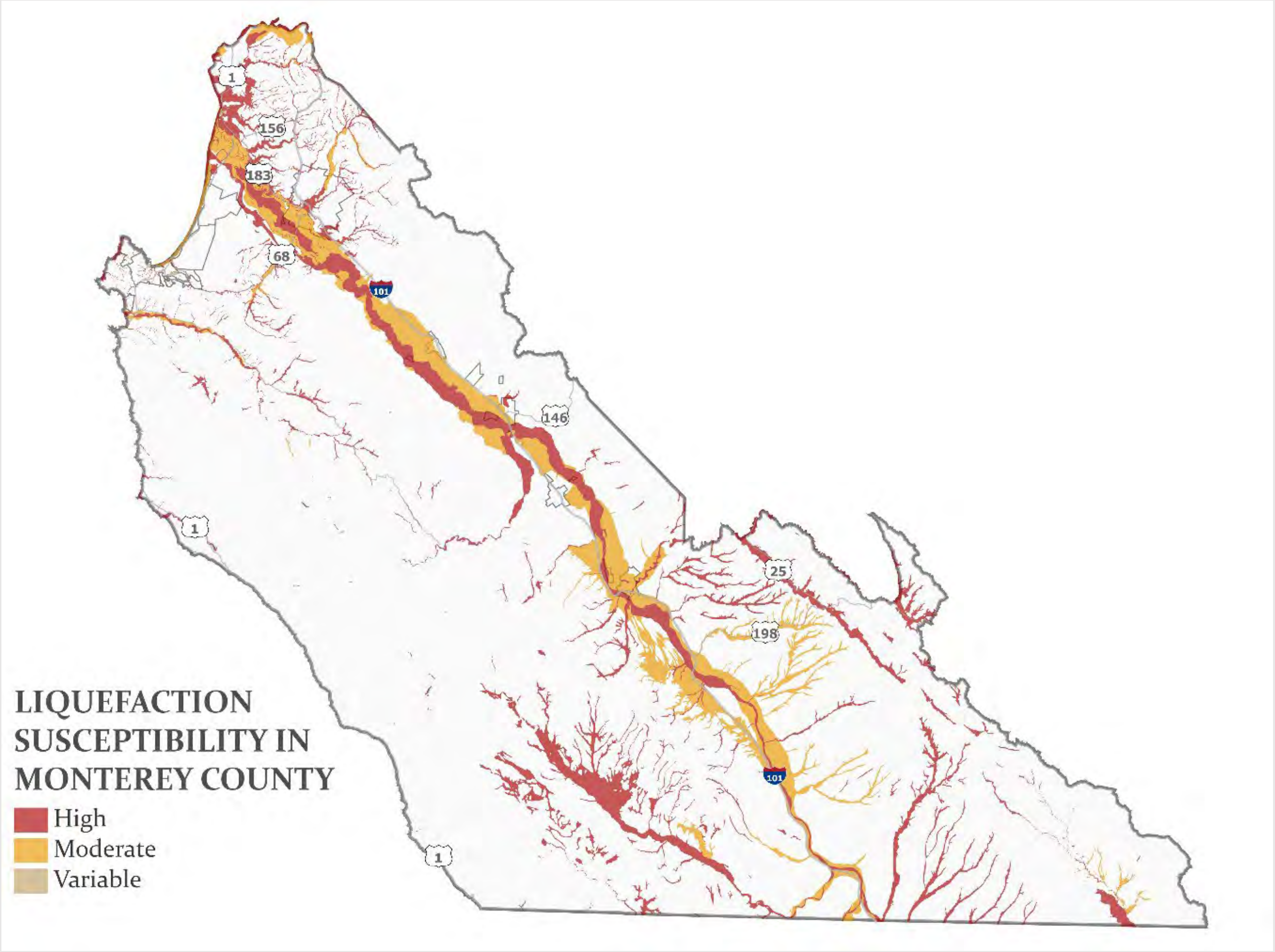

SANTA CRUZ COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
SAN BENITO COUNTY
FRESNO COUNTY
SAN LUIS OBISPO COUNTY
Pacific Ocean
Monterey Bay
PACIFIC GROVE
SAND CITY
MARINA
SEASIDE
SALINAS
CARMEL BY-THE-SEA
DEL REY OAKS
GONZALES
SOLEDAD
GREENFIELD
KING CITY
Los Padres National Forest
Fort Hunter Liggett
Camp Roberts
Peninsula Cities
SOLEDAD
SALINAS
KING CITY
GREENFIELD
GONZALES
Earthquake Shaking Potential
Multi-Jurisdictional Hazard Mitigation Plan 2020
Figure 9-4
Monterey County, CA
LEGEND
DATE: 11/2/2020
Monterey County
Office of Emergency Services
1322 Natividad Road
Salinas, CA 93906
831-796-1905

Liquefaction Susceptibility

Soil liquefaction maps are also useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. Areas in Monterey County most susceptible to liquefaction include the Salinas River and floodplain, the Moss Landing and Elkhorn Slough areas, the Carmel River and floodplain, the San Antonio and Lockwood Valleys, and the Peachtree and Cholame Valleys.

Liquefaction susceptibility in Monterey County is shown in *Figure 9-5*.

Figure 9-5
Liquefaction Susceptibility in Monterey County

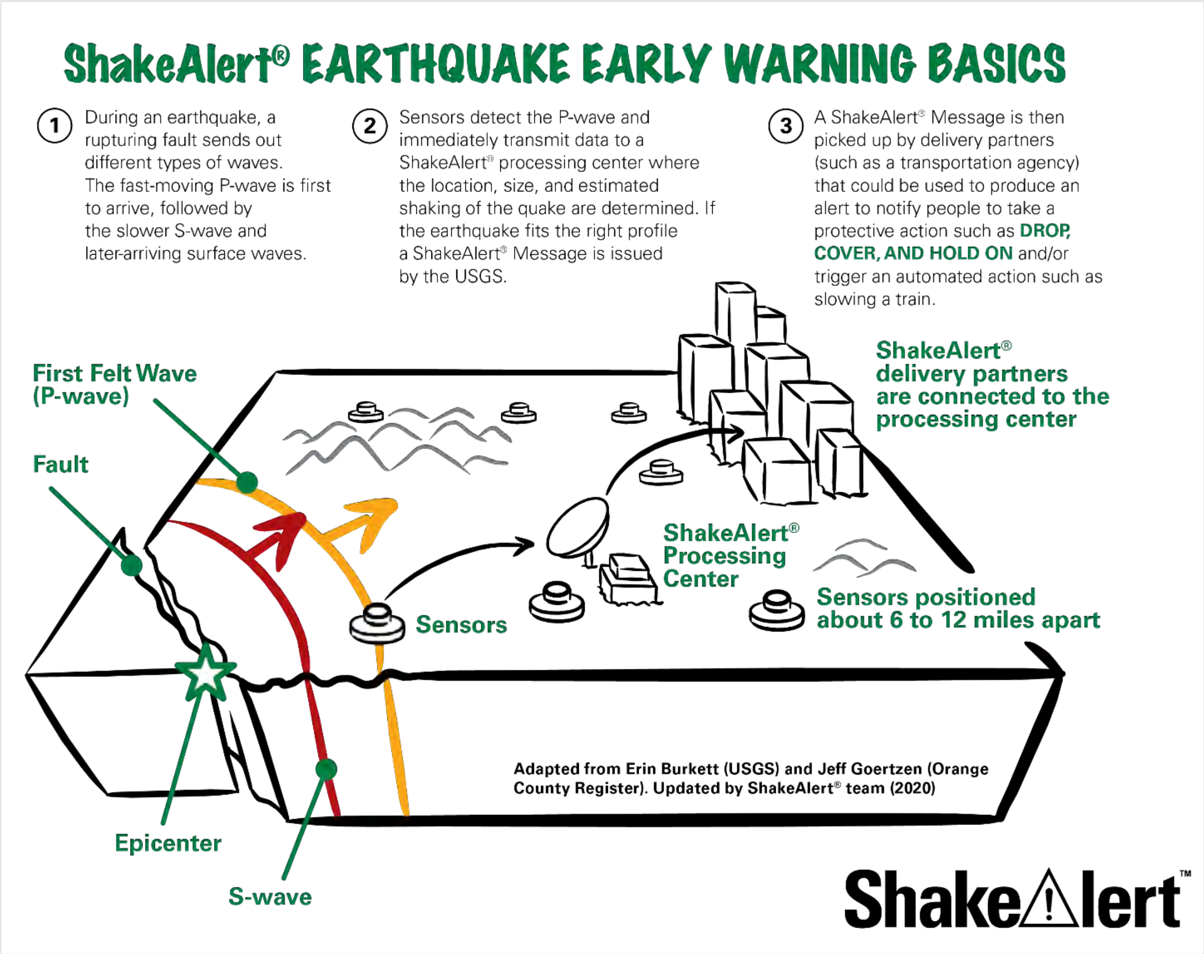


9.2.5 WARNING TIME

There is no current reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

In 2019, the USGS released ShakeAlert, an earthquake early warning (EEW) system that detects significant earthquakes quickly so that alerts can reach many people before shaking arrives. ShakeAlert is not earthquake prediction, rather a ShakeAlert Message indicates that an earthquake has begun, and shaking is imminent. The USGS has estimated the warning time would range from seconds to tens of seconds. ShakeAlert can give enough time to take preventative actions before the shaking starts to reduce damage and casualties during an earthquake. *Figure 9-6* provides more information on how the ShakeAlert system works.

Figure 9-6
ShakeAlert Earthquake Early Warning Basics



9.3 SECONDARY HAZARDS

Earthquakes can cause collateral emergencies including dam and levee failures, seiches, hazmat incidents, urban conflagration, avalanches, and landslides. In addition to ground motion, several secondary natural hazards can occur from earthquakes. Additionally, urban conflagration can result from gas lines or power lines that are broken or downed during the earthquake. It may be difficult to control a fire, particularly if the water lines feeding fire hydrants are also broken.

9.3.1 DAM AND LEVEE FAILURE

Earthen dams and levees are highly susceptible to seismic events, and the impacts of their eventual failures can be considered secondary risk exposure to earthquakes.

For more information on dam and levee failure risk in Monterey County, refer to **Section 7**, *Dam and Levee Failure.*

9.3.2 LANDSLIDES

Earthquakes can cause disastrous landslides. Landslides occur because of horizontal seismic inertia forces induced in the slopes by the ground shaking. The most common earthquake-induced landslides include shallow, disrupted landslides such as rock falls, rockslides, and soil slides. Debris flows are created when surface soil on steep slopes becomes totally saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill at extremely high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

For more information on landslide risk in Monterey County, refer to **Section 15**, *Slope Failure*.

9.3.3 TSUNAMIS

Depending on the location, earthquakes can trigger tsunamis. Tsunamis significantly damage many locations beyond what the earthquake struck; however, coastal communities near the earthquake epicenter that are also vulnerable to tsunamis could experience devastating impacts. As an Oceanic Plate is subducted beneath a Continental Plate, it sometimes brings down the lip of the Continental Plate with it. Eventually, too much stress is put on the lip, and it snaps back, sending shockwaves through the earth's crust, causing a tremor under the sea, known as an Undersea Earthquake. Factors that affect tsunami generation from an earthquake event include magnitude (generally, a 7.5 magnitude and above), depth of event (a shallow marine event that displaces seafloor), and type of earthquake (thrust as opposed to strike-slip).

For more information on tsunami risk in Monterey County, refer to **Section 16**, *Tsunami*.

9.4 RISK ASSESSMENT

9.4.1 POPULATION

According to the FEMA National Risk Index, 415,057 people, or the entire population is exposed to earthquake risk. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

As seen in *Table 9-6*, close to 200,000 people, almost half of the population of Monterey County, live in areas with high or moderate liquefaction susceptibility.

Table 9-6
Population Exposed to Areas Susceptible to Liquefaction in Monterey County

Supervisorial District	High	Moderate
District 1	23,680	3,256
District 2	45,825	9,223
District 3	14,729	24,549
District 4	7,622	19,936
District 5	35,764	14,625
Total	127,620	71,589

Residents in high-risk areas are more vulnerable to the impact of earthquakes. The degree of vulnerability is dependent on many factors, including the age and construction type of the structures people live in, the soil their homes are constructed on, and their proximity to the fault location, etc.

Two groups are particularly vulnerable to earthquake hazards: the population below the poverty level and those with access and functional needs. Those below the poverty level may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Economically disadvantaged residents are also less likely to have insurance to compensate for losses in earthquakes. Those with access and functional needs are vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Some residents may also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

9.4.2 PROPERTY

All structures in the County are susceptible to earthquake impacts to varying degrees. The most common type of damage from ground shaking is structural damage to buildings, which can range from cosmetic stucco cracks to total collapse. The overall level of structural damage from a nearby large earthquake would likely be moderate to heavy, depending on the characteristics of the earthquake, the type of ground, and the condition of the building. Besides damage to buildings, strong ground shaking can cause severe damage by falling objects such as bookcases or water heaters, or broken water or gas pipes. Fire and explosions resulting from ruptured gas pipes are also major hazards associated with strong ground shaking.

According to Monterey County Assessor records, there are 128,966 residential and non-residential buildings in the County, with a total value of $73,489,253,104. Since all structures in the County are susceptible to earthquake impacts to varying degrees, this represents the property exposure to seismic events.

Assessor's data value total includes land value. Since following an earthquake, the land is likely to still have value even if the structure is destroyed, the exposed value is likely an overestimate. Therefore, FEMA data was also included in this analysis in addition to the Assessor's data. According to the FEMA National Risk Index, in Monterey County, $41,169,506,000 in total building value is exposed to earthquake risk.

A large amount of property in the County is also exposed to liquefaction risk., As seen in *Table 9-7*, close to 20,000 residential properties, about $12 billion in property value is in areas with high or moderate liquefaction susceptibility. As seen in *Table 9-8*, close to 22,000 non-residential properties, about $11 billion in property value is in areas with high or moderate liquefaction susceptibility.

Table 9-7
Residential Property Exposed to Areas Susceptible to Liquefaction in Monterey County

Supervisorial District	High		Moderate	
	#	Value	#	Value
District 1	673	$372,310,680	253	$133,011,281
District 2	3,547	$1,591,632,718	472	$282,454,095
District 3	1,838	$621,850,036	3,287	$948,153,442
District 4	837	$398,868,120	4,514	$1,933,056,731
District 5	3,729	$3,772,532,646	2,268	$1,882,248,356
Total	10,624	$6,757,194,200	10,794	$5,178,923,905

Table 9-8
Non-Residential Property Exposed to Areas Susceptible to Liquefaction in Monterey County

Supervisorial District	High		Moderate	
	#	Value	#	Value
District 1	1,270	$827,677,352	922	$421,513,584
District 2	4,000	$1,109,321,385	1,638	$397,837,469
District 3	3,041	$1,851,569,790	3,273	$2,914,179,282
District 4	745	$744,052,338	2,608	$1,124,210,594
District 5	3,013	$1,754,854,558	1,147	$539,666,562
Total	12,069	$6,287,475,423	9,588	$5,397,407,491

Poorly constructed buildings and manufactured housing units are more vulnerable to structural failure during an earthquake, as well as secondary hazards such as utility disruption and urban conflagration. Older buildings are also more vulnerable to structural failure, as they may have been built before building and seismic code requirements that directly affect the structural integrity of development.

Of particular concern in Monterey County is unreinforced masonry buildings, which are constructed from materials such as adobe, brick, hollow clay tiles, or other masonry materials and do not contain an internal reinforcing structure, such as rebar in concrete or steel bracing for brick. Unreinforced masonry poses a significant danger during an earthquake because the mortar holding masonry together is typically not strong enough to withstand significant earthquakes. The brittle composition of these buildings can break apart and fall away or buckle, potentially causing a complete collapse of the building.

9.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

All critical facilities in the County are exposed to the earthquake hazard. Earthquakes pose numerous risks to critical facilities and infrastructure. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment. Depending on the year of build and construction of each facility containing hazardous materials, the earthquake-initiated hazardous material release potential will vary. Hazardous materials contained within masonry or concrete structures built before certain benchmark years may be particularly vulnerable.

Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Linear utilities and transportation routes are vulnerable to rupture and damage during and after a significant earthquake event. The cascading impact of a single failure can have affects across multiple systems and utility sectors. Degrading infrastructure systems and future large earthquakes with epicenters near critical regional infrastructure could result in system outages that last weeks for the most reliable systems, and multiple months for others.

Telecommunication systems can be affected by system failure, overloads, loss of electrical power and possible failure of some alternate power systems. Immediately following an event, numerous failures will occur, compounded by system use overload.

Large ground motions resulting from liquefaction, especially lateral spreading, can cause damage to buried pipelines. Most pipe breaks during the Loma Prieta earthquake were in areas with significant liquefiable soil. Broken pipelines represent a serious public safety issue as demonstrated by burning natural gas lines in the 1994 Northridge earthquake and broken water mains in San Francisco in the 1906 earthquake.

Critical facilities exposed to liquefaction risk are summarized in *Table 9-9*.

Table 9-9
Critical Infrastructure in High Liquefaction Susceptibility Areas in Monterey County

Critical Infrastructure Type	High Liquefaction Susceptibility
Facilities	
Emergency Response	5
Fire Station	7
Police Station	0
Medical Facilities	14
Military Facility	1
Large Public Facilities	0
Educational Facilities	17
Power Plant	1
Water & Wastewater Facilities	87
Stormwater Facilities	7
Government Facilities	53
Communication Facilities	175
Rain Gauges	17
Lighthouses	1
Dams	1
Hazardous Materials	
Active or Idle Oil Well	250
Landfill	0
Underground Tank	39
Cal ARP Facility	11
Transportation	
Airport	4
Bridge	111
Harbor	1
Highway/Freeway (Miles)	100
Driveway (Miles)	2
Major Road (Miles)	443
Local (Miles)	899
Railroad (Miles)	29

9.4.4 ENVIRONMENT

Environmental problems as a result of an earthquake can be numerous. Secondary hazards will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly damage surrounding habitat. It is also possible for streams to be rerouted after an earthquake. Rerouting can change the water quality, possibly damaging habitat and feeding areas. Streams fed by groundwater wells can dry up because of changes in underlying geology.

9.4.5 ECONOMIC IMPACT

A large earthquake could have a massive economic impact on Monterey County. The number of economic damages will likely vary greatly due to a variety of factors including magnitude and location of the epicenter. Other than direct economic losses due to an earthquake, indirect economic consequences can occur due to business interruption and loss of functions of utilities.

9.5 FUTURE TRENDS IN DEVELOPMENT

Land use in the County will be directed by general plans adopted under California's General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. The information in this plan provides a tool to ensure that there is no increase in exposure in areas of high seismic risk. The geologic hazard portions of the County are heavily regulated under California's General Planning Law.

Development in the County is also be regulated through building standards and performance measures so that the degree of risk will be reduced. The International Building Code establishes provisions to address seismic risk.

9.6 ISSUES

Important issues associated with earthquakes in Monterey County include the following:

- Unreinforced masonry buildings and building stock built prior to 1975, when seismic provisions became uniformly applied through building code applications, are a major concern in the event of a large earthquake.
- An earthquake could trigger other natural hazard events such as dam failures and landslides, which could severely impact the County.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Levee failures could happen at multiple locations, increasing the impacts of the individual events.
- Citizens would be expected to be self-sufficient up to 3 days after a major earthquake without government response agencies, utilities, private-sector services, and infrastructure components.
- After a major seismic event, Monterey County is likely to experience disruptions in the flow of goods and services resulting from the destruction of major transportation infrastructure across the broader region.

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10. FLOODING

10.1 OVERVIEW

Flooding is the accumulation of water where usually none occurs or the overflow of excess water from a stream, river, lake, reservoir, or coastal body of water onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Nationwide, floods result in more deaths than any other natural hazard. Physical damage associated with floods includes the following:

- Inundation of structures, causing water damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features.
- Impact damage to structures, roads, bridges, culverts, and other features from high-velocity flow and from debris carried by floodwaters. Debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping.
- Destruction of crops, erosion of soil, and deposition of debris and sediment on croplands.
- Release of sewage and hazardous or toxic materials as wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.

10.1.1 FLOODPLAINS

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

10.1.2 NATIONAL FLOOD INSURANCE PROGRAM

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. FEMA has prepared a detailed Flood Insurance Study for Monterey County and all incorporated areas, which was last revised in June of 2017.[34] The study presents water surface elevations for floods of various magnitudes, including the 1% annual chance flood (100-year flood) and the 0.2% annual chance flood (500-year flood).

Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principal tool for identifying the extent and location of the flood hazard. Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.

[34] Federal Emergency Management Agency, Flood Insurance Study, Monterey County

- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

As listed in *Table 10-1*, Monterey County and all incorporated cities participate in the NFIP.

Table 10-1
NFIP Coverage

Jurisdiction	Community Number	Policies in Force	Total Coverage	Total Written Premium + Federal Policy Fee
Carmel-By-The-Sea	060196	29	$9,940,000	$13,888
Del Rey Oaks	060197	19	$6,577,500	$50,436
Gonzales	060198	14	$5,474,500	$18,502
Greenfield	060446	3	$1,050,000	$1,260
King City	060199	17	$4,318,600	$28,721
Marina	060727	45	$13,664,400	$61,833
Monterey	060200	58	$19,847,400	$49,129
Monterey County	060195	1,277	$362,723,300	$1,732,791
Pacific Grove	060201	35	$11,144,000	$14,846
Salinas	060202	317	$95,459,500	$320,007
Sand City	060435	3	$1,400,000	$3,109
Seaside	060203	10	$2,789,000	$3,748
Soledad	060204	1	$350,000	$467

FEMA Regulatory Flood Zones

FEMA defines flood hazard areas as areas expected to be inundated by a flood of a given magnitude. These areas are determined via statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FIRMs, which provide the following information:

- Locations of specific properties in relation to Special Flood Hazard Area (SFHAs)
- Base flood elevations (1% annual chance) at specific sites
- Magnitudes of flood in specific areas
- Undeveloped coastal barriers where flood insurance is not available
- Regulatory floodways and floodplain boundaries (1% and 0.2% annual chance floodplain boundaries)

Land area covered by floodwaters of the base flood is the SFHA on a FIRM—an area where NFIP floodplain management regulations must be enforced, and where mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities because many communities have maps showing the extent of the base flood and likely depths that would occur.

The base flood elevation (the water elevation of a flood that has a 1% chance of occurring in any given year) is one of the most important factors in estimating potential damage from flooding. A structure within a 1% annual chance floodplain has a 26% chance of undergoing flood damage during the term of a 30-year mortgage. The 1% annual chance flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 0.2% annual chance flood designations (500-year events). FIRMs, and other flood hazard information can be used to identify the expected extent of flooding from a 1% and 0.2% annual chance event. FIRM maps depict flood zones, defined in *Table 10-2*.

Table 10-2
FEMA Flood Zones

Flood Zone	Definition
Special Flood Hazard Areas (SFHA) Subject to Inundation by 100-Year Flood	
Zone A	No base flood elevations determined
Zone AE	Base flood elevations determined
Zone AH	Flood depths of 1-3 feet (usually areas of ponding); base flood elevations determined
Zone AO	Flood depths of 1-3 feet (usually sheet flow on sloping terrain); average depths determined; for areas of alluvial fan flooding, velocities also determined
Zone AR	SFHA formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified; zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood
Zone A99	Area to be protected from 1% annual chance flood by a federal flood protection system under construction; no base flood elevations determined
Zone VE	Area where waves and fast-moving water can cause extensive damage during the base flood event. Wave heights are larger than 3 feet. A detailed study has been done and BFEs have been calculated.
Other Flood Areas	
Zone X (shaded)	Areas of 0.2% annual chance flood (i.e., 500-year flood); areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood
Other Areas	
Zone X (unshaded)	Areas determined to be outside the 0.2% annual chance floodplain
Zone D	Areas in which flood hazards are undetermined, but possible

Community Rating System (CRS)

The Community Rating System (CRS) is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three goals of the CRS: 1) reduce flood losses, 2) facilitate accurate insurance rating, and 3) promote awareness of flood insurance.

Flood insurance premium rates in Community Rating System communities are discounted in increments of 5%. A Class 10 community is not participating in the CRS and receives no discount. A Class 9 community receives a 5% discount for all policies in its Special Flood Hazard Areas, a Class 8 community receives a 10% discount, all the way to a Class 1 community, which receives a 45% premium discount. The CRS classes for local communities are based on 18 creditable activities related to public information, mapping and regulations, flood damage reduction, and flood preparedness. As noted in *Table 10-3*, Monterey County and the City of Salinas are currently participating in the CRS program.

Table 10-3
Community Ratings System (CRS) Participation

Community Name	CRS Entry Date	Current Effective Date	Current Class	Discount for SFHA	Discount for Non- SFHA
Monterey County	10/1/1991	10/1/2020	5	25%	10%
Salinas	10/1/1991	10/1/2013	7	15%	5%

10.1.3 TYPES OF FLOODING

In Monterey County four types of flooding occur: riverine flooding, coastal flooding, flash flooding, and stormwater runoff flooding.

Coastal Flooding

Coastal or tidal floods are characterized by inundation of normally dry lands by bay waters, often caused by extreme high tide events that result in shallow flooding of low-lying coastal areas. Colloquially known as “king tides,” extreme high-level tide events are the highest predicted high tide events of the year at a coastal location. These tides exceed the highest water level reached at high tide on an average day and normally occur once or twice per year. King tide events are the leading cause of flooding near bay waters.

Coastal flooding in Monterey County is generally associated with Pacific Ocean storms in the months of November through February. Coastal flooding in conjunction with high tides and strong winds is a significant hazard.

Riverine Flooding

Riverine flooding is overbank flooding of rivers and streams. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers. Riverine floodplains range from narrow, confined channels in the steep valleys of mountainous and hilly regions to wide, flat areas in plains and coastal regions. The amount of water in the floodplain is a function of the size and topography of the contributing watershed, the regional and local climate, and land use characteristics. Flooding in steep, mountainous areas is usually confined, strikes with less warning time, and has a short duration. Larger rivers typically have longer, more predictable flooding sequences and broad floodplains.

Flash Flooding

The National Weather Service defines a flash flood as a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level. Such floods generally begin within 6 hours of the rain event that causes them. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising floodwaters.

Flash floods can tear out trees, undermine buildings and bridges, and scour new channels. In urban areas, flash flooding is an increasingly serious problem due to removal of vegetation and replacement of ground cover with impermeable surfaces such as roads, driveways, and parking lots. The greatest risk from flash floods is occurrence with little to no warning. Major factors in predicting potential damage are intensity and duration of rainfall, and steepness of watershed and streams.

Localized Stormwater Flooding

Urban storm drainpipes and pump stations have a finite capacity, and prolonged heavy rainfall contributes to a large volume of runoff resulting in high peak flows of moderate duration. When rainfall exceeds this capacity, or the system is clogged, water accumulates in the street until it reaches a level of overland release.

Urban drainage systems can play a role in flooding in two ways:

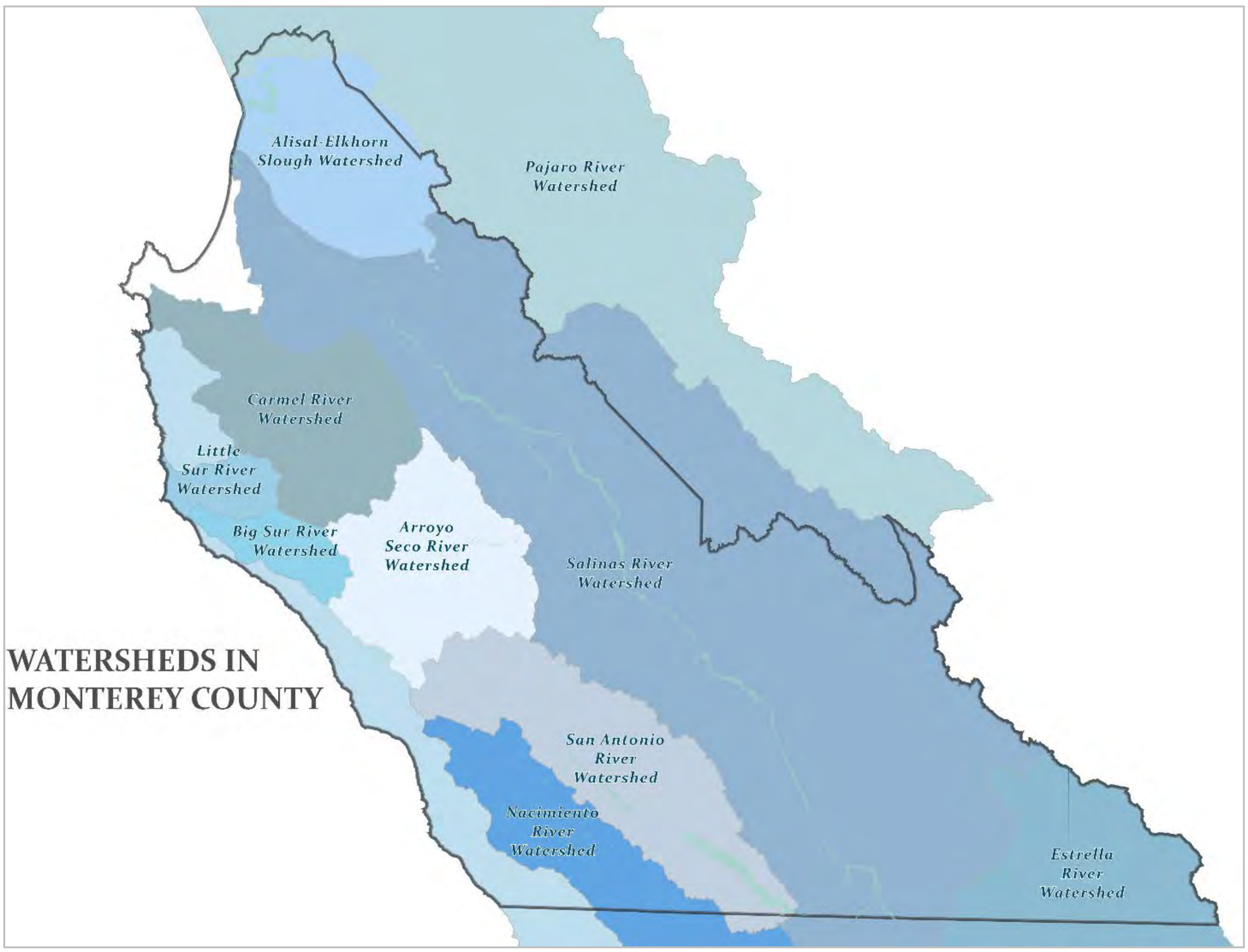
- Drainage systems reduce the amount of time surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in the area
- If stormwater runoff exceeds the capacity of the drainage system, then stormwater runoff flooding can result throughout the system’s service area. This is especially likely when groundwater levels are high and during high tides.

Stormwater flooding may occur outside of recognized drainage channels or delineated floodplains due to a combination of locally heavy precipitation, increased surface runoff, and inadequate facilities for drainage and stormwater conveyance. Such events frequently occur in flat areas and in urbanized areas with large impermeable surfaces. Local drainage may result in “nuisance flooding,” in which streets or parking lots are temporarily closed, and minor property damage occurs.

10.1.4 WATERSHEDS IN MONTEREY COUNTY

Monterey County consists of four predominant watersheds draining to the Salinas River, the Pajaro River, the Carmel River, and the Big Sur River. These watersheds vary in patterns of land use from rural open space and permanent grazing to farmland and agricultural industrial, to low, medium, and high-density residential use. Increased development over the past 100 years has resulted in increased runoff that poses a flood threat. To accommodate the increasing runoff, many cities and communities in these watersheds have developed an extensive system of channels and storm drain facilities. The overall drainage pattern in the county is from south to north; this is the direction of flow for the Salinas River which is the largest river on the central coast of California. Watersheds in Monterey County are mapped in *Figure 10-1*.

Figure 10-1
Watersheds in Monterey County



Source: Monterey County Water Resources Agency (MCWRA)

The four predominant watersheds are described and listed in order of magnitude, from largest to smallest.

Salinas River Watershed

The Salinas River Watershed originates 4,000 feet above sea level in the La Panza Range near Santa Margarita in San Luis Obispo County and drains a 4,200 square mile area. The Gabilan and Santa Lucia Ranges are the sources of the principal watercourses in the area. The Salinas River has three main tributaries, namely, the Nacimiento, San Antonio, and Arroyo Seco Rivers. It flows for over 110 miles within Monterey County and empties into the Monterey Bay.

Pajaro River Watershed

The Pajaro River Watershed originates from 4,700 feet above sea level in the Diablo and Gabilan Ranges in San Benito County and drains a 1,300 square mile area. The watershed is bound by the Santa Cruz Mountains in the north, and the Gabilan Range in the south. The watershed area spans four counties, namely, Santa Cruz, Santa Clara, San Benito, and Monterey. The Pajaro River has numerous tributaries, which include Corralitos, Uvas, Llagas, San Benito, Pacheco, and Santa Ana Creeks, and flows for approximately 30 miles where it empties into Monterey Bay.

Carmel River Watershed

The Carmel River Watershed originates 4,000 feet above sea level in the Santa Lucia Range and drains a 256 square mile area. The Carmel River has two main tributaries, Cachagua and Tularcitos Creeks, and flows for approximately 26 miles where it empties into the Pacific Ocean.

Big Sur River Watershed

The Big Sur River Watershed originates from 3,000 feet above sea level along Pine Ridge in the Santa Lucia Mountains and drains a 60 square mile area. The Big Sur River has numerous tributaries which include Redwood Creek, Ventana Creek, Post Creek, and Pfeiffer-Redwood Creek, and flows for approximately 15 miles where it empties into the Pacific Ocean.

10.2 HAZARD PROFILE

10.2.1 HISTORY

Historic records show flooding and flood damage have occurred on a fairly regular basis (every few years) within Monterey County. The County experienced severe damages in:

January 1966: Flood conditions along the length of the Salinas River caused extensive damage during the storm of January 1966. Most of this damage was to agricultural crops; over 32,000 acres were inundated, at an estimated loss of $6,572,000. The cities in the county experienced some flooding and damage, although the rural areas and agricultural production were the most affected, with Salinas Valley agriculture sustaining a $3,755,000 loss.

1969: There were two distinct floods in 1969, one at the end of January and one at the end of February. In each flood, both the Salinas and Carmel Rivers flooded. Damage from the storms was extremely costly, causing an estimated $16 million in damages.

1978: A series of storms emanating from a southerly direction, caused extensive beachfront and coastal damage. Persistent rains in the Salinas Valley, caused an estimated $20,000,000 in flood damages, flooding more than 20,000 acres of irrigated farmland, with as much as 1,000 acres of the prime farmlands flooded beyond agricultural use for the year.

March 1983: “El Niño” storms brought an extremely unusual series of high tides, storm surges, and storm waves along the coast, and heavy rains causing extensive flooding and erosion in the Salinas Valley. Farmland and roadways were damaged, and Monterey County was declared a disaster area.

January 1995: In January 1995, a 10- to 20-year event caused prolonged and sustained precipitation resulting in extensive flooding throughout the region. Most river valleys were affected, with major damage experienced in the Pajaro Valley and Carmel Valley. Five localized areas within the Carmel Valley area were significantly affected by downstream flooding of the Carmel River. The January 1995 flood damaged 125 residences resulting in an estimated damage cost of approximately $2.5 million. In addition, an estimated $927,000 in damage to public facilities and utilities occurred.

March 1995: From March 10-13, 1995, Monterey County experienced a second significant winter storm which resulted in sustained precipitation falling on already-saturated watersheds. Devastating flooding occurred throughout the County, particularly along the Carmel, Arroyo Seco, Salinas, and Pajaro Rivers. Damage was extensive throughout the County with virtually every community affected. Pajaro, Castroville, Mission Fields, Carmel Valley, Cachagua, Carmel Highlands, Spreckels, and Big Sur sustained devastating damage. Over 1,500 residences were damaged, including 60 homes which were declared uninhabitable. In addition, an estimated 100 businesses were affected, and the tourism industry sustained substantial losses for a period of several months.

In all, over 11,000 people were directly affected, and major portions of the County's agricultural lands subjected to widespread destruction. At the height of the flood, 63 roads and 15 bridges were closed, including the Highway 1 bridge over the Carmel River. The closure of the Highway 1 bridge over the Carmel River resulted in the complete elimination of access to portions of Carmel Valley, Carmel Highlands, and Big Sur for a period of several days, requiring evacuations to take place with helicopters.

62 roads and three bridges sustained damage. Public and private water systems were damaged, affecting approximately 3,500 homes and businesses. Eight large water systems and over fifty small systems were affected. Many residents were without domestic water service for extended periods. A number of areas were required to boil domestic water prior to use.

Sewage treatment facilities and private septic systems along all three major rivers (Carmel, Salinas, and Pajaro) were flooded and untreated sewage was released into the rivers. The amount of untreated sewage released could not be confirmed, but it may have been many thousands of gallons. Major treatment plants affected included Carmel Ranch, Watsonville, King City, Soledad, and Gonzales. Gas and electric service provided by Pacific Gas and Electric were affected by the storm, resulting in serious disruptions in service to widespread areas. Many public facilities and services were closed or interrupted, including public schools in affected communities. Zmudowski State Beach was closed as a result of the discovery of 27 barrels of potentially hazardous materials on the beach.

February 1998: A series of "El Niño" winter storms hit Monterey County and the close timing of the rainfall events contributed to intense flooding and saturated ground. An estimated 50 roads and highways were closed or restricted, in most cases due to washouts, landslides, and mudslides. Several communities were evacuated, including Pajaro's entire population of 3,500 people, after the levee along the Pajaro River was breached in several places.

Drinking water quality warnings remained in effect for certain areas for some time afterward. By the end of the first week of February, at least 6,600 homes and businesses had been without power for varying periods of time. Countywide losses from that storm were estimated at over $38 million, with agriculture-related losses totaling over $7 million and involving approximately 29,000 damaged acres.

In the 1998 storm event, the Las Lomas area experienced severe damage of eight residential parcels. Monterey County acquired the parcels through the Federal Hazard

Mitigation Success Story
Severe Repetitive Loss Property Elevation

In 2015, Monterey County completed the elevation of a Severe Repetitive Loss (SRL) structure located along the Carmel River. Based on historical data and FEMA flood mapping it can be assumed this structure would have sustained damages during the major flood events in 2017 and 2019.

In 2017 damages would have been minimal, with estimated flooding at 1.5 feet above the finished floor elevation. This would have resulted in about $83,652 in damages with no mitigation. With mitigation, it is estimated that no damage would have occurred, a savings of $83,652.

In 2019, significant flooding of up to 6 feet above the finished floor elevation would have resulted in approximately $255,718 in damages with no mitigation. With mitigation it is estimated that $88,946 in damages would have resulted from flood depths of 6 feet, a savings of $166,772.

Taking in to account each event, this project has a combined estimated savings of $250,424 since its completion in 2015.

Mitigation Grant Program and all structures were removed. Each parcel was subsequently rezoned to “open space” in perpetuity.

January 2008: A strong coastal storm in January 2008 brought flooding rains, high winds, record high surf, and coastal flooding to Monterey County and resulted in nearly $1 million in property damages. Approximately 30 homes in the Carmel Lagoon area were affected by some degree of flooding.

October 2010: In October 2010, a strong low-pressure system made its way through Central California and led to record breaking heavy rains across the area, causing an estimated $200,000 in damages. In Salinas, the Pacific Coast Christian Academy and Little Lamb Preschool were flooded after Little Bear Creek breached its banks.

March 2011: A series of systems affected Monterey County with heavy rain and strong winds causing an estimated $1 million in property damages. Nearly 1,300 acres of crops or croplands were impacted by flooding from the Salinas River and its tributaries causing an estimated $1.5 million in losses.

December 2014: An atmospheric river brought heavy rain, gusty winds, and a strong winter storm that impacted the region for several days in mid-December. The Moro Cojo Slough backed up and flooded homes and roadway along its banks. Sandbagging operations were needed to protect the homes from significant damage. The slough flap gates were damaged and could not properly drain the slough into Moss Landing Harbor.

The unincorporated community of Bolsa Knolls along Santa Rita Creek was flooded when a nearby levee broke open. Emergency crews reported that homes on Paul Avenue and Russell Road where evacuated and more than 18 inches of water flooded homes in a short amount of time. Fifteen homes were

Mitigation Success Story
Salinas River Stream Maintenance Program

Monterey County is subject to major flood events along the Salinas River. In 2016, programmatic permits were approved for the Salinas River Stream Maintenance Program (SMP). The Salinas River SMP was developed as a collaboration between the Monterey County Water Resources Agency, the Resource Conservation District of Monterey County (RCDMC), the Salinas River Channel Coalition, the Grower Shipper Association of Central California, The Nature Conservancy, and the Conservation Collaborative.

The SMP employs a multi-benefit approach for stream maintenance that enhances conveyance capacity of the river corridor by mimicking the sandy-bottomed river’s natural, braided form in a manner that protects habitat, while reducing flood risk.

flooded and damaged due to flooding along Santa Rita Creek. The heavy rain also overwhelmed the sewage plant in Castroville resulting in a sewage spill.

2016: Monterey County was hit with several significant storm events during the 2016 El Niño winter. The first one took place on January 19, 2016, the second from March 5 and 6, 2016, and the third on March 11, 2016. These storms caused severe roadway damage totaling $7,318,000 in repair costs.

2017: A series of atmospheric river events in January and February of 2017 caused widespread roadway flooding and damage in Monterey County. Combined, the January and February storms caused an estimated $52 million to County roads.

2019: An atmospheric river caused widespread heavy rainfall, roadway flooding, and strong winds. This caused flash flooding in Chualar where homes were flooded, and cars were stranded on a flooded highway. This event caused an estimated $2 million in damages.

10.2.2 LOCATION

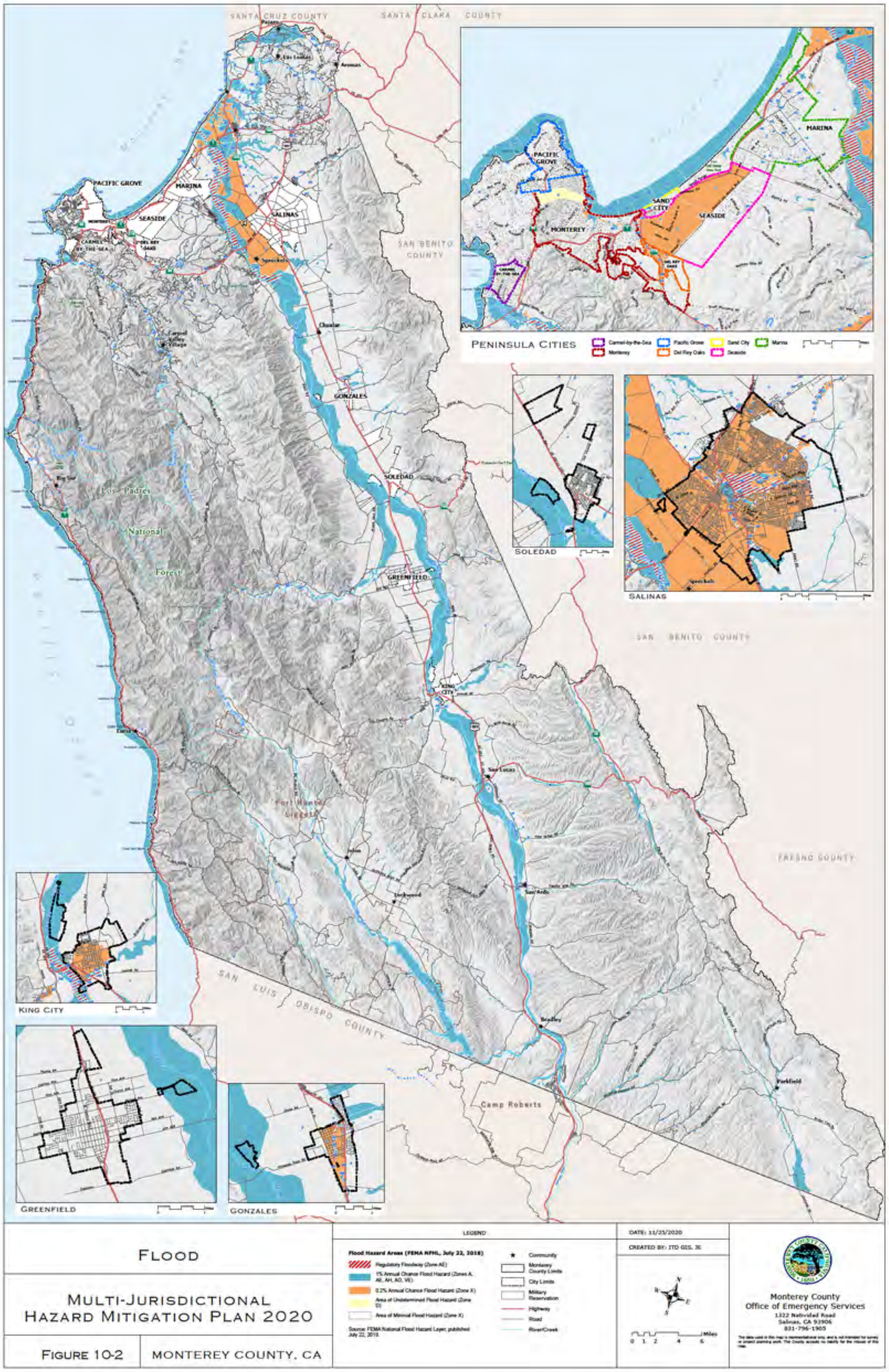
Principal Flooding Sources

FEMA's Flood Insurance Study for Monterey County assessed several creeks, channels, and water bodies, including the following flooding sources:

- Arroyo Seco
- Big Sur River
- Bixby Creek
- Calera Creek
- Canyon Del Rey
- Carmel River
- Castroville Boulevard Wash
- Corncob Canyon Creek
- Del Monte Lake
- East Branch Gonzales Slough
- El Estero Lake
- El Toro Creek
- Elkhorn Slough
- Gabilan Creek
- Gonzales Slough
- Harper Creek
- Josselyn Canyon Creek
- Little Sur River
- Natividad Creek
- Pajaro River
- Pine Canyon Creek
- Salinas River
- San Benancio Gulch
- San Jose Creek
- San Lorenzo Creek
- San Miguel Canyon Creek
- Santa Rita Creek
- Seal Rock Creek
- Tembladero Slough
- Tomasello Creek
- Watson Creek

Shallow (1- to 3-foot) and sheet flooding conditions generally occur in the Salinas, Carmel, Pajaro, and Big and Little Sur Valleys. In addition, flooding can occur along the beach, where it is not uncommon to see winter storms produce 15-foot breakers. Flooding in these areas generally occurs during the rainy season, from October to April.

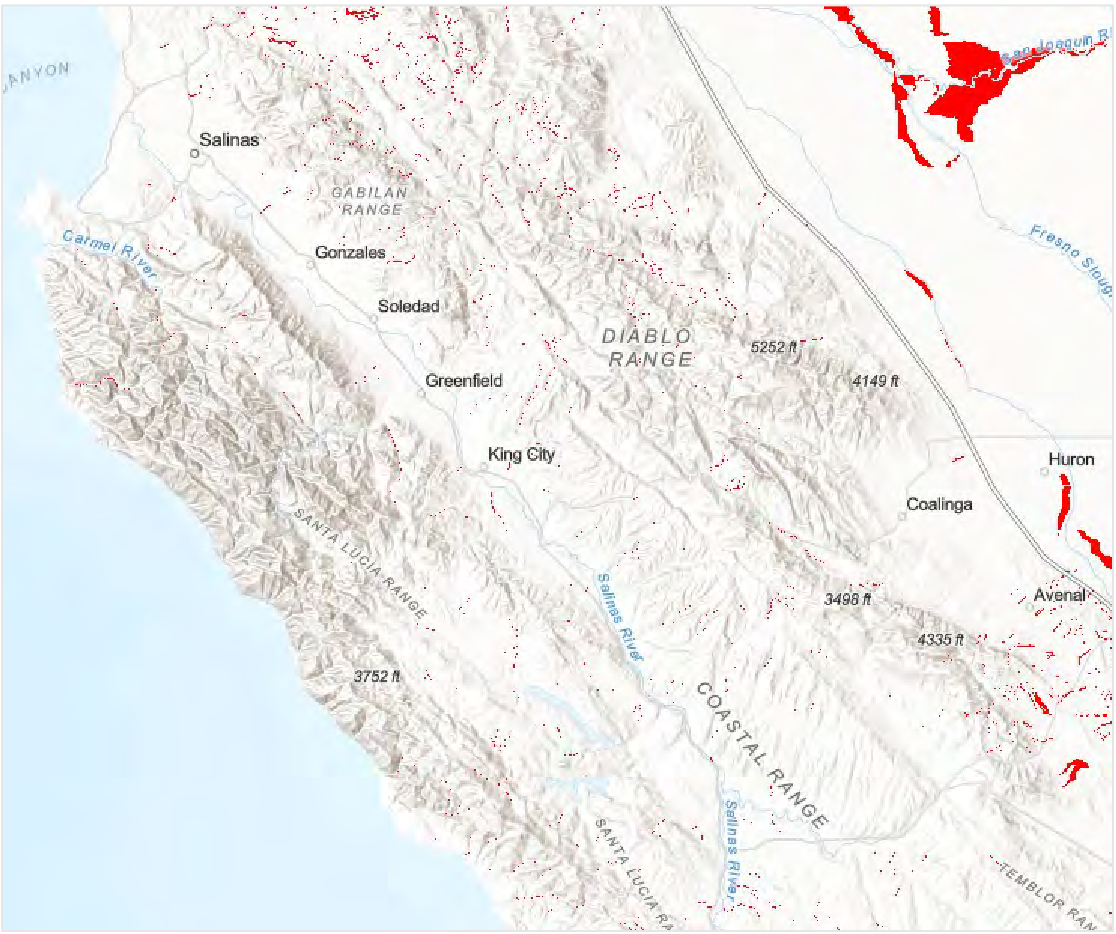
Figure 10-2 shows the extent of the 100-year and 500-year floodplains, as well as the known localized flooding within the entire County according to current effective FIRMs (2017).


SANTA CRUZ COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
FRESNO COUNTY
SAN LUIS OBISPO COUNTY
PACIFIC GROVE
MONTEREY
CARMEL-BY-THE-SEA
SEASIDE
DEL REY OAKS
MARINA
SALINAS
Spreckels
Chualar
GONZALES
SOLEDAD
GREENFIELD
KING CITY
San Lucas
San Ardo
Bradley
Parkfield
Camp Roberts
Big Sur
Los Padres National Forest
Fort Hunter Liggett
PENINSULA CITIES
Carmel-by-the-Sea
Monterey
Pacific Grove
Del Rey Oaks
Sand City
Seaside
Marina
SOLEDAD
SALINAS
KING CITY
GREENFIELD
GONZALES
FLOOD
MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN 2020
FIGURE 10-2
MONTEREY COUNTY, CA
LEGEND
Flood Hazard Areas (FEMA NFHL, July 22, 2018)
Regulatory Floodway (Zone AE)
1% Annual Chance Flood Hazard (Zones A, AE, AH, AO, VE)
0.2% Annual Chance Flood Hazard (Zone X)
Area of Undetermined Flood Hazard (Zone D)
Area of Minimal Flood Hazard (Zone X)
Source: FEMA National Flood Hazard Layer, published July 22, 2018.
Community
Monterey County Limits
City Limits
Military Reservation
Highway
Road
River/Creek
DATE: 11/25/2020
CREATED BY: ITD GIS, JK
Miles
0 1 2 4 6
Monterey County
Office of Emergency Services
1322 Natividad Road
Salinas, CA 93906
831-796-1905

Flood Awareness Zones

Flood Awareness Zones have been developed by California DWR to map areas of additional flood threat throughout the state. The intent of the Awareness Floodplain Mapping project is to identify all pertinent flood hazards for areas that are not mapped under the NFIP and to provide the community and residents an additional tool in understanding potential flood hazards currently not mapped as a regulated floodplain. The awareness maps identify the 100-YR flood hazard areas using approximate assessment procedures. These floodplains are shown simply as flood prone areas without specific depths and other flood hazard data.

Figure 10-3
DWR Flood Awareness Zones



Flood Insurance Claims

A repetitive loss (RL) area is an area where multiple properties in close proximity to each other have experienced repetitive losses from flooding. RL property is a FEMA designation, defined as an insured property that has made two or more claims of more than $1,000 in any rolling 10-year period. RL properties may be classified as a Severe Repetitive Loss (SRL) property under certain conditions. A SRL property has had four or more claims of at least $5,000, or at least two claims that cumulatively exceed the building's value. A property that sustains repetitive flooding may or may not be on the County's RL property list for a number of reasons:

- Not everyone is required to carry flood insurance.
- Owners who have completed the terms of their mortgage or who purchased their property outright may choose not to carry flood insurance and instead bear the costs of recovery on their own.
- The owner of a flooded property that does carry flood insurance may choose not to file a claim. Even insured properties that are flooded regularly with filed claims may not meet the $1,000 minimum threshold to be recognized as an RL property.
- The owner adopted mitigation measures that reduce the impact of flooding on the structure, removing it from the RL threat and the RL list.

Many jurisdictions are required to address only the properties on the RL list. These properties are representative of the community's overall repetitive flooding problem, but do not include all damage. The Privacy Act of 1974 restricts the release of certain types of data to the public. Flood insurance policy and claims data are included in the list of restricted information. FEMA can only release such data to state and local governments, and only if the data are used for floodplain management, mitigation, or research. Therefore, this plan does not identify RL properties or include claim data for any individual property. Flood insurance statistics on loss can still help identify locations vulnerable to flooding, therefore *Table 10-4* summarizes loss statistics by jurisdiction.

Table 10-4
NFIP Loss Statistics for Monterey County

Jurisdiction	Community Number	Total Losses Claims	Total Net Dollars Paid
Carmel-By-The-Sea	060196	3	$127,113
Del Rey Oaks	060197	1	$750
Gonzales	060198	10	$187,853
Greenfield	060446	1	$0
King City	060199	12	$715,518
Marina	060727	0	$0
Monterey	060200	37	$2,654,717
Monterey County	060195	1,163	$23,735,682
Pacific Grove	060201	1	$6,784
Salinas	060202	31	$160,884
Sand City	060435	0	$0
Seaside	060203	2	$125,032
Soledad	060204	0	$0
	Total	**1,261**	**$27,714,334**

10.2.3 FREQUENCY

Monterey County has experienced 10 significant flood events since 1995. This indicates an approximate 38% chance of a significant and damaging flood event in any given year, with a recurrence interval of 2.6 years. Smaller floods may occur more frequently and are an annual hazard. The FEMA National Risk Index calculates an annualized frequency value for riverine and coastal flood hazards in Monterey County. For flooding, annualized frequency was based on the number of distinct hazard events that have occurred. Flooding in Monterey County has an annualized frequency of 2.7 distinct coastal flood events per year and 0.95 distinct riverine flood events per year.

10.2.4 SEVERITY

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Although jurisdictions can implement mitigation and take preventative actions to significantly reduce the severity and threat of flood events, some type of residual risk will always exist (i.e., risk of a hazard event occurring despite technical and scientific measures applied to prevent it). Threats associated with residual risk include failure of a reservoir, a dam, levee, or other infrastructure, or a severe flood event that exceeds flood design standards or drainage capacity.

Flood risk has increased with population and urbanization. Increased impervious surfaces and channelization of streams has resulted in increased runoff and intensified flood flows. Increased development in floodplains has put more property and lives at risk for flooding. The damages caused by flooding in the Salinas Valley today, even with the construction of major flood control infrastructure, are far more substantial than they were a century ago. Along the Big Sur coast, streams and rivers draining the steep coastal mountains are subject to short, intense floods, capable of producing significant damage to property. Wildfires also exacerbate flood risk in Big Sur, denuding areas of vegetation, which can lead to increased sheet flow and greater velocities during subsequent rainstorms and causing water quality problems in coastal waters. The impact and severity of coastal flooding is additionally affected by tides, storm surge (the rise in water from wind stress and low atmospheric pressure), waves, and peak still-water elevation.

10.2.5 WARNING TIME

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. The Monterey County Water Resources Agency (MCWRA) provides flood warning services to Monterey County. MCWRA staff monitors county wide hydrologic conditions during every significant storm event. A real time flood warning system allows MCWRA staff to provide hydrologic data as well as expertise to emergency managers and local law enforcement any hour of the day or night as needed for the protection of life and property in Monterey County.

10.3 SECONDARY HAZARDS

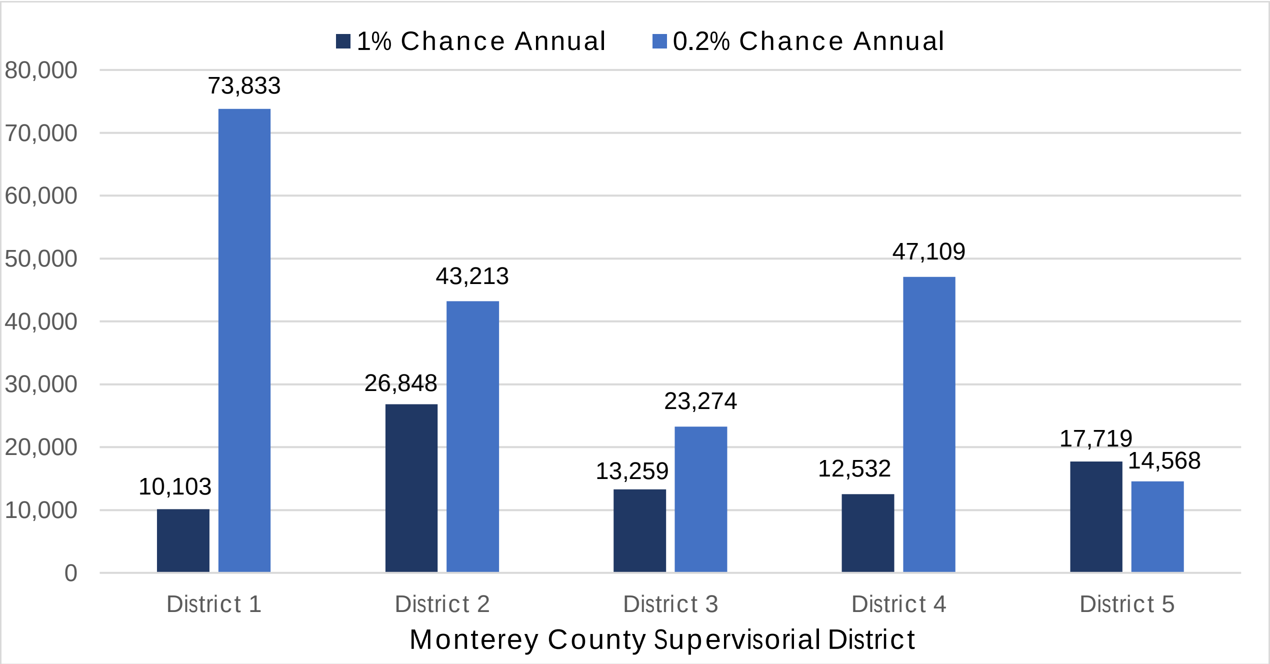
The most problematic secondary hazard for flooding is erosion, which in some cases can be more harmful than actual flooding. Flooding is also responsible for landslides when high flows over-saturate soils on steep slopes and cause them to fail. Hazardous materials spills are a secondary hazard of flooding if storage tanks rupture and spill into streams or storm sewers. It is also recognized that wildland fires within a watershed can exacerbate the flood hazard by virtue of increased rate and volume of runoff and attendant erosion and sediment discharge.

10.4 RISK ASSESSMENT

10.4.1 POPULATION

As seen in *Figure 10-4*, in Monterey County, 80,461 people are located in the 1% annual chance flood zone.

Figure 10-4
Population Exposed to Flood Risk



Floods can be extremely dangerous, and even six inches of moving water can knock over a person given a strong current. A car will float in less than two feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else. During a flood, people can also suffer heart attacks or electrocution due to electrical equipment short outs.

Certain health hazards are also common to flood events. Standing water and wet materials in structures can become breeding grounds for microorganisms such as bacteria, mold, and viruses. This can cause disease, trigger allergic reactions, and damage materials long after the flood. When floodwaters contain sewage or decaying animal carcasses, infectious disease becomes a concern. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts.

10.4.2 PROPERTY

As noted in *Table 10-5,* about 35,000 residential properties, almost $16 billion in property value, in Monterey County is in a mapped FEMA Flood Zone.

Table 10-5
Residential Property Exposed to Flood Hazard Risk by Flood Zone

Supervisorial District	1% Annual Chance		0.2% Annual Chance	
	#	Value	#	Value
District 1	340	$215,814,543	9,716	$3,363,261,908
District 2	1,094	$496,002,748	7,941	$3,458,129,047
District 3	656	$183,474,624	3,550	$1,032,959,384
District 4	118	$67,526,512	10,974	$4,751,738,760
District 5	1,992	$2,729,269,901	1,298	$1,043,994,419
Total	4,200	$3,692,088,328	33,479	$13,650,083,518

As noted in *Table 10-6,* over 20,000 non-residential properties, about $10 billion in property value, in Monterey County is in a mapped FEMA Flood Zone.

Table 10-6
Non-Residential Property Exposed to Flood Hazard Risk by Flood Zone

Supervisorial District	1% Annual Chance		0.2% Annual Chance	
	#	Value	#	Value
District 1	423	$218,575,592	4,405	$1,607,035,317
District 2	2,697	$854,792,968	3,207	$739,146,623
District 3	2,133	$2,351,465,862	2,193	$724,778,875
District 4	388	$570,972,637	4,513	$1,479,403,355
District 5	1,734	$1,173,086,410	1,022	$508,954,540
Total	7,375	$5,168,893,469	15,340	$5,059,318,710

10.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Flood events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the County, including for emergency service providers needing to get to vulnerable populations or to make repairs. Additionally, underground utilities can be damaged. Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up or overwhelmed by inflow and infiltration, causing sanitary sewer overflows.

Facilities that are known to manufacture, process, store, or otherwise use hazardous materials could be damaged in a flood. If damaged by a flood, these facilities could release chemicals that cause cancer or other significant adverse acute human health effects, or significant adverse environmental effects. During a flood, containers holding these materials can rupture and leak into the surrounding area, disastrously affecting the environment and residents. *Table 10-7* summaries critical infrastructure in the 100-year floodplain in Monterey County.

Table 10-7
Critical Infrastructure in the 100-Year Floodplain in Monterey County

Critical Infrastructure Type	1% Annual Chance
Facilities	
Emergency Response	0
Fire Station	2
Police Station	0
Medical Facilities	3
Military Facility	0
Large Public Facilities	0
Educational Facilities	6
Power Plant	0
Water & Wastewater Facilities	61
Stormwater Facilities	8
Government Facilities	20
Communication Facilities	78
Rain Gauges	19
Lighthouses	0
Dams	0
Hazardous Materials	
Active or Idle Oil Well	853
Landfill	0
Underground Tank	15
Cal ARP Facility	9
Transportation	
Airport	1
Bridge	93
Harbor	3
Highway/Freeway (Miles)	89
Driveway (Miles)	1
Major Road (Miles)	310
Local (Miles)	527
Railroad (Miles)	23

10.4.4 ENVIRONMENT

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

While the vulnerability assessment focuses on human vulnerability to flood events, the impact of human activities on flooding is also worth noting. Due to negative impacts of floods, many structural and other measures have been devised to limit how far a floodplain can extend. However, floodplains have many natural and beneficial functions, and disruption of natural systems can have long-term consequences for entire regions.

Some well-known, water-related functions of floodplains (noted by FEMA) include:

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperatures of water
- Surface water quality maintenance
- Promote infiltration and aquifer recharge

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species.

10.4.5 ECONOMIC IMPACT

Flooding can result in economic losses through closure of businesses and government facilities, disrupt communications, disrupt the provision of utilities such as water and sewer service, result in excessive expenditures for emergency response, and generally disrupt the normal function of a community.

Locations that are directly flooded experience the greatest economic impact. In these areas, renovations of commercial buildings may be necessary, disrupting associated services. Significant damage may occur in agricultural areas, with destruction of crops and agricultural products. The tourism industry may be affected by major flood events, as popular vacation areas tend to overlap flood hazard zones. Finally, flooding can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation or running on backup generator power.

10.5 FUTURE TRENDS IN DEVELOPMENT

The planning partners are equipped to handle future growth within flood hazard areas. All municipal planning partners have general plans that address frequently flooded areas in the safety elements of their General Plans. Additionally, all municipal planning partners are participants in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. All municipal planning partners have committed to maintaining their good standing under the NFIP through actions identified in this plan.

10.6 ISSUES

Important issues associated with flooding in Monterey County include the following:

- The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the County is questionable.
- The effect of climate change on flood risk is uncertain.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- The economy affects a jurisdiction’s ability to manage its floodplains. Budget cuts and personnel losses can strain resources needed to support floodplain management.

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11. HAZARDOUS MATERIALS INCIDENT

11.1 OVERVIEW

According to the Environmental Protection Agency (EPA), a hazardous material is any item or agent (biological, chemical, physical) which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. These substances may be highly toxic, reactive, corrosive, flammable, radioactive, or infectious. Hazardous materials can be present in any form, gas, solid, or liquid. Environmental or atmospheric conditions can influence hazardous materials if they are uncontained. Hazardous materials include hundreds of substances that pose a significant risk to humans.

Title 49 of the Code of Federal Regulations (CFR) lists thousands of hazardous materials, including gasoline, insecticides, household cleaning products, and radioactive materials. State-regulated substances that have the greatest probability of adversely impacting the community are listed in the CCR, Title 19. Numerous federal, state, and local agencies, including the US Environmental Protection Agency (EPA), US Department of Transportation (DOT), National Fire Protection Association, FEMA, the US Army, and the International Maritime Organization regulate hazardous materials.

Hazardous material releases can pose a risk to life, public health, air quality, water quality and the environment. A release or spill of bulk hazardous materials could result in fire, explosion, toxic cloud or direct contamination of water, people, and property. The effects may involve a local area or many square miles. They may result in the evacuation of a facility or an entire neighborhood. In addition to the immediate risk, long-term public health and environmental impacts may result from sustained exposure to certain substances. Damage to property could range from immediate destruction by explosion to permanent contamination by a persistent hazardous material.

Natural hazards may cause the release of hazardous materials and complicate response activities. The impact of earthquakes on fixed facilities may be particularly serious due to the impairment or failure of the physical integrity of containment facilities. The threat of any hazardous material event may be magnified due to restricted access, reduced fire suppression and spill containment, and even complete cut-off of response personnel and equipment.

11.1.1 TYPES OF HAZARDOUS MATERIALS INCIDENTS

The following are the most common types of hazardous material incidents:

- **Fixed Facility Hazardous Materials Incident**: This is the uncontrolled release from a fixed site of materials that pose a risk to health, safety, and property. Fixed site facilities include refineries, chemical plants, storage facilities, manufacturing facilities, warehouses, wastewater treatment plants, swimming pools, dry cleaners, automotive sales/repair, and gas stations. It is possible to identify and prepare for fixed-site incidents because federal and state laws require those facilities to notify state and local authorities about materials being used or produced at the site.
- **Hazardous Materials Transportation Incident**: A hazardous materials transportation incident is any event during transport resulting in uncontrolled release of materials that can pose a risk to health, safety, and property. Transportation incidents are difficult to prepare for because there is little if any notice about what materials could be involved should an accident happen. Transported hazardous wastes include thousands of shipments of radiological materials moved across the United States by ground transportation, mostly medical materials, and low-level radioactive waste. Hazardous materials transportation incidents can occur on any transportation corridor, although most occur on interstate highways, other major federal or state highways, or major rail lines. Accidents may involve bulk petroleum products, reactive materials, chemical wastes, explosives, and other toxic substances that are being transported or temporarily stored while in transit.
- **Interstate Pipeline Hazardous Materials Incident**: There are a significant number of interstate natural gas, heating oil, and petroleum pipelines running through the State of California. These are used to provide natural gas to utilities and to transport these materials from production facilities to end-users.

Hazard Materials Classifications

The US Department of Transportation (USDOT) divides hazardous materials into nine major hazard classes. A hazard class is a group of materials that share a common major hazardous property, i.e., radioactivity, flammability, etc. These hazard classes include:

- *Class 1*: Explosives
- *Class 2*: Compressed Gases
- *Class 3*: Flammable Liquids
- *Class 4*: Flammable Solids; Spontaneously Combustible Materials; Dangers When Wet Materials/Water-Reactive Substances
- *Class 5*: Oxidizing Substances and Organic Peroxides
- *Class 6*: Toxic Substances and Infectious Substances
- *Class 7*: Radioactive Materials
- *Class 8*: Corrosives
- *Class 9*: Miscellaneous Hazardous Materials/Products, Substances, or Organisms

11.1.2 OVERSIGHT

Hazardous materials management is regulated by federal and state codes. The state fire marshal and the Pipeline and Hazardous Materials Safety Administration enforce oil and gas pipeline safety regulations. The federal government enforces hazardous material transport pursuant to its interstate commerce regulation authority. The Department of Toxic Substances Control (DTSC), a Division of the California Environmental Protection Agency, acts to protect California from exposure to hazardous waste by cleaning up existing contamination and looking for ways to reduce the amount of hazardous waste produced. DTSC regulates hazardous waste primarily under the authority of the Federal Resource Conservation and Recovery Act and the California Health and Safety Code. Other laws that affect hazardous waste are specific to handling, storage, transportation, disposal, treatment, cleanup, and emergency planning. DTSC has the authority to implement permitting, inspection, compliance, and corrective action programs to ensure that people who manage hazardous waste follow requirements.

Businesses are required to disclose all hazardous materials and waste above certain designated quantities that they use, store, or handle at their facility. They must prepare chemical inventory and business emergency plans, review the plans regularly, and conduct training. Any release or possible release of hazardous materials must be reported to the Cal OES Warning Center. Businesses using certain regulated substances (about 260 specific flammable or toxic chemicals) must develop a risk management plan. The plan must include an analysis of operations on-site, and projection of off-site consequences with accompanying mitigation plans.

11.2 HAZARD PROFILE

11.2.1 HISTORY

According to data from Cal OES Warning Center from 2016 through June 2, 2021. The records show 667 hazardous materials spills in Monterey County over the 5-year timeframe. *Table 11-1* lists the number of hazardous material incidents by spill site and type of substance spilled in Monterey County reported to the Cal OES Warning Center.

Table 11-1
Hazardous Materials Spills in Monterey County by Spill Site and Substance Spilled (2016-2021)

Spill Site	Type of Substance Spilled							
	Chemical	Petroleum	Radiological	Sewage	Vapor	Unnamed / Other	Railroad Derailment	Total
Airport		1		1				2
Industrial	2	4			5	2		13
Business	10	21		29	15	14		89
Military Base		6		3	1			10
Oil Field		17				1		18
Other	7	24		29	7	10		77
Pipeline		1						1
Railroad	1	2		1		1	44	49
Residence	3	8		83	4	3		101
Road	4	51	2	53	2	2		114
School		1		5		1		7
Gas Station		13		1				14
Ship/ Harbor	1	18		1		2		22
Sewage Facility	1	1		8		2		12
Utilities/ Substation		3		1				4
Waterways	2	106		13		13		134
Total	31	277	2	228	34	51	44	667

Source: Cal OES Spill Release Reporting Data (2016 through June 2, 2021)

As seen in *Table 11-2*, the most common causes of hazardous materials incidents were unknown (26%), followed by blockages (18%) and mechanical (18%).

Table 11-2
Hazardous Materials Spills in Monterey County by Cause of Spill (2016-2021)

Cause	Number
Blockage	121
Broken Pipe	20
Collision	57
Human Error	96
Mechanical	117
Other	67
Overflow	15
Rail	1
Unknown	173
Total	**667**

Source: Cal OES Spill Release Reporting Data (2016 through June 2, 2021)

Of the 667 reported incidents, 175 (26%) occurred in unincorporated Monterey County, including 49 in the vicinity of Moss Landing (7%). 157 reported incidents (24%) occurred in the City of Monterey and 135 incidents (30%) occurred in the City of Salinas. Additionally, over this 5-year timeframe hazardous material releases have been related to 40 injuries, 16 fatalities, and 23 evacuations. Further historical hazardous material spill report data is available on the Cal OES website.

11.2.2 LOCATION

The following locations have the potential of hazardous materials releases:

- **Business and Industrial Facilities**: Retail, manufacturing and light industrial firms are areas of concern. These facilities have the highest concentration of hazardous materials at fixed facilities in the planning area due to their manufacturing operations. Anhydrous ammonia and chlorine gas are the two most common extremely hazardous substances used in Monterey County. These materials are used primarily for cold storage by the produce industry, drinking water and wastewater treatment, and water treatment and cooling for pre-cut salad processing. It is anticipated that a release occurring at these businesses would present the greatest likelihood of having an off-site consequence and could have a major impact on the surrounding areas. In addition to these types of businesses, there are several large agricultural chemical wholesalers and applicators that handle large quantities of various pesticides. Another business that may present significant hazards because of the types and quantities of chemicals handled and the proximity to populated areas would include electric power generating facilities. Approximately 90 businesses have been identified under the California Accidental Release Prevention (CalARP) program as handling and storing a regulated hazardous substance in quantities above the California recognized threshold quantities.
- **Agricultural Areas**: Accidental releases of pesticides, fertilizers, and other agricultural chemicals may be harmful to both humans and the environment. Monterey's agricultural industry is a heavy user of pesticides and fertilizers, and the incorrect production and storage of these chemicals can only contaminate the soil, air, and water, and can cause a fire or an explosion. Agricultural pesticides are transported daily in and around the County.
- **Harbors**: Harbors are a potential location for hazardous materials spills. Marine tank vessels and refined petroleum products such as gasoline, diesel and bunker fuel used by ships are sources of potential oil spills. The Monterey and Moss Landing Harbors are potential locations for hazardous materials incidents.
- **Illegal Drug Operations**: Illegal operations such as laboratories for methamphetamine can pose a threat. Laboratory residues are often dumped along roadways or left in rented hotel rooms, creating a serious health threat to unsuspecting individuals and to the environment.

- **Illegal Dumping Sites**: Hazardous wastes such as used motor oil, solvents, or paint are occasionally dumped in remote areas or along roadways, creating a potential health threat to unsuspecting individuals and to the environment.
- **Transportation Routes**: The County's transportation system consists of a network of federal, state, and county roads, airports, and rail service that all have the potential for hazardous material incidents. The trucks and trains that use these transportation corridors commonly carry a variety of hazardous materials, including gasoline, other crude oil derivatives, and other chemicals known to cause human health problems. Major transportation routes in the County include:
  - US 101, State Route 1 (Highway 1), State Route 156, State Route 183, State Route 68, State Route 198, and County Routes G14, G15, and G18
  - Amtrak long distance and intercity trains through the County
  - Railroad lines
  - General Aviation Airports
- **Pipelines**: This information is provided by the National Pipeline Mapping System and is available to general public. Information does indicate that several pipelines conveying gas or hazardous liquids cross the County.
- **Oil Fields:** The County's active oil fields are subject to fire or explosion. The San Ardo Oil Fields are a possible location of a hazardous materials incident.

DTSC Hazardous Waste and Substances Site List (as of May 13, 2021), lists 110 sites in Monterey County with potential to release hazardous materials. Additionally, two sites in Monterey County are currently listed by the EPA on the Federal Superfund National Priorities List (NPL):

Crazy Horse Sanitary Landfill

The Crazy Horse Sanitary Landfill site is a 125-acre sanitary landfill in Salinas, California. A landfill has operated on site since 1950. The landfill is owned by the City of Salinas and operated by Salinas Disposal Services. The facility receives about 162,000 tons of refuse a year. Landfill operations contaminated groundwater with hazardous chemicals. Following initial actions to protect human health and the environment, EPA is evaluating whether additional cleanup measures are needed.

Fort Ord

The 27,827-acre Fort Ord site was established in 1917 by the US Army as a maneuver area and field artillery target range. In 1991, Fort Ord was selected for decommissioning, but the post did not formally close until 1994. Prior to closing in September 1994, the base's primary mission was training infantry military personnel. The EPA placed the site on the Superfund program's National Priorities List (NPL) in 1990. The site contained leaking petroleum underground storage tanks, a 150-acre landfill used to dispose of residential waste and small amounts of commercial waste generated by the base, a former fire drill area, motor pool maintenance areas, small dumpsites, small arms target ranges, an 8,000-acre firing range and other limited areas that pose threats from unexploded ordnance.

On November 20, 2020, the EPA published a Federal Register notice announcing its proposal to remove 11,934 acres of the 27,827-acre Fort Ord Superfund site from the NPL. This deletion is a “partial deletion” (meaning it includes only a part of the cleanup at a portion of the site where cleanup is finished); and only covers cleanup work for military munitions and soil pollution. EPA and the State of California will continue to oversee the US Army’s cleanup at the rest of the site. The Army is the lead federal agency for the cleanup. The Army will continue to clean up the groundwater and soil gas on the 11,934 acres. It will also cleanup all pollution at the remaining 15,893 acres of the site. Both the groundwater and soil cleanup for the 11,934 acres and the entirety of the 15,893 acres are still in the Superfund program.

11.2.3 FREQUENCY

Hazardous material incidents may occur at any time in the County, given the presence of transportation routes dividing the County, the location of businesses and industry that use hazardous materials, the presence of scattered illegitimate businesses such as clandestine drug laboratories, and the improper disposal of hazardous waste. Based on previous occurrences (as noted above 667 incidents occurred over a 5-year period), Monterey County can expect small hazardous material incidents to occur many times a year. The likelihood of a significant hazardous materials release within the County is more limited and difficult to predict but is assumed to be highly likely.

11.2.4 SEVERITY

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. Hazards can occur during production, storage, transportation, use or disposal. The release or spill of hazardous materials requires a different response depending on factors such as the amount, type, and location of the spill. Each location should have its own specific cleanup procedure, and all personnel handling such material should have received instruction on that procedure. The speed of onset of a hazardous materials spill is generally short. The duration is typically short as well, though certain chemicals can pollute earth and groundwater for long periods of time. Comprehensive information on the probability and magnitude of a hazardous material event is not available. Wide variations among the characteristics of hazardous material sources and among the materials themselves make such an evaluation difficult.

11.2.5 WARNING TIME

Hazardous material incidents occur without predictability under circumstances that give responders little time to prepare.

11.3 SECONDARY HAZARDS

Roadway or railroad closures due to a transportation-related hazardous material spill would have serious effects on the local economy and ability to provide services. Loss of major travel routes would result in loss of commerce and could impact the ability to provide emergency services to citizens. The ability to receive fuel deliveries could be impacted. It is also common to see hazardous materials releases as escalating incidents resulting from other hazards such as floods, wildfires, and earthquakes. The release of hazardous materials can greatly complicate or even eclipse the response to the natural hazards disaster that caused the spill.

11.4 RISK ASSESSMENT

To assess hazardous materials incident risk, buffer distances were used. The chosen buffer distance was based on guidelines in the US Department of Transportation's Emergency Response Guidebook that suggests distances useful to protect people from vapors resulting from spills involving dangerous and toxic substances. The recommended buffer distance, or "protective action distance" is the area surrounding the incident in which people are at risk of harmful exposure. For this plan, a buffer distance of one mile was used, but actual buffer distances will vary depending on the nature and quantity of the release, whether the release occurred during the night or daytime, and prevailing weather conditions.

To analyze the risk in the County to a transportation-related hazardous materials release, a one-mile buffer was applied to highways in the US Dept of Transportation, National Transportation Atlas Database. The result is a two-mile buffer zone around each transportation corridor that is used for this analysis. Risk from a fixed facility hazardous materials release was analyzed using a one-mile buffer applied to facilities identified in the Monterey County 2019 Hazardous Materials Plan.

11.4.1 POPULATION

As seen in *Table 11-3*, close to 250,000 people could be exposed to mobile source hazardous materials incidents, and a little over 100,000 people could be exposed to a fixed source hazardous materials incident.

Table 11-3
Population Exposed to Hazardous Materials Incident Risk in Monterey County

Supervisorial District	Mobile Source	Fixed Source
District 1	43,569	46,909
District 2	41,632	15,718
District 3	64,443	35,240
District 4	58,962	16,439
District 5	40,379	2,956
Total	248,985	117,262

Variables affecting exposure in the event of a hazardous materials incident include the type of product, the physical and chemical properties of the substance, the physical state of the product, the ambient temperature, wind speed, wind direction, barometric pressure, and humidity. With so many variables, true population exposure numbers are difficult to determine. In general, those who live near transportation corridors or businesses with hazardous materials are more at risk; but each chemical incident is different, and the scenarios are numerous.

Hazardous materials pose a significant risk to emergency response personnel. All potential first responders and follow-on emergency personnel in the County currently are and will be properly trained to the level of emergency response actions required of their individual position at the response scene. Hazardous materials incidents can also pose a serious long-term threat to public health, and those who already are at high risk of health complications, the young, and the elderly, may be more vulnerable to health impacts.

11.4.2 PROPERTY

During a hazardous materials transportation spill, it is generally people that are at risk to the effects of the spill. During a spill, buildings, property, and their values are at a lesser risk; however, given the location of hazardous materials in the County, an analysis is performed here.

Table 11-4 and *Table 11-5* summarizes property that is exposed to hazardous material incident risk from fixed and mobile source.

Table 11-4
Residential Property Exposed to Hazardous Materials Incident Risk in Monterey County

Supervisorial District	Mobile Source		Fixed Source	
	#	Value	#	Value
District 1	5,374	$2,014,276,564	5,348	$1,709,901,633
District 2	7,762	$3,094,087,641	1,400	$529,147,582
District 3	8,823	$2,722,732,839	5,114	$1,607,471,282
District 4	11,156	$5,267,765,844	3,512	$1,511,657,663
District 5	12,968	$14,243,375,574	526	$327,493,551
Total	46,083	$27,342,238,462	15,900	$5,685,671,711

Table 11-5
Non-Residential Property Exposed to Hazardous Materials Incident Risk in Monterey County

Supervisorial District	Mobile Source		Fixed Source	
	#	Value	#	Value
District 1	3,969	$1,574,141,766	3,170	$1,315,727,602
District 2	5,299	$1,581,922,328	1,218	$575,693,618
District 3	5,047	$3,361,071,791	2,978	$1,866,871,670
District 4	5,799	$2,233,416,936	1,878	$675,704,517
District 5	7,444	$3,435,240,541	180	$36,676,356
Total	27,558	$12,185,793,362	9,424	$4,470,673,763

11.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Hazardous materials may be stored at or transported along critical facilities. These facilities are susceptible to accidents and are visible targets for terrorism. The impact of a hazardous material spill or transportation incident will likely be localized to the particular facility, hospital, port, airport, railroad, road, highway, or interstate. The potential losses vary because of the variable nature of the hazardous material spill, but costs from product loss, property damage and decontamination and other costs can add up to millions of dollars. Critical infrastructure exposed to hazardous materials risk is summarized in *Table 11-6*.

Table 11-6
Critical Infrastructure Exposed to Hazardous Materials Incident Risk in Monterey County

Critical Infrastructure Type	Mobile Source	Fixed Source
Facilities		
Emergency Response	36	11
Fire Station	32	9
Police Station	0	5
Medical Facilities	0	22
Military Facility	3	0
Large Public Facilities	3	1
Educational Facilities	119	48
Power Plant	1	0
Water & Wastewater Facilities	233	61
Stormwater Facilities	4	6
Government Facilities	151	103
Communication Facilities	890	335
Rain Gauges	12	2
Lighthouses	1	0
Dams	0	0
Hazardous Materials		
Active or Idle Oil Well	1522	20
Landfill	0	1
Underground Tank	121	-
Cal ARP Facility	72	-
Transportation		
Airport	5	2
Bridge	52	12
Harbor	1	0
Highway/Freeway (Miles)	-	73
Driveway (Miles)	-	0
Major Road (Miles)	-	133
Local (Miles)	-	283
Railroad (Miles)	-	23

11.4.4 ENVIRONMENT

The risk of hazardous material spills to the environment is considerable. Hazardous materials spilled along roads or railways can pollute rivers, streams, wetlands, riparian areas, and adjoining fields. Other hazardous materials released into the air can severely impact plant and animal species. Reducing risk exposure to the built environment will also mitigate potential losses to the natural environment.

Depending on the characteristic of the hazardous material or the volume of product involved, the affected area can be as small as a room in a building or as large as many square miles that require soil remediation. More widespread effects occur when a product contaminates the municipal water supply or water system such as a port, river, lake, or aquifer. Such environmental damage can linger for decades.

11.4.5 ECONOMIC IMPACT

Hazardous materials incidents in Monterey County have the potential to impact many important economic sectors. Large hazardous material spills can drive away tourists. Hazardous materials incidents could impact the agricultural industry, which could have large economic implications.

11.5 FUTURE TRENDS IN DEVELOPMENT

The number and types of hazardous chemicals stored in and transported through the County will likely continue to increase. As population grows, the number of people vulnerable to the impacts of hazardous materials spills will increase. Development will continue to happen within hazardous materials incident risk zones.

Population and business growth along major transportation corridors increases the vulnerability to transportation-related hazardous material spills. Those who choose to develop in these areas should be made aware of the risks associated with living within close proximity to hazardous materials risk.

11.6 ISSUES

Key issues associated with hazardous materials incidents in Monterey County include:

- Train first responders and all appropriate local government staff to implement protocols contained in the *Monterey County Hazardous Materials Plan*.
- Anhydrous ammonia and chlorine gas, two chemicals commonly used in industrial processing in Monterey County are anticipated to present the greatest likelihood of having an off-site consequence and could have a major impact on the surrounding areas. The County should continue to monitor and regulate the use of these chemicals.
- Power generating facilities present a hazardous materials release risk.

- Accidental releases of pesticides, fertilizers, and other agricultural chemicals are a concern due to their potential to have harmful effects on both humans and the environment.
- Work proactively with hazardous materials facilities to follow best management practices:
    - Placards and labeling of containers
    - Emergency plans and coordination
    - Standardized response procedures
    - Notification of the types of materials being transported through the County at least annually
    - Random inspections of transporters as allowed by each company
    - Installation of mitigating techniques along critical locations
    - Routine hazard communication initiatives
    - Consideration of using alternative products that are safer

12. HUMAN-CAUSED HAZARDS

12.1 OVERVIEW

Although the Disaster Mitigation Act does not require an assessment of human-caused hazards, the Monterey County Steering Committee decided to include human-caused hazards in this hazard mitigation plan for the following reasons:

- Monterey County takes a proactive approach to disaster preparedness in order to protect the public safety of all citizens.
- Preparation for and response to a human-caused disaster involves much of the same staff, training, critical decision making, and commitment of resources as a natural hazard.
- The multi-hazard mitigation planning effort is an opportunity to inform the public about all hazards, including human-caused hazards.
- The likelihood of a human-caused hazard event in the County is greater than that of several of the natural hazards identified in this Plan.
- During public outreach events, many community members expressed concern for increasing amounts of human-caused hazards.

The following human-caused hazards discussed in this plan: Cyber-Attack, Targeted Violence, Terrorism, and Mass Migration.

12.1.1 CYBER-ATTACK

A cyber-attack is an intentional and malicious crime that compromises the digital infrastructure of a person or organization, often for financial or terror-related reasons. Such attacks vary in nature and are perpetrated using digital mediums or sometimes social engineering to target human operators. Generally, attacks last minutes to days, but large-scale events and their impacts can last much longer. As information technology continues to grow in capability and interconnectivity, cyber-attacks become increasingly frequent and destructive.

Types of Cyber-Attacks

Cyber-threats differ by motive, attack type and perpetrator profile. Motives range from the pursuit of financial gain to political or social aims. Cyber-threats are difficult to identify and combat. Types of threats include using viruses to erase entire systems, breaking into systems, and altering files, using someone's personal computer to attack others, or stealing proprietary, protected, or confidential information. The spectrum of cyber-risks is limitless, with threats having a wide range of effects on the individual, community, and all private and public organizations. This risk assessment includes cyber-attacks and cyber-terrorism under the inclusive hazard of cyber-threats. The terms often are used interchangeably, though they are not the same. While all cyber-terrorism is a form of cyber-attack, not all cyber-attacks are cyber-terrorism.

Public and private computer systems can experience a variety of cyber-attacks, from blanket malware infection to targeted attacks on system capabilities. Cyber-attacks specifically seek to breach Information Technology (IT) security measures designed to protect an individual or organization. The initial attack is followed by more severe attacks for the purpose of causing harm, stealing data, or financial gain. Organizations are prone to different types of attacks that can be automated or targeted.

Ransomware Attacks

Ransomware attacks, a type of cyber-attack, is becoming increasingly common against individuals, small- and medium-sized organizations, utilities, and local governments. Cyber ransom occurs when an individual downloads ransom malware, or ransomware, often through phishing, and the subsequent execution of code results in encryption of all data and personal files stored on the system. The victim then receives a message that demands a fee in the form of electronic currency or cryptocurrency, such as Bitcoin, for the decryption code. Cyber-attacks often target government networks to gain access to sensitive personal information of citizens and employees, as well as proprietary software, strategic plans, and other information.

Prior to the COVID-19 pandemic, state and local governments were already plagued by cybersecurity threats. Ransomware attacks, in which the attacker encrypts a system and demands money to unlock it, have increasingly impacted government entities across the nation over the past two years.

Cyber-Terrorism

Cyber-terrorism is the use of computers and information, particularly over the Internet, to recruit others to an organization's cause, cause physical or financial harm, or cause a severe disruption of infrastructure service. Such disruptions can be driven by religious, political, or other motives. Like traditional terrorism tactics, cyber-terrorism seeks to evoke strong emotional reactions, but it does so through information technology rather than a physically violent or disruptive action. Cyber-terrorism has three main types of objectives:

- **Organizational**: Cyber-terrorism with an organizational objective includes specific functions outside of or in addition to a typical cyber-attack. Terrorist groups today use the internet on a daily basis. This daily use may include recruitment, training, fundraising, communication, or planning. Organizational cyber-terrorism can use platforms such as social media as a tool to spread a message beyond country borders and instigate physical forms of terrorism. Additionally, organizational goals may use systematic attacks as a tool for training new members of a faction in cyber-warfare.
- **Undermining**: Cyber-terrorism with undermining as an objective seeks to hinder the normal functioning of computer systems, services, or websites. Such methods include defacing, denying, and exposing information. While undermining tactics are typically used due to high dependence on online structures to support vital operational functions, they typically do not result in grave consequences unless undertaken as part of a larger attack.
- **Destructive**: The destructive objective for cyber-terrorism is what organizations fear most. Through the use of computer technology and the Internet, terrorists seek to inflict destruction or damage on tangible property or assets, and death or injury to individuals.

12.1.2 TARGETED VIOLENCE

Targeted violence refers to any incident of violence in which an attacker selects a particular target prior to the violent attack. Unlike terrorism, targeted violence includes attacks otherwise lacking a clearly discernible political, ideological, or religious motivation, but that are of such severity and magnitude as to suggest an intent to inflict a degree of mass injury, destruction, or death commensurate with known terrorist tactics. Targeted violence has a significant impact on the safety and security of communities, schools, places of worship, and other public gatherings. The threats of terrorism and targeted violence increasingly intersect with one another.

Active shooter attacks are typically motivated by the desire to maximize human casualties. They are differentiated from other attack types by the indiscriminate nature of the victim's targets of opportunity rather than actions directed toward a specific target. Active shooter attacks have evolved over the last decade ranging from "lone wolf" shooters who act alone and without any organizational affiliation to organized groups acting in concert to achieve a specific objective.

An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms and there is no pattern or method to their selection of victims. Active shooter situations are unpredictable and evolve quickly. Typically, the immediate deployment of law enforcement is required to stop the shooting and mitigate harm to victims. Active shooter situations are often over within 10 to 15 minutes, before law enforcement arrives on the scene.

12.1.3 TERRORISM

Terrorism is defined in the Code of Federal Regulations 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" (28 CFR, Section 0.85). The FBI categorizes two types of terrorism in the US:

- Domestic terrorism involves groups or individuals without foreign direction whose terrorist activities, including the use of WMDs, are directed at the government or population. The FBI, the primary response agency for domestic terrorism, coordinates domestic preparedness programs and activities to limit domestic terrorism.
- International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States, or whose activities transcend national boundaries.

Terrorism can be perpetrated through several methods including Weapons of Mass Destruction (WMD), which includes biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; agriterrorism; and "cyber-terrorism." Within these general categories, however, there are many variations. Particularly in the area of biological and chemical weapons, there are a wide variety of agents and ways for them to be disseminated. *Table 12-1* provides a hazard profile summary for terrorism-related hazards.

Table 12-1
Event Profiles for Terrorism

Hazard	Application Mode	Hazard Duration/ Extent	Mitigating and Exacerbating Conditions
Conventional Bomb/ Improvised Explosive Device	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile.	Instantaneous; additional "secondary devices" may be used, lengthening the time duration of the hazard. Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure.	Overpressure at a given standoff is inversely proportional to the cube of the distance from the blast; thus, each additional increment of standoff provides progressively more protection. Terrain, structures, etc. can provide shielding by absorbing and/or deflecting energy/debris. Exacerbating conditions: ease of access to target; lack of shielding; poor construction; ease of device concealment.

Table 12-1
Event Profiles for Terrorism

Hazard	Application Mode	Hazard Duration/ Extent	Mitigating and Exacerbating Conditions
Chemical Agent	Liquid/aerosol contaminants dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists. Contamination can be carried out of the initial target area by persons, vehicles, water, and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperature affects evaporation of aerosols. Ground temperature affects evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazard. Precipitation can dilute but also spread agent. Wind can disperse vapors but cause target area to be dynamic. Micro-meteorological effects of buildings/terrain can alter travel and duration of agents. Sheltering in place can protect people from harmful effects.
Arson/ Incendiary Attack	Initiation of fire or explosion on or near target via direct contact or remotely via projectile.	Generally, minutes to hours. Extent of damage determined by type and quantity of device, accelerant, and materials present at or near target.	Mitigation factors include built-in fire detection and protection systems and fire-resistive construction. Inadequate security can allow easy access to target and easy concealment of incendiary device. Noncompliance with fire and building codes, as well as failure to maintain existing fire protection systems, can increase the effectiveness of a fire weapon.
Armed Attack	Tactical assault or random attack.	Generally, minutes to days. Extent varies based on perpetrators' intent and capabilities.	Inadequate security can allow easy access to target, easy weapons concealment, and undetected initiation of attack.
Biological Agent	Liquid or solid contaminants dispersed using aerosols or by point or line sources such as munitions, covert deposits, moving sprayers.	Hours to years, depending on the agent and the conditions in which it exists. Depending on the agent used and the effectiveness of deployment, agent can spread via wind and water. Infection can spread via humans or animals.	Altitude of release above ground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate wind will disperse agents but higher winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents.
Cyber-Terrorism	Electronic attack, one computer against another.	Minutes to days. Generally, no direct effects on built environment.	Inadequate security can allow access to critical computer systems, letting them to be used to conduct attacks.

Table 12-1
Event Profiles for Terrorism

Hazard	Application Mode	Hazard Duration/ Extent	Mitigating and Exacerbating Conditions
Agriterrorism	Direct, covert contamination of food supplies or introduction of pests or disease agents to crops and livestock.	Days to months. Extent varies by type of incident. Food contamination may be limited to specific sites, while pests and diseases may spread widely.	Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.
Radiological Agent	Radioactive contaminants dispersed using sprayers/ aerosol generators, or by point or line sources.	Seconds to years, depending on material used. Initial effects will be localized to site of attack; based on climatic conditions, successive behavior of material may be dynamic.	Duration of exposure, distance from source of radiation, and the amount of shielding between source and target determine exposure to radiation
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air, or at high altitude.	Light/heat flash and blast/shock wave last seconds; nuclear radiation and fallout can persist for years. Initial blast effects of a subsurface, ground or air burst are static, determined by device's characteristics/ employment; fallout of radioactive contaminants may be dynamic.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat, and blast energy decrease logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.
Intentional Hazardous Material Release	Solid, liquid, and/or gaseous contaminants released from fixed or mobile containers	Hours to days. Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination may be carried out of the incident area by persons, vehicles, water, and wind.	Weather conditions directly affect how the hazard develops. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Sheltering in place can protect people and property from harmful effects. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection and containment features, can substantially increase the damage from a hazardous materials release.

Source: FEMA 386-7, State and Local Mitigation Planning How-To Guide: Integrating Manmade Hazards

The effects of terrorism can include injuries, loss of life, property damage, or disruption of services such as electricity, water supplies, transportation, or communications. Effects may be immediate or delayed. Terrorists often choose targets that offer limited danger to themselves and areas with relatively easy public access. Foreign terrorists look for visible targets where they can avoid detection before and after an attack, such as international airports, large cities, major special events, and high-profile landmarks.

In dealing with terrorism, the unpredictability of human beings must be considered. People with a desire to perform such acts may seek out targets of opportunity that may not fall into established lists of critical areas or facilities. First responders train to respond not only to organized terrorism events, but also to random acts by individuals who, for a variety of reasons ranging from fear to emotional trauma to mental instability, may choose to harm others and destroy property. While education, heightened awareness, and early warning of unusual circumstances may deter terrorism, intentional acts that harm people and property are possible at any time. Public safety entities must react to the threat, locating, isolating, and neutralizing further damage and investigating potential scenes and suspects to bring criminals to justice.

12.1.4 MASS MIGRATION

Population migration of large scales can lead to resource pressure - such resources include water, gasoline, housing, transportation, first responders, medical care, government services - on communities receiving the migrants and can exacerbate existing instability. In communities lacking the capacity to manage a rapid influx or exodus or already managing underlying threats, migration of this scale greatly increases the potential to destabilize communities. Types of mass migration include large gatherings, planned events, tourism, migrant agriculture, and permanent retreats from hazard impacted areas.

Large Gatherings/ Special Events

Large gatherings refer to a planned or spontaneous event, indoors or outdoors, with a significant number of people participating or in attendance such as a community event or gathering, concert, festival, conference, parade, wedding, protests, or sporting event.

Special events result in concentrations of large numbers of people in limited geographic areas. Such concentrations exacerbate the effects of any other hazard that may result from or be coincidental to the event. Special events may increase the likelihood of human-caused hazards such as terrorism, civil unrest or high-occupancy building fires. Injuries and/or loss of life may be much greater if naturally occurring hazards such as earthquakes or adverse weather occur during a special event. Simply having a massive concentration of people requires additional planning and caution, regardless of the special risks associated with any particular event. Large-scale special events require the deployment of police, fire, and emergency medical personnel, rendering these resources unavailable for response to emergencies in other locations in the community. Many large-scale special events result in street closures and increased traffic congestion, slowing response time for emergency personnel and equipment.

Transient and Non-Resident Populations

The physical location and the geographic terrain of Monterey County has created a nexus for several economic drivers which attract transient, non-resident populations. In Monterey County, the Agriculture and Tourism sectors experience seasonal fluctuations, and subsequently an ongoing high rate of population influx and outflow.

A migrant farmworker is defined as an individual who is required to be absent from a permanent place of residence for the purpose of seeking employment in agricultural work. Due to the seasonal nature of agriculture, workers travel and work throughout the US, serving as the backbone for this major industry. The National Agricultural Workers Survey (NAWS) defines a migrant farmworker as a person who reported jobs that were at least 75 miles apart or who reported moving more than 75 miles to obtain a farm job during a 12-month period. While the vast majority of farmworkers in the US are settled (81%), around 19% are migratory.[35] California growers employ one out of three of the nation’s farmworkers. Annual influxes of agricultural workers can place a strain on local resources.

Over the past decades, global tourism industry has been growing exponentially, more than doubling between 1992 and 2012. By 2030, annual international tourism is estimated to grow to up to 1.8 billion.[36] Therefore, tourism is becoming globally one of the most important economic activities, at the same time, the sector is regularly challenged by crises caused by natural, man-made or other often subjective risks. Risks associated with the tourism industry include:

- Tourism infrastructure is often located in areas exposed to sudden-onset natural disasters, in particular beach and coastal areas, river valleys and mountain regions.
- Many natural disasters, crime incidents, epidemics, acts of terrorism and civil strife are either deliberately targeted at places where tourists gather or coincidentally occur in areas with high concentrations of tourists.
- Tourists often lack familiarity with a destination region, local customs, language, or a lack of awareness of local security risks and threats often result in the tourists having a higher propensity to find themselves in dangerous situations than many local residents.
- As seen during the COVID-19 Pandemic, tourism has also been a significant contributing factor in the rapid spread of infectious diseases.
- A large-scale disaster is likely to stretch the capacity of emergency services in any jurisdiction, but large tourist populations can further strain the capabilities of medical, emergency rescue, police, ambulance, and hospital services to cope with a disaster.
- While residents are normally easy to locate and identify by local emergency agencies, tourists by virtue of their transient presence are not.

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[35] Findings from the National Agricultural Workers Survey (NAWS) 2015-2016: A Demographic and Employment Profile of United States Farmworkers. JBS International (January 2018).

[36] Tourism and Disaster Risk. UN World Conference on Disaster Risk Reduction (2015)

Retreat from Hazard Impacted Areas

One of the most pressing concerns relates to the growth in climate-induced migration. In 2017, 68.5 million people were forcibly displaced, more than at any point in human history. While it is difficult to estimate, approximately one-third of these (22.5 million to 24 million people) were forced to move by “sudden onset” weather events, such as flooding, wildfires, and intensified storms.[37] While the remaining two-thirds of displacements are the results of other crises, it is becoming apparent that climate change is contributing to so-called slow onset events such as desertification, sea-level rise, ocean acidification, air pollution, rain pattern shifts and loss of biodiversity. Put simply, climate change will cause population movements by making certain parts of the world much less viable places to live; by causing food and water supplies to become more unreliable and increasing the frequency and severity of floods and storms. Migration is possibly the most direct adaptation strategy to climate change. As climate change continues with tremendous changes in local living conditions, populations in communities with worsening conditions consider moving to better places, provided the costs of migration are affordable. Additionally, sudden climatic changes or natural disasters might lead, in the absence of alternatives, to migration choices which are forced rather than the result of a well-planned process.

Evidence of sudden disaster-induced displacement can be found after catastrophic Camp Fire in 2018. The wildfire destroyed over 18,000 structures and led to the temporary displacement of approximately 56,000 residents and the longer-term displacement of over 20,000 residents. The majority of long-term displaced residents fled the Town of Paradise, where nearly 95% of the community’s structures were damaged and destroyed. The sudden influx of people across the region for an extended period of time put a strain on the resources of municipalities surrounding the burn scar. In 2019, the City of Chico estimated more than $500 million in impacts associated with sudden growth and pressure on local infrastructure. The impacts of the Camp Fire have substantially changed the dynamics of growth in the region, with some communities, like the City of Chico, experiencing more than a decade worth of growth in one year. Meanwhile, the Town of Paradise experienced a population loss of about 83% from 2018 to 2019 and Butte County saw a loss of more than 10,000 residents between 2019 and 2020. It will likely take at least two decades for the Town of Paradise to approach its former population, but the level of losses means the community will never be made whole. Many former residents of both Paradise and Butte County are likely to never return. Understanding how many of these residents may return in the future will require more extensive research and outreach, but interviews and surveys conducted as part of the Town of Paradise Recovery Plan revealed between that about 25% and 35% were looking to return in the future.[38]

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[37] The climate crisis, migration, and refugees. John Podesta, The Brookings Institute (July 25, 2019).

[38] The Impacts of Camp Fire Disaster on Housing Market Conditions and Housing Opportunities in the Tri-County Region. Peloton Research + Economics (September 1, 2020)

12.2 HAZARD PROFILE

12.2.1 HISTORY

Cyber-Attack

The County has experienced a number of coordinated attacks over recent years. In 2015, one large County department was hit by the CryptoWall ransomware as a result of a user downloading an infected file. Over 1,500 shared files were encrypted, became unrecoverable, and had to be restored from backup.

Another ransomware incident occurred in 2020, when an attacker successfully broke into and planted the "CrySIS" ransomware variant on a file server in one of the County's newly merged departments. A ransom note asking for $10,000 was left behind. The ransomware encrypted all shared files on the department's file server, effectively destroying years of work. The technology for this new department has since been upgraded and brought up to County standards.

On a monthly basis, the County is hit by credential stealing attacks. In these attacks, an end-user surrenders their Office365 credentials to an attacker, usually through a phishing attack. The attacker then logs into Office365 remotely, sets up automated Outlook rules so that the victim cannot see any replies to the emails sent from this account, and then proceeds to use the account to trick other County users into surrendering their credentials as well. The goal of the attacker in these cases is most likely financial gain through the sales of the credentials, spamming, and potential theft of information. This can be mitigated through the deployment of user-friendly two-factor authentication.

Targeted Violence

In the US, between 2000 to 2018 there were 277 active shooter incidents and 2,430 casualties, including 884 killed and 1,546 wounded.[39] In the neighboring jurisdiction of Santa Clara County, a mass shooting occurred at the Gilroy Garlic Festival in Gilroy, California, on July 28, 2019. The gunman killed himself and three others and wounded 17 people. The FBI opened a domestic terrorism investigation into the incident.

Terrorism

In May and June 2020 multiple attacks were made on federal and local law enforcement in Oakland and Ben Lomond, California. The actors were affiliated with the Boogaloo Movement, known for its extremist, anti-law enforcement views and ties to a movement that believes a second American Civil War is coming soon. The actors are accused of assassinating a Federal Protective Services Officer and injuring his partner on the night of May 29, after firing on them

[39] Quick Look: 277 Active Shooter Incidents in the United States From 2000 to 2018, Federal Bureau of Investigations Office of Partner Engagements

from a white van, in what is described as "an ambush." The actors purposefully chose the night of massive protests to gain cover for the attacks.

On June 6, 2020, Santa Cruz deputies responded to a call about a suspicious van parked off the road. The caller saw guns and bomb-making materials inside the van, according to the sheriff's department. The actor would later lob pipe bombs and open fire with assault weapons on law enforcement officers in Ben Lomond, killing one Santa Cruz deputy and injuring two other Santa Cruz deputies.

Mass Migration

An influx of agricultural workers to the Salinas and Pajaro Valleys occurs every year during peak growing season. For the three-year period 2014-16, the average monthly employment in the region reached 80,715 during July. The month of the lowest total, with 34,737 employed, was January, reflecting the seasonal pattern of agriculture sector jobs. The three-year annual average of monthly employment in the region increased from 49,035 during 2005-07 to 60,837 during 2014-16. Thus, annual average agricultural employment in the Salinas-Pajaro Valleys increased by a remarkable 24% during the past decade.[40]

Monterey County has more farmworkers per acre than any other county in the nation; half of those laborers will come from outside the county. The seasonal increase of migratory agricultural workers during the peak of the 2020 COVID-19 pandemic provided significant challenges for reducing the spread of COVID-19 and protecting vulnerable populations.

Monterey County receives 4.6 million visitors a year and hosts approximately 50 large events per year, therefore large population influxes of tourists and event attendees have historically happened regularly in the County.

12.2.2 LOCATION

Cyber-Attack

This hazard is not geographically based. Attacks can originate from any computer to affect any other computer in the world. If a system is connected to the Internet or operating on a wireless frequency, it is susceptible to exploitation. An international study released by Malwarebytes in 2016 found that 46% of all ransomware attacks originated from email.[41]

Targets of cyber-attacks can be individual computers, networks, organizations, business sectors, or governments. Financial institutions and retailers are often targeted to extract personal and financial data that can be used to steal money from individuals and banks. The most affected sectors are finance, energy and utilities, and defense and aerospace, as well as communication, retail, and health care. Both public and private operations in Monterey County are threatened

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[40] Farmworker Housing Study and Action Plan for Salinas Valley and Pajaro Valley, California Institute for Rural Studies (April 2018)

[41] Understanding the Depth of the Global Ransomware Problem, Malwarebytes (August 2016)

on a near-daily basis by millions of currently existing cyber-attacks developed to automatically seek technological vulnerabilities.

Targeted Violence

Active shooter incidents typically occur at the following locations: areas of commerce - 43.7%; educational environments - 20.6%; government property - 9.4%; open spaces - 13.4%; residences - 4.3%; houses of worship - 4%; health care facilities - 4.3%; and other location - 0.4%.[42]

Terrorism

Monterey County has identified numerous high-profile targets for potential terrorists. Large population centers, high visibility tourist attractions, and critical infrastructure accessible to the public present security challenges of an ongoing nature in the County.

Some key assets considered as locations for terrorist attacks in Monterey County include:

- Government Offices
- Emergency Services
- Transportation infrastructure
- Health care system
- Agricultural facilities
- Recreational facilities
- Military Installations
- Politically or symbolically significant sites
- Energy, water, and related utility systems
- Telecommunications and information systems
- Mobile assets
- Events and attractions

Mass Migration

The mass migration of agricultural workers is likely to affect the Salinas and Pajaro Valleys and cities along the Highway 101 corridor.

Large events in Monterey County include the AT&T Pebble Beach Pro-Am, the Sea Otter Classic, the California International Air Show, the Big Sur International Marathon, the Big Sur Food & Wine Festival, the Firestone Grand Prix, the California Rodeo Salinas, the Sand City West End Celebration, the Artichoke Festival, the Monterey Jazz Festival, and the Concours D'Elegance.

Major tourist attractions are primarily located on the coast and on the densely populated Monterey Peninsula. In 2016, the Monterey County Convention and Visitors Bureau, surveyed approximately 1,300 visitors to the County, both at area lodging properties and specific tourism locations. Based on the 2016 Monterey County Visitor Profile Report Findings,[43]major attractions include Cannery Row, Fisherman's Wharf, the 17-Mile Drive, state parks and beaches, and the Monterey Bay Aquarium. *Figure 12-1* shows the percentage visitors who indicated that they had visited or were planning to visit the listed Monterey County attractions.

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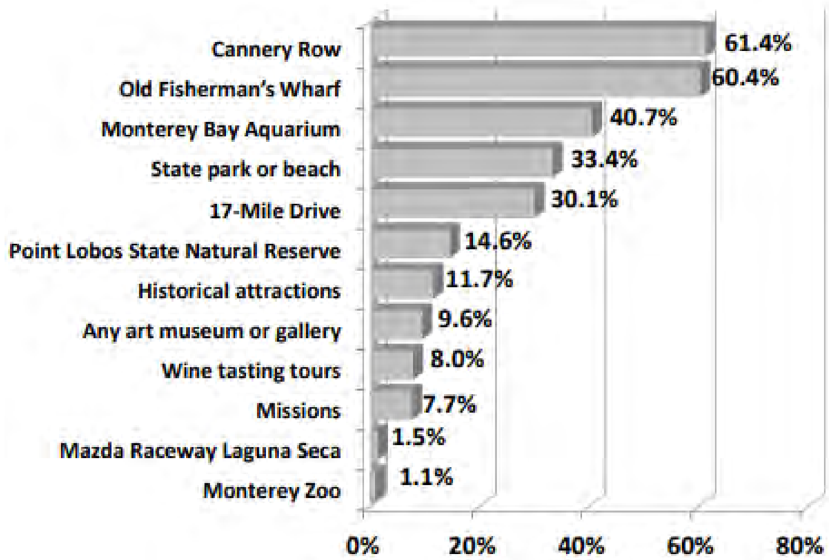
[42] Quick Look: 277 Active Shooter Incidents in the United States From 2000 to 2018, Federal Bureau of Investigations Office of Partner Engagements

[43] 2016 Monterey County Visitor Profile Final Report of Findings, Monterey County Convention and Visitors Bureau (January 2017)

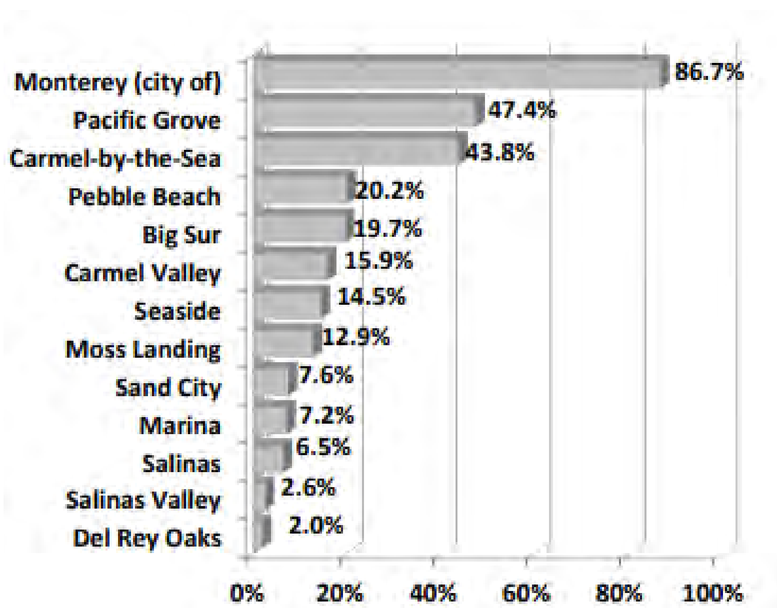
Figure 12-1
Monterey County Attractions Visited



Source: Monterey County Convention and Visitors Bureau

The most visited areas of the County are the Cities of Monterey, Pacific Grove, and Carmel-by-the-Sea, and the unincorporated area of Pebble Beach. *Figure 12-2* shows the percentage visitors who indicated that they had visited or were planning to visit the listed area.

Figure 12-2
Monterey County Areas Visited



Source: Monterey County Convention and Visitors Bureau

12.2.3 FREQUENCY

Cyber-Attack

Cyber-security threats are experienced on a daily basis, often without being noticed. Up-to-date virus protection software used in the public and private sector prevents most cyber-attacks from becoming successful, but regardless the number of security attacks is increasing. Nearly 80% of US companies have suffered a cyber-attack in the last year and more than half experienced a ransomware incident.[44]

State and local governments often struggle with cybersecurity due to limited resources, are often under attack by cyber-criminals and ransomware operators. COVID-19 has increased these challenges. The combination of reduced tax revenues and the additional costs caused by the pandemic are likely to strain budgets reducing expenditures on cybersecurity. This risk is exacerbated by an increasingly decentralized staff. Many employees are still working from home and therefore using their home Wi-Fi network, which is likely less secure than government networks.

Targeted Violence

Studies indicate that the rate at which public mass active shooter incidents occur has tripled since 2011. Between 1982 and 2011, a mass active shooter incident occurred roughly once every 200 days. Between 2011 and 2014 that rate has accelerated greatly with at least one mass shooting occurring every 64 days in the United States.[45]

Terrorism

The likelihood of a terrorist event varies with the method of attack, as follows:

- Chemical: The risk of a chemical event is present in the County. The petroleum and agricultural community use and store significant amounts of chemicals that could be used in destructive ways.
- Explosives: The elements necessary to construct a WMD explosive are readily available. Agricultural communities maintain sufficient products for use in explosive devices. Pipe bomb and suspicious package events have occurred in Monterey County, though none have been specifically identified as a WMD.
- Radiological/Nuclear: The major transportation arteries for vehicles or rail that cross through or near the County contribute to the risk of a radiological event. Such products can pass through any of the regional transportation corridors.
- Biological: Anthrax incidents that occurred in the US in October 2001 demonstrate the potential for spreading terror through biological weapons. An agent also could be introduced to livestock, causing harm to public health and the economy.

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[44] Understanding the Depth of the Global Ransomware Problem, Malwarebytes (August 2016)
[45] Rate of Mass Shootings Has Tripled Since 2011, Harvard Research Shows, Amy P. Cohen, Deborah Azrael, and Matthew Miller (October 15, 2014)

- Combined Hazards: WMD agents can be combined to have a greater total effect. Given the risks associated with chemical agents in Monterey County, the possibility of a combined event exists.

Mass Migration

Mass migration is possible anytime and is likely to occur every year. Mass migration of agricultural workers follows seasonal patterns each year. The peak average monthly employment occurs in July (80,715 average monthly employment from 2014-16) and is at its lowest in January (34,737 average monthly employment from 2014-16). [46]

Tourist populations tend to visit the County during the summer months. Monterey County visitors spend an average of 3.6 days and 2.7 nights in the area. [47]

12.2.4 SEVERITY

Cyber-Attack

There is no official index for measuring the severity of a cyber-attack. An international study released by Malwarebytes in 2016 found that cyber-ransom threats caused 34% of business victims to lose revenue and 20% had to stop business immediately. The study also reported that nearly 60% of all cyber-ransom attacks demanded over $1,000, over 20% asked for more than $10,000, and 1% asked for over $150,000. [48]

Targeted Violence

The severity of targeted violence may vary from a few injured people to multiple injuries and fatalities. A Multiple Casualty Incident (MCI) is defined as any incident with three or more fatalities or critically injuries. MCIs may result from acts of violence such as shootings or hostage situations. Effects may include serious injuries, loss of life, and associated property damage. Because large numbers of patients may be involved, significant MCIs may tax local emergency medical and hospital resources, and therefore require a regional response. First responders, including fire, police, and emergency room staffs at local hospitals, follow established protocols for MCIs. Emergency response mutual aid is requested should local officials be unable to respond appropriately with available personnel and equipment.

Terrorism

The severity of a terrorist attack may vary from a few injured people to multiple injuries and fatalities. Terrorism can also cause the destruction of property, widespread illness and injury, the displacement of large numbers of people, and devastating economic loss.

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[46] Farmworker Housing Study and Action Plan for Salinas Valley and Pajaro Valley, California Institute for Rural Studies (April 2018)

[47] 2016 Monterey County Visitor Profile Final Report of Findings, Monterey County Convention and Visitors Bureau (January 2017)

[48] Understanding the Depth of the Global Ransomware Problem, Malwarebytes (August 2016)

Mass Migration

The severity of mass migration events varies by type of migration and the ability of the location of the migration to absorb the excess population. Mass migration can increase use of limited roadway infrastructure, reduce short-term housing inventory, and increase demand for public safety resources. Mass migration can affect the already limited housing inventory in the County and lead people to live in congested housing. California has severe housing challenges for both rental and homeownership in terms of both supply and affordability. The production of housing has not returned to the level required to meet the projected housing need. [49] The severity of incidents associated at a special event varies greatly but some special events present more risks than others (such as a political rally). It is not uncommon for people to be injured and killed as perpetrators, participants and/or innocent spectators.

12.2.5 WARNING TIME

Cyber-Attack

There is no warning time for cyber-attacks.

Targeted Violence

While active shooter situations are often unpredictable, paying careful attention to warning signs could go a long way in mitigating a potential incident. Some shooters demonstrate progressively escalating risk factors in their mindsets and behaviors that characterize them as violent prior to an attack. Recognizing these warning signs and reaching out for help could bring at-risk individuals to the attention of law enforcement sooner and prevent a future attack. Potential warning signs[50] include:

- Increasingly erratic, unsafe, or aggressive behaviors.
- Hostile behavior based on claims of injustice or perceived wrongdoing.
- Drug and alcohol abuse.
- Claims of marginalization or distancing from friends and colleagues.
- Changes in performance at work.
- Sudden and dramatic changes in home life or in personality.
- Financial difficulties.
- Pending civil or criminal litigation.
- Observable grievances and making statements of retribution.

Terrorism

Warning time for a terrorist attack varies greatly. The Federal Bureau of Investigation (FBI) and the Northern California Regional Intelligence Center (NCRIC) monitor intelligence related to threats of terrorism.

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[49] California migration: The story of 40 million, CAL MATTERS (July 29, 2019)

[50] Active Shooter Attacks: Security Awareness for Soft Targets and Crowded Places, Department of Homeland Security

Mass Migration

There is no warning time associated with mass migration events. Peak agriculture employment and the tourism season occur during the summer months so the summer season could be considered a time for higher alert to the risk of mass migration. Large events generally have dates identified months in advanced and involve pre-planning efforts, such as permit acquisition, so warning time for the event itself is generally extensive. There is usually no warning time for special events incidents unless a person calls in or posts a specific threat on social media. Then authorities may have a few hours warning time.

12.3 SECONDARY HAZARDS

The following are the most likely secondary hazards associated with human-caused hazards:

Cyber-Attack

Computer security breaches associated with data and telecommunications losses can have significant economic impact. Ransomware attacks on local governments can have wide reaching impacts on services. In the short-term, it can impact emergency response; in the long-term, it can cause a large financial impact on a jurisdiction.

Targeted Violence

An active shooter incident or MCI can make the general public nervous about going out, so that more people stay at home.

Terrorism

The largest secondary impact caused by a terrorist event would be economic. Economic impacts from terrorism could be significant. The cost of a terrorist act would be felt in loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the local level.

Mass Migration

Mass migration impacts to transportation infrastructure could cause roadway or railroad closures, which would have serious effects on the local economy and ability to provide services. Loss of major travel routes would result in loss of commerce and could impact the ability to provide emergency services to citizens. The ability to receive fuel deliveries could be impacted. Mass migration can also have impact on public health and lead to increased crime. The secondary impacts of special events incidents are possible copy-cats deploying the same tactics at an event in their area.

12.4 RISK ASSESSMENT

It is often quite difficult to quantify the potential losses from human-caused hazards. While the facilities themselves have a tangible dollar value, loss from a human-caused hazard often inflicts an even greater toll on a community, both economically and emotionally. The impact to identified values will vary from event to event and depend on the type, location, and nature of a specific incident.

12.4.1 POPULATION

Cyber-Attack

The entire County's population is exposed to cyber-attacks personally or at places of employment. All populations who directly use a computer or receive services from automated systems are exposed to cyber-terrorism. Because it is difficult to predict the particular target of cyber-terrorism, assessing vulnerability to the hazard is also difficult.

Although all individuals in the County are vulnerable to an attack, certain types of attacks would impact specific segments of the population. If the cyber-attack targeted the County's power or utility grid, individuals with medical needs would be impacted the greatest. These populations are most vulnerable because many of the life-saving systems they rely on require power. Also, if an attack occurred during months of extreme hot weather, those 65 years of age and older would be vulnerable to the effects of the lack of climate control. These individuals might require an air-conditioned shelter operating on a back-up generator. If a cyber-attack targeted a facility storing or manufacturing hazardous materials, individuals living adjacent to these facilities would be vulnerable to the secondary effects, should the attack successfully cause a critical failure at that facility.

Targeted Violence

A targeted violence event could range from an individual attack to a coordinated attack by multiple agents upon multiple targets. Large-scale incidents have the potential to kill or injure many people in the immediate vicinity and may also affect people a relative distance from the initial event.

Terrorism

A terrorist event could range from an individual attack to a coordinated attack by multiple agents upon multiple targets. Large-scale incidents have the potential to kill or injure many people in the immediate vicinity and may also affect people a relative distance from the initial event. Variables affecting exposure for a WMD attack include the physical and chemical properties of the WMD, the ambient temperature, wind speed, wind direction, barometric pressure, and humidity.

Mass Migration

The entire population of Monterey County could be impacted by a mass migration event, depending on the size and severity.

12.4.2 PROPERTY

Cyber-Attack

Structures are usually not impacted by cyber-attacks, but systems operated by electronics and computers are exposed. A catastrophic cyber-attack can have far-ranging effects on public and private infrastructure systems. Cyber-attacks can cause physical damage if real assets or end consumers are affected by service disruption. This might occur if cyber-attacks target industries related to utilities, life support, transportation, human services, or telecommunications. In many cases, attacks on these systems initially will not be detected, and any malfunction will be thought to be system failure.

Targeted Violence

All structures in the County are physically vulnerable to a targeted violence event. The emphasis on accessibility, the opportunity for roof access, driveways underneath some structures, unmonitored areas, the proximity of many structures to transportation corridors and underground pipelines, and the potential for an active shooter to strike any structure randomly all have an impact on the vulnerability of structures. Schools, churches, large event venues, and workplaces are known locations of previous targeted violence incidents and are likely more vulnerable to attack.

Terrorism

All structures in the County are physically vulnerable to a terrorism event. The emphasis on accessibility, the opportunity for roof access, driveways underneath some structures, unmonitored areas, the proximity of many structures to transportation corridors and underground pipelines, and the potential for a terrorist to strike any structure randomly all have an impact on the vulnerability of structures.

Mass Migration

Structures are unlikely to be impacted by mass migration events but can restrict an already limited housing inventory in the County, both through increases in population and when housing is taken off the market for the purposes of vacation rental. Congested housing can lead structures to deteriorate faster. Increased use of facilities and visitor-serving amenities are also likely to deteriorate at faster rates when utilized by larger and larger populations.

12.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Cyber-Attack

All critical facilities and infrastructure that are operated by a computer system are exposed to cyber-attacks. Cyber-attacks may affect structures if any critical electronic systems suffer service disruption. For instance, a cyber-attack may cripple the electronic system that controls a cooling system or pressure system within critical infrastructure. This may result in physical damage to the structure from components overheating, or an explosion if pressure relief systems are rendered inoperable.

Targeted Violence

All critical facilities and infrastructure could be impacted by targeted violence.

Terrorism

Terrorism events can pose a serious long-term threat to critical facilities and infrastructure. The exposure and vulnerability of critical facilities and infrastructure to a terrorism event is based on the two distinct but complementary approaches. First, any given place in the built environment has a certain level of inherent vulnerability that exists independent of any protective or mitigation actions that are applied to it. Second, the security, design, and other mitigation tools used to protect a place determine its tactical vulnerability. [51] The inherent vulnerability of critical infrastructure is based on:

- *Visibility*: How aware is the public of the existence of the facility, system, or location?
- *Utility*: How valuable is the place in meeting the objective(s) of a potential terrorist?
- *Accessibility*: How accessible is the place to the public?
- *Asset mobility*: Is the asset's location fixed or mobile? If mobile, how often is it moved, relocated, or repositioned?
- *Presence of hazardous materials*: Are flammable, explosive, biological, chemical, and/or radiological materials present on site?
- *Potential for collateral damage*: What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- *Occupancy*: What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

The tactical vulnerability of each critical infrastructure is based on:

- *Site Perimeter*: Is the facility designed with security in mind—both site-specific and with regard to adjacent land uses? Are vehicle access and parking managed in a way that separates vehicles and structures?
- *Building Envelope*: Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological, and radiological contaminants?
- *Facility Interior*: Does security screening cover all public and private areas? Are public and private activities separated? Are critical building systems and activities separated? Are utilities and HVAC systems protected and/or backed up with redundant systems? Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient? Are the building's water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility? Are systems and personnel in place to monitor and protect the facility?

Mass Migration

All critical facilities and infrastructure have the potential to be impacted by mass migration events. In particular, water and road infrastructure capacity could quickly become overwhelmed.

[51] FEMA 386-7, State and Local Mitigation Planning How-To Guide: Integrating Manmade Hazards

12.4.4 ENVIRONMENT

Cyber-Attack

While effects of cyber-threats on the natural environment are unlikely, they can occur. It would only be through a secondary effect that the environment could be affected by a cyber-attack. Such effects may come from a system failure that, for example, allows a release of hazardous materials or improper disposal of waste or if a cyber-attack shut down a hydroelectric dam so that a river would be affected.

Targeted Violence

Targeted violence is unlikely to be associated with environmental impacts.

Terrorism

A terrorism event using a WMD can kill wildlife, destroy habitat, and contaminate critical resources in the food chain.

Mass Migration

Mass migration is unlikely to be associated with environmental impacts, though increased motorists on the road could lead to increases in pollution.

12.4.5 ECONOMIC IMPACTS

Cyber-Attack

Economic impacts can be far-reaching if a cyber-attack or space weather event is prolonged for a week or longer. Cyber-attacks can have extensive fiscal impacts. Companies and government services can lose large sums of unrecoverable revenue from site downtime and possible compromise of sensitive confidential data. Cyber incidents could result in the theft or modification of important data—including personal, agency, or corporate information— and the sabotage of critical processes, including the provision of basic services by government or private-sector entities.

Targeted Violence

The economic impact price tag of potential losses from targeted violence could be huge if lives are lost, jobs are lost, and assets are damaged. Violence can cause fear in residents and visitors to go into public spaces in the County, which could affect the economy.

Terrorism

The economic impact price tag of potential losses from terrorism could be huge if lives are lost, jobs are lost, and assets are damaged. Terrorism can cause fear in residents and visitors to go into public spaces in the County, which could affect the economy.

Mass Migration

Monterey County's economy is primarily based upon tourism in the coastal regions and agriculture in the Salinas Valley. In 2019, Monterey County agriculture accounted for a production value of over $4.4 billion. The Agricultural industry generates $11.7 billion in economic output and one in five jobs in Monterey County directly attributable to the agricultural industry.[52] Tourism spending in the County annually is approximately $3.24 billion and supports 27,000 jobs and generates $153 million in local tax revenue.[53] Therefore, if mass migration risks impact either of these industries, economic impacts could be severe.

12.5 FUTURE TRENDS IN DEVELOPMENT

Cyber-Attack

The County will continue to be impacted and compelled to respond to cyber-attacks in the future. The nature of these attacks is projected to evolve in sophistication over time. The County and its incorporated jurisdictions are expected to remain vigilant in their efforts to prevent attacks from occurring or disrupting business operations. The reality remains that many computers and networks in organizations of all sizes and industries around the US will continue to suffer intrusion attempts on a daily basis from viruses and malware that are passed through websites and emails.

Targeted Violence

Future economic, cultural, and societal trends are likely to impact the frequency and magnitude of targeted violence incidents. Additionally, studies have linked high temperatures with increases in intense violence.[54] Increasing evidence indicates that climate change is causally associated with collective violence, generally in combination with other factors. Increased temperatures and extremes of precipitation with their associated consequences, including resultant scarcity of cropland and other key environmental resources, are major pathways by which climate change leads to collective violence.[55]

Terrorism

The agencies and organizations involved with terrorism in the County, specifically threat analyses and threat reduction, are examining the challenges presented by future development and expansion. Individually, and in collaboration with task forces and other facilities, plans are underway for continuation, changes and/or expansion of current initiatives. Buildings and other structures constructed to resist earthquakes and fires usually have qualities that also limit damage from blasts and resist fire spread and spread of noxious fumes in the event of a terrorist attack.

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[52] Economic Contributions of Monterey County Agriculture, Monterey County Agricultural Commissioner's Office (June 2020)

[53] 2020-2021 Annual Report, Monterey County Convention & Visitors Bureau

[54] Heat and Violence, Craig A. Anderson, *Current Directions in Psychological Science* (February 2001)

[55] Climate Change and Collective Violence, Barry S. Levy, Victor W. Sidel, and Jonathan A. Patz, *Annual Review of Public Health* (March 2017)

Mass Migration

Agricultural employment in the County has seen large increases in the past 10-years and could continue to see increases. Tourism in Monterey County is likely to expand and therefore, the risk of tourism associated with mass migration could increase.

Special event incidents occur when any large crowd of persons gather. For events having the potential for large crowds or mob activity, pre-planning and permits are issued, so potential disturbances are quelled through the presence of sufficient law enforcement personnel, pre-planning for crowd and traffic control.

Climate change is likely to exacerbate hazard risk and therefore, the risk of hazard-induced migration is likely to increase in the future. This dangerous situation for vulnerable communities is a perfect example of how the climate crisis magnifies and upholds existing inequities associated with racism, extreme income inequality, and other structural disparities. As average temperatures rise and heat waves and wildfires get more frequent and severe, farmworkers will be at an ever-heightened risk of heat- and smoke-related illnesses. California as a whole is seeing this layering of crises unfold in real time, as the state battles COVID-19, wildfires of historic proportions, and scorching heat waves.

12.6 ISSUES

Issues associated with Human-Caused Hazards in Monterey County include:

- Continue regular and redundant emergency preparedness training for field level responders (police, fire, and public works) and public information staff in order to respond quickly in the event of a disaster associated.
- Continue to improve response times for public safety throughout the County so as to reduce exposure to human-caused incidents. Maintain appropriate staffing levels of public safety personnel to address vulnerabilities identified in this chapter.
- Work with the private sector to enhance and create business continuity plans to be followed in the event of an emergency
- Participate in regional, state, and federal efforts to gather terrorism information at all levels and keep public safety officials briefed at all times regarding local threats. Further develop response capabilities based on emerging threats.

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13. PUBLIC HEALTH HAZARDS

13.1 OVERVIEW

The US Center for Disease Control defines a disease outbreak as the occurrence of more cases of disease than normally expected within a specific place or group of people over a given period of time. An epidemic is the spread of an infectious disease beyond a local population, reaching people in a wider geographical area. Several factors determine whether an outbreak will become an epidemic including the ease with which the disease spreads from vectors, such as animals, to people and the ease with which it spreads from person to person.

A pandemic is an epidemic that occurs worldwide or over an exceptionally large area and affects a large number of people or animals. Pandemics can greatly increase morbidity and mortality over a wide geographic area and cause significant economic, social, and political disruption. Evidence suggests that the likelihood of pandemics has increased over the past century because of increased global travel and integration, urbanization, changes in land use, and greater exploitation of the natural environment.

Pandemics are hazards that have a long duration. Though daily impacts may be low, cumulative impacts are likely to be overwhelming for both the health system and the community. During a moderate pandemic, Monterey County could see a sustained increase in intensive care unit admissions, in emergency department (ED) admissions, in patients needing to be placed in respiratory isolation, and in deaths. Capacity to provide medical care, including basic emergency medical system (EMS), hospital ED services, and isolation rooms, will be reduced. At the same time, a higher than usual absenteeism rate for all employees is expected.

13.1.1 INFLUENZA

Epidemics of the flu typically occur in the fall and winter. The flu can cause mild to severe illness, and at times can lead to death. Anyone can get sick with the flu, but some people are at a higher risk of flu-related complications if they get sick. This includes older and younger people and people with certain chronic medical conditions.

Because flu seasons fluctuate in length and severity, a single estimate cannot be used to summarize influenza-associated deaths. The US Centers for Disease Control and Prevention (CDC) estimates that during the 2019–2020 flu season 38 million people fell ill, 18 million people went to a health care provider, 400,000 were hospitalized, and 22,000 died. Yearly vaccination is the primary method for preventing influenza.

H1N1

In April 2009, the World Health Organization (WHO) issued a health advisory on an outbreak of influenza-like illness caused by a new subtype of influenza A (A/H1N1) in Mexico and the United States. The disease spread rapidly, and in June the WHO declared an H1N1 pandemic, marking the first global pandemic since the 1968 Hong Kong flu. In October, the US declared H1N1 a national emergency. In August 2010, the WHO declared an end to the pandemic globally. H1N1 viruses and seasonal influenza viruses are co-circulating in many parts of the world. It is likely that the 2009 H1N1 virus will continue to spread for years to come, like a regular seasonal influenza virus.

H5N1/H7N9

The highly pathogenic H5N1 avian influenza virus is an influenza A subtype that occurs mainly in birds, causing high mortality among birds and domestic poultry. More than 700 human infections with H5N1 viruses have been reported to WHO from primarily 15 countries in Asia, Africa, the Pacific,

Historic Hazards
1918 Influenza Pandemic

The 1918 influenza pandemic was caused by an H1N1 virus of avian origin. The pandemic spread worldwide from 1918-1919. An estimated 500 million people became infected and 50 million died. An estimated 675,000 deaths occurred in the US.

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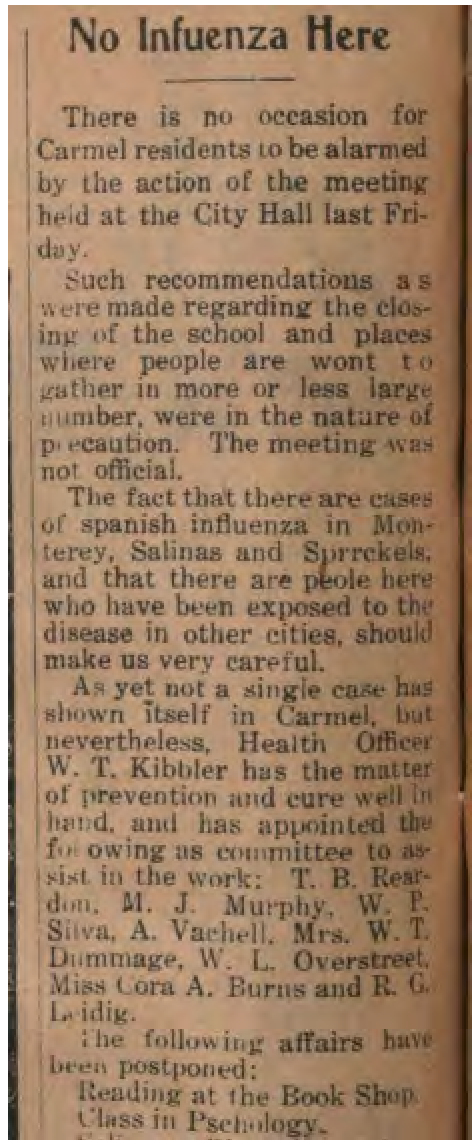

No Infuenza Here

There is no occasion for Carmel residents to be alarmed by the action of the meeting held at the City Hall last Friday.

Such recommendations as were made regarding the closing of the school and places where people are wont to gather in more or less large number, were in the nature of precaution. The meeting was not official.

The fact that there are cases of spanish influenza in Monterey, Salinas and Sprrckels, and that there are peole here who have been exposed to the disease in other cities, should make us very careful.

As yet not a single case has shown itself in Carmel, but nevertheless, Health Officer W. T. Kibbler has the matter of prevention and cure well in hand, and has appointed the following as committee to assist in the work: T. B. Reardon, M. J. Murphy, W. P. Silva, A. Vachell, Mrs. W. T. Dummage, W. L. Overstreet, Miss Cora A. Burns and R. G. Leidig.

The following affairs have been postponed:

Reading at the Book Shop.

Class in Pschology.

Europe, and the Near East since November 2003. Indonesia, Vietnam, and Egypt have reported the highest number of human H5N1 cases to date. The first report of a human infection with H5N1 in the Americas was in Canada in January of 2014 and occurred in a traveler recently returning from China. Although human infections with this virus are rare, approximately 60% of the cases have died.

H5N1 virus infections of humans are rare, and most cases have been associated with direct poultry contact during poultry outbreaks. Rare cases of limited human-to-human spread of H5N1 virus may have occurred, but there is no evidence of sustained human-to-human transmission. Nonetheless, because all influenza viruses have the ability to change and mutate, scientists are concerned that H5N1 viruses one day could be able to infect humans more easily and spread more easily from one person to another, potentially causing another pandemic.

13.1.2 CORONAVIRUSES

Coronaviruses are a large group of viruses that cause diseases in animals and humans. They often circulate among camels, cats, and bats, and can sometimes evolve and infect people. In animals, coronaviruses can cause diarrhea in cows and pigs, and upper respiratory disease in chickens. In humans, the viruses can cause mild respiratory infections, like the common cold, but can lead to serious illnesses, like pneumonia. Coronaviruses are named for the crown-like spikes on their surface. Human coronaviruses were first identified in the mid-1960s. They are closely monitored by public health officials.

Severe Acute Respiratory Syndrome (SARS)

Severe Acute Respiratory Syndrome (SARS) is a viral respiratory illness caused by a coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the global outbreak was contained. According to the WHO, 8,098 people worldwide became sick with SARS during the 2003 outbreak and 774 died. In the United States, only 11 people had laboratory evidence of SARS-CoV infection. All of these people had traveled to parts of the world where SARS was present. SARS did not spread more widely in the United States. Since 2004, there have not been any known cases of SARS reported anywhere in the world.

In general, SARS begins with a high fever, headache, an overall feeling of discomfort and body aches. Some people also have mild respiratory symptoms at the outset. About 10% to 20% of patients have diarrhea. After two to seven days, SARS patients may develop a dry cough. Most patients develop pneumonia. The main way that SARS seems to spread is by close person-to-person contact. The virus that causes SARS is thought to be transmitted most readily by respiratory droplets produced when an infected person coughs or sneezes. Droplet spread can happen when droplets from the cough or sneeze of an infected person are propelled a short distance (generally up to 3 feet) through the air and deposited on the mucous membranes of the mouth, nose, or eyes of persons nearby. The virus also can spread when a person touches a surface or object contaminated with infectious droplets and then touches their mouth, nose, or eyes. It is also possible that the SARS virus might spread more broadly through the air or by other ways that are not now known.

Middle East Respiratory Syndrome (MERS)

Middle East Respiratory Syndrome (MERS) is an illness caused by a coronavirus called Middle East Respiratory Syndrome Coronavirus (MERS-CoV). Most MERS patients developed severe respiratory illness with symptoms of fever, cough, and shortness of breath. About 3 or 4 out of every 10 patients reported with MERS have died.

Health officials first reported the disease in Saudi Arabia in September 2012. Through retrospective (backward-looking) investigations, they later identified that the first known cases of MERS occurred in Jordan in April 2012. So far, all cases of MERS have been linked through travel to, or residence in, countries in and near the Arabian Peninsula. The largest known outbreak of MERS outside the Arabian Peninsula occurred in the Republic of Korea in 2015. The outbreak was associated with a traveler returning from the Arabian Peninsula.

MERS-CoV has spread from ill people to others through close contact, such as caring for or living with an infected person. MERS can affect anyone, and MERS patients have ranged in age from younger than 1 to 99 years old. The CDC continues to closely monitor MERS globally and recognizes the potential for MERS-CoV to spread further and cause more cases globally and in the US.

Novel Coronavirus (COVID-19)

Coronavirus Disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019 and spread worldwide, leading to an ongoing pandemic. Symptoms of COVID-19 are variable, but often include fever, cough, headache, fatigue, breathing difficulties, and loss of smell and taste. The incubation period for COVID-19 is thought to extend to 14 days, with a median time of 4-5 days from exposure to symptoms onset.

COVID-19 transmits when people breathe in air contaminated by droplets and small airborne particles containing the virus. This risk is highest when people are in close proximity, but they can be inhaled over longer distances, particularly indoors. Transmission can also occur if splashed or sprayed with contaminated fluids in the eyes, nose, or mouth, and, rarely, via contaminated surfaces. People remain contagious for up to 20 days and can spread the virus even if they do not develop symptoms. Age and existing comorbidities are a strong risk factor for severe illness, complications, and death. A large cohort that included more than 44,000 people with COVID-19 from China, showed that illness severity can range from mild to critical:

- Mild to moderate (mild symptoms up to mild pneumonia): 81%
- Severe (dyspnea, hypoxia, or more than 50% lung involvement on imaging): 14%
- Critical (respiratory failure, shock, or multiorgan system dysfunction): 5%

In this study, all deaths occurred among patients with critical illness, and the overall case fatality ratio (CFR) was 2.3%. The CFR among patients with critical disease was 49%.[56] Among US COVID-19 cases reported January 22–May 30, 2020, the proportion of people who were hospitalized was 14%, including 2% admitted to the intensive care unit. Overall, 5% of patients died.[57]

Several COVID-19 vaccines have been approved and distributed in various countries, which have initiated mass vaccination campaigns. Other preventive measures include physical or social distancing, quarantining, ventilation of indoor spaces, covering coughs and sneezes, hand washing, and keeping unwashed hands away from the face. The use of face masks or coverings has been recommended in public settings to minimize the risk of transmissions. While work is underway to develop drugs that inhibit the virus, the primary treatment is symptomatic. Management involves the treatment of symptoms, supportive care, isolation, and experimental measures. COVID-19 is the most recent (and still active in 2022) pandemic declared by the World Health Organization.

13.1.3 VIRAL HEMORRHAGIC FEVERS

Viral hemorrhagic fevers (VHFs) are a group of illnesses caused by several distinct families of viruses. VHFs represent a multisystem syndrome (multiple systems in the body are affected). Characteristically, the overall vascular system is damaged and the body's ability to regulate itself is impaired. These symptoms are often accompanied by hemorrhage (bleeding); however, the bleeding itself is rarely life-threatening. While some types of hemorrhagic fever viruses can cause relatively mild illnesses, many cause severe, life-threatening disease. The viruses that cause VHFs are distributed over much of the globe. However, because each virus is associated with one or more host species, the virus, and the disease it causes are usually seen only where the host species live.

Ebola

The 2014 Ebola virus outbreak was unprecedented in geographical reach and impact on health care systems across the globe. This was the largest and deadliest Ebola virus outbreak ever recorded. It was the first occurrence of the virus in the West African countries of Guinea, Liberia, Sierra Leone, Nigeria, Mali, and Senegal. Ebola is more common in Central African countries, such as the Democratic Republic of Congo and Sudan, where it was first discovered in 1976. It was also the first time that Ebola made it to the United States and Europe, prompting world-wide preparedness and response efforts.

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[56] Wu Z, McGoogan JM. Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020 Feb 24;323(13):1239–42.

[57] Stokes EK, Zambrano LD, Anderson KN, et al. Coronavirus Disease 2019 Case Surveillance — United States, January 22–May 30, 2020. MMWR. 2020 Jun 19;69:759–765.

In August 2014, two US healthcare workers returned to the United States for treatment for Ebola. The case that most impacted the health care system in the United States was a patient diagnosed with Ebola in Dallas, Texas who died due to Ebola in October 2014. The nurse who provided care for him later tested positive for Ebola. This caused responses across the country from hospitals, emergency medical teams, fire departments and public health agencies to enhance isolation precautions, develop emergency policies, train with personal protective equipment, and conduct multi-agency emergency exercises in case the spread of Ebola became a pandemic.

Hantavirus

Hantavirus is a rodent-borne disease. It was discovered in 1993 in the southwestern US, and it has been determined that the disease had been present, but unrecognized, at least as early as 1959. It has now been identified in over half of the states of the US In 2013, seven cases of hantavirus occurred in Yosemite National Park. Hantavirus has also been detected in the Sierra Nevada region.

The hantavirus spreads when individuals touch or eat something contaminated with infected rodent urine, droppings, or saliva. It can also be transmitted through aerosolization, which occurs when dried materials contaminated by infected rodent droppings or saliva are disturbed and brought up into the air and inhaled.

Infected persons first develop symptoms one to five weeks after exposure. Early symptoms include fever, headache, and muscle aches, especially in the thighs, hips, back, and shoulders. Other early symptoms include dizziness, chills, nausea, vomiting, diarrhea, and abdominal pain. After two to seven days of these symptoms, patients develop breathing difficulties that range from cough and shortness of breath to severe respiratory failure. Approximately 40% of hantavirus patients die from the disease.

13.1.4 TICK & MOSQUITO BORNE ILLNESS

Ticks are small, insect-like creatures most often found in naturally vegetated areas. They feed by attaching to animals and humans, sticking their mouthparts into the skin, and sucking blood for up to several days. Ticks do not fall from trees, jump, or fly. Most species are found on wild grasses and low plants. Adult ticks wait at the ends of grass or other foliage for a host to brush by so they may attach. Sometimes ticks carry bacteria or viruses that can be transmitted to a person while the tick is attached and feeding. The following species of ticks are known to commonly bite humans:

- Western blacklegged tick (*Ixodes pacificus*)
- American dog tick (*Dermacentor variabilis*)
- Pacific Coast tick (*Dermacentor occidentalis*)
- Wood tick (*Dermacentor andersoni*)
- Brown dog tick (*Rhipicephalus sanguineus*)
- *Ornithodoros hermsi*
- *Ornithodoros parkeri*
- *Ornithodoros coriaceus*

Tularemia

Tularemia, named after Tulare County in California, where it was first described in 1911, is a tick-borne disease of animals and humans caused by the bacterium *Francisella tularensis*. Tularemia is similar to plague but is typically spread differently. Humans usually become infected with Tularemia by tick and deer fly bites, skin contact with infected animals, ingestion of contaminated water or meat, or inhalation of contaminated dusts or aerosols. Symptoms vary depending upon the route of infection.

Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Although Tularemia can be life-threatening, most infections can be treated successfully with antibiotics. Steps to prevent Tularemia include use of insect repellent, wearing gloves when handling sick or dead animals, and not mowing over dead animals. In the United States, naturally occurring infections have been reported from all states except Hawaii.

Lyme Disease

Lyme disease, named after the city in Connecticut, where it was first identified in 1975, is a tick-borne disease caused by the bacterium *Borrelia burgdorferi*, which normally lives in mice, squirrels, and other small animals. It is transmitted among these animals and to humans through the bites of certain species of ticks. In the northeastern and north-central United States, the black-legged tick (or deer tick, *Ixodes scapularis*) transmits Lyme disease. In the Pacific coastal United States, the disease is spread by the western black-legged tick (*Ixodes pacificus*). Other major tick species found in the United States have not been shown to transmit the disease.

Typical symptoms include fever, headache, fatigue, and a skin rash. If left untreated, infection can spread to joints, the heart, and the nervous system. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks. Laboratory testing is helpful in later stages of the disease. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly, landscaping, and integrated pest management. The ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases as well.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is a potentially fatal tick-borne disease caused by the bacterium *Rickettsia rickettsii*. It is transmitted to humans by the bite of an infected American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), or brown dog tick (*Rhipicephalus sanguineus*).

Typical symptoms include fever, headache, abdominal pain, vomiting, and muscle pain. A rash may also develop, but is often absent in the first few days, and in some patients, never develops. Rocky Mountain spotted fever can be a severe or even fatal illness if not treated in the first few days of symptoms. It can be treated successfully with a few weeks of antibiotics. Steps to prevent the disease include using insect repellent, removing ticks promptly, landscaping, and integrated pest management. The ticks that transmit Rocky Mountain spotted fever can occasionally transmit other tick-borne diseases as well.

Malaria

Malaria is a sometimes-fatal mosquito-borne disease caused by a parasite that commonly infects the Anopheles mosquito, which feeds on humans. People who contract malaria are typically extremely sick with high fevers, chills, and flu-like illness. Although malaria can be fatal, illness and death can usually be prevented.

On average 1,500 cases of malaria are diagnosed in the United States each year. The vast majority are in travelers and immigrants returning from countries where malaria transmission occurs, many from sub-Saharan Africa and South Asia. In many temperate areas, such as western Europe and the United States, economic development and public health measures have succeeded in eliminating malaria. However, most of these areas have Anopheles mosquitoes that can transmit malaria, and reintroduction of the disease is a constant risk.

West Nile Virus

West Nile Virus is a potentially serious mosquito-borne that may affect residents in the County. Experts believe West Nile Virus is established as a seasonal epidemic in North America that flares up in the summer and continues into the fall. Mosquitoes transmit the virus to birds, livestock, and humans. Between 1999 and 2019, a total of 51,801 cases of West Nile Virus disease in people was reported to CDC, 7,026 of which were in California.

According to the CDC, approximately 80% of people who are infected with West Nile Virus will show no symptoms. Up to 20% have symptoms such as fever, headache, and body aches, nausea, vomiting, and sometimes swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms can last for as short as a few days, though even healthy people have become sick for several weeks. About 1% of people infected with West Nile Virus will develop severe illness, with symptoms that can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness, and paralysis. These symptoms may last several weeks, and neurological effects may become permanent. There is no specific treatment for West Nile Virus infection. In more severe cases, people may need to go to the hospital where they can receive supportive treatment including intravenous fluids, help with breathing and nursing care.

Dengue Fever

Dengue is a mosquito-borne disease caused by any of four closely related dengue viruses (DENV-1, DENV-2, DENV-3, and DENV-4). People get dengue from the bite of an infected mosquito. The mosquito becomes infected when it bites a person who has dengue virus in their blood. It takes a week or more for the dengue virus to replicate in the mosquito; then the mosquito can transmit the virus to another person when it bites. Dengue is transmitted by the yellow fever mosquito (*Aedes aegypti*) and the Asian tiger mosquito (*Aedes albopictus*). Dengue virus cannot be transmitted from person to person.

Generally, younger children and those with their first dengue infection have a milder illness than older children and adults. The main symptoms are high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, bruising, and sometimes mild bleeding from the nose or mouth. Severe dengue patients proceed to experience more bleeding, severe pain in the abdomen, respiratory distress, and fluid accumulation in the abdomen and around the lungs as the smallest blood vessels (capillaries) begin to leak. If not treated, severe dengue can result in death. There is no specific treatment for dengue infection. Rest and fluids are generally sufficient for persons with dengue. Severe dengue may require hospitalization and intensive medical care.

Zika Virus

Zika is a mosquito-borne disease. The most common symptoms of Zika are fever, rash, joint pain, and conjunctivitis (red eyes). The illness is usually mild, with symptoms lasting for several days to a week after being bitten by an infected mosquito. People usually do not get sick enough to go to the hospital, and they rarely die of Zika. For this reason, many people might not realize they have been infected. However, Zika virus infection during pregnancy can cause a serious birth defect called microcephaly, as well as other severe fetal brain defects. Once a person has been infected, he or she is likely to be protected from future infections.

Zika virus is transmitted by yellow fever mosquito (Aedes aegypti) and the Asian tiger mosquito (Aedes albopictus). An Aedes mosquito can only transmit Zika virus after it bites a person who has this virus in their blood. Zika virus is not spread through casual contact but can be spread by infected men to their sexual partners. There is a growing association between Zika and microcephaly (abnormally small head and brain) in newborns, as well as Zika and Guillain-Barré Syndrome, a disease affecting the nervous system. Studies are ongoing to further evaluate these associations.

13.1.5 VALLEY FEVER

Valley Fever, also called coccidioidomycosis, is an infection caused by the fungus *Coccidioides*. The illness is caused by breathing in a fungus which lives naturally in the soil of nearby San Luis Obispo and Santa Barbara Counties. People get sick by breathing in a form of the Valley Fever fungus called spores. Spores are too small to be seen. They can get into the air with dust when it is windy or when dirt is disturbed. In extremely rare cases, the fungal spores can enter the skin through a cut, wound, or splinter and cause a skin infection. Valley Fever cannot be spread from one person to another or from an animal to a person.

Most people who become infected with Valley Fever (60%) do not experience any symptoms and do not need treatment. Around 30 to 40% of people develop flu-like symptoms such as severe fatigue, cough, fever, heavy sweating at night, loss of appetite, muscle, and joint aches, and sometimes a rash. Approximately 5 to 10% of people who get Valley Fever will develop serious or long-term problems in their lungs. In an even smaller percentage of people (about 1%), the infection spreads from the lungs to other parts of the body, such as the central nervous system (brain and spinal cord), skin, or bones and joints. This type of infection can be serious and is sometimes fatal.

Symptoms of valley fever may appear between 1 and 3 weeks after a person breathes in the fungal spores and usually last for a few weeks to a few months. Valley Fever is more common among older adults, though anyone of any age can contract it. Several groups of people are at higher risk for developing the severe forms of Valley Fever, including African Americans, Filipinos, women in the third trimester of pregnancy, and people with weak immune systems.

Valley Fever appears to be on the rise in recent years, with 2017 bringing the highest number of recorded cases on record to California. According to the CDC, while the reasons for the increased incidence in Valley Fever in 2016 are not known, climatic and environmental factors favorable to Valley Fever proliferation and airborne release might have contributed, including rainfall after several years of drought and soil disturbance resulting from construction. The UC Davis Valley Fever Center attributes the increase in cases to drought conditions and firefighting equipment stirring up fungus in the soil. A March 2013 Morbidity and Mortality Weekly Report published by the Centers for Disease Control and Prevention (CDC) and referenced in the 2018 California State Hazard Mitigation Plan notes that more than 20,000 cases of Valley Fever are reported each year in the United States, but many more cases likely go undiagnosed. Some researchers estimate that each year the fungus infects more than 150,000 people, many of whom are sick without knowing the cause or have symptoms so mild they are not recognized.

13.1.6 POLICIES, PLANS, AND REGULATORY ENVIRONMENT

United States Department of Health and Human Services

The US Department of Health and Human Services has statutory responsibility for preventing the introduction, transmission, and spread of communicable diseases in the United States. The Center for Disease Control and Prevention (CDC) is housed within the Department of Health and Human Services and is responsible for controlling the introduction and spread of infectious diseases. The CDC's roles include:

- Instituting public education and awareness related to disease spread and prevention
- Studying and tracking transmission rates, treatment options, and vaccines
- Maintaining active surveillance of diseases through investigation and data collection, analysis, and distribution
- Developing and implementing operational programs and guidance relating to environmental health problems
- Conducting research aimed at developing and testing effective disease prevention, control, and health
- Implementing a program to sustain a strong national workforce in disease prevention and control, and conducts a national program for improving the performance of clinical laboratories

The Division of Global Migration and Quarantine works to control disease transmission internationally through the operation of Quarantine Stations at ports of entry, establishment of standards for medical examination of persons destined for the United States, and administration of interstate and foreign quarantine regulations, which govern the international and interstate movement of persons, animals, and cargo.

California Department of Public Health

The California Department of Public Health (CDPH) is responsible for protecting public health within the state of California. The CDPH consists of public health professions, researchers, scientists, doctors, nurses, and other staff members who aid in implementing the organizations programs and services. The essential functions of the CDPH are comprehensive in scope and include infectious disease control and prevention, food safety, environmental health, laboratory services, patient safety, emergency preparedness, chronic disease prevention and health promotion, family health, health equity and vital records and statistics.

Monterey County Health Department

The Monterey County Health Department exists to enhance, protect, and improve the health of the people in Monterey County. To accomplish this, the Department provides a wide variety of health-related services in the areas of public health, environmental health, behavioral health, and clinic services. The Public Health Bureau has programs that cover several essential public health services, including surveillance, disaster preparedness, diagnosing and addressing health problems, outreach, and education, and mobilizing community partnerships to identify and solve health problems. The Communicable Disease Prevention and Control Unit is responsible for preventing and controlling the spread of infectious diseases.

13.2 HAZARD PROFILE

The severity of human health hazards is dependent upon the hazard and the population exposed to it. As the population increases, so does the risk of exposure to public health hazards. The key to reducing the disease hazard is isolation so that the infected population does not continue to spread the hazard to the uninfected population. For disease health hazards, promoting education and personal preparedness will help to mitigate and reduce the severity of the hazard.

13.2.1 HISTORY

Table 13-1 lists communicable disease cases in Monterey County from 2009 to 2019 for select disease discussed in this plan.

Table 13-1
Selected Communicable Disease Cases in Monterey Country (2009-2019)

Disease	Year											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Dengue Fever	0	1	1	1	0	1	2	1	3	0	1	**12**
Hantavirus	0	0	0	0	0	0	0	0	0	0	0	**0**
Lyme Disease	0	1	1	1	1	0	2	2	0	0	3	**12**
Malaria	2	3	3	0	1	1	0	0	0	1	2	**13**
Rickettsiosis	0	0	1	2	1	1	0	0	0	0	1	**6**
Tularemia	0	0	0	0	0	0	0	0	1	0	1	**2**
Valley Fever	39	56	67	76	69	24	38	79	191	238	164	**1,041**
West Nile Virus	1	0	0	1	0	0	0	1	0	1	0	**4**
Zika Virus	0	0	0	0	0	0	0	5	1	0	0	**6**

Source: California Department of Public Health- West Nile Virus Cases, 2006-present and Infectious Diseases by Disease, County, Year, and Sex

There were two confirmed cases of SARS in California during the worldwide outbreak in 2002-2003, neither of them in Monterey County. From 2011 through 2015, there were 16 cases of hantavirus in California, neither occurred in Monterey County.

An estimated 22,500 to 90,000 Monterey County residents become ill from influenza each flu season. *Table 13-2* lists severe influenza cases by flu season for residents under 64 in Monterey County from 2013-2018.

Table 13-2
Severe Influenza Cases in Monterey County (Age 64 and Younger) by Flu Season: 2013-2018

Flu Season	ICU Admissions	Fatalities
2013-2014 Flu Season	12	7
2014-2015 Flu Season	6	2
2015-2016 Flu Season	2	1
2016-2017 Flu Season	8	4
2017-2018 Flu Season*	6	7

*Data should be considered provisional
Source: Monterey County Health Department Epidemiology & Surveillance Unit, Influenza - Local Data, Current as of March 10, 2018

Pandemics

There have been six pandemics since 1900. The previous pandemics occurred in 1918-1920, 1957-1958, 1968- 1969, 1977-1978, 2009-2010, and 2019-present.

1918 Pandemic: The 1918-1920 Pandemic, commonly referred to as the Spanish Flu, was unusually severe, infecting close to one-third of the world's population, or 500 million people. The 1918 pandemic had an extensive mortality rate, killing as much as 1% of the world's population, or 40 million people worldwide, including about 675,000 in the United States.

1957-1958 (H2N2 Virus) Pandemic: In February 1957, a new influenza A (H2N2) virus emerged in East Asia, triggering a pandemic ("Asian Flu"). This H2N2 virus was comprised of three different genes from an H2N2 virus that originated from an avian influenza A virus, including the H2 hemagglutinin and the N2 neuraminidase genes. It was first reported in Singapore in February 1957, Hong Kong in April 1957, and in coastal cities in the United States in summer 1957. The estimated number of deaths was 1.1 million worldwide and 116,000 in the United States.

1968 (H3N2 Virus) Pandemic: The 1968 pandemic was caused by an influenza A (H3N2) virus comprised of two genes from an avian influenza A virus, including a new H3 hemagglutinin, but also contained the N2 neuraminidase from the 1957 H2N2 virus. It was first noted in the United States in September 1968. The estimated number of deaths was 1 million worldwide and about 100,000 in the United States. Most excess deaths were in people 65 years and older. The H3N2 virus continues to circulate worldwide as a seasonal influenza A virus. Seasonal H3N2 viruses, which are associated with severe illness in older people.

2009 (H1N1 Virus) Pandemic: In the spring of 2009, a novel influenza A (H1N1) virus, commonly known as swine flu emerged. It was detected first in the United States and spread quickly across the US and the world. This new H1N1 virus contained a unique combination of influenza genes not previously identified in animals or people. The H1N1 virus was quite different from H1N1 viruses that were circulating at the time of the pandemic. Few young people had any existing immunity (as detected by antibody response) to the H1N1 virus, but nearly one-third of people over 60 years old had antibodies against this virus, likely from exposure to an older H1N1 virus earlier in their lives. Since the H1N1 virus was different from circulating viruses, vaccination with seasonal flu vaccines offered little cross-protection against H1N1 virus infection

In April 2009, the World Health Organization (WHO) issued a health advisory on an outbreak of influenza-like illness caused by a new subtype of influenza A (A/H1N1) in Mexico and the United States. The disease spread rapidly, and in June the WHO declared an H1N1 pandemic. In October, the US declared H1N1 a national emergency.

From April 12, 2009, to April 10, 2010, the CDC estimated there were 60.8 million cases (range: 43.3-89.3 million), 274,304 hospitalizations (range: 195,086-402,719), and 12,469 deaths (range: 8868-18,306) in the United States due to the H1N1 virus. Additionally, the CDC estimated that 151,700-575,400 people worldwide died from H1N1. Globally, 80% of virus-related deaths were estimated to have occurred in people younger than 65 years of age, which differs greatly from typical seasonal influenza epidemics, during which about 70% to 90% of deaths are estimated to occur in people 65 years and older. [58]

[58] 2009 H1N1 Pandemic (H1N1pdm09 virus), Centers for Disease Control and Prevention (CDC)

In Monterey County, the 2009 pandemic led to 16 ICU admissions and 3 fatalities.[59]

In August 2010, the WHO declared an end to the pandemic globally. H1N1 viruses and seasonal influenza viruses are co-circulating in many parts of the world. It is likely that the 2009 H1N1 virus will continue to spread for years to come, like a regular seasonal influenza virus.

COVID-19 (SARS-CoV-2) Pandemic: Currently, COVID-19, a contagious disease caused by a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is an ongoing pandemic, which has had a large effect worldwide and on Monterey County.

COVID-19 was declared a Public Health Emergency of International Concern in January 2020 by the World Health Organization. On February 4, 2020, the US declared a public health emergency. On February 28, 2020, the first case of community spread was detected in California and by March 4, the first COVID-19 death in California occurred. Therefore, on March 4, 2020, Governor Newsom declared a State of Emergency and on March 6th, the Monterey County Board of Supervisors also proclaimed a state of emergency. On March 13th, the President of the US declared a National Emergency. Local emergencies were also proclaimed by all incorporated jurisdictions in Monterey County by the end of March 2020.

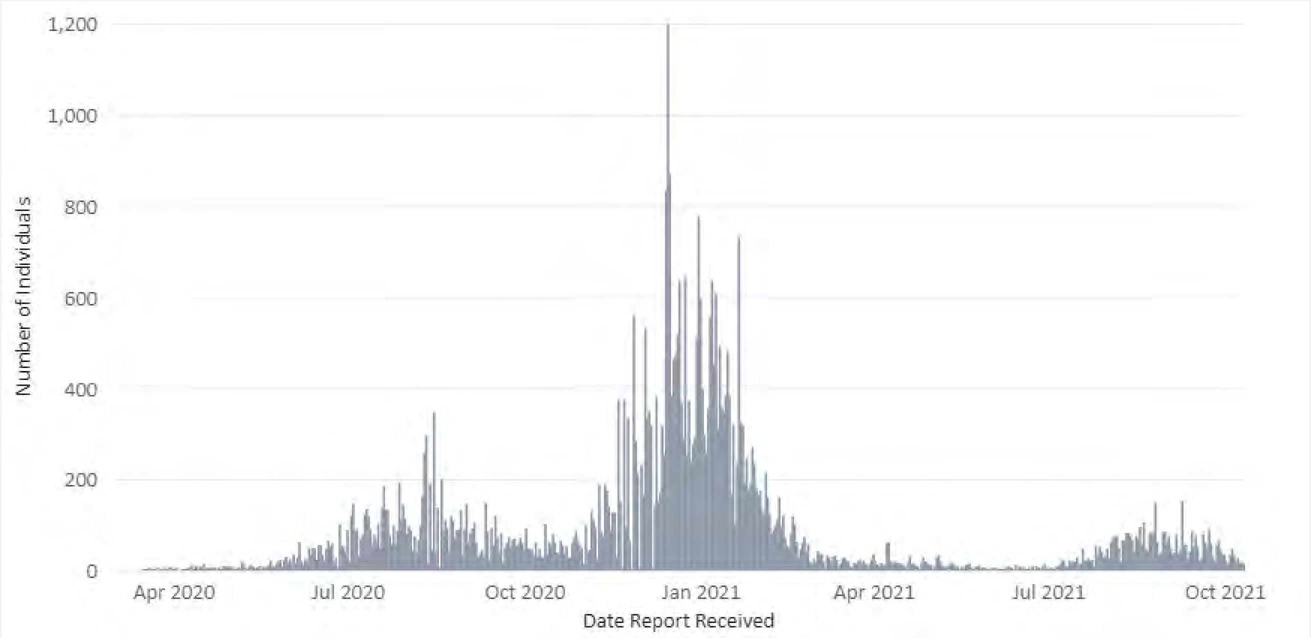
On March 13, 2020, 12 passengers from the Diamond Princess Cruise Ship were quarantined in Asilomar Hotel, Pacific Grove while undergoing testing. On March 17, the first two cases of COVID-19 in Monterey County were confirmed and the County of Monterey Health Officer issued a Shelter-in-Place Order. The first death due to complications from COVID-19 in Monterey County occurred on March 21.

As of October 9, 2021, according to data from the Centers for Disease Control and Prevention, the United States has had a total of 44,217,318 total cases of COVID-19 and 711,020 deaths caused by COVID-19.[60] As of October 11, 2021, the State of California has had 4,553,194 confirmed cases of COVID-19, resulting in 69,741 deaths. The current daily average of new cases is 5,212 with 92 daily average deaths per day. Statewide, 71.4% of people have been fully vaccinated, and 9.9% of people have been partially vaccinated against COVID-19.[61]

As of October 11, 2021, there have been 48,416 confirmed cases of COVID-19 and 584 COVID-19 deaths in Monterey County. *Figure 13-1* shows cases of COVID-19 among Monterey County residents by date of report.

[59] Influenza - Local Data, Monterey County Health Department
[60] United States COVID-19 Cases, Deaths, and Laboratory Testing (NAATs) by State, Territory, and Jurisdiction, Centers for Disease Control and Prevention (CDC), Accessed October 12, 2021
[61] Tracking COVID-19 in California, State of California, Accessed October 12, 2021

Figure 13-1
COVID-19 Cases Among Monterey County Residents by Date



As seen in the *Figure 13-1*, Monterey County saw cases start to grow in the summer of 2020, with its first large spike in COVID-19 cases in August of 2020. The largest spike in cases occurred in December and January 2021, and began to decline in the Spring of 2021, with some growth in cases occurring again in July and August of 2021.

Table 13-3 lists COVID-19 cases by age group in Monterey County and *Figure 13-2* shows COVID-19 cases by region of residence, as of October 11, 2021.[62]

Table 13-3
COVID-19 Cases Among Monterey County Residents by Age Group

Age in Years	Incident Cases	Percent of Total Cases
0-17	6,851	14.15%
18-24	6,469	13.36%
25-34	9,800	20.23%
35-44	9,044	18.67%
45-54	7,361	15.20%
55-64	5,123	10.58%
65-74	2,300	4.75%
75-110	1,471	3.04%
Other	12	0.02%

[62] 2019 Novel Coronavirus (2019-NCoV) - Local Data, Monterey County

Figure 13-2
COVID-19 Cases Among Monterey County Residents by Region of Residence

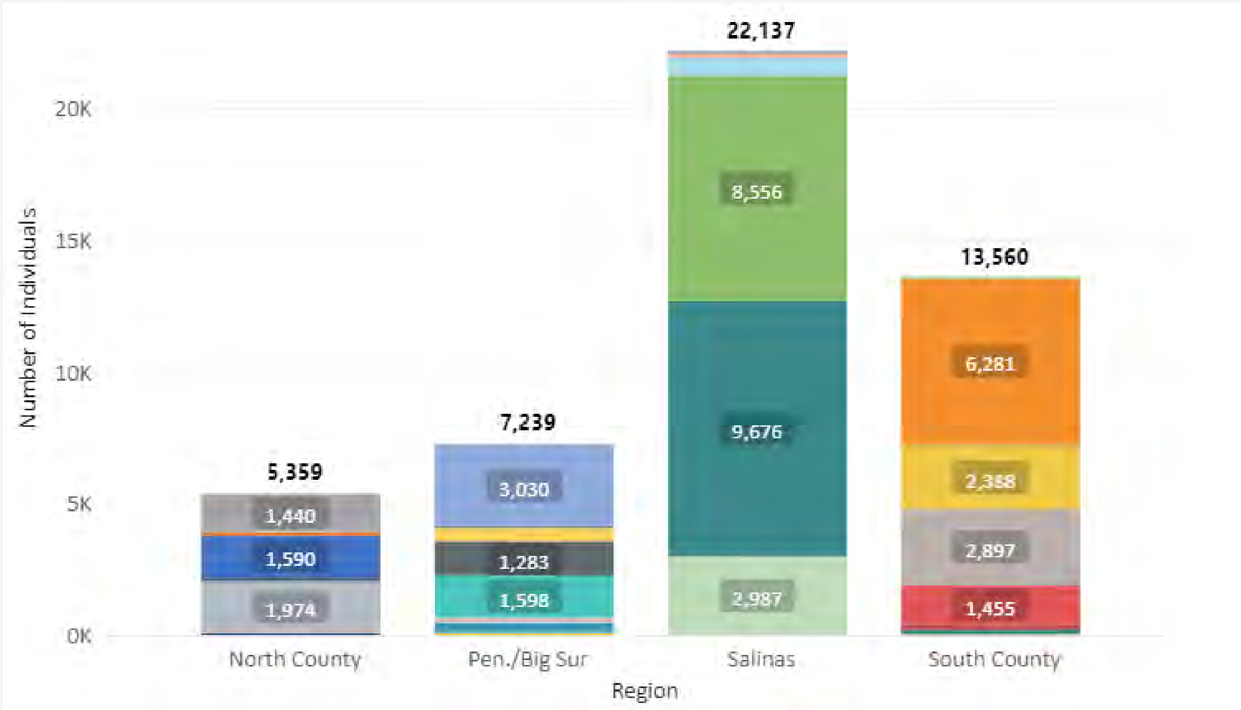


Table 13-4 lists severe cases of COVID-19 by age group based on the number of hospitalized individuals in Monterey County.

Table 13-4
Severe COVID-19 Cases Among Monterey County Residents by Age Group

Age in Years	Hospitalized Individuals	Proportion of Hospitalized Cases
0-17	49	2.71%
18-24	47	2.60%
25-34	180	9.94%
35-44	227	12.54%
45-54	322	17.79%
55-64	344	19.01%
65-74	309	17.07%
75-110	332	18.34%
Total	**1810**	**100.00%**

Table 13-5 lists COVID-19 fatalities by age group in Monterey County.

Table 13-5
COVID-19 Fatalities Among Monterey County Residents by Age Group

Age in Years	Number of Fatalities	Proportion of Fatalities
0-34	13	2.22%
35-44	15	2.56%
45-54	49	8.36%
55-64	104	17.75%
65-74	126	21.50%
75+	279	47.61%
Total	**586**	**100.00%**

13.2.2 LOCATION

All of the County is susceptible to the human health hazards discussed in this chapter. While some hazards, such as the West Nile Virus and Lyme Disease, can have a geographic presence within the County, other diseases can cause exposure to the County from outside the local region. Local residents who travel can become exposed to diseases while abroad and bring the diseases back with them, potentially placing the region at risk for exposure. COVID-19, for example, may be transported into the County, through residents and visitors who travel extensively. It is difficult to map the extent of human-health hazards compared to others, such as floods, wildfires, and dam failures.

13.2.3 FREQUENCY

Due to increased air travel and growing population, the probability of a communicable disease epidemic is a growing threat. Certain human health hazards, such as influenza, can be expected seasonally, with variations on specific strains year to year. Additionally, tick-borne diseases are likely to increase during spring and fall, when people participate in outdoor activities such as hiking.

The frequency of other health hazards is difficult to establish and depends largely on the unique circumstances surrounding a localized outbreak and its subsequent expansion into epidemics. While the probability of a major infectious disease outbreak is relatively low, it can have catastrophic social and economic consequences.

Influenza: According to the CDC, influenza has a predictable pattern and a near certainty of occurrence. The CDC estimated that on average, about 8% of the US population gets sick from flu each season, with a range of between 3% and 11%, depending on the season. [63]

COVID-19: A report released by the World Health Organization and the China Joint Commission found that transmission rates of COVID-19 vary based on location. In general, between 1% and

[63] Seasonal Incidence of Symptomatic Influenza in the United States, Centers for Disease Control and Prevention

5% of people in contact with a confirmed case of the virus subsequently, become a laboratory-confirmed case of COVID-19. [64]

West Nile Virus: In California, mosquitoes are monitored and controlled primarily to reduce cases of West Nile Virus, malaria, encephalitis, dog heartworm, and sensitivity to bites. Human mosquito-borne diseases, including West Nile Virus, have declined significantly in California since the creation of mosquito and vector control agencies.

Lyme Disease: There have been 12 confirmed cases of Lyme disease in Monterey County between 2009-2019. Cases are expected to continue to develop, and instances may increase with warming temperatures due to climate change.

The frequency and probability of other diseases discussed in this profile are unpredictable and contingent on factors such as public awareness, treatment options, and vaccination rates.

13.2.4 SEVERITY

The severity of the human health hazard varies from individual to individual. Typically, young children and older adults are more susceptible to acquiring communicable diseases due to developing or diminishing immune systems or experiencing adverse effects from extreme weather conditions. These populations often experience the most severe of symptoms, as their immune systems are not capable of fighting off infection or efficiently regulating temperature. In general, severity varies depending on the pathology of the disease, the health of the infected, and the availability of treatments for alleviating symptoms or curing the disease.

13.2.5 WARNING TIME

Warning time for public health risks varies from a few hours or days to a few months, depending on the illness and outbreak to the population.

13.3 SECONDARY HAZARDS

Human health hazards are not like natural hazards that have measurable secondary impacts, such as earthquakes, floods, or wildfires. This is primarily due to the fact that human health hazards do not generally impact buildings and critical infrastructure as natural hazards do. The largest secondary impact caused by human health hazards would be economic. Large outbreaks of any human health hazard could reduce the workforce significantly, causing businesses and agencies to close or be greatly impacted.

Moreover, as the COVID-19 pandemic is revealed, a pandemic can add significant challenges to ongoing hazard mitigation efforts, not to mention confusing and complicating response efforts for other natural hazard events. This is an emerging issue, and developments result in guidance

[64] Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)

changes. Mitigating the impacts of the pandemic, in many instances, means mitigating the impact of a pandemic to other hazards that could occur simultaneously.

Another secondary impact could be stigmatization. The fear of the health hazard and fear of the unknown could lead to isolation, violence, and self-inflicted injury. Hospitals and healthcare providers could be overwhelmed with the “worried well” seeking care and comfort. Education and providing key and critical information can reduce and mitigate this secondary risk.

13.4 RISK ASSESSMENT

13.4.1 POPULATION

All citizens in the County could be susceptible to the human health hazards discussed in this chapter. A large outbreak or epidemic, a pandemic, or a use of biological agents as a weapon of mass destruction could have devastating effects on the population. While all of the population is at risk to the human health hazards discussed in this chapter, the young and the elderly, those with compromised immune systems, and those with special needs are most vulnerable. The introduction of a disease such as the plague or influenza could rapidly impact those at risk.

13.4.2 PROPERTY

None of the health hazards discussed in this chapter would have significant impact on the structural environment or property.

13.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

None of the health hazards discussed in this chapter would have significant impact on the critical facilities or infrastructure of the County. However, health care facilities (including long-term care and clinics and even veterinary offices) are prepared for pandemic disease hazards. Emergency management planning incorporates all disciplines responding to an event, (fire agencies, law enforcement, first responder ground and air ambulance agencies, public health, mental and spiritual health). Planning includes identifying shelters, alternate treatment facilities, isolation capacity, and methods to immediately expand physical and human resources.

13.4.4 ENVIRONMENT

None of the health hazards discussed in this chapter would have significant impact on the environment of the planning area. While many of the vectors of the health hazards discussed in this chapter (mosquitoes, rodents, fleas, ticks, and deer flies) rely on local or regional environments for their survival, the human health hazard that they carry or potentially transmit would have no significant impact on the environment.

13.4.5 ECONOMY

The economic impact of a human health hazard could be localized to a single region or population or could be widespread. The impact could be significant, depending on the hazard, number of cases and the availability of resources to care for those affected by the hazard. Other financial impacts could be absorbed or managed by the organization affected.

13.5 FUTURE TRENDS IN DEVELOPMENT

Unless a catastrophic incident occurs, it is estimated that the County's population will continue to grow. When more people visit Monterey County or move into the area, the impacts from and the potential for a pandemic outbreak rises. Urban areas, in particular, will become more vulnerable as density increases and illnesses or contamination spread more rapidly. The potential for communicable diseases and vector-borne diseases in the County is not likely to lessen or prohibit growth or development.

13.6 ISSUES

Important issues associated with the human health hazards include the following:

- Prevention through vaccination and personal emergency and disaster preparation will help to reduce the impacts of human health hazards
- Medical and response personnel need to be integrated in a unified command to provide care when needed in response to human health hazards.
- Medical and response personnel must be adequately trained and supplied.
- A system needs to be in place for informing the public with a unified message about a human health hazard.
- Health agencies and facilities require surge capacity management and adaptation to the rising number and needs of the region.
- Critical facilities may not have adequate fresh air/ ventilation to be appropriate for essential work during pandemic.
- Need for additional sheltering locations in event of pandemic social distancing needs paired with another hazard event (flood, wildfire, earthquake)
- COVID-19 exists as a threat to the entire population of Monterey County.

14. SEVERE WEATHER

14.1 OVERVIEW

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. Severe weather can be categorized into two groups: general severe weather (systems that form over wide geographic areas) and localized severe weather (systems with a more limited geographic area). The most common severe weather events that impact Monterey County and that are profiled in this chapter are:

- Severe Winter Storms
- Extreme Cold and Freeze
- Windstorms
- Extreme Heat

Due to the size of the County and changes in elevation and climate, weather conditions can vary greatly. The proximity to the Pacific Ocean both moderates and exaggerates certain types of adverse weather. Winter storms impacting coastal portions of the County tend to be more extreme than in the inland portions. The ocean's influence is also a significant factor in moderating extreme hot and cold temperatures, hailstorms, and other cold weather events. These events are rare and short lived, causing little if any life-threatening situations and only occasional significant damage to property or agricultural concerns.

When reading this chapter, it is important to note that when the term "severe weather" is used, it is referring in aggregate to the sub-hazards profiled in this chapter. These hazards have been grouped because each hazard can impact and has impacted the entire County and has no clearly defined extent or location mapping. Since there is no clearly defined extent or location mapping available for these hazards, no geospatial analysis is available to support exposure or vulnerability analysis. Quantitative analysis is included from the FEMA National Risk Assessment, but the analyses for these hazards are mainly qualitative.

14.1.1 SEVERE WINTER STORMS

Most severe winter storms in Monterey County consist of heavy rain events, sometimes accompanied by thunderstorms, high winds, dense fog, hail, and freeze events. Heavy rain refers to events where the amount of rain exceeds normal levels. The amount of precipitation needed to qualify as heavy rain varies with location and season.

Monterey County's weather is influenced by the Pacific Ocean and routine climate patterns such as El Niño. El Niño is the warm phase of the El Niño-Southern Oscillation cycle, a pattern found in the tropical Pacific when there are fluctuations in temperatures between the ocean and atmosphere. During El Niño, the surface winds across the entire tropical Pacific are weaker than normal and the ocean surface is at above-average temperatures in the central and eastern tropical Pacific Ocean. El Niño typically develops over North America during the winter season causing the severe winter storms experienced by the County. This climate pattern occurs every few years and brings with it above-average rain and snow across the southern region of United States, especially in California.

A relatively common weather pattern that brings southwest winds and heavy rain to California is often referred to as an atmospheric river. Atmospheric rivers are long, narrow regions in the atmosphere that transport most of the water vapor carried away from the tropics. These columns of vapor move with the weather, carrying large amounts of water vapor and strong winds. When the atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow, causing flooding and mudslides.

For more information on flooding events or landslides caused by heavy rain, refer to *Flooding* in **Section 10** or *Slope Failure* in **Section 15**.

Hail is formed when water droplets freeze and thaw as they are thrown high into the upper atmosphere by the violent internal forces of thunderstorms. Hail is sometimes associated with severe storms within Monterey County. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph). Severe hailstorms can be quite destructive, causing damage to roofs, buildings, automobiles, vegetation, and crops. Dense fog is also sometimes associated with severe storms in the County. Dense fog reduces visibility making driving more dangerous. The National Weather Service issues dense fog advisories when appropriate.

14.1.2 EXTREME COLD AND FREEZE

Extreme cold often accompanies a winter storm or is left in its wake. A freeze refers to a particularly cold spell of weather where the temperature drops below 32 degrees, most typically in the early morning hours. Usually, these cold spells will last only two or three days when the ocean influence will overcome the cold front and the early morning temperatures will return to the normal 45 to 55-degree range. Rainfall during these periods may result in snowfall in the higher elevations of the County. Prolonged exposure to cold can be life-threatening, particularly to infants and the elderly. Freezing temperatures can cause significant damage to the agricultural industry.

14.1.3 WINDSTORM

Windstorms are generally short-duration events involving straight-line winds or gusts of over 50 mph, strong enough to cause property damage. Windstorms are especially dangerous in areas with significant trees and areas with exposed property, poorly constructed buildings, manufactured housing units, major infrastructure, and above-ground utility lines. A windstorm can topple trees and power lines, cause damage to residential, commercial, and critical facilities, and leave debris in its wake.

Damaging winds are classified as those exceeding 60 mph and can reach up to 100 mph, producing a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-Line Winds**: Any thunderstorm wind that is not associated with rotation; this term is used primarily to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the downdraft.
- **Downdrafts**: A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts:** A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts:** A small, concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5-10 minutes, with maximum wind speeds up to 168 mph. There are both wet and dry microbursts. A wet microburst is accompanied by heavy precipitation. Dry microbursts, common in the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust Front:** A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho:** A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm cooled air). The word “derecho” is of

Spanish origin and means "straight ahead." Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.

- **Bow Echo:** A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

High winds can occur during a severe thunderstorm, with a strong weather system, or can flow down a mountain. When winds are sustained at 40-50 mph, isolated wind damage is possible. Widespread significant wind damage can occur with higher wind speeds. During strong thunderstorms, straight line wind speeds can exceed 100 mph. High winds can blow objects around and pose a significant threat to public safety.

Windstorms can also be created by thermally forced circulations during the spring to summer months. Known as sea breezes, these winds are strongest when the land becomes warmer than the adjacent ocean. Driven by the differential heating of land versus water, sea breeze formation is conducive under synoptic conditions that allow strong heating of land areas. The wind direction associated with the sea breeze is directed inland along the surface pressure gradient. Therefore, sea breeze fronts generally push inland for approximately 25 miles as the day progresses. The sea breeze circulation will intensify as the daytime solar heating reaches its maximum before diminishing and reversing to a land breeze circulation as the land cools.

Mitigation Success Story
City of Salinas Free Tree Program

In February 2017, 60-mile per hour winds and heavy rainfall brought down power lines and trees. Over 600 trees were lost in the storm, exacerbating a long growing problem. The City had already lost close to 350 trees, largely due to drought. The City completed an Urban Forest Assessment and started the "Free Tree--Adopt A Tree Program." Residents can apply to "Adopt-A-Tree" and the City will purchase and plant a tree if the resident agrees to water it until its established.

Planting trees is a great example of a multi-benefit mitigation project. Trees contribute significantly to environmental quality and human health and well-being. The urban forest is a form of "green infrastructure" that provides millions of dollars of benefit at a very low cost. Trees reduce the impact of weather and climate hazards. During storms, trees absorb rainwater, reducing runoff and preventing pollutants from entering waterways. Large tree canopies create shade and conserve energy, which reduces the impact of extreme heat and helps meet climate change goals.

All of Monterey County is subject to strong southeasterly winds associated with powerful cold fronts. These winds, which are usually part of a strong Pacific storm, generally occur during the winter months, from November to February. As the wind passes through the narrowing Salinas valley, the wind velocity increases and moisture-holding capacity decreases. As such, this wind is relatively hot and dry in southern portions of the valley, such as Soledad. Sea breeze winds, with average winds speeds of 10–15 mph, can be expected annually from March through October.

14.1.4 EXTREME HEAT

Extreme heat is unexpected, unusual, or unseasonable hot temperature that can create dangerous situations. Heat waves are periods of abnormally hot weather lasting days to weeks. According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat.

Ambient air temperature and relative humidity are components of heat conditions, together defining a heat index, as shown *Figure 14-1*. The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature.

Figure 14-1
National Weather Service Heat Index

NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

14.2 HAZARD PROFILE

14.2.1 HISTORY

Severe Winter Storms and Extreme Freeze

Table 14-1 summaries severe winter storm and freeze events that have occurred in the County.

Table 14-1
Severe Winter Storms and Extreme Freeze Events in Monterey County (2010-2020)

Date	Description
11/10/2020	A cold airmass brought below freezing temperatures. Overnight low temperature records were broken in King City. Warnings were issued for the Salinas Valley where lows dropped into the 20s.
3/17/2020	A storm brought several days of showers. Vehicles were reported as spinning out on US-101 S near King City due to accumulating hail on roadway.
2/3/2020-2/5/2020	As a low-pressure system exited, skies began to clear, and wind sheltered locations saw a drop in overnight temperatures to below freezing. Recorded temperatures reached as low as 18 degrees.
11/29/2019	An atmospheric river caused a closure of Hwy 1 at Paul's Slide. Parkfield recorded heavy rainfall.
10/31/2019	A dry airmass and lighter winds led to freezing temperatures in the interior valleys. A Freeze Warning was issued for the Salinas Valley and Interior Monterey County.
2/17/2019	Isolated thunderstorms developed late afternoon and produced hail and lightning over the region.
2/10/2019	A cold front moved through the region. Hail covered the greens at Pebble Beach suspending final rounds of the Pro Am.
2/5/2019-2/6/2019	A very cold airmass brought snow to lower elevation peaks prompting a rare Winter Weather Advisory. Junipero Serra Peak received about 1 ft of snow and Cone Peak received about 8 in of snow.
1/1/2019-1/2/2019	Cold overnight temperatures in the mid-30s to low 40s across Santa Clara County resulted in two fatalities. Widespread freezing temperatures were reported elsewhere across the region.
12/28/2018-12/29/2018	A cold dry air mass caused temperatures to drop below freezing overnight. This prompted the issuance of a freeze warning.
11/29/2018	A cool unstable air mass caused scattered thunderstorms that produced lightning and small hail.
4/16/2018	A late season storm brought rain, winds, hail, thunder, and lightning to the region.
3/3/2018	A strong cold front brought widespread rainfall causing localized flooding, strong winds, and lighting.
1/22/2017	A storm brought rain, lightning, wind, hail, snow, and record-breaking surf.

Table 14-1
Severe Winter Storms and Extreme Freeze Events in Monterey County (2010-2020)

Date	Description
1/20/2017	A storm brought heavy rain, strong winds, and hail.
4/27/2016	Low level urban flooding due to heavy rain and hail were reported.
2/9/2015	A strong winter storm impacted California following up the driest January on record. The storm brought heavy rain, winds, and damage to trees and power lines along with some minor flooding. The County gauge on Three Peaks at Elevation 3362 feet measured a 72-hour rainfall total of 10.4 inches.
12/11/2014	An atmospheric river brought a storm with heavy rain and winds. Boats in Monterey Harbor had to be pumped out to avoid sinking. Rain overwhelmed a sewage plant in Castroville causing a spill.
11/30/2012	A series of significant winter storms brought strong and gusty winds, heavy rainfall, high surf. Minor urban and small stream flooding was observed across Monterey County due to the heavy rainfall.
1/1/2011	A storm system brought strong gusty winds and heavy rain. A large tree fell on an occupied vehicle causing the closure of State Route 183 in Monterey.
1/20/2010	The third in a series of storms brought strong winds and heavy rain. An intense hailstorm occurred near Ryan Ranch just southeast of Del Rey Oaks.

Source: NOAA Storm Events Database

Windstorm

A windstorm in October 2009 was the result of a strong low-pressure system caused an estimated $1 million in damage, mainly due to falling trees hitting cars and buildings in the affected area. A wind event from November 2011 caused damage and one fatality in Big Sur due to a falling tree. In addition to winter windstorms, every year, between the months of March and October, when the Pacific High attains its greatest strength, prevailing northwest sustained surface winds in Salinas Valley reach average speeds of 10 to 15 mph with associated wind gusts up to 45 mph.

The County has also recorded five tornadoes between 1950 and 2020. All five tornadoes occurred in the northeastern portion of Monterey County. The largest tornado, occurred in 1992, reaching a magnitude of F1 (maximum wind speeds of 73–112 mph) resulted in two injuries from flying glass.

Extreme Heat

In October 2012, an unseasonable heat wave gripped the Monterey area. Temperatures soared well into the 90s and 100s, which resulted in all-time record high temperatures for October, reaching 100 and 101 in Salinas. Farm workers who were picking in the fields near Salinas were negatively impacted by the excessive heat, which lead to a fatality of a farm worker on October

2. In July of 2006, intense heat settled over the County with temperatures soaring to as high as 115°F. Temperatures exceeded 100°F for 15 consecutive days in July, with high temperatures soaring to over 110°F. Overnight lows stayed in the mid-60s for several nights.

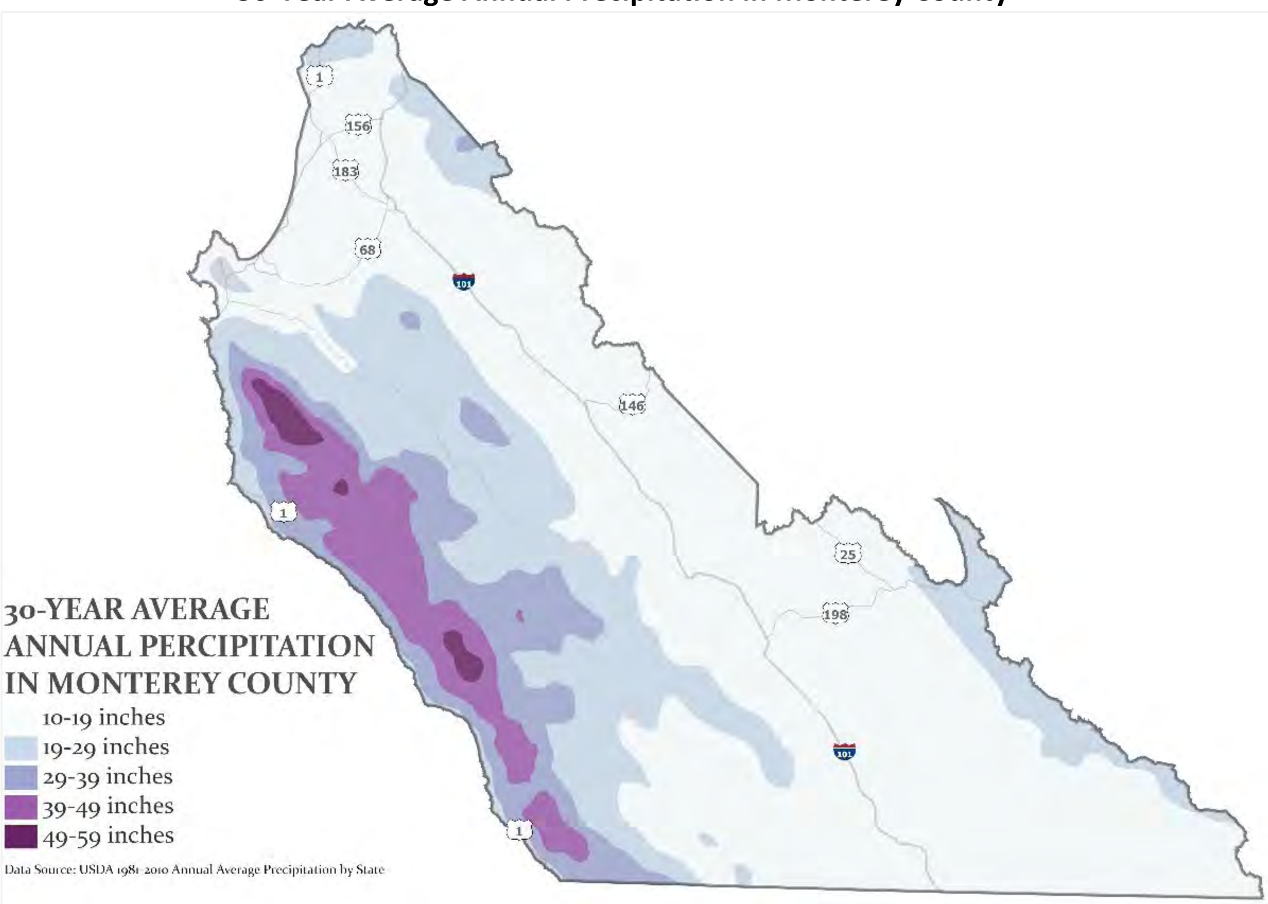
14.2.2 LOCATION

All severe weather events profiled in this assessment have the potential to happen anywhere in the County. Maps of the average distribution of weather conditions were used to provide an indication of which areas may be more vulnerable to different severe weather hazards.

Severe Winter Storms

As seen in *Figure 14-2*, higher annual precipitation occurs along the Big Sur coast, in the Del Monte Forest, and in the hills above the Salinas Valley. These areas therefore may be more likely to experience heavy rain during a winter storm. Communities in low lying areas next to streams, lakes, or the ocean are likely more susceptible to flooding following heavy rain events.

Figure 14-2
30-Year Average Annual Precipitation in Monterey County

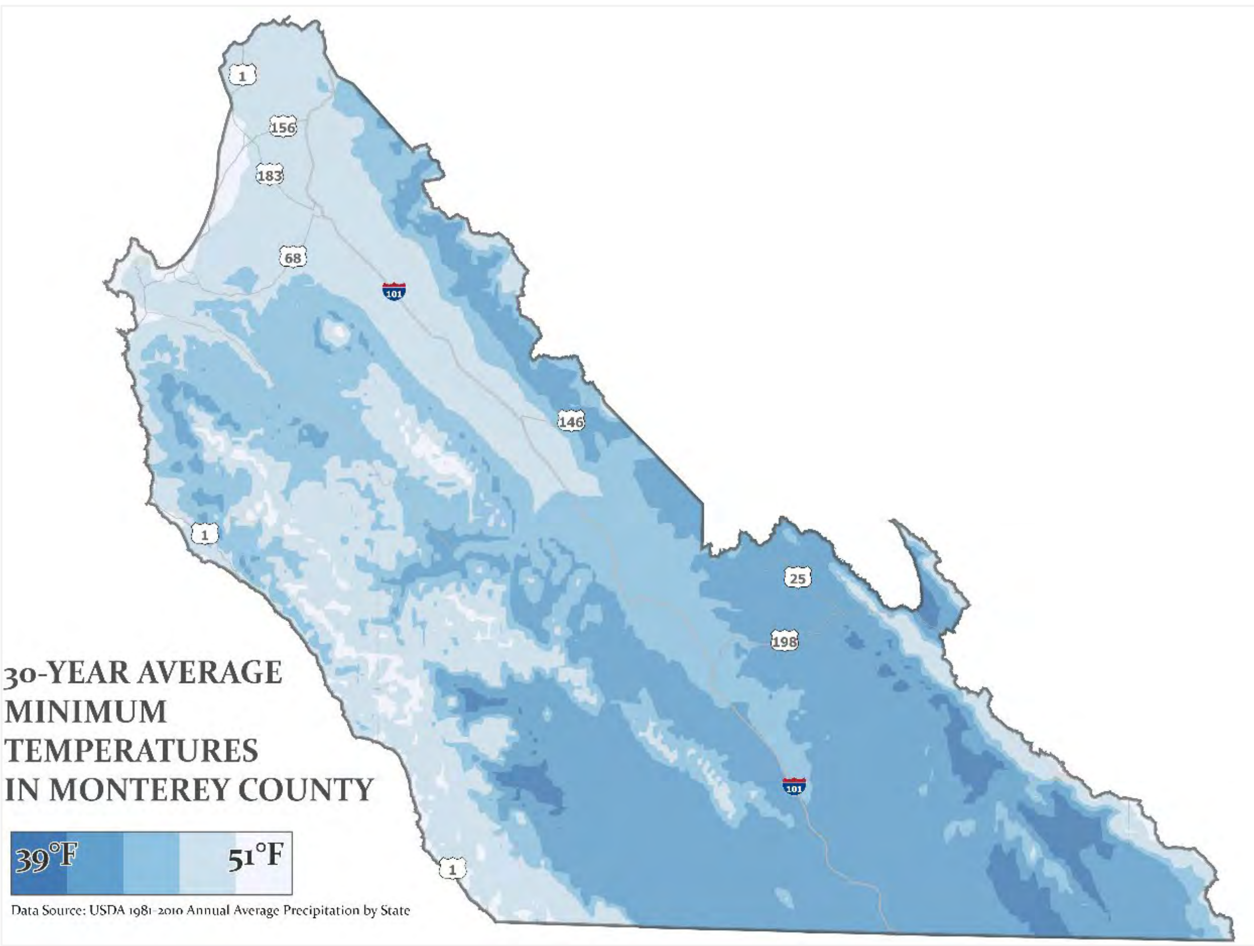


Extreme Cold and Freeze

Exposure to extremely cold temperatures varies depending on distance from the coast and elevation. Coastal temperatures are lower, while inland and higher elevation areas experience a greater range of temperatures. Historically extreme freeze events have been most frequently experienced in the mountains and interior valleys in the County, notably the Southern end of the Salinas Valley.

As seen in *Figure 14-3*, mountainous areas of the County, including the Santa Lucia and Gabilan Ranges, areas along the Big Sur Coast, and the Southern portion of the Salinas Valley experience the coldest average temperatures. These areas therefore may be more likely to experience colder than average temperatures during extreme cold and freeze events.

Figure 14-3
30-Year Average Minimum Temperatures in Monterey County

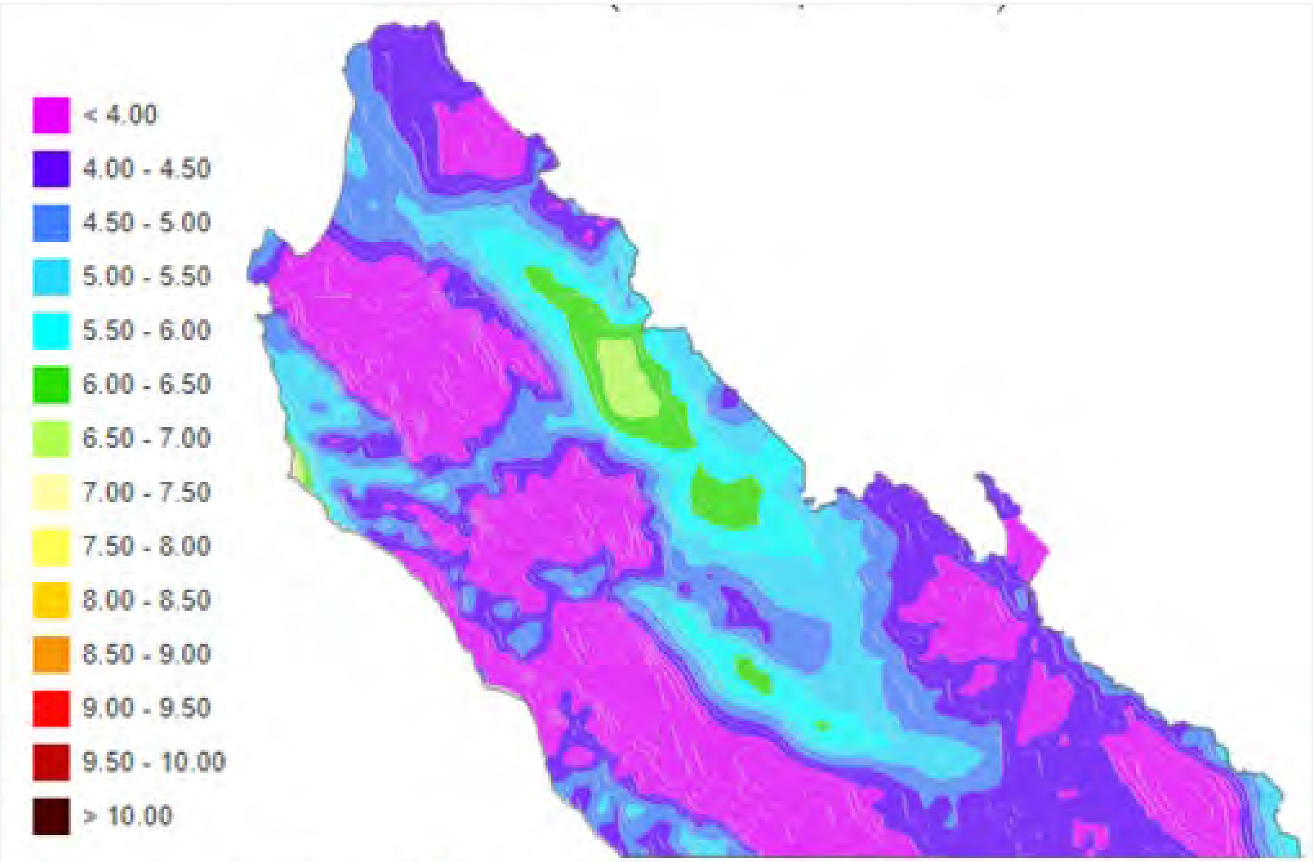


Windstorm

The Monterey Bay acts as a funnel, channeling ocean air through the Salinas Valley. Warmer air from the southern end of the valley warms and rises, producing pressure that in its turn draws in cooler air from Monterey Bay. The wind created as a result is shifted from the broad expanse of the Bay through the narrower Salinas Valley. The geographical constriction produces a decrease in air pressure, which correspondingly increases the flow of cold ocean air across the valley.

As seen in *Figure 14-4,* the fastest wind speeds occur in the Salinas Valley. Portions of the Peninsula, Carmel Highlands, and Monterey Bay may also experience high winds. Wind events are likely to be most damaging in areas that are heavily wooded.

Figure 14-4
Land-Based Wind Speed (Meters/Second)



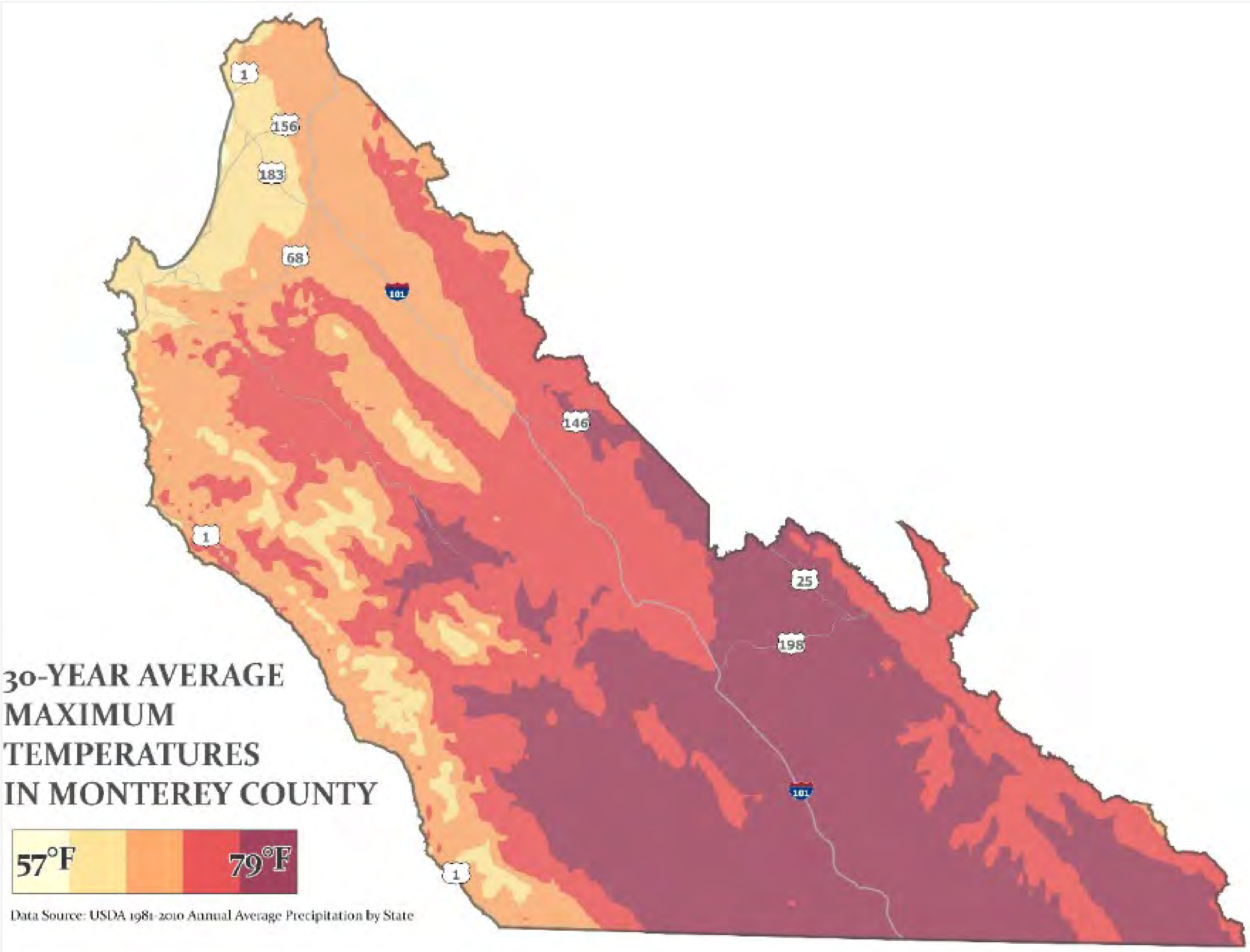
Data Source: National Renewable Energy Laboratory (NREL), WIND Toolkit

Extreme Heat

Proximity to extreme heat varies depending on distance from the coast and elevation. Coastal temperatures are lower, while inland and higher elevation areas experience a greater range of temperatures. The inland regions of the County have historically been the most likely to experience high heat conditions.

As seen in *Figure 14-5*, areas of South County, the lower Salinas Valley, and mountainous areas in the southern region of the County, including the Santa Lucia and Gabilan Ranges are the most prone to high temperatures and are the area's most likely to experience extreme heat or heat waves.

Figure 14-5
30-Year Average Maximum Temperatures in Monterey County



14.2.3 FREQUENCY

Predicting the frequency of severe weather events in a constantly changing climate is a difficult task. The County can expect to experience exposure to and adverse impacts from some type of severe weather event at least annually. Severe storms and rainfall are limited almost entirely to the winter season (November - April), while extreme heat is mostly limited to summer months.

The FEMA National Risk Index calculates an annualized frequency value for certain natural hazards in Monterey County. The natural hazard annualized frequency was defined by FEMA as the expected frequency or probability of a hazard occurrence per year. Annualized frequency was derived either from the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. Since most severe weather hazards have tracked actual hazard occurrences, annualized frequency was based on either the number of distinct hazard events that have occurred or the count of days on which a hazard has occurred.

Table 14-2 summarizes the annualized frequency values and hazard occurrence basis (event or event-day) provided by the FEMA National Risk Index for the severe weather hazards that were included in the Index.

Table 14-2
Annualized Frequency of Severe Weather Hazards in Monterey County

Hazard	Hazard Occurrence Basis	Annualized Frequency
Hail	Distinct Events	0.47 Events per Year
Heat Wave	Event-Days	1.21 Event Days per Year
Lightning	Distinct Events	0.36 Events per Year
Strong Wind	Distinct Events	0.13 Events per Year
Tornado	Distinct Events	1.22 Events per Year
Winter Weather	Event-Days	0.07 Event Days per Year
Source: FEMA National Risk Index		

14.2.4 SEVERITY

Severe Winter Storms

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon but can occur. Roads may become impassable due to flooding, downed trees, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power.

Heavy rain can have significant impacts, including flash flooding, mudslides, and landslides. Stormwater runoff from heavy rains can also impair water quality by washing pollutants into water bodies. Thunderstorms carry the same risks as heavy rain events, and depending on the type of storm, they can also include tornados, lightning, and heavy winds, increasing risk of injury and property damage. Lightning strikes are a danger during thunderstorms and can cause death or injury to one or several persons. Long-term injuries from lightning strike can include memory and attention loss, chronic numbness, muscle spasm, stiffness, depression, hearing loss and sleep disturbance.

Extreme Cold and Freeze

Late or early freeze events can have a devastating effect on agriculture and the economy of the region. Crops can be damaged by below-freezing temperatures. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat.

Windstorms

Windstorms are a frequent problem in the County and have been known to cause damage to utilities. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30% higher. Tornadoes are potentially the most dangerous of local storms, but they are not common. If a major tornado were to strike within the populated areas of the County, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed.

Extreme Heat

Extreme heat is the primary weather-related cause of death in the US Extreme heat can kill by taxing the human body beyond its abilities. Since heat affects everybody differently and to better address heat risk the National Weather Service (NWS) developed an experimental HeatRisk forecast, which provides one value each day that indicates the approximate level of heat risk concern for any location, along with identifying the groups who are most at risk.

The scale is summarized in *Table 14-3*.

Table 14-3
NWS Experimental HeatRisk Forecast Risk Levels

Category	Level	Meaning
Green	0	No Elevated Risk
Yellow	1	Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration
Orange	2	Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration
Red	3	High Risk for much of the population, especially those who are heat sensitive and those without effective cooling and/or adequate hydration
Magenta	4	Very High Risk for entire population due to long duration heat, with little to no relief overnight

Heat can cause a variety of health-related issues including:

- **Heat Exhaustion**: Heat exhaustion is a mild form of heat-related illness that can develop after several days of exposure to high temperatures and inadequate or unbalanced replacement of fluids. It is the body's response to an excessive loss of the water and salt contained in sweat. Those most prone to heat exhaustion are elderly people, people with high blood pressure, and people working or exercising in a hot environment.
- **Heat Cramps**: Heat cramps usually affect people who sweat a lot. Sweating depletes the body's salt and moisture. The low salt level in the muscles can cause heat cramps. Heat cramps may also be a symptom of heat exhaustion.

- **Heat Stroke**: Heat stroke is a severe, dangerous form of heat-related illness. It occurs when the body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. Body temperature may rise to 106°F or higher within 10 to 15 minutes. Heat stroke can cause death or permanent disability.

14.2.5 WARNING TIME

Meteorologists can often predict the likelihood of a severe weather event. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. The Monterey Weather Forecast Office of the NWS monitors weather stations and issues watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

14.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, mudslides, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes become oversaturated and fail. As noted previously, for information on the impacts of hazards related to severe weather, refer to *Flooding* in **Section 10***, Slope Failure* in **Section 15**, *and Utility Interruption* in **Section 17**.

14.4 RISK ASSESSMENT

A lack of clearly defined extent and location mapping for the severe weather hazards profiled in this chapter prevented a detailed analysis for exposure and vulnerability. However, it can be assumed that the entire County is exposed to some extent to the severe weather hazards profiled in this assessment. Certain areas are more exposed due to geographic location and local weather patterns.

The FEMA National Risk Index calculates exposure and annual expected loss of building value and population for some severe weather hazards in Monterey County. Though the entire County is considered vulnerable to these hazards, the FEMA data was used in this risk assessment to provide some scale for the potential risk and impacts.

14.4.1 POPULATION

Population exposed in Monterey County to severe weather based on the FEMA National Risk Index is summarized in *Table 14-4*.

Table 14-4
Population Exposed to Severe Weather Hazards in Monterey County

Hazard	Exposed Population
Hail	415,057
Heat Wave	413,337
Lightning	415,057
Strong Wind	415,057
Tornado	85
Winter Weather	12,879
Source: FEMA National Risk Index	

Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding following severe winter storms.

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard.

14.4.2 PROPERTY

All property is vulnerable during the severe weather events profiled in this chapter. Building value exposed and the expected annual loss of building value in Monterey County to severe weather based on the FEMA National Risk Index is summarized in *Table 14-5*.

Table 14-5
Exposed and Expected Annual Loss of Building Value to Severe Weather Hazards

Hazard	Exposed Building Value	Expected Annual Loss- Building Value
Hail	$41,169,506,000	$1
Heat Wave	$40,973,571,144	$72
Lightning	$41,169,506,000	$5,966
Strong Wind	$41,169,506,000	$16,331
Tornado	$8,429,968.67	$204,827
Winter Weather	$2,219,002,076	$4,195
Source: FEMA National Risk Index		

Properties in poor condition or in particularly vulnerable locations may be at risk of the most damage. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse. Extreme heat events are not known for causing direct damage to buildings, but may damage building systems such as heating, ventilation, and air conditioning systems.

14.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

All critical facilities are likely exposed to all of the severe weather hazards profiled in this assessment. The most common problems associated with severe weather are loss of utilities. Prolonged periods of extreme heat could result in power outages caused by increased demand for power for cooling. Downed power lines associated with wind and/or thunderstorm events can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to secondary hazards such as mudslides and landslides.

14.4.4 ENVIRONMENT

The environment is highly exposed to severe weather events profiled in this assessment. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flood events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads. Vegetation can die as a result of prolonged periods of extreme heat.

14.4.5 ECONOMIC IMPACT

Economic impact of a severe storm is typically short term. Lightning can cause power outages and fires. Hail can destroy exposed property; an example is car lots, where entire inventories can be damaged. Generally, long-term economic impacts center more around hazards that cascade from a severe thunderstorm, including wildfires ignited by lightning, and flooding. In general, all severe weather poses a risk to the agriculture economy in the County.

14.5 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms, extreme heat, and high winds. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. New critical facilities, such as communication towers should be built to withstand heavy rain, wind, and hail damage. Future development projects should consider adverse weather hazards at the planning, engineering, and architectural design stage with the goal of reducing vulnerability. Stormwater master planning and site review should account for buildings to withstand adverse weather events considered for all new development. Thus, development trends in the County are not expected to increase overall vulnerability to the hazard but all development will be affected by adverse weather and storm events and population growth will increase potential exposure to hazards such as thunderstorms and dense fog.

14.6 ISSUES

Important issues associated with a severe weather in Monterey County include the following:

- Older building stock in the County is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Cities may need to open cooling centers during extreme heat events.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Dead or dying trees as a result of drought conditions are more susceptible to falling during severe storm events.
- Public education on dealing with the impacts of severe weather needs to continue to be provided so that citizens can be better informed and prepared for severe weather events. In particular, fog should be considered since fog may be downplayed despite its potential for transportation accidents.
- Debris management (downed trees, etc.) must be addressed, because debris can impact the severity of severe weather events, requires coordination efforts, and may require additional funding.
- The effects of climate change may result in an increase of heavy rain or more atmospheric storm events and will likely lead to increased temperatures and changes in overall precipitation amounts.

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15. SLOPE FAILURE

15.1 OVERVIEW

The term "slope failure" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. Slope failure can range from slow moving rotational slumps and earth flows, which can slowly distress structures but are less threatening to personal safety, to fast-moving rock avalanches and debris flows that are a serious threat to structures and have been responsible for most fatalities during landslide events.

Slope failure occurs when the strength of the soils forming the slope is exceeded by pressure, such as weight, gravity, or saturation. This can be initiated by storms, earthquakes, fires, or human modification of the land. Large debris can block transportation routes, dam creeks and drainages, and contaminate water supplies. When these hazards affect transportation routes, they are frequently expensive to clean-up and can have significant economic impacts.

15.1.1 TYPES OF SLOPE FAILURE

The various types of slope failure can be differentiated by the kinds of material involved and the mode of movement. The term encompasses five modes of slope movement: falls, topples, slides, spreads, and flows. These are further subdivided by the type of geologic material.

Falls: Falls are abrupt, downward movements of rock or earth, or both, that detach from steep slopes or cliffs. Falls are triggered by the undercutting of the slope by natural processes such as streams and rivers or differential weathering, human activities such as excavation during road building and/or maintenance, and earthquake shaking or other intense vibration. Steep or vertical slopes, particularly in coastal areas, and along rocky banks of rivers and streams are susceptible to falls.

Topple: A topple is the forward rotation out of a slope of a mass of soil or rock. Toppling is driven by gravity exerted by the weight of material upslope from the displaced mass or is due to cracks in the mass. Topples can consist of rock, debris, or earth materials.

Slides: A slide is a mass movement of soil or rock occurring where there is a distinct zone of weakness that separates the slide material from more stable underlying material. Slides can be triggered by intense and/or sustained rainfall or rapid snowmelt which can saturate slopes. Rapid drops in river level following floods, ground-water levels rising because of filling reservoirs, or the rise in level of streams, lakes, and rivers, which cause erosion at the base of slopes. Slides can also be earthquake induced.

Spreads: Lateral spreads are distinctive because they usually occur on very gentle slopes or flat terrain. The dominant mode of movement is lateral extension accompanied by shear or tensile fractures. The failure is caused by liquefaction, the process whereby saturated, loose, cohesionless sediments (usually sands and silts) are transformed from a solid into a liquefied state. Failure is usually triggered by rapid ground motion, such as that experienced during an earthquake, but can also be artificially induced.

Flows: A form of rapid mass movement in which loose soil, rock and sometimes organic matter combine with water to form a slurry that flows downslope.

Debris flows, rockslides, and flood flows will be described in more detail in this plan as they the most likely to occur in Monterey County.

Debris Flows

Debris flows are common types of fast-moving landslides in Monterey County. These flows generally occur during periods of intense rainfall. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that are typically about 10 mph, but can exceed 35 mph. The consistency of debris flows ranges from watery mud to thick, rocky mud that can carry large items such as boulders, trees, and cars. They are particularly dangerous to life and property because of their high speeds and the sheer destructive force of their flow.

Debris flow risk in the County is primarily associated with burn scars. Vegetation and soil changes after a fire increase the runoff and erosion in a watershed, and significantly increase the likelihood of debris flows. Debris flows can initiate during even moderate rainstorms over burn areas and often occur with little warning. Post-fire flow can alternate between flood and debris flow. It is important to distinguish between flood flows and debris flows as both are risks in the County. Distinguishing between debris flow and flood deposits can be difficult, but certain sedimentary structures and textures can give clues to the mechanism of deposition.

Debris flows are more dangerous and more destructive and dangerous than floods because they often have peak discharge levels that are 10-50 times greater. Flow height can be up to 5 times greater with flow velocity that is flow velocity same or greater. They also contain much higher levels of sediment content which can cause faster and more uncontrollable flows.

Flood Flows

A flood flow differs from a flood in that the amount of suspended sediment is sufficient to significantly change fluid properties and sediment transport mechanisms. Large volumes of sand are transported in dynamic suspension throughout the water column, although maintenance of high sediment loads depends on flow velocity and turbulence. Flows can be highly erosive.

Rockslides

A rockslide, common along the Big Sur coast, is a slow-moving or “creeping” landslide in weathered, fractured, or otherwise-weakened rock. Movement on deep-seated rockslides typically is only fractions of an inch per year; however, an increase in rainfall or slope instability can accelerate movement to several yards a minute or faster.

15.1.2 SLOPE FAILURE CAUSES

Mass movements are caused by a combination of geological and climate conditions, as well as encroaching urbanization. Vulnerable natural conditions related to the geology, topography, and vegetation are affected by residential, agricultural, commercial, and industrial development and the infrastructure that supports it. Relative susceptibility to landslides can be described according to the following geologic conditions:

- *Low*: Flatlands and low relief terrain, includes mainly Quaternary deposits. In steep terrain, includes mainly crystalline basement rock, volcanic rock, and Cretaceous sandstone.
- *Moderate*: Moderately steep terrain underlain by mainly unconsolidated and weakly cemented sandstone, shale, and Franciscan Complex.
- *High*: Steep terrain underlain by mainly unconsolidated and weakly cemented sandstone, shale, Franciscan Complex, and existing landslides.

The factors that can contribute to slope failure include: Change in slope of the terrain; Increased load on the land; Shocks, vibrations, and earthquakes; Change in water content; Groundwater movement; Frost action; Weathering of rocks and erosion; Removing or changing the type of vegetation covering slopes.

Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. Earthquake shaking and other factors can also induce landslides underwater. These landslides are called submarine landslides. Submarine landslides sometimes cause tsunamis that damage coastal areas.

15.2 HAZARD PROFILE

15.2.1 HISTORY

Big Sur Coastline

The Big Sur area is one of the most landslide-prone stretches of the California coast, with over 1,500 mapped historic large landslides. *Table 15-1* summarizes the most destructive landslides that have occurred along the Big Sur coast.

Historically, landslide activity has increased during severe El Niño years. During the 1972–1973 El Niño season, a landslide along the Big Sur coast resulted in one death. Throughout the 1997–1998 El Niño season, Highway 1 closed all along the Big Sur Coast due to flooding and mudslides and about 40 different sections of the highway were damaged.

In more recent year's numerous landslide events have been recorded in Big Sur, damaging structures, and forcing the closure of Highway 1. 2017 saw record damage along Highway 1. In February, a column of the Pfeiffer Canyon Bridge was displaced by an active landslide, which moved eight inches in one night and destabilized the bridge. This section of Highway 1 was closed for eight months and the new bridge cost about $24 million.

In March of 2017, Paul's Slide buried Highway 1 with debris and left only 11 feet of roadway. Around 2 million cubic yards of material came down the hill. In May, at Mud Creek, a deep-rooted debris flow caused by the heavy winter rains, covered a quarter mile of the Highway 1 in 6 million cubic yards of debris, close to 40 feet of debris slid down the hillside. Caltrans rebuilt the highway atop the slide in a $54 million, 14-month project.

Mitigation Success Story
Rain Rocks Shed/Pitkin's Curve Bridge

Landslides repeatedly damaged Highway 1 at Pitkins Curve and Rain Rocks.

1998	A landslide at Pitkins Curve caused $1 million damage. A rockfall at Rain Rocks, required emergency slope stabilization at cost of $1 million.
2000	A landslide washed out the highway. Crews hauled away 7,000 truckloads of debris at a cost of $3.4 million.
2001	After a landslide and a rockfall, crews to haul away 1,400 truckloads of debris at a cost of $1.5 million.
2002 2009	Every year, about 700 truckloads of debris was hauled from the site, averaging about $1 million in maintenance annually.
2013	The Rain Rocks Shed/Pitkin's Curve Bridge was completed.

The Rain Rocks Shed/Pitkin's Curve Bridge is an innovative mitigation strategy. The new bridge and shed allow rocks to keep rolling. This is a unique and sustainable solution to what was once an ongoing problem. Though the project cost $39 million, over the 50-year lifespan the cost of maintaining the highway with the new structures is estimated at $1.7 million, while it would have cost about $112 million to maintain the highway without the project.

In 2021, an atmospheric river resulted in a post-fire debris flow washing out a 150-foot-long stretch of Highway 1 near Rat Creek below the Dolan Fire burn scar. Flows also damaged another 60 locations along the highway.

Table 15-1
Historic Large Landslides Along Highway 1 on the Big Sur Coast, Monterey County

Location	Date	Event	Event Narrative	Cost
Big Sur	3/1/1983	Landslide	A series of storms caused four major slides between January and April. A slide in March, near Julia Pfeiffer Burns State Park, was at the time the largest slide to affect Hwy 1.	$10 million
Gorda	1/2/1997	Landslide	A landslide near Gorda, closed Hwy 1 for one month.	$5.5 million
Big Sur	2/6/1998	Mudslide	El Niño storms caused severe damage to Hwy 1. About 40 sections of Hwy 1 were affected by flooding and landslides.	$32 million
Gorda	2/14/2000	Landslide	Hwy 1 at Pitkin's Curve was closed due to a landslide that took out both lanes and created 7,000 truckloads of debris. A secondary landslide occurred during repair in March.	$3.4 million
Big Sur	2/1/2001	Landslide	A landslide above Pitkin's Curve disrupted traffic for 2 months, requiring removal of 1,400 truckloads of debris.	$1.5 million
Big Sur	11/1/2008	Landslide	Heavy rain following the Basin Complex fire resulted in debris flows and flash flooding. A foot bridge, 2 fishponds, and 2 residences were damaged by a 6-foot debris flow.	
Big Sur	4/7/2009	Debris Flow	Heavy rain on the Basin-Complex burn scar, caused flash flooding and debris flows. At least 3 separate debris flows were reported along Hwy 1. At Big Sur Lodge, vehicles were stuck in mud, and one was forced into a culvert and buried.	
Big Sur	3/16/2011	Landslide	Heavy rain in Big Sur washed out a 40 ft section of Hwy 1 section near the Bixby Creek Bridge and Rocky Creek.	$2.5 million
Gorda	4/14/2011	Landslide	A rock and mudslide closed Hwy 1 near Alder Creek. The initial small slide was cleared, but the storms from March provided the necessary moisture to cause the hillside to fail weeks later, producing another much debris flow later in April.	$5 million

Table 15-1
Historic Large Landslides Along Highway 1 on the Big Sur Coast, Monterey County

Location	Date	Event	Event Narrative	Cost
Posts	12/22/2012	Debris Flow	An atmospheric river caused several slides, including one at Partington Creek that blocked Hwy 1 and a private road. 32 homes were isolated, and 40 tourists were stranded.	
Posts	2/9/2017	Debris Flow	A slide closed Hwy 1 and displaced a column of the Pfeiffer Canyon Bridge, moving 8 inches in one night and destabilizing the bridge. Caltrans determined it was unrepairable and closed the road for 8 months to build a new bridge.	$24 million
Lucia	3/11/2017	Landslide	Paul's Slide buried Hwy 1 with 2 million cubic yards of debris leaving only 11 ft of roadway. 435 residents were caught between the slide and the closure at Pfeiffer Canyon Bridge.	
Gorda	5/19/2017	Debris Flow	A deep-rooted debris flow at Mud Creek, covered a quarter mile of the Hwy 1 in 6 million cubic yards of debris.	$54 million
Lucia	1/27/2021	Debris Flow	An atmospheric river washed out a 150-foot-long stretch of Hwy 1 near Rat Creek below the Dolan Fire burn scar. Flows damaged another 60 locations along the highway.	

Sources: NOAA Storm Events Database; A History of Road Closures Along Highway 1, Big Sur Monterey and San Luis Obispo Counties, California

Historic Slope Failure in Other Geographic Regions

Besides the Big Sur coastline other areas of the County are vulnerable to debris flows. Throughout the 1997–1998 El Niño season, a series of debris slides failed along the northern flank of Saddle Mountain in Carmel Valley and impacted Saddle Mountain Recreation Area. A landslide in Las Lomas in rural north Monterey County caused several homes to be destroyed and resulted in a Hazard Mitigation Grant Program (HMGP) project that involved buying out the affected homes and preserving the land where the slide occurred as perpetual open space.

The 2017 storms caused flooding and debris flows in Prunedale and Spreckels resulting in mud, and rocks covering various sections of roadway, including Crazy Horse Canyon Road, Live Oak Road, Garin Road, and Elkhorn Road. Highway 101 was blocked at Crazy Horse Canyon Road and Highway 68 was blocked with over 1 foot of mud at River Road. One heavy slide caused mud, about 3 feet deep, to block Moro Road. In 2019, heavy rainfall caused large rocks to block Carmel Valley Road at Laureles Grade. In 2021 an annual expected storm caused a large debris flow in the River Fire burn scar. The flow damaged 25 homes and caused one injury.

15.2.2 LOCATION

The best available predictor of where slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

Debris and sediment flows are a particular threat to life and property in mountainous areas of Monterey County. Areas of highest susceptibility to large landslides include Carmel Valley, the Arroyo Seco district, and the foothills of southern Salinas Valley. In this area, rocks have been weakened through faulting, fracturing, and uplift, and are vulnerable to earthquake or rain induced landslides.

Landslides are most common along the steep slopes of the Big Sur coast. Recurrent uplift, in combination with relentless erosion by ocean waves, creates extreme topography, making the area highly susceptible to landslides. Rocks that have been weakened through faulting and fracturing also help provide ideal conditions for large landslides. During the winter months, Big Sur receives both heavy rainfall (as much as 80 inches per year) and high wave energy. In summer and fall, occasional wildfires remove vegetation, making the areas slopes more vulnerable to erosion. All these factors produce chronic landslides, such as those that block, undermine, or damage the Coast Highway.

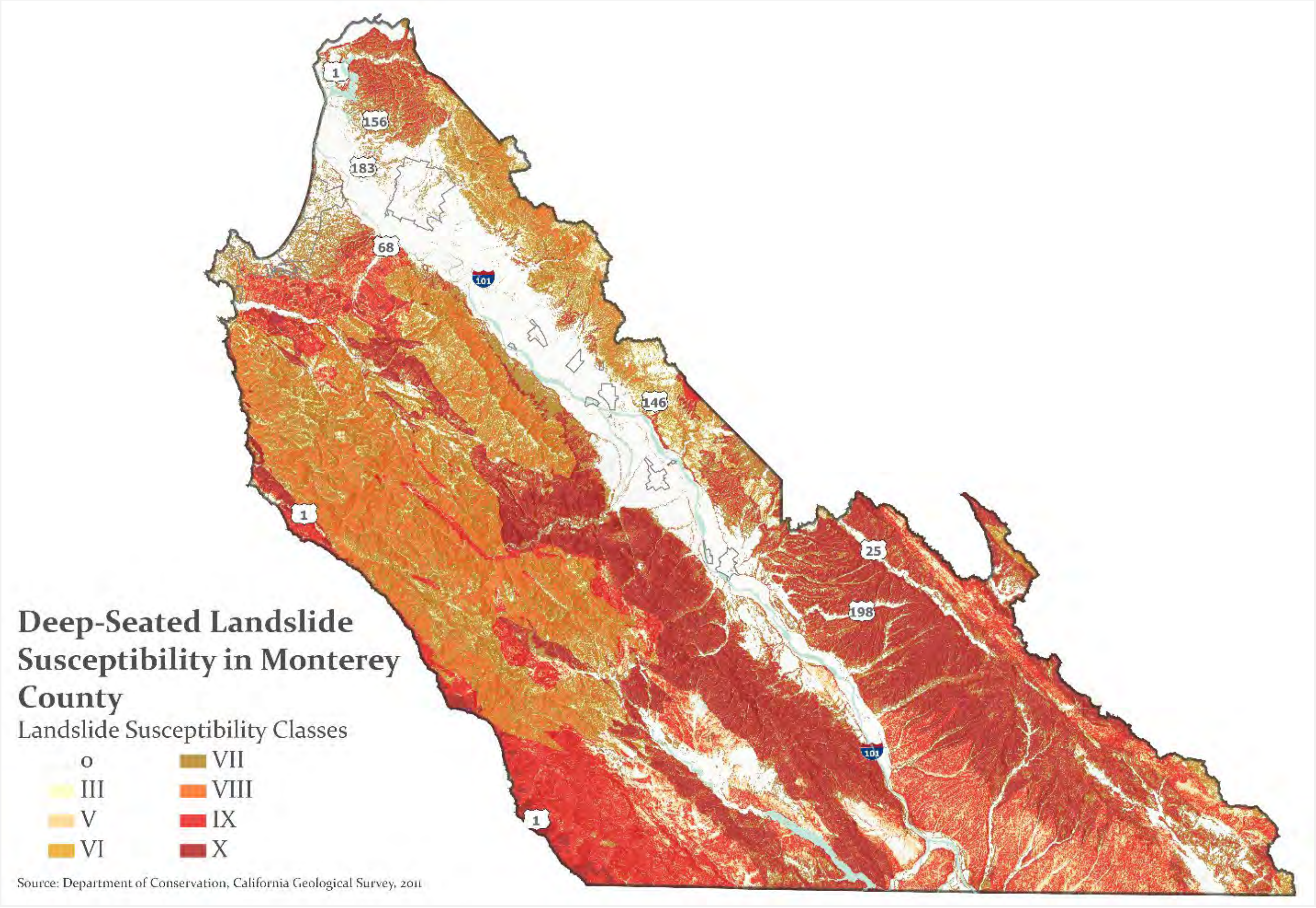
The potential for debris flows increases significantly in areas recently burned by large wildfires. Wildfires can greatly reduce the amount of vegetation, which reduces the ability for the ground to absorb rainwater, allowing excessive water runoff that can include large amounts of debris. An area of current particular concern is the burn scars of the 2020 Dolan, River, and Carmel fires. While post-fire assessment data and detailed mapping on vulnerability to debris flow is not available, structures located anywhere near the burn area should be considered potentially at risk during and following high intensity rainfall events until the vegetation is restored.

The California Geological Survey maps the relative likelihood of deep land sliding based on regional estimates of rock strength and steepness of slopes. On the most basic level, weak rocks and steep slopes are more likely to generate landslides. Their mapping uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope.

This mapping shows the distribution of landslide hazards and provides an overview of where landslides are more likely. This mapping does not include information on landslide triggering events, such as rainstorms or earthquake shaking, nor does it address susceptibility to shallow landslides such as debris flows and is not appropriate for evaluation of landslide potential at any specific site.

Mapping of deep-seated landslide susceptibility in Monterey County based on data from the California Geological Survey[65] is shown in *Figure 15-1*.

Figure 15-1
Deep-Seated Landslide Susceptibility in Monterey County



Additionally, areas in the County are susceptible to earthquake induced landslides. *Figure 15-2* shows earthquake induced landslide susceptibility in Monterey County.

[65] CGS Map Sheet 58: Deep-Seated Landslide Susceptibility, California Geological Survey (May 2011)

EARTHQUAKE INDUCED LANDSLIDE SUSCEPTIBILITY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN 2020

FIGURE 15-2 MONTEREY COUNTY, CA

15.2.3 FREQUENCY

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. In Monterey County, landslides typically occur during and after severe storms, so the potential for landslides largely coincides with the potential for sequential severe storms that saturate steep, vulnerable soils. The FEMA National Risk Index estimates that the annualized frequency of landslide events in Monterey County is 0.43 distinct events per year.

In general Monterey County can expect to experience significant landslide events during strong El Niño years, large atmospheric rivers, or during a large earthquake event. In areas recently burned by wildfires, landslides may occur more frequently and are possible during annual rain events.

15.2.4 SEVERITY

Slope failures destroy property and infrastructure and can take the lives of people. When landslides occur — in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support — they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

Slope failure can pose a serious hazard to properties on or below hillsides. They can block access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This can result in economic losses for businesses. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Slope failures can also damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

In Monterey County, landslides and mudslides are a common occurrence and have caused damage to homes, public facilities, roads, parks, and sewer lines. Landslides along the county's coastline, in conjunction with wave action, have resulted in road failure, severe erosion, cliff failure, and loss of bluff top area that threatens development. In Big Sur, landslides have caused millions of dollars in damages and have led to closures of Highway 1, which can range from a few days to over a year.

15.2.5 WARNING TIME

The velocity of landslides ranges from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some types of slope failure, occur slowly but can have significant property or health consequences. The identification of those hazards generally takes site-specific analysis to determine if the site soils and geology are susceptible to these hazards and what mitigation is most relevant and prudent for a site. For these types of hazards, warning time is long.

For other hazards, such as debris flows, rockfalls, and landslides, warning time is often very short and may not occur at all. Identifying areas where these events are known have occurred, or which have ideal characteristics for these hazards to occur, could help with hazard preparedness when triggering-type events like intense rainfall occur.

Some methods used to monitor landslides can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides.

When wildfire-induced landslide threats exist a state team of foresters, hydrologists, and GIS specialists from CAL FIRE, engineering geologists from the California Geological Survey (CGS) and Regional Water Quality Control Boards (RWQCB), and civil engineers from the Department of Water Resources (DWR), can be assembled into a Watershed Emergency Response Team (WERT) to assess potential life-safety hazards from post-fire debris flows, hyper-concentrated flows, and flood flows on Local and State Responsibility Areas.

An Emergency Stabilization-Burned Area Emergency Response (BAER) is a rapid assessment of burned watersheds that identifies imminent post-wildfire threats to human life and safety, property, and critical natural or cultural resources on federal land. The BAER identifies emergency stabilization measures that can be implemented before the first post-fire damaging events. BAER measures include actions such as: mulching, seeding, installation of erosion and water run-off control structures, temporary barriers to protect recovering areas, and the installation of warning signs.

The USGS also conducts post-fire debris-flow hazard assessments for select fires using geospatial data related to basin morphometry, burn severity, soil properties, and rainfall characteristics to estimate the probability and volume of debris flows that may occur in response to a storm. This identification and analysis will not reduce the warning time, but it will make proactive response to potential triggering events more effective.

15.3 SECONDARY HAZARDS

There are some hazards that can trigger or exacerbate slope failure. Flooding, for example, can undercut the toe of a slope which can remove the support for the slope and cause a landslide. Wildfires create long-term impacts by altering the soil structure, impeding its ability to absorb moisture, and destroying vegetation that binds the soil with roots and absorbs rainfall and runoff. Post-wildfire, even small rainfall events can cause devastating landslides. Areas that are mapped currently as low to moderate risk of these hazards may have high risk after a wildfire.

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation.

This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

15.4 RISK ASSESSMENT

Data developed for the Monterey County 2010 General Plan Update - *Relative earthquake-induced landslide susceptibility of Monterey County (Lewis Rosenberg)* - was used to assess earthquake induced slope failure risk in Monterey County.

Additionally, data from the FEMA National Risk Index was used to capture a wider swath of slope failure risk.

15.4.1 POPULATION

The FEMA National Risk Index estimates that a population of 79,208 people is exposed to landslide risk in Monterey County. As summarized in *Table 15-2*, close to 90,000 people are exposed to high or moderate earthquake induced landslide risk in Monterey County.

Table 15-2
Population Exposed to Earthquake Induced Landslide Risk in Monterey County

Supervisorial District	High	Moderate
District 1	0	0
District 2	10,603	20,284
District 3	3,940	4,109
District 4	307	760
District 5	18,752	28,902
Total	33,602	54,055

Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to failure, increases the number of lives endangered by this hazard. Populations with access and functional needs as well as elderly populations and the young are more vulnerable to the landslide hazards as they may not be able to evacuate quickly enough to avoid the impacts of a landslide.

15.4.2 PROPERTY

The FEMA National Risk Index estimates that $10,420,650,330 of building value in Monterey County is exposed to landslide risk. On average, $16,721 in building value is exposed annually to landslide risk.

As summarized in *Table 15-3*, about 10,000 residential properties, around $9 billion in value, is exposed to high or moderate earthquake-induced landslide risk in Monterey County.

Table 15-3
Residential Property Exposed to Earthquake Induced Landslide Risk in Monterey County

Supervisorial District	High		Moderate	
	#	Value	#	Value
District 1	0	$0	0	$0
District 2	255	$121,610,859	2,985	$1,462,850,110
District 3	402	$111,813,559	587	$168,618,666
District 4	0	$837,871	129	$61,419,691
District 5	1,889	$2,237,652,534	4,665	$5,235,107,467
Total	2,546	$2,471,914,823	8,366	$6,927,995,934

As summarized in *Table 15-4*, close to 11,000 non-residential properties, around $3 billion in value, is exposed to high or moderate earthquake-induced landslide risk in Monterey County.

Table 15-4
Non-Residential Property Exposed to Earthquake Induced Landslide Risk in Monterey County

Supervisorial District	High		Moderate	
	#	Value	#	Value
District 1	0	$0	0	$0
District 2	170	$42,267,723	1,604	$205,569,876
District 3	2,714	$882,625,037	3,298	$1,067,573,258
District 4	7	$0	38	$10,636,707
District 5	1,196	$472,577,390	2,039	$1,025,327,227
Total	4,087	$1,397,470,150	6,979	$2,309,107,068

15.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

A significant amount of linear infrastructure and critical lifelines are exposed to slope failure. Access to major roads is crucial to life-safety, response, and recovery operations after a disaster event. Slope failure events can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems, and delays for public and private transportation. This can result in economic losses for businesses. Slope failure can significantly impact bridges, by knocking out bridge abutments or significantly weaken the soil supporting them. Highly susceptible areas of the County include mountain and coastal roads and transportation infrastructure.

Power lines are generally elevated above steep slopes, but the towers supporting them can be subject to slope failure. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and rip down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses

Critical infrastructure determined to be exposed to earthquake-induced landslide risk is summarized in *Table 15-5*.

Table 15-5
Critical Infrastructure Exposed to Earthquake Induced Landslide Risk in Monterey County

Critical Infrastructure Type	High	Moderate
Facilities		
Emergency Response	2	1
Fire Station	2	3
Police Station	0	0
Medical Facilities	0	2
Military Facility	0	0
Large Public Facilities	0	0
Educational Facilities	0	2
Power Plant	0	0
Water & Wastewater Facilities	11	53
Stormwater Facilities	0	0
Government Facilities	6	9
Communication Facilities	142	205
Rain Gauges	2	3
Lighthouses	0	0
Dams	0	0
Hazardous Materials		
Active or Idle Oil Well	268	822
Landfill	0	0
Underground Tank	0	2
Cal ARP Facility	0	0
Transportation		
Airport	0	0
Bridge	8	9
Harbor	0	0
Highway/Freeway (Miles)	2	26
Driveway (Miles)	0	3
Major Road (Miles)	192	278
Local (Miles)	780	780
Railroad (Miles)	10	10

15.4.4 ENVIRONMENT

Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides. Disposal of landslide debris into the Monterey Bay National Marine Sanctuary (MBNMS) could damage critical marine habitats.

15.4.5 ECONOMIC IMPACT

Millions of visitors travel annually along the Highway 1 in Big Sur, bringing many millions of dollars to the local economy. Maintaining safe access along the Highway is essential for both tourism and the livelihood of residents. Landslides in Big Sur frequently damage the popular and economically essential Highway 1 and can close the road for weeks or months at a time. Maintenance of the highway is expensive and controversial.

15.5 FUTURE TRENDS IN DEVELOPMENT

Land use controls (such as prohibiting development on unstable soils or steep slopes) are the most cost-effective way to prevent loss of life and property. The planning partners are equipped to handle future growth within landslide hazard areas. Landslide risk areas are addressed in the safety elements of local general plans. The State of California has adopted the International Building Code (IBC) by reference in its California Building Standards Code. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk.

15.6 ISSUES

Key issues related to slope failure in Monterey County include:

- There are existing homes in landslide risk areas throughout the County. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- The impact of landslides on tourism in Big Sur.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

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16. TSUNAMI

16.1 OVERVIEW

A tsunami is a wave or series of waves, caused by a displacement of the ocean floor, generated by an earthquake, landslide, volcanic eruption, or even large meteor hitting the ocean. What typically happens is a large, submarine earthquake (magnitude 8 or higher) creates a significant upward movement of the sea floor resulting in a rise or mounding of water at the ocean surface. The mound of water moves away from this center in all directions as a tsunami. These events are also often referred to as tidal waves or seismic sea waves.

A tsunami wave is not a tall breaking wave or a tidal wave, although that term is a common misnomer for a tsunami. A tsunami actually resembles a flood or surge, consisting of several waves or surges. The first tsunami surge is often not the highest and the largest surge may occur hours after the first wave. It is not possible to predict how many surges or how much time will elapse between waves for a particular tsunami. This will become a major issue for public safety officials responding to a tsunami.

Visually, tsunamis differ from typical wind waves as well. A tsunami is virtually undetectable to the eye until it has nearly reached the shore. A tsunami looks more like a storm surge experienced in a large hurricane than it does a wind wave. Similar to a hurricane’s storm surge, a tsunami is capable of bringing in large amounts of water inland very quickly, and can inundate areas that are normally dry, even during highest tides. The surges are extremely strong, and the currents uproot and carry everything within its path. These debris filled surges are deadly and destructive to everything in their path.

In deep ocean water, tsunamis may travel as fast as 600 miles per hour. As they approach the shore, waves may increase in size and can cause extensive damage to coastal structures. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. The first wave usually is not the largest. Several larger and more destructive waves often follow the first one. As tsunamis reach the shoreline, they may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour).

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Offshore canyons can focus tsunami wave energy and islands can filter the energy. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. It has been estimated, for example, that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide.

The first visible indication of an approaching tsunami may be recession of water caused by the trough preceding the advancing, large inbound wave crest. Rapid draw down can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water’s surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.

Conversely, the first indication of a tsunami may be a rise in water level. The advancing tsunami may initially resemble a strong surge increasing the sea level like the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, 3 to 6 feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, and other debris. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

At some locations, the advancing turbulent wave front will be the most destructive part of the wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping all before it and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris with it, resulting in further destruction. Ships and boats, unless moved away from shore, may be dashed against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater.

16.1.1 TSUNAMI TYPES

Tsunamis are typically classified as local or distant. Locally generated tsunamis have minimal warning times, leaving few options except to run to high ground. They may be accompanied by damage resulting from the triggering earthquake due to ground shaking, surface faulting, liquefaction, or landslides. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement evacuation plans.

Local Source

Local tsunami sources, like large offshore faults and massive submarine landslides, can put adjacent coastal communities at the greatest risk because the public must respond quickly with little or no official guidance. The time between the earthquake that generates the tsunami and the first wave coming ashore can be as little as 10-20 minutes, certainly not enough time for a full response.

Distant Source

A tsunami caused by an exceptionally large earthquake elsewhere on the Pacific Rim could reach the California coast many hours (4-15) after the earthquake. Scientific equipment from across the globe is able to measure the earthquake, and the amplitude and speed of a resulting tsunami, thus adequate warning and response can be accomplished through proper planning and exercising.

16.2 HAZARD PROFILE

16.2.1 HISTORY

As shown in *Table 16-1*, ten observed tsunamis generated waves in Monterey County. Almost all of the tsunamis were produced by earthquakes and resulted in wave run-ups of 1 meter or less. In Monterey County, two earthquakes have caused recorded tsunami run-up heights that exceeded 1 meter. The 1960 Chilean Earthquake of estimated magnitude 9.5 (largest ever recorded) caused a 1.1-meter run-up-and killed one person, while the slightly smaller but nearer 1964 Alaska earthquake of magnitude 9.2 caused a 1.4-meter run up and significant boat damage at harbors in the Monterey Bay area.

In 1989, the magnitude 6.9 Loma Prieta earthquake, which was centered inland on the San Andreas fault in the Santa Cruz Mountains, triggered a small to moderate landslide offshore in Monterey Canyon. This caused a 1-foot tsunami measured at the tide gauge in Monterey. In 2011, a tsunami caused by an earthquake off the coast of Japan created large and rapid changes in water level (up to 6 feet) at Moss Landing, causing large volumes of water to rush in and out of the north and south harbor areas. This ebbing and flowing combined with large sediment transport resulted in shear stresses on dock structures in the harbor, causing approximately $1.5 million in damages to 220 timber dock piles.

Table 16-1
Historic Monterey County Tsunami Events

Date	Origin	Cause	Location of Effects	Wave Run-Up	Damage
04/01/1946	Aleutian Islands	Earthquake (M8.8)	Monterey, Pacific Grove	3-5 feet	Slight turbulence, localized flooding
03/09/1957	Aleutian Islands	Earthquake (M8.6)	Monterey	2 feet	No damage
05/22/1960	Chile	Earthquake (M9.5)	Monterey, Moss Landing, Pacific Grove	2-4 feet	Severe currents, seawall submerged, no damage
03/28/1964	Alaska	Earthquake (M9.2)	Monterey, Moss Landing, Pacific Grove	5-8 feet	Strong currents, boats damaged, minor damage to utilities
10/18/1989	Northern California	Earthquake (M6.9)	Monterey, Moss Landing	1-3 feet	No damage
02/27/2010	Chile	Earthquake (M8.8)	Monterey	1 foot	No damage
03/11/2011	Japan	Earthquake (M9.0)	Monterey, Moss Landing	2-6 feet	$1.5 million in damages to dock piles in Moss Landing Harbor
01/15/2022	Tonga	Volcano	Monterey, Moss Landing, Pacific Grove	2-3 feet	TBD

16.2.2 LOCATION

The entire coastal area of Monterey County is susceptible to a tsunami. The Big Sur coast is less susceptible to significant tsunami run-up due to the rugged and steep cliffs of the coastal mountains. However, the coastal low-lying areas and riverine valleys to the north are highly susceptible to tsunamis.

If a large enough earthquake occurs in the Monterey Bay and produces a tsunami it would reach the shore in a matter of minutes. The San Gregorio Fault, which runs more or less parallel to the coastline, is the likeliest point of origin for a near-shore tsunami event. Although not generally considered a fault capable of producing a “mega-earthquake” (>8.0), it is capable of a large enough earthquake that could trigger an offshore landslide in a submarine canyon in the Monterey Bay. If an event such as this were to occur, any potentially resulting tsunami would reach shore in less than 30 minutes, and possibly as little as 10 minutes.

A tsunami caused by an exceptionally large earthquake elsewhere on the Pacific Rim could reach the California coast many hours (4-15) after the earthquake. A thrust-type earthquake (vertical displacement) is more likely to produce a tsunami than an earthquake from a lateral strike-slip fault, such as the San Andreas. Because of this, subduction zones, where dense oceanic crust burrows underneath less-dense continental crust, are more likely to produce a large tsunami.

Perhaps the most likely source for a significant tsunami exceeding 1 meter in run-up height would be from a rupture along the Cascadia Subduction zone in the Pacific Northwest, which evidence indicates has not had a major rupture since 1700 and could produce an earthquake in the Richter magnitude 9.0 range. The Aleutian Islands and Gulf of Alaska are also capable of producing large offshore earthquakes that may produce large tsunamis.

Since large tsunamis are infrequent and the likelihood that the largest potential tsunamis have not yet occurred in Monterey County, the state tsunami program developed a suite of maximum credible tsunami scenarios as part of their tsunami inundation mapping project for local evacuation planning. The general tsunami wave heights (flow depths) for key locations from these scenarios are provided in *Table 16-2*, *Table 16-3*, and *Table 16-4*.[66]

NOTE: The projections do not include any adjustments for ambient conditions, such as storm surge and tidal fluctuations, and model error (it is important to note this difference, as those numbers can increase the projected water height during an event).

Table 16-2
Tsunami Source Scenario Model Results- North County

Tsunami Source	Travel Time	Location- Near Shore Tsunami Heights *Feet Above Mean Sea Level*				
		Pajaro River	Moss Landing	Salinas River	Marina	Sand City
Monterey Canyon Landslide	10-15 min	7	5	8	14	7
M9 Cascadia- Full Rupture	1hr	4	3			4
M9.2 Alaska 1964 EQ	5hr	10	7	7	6	10
M8.9 Central Aleutians I	5hr	7	5	7	6	6
M8.9 Central Aleutians II	5hr	4	3			4
M9.2 Central Aleutians III	5hr	12	10	12	12	12
M8.8 Kuril Islands II	9hr	3	3			3
M8.8 Kuril Islands III	9hr	3	3			4
M8.8 Kuril Islands IV	9hr	4	3			3
M8.8 Japan II	10hr	3	3			4
M.8.6 Marianas Trench	11hr	4	2	3	2	3
M9.5 Chile 1960 EQ	13hr	4	3			4
M9.4 Chile North	13hr	7	3			5
Maximum Runup- Local Source		8	6	9	15	8
Maximum Runup- Distant Source		13	11	12	13	13

[66] Monterey County Tsunami Playbook

Table 16-3
Tsunami Source Scenario Model Results- Monterey

Tsunami Source	Travel Time	Location- Near Shore Tsunami Heights *Feet Above Mean Sea Level*		
		Monterey - Marina	Monterey - Aquarium	Monterey - Point Pinos
Monterey Canyon Landslide	10-15 min	7	17	16
M9 Cascadia- Full Rupture	1hr	4	3	3
M9.2 Alaska 1964 EQ	5hr	10	8	7
M8.9 Central Aleutians I	5hr	6	5	4
M8.9 Central Aleutians II	5hr	3	3	3
M9.2 Central Aleutians III	5hr	12	9	7
M8.8 Kuril Islands II	9hr	2	2	2
M8.8 Kuril Islands III	9hr	4	3	3
M8.8 Kuril Islands IV	9hr	3	3	3
M8.8 Japan II	10hr	4	3	3
M.8.6 Marianas Trench	11hr	3	2	2
M9.5 Chile 1960 EQ	13hr	4	3	3
M9.4 Chile North	13hr	5	4	3
Maximum Runup- Local Source		8	18	17
Maximum Runup- Distant Source		13	10	8

Table 16-4
Tsunami Source Scenario Model Results- South County

Tsunami Source	Travel Time	Location- Near Shore Tsunami Heights *Feet Above Mean Sea Level*		
		Cypress Point	Carmel	Monastery Beach
Monterey Canyon Landslide	10-15 min	13	4	4
M9 Cascadia- Full Rupture	1hr	3	3	2
M9.2 Alaska 1964 EQ	5hr	7	8	7
M8.9 Central Aleutians I	5hr	5	6	5
M8.9 Central Aleutians II	5hr	3	3	3
M9.2 Central Aleutians III	5hr	9	10	9
M8.8 Kuril Islands II	9hr	2	2	2
M8.8 Kuril Islands III	9hr	3	3	3
M8.8 Kuril Islands IV	9hr	3	3	3
M8.8 Japan II	10hr	3	3	3
M.8.6 Marianas Trench	11hr	2	2	2
M9.5 Chile 1960 EQ	13hr	3	3	3
M9.4 Chile North	13hr	3	3	3
Maximum Runup- Local Source		14	4	4
Maximum Runup- Distant Source		10	12	11

16.2.3 FREQUENCY

The frequency of tsunamis is related to the frequency of the events that cause them, so it is similar to the frequency of seismic activity or landslides. As noted above, Monterey County has experienced 10 notable tsunamis over the past 100 years and has been impacted significantly by one. Although these numbers could be averaged to generate an expected occurrence rate, there have been as few as 1 and as many as 45 years in between events, and an averaged recurrence interval would not be meaningful. For the purposes of this plan, the probability that Monterey County will experience a tsunami has been estimated to be possible, averaging a 1-foot to 11-foot wave run-up for all coastal and low-lying areas within the county.

16.2.4 SEVERITY

Tsunamis are a threat to life and property to anyone living near the ocean, but the impact of a tsunami can vary widely. The tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of a tsunami. A small tsunami may result in unusual tides or currents that can be dangerous to swimmers or cause damage to berthed boats. Powerful tsunamis, such as the one that struck Southeast Asia in December 2004, can level structures, and result in significant loss of human life. Tsunami waves can persist for many hours because of complex interactions with the coast. Large tsunamis cause strong rips and currents in oceans around the world for up to a few days after the initiating earthquake.

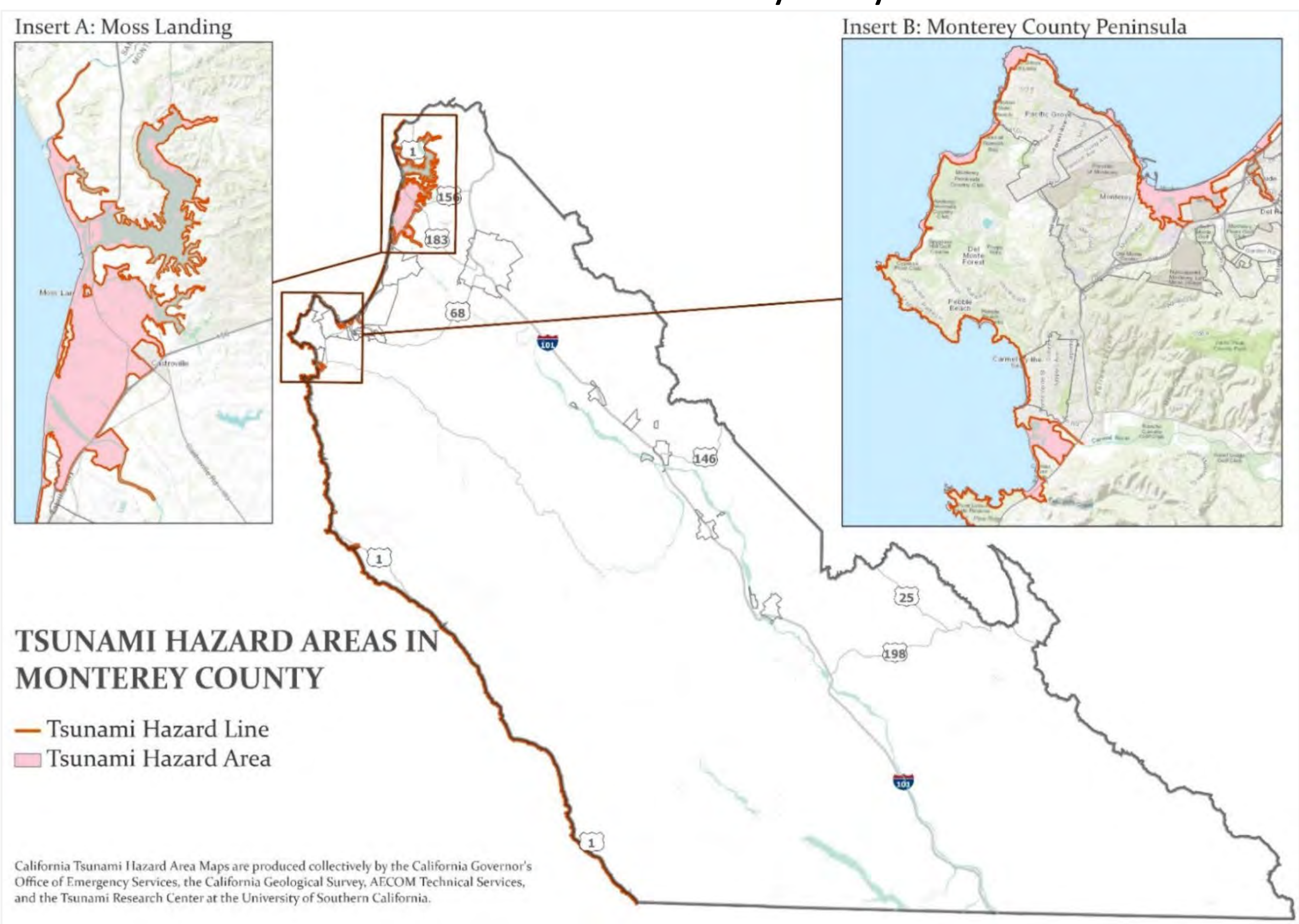
When they strike land, most tsunamis are less than 10 feet high, but in extreme cases, they can exceed 100 feet near their source. A tsunami may come onshore like a fast-rising flood or a wall of turbulent water, and a large tsunami can flood low-lying coastal areas more than a mile inland. Rushing water from waves, floods, and rivers is incredibly powerful. Just six inches of fast-moving water can knock adults off their feet, and twelve inches can carry away a small car. Tsunamis can be particularly destructive because of their speed and volume. They are also dangerous as they return to the sea, carrying debris and people with them. Harbors in particular are vulnerable to damage from strong tsunami currents, potential damage includes:

- Sudden and significant water-level fluctuations can cause boats and docks to hit bottom (grounded) as water levels drop, and docks to overtop piles as water levels rise
- Strong and unpredictable currents can occur, especially where there are narrow passages, channels, or harbor openings, or other natural or man-made structures that form constrictions
- Tsunami-induced bores, seiches, and amplified waves can cause swamping of boats and damage to docks
- Eddies/whirlpools can cause boats to break their moorings and float uncontrolled
- Drag on deep draught boats can cause damaging forces to the docks they are moored to
- Free floating boats, docks, and/or debris in the water can damage structures and infrastructures in the harbor

- Dangerous tsunami conditions which may potentially last tens of hours after first wave arrival, can cause problems for inexperienced and unprepared boaters who may try to move their boats within harbors, take their boats offshore, or reenter the harbor during a tsunami
- Sediment movement from both erosion and deposition can create hazards to navigation
- Environmental issues with debris and contaminants in the water can slow/delay recovery efforts for long periods of time

Overall, the County could see moderate impacts from a tsunami originating in the Pacific Ocean. This could have severe impacts, and the resulting floodwater waves can carry damaging debris and inundate homes, businesses, and government buildings. *Figure 16-1* shows the tsunami inundation zones in Monterey County, which demonstrates the extent of potential impacts from a tsunami.

Figure 16-1
Tsunami Hazard Areas in Monterey County



16.2.5 WARNING TIME

There are two ways to identify if a tsunami may be coming: natural warning and official warning. Strong ground shaking, a loud ocean roar, or the water receding unusually far exposing the sea floor are all nature's warnings that a tsunami may be coming. If any of these warning signs are observed, the public should immediately go to higher ground. A tsunami may arrive within minutes and may last for eight hours or longer. The public should be instructed to stay away from coastal areas until officials announce that it is safe to return.

Official warnings are issues by the National Tsunami Warning Center (NTWC), which provides information about the tsunami in "bulletins" to the state and local jurisdictions. These bulletins include information about the tsunami source, typically an earthquake (location, depth, magnitude), and forecasts about the impending tsunami itself (alert level, first arrival, maximum amplitudes, or wave height). The National Tsunami Warning Center (NTWC) in Palmer, AK, is the primary warning center for the California coastline and issues four types of tsunami statements, these four levels of "alert" are (from least to greatest significance):

- **Tsunami Information Statement**: Issued to inform and update emergency managers and the public that an earthquake has occurred, or that a tsunami Watch, Advisory or Warning has been issued elsewhere in the ocean.
- **Tsunami Watch:** Issued to alert emergency managers and the public of an event which may later impact the Watch area. May be upgraded to an Advisory or Warning - or canceled - based on updated information and analysis.
- **Tsunami Advisory:** Issued due to the threat of a tsunami which may produce strong currents or waves dangerous to those in or near the water; typically called when forecasted tsunami amplitudes between 0.3m and 1m (1ft and 3ft) above existing tidal conditions are expected. Coastal communities are advised that beach and harbor areas could expect rapid, moderate tidal changes and strong currents.
- **Tsunami Warning:** Issued when a tsunami with significant widespread inundation is imminent or expected; typically called when forecasted tsunami amplitudes are equal to or greater than 1m (3ft). Coastal communities are advised to evacuate people from low-lying areas identified as vulnerable to tsunamis.

It is important to note that Tsunami Advisories and Warnings are situations where coastal emergency managers and harbor masters are recommended to take action to protect lives and property, including limiting access to beaches or waterfront areas to full evacuation of the local official evacuation zone identified in their emergency response plans. While the potential for disaster exists with a Tsunami Watch, the situation is truly unknown at the time a watch is issued. The public is only asked to monitor the situation in case an advisory or warning may be issued at a later time.

The following actions and impacts are recommended based on the type of tsunami alert that is issued:

Warning	Inundating wave possible	Full evacuation suggested
Advisory	Strong currents likely	Stay away from the shore
Watch	Danger levels not yet known	Stay alert for more information
Information	Minor waves at most	No action suggested

This official alert system is not considered to be effective for communities close to the tsunami source, because the first wave would arrive before the data can be processed and analyzed, and communications systems may be impacted by the precipitating event. In this case, strong ground shaking would provide the first warning of a potential tsunami and evacuations should begin immediately.

16.3 SECONDARY HAZARDS

A tsunami is always a secondary hazard because it requires an earthquake or landslide to displace a vast volume of water. Secondary hazards can trigger tertiary hazards, for example in 2011 Japan experienced a triple disaster, a subduction zone earthquake with a magnitude of 9.0 that triggered the devastating tsunami which in turn caused a cooling system failure at the Fukushima Nuclear plant.

Additionally, evacuation routes could be blocked as a result of the source of the tsunami such as landslides, power lines, or other debris. People could be trapped in damaged buildings along the waterfront and not be able to evacuate before a tsunami arrives.

16.4 RISK ASSESSMENT

16.4.1 POPULATION

In Monterey County, as seen, in *Table 16-5*, close to 8,000 people are exposed to tsunami inundation areas.

Table 16-5
Population in Tsunami Inundation Zone

Supervisorial District	Population
District 1	0
District 2	3,725
District 3	0
District 4	122
District 5	3,740
Total	7,587

16.4.2 PROPERTY

As seen in *Table 16-6*, in Monterey County, about 850 residential properties, close to $2 billion in residential property value, is located in tsunami inundation areas.

Table 16-6
Residential Property in Tsunami Inundation Zone

Supervisorial District	Number of Properties	Property Value
District 1	0	$0
District 2	232	$151,714,929
District 3	0	$0
District 4	3	$735,480
District 5	610	$1,784,859,471
Total	845	1,937,309,880

Summarized in *Table 16-7*, about 3,500 non-residential properties, close to $1.5 billion in value is located in tsunami inundation areas.

Table 16-7
Non-Residential Property in Tsunami Inundation Zone

Supervisorial District	Number of Properties	Property Value
District 1	0	$0
District 2	1,661	$255,042,798
District 3	0	$0
District 4	183	$219,994,034
District 5	1,718	$1,050,596,597
Total	3,562	$1,525,633,429

16.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Roads are the primary resource for evacuation to higher ground before and during a tsunami event. Roads also can serve as flood control facilities for low depth, low velocity floods by acting as levees or berms and diverting or containing flood flows. The major road in the County that intersect tsunami inundation areas is Highway 1. This is a major road that may be impacted by a tsunami, based on exposure; it is NOT an evacuation route for tsunami events. Evacuation routes are identified in emergency response plans in effect within the County. Bridges exposed to tsunami events can be extremely vulnerable to forces transmitted by wave run-up and by debris carried by the wave action. Additionally, a tsunami would impact and damage the infrastructure and equipment in the Monterey and Moss Landing Harbors.

Water and sewer systems can be affected by the flooding associated with tsunami events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers, and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

Table 16-8 summarizes critical infrastructure in the mapped tsunami inundation zone in Monterey County.

Table 16-8
Critical Infrastructure in Tsunami Inundation Zone in Monterey County

Critical Infrastructure Type	Tsunami Inundation Zone
Facilities	
Emergency Response	0
Fire Station	0
Police Station	0
Medical Facilities	0
Military Facility	0
Large Public Facilities	0
Educational Facilities	2
Power Plant	0
Water & Wastewater Facilities	10
Stormwater Facilities	1
Government Facilities	0
Communication Facilities	7
Rain Gauges	2
Lighthouses	0
Dams	0
Hazardous Materials	
Active or Idle Oil Well	3
Landfill	0
Underground Tank	0
Cal ARP Facility	0
Transportation	
Airport	0
Bridge	7
Harbor	2
Highway/Freeway (Miles)	0
Driveway (Miles)	0
Major Road (Miles)	9
Local (Miles)	10
Railroad (Miles)	4

16.4.4 ENVIRONMENT

Inundation of water by tsunami and introduction of foreign debris could be hazardous to the environment. All wildlife inhabiting the inundation area is exposed. The vulnerability of aquatic habit and associated ecosystems would be highest in low-lying areas of the Monterey Bay coastline and the protected wetland habitats in the Elkhorn and Moro Cojo Slough. Tsunami waves can carry destructive debris and pollutants that can devastate the environment. Millions of dollars spent on habitat restoration and conservation in Monterey County could be wiped out by one significant tsunami. There are currently no tools available to measure these impacts. However, the potential financial impact of a tsunami event on the environment could equal or exceed the impact on property. Community planners and emergency managers should take this into account when preparing for the tsunami hazard and considering future development.

16.4.5 ECONOMIC IMPACT

A tsunami along the coast of Monterey could have an impact on the tourism industry, which is the second largest industry in the County. A tsunami could also impact coastal dependent industries such as harbors, marine sciences, and commercial fishing, as well as effect agricultural operations near the coast.

16.5 FUTURE TRENDS IN DEVELOPMENT

Future development is possible in tsunami inundation zones, but it is likely to be limited due to already regulated flood risk in the areas at risk to tsunami inundation.

16.6 ISSUES

Important issues associated with a tsunami in the County include the following:

- As tsunami warning technologies evolve, the tsunami warning capability within Monterey County will need to be enhanced to provide the highest degree of warning.
- With the possibility of climate change, the issue of sea level rise may become an important consideration as tsunami inundation areas are identified through future studies.
- Lack of understanding of inundation areas has resulted in over self-evacuation; in past incidents people have self-evacuated to the City of Salinas. Further public information and socialization of tsunami risks may be required.
- Special attention will need to be focused on the vulnerable communities in the tsunami zone and on hazard mitigation through public education and outreach.

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17. UTILITY INTERRUPTION

17.1 OVERVIEW

Utility interruptions are electrical, natural gas, sewage, telecommunication, or water failures or interruptions that affect people.

Power Failure

A power failure is any interruption or loss of electrical service due to disruption of power generation or transmission caused by an accident, sabotage, natural hazards, equipment failure, or fuel shortage. These interruptions can last anywhere from a few seconds to several days. Power failures are considered significant only if the local emergency management organization is required to coordinate basic services such as the provision of food, water, and heating as a result. Power failures are common with severe weather and winter storm activity. Pacific Gas and Electric (PG&E) is responsible for operating and maintaining the electrical transmission and distribution system in the County.

The scope and scale of electrical power disruption impacts will vary based on how widespread the disruption is, when and where it occurs, its duration, its cause, the characteristics of the affected population and region, and other concurrent emergencies. While the electric power industry does not have a universal agreement for classifying disruptions, it is important to recognize that different types of outages are possible, so that plans may be made to handle them effectively. Electric power disruptions can generally be grouped into two categories:

- **Intentional Electrical Disruptions**: Some disruptions are purposefully done to upgrade, fix, or protect electrical power systems and/or the surrounding area. Intentional power disruptions can be scheduled or done without notice and can last several minutes to several days; when possible, the electrical service provider will give the Operational Area and its customers advance notice of the disruption.

- **Unintentional Electrical Disruptions**: Unintentional disruptions are not done purposefully, range in duration and often occur without notice. These types of disruptions include:
  - Accidents by the utility provider, contractor, or others
  - Malfunctions or equipment failures, due, for example, to age, improper operation, excessive operation, or manufacturing defect
  - Overloads on either the utility's equipment or a customer's equipment
  - Equipment that cannot operate within its design criteria (known as reduced capability)
  - Tree contact
  - Vandalism or intentional damage
  - Disasters, such as extreme weather/winds, earthquakes, floods, and wildfires

Load Shedding: Load Shedding occurs when the power system is under extreme stress, due to heavy demand and/or failure of critical components, the electrical service provider may interrupt or cut service (or load) to select customers to prevent the entire system from collapsing. This can be done with or without warning.

Public Safety Power Shutoff (PSPS): The State's investor-owned electric utilities, including Pacific Gas and Electric Company (PG&E), may shut off electric power, referred to as "de-energization" or Public Safety Power Shut-offs (PSPS), to protect public safety under California law, specifically California Public Utilities Code (PU Code) Sections 451 and 399.2(a). This is done to reduce the chance of fire ignition in high fire threat areas. PG&E has stated they may de-energize, or shutoff power, to electrical grids or blocks of areas in advance of or during periods of heightened risk of wildland fires. In these instances, power will remain out for as long as extreme and dangerous conditions pose a potential fire risk and until PG&E can inspect and repair power lines and equipment. Once the electrical service provider deems it is safe to do so, power will be systematically restored.

Water or Wastewater Disruption

Water or wastewater disruption is a secondary impact from a natural disaster or intentional act. A breach in the pipelines that carry water through the County would have significant temporary impacts until alternative water sources are pumped and treated. Long-term disruption would have significant impacts on residences and businesses in the planning area if demand exceeds secondary supplies and water conservation measures do not provide enough relief to reduce demand to equal the secondary supplies.

Disruption of the County’s wastewater collection and wastewater treatment plants would have significant regional impacts. Such disruption could result if the system were to be overwhelmed by a significant storm or discharge of materials in such quantities that the treatment plant could not adequately treat the waste. Natural hazards such as earthquake or flood, major power outages, or terrorism directed at the facilities and systems could disrupt the process of collecting and treating millions of gallons of sewage. Wastewater treatment plants may also have emergencies internal to the plant such as oxygen deficiencies that render them incapable of treating waste. The disruption of service may also have significant environmental impacts on the waterways adjacent to the treatment plants.

Data and Telecommunications Interruptions

The loss of data or telecommunications is often a secondary hazard to natural and other human-caused hazards. Data and telecommunications provide a primary method for service to the community by the government and the private sector. A loss of data and telecommunications could result in loss of emergency dispatch capabilities, emergency planning services, infrastructure monitoring capabilities, access to statistical data, and access to financial and personnel records.

Pipeline Interruptions

Pipelines are often considered the safest and most reliable way to transport natural gas, crude oil, liquid petroleum products, and chemical products, but there is still an inherent risk due to the nature of the hazardous materials. Failures of pipelines can occur when pipes corrode, are damaged during excavation, are incorrectly operated, or are damaged by other forces.

Intra-state liquid petroleum pipelines are regulated by the Office of the State Fire Marshal Pipeline Safety Division. Natural gas pipelines are regulated by the California Public Utilities Commission. Pipelines are also monitored by supervisory control and data acquisition systems that measure flow rate, temperature, and pressure. These systems transfer real-time data via satellite from the pipelines to a control center where valves, pumps, and motors are remotely operated. If tampering with the pipeline occurs, an alarm will sound. The ensuing valve reaction is instantaneous, with the system isolating any rupture and setting off a chain reaction that shuts down pipeline pumps and alerts pipeline operators within seconds.

Transmission pipelines and distribution pipelines provide different services. Transmission pipelines transport raw material for further refinement. These pipes are large and far reaching, operating under high pressure. Distribution pipelines provide processed materials to end users. These are smaller in diameter, some as small as a half an inch, and operate under lower pressure. More serious accidents occur on distribution pipelines than on any other type due to their number, intricate networking, and location in highly populated areas.

17.1.1 SPACE WEATHER

All weather on Earth, from the surface of the planet into space, is influenced by the small changes the sun undergoes during its solar cycle. These variations are referred to as space weather. Sudden bursts of plasma and magnetic field structures from the sun’s atmosphere—called coronal mass ejections—together with sudden bursts of radiation, or solar flares, all cause weather effects on Earth. Extreme space weather can cause damage to critical infrastructure, especially the electric grid. It can produce electromagnetic fields that induce extreme currents in wires, disrupting power lines, and even causing wide-spread blackouts. In severe cases, it produces solar energetic particles, which can damage satellites used for commercial communications, global positioning, intelligence gathering, and weather forecasting.

NOAA's Space Weather Prediction Center has developed space weather scales ranging from minor to extreme effects as a way to communicate to the general public the current and future space weather conditions and their possible effects on people and systems. Descriptions of three general NOAA classifications of space weather— geomagnetic storms, solar radiation storms and radio blackouts—are included in *Figure 17-1*. NOAA Space Weather Prediction Center studies have determined that different types of space weather may occur separately.

The most important impact the sun has on Earth is related to its brightness or irradiance. The sun produces energy in the form of photons of light. The variability of the sun's output is wavelength dependent:

- Most of the energy from the sun is emitted in the visible wavelengths. The output from the sun in these wavelengths is nearly constant and changes by only 0.1% over the course of the 11-year solar cycle.
- At ultraviolet or UV wavelengths, solar irradiance is more variable, with changes up to 15% over the course of the 11-year solar cycle. This has a significant impact on the absorption of energy by ozone and in the stratosphere.
- At still shorter wavelengths, like extreme ultraviolet, solar irradiance changes by 30 to 300% over a period of minutes. These wavelengths are absorbed in the upper atmosphere, so they have minimal impact on the climate of Earth.
- At the other end of the light spectrum, at infrared wavelengths, solar irradiance is very stable and only changes by a percent or less over the solar cycle.

Other types of space weather can impact the atmosphere. Energetic particles penetrating into the atmosphere can change chemical constituents. These changes in minor species such as nitrous oxide can have long lasting consequences in the upper and middle atmosphere; however, it has not been determined if these have a major impact on the Earth's climate.

Space weather (geomagnetic storms, solar radiation storms, solar flare radio blackouts, solar radio bursts, and cosmic radiation) can impact aviation operations at the Monterey Airport. Effects include degradation or loss of HF radio transmission and satellite navigation signals; navigation system disruptions; and avionics errors. Airport dispatchers use space weather forecasts for flight planning at high latitudes, especially for polar routes.

Figure 17-1

NOAA Space Weather Scales

Category: Scale	Category: Descriptor	Effect (Duration of event will influence severity of effects)	Physical measure	Average Frequency (1 cycle = 11 years)
Geomagnetic Storms			Kp values* determined every 3 hours	Number of storm events when Kp level was met; (number of storm days)
G 5	Extreme	Power systems: widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. Spacecraft operations: may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. Other systems: pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).**	Kp=9	4 per cycle (4 days per cycle)
G 4	Severe	Power systems: possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. Spacecraft operations: may experience surface charging and tracking problems, corrections may be needed for orientation problems. Other systems: induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).**	Kp=8	100 per cycle (60 days per cycle)
G 3	Strong	Power systems: voltage corrections may be required, false alarms triggered on some protection devices. Spacecraft operations: surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. Other systems: intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).**	Kp=7	200 per cycle (130 days per cycle)
G 2	Moderate	Power systems: high-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. Spacecraft operations: corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).**	Kp=6	600 per cycle (360 days per cycle)
G 1	Minor	Power systems: weak power grid fluctuations can occur. Spacecraft operations: minor impact on satellite operations possible. Other systems: migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).**	Kp=5	1700 per cycle (900 days per cycle)

* Based on this measure, but other physical measures are also considered.
** For specific locations around the globe, use geomagnetic latitude to determine likely sightings (see www.swpc.noaa.gov/Aurora)

Scale	Descriptor	Effect	Physical measure	Average Frequency
Solar Radiation Storms			Flux level of ≥ 10 MeV particles (ions)*	Number of events when flux level was met**
S 5	Extreme	Biological: unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. *** Satellite operations: satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. Other systems: complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle
S 4	Severe	Biological: unavoidable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: may experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. Other systems: blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S 3	Strong	Biological: radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. Other systems: degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S 2	Moderate	Biological: passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk.*** Satellite operations: infrequent single-event upsets possible. Other systems: effects on HF propagation through the polar regions, and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S1	Minor	Biological: none. Satellite operations: none. Other systems: minor impacts on HF radio in the polar regions.	10	50 per cycle

* Flux levels are 5 minute averages. Flux in particles·s^{-1}·$ster^{-1}$·cm^{-2} Based on this measure, but other physical measures are also considered.
** These events can last more than one day.
*** High energy particle (>100 MeV) are a better indicator of radiation risk to passenger and crews. Pregnant women are particularly susceptible.

NOAA Space Weather Scales

Category		Effect	Physical measure	Average Frequency (1 cycle = 11 years)
Radio Blackouts			GOES X-ray peak brightness by class and by flux*	Number of events when flux level was met; (number of storm days)
R 5	Extreme	HF Radio: Complete HF (high frequency**) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. Navigation: Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20 ($2x10^{-3}$)	Fewer than 1 per cycle
R 4	Severe	HF Radio: HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. Navigation: Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10 (10^{-3})	8 per cycle (8 days per cycle)
R 3	Strong	HF Radio: Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. Navigation: Low-frequency navigation signals degraded for about an hour.	X1 (10^{-4})	175 per cycle (140 days per cycle)
R 2	Moderate	HF Radio: Limited blackout of HF radio communication on sunlit side of the Earth, loss of radio contact for tens of minutes. Navigation: Degradation of low-frequency navigation signals for tens of minutes.	M5 ($5x10^{-5}$)	350 per cycle (300 days per cycle)
R 1	Minor	HF Radio: Weak or minor degradation of HF radio communication on sunlit side of the Earth, occasional loss of radio contact. Navigation: Low-frequency navigation signals degraded for brief intervals.	M1 (10^{-5})	2000 per cycle (950 days per cycle)

* Flux, measured in the 0.1-0.8 nm range, in $W \cdot m^{-2}$. Based on this measure, but other physical measures are also considered.

** Other frequencies may also be affected by these conditions.

URL: *www.swpc.noaa.gov/NOAAscales* April 7, 2011

17.2 HAZARD PROFILE

17.2.1 HISTORY

The Monterey County Emergency Operations Center (EOC) was activated for a PSPS in 2019. On October 26-29, 2019, Pacific Gas and Electric Company de-energized areas of incorporated and unincorporated Monterey County resulting in prolonged complete loss of electricity due to a Public Safety Power Shutoff (PSPS). Those impacted included:

- Customers De-Energized: 10,607 Total Customers
- 279 Medical Baseline Customers
- 79 Critical Facilities, including the Salinas Valley State Prison

During 2021, multiple utility interruptions occurred. The January 2021 atmospheric river event caused both telecommunications and power outages in the County. On August 5, 2021, the explosion of multiple transformers in the City of Soledad caused at one point in time, the loss of power to over 3,500 customers. On the same day, a car crash into a power pole caused outages in the City of Greenfield.

On August 15, 2021, over 2,500 customers in the Carmel Valley lost power due to unknown causes. From October 9-10, 2021, Pacific Gas and Electric Company de-energized areas of incorporated and unincorporated Monterey County resulting in prolonged complete loss of electricity due to a Public Safety Power Shutoff (PSPS). Around 850 customers lost power for some amount of time.

There have also been a number of telecommunications outages that have impacted County residents. In November of 2021, AT&T had a major fiber cut between Salinas and Gonzales, which affected every AT&T provided service in South County, including the transport from cell sites to AT&T's backbone. AT&T's Big Sur cellular service was also affected since it connects at Greenfield.

17.2.2 LOCATION

Electrical generation, transmission, and distribution system are located throughout the County. Previous significant Public Safety Power Shutoff events have impacted Unincorporated Monterey County: Aromas, Gabilan Foothills, Carmel Valley, Chualar; and Incorporated Cities of Monterey County: City of Gonzales, City of Soledad, City of Greenfield.

Space Weather

Different types of space weather can affect different technologies in the County. Solar flares can produce strong x-rays that degrade or block high-frequency radio waves used for radio communication during events known as radio blackout storms. Solar energetic particles can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes during solar radiation storms. Coronal mass ejections can cause geomagnetic storms on Earth and induce extra currents in the ground that can degrade power grid operations and modify the signal from radio navigation systems (GPS), causing accuracy to be degraded.

17.2.3 FREQUENCY

The frequency of utility failure and power interruption is likely to remain constant, but the length of time a utility is shut down should lessen in the future as more redundancies are built into infrastructure and utilities. In addition, leak detection sensors alert utilities to faults and failures more quickly.

Space Weather

Space weather events occur daily, but do not always affect residents in the County. They are all monitored and reported by NOAA's Space Weather Prediction Center.

17.2.4 SEVERITY

The severity of utility failure and power interruptions varies too widely to be able to measure. Electricity, for example, may be out for a few hours to several weeks, depending on the cause of the event.

Space Weather

The severity of space weather can be far-reaching, as virtually all infrastructure and services depend on the electric power grid. Ground currents induced during geomagnetic storms can melt copper windings of transformers, which are the primary components of power distribution systems. Power lines traversing the County can pick up the currents and spread the problem over the entire area.

17.2.5 WARNING TIME

Utility failure and power interruptions occur at any time without warning. However, they usually are a secondary effect from a storm event, landslide, or human-caused issues.

Space Weather

Space weather prediction services in the United States are provided primarily by NOAA's Space Weather Prediction Center and the US Air Force's Weather Agency, which work closely together to address the needs of civilian and military user communities. The Space Weather Prediction Center draws on a variety of data sources, both space and ground-based, to provide forecasts, watches, warnings, alerts, and summaries as well as operational space weather products to civilian and commercial users.

17.3 SECONDARY HAZARDS

Utility losses can cause a reduction in employment and in wholesale and retail sales, require utility repairs, and increase medical risk. Local government may lose tax revenue, and the finances of private utility companies and the businesses that rely on them can be disrupted.

Space Weather

The most likely secondary impact of space weather on residents, businesses and visitors to the County is disruption of the electric power grid. Space weather can have an impact on advanced technologies, which has a direct impact on daily life.

17.4 RISK ASSESSMENT

17.4.1 POPULATION

All residents and visitors in the County are exposed to utility interruptions. This will continue as people are dependent on basic utility services such as electricity, water, wastewater, natural gas, etc. Utility disruptions can have both a direct impact on society and trigger or worsen disruptions to water, transportation, and other systems, that in turn may cause further societal impacts. Additional emergencies occurring during power disruptions can compound these effects and influence the timeline of restoration. Depending on the circumstances surrounding the incident, utility disruption can impact transportation/fuel, communications, housing, critical infrastructure, first response, and the economy.

Space Weather

Space weather exposure of the County's population is minimal. The main exposure is of satellite operations, HF radio communications, and the power grid that people use.

17.4.2 PROPERTY

All property throughout the County is exposed to some type of utility infrastructure failure.

Space Weather

It is unlikely that the impacts of space weather would have a negative impact on property and structures themselves, but a magnetic or black-out event caused by space weather, would affect public and private infrastructure systems.

17.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

All critical facilities and infrastructure that are operated by electricity are exposed to utility interruption and a space weather phenomenon. Damage to critical facilities can disrupt health care, fire and police services and impair search and rescue and emergency medical care.

17.4.4 ENVIRONMENT

The environment is usually not exposed to utility interruption unless it is a spill that contaminates water or open land or creates a wildfire that burns acres.

Space Weather

Migratory animals are exposed to geomagnetic storms associated with space weather.

17.4.5 ECONOMIC IMPACT

Utility losses could cause a reduction in employment and wholesale and retail sales, a need for utility repairs, and increased medical risks. Local governments might lose tax revenues, and the finances of private utility companies and the businesses that rely on them would be disrupted. Utility interruption can also affect agricultural production, which can have a large economic effect on Monterey County.

FEMA has developed standard loss-of-use estimates in conjunction with its benefit-cost analysis methodologies to estimate the cost of lost utilities on a per-person, per-use basis, as summarized in *Table 17-1*.

Table 17-1
FEMA Standard Value for Loss of Service for Utilities and Roads/Bridges

Interruption	Total Economic Impact
Complete Loss of Electric Power	$126 per person per day
Complete Loss of Potable Water Service	$93 per person per day
Complete Loss of Wastewater Service	$41 per person per day
Complete Loss of Road/Bridge Service	$38.15 per vehicle per hour of vehicle delay; $0.55 per mile of vehicle delay (current mileage rate)

Source: FEMA BCA Reference Guide, June 2009, Appendix C FEMA Standard Values

17.5 FUTURE TRENDS IN DEVELOPMENT

The likelihood of utility interruption in the future will continue as development and population growth continue in the County. The majority of utilities in the County are privately owned, and market forces are, as a rule, insufficient to induce needed investments in protection. Private organizational strategies and policies will need to work together to ensure reliable and resilient services for the long term.

17.6 ISSUES

Key issues associated with utility interruptions in Monterey County include:

- Heat-related equipment failures and electrical infrastructure igniting wildfires has resulted in unintentional and intentional rolling blackouts and power shutoffs throughout the County. Public Safety/ Utility Initiated Power Shut Offs to prevent wildfire ignition can have notably significant impacts due to the length of disruption time, limited efficacy of the strategy, and the effect on first responder capabilities.
- The economic impact of utility interruptions on industry, particularly the agricultural industry is a large concern in the County. Loss of power for more than a few hours can result in large economic losses.
- More vulnerable populations in isolated areas or who rely on medical devices are at increased risk during prolonged power outages.
- Extreme and prolonged heatwaves across the state increase the demand for use of the aging electrical grid significantly depleting electricity reserves resulting in blackouts. Heatwaves are expected to increase in intensity and magnitude due to climate change, which will likely exacerbate this problem.
- Monterey County has limited microgrids and reliance on the macro-grid makes the County vulnerable to rolling and prolonged power outages.

18. WILDFIRE

18.1 OVERVIEW

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be caused by human activities (such as arson or campfires) or by natural events such as lightning. Wildfires are costly, putting lives and property at risk and compromising rivers and watersheds, open space, timber, range, recreational opportunities, wildlife habitats, historic and cultural areas assets, scenic assets, and local economies. Vulnerability to flooding increases due to the destruction of forest and ground cover within watersheds. The potential for significant damage to life and property increases in areas where development is adjacent to dense vegetation, known as wildland urban interface (WUI) areas.

Reported outcomes of wildfire typically include only those that are attributable to the physical fire itself; these outcomes largely occur during the fire event and within or near the wildfire perimeter. However, wildfires can also generate smoke plumes or increase the risk of post-wildfire landscape events such as erosion, debris flows, and flooding.

18.1.1 WILDFIRE PROTECTION RESPONSIBILITY AREAS

Local, state, tribal, and federal organizations all have legal and financial responsibility for wildfire protection. In many instances, two fire organizations have dual primary responsibility on the same parcel of land—one for wildfire protection and the other for structural fire protection. To address wildfire jurisdictional responsibilities, the California State Legislature outlined various wildfire responsibilities, described below, in Cal. Pub. Res.Code§4291.5 and Cal. Health & SafetyCode§13108.5. *Figure 18-1* shows the Fire Protection Responsibility areas

(Federal Responsibility Areas, State Responsibility Areas, and Local Responsibility Areas) in Monterey County.

Federal Responsibility Area (FRA)

Federal Responsibility Areas (FRA) are fire-prone wildland areas that are owned or managed by a federal agency. Primary financial and rule-making jurisdictional authority rests with the federal land agency. In many instances, FRAs are interspersed with private land ownership or leases. Fire protection for developed private property is usually not the responsibility of the federal land management agency; structural protection responsibility is that of a local government agency.

The agencies that control federal lands within Monterey County include:

- US Forest Service: Los Padres National Forest
- National Park Service: Pinnacles National Park
- Dept. of Defense: Fort Hunter Liggett, Defense Language Institute, Presidio of Monterey
- Bureau of Land Management: Various
- California National Guard: Camp Roberts

State Responsibility Area (SRA)

State Responsibility Areas (SRA) are lands in California where California Department of Forestry and Fire (CAL FIRE) has legal and financial responsibility for wildfire protection and administers fire hazard classifications and building standard regulations. SRAs include forested lands and land that is generally considered wildland. SRAs do not include incorporated cities or federal lands. CAL FIRE is responsible for carrying out the mandate for wildland fire protection within SRAs. The CAL FIRE San Benito-Monterey Unit (BEU) provides wildland fire protection to the 2.1 million acres of SRA land in the County.

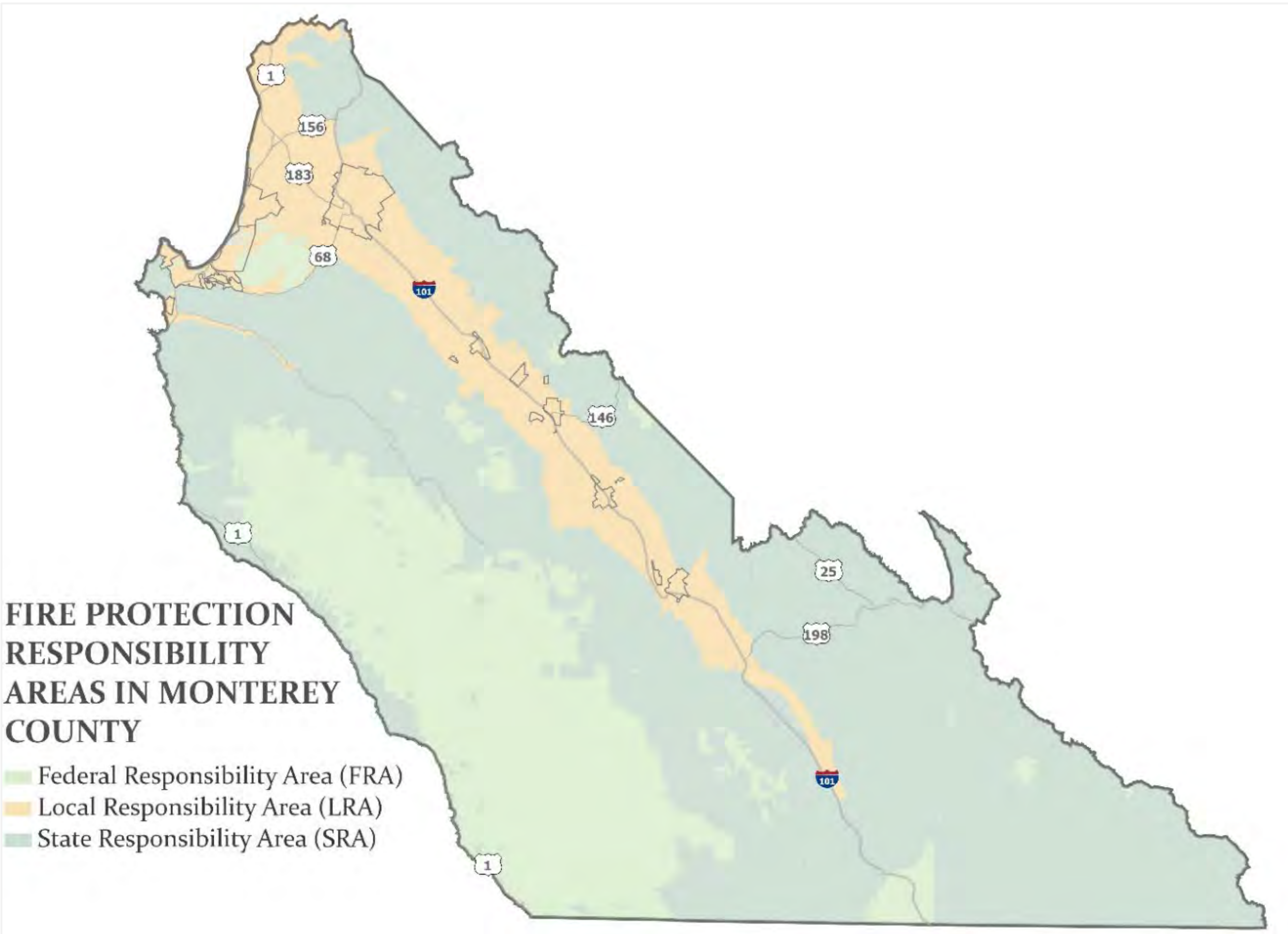
The law also allows CAL FIRE to provide fire protection services to local communities under contract. When contracting to provide services, authority is delegated to CAL FIRE by the contracting agency. CAL FIRE will respond to reported fires and may provide EMS and other incident responses as contracted for. SRAs may overlap some or all of a special district’s jurisdiction, as is the case in unincorporated Monterey County.

CAL FIRE BEU has Cooperative Fire Protection Agreements with the Pebble Beach Community Services District, the Cypress Fire Protection District, the Carmel Highlands Fire Protection District, the Aromas Tri-County Fire Protection District, the South Monterey County Fire Protection District, and the Soledad Fire Department. They have Dispatch Agreements with the Cachagua Fire Protection District and the Mid Coast Volunteer Fire Brigade.

Local Responsibility Area (LRA)

Local Responsibility Areas (LRAs) include land in cities, cultivated agriculture lands, nonflammable areas in unincorporated areas, and lands that do not meet the criteria for SRA or FRA. LRA fire protection is typically provided by city fire departments, fire protection districts, and counties, or by CAL FIRE under contract to local governments. LRAs may include flammable vegetation and wildland urban interface areas where the financial and jurisdictional responsibility for improvement and wildfire protection is that of a local government agency.

Figure 18-1
Fire Protection Responsibility Areas in Monterey County



18.1.2 FIRE PROTECTION DISTIRCTS AND AGENCIES

The special districts providing fire protection services cover about 1,497 square miles, almost half of the 3,281 square miles of land area in Monterey County.

Table 18-1 summarizes the Fire Protection Districts and service areas of the Fire Protection Districts are mapped in *Figure 18-2*.

Table 18-1
Fire Protection Districts in Monterey County

Fire Protection District	Estimated Area (Square Miles)	Estimated Population	Responding Agency	ISO Public Protection Classification
Aromas Tri-County Fire Protection District	17.3	5,800	CAL FIRE BEU	4 / 4X
Big Sur Volunteer Fire Brigade	254.0	4,350	Big Sur Fire	8 / 10
Cachagua Fire Protection District	108.0	1,000	Cachagua Fire	9 / 10
Carmel Highlands Fire Protection District	9.3	1,075	CAL FIRE BEU	2 / 9
Cypress Fire Protection District	11.4	7,600	CAL FIRE BEU	2 / 9
Gonzales Rural Fire Protection District	58.4	650	Gonzales Fire	3 / 3X (5 in City)
Greenfield Fire Protection District	43.2	700	Greenfield Fire	5 / 10
Mid-Coast Volunteer Fire Brigade	41.0	270	Mid-Coast Fire	5 / 7B
Mission Soledad Rural Fire Protection District	59.6	1,150	CAL FIRE BEU	3 / 10 (4 in City)
Monterey County Regional Fire Protection District	399.6	38,350	Regional Fire	3 / 10
North County Fire Protection District	122.9	42,000	North County Fire	4 /10
Pebble Beach Community Services District	8.3	4,100	CAL FIRE BEU	1
South Monterey County Fire Protection District	637.2	4,600	CAL FIRE BEU	8 / 10

Aromas Tri-County Fire Protection District

The Aromas Tri-County Fire Protection District provides fire protection and emergency medical services to approximately 5,800 people throughout forty square miles in the northeast corner of Monterey County and adjacent areas of San Benito and Santa Cruz Counties. Monterey County is the district's principal county because it has the highest assessed value among the three counties within the district's boundaries. The district provides services through a contract with CAL FIRE.

Big Sur Volunteer Fire Brigade

The Big Sur Volunteer Fire Brigade provides services to the rural community of Big Sur. The Brigade is a 501(c)3 nonprofit and is not a public agency. The Brigade provides fire protection and emergency medical services to approximately 4,350 people over an area of 254 square miles along the southern half of Monterey County coastline and to the inland to areas within the Los Padres National Forest. The Brigade is staffed by volunteers.

Cachagua Fire Protection District

The Cachagua Fire Protection District provides fire suppression and emergency medical services to the rural and mountainous areas at the eastern end of Carmel Valley, known as the Cachagua area. The district comprises approximately 108 square miles of territory and serves over 1,000 residents. The Fire Protection District is staffed by volunteers.

Carmel Highlands Fire Protection District

The Carmel Highlands Fire Protection District provides services through a contract with CAL FIRE. The district provides a high level of fire protection and emergency paramedic medical services to approximately 1,075 people throughout 9 square miles in the coastal area south of Carmel-by-the-Sea. The district works closely with two adjacent districts - the Cypress Fire Protection District and the Pebble Beach Community Services District - that are both also serviced by CAL FIRE. These three special districts operate what is essentially a seamless regional fire department. The residents of these three special districts benefit from a sharing of stations, apparatus, and staffing. The arrangement has been formed through cost sharing agreements, without the formality or bureaucracy of consolidation.

Cypress Fire Protection District

The Cypress Fire Protection District provides services through a contract with CAL FIRE. The district provides a high level of fire protection and emergency paramedic medical services to approximately 7,600 people throughout 11 square miles within the mouth of the Carmel Valley, and unincorporated portions of Carmel and Monterey. As mentioned above, the district works closely with the Carmel Highlands FPD and the Pebble Beach Community Services District, which are also staffed through CAL FIRE.

Gonzales Rural Fire Protection District

The Gonzales Rural Fire Protection District provides fire protection and emergency medical services to approximately 650 people throughout 58 square miles in the rural area surrounding the City of Gonzales. The small size of the district does not allow it to economically maintain independent fire protection service, so the district has contracted with the City of Gonzales to provide fire protection and emergency medical services within District boundaries.

Greenfield Fire Protection District

The Greenfield Fire Protection District provides fire protection and emergency medical services to approximately 700 people throughout 43 square miles in the rural area surrounding the City of Greenfield. The district contracts with the City of Greenfield to receive fire protection and emergency medical services from the City Fire Department.

Mid-Coast Volunteer Fire Brigade

The Mid-Coast Volunteer Fire Brigade provides services to the rural communities of Garrapata, Palo Colorado, Rocky Creek, Bixby, and the coast from Garrapata State Park south to "South Forty" on Hurricane Point. The Brigade is a 501(c)3 nonprofit and is not a public agency. The Brigade provides fire protection and emergency medical services to approximately 270 people over an area of 41 square miles along the middle of Monterey County's coastline and to the inland rural areas. The Brigade is staffed by volunteers.

Mission Soledad Rural Fire Protection District

The Mission Soledad Rural Fire Protection District provides fire protection and emergency medical services to approximately 1,150 people throughout 60 square miles in the rural area surrounding the City of Soledad. The district has provided services through a contract with the City of Soledad. The City of Soledad, in turn, contracts with CAL FIRE to provide services to the City and District.

Monterey County Regional Fire District

Monterey County Regional Fire District provides services from rural areas north of the City of Salinas south to the Federal Ventana Wilderness and the outskirts of the City of Gonzales, from the Cities of Marina, Seaside, and Monterey on the west to the San Benito County line in the east. The district provides a high level of fire protection and emergency paramedic medical services to approximately 38,350 people throughout its 400-square mile district. The district also provides ambulance service to Carmel Valley residents.

North County Fire Protection District of Monterey County

North County Fire Protection District of Monterey County provides services to rural communities in northern Monterey County. The district provides fire protection and emergency medical services to approximately 42,000 people throughout 123 square miles.

Pebble Beach Community Services District

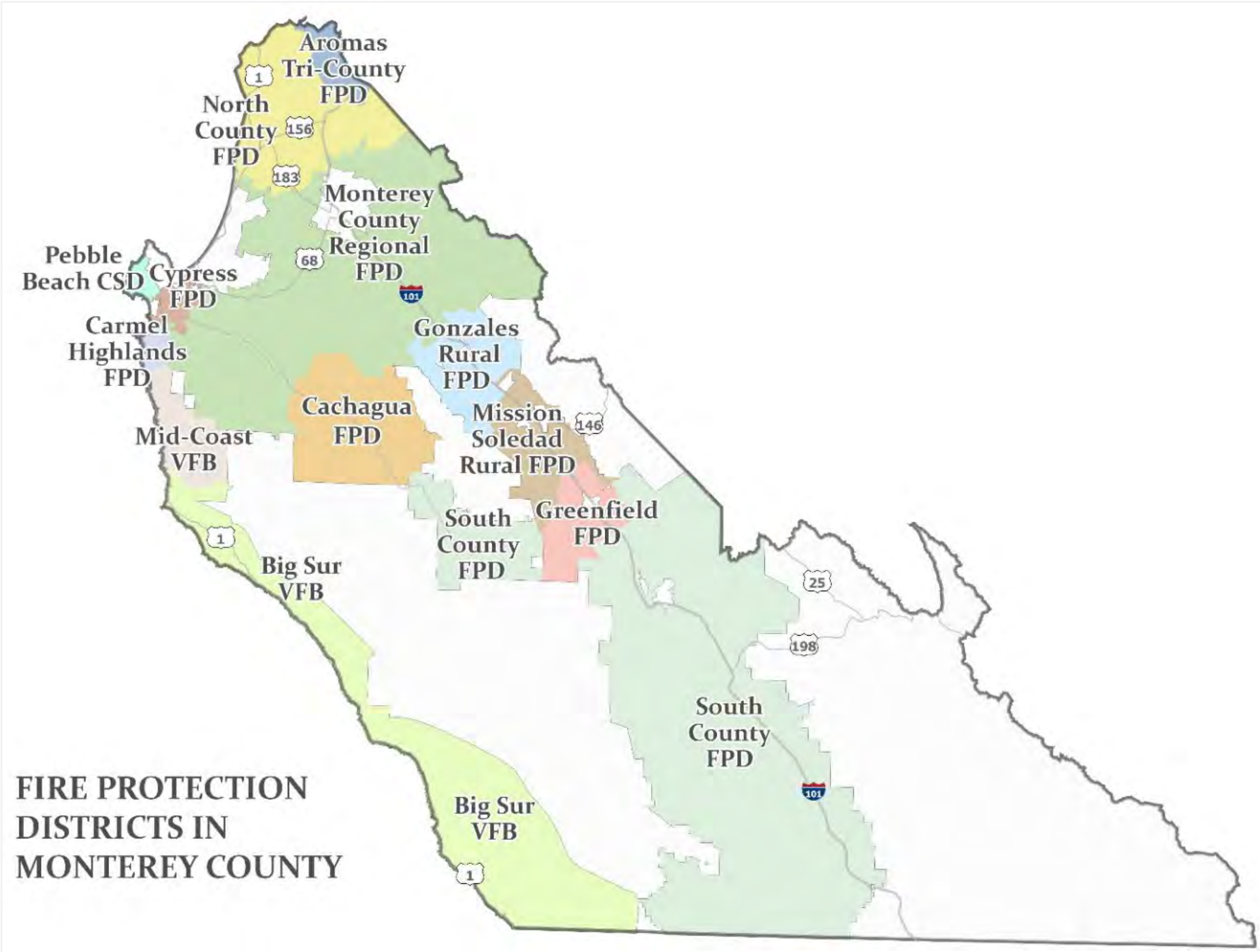
The Pebble Beach Community Services District provides a high level of fire protection and emergency paramedic medical services to approximately 4,100 people throughout 8 square miles to the north of the City of Carmel and to the west of Cities of Monterey and Pacific Grove. The district provides services through a contract with CAL FIRE. As noted previously, the district works closely with the Carmel Highlands and Cypress Fire Protection Districts, which are also staffed through CAL FIRE.

South Monterey County Fire Protection District

The South Monterey County Fire Protection District provides fire protection and emergency medical services to a large unincorporated portion of the southern Salinas Valley, including Arroyo Seco, the San Antonio Valley, and the unincorporated area around King City. The district provides services to approximately 4,600 people throughout its 637-square mile district. South

Monterey County FPD serves the largest geographic area of any of the County's fire protection districts. The district provides services through a contract with CAL FIRE.

Figure 18-2
Fire Protection Districts in Monterey County



18.1.3 THE FIRE EQUATION

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

- **Topography**: As slope increases, the rate of fire spread increases. South-facing slopes are subject to more solar radiation, making them drier, which intensifies fire behavior.
- **Fuel**: The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire. The ratio of living to dead plant matter and the fuel's continuity, both horizontally and vertically are also important factors. The

risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases.

- **Weather**: The most variable factor affecting fire behavior is weather. Temperature, humidity, wind, and lightning can affect ignition and spread. High temperatures and low humidity can lead to extreme wildfire activity. By contrast, cooling and higher humidity often signal reduced wildfire occurrence and easier containment.

Vegetation Management and Fuel Reduction

Since fuel reduction is the one element of the fire equation that can be impacted, vegetation management and clearance around structures is key to reducing risk. A number of agencies in the County are involved in various fuel reduction activities. A variety of strategies and projects have been deployed in an effort to reduce the threat of wildfires.

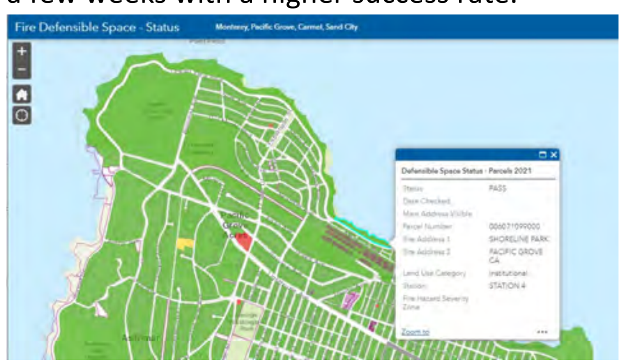
CAL FIRE BEU administers a Vegetation Management Program. The purpose of the program is to reintroduce fire to the landscape, restoring aspects of historic fire regimes, and to reduce flammable vegetation that may contribute to large, damaging wildfires and high fire suppression costs. The Vegetation Management Program is a cost-sharing program that focuses on the use of prescribed fire and mechanical means for addressing wildland fire fuel hazards and other resource management issues on State Responsibility Area (SRA) lands. The program allows private landowners to enter into a contract with CAL FIRE to use prescribed fire to accomplish a combination of fire protection and resource management goals. CAL FIRE also manages some significant shaded fuel break projects at strategic, high-risk locations.

Local fire agencies conduct property inspections for defensible space, implement community projects, and share public

Mitigation Success Story
Monterey Fire Defensible Space Inspection

In order to mitigate the threat of wildfires, the City of Monterey Fire Department conducts annual Defensible Space Inspections of all residential parcels in its response area, which includes the cities of Monterey, Pacific Grove, Carmel-by-the-Sea, and Sand City, as well as the Monterey Regional Airport. Tracking the inspection status of each parcel was a challenge.

In 2020, Monterey Fire collaborated with the City to develop a collector app using GIS technology. The app allows fire crews to conduct inspections and record if a parcel is compliant with defensible space requirements. The results of the inspection are immediately visible online in a public facing portal. As follow-up inspections are completed, the information can be quickly updated. Staff can immediately see which parcels need follow-up and the completion rate. A project that used to take several months and often resulted in some missed parcels, can now be completed in a few weeks with a higher success rate.



information on wildfire risk. Monterey County Public Works conducts roadside clearance operations with priority given to roadways considered to be primary evacuation routes.

Other agencies and organizations also take a role in vegetation management and fuel reduction. The Fire Safe Council of Monterey County is a non-profit organization committed to protecting lives and property from harm by wildfires, and to educating the public on wildfire dangers and how to reduce them. The Council coordinates projects and is a conduit for fuel reduction grants. They also coordinated the publication of the Monterey County Community Wildfire Protection Plan.

The Resource Conservation District of Monterey County (RCDMC) administers a Fire and Fuels Mitigation Program. Through the program the RCDMC has assisted with grant funding and coordination for fuels projects, fire infrastructure and natural resources mapping, prescribed burning, and wildfire prevention outreach in Monterey County. The program also has been instrumental in assisting other local groups with work that includes promoting prescribed burning, mapping, and defensible space. Key projects include:

- Los Padres Strategic Community Fuel Break Collaborative Project
- Prescribed burn association for Monterey, San Benito, and Santa Cruz counties

18.1.4 DEVELOPMENT PATTERNS AND WILDFIRE HAZARD

It is important to differentiate wildland fires from fires that occur in the wildland urban interface (WUI). The WUI refers to the area where houses intermingle with undeveloped wildland vegetation. The potential for significant damage to life and property exists in the WUI where development is adjacent to vegetated areas. The impacts and strategies for prevention and mitigation differ significantly between wildland fires and fires in the WUI. For example, fuel loads for wildland fires consist primarily of vegetation, whereas WUI fires have fuel loads consisting of vegetation and houses.

WUI fires have become a defining challenge for California as development continues to expand into less densely populated regions, putting more homes and people at risk. CAL FIRE classifies development into two WUI classes, interface and intermix, each presenting unique fire protection problems and opportunities for risk mitigation.

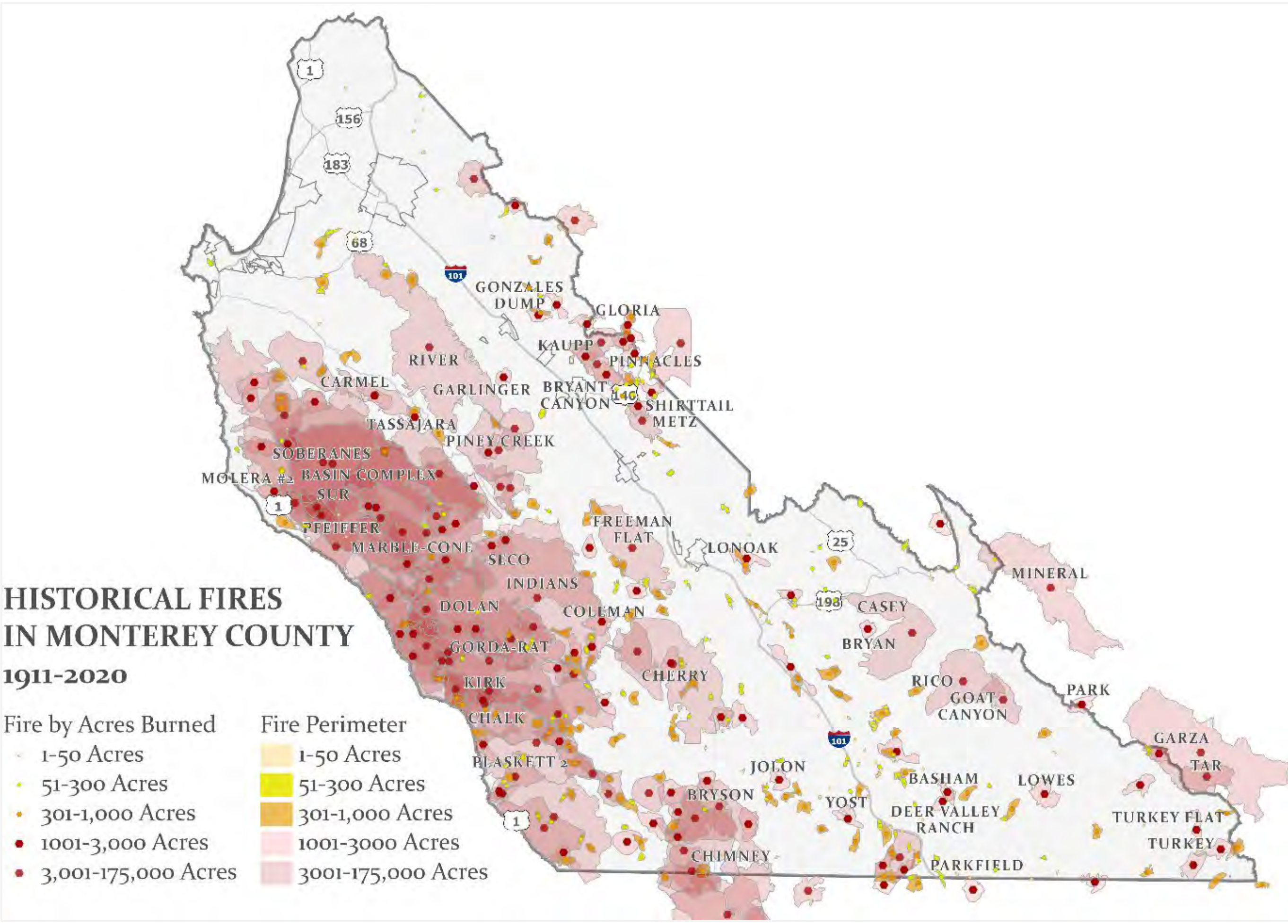
- **Interface**: Interface represents dense urban development adjacent to wildland. The definable boundary between houses and wildland provides a line of defense and focuses mitigation efforts along this boundary.
- **Intermix**: Intermix represents sparse development interspersed within a landscape that maintains much of the wildland characteristics. Intermix areas often require fire agencies to devote resources to protect individual houses. Mitigation includes prevention efforts, fire resistant building materials, and defensible space.

18.2 HAZARD PROFILE

18.2.1 HISTORY

Fire history is an important component in understanding fire frequency, fire type, significant ignition sources, and vulnerable areas. The history of wildfires in the County is significant. Since 1911, there has been an average of 4 wildfires a year, with an average of 17,000 acres burning annually. Historic wildfires from 1911 to 2020 in Monterey County are mapped in *Figure 18-3*.

Figure 18-3
Historical Wildfires in Monterey County (1911-2020)



The Marble-Cone Fire in August 1977 burned almost 178,000 acres of land, making it the largest wildfire in recorded California history at that time. Since the Marble-Cone Fire, Monterey County has had over 50 large wildfires, listed in *Table 18-2*.

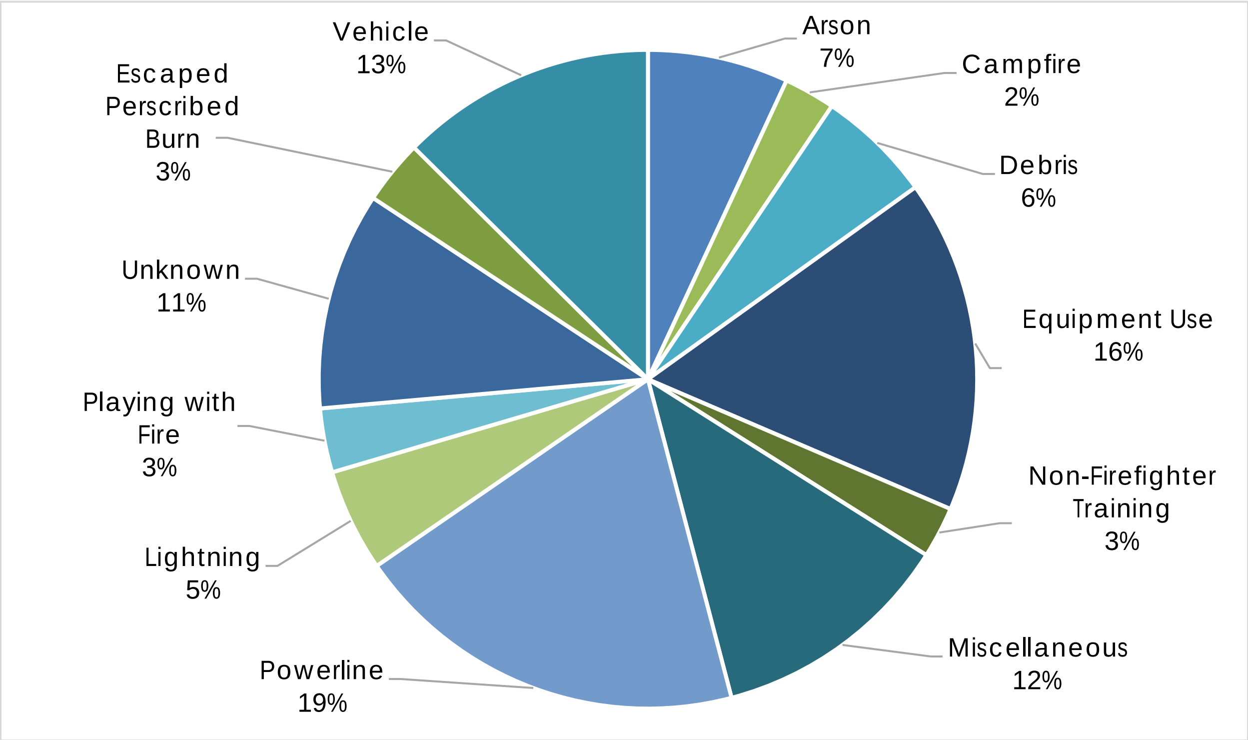
Table 18-2
Large (Over 900 Acre) Historical Wildfires in Monterey County (1977-2020)

Year	Fire Name	Acres Burned	Cause	Year	Fire Name	Acres Burned	Cause
2020	Carmel	6,905	Lightning	1996	Wild	25,620	Arson
2020	River	48,088	Vehicle	1994	Pinnacles	939	Unknown
2020	Dolan	124,924	Arson	1994	Basham	1,098	Unknown
2019	Lonoak	2,546	Powerline	1993	Metz	1,359	Unknown
2018	Turkey	2,225	Miscellaneous	1993	Rancho	5,415	Unknown
2017	Garza	48,887	Vehicle	1992	Unnamed	3,738	Miscellaneous
2017	Park	1,649	Equipment Use	1992	Seco	2,559	Miscellaneous
2017	Parkfield	1,816	Powerline	1992	Jolon	1,625	Arson
2016	Chimney	46,235	Vehicle	1989	Molera #2	2,745	Unknown
2016	Metz	3,876	Debris	1986	Bryant Canyon	2,428	Unknown
2016	Soberanes	132,127	Campfire	1986	Deer Valley Ranch	1,073	Unknown
2016	Coleman	2,520	Debris	1986	Lowes	2,852	Unknown
2015	Tassajara	1,100	Arson	1986	River	5,469	Debris
2013	Pfeiffer	917	Powerline	1986	Bottcher	2,285	Campfire
2012	Turkey	2,700	Equipment Use	1985	Gorda-Rat	65,700	Lightning
2009	Bryson	2,257	Structure	1985	Wizard	5,215	Miscellaneous
2009	Gloria	6,436	Miscellaneous	1985	Unnamed	14,370	Unknown
2008	Chalk	11,200	Miscellaneous	1985	Seco	1,800	Arson
2008	Indians	81,378	Campfire	1985	Cherry	40,642	Arson
2008	Basin Complex	162,818	Lightning	1985	Garlinger	1,078	Miscellaneous
2007	Tar	5,670	Unknown	1985	Piney Creek	1,563	Equipment Use
2006	Rico	14,507	Lightning	1981	Gonzales	4,850	Miscellaneous
2005	Johnson Fire	1,393	Equipment Use	1980	Shirttail	2,045	Unknown
2000	Plaskett 2	5,856	Miscellaneous	1979	Nacimiento	5,371	Arson
2000	North Fork	1,736	Equipment Use	1979	Freeman Flat	3,207	Unknown
2000	Unnamed	2,073	Non-Firefighter Training	1979	Kaupp	1,609	Unknown
1999	Kirk	86,700	Lightning	1978	Turkey Flat	1,330	Unknown
1998	Unnamed	8,702	Non-Firefighter Training	1978	Yost	1,619	Unknown
1996	Sur	4,410	Miscellaneous	1977	Marble-Cone	173,333	Lightning

In more recent years the frequency, intensity, and impact of large wildland fires in Monterey County have increased, specifically in the Los Padres National Forest. The Basin Complex Fire, a massive wildfire near Big Sur in 2008, burned more than 162,000 acres, destroyed 58 structures, and damaged an additional 9 structures. This fire burned the majority of the Ventana Wilderness. State and federal officials spent more than $120 million to fight the fire, making it is the most expensive fire in California history up to that time, and the second most expensive in US history. The Indians Fire during this same event period burned an additional 81,000 acres, leaving 15 structures destroyed and one damaged. These combined events made 2008 the most destructive year in recorded history for fires in Monterey County.

In December 2013, the Pfeiffer Fire burned 917 acres near Big Sur and damaged or destroyed 38 structures, including 34 residential structures and 4 outbuildings. On July 22, 2016, the Soberanes Fire began as an illegal campfire located in Garrapata State Park in Monterey County. Fed by winds and dry, unmanaged vegetation resulting from several years of extreme drought, the fire quickly spread beyond the park to threaten lives, homes, property, and the environment. It was the costliest firefight in US history, costing a total of $260 million. 2020, was another record year for fires in Monterey County, with the River, Carmel, and Dolan burning 48,000, 6,905, and 124,924 acres, respectively. Shown in *Figure 18-4*, the most commonly known causes of fires in Monterey County since the year 2000, are powerlines (19%), other mechanical or electrical equipment (16%), vehicles (13%), miscellaneous (12%), and arson (7%). Sometimes the cause of a fire cannot be determined, and this represents another large category, with 11% of fires in the County having an unknown cause.

Figure 18-4
Causes of Wildfires in Monterey County (2000-2020)

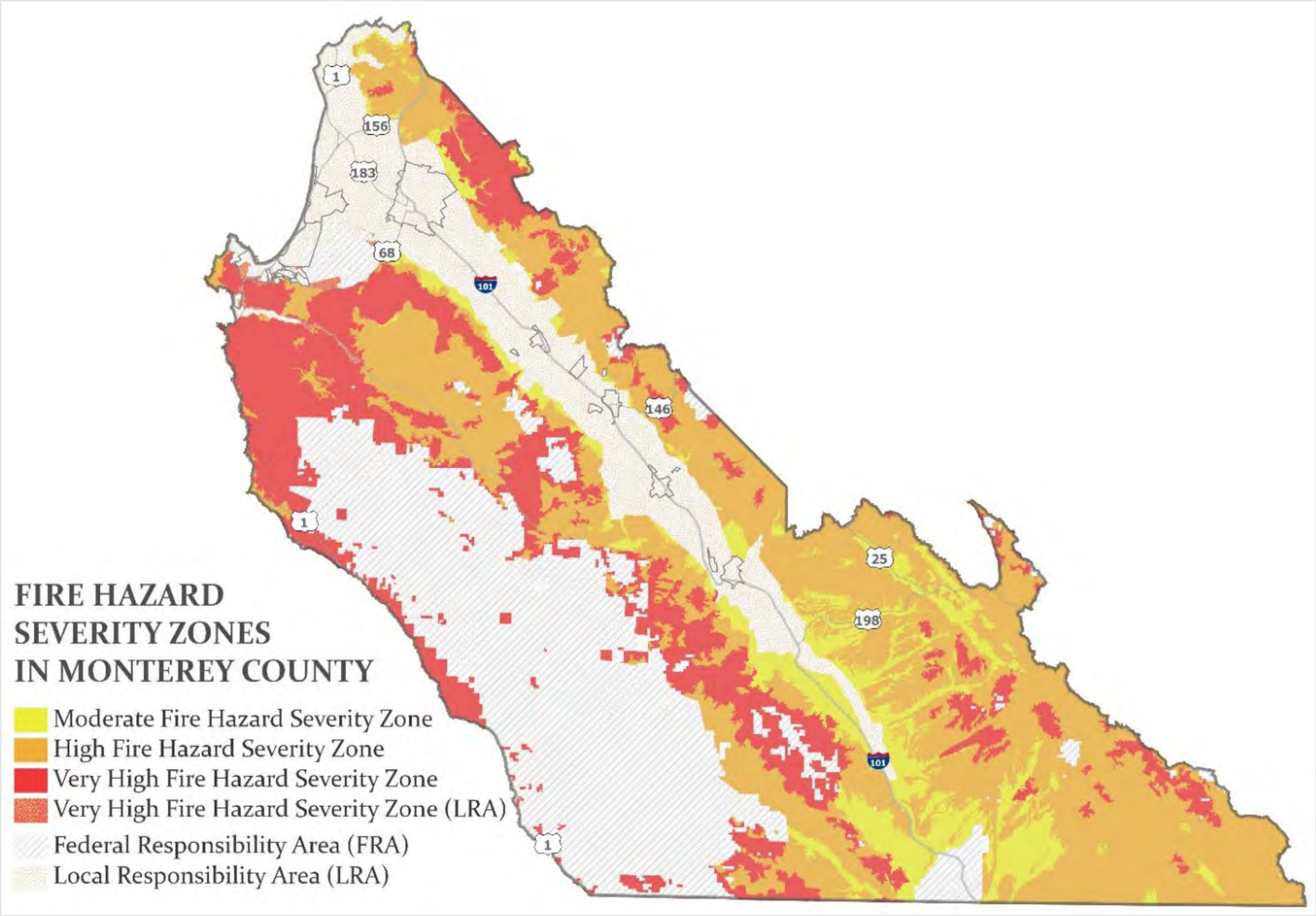


18.2.2 LOCATION

Fire Hazard Severity Zones (FHSZ) are areas mapped by CAL FIRE that designate zones (based on factors such as fuel, slope, and fire weather) with varying degrees of fire hazard (i.e., moderate, high, and very high). While FHSZ do not predict when or where a wildfire will occur, they do identify areas where wildfire hazards could be more severe and therefore are of greater concern. The FHSZ model inputs frequency of fire weather, ignition patterns, expected rate-of spread, and past fire history. It also accounts for flying ember production based on the area of influence where embers are likely to land and cause ignitions.

Fire Hazard Severity Zones in Monterey County are mapped in *Figure 18-5*

Figure 18-5
Fire Hazard Severity Zones in Monterey County



CAL FIRE also maps fire threat, which combines expected fire frequency with potential fire behavior. About 80% of land in Monterey County is categorized as high, very high, or extreme fire threat.

Based on historical fire data, some portions of the County are more susceptible to wildfires, with some areas having burned 6-7 times during the recorded fire history period. The mountainous, highly combustible areas in and around the Los Padres National Forest are very susceptible to wildland fires. The communities along the Big Sur coast, including Big Sur, Post, Lucia, Gorda, and Plaskett, are also at great risk to wildland fires. Sudden Oak Death is present and expanding in this area and presents a serious and growing wildland fire danger.

Homes and property in the wildland urban interface (WUI) are likely areas of concern for future fires. Of the about 35,000 housing units located in the WUI, 38% are in an intermix zone and 62% are in an interface zone.[67] As both types of WUI account for significant area in Monterey County, mitigation strategies should address both zones.

The CAL FIRE BEU Unit Strategic Plan[68] has identified the following high risk fire areas in Monterey County:

- State Highway 68 Corridor between Salinas and Monterey Peninsula / Laureles Grade
- Carmel Valley, Carmel Valley Village, and Cachagua
- Carmel Highlands / Palo Colorado Canyon
- Pine Canyon (King City)
- North Monterey County / Aromas
- Jacks Peak / Pebble Beach

18.2.3 FREQUENCY

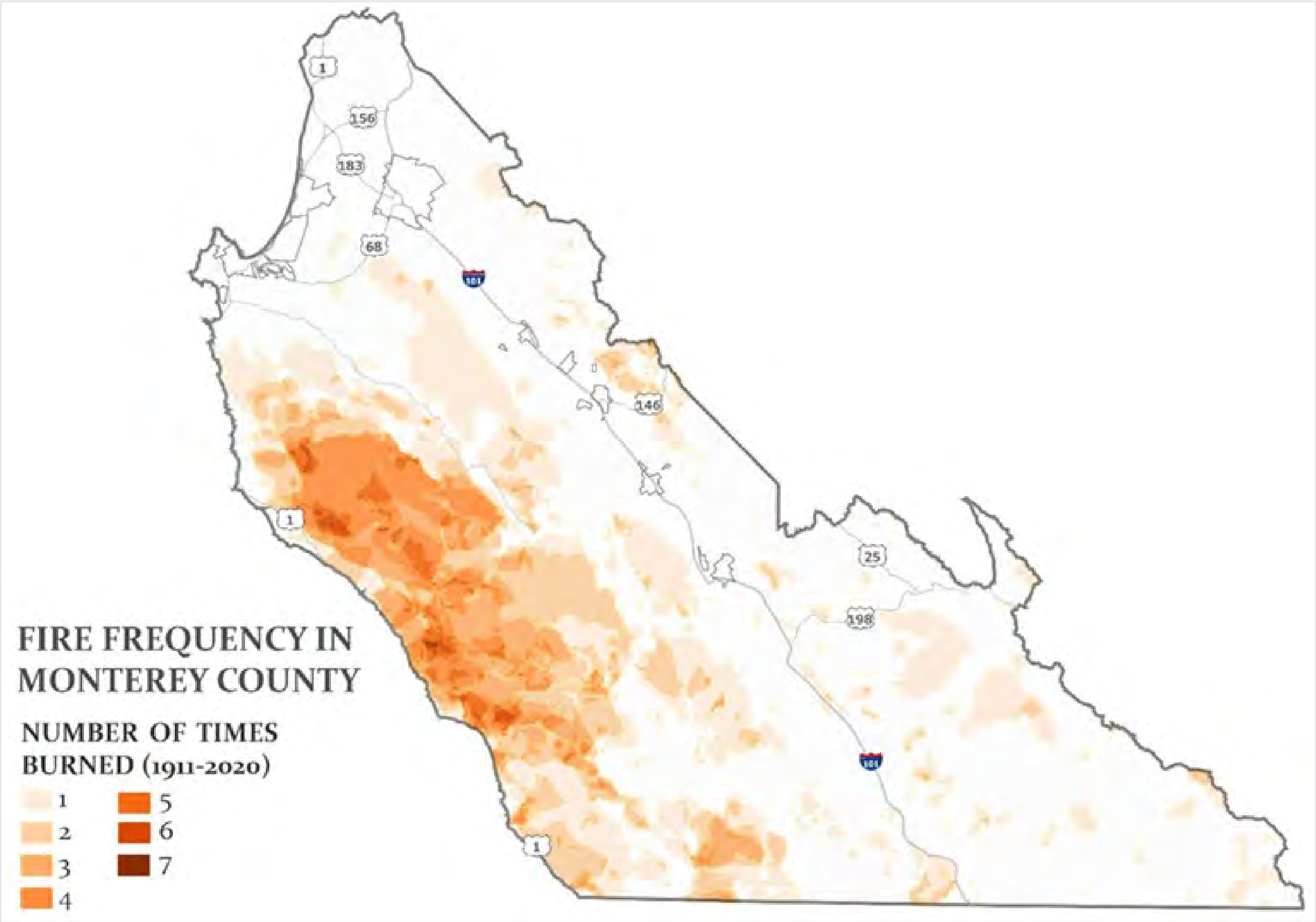
The geography, weather patterns and vegetation in the County provide ideal conditions for recurring wildfires. As noted previously, there has been an average of 4 wildfires a year, with an average of 17,000 acres burning annually. In the past 20 years, close to 750 thousand acres of the County has burned. Therefore, Monterey County is likely to face a wildland fire threat each and every year and can expect a large wildland fire to occur every few years.

Fire frequency, defined as number of times burned between 1911 and 2021 is mapped in *Figure 18-6*. Areas in the Los Padres National Forest, along the Big Sur coast, and the Ventana Wilderness, are the most frequently burned areas in the County, burning in some areas more than 4-5 times in the last 100 years.

[67] CAL FIRE, California’s Forests and Rangelands, 2017 Assessment

[68] Unit Strategic Fire Plan San Benito-Monterey, June 2020

Figure 18-6
Fire Frequency in Monterey County



18.2.4 SEVERITY

As outlined in the Monterey County Community Wildfire Protection Plan[69] each area of the County is unique in the various aspects that impact fire behavior. Variations in type of vegetation, slope, and microclimate weather all play a role in fire spread potential. Density of structures, road access, water supply, and available timely fire suppression resources also impact the fire spread potential. The severity of the wildland fire hazard is determined by the relationship between three factors: fuel classification, topographic slope, and critical fire weather frequency.

Fuels

Hazardous levels of fire fuels can cause fire intensities to exceed firefighting tactical ability to contain and control them. Vegetation distribution throughout the county varies by location and topography, with dramatic differences observed between coastal, valley, and inland regions.

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[69] Fire Safe Council for Monterey County, Monterey County Community Wildfire Protection Plan, 2010

Dominant vegetative cover within Monterey County is herbaceous or grassland cover, distributed primarily in the low-lying valley areas along the Highway 101 corridor. While this fuel type can burn quickly under strong, dry wind patterns, it does not produce the high heat intensity and high flame lengths associated with chaparral fuel types. Other significant vegetative cover types include light brush, light grass/woodland, and hardwood litter, which are primarily associated with the steeper, upland areas in the southern, western, and northern portions of the County. Fire behavior in brush fuel types may produce flame lengths greater than 12 feet, and resistance to control may be high. Fire behavior in woodlands is variable, depending on surface fuel conditions and the presence of ladder fuels. However, crown fire is common if slope and wind conditions are favorable to allowing fire to enter the canopy.

In extreme warm/wet years, abundant precipitation and intense rainfall followed by high spring and summer temperatures rapidly dry the abundant fuels produced by the high precipitation. Another concern within Monterey County is the presence of the Sudden Oak Death (SOD) pathogen and Pitch Canker disease. These infections can cause rapid tree mortality which can lead to a marked increase in surface fuel loads and subsequent fire behavior.

Topography

The topography of Monterey County is extremely variable, with elevations ranging from sea level to over 5,800 feet above mean sea level. Within the Salinas Valley, slopes are relatively flat across the valley floor, with elevations ranging from sea level to about 400 feet above mean sea level in the southern portions of the valley. More significant topographic variation is found in the eastern and western portions of the County, often characterized by steep slopes, deeply incised canyons, and narrow valleys. Slope measurements reach up to 175% gradients, most notably in the Los Padres National Forest located in the western portion of the County and the Gabilan Range located along the eastern County boundary. The regional topographic conditions within Monterey County have considerable effect on wildland fire behavior, as well as on the ability of firefighters to access and respond to wildfires. Steep slope and canyon alignments are conducive to channeling, deflecting, concentrating, or dispersing winds, and creating extremely erratic wildfire conditions, especially during wind driven fire events

Weather

In Monterey County, the joining of marine and land air masses over uneven topography significantly compounds fire behavior. Erratic fire behavior due to rapidly shifting winds and humidity under "normal" conditions is common. During warmer and drier offshore wind flow regimes, which occur several times each year, wind patterns shift from onshore northwest to offshore east-northeast in the northern section of the County, and east-southeast in the southern portions of the County, often with above-average velocities. These conditions are associated with "Severe Fire Weather" and "Red Flag" fire warnings. Fire behavior under rare or extreme fire weather conditions constitute the greatest threat of destructive uncontrolled wildland fires, and historically are immune to planned tactical response and aggressive initial attack. During extreme fire-weather conditions, fuel factors like age, density and moisture content may be overshadowed by weather factors such as high wind and low humidity.

18.2.5 WARNING TIME

Regardless of the circumstances that start a wildfire, warning time can be short since there is no way to predict when a wildfire might break out. Hazardous levels of fire fuels can cause fire intensities to exceed firefighting tactical ability to contain and control. High wind events that occur across much of California in autumn can create fires that are difficult to control, greatly increasing area burned and loss of life. Special attention should be paid to fires during severe wind events to improve warning time for those that might be affected or need to evacuate. Dry lightning may trigger wildfires as seen during the SCU Lightning Complex in 2020. Reliable NWS lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm. If a fire does break out and spreads rapidly, residents may need to evacuate within hours or minutes. A fire's peak burning period generally is between 1 and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications has contributed to a significant improvement in warning time.

In Monterey County, the safety of ingress and egress is not uniform in all areas. It is possible that some communities may become trapped without the option to evacuate, forcing them to shelter in place and defend themselves. Examples are the Big Sur coast, Palo Colorado, Partington Ridge, Los Burros Road, Cachagua, and White Rock.

18.3 SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. The indirect effects of wildfires can be catastrophic.

18.3.1 WILDFIRE SMOKE

Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire contains visible and invisible emissions comprising particulate matter such as soot and tar; gases such as carbon monoxide, carbon dioxide, and nitrogen oxides; and toxics such as formaldehyde and benzene. Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency or temperature of combustion, and the weather. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

18.3.2 POST-FIRE INDUCED DEBRIS FLOWS AND FLOOD FLOWS

Fires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the County by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. Wildfires strip the land of vegetation and destroy forest resources. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Wildfires can also bake soils, thus increasing the imperviousness of the ground. This increases the amount and speed of the runoff generated by storm events, further increasing the chance of flooding.

Lands stripped of vegetation are also subject to increased debris flow hazards. Slopes stripped of vegetation are exposed to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. The soils in a burn scar are highly erodible so flood waters can contain significant amounts of mud, boulders, and vegetation. For example, following the record fires in 2020, annual winter storms in 2021 caused flash floods and debris flows in the County. Fast moving mud and debris in the River Fire burn scar damaged 25 homes and injured 2 people. A large mudslide in the Dolan Fire burn scar took out a 150-foot section of Highway 1.

When wildfire-induced threats to life and safety are present, a state team of foresters, hydrologists, and geographic information systems specialists from CAL FIRE, engineering geologists from the California Geological Survey (CGS) and Regional Water Quality Control Boards (RWQCB), and civil engineers from the Department of Water Resources (DWR), can be assembled into a Watershed Emergency Response Team (WERT) to assess potential life-safety hazards from post-fire debris flows, hyper-concentrated flows, and flood flows.

An Emergency Stabilization-Burned Area Emergency Response (BAER) is a rapid assessment of burned watersheds that identifies imminent post-wildfire threats to human life and safety, property, and critical natural or cultural resources. The BAER identifies emergency stabilization measures that can be implemented before the first post-fire damaging events. BAER measures include actions such as: mulching, seeding, installation of run-off control structures, temporary barriers to protect recovering areas, and the installation of warning signs. The USGS also conducts post-fire debris-flow hazard assessments for select fires using geospatial data related to basin morphometry, burn severity, soil properties, and rainfall characteristics to estimate the probability and volume of debris flows that may occur in response to a storm.

18.4 RISK ASSESSMENT

For purposes of this analysis CAL FIRE Fire Threat data was used. Fire Threat combines expected fire frequency with potential fire behavior to create 4 threat classes, extreme, very high, high, and moderate. Wildland Fire Threat in Monterey County is mapped in *Figure 18-7.*

Wildland Fire Threat

Multi-Jurisdictional Hazard Mitigation Plan 2020

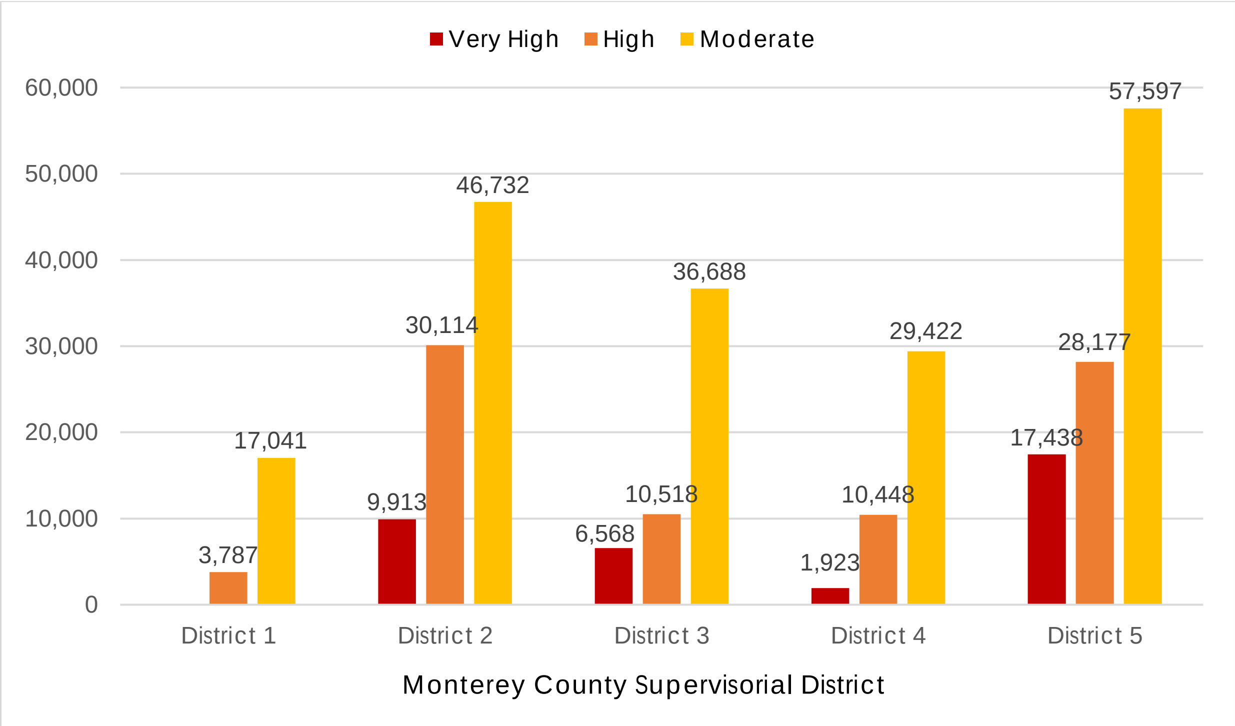
Figure 18-7 Monterey County, CA

18.4.1 POPULATION

Wildfire is of greatest concern to populations residing in the moderate, high, and very high fire hazard threat zones. US Census data was used to estimate populations within the CAL FIRE identified fire threat zones.

As seen in *Figure 18-8*, 306,366 people, representing 74% of the population in Monterey County live in a very high, high, or moderate fire threat zone. 35,842 people, or 9% of the total population live in a very high fire threat zone. 83,044 people, or 20% of the total population live in a high fire threat zone. 187,480 people, or 45% of the total population live in a moderate fire threat zone.

Figure 18-8
Population Exposed to Wildfire Risk



Those who live in more rural intermix areas of the County, such as the Big Sur coast, Palo Colorado, Partington Ridge, Los Burros Road, Cachagua, and White Rock may be particularly vulnerable to a wildfire due to their isolated location. It is possible these communities could become trapped without the option to evacuate, forcing them to shelter in place.

Farmworkers are particularly vulnerable to wildfire impacts because of the potential degradation of transportation infrastructure, the increased exposure to wildfire smoke while working outdoors, and direct economic effects on the agricultural industry. Because many agricultural workers are migrant and/or cannot afford to live in the County due to the lack of affordable housing, they may not be fully captured in these population numbers.

18.4.2 PROPERTY

As summarized in *Table 18-3*, in Monterey County, 35,252 residential properties are in either very high, high, or moderate fire risk zones. This accounts for about $33 billion in residential property value.

Table 18-3
Residential Property Exposed to Wildfire Risk by Fire Hazard Threat Zone

Supervisorial District	Very High		High		Moderate	
	#	Value	#	Value	#	Value
District 1	0	$0	23	$13,604,833	324	$202,243,637
District 2	676	$391,324,023	3,138	$1,584,293,526	5,380	$2,644,748,875
District 3	1,292	$415,516,076	1,599	$474,881,281	1,372	$426,980,382
District 4	12	$94,828,547	177	$336,350,806	1,140	$862,189,835
District 5	2,469	$2,833,126,759	5,144	$5,981,555,168	12,506	$16,833,680,153
Total	4,449	$3,734,795,405	10,081	$8,390,685,614	20,722	$20,969,842,882

As summarized in *Table 18-4*, In Monterey County, 33,344 non-residential properties are in either very high, high, or moderate fire risk zones. This is account for about $16 billion in non-residential property values.

Table 18-4
Non-Residential Property Exposed to Wildfire Risk by Fire Hazard Threat Zone

Supervisorial District	Very High		High		Moderate	
	#	Value	#	Value	#	Value
District 1	0	$0	21	$29,381,019	578	$425,871,786
District 2	492	$161,328,159	1,930	$429,905,806	3,634	$1,158,346,855
District 3	4,913	$2,049,593,977	5,675	$2,626,148,904	4,422	$3,128,901,995
District 4	37	$4,709,738	219	$175,659,923	1,135	$875,700,350
District 5	1,670	$454,937,569	3,581	$1,537,735,682	5,037	$2,981,931,211
Total	7,112	$2,670,569,443	11,426	$4,798,831,334	14,806	$8,570,752,197

18.4.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities made of wood frame construction are especially vulnerable during wildfire events. In the event of a wildfire, there would likely be damage to infrastructure dependent on the severity of the wildfire and nature of the infrastructure. Most roads and railroads would sustain minimal to moderate damage except in the worst scenarios.

Power lines are the most at risk from wildfire since most transmission poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

Critical facilities of high concern and priority to protect from wildfires include communications infrastructure such as repeater sites, cell towers, radio towers, FAA communications, and the Big Sur Very High Frequency Omni-Directional Range (VOR). They are among the highest priorities to protect from wildfires.

Table 18-5 summarizes critical infrastructure in very high, high, or moderate fire risk zones.

Table 18-5
Critical Infrastructure Exposed to Wildfire Risk by Fire Hazard Threat Zone

Critical Infrastructure Type	Very High	High	Moderate
Facilities			
Emergency Response	0	8	7
Fire Station	1	6	4
Police Station	0	0	0
Medical Facilities	0	2	7
Military Facility	0	0	2
Large Public Facilities	0	0	0
Educational Facilities	0	3	8
Power Plant	0	0	0
Water & Wastewater Facilities	23	46	103
Stormwater Facilities	0	0	2
Government Facilities	12	14	24
Communication Facilities	498	401	253
Rain Gauges	10	15	6
Lighthouses	0	0	0
Dams	0	0	0
Hazardous Materials			
Active or Idle Oil Well	735	728	284
Landfill	0	0	0
Underground Tank	1	0	1
Cal ARP Facility	0	3	1
Transportation			
Airport	0	4	2
Bridge	20	53	29
Harbor	0	0	0
Highway/Freeway (Miles)	47	93	160
Driveway (Miles)	0	2	3
Major Road (Miles)	335	456	543
Local (Miles)	1,008	1,311	1,331
Railroad (Miles)	23	37	56

18.4.4 ENVIRONMENT

Many ecosystems adapt to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes such as frequency and seasonality, spatial attributes such as size and spatial complexity, and magnitude attributes such as intensity and severity, each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability. Severe environmental impacts associated with wildfires in Monterey County include:

- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.
- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- Destroyed Endangered Species Habitat—Fire can have devastating consequences for endangered species.

18.4.5 ECONOMIC IMPACT

Local economic impacts from catastrophic wildfires include the cost of fire suppression, disruptions to consumption and production of local goods and services. Immediate effects may include decreased recreation/tourism and timber harvest, as well as disruptions from evacuations and transportation delays. Other effects include direct property losses (in the form of buildings, timber, livestock, and other capital), damage to human health, and possible changes in the long-term structure of the local economy.

The tourism sector is critical economic sector in Monterey County, which is especially vulnerable to increasing risks of forest fires. The Big Sur area is a popular attraction bordering the Los Padres National Forest which is highly prone to fire risk. Big Sur was heavily impacted during the Basin Complex Fires in 2008, the Pfeiffer Fire in December of 2013, the Soberanes Fire of 2016, and the Dolan Fire in 2020. Laguna Seca is a popular recreational facility playing host to several large events throughout the year is also in a fire risk area. Increased fire threats and active wildfire will make these tourist areas less attractive, which, in turn, could negatively impact local businesses. These may include small, medium, and large-scale businesses such as hotels, restaurants, and transportation, which are important contributors to the local economy.

Agriculture, the other key economic sector in the County, is also vulnerable to wildfire risk. Structures, irrigation systems, and equipment, crops, livestock, and stored commodities can be lost to wildfire. Fires can also affect soil quality, which can have a ripple effect lasting many, many years. Smoke also can have many negative impacts on crops. When less sunlight reaches crops, crops develop more slowly. Less sunlight can lead to higher disease loads. When ash coats leaves and fruit, crops have even less access to light. Some crops can absorb enough smoke to change the flavor. Fires also create a high-risk environment for agricultural workers and protecting workers can delay harvest, leading to destroying overly ripe crops. There is no well-established protocol to mitigate the occupational health and safety risks associated with wildfires, which can leave workers vulnerable. In addition to the dangers of an active fire, wildfire smoke, ash, and chemicals used to treat fires negatively affect air and water quality.

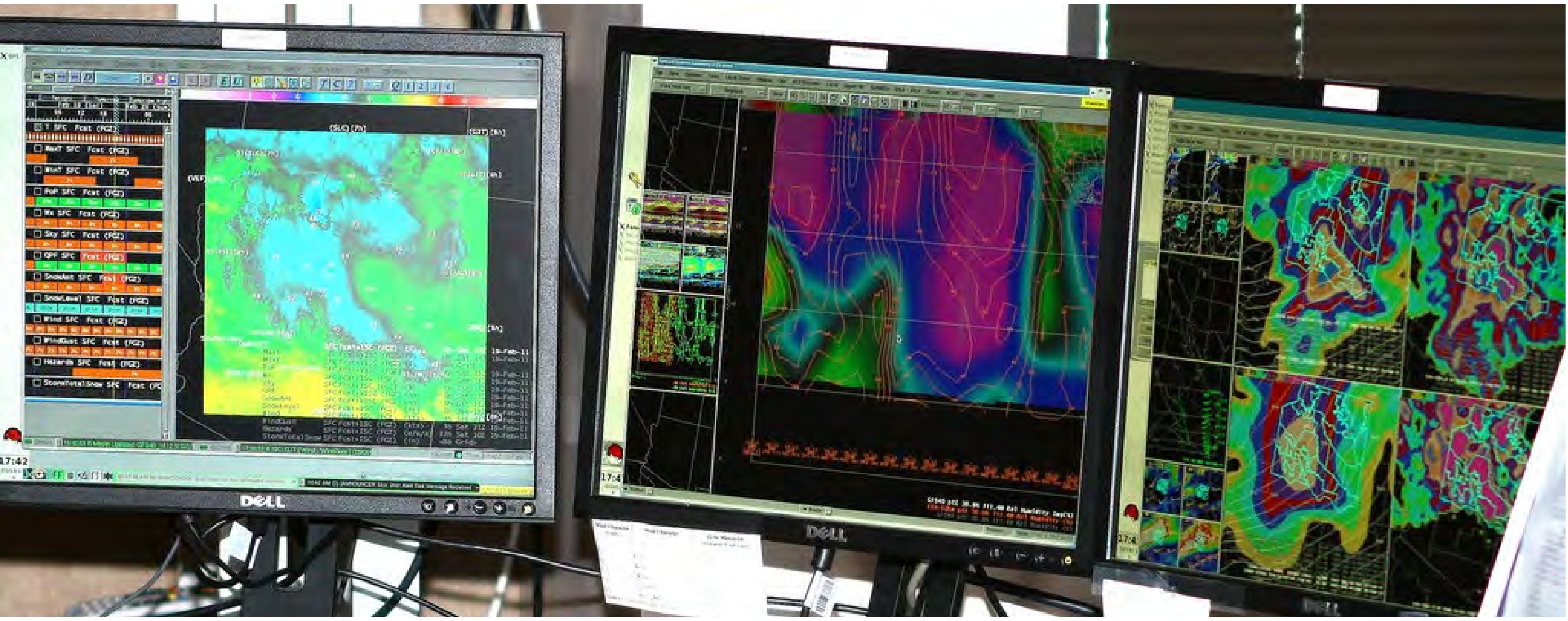
18.5 FUTURE TRENDS IN DEVELOPMENT

The expansion of the wildland urban interface can be managed with strong land use and building codes. Monterey County is well equipped with these tools and this planning process has assessed capabilities with regards to the tools. As the County experiences future growth, it is anticipated that the exposure to this hazard will remain as assessed over time due to these capabilities.

18.6 ISSUES

The major issues associated with wildfire in Monterey County include the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change is likely to increase the frequency and severity of wildland fires in Monterey County.
- Future housing growth and development in the WUI should continue to be managed.
- Limited water supply for firefighting in high-risk wildfire areas can limit response capabilities.
- Ingress and egress in interface and intermix areas can be limited due to a lack of road infrastructure.
- Wildfire poses a large threat to key economic sectors: Agriculture and Tourism.
- Continuing and expanding hazardous fuels reduction programs. Fuel mitigation regulations hinder the ability of private property owner’s ability to reduce risk on their property.



19. CLIMATE CHANGE

19.1 OVERVIEW

Climate is a description of long-term weather patterns. Climate change refers to any distinct change in measures of climate lasting for a long period of time, more specifically major changes in temperature, rainfall, snow, or wind patterns. Climate change may be limited to a specific region or may occur across the whole Earth. Climate change may result from:

- Natural factors, such as changes in the Sun's energy or slow changes in the Earth's orbit around the Sun
- Natural processes within the climate system, such as changes in ocean circulation
- Human activities that change the atmosphere's make-up, and the land surface, such as burning fossil fuels, cutting down forests, planting trees, or building developments in cities and suburb

The effects of climate change are varied and include warmer and more varied weather patterns, melting ice caps, and poor air quality, for example. Climate change will affect the people, property, economy, and ecosystems in Monterey County. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards. Increasing temperatures and rising sea-levels will have direct impacts on public health and infrastructure. Drought, coastal and inland flooding, and wildfire will continue to affect people's livelihoods and local economies. Changing weather patterns and more extreme conditions will impact tourism and rural economies, along with changes to agriculture and crops, which are a critical backbone of Monterey County's economic success. There will also be negative impacts to our ecosystems, both on land and in the ocean, leading to local extinctions, migrations, and management challenges.

19.1.1 SEA LEVEL RISE

Another outcome of global climate change is sea-level rise. The sea level rose during the 20th century, and observations and projections suggest that it will rise at a higher rate during the 21st century. Rising seas increase the risk of coastal flooding, storm surge inundation, coastal erosion and shoreline retreat, and wetland loss. The cities and infrastructure that line many coasts are already vulnerable to damage from storms, which is likely to increase as sea level continues to rise and inundate areas further inland.

Globally, sea level is rising primarily because global temperatures are rising, causing ocean water to expand and land ice to melt. However, sea-level rise varies from place to place. Sea-level rise along the Pacific coast depends on the global mean sea-level rise and also on regional factors, such as ocean and atmospheric circulation patterns in the northern Pacific Ocean, gravitational and deformational effects of land ice mass changes, and tectonics along the coast. The comparative importance of these factors determines whether local sea level is higher or lower than the global mean, and how fast it is changing which has enormous implications for coastal planning.

19.1.2 CLIMATE CHANGE AND HAZARD MITIGATION

The *2018 California State Hazard Mitigation Plan* states that California is already experiencing the impacts of climate change, including prolonged drought, increased coastal flooding and erosion, and tree mortality. The state has also seen increased average temperatures, more extreme heat days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. The intensity of extreme weather events is also increasing. Extreme weather events and resulting hazards, such as heat waves, wildfires, droughts, and floods are already being experienced.

An essential aspect of hazard mitigation is predicting the likelihood of hazard events. Typically, predictions are based on records of past events, which assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies are used to estimate future frequencies. For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. Information about how climate patterns are changing can increase the reliability of future hazard projections. The risk, severity, and likelihood of many hazards in Monterey County are affected by climate patterns. For this reason, an understanding of climate change is essential to efforts to effective hazard mitigation.

A Hazard Mitigation Framework for Climate Adaptation

A hazard mitigation framework for adaptation planning creates a beneficial risk management focus for climate adaptation. The complexity and cumulative nature of climate impacts in Monterey County requires a multi-hazard approach to climate change risk. Therefore, addressing climate change in the plan as a separate hazard that will increase the risk of other hazards in this plan was determined to be the most appropriate strategy. Examples of the cumulative impacts of climate change that could affect Monterey County include:

- Wildfires are likely to increase in severity and frequency due to climate change, and more frequent and severe wildfires will release more carbon into the atmosphere exacerbating climate change.
- Precipitation variability can increase the length of fire season and worsen floods and coastal storms.
- As sea levels rise more extreme storm events will cause increased flooding impacts and increase coastal erosion rates.
- Wildfires followed by storm events increase the risk of landslides. Increased erosional forces related to sea-level rise will affect sea cliffs, creating steeper slopes while undermining the base of sea cliffs, increasing the risk and magnitude of landslides.
- Exposure to wildfires, wildfire smoke, and post-wildfire events such as erosion, debris flow, and flooding can affect a watershed’s functioning and its associated ecosystem services, including water quantity and water quality. Increased sedimentation in the watershed will increase flood risk.
- Sea level rise will cause wetlands to recede reducing critical ecosystem services, including carbon sequestration, flood risk reduction, water filtration, erosion control, and groundwater recharge.
- Droughts will be more extreme and last longer due to climate change and this will have a large effect on water availability and agricultural production. Droughts increase the probability of wildfire occurrence and as fires burn more intensely, the chances heat destroys valuable topsoil increases, further affecting agriculture. Droughts decrease water availability when fire risk is highest, which could be an issue when fighting fires.
- Drought can lead to groundwater overdraft, which causes land subsidence and increases the risk of seawater intrusion. Land subsidence increases sea level rise risk by creating more low-lying areas vulnerable to flooding and increasing the risk of groundwater daylighting, while seawater intrusion further reduces water supply.
- Worsened hazards can affect multiple sectors of the local economy including recreation, tourism, agriculture, and forestry. Homes that are destroyed or in hazardous areas could lose value reducing homeowner’s ability to recover and effecting government revenue needed for recovery and adaptation.

In order to capture these cumulative effects and avoid maladaptation, the County decided to approach climate change resilience with a systematic multi-hazard approach.

19.2 HAZARD PROFILE

19.2.1 HISTORY

Though climate change has not been proven solely responsible for any disasters, past flooding, wildfire, and drought disasters may have been exacerbated by it. It is difficult to make direct connections to individual disasters but increases in both the magnitude and impact of hazards over the last few years is likely linked to climate change.

The powerful El Niño of 2015-16 was one of the three largest in the historical record and resulted in winter wave energy over 25% larger than a typical winter, driving unprecedented beach erosion that was 45% higher than normal.[70] The impacts from flooding and debris flows have also been increasing. Storms in 2017 caused a record amount of damage across the County. In 2021, storms caused a mudslide in the burn scar left by the River Fire that damaged 25 homes in Chualar. Flooding also occurred near the Carmel Lagoon and the Carmel River State Beach. The County has experienced an increase in wildfires, with 2018, 2019 and 2020 growing the acreage of forest burned due to extremely dry conditions. In 2020, the River, Carmel, Dolan, and Coleman fires burned a combined 180,000 acres.

Previous studies have indicated that important areas and public infrastructure will be increasingly at risk from climate change hazards. Additionally, unlike earthquakes and floods that occur over a finite time period, climate change is an ongoing hazard. Many communities are already experiencing the effects, while other effects may not be seriously experienced for decades or may be avoided altogether by mitigation actions taken today.

Mitigation Success Story
City of Gonzales Growing Green

One of the best ways to reduce the impact of future climate hazards is to make progress on climate goals today. The City of Gonzales was the first city in the County with a certified climate action plan and has already met its 2020 target for reducing energy use and greenhouse gas emissions.

Gonzales harnesses the wind and sun to reduce its carbon footprint and demonstrates how a community can use its stewardship of the environment as a way of encouraging economic vitality. Solar panels power the community pool, police headquarters, a wastewater treatment plant, and water wells.

Work on the environment and economy falls under the direction of the Gonzales Grows Green (G3) initiative. Harnessing the strong valley breeze that arises every afternoon, the City partnered with Taylor Farms to build a wind turbine on City owned land. Nonprofit developer, Foundation Windpower, built and financed the project and another food processor, Mann Packing/DelMonte Fresh, will use energy from a second wind turbine when it opens a new plant, creating 525 jobs.

[70] California Fourth Climate Change Assessment, Central Coast Region Report

19.2.2 LOCATION

The effects of climate change are not limited by geographical borders. Monterey County, the State of California, the United States, and the rest of the world are all at risk of climate change. As such, the entire County is at risk to the effects of climate change.

19.2.3 FREQUENCY

In terms of how likely and quickly impacts will occur, temperature related impacts are the most likely near-term climate change exposure facing the County and should be addressed and prioritized in future adaptation planning efforts. While sea-level rise has a high certainty rating and is already occurring, its onset is not expected to occur until closer to the end of the century in terms of changes in areas already vulnerable to flooding or causing permanent inundation in tidally influenced areas of the County. Addressing increases in flooding and wildfire risk have mid-term onsets and should be prioritized accordingly.

19.2.4 SEVERITY

The State of California has been taking action to address climate change for over 20 years, focusing on both greenhouse gas emissions reduction and adaptation. The California Adaptation Planning Guide (APG) provides guidance and support for communities addressing the unavoidable consequences of climate change. The *California Fourth Climate Change Assessment* [71] identifies the following climate change impacts of concern to the Central Coast:

- Maximum and minimum temperatures will continue to increase through the next century, with greater increases in inland areas. Precipitation is expected to increase slightly, but precipitation variability will increase substantially
- Projected future droughts are likely to be a serious challenge to already stressed water supplies. Higher temperatures may result in increases in water demand for agriculture and landscaping. Reduced surface water will lead to increases in groundwater extractions that may result in increased seawater intrusion. Lower surface flows will lead to higher pollutant concentrations and will impact aquatic species.
- Impacts to the region's public health include increases in heat-related illnesses for agricultural workers, harmful particulate matter from wildfires, and an increase in ground-level ozone. Infectious/Vector-borne diseases include an increase in Valley Fever and Pacific Coast tick fever, and an increase in harmful algal blooms will have detrimental effects on animals and people exposed to toxins released from the algae.
- Agricultural production is highly sensitive to climate change, including amounts, forms, and distribution of precipitation, changes in temperatures, and increased frequency and intensity of climate extremes. The Salinas Valley is identified as one of the most vulnerable agricultural regions under climate change.

[71] California Fourth Climate Change Assessment, Central Coast Region Report

- Periodic El Niño events dominate coastal hazards while atmospheric rivers, expected to increase, are the dominant drivers of locally extreme rainfall events.
- Recently observed and projected acceleration in sea level rise poses a significant threat to coastal communities. Future flooding is also a serious concern.
- Estuarine systems will be affected by accelerated sea level rise, warming of water and air, ocean acidification, and changes in runoff. Some marshes may drown or become shallow mudflats, leading to a loss of the ecosystem services that marshes provide.
- Many beaches will narrow considerably. As many as two-thirds will be completely lost over the next century, along with the ecosystems supported by those beaches. The landward erosion of beaches will be driven by accelerating sea level rise combined with a lack of ample sediment, effectively drowning the beaches between the rising ocean and the backing cliffs and/or urban hardscape.
- Frequent and sometimes large wildfires will continue to be a major disturbance and post-fire recovery time may be lengthened.

Some of these changes are direct or primary climatic changes, such as increased temperature, while others are indirect climatic changes or secondary impacts resulting from these direct changes, such as heat and air pollution. Some direct changes may interact with one another to create unique secondary impacts.

Climate change projections contain inherent uncertainty, largely derived from the fact that they depend on future greenhouse gas emission scenarios. Generally, the uncertainty in greenhouse gas emissions is addressed by the presentation of differing scenarios. Uncertainty in outcomes is generally addressed by averaging a variety of model outcomes.

Despite this uncertainty, climate change projections present valuable information to help guide decision-making for possible future conditions. Representative concentration pathways, or RCPs, are different scenarios for the future severity of climate change. The following sections summarize information developed for the County by Cal-Adapt, a resource for public information on how climate change might impact local communities, based on the most current data available. The projections are averaged across the countywide planning area and include information from two emissions scenarios, which were developed by the IPCC:

- Medium Emissions Scenario (RCP 4.5): Emissions peak around 2040 and then decline
- High Emissions Scenario (RCP 8.5): Emissions continue to rise strongly through 2050 and plateau around 2100

Temperature

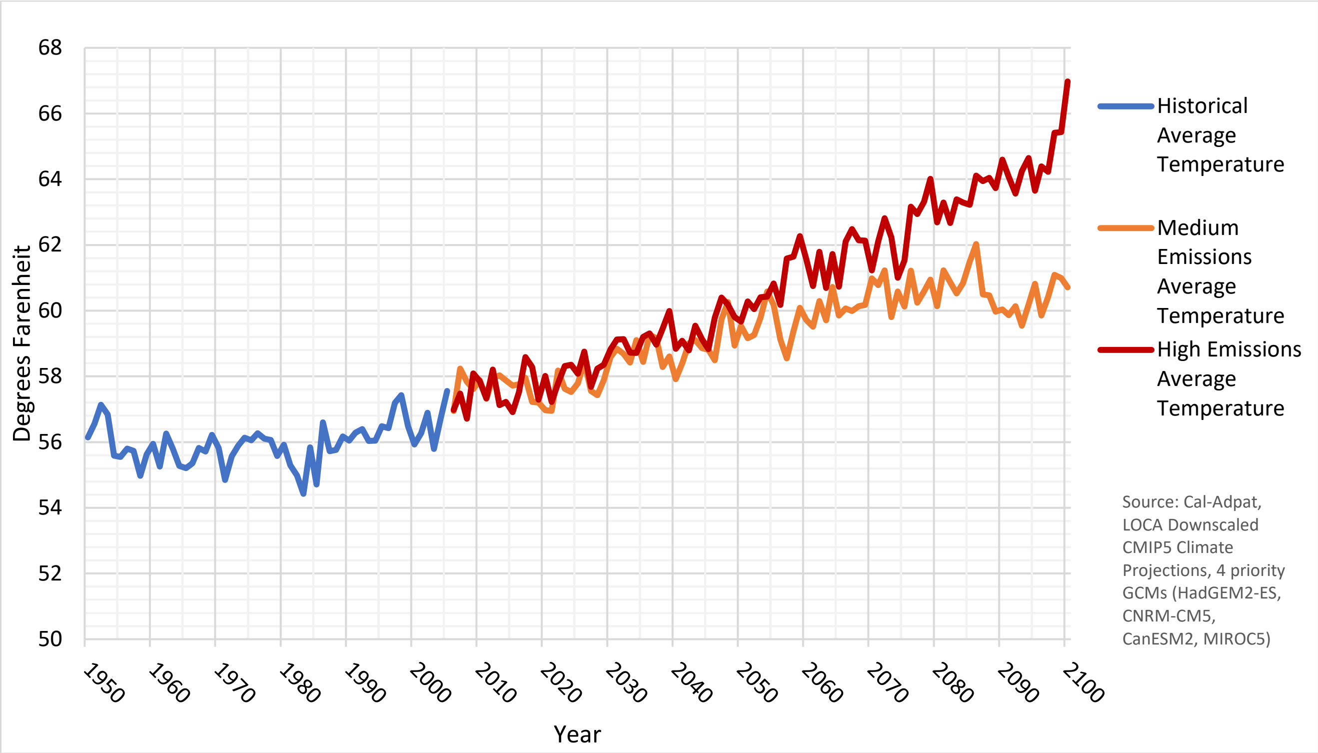
The historical (1961-1990) average maximum temperature in Monterey County was 70.1°F and the average minimum temperature was 41.5°F. While average temperatures may fluctuate from year-to-year, and may differ from one municipality to the next, the trend for the County indicates that average temperatures are increasing. By Mid-Century, average annual maximum temperatures are expected to increase 3.4°F – 4.2°F, depending on the emissions scenario. By the end of the century, annual maximum temperatures could increase 4.5°F – 7.4°F. Predicted changes in annual average minimum and maximum temperatures in Monterey County is summarized in *Table 19-1*.

Table 19-1
Predicted Change in Annual Average Temperatures in Monterey County (Cal Adapt)

Emissions Scenario	Average Minimum Temperatures			Average Maximum Temperatures		
	Change	30-Year Average	30-Year Range	Change	30-Year Average	30-Year Range
Baseline (1961-1990)						
Modeled Historical	-	41.7 °F	41.0 - 42.3 °F	-	70.0 °F	69.5 - 70.5 °F
Mid-Century (2035-2064)						
Medium Emissions (RCP 4.5)	+3.1 °F	44.8 °F	43.1 - 46.2 °F	+3.4 °F	73.4 °F	71.8 - 74.8 °F
High Emissions (RCP 8.5)	+3.9 °F	45.6 °F	43.9 - 47.1 °F	+4.2 °F	74.2 °F	72.3 - 76.1 °F
End-Century (2070-2099)						
Low Emissions (RCP 4.5)	+4.1 °F	45.8 °F	43.5 - 47.7 °F	+4.5 °F	74.5 °F	72.4 - 76.9 °F
High Emissions (RCP 8.5)	+7.0 °F	48.7 °F	45.8 - 51.5 °F	+7.4 °F	77.4 °F	74.6 - 81.4 °F

Figure 19-1 shows the projected increases in average temperatures in Monterey County under various climate change scenarios.

Figure 19-1
Projected Increase in Average Temperature in Monterey County

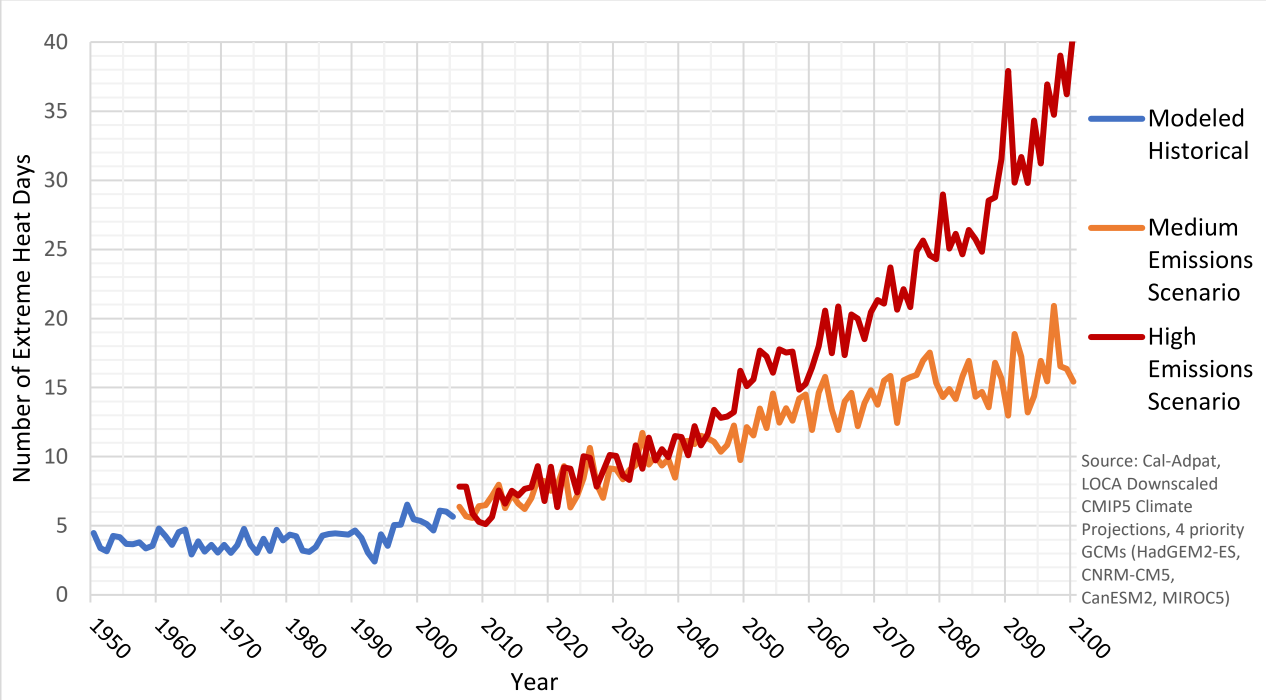


Extreme Heat

Extreme hot temperatures are likely to become more common. The extreme heat day temperature threshold for Monterey County is 92.5°F. The historical average (1961-1990) number of extreme heat days is 4 days. By Mid-Century, there are projected to be an annual average of 8-11 days with temperatures over the extreme heat day threshold. By the end of the century, there are projected to be an annual average of 12-24 days per year with temperatures over the extreme heat day threshold.

Figure 19-2 shows the projected increases in extreme heat days in Monterey County under various climate change scenarios.

Figure 19-2
Projected Increase in Extreme Heat Days in Monterey County



Precipitation

Projections of changes in precipitation are more nuanced than projected changes in temperature and have less separation between emissions scenarios. There is a projected increase of year-to-year variability with wetter days during periods of precipitation, but with fewer total days with precipitation. Average annual precipitation under RCP8.5 shows significant increases by 2100. Precipitation is generally expected to increase throughout Monterey County. Historical annual average precipitation in Monterey County is 19.3 inches and annual average precipitation is projected to increase by 1.8 to 5.1 inches annually.

While average precipitation is expected to increase by a relatively small amount, annual variability increases substantially by the end of the century. Projections suggest that extremely wet and dry years may become more severe, and that the wettest day of the year will become wetter relative to historical conditions.

Fog

A key feature of the Coastal regions of Monterey County is summertime coastal fog and low clouds. Low clouds reflect solar radiation, which cools the land surface. Fog droplets also add water to coastal systems. The landscape pattern of coastal fog and low clouds is remarkably stable. Low elevation sites and valleys that are open to northwest summer winds, such as Salinas Valley and Monterey Peninsula, average 15 hours/day of summertime fog and low cloud cover annually. Agriculture benefits when fog and low clouds reduce evapotranspiration rates, reducing crop demand for water and irrigation.

The future of coastal fog under climate change remains uncertain. Coastal fog formation and onshore transport are a result of complex feedbacks between ocean, air, and land systems and provide a unique focal point to better understand global to local climate change dynamics.

19.2.5 WARNING TIME

As this section has described, many existing hazards could be intensified as a result of climate change, decreasing warning times and exacerbating impacts. Warning times are discussed under the various other hazards. Other climate change impacts are more long-term; scientists have a high confidence in predicting the rise in global temperatures and have reached a consensus on the future impacts of climate change and the time frame in which they will occur.

19.3 RESPONSES TO CLIMATE CHANGE

Communities and governments worldwide are working to address, evaluate and prepare for climate change impacts that are likely to affect communities in coming decades. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term “mitigation” can be confusing because the term’s meaning changes across disciplines:

- Mitigation in emergency management - as generally addressed in this hazard mitigation plan - is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters.
- Mitigation in climate change discussions is defined as a human intervention to reduce impacts on the climate system. It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.

In this chapter, mitigation is used as defined by the climate change community. In the other chapters of this plan, mitigation is primarily used in an emergency management context.

Adaptation refers to adjustments in natural or human systems in response to the actual or anticipated effects of climate change and associated impacts. These adjustments may moderate harm or exploit beneficial opportunities. Mitigation and adaptation are related, as the world's ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some initiatives and actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions.

Societies across the world are facing the need to adapt to changing conditions associated with natural disasters and climate change. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Adaptive capacity is the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change. Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, including variability and extremes. Adaptive capacity goes beyond human systems, as some ecosystems are able to adapt to change and to buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water during times of plenty, releasing it through the year; floodplains can absorb vast volumes of water during peak flows; coastal ecosystems can hold out against storms, attenuating waves and reducing erosion. Other ecosystem services, such as food provision, timber, materials, medicines, and recreation, can provide a buffer to societies in the face of changing conditions. Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services.

Assessment of the current climate action planning efforts of the planning partners are included in the jurisdiction-specific annexes in **Volume 2.**

19.3.1 COMMUNITY RESILIENCE

Adaptation and resilience are not the same thing, although they are related. As noted previously, adaptation refers to adjustments in natural or human systems in response to the actual or anticipated effects of climate change and associated impacts. Resilience is the capacity of any entity - an individual, a community, an organization, or a natural system - to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience. A community's resilience is determined by its ability to survive, adapt, and thrive no matter what acute shock or chronic stressor it experiences. Put simply, adaptation is an action or set of actions, and resilience describes a desired outcome.

Flooding, drought, and other climate-hazards increase risk to already vulnerable populations. Becoming more resilient by anticipating and addressing community threats, holds the potential to save lives, to save billions in recovery dollars and economic losses, and encourages social equity and connectedness, fostering communities that grow and recover in ways that make them stronger than before.

Monterey County is taking steps to prepare for the impacts of a changing climate and a series of adaptive steps can greatly contribute to resilience. In a resilient Monterey County:

- Built infrastructure systems can withstand changing conditions and shocks, including changes in climate conditions, while continuing to provide critical services.
- People and communities can respond to changing average conditions, shocks, and stresses in a manner that minimizes risks to public health, safety, and economic disruption; and maximizes equity and protection of the most vulnerable so that they do not simply survive climate-related events but thrive after these events.
- Natural systems can adjust and maintain functioning ecosystems in the face of change.

The Monterey County Community Resilience Plan is a countywide framework outlining the challenges and opportunities to building a more resilient Monterey County. Through the resilience assessment and community discussions, Monterey County has identified six strategies to build community resilience and address the unpredictable impacts of environmental, social, and economic shocks and stresses.

Strategy 1: Build Social Capital

Social capital encompasses the social networks, associations, and the trust that they generate among groups and individuals within the community. Social capital has the potential to contribute to resilience by enhancing sense of belonging and strengthening bonds between individuals and groups within communities. By building social capital and creating a strong sense of community, Monterey County can build a network of social support, which can help the community work together to be more prepared before, during, and after disasters. A socially connected community is more resilient and better able to withstand disasters and foster community recovery.

Strategy 2: Enhance Emergency Services Infrastructure

Emergency preparedness, response, and recovery, efforts can help protect the community from the impacts of disasters. Enhancing emergency services infrastructure can make it easier to withstand, respond to and recover from emergencies. Further, advanced planning for critical facilities and infrastructure, transportation, and communication systems can make response and recovery efforts easier. For communities to function and prosper, they need buildings and infrastructure systems that are operational. When buildings and infrastructure systems are damaged, social services frequently are interrupted, economic losses soar, and resources must be re-allocated to repair and rebuild. Continual improvements in preparedness in response to threats and disruptions will build a stronger and more resilient Monterey County.

Strategy 3: Move Toward Sustainability

Resilience and sustainability represent complementary values. Sustainability is the ability to continue important functions indefinitely without a decline in quality. Resilience is the ability to thrive in the face of change. Together, these two concepts identify a key social, economic, and environmental goal: to create systems that enhance, rather than degrade, the world around them, and in turn that can withstand inevitable shocks from environmental and technological changes.

Strategy 4: Create Healthy Communities

Health, meaning physical, behavioral, social, and environmental health and wellbeing, is a big part of overall resilience. In many ways, health is a key foundation of resilience because almost everything done to prepare for disasters and protect infrastructure is ultimately in the interest of preserving human health and welfare. A resilient community has accessible health systems that are able to withstand disasters. The community can take collective action after an adverse event because it has developed resources that reduce the impact of major disturbances and help protect people's health. Resilient communities promote individual and community physical, behavioral, and social health to strengthen their communities for daily, as well as extreme, challenges.

Strategy 5: Encourage Resilient Households

A resilient community has the capacity, resources, and tools necessary to prepare for, withstand, and respond to system shocks and unexpected events, and this can start at the household level. Preparing families and households to anticipate the impacts of natural hazards and disasters, will increase their ability to persevere through the event and get back to normal life as quickly as possible.

Strategy 6: Empower Social Mobility

A resilient community understands that hazards and disasters have disproportionately adverse impacts on vulnerable populations (including economically disadvantaged, racial and ethnic minorities, the uninsured, low-income children, and elderly residents, the homeless, and those with chronic health conditions) and works to understand and meet the needs of all.

19.4 RISK ASSESSMENT- SEA LEVEL RISE

This Plan highlights sea-level rise within the climate change section because this hazard has delineated hazard boundaries and quantifiable exposure and damage estimations directly related to climate change.

While flooding already poses a risk in Monterey County, rising seas will put new areas at risk and increase the likelihood and intensity of floods in areas already at risk. Rising sea levels will affect Monterey County in several ways including increased tidal inundation, coastal erosion, tsunami inundation, and seawater intrusion, as well as worsened storm surge leading to increased coastal and fluvial flooding. Coastal levees and flood control structures will be undersized to manage the combined influences of higher flow events and sea level rise. Erosion of barrier dunes will expose previously protected areas to flooding.

Under medium to medium-high emissions scenario, projections indicate mean sea level along the coast of Monterey County could rise close to 5 feet by 2100[72] The current sea level rise projections for the Monterey Tide Gauge are summarized in *Table 19-2.*

Table 19-2
Monterey Tide Gauge Projected Sea Level Rise (in feet)

Year	Low Risk Aversion[1]*	Medium-High Risk Aversion[2]*	Extreme Risk Aversion**
	Upper Limit of Likely	*1-in-200 Chance*	*Single Scenario*
2030	0.5	0.8	1.0
2040	0.8	1.2	1.7
2050	1.1	1.9	2.7
2060	1.4	2.6	3.8
2070	1.8	3.4	5.1
2080	2.3	4.4	6.6
2090	2.8	5.5	8.2
2100	3.3	6.9	10.1

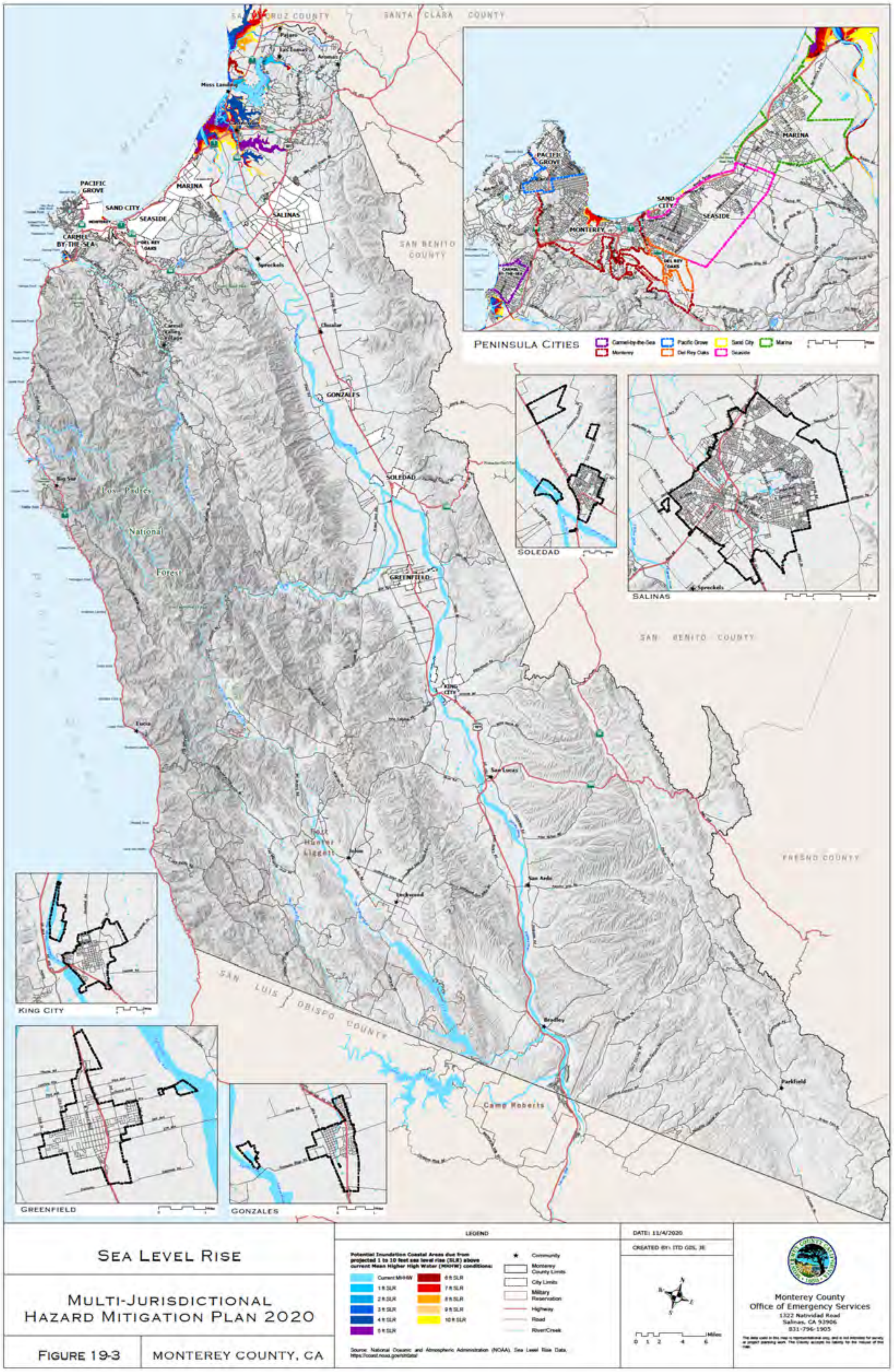
[1] ~17% probability sea level rise exceeds number listed
[2] 0.5% probability sea level rise exceeds number listed
* Probabilistic Projections (in feet) (based on Kopp et al. 2014)
** H++ Scenario, no associated probability (Sweet et al. 2017)

While mean sea level will rise across the County, it is relative. Locational differences in elevation between the height of the sea surface and the height of the land surface will lead to a variation in the risks posed to communities and ecosystems from coastal flooding. Relative sea level rise across the County will be determined by vertical land motion, changes in the height of the geoid (the gravitationally determined surface of the ocean in the absence of tides and ocean currents), and changes in the height of the sea surface relative to the geoid. Additionally, land use patterns and development, flood control structures, habitat, and geomorphology vary greatly. Therefore, the change in relative sea level will vary across the County coastline.

Sea level rise risk exposure was calculated based on the NOAA Office for Coastal Management's sea level rise projections.[73] Based on NOAA's scenarios*, Figure 19-3* shows the potential inundation coastal areas from projected 1 to 10 feet sea level rise above the current Mean Higher High Water (MHHW) condition.

Three sea level rise levels (25 cm, 75 cm, and 200 cm) were chosen to represent planning horizons based on Ocean Protection Council (OPC) Sea Level Rise Projections for the Monterey Tide Gauge. 25 cm of sea level rise represents near term (2030) risk, 75 cm represent mid-term (2060) risk, and 200 cm represent long-term (2100) risk. This assessment is based on current conditions and does consider any adaptation or mitigation measures that may be taken in the coming decades.

[72] State of California Sea-Level Rise Guidance, Ocean Protection Council (2018)
[73] Sea Level Rise Viewer, NOAA Office for Coastal Management


SANTA CLARA COUNTY
SAN BENITO COUNTY
FRESNO COUNTY
SAN LUIS OBISPO COUNTY
Moss Landing
PACIFIC GROVE
SAND CITY
SEASIDE
MARINA
SALINAS
MONTEREY
DEL REY OAKS
CARMEL BY-THE-SEA
GONZALES
SOLEDAD
GREENFIELD
KING CITY
Big Sur
Los Padres National Forest
Camp Roberts
Parkfield
PENINSULA CITIES
Carmel-by-the-Sea
Monterey
Pacific Grove
Del Rey Oaks
Sand City
Seaside
Marina
SOLEDAD
SALINAS
KING CITY
GREENFIELD
GONZALES
SEA LEVEL RISE
MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN 2020
FIGURE 19-3
MONTEREY COUNTY, CA
LEGEND
Potential Inundation Coastal Areas due from projected 1 to 10 feet sea level rise (SLR) above current Mean Higher High Water (MHHW) conditions:
Current MHHW
1 ft SLR
2 ft SLR
3 ft SLR
4 ft SLR
5 ft SLR
6 ft SLR
7 ft SLR
8 ft SLR
9 ft SLR
10 ft SLR
Community
Monterey County Limits
City Limits
Military Reservation
Highway
Road
River/Creek
Source: National Oceanic and Atmospheric Administration (NOAA), Sea Level Rise Data, https://coast.noaa.gov/slrdata/
DATE: 11/4/2020
CREATED BY: ITD GIS, JE
Miles
0 1 2 4 6
Monterey County
Office of Emergency Services
1322 Natividad Road
Salinas, CA 93906
831-796-1905

19.4.1 POPULATION AND PROPERTY

Table 19-3, *Table 19-4*, and *Table 19-5* summarize people and property that will be exposed to sea level rise risk in the Supervisorial District 2, 4, and 5, respectively. Districts 1 and 3 are not located on the coast and were not considered exposed to sea level rise risk.

Table 19-3
Population and Property Exposed to Sea Level Rise in Monterey County District 2

Sea Level Rise Amount	Population	Residential Property		Non-Residential Property	
		#	Value	#	Value
1 ft Sea Level Rise (2030)	2,129	39	$12,796,994	1,342	$153,665,283
3 ft Sea Level Rise (2060)	2,570	54	$19,137,706	1,449	$212,686,695
7 ft Sea Level Rise (2100)	7,000	294	$140,045,288	1,757	$334,589,838

Table 19-4
Population and Property Exposed to Sea Level Rise in Monterey County District 4

Sea Level Rise Amount	Population	Residential Property		Non-Residential Property	
		#	Value	#	Value
1 ft Sea Level Rise (2030)	85	1	$170,236	73	$172,367,581
3 ft Sea Level Rise (2060)	85	1	$170,236	78	$173,380,493
7 ft Sea Level Rise (2100)	127	4	$1,443,035	96	$199,664,235

Table 19-5
Population and Property Exposed to Sea Level Rise in Monterey County District 5

Sea Level Rise Amount	Population	Residential Property		Non-Residential Property	
		#	Value	#	Value
1 ft Sea Level Rise (2030)	1,056	165	$901,001,664	391	$463,086,630
3 ft Sea Level Rise (2060)	1,070	183	$1,044,954,182	418	$593,512,581
7 ft Sea Level Rise (2100)	1,830	218	$1,212,814,204	708	$747,868,671

It is also important to consider the combined effect of sea level rise with worsened storm surge. During a 1% annual chance flood, 5 feet of sea level rise would leave around 14,000 people and $2.2 billion in property vulnerable to flooding in the County. [74]

Coastal Storm Modeling System (CoSMoS) expands and improves on earlier sea level rise studies by dynamically modeling storm and sea level rise scenarios across California, and incorporating fluvial discharge, ocean swell, storm surge, and sea level anomalies (as during El Niño). CoSMoS modeling indicates some areas will be increasingly vulnerable to the cumulative impacts of sea level rise.

[74] California Climate Change Center, The Impacts of Sea Level Rise on the California Coast (May 2009)

For example, as seen in *Figure 19-4,* with 1.6 feet of sea level rise flood extent in the Moss Landing area will vary based on the storm magnitude.

Figure 19-4
1.6 Feet Sea Level Rise in the Moss Landing Area with Various Storm Scenarios (CoSMoS)

19.4.2 CRITICAL FACILITIES AND INFRASTRUCTURE

Some critical infrastructure and facilities are at increased risk of coastal flooding in the County due to sea level rise. Portions of Highway 1 in the northern end of the County will become increasingly vulnerable to sea level rise risk. Critical facilities and other important assets may be damaged by temporary inundation, resulting in loss of services such as power or wastewater treatment.

Table 19-6 summarizes critical infrastructure exposed to sea level rise risk.

Table 19-6
Critical Infrastructure Exposed to Sea Level Rise Risk

Critical Infrastructure Type	1 ft Sea Level Rise (2030)	3 ft Sea Level Rise (2060)	7 ft Sea Level Rise (2100)
Facilities			
Emergency Response	0	0	0
Fire Station	0	0	0
Police Station	0	0	0
Medical Facilities	0	0	0
Military Facility	0	0	0
Large Public Facilities	0	0	0
Educational Facilities	0	1	2
Power Plant	0	0	0
Water & Wastewater Facilities	1	1	11

Table 19-6
Critical Infrastructure Exposed to Sea Level Rise Risk

Critical Infrastructure Type	1 ft Sea Level Rise (2030)	3 ft Sea Level Rise (2060)	7 ft Sea Level Rise (2100)
Stormwater Facilities	0	0	3
Government Facilities	0	0	0
Communication Facilities	4	7	17
Rain Gauges	0	1	0
Lighthouses	0	0	0
Dams	0	0	0
Hazardous Materials			
Active or Idle Oil Well	2	3	4
Landfill	0	0	0
Underground Tank	0	0	0
Cal ARP Facility	0	0	0
Transportation			
Airport	0	0	0
Bridge	8	0	9
Harbor	3	3	3
Highway/Freeway (Miles)	0.2	2	36
Driveway (Miles)	0	0	0
Major Road (Miles)	8	12	49
Local (Miles)	6	9	20
Railroad (Miles)	3	1	9

As noted previously, it is also important to consider the combined effect of sea level rise with worsened storm surge. During a 1% annual chance flood, 5 feet of sea level rise would leave around 141 miles of highways and roads, and 23 miles of railway vulnerable to flooding in the County.[75]

19.4.3 ENVIRONMENT

Important coastal habitat may be lost as sea level rise permanently inundates areas, or it may be damaged due to extreme tide and storm surge events. Seawater intrusion into freshwater resources may occur, further altering habitat and ecosystems. Protective ecosystem services may be lost as land area and wetlands are permanently inundated.

Monterey County contains many important protected habitats, including the Monterey Bay National Marine Sanctuary, the largest marine protected area in the United States, as well as the Elkhorn Slough State National Estuarine Research Reserve, the Moss Landing State Wildlife Area, the Moro Cojo State Marine Reserve, and the Salinas River Dunes Natural Wildlife Refuge.

[75] California Climate Change Center, The Impacts of Sea Level Rise on the California Coast (May 2009)

The Elkhorn Slough, a unique tidal salt marsh, provides critical habitats for many species, including a large variety of aquatic birds, marine invertebrates, and fish, as well as sea otters, sea lions, and harbor seals. Biodiversity in the Elkhorn Slough is among the highest in the US. The Moro Cojo Slough and Old Salinas River also provide important habitats for threatened species. This is currently the third largest extent of estuarine marsh in the State, but around 85% is at risk of degradation and could become open water due to sea level rise. Researchers have estimated the slough and the adjacent Moss Landing Harbor area host roughly 5% of the statewide population of sea otters.[76] These areas likely will play an important role in the recovery of the California sea otter population and therefore conservation of this area is particularly important. Beach dunes provide important habitat for many native plants and animals, including the western snowy plover, western fence lizard, beach wild rye, and many more species. Loss of coastal dunes means loss of important habitat for species as well as loss of an important protective buffer.

19.4.4 ECONOMIC IMPACT

Sea level rise will impact the local economy. Tourism is a major economic driver in Monterey County, and future sea level rise could threaten popular beaches and recreational facilities. Sea level rise could affect vertical and lateral beach access points, which would prevent residents and visitors from accessing the beach and may increase the risk of injuries.

Beach tourism is important to the County' economy and generates significant revenue as many visitors rent hotels or other accommodations, dine out or shop at area stores. Visitor-serving areas such as those on the Monterey Peninsula and in Big Sur include local businesses and hotels that benefit the local economy. These businesses depend on tourism, and cities and communities within the County benefit from sales tax revenues. Disruption of these areas due to impacts of sea level rise could decrease economic activity and affect the local economy. Future sea level rise in the County may also negatively impact coastal businesses and households and decrease coastal real estate opportunities. Coastal businesses may relocate to other areas rather than face high costs from increased risk to storm surge and costs associated with managed retreat. Local tax revenue may decline as areas that were previously occupied by houses and businesses are permanently inundated.

Sea level rise is also likely to increase the risk of flooding in the lower Salinas Valley. This could lead to the flooding on large swaths of agricultural land and threaten a major economic driver. Sea level rise in addition to coastal storms and erosion impacts could lead to severe flooding and inundation of economically important infrastructure such as harbors and buildings related to commercial and recreational fisheries.

[76] Elkhorn Slough, Technical Report Series

19.5 RISK ASSESSMENT- HAZARDS OF CONCERN

This section discusses the increased risk posed by specific hazards previously profiled in this plan that were identified as likely to increase in impact due to climate changes. The following sections provide information on how each identified hazard of concern for this planning process may be impacted by climate change and how these impacts may alter current exposure and vulnerability to these hazards for the people, property, critical facilities, and the environment in Monterey County.

19.5.1 AGRICULTURAL EMERGENCIES

The Salinas Valley is identified as one of the most vulnerable agricultural regions under climate change. [77] The amounts, forms, and distribution of precipitation, as well as the increased frequency and intensity of climate extremes, will affect water availability as well as pests, crop yields, and the length of the growing season.

Many weeds, pests, and fungi thrive under warmer temperatures, wetter climates, and increased CO2 levels. The ranges and distribution of weeds and pests are likely to increase with climate change. This could cause new problems for farmers' crops previously unexposed to these species. Plant and livestock diseases are also affected by temperature related climate factors. [78] Warmer temperatures could allow some parasites and pathogens to survive more easily and increased rainfall, moisture-reliant pathogens could thrive. [79]

For any particular crop, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction. Many permanent crops are sensitive to small temperature changes during development stages and/or close to harvest. Threshold temperature impacts can affect dairy production and wine grape quality. For example, the yields for wine grapes and strawberries may be reduced due to warm winters. [80] Extreme events, especially floods and droughts, can harm crops and reduce yields. Dealing with drought could become a challenge in areas where rising summer temperatures cause soils to become drier. Heat could also directly threaten livestock. Heat stress affects animals both directly and indirectly. Over time, heat stress can increase vulnerability to disease, reduce fertility, and reduce milk production.

Climate change also has the potential to impact water availability. It may cause farmers to change the crops they plant, affecting water demand and the amount of water they apply. Adaptation options to shift varieties or locations of production would require significant time

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[77] Vulnerability and Adaptation to Climate Change in California Agriculture, California Energy Commission
[78] Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources, US Climate Change Science Program and the Subcommittee on Global Change Research (2008)
[79] The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States, US Climate Change Science Program and the Subcommittee on Global Change Research (2008)
[80] Ch. 6: Agriculture. Climate Change Impacts in the United States: The Third National Climate Assessment, US Global Change Research Program (2014)

and capital investment. Climate change could also impact agriculture in the region by increasing the demand for irrigation to meet higher evaporative processes. Monterey County is highly reliant on groundwater for agricultural operations. As climate change exacerbates drought conditions overdraft of the aquifers is likely to increase. Seawater intrusion is already a major threat to groundwater supply, and this is likely to increase as sea levels rise.

19.5.2 COASTAL EROSION

Sea level rise is likely to increase rates of coastal erosion due to the increase in the frequency, severity, and duration of high tides and wind-driven waves associated with severe storms. Higher sea level will expose beaches, cliffs, and coastal dunes to more persistent erosional forces. High tides may also coincide with heavy rain exacerbating coastal flooding, coastal erosion, and landslides, such as were experienced during the 1998 and 2016 El Nino storms.[81] Over the next 50 years, sea level rise is predicted to increase coastal erosion 20-25% over historic erosion rates and in the 50-100-year timeframe, erosion rates are projected to increase an additional 40-50% over historic rates.[82]

To determine coastal erosion risk, USGS Pacific Coastal and Marine Science Center CoSMos shoreline change, and cliff retreat projection data was used. For cliff retreat modeling an end of century (2100) forced sea level rise amount of 200 cm was used. For shoreline change, winter erosion uncertainty modeling was used to capture the degree of uncertainty associated with future shoreline erosion. Hold the Line scenario modeling was chosen for both types of erosion. Three sea level rise levels (25 cm, 75 cm, and 200 cm) to represent planning horizons based on OPC Sea Level Rise Projections for the Monterey Tide Gauge. 25 cm of sea level rise represents near term (2030) risk, 75 cm represent mid-term (2060) risk, and 200 cm represent long-term (2100) risk. *Table 19-7* summarizes coastal erosion risk in Monterey County based on sea level rise scenario and erosion type.

Table 19-7
Population and Property Exposed to Coastal Erosion Risk in Monterey County

Sea Level Rise Scenario/ Erosion Type	Population	Residential Property		Non-Residential Property	
		#	Value	#	Value
Cliff Erosion					
Sea Level Rise (25 cm)	1,027	206	$1,183,367,352	226	$221,988,454
Sea Level Rise (75 cm)	1,642	226	$1,244,106,508	227	$223,536,860
Sea Level Rise (200 cm)	1,932	253	$1,323,971,611	248	$240,099,182
Shoreline Erosion					
Sea Level Rise (25 cm)	489	4	$3,099,857	24	$196,070,566
Sea Level Rise (75 cm)	213	4	$3,099,857	54	$196,070,566
Sea Level Rise (200 cm)	213	4	$3,099,857	49	$190,008,411

[81] Governor's Office of Emergency Services (Cal OES), State of California Hazard Mitigation Plan
[82] Association of Monterey Bay Area Governments, Coastal Regional Sediment Management Plan

19.5.3 DAM AND LEVEE FAILURE

On average, changes in California's annual precipitation levels are not expected to be dramatic; however, small changes may have significant impacts for water resource systems, including dams and levees. Dams and levees are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam or levee. If the hygrograph changes, it is conceivable that the dam or levee can lose some or all of its designed margin of safety, also known as freeboard. In the case of dams, if freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream.

For levees, a reduction in freeboard caused by a changing hydrograph means that a levee may no longer protect an area against the design-storm standard for which it was originally built (for example 1-%-annual chance). This means that risk to the area that a levee is protecting from inundation will increase. Levee accreditation may be rescinded, resulting in currently protected areas being mapped within a flood hazard area.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Climate change could lead to increases in flood flows, which would result in that water infrastructure, such as dams, would need to manage flows for which they were not designed. Climate change may result in the need for increased safety precautions to address higher winter runoff, frequent fluctuations of water levels, and increased potential for sedimentation and debris accumulation from changing erosion patterns and increases in wildfires. Climate change will likely impact the ability of dam operators to estimate extreme flood events.

19.5.4 DROUGHT

With a warmer climate, droughts could become more frequent, more severe, and longer lasting. While climate models tend to differ about future precipitation trends and their magnitudes in California, projections show an increase in extreme dry events and only modest changes in mean precipitation. When combined with increasing temperatures, even minor fluctuations will increase pressure on Monterey County's water resources, which are already over-stretched by the demands of a growing agriculture economy and population. Existing local surface storage and groundwater recharge will become less reliable and more expensive. Decreasing snowmelt and spring stream flows coupled with increasing demand for water resulting from both a growing population and hotter climate could lead to increasing water shortages.

Some areas could experience longer, more intense droughts, resulting from higher summer temperatures and reduced precipitation. Reduction in precipitation coupled with heat stress could adversely impact crop production and dry out soils. Drought may threaten pasture and feed supplies. Drought reduces the amount of quality forage available to grazing livestock. For animals that rely on grain, changes in crop production due to drought could also become a problem. Drought is likely to lead to reduced water supplies, leaving less water available for irrigation when more is needed.

More extreme droughts and higher temperatures will also alter the natural recharge of groundwater and potentially exacerbate groundwater overdraft. Reduced groundwater storage limits the use of groundwater as a backup supply during drought. One of the most persistent water quality problems in the region, the intrusion of salt water into groundwater aquifers and wells, could potentially increase under climate change depending on the implementation of adaptation projects.

19.5.5 EARTHQUAKE

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes. The study found that as glaciers melt, they lighten the load on the Earth's crust. Tectonic plates, which are mobile pieces of the Earth's crust, can then move more freely.[83]

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events.

19.5.6 FLOODING

Scientist's project greater storm intensity with climate change, resulting in more direct runoff and flooding. High frequency flood events in particular will likely increase with a changing climate. What is currently considered a 1-%-annual-chance flood may also strike more often, leaving many communities at greater risk. Extreme atmospheric river events, the dominant driver of locally extreme rainfall events and associated flooding, are expected to increase under projected climate change.

[83] Retreating Glaciers Spur Alaskan Earthquakes, NASA (August 2004)

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas, such as the Sierra Nevada watersheds, to contribute to peak storm runoff. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

19.5.7 HUMAN CAUSED HAZARDS

Studies have linked high temperatures with increases in intense violence.[84] Increasing evidence indicates that climate change is causally associated with collective violence, generally in combination with other factors. Increased temperatures and extremes of precipitation with their associated consequences, including resultant scarcity of cropland and other key environmental resources, are major pathways by which climate change leads to collective violence.[85]

Large-scale human migration due to resource scarcity, increased frequency of extreme weather events, and other factors is likely to increase with climate change. Populations in communities with worsening conditions may consider moving to better places, provided the costs of migration are affordable. However, sudden climatic changes or natural disasters might lead, in the absence of alternatives, to migration choices which are forced rather than the result of a well-planned process. The exact impact of climate induced migration is uncertain at this time. More favorable areas are likely to see increases in population, while other areas see dramatic decreases.

19.5.8 PUBLIC HEALTH HAZARDS

Increased temperatures that manifest as heat waves directly harm human health through heat-related illnesses and the exacerbation of pre-existing conditions in vulnerable populations. Heat waves are defined as five days over 79°F to 85°F along the coast and 99°F to 101°F inland. Coastal areas should expect one more heat wave per year by 2050 and four to eight more per year by 2100. Inland, three to four more heat waves are expected to 2050 and eight to ten more per year in 2100.[86] Some populations in Monterey County are especially vulnerable to the effects of more frequents extreme heat events. Heat waves and prolonged heat days in the

[84] Heat and Violence, Craig A. Anderson, *Current Directions in Psychological Science* (February 2001)
[85] Climate Change and Collective Violence, Barry S. Levy, Victor W. Sidel, and Jonathan A. Patz, *Annual Review of Public Health* (March 2017)
[86] Climate Change and Health Profile Report: Monterey County, California Department of Public Health (February 2017)

area would increase the exposure of thousands of outdoor workers to heat related illnesses, including vulnerable populations such as agricultural field workers.

Rising temperatures and more extreme drought events are increasingly associated with an uptick in vector-borne and infectious disease transmission. Climate is one of the factors that influence the distribution of diseases borne by vectors (such as fleas, ticks, and mosquitoes), which spread pathogens that cause illness. The geographic and seasonal distribution of vector populations, and the diseases they can carry, depends not only on climate but also on land use, socioeconomic and cultural factors, pest control, access to health care, and human responses to disease risk, among other factors. Daily, seasonal, or year-to-year climate variability can sometimes result in vector/pathogen adaptation and shifts or expansions in their geographic ranges. Such shifts can alter disease incidence depending on vector-host interaction, host immunity, and pathogen evolution. Additionally, lack of soil moisture due to drought and evaporation from high temperatures increases dust particle concentration, which sometimes house harmful fungal spores and viruses.[87]

Cases of vector-borne disease, including Lyme disease, are expected to rise with climate change. A newly identified vector-borne disease, Pacific Coast Tick Fever, is spread by *Dermacentor occidentalis*, which harbors *Rickettsia philipii*, the causative agent of the disease. Although still an emerging illness, a few of the human cases originated in the Central Coast. With Pacific Coast Tick Fever exhibiting a summer trend so far, climate change and increasing temperatures have the potential to extend transmittal season in the Central Coast.

West Nile Virus, a mosquito-borne illness has also made a presence in the Monterey County, though to a much smaller extent than other parts of California. Rising temperatures, changing precipitation patterns, and a higher frequency of some extreme weather events associated with climate change will influence the distribution, abundance, and prevalence of infection in the mosquitoes that transmit West Nile virus and other pathogens by altering habitat availability and mosquito and viral reproduction rates. Alterations in the distribution, abundance, and infection rate of mosquitoes will influence human exposure to bites from infected mosquitoes, which is expected to alter risk for human disease.

The California Department of Public Health (CDPH) has also identified the Central Coast, and Monterey County as a high-risk area for Valley Fever. The illness, transmitted by the *Coccidioides immitis* fungus, is found in disturbed, dry soil particles that are breathed in. Its symptoms include chest pain, exhaustion, fever, coughing, joint and muscle pain, and difficulty breathing, among other symptoms, and can persist for weeks or even months. In particular, the 2006 Santa Barbara fires, driven to a great extent by high winds, may have exposed some

[87] The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, US Global Change Research Program (2016)

firefighters to the illness while they engaged in soil disruption and removing vegetation to prevent wildfire spread.

Vector-borne pathogens are expected to emerge or reemerge due to the interactions of climate factors with many other drivers, such as changing land-use patterns. The impacts to human disease, however, will be limited by the adaptive capacity of human populations, such as vector control practices or personal protective measures.

19.5.9 SEVERE WEATHER

Climate change has already increased the number and strength of severe weather events and is likely to continue to increase in prolonged periods of excessively high temperatures, heat waves, extended frost, and severe winter storms. Extreme atmospheric river events, the dominant driver of locally extreme rainfall events and associated flooding, are expected to increase under projected climate change. Climate change impacts on other severe weather events such as thunderstorms and high winds are still not well understood.

19.5.10 SLOPE FAILURE

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature is likely to affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

The entire County will continue to be at risk for large, intense fires and thus as precipitation extremes increase, the probability also increases that an intense rain event will follow soon after a fire. Many areas of the County not previously in high landslide risk areas, may become increasingly at risk of post-fire debris flows due to increasing wildfire risk.

19.5.11 TSUNAMI

The impacts of global climate change on tsunami probability are unknown. Some scientists say that melting glaciers could induce tectonic activity, inducing earthquakes. Other scientists have indicated that underwater avalanches (also caused by melting glaciers), may also result in tsunamis. Even if climate change does not increase the frequency with which tsunamis occur, it may result in more destructive waves. As sea levels continue to rise, tsunami inundation areas would likely reach further into communities than current mapping indicates.

19.5.12 WILDFIRE

Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. Prediction of fire severity and frequency change in Monterey County is challenging given the uncertainty in climate predictions of precipitation and wind for the region and the high and complex sensitivity of fire regimes in Mediterranean type Ecosystems to precipitation and climatic water deficits. It is important to recognize, however, that the basic characterization of this system as one that is dominated by fire is unlikely to change, and it is highly likely that that Monterey County will continue to see large, severe fires. Consequently, growing populations and expansion into the WUI will increase vulnerability to fires and projected increases in precipitation intensity during storms may increase post-fire impacts.

Changes in climate patterns may impact the distribution and perseverance of insect outbreaks that create dead trees (increase fuel). When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

19.6 ISSUES

The major issues for climate change are the following:

- Planning for climate change related impacts can be difficult due to inherent uncertainties in projection methodologies.
- Average temperatures are expected to continue to increase in the County, which may lead to a host of primary and secondary impacts, such as an increased incidence of heat waves. Expected changes in precipitation patterns are still poorly understood and could have significant impacts on the water supply and flooding in the County.
- Increased average temperatures along with changes in precipitation could affect groundwater supplies in the County
- Some impacts of climate change are poorly understood such as potential impacts on the frequency and severity of earthquakes, thunderstorms, and tsunamis.
- Heavy rain events may result in inland stormwater flooding after stormwater management systems are overwhelmed.
- Permanent and temporary inundation resulting from sea level rise has the potential to impact significant portions of the population and assets in the County.
- A warmer climate will have an impact on the agriculture industry requiring research to better understand future impacts.
- Sea level rise has the potential to have major impacts on tourism industry.

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PART C: MITIGATION CAPABILITY AND STRATEGY

THIS PART DESCRIBES THE OVERALL CAPABILITY TO IMPLEMENT HAZARD MITIGATION ACTIVITIES AND PROVIDES A VISION FOR FUTURE MITIGATION IN THE COUNTY. IT CONSISTS OF THE FOLLOWING SECTIONS:

20. CAPABILITY ASSESSMENT
21. MITIGATION STRATEGY
22. PLAN IMPLEMENTATION AND MAINTENANCE

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20. CAPABILITY ASSESSMENT

Thus far, the planning process has identified the hazards posing a threat to Monterey County and described, in general, the vulnerability of the County to these risks. The next step is to assess what loss prevention mechanisms are already in place, through the completion of a hazard mitigation Capability Assessment. The Capability Assessment helps determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects. As in any planning process, it is important to try to establish which goals and actions are feasible, based on an understanding of the organizational capacity of the agencies or departments tasked with their implementation.

The Capability Assessment is an important tool in determining which mitigation actions are practical and likely to be implemented over time based on a local government's existing authorities, policies, programs, and resources available to support such implementation. The combination of the hazard Risk Assessment with the mitigation Capability Assessment results in the County's net vulnerability to disasters, and more accurately focuses the goals, objectives, and proposed actions of this Plan. The Capability Assessment had three primary components:

1. An analysis of federal and state laws, ordinances, plans and programs that can support or impact hazard mitigation actions
2. An inventory of a jurisdiction's plans, ordinances, programs, technical studies, or activities already in place and their relevancy to hazard mitigation
3. An analysis of a jurisdiction's current capacity and resources to carry out relevant plans, ordinances, programs, or activities related to hazard mitigation

A careful examination of local capabilities will detect any existing gaps, shortfalls, or weaknesses associated with ongoing government activities that could hinder proposed mitigation activities and possibly even exacerbate hazard vulnerability. The Capability Assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should be leveraged and continue to be supported and enhanced, if possible, through future mitigation efforts.

The Capability Assessment serves as a critical part of the planning process and helps identify and target meaningful mitigation actions for incorporation into the Mitigation Strategy. It helps establish both the countywide and jurisdiction-specific mitigation goals and ensures that those goals and the mitigation actions that follow are realistically achievable given current local conditions.

20.1 INCORPORATION OF EXISTING PLANS, STUDIES, REPORTS, AND TECHNICAL INFORMATION

Existing laws, ordinances, plans and programs at the federal, state, and local level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). The following federal and state programs have been identified as programs that may interface with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan. Information presented in this section can be used in review local capabilities to implement the actions found in the jurisdictional annexes of **Volume 2**.

Each planning partner has individually reviewed existing local plans, studies, reports, and technical information in its jurisdictional annex. The Local process is described in Section 20.2 *Local Capability Assessment* and individual jurisdiction results are presented in **Volume 2**.

20.1.1 FEDERAL

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards. The NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency responder disciplines. These cases necessitate coordination across a spectrum of organizations.

Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, terrorist activities, and other human-caused disasters) regardless of size or complexity. Although participation is voluntary, Federal departments and agencies are required to make adoption of NIMS by local and state jurisdictions a condition to receive Federal Preparedness grants and awards.

Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the US Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of the Federal Emergency Management Agency, the Small Business Administration, and the US Army Corps. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other disaster assistance programs. CDGB-DR funding is a potential alternative source of funding for actions identified in this plan.

To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective. Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger.

Emergency Watershed Program

The USDA Natural Resources Conservation Service (NRCS) administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. This federal program could be a possible funding source for actions identified in this plan.

Financial and technical assistance are available for the following activities:

- Removing debris from stream channels, road culverts, and bridges
- Reshaping and protect eroded banks
- Correcting damaged drainage facilities
- Establishing cover on critically eroding lands
- Repairing levees and structures
- Repairing conservation practices

Emergency Relief for Federally Owned Roads Program

The US Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs. Eligible activities under this program meet some of the goals and objectives for this plan and the program is a possible funding source for actions identified in this plan.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. Monterey County and all of the municipal planning partners participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, all participating jurisdictions were in good standing with NFIP requirements. Full compliance and good standing under the NFIP are application prerequisites for all FEMA grant programs for which participating jurisdictions are eligible under this plan.

Presidential Executive Orders 11988 and 13690

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. It requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values of floodplains. The requirements apply to the following activities:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

Executive Order 13690 expands Executive Order 11988 and acknowledges that the impacts of flooding are anticipated to increase over time due to the effects of climate change and other threats. It mandates a federal flood risk management standard to increase resilience against flooding and help preserve the natural values of floodplains. This standard expands management of flood issues from the current base flood level to a higher vertical elevation and corresponding horizontal floodplain. The goal is to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

The Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues is addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The CWA is important to hazard mitigation in several ways. There are often permitting requirements for any construction within 200 feet of water of the United States, which may have implications for mitigation projects identified by a local jurisdiction. Additionally, CWA requirements apply to wetlands, which serve important functions related to preserving and protecting the natural and beneficial functions of floodplains and are linked with a community's floodplain management program.

Finally, the National Pollutant Discharge Elimination System is part of the CWA and addresses local stormwater management programs. Stormwater management plays a critical role in hazard mitigation by addressing urban drainage or localized flooding issues within jurisdictions. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Presidential Executive Order 11990

Executive Order 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The requirements apply to the following activities:

- Acquiring, managing, and disposing of federal lands and facilities

- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered.

Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention. Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes.

The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographic areas that are essential for the conservation and management of a listed species, whether occupied by the species or not."

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. NEPA established the Council on Environmental Quality (CEQ), whose regulations (40 CFR Parts 1500-1508) set standards for NEPA compliance. Consideration and decision-making regarding environmental impacts must be documented in an environmental impact statement or environmental assessment.

Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and an unbiased presentation of direct, indirect, and cumulative environmental impacts. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency alert, officials must use a combination of warning methods to ensure that all residents have all necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or other visual alerts. Two technical documents for shelter operators address physical accessibility needs of people with disabilities, as well as medical needs and service animals. The ADA intersects with disaster preparedness programs in regard to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (e.g., vehicles with wheelchair lifts or paratransit buses).

Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Civil Rights Act of 1964

The Civil Rights Act of 1964 prohibits discrimination based on race, color, religion, sex, or nation origin and requires equal access to public places and employment. The Act is relevant to emergency management and hazard mitigation in that it prohibits local governments from favoring the needs of one population group over another. Local government and emergency response must ensure the continued safety and well-being of all residents equally, to the extent possible. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Army Corps of Engineers Programs

The US Army Corps of Engineers has several civil works authorities and programs related to flood risk and flood hazard management. The Floodplain Management Services program offers 100-% federally funded technical services such as development and interpretation of site-specific data related to the extent, duration, and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.

For more extensive studies, the Army Corps offers a cost-shared program called Planning Assistance to States and Tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50% of the cost. The Army Corps has several cost-shared programs (typically 65% federal and 35% non-federal) aimed at developing, evaluating, and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed, including:

- The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.
- Larger scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65% federal and 35% nonfederal.
- Watershed management planning studies can be specifically authorized and are cost-shared at 50% federal and 50% non-federal.

The Army Corps also provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fight activities and cost share in the repair of flood protective structures. The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; for rehabilitation of flood control and hurricane protection structures. Funding for the Army Corps emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state, and federal agencies.

Under PL 84-99, the Army Corps can supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fight efforts require a project cooperation agreement signed by the public sponsor and the sponsor must remove all flood fight material after the flood has receded. PL 84-99 also authorizes emergency water support and drought assistance in certain situations and allows for “advance measures” assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.

Under PL 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20% cost to the eligible non-federal system owner. All systems considered eligible for PL 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged. All of these authorities and programs are available to the planning partners to support any intersecting mitigation actions.

20.1.2 STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Acts main purpose is to prevent construction of buildings used for human occupancy on the surface trace of active faults. Before a new project is permitted, cities and counties require a geologic investigation to demonstrate that proposed buildings will not be constructed on active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as liquefaction or seismically induced landslides.

The law requires the State of California Geologist to establish regulatory zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. All seismic hazard mitigation actions identified in this plan will seek full compliance with the Alquist-Priolo Earthquake Fault Zoning Act.

California General Planning Law

California state law requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The general plan expresses the community’s goals, visions, and policies relative to future land uses, both public and private. The general plan is mandated and prescribed by state law (Cal. Gov. Code §65300 et seq.) and forms the basis for most local government land use decision-making.

The plan must consist of an integrated and internally consistent set of goals, policies, and implementation measures. In addition, the plan must focus on issues of the greatest concern to the community and be written in a clear and concise manner. City and county actions, such as those relating to land use allocations, annexations, zoning, subdivision and design review, redevelopment, and capital improvements, must be consistent with the plan. All municipal planning partners to this plan have general plans that are currently compliant with this law and have committed to integrating this mitigation plan with their general plans through provisions referenced below (AB-2140 and SB-379).

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970, shortly after the federal government enacted the National Environmental Policy Act, to institute a statewide policy of environmental protection. CEQA requires state and local agencies in California to follow a protocol of analysis and public disclosure of the potential environmental impacts of development projects. CEQA makes environmental protection a mandatory part of every California state and local agency's decision-making process.

CEQA establishes a statewide environmental policy and mandates actions all state and local agencies must take to advance the policy. Jurisdictions conduct analysis of the project to determine if there are potentially significant environmental impacts, identify mitigation measures, and possible project alternatives by preparing environmental reports for projects that requires CEQA review. This environmental review is required before an agency acts on any policy, program, or project.

Monterey County has determined that this plan update is categorically exempt from the formal CEQA protocol. The County will initiate the formal CEQA protocol on any project recommended in this plan that requires adherence to this protocol at the initiation of the project. Any project action identified in this plan will seek full CEQA compliance upon implementation.

California Disaster Assistance Act

The California Disaster Assistance Act (CDAA) authorizes the Director of the California Governor's Office of Emergency Services (Cal OES) to administer a disaster assistance program that provides financial assistance from the state for costs incurred by local governments as a result of a disaster event. Funding for the repair, restoration, or replacement of public real property damaged or destroyed by a disaster is made available when the Director concurs with a local emergency proclamation requesting state disaster assistance.

The program also provides for the reimbursement of local government costs associated with certain emergency activities undertaken in response to a state of emergency proclaimed by the Governor. In addition, the program may provide matching fund assistance for cost sharing required under federal public assistance programs in response to a Presidential Major Disaster or Emergency Declaration. The implementing regulations for CDAA can be found in Title 19 of the California Code of Regulations, Chapter 6.

Assembly Bill 162: Flood Planning

This California State Assembly Bill passed in 2007 requires cities and counties to address flood-related matters in the land use, conservation, and safety and housing elements of their general plans. The land use element must identify and annually review the areas covered by the general plan that are subject to flooding as identified in floodplain mapping by either FEMA or the state Department of Water Resources (DWR). During the next revision of the housing element on or after January 1, 2009, the conservation element of the general plan must identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for the purpose of groundwater recharge and stormwater management.

The safety element must identify information regarding flood hazards, including:

- Flood hazard zones
- Maps published by FEMA, DWR, the US Army Corps of Engineers, the Central Valley Flood Protection Board, and the Governor's Office of Emergency Services (Cal OES)
- Historical data on flooding
- Existing and planned development in flood hazard zones

The general plan must establish goals, policies, and objectives to protect from unreasonable flooding risks, including:

- Avoiding or minimizing the risks of flooding new development
- Evaluating whether new development should be located in flood hazard zones
- Identifying construction methods to minimize damage

AB 162 establishes goals, policies, and objectives to protect from unreasonable flooding risks. It establishes procedures for the determination of available land suitable for urban development, which may exclude lands where FEMA or DWR has concluded that the flood management infrastructure is not adequate to avoid the risk of flooding.

Assembly Bill 2140: General Plans—Safety Element

This bill provides that the state may allow for more than 75% of public assistance funding under the California Disaster Assistance Act only if the local agency is in a jurisdiction that has adopted a local hazard mitigation plan as part of the safety element of its general plan. The local hazard mitigation plan needs to include elements specified in this legislation. In addition, this bill requires Cal OES to give preference for federal mitigation funding to cities and counties that have adopted local hazard mitigation plans. The intent of the bill is to encourage cities and counties to create and adopt hazard mitigation plans.

Assembly Bill 70: Flood Liability

This bill provides that a city or county may be required to contribute a fair and reasonable share to compensate for property damage caused by a flood to the extent that it has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project, unless the city or county meets specified requirements.

Assembly Bill 32: The California Global Warming Solutions Act

This bill identifies the following potential adverse impacts of global warming:

- Exacerbation of air quality problems
- Reduction in the quality and supply of water to the state from the Sierra snowpack
- A rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment
- An increase in the incidences of infectious diseases, asthma, and other human health-related problems

AB 32 establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020 (a reduction of approximately 25% from forecast emission levels), with further reductions to follow. The law requires the state Air Resources Board to establish a program to track and report greenhouse gas emissions, approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions from sources of greenhouse gas emissions, adopt early reduction measures to begin moving forward, and adopt, implement, and enforce regulations, including market mechanisms such as "cap and-trade" programs, to ensure that the required reductions occur. The Air Resources Board has adopted a statewide greenhouse gas emissions limit and an emissions inventory, along with requirements to measure, track, and report greenhouse gas emissions by the industries it determined to be significant sources of greenhouse gas emissions.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

Senate Bill 97, enacted in 2007, amends CEQA to clearly establish that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for CEQA analysis. It directs the Governor's Office of Planning and Research to develop draft CEQA guidelines for the mitigation of greenhouse gas emissions or their effects by July 2009 and directs the California Natural Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010.

Senate Bill 1241: General Plans: Safety Element—Fire Hazard Impacts

In 2012, Senate Bill 1241 was enacted, requiring that all future General Plans address fire risk in state responsibility areas and very high fire hazard severity zones in their safety element. In addition, the bill requires cities and counties to make certain findings regarding available fire protection and suppression services before approving a tentative map or parcel map.

Senate Bill 1000: General Plan Amendments—Safety and Environmental Justice Elements

In 2016, Senate Bill 1000 amended California's Planning and Zoning Law in two ways. The original law established requirements for initial revisions of general plan safety elements to address flooding, fire, and climate adaptation and resilience. It also required subsequent review and revision as necessary based on new information. Senate Bill 1000 specifies that the subsequent reviews and revision based on new information are required to address only flooding and fires (not climate adaptation and resilience).

Additionally, Senate Bill 1000 adds a requirement that, upon adoption or revision of any two other general plan elements on or after January 1, 2018, an environmental justice element be adopted for the general plan or environmental justice goals, policies and objectives be incorporated into other elements of the plan.

Senate Bill 379: General Plans: Safety Element—Climate Adaptation

Senate Bill 379 builds upon the flood planning inclusions into the safety and housing elements and the hazard mitigation planning safety element inclusions in general plans outlined in AB 162 and AB 2140, respectively. SB 379 focuses on a new requirement that cities and counties include climate adaptation and resiliency strategies in the safety element of their general plans beginning January 1, 2017. In addition, this bill requires general plans to include a set of goals, policies and objectives, and specified implementation measures based on the conclusions drawn from climate adaptation research and recommendations.

This update process for this hazard mitigation plan was conducted with the intention of full compliance with this bill. However, at the time of the update, there was no clear guidance from the state on what constitutes full compliance or what protocol is to be used to determine compliance. When such guidance has been established, the planning partners will submit this plan or its subsequent updates to the state for review and approval.

California State Building Code California Code of Regulations

Title 24 (CCR Title 24), also known as the California Building Standards Code, is a compilation of building standards from three sources:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions
- Building standards authorized by the California legislature that constitute extensive additions not covered by the model codes adopted to address particular California concerns.

The state Building Standards Commission is authorized by California Building Standards Law (Health and Safety Code Sections 18901 through 18949.6) to administer the processes related to the adoption, approval, publication, and implementation of California’s building codes. These building codes serve as the basis for the design and construction of buildings in California. The national model code standards adopted into Title 24 apply to all occupancies in California, except for modifications adopted by state agencies and local governing bodies. Since 1989, the Building Standards Commission has published new editions of Title 24 every three years.

Standardized Emergency Management System

CCR Title 19 establishes the Standardized Emergency Management System (SEMS) to standardize the response to emergencies involving multiple jurisdictions. SEMS is intended to be flexible and adaptable to the needs of all emergency responders in California. It requires emergency response agencies to use basic principles and components of emergency management. Local governments must use SEMS by December 1, 1996, to be eligible for state funding of response-related personnel costs under CCR Title 19 (Sections 2920, 2925 and 2930). The roles and responsibilities of Individual agencies contained in existing laws, or the state emergency plan are not superseded by these regulations. This hazard mitigation plan is considered to be a support document for all phases of emergency management, including those associated with SEMS.

State of California State Hazard Mitigation Plan (SHMP)

Under the DMA, California must adopt a federally approved state multi-hazard mitigation plan to be eligible for certain disaster assistance and mitigation funding. The intent of the *State of California Hazard Mitigation Plan* is to reduce or prevent injury and damage from hazards in the state through the following:

- Documenting statewide hazard mitigation planning in California
- Describing strategies and priorities for future mitigation activities
- Facilitating the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meeting state and federal statutory and regulatory requirements

The plan is an annex to the State Emergency Plan, and it identifies past and present mitigation activities, current policies and programs, and mitigation strategies for the future. It also establishes hazard mitigation goals and objectives. The plan will be reviewed and updated annually to reflect changing conditions and new information, especially information on local planning activities. Under 44 CFR Section 201.6, local hazard mitigation plans must be consistent with their state's hazard mitigation plan. In updating this plan, the Steering Committee reviewed the California State Hazard Mitigation Plan to identify key relevant state plan elements.

California Adaptation Planning Guide

The California Adaptation Planning Guide (APG), updated in 2020, is designed to support local government, regional organizations, and climate collaborative groups to integrate best practices and current science into their adaptation planning efforts. The APG provides helpful resources to local governments as they comply with state requirements for local adaptation planning and provides recommendations and advice on community-level climate change adaptation planning.

Safeguarding California Plan

The Safeguarding California Plan– California's Climate Adaptation Strategy was updated in 2018. The update is the State's roadmap for the strategies that will be used by state agencies to protect communities, infrastructure, services, and the natural environment from climate change impacts. This holistic strategy primarily covers state agencies' programmatic and policy responses across different policy areas, but it also discusses the ongoing related work to with coordinated local and regional adaptation action and developments in climate impact science.

California Coastal Act

The California Coastal Act is umbrella legislation designed to encourage each city or county lying wholly or partly within the coastal zone to create Local Coastal Programs (LCPs) to govern decisions that determine the short- and long-term conservation and use of coastal resources. These LCPs can be thought of as the equivalent of General Plans for areas within the Coastal Zone. The specific contents of such plans are not specified by state law, but they must be certified by the Coastal Commission as consistent with policies of the Coastal Act (Public Resources Code, Division 20). Until the Coastal Commission certifies an LCP, the Commission makes the final decisions on all development within a jurisdiction (city or county) within the Coastal Zone. Once an LCP is certified for a jurisdiction, decisions are handled locally, but can be appealed to the Commission.

Section 30253(1) of the Coastal Act states that new development shall minimize risks to life and property in areas of high geologic, flood, and fire hazard. Development should be prevented or limited in high hazard areas whenever possible. However, where development cannot be prevented or limited, land use density, building value, and occupancy should be kept at a minimum. Additionally, the Coastal Act has provisions relating to geologic hazards but does not mention tsunamis specifically.

There are identified coastal zones in Monterey County and affected planning partners have developed local coastal plans to address them. Any mitigation project identified in this plan that intersects the mapped coastal zone will be consistent with the recommendations of the local coastal plan.

Governor’s Executive Order S-13-08

Governor’s Executive Order S-13-08 enhances the state’s management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. There are four key actions in the executive order:

- Initiate California’s first statewide climate change adaptation strategy to assess expected climate change impacts, identify where California is most vulnerable, and recommend adaptation policies. This effort will improve coordination within state government so that better planning can more effectively address climate impacts on human health, the environment, the state’s water supply and the economy.
- Request that the National Academy of Science establish an expert panel to report on sea level rise impacts in California, to inform state planning and development efforts.
- Issue interim guidance to state agencies for how to plan for sea level rise in designated coastal and floodplain areas for new projects.
- Initiate a report on critical infrastructure projects vulnerable to sea level rise.

Senate Bill 99 General Plans: Safety Element: Emergency Evacuation Routes

SB 99 requires that, upon the next revision of the housing element on or after January 1, 2020, local governments to review and update the safety element of their General Plan to include information identifying residential developments in hazard areas that do not have at least 2 emergency evacuation routes.

Assembly Bill 747 Planning and Zoning: General Plan: Safety Element

AB 747 requires, that upon the next revision of a local hazard mitigation plan on or after January 1, 2022, the safety element to be reviewed and updated as necessary to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. The bill authorizes a city or county that has adopted a local hazard mitigation plan, emergency operations plan, or other document that fulfills commensurate goals and objectives to use that information in the safety element to comply with this requirement by summarizing and incorporating by reference that other plan or document in the safety element.

Strategic Fire Plan for California

The Strategic Fire Plan for California is the state's road map for reducing the risk of wildfire. The Fire Plan is a cooperative effort between the State Board of Forestry and Fire Protection and the California Department of Forestry and Fire Protection. The 2018 update reflects a focus on (1) fire prevention and suppression activities to protect lives, property, and ecosystem services, and (2) natural resource management to maintain the state's forests as a resilient carbon sink to meet California's climate change goals and to serve as important habitat for adaptation and mitigation. By placing the emphasis on what needs to be done long before a fire starts, the Strategic Fire Plan looks to reduce firefighting costs and property losses, increase firefighter safety, and contribute to overall ecosystem health.

Fire Hazard Planning: General Plan Technical Advice Series

CA Governor's Office of Planning and Research (OPR) Fire Hazard Planning technical advisory provides guidance on those policies and programs and is also intended to assist city and county planners in discussions with professionals from fire hazard prevention and mitigation, disaster preparedness, and emergency response and recovery agencies as they work together to develop effective fire hazard policies for the general plan. The 2020 update includes specific land use strategies to reduce fire risk to buildings, infrastructure, and communities and was prepared in consultation with the Department of Forestry and Fire Protection, the State Board of Forestry and Fire Protection, and other fire and safety experts.

20.2 LOCAL CAPABILITY ASSESSMENT

In order to facilitate the inventory and analysis of participating jurisdictions capabilities, several survey instruments were distributed and discussed with staff from each jurisdiction planning team during the jurisdiction-specific planning meetings. The surveys included a Safe Growth Survey, a National Flood Insurance Program (NFIP) Survey, and a Capability Assessment Survey, each of which was completed by the appropriate staff member as determined by Local Jurisdiction Leads. Each of these three survey instruments is described below and summarized, if possible, in aggregate.

Details are provided in each respective jurisdiction annex in **Volume 2**. Full copies of completed surveys are available upon request.

20.3 SAFE GROWTH SURVEY

The Safe Growth Survey is a survey instrument adapted from a technique [88] recommended by organizations such as the American Planning Association (APA) and FEMA. [89] The Safe Growth Survey helped evaluate the extent to which each local jurisdiction in Monterey County is positioned to grow safely relative to its natural hazards. The survey consists of nine distinct topic areas, including:

- Land Use
- Transportation
- Environmental Management
- Public Safety
- Zoning
- Subdivision Regulations
- Capital Improvements
- Building Codes
- Economic Development

The Safe Growth Survey was completed by appropriate planning, zoning, and/or community development staff for each participating municipal jurisdiction. This information is not provided for participating special districts since they do not regulate land use and development.

While a somewhat subjective exercise, the Safe Growth Survey was used to provide some quantitative measures of how adequately existing planning mechanisms and tools are being used to address the notion of safe growth. The goal of the survey was to further integrate the subject of hazard risk management into the dialogue of local planners. The survey assisted in gaining an understanding of how an individual jurisdiction's various comprehensive plans, capital improvement plans, and zoning and subdivision ordinances may allow growth in hazardous areas. This understanding helps identify how these documents can be amended to guide growth to safe locations and assisted in identifying new mitigation actions as they relate to planning policies or programs already in place and to future growth and community development practices.

The Safe Growth Survey was used as part of the 2013-2014 MJHMP Plan update, which allowed the survey results to be compared over time, in order to measure progress. It is anticipated that the Safe Growth Survey will be used again during future plan updates to continue to measure progress over time.

Safe Growth Survey Results

The Safe Growth Survey included a number of statements for each topic area listed above. Statements were answered on a scale from 1 to 5 based on the degree to which the respondent agreed or disagreed with the statement as it related to the respective jurisdiction's current plans, policies, and programs for guiding future community growth and development. Scores

[88] Safe Growth Audits, David R. Godschalk, FAICP (October 2009)
[89] Local Mitigation Planning Handbook, *Worksheet 4.2: Safe Growth Audit*, FEMA (March 2013)

for each statement were averaged by topic area to provide a topic area score and the topic area scores were averaged to provide an overall survey score.

Results were averaged for all participating jurisdictions and are presented in aggregate in *Table 20-1*. Individual jurisdiction results are presented in ***Volume 2*** for each jurisdiction in their respective Annex, in the *Land Use & Development Trends* Section.

Table 20-1
Countywide Safe Growth Survey Results

Topic Area	2021	2016
Land Use	3.67	3.79
Transportation	3.59	3.49
Environmental Management	4.13	3.76
Public Safety	3.56	3.77
Zoning Ordinance	3.48	3.53
Subdivision Regulations	2.90	3.12
Capital Improvement Program & Infrastructure Policies	3.28	2.97
Building Code	4.31	4.50
Economic Development	3.54	3.38
Average Survey Ratings	**3.61**	**3.59**

20.4 NFIP SURVEY

Per 44 CFR Section 201.6(c)(3)(ii), the Plan must address a jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate. It should be noted that Special Districts are not eligible for flood insurance under the NFIP. The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to identified flood hazards. In return for meeting minimum regulatory standards, communities may purchase flood insurance through the NFIP. Participation in the NFIP is voluntary but is promoted by FEMA as a critical means to make flood insurance available to community residents and to implement and sustain an effective, long-term hazard mitigation program aimed at reducing future flood losses.

The NFIP Survey was designed to help gather information from each jurisdiction on the current status of their participation in the NFIP, including existing floodplain management programs and continued compliance with federal requirements and standards. The NFIP Survey, adapted from the FEMA recommended tool,[90] asked the following questions in order to determine a community's participation in and continued compliance with the NFIP:

- Please identify your jurisdiction's designated Floodplain Administrator.

[90] Local Mitigation Planning Handbook, *Worksheet 4.3: National Flood Insurance Program*, FEMA (March 2013)

- How many NFIP flood insurance policies are in effect in your jurisdiction and what is the total premium and coverage?
- How many loss claims have been made in your jurisdiction and what is the total amount of paid claims?
- Please list the regulations that were adopted to meet federal NFIP requirements, including the date and section number.
- What is the date of your jurisdiction's last NFIP Community Assistance Visit (CAV) of Community Assistance Contact (CAC)?
- Describe any local "higher standards" that exceed NFIP minimum requirements.
- Describe any additional floodplain management provisions that are integrated into other plans or processes that the community uses to guide development.
- Describe any other floodplain management activities your jurisdiction performs that go beyond FEMA minimum requirements.
- Please describe any existing impediments to running an effective NFIP program in your jurisdiction, if any.
- Please identify some specific actions that your jurisdiction can take related to continued compliance with the NFIP.

NFIP Survey Results

All municipal jurisdictions in Monterey County actively participate in, and are in good standing with, the NFIP. Each jurisdiction has adopted and enforces a local flood damage prevention ordinance in compliance with at least the minimum federal standards for new construction located in identified Special Flood Hazard Areas (SFHA). These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by the 1-%-annual-chance flood event, and that new floodplain development will not aggravate existing flood problems or increase damage to other properties.

Another key service provided by the NFIP is the mapping of identified flood hazard areas. Once prepared, the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community. All jurisdictions in Monterey County have coordinated with FEMA in the development and update of FIRMs to identify the regulatory Special Flood Hazard Areas for their jurisdictions.

Responses to the questions listed above and more information on the current administration of the NFIP in each jurisdiction is provided **Volume 2**, in respective jurisdiction annexes, in the *Capability Assessment* Section, under *National Flood Insurance Program (NFIP) Compliance*.

As previously included in the *Flooding*, **Section 10**, NFIP Participation in Monterey County is summarized in *Table 20-2*.

Table 20-2
NFIP Participation

Jurisdiction	Community Number	Policies in Force	Total Coverage	Total Written Premium + Federal Policy Fee
Carmel-By-The-Sea	060196	29	$9,940,000	$13,888
Del Rey Oaks	060197	19	$6,577,500	$50,436
Gonzales	060198	14	$5,474,500	$18,502
Greenfield	060446	3	$1,050,000	$1,260
King City	060199	17	$4,318,600	$28,721
Marina	060727	45	$13,664,400	$61,833
Monterey	060200	58	$19,847,400	$49,129
Monterey County	060195	1,277	$362,723,300	$1,732,791
Pacific Grove	060201	35	$11,144,000	$14,846
Salinas	060202	317	$95,459,500	$320,007
Sand City	060435	3	$1,400,000	$3,109
Seaside	060203	10	$2,789,000	$3,748
Soledad	060204	1	$350,000	$467

20.5 CAPABILITY ASSESSMENT SURVEY

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.6(b)(3)). Additionally, per 44 CFR Section 201.6(c)(3), the plan must include a mitigation strategy based on existing authorities, policies, programs, and resources, therefore each jurisdiction undertook a review of their current capabilities to implement hazard mitigation actions.

The Capability Assessment Survey requested information on a variety of "capability indicators" such as existing local plans, policies, programs, or ordinances that may reduce, or in some circumstances, increase the community's hazard vulnerability. Other indicators included information related to each jurisdiction's fiscal, administrative, and technical capabilities such as access to local budgetary and personnel resources necessary to implement hazard mitigation measures. Survey respondents were also asked to comment on existing activities or capabilities to conduct public education and outreach, as well as the current political climate in their jurisdiction to implement hazard mitigation actions.

The Survey was based on the FEMA recommended tool and included a summary of a jurisdiction's overall capability in the following four different types of capabilities as defined by FEMA. [91]

[91] Local Mitigation Planning Handbook, *Worksheet 4.1: Capability Assessment Worksheet*, FEMA (March 2013)

- *Planning and Regulatory Capabilities*: capabilities based on the jurisdiction's implementation of ordinances, policies, local laws, and State statutes, and plans and programs that relate to guiding and managing growth and development.
- *Administrative and Technical Capabilities*: capabilities associated with the jurisdiction's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.
- *Fiscal Capabilities*: refers to the fiscal resources that a jurisdiction has access to or is eligible to use to fund mitigation actions.
- *Education and Outreach Capabilities:* refers to education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.

At a minimum, survey results provide an extensive inventory of existing local plans, ordinances, programs, and resources in place or under development in addition to their overall effect on hazard loss reduction as perceived by local government staff. The Survey also required the respondent to conduct a self-assessment of their jurisdiction's specific capabilities (on a scale of Degree of Capability from Limited to High).

The survey instrument thereby not only helps to accurately assess each jurisdiction's degree of local capability, but also serves as a source of introspection for jurisdictions to assess their capability and recast identified gaps, weaknesses, or conflicts as opportunities to be addressed in the development of new mitigation actions.

For participating special districts, a slightly different capability assessment was used in order to capture capabilities more specific to their individual services. Special district capability assessments are included in the respective annexes.

For participating municipal jurisdictions, the documents and/or resources included and assessed under each of the capability categories is summarized in *Table 20-3.*

Table 20-3
Capability Assessment Survey- Documents and Resources Assessed

Planning and Regulatory Capability		
Planning Documents		
• General Plan	• Emergency Operations Plan	
• Capital Improvement Plan	• Continuity of Operations Plan	
• Floodplain Management Plan	• Community Wildfire Protection Plan	
• Open Space Management Plan	• Evacuation Plan	
• Stormwater Management Plan	• Historic Preservation Plan	
• Coastal or Shoreline Management Plan	• Transportation Plan	
• Local Coastal Program	• Disaster Recovery Plan	
• Climate Action/ Adaptation Plan	• Economic Development Plan	
Code, Ordinance, or Requirements		
• Floodplain Ordinance	• Unified Development Ordinance	
• Zoning Ordinance	• Post-Disaster Redevelopment Ordinance	
• Subdivision Ordinance4	• Building Code	
• Site Plan Review Requirements	• Fire Prevention Code	
Administrative and Technical Capability		
• Planner(s) or engineer(s) with knowledge of land development and land management practices		
• Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure		
• Planner(s) or engineer(s) with an understanding of manmade or natural hazards		
• Building Inspector	• Emergency Manager	
• Floodplain Manager	• Land Surveyors	
• Resource development staff or grant writers	• Public Information Officer	
• Scientist(s) familiar with the hazards of the community	• Personnel skilled in Geographic Information Systems (GIS)	
• Staff with education or expertise to assess the community's vulnerability to hazards	• Warning systems/services	
• Maintenance programs to reduce risk	• Mutual Aid Agreements	
Fiscal Capabilities		
Funds and Taxes	**Bonds and Grants**	**Fees**
• General Funds	• General Obligation Bonds	• Stormwater Utility Fees
• Special Purpose Taxes	• Special Tax and Revenue Bonds	• Gas / Electric Utility Fees
• Capital Improvements Project Funding	• Community Development Block Grants	• Water / Sewer Fees • Development Impact Fees
Education and Outreach Capabilities		
• Local citizen or non-profit groups focused on environmental protection, emergency preparedness, access, and functional needs populations, etc.		
• Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)		
• Natural disaster or safety related school programs		
• Public-private partnership initiatives addressing disaster-related issues		

Additionally, classifications under various community mitigation programs were included. Other programs, such as the Community Rating System, Storm/Tsunami Ready, and Firewise USA, can enhance a jurisdiction's ability to mitigate, prepare for, and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum requirements set forth by local, state, and federal regulations in order to create a more resilient community. These programs complement each other by focusing on communication, mitigation, and community preparedness to save lives and minimize the impact of natural hazards on a community. The programs reviewed here are applicable to municipal partners only, so they are not included in the capability assessments for special-purpose districts.

Community programs in the survey included:

- Community Rating System (CRS)
- ISO Public Protection Classification
- StormReady Certification
- TsunamiReady Certification
- Firewise Communities Certification

Capability Assessment Survey Results

Survey results are summarized in each individual Jurisdiction Annex in the *Capability Assessment* Section. *Table 20-4* summarizes the communities who participate in various community mitigation programs.

Table 20-4
Jurisdictions Participating in Various Community Mitigation Programs

Community Ratings System (CRS) Participation	
Monterey County	*Current CRS Class*: 5
City of Salinas	*Current CRS Class*: 7
Storm Ready Communities	**Tsunami Ready Communities**
Monterey County	Monterey County
Unincorporated Community of Pebble Beach	Unincorporated Community of Pebble Beach
City of Marina	City of Carmel-by-the-Sea
City of Monterey	City of Marina
City of Pacific Grove	City of Monterey
	City of Pacific Grove
Firewise Ready Communities	
Unincorporated Community of Robles del Rio	
Unincorporated Community of Rancho Tierra Grande	

The overall self-assessment of capability classifications provided in *Table 20-5* are designed to provide a general overview of capability assessment results and indicate each individual jurisdiction's perceived local capability. More information on the specific capabilities that are unique to each jurisdiction is provided in each jurisdiction's respective annex.

Table 20-5
Participating Jurisdictions Self-Assessment of Capability Ratings

Jurisdiction	Planning & Regulatory Capability	Administrative & Technical Capability	Financial Capability	Education & Outreach Capability	Political Capability	Overall Capability
Monterey County	High	Moderate	Limited	Moderate	Moderate	Moderate
City of Carmel-by-the-Sea	Moderate	Moderate	Limited	Limited	Limited	Limited
City of Del Rey Oaks	Moderate	High	Limited	Moderate	Moderate	Moderate
City of Gonzales	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
City of Greenfield	Moderate	Limited	Limited	Moderate	Moderate	Moderate
City of King	Moderate	Moderate	Limited	Limited	Moderate	Moderate
City of Marina	Moderate	Moderate	High	Moderate	Moderate	Moderate
City of Monterey	High	High	High	High	High	High
City of Pacific Grove	High	High	Moderate	High	Moderate	High
City of Salinas	High	Moderate	Limited	Moderate	Moderate	Moderate
City of Sand City	Moderate	Limited	Limited	Limited	Moderate	Limited
City of Seaside	High	High	Limited	High	Moderate	Moderate
City of Soledad	Moderate	Moderate	Limited	Moderate	High	Moderate
Carmel Area Wastewater District	Moderate	High	High	High	High	High
Monterey One Water	High	High	Limited	Moderate	Limited	Moderate
Monterey Regional Waste Management District	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Moss Landing Harbor District	Moderate	Moderate	Limited	Limited	Moderate	Moderate

21. MITIGATION STRATEGY

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The mitigation strategy section is a blueprint for Monterey County to follow to become less vulnerable to the negative effects of the hazards identified and addressed in this Plan. The Steering Committee established guiding principles and a set of goals for this plan, based on data from the risk assessments, stakeholder input, and the results of the public involvement strategy.

The intent of the mitigation strategy is to provide Monterey County with a vision and overall goals that will serve as guiding principles for future mitigation policy and project administration, along with an analysis of mitigation techniques deemed available to meet those goals and reduce the impact of identified hazards.

21.1 GUIDING PRINCIPLE

A guiding principle focuses the range of objectives and actions to be considered. The purpose of the guiding principle is to represent the overall intended outcome of the MJHMP. The guiding principle for this hazard mitigation plan is as follows:

Reduce the risk to life and property in Monterey County in an efficient and effective manner by decreasing the long-term vulnerability from hazards through coordinated planning, partnerships, capacity building, and implementation of effective risk reduction measures.

21.2 MITIGATION GOALS

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 C.F.R. § 201.6(c)(3)(i)). Mitigation goals represent broad statements that are achieved through the implementation of more specific mitigation actions. Each goal, purposefully broad in nature, serves to establish the parameters that were used to review and update existing mitigation actions and to aid in formulating new ones.

Goals discussed in this section describe what actions should occur. Specific, measurable mitigation actions explain how to accomplish the goals. The goals form the basis for the development of the Mitigation Action Strategy and specific mitigation projects. The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved. The consistent implementation of mitigation actions over time will ensure that these mitigation goals are achieved.

Mitigation goals for this Plan update include:

Goal #1	Minimize risk and vulnerability of Monterey County to hazards and protect lives and prevent losses to property, public health, economy, and the environment.
Goal #2	Increase the resilience of infrastructure and critical facilities and reduce long-term vulnerabilities of existing and future critical facilities, property, infrastructure, and high hazard potential dams due to natural hazards.
Goal #3	Build and support capacity to enable local government and the public to prepare for, respond to, and recover from the impact of natural hazards.
Goal #4	Encourage the development and implementation of long-term, cost-effective, and environmentally sound mitigation projects.
Goal #5	Promote and implement hazard mitigation policies and projects that are consistent with state, regional, and local climate action, and adaptation goals.
Goal #6	Inform the public on the risk from hazards of concern and increase awareness, preparation, mitigation, response, and recovery activities to promote public safety.
Goal #7	Enhance codes and their enforcement where feasible, so that new construction can withstand the impacts of known hazards and to lessen the impact of development on the environment’s ability to absorb the impact of natural hazards.
Goal #8	Consider the impacts of known hazards in all planning mechanisms that address current and future land uses within the County.
Goal #9	Establish a partnership among all levels of government and the business community to improve and implement methods to protect property.
Goal #10	Encourage hazard mitigation measures that promote and enhance natural processes and minimize adverse impacts on the ecosystem.

21.3 IDENTIFICATION OF MITIGATION ACTIONS

In formulating the mitigation strategy, a wide range of actions was considered in order to help achieve the established mitigation goals, in addition to addressing any specific hazard concerns. These activities were discussed during the Planning Team meetings. In general, all activities considered by the Planning Team can be classified under one of the following five broad categories of mitigation techniques: local plans and regulations, structure and infrastructure projects, natural systems protection, education and outreach, and emergency preparedness and response. All of these categories are described in detail below.

Local Plans and Regulations

Mitigation actions that fall under this category include government authorities, policies, or codes that influence the way land and buildings are developed and built.

Examples of these types of actions include:

- Comprehensive and General Plans
- Climate Action and Adaptation Plans
- Land Use Ordinances and Subdivision Regulations
- Zoning and Building Code Updates
- Capital Improvement Plans, Stormwater Management Regulations, and Master Plans

Structure and Infrastructure Projects

Mitigation actions that fall under this category involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.

Examples of these types of actions include:

- Elevation of Flood-Prone Structures
- Utility Undergrounding
- Structural Retrofits
- Stormwater System Upgrades

Natural Systems Protection

Mitigation actions that fall under this category minimize damage and losses and also preserve or restore the functions of natural systems.

Examples of these types of actions include:

- Stream Corridor and Wetland Restoration
- Sediment and Erosion Control
- Forest and Vegetation Management
- Conservation Easements and Open Space Preservation

Education and Outreach

Mitigation actions that fall under this category inform and educate the public, elected officials, and property owners about hazards and potential ways to mitigate them. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

Examples of these types of actions include:

- Risk Communication and Education Programs
- Real Estate Disclosures
- Participation in StormReady or Firewise Program

Emergency Preparedness and Response

Though emergency preparedness and response activities do not always fall under hazard mitigation, stakeholders in Monterey County believe this is an incredibly important category of strategies for reducing the risk to life and property posed by the hazards in the MJHMP.

Examples of these types of actions include:

- Warning Systems
- Emergency Operations Center Improvements
- Emergency Operations Plan Updates
- Community Emergency Response Team (CERT) Programs
- Communications Enhancements
- Emergency Response Training and Exercises
- Evacuation Planning
- Sandbagging for Flood Protection

21.4 MITIGATION ACTION PRIORITIZATION

Multiple factors were considered to determine the mitigation priorities for the next five-year implementation period and which mitigation actions should be given highest priority for implementation. FEMA's recommended prioritization criteria, STAPLEE, were used to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another.

STAPLEE stands for the following:

- *Social*: Does the measure treat people fairly? (e.g., different groups, different generations) Does it consider social equity, disadvantaged communities, or vulnerable populations?
- *Technical*: Will it work? (Is the action technically feasible? Does it solve the problem?)

- *Administrative*: Is there capacity to implement and manage the project? Is there adequate staffing, funding, and other capabilities to implement the project?
- *Political*: Who are the stakeholders? Did they get to participate? Will there be adequate political and public support for the project?
- *Legal*: Does the jurisdiction have the legal authority to implement the action? Is it legal? Are there liability implications?
- *Economic*: Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- *Environmental*: Does the action comply with environmental regulations? Will there be negative environmental consequences from the action?

In accordance with the Disaster Mitigation Act requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed actions were weighed against estimated costs as part of the prioritization process.

The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- *High*: Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source.
- *Medium*: The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- *Low*: The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- *High*: Project will provide an immediate reduction of risk exposure for life and property.
- *Medium*: Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- *Low*: Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

21.4.1 MITIGATION ALTERNATIVES

In compliance with 44 CFR (Section 201.6(c)(3)(ii)): A section is included that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure

21.5 HAZARD PRIORITIZATION

As described previously, hazards were prioritized using a combination of historical data, local knowledge, and consensus opinions to produce a matrix that illustrates the degree of risk of each profiled hazard. Details on the creation of the matrix and the full results of the risk ranking process are included in **Section 4.4**, *Hazard Prioritization and Risk Ranking*.

Table 21-1 lists the highest-ranking hazards from the prioritization process.

Table 21-1
High and Substantial Hazards from Countywide Risk Prioritization

Ranking	Hazard	Degree of Risk Score (Out of 16)	Degree of Risk
1	Drought & Water Shortage	12.3	High
2	Earthquake	11.9	Substantial
3	Pandemic	11.2	Substantial
4	Wildfire	10.8	Substantial
5	Epidemic	10.7	Substantial
6	Cyber-Attack	10.5	Substantial
7	Utility Interruption/ PSPS	10.2	Substantial
8	Localized Stormwater Flooding	10.2	Substantial
9	Severe Winter Storms	10.1	Substantial

21.5.1 COUNTYWIDE PROBLEM STATEMENTS

Problem Statements are statements of particular interest regarding primary hazards of concern, geographic areas of concern, or vulnerable community assets. As part of the planning process, the Steering Committee identified key vulnerabilities and hazards of concern applicable to the entire County. Hazard Problem Statements helped the Steering Committee identify common issues and weaknesses, determine appropriate mitigation strategies, and understand the realm of resources needed for mitigation.

The Countywide Hazard Problem Statements were based on the risk assessments, the risk prioritization process, the vulnerability analysis, and local knowledge, as well as the jurisdiction specific problem statements and community and stakeholder input. While only risks which ranked as High were prioritized for mitigation actions in individual annexes, for the purposes of the countywide plan, High and Substantial risk hazards were included in problem statements and countywide mitigation actions. For simplicity, the Hazard Problem Statement for Pandemic and Epidemic were combined. Countywide Hazard Problem Statements are identified below:

Drought & Water Shortage

In Monterey County, water supply is extremely limited during non-drought years. As such, droughts are a serious threat in the County and could have devastating impacts on the agricultural industry, a major economic driver and job provider. Additionally, prolonged periods of drought can reduce water available for residential users and increase water prices. Governing authorities have been established to limit water use and protect water supply. Procurement of water credits/rights may limit new development necessary to meet increasing housing demands. Periods of drought also lead to increased pumping of groundwater wells, which can exacerbate sea water intrusion into the aquifer, increase land subsidence risks, and effect water quality. Contamination of drinking water, though unlikely, could be catastrophic. Drought conditions are likely to increase in future climate change scenarios.

Earthquake

Monterey County has several fault systems, including three major active faults: The San Andreas Fault, the Palo Colorado-San Gregorio Fault, and the Monterey Bay-Tularcitos Fault. Due to the location of population centers and building history in the County, any large earthquake will likely have significant impacts on people, property, and critical infrastructure including water systems, telecommunications infrastructure, roads, bridges, healthcare systems, and utilities. Damages and debris could isolate large populations from these critical lifelines. Older unreinforced-masonry structures in the County are particularly vulnerable to earthquake risk. An earthquake can also produce cascading impacts due to urban conflagration, wildfires, seiches, landslides, tsunamis, dam failure, and levee failure.

Pandemic/ Epidemic

The whole population of Monterey County is vulnerable to disease. The impacts of the COVID-19 Pandemic on the County have demonstrated the catastrophic risks that can be associated with large-scale disease outbreaks. Critical healthcare systems can become overwhelmed, limiting access to life-saving medical services. Continuity of government due to impacted workforces can result in limitations to essential government services. Disease outbreaks can place a disproportionate burden on the County's most vulnerable populations. Additionally, due to the large number of transient populations, such as tourists and migrant farmworkers, eradication of any new disease outbreak can be difficult without significant impacts to industry and the local economy.

Wildfire

California, and subsequently Monterey County, is in cycle of extreme heat, drought, and fire, all amplified by climate change. Wildfires are a natural part of the California environment; however, fire behavior has increased in frequency, size, and impact from longer wildfire "seasons." Deferred vegetation management and population sprawl in the wildland urban interface and intermix, have increased probability and impact of wildfires. Sudden oak death and invasive species have created unhealthy forests. Large wildfires, such as the 2020 Wildfires in Monterey County, can cause housing inventories to become significantly limited thus increasing the demand on the housing market; additionally, many property owners have been unable to obtain or retain fire insurance at an affordable price or at all. Pre-existing water supply challenges in the County can lead to limited water available for fire suppression.

Cyber-Attack

Nearly every aspect of life in Monterey County is dependent on systems and resources connected and managed through computer systems. Cyber-attacks can have catastrophic impacts on the ability of government, public and private entities to access banking, electricity, water, telecommunications, transportation, and other information systems necessary for survival. Due to the tightly coupled nature of technological system and critical lifelines, any failure of service continuity could cost lives.

Utility Interruption/ PSPS

Heat-related equipment failures and electrical infrastructure igniting wildfires has resulted in unintentional and intentional rolling blackouts and power shutoffs throughout the County. Public Safety/ Utility Initiated Power Shut Offs to prevent wildfire ignition can have notably significant impacts due to the length of disruption time, limited efficacy of the strategy, and the effect on first responder capabilities. Extreme and prolonged heatwaves across the state increase the demand for use of the aging electrical grid, significantly depleting electricity reserves resulting in blackouts. Heatwaves are expected to increase in intensity and magnitude due to climate change, which will likely exacerbate this problem. Traditional energy sources increase climate change risk and are failing more consistently, but energy alternative technology cannot meet current nighttime demand.

Additionally, Monterey County has limited microgrids and reliance on the macro-grid makes the County vulnerable to rolling and prolonged power outages. Over the last decade Monterey County residents have begun adjusting to the increasing unreliability of macro utilities. Loss of power for more than a few hours can result in large economic losses, specifically related to food and agriculture. More vulnerable populations in isolated areas or who rely on medical devices are at increased risk during prolonged power outages.

Localized Stormwater Flooding

Localized flooding has the potential to significantly impact people, property, and critical infrastructure in the County. Undersized and aging drainage infrastructure, deferred maintenance, increased run-off due to drought conditions, the built environment, and trends in precipitation and weather can all increase the risk of localized stormwater flooding. Climate change is likely to exacerbate the intensity and magnitude of precipitation events, increasing the risk associated with localized stormwater flooding causing drainage infrastructure to be undersized in increasingly more common events.

Additionally, unhoused residents living in stormwater drainage areas can lead to increasing flood risk due to accumulated debris and trash, which can complicate both flood response and mitigation activities.

Severe Winter Storms

Severe winter storms have been increasing in intensity, magnitude, and severity in Monterey County and are associated with a variety of hazards in this Plan. Severe winter storms and heavy rain can have significant impacts including flash flooding, localized stormwater flooding, mudslides, and landslides. Secondary hazards can cause immobility and loss of utilities. Roads may become impassable due to flooding, downed trees, or landslides. Power lines may be downed due to high winds, and services such as water or telecommunications infrastructure may not be able to operate without power.

Stormwater runoff from heavy rains can also impair water quality by washing pollutants into water bodies. Severe winter storms can also cause large storm surge and wave action along the coastline, flooding low lying areas and causing dramatic erosion. Coastal bluff and cliff failure due to erosion can create hazardous conditions due to roadway collapse, undermined home foundations and damage to utilities. Additionally, future sea level rise scenarios are likely to exacerbate coastal and inland flood risks during winter storms.

Road Infrastructure

The occurrence of any hazard profiled in this Plan in combination with aging and limited road infrastructure can result in limited egress of evacuees and minimal ingress of first responders. Roadways can be compromised in severe weather incidents, further limiting road capacity. Road infrastructure is not developing at a rate commensurate with the rate that population and housing is expanding. Further, the topography of the County limits where new roads can be built.

21.6 MITIGATION ACTION PLAN

The mitigation strategy is the guidebook to future hazard mitigation administration, capturing the key outcomes of the planning process. The Hazard Mitigation Action Plan Matrix for each jurisdiction, included in each participating jurisdictions respective annex in **Volume 2**, lists each priority mitigation action, identifies a time frame, the responsible party, potential funding sources, and prioritization, which meet the requirements of FEMA and DMA 2000. It should be noted that each jurisdiction has also prioritized the countywide actions listed below within their respective mitigation action plans.

21.6.1 COUNTYWIDE MITIGATION ACTION PLAN

The Steering Committee reviewed the catalogs of hazard mitigation alternatives and selected area-wide actions to be included in a hazard mitigation action plan. The selection of area-wide actions was based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives.

Table 21-2 summarizes Countywide mitigation actions by hazard.

Table 21-2
Countywide Mitigation Action Plan

Hazard	Mitigation Action
Drought	Provide public information on water conservation and assess the potential for community-wide water conservation programs.
Earthquake	Provide information on earthquake risk and preparedness to the public. Continue to adopt and implement current earthquake building standards and upgrade, remove, or replace unreinforced masonry buildings, as feasible.
Pandemic/ Epidemic	Provide unified information to the public regarding personal protective measures and mitigating strategies in accordance with CDC guidelines. Implement public health measures in government facilities.
Wildfire	Continue to collaborate across the operational area with all jurisdictions with fire protection and suppression responsibility on wildfire mitigation efforts.
Cyber-Attack	Seek to increase redundancy in IT infrastructure, implement protective cyber-security measures, and train staff on common cyber-attack methods.
Utility Interruption	Encourage the development of and use of microgrids and the hardening of utility of infrastructure, where possible. Provide backup generators for critical infrastructure and facilities.
Localized Stormwater Flooding	Maintain good standing in the National Flood Insurance Program and encourage coordination on drainage system maintenance.
Severe Winter Storms	Maintain StormReady and TsunamiReady certification, as applicable.
Climate Change	Support, encourage, and implement, when feasible, countywide climate action, adaptation, and resiliency initiatives.
All Hazards	Incorporate and make consistent other planning documents with appropriate goals, policies, and objectives to address hazards identified within the Multi-Jurisdictional Hazard Mitigation Plan.

22. PLAN IMPLEMENTATION AND MAINTENANCE

22.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing bodies of the jurisdictions requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that it has been formally adopted. This plan will be submitted for a pre-adoption review to Cal OES and FEMA Region IX. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in *Appendix 1*.

22.2 PLAN MAINTENANCE

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate

- A discussion on how the community will continue public participation in the plan maintenance process.

This section details the formal process that will ensure that the Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This section also describes how public participation will be integrated throughout the plan maintenance and implementation process.

It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

22.2.1 PLAN IMPLEMENTATION

Each jurisdiction participating in this Plan is responsible for implementing specific mitigation actions as prescribed in their locally adopted Annex. In each Annex's Mitigation Action Plan, every proposed action is assigned to a specific local department or agency in order to assign responsibility and accountability and increase the likelihood of subsequent implementation. This approach enables individual jurisdictions to update their own unique mitigation action list as needed without altering the county level Plan. The separate adoption of locally specific actions also ensures that each jurisdiction is not held responsible for the monitoring and implementation of actions belonging to other jurisdictions involved in the planning process.

In addition to the assignment of a local lead department or agency, an implementation time period or a specific implementation date or window has been assigned to each mitigation action to help assess whether actions are being implemented in a timely fashion. The jurisdictions present within Monterey County will seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in the Mitigation Action Plans.

It will be the responsibility of each participating jurisdiction to determine additional implementation procedures beyond those listed within their Mitigation Action Plan. This includes integrating the requirements of the MJHMP into other local planning documents, processes, or mechanisms such as comprehensive or capital improvement plans, when appropriate. The members of the Steering Committee will remain charged with ensuring that the goals and strategies of new and updated local planning documents for their jurisdictions or agencies are consistent with the goals and actions of the MJHMP and will not contribute to increased hazard vulnerability in Monterey County.

Although the development and maintenance of this stand-alone MJHMP is deemed by the Steering Committee to be the most effective and appropriate method to implement local hazard mitigation actions at this time, the planning team recognizes that resilient communities proactively protect themselves against hazards through the institution of mitigation principles into daily actions and policy decisions.

The planning team and the communities they represent will continue to create opportunities to weave the thread of hazard mitigation and the strategies and goals identified in this plan into all community and emergency planning processes.

22.2.2 INCORPORATION INTO OTHER PLANNING MECHANISMS

The information on hazard, risk, vulnerability, and mitigation contained in this Plan is based on the best science and technology available at the time this plan was prepared. The general plans of the planning partners are considered to be integral parts of this plan. The planning partners, through adoption of general plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided them with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their general plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a general plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual general plans by identifying a mitigation action as such and giving that action a high priority. Additionally, all planning partners are committed to being in full compliance with California Assembly Bill 2140 and Senate Bill 379, which promote the integration of local hazard mitigation plans and general plans and mandate that these plans address climate change.

Moving forward, hazard mitigation strategies and goals should be incorporated into other community planning efforts. Examples may include but are not limited to:

- Emergency Operations Plans can address threat and hazard vulnerability and ensure jurisdictions strengthen their core capabilities to address the highest risks.
- County and local general plans, especially the safety element, is an appropriate document to codify hazard mitigation goals and strategies. Other relevant policy areas with the general plan include land use, transportation, resource management and conservation, and recreation and open space.
- Climate Action and Adaptation plans should recognize that the long-term impacts of climate change can potentially affect hazards by increasing their severity.

Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan could include the following:

- Debris management plans
- Recovery plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans
- Comprehensive flood hazard management plans
- Resiliency plans
- Community Development Block Grant-Disaster Recovery action plans
- Public information/education plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

More information on plan integration is included in each jurisdictions respective annex in **Volume 2**.

22.2.3 PLAN MONITORING AND EVALUATION

The agency with the overall responsibility for monitoring this Plan is the Monterey County Office of Emergency Services. Periodic revisions and updates of the MJHMP are required to ensure that the goals of the Plan are kept current, considering potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with applicable federal and state regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to each jurisdiction's individual Mitigation Action Plan.

The Steering Committee meets on an annual basis, or "as needed" determined by the Monterey County Office of Emergency Services, in order to maintain oversight of key elements of the plan maintenance strategy. The principal role of the Steering Committee in the plan maintenance strategy will be to review progress made on current plan goals, actions, and strategies, and identify any new opportunities for collaboration. The Committee will also provide a review forum for enhancements to be considered at the next update.

Future plan updates will be overseen by a steering committee similar to the one that participated in this update process, so keeping a steering committee intact will provide a head start on future updates.

Annual Progress Report

As part of this monitoring, evaluation, and enhancement process, each participating jurisdiction will be expected to provide an annual status report and an update at annual Steering Committee meetings. Prior to annual meetings the Monterey County Office of Emergency Services will send out the Countywide Mitigation Goals and Action Plan, in addition to the respective jurisdictions Mitigation Action Plan. Annual progress reports will provide an opportunity for jurisdictions to review their respective Mitigation Action Plan and evaluate the Plan's implementation effectiveness.

Completion of the progress report will be the responsibility of each participating jurisdiction, not the Steering Committee. The Steering Committee will serve as a resource to the planning partners as needed to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

The planning team has created a template that shows the minimum level of detail that will be sought for preparing a progress report (see *Appendix 2*). The annual progress report will ensure that the plan is continuously maintained and updated to reflect changing conditions and needs within Monterey County. If determined appropriate or as requested, the annual report will be presented to local governing bodies of participating jurisdictions and/or to the public in order to report progress on the actions identified in the Plan.

Post-Disaster Mitigation Webinars

Following state or federally declared disasters in the Monterey County Operational Area, the Monterey County Office of Emergency Services will host, as a part of the recovery process, informational webinars on FEMA Post-Disaster Mitigation Funding opportunities. After-Action Reports will also include a discussion item on how to mitigate future incidents.

22.2.4 PLAN UPDATE

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The planning partners intend to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption.

It will not be the intent of future updates to develop a completely new hazard mitigation plan for the planning area. The Plan will be reviewed by the planning team every five years to determine whether there have been any significant changes in Monterey County or the surrounding area that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, the increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the necessary content of the Plan.

The plan review provides community officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented as assigned.

During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals address current and expected conditions?
- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the Plan?
- Are there implementation problems, such as technical, political, legal, or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did the jurisdictions, agencies, and other partners participate in the plan implementation process as proposed?

Following the five-year update, any revisions deemed necessary will be summarized and implemented according to the reporting procedures outlined herein. Upon completion of the review and update/amendment process, the MJHMP will be submitted to the State Hazard Mitigation Officer at the California Governor's Office of Emergency Services (Cal OES) for final review and approval in coordination with the Federal Emergency Management Agency.

Disaster Declaration

Following a disaster declaration, the Plan will be revised as necessary to reflect lessons learned, or to address specific issues and circumstances arising from the event. It will be the responsibility of the Monterey County Office of Emergency Services to convene the Steering Committee and ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Reporting Procedures

The results of the five-year review will be summarized by the Planning Team in the relevant sections of the updated plan. This includes: a comprehensive description of the plan update process including an evaluation of plan effectiveness; any updates to the planning area profile; any notable revisions or updates to the risk assessment or capability assessment; updated mitigation goals and consideration of mitigation action alternatives; status updates on previously adopted mitigation action plans (including the identification of reasons for delays or obstacles to their implementation) as well as the identification of newly proposed mitigation actions; and revisions or updates to plan maintenance procedures.

Any necessary revisions or changes to the countywide Plan elements must follow the monitoring, evaluation, and enhancement procedures outlined herein. For changes and updates to the individual Mitigation Action Plans, appropriate local designees will assign responsibility for the completion of the task.

22.2.5 CONTINUED PUBLIC INVOLVEMENT

Public participation is an integral component of the mitigation planning process and will continue to be essential as this Plan evolves and is updated over time. The most appropriate and meaningful opportunities for the general public to be involved in the maintenance and implementation of the MJHMP is during the five-year plan review process as described earlier in this section. The participating jurisdictions of Monterey County have been diligent and successful in gaining widespread public involvement during the five-year plan review process through multiple methods. While the five-year plan review process represents the greatest opportunity for such involvement, other efforts to involve the public in the maintenance, evaluation, and revision process will continue to be made, as necessary.

Each participating jurisdiction has agreed to provide links to the hazard mitigation plan website on their individual jurisdictional websites to increase avenues of public access to the plan. The Monterey County Office of Emergency Services will maintain the hazard mitigation plan website, which will house the final plan and become the one-stop shop for information regarding the plan implementation. Copies of the plan will also be distributed to local libraries.

Additionally, as determined feasible, information on mitigation progress discussed at annual Steering Committee Meetings will be announced to the public.

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APPENDIX 1
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

APPENDIX 2
PLAN PROGRESS REPORT TEMPLATE

PROGRESS REPORT TEMPLATE

Reporting Period: Click or tap to enter a date.

Background: Monterey County and participating local cities and special districts developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating planning partners organized resources, assessed risks from natural hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, participating jurisdictions are in compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act.

The plan can be viewed on-line at:

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the planning partners. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

Hazard Events within the Planning Area: During the reporting period, the following hazard events in the planning area that had a measurable impact on people or property occurred:

- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.

Mitigation Success Stories: *Insert brief overview of mitigation accomplishments during the reporting period.*

Click or tap here to enter text.

Review of the Action Plan: *Provide a description of the implementation of each action item in the action plan, including a statement on how the project was implemented or not implemented during the reporting period.*

Address the following in the "status" column of the following table:

- Project Completed
- Action ongoing toward completion
- No progress at this time

In the "narrative update" column address the following questions"

- Was any element of the action carried out during the reporting period?
- If no action was completed, why?
- Is the timeline for implementation for the action still appropriate?
- If the action was completed, does it need to be changed or removed from the action plan?

Mitigation Action Status

#	Description	Status	Narrative Update
		Choose an item.	
		Choose an item.	
		Choose an item.	
		Choose an item.	
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		Choose an item.	
		Choose an item.	

Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each action and the prioritization process.

Changes That May Impact Implementation of the Plan: *Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory, and financial capabilities identified during the plan's development.*

Click or tap here to enter text.

Recommendations for Changes or Enhancements: *Note any recommendations for new projects or revised recommendations for future updates or revisions to the plan.*

- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets. The report is posted on the Monterey County Office of Emergency Services website.*

Any questions or comments regarding the contents of this report should be directed to:

Name: Click or tap here to enter text.

Agency: Click or tap here to enter text.

Title: Click or tap here to enter text.

Email: Click or tap here to enter text.

Phone Number: Click or tap here to enter text.

APPENDIX 3
STEERING COMMITTEE MEETING AGENDAS

2021 MONTEREY COUNTY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE

MEETING INFORMATION

MEETING: Pre-Planning Meeting	**DATE:** 5/22/19
LOCATION: 1441 Schilling Place, Salinas CA, Saffron Conference Room	**TIME:** 9:00AM-11:00AM

CONFERENCE CALL:

- Meeting link: https://monterey-county-oes.my.webex.com/monterey-county-oes.my/j.php?MTID=mcabf817afb7d21224a71a6b9bb19a830
- Phone: +1-510-338-9438
- Meeting number/ Access code: 625 637 402
- Password: ZbaMhUkm
- Host key: 131101

AGENDA

1. **WELCOME AND INTRODUCTIONS** — *Gerry Malais, Monterey Co. OES* *09:00*

2. **HAZARD MITIGATION OVERVIEW** — *Kelsey Scanlon, Monterey Co. OES* *09:10*

   - **Purpose:** Review purpose and scope of hazard mitigation efforts.
   - **Outcomes**: Identify short and long-term outcomes of effective hazard mitigation planning efforts.

3. **GRANT UPDATE** — *Kelsey Scanlon, Monterey Co. OES* *09:20*

   - **Purpose:** Review grant application milestones; provide status update of grant application; discuss next steps if grant is obligated; review proposed reimbursement amount; review eligible activities; recommendations for tracking time and resources.
   - **Outcomes:** All jurisdictions should begin tracking time and resources assigned to hazard mitigation planning activities.

4. **PLAN UPDATE PROCESS** — *Kelsey Scanlon, Monterey Co. OES* *09:30*

   - **Purpose**: Review Code of Federal Regulations; discuss the planning timeline, significant dates, and milestones.
   - **Outcomes:** Consensus on planning timeline, milestones, and responsibilities.

5. PLANNING MEETINGS *Kelsey Scanlon, Monterey Co. OES* *09:40*

- **Purpose:** Discuss Steering Committee participants and meetings; discuss and plan jurisdiction specific meetings; and discuss technical expert/hazard specific meetings; review organization chart.
- **Outcomes**: Identify quantity of meetings, dates, times, and members of the Steering Committee, Jurisdiction Specific Planning Teams, and Technical / Hazard Specific planning meetings.

6. PUBLIC OUTREACH STRATEGY *Kelsey Scanlon, Monterey Co. OES* *09:50*
Lubna Mohammad, Monterey Co. OES

- **Purpose:** Discuss public outreach requirements and proposed strategy; present public outreach toolkit; review hazard mitigation website and jurisdiction specific webpages.
- **Outcomes:** Identify quantity and scope of public outreach per jurisdiction; provide guidance on overall public outreach strategy.

7. GENERAL PLAN SAFETY ELEMENT *Capt. Gene Potkey, CAL FIRE* *10:15*
Capt. Kevin Lindo, CAL FIRE

- **Purpose:** Review General Plan Safety Element requirements for MJHMP update process; Discuss integration and adoption of MJHMP into General Plan Safety Element; Review fire hazard severity zones; subdivision map act; CEQA.
- **Outcomes:** Identify requirements, deliverables and review process.

8. NEXT MEETING *Kelsey Scanlon, Monterey Co. OES* *10:55*

- Next Meeting TBD - grant obligation pending

9. ADJOURN 11:00

2021 MONTEREY COUNTY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE

MEETING INFORMATION	
MEETING: Steering Committee Meeting #1	**DATE:** 01/22/20
LOCATION: 1322 Natividad Rd, Salinas CA	**TIME:** 9:00AM-11:00AM
CONFERENCE CALL: • https://montereycty.zoom.us/j/256487941 • Dial: 1 669 900 6833 US (San Jose) • Meeting ID: 256 487 941	

AGENDA

1. **Welcome and Introductions**

2. **Grant Update**

3. **Hazard Mitigation Overview**

    - **Handout: Review FEMA Evaluation Of 2016 Plan**

4. **Workplan**

    - **Handout: Progress Tracker**

Activity	Timeframe
Community & Public Outreach	May 2019 – March 2021
Update Period	January 2020 – August 2020
Plan Review & Revisions	September 2020 – March 2021
Approval	March 2021 – December 2021
Adoption	December 2021 – December 2022
Closeout	January 2022

5. **Planning Meetings**

    a. **Decision**: Approve Workplan and Planning Process

~~Pre-Planning Meeting~~	~~May 22, 2019~~
~~Initial Planning Meeting # 1~~	~~January 22, 2020~~
Planning Meeting #2	February 19, 2020
Planning Meeting #3	March 18, 2020
Planning Meeting #4	April 15, 2020
Planning Meeting #5	May 20, 2020
Final Planning Meeting #6	July 15, 2020
Final Planning Meeting #7	August 12, 2020

6. **Roles, Responsibilities, Tasks**
    - 35 Tasks
    - **Handout: Planning Task List**
7. **Public Outreach Strategy**
    - Public Information Resources
    - **Handout: Review and Approve Public Outreach Strategy**
    - Review Public Forum Outcomes
    - Public Outreach Action Items
8. **Stakeholder Forum**
    - June 5, 2020
    - Handout: 2016 Stakeholder List
9. **Information Requirements**
    - Executive Summary Introduction
        - **Decision**: Approve Organization of Plan
    - Community Profile
    - Hazard Analysis & Maps
        - **Decision**: Inclusion of new hazards (Power Disruption, Acts of Violence/Terrorism, Train Derailment, Public Health)
    - Vulnerability Analysis
    - Capability Assessment
    - Mitigation Strategy / Appendices
    - Maintenance
10. **Next Meeting**

Next Meeting:

- Planning Meeting #2 | February 19, 2020 | 9:00am-11:00am | 1322 Natividad Rd, Salinas CA

Action Items:

- *Kelsey to send out presentation, handouts and follow up material.*
- *Publish 1 Press Release Announcing Update*
- *Identify Public Outreach Event*
- *Review Community Profile Chapter*
- *Submit updates by February 22, 2020 COB*

11. **Adjourn**

2021 MONTEREY COUNTY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE

<table>
<tr><th colspan="2">MEETING INFORMATION</th></tr>
<tr><td>MEETING: Steering Committee Meeting #2</td><td>DATE: 02/19/20</td></tr>
<tr><td>LOCATION: 1322 Natividad Rd, Salinas CA</td><td>TIME: 9:00AM-11:00AM</td></tr>
<tr><td colspan="2">CONFERENCE CALL:
• https://montereycty.zoom.us/j/656290816
• +1 669 900 6833
• Meeting ID: 656 290 816</td></tr>
</table>

AGENDA

1. **Welcome and Introductions**

2. **Grant Update**

3. **Workplan**
   - Progress on Schedule
   - Handout: Progress Tracker

Action Items:

- Jurisdictions to submit documentation of Jurisdiction Planning Meeting

Activity	Timeframe
Community & Public Outreach	May 2019 – March 2021
Update Period	January 2020 – August 2020
Plan Review & Revisions	September 2020 – March 2021
Approval	March 2021 – December 2021
Adoption	December 2021 – December 2022
Closeout	January 2022

4.
5. **Public Outreach Strategy**

Action Items:

- Kelsey to send Press Release and Social Media Language on 2/19/20
- The following jurisdictions still need to identify a date for a Public Forum or Governing Body Presentation: Carmel-by-The-Sea, Del Rey Oaks, Greenfield, King City, Marina, Monterey, Salinas, Sand City, Soledad.

6. **Community Profile Review**
   - Draft attached for review.
   - New to the Chapter:
     - Cover page and format.

  - Addition of Plan Requirements Boxes throughout the plan.
  - Addition of "References and Resources" Section in each chapter.
  - Update of census information; new census information (i.e. county-to-county commute, native language statistics, poverty, health).
  - Addition of Disabilities, Access, and Functional Needs Demographic Information
  - Addition of Social Vulnerability Assessment of the community.
  - Addition of housing and infrastructure trends
  - Addition of participating special districts in the "Community Descriptions"
  - Integration of Community priorities based on the results of the public outreach strategy.
- **Action Items:**
  - County to complete social vulnerability, disabilities, and community priorities sections.
  - County to include language regarding multi-family use of single structures and occupancy of illegal structures.
  - The following jurisdictions still need to submit changes: City of Gonzales, City of Greenfield, King City, Marina, Monterey County Water Resources Agency.

7. Information Requirements

- Decision: Modification of planning timeline. See Task List.

Action Items:

- Jurisdictions to complete and submit 1 Capability Assessment Survey by May 13, 2020.
- Jurisdictions to complete and submit 1 Safe Growth Survey by May 13, 2020.
- Jurisdictions to complete and submit 1 NFIP Survey by May 13, 2020.
- County to update and distribute Hazard Analysis Chapter for review at March meeting.

8. Next Steps

Next Meeting:

- Planning Meeting #3 | March 18, 2020| 9:00am-11:00am | 1322 Natividad Rd, Salinas CA

~~Pre-Planning Meeting~~	~~May 22, 2019~~
~~Initial Planning Meeting # 1~~	~~January 22, 2020~~
~~Planning Meeting #2~~	~~February 19, 2020~~
Planning Meeting #3	March 18, 2020
Planning Meeting #4	April 15, 2020
Planning Meeting #5	May 20, 2020
Stakeholder Forum	June 5, 2020
Final Planning Meeting #6	July 15, 2020
Final Planning Meeting #7	August 12, 2020

9. Adjourn

Send Update

Title: '21 Hazard Mitigation Plan Steering Committee: Planning Meeting #6

Required: 'ptomasi@ci.carmel.ca.us'; 'BDempsey@ci.seaside.ca.us'; 'jlangborg@ci.greenfeild.ca.us'; 'sadams@kingcity.com'; 'dmccoun@cityofmarina.org'; 'panholzer@monterey.org'; 'ahunter@cityofpacificgrove.org'; 'samk@ci.salinas.ca.us'; 'michelev@ci.salinas.ca.us'; 'BFerrante@SandCityPD.org'; 'brian.nichols@fire.ca.gov'; Dugan, John x6654; Bodensteiner, Jennifer M. x4970; Buche, Brent Ext.8982; 'rachel@my1water.org'; 'sarah@my1water.org'; Criollo, German Ext.4941; 'jmuscio@ci.gonzales.ca.us'; 'jlangborg@ci.greenfield.ca.us'; Meister, Teresa L. x1905; 'dliberto@kingcity.com'

Optional

Start time: Wed 7/15/2020 9:00 AM ☐ All day ☐ Time zones

End time: Wed 7/15/2020 11:00 AM Make Recurring

Location: 1322 Natividad Rd, Salinas CA; https://montereycty.zoom.us/j/138205805 Room Finder

Hazard Mitigation Plan Partners,

This meeting is still scheduled to occur virtually. Likely it will not take that full hour but we will discuss the workplan moving forward.

Please join us for the Planning Meeting #6 of the 2021 Monterey County Multi-Jurisdictional Hazard Mitigation Plan Update. Agenda, workplan, and PowerPoint forthcoming. If you would like to host this meeting in your jurisdiction, please let me know.

Thanks,

Kelsey

Join Zoom Meeting
https://montereycty.zoom.us/j/138205805?pwd=czQ2cWFQZE9CZVI0Y2o0aWdDTnZBUT09

Password: 295096

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+1 346 248 7799 US (Houston)
+1 253 215 8782 US (Tacoma)
+1 312 626 6799 US (Chicago)
+1 929 205 6099 US (New York)
+1 301 715 8592 US (Germantown)
Meeting ID: 138 205 805
Find your local number: https://montereycty.zoom.us/u/adzMXAU5Ao

2021 MONTEREY COUNTY

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE

MEETING INFORMATION	
MEETING: Steering Committee Meeting #8	**DATE: April 15, 2021**
LOCATION: Virtual or In-Person (1322 Natividad Rd, Salinas CA)	**TIME: 9:00-10:30AM**
CONFERENCE CALL Information: • https://montereycty.zoom.us/j/97936426204?pwd=RytIeW44bXhRemRkWWNNMkNGMVF6Zz09 • Password: 311561 • 1 669 900 6833 US (San Jose) • Meeting ID: 979 3642 6204	

AGENDA

1. **Welcome and Introductions**
2. **Grant Update**
3. **Staffing Update**
4. **Updated Timeline**
5. **Public Meetings**
   Action Items: The following jurisdictions still need to identify a date for a Public Forum or Governing Body Presentation: Carmel-by-The-Sea, Del Rey Oaks, Marina, Salinas, Seaside, Soledad.

6. **Jurisdiction Mitigation Strategies Listening Sessions**
   Action Items:
   - Send Date for Jurisdiction Stakeholder Listening Session
   - OES will send out agenda and calendar invite for meeting
7. **Information Requirements**
   Action Items:
   - Jurisdictions to complete and submit 1 Capability Assessment Survey by
   - Jurisdictions to complete and submit 1 Safe Growth Survey by
   - Jurisdictions to complete and submit 1 NFIP Survey by
   - Jurisdictions to review and update critical facilities list.
   - Jurisdictions to complete and submit land use and development trend information
   - County to update and distribute Hazard Analysis Chapter for review at May meeting
   - County to provide updated format of City Appendices at May meeting

8. Next Steps

Steering Committee: Pre-Planning Meeting / Public Outreach Strategy Development	Complete	May 22, 2019
Steering Committee: Initial Planning Meeting # 1	Complete	January 22, 2020
Steering Committee: Planning Meeting #2	Complete	February 19, 2020
~~Steering Committee: Planning Meeting #3~~	~~Cancelled~~	~~March-20~~
~~Steering Committee: Planning Meeting #4~~	~~Cancelled~~	~~April-20~~
~~Steering Committee: Planning Meeting #5~~	~~Cancelled~~	~~May-20~~
~~Stakeholder Committee Meeting~~	~~Cancelled~~	~~June-20~~
Steering Committee: Planning Meeting #6	Complete	July 15, 2020
~~Steering Committee: Planning Meeting #7~~	~~Cancelled~~	~~August-20~~
Steering Committee: Planning Meeting #8	On Schedule	April15, 2021
Steering Committee: Planning Meeting #9	On Schedule	May 20, 2021
Jurisdiction Mitigation Strategy Listening Sessions	On Schedule	June-August 21
Steering Committee: Planning Meeting #10 (FINAL Before DC)	On Schedule	September23, 2021
Steering Committee: Planning Meeting #11 (FINAL)	On Schedule	November11, 2021

9. Adjourn

Send Update

Title MJHMP Steering Committee Meeting #9

Required panholzer@monterey.org; Alyson Hunter <ahunter@cityofpacificgrove.org>; samk@ci.salinas.ca.us; michelev@ci.salinas.ca.us; skylart@ci.salinas.ca.us; BFerrante@SandCityPD.org; MGutierrez@ci.seaside.ca.us; dliberto@kingcity.com; Scanlon, Kelsey x1902; Dugan, John x6654; Bodensteiner, Jennifer M. x4970; Criollo, German Ext.4941; rachel@my1water.org; sarah@my1water.org; Henson, Alex x4874; Molfino, Tracy L. x1993; Malais, Gerry x1901; Charisse Rugamas Castro <ccastro@ci.seaside.ca.us>; DNava@ci.seaside.ca.us; David Ramirez <dramirez@mrwmd.org>

Optional Meister, Teresa L. x1905

Start time Fri 5/21/2021 9:00 AM All day Time zones

End time Fri 5/21/2021 10:30 AM Make Recurring

Location https://montereycty.zoom.us/j/94696090613 Room Finder

Hold for May Multi-Jurisdictional Hazard Mitigation Plan Steering Committee Meeting. Agenda to Follow.

Join Zoom Meeting
https://montereycty.zoom.us/j/94696090613

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+1 346 248 7799 US (Houston)
+1 253 215 8782 US (Tacoma)
+1 312 626 6799 US (Chicago)
+1 929 205 6099 US (New York)
+1 301 715 8592 US (Washington DC)
Meeting ID: 946 9609 0613
Find your local number: https://montereycty.zoom.us/u/ab99x85TCZ

Join by SIP
94696090613@zoomcrc.com

Join by H.323
162.255.37.11 (US West)
162.255.36.11 (US East)

2021 Monterey County Multi-Jurisdictional Hazard Mitigation Plan Update

MEETING: STEERING COMMITTEE MEETING #9

DATE: MAY 21, 2021

TIME: 9:00AM -10:30AM

1

Agenda

1. Welcome and Introductions
2. Timeline
3. Action Items from Last Meeting
4. Jurisdiction Mitigation Strategies Listening Sessions
5. Jurisdiction Annex Overview
6. Next Steps & Action Items
7. Adjourn

2

Send Update

Title: MJHMP Steering Committee Meeting #10

Required: George.Nunez@fire.ca.gov; buikema@cawd.org; ptomasi@ci.carmel.ca.us; jmuscio@ci.gonzales.ca.us; jlangborg@ci.greenfield.ca.us; sadams@kingcity.com; dmccoun@cityofmarina.org; panholzer@monterey.org; Alyson Hunter <ahunter@cityofpacificgrove.org>; skylart@ci.salinas.ca.us; BFerrante@SandCityPD.org; Dugan, John x6654; Bodensteiner, Jennifer M. x4970; rachel@my1water.org; 'CBourquin@delreyoaks.org'; razzeca@mosslandingharbor.dst.ca.us

Optional: Scanlon, Kelsey x1902; Geoff English <genglish@kingcity.com>; Molfino, Tracy L. x1993; dliberto@kingcity.com; Patrick Treanor <Treanor@cawd.org>; Charisse Rugamas Castro <ccastro@ci.seaside.ca.us>; cvega@ci.greenfield.ca.us; Henson, Alex x4874; JHoyne@delreyoaks.org; Lin, Justin x1903; Brent Slama <BSlama@cityofsoledad.com>

Start time: Tue 9/21/2021 9:00 AM ☐ All day ☐ Time zones

End time: Tue 9/21/2021 10:30 AM Make Recurring

Location: https://montereycty.zoom.us/j/97761485410?pwd=dVNQWmttTU1Hb3F0OERVSFFkWHM1 Room Finder

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Laura Emmons
Emergency Services Planner
emmonsl@co.monterey.ca.us
(831) 521-0089

Join Zoom Meeting
https://montereycty.zoom.us/j/97761485410?pwd=dVNQWmttTU1Hb3F0OERVSFFkWHM1dz09&from=addon

Password: 606273

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+1 346 248 7799 US (Houston)
+1 929 205 6099 US (New York)
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)
Meeting ID: 977 6148 5410
Find your local number: https://montereycty.zoom.us/u/aewOrSyOiC

Join by SIP
97761485410@zoomcrc.com

2021 Monterey County Multi-Jurisdictional Hazard Mitigation Plan Update

MEETING: STEERING COMMITTEE MEETING #10

DATE: SEPTEMBER 21, 2021

TIME: 9:00AM -10:30AM

1

Agenda

1. Welcome and Introductions
2. Timeline Update
3. Countywide Mitigation Strategy
4. Threat Hazard Risk Assessment Preliminary Results
5. Countywide Mitigation Actions
6. Plan Maintenance Strategy
7. Jurisdiction Annex Overview
8. Next Steps & Action Items
9. Adjourn

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