City of Garden Grove
Local Hazard Mitigation Plan Update

January 2020 Public Review Draft

GARDEN GROVE

Foster Morrison

Executive Summary

The City of Garden Grove prepared this Local Hazard Mitigation Plan (LHMP) to guide hazard mitigation planning to better protect the people and property of the City from the effects of natural disasters and hazard events. This LHMP demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This LHMP was also developed in order for the City to be eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) Program, and the Flood Mitigation Assistance (FMA) Program.

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated. The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards

LHMP Plan Development Process

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented. This plan documents the hazard mitigation planning process and identifies relevant hazards and vulnerabilities and strategies the City will use to decrease vulnerability and increase resiliency and sustainability in the community.

This is a single jurisdictional LHMP with the City of Garden Grove seeking FEMA approval of this LHMP for their jurisdiction. This LHMP covers the geographical boundaries of Garden Grove, referred to as the Garden Grove Planning Area.

This LHMP was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. Led by the City of Garden Grove, Department of Public Works, the City followed a planning process prescribed by FEMA as detailed in Table ES-1.

Table ES-1 Local Hazard Mitigation Planning Process

DMA Process	Modified CRS Process
1) Organize Resources	
201.6(c)(1)	1) Organize the Planning Effort
201.6(b)(1)	2) Involve the Public

DMA Process	Modified CRS Process
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies
2) Assess Risks	
201.6(c)(2)(i)	4) Identify the Hazards
201.6(c)(2)(ii)	5) Assess the Risks
3) Develop the Mitigation Plan	
201.6(c)(3)(i)	6) Set Goals
201.6(c)(3)(ii)	7) Review Possible Activities
201.6(c)(3)(iii)	8) Draft an Action Plan
4) Implement the Plan and Monitor Progress	
201.6(c)(5)	9) Adopt the Plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan

The planning process began with the organizational phase to establish the hazard mitigation planning committee (HMPC) comprised of key City representatives, and other local and regional stakeholders; to involve the public; and to coordinate with other departments and agencies. A detailed risk assessment was then conducted followed by the development of a focused mitigation strategy for Garden Grove. Once approved by Cal OES and FEMA, this LHMP will be adopted and implemented by the City over the next five years.

Risk Assessment

The HMPC conducted a risk assessment that identified and profiled hazards that pose a risk to the City, assessed the vulnerability of the Garden Grove Planning Area to these hazards, and examined the City's existing capabilities to mitigate them.

The City is vulnerable to numerous hazards that are identified, profiled, and analyzed in this plan. Dam failures, floods, earthquakes, drought, and other severe weather events are among the hazards that can have a significant impact on the City. Climate change can exacerbate these hazards. Table ES-2 details the hazards identified for the City LHMP.

Table ES-2 Garden Grove Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Negligible	Medium	–
Dam Failure	Significant	Unlikely	Catastrophic	High	Medium
Drought and Water Shortage	Extensive	Likely	Limited	Medium	Medium
Earthquake	Extensive	Highly Likely/Occasional	Catastrophic	High	Low
Earthquake: Liquefaction	Limited	Occasional	Critical	Medium	Low
Flood: (100/500 year)	Extensive	Occasional/Unlikely	Critical	High	High
Flood: Localized/Stormwater	Significance	Highly Likely	Limited	Medium	High
Levee Failure	Limited	Unlikely	Limited	Medium	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Negligible	Low	Medium
Severe Weather: Heavy Rains and Storms	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: High Winds	Extensive	Highly Likely	Limited	Medium	Low
Wildfire (Conflagration)	Extensive	Highly Likely	Catastrophic	Medium	Medium

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal future impact
Medium: moderate future impact
High: widespread future impact

Mitigation Strategy

Based on the results of the risk assessment, the HMPC developed a mitigation strategy for reducing the City's risk and vulnerability to identified hazards. The resulting Mitigation Strategy for Garden Grove is comprised of LHMP goals and objectives and a mitigation action plan which includes a series of mitigation action projects and implementation measures. The goals and objectives of this LHMP are:

Goal 1: Minimize risk and vulnerability of Garden Grove to natural hazards and protect lives and prevent losses to property, economy, public health and safety, and the environment

- Provide protection for existing and future development.
- Promote natural systems protection and management
- Identify strategies for mitigating hazards to reduce adverse impacts and hazard related losses.
- Integrate mitigation efforts into facility maintenance programs to increase life expectancy and performance of structures.
- Establish a City policy for hazard loss reduction

Goal 2: Provide protection for critical facilities to minimize loss of life and injury from hazard impacts

- Minimize impacts to critical facilities, utilities, and services and minimize disruptions.
- Implement technology enhancements for minimizing interruption of critical services and efficiently restoring impacted facilities

Goal 3: Increase community outreach, education, and awareness of risk and vulnerability to hazards and promote preparedness and self-responsibility to reduce hazard-related losses

- Establish a Citywide public information program that utilizes a variety of outreach strategies and mechanisms to reach all Garden Grove residents and visitors
- Inform and educate residents, businesses, visitors, and other stakeholders as to all hazards they are exposed to, where they occur, what they can do to mitigate exposure or damages.
- Maximize use of technologies in public education and awareness activities.

Goal 4: Improve City's capabilities to reduce hazard-related losses and to be prepared for, respond to, and recover from a disaster event

- Continued improvements to emergency services and public safety capabilities.
- Increase the use of shared resources, mutual aid and build partnerships with other agencies and jurisdictions
- Integrate hazard planning and mitigation into routine City functions
- Make better use of technology
- Provide resources and services to at risk populations
- Promote incident stabilization

Mitigation actions and projects to support these goals are shown on Table ES-3.

Table ES-3 City of Garden Grove's Mitigation Actions

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Multi-Hazard Actions					
Action 1.Integrate Local Hazard Mitigation Plan into Safety Element of General Plan	1, 2, 3, 4	X	X		Prevention
Action 2.Public Awareness, Education, Outreach, and Preparedness Program Enhancements.	1, 2, 3, 4	X	X	X	Public Information
Action 3.Urban Forest Management Plan	1, 2, 3, 4	X	X		Prevention Natural Resource Protection
Action 4.Information Technology Cloud Infrastructure and Backups	1, 2, 3, 4	X	X		Prevention Emergency Services
Action 5.Identify and Establish/Activate Shelter(s)	1, 2, 3, 4	X	X		Emergency Services
Action 6.Action 6.New Construction and Building Retrofits with Non-cellulose Materials	1, 2, 4	X	X		Prevention Property Protection Structural Projects
Action 7.Building Maintenance Program Focusing on Roofs, Gutters, Drains, and Eves	1, 2, 4	X	X		Prevention Property Protection Structural Projects
Action 8.Backup Generators for Critical Facilities	1, 2, 4	X	X	X	Property Protection Emergency Services
Action 9.Tree Maintenance	1, 2, 4	X	X		Property Protection Natural Resource Protection
Action 10. Southern California Edison's (SCE) Tariff Rule 20A Utility Undergrounding	1, 2, 4	X	X		Prevention Property Protection
Action 11. EOC Update	1, 2, 4	X	X		Prevention Emergency Services

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Climate Change Actions					
Action 12. Ongoing Recycling and Greenhouse Gas Reduction Program	1, 2, 4	X	X		Prevention
Dam Failure, Flood: 1%/0.2% Annual Chance, Localized Flood, Severe Weather: Heavy Rain and Storm Actions					
Action 13. Catch Basin Maintenance Program Enhancements	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 14. Roadway Re-Construct/Bonser Avenue	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 15. MS4 Capacity Upgrade in Target Locations/Garden Grove Blvd Storm Drain	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 16. MS4 Capacity Upgrade in Target Locations - Yockey/Newland Storm Drain Phase 1	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 17. Line B5 Storm Drain Project	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 18. Drainage Master Plan (Update/Implementation)	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 19. Stormwater Drainage Improvements Using Updated DFIRMs Maps and Zones Project	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Drought and Water Shortage Actions					
Action 20. Public Education - Tree Watering during Drought	1, 2, 3, 4		X	X	Public Information

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Earthquake and Earthquake Liquefaction Actions					
Action 21. Install Seismic Shutoff Valves On all City Facility Above Ground Gas Valves. Seismic Retrofit	1, 2, 4	X	X		Property Protection
Action 22. Conduct a Police Building Seismic Facility Assessment / Evaluate for Seismic Retrofit	1, 2, 4	X	X		Prevention Property Protection
Action 23. Conduct Facility Assessment / Evaluate for Seismic Retrofit	1, 2, 4	X	X		Prevention Property Protection
Severe Weather Actions					
Action 24. Activate and Enhance Cooling Center Locations	1, 2, 3, 4	X	X		Prevention Emergency Services
Action 25. Secure All Roofs and Eves	1, 2, 4	X	X		Property Protection
Wildfire Actions					
Action 26. Turn Off Power to Electrical Outlets / Tamper Proof Covers in Public Areas	1, 2, 4	X	X		Prevention Property Protection Natural Resource Protection
Action 27. Upgrade Wooden Electrical Panels in Parks	1, 2, 4	X	X		Property Protection Natural Resource Protection

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Abbreviations and Acronyms

Acronym	Definition
AB	Assembly Bill
ABAG	Association of Bay Area Governments
ADU	Accessory Dwelling Unit
AF	Acre Feet
APG	California Adaptation Planning Guide
AQI	Air Quality Index
ASAUA	Anaheim/Santa Ana Urban Area
BAM	Best Available Map
BLM	Bureau of Land Management
BMP	Best Management Practices
CA	California
CAC	Community Assistance Contact
CAV	Community Assistance Visit
CA-DWR	California Department of Water Resources
Cal OES	California Office of Emergency Services
CAP	Climate Adaptation Plan
CAS	Climate Adaptation Strategy
CBC	California Business Code
CCSM	Community Climate System Model
CDAA	California Disaster Assistance Act
CDBG	Community Development Block Grant
CDEC	California Data Exchange Center
CDFA	California Department of Food & Agriculture
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CERT	Community Emergency Response Training
CFR	Code of Federal Regulations
CGS	California Geologic Survey
CLOMR	Conditional Letter of Map Revision
CMU	Concrete Masonry Unit
COPD	Chronic Obstructive Pulmonary Disease
CNPS	California Native Plant Society
CNRA	California Natural Resource Agency
CPUC	California Public Utility Commission
CRS	(National Flood Insurance Program's) Community Rating System

Acronym	Definition
CRV	Content Replacement Values
CWPP	Community Wildfire Protection Plan
CVP	Central Valley Project
DAC	Disadvantaged Community
DMA	Disaster Mitigation Act of 2000
DOF	Department of Finance
DOT	Department of Transportation
DSOD	Division of Safety of Dams
EAS	Emergency Alert System
EF	Enhanced Fujita
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
F	Fujita
FBFM	Flood Boundary and Floodway Maps
FEMA	Federal Emergency Management Agency
FHSZ	Fire Hazard Severity Zone
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance Program
FRA	Federal Responsibility Area
FRAP	Fire and Resource Assessment Program
FWS	US Fish and Wildlife Service
GGPD	Garden Grove Police Department
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GWR	Groundwater Replenishment
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
HI	Heat Index
HR	Hydrologic Region
I	Interstate
IBC	International Business Code
ICC	Increased Cost of Compliance
IPCC	Intergovernmental Panel on Climate Change
IRC	International Residential Code
LFPZ	Levee Flood Protection Zone
LHMP	Local Hazard Mitigation Plan
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision

Acronym	Definition
LRA	Local Responsibility Area
LSO	Levee Safety Officer
MHDP	Multi Hazards Demonstration Project
MHI	Median Household Income
MMI	Modified Mercalli Intensity Scale
MPAH	Master Plan of Arterial Highways
MSL	Mean Sea Level
MWDOC	Municipal Water District of Orange County
NASA	National Aerospace and Science Agency
NAVD 88	North America Vertical Datum 1988
NCDC	National Climactic Data Center
NDMC	National Drought Mitigation Center
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGVD 29	National Geodetic Vertical Datum 1929
NIDIS	National Integrated Drought Information System
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDP	National Performance of Dams Program
NPS	National Park Service
NWS	National Weather Service
OCPW	Orange County Public Works
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
OHP	Office of Historic Preservation
PDM	Pre-Disaster Mitigation Program
PM	Particulate Matter
PNAS	Proceedings of the National Academy of Sciences
PPI	Program for Public Information
PRP	Preferred Risk Policy
PSPS	Public Safety Power Shutoff
RACES	Radio Amateur Civil Emergency Service
RAWS	Remote Automated Weather Stations
RCP	Representative Concentration Pathway
RL	Repetitive Loss
SB	Senate Bill
SAC-SJ	Sacramento-San Joaquin

Acronym	Definition
SBA	Small Business Administration
SCE	South California Edison
SFHA	Special Flood Hazard Area
SGMA	Sustainable Groundwater Management Act
SHBC	State Historical Building Code
SOI	Sphere of Influence
SOP	Standardized Operations Procedures
SR	State Route
SRA	State Responsibility Area
SRL	Severe Repetitive Loss
SWP	State Water Project
UCERF	Uniform California Earthquake Rupture Forecast
UHI	Urban Heat Island
USACE	US Army Corp of Engineers
USGS	United States Geologic Survey
USDA	United States Department of Agriculture
UWMP	Urban Water Management Plan
VHFHSZ	Very High Fire Hazard Severity Zone
WMP	Wildlife Hazard Management Plan
WRCC	Western Regional Climate Center
WUI	Wildland Urban Interface

Chapter 1 Introduction

1.1 Purpose

The City of Garden Grove prepared this Local Hazard Mitigation Plan (LHMP) to guide hazard mitigation planning to better protect the people and property of the City from the effects of hazard events. This LHMP demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This LHMP was also developed so the City can be eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, and the Flood Mitigation Assistance (FMA) program.

1.2 Background and Scope

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of $6 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2017 Interim Report).

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented. This LHMP documents the City's hazard mitigation planning process and identifies relevant hazards, vulnerabilities, and mitigation strategies the City will use to decrease vulnerability and increase resiliency and sustainability in the community.

This Garden Grove LHMP is a single jurisdictional plan that geographically covers the entire area within the City's jurisdictional boundaries (i.e., the Planning Area). This Plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act (DMA) or DMA 2000.) This planning effort also follows FEMA's most current Plan Preparation and Review Guidance. While the DMA 2000 emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the City is subject to many kinds of hazards, access to these programs is vital.

Information in this LHMP will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. Garden Grove has been affected by hazards in the past and is thus committed to reducing future impacts from hazard events and becoming eligible for mitigation-related federal funding.

1.3 Plan Organization

The City of Garden Grove's Local Hazard Mitigation Plan is organized as follows:

Chapters

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption
- Chapter 7: Plan Implementation and Maintenance

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Chapter 2 Community Profile

2.1 City of Garden Grove Overview

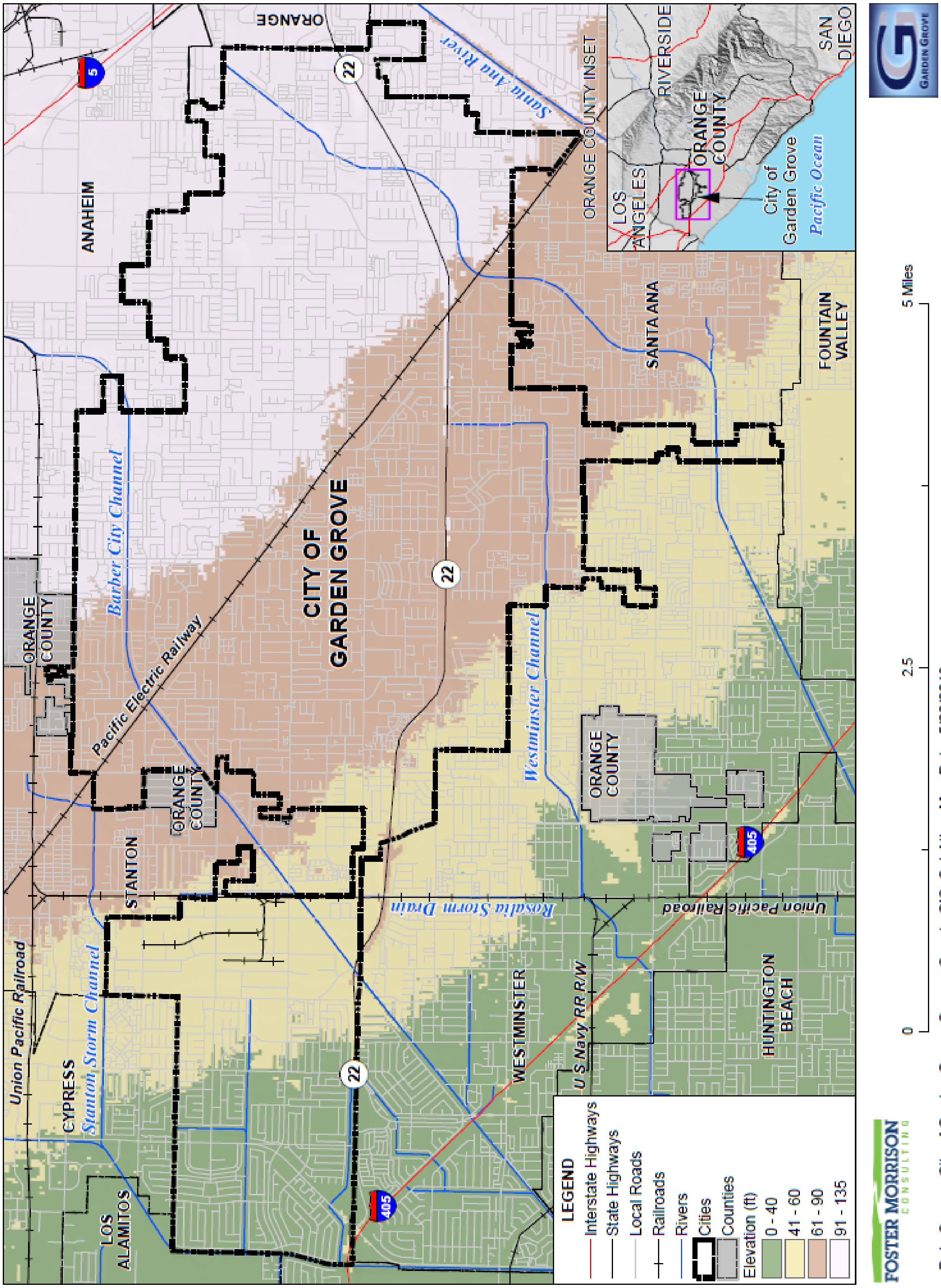
Garden Grove is a city in northern Orange County. It is located 34 miles southeast of the City of Los Angeles. It is bordered by Anaheim, Cypress, and Stanton to the north, Orange to the east, Santa Ana and Westminster to the south, and Los Alamitos and Seal Beach to the west.

The City is the fourth largest in Orange County, covering 17.8 square miles with more than 10,000 businesses. The City is a full-service municipality with its own police departments as well as its own school district. Fire protection for the City is provided by the Orange County Fire Authority. The City owns and operates its own water system and is served by the Garden Grove Sanitary District. The Garden Grove Unified School District (District) has 47 elementary, 10 intermediate, and 7 high schools. Total attendance exceeds 48,000 students according to the District website. In addition, there are two adult and two special education centers, as well as nine colleges and universities within a 15-mile radius of the City.

The City is bisected by State Route 22 (SR-22) also known as the Garden Grove Freeway. SR-22 connects the City to Interstate 5, 405, and State Route 57. As stated in the City's General Plan, there are approximately 835 acres of industrial area in the City (including multi-use areas). The City has five industrial parks on the west side of the City. The area has underground utilities, rail service, and freeway access. According to the 2010 U.S. Census, the City has approximately 47,755 households interspersed among its 20 city parks.

The City can be seen on Figure 2-1 below.

Figure 2-1 City of Garden Grove



Data Source: City of Garden Grove, Orange County GIS, Cal-Atlas; Map Date: 5/20/2019.

2.2 History

Spanish soldiers commanded by Gaspar de Portola first discovered Orange County as they made their way north across California in 1769. During their journey, the soldiers camped on a wide grassy plain east of present day Garden Grove. They named the area the Santa Ana Valley and claimed the state of California as a possession of Spain. The Santa Ana Valley was divided into ranchos as some of the soldiers settled in the area. In 1822, Mexico gained independence from Spain, and California became a province of Mexico. It was the treaty of Guadalupe Hidalgo in 1848, at the end of the Mexican-American War, that made all of California a territory of the United States of America. In 1850, California became the 31st state in the union.

A businessman named Abel Stearns bought large tracts of land in Southern California in 1868 and divided some of it into smaller lots to sell to settlers. In 1874, Alonzo Cook purchased 160 acres of land in the area for about $15 an acre. Recognized as Garden Grove's Founding Father, he later donated land north of Main Street and Garden Grove Boulevard for use as the site of the first schoolhouse and post office. Cook suggested the name "Garden Grove" for the school and surrounding village. Some countered that the name did not fit the open terrain. Cook responded, "We'll make it appropriate by planting trees and making it beautiful."

By the time Orange County incorporated in 1889, the Garden Grove area had a population of about 200. It continued as a quiet farming community into the 20th Century, when in 1905, the Pacific Electric Railroad came through Garden Grove. The railroad brought tourists, visitors, and before long, more settlers. Soon after came the first telephone, gas and electric services for the residents near Main Street.

During the next 40 years, agriculture continued as the town's main economy. Although ideally located in the center of the county, Garden Grove's growth was slowed by two disasters during those years. The first was in 1916, when the center of town was flooded and came under about four feet of water after days of heavy rains. Then, in 1933, another disaster damaged the old town section of Garden Grove when an earthquake struck. Following each of these catastrophes, however, the residents joined in spirit and labor to repair the damage and continue the progress of Garden Grove.

World War II had an important impact on city growth. Servicemen who had visited California during their training for war came back to settle and raise their families. Available land and low prices caused a sudden building boom, making Garden Grove the fastest growing city in the nation in the 1950s. As the area grew, its rural nature changed to a more modern society and the need for city government was evident.

Residents formally decided to incorporate their town on June 18, 1956, to become the City of Garden Grove. Since incorporation, the pioneer spirit has continued to be part of life for Garden Grove. At the time of the 1960 census, Garden Grove had a population of nearly 44,000. Today, the population is over 170,000.

2.3 Geography and Climate

The City lies on the coastal plain of the Los Angeles Basin. The topography of the City is relatively flat. The City of Garden Grove climate is usually hot and dry in the summer and has mild winters. Data from the Western Regional Climate Center, from 1906 to 2016, shows the record maximum temperatures were a high of 112°F (on June 14, 1917) and a low of 22°F (on December 31, 1918). Average summer highs range from the lower to upper 80s. Average winter lows range from the lower to upper 40s. Garden Grove averages 25 days each year with temperatures exceeding 90°F. Annual precipitation averages just over 13 inches in the Garden Grove vicinity; more than 50 percent of the annual precipitation normally occurs from December through February. Record 24-hour rainfalls for the City was 4.69 inches on February 16, 1927. The highest annual precipitation for the City occurred in 1941, when over 32 inches of rain fell in the City. The City consists of gently sloping lowlands with the elevation ranging from 15 feet to 175 feet above mean sea level.

2.4 Economy and Tax Base

The Garden Grove General Plan Economic Development Element note that Garden Grove currently has a fiscally sustainable City budget, though it is highly dependent on retail sales tax revenue. In recent years, Garden Grove's revenue has grown strong. From fiscal year 1999 to 2007 revenues increased 60.8 percent, while inflation was just 30.9 percent during this timeframe. In addition, City revenue per capita grew 45.7 percent, indicating that the City has more purchasing power per resident to supply services. Like most of California and the rest of the County from 2007 to 2011, there was a loss of housing values. Housing values began to rebound slowly in 2012 and then more robustly in 2014. Currently, the Comprehensive Annual Financial Report for 2018 noted that:

> ***The local economy is stable as the City has diversified revenue sources including a stable property tax base, well-diversified sales tax base, and strong transient occupancy (hotel) tax derived from tourism, including Disneyland, in Orange County. The City's financial outlook is optimistic with modest base revenue growth expectations. The City's four largest revenue sources: transient occupancy tax (TOT), sales tax, property tax, and motor vehicle tax are expected to grow. However, sales tax is expected to increase beyond the originally anticipated growth rate as a result of a new sales tax measure, Measure O. On July 24, 2018, the Garden Grove City Council voted to place Measure O on the November 2018 ballot which was approved by the citizens of Garden Grove. Measure O, which will become effective April 2019, is a local, 1 percent sales tax which will provide a reliable source of locally-controlled revenue for Garden Grove's public safety and quality-of-life services. The City is also working to actualize two major disposition and development agreements that will add additional major hotel brands and rooms in the Harbor Resort corridor over the next few years. Both developments are anticipated to generate increases in property tax, sales tax, and TOT revenues to the City.***
>
> ***However, there are real concerns relative to rising labor costs and unfunded pension liability requirements. The improved economy and resulting low unemployment rate are expected to drive up labor costs, which may create budget challenges for the City. Also, increasing pension costs, particularly unfunded liability requirements, present serious future budget challenges for the City. In December 2016, the CalPERS Board of Administration voted to modify their mortality rate and other actuarial assumptions, including lowering the discount rate from 7.5 percent to 7.0 percent over three years. These changes were effective beginning FY 2017-18, and will result in significant***

increases in required employer contributions for pension normal costs and unfunded liability.

The US Census Bureau tracks economic statistics for the City of Garden Grove. These are shown in Table 2-1.

Table 2-1 City of Garden Grove Civilian Employed Population 16 years and Over

Industry	Estimated Employment	Percent
Agriculture, forestry, fishing and hunting, and mining	306	0.4%
Construction	5,554	6.6%
Manufacturing	13,914	16.6%
Wholesale trade	2,135	2.5%
Retail trade	9,703	11.6%
Transportation and warehousing, and utilities	3,249	3.9%
Information	1,006	1.2%
Finance and insurance, and real estate and rental and leasing	4,660	5.6%
Professional, scientific, and management, and administrative and waste management services	8,514	10.2%
Educational services, and health care and social assistance	15,221	18.2%
Arts, entertainment, and recreation, and accommodation and food services	10,194	12.2%
Other services, except public administration	7,027	8.4%
Public administration	2,296	2.7%

Source: US Census Bureau American Community Survey 2016 Estimates

The top employers in the City are:

- Air Industries Corp. 681
- American Apparel Knit & Dye 535
- Prime Healthcare Services 516
- Walmart 412
- Saint-Gobain Performance Plastics 363
- Office Max Inc. 360
- Hyatt Regency Orange County 350
- GKN Aerospace Transparency Systems, Inc. 335
- Kaiser Foundation Health 317
- NBTY Acquisition, LLC 298

Garden Grove is primarily a residential community, and as such, property tax and real property transfer tax, make up 72% of General Fund revenues. As the City is largely built out, increases in revenue are driven primarily by the turnover of homes and increasing property values. Table 2-2 shows the breakdown of the City's values by property use type from as of March 2019

Table 2-2 Garden Grove – Values by Property Use

Property Use Category	Total Parcels	Total Value	Percentage of Total Value
Civic	86	$210,917,459	1.5%
Commercial	548	$712,083,256	5.1%
Industrial	346	$973,284,208	7.0%
Mixed Use	1,366	$1,952,789,827	14.1%
Open Space	141	$56,134,758	0.4%
Residential	29,778	$9,931,824,195	71.8%
Unknown	41	$418,084	0.1%
Grand Total	**32,306**	$13,837,451,787	**100.0%**

Source: City of Garden Grove March 2019 Parcel/Assessor's Data

2.5 Population and Socioeconomic Makeup

Founded in the late 1800s and incorporated in 1956, Garden Grove has experienced growth curves that mirror those of centrally located Orange and Los Angeles county communities. The 2000 Census indicated that the City had attained a population of 165,196. The 2010 Census estimated the City population to be 170,883. The California Department of Finance 2018 estimate for the City population was 176,896. The General Plan Land Use Element noted that the City of Garden Grove is a mature and fully built out urbanized city. Most of the land within the City has been developed (over 99 percent) and redevelopment is occurring throughout the City. Select social and economic information for the City is shown in Table 2-3.

Table 2-3 Garden Grove – Select Social and Economic Statistics

Statistic	Number
Populations	
Population under 5	6.7%
Population over 65	10.8%
Median Age	35.6
Racial Makeup	
White	39.9%
Black or African American	1.3%
American Indian or Alaska Native	0.6%
Asian	37.1%
Native Hawaiian or Pacific Islander	0.6%
Other Races	16.9%
Two or more races	3.6%
Income and Poverty	
Median income	$62,675

Statistic	Number
Mean Income	$79,981
Poverty rate	
All families	12.8%
All people	15.8%
Unemployment Rate (March 2019)	3.2%

Source: 2010 US Census, 2013-2017 US Census American Community Survey, Bureau of Labor Statistics

Chapter 3 Planning Process

Requirements §201.6(b) and §201.6(c)(1): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
2) 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 nonprofit interests to be involved in the planning process; and
3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

The City of Garden Grove recognized the importance and need of a Local Hazard Mitigation Plan (LHMP) and initiated its development. After receiving a grant from the Federal Emergency Management Agency (FEMA), which served as the primary funding source for this Plan, the City contracted with Foster Morrison Consulting, Ltd. (Foster Morrison) to facilitate and develop the LHMP. Jeanine Foster, a professional planner with Foster Morrison, was the project manager in charge of overseeing the planning process and the development of this LHMP update. Chris Morrison, also a professional planner with Foster Morrison, was the lead planner for the development of this LHMP Update. Brenna Howell, with Howell Consulting, also supported the planning effort as part of the Foster Morrison team. The Foster Morrison's team's role was to:

- Assist in establishing the Hazard Mitigation Planning Committee (HMPC) as defined by the Disaster Mitigation Act (DMA);
- Meet the DMA requirements as established by federal regulations and following FEMA's planning guidance;
- Support objectives under the National Flood Insurance Program's (NFIP) and the Flood Mitigation Assistance (FMA) program;
- Facilitate the entire planning process;
- Identify the data requirements that HMPC participants could provide and conduct the research and documentation necessary to augment that data;
- Assist in facilitating the public input process;
- Produce the draft and final plan documents; and
- Coordinate with the California Office of Emergency Services (Cal OES) and FEMA Region IX plan reviews.

3.1 Local Government Participation

Garden Grove made a commitment to the development of this 2020 single-jurisdictional LHMP, as the participating jurisdiction. The DMA planning regulations and guidance stress that each local government (participating jurisdiction) seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC;
- Detail where within the Planning Area the risk differs from that facing the entire area;
- Identify potential mitigation actions; and
- Formally adopt the plan.

For Garden Grove, "participation" meant the following:

- Providing facilities for meetings;
- Providing printed materials for meeting attendees;
- Attending and participating in the HMPC meetings;
- Completing and returning the Data Collection Worksheets;
- Collecting and providing other requested data (as available);
- Coordinating information sharing between internal and external agencies;
- Managing administrative details;
- Making decisions on plan process and content;
- Identifying mitigation actions for the Plan;
- Reviewing and providing comments on drafts of the Plan;
- Providing hardcopy Draft documents of LHMP for public review;
- Informing the public, local officials, and other interested stakeholders about the planning process and providing opportunity for them to comment on the plan;
- Coordinating, and participating in the public input process; and
- Coordinating the formal adoption of the Plan by the Garden Grove City Council.

Garden Grove seeking FEMA approval of this LHMP met all of these participation requirements. Multiple representatives from the City attended the HMPC meetings described in Table 3-3 and also brought together an internal planning team to help collect data, identify mitigation actions and implementation strategies, and to review and provide data on plan drafts. Appendix A provides additional information and documentation of the planning process.

Specific individuals representing City departments participating in this LHMP were actively involved throughout the LHMP development process as identified in Appendix A in the sign-in sheets for the meetings and as evident through the data, information and input provided by HMPC representatives to the development of this LHMP. This Chapter 3 and Appendix A provides additional information and documentation of the planning process and participants to this LHMP, including members of the HMPC.

3.2 The 10-Step Planning Process

Foster Morrison established the planning process for the City of Garden Grove 2020 LHMP using the DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1. Organize Resources;
2. Assess Risks;
3. Develop the Mitigation Plan; and
4. Implement the Plan and Monitor Progress.

Into this process, Foster Morrison integrated a more detailed 10-step planning process used for FEMA's CRS and FMA programs. Thus, the modified 10-step process used for this plan meets the requirements of six major programs: FEMA's Hazard Mitigation Grant Program (HMGP); Pre-Disaster Mitigation (PDM) program; CRS program; FMA Program; Severe Repetitive Loss (SRL) program; and new flood control projects authorized by the U.S. Army Corps of Engineers (USACE).

Table 3-1 shows how the modified 10-step process fits into FEMA's four-phase process. The sections that follow describe each planning step in more detail.

Table 3-1 Mitigation Planning Processes Used to Develop the Garden Grove Local Hazard Mitigation Plan

DMA Process	Modified CRS Process
1) Organize Resources	
201.6(c)(1)	1) Organize the Planning Effort
201.6(b)(1)	2) Involve the Public
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies
2) Assess Risks	
201.6(c)(2)(i)	4) Identify the Hazards
201.6(c)(2)(ii)	5) Assess the Risks
3) Develop the Mitigation Plan	
201.6(c)(3)(i)	6) Set Goals
201.6(c)(3)(ii)	7) Review Possible Activities
201.6(c)(3)(iii)	8) Draft an Action Plan
4) Implement the Plan and Monitor Progress	
201.6(c)(5)	9) Adopt the Plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan

3.2.1. Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

With Garden Grove's commitment to participate in the DMA planning process, Foster Morrison worked with the Garden Grove's Department of Public Works, as overall project lead, to establish the framework and organization for development of the Plan. An initial call was held with key City representatives in late Fall of 2018 to discuss the organizational and process aspects of this LHMP development process.

The initial kick-off meeting was held on February 28, 2019. Invitations to the kickoff meeting was extended to key City departments as well as to other federal, state, and local stakeholders that might have an interest in participating in the planning process. Representatives from the City and key community stakeholders participated in this LHMP project with additional invitations extended as appropriate throughout the planning process. The list of invitees is included in Appendix A.

The HMPC, comprising key City staff and other government and stakeholder representatives developed the Plan with leadership from the Garden Grove Department of Public Works and facilitation by Foster Morrison. Table 3-2 shows who participated on the HMPC. TO BE UPDATED AFTER FINAL MEETING

Table 3-2 Hazard Mitigation Planning Committee

Department	Name and Title
City of Garden Grove, City Manager	Scott Stiles, City Manager
City of Garden Grove, Streets/Environmental	AJ Holmon, Manager
City of Garden Grove, Community Development	Lisa Kim, Director
City of Garden Grove, Building Services	David Dent, Manager
City of Garden Grove, Planning Services	Lee Marino, Manager
City of Garden Grove, Building Services	Mike Austin, Supervising Building Inspector
City of Garden Grove, Planning Services	Lorena Soules, Permit Counter Supervisor
City of Garden Grove, Finance	Trevor Smouse, Sr. Program Specialist
City of Garden Grove, Parks and Recreation	Mark Freeman, Supervisor
City of Garden Grove, Housing	Danny Huynh, Manager
City of Garden Grove, Police	Amir El-Farra, Police Captain
City of Garden Grove, IT/GIS	Joseph Schwartz , GIS Coordinator
City of Garden Grove, Public Works	Raquel Manson, Sr. Admin Analyst
City of Garden Grove, Public Works	Phil Carter, Facilities Manager
City of Garden Grove, Public Works	Joe Flores, Supervisor
City of Garden Grove, Water/Sewer	Sam Kim, Manager
City of Garden Grove, Water/Sewer	Robert Bermudez, Supervisor
City of Garden Grove, Water/Sewer	Brent Hayes, Supervisor
City of Garden Grove, Water/Sewer	Katie Delfin, Sr. Admin Analyst
City of Garden Grove, Community Relations/PIO	Ana Pulido, Supervisor
City of Garden Grove, Community Relations/PIO	Veronica Avila, Admin Aide
OC Public Works	Kevin Onuma, Deputy Director, OC Operations and Maintenance
OC Public Libraries	Stephanie Brown, Administrative Manager
OC Community Resources	Julie Oakley, Deputy Director
SCAQMD	Debra Ashby, Sr. Public Info Specialist
MWDOC	Francisco Soto, WEROC Emergency Coordinator
OC Environmental Health	Lauren Robinson
CalOES	Leah Greenbaum, Emergency Services Coordinator
Cal DWR	Anthony Nhan (DDW)
So Cal Edison	James Peterson, Government Relations Manager

Department	Name and Title
City of Santa Ana	Steve Rhyner, Emergency Operations Coordinator
City of Stanton	Allan Rigg, Public Works Director/City Engineer
City of Garden Grove	Steve Porras
City of Garden Grove Fire Department	Paul Whittaker
City of Garden Grove	Mark Laong
City of Garden Grove	Lia Gountouma
City of Garden Grove	William Munroy
City of Garden Grove Streets	Albert Eurs
South Coast AQMD	Amparo Medina
South Coast AQMD	Jesus Orza
Orange County Public Works	Penny Law
City of Garden Grove Public Works	Albert Holmow, Manager
So Cal Gas	Lanae, Public Affairs
OC Fire Authority	Jeeter Mcalain

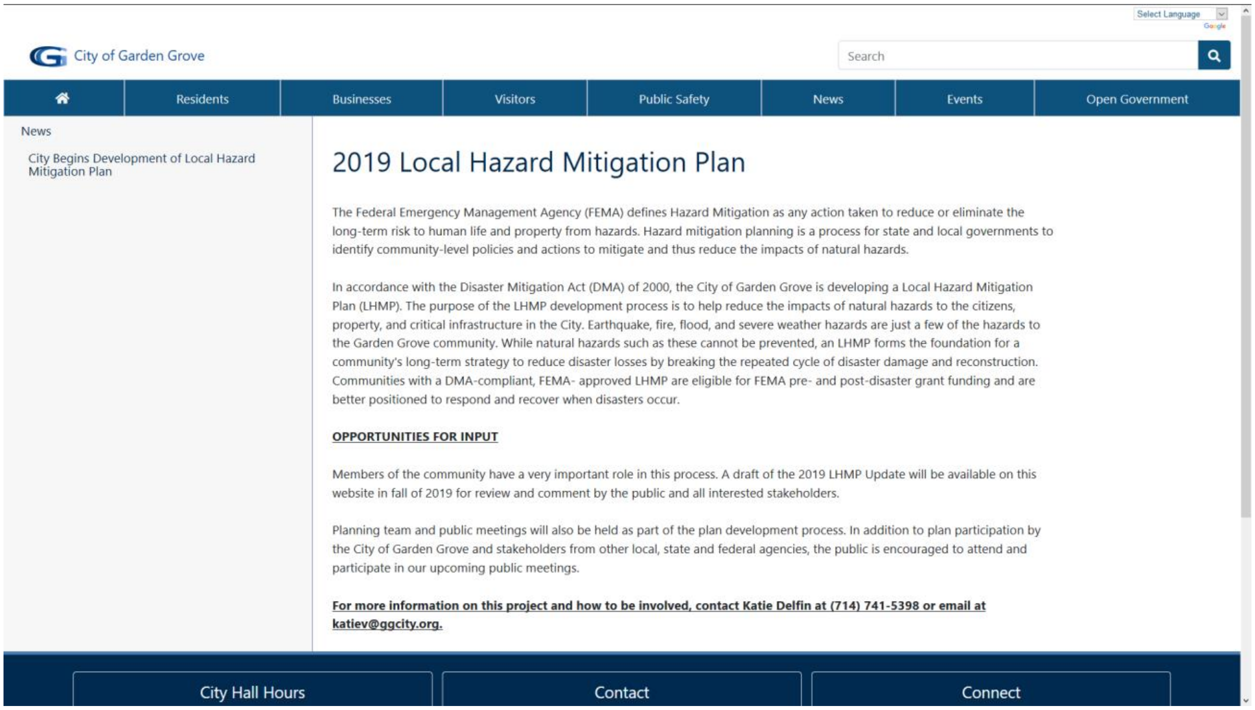
This list includes all HMPC members that attended one or more HMPC meetings detailed in Table 3-3, as well as those who provided key input into the Plan development process. In addition to providing representation on the HMPC, the City further formulated an internal planning team to collect and provide requested data and to conduct timely reviews of the draft documents. The internal planning team includes both those participating on the HMPC and other City staff.

Meetings

The planning process officially began with an internal project planning call in late Fall 2018 followed by an HMPC kick-off meeting held in Garden Grove on February 28, 2019. The meetings covered the scope of work and an introduction to the DMA requirements. During the HMPC meetings, participants were provided with data collection worksheets to facilitate the collection of information necessary to support development of the LHMP. Using FEMA guidance, these worksheets were designed to capture information on past hazard events, identify hazards of concern to the City, quantify values at risk to identified hazards, inventory existing capabilities, and to identify possible mitigation actions. A copy of the worksheets for this project are included in Appendix A. The City of Garden Grove seeking FEMA approval of this LHMP completed and returned the worksheets to Foster Morrison for incorporation into this LHMP.

During the planning process, the HMPC communicated through face-to-face meetings, email, telephone conversations, Dropbox websites, and through a City developed webpage dedicated to the plan development process. This later website was developed to provide information to the HMPC, the public and all other stakeholders on the LHMP process. Draft documents were also posted on this website so that the HMPC members and the public could easily access and review them. The LHMP website (shown on Figure 3-1) can be accessed at: https://ggcity.org/localhazardmitigationplan.

Figure 3-1 Garden Grove Local Hazard Mitigation Plan Website



Source: City of Garden Grove

The HMPC met formally five times during the planning period (December 2018 – April 2020) which adequately covers the four phases of DMA and the 10-Step CRS planning process. The formal meetings held and topics discussed are described in Table 3-3. Invitations, agendas and sign-in sheets for each of the meetings are included in Appendix A.

Table 3-3 HMPC Meetings

Meeting Type	Meeting Topic	Meeting Date(s)	Meeting Location(s)
HMPC #1 Kick-off Meeting	1) Introduction to DMA and the planning process 2) Overview of current LHMP; 3) Organize Resources: the role of the HMPC, planning for public involvement, coordinating with other agencies/stakeholders 4) Introduction to Hazard Identification	February 28, 2019	Garden Grove Community Meeting Center
HMPC #2	1) Risk assessment overview and work session - Assess the Hazard - Assess the Problem	June 27, 2019	Garden Grove Courtyard Center
HMPC #3	1) Review of risk assessment summary 2) Review and update of mitigation goals 3) Intro to Mitigation Action Strategy - Set Goals - Review possible activities	August 28, 2019	Garden Grove Courtyard Center

Meeting Type	Meeting Topic	Meeting Date(s)	Meeting Location(s)
HMPC #4	1) Review of mitigation alternatives 2) Review and update of mitigation actions from the 2012 Plan 3) Identify updated list of mitigation actions by hazard 4) Review of mitigation selection criteria 5) Update and prioritize mitigation actions 6) Mitigation Action Strategy Implementation and Draft Action Development - Review possible activities - Draft an Action Plan	August 29, 2019	Garden Grove Courtyard Center
HMPC #5	1) Review of final HMPC, jurisdictional and public comments and input to plan 2) Review and documentation of changed conditions, vulnerabilities and mitigation priorities 3) Draft an Action Plan 4) Plan maintenance and Implementation Procedures	January 23, 2020	Garden Grove Courtyard Center

Planning Step 2: Involve the Public

Up-front coordination discussions with the City of Garden Grove established the initial plan for public involvement. Public involvement activities for this LHMP included press releases, social media communications, stakeholder and public meetings, development of an LHMP webpage and associated website postings, and the solicitation of public and stakeholder comments on the draft Plan through a variety of mechanisms. Information provided to the public included an overview of the LHMP process, including a review of the hazard risk assessment and proposed mitigation strategies for this LHMP. At the planning team kick-off meeting, the HMPC discussed additional strategies for public involvement and agreed to an approach using established public information mechanisms and resources within the City.

Early Public Outreach Activities

Public outreach for this LHMP began at the beginning of the plan development process with the development of a Garden Grove webpage and outreach document on the LHMP development process through a variety of mechanisms as described below:

- Early public meeting press release
- Post on OC Breeze website
- Post on the City website

Information on these outreach efforts can be seen in Appendix A to this Plan.

Public Meetings

Although two public meetings were planned for this LHMP project, only one public meeting was held towards the end of the project to allow the public to review and comment on the draft LHMP prior to finalization and submittal to Cal OES and FEMA. An early public meeting was advertised and scheduled, but cancelled the day of the meeting due to another public meeting conflict. Additional information is provided below.

Public Meeting #1: LHMP Kickoff (Meeting Cancelled)

Public outreach for this LHMP began at the beginning of the plan development process with an advertisement placed in the OC Breeze and other local outreach methods to inform the public of the purpose of the DMA and the hazard mitigation planning process for the City of Garden Grove. A press release was also issued at the beginning of the project to invite the public to a public meeting for the kick-off the LHMP project on February 28, 2019, but again this meeting was cancelled.

Public Meeting #2: Meeting on the Draft LHMP

The first draft of the Plan was provided to the HMPC in November of 2019, with a public review draft provided in January of 2020. A public meeting was held on January 22, 2020 to present the draft LHMP and to collect public comments on the Plan prior to finalization and submittal to Cal OES/FEMA. The public meeting on the draft LHMP was advertised in a variety of ways to maximize outreach efforts to the public and included an advertisement in the local newspaper. The advertisement in the local newspaper included information on the date, location and time of the meeting, where the draft Plan could be accessed in the community, and how to provide comments on the draft Plan. In addition to a copy of the draft Plan being placed on the City website in advance of these meetings (see Figure 3-1), hard copies of the draft of the Plan were made available to interested parties at the Planning Department and the Garden Grove Public Library. This can be seen on Figure 3-2.

Figure 3-2 City of Garden Grove– Plan in Garden Grove Library

Documentation to support the public meetings can be found in Appendix A. In addition to advertisement for public participation, notices of meetings were sent directly to all persons on the HMPC contact list and also to other agency and key stakeholders with an interest in the Garden Grove LHMP project. The majority of these people reside in Garden Grove, Orange County and surrounding communities. Additional outreach for review of the Draft LHMP included:

- INSERT

The formal public meetings for this project are summarized in Table 3-4.

Table 3-4 Public and Stakeholder Meetings

Meeting Type	Meeting Topic	Meeting Date	Meeting Locations
Public Meeting #1	1) Intro to DMA and mitigation planning 2) The Garden Grove LHMP Development Process	February 28, 2019 (Cancelled)	Garden Grove Community Center

Meeting Type	Meeting Topic	Meeting Date	Meeting Locations
Public Meeting #2	1)Presentation of Draft LHMP and solicitation of public and stakeholder comments	January 22, 2020	

Where appropriate, stakeholder and public comments and recommendations were incorporated into the LHMP throughout the Plan development process, including the sections that address mitigation goals and strategies. Several public comments were received on the Draft Plan and considered in refinements to the Risk Assessment and Mitigation Strategy sections of this Plan. Public comments received and how they were addressed is included in a comment-response summary included in Appendix A. All newspaper advertisements, website postings, and public outreach efforts are on file with the Garden Grove Department of Public Works and are also included in Appendix A.

The draft LHMP is currently available online on the Garden Grove website at: https://ggcity.org/localhazardmitigationplan.

Planning Step 3: Coordinate with Other Departments and Agencies

Early in the planning process, the HMPC determined that data collection, mitigation strategy development, and plan approval would be greatly enhanced by inviting other local, state and federal agencies and organizations to participate in the process. Based on their involvement in hazard mitigation planning, their involvement in the Planning Area, and/or their interest as a neighboring jurisdiction, representatives from the following agencies were invited to participate on the HMPC:

- California Department of Water Resources
- CAL FIRE
- Cal OES
- Cal Trans
- California Department of Water Resources
- CGS - Earthquake Program
- City of Anaheim
- City of Buena Park
- City of Cypress
- City of Fountain Valley
- City of Los Alamitos
- City of Orange
- City of Orange
- City of Santa Ana
- City of Seal Beach
- City of Seal Beach
- City of Stanton
- City of Stanton
- City of Stanton
- City of Tustin
- City of Westminster
- FEMA Region IX - Hazard Mitigation
- Fire Departments

- Fish and Wildlife
- Municipal Water District of Orange County
- Orange County Community Resources
- Orange County Fire Authority
- Orange County Healthcare
- Orange County Libraries
- Orange County Parks
- Orange County Public Works
- Orange County Vector Control
- Orange County Water District
- National Weather Service
- Orange County
- Red Cross
- Southern California Edison
- United States Corps of Engineers
- USGS

Coordination with key agencies, organizations, and advisory groups throughout the planning process allowed the HMPC to review common problems, development policies, and mitigation strategies as well as identifying any conflicts or inconsistencies with regional mitigation policies, plans, programs and regulations. Coordination involved contacting these agencies and informing them on how to participate in the LHMP development process and if they had any expertise or assistance they could lend to the planning process, risk assessment, or mitigation strategy. These groups and agencies were solicited asking for their assistance and input, telling them how to become involved in the LHMP, and inviting them to HMPC meetings.

In addition, as part of the overall stakeholder and agency coordination effort, the HMPC coordinated with and utilized input to the LHMP update from the following agencies:

- Cal-Adapt
- CAL OES
- CAL FIRE
- California Department of Conservation
- California Department of Finance
- California Department of Water Resources
- California Geological Survey
- FEMA Region IX
- Library of Congress
- Metropolitan Water District of Orange County
- National Oceanic and Atmospheric Association
- National Performance of Dams Program
- National Register of Historic Places
- National Resource Conservation Service
- National Response Center
- National Weather Service
- Southern California Edison
- United States Army Corps of Engineers
- United States Bureau of Land Management
- United States Bureau of Reclamation

- United States Geological Survey
- Western Regional Climate Center

Several opportunities were provided for the groups listed above to participate in the planning process. At the beginning of the planning process, invitations were extended to some of these groups to actively participate on the HMPC. Others assisted in the process by providing data directly as requested in the Data Worksheets or through data contained on their websites or as maintained by their offices. Further as part of the public outreach process, all groups were invited to attend the public meeting and to review and comment on the LHMP prior to submittal to CAL OES and FEMA.

Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community and District planning efforts is also paramount to the success of this LHMP. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Garden Grove uses a variety of comprehensive planning mechanisms, such as general and master plans and state requirements, to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this LHMP establishes a credible and comprehensive plan that ties into and supports other City programs. The development of this LHMP incorporated information from the following existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions.

- Cal OES plans
- Cal-Adapt Plans
- Community Wildfire Protection Plans
- Environmental Impact Reports
- FEMA mitigation planning documents
- Flood Insurance Studies
- Municipal Water District of Orange County LHMP
- Orange County LHMP
- US Army Corps of Engineers Reports
- US Fish and Wildlife reports
- USGS Reports

Specific source documents are referenced at the beginning of each section of Chapter 4 and in Appendix B. These and other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment, and capability assessment. In accordance with DMA requirements and guidance, Best Available Data was used throughout in the development of this LHMP. Where the data from the existing studies and reports is used in this LHMP, the source document is referenced throughout this Plan. Appendix B, References, provides a detailed list of references used in the preparation of this LHMP.

3.2.2. Phase 2: Assess Risks

Planning Steps 4 and 5: Identify the Hazards and Assess the Risks

Foster Morrison led the HMPC in a research effort to identify, document, and profile all the hazards that have, or could have, an impact the Garden Grove Planning Area. The HMPC relied on information from the City's Safety Element to the General Plan, the 2018 State of California Hazard Mitigation Plan, and many other sources to establish the hazards list and associated data for this LHMP. Data collection worksheets were developed and used in this effort to aid in determining hazards and vulnerabilities and where the risk varies across the Planning Area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities.

The HMPC also conducted a capability assessment to review and document the City's current capabilities to mitigate risk from and vulnerability to hazards. By collecting information about existing City programs, policies, regulations, ordinances, and emergency plans, the HMPC could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. A more detailed description of the risk assessment process, methodologies, and results are included in Chapter 4 Risk Assessment.

3.2.3. Phase 3: Develop the Mitigation Plan

Planning Steps 6 and 7: Set Goals and Review Possible Activities

Foster Morrison facilitated brainstorming and discussion sessions with the HMPC that described the purpose and process of developing planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Chapter 5 Mitigation Strategy. Additional documentation on the process the HMPC used to develop the goals and mitigation strategy is in Appendix C.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, a complete first draft of the LHMP was developed. This complete draft was provided for HMPC review and comment via a Dropbox web link. HMPC comments were integrated into the second, public review draft, which was advertised and distributed to collect public input and comments. The HMPC integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a third draft for review and approval by CAL OES and FEMA Region IX, contingent upon final adoption by the Garden Grove City Council.

3.2.4. Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

In order to secure buy-in and officially implement the LHMP, the Plan was adopted by the Garden Grove City Council using the sample resolution contained in Appendix D.

Planning Step 10: Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is in the effectiveness of its implementation. Up to this point in the planning process, all of the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing appropriate mitigation actions. Each recommended action includes key descriptors, such as a lead manager and possible funding sources, to help initiate implementation. An overall implementation strategy is described in Chapter 7 Plan Implementation and Maintenance.

Finally, there are numerous organizations within the Garden Grove Planning Area whose goals and interests interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning Step 3, is paramount to the implementation and ongoing success of this LHMP and hazard mitigation in the City and is addressed further in Chapter 7.

Chapter 4 Risk Assessment

Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction's potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment into a four-step process:

1. Identify hazards
2. Profile hazard events
3. Inventory assets
4. Estimate losses

Data collected through this process has been incorporated into the following sections of this chapter:

- **Section 4.1 Hazard Identification: Natural Hazards** identifies the natural hazards that threaten the City and describes why some hazards have been omitted from further consideration.
- **Section 4.2 Hazard Profiles** discusses the threat to the City and describes previous occurrences of hazard events and the likelihood of future occurrences.
- **Section 4.3 Vulnerability Assessment** assesses the City's total exposure to natural hazards, considering assets and values at risk, critical facilities, populations, and future development trends.
- **Section 4.4 Capability Assessment** inventories existing mitigation activities and policies, regulations, and plans that pertain to mitigation in the City and can affect net vulnerability.

This risk assessment covers the entire geographical extent of the City of Garden Grove, henceforth known as the City of Garden Grove Planning Area.

4.1 Hazard Identification: Natural Hazards

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

The HMPC conducted a hazard identification study to determine the hazards that threaten the City. This section details the methodology and results of this effort.

Data Sources

The following data sources were used for this Hazard Identification: Natural Hazards portion of the plan:

- HMPC input
- National Oceanic and Atmospheric Administration
- City of Garden Grove 2030 General Plan Safety Element
- 2015 Orange County Local Hazard Mitigation Plan
- 2018 State of California Hazard Mitigation Plan
- 2018 Orange County Regional Water and Wastewater Hazard Mitigation Plan
- FEMA Disaster Declaration Database

4.1.1. Methodology and Results

Using existing natural hazards data and input gained through the kickoff planning meeting, the HMPC agreed upon a list of natural hazards that could affect Garden Grove. Hazards data from the California Office of Emergency Services (Cal OES), FEMA, the National Oceanic and Atmospheric Administration (NOAA), and many other sources were examined to assess the significance of these hazards to the City. Significance of each identified hazard was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage. The natural hazards evaluated as part of this LHMP include those that have occurred historically or have the potential to cause significant human and/or monetary losses in the future.

As a starting point, the updated 2018 California State Hazard Mitigation Plan was consulted to evaluate the applicability of State hazards of concern to the City. Building upon this effort, hazards from the 2015 and 2018 Orange County LHMPs, the 2019 Final Draft of the Orange County Regional Water and Wastewater LHMP, and the City of Garden Grove 2030 General Plan Safety Element were also identified and considered.

Certain hazards were excluded from consideration for this LHMP Update. They are shown in Table 4-1.

Table 4-1 City of Garden Grove – Excluded Hazards

Hazard Excluded	Why Excluded
Agricultural and Silvicultural Pests and Diseases	No agriculture exists in or near the City, and there are few bodies of water or rivers that exist in the City.

Hazard Excluded	Why Excluded
Air Pollution	While a concern, the City noted that air pollution is handled through the General Plan and other City planning mechanisms and is discussed in this LHMP as an impact of fires.
Airline Crashes	There have been no past occurrences in the City of airplane crashes.
Avalanches	The City does not have sufficient snowfall nor sloped areas to have avalanche as a hazard.
Civil Disorder	The City did consider this a hazard, but it is dealt with in the EOP or other planning mechanisms.
Coastal Flooding, Erosion, and Sea Level Rise	The City is not on the coast.
Cyber Threats	The County did consider this a hazard, but it is dealt with in the EOP or other planning mechanisms.
Energy Shortage and Energy Resilience	While a hazard, the City noted that energy issues are handled through the General Plan and other planning documents.
Epidemic/Pandemic/Vector Borne Disease Hazards	The City did not consider this a hazard due to the low likelihood of occurrence. Further this hazard falls under the public health department.
Freeze	The City has relatively low numbers of days that fall below 32°F.
Insects Pests and Diseases	The City did not include this a hazard due to the limited likelihood of occurrence and the City's desire to focus on natural hazards of concern to FEMA
Landslide and Debris Flows	The City did not consider this a hazard due to its relatively flat topography.
Natural Gas Pipeline Hazards	The City did not consider this a hazard due to the low number of gas pipelines traversing the City, according to the California Energy Commission.
Oil Spills	The City did not consider this a hazard, as there are few pipelines or oil wells in the City and limited transportation of oil.
Radiological Accidents	There are no areas in the City at risk to this hazard.
Terrorism	The City did consider this a hazard, as it is dealt with in the EOP or other planning mechanisms.
Tornado	Tornadoes are exceedingly rare in the City.
Tsunami and Seiche	The City is not on the coast or next to a large body of water.
Volcano	Volcanic activity near the City is low.
Well Stimulation and Hydraulic Fracking	This is not occurring in the City and not a hazard to be considered in this LHMP.

The worksheet below was completed by the HMPC to identify, profile, and rate the significance of identified hazards, which include those hazards determined to be of medium or higher significance as rated below. Only the more significant (or priority) hazards have a more detailed hazard profile and are analyzed further in Section 4.3 Vulnerability Assessment. Table 4-35 in Section 4.2.14 Natural Hazards Summary provides an overview of these significant hazards.

Table 4-2 City of Garden Grove Hazard Identification

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Negligible	Medium	–
Dam Failure	Significant	Unlikely	Catastrophic	High	Medium
Drought and Water Shortage	Extensive	Likely/Occasional	Limited	Medium	Medium
Earthquake	Extensive	Highly Likely/Occasional	Catastrophic	High	Low
Earthquake: Liquefaction	Limited	Occasional	Critical	Medium	Low
Flood: (100/500 year)	Extensive	Occasional/Unlikely	Critical	High	High
Flood: Localized/Stormwater	Significance	Highly Likely	Limited	Medium	High
Levee Failure	Limited	Unlikely	Limited	Medium	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Negligible	Medium	Medium
Severe Weather: Heavy Rains and Storms	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: High Winds	Extensive	Highly Likely	Limited	Medium	Low
Wildfire (Conflagration)	Extensive	Highly Likely	Catastrophic	Medium	Medium

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal future impact
Medium: moderate future impact
High: widespread future impact

Source: City of Garden Grove

4.1.2. Disaster Declaration History

One method to identify hazards based upon past occurrences is to look at what events triggered federal and/or state disaster declarations within the City (though disaster declarations are declared on a county basis). Disaster declarations are granted when the severity and magnitude of the event's impact surpass the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, following the local agency's declaration, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state government's capacity is exceeded, a federal disaster declaration may be issued allowing for the provision of federal disaster assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors. This section focuses on state and federal disasters and emergency declarations.

Orange County has experienced 37 federal and 37 state declarations since 1950. 2 of the federal declarations was associated with earthquake events, 15 from fire, 17 with flood events, 1 with hurricane (for evacuations stemming from Hurricane Katrina in 2005), and 2 from landslides. 3 of the state declarations was associated with agricultural hazards, 1 from drought, 1 from high tides, 2 from earthquake, 3 were economic, 6 was from fire, 19 from flood, and 2 from landslide. Details of federal and state disaster declarations is shown in Table 4-3. A summary of federal and state disaster declarations is shown in Table 4-4.

Table 4-3 Orange County Disaster Declarations 1950-2019

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2017	California Wildfires	Fire	Fire	DR-4344	10/9/2017	10/10/2017
2017	Canyon 2 Fire	Fire	Fire	FM-5223	–	10/9/2017
2017	Canyon Fire	Fire	Fire	FM-5213	–	9/26/2017
2017	California Severe Winter Storms, Flooding, and Mudslides	Flood	Storms	DR-4305	2/10/2017	3/16/2017
2014	California Drought	Drought	Drought	GP 2014-13	1/17/2014	–
2011	California Winter Storms, Flooding, and Debris and Mud Flows	Flood	Storms	DR-1952	12/21/2010, 12/23/2010, 12/24/2010, 12/30/2010	1/26/2011
2009	49er Fire	Fire	Fire	FM-2832	–	8/31/2009

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2008	California Wildfires	Fire	Fire	DR-1810	–	11/18/2008
2008	Freeway Complex Fire	Fire	Fire	FM-2792	–	11/15/2008
2007	California Wildfires	Fire	Fire	DR-1731	–	10/24/2007
2007	California Wildfires	Fire	Fire	EM-3279	–	10/23/2007
2007	Santiago Fire	Fire	Fire	FM-2737	–	10/22/2007
2007	241 Fire	Fire	Fire	FM-2683	–	3/11/2007
2006	Sierra Fire	Fire	Fire	FM-2630	–	2/6/2006
2005	Hurricane Katrina Evacuations	Economic	Hurricane	EM-3248 2005	–	9/13/2005
2005	California Severe Storms, Flooding, Landslides, and Mud and Debris Flows	Flood	Storms	DR-1585	3/16/2005	4/14/2005
2005	California Severe Storms, Flooding, Debris Flows, and Mudslides	Flood	Storms	DR-1577	1/12/2005	2/4/2005
2003	Exotic Newcastle Disease Epidemic	Agricultural	Disease	GP 2003	1/3/2003	–
2002	Antonio Fire	Fire	Fire	FSA-2405	–	5/14/2002
2001	Energy Emergency	Economic	Greed	GP-2001	1/1/2001	–
1998	1998 El Nino Floods	Flood	Storms	DR-1203	Proclaimed	2/19/1998
1997	Floods (Orange)	Flood	Storms	97-04	12/10/1997	–
1996	California Severe Fires	Fire	Fire	EM-3120	–	10/23/1996
1996	1996 Severe Fires	Fire	Fire	96-04	10/22/1996	–
1995	1995 Severe Winter Storms	Flood	Storms	DR-1046	1/6/95-3/14/95	3/12/1995
1995	1995 Severe Winter Storms	Flood	Storms	DR-1044	1/6/95-3/14/95	1/13/1995

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1994	Northridge Earthquake	Earthquake	Earthquake	DR-1008	1/17/1994	1/17/1994
1993	California Fires, Mud & Landslides, Soil Erosion, Flooding	Post Fire Mud & Landslides, Soil Erosion, Flooding	Fires and Storms	DR-1005	10/27/93, 10/28/93	10/28/1993
1993	California Severe Storm, Winter Storm, Mud & Landslides, Flooding	Flood	Storms	DR-979	1/7/93 - 2/19/93	2/3/1993
1992	California Snow Storm, Heavy Rain, High Winds, Flooding, Mudslide	Flood	Storms	DR-935	2/12/92, 2/19/92	2/25/1992
1989	Mediterranean Fruit Fly	Agricultural	Insect Pest	GP 1989	11/20/1989	–
1988	California Severe Storms, High Tides, Flooding	Flood	Storms	DR-812	1/21/1988	2/5/1988
1987	California Earthquake and Aftershocks	Earthquake	Earthquake	DR-799	10/2/87 - 10/5/87	10/7/1987
1982	Winter Storms	Flood	Flood	DR-677	12/8/82-3/21/83	2/9/1983
1982	Dayton Hills Fire	Fire	Fire	GP	10/10/1982	–
1982	California Urban Fires	Fire	Fire	DR-657	4/21/1982	4/24/1982
1980	California Burs, Timber Fires	Fire	Fire	DR-635	11/18/1980, 11/25/80	11/27/1980
1980	California Severe Storms, Mudslides, Flooding	Flood	Storms	DR-615	2/21/80, 2/7/80, 2/19/80	2/21/1980
1979	Gasoline Shortage	Economic	OPEC	–	5/8/79 - 11/13/79	–
1978	California Landslides	Landslides	Storms	DR-566	10/5/1978	10/9/1978

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1978	California Coastal Storms, Mudslides, and Flooding	Flood	Storms	DR-547	3/9/78, 2/27,78, 2/13/78	2/15/1978
1974	Gasoline Shortage	Economic	OPEC	–	2/28/74, 3/4/74, 3/10/74	–
1972	Exotic Newcastle Disease	Agricultural	Disease	–	4/10/72, 5/22/72	–
1969	1969 Storms	Flood	Storms	DR-253	1/23/69-3/12/69	1/26/1969
1967	Woodson Fire	Fire	Fire	–	1/7/1967	–
1963	High Tides and Heavy Surf	Flood	High Tides	–	Unknown	–
1958	1958 April Storms and Floods	Flood	Storms	DR-82	4/5/1958	4/4/1958
1958	1958 February Storms and Floods	Flood	Storms	CDO 58-03	2/26/1958	–
1955	1955 Floods	Flood	Flood	DR-47	12/22/1955	12/23/1955
1950	1950 Floods	Flood	Flood	OCD 50-01	11/21/1950	–

Source: Cal OES, FEMA

Table 4-4 Orange County Disaster Declarations 1950-2019 Summarized by Disaster Type

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Agricultural	3	1972, 1989, 2003	0	–
Drought	1	2014	0	–
Earthquake	2	1987, 1994	2	1987, 1994
Economic	3	1974, 1979, 2001	0	–
Fire	6	1967, 1980, 1982 (twice), 1996, 2017	15	1980, 1982, 1996, 2002, 2006, 2007 (four times), 2008 (twice), 2009, 2017 (three times)
Flood	19	1950, 1955, 1958 (twice), 1969, 1978, 1980, 1982, 1988, 1992, 1993, 1995 (twice), 1997, 1998, 2005 (twice), 2011, 2017	17	1955, 1958, 1969, 1978, 1980, 1982, 1983, 1988, 1992, 1993, 1995 (twice), 1998, 2005 (twice), 2011, 2017
High Tides	1	1963	0	
Hurricane	0	–	1	2005

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Landslide	1	1978	1	1978
Post Fire Mud & Landslides, Soil Erosion, Flooding	1	1993	1	1993
Totals	**37**	–	**37**	**–**

Source: Cal OES, FEMA

4.2 Hazard Profiles

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The hazards identified in Section 4.1 Hazard Identification Natural Hazards, are profiled individually in this section. In general, information provided by planning team members is integrated into this section with information from other data sources. These profiles set the stage for Section 4.3 Vulnerability Assessment, where the vulnerability is quantified, as data allows, for each of the priority hazards.

Each hazard is profiled in the following format:

- **Hazard/Problem Description**—This section gives a description of the hazard and associated issues followed by details on the hazard specific to the City. Where known, this includes information on the hazard location, extent, seasonal patterns, speed of onset/duration, and magnitude and/or any secondary effects.
- **Past Occurrences**—This section contains information on historical incidents, including impacts where known. The extent or location of the hazard within or near the City is also included here. Historical incident worksheets were used to capture information from the City on past occurrences.
- **Likelihood of Future Occurrence**—The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. It was determined by dividing the number of events observed by the number of years on record and multiplying by 100. This gives the percent chance of the event happening in any given year (e.g., three droughts over a 30-year period equates to a 10 percent chance of a experiencing a drought in any given year). The likelihood of future occurrences is categorized into one of the following classifications:
  - ✓ **Highly Likely**—Near 100 percent chance of occurrence in next year or happens every year
  - ✓ **Likely**—Between 10 and 100 percent chance of occurrence in next year or has a recurrence interval of 10 years or less
  - ✓ **Occasional**—Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years
  - ✓ **Unlikely**—Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.
- **Climate Change**—This section contains the effects of climate change (if applicable). The possible ramifications of climate change on the hazard are discussed.

Section 4.2.14 Natural Hazards Summary provides an initial assessment of the profiles and assigns a level of significance or priority to each hazard. Those hazards determined to be of medium or high significance were characterized as priority hazards that required further evaluation in Section 4.2.14 Vulnerability Assessment. Those hazards that occur infrequently or have little or no impact on the City were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency and resulting damage, including deaths/injuries and property, crop, and economic damage. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the City, enabling Garden Grove to focus resources where they are most needed.

The following sections provide profiles of the priority natural hazards that the HMPC identified in Section 4.1 Hazard Identification. Given that most disasters that affect the City are directly or indirectly related to severe weather events, severe weather hazards begin this section, and the other individual hazard profiles follow alphabetically.

Data Sources

The following data sources formed the basis for this Hazard Profiles portion of the plan:

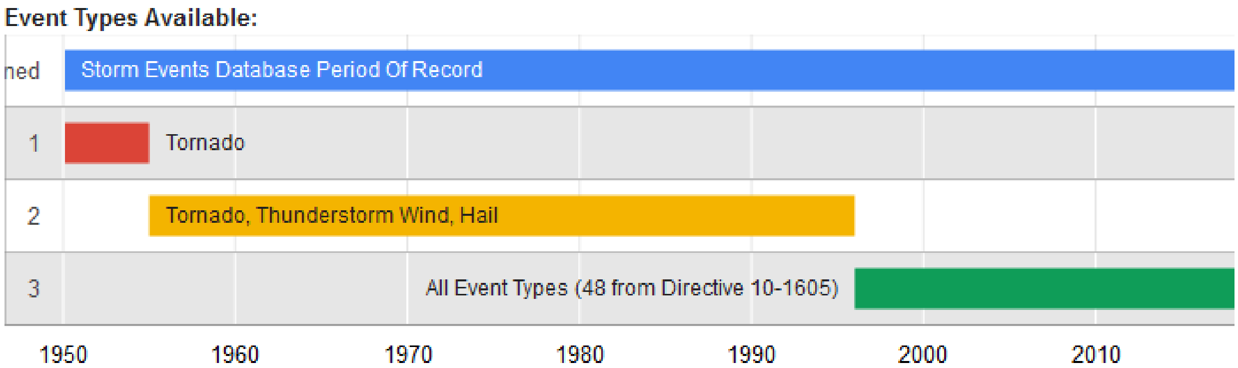
- 2014 California Climate Adaptation Strategy
- 2015 Orange County Local Hazard Mitigation Plan
- 2017 Orange County Draft CWPP
- 2019 Final Draft of the Orange County Regional Water and Wastewater LHMP
- CAL FIRE Fire Hazard Severity Zones
- CAL FIRE Fire History Database
- Cal-Adapt – Extreme Precipitation Events
- Cal-Adapt – Precipitation: Decadal Averages Map
- Cal-Adapt – Projected Wildfire Burn Area Increase
- Cal-Adapt – Temperature: Decadal Averages Map
- Cal-Adapt: – Wildfire: Decadal Averages
- California Department of Water Resources
- California Department of Water Resources – Best Available Maps
- California Department of Water Resources Division of Safety of Dams
- California Division of Mines and Geology
- California Natural Resource Agency
- California's Adaptation Planning Guide: Understanding Regional Characteristics
- California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources
- City of Garden Grove 2016 Emergency Operations Plan
- City of Garden Grove 2030 General Plan
- City of Garden Grove 2030 General Plan Environmental Impact Report
- City of Garden Grove 2030 General Plan Safety Element
- City of Garden Grove 2015 Urban Water Management Plan
- Climate Change and Health Profile Report - Orange County
- Federal Emergency Management Agency
- FEMA – Disaster Declaration Database

- FEMA Orange County Digital Flood Insurance Rate Map 3/21/2019
- FEMA Orange County Flood Insurance Study
- FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes
- Intergovernmental Panel on Climate Change (IPCC)
- IPCC 2014 Fifth Assessment Synthesis Report
- Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR
- Multi-Hazard Identification and Risk Assessment, FEMA 1997
- National Climate Assessment
- National Drought Mitigation Center
- National Integrated Drought Information System
- National Levee Database
- National Oceanic and Atmospheric Administration's National Climatic Data Center Storm Events Database
- National Performance of Dams Program
- National Weather Service
- NOAA Storm Prediction Center
- NOAA's Climate Prediction Center
- Orange County Climate Change and Health Report
- Orange County Water District
- Petersen, M. et al., 2018 One-Year Seismic Hazard Forecast from Induced and Natural Earthquakes - Seis. Res. Lett., doi.org/10.1785/0220180005.
- Science Magazine
- Southern California Association of Governments
- U.S. Drought Monitor
- U.S. Geologic Survey National Earthquake Information Center Database
- U.S. Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977
- U.S. Geological Survey Open File Report 2015-3009
- US Army Corps of Engineers
- USACE Levee Safety Program Santa Ana River 1 Levee System Report
- Vaisala National Lightning Detection Network
- Western Regional Climate Center

4.2.1. Severe Weather: General

Severe weather is generally any destructive weather event, but usually occurs throughout the City Planning Area as extreme temperatures and localized storms that bring heavy rain, and strong winds, and much less frequently hail and lightning. The National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) has been tracking severe weather since 1950. Their Storm Events Database contains data on the following events shown on Figure 4-1.

Figure 4-1 NCDC Storm Events Database Period of Record



Event Types Available:
Add more info about event types here. Link to collections page/tab when referencing data collection source.

1. Tornado: From 1950 through 1954, only tornado events were recorded.

2. Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, only tornado, thunderstorm wind and hail events were keyed from the paper publications into digital data. From 1993 to 1995, only tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files.

3. All Event Types (48 from Directive 10-1605): From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605.

Source: NCDC

This database contains 591 severe weather events that occurred in Orange County between January 1, 1950, and October 31, 2018. Table 4-5 summarizes these events.

*Table 4-5 Orange County NCDC Storm Events 1/1/1950-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Coastal Flood	6	0	0	0	0	$35,000	$0
Debris Flow	6	1	0	0	0	$318,500	$0
Dense Fog	47	0	0	1	0	$0	$0
Drought	26	0	0	0	0	$0	$0
Dust Devil	1	0	0	0	0	$6,000	$0
Excessive Heat	8	0	0	0	0	$0	$0
Flash Flood	38	2	0	2	0	$63,745,000	$480,000
Flood	33	0	0	3	0	$40,735,000	$242,000
Frost/Freeze	1	0	0	0	0	$0	$0
Funnel Cloud	34	0	0	0	0	$0	$0
Hail	11	1	0	0	0	$75,100	$0
Heat	9	1	0	0	0	$0	$0

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Heavy Rain	15	1	0	19	1	$36,280,000	$0
Heavy Snow	2	0	0	0	0	$0	$0
High Surf	43	1	0	7	0	$265,000	$0
High Wind	153	1	0	0	0	$633,000	$1,000
Lightning	4	0	0	0	0	$62,000	$0
Rip Current	26	14	18	0	0	$20,000	$0
Storm Surge	2	0	0	0	0	$242,500	$0
Strong Wind	12	0	0	0	0	$468,000	$0
Thunderstorm Wind	34	0	0	0	0	$1,246,000	$20,000
Tornado	32	0	0	0	0	$0	$0
Tsunami	0	0	0	0	0	$0	$0
Waterspout	13	0	0	0	0	$0	$0
Wildfire	30	0	3	22	0	$31,535,000	$0
Winter Storm	3	0	0	0	0	$5,000	$0
Winter Weather	2	0	0	0	0	$0	$0
Total	**591**	**22**	**21**	**54**	**1**	**$175,671,100**	**$743,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

The NCDC table above summarizes severe weather events that occurred in greater Orange County, which may have also occurred within the City. Only a few of the events actually resulted in state and federal disaster declarations. It is further interesting to note that different data sources capture different events during the same time period, and often display different information specific to the same events. While the HMPC recognizes these inconsistencies, they see the value this data provides in depicting the City's "big picture" hazard environment.

As previously mentioned, most all of Orange County's state and federal disaster declarations have been a result of severe weather. For this plan, severe weather is discussed in the following subsections:

- Extreme Heat
- Heavy Rains and Storms
- High Winds

While the HMPC decided not to include cold and freeze as a hazard, cold weather does happen periodically, with little effect to the City. On average, the City sees 6.2 days per year where the low falls below 32°F. Record colds from the closest weather station are shown in Table 4-6.

Table 4-6 City of Garden Grove– Record Cold Temperatures by Month from 1906 to 2016

Month	Temperature	Date	Month	Temperature	Date
January	22°	1/1/1919	July	39°	7/5/1923
February	25°	2/14/1949	August	45°	8/17/1918
March	29°	3/2/1939	September	40°	9/9/1917
April	31°	4/11/1953	October	34°	10/12/1924
May	35°	5/4/1950	November	24°	11/28/1919
June	39°	6/8/1950	December	22°	12/31/1918

Source: Western Regional Climate Center – Santa Ana Fire Station Coop Station

4.2.2. Severe Weather: Extreme Heat

Hazard/Problem Description

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. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died.

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds a level at which the body can remove it, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise, and heat-related illness may develop. Elderly persons, small children, chronic invalids, those on certain medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions.

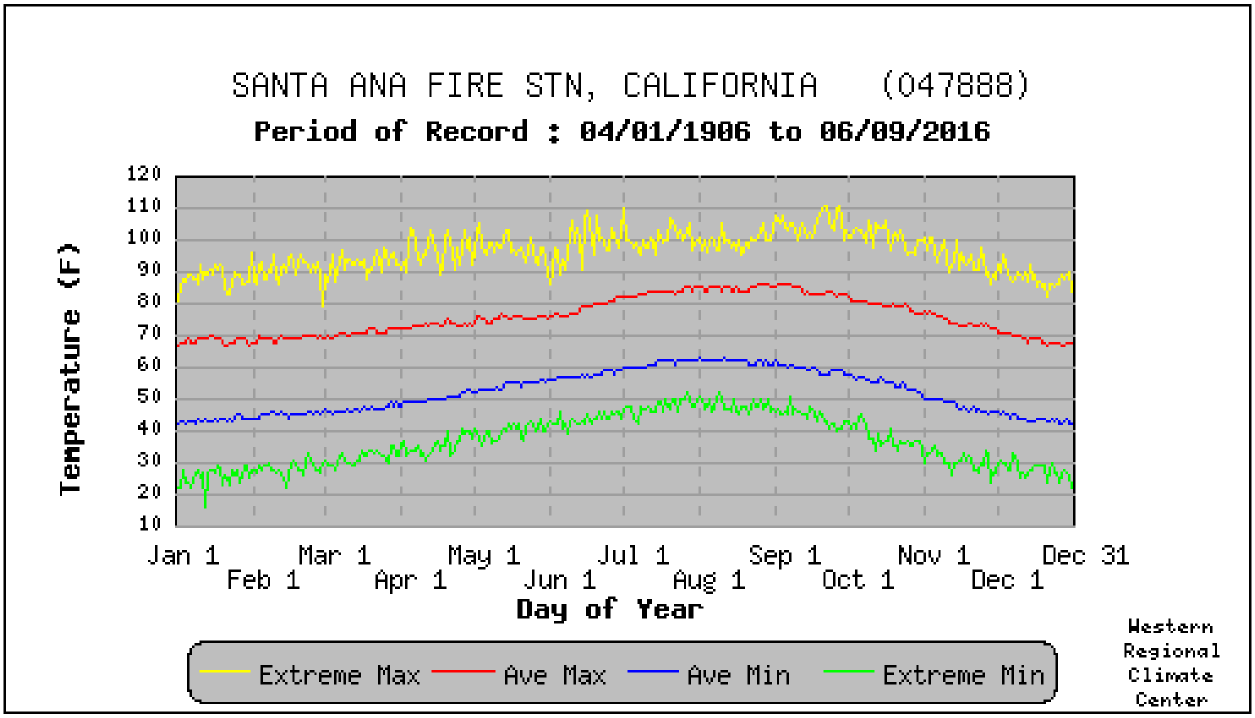
Location

Extreme heat events occur on a regional basis. The Orange County area tends to have numerous extreme heat days due to its location. Extreme heat can occur in any location of the City. All portions of the City are at risk to extreme heat. Extreme heat occurs throughout the Planning Area primarily during the summer months. The WRCC maintains data on weather normal and extremes in the western United States. WRCC data for the City is summarized below.

City of Garden Grove—Santa Ana Fire Station Weather Station, Period of Record 1906 to 2016

According to the WRCC, in Garden Grove, monthly average maximum temperatures in the warmest months (May through October) range from the upper-70s to the mid-80s. The highest recorded daily extreme was 112°F on June 14, 1917. In a typical year, maximum temperatures exceed 90°F on 24.8 days. Figure 4-2 shows the average daily high temperatures and extremes for the City. Table 4-7 shows the record high temperatures by month for the City.

Figure 4-2 City of Garden Grove — Daily Temperature Averages and Extremes



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Table 4-7 City of Garden Grove– Record High Temperatures 1906 to 2016

Month	Record High	Date	Month	Record High	Date
January	96°	1/32/2003	July	110°	7/1/1985
February	95°	2/20/1995	August	105°	8/10/1935
March	98°	3/25/1988	September	111°	9/21/1939
April	104°	4/5/1989	October	106°	10/16/1958
May	105°	5/3/2004	November	101°	11/1/1966
June	112°	6/14/1917	December	95°	12/3/1958

Source: Western Regional Climate Center

Extent

Heat emergencies are often slower to develop, taking several days of continuous, oppressive heat before a significant or quantifiable impact is seen. Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations. Heat waves do not generally cause damage or elicit the immediate response of floods, fires, earthquakes, or other more "typical" disaster scenarios. While heat waves are obviously less dramatic, they are potentially deadlier. According to the 2018 California State Hazard Mitigation Plan, the worst single heat wave event in California occurred in Southern California in 1955, when an eight-day heat wave resulted in 946 deaths.

The National Weather Service (NWS) has in place a system to initiate alert procedures (advisories or warnings) when extreme heat is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. The NWS HeatRisk forecast provides a quick view of heat risk potential over the upcoming seven days. The heat risk is portrayed in a numeric (0-4) and color (green/yellow/orange/red/magenta) scale which is similar in approach to the Air Quality Index (AQI) or the UV Index. This can be seen in Table 4-8.

Table 4-8 National Weather Service HeatRisk Categories

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

Source: National Weather Service

The NWS office in Los Angeles can issue the following heat-related advisory as conditions warrant.

- **Heat Advisories** are issued during events where the HeatRisk is on the Orange/Red threshold (Orange will not always trigger an advisory)
- **Excessive Heat Watches/Warnings** are issued during events where the HeatRisk is in the Red/Magenta output

Extreme heat is made worse when it is experienced over a longer stretch of time.

Past Occurrences

Disaster Declaration History

There have been no FEMA or Cal OES disasters related to extreme heat, as shown in Table 4-3.

NCDC Events

The NCDC has tracked heat and extreme heat events since 1996 for Orange County. 9 events were recorded for Orange County, as shown in Table 4-6. Specifics on damages in the City were not included in the database.

*Table 4-9 Orange County NCDC Heat Events 1/1/1996-10/31/2018**

Event Type	Date	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Heat	8/2/1997	0	0	0	0	$0	$0

Event Type	Date	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Heat	9/1/2002	0	0	0	0	$0	$0
Heat	7/21/2006	0	0	0	0	$0	$0
Heat	9/1/2007	0	1	0	0	$0	$0
Heat	10/25/2017	0	0	0	0	$0	$0
Heat	11/22/2017	0	0	10	0	$0	$0
Heat	11/22/2017	0	0	1	0	$0	$0
Heat	11/23/2017	1	0	1	0	$0	$0
Heat	8/6/2018	0	0	0	0	$0	$0
Total		**1**	**1**	**12**	**0**	**$ 0**	**$ 0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

Hazard Mitigation Planning Committee Events

Though the HMPC noted that extreme heat does occur during the summer months, no specific events or damages from extreme heat could be recalled. However, every summer, extreme heat events occur necessitating the opening of the cooling centers by the City. When temperatures reach or exceed 95° F cooling centers are opened in the City. On September 4 of 2019, extreme high temperatures occurred. The City opened a Cooling Center at H. Louis Lake Senior Center. The cooling center was open from 11:00 am to 5:00 pm.

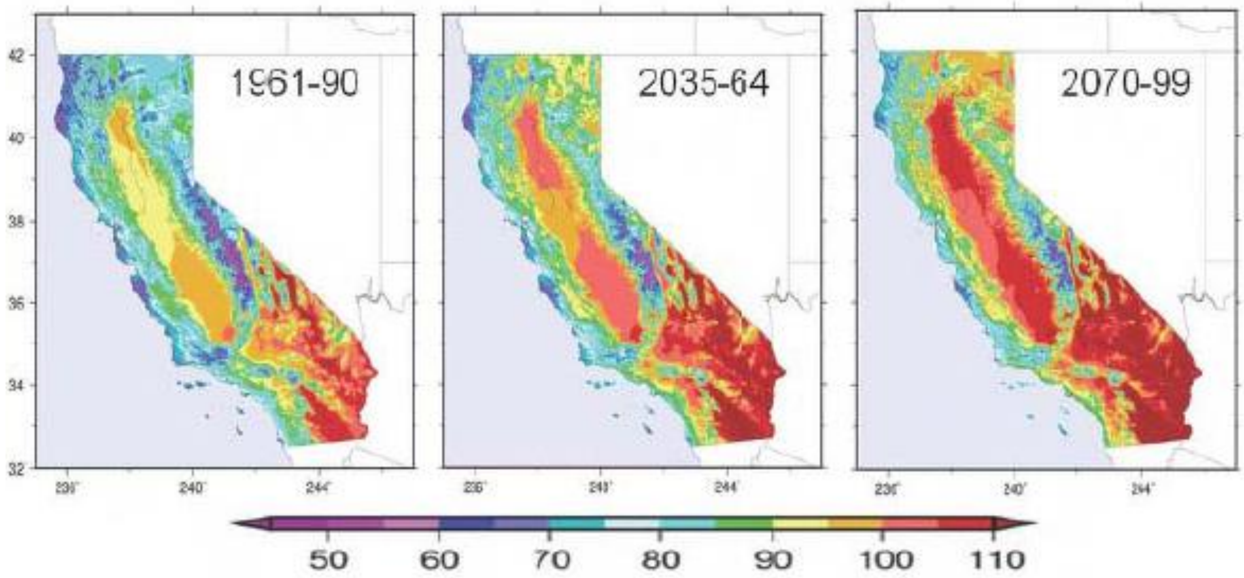
Likelihood of Future Occurrences

Highly Likely—Temperature extremes are likely to continue to occur annually in the City Planning Area. Temperatures at or above 90°F can occur on summer days in the City.

Climate Change and Extreme Heat

The 2014 California Climate Adaptation Strategy (CAS), citing a California Energy Commission study, states that "over the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined." This study shows that California is getting warmer, leading to an increased frequency, magnitude, and duration of heat waves. These factors may lead to increased mortality from excessive heat, as shown in Figure 4-3.

Figure 4-3 California Historical and Projected Temperature Increases – 1961 to 2099



Source: Dan Cayan; California Climate Adaptation Strategy

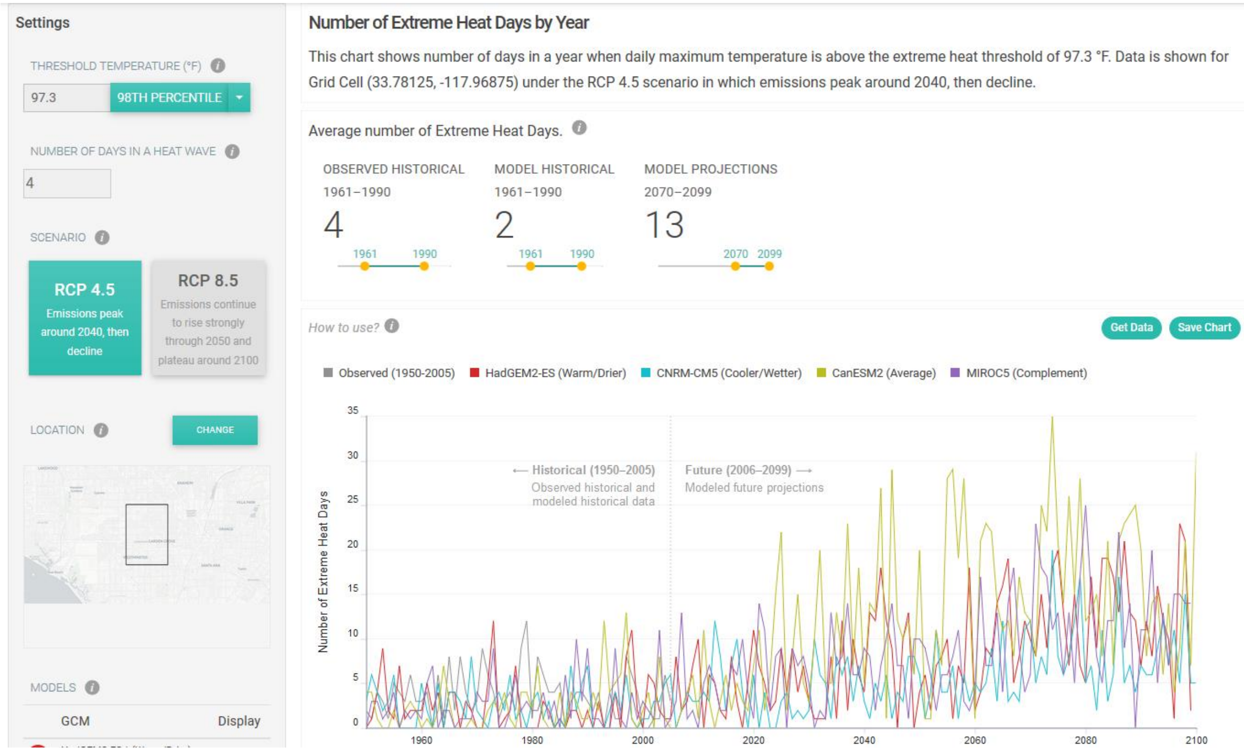
As temperatures increase, California and the City will face increased risk of death from dehydration, heat stroke, heat exhaustion, heart attack, stroke and respiratory distress caused by extreme heat. According to the 2013 California Climate Adaptation Study (CAS) report and the 2018 State of California Hazard Mitigation Plan, by 2100, hotter temperatures are expected throughout the state, with projected increases of 3-5.5°F (under a lower emissions scenario) to 8-10.5°F (under a higher emissions scenario). These changes could lead to an increase in deaths related to extreme heat in the City.

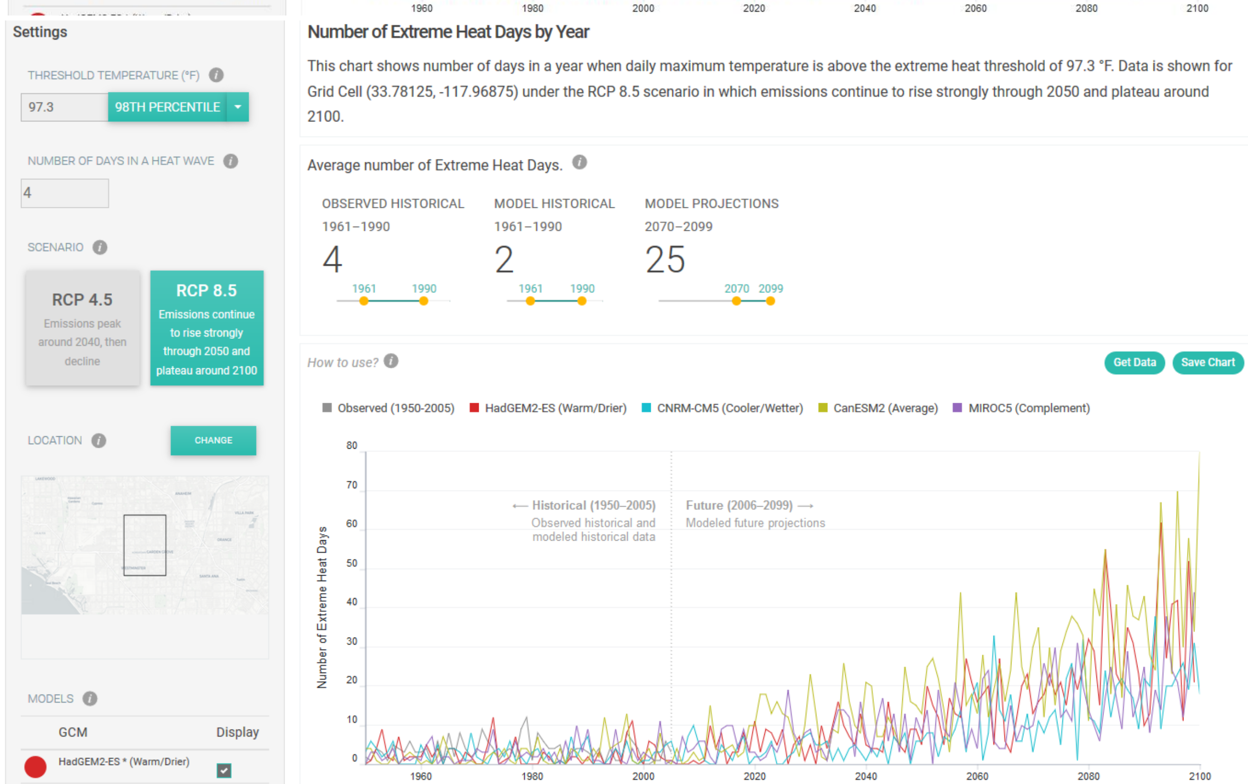
Cal Adapt also noted that overall temperatures are expected to rise substantially throughout this century. During the next few decades, scenarios project average temperature to rise between 1 and 2.3°F; however, the projected temperature increases begin to diverge at mid-century so that, by the end of the century, the temperature increases projected in the higher emissions scenario (RCP (Representative Concentration Pathway) 8.5) are approximately twice as high as those projected in the lower emissions scenario (RCP 4.5).

These projections also differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand. Future temperature estimates from Cal-Adapt for the City of Garden Grove are shown in Figure 4-4. It shows the following:

- The upper chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 86.3°F. Data is shown for Garden Grove under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100.
- The lower chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 86.3 °F. Data is shown for Garden Grove under the RCP 4.5 scenario in which emissions peak around 2040, then decline.

Figure 4-4 City of Garden Grove – Future Temperature Estimates in High and Low Emission Scenarios





Source: Cal-Adapt – Temperature: Decadal Averages Map

4.2.3. Severe Weather: Heavy Rains and Storms

Hazard/Problem Description

Storms in the City Planning Area are generally characterized by heavy rain often accompanied by strong winds and infrequently, lightning and hail. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado. Heavy precipitation in the Garden Grove area falls mainly in the fall, winter, and spring months.

Heavy Rain and Storms

The NWS reports that heavy rains, storms and thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads out at Earth's surface and causes strong winds associated with thunderstorms.

According to the HMPC, short-term, heavy storms can cause both general flooding as well as localized drainage issues. With increased growth of the area, adequate drainage and conveyance systems have become an increasingly important issue. In addition to the flooding that often occurs during these storms, strong winds, when combined with saturated ground conditions, can cause power outages and down very mature trees.

Location

Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the City, County, and Los Angeles Basin. All portions of the City are at risk to heavy rains. Most of these rains occur during the winter months, as discussed below. Past event locations are shown on Figure 4-11 below.

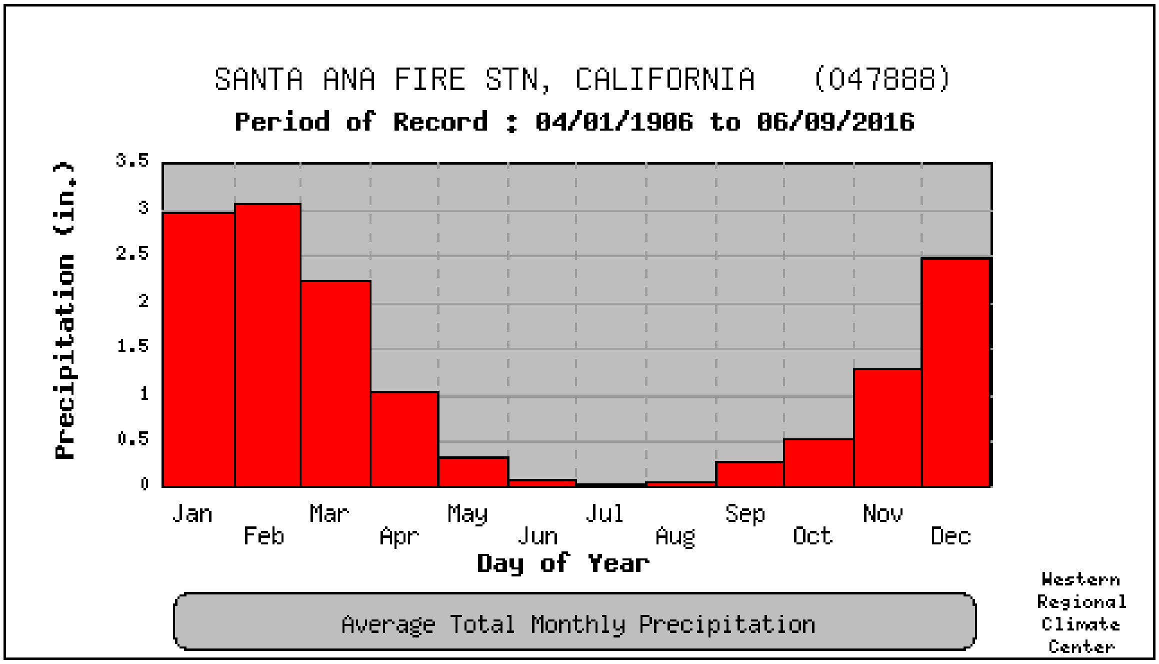
Extent

There is no scientific scale by which heavy rains and storms are measured. Magnitude of storms is measured often in rainfall and damages. The speed of onset of heavy rains can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms in California is often short, ranging from minutes to hours. Information from the WRCC station is summarized below.

City of Garden Grove—Santa Ana Fire Station Weather Station, Period of Record 1906 to 2016

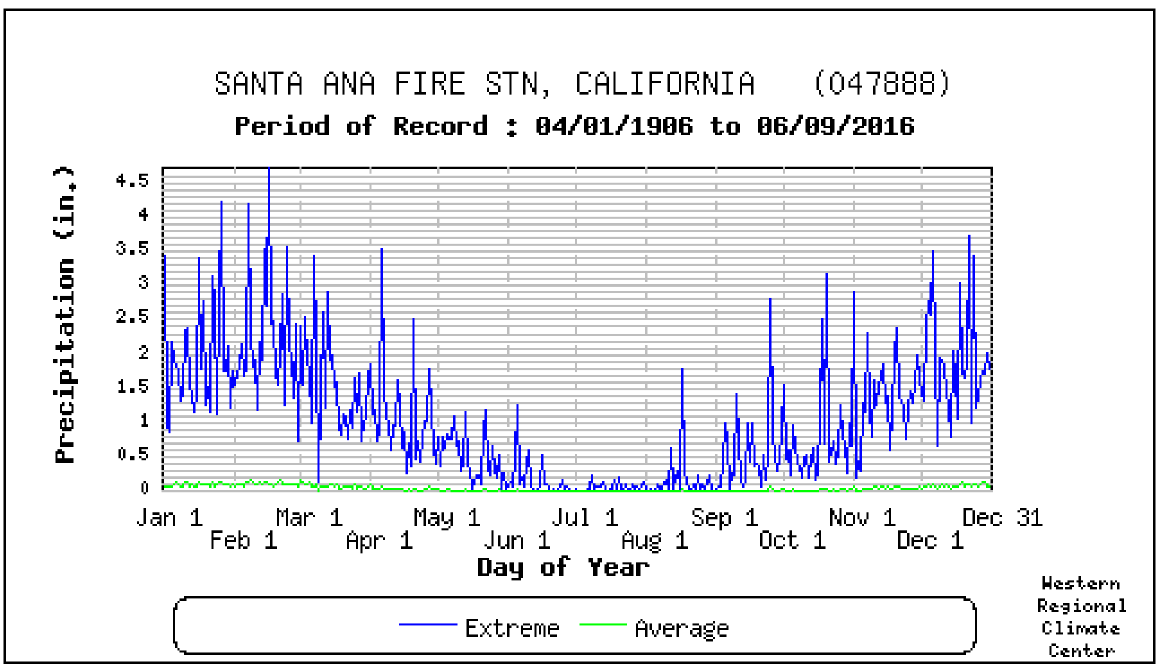
According to the WRCC, average annual precipitation in Garden Grove is 13.69 inches per year. The highest recorded annual precipitation is 32.36 inches in 1941; the highest recorded precipitation for a 24-hour period is 4.69 inches on February 16, 1927. The lowest recorded annual precipitation was 3.55 inches in 1961. Average monthly precipitation for Garden Grove is shown in Figure 4-5. Daily average and extreme precipitations are shown in Figure 4-6.

Figure 4-5 City of Garden Grove – Monthly Average Total Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

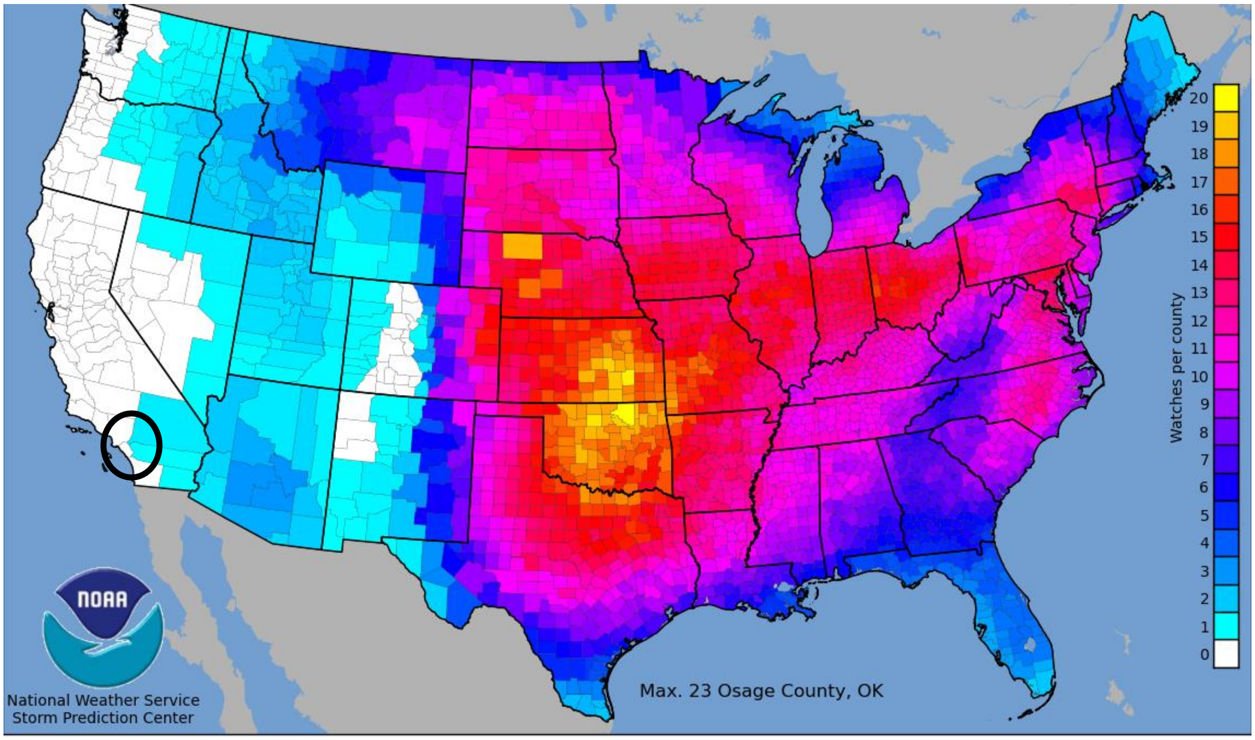
Figure 4-6 City of Garden Grove – Daily Average and Extreme Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

The NOAA Storm Prediction Center tracks thunderstorm watches on a county basis. Figure 4-7 shows thunderstorm watches in the City and the United States for a 20-year period between 1993 and 2012.

Figure 4-7 City of Garden Grove – – Average Thunderstorm Watches per Year (1993 to 2012)



Source: NOAA Storm Prediction Center. Map retrieved 5/16/2019

Hail

While infrequent, hail can occur throughout the Planning Area during storm events. 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, in the form of small pellets, is sometimes associated with severe storms within the City of Garden Grove. Hailstones in general 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.

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-10 indicates the hailstone measurements utilized by the National Weather Service.

Table 4-10 Hailstone Measurements

Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball
.75 inch	Dime/Penny

Average Diameter	Corresponding Household Object
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

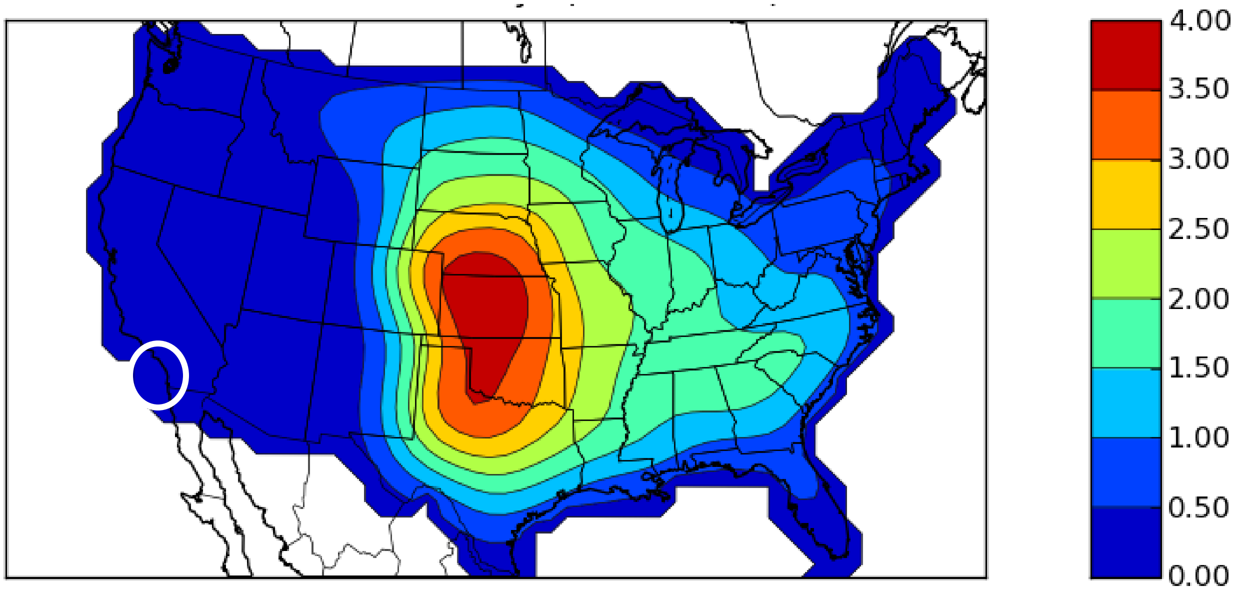
Location

Hail events can occur in any location of the City. All portions of the City are at risk to hail. Hail tends to be rare in the City and Orange County, as discussed in the extent section below. Past event locations are shown on Figure 4-11 below.

Extent

Hail tends to be rare in California. The amount of hail that falls and the size of hailstones determines the scale of a hailstorm. The speed of onset of hail can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms that can cause hail in California is often short, ranging from minutes to hours. Hail events last shorter than the duration of the total thunderstorm. The National Weather Service tracks hail events. Figure 4-8 shows the average days each year where hail of greater than 1" in diameter occurred during a 20-year period from 1990 to 2009.

Figure 4-8 City of Garden Grove – Average Hail Days per Year (1990 to 2009)



Source: National Weather Service. Map retrieved 5/16/2019

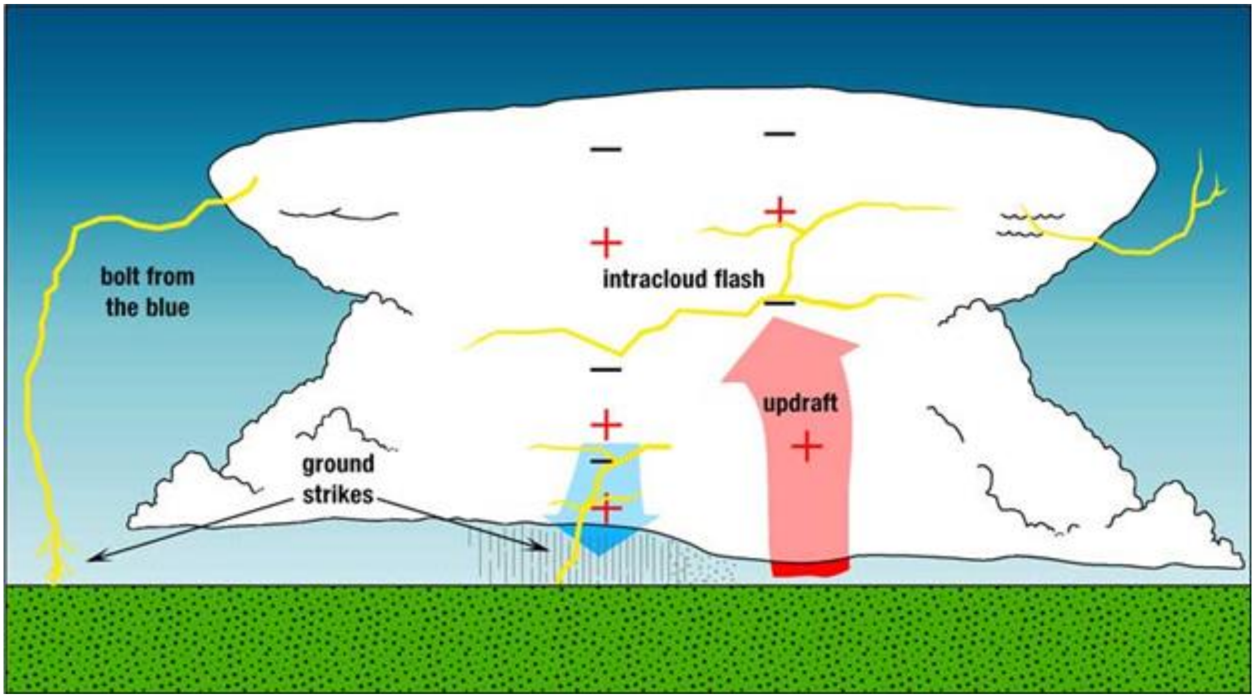
Lightning

Lightning, while rare in Garden Grove, can occur throughout the City during storm events. Lightning is defined by the NWS as any and all of the various forms of visible electrical discharge caused by thunderstorms. Thunderstorms and lightning are usually (but not always) accompanied by rain. Cloud-to-ground lightning can kill or injure people by direct or indirect means. Objects can be struck directly, which may result in an explosion, burn, or total destruction. Or, damage may be indirect, when the current passes through or near an object, which generally results in less damage.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat (see Figure 4-9). Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

Figure 4-9 Cloud to Ground Lightning



Source: National Weather Service

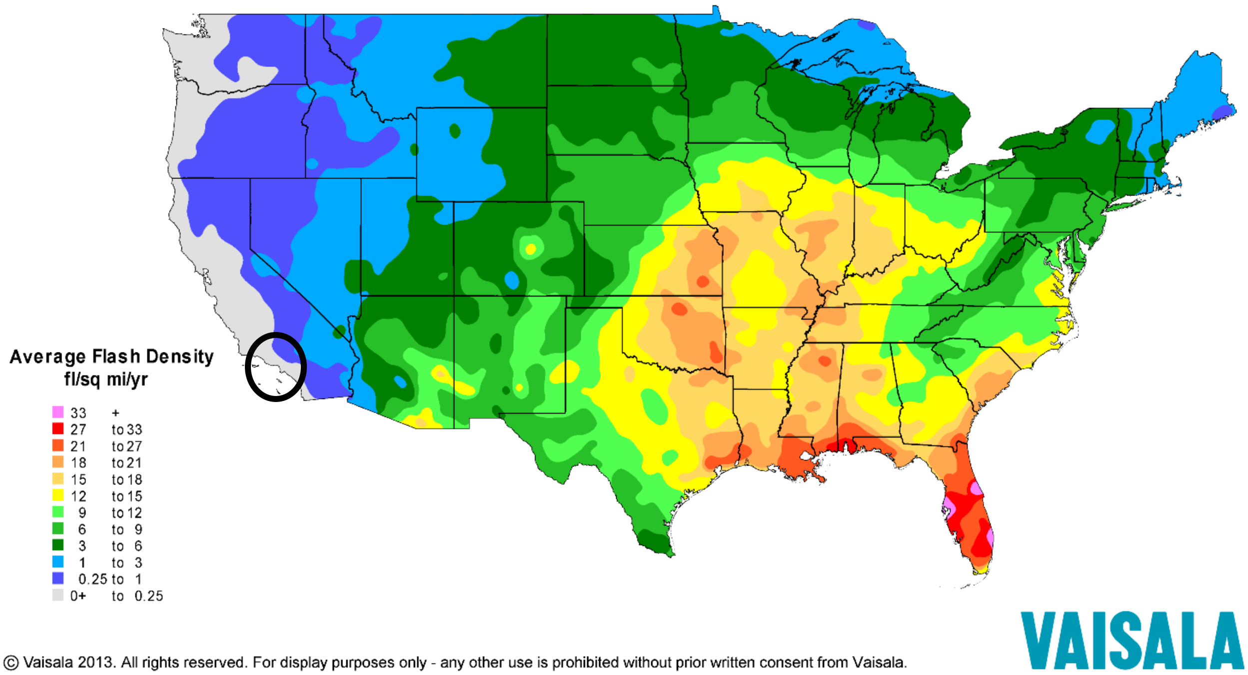
Location

Lightning events can occur in any location of the City and are often associated with thunderstorms. All portions of the City are at risk to lightning. Lightning tends to be rare in the City, as discussed in the extent section below. Past event locations are shown on Figure 4-11 below.

Extent

Lightning in the City can occur during thunderstorms. The speed of onset of thunderstorms that can cause lightning can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms in California is often short, ranging from minutes to hours. Thunderstorms and lightning are rare in the City. Vaisala maintains the National Lightning Detection Network. It tracks cloud to ground lightning incidences in the United States. Figure 4-10 shows lightning incidences in the City and the rest of the United States from 1997 to 2012.

Figure 4-10 City of Garden Grove – Lightning Incidence Map 1997 to 2012



Source: Vaisala National Lightning Detection Network. Map retrieved 5/16/2019.

Past Occurrences

Disaster Declaration History

A search of FEMA and Cal OES disaster declarations turned up multiple events. Heavy rains and storms have caused flooding in the County and City of Garden Grove Planning Area. Events where flooding resulted in a state or federal disaster declaration are shown in Table 4-11.

Table 4-11 Orange County – Disaster Declarations from Heavy Rain and Storms (and Floods) 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (Heavy Rains and Storms)	19	1950, 1955, 1958 (twice), 1969, 1978, 1980, 1982, 1988, 1992, 1993, 1995 (twice), 1997, 1998, 2005 (twice), 2011, 2017	17	1955, 1958, 1969, 1978, 1980, 1982, 1983, 1988, 1992, 1993, 1995 (twice), 1998, 2005 (twice), 2011, 2017

Source: FEMA, Cal OES

NCDC Events

The NCDC data recorded 30 hail, heavy rain, and winter weather incidents for Orange County since 1950. A summary of these events is shown in Table 4-12 Some of these events have mapped coordinates. Those can be seen in Figure 4-11. Events that caused flooding are discussed in greater detail in Section 4.2.10.

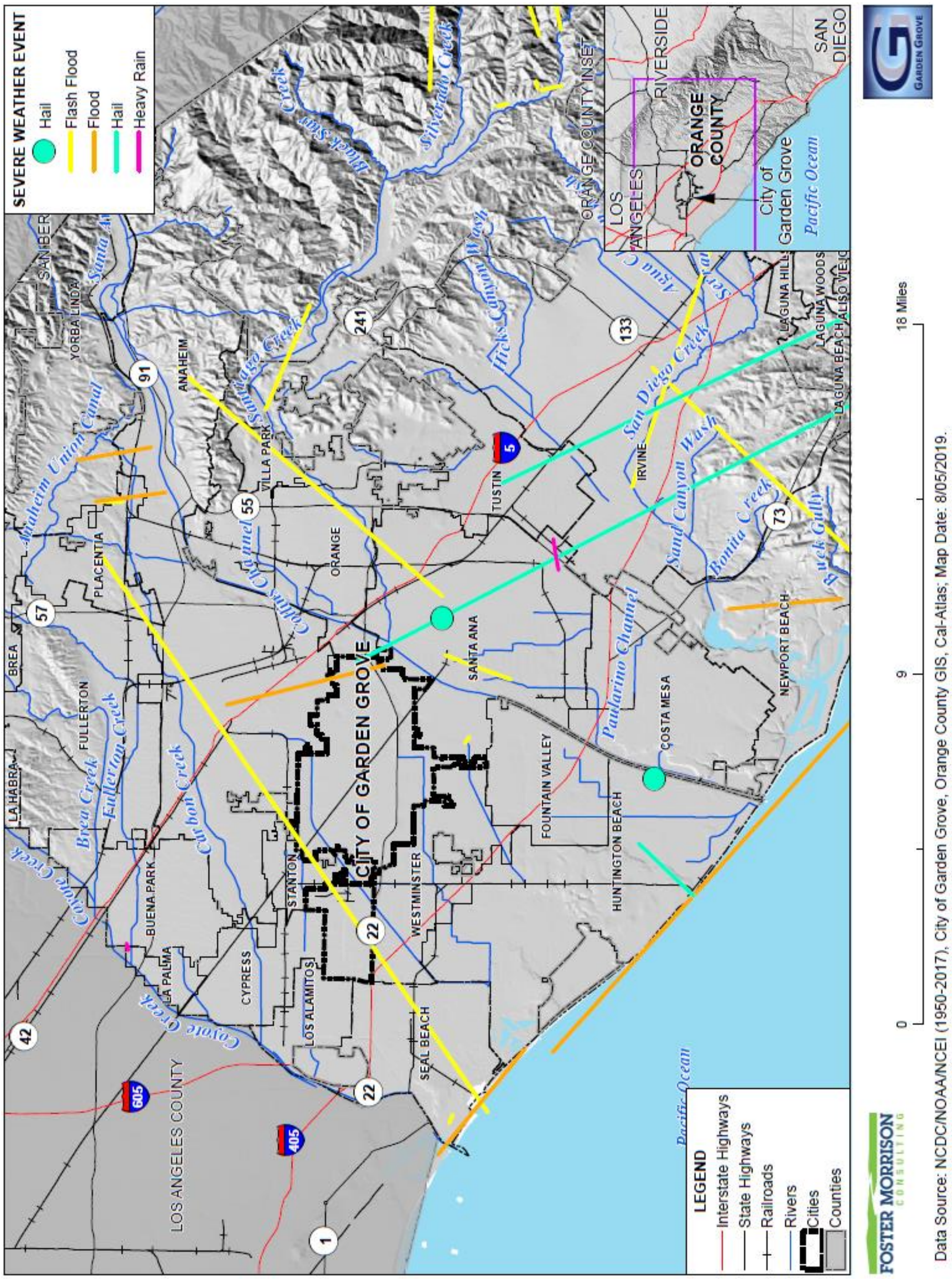
*Table 4-12 Orange County NCDC Heavy Rain and Storm Events 1955-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Hail	11	1	0	0	0	$75,100	$0
Heavy Rain	15	1	0	19	1	$36,280,000	$0
Lightning	4	0	0	0	0	$62,000	$0
Total	**30**	**2**	**0**	**19**	**1**	**$36,417,100**	**$ 0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

Figure 4-11 City of Garden Grove – Hail, Heavy Rain, Flash Flood, Flood, and Lightning Event Locations 1955-10/31/2018



Hazard Mitigation Planning Committee Events

The HMPC noted that heavy rains and storms occur on an annual basis, but could recall no events where damages, injuries, or deaths occurred.

Likelihood of Future Occurrences

Highly Likely – Based on NCDC data and HMPC input, 30 heavy rain, hail, lightning, and thunderstorm wind incidents over a 69-year period (1950-2018) equates to a severe storm event every 2.3 years. As noted, this database likely doesn't capture all heavy rain, hail, lightning, and winter weather events. Severe weather is a well-documented seasonal occurrence that will continue to occur often in the City of Garden Grove.

Climate Change and Heavy Rains and Storms

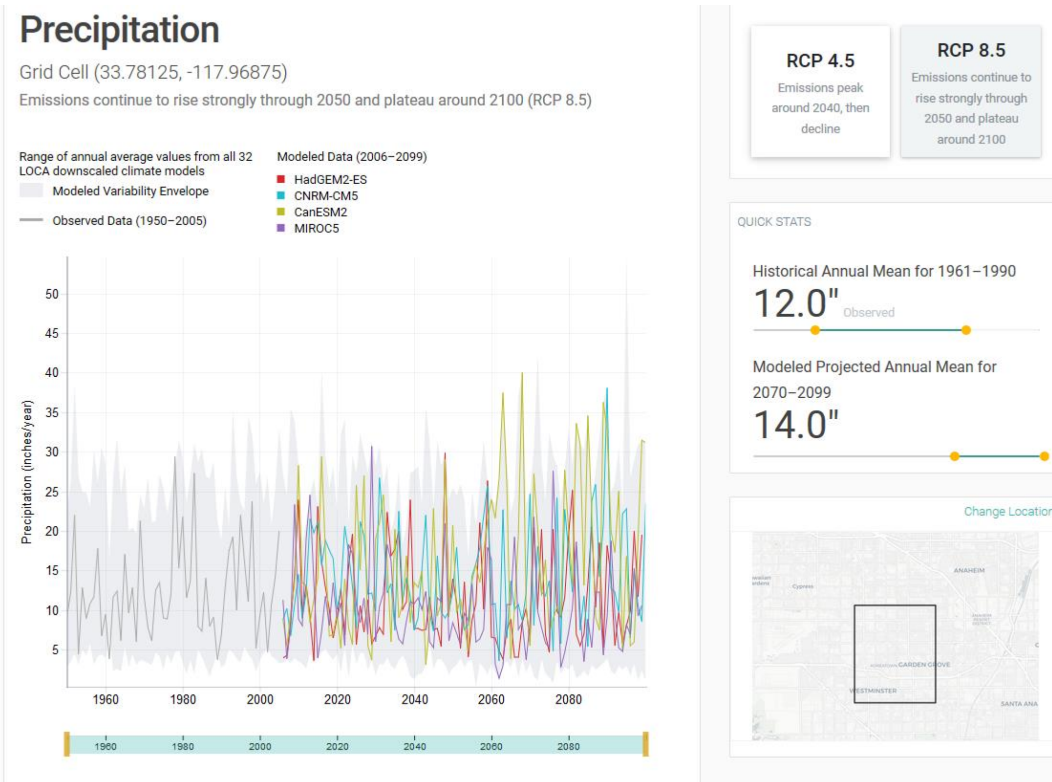
According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is unlikely that hail will become more common in the City. The amount of lightning is not projected to change.

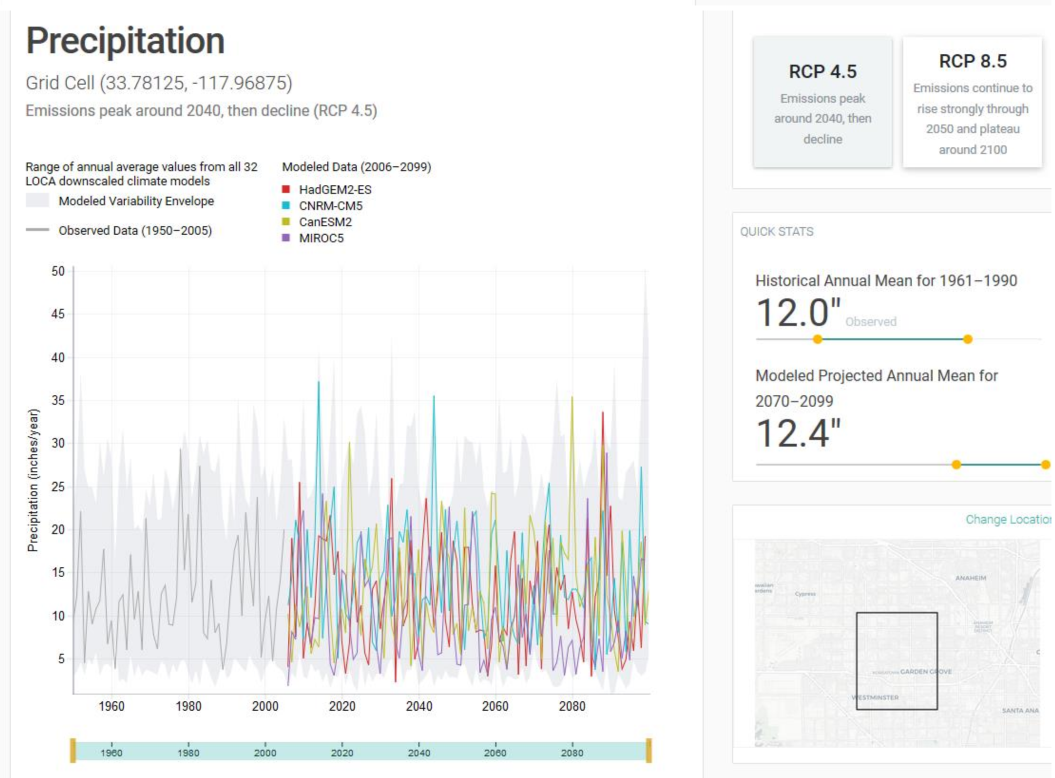
Cal-Adapt noted that, on average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century. The Mediterranean seasonal precipitation pattern is expected to continue, with most precipitation falling during winter from North Pacific storms. One of the four climate models projects slightly wetter winters, and another projects slightly drier winters with a 10 to 20 percent decrease in total annual precipitation. However, even modest changes would have a significant impact because California ecosystems are conditioned to historical precipitation levels and water resources are nearly fully utilized. Future precipitation estimates for the City are shown in Figure 4-12. Figure 4-12 consists of two charts:

- The upper chart shows annual averages of observed and projected Precipitation values for the selected area on map under the RCP 8.5 scenario. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.
- The lower chart shows annual averages of observed and projected Precipitation values for the selected area on map under the RCP 4.5 scenario. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.

These models have been selected by California state agencies as priority models for research contributing to California's Fourth Climate Change Assessment.

Figure 4-12 City of Garden Grove – Future Precipitation Estimates in High and Low Emission Scenarios





Source: Cal-Adapt – Precipitation: Decadal Averages Map

In addition to these models, Cal Adapt has also modeled the anticipated effects of climate change on extreme precipitation events. Cal-Adapt's Extreme Precipitation Tool describes what an extreme precipitation event looks like by providing estimates of intensity and frequency of extreme precipitation events. The tools and visualizations allow you to examine how extreme precipitation events are likely to change in a warming climate over the City of Garden Grove. Future precipitation estimates for the City are shown in Figure 4-13. Figure 4-13 consists of two charts:

- The upper chart shows estimated intensity (Return Level) of Extreme Precipitation events which are exceeded on average once every 50 years (Return Period) and how it changes in a warming climate over historical, mid-century and late-century time periods. Data is shown for Garden Grove under the RCP 4.5 scenario in which emissions peak around 2040, then decline. Extreme Precipitation events are days during a water year (Oct–Sep) with 2-day rainfall totals above an extreme threshold of 0.83 inches.
- The lower chart shows estimated intensity (Return Level) of Extreme Precipitation events which are exceeded on average once every 50 years (Return Period) and how it changes in a warming climate over historical, mid-century and late-century time periods. Data is shown for Garden Grove under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100. Extreme Precipitation events are days during a water year (Oct–Sep) with 2-day rainfall totals above an extreme threshold of 0.83 inches.

Figure 4-13 City of Garden Grove – Changes in Intensity of Extreme Precipitation Events

Source: Cal-Adapt – Extreme Precipitation Events

4.2.4. Severe Weather: High Winds and Tornado

Hazard/Problem Description

High Winds

High winds, often accompanying severe storms and thunderstorms, can cause significant property damage, threaten public safety, and have adverse economic impacts from business closures and power loss. High winds, as defined by the NWS glossary, are sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration. These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events such as heavy rains and thunderstorms.

Straight-line winds may also exacerbate existing weather conditions by increasing the effect on temperature and decreasing visibility due to the movement of particulate matters through the air, as in dust and snowstorms. The winds may also exacerbate fire conditions by drying out the ground cover, propelling fuel around the region, and increasing the ferocity of exiting fires. These winds may push automobiles off roads, damage roofs and structures, down trees, cause utility outages, and cause secondary damage due to flying debris.

Santa Ana Winds

Of special concern in the City are Santa Ana winds. The NWS defines Santa Ana winds as strong downslope winds that blow through the mountain passes in southern California. Santa Ana winds often bring the lowest relative humidities of the year to coastal Southern California. These low humidities, combined with the warm, compressionally-heated airmass, plus the high wind speeds, create critical fire weather conditions in wildfire prone areas. The combination of wind, heat, and dryness accompanying the Santa Ana winds turns the chaparral into explosive fuel feeding the infamous wildfires for which the region is known. Although the winds often have a destructive nature, they have some benefits as well. They cause cold water to rise from below the surface layer of the ocean, bringing with it many nutrients that ultimately benefit local fisheries.

The HMPC noted that Santa Ana winds can affect the Garden Grove area. Winds tend to channel below specific passes and canyons, coming in gust clusters. High winds may blow in one neighborhood, while a few blocks away there are only gentle warm breezes. Offshore winds from the northeast or east must reach 30 mph or more below passes and canyons to reach minimum criteria for Santa Ana wind advisories. Typically wind speeds are in the 40 to 55 mph range, and in extreme cases, winds can gust locally to over 100 mph.

Location

The entire City is subject to significant, non-tornadic (straight-line) winds, as well as Santa Ana winds as previously described. Each area of the City is at risk to high winds. Past event locations are shown on Figure 4-17 below.

Extent

Magnitude of winds is measured often in speed and damages. The speed of onset of high winds can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorm winds in California is often short, ranging from minutes to hours. The Beaufort scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. Figure 4-14 shows the Beaufort wind scale.

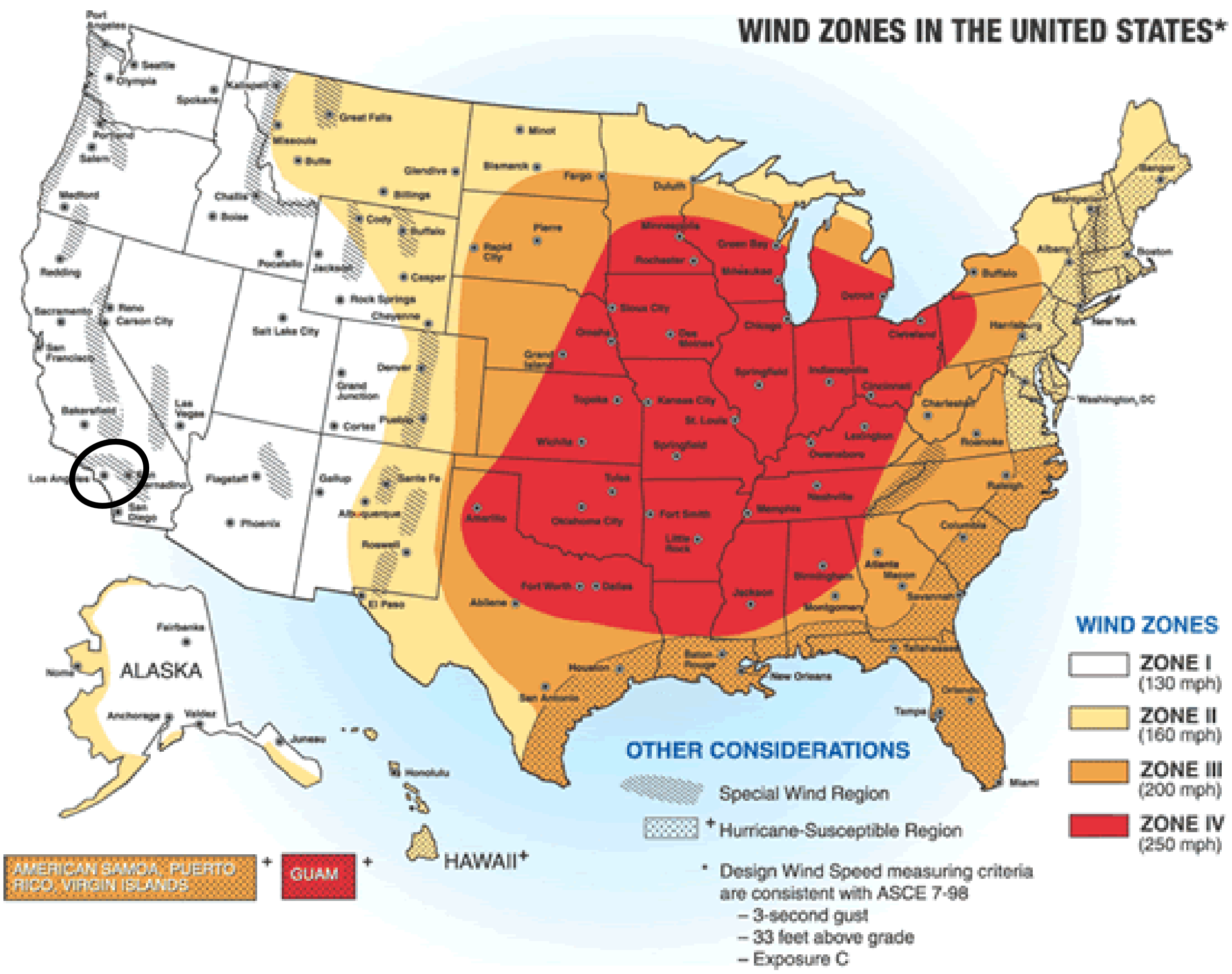
Figure 4-14 Beaufort Wind Scale

Beaufort Number	Wind Speed (miles/hour)	Wind Speed (km/hour)	Wind Speed (knots)	Description	Wind Effects on Land
0	< 1	< 1	< 1	Calm	Calm. Smoke rises vertically.
1	1-3	1-5	1-3	Light Air	Wind motion visible in smoke.
2	4-7	6-11	4-6	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	12-19	7-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	20-28	11-16	Moderate Breeze	Dust and loose paper are raised. Small branches begin to move.
5	19-24	29-38	17-21	Fresh Breeze	Small trees begin to sway.
6	25-31	39-49	22-27	Strong Breeze	Large branches are in motion. Whistling is heard in overhead wires. Umbrella use is difficult.
7	32-38	50-61	28-33	Near Gale	Whole trees in motion. Some difficulty experienced walking into the wind.
8	39-46	62-74	34-40	Gale	Twigs and small branches break from trees. Cars veer on road.
9	47-54	75-88	41-47	Strong Gale	Larger branches break from trees. Light structural damage.
10	55-63	89-102	48-55	Storm	Trees broken and uprooted. Considerable structural damage.
11	64-72	103-117	56-63	Violent Storm	Widespread damage to structures and vegetation.
12	> 73	> 117	> 64	Hurricane	Considerable and widespread damage to structures and vegetation. Violence.

Source: National Weather Service

Figure 4-15 depicts wind zones for the United States. The map denotes that Garden Grove falls into Zone I, which is characterized by high winds of up to 130 mph. Areas near the City fall into Zone II, due to the Santa Ana winds which can occur in those areas.

Figure 4-15 Wind Zones in the United States



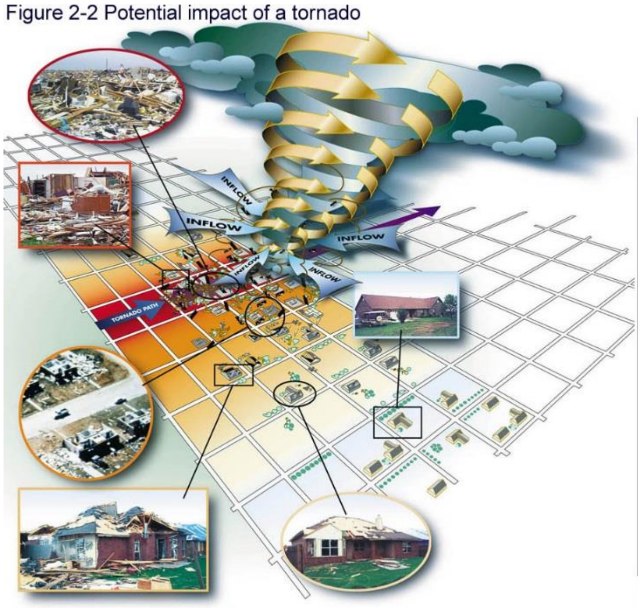
Source: FEMA

Tornadoes

Tornadoes and funnel clouds can also occur during these types of severe storms. Tornadoes are another severe weather hazard that, though rare, can affect areas in the Valley in the Butte County Planning Area, primarily during the rainy season in the late fall and early spring. Tornadoes form when cool, dry air sits on top of warm, moist air. Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes are the most powerful storms that exist. They can have the same pressure differential across a path only 300 yards wide or less as 300-mile-wide hurricanes. Figure 4-16 illustrates the potential impact and damage from a tornado.

Figure 4-16 Potential Impact and Damage from a Tornado

Figure 2-2 Potential impact of a tornado



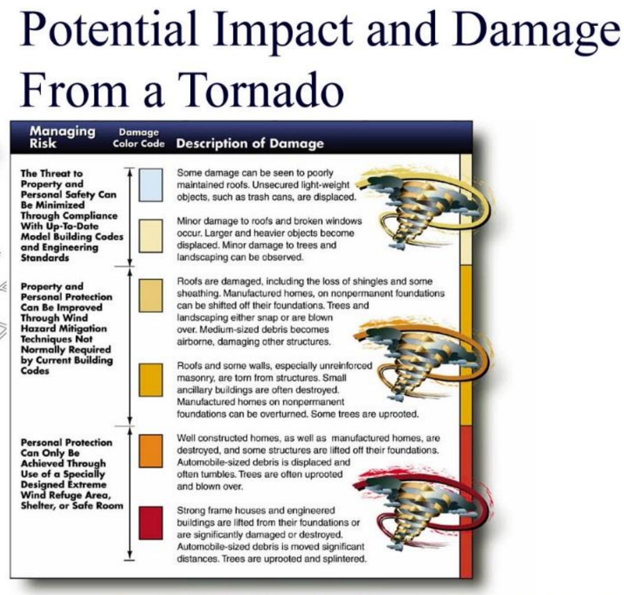


Figure 2-2 Potential damage table for impact of a tornado

Source: FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes

Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, the majority of injuries and deaths generally result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

Location and Extent

Tornadoes, while rare, can occur at any location in the County. The areas in the Valley in the County tend to be at greater risk than the areas in the foothills and at elevation. Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table 4-13 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 4-14 shows the wind speeds associated with the Enhanced Fujita Scale ratings.

Table 4-13 Original Fujita Scale

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/f-scale.html

Table 4-14 Enhanced Fujita Scale

Enhanced Fujita (EF) Scale	Enhanced Fujita Scale Wind Estimate (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/ef-scale.html

It is difficult to predict a tornado or the conditions that preclude a tornado far in advance. Tornadoes can strike quickly with very little warning. In California it is rare for tornadoes to exceed EF3 magnitude. Most tornadoes that touch down are not long lived.

Past Occurrences

Disaster Declaration History

There have been no past federal or state disaster declarations due to high winds, according to Table 4-3.

NCDC Events

The NCDC data recorded 279 high wind and tornado incidents for Orange County since 1955. A summary of these events is shown in Table 4-15. Some of these events have mapped coordinates which include areas of the City. These are shown on Figure 4-17.

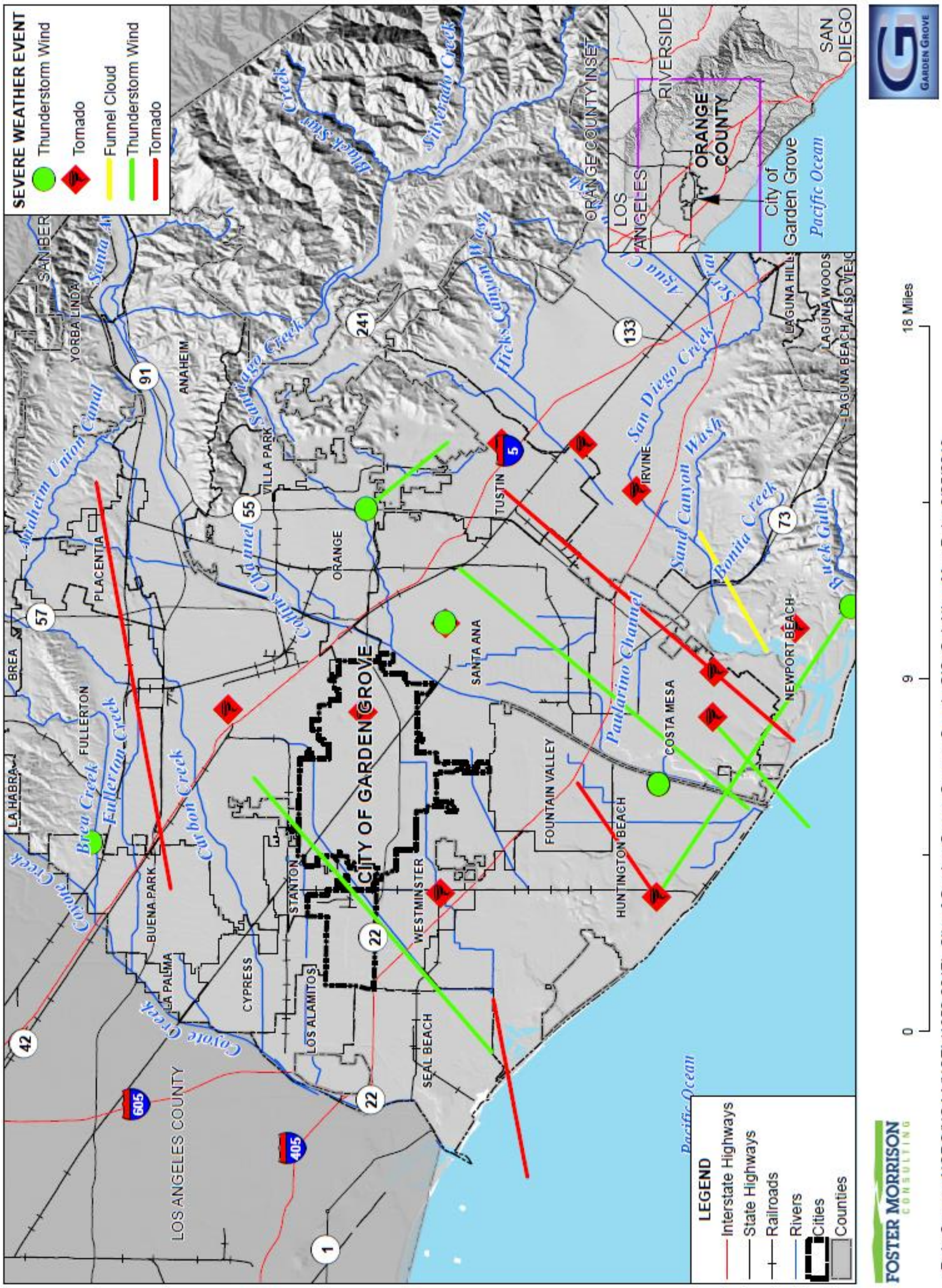
*Table 4-15 Orange County NCDC High Wind and Tornado Events 1955-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Dust Devil	1	0	0	0	0	$6,000	$0
Funnel Cloud	34	0	0	0	0	$0	$0
High Wind	153	1	0	0	0	$633,000	$1,000
Strong Wind	12	0	0	0	0	$468,000	$0
Thunderstorm Wind	34	0	0	0	0	$1,246,000	$20,000
Tornado	32	0	0	0	0	$0	$0
Waterspout	13	0	0	0	0	$0	$0
Total	**279**	**1**	**0**	**0**	**0**	**$2,353,000**	**$21,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

Figure 4-17 City of Garden Grove –High Wind and Tornado Events 1955-10/31/2018



Hazard Mitigation Planning Committee Events

The HMPC noted that winds are a seasonal occurrence, and have caused damages to trees in the City in the past. These damages are absorbed in City budgets for tree maintenance. Large damage events could not be recalled by the HMPC.

Likelihood of Future Occurrences

Highly Likely– Based on NCDC data and HMPC input, 279 wind incidents over a 64-year period (1955-2018) equates to a severe wind event multiple times each year. High winds are a well-documented seasonal occurrence that will continue to occur annually in City.

Climate Change and High Winds

According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual thunderstorm events is likely to increase during the 21st century. This may bring stronger thunderstorm winds. The CAS does not discuss non-thunderstorm winds or tornadoes.

4.2.5. Climate Change

Hazard/Problem Description

Climate change is the distinct change in measures of weather patterns over a long period of time, ranging from decades to millions of years. More specifically, it may be a change in average weather conditions such as temperature, rainfall, snow, ocean and atmospheric circulation, or in the distribution of weather around the average. While the Earth's climate has cycled over its 4.5-billion-year age, these natural cycles have taken place gradually over millennia, and the Holocene, the most recent epoch in which human civilization developed, has been characterized by a highly stable climate – until recently.

This LHMP is concerned with human-induced climate change that has been rapidly warming the Earth at rates unprecedented in the last 1,000 years. Since industrialization began in the 19th century, the burning of fossil fuels (coal, oil, and natural gas) at escalating quantities has released vast amounts of carbon dioxide and other greenhouse gases responsible for trapping heat in the atmosphere, increasing the average temperature of the Earth. Secondary impacts include changes in precipitation patterns, the global water cycle, melting glaciers and ice caps, and rising sea levels. According to the Intergovernmental Panel on Climate Change (IPCC), climate change will "increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" if unchecked.

Through changes to oceanic and atmospheric circulation cycles and increasing heat, climate change affects weather systems around the world. Climate change increases the likelihood and exacerbates the severity of extreme weather – more frequent or intense storms, floods, droughts, and heat waves. Consequences for human society include loss of life and injury, damaged infrastructure, long-term health effects, loss of agricultural crops, disrupted transport and freight, and more. Climate change is not a discrete event but a long-term hazard, the effects of which communities are already experiencing.

Climate change adaptation is a key priority of the State of California. The 2018 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

In Orange County, the HMPC noted that each year it seems to get a bit warmer. It appears that the temperatures have been increasing more in the early fall (September/October). It was also noted that 2017 was one of the wettest years ever. California's Adaptation Planning Guide: Understanding Regional Characteristics has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. Orange County falls within the South Coast Region. Table 4-16 provides a summary of Cal-Adapt Climate Projections for the Bay Area Region.

Table 4-16 Orange County – Cal Adapt Climate Projections

Effect	Ranges
Temperature Change, 1990-2100	January increase in average temperatures: 1°F to 2.5°F by 2050 and 5°F to 6°F by 2100 Temperature Change, July increase in average temperatures: 3°F to 4°F by 2050 and 5°F to 10°F by 2100 with larger 1990-2100 increases projected inland. *(Modeled high temperatures; high carbon emissions scenario)*
Precipitation	Annual precipitation will vary by area but will decline overall throughout the century. Low-lying coastal areas will lose up to 2 inches by 2050 and 3 to 5 inches by 2090, while high elevations will see a drop of 4 to 5 inches by 2050 and 8 to 10 inches by 2090. *(Community Climate System Model 3 (CCSM3) climate model; high emissions scenario)*
Sea Level Rise	By 2100, sea levels may rise up to 66 inches, posing considerable threats to coastal areas in the region including Venice Beach, the Port of Long Beach, the South Coast naval stations, and San Sea Level Rise Diego Harbor. As a result of sea level rise, 45 percent more land in Los Angeles County, 40 percent more land in San Diego County, 35 percent more land in Ventura County, and 28 percent more land in Orange County will be vulnerable to 100-year floods.
Heat wave	Along the coast, a heat wave is five days over temperature in the 80s. Inland, the temperature must hit the 90s and 100s for five days. All areas can expect 3 to 5 more heat waves by 2050 and 12 to 14 by 2100 in most areas of the region.
Wildfire	Little change is projected in the already high-fire risk in this region, save for slight increases expected in a few coastal mountainous areas such as near Ojai and in Castaic, Fallbrook, and Mission Viejo.

Source: California's Adaptation Planning Guide: Understanding Regional Characteristics

The HMPC noted that temperatures have been warming. The biggest issues related to climate change in the City play into drought conditions and dry vegetation. Urban trees are also being affected by climate change conditions, as climate conditions cause them to dry out and become more vulnerable to falling over during storm events. The HMPC also noted the climate change in Garden Grove creates more intense rain events.

Location

Climate change is a global phenomenon. It is expected to affect the whole of the City, Orange County, and State of California.

Extent

There is no one scale to measure the extent of climate change. Climate change exacerbates other hazards, such as drought, extreme heat, flooding, wildfire, and others. The speed of onset of climate change is very slow. The duration of climate change is not yet known, but is feared to be tens to hundreds of years.

Past Occurrences

Disaster Declaration History

Climate change has never been directly linked to any declared disasters, as shown in Table 4-3.

NCDC Events

The NCDC does not track climate change events.

Hazard Mitigation Planning Committee Events

While the HMPC noted that climate change is of concern, no specific quantifiable dollar damages associated with climate change could be determined. The City noted that during the last 5 to 7 years, urban trees have been stressed due to drought. Trees in parks seem to get more water than the trees that line the streets, making the trees lining the street more vulnerable. The trees getting less water seem to be more stressed each year. This indicates the City is getting hotter. HMPC members noted that the strength of storms does seem to be increasing and the temperatures seem to be getting hotter.

Likelihood of Future Occurrence

Highly Likely – Climate change is virtually certain to continue without immediate and effective global action. According to NASA, 2018 was on track to be one of the hottest years on record, and 16 of the 18 hottest years ever have occurred since 2000. Without significant global action to reduce greenhouse gas emissions, the IPCC concludes in its Fifth Assessment Synthesis Report (2014) that average global temperatures are likely to exceed 1.5 C by the end of the 21st century, with consequences for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges.

Climate Scenarios

The United Nations IPCC developed several greenhouse gas (GHG) emissions scenarios based on differing sets of assumptions about future economic growth, population growth, fossil fuel use, and other factors. The emissions scenarios range from "business-as-usual" (i.e., minimal change in the current emissions trends) to more progressive (i.e., international leaders implement aggressive emissions reductions policies).

Each of these scenarios leads to a corresponding GHG concentration, which is then used in climate models to examine how the climate may react to varying levels of GHGs. Climate researchers use many global climate models to assess the potential changes in climate due to increased GHGs.

Key Uncertainties Associated with Climate Projections

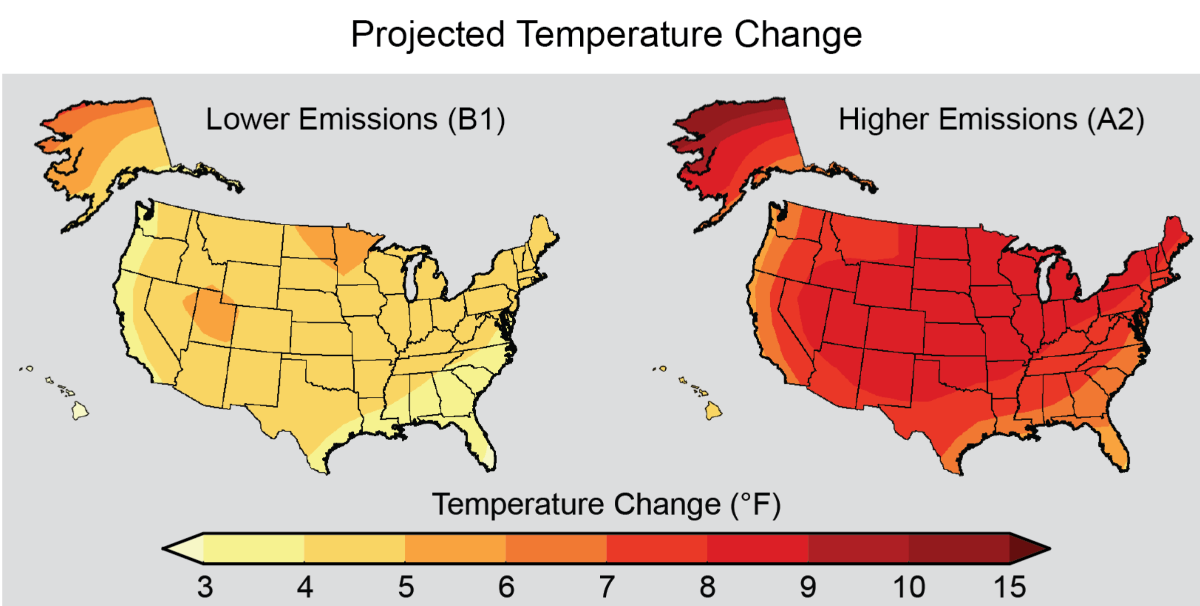
Climate projections and impacts, like other types of research about future conditions, are characterized by uncertainty. Climate projection uncertainties include but are not limited to:

- Levels of future greenhouse gas concentrations and other radiatively important gases and aerosols,
- Sensitivity of the climate system to greenhouse gas concentrations and other radiatively important gases and aerosols,
- Inherent climate variability, and
- Changes in local physical processes (such as afternoon sea breezes) that are not captured by global climate models.

Even though precise quantitative climate projections at the local scale are characterized by uncertainties, the information provided can help identify the potential risks associated with climate variability/climate change and support long term mitigation and adaptation planning.

Maps show projected change in average surface air temperature in the later part of this century (2071-2099) relative to the later part of the last century (1970-1999) under a scenario that assumes substantial reductions in heat trapping gases and a higher emissions scenario that assumes continued increases in global emissions. These are shown in Figure 4-18.

Figure 4-18 Projected Temperature Change (2071-2099) – Lower and Higher Emissions Scenario



Source: National Climate Assessment. Map Date 2016.

According to the California Natural Resource Agency (CNRA), climate change is already affecting California and is projected to continue to do so well into the foreseeable future. Current and projected changes include increased temperatures, sea level rise, a reduced winter snowpack altered precipitation patterns, and more frequent storm events. Over the long term, reducing greenhouse gases can help make these changes less severe, but the changes cannot be avoided entirely. Unavoidable climate impacts can result in a variety of secondary consequences including detrimental impacts on human health and safety, economic continuity, ecosystem integrity and provision of basic services.

The CNRA's 2014 Climate Adaptation Strategy (CAS) delineated how climate change may impact and exacerbate natural hazards in the future, including wildfires, extreme heat, floods, and drought:

- Climate change is expected to lead to increases in the frequency, intensity, and duration of extreme heat events and heat waves in the City of Garden Grove, Orange County and the rest of California, which are likely to increase the risk of mortality and morbidity due to heat-related illness and exacerbation of existing chronic health conditions. Those most at risk and vulnerable to climate-related illness are the elderly, individuals with chronic conditions such as heart and lung disease, diabetes, and mental illnesses, infants, the socially or economically disadvantaged, the homeless, and those who work outdoors.
- Higher temperatures will melt the Sierra snowpack earlier and drive the snowline higher, resulting in less snowpack to supply water to California users.
- Droughts are likely to become more frequent and persistent in the 21st century.
- Intense rainfall events, periodically ones with larger than historical runoff, will continue to affect California with more frequent and/or more extensive flooding.
- Storms and snowmelt may coincide and produce higher winter runoff from the landward side, while accelerating sea-level rise will produce higher storm surges during coastal storms. Together, these changes may increase the probability of floods and levee and dam failures, along with creating issues related to saltwater intrusion.
- Warmer weather, reduced snowpack, and earlier snowmelt can be expected to increase wildfire through fuel hazards and ignition risks. These changes can also increase plant moisture stress and insect populations, both of which affect forest health and reduce forest resilience to wildfires. An increase in wildfire intensity and extent will increase public safety risks, property damage, fire suppression and emergency response costs to government, watershed and water quality impacts, vegetation conversions and habitat fragmentation.

4.2.6. Dam Failure

Hazard/Problem Description

Dams are manmade structures built for a variety of uses including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they are usually engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped or fail. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can also result from any one or a combination of the following causes:

- Earthquake;
- Inadequate spillway capacity resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage, or piping or rodent activity;
- Improper design;
- Improper maintenance;
- Negligent operation; and/or
- Failure of upstream dams on the same waterway.

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.

In general, there are three types of dams: concrete arch or hydraulic fill, earth and rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously; the flood wave builds up rapidly to a peak then gradually declines. An earth-rockfill dam fails gradually due to erosion of the breach; a flood wave will build gradually to a peak and then decline until the reservoir is empty. And, a concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

The California Department of Water Resources (Cal DWR) Division of Safety of Dams has jurisdiction over impoundments that meet certain capacity and height criteria. Embankments that are less than six feet high and impoundments that can store less than 15 acre-feet are non-jurisdictional. Additionally, dams that are less than 25 feet high can impound up to 50 acre-feet without being jurisdictional. Cal DWR, Division of Safety of Dams assigns hazard ratings to large dams within the State. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in four categories that identify 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.

Location

According to data provided by Orange County, Cal DWR, and Cal OES, there are 43 dams in Orange County constructed for flood control, storage, electrical generation, and recreational purposes. Of these dams, 16 are rated as extremely high, 22 are rated as high hazard, 3 are rated as significant hazard, and 2 are rated as low hazard dams. Figure 4-19 identifies the dams in Orange County, which are also shown on Table 4-17. It should be noted that none of these dams are physically located in Garden Grove.

Figure 4-19 Orange County Dam Inventory

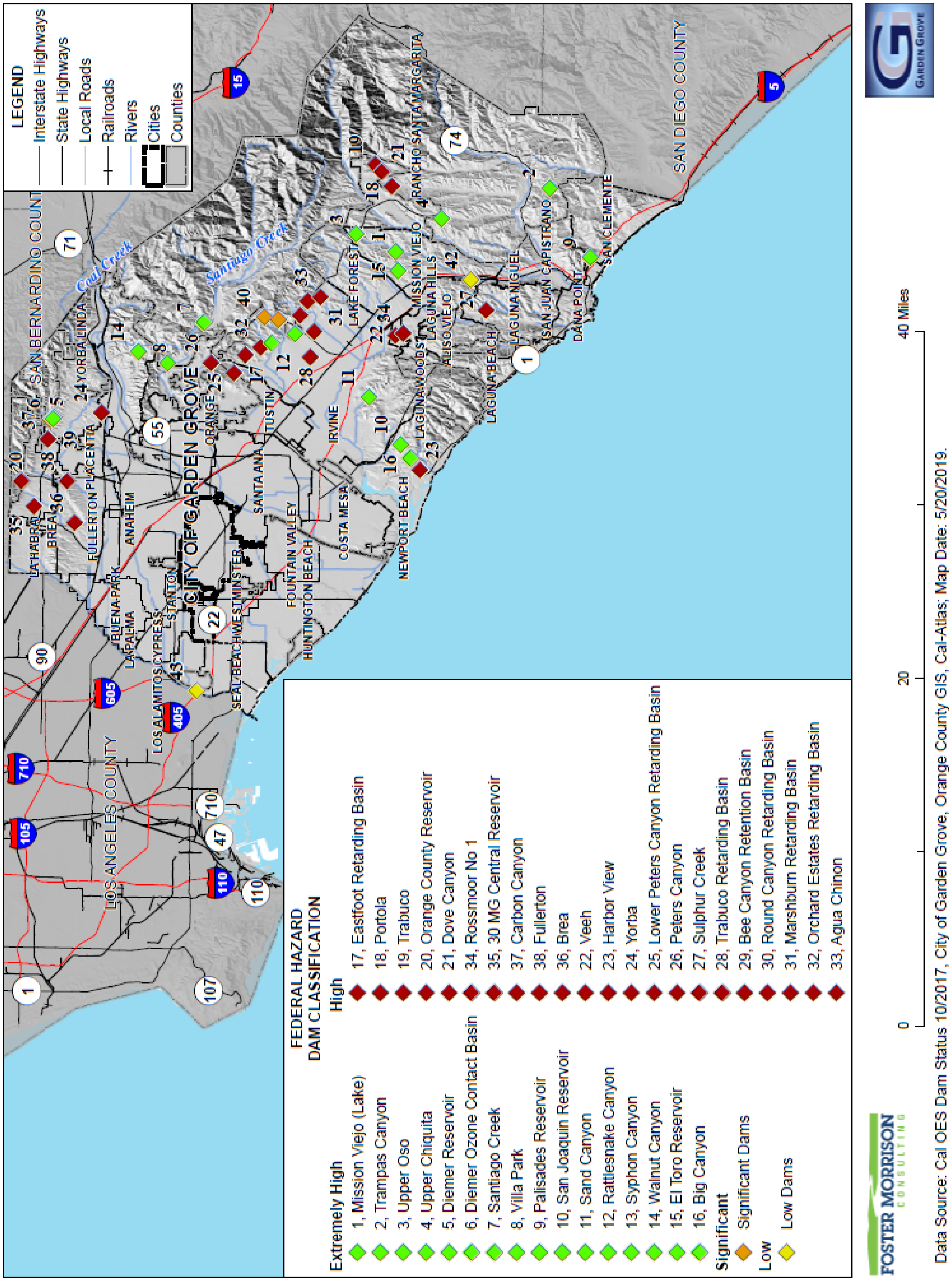


Table 4-17 Orange County Dam Inventory

Dam Name	Owner Name	Dam Type	Year Built	Dam Height feet	Dam Length feet	Capacity acre feet*	Jurisdictional Status	Downstream Hazard	Condition Assessment
30 MG Central Reservoir	City of Brea	Earth	1924	30	1,596	92	Certified	High	Satisfactory
Agua Chinon	County of Orange	Earth	1998	41	480	256	Certified	High	Satisfactory
Bee Canyon Retention Basin	County of Orange	Earth	1994	62	570	243	Certified	High	Satisfactory
Big Canyon	City of Newport Beach	Earth	1959	65	3,824	600	Certified	Extremely High	Satisfactory
Brea	USACE	Earth	1942	88	1,792	7,420	–	High	–
Carbon Canyon	USACE	Earth	1961	100	2,650	12,000	–	High	–
Diemer No. 8	Metropolitan Water District of Southern California	Earth	1968	172	1,004	18	Certified	Significant	Satisfactory
Diemer Ozone Contact Basin	Metropolitan Water District of Southern California	Earth	2011	32	1,012	23	Certified	Extremely High	Satisfactory
Diemer Reservoir	Metropolitan Water District of Southern California	Earth	1963	22	1,880	80	Certified	Extremely High	Satisfactory
Dove Canyon	Dove Canyon Master Association	Earth	1989	88	700	415	Certified	High	Satisfactory
East Hicks Canyon Retarding Basin	County of Orange	Earth	1997	49	1,168	75	Certified	Significant	Satisfactory
Eastfoot Retarding Basin	City of Irvine	Earth	2007	38.5	1,000	213	Certified	High	Satisfactory
El Toro Reservoir	El Toro Water District	Earth	1967	113.3	900	877	Certified	Extremely High	Satisfactory

Dam Name	Owner Name	Dam Type	Year Built	Dam Height feet	Dam Length feet	Capacity acre feet*	Jurisdictional Status	Downstream Hazard	Condition Assessment
Fullerton Dam	USACE	Earth	1941	47	584	134	–	High	–
Galivan Retarding Basin	County of Orange	Earth	2000	14	600	169	Certified	Low	Satisfactory
Harbor View	County of Orange	Earth	1964	65	330	28	Certified	High	Satisfactory
Hicks Canyon Retention Basin	County of Orange	Earth	1997	60	806	110	Certified	Significant	Satisfactory
Lower Peters Canyon Retarding Basin	County of Orange	Earth	1990	52	1,166	206	Certified	High	Satisfactory
Marshburn Retarding Basin	County of Orange	Earth	1998	27	2,456	424	Certified	High	Satisfactory
Mission Viejo, Lake	Lake Mission Viejo Association, Inc.	Earth	1976	123	1,750	4,300	Certified	Extremely High	Satisfactory
Orange County Reservoir	Metropolitan Water District of Southern California	Earth	1941	103	655	217	Certified	High	Satisfactory
Orchard Estates Retarding Basin	County of Orange	Earth	1999	21	810	138	Certified	High	Satisfactory
Palisades Reservoir	South Coast Water District	Earth	1963	146	620	147	Certified	Extremely High	Satisfactory
Peters Canyon	County of Orange	Earth	1932	54	580	1090	Certified	High	Satisfactory
Portola	Santa Margarita Water District	Earth	1980	53	1,200	586	Certified	High	Satisfactory
Rattlesnake Canyon	Irvine Ranch Water District	Earth	1959	79	980	1480	Certified	Extremely High	Satisfactory

Dam Name	Owner Name	Dam Type	Year Built	Dam Height feet	Dam Length feet	Capacity acre feet*	Jurisdictional Status	Downstream Hazard	Condition Assessment
Rossmoor No 1	El Toro Water District	Earth	1964	36	305	43	Certified	High	Satisfactory
Rossmoor Retarding Basin	County of Orange	Earth	2002	14	95	175	Certified	Low	Satisfactory
Round Canyon Retarding Basin	County of Orange	Earth	1994	98	750	286	Certified	High	Satisfactory
San Joaquin Reservoir	Irvine Ranch Water District	Earth	1966	224	873	3,036	Certified	Extremely High	Satisfactory
Sand Canyon	Irvine Ranch Water District	Earth	1912	58	861	960	Certified	Extremely High	Satisfactory
Santiago Creek	Serrano Water District and Irvine Ranch Water District	Earth	1933	136	1,425	25,000	Certified	Extremely High	Satisfactory
Sulphur Creek	County of Orange	Earth	1966	42	485	520	Certified	High	Satisfactory
Syphon Canyon	Irvine Ranch Water District	Earth	1949	59	843	578	Certified	Extremely High	Satisfactory
Trabuco	Trabuco Canyon Water District	Earth	1984	108	620	138	Certified	High	Satisfactory
Trabuco Retarding Basin	County of Orange	Earth	1996	18	2,250	390	Certified	High	Satisfactory
Trampas Canyon	Santa Margarita Water District	Earth	1975	183	1,300	5,700	Certified	Extremely High	Satisfactory
Upper Chiquita	Santa Margarita Water District	Earth	2012	177.2	965	754	Certified	Extremely High	Satisfactory
Upper Oso	Santa Margarita Water District	Earth	1979	142	800	3700	Certified	Extremely High	Satisfactory

Dam Name	Owner Name	Dam Type	Year Built	Dam Height feet	Dam Length feet	Capacity acre feet*	Jurisdictional Status	Downstream Hazard	Condition Assessment
Veeh	Lake Hills Community Church	Earth	1936	37	417	185	Certified	High	Satisfactory
Villa Park	County of Orange	Earth	1963	118	1,475	15,600	Certified	Extremely High	Satisfactory
Walnut Canyon	City of Anaheim	Earth	1968	187	930	2,570	Certified	Extremely High	Satisfactory
Yorba	County of Orange	Hydraulic Fill	1907	45	920	1,200	Certified	High	Satisfactory

Source: Cal OES, National Performance of Dams Program, Cal DWR, City of Garden Grove General Plan
*One acre foot equals 325,000 gallons

Dams of Concern

Of the 43 dams, only 4 were thought to have the possibility to impact the City of Garden Grove. These dams are shown in Table 4-18. Of these 4, only the Prado Dam was found to impact the City.

Table 4-18 City of Garden Grove– Dams of Concern

Dam Name	Why a Source of Concern	Comments
Prado Dam (in San Bernardino County)	City inside Cal OES inundation area. Noted in the 2016 City EOP.	Dam analysis was performed on this dam in this LHMP. The whole of the City falls within this Dam inundation area.
Seven Oaks Dam	HMPC comment	Dam is upstream on the Santa Ana River. There was concern about the dam failing/overtopping in 2010. This dam is located in San Bernardino County. Inundation mapping indicated that the City did not fall into the inundation area.
Santiago Creek	Thought to be in Cal OES inundation area. Noted in the 2016 City EOP.	Dam analysis was performed on this dam. The Cal OES dam inundation zone falls outside of the City.
Villa Park	Thought to be in Cal OES inundation area. Noted in the 2016 City EOP.	Dam analysis was performed on this dam. The Cal OES dam inundation zone falls outside of the City.

Source: City of Garden Grove

The City of Garden Grove 2016 Emergency Operations Plan (EOP) noted that over the years, an extensive flood control system has been developed throughout the Santa Ana River watershed. One of the major flood control facilities is Prado Dam. The US Army Corp of Engineers (USACE) noted that Prado Dam is a flood risk management project constructed, owned, and operated by the USACE, Los Angeles District. The Dam is located in San Bernardino County, California, approximately 2 miles west of the City of Corona, and on the lower Santa Ana River approximately 30.5 miles upstream from the confluence with the Pacific Ocean. Prado Dam and Reservoir serve as the principal regulating structure on the Santa Ana River, and is comprised of more than 11,500 acres: 4,100 acres of which are riparian habitat; 4,823 acres are recreation areas, and 2,400 acres are owned by the Orange County Water District. The Corps owns

9,100 acres in the Basin. The primary authorized purpose of this project is flood risk management, followed by authorization for recreation and water conservation.

As originally designed, the Prado reservoir below the existing spillway crest elevation of 543 ft, NGVD29 has a gross storage capacity of 217,000 ac-ft, of which 205,000 ac-ft is utilized for temporary storage of flood runoff and the remaining 12,000 ac-ft for sediment accumulation over a 50-yr period. Improvements have begun to the dam. The Orange County Public Works Infrastructure Program noted that the plan of improvement (currently underway) for the Prado Dam and reservoir, which has an estimated cost of $880 million includes:

- Raising the existing embankment 28.4 feet to an elevation of 594.4 feet - Completed.
- Raising the spillway crest from elevation of 543 ft. to 563 ft – Planned for 2021
- Constructing new outlet works increasing the maximum discharge capacity from 9,000 cfs to 30,000 cfs - Completed.
- Constructing new levees and dikes- Underway
- Acquiring over 1,700 acres of property rights for reservoir expansion -Underway
- Relocating and protecting 30 various utility lines- Underway
- Increasing reservoir area from 6,695 acres to 10,256 acres.
- Increasing-impoundment from 217,000 acre-feet to 362,000 acre-feet.

Extent

Dam failure is a natural disaster from two perspectives. First, the inundation from released waters resulting from dam failure is related to naturally occurring floodwaters. Second, dam failure would most probably happen in consequence of the natural disaster triggering the event. There is no scale with which to measure dam failure, only a scale to measure dam failure vulnerability based on size of dam and proximity to development. Dam failure may range from a small breach to a total failure. While a dam may fill slowly with runoff from winter storms, a dam break can have a very quick speed of onset. The duration of dam failure is not long – only as long as it takes to empty the reservoir of water the dam held back. In a Prado Dam breach event, the 2-mile reach upstream from Imperial Highway would have a surge wave depth and velocity of about 36 feet and 24 feet per second respectively. Between Imperial Highway and the Santa Ana Freeway, depths range from 9 feet to 32 feet with velocities from 5 to 9 feet per second. Specific depths in the City were unavailable.

Dam inundation from a Prado Dam failure could affect the entirety of the City. This can be seen in Table 4-19.

Table 4-19 City of Garden Grove – Geographical Extent affected by Dam Failure

Dam Inundation Area	Total Acres	% of Total Acres
Prado Dam	8,994	100.0%
Grand Total	**8,994**	**100.0%**

Source: Cal OES

Past Occurrences

Disaster Declaration History

There have been no disasters declarations related to dam failure in Orange County, as shown in Table 4-3.

NCDC Events

The NCDC does not track dam failure events.

National Performance of Dams Program Events

The National Performance of Dams Program at Stanford University tracks dam failures. A search of the National Performance of Dams Program database showed no past dam failure events on dams that could affect the City.

Hazard Mitigation Planning Committee Events

On **January 14, 2005**, after days of heavy rain, water began seeping through an earthen extension at Prado Dam. Authorities released water in order to relieve pressure and sent a flood warning to areas downriver of the dam. Over 3,000 residents were evacuated from their homes for nearly twenty-four hours for fear of flooding. The gymnasium at Corona High School in Corona, CA was converted by the American Red Cross into a temporary shelter. No damages were reported in the City of Garden Grove.

The HMPC noted no other events where the City was under threat of dam failure.

Likelihood of Future Occurrences

Unlikely – There have been no recorded events of dam failure in or around Garden Grove. None of the dams of concern have ever been at risk of failure in the past. Based on past occurrences, it is unlikely a dam failure will occur in the future that would impact the City of Garden Grove.

Climate Change and Dam Failure

Increases in both precipitation and heat causing snow melt in areas upstream of dams could increase the potential for dam failure and uncontrolled releases on dams that could affect the City of Garden Grove.

4.2.7. Drought and Water Shortage

Hazard/Problem Description

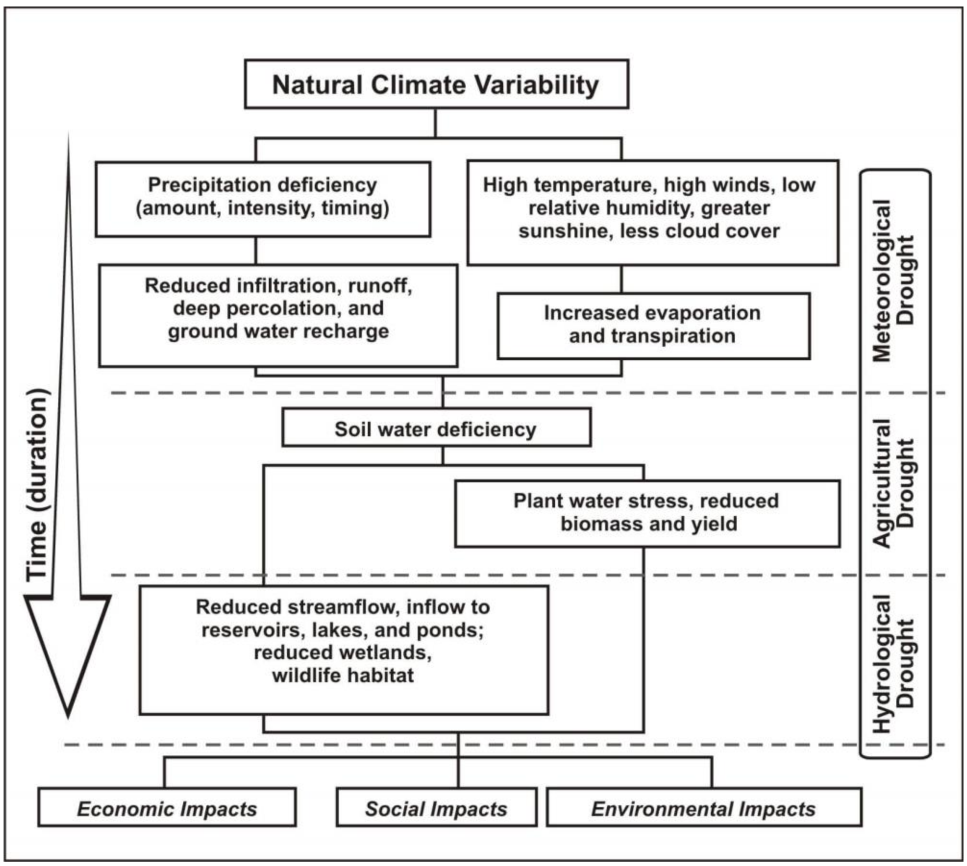
Drought

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Water districts normally require at least a 10-year planning horizon to implement a multiagency improvement project to mitigate the effects of a drought and water supply shortage.

Drought is a complex issue involving (see Figure 4-20) many factors—it occurs when a normal amount of precipitation and snow is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects:

- Meteorological drought is usually defined by a period of below average water supply.
- Agricultural drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- Hydrological drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- Socioeconomic drought occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

Figure 4-20 Causes and Impact of Drought



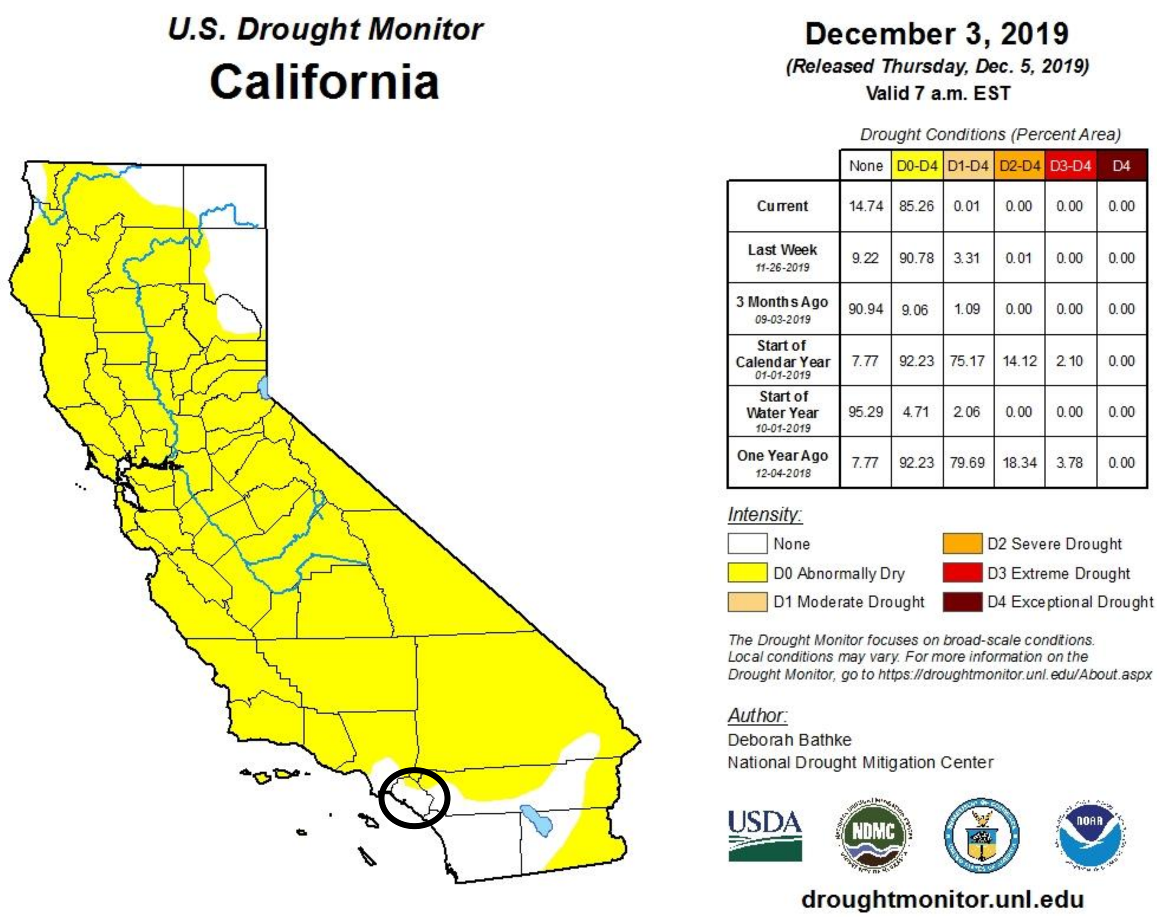
Source: National Drought Mitigation Center (NDMC)

Drought can cause increased wildfire risk. This is discussed in Section 4.2.13. Drought can also damage urban trees and vegetation during periods of extreme heat, as discussed in Section 4.2.2.

Location

Drought is a regional phenomenon. Drought affects the whole of the City. Drought in the United States is monitored by the National Integrated Drought Information System (NIDIS). A major component of this portal is the U.S. Drought Monitor. The Drought Monitor concept was developed jointly by the NOAA's Climate Prediction Center, the NDMC, and the USDA's Joint Agricultural Weather Facility in the late 1990s as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state, and academic scientists who are intimately familiar with the conditions in their respective regions. A snapshot of the current 2019 drought conditions in California and the Planning Area can be found in Figure 4-21. Snapshot from 2013 to 2018 are shown in Figure 4-22.

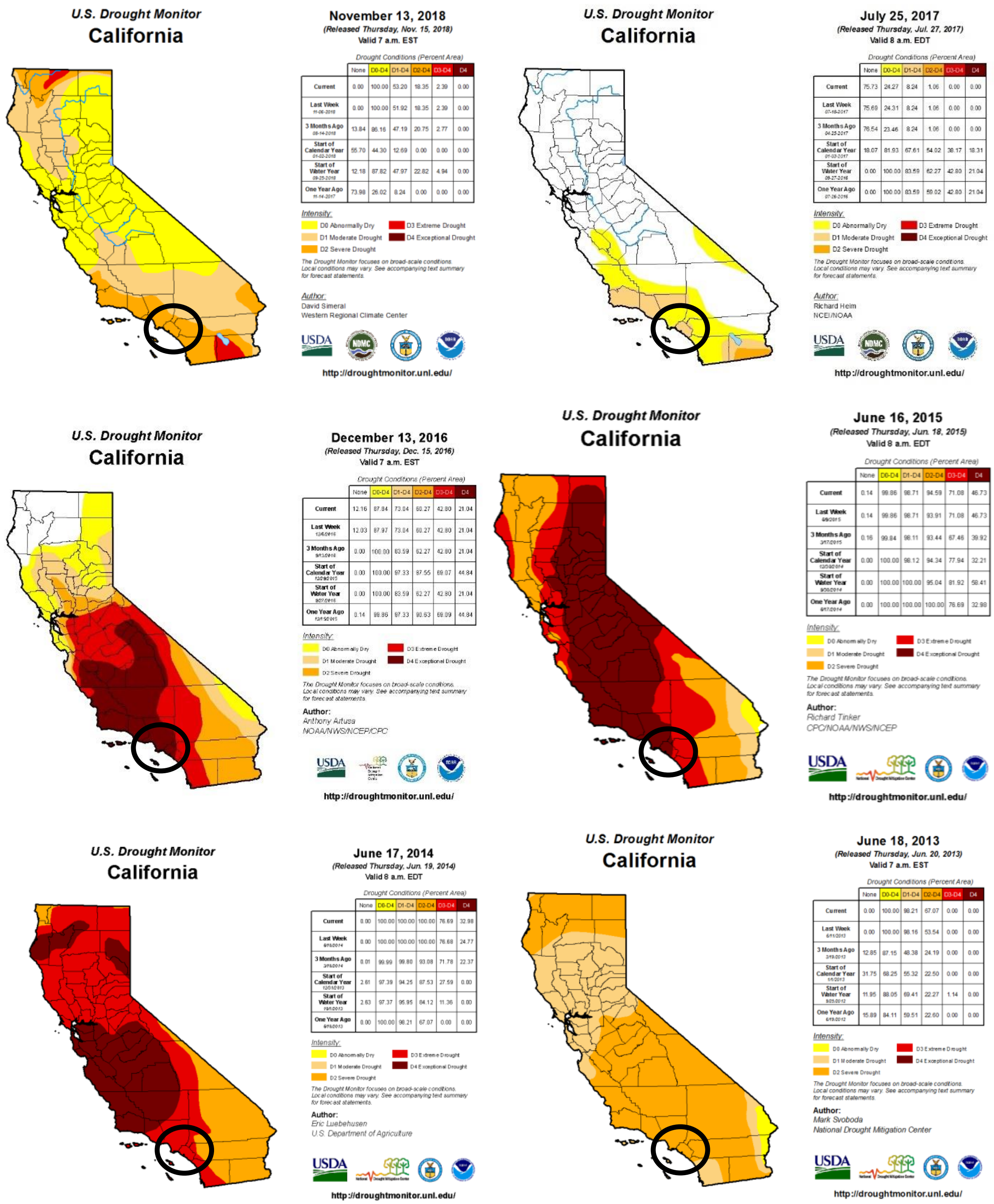
Figure 4-21 Current Drought Status in the City of Garden Grove



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	14.74	85.26	0.01	0.00	0.00	0.00
Last Week 11-26-2019	9.22	90.78	3.31	0.01	0.00	0.00
3 Months Ago 09-03-2019	90.94	9.06	1.09	0.00	0.00	0.00
Start of Calendar Year 01-01-2019	7.77	92.23	75.17	14.12	2.10	0.00
Start of Water Year 10-01-2019	95.29	4.71	2.06	0.00	0.00	0.00
One Year Ago 12-04-2018	7.77	92.23	79.69	18.34	3.78	0.00

Source: US Drought Monitor

Figure 4-22 Previous Drought Status in the City of Garden Grove



Source: US Drought Monitor

Cal DWR says the following about drought:

> ***One dry year does not normally constitute a drought in California. California's extensive system of water supply infrastructure—its reservoirs, groundwater basins, and inter-regional conveyance facilities—mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Hydrologic conditions constituting a drought for water users in one location may not constitute a drought for water users elsewhere, or for water users having a different water supply. Individual water suppliers may use criteria such as rainfall/runoff, amount of water in storage, or expected supply from a water wholesaler to define their water supply conditions.***

The drought issue in California is further compounded by water rights. Water is a commodity possessed under a variety of legal doctrines. The prioritization of water rights between farming and federally protected fish habitats in California contributes to this issue.

Extent

As shown on the previous figures, drought is tracked by the US Drought Monitor. The Drought Monitor includes a scale to measure drought intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)

Drought is not initially recognized as a problem because it normally originates in what is considered good weather, which typically includes a dry late spring and summer in Mediterranean climates, such as in California. The drought complications normally appear more than a year after a drought begins. The most direct and likely most difficult drought impact to quantify is to local economies. The State has conducted some empirical studies on the economic effects of fallowed lands with regard to water purchased by the State's Water Bank; but these studies do not quantitatively address the situation in Orange County. It can be assumed, however, that the loss of production in one sector of the economy would affect other sectors.

Drought has the potential to affect the entire City and Orange County. Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in the Planning Area are those related to water intensive activities such as, municipal usage, commerce, tourism, recreation, and wildfire protection. Also, during a drought, allocations go down and water costs increase, which results in reduced water availability. Voluntary conservation measures are a normal and ongoing part of system operations and actively implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding and erosion.

Water Shortage

Southern California's water resources have historically been affected by periodic drought cycles. Multi-year droughts in particular have significantly diminished the supply of water available to Garden Grove Water Services Division customers. However, when precipitation levels are up, these water sources can and do rebound.

The City of Garden Grove Urban Water Management Plan (UWMP) noted that the local rainfall has limited impacts on reducing demand for the City, due to the high amounts of impervious surfaces in the City. Water that infiltrates into the soil may enter groundwater supplies depending on the local geography. However, due to the large extent of impervious cover in southern California, rainfall runoff quickly flows to a system of concrete storm drains and channels that lead directly to the ocean. Orange County Water District (OCWD) is one agency that has successfully captured stormwater along the Santa Ana River and in recharge basins for years and used it as an additional source of supply for groundwater recharge.

Garden Grove's water supply comes from two sources; imported water from Metropolitan Water District of Southern California (Met or MWDOC), and local groundwater. The Water Services Division is responsible for maintaining the wells, reservoirs, import water connections, and the distribution systems that deliver water to residents of Garden Grove. To meet the increasing demand for water in the densely populated Southern California Region, the OCWD and the Orange County Sanitation District (OCSD) are working together on a groundwater replenishment system.

The UWMP noted that approximately 68.5 percent of the City's water demand is residential; commercial, industrial, institutional and governmental accounts for the remaining 31.5 percent of the total demand. The City does not sell water to other agencies although it does maintain emergency interconnections with neighboring systems.

Location

Since water shortage happens on a regional scale and water supply sources are similar throughout the City, the entirety of the City is at risk.

Extent

There is no established scientific scale to measure water shortage. The speed of onset of water shortage tends to be lengthy. The duration of water shortage can vary, depending on the severity of the drought that accompanies it.

Past Occurrences

Disaster Declaration History

There have been two state and one federal disaster declarations for Orange County. These are shown on Table 4-20.

Table 4-20 Orange County – State and Federal Drought Disaster Declarations 1950-2019

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Drought	1	2014	0	–

Source: Cal OES, FEMA

NCDC Events

There have been 26 NCDC drought events in Orange County, as shown on Table 4-21. All of the events were from the 2007-2009 drought that affected the County. No injuries, damages, or deaths were reported due to these events.

*Table 4-21 Orange County NCDC Drought Events 1/1/1950-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Drought	26	0	0	0	0	$0	$0

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

Hazard Mitigation Planning Committee Events

The 2018 California State Hazard Mitigation Plan discussed the major droughts from 1900 to 2017. This discussion below appends to the tables and figures above.

The 1975-1977 Drought

From November 1975 through November 1977, California experienced one of its most severe droughts. Although people in many areas of the state are accustomed to very little precipitation during the growing season (April to October), they expect it in the winter. In 1976 and 1977, the winters brought only one-half and one-third of normal precipitation, respectively. Most surface storage reservoirs were substantially drained in 1976, leading to widespread water shortages when 1977 turned out to be even drier. 31 counties were affected, resulting in $2.67 billion in crop damage. The City could recall no specific damages that could be attributed to this drought event.

The 1987-1992 Drought

From 1987 to 1992, California again experienced a serious drought due to low precipitation and run-off levels. The hardest-hit region was the Central Coast, roughly from San Jose to Ventura. In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry-farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered, recreational use of lakes and rivers decreased, forestry losses and fires increased, and hydroelectric power production decreased. In February 1991, DWR and Cal OES surveyed drought conditions in all 58 California counties and found five main problems: extremely dry rangeland, irrigated agriculture with severe surface water shortages and falling groundwater levels, widespread rural areas where individual and community supplies were going dry, urban area water rationing at 25 to 50 percent of normal usage, and environmental impacts.

Storage in major reservoirs had dropped to 54 percent of average, the lowest since 1977. The shortages led to stringent water rationing and severe cutbacks in agricultural production, including threats to survival of permanent crops such as trees and vines. Fish and wildlife resources were in critical shape as well. Not since the 1928-1934 drought had there been such a prolonged dry period. In response to those conditions, the Governor established the Drought Action Team. This team almost immediately created an emergency drought water bank to develop a supply for four critical needs: municipal and industrial uses, agricultural uses, protection of fish and wildlife, and carryover storage for 1992. The large-scale transfer program, which involved over 800,000 acre-feet of water, was implemented in less than 100 days with the help and commitment of the entire water community and established important links between state agencies, local water interests, and local governments for future programs. The City could recall no specific damages that could be attributed to this drought event.

The 2007-2009 Drought

Water years 2007-2009 were collectively the 15th driest three-year period for DWR's eight-station precipitation index, which is a rough indicator of potential water supply availability to the State Water Project (SWP) and Central Valley Project (CVP). Water year 2007 was the driest single year of that drought, and fell within the top 20 percent of dry years based on computed statewide runoff. In June 2008, a state emergency proclamation was issued due to water shortage in selected Central Valley counties. In February 2009, for the first time in its history, the State of California proclaimed a statewide drought. The state placed unprecedented restrictions on CVP and SWP diversions from the Delta to protect listed fish species, a regulatory circumstance that exacerbated the impacts of the drought for water users.

The greatest impacts of the 2007–2009 drought were observed in the CVP service area on the west side of the San Joaquin Valley, where hydrologic conditions combined with reduced CVP exports resulted in substantially reduced water supplies (50 percent supplies in 2007, 40 percent in 2008, and 10 percent in 2009) for CVP south-of Delta agricultural contractors. Small communities on the west side highly dependent on agricultural employment were especially affected by land fallowing due to lack of irrigation supplies, as well as by factors associated with current economic recession. The coupling of the drought and economic recession necessitated emergency response actions related to social services, such as food banks and unemployment assistance. The City could recall no specific damages that could be attributed to this drought event.

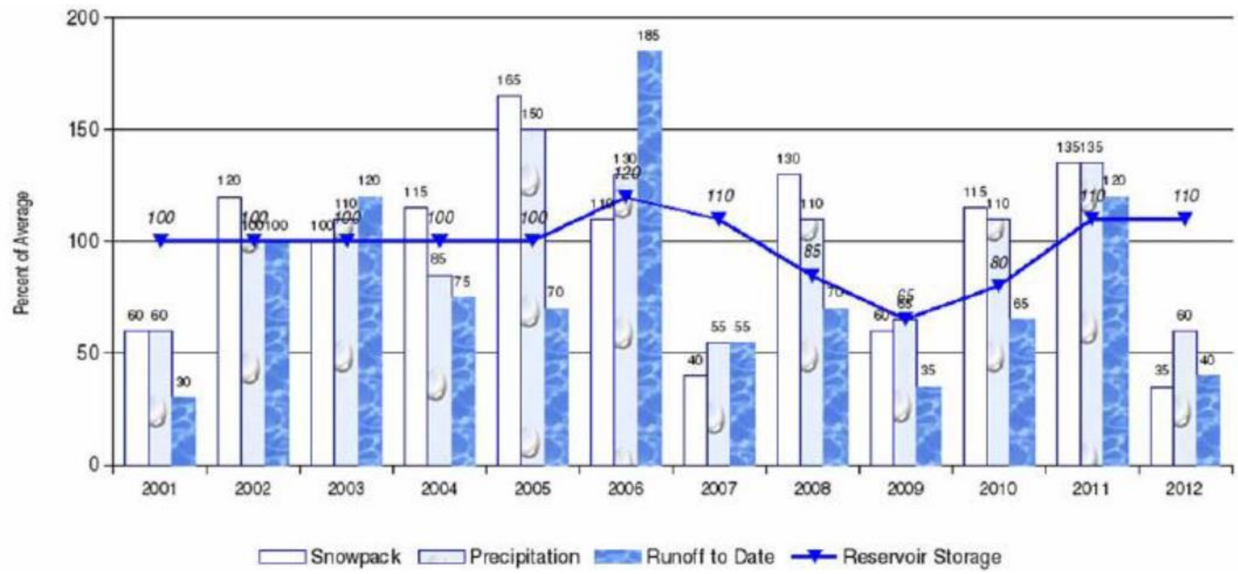
The 2012-2017 Drought

The statewide drought of 2012-2017 will be remembered as one of the most severe and costliest droughts of record in California. The drought that spanned water years 2012 through 2017 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra-Cascades snowpack on record (2015, with 5 percent of average). It was marked by extraordinary heat: 2014, 2015, and 2016 were California's first, second, and third warmest years in terms of statewide average temperatures. By the time the drought was declared officially over in April 2017, the state had expended $6.6 billion in drought response and mitigation programs, and had been declared a federal disaster area. The following discussion outlines the chronology of events and milestones reached during the drought as well as a summary of Executive Orders issued by the Governor, disaster assistance programs initiated, and grant programs designed to alleviate the impacts of the drought. The City could recall no specific damages that could be attributed to this drought event.

Water Shortage

Figure 4-23 illustrates several indicators commonly used to evaluate water conditions in California. The percent of average values are determined by measurements made in each of the ten major hydrologic regions. The chart describes water conditions in California between 2007 and 2018. The chart illustrates the cyclical nature of weather patterns in California.

Figure 4-23 Water Supply Conditions, 2007 to 2012



Source: 2018 State of California Hazard Mitigation Plan

Beginning in 2012, snowpack levels in California dropped dramatically. 2015 estimates place snowpack as 5 percent of normal levels. Snowpack measurements have been kept in California since 1950 and nothing in the historic record comes close to 2015's severely depleted level. The previous record for the lowest snowpack level in California, 25 percent of normal, was set both in 1976-77 and 2013-2014. In "normal" years, the snowpack supplies about 30 percent of California's water needs, according to the California Department of Water Resources. Snowpack levels began to increase in 2016, and in 2017 snowpack increased to the largest in 22 years, according to the State Department of Water Resources. In late 2017 and early 2018, drought conditions had begun to return to southern California. Limited drought conditions have occurred through 2019 as well.

With a reduction in water, water supply issues based on water rights becomes more evident. Drought and water supply issues will continue to be a concern to the Planning Area.

Likelihood of Future Occurrence

Drought

Likely—Historical drought data for the Planning Area and region indicate there have been 5 significant droughts in the last 85 years. This equates to a drought every 17 years on average or a 5.9 percent chance of a drought in any given year. However, based on this data and given the multi-year length of droughts, the HMPC determined that future drought occurrence in the Planning Area are likely.

Water Shortage

Likely— Recent historical data for water shortage indicates that the City may at some time be at risk to both short and prolonged periods of water shortage. Based on this it is possible that water shortages will affect the City in the future during extreme drought conditions. However, to date, Garden Grove has continued to have relatively consistent water supply.

Climate Change and Drought and Water Shortage

Climate scientists studying California find that drought conditions are likely to become more frequent and persistent over the 21st century due to climate change. The experiences of California during recent years underscore the need to examine more closely the state's water storage, distribution, management, conservation, and use policies. The Climate Adaptation Strategy (CAS) stresses the need for public policy development addressing long term climate change impacts on water supplies. The CAS notes that climate change is likely to significantly diminish California's future water supply, stating that:

California must change its water management strategies and uses because climate change will likely create greater competition for limited water supplies needed by the environment, agriculture, and cities.

Members of the HMPC noted a report published in Science magazine in 2015 that stated:

> ***Given current greenhouse gas emissions, the chances of a 35+ year "megadrought" striking the Southwest by 2100 are above 80 percent.***

A report from the Public Policy Institute of California noted that thousands of Californians – mostly in disadvantaged communities – already face acute water scarcity, contaminated groundwater, or complete water loss. Climate change would make these effects worse.

4.2.8. Earthquake

Hazard/Problem Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, gas, communication, and transportation. Earthquakes may also cause collateral emergencies including dam and levee failures, seiches, hazmat incidents, fires, avalanches, and landslides. 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. This section briefly discusses issues related to types of seismic hazards.

Ground Shaking

Ground shaking is motion that occurs as a result of energy released during faulting. The damage or collapse of buildings and other structures caused by ground shaking is among the most serious seismic hazards. Damage to structures from this vibration, or ground shaking, is caused by the transmission of earthquake vibrations from the ground to the structure. The intensity of shaking and its potential impact on buildings is determined by the physical characteristics of the underlying soil and rock, building materials and workmanship, earthquake magnitude and location of epicenter, and the character and duration of ground motion.

Actual ground breakage generally affects only those buildings directly over or nearby the fault. Ground shaking generally has a much greater impact over a greater geographical area than ground breakage. The amount of breakage and shaking is a function of earthquake magnitude, type of bedrock, depth and type of soil, general topography, and groundwater. As with most communities in southern California near active faults, Garden Grove would be susceptible to violent ground shaking.

Seismic Structural Safety

Older buildings constructed before building codes were established, and even newer buildings constructed before earthquake-resistance provisions were included in the codes, are the most likely to be damaged during an earthquake. Buildings one or two stories high of wood-frame construction are considered to be the most structurally resistant to earthquake damage. Older masonry buildings without seismic reinforcement (unreinforced masonry) and soft story buildings are the most susceptible to the type of structural failure that causes injury or death.

The susceptibility of a structure to damage from ground shaking is also related to the underlying foundation material. A foundation of rock or very firm material can intensify short-period motions which affect low-rise buildings more than tall, flexible ones. A deep layer of water-logged soft alluvium can cushion low-rise buildings, but it can also accentuate the motion in tall buildings. The amplified motion resulting from softer alluvial soils can also severely damage older masonry buildings.

Other potentially dangerous conditions include, but are not limited to: building architectural features that are not firmly anchored, such as parapets and cornices; roadways, including column and pile bents and abutments for bridges and overcrossings; and above-ground storage tanks and their mounting devices. Such features could be damaged or destroyed during strong or sustained ground shaking.

Surface Rupture and Ground Failure

The Garden Grove 2016 EOP noted that fissuring, settlement, and permanent horizontal and vertical shifting of the ground often accompanies large earthquakes. Although not as pervasive or as costly as the shaking itself, these ground failures can significantly increase damage and under certain circumstances can be the dominant cause of damage.

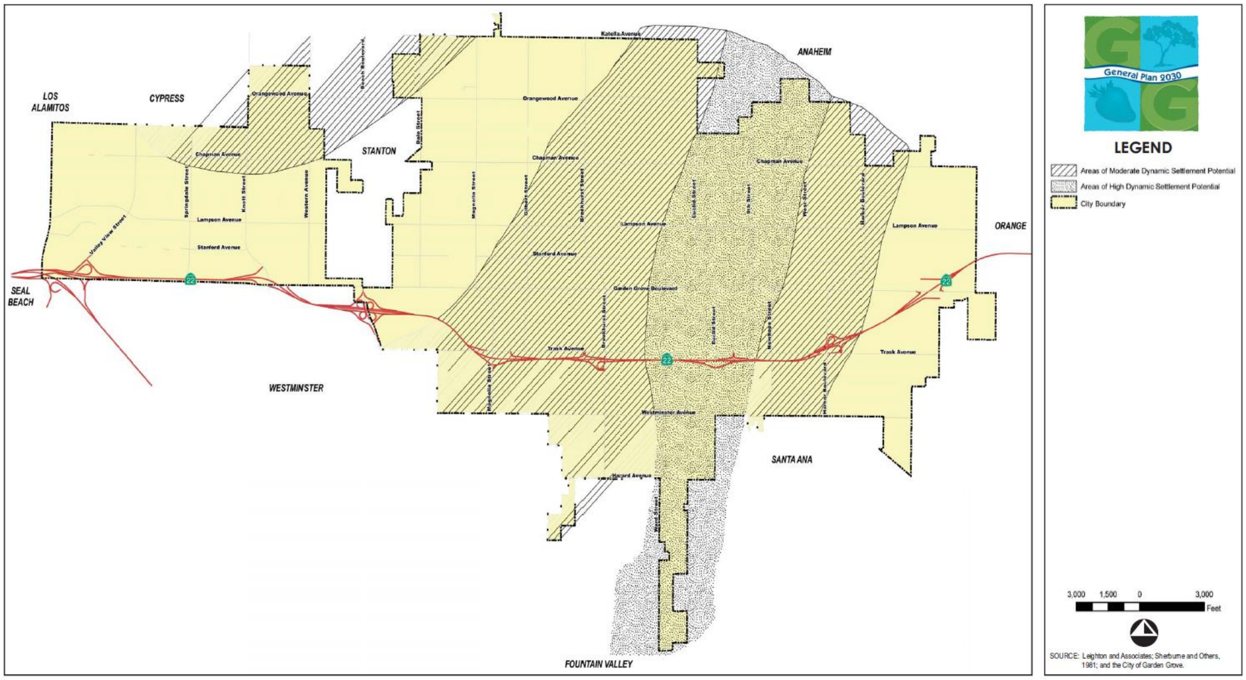
Liquefaction Potential

Liquefaction is a process whereby soil is temporarily transformed to a fluid formed during intense and prolonged ground shaking. Areas most prone to liquefaction are those that are water saturated (e.g., where the water table is less than 30 feet below the surface) and consist of relatively uniform sands that are loose to medium density. In addition to necessary soil conditions, the ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction. Liquefaction during major earthquakes has caused severe damage to structures on level ground as a result of settling, titling, or floating If liquefaction occurs in or under a sloping soil mass, the entire mass may flow toward a lower elevation. Also of particular concern in terms of developed and newly developing areas are fill areas that have been poorly compacted. Liquefaction is discussed in greater detail in Section 4.2.9.

Settlement

Settlement can occur in poorly consolidated soils during ground shaking. During settlement, the soil materials are physically rearranged by the shaking to result in a less stable alignment of the individual minerals. Settlement of sufficient magnitude to cause significant structural damage is normally associated with rapidly deposited alluvial soils or improperly founded or poorly compacted fill. These areas are known to undergo extensive settling with the addition of irrigation water, but evidence due to ground shaking is not available. According to the General Plan Safety Element for the City, the City has areas of moderate and high settlement potential; refer Figure 4-24. The areas of moderate potential are located in the northwest and eastern portions of the City, while the areas of high potential are located in the central portion of the City, generally near Euclid Street.

Figure 4-24 City of Garden Grove – Areas of Dynamic Settlement



Source: City of Garden Grove General Plan Safety Element

Landslide/Debris Flows

Landslides can occur as a result of horizontal seismic inertia 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 very high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

Location

Garden Grove is located in a geologically active part of the United States and is at risk to earthquakes from multiple faults. The region's geology is dominated by the intersection of the Pacific and North American tectonic plates, two components of the earth's crust that are moving in opposite directions. Large earthquake faults have developed in response to the stress between the plates. When enough strain builds up along a fault line, the plates slip and an earthquake occurs.

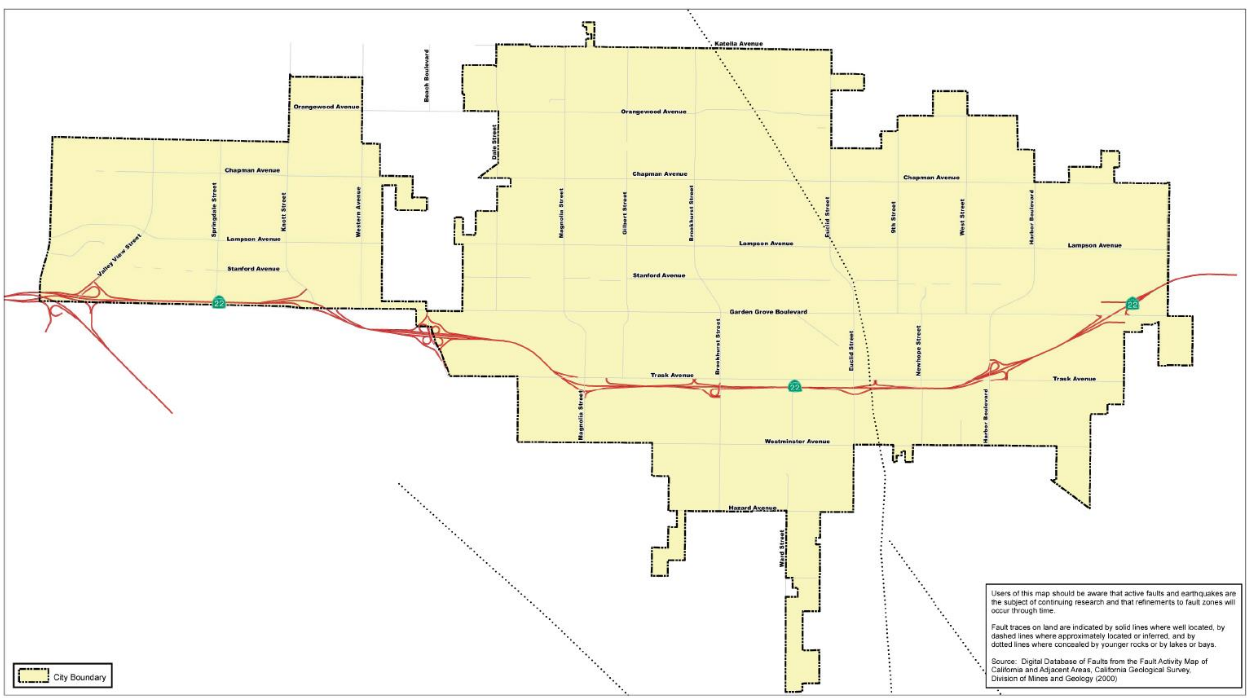
Faults

A fault is defined as "a fracture or fracture zone in the earth's crust along which there has been displacement of the sides relative to one another." For the purpose of planning there are two types of faults, active and inactive. Active faults have experienced displacement in historic time, suggesting that future displacement may be expected. Inactive faults show no evidence of movement in recent geologic time, suggesting that these faults are dormant. This does not mean, however, that faults having no evidence of surface displacement within the last 11,000 years are necessarily inactive. For example, the 1975 Oroville earthquake, the 1983 Coalinga earthquake, and the 1987 Whittier Narrows earthquake occurred on faults not previously recognized as active. Potentially active faults are those that have shown displacement within the last 1.6 million years (Quaternary). An inactive fault shows no evidence of movement in historic (last 200 years) or geologic time, suggesting that these faults are dormant.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible ground shaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

According to the City of Garden Grove 2030 General Plan Environmental Impact Report, Section Five – Geology, there are no Alquist Priolo Earthquake Fault Zones located within the City of Garden Grove. However, two fault splays associated with the in-active Pelican Hills Fault Zone traverse the central and western portions of the City in a northwest to southeast trending direction. Figure 4-25 depicts the location of the fault splays traversing the City.

Figure 4-25 City of Garden Grove – Fault Splays of the Pelican Hills Fault Zone



Source: City of Garden Grove 2030 General Plan Environmental Impact Report

Additionally, there are several potentially active faults within proximity to the City. Figure 4-26 depicts the location of faults in southern California. The Newport-Inglewood, Whittier, and Palos Verdes Faults are the most likely to cause high ground acceleration in the City. The San Andres Fault has the highest probability of generating a maximum credible earthquake in California. The Norwalk Fault, though closer to the City, is predicted to generate smaller magnitude earthquakes as it is not a designated Alquist Priolo Earthquake Fault. These faults are discussed in further detail below.

- **Pelican Hill Fault Zone**. The Pelican Hill Fault Zone is considered an inactive fault. However, minor historical seismicity recorded in the area may be related to this fault. These fault splays are located or inferred from water well data and are concealed by younger rocks or by lakes or bays; thus, these faults do not reach the surface.
- **Newport-Inglewood Fault Zone**. The Newport-Inglewood Fault Zone is located approximately five miles southwest of the City of Garden Grove at its closes point. The Newport-Inglewood Fault Zone is a series of echelon northwest-trending and vertically-dipping faults extending approximately 47 miles from the southern edge of the Santa Monica Mountains southeastward to the offshore area near Newport Beach, the fault zone continues offshore southeasterly past Oceanside and is known as the Offshore Zone of Deformation. This fault has right-lateral movement, with a local reverse slip associated with fault steps. The zone is seismically active with a number of recorded earthquakes, including the historic 6.4 magnitude Long Beach Earthquake. This fault zone could generate a 7.6-plus magnitude maximum credible earthquake.
- **Norwalk Fault**. The Norwalk Fault is approximately 16 miles long and is located north of Garden Grove. Seismic activity has occurred along the fault and may have been the cause of a recent 4.7 magnitude earthquake.
- **Elsinore Fault Zone**. Whittier Section. The Whittier Fault is located approximately ten miles northeast of the City of Garden Grove at its closes point. The Whittier section of the Elsinore Fault Zone extends over 20 miles from the Whittier Narrows southeasterly to the Santa Ana River where it merges with the southeasterly trending Elsinore fault and other smaller faults. Movement on this fault occurs as a right-lateral strike-slip (movement is parallel to the direction or trend of the fault plane) with some reverse slip. The Whittier Fault is considered capable of generating earthquakes with a Magnitude of 7.2.
- **San Andreas Fault**. The San Andreas Fault is located approximately 44 miles north of the City of Garden Grove at its closes point. The San Andreas Fault extends more than 600 miles over the length of California. The fault is divided into segments. This fault has a right-lateral strike- slip movement. An earthquake along the San Andreas Fault could affect most of southern California. Several earthquakes have been attributed to this fault. It is estimated by geologists that this fault may be capable of generating an earthquake of magnitude 8.5 on the Richter scale, which is designated as the maximum credible earthquake.

Figure 4-26 City of Garden Grove – Potentially Active Faults in or near the City

Source: Cal OES

Extent

The speed of onset of earthquake is short. Duration of shaking is also short, though aftershocks may continue to occur for a period of time. The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales. One of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology. The Richter Magnitude Scale is used to quantify the magnitude or strength of the seismic energy released by an earthquake. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface (see Table 4-22). Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Table 4-22 Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors; by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, and great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Multi-Hazard Identification and Risk Assessment, FEMA 1997

Past Occurrences

Disaster Declaration History

There have been two state and federal disaster declarations in Orange County. The most recent damaging earthquake event affecting Southern California was the 1994 Northridge Earthquake which was a 6.7-magnitude, it affected a populated area of Los Angeles located 20 miles northwest of the downtown LA, with damages estimated at more than $20 billion, and resulted in 57 deaths. HOW WAS GARDEN GROVE AFFECTED?

The 1987, 5.9-magnitude Whittier Narrows earthquake occurred and lasted about 20 seconds, killed eight people and damaged thousands of buildings. Damages are estimated at $100 million. The earthquake occurred on the Whittier fault, which runs from Chino Hills to Whittier and is part of the larger Puente Hills Fault that stretches from just west of downtown Los Angeles to the Puente Hills area. WAS THE CITY AFFECTED BY THESE EARTHQUAKES? IF SO, HOW?

Table 4-23 Orange County Disaster Declarations 1950-2019 from Earthquake

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Earthquake	1	1994	1	1994
Earthquake	1	1987	1	1987

Source: Cal OES, FEMA

NCDC Events

The NCDC does not track earthquakes.

USGS Events

The USGS National Earthquake Information Center database contains data on earthquakes in the Garden Grove area. Table 4-24 shows the approximate distances earthquakes can be felt away from the epicenter. According to the table, a magnitude 5.0 earthquake could be felt up to 90 miles away. The USGS database was searched for magnitude 5.0 or greater on the Richter Scale within 90 miles of the City of Garden Grove. 170 events were found. These results are detailed in Table 4-25.

Table 4-24 Approximate Relationships between Earthquake Magnitude and Intensity

Richter Scale Magnitude	Maximum Expected Intensity (MMI)*	Distance Felt (miles)
2.0 - 2.9	I – II	0
3.0 - 3.9	II – III	10
4.0 - 4.9	IV – V	50
5.0 - 5.9	VI – VII	90
6.0 - 6.9	VII – VIII	135
7.0 - 7.9	IX – X	240
8.0 - 8.9	XI – XII	365

*Modified Mercalli Intensity Scale.

Source: United States Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977.

*Table 4-25 Magnitude 5.0 Earthquakes or greater within 90 Miles of Garden Grove**

Date	Richter Magnitude	Location
6/10/2016	5.19	20km NNW of Borrego Springs, CA
3/29/2014	5.1	2km NW of Brea, CA
7/7/2010	5.42	20km NNW of Borrego Springs, CA
7/29/2008	5.44	5km S of Chino Hills, CA
6/12/2005	5.2	10km ESE of Anza, CA
10/31/2001	5.02	16km ESE of Anza, CA
10/16/1999	5.6	7km ENE of Running Springs, CA

Date	Richter Magnitude	Location
4/26/1997	5.07	12km ESE of Piru, California
6/26/1995	5.02	11km SW of Valencia, California
3/20/1994	5.24	3km WNW of Panorama City, California
1/29/1994	5.06	6km NNE of Chatsworth, California
1/19/1994	5.07	10km SSW of Valencia, California
1/19/1994	5.06	8km ESE of Piru, California
1/18/1994	5.24	10km ESE of Piru, California
1/17/1994	5.58	7km NNE of Simi Valley, California
1/17/1994	5.2	9km N of Chatsworth, California
1/17/1994	5.89	1km ENE of Granada Hills, California
1/17/1994	6.7	1km NNW of Reseda, CA
8/21/1993	5	12km S of Joshua Tree, California
12/4/1992	5.26	10km SE of Lucerne Valley, California
11/27/1992	5.29	10km NNW of Big Bear City, California
9/15/1992	5.26	9km SE of Yucca Valley, California
8/17/1992	5.23	7km SE of Big Bear Lake, California
7/1/1992	5.34	24km N of Yucca Valley, California
7/1/1992	5.34	24km N of Yucca Valley, California
6/29/1992	5.08	4km ESE of Yucca Valley, CA
6/29/1992	5.69	3km ESE of Yucca Valley, California
6/28/1992	5.26	1km N of Big Bear Lake, California
6/28/1992	6.3	7km SSE of Big Bear City, CA
6/28/1992	5.53	11km SSE of Big Bear Lake, California
6/28/1992	5.41	26km NNW of Yucca Valley, CA
6/28/1992	5.49	0km E of Yucca Valley, CA
6/28/1992	5	1km SSE of Yucca Valley, California
6/28/1992	5	7km SSW of Yucca Valley, California
6/28/1992	5.7	2km SSW of Joshua Tree, California
6/28/1992	5.77	3km NE of Yucca Valley, California
6/28/1992	7.3	Landers, California Earthquake
4/23/1992	6.1	17km NNE of Thousand Palms, California
6/28/1991	5.8	13km NNE of Sierra Madre, CA
2/28/1990	5.51	6km NNE of Claremont, CA
12/16/1988	5.03	12km SW of Morongo Valley, CA
12/3/1988	5.02	1km SSE of Pasadena, CA
6/10/1988	5.37	16km NE of Lebec, CA
10/4/1987	5.25	2km WSW of Rosemead, CA
10/1/1987	5.9	2km SSW of Rosemead, CA
7/13/1986	5.45	47km ENE of San Clemente Is. (SE tip), CA

Date	Richter Magnitude	Location
7/8/1986	6	6km SSW of Morongo Valley, CA
9/4/1981	5.45	11km NNW of Santa Barbara Is., CA
2/25/1980	5.34	18km ESE of Anza, CA
3/15/1979	5.23	23km NNW of Joshua Tree, CA
1/1/1979	5.21	13km S of Malibu Beach, CA
6/1/1975	5.28	38km SW of Ludlow, CA
8/6/1973	5.14	9km SSE of Santa Cruz Is. (E end), CA
2/21/1973	5.3	22km W of Malibu, CA
2/9/1971	5.3	10km SSW of Agua Dulce, CA
2/9/1971	5.8	10km SSW of Agua Dulce, CA
2/9/1971	5.8	10km SSW of Agua Dulce, CA
2/9/1971	6.6	10km SSW of Agua Dulce, CA
9/12/1970	5.22	3km W of Lytle Creek, CA
4/28/1969	5.46	1km ENE of Borrego Springs, CA
9/23/1963	5.29	6km SSE of Hemet, CA
7/23/1952	5.55	13km ENE of Grapevine, CA
7/21/1952	5.18	5km SW of Tehachapi, CA
12/26/1951	5.75	11km NNE of San Clemente Is. (SE tip), CA
12/4/1948	6	16km E of Desert Hot Springs, CA
2/24/1948	5.2	42km SSW of San Clemente Is. (SE tip), CA
7/25/1947	5.24	10km SSE of Yucca Valley, CA
7/24/1947	5.3	4km NNE of Desert Hot Springs, CA
6/12/1944	5.24	12km WSW of Morongo Valley, CA
6/12/1944	5.06	10km NNE of Cabazon, CA
11/14/1941	5.12	5km E of Lomita, CA
9/21/1941	5.1	2km NNE of Frazier Park, CA
5/18/1940	5.2	11km S of Joshua Tree, CA
5/18/1940	5.31	6km SSE of Joshua Tree, CA
5/31/1938	5.23	8km ENE of Trabuco Canyon, CA
3/11/1933	5	Greater Los Angeles area, California
3/11/1933	5.29	7km W of Newport Beach, CA
3/11/1933	5.02	2km ENE of Westminster, CA
3/11/1933	6.4	Long Beach, California Earthquake
8/31/1930	5.25	Santa Monica Bay, California
1/16/1930	5.1	Southern California
1/16/1930	5.25	Southern California
4/18/1928	5.2	Santa Barbara Channel, California
8/4/1927	5.3	Santa Monica Bay, California
2/18/1926	5.5	Channel Islands region, California

Date	Richter Magnitude	Location
7/23/1923	5.96	Greater Los Angeles area, California
1/1/1920	5	Southern California
6/6/1918	5	Southern California
4/21/1918	6.75	Southern California
10/23/1916	5.5	Southern California
10/23/1916	5.96	Central California
9/30/1916	5	Southern California
5/15/1910	5.3	Southern California
5/13/1910	5	Southern California
4/11/1910	5	Southern California
9/20/1907	5.3	Southern California
12/25/1899	6.75	Southern California
7/22/1899	6.36	Southern California
7/22/1899	5.5	Greater Los Angeles area, California
10/23/1894	5.7	Southern California
7/30/1894	5.9	Southern California
5/19/1893	5.5	Santa Barbara Channel, California
4/4/1893	5.4	Greater Los Angeles area, California
2/9/1890	6.75	Southern California
8/28/1889	5.2	Greater Los Angeles area, California
2/7/1889	5.3	Southern California
5/27/1862	5.9	San Diego County urban area, California
12/16/1858	6	Greater Los Angeles area, California
7/11/1855	6	Greater Los Angeles area, California
11/14/1941	5.12	5km E of Lomita, CA
9/21/1941	5.1	2km NNE of Frazier Park, CA
5/18/1940	5.2	11km S of Joshua Tree, CA
5/18/1940	5.31	6km SSE of Joshua Tree, CA
5/31/1938	5.23	8km ENE of Trabuco Canyon, CA
3/11/1933	5	Greater Los Angeles area, California
3/11/1933	5.29	7km W of Newport Beach, CA
3/11/1933	5.02	2km ENE of Westminster, CA
3/11/1933	6.4	Long Beach, California Earthquake
8/31/1930	5.25	Santa Monica Bay, California
1/16/1930	5.1	Southern California
1/16/1930	5.25	Southern California
4/18/1928	5.2	Santa Barbara Channel, California
8/4/1927	5.3	Santa Monica Bay, California
2/18/1926	5.5	Channel Islands region, California

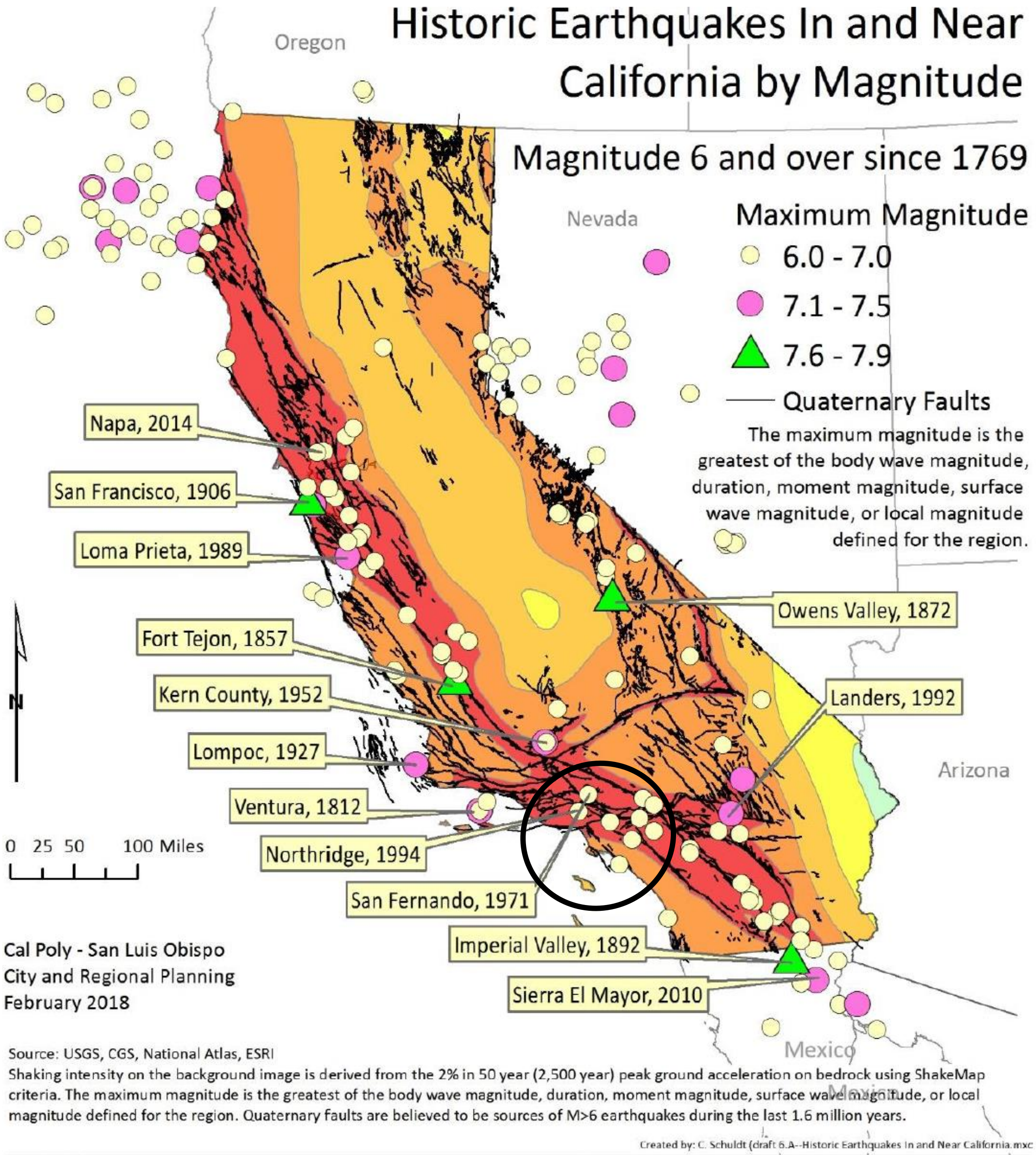
Date	Richter Magnitude	Location
7/23/1923	5.96	Greater Los Angeles area, California
1/1/1920	5	Southern California
6/6/1918	5	Southern California
4/21/1918	6.75	Southern California
10/23/1916	5.5	Southern California
10/23/1916	5.96	Central California
9/30/1916	5	Southern California
5/15/1910	5.3	Southern California
5/13/1910	5	Southern California
4/11/1910	5	Southern California
9/20/1907	5.3	Southern California
12/25/1899	6.75	Southern California
7/22/1899	6.36	Southern California
7/22/1899	5.5	Greater Los Angeles area, California
10/23/1894	5.7	Southern California
7/30/1894	5.9	Southern California
5/19/1893	5.5	Santa Barbara Channel, California
4/4/1893	5.4	Greater Los Angeles area, California
2/9/1890	6.75	Southern California
8/28/1889	5.2	Greater Los Angeles area, California
2/7/1889	5.3	Southern California
5/27/1862	5.9	San Diego County urban area, California
12/16/1858	6	Greater Los Angeles area, California
7/11/1855	6	Greater Los Angeles area, California
6/6/1918	5	Southern California
4/21/1918	6.75	Southern California
10/23/1916	5.5	Southern California
10/23/1916	5.96	Central California
9/30/1916	5	Southern California
5/15/1910	5.3	Southern California
5/13/1910	5	Southern California
4/11/1910	5	Southern California
9/20/1907	5.3	Southern California
12/25/1899	6.75	Southern California
7/22/1899	6.36	Southern California
7/22/1899	5.5	Greater Los Angeles area, California
10/23/1894	5.7	Southern California
7/30/1894	5.9	Southern California
5/19/1893	5.5	Santa Barbara Channel, California

Date	Richter Magnitude	Location
4/4/1893	5.4	Greater Los Angeles area, California
2/9/1890	6.75	Southern California
8/28/1889	5.2	Greater Los Angeles area, California
2/7/1889	5.3	Southern California
5/27/1862	5.9	San Diego County urban area, California
12/16/1858	6	Greater Los Angeles area, California
7/11/1855	6	Greater Los Angeles area, California

Source: USGS National Earthquake Information Center Database – search dates 1/1/1850 to 06/1/2019

Figure 4-27 shows major historical earthquakes in California from 1769 to 2017.

Figure 4-27 Historic Earthquakes in California 1769 to 2017



	MMI	Damage	Effects
	X	Very Heavy	Some well-built, wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
	IX	Heavy	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.
	VIII	Moderate to Heavy	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
	VII	Moderate	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.
	VI	Light	Felt by all, many frightened. Some heavy furniture moved; a few instance of fallen plaster. Damage slight.
	V	Very Light	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

Source: 2018 State of California Multi-Hazard Mitigation Plan

Hazard Mitigation Planning Committee Events

The 2015 Orange County LHMP noted that the County and City of Garden Grove sits in one of the most historically seismically active regions in the United States. The City has been subjected to numerous seismic events, originating both on faults within the County and in other parts of the region.

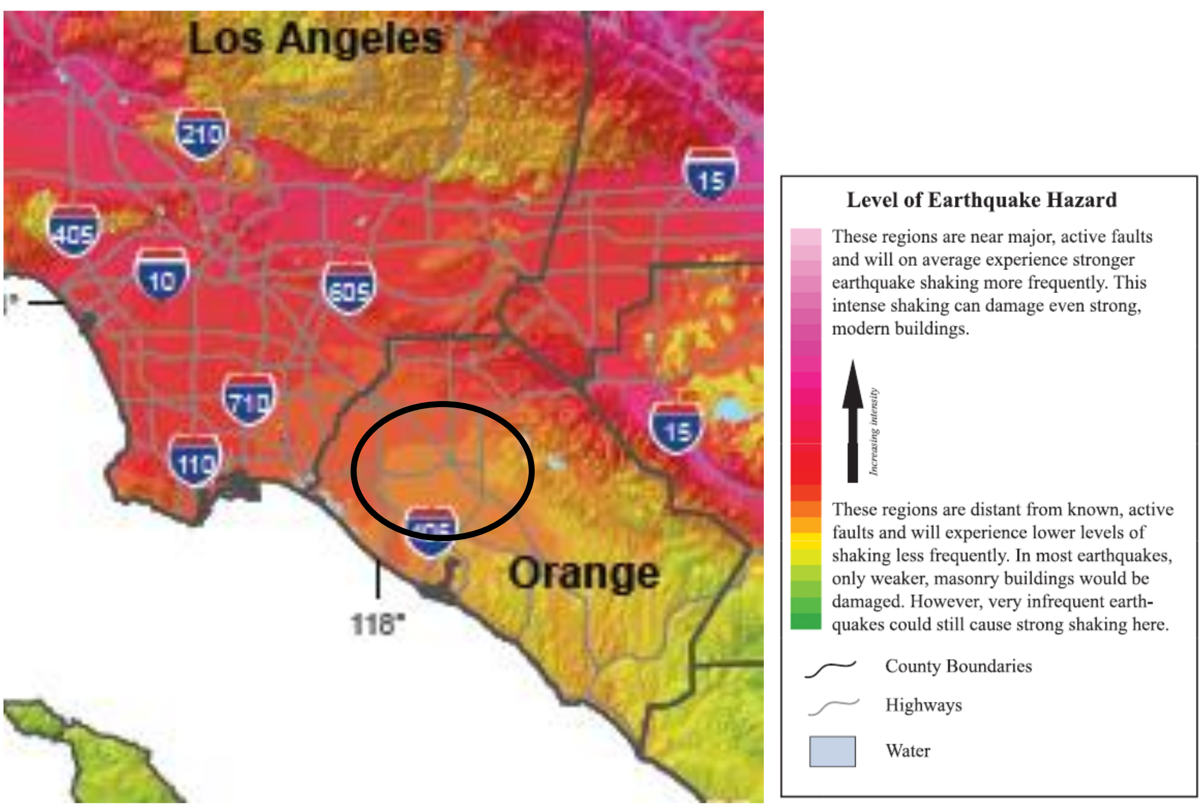
Likelihood of Future Occurrences

Occasional (major earthquake); Highly Likely (minor earthquake)—It is likely that Garden Grove will be subject to minor earthquakes in the future. Major earthquakes are considered to be occasional in the City.

Mapping of Future Occurrences

Maps indicating the maximum expectable intensity of ground shaking for the City are available through several sources. Figure 4-28, prepared by the California Division of Mines and Geology, shows the expected relative intensity of ground shaking and damage in California from anticipated future earthquakes. The shaking potential is calculated as the level of ground motion that has a 2% chance of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2,500-year average repeat time. Although the greatest hazard is in areas of highest intensity as shown on the map, no region is immune from potential earthquake damage.

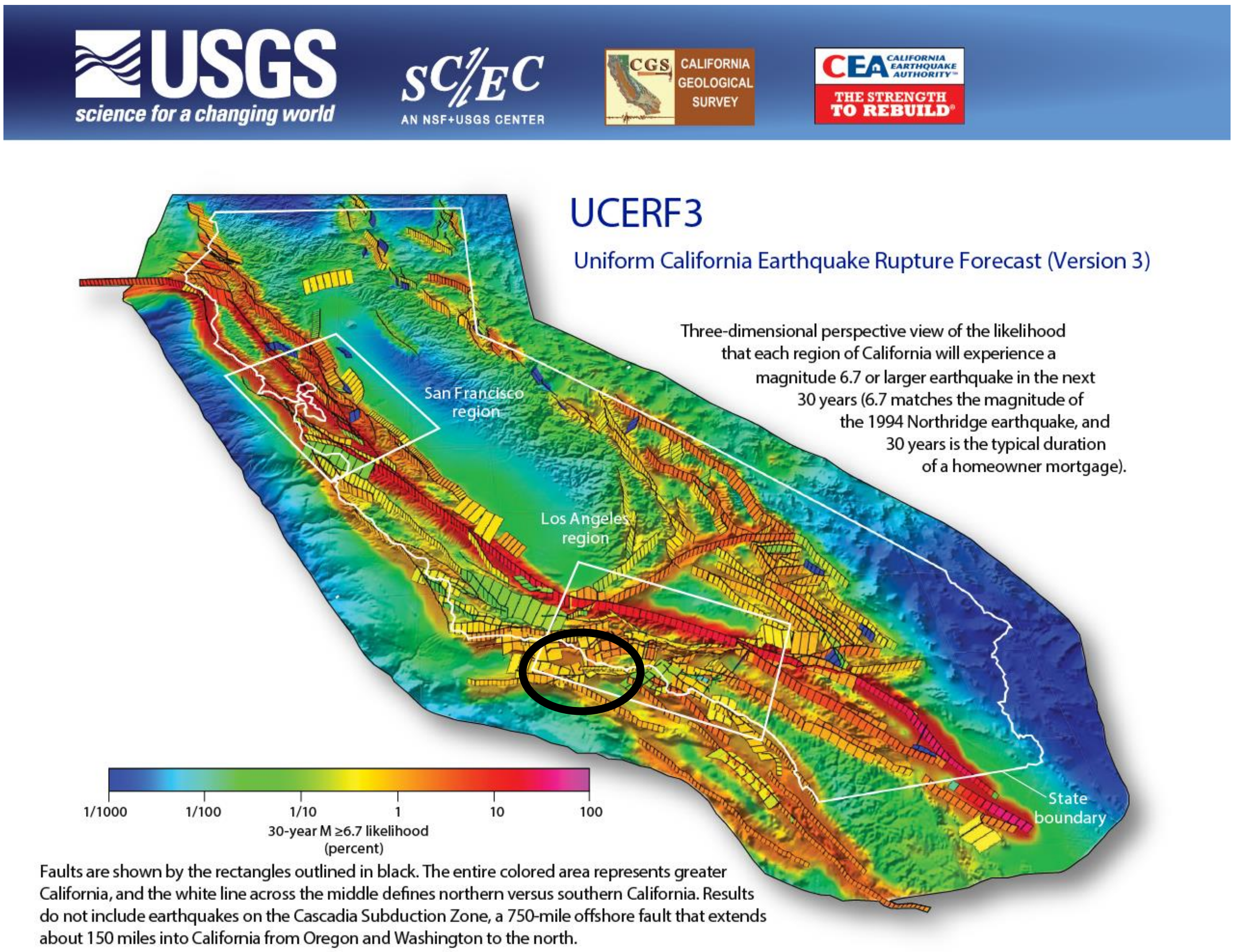
Figure 4-28 Maximum Expectable Earthquake Intensity – 2% Chance in 50 Years



Source: California Division of Mines and Geology

In 2014, the USGS and the California Geological Survey (CGS) released the time-dependent version of the Uniform California Earthquake Rupture Forecast (UCERF III) model. The UCERF III results have helped to reduce the uncertainty in estimated 30-year probabilities of strong ground motions in California. The UCERF map is shown in Figure 4-29 and indicates that Garden Grove has a moderate to high risk of earthquake occurrence – a 10 percent chance in the next 30 years. This coincides with the likelihood of future occurrence rating of occasional.

Figure 4-29 Probability of Earthquake Magnitudes Occurring in 30 Year Time Frame



Source: United States Geological Survey Open File Report 2015-3009

Climate Change and Earthquake

Climate change is unlikely to increase earthquake frequency or strength.

4.2.9. Earthquake Liquefaction

Hazard/Problem Description

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event and is associated primarily with relatively loose, saturated fine- to medium-grained unconsolidated soils. Areas most prone to liquefaction are those that are water saturated (e.g., where the water table is less than 30 feet below the surface) and consist of relatively uniform sands that are loose to medium density. In addition to necessary soil conditions, the ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is in the subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are not uncommon in alluvial deposits in moderate to large canyons and could also be present in other areas of alluvial soils where the groundwater level is shallow (i.e., 50 feet below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

Liquefaction during major earthquakes can cause severe damage to structures on level ground as a result of settling, titling, or floating. If liquefaction occurs in or under a sloping soil mass, the entire mass may flow toward a lower elevation. Also of particular concern in terms of developed and newly developing areas are fill areas that have been poorly compacted.

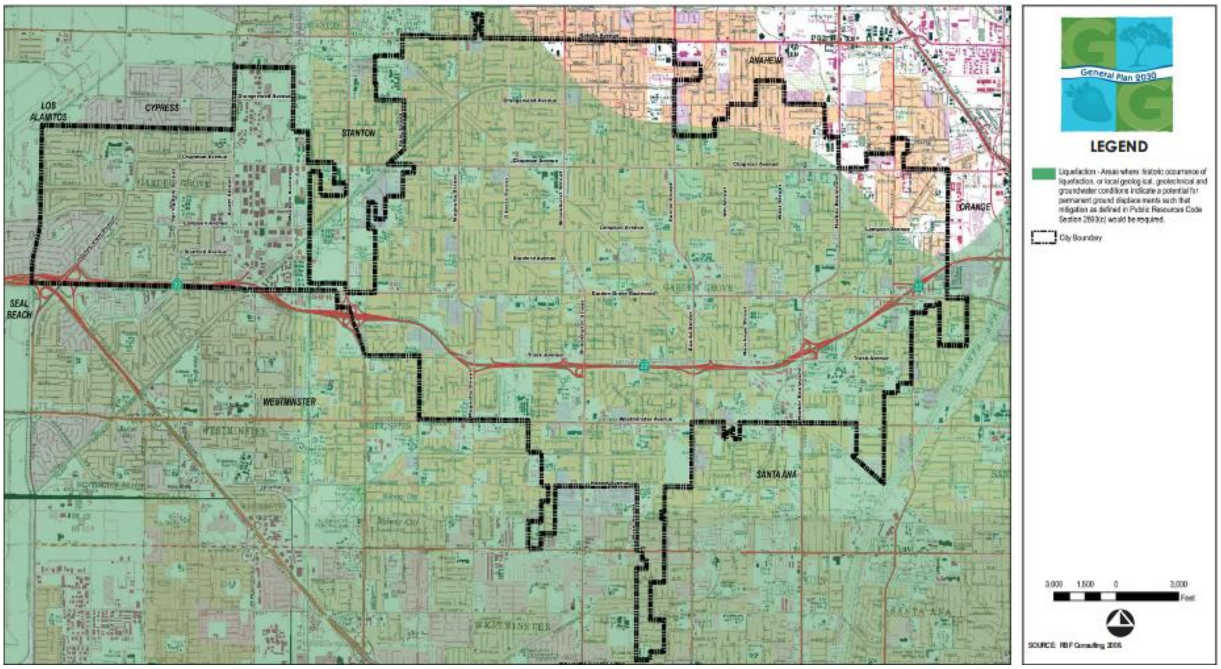
Typical effects of liquefaction include:

- Loss of bearing strength—the ground can liquefy and lose its ability to support structures.
- Lateral spreading—the ground can slide down very gentle slopes or toward stream banks riding on a buried liquefied layer.
- Sand boils—sand-laden water can be ejected from a buried liquefied layer and erupt at the surface to form sand volcanoes; the surrounding ground often fractures and settles.
- Flow failures—earth moves down steep slope with large displacement and much internal disruption of material.
- Ground oscillation—the surface layer, riding on a buried liquefied layer, is thrown back and forth by the shaking and can be severely deformed.
- Flotation—light structures that are buried in the ground (like pipelines, sewers and nearly empty fuel tanks) can float to the surface when they are surrounded by liquefied soil.
- Settlement—when liquefied ground re-consolidates following an earthquake, the ground surface may settle or subside as shaking decreases and the underlying liquefied soil becomes more dense.

Location

Liquefaction hazard maps from the General Plan Safety Element (sourced from the CGS) indicate a majority of Garden Grove is subject to liquefaction. This can be seen on Figure 4-30.

Figure 4-30 City of Garden Grove – Liquefaction Zones



Source: City of Garden Grove 2030 General Plan Safety Element

Extent

The speed of onset of earthquake is short. Duration of shaking is also short, though aftershocks may continue to occur for a period of time. There is no scientific measurement of liquefaction. It should be noted that liquefaction extent is derived from the amount of shaking that occurs during the earthquake, coupled with the level of the water table. Liquefaction affects a majority of the City. GIS analysis was performed to determine what percentages of the City would be affected by liquefaction (using CGS data). The CGS uses a scale of either in or outside a liquefaction zone. Methodologies for this analysis and maps showing extent can be found in Section 4.3.7. 1.9% of all area in Garden Grove falls in the USGS moderate susceptibility areas. This can be seen in Table 4-26.

Table 4-26 City of Garden Grove – Liquefaction Extents in USGS Zones

Liquefaction Area	Total Acres	% of Total Acres
Inside Liquefaction Potential Zone	8,310	92.4%

Source: USGS

The speed of onset of liquefaction is short, and often comes with little warning. The duration where the ground liquefies is also short; however, during this short period vast amounts of damage can occur.

Past Occurrences

Disaster Declaration History

There have been no federal or state disaster declarations due to earthquake liquefaction, as shown in Table 4-3.

NCDC Events

The NCDC does not track liquefaction events.

Hazard Mitigation Planning Committee Events

The HMPC could recall no past events of liquefaction in the City.

Likelihood of Future Occurrences

Occasional – Liquefaction is a byproduct of earthquakes and soils. The ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction. Liquefaction can occur during periods of intense ground shaking. This happens during large earthquake events. The probabilities of these large earthquake events were shown in Figure 4-29.

Climate Change and Liquefaction

According to the CAS, climate change is unlikely to increase earthquake frequency or strength. There is no direct influence of climate change considered, however sea level rise may increase the potential for higher ground water levels and more pore water pressure in low-lying coastal areas and thus could amplify the likelihood of liquefaction in the event of an earthquake.

4.2.10. Flood: (1% and 0.2% Annual Chance)

Hazard/Problem Description

According to Cal DWR, flooding is the rising and overflowing of a body of water onto normally dry land. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. 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. Floodwaters can transport large objects downstream which can damage or remove stationary structures. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utilities lines and interrupt services. Standing water can cause damage to crops, roads, foundations, and electrical circuits. 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 from any type of flooding.

There are generally three types of freshwater floods that can occur: riverine, flash, and urban stormwater. Regardless of the type of flood, the cause is often the result of severe weather and excessive rainfall, either in the flood area or upstream reaches.

- **Riverine flooding** is the most common type of flood event and occurs when a watercourse exceeds its "bank-full" capacity. Riverine flooding generally occurs as a result of prolonged rainfall, or rainfall that is combined with already saturated soils from previous rain events. The duration of riverine floods may vary from a few hours to many days. Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization. The warning time associated with slow rise floods assists in life and property protection. These types of floods are rare in the City of Garden Grove, due to the upstream protection of the Prado Dam and the levees that exist along the Santa Ana River. The HMPC noted a limited channel system that drains the City.
- The term "**flash flood**" describes localized floods of great volume and short duration. In contrast to riverine flooding, this type of flood usually results from a heavy rainfall on a relatively small drainage area. Precipitation of this sort usually occurs in the winter and spring. Flash floods often require immediate evacuation within the hour. These types of floods can occur in the City of Garden Grove and are most often associated with stormwater flood events.
- **Stormwater/Urban** flood events have increased as land has been converted from fields or woodlands to roads and parking lots and lost its ability to absorb rainfall. Urbanization increases runoff by two to six times that of natural terrain. Stormwater urban flooding is quite common in Garden Grove. This is discussed in the Section 4.2.11 below.

Floodplain Mapping

FEMA established standards for floodplain mapping studies as part of the National Flood Insurance Program (NFIP). The NFIP makes flood insurance available to property owners in participating communities adopting FEMA-approved local floodplain studies, maps, and regulations. Floodplain studies that may be approved by FEMA include federally funded studies; studies developed by state, city, and regional public agencies; and technical studies generated by private interests as part of property annexation and land development efforts. Such studies may include entire stream reaches or limited stream sections depending on the nature and scope of a study. A general overview of floodplain mapping and associated products is provided in the following paragraphs.

Flood Insurance Study (FIS)

The FIS develops flood-risk data for various areas of the community that will be used to establish flood insurance rates and to assist the community in its efforts to promote sound floodplain management. The current Orange County FISs, which includes the City of Garden Grove, are dated December 3, 2009 and March 21, 2019.

Digital Flood Insurance Rate Maps (DFIRM)

As part of its Map Modernization program, FEMA is converting paper FIRMS to digital FIRMs, DFIRMS. These digital maps:

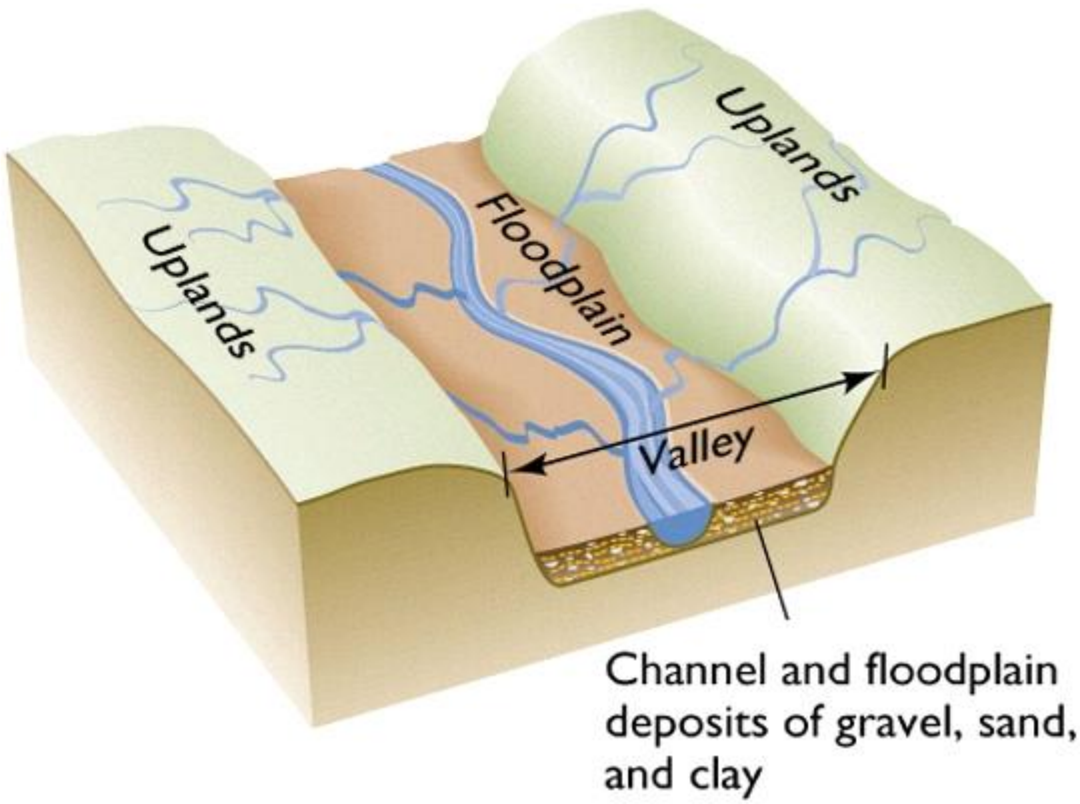
- Incorporate the latest updates (LOMRs and LOMAs);
- Utilize community supplied data;
- Verify the currency of the floodplains and refit them to community supplied basemaps;
- Upgrade the FIRMs to a GIS database format to set the stage for future updates and to enable support for GIS analyses and other digital applications; and
- Solicit community participation.

DFIRMs for Orange County and Garden Grove, dated March 21, 2019 are used for this Plan's flood hazard analysis. This is shown in Section 4.3.8. However, while the latest Orange County DFIRMs are dated 2019, the City of Garden Grove has not had DFIRM map changes since 2009.

Location

The area adjacent to a channel is the floodplain (see Figure 4-31). Floodplains are illustrated on flood maps, which show areas of potential flooding and water depths. In its common usage, the floodplain most often refers to that area that is inundated by the 100-year flood, the flood that has a one percent chance in any given year of being equaled or exceeded (1% annual chance flood). The 1% annual chance flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program (NFIP). The 500-year flood is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year (0.2% annual chance flood). The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

Figure 4-31 Floodplain Schematic



Source: FEMA

Hydrologic Regions

According to Cal DWR, California is divided into 10 hydrologic regions. The City is traversed by one hydrologic region:

- The South Coast hydrologic region (HR) covers approximately 6.78 million acres (10,600 square miles) of the southern California watershed that drains to the Pacific Ocean. The HR is bounded on the west by the Pacific Ocean and the watershed divide near the Ventura-Santa Barbara County line. The northern boundary corresponds to the crest of the Transverse Ranges through the San Gabriel and San Bernardino mountains. The eastern boundary lies along the crest of the San Jacinto Mountains and low-lying hills of the Peninsular Range that form a drainage boundary with the Colorado River HR. The southern boundary is the international boundary with the Republic of Mexico. Significant geographic features include the coastal plain, the central Transverse Ranges, the Peninsular Ranges, and the San Fernando, San Gabriel, Santa Ana River, and Santa Clara River valleys. The South Coast HR includes all of Orange County, most of San Diego and Los Angeles Counties, parts of Riverside, San Bernardino, and Ventura counties, and a small amount of Kern and Santa Barbara Counties. According to 2000 census data, about 17 million people live within the boundaries of the South Coast HR, approximately 50 percent of the population of California. Because this HR amounts to only about 7 percent of the surface area of the State, this has the highest population density of any HR in California (DWR 1998). Major population centers include the metropolitan areas surrounding Ventura, Los Angeles, San Diego, San Bernardino, and Riverside.

A map of the California's hydrological regions is provided in Figure 4-32.

Figure 4-32 California Hydrologic Regions

Garden Grove Watersheds, Streams, Drainage, and Channels

The City of Garden Grove is within the Westminster Watershed. The Westminster watershed covers 74.1 square miles in the southwestern corner of Orange County. In addition to Garden Grove, the watershed includes the cities of Anaheim, Cypress, Fountain Valley, Huntington Beach, Los Alamitos, Santa Ana, Seal Beach, Stanton, and Westminster. Three main tributaries drain this watershed. The Los Alamitos Channel drains into the San Gabriel River; the Bolsa Chica Channel empties into the Anaheim Bay-Huntington Harbour complex; and the East Garden Grove-Wintersburg Channel drains through Bolsa Bay into Huntington Harbour.

There are five drainage channels in the City:

- Bolsa Chica Channel
- Stanton Storm Drain
- Anaheim-Barber City Channel
- Westminster Channel
- East Garden Grove-Wintersburg Channel

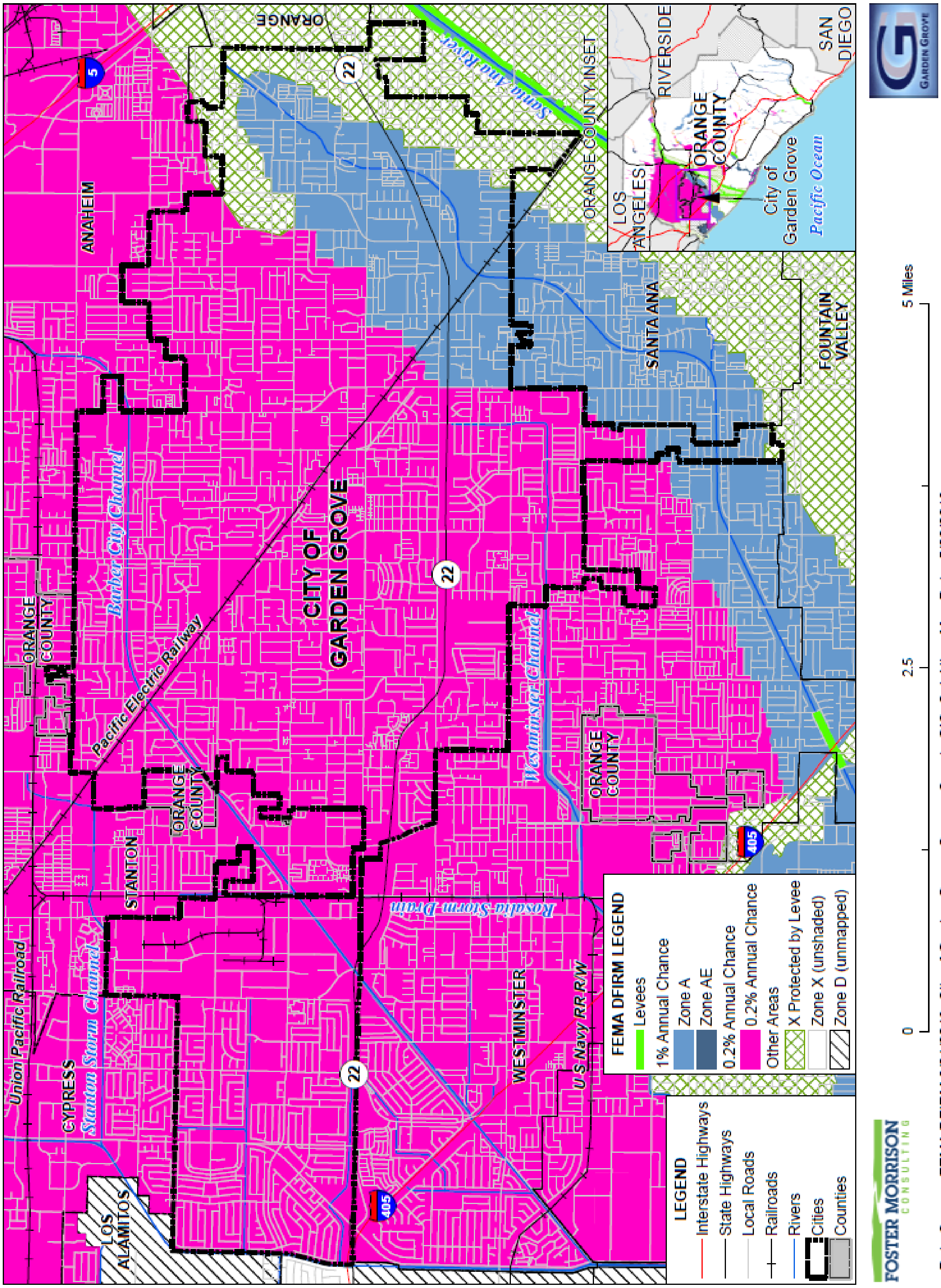
The Bolsa Chica Channel and the Stanton Storm Drain serve the westerly portion of the City. The Anaheim-Barber City channel drains in the central area of the City, while the Westminster Channel drains most of the easterly portion of the City. The East Garden Grove-Wintersburg Channel drains in the eastern fringe of the City and a portion of the City of Orange. These major drainage facilities were constructed by the Orange County Flood Control District. The eastern boundary of the City is only a short distance from the Santa Ana River levees.

Types and Sources of Flooding in Garden Grove

According to the City of Garden Grove 2030 General Plan EIR report and the Orange County FIS, the City is within designated Flood Zones A and X (shaded). As noted above, Flood Zone A is an area subject to inundation by the 1% annual chance of a flood event and mandatory flood insurance purchase requirements and floodplain management standards apply. However, the portion of the City within Flood Zone X (shaded) are located outside the one percent annual chance floodplain and flood insurance purchase is not required in this area. This Zone X (shaded) is the 500-year or 0.2% annual chance floodplain.

This can be seen in Figure 4-33. The City is considered to be in zones A (1% annual chance), X Protected by Levee, and X (shaded) (0.2% annual chance).

Figure 4-33 City of Garden Grove – DFIRM Flood Zones



Data Source: FEMA DFIRM 3/21/2019, City of Garden Grove, Orange County GIS, Cal-Atlas; Map Date: 5/20/2019.

The City of Garden Grove 2016 EOP note that the main source of the flood hazard within the City is the Santa Ana River. While the Santa Ana River does not enter Garden Grove, the floodplain of the River extends into the City. Originating near the summit of Mount San Gorgornio at the 8,000 foot level, it extends 90 miles and drains into both the San Bernardino and Santa Ana mountain ranges in three counties over a total of 3,200 square miles. Over 27 miles of the river's course flows through the County. One-third of this is natural and the remaining two-thirds is leveed, sand-bottom channel. Once the largest river in Southern California, the Santa Ana River previously enjoyed perennial flow. It is now dry most of the year due to the construction of the Prado Dam, increased upstream usage, and the development of settling basins in northern part of the County.

The City consists of gently sloping lowlands with the elevation ranging from 15 feet to 175 feet above mean sea level. Mean annual rainfall is about 12 inches, occurring mainly during the period of December to April. Nearly all the drainage is developed. Open spaces have been replaced by population and ground cove while watersheds have been replaced by impervious substances such as streets and buildings. Rainwater that can no longer filter into the soil gathers as runoff and must be collected and redistributed, thus adding to the burden of the natural drainage system.

The City is also at risk to flooding resulting from dam failures. Dam failure flooding is discussed separately in Section 4.2.6 of this document. With the presence of levees throughout Orange County, the potential for levee failure flooding in the City Planning Area is discussed separately in Section 4.2.12 of this document. Regardless of the type of flood, the cause is often the result of severe weather and excessive rainfall, either in the flood area or upstream reach.

The potential for flooding can change and increase through various land use changes and changes to land surface, resulting in a change to the floodplain. Environmental changes can create localized flooding problems in and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

Department of Water Resource (DWR) Floodplain Mapping

Also to be considered when evaluating the flood risks in Orange County are various floodplain maps developed by Cal DWR for various areas throughout California, including Orange County and Garden Grove. These maps illustrate areas beyond the FEMA DFIRMs that are prone to flooding within the City of Garden Grove.

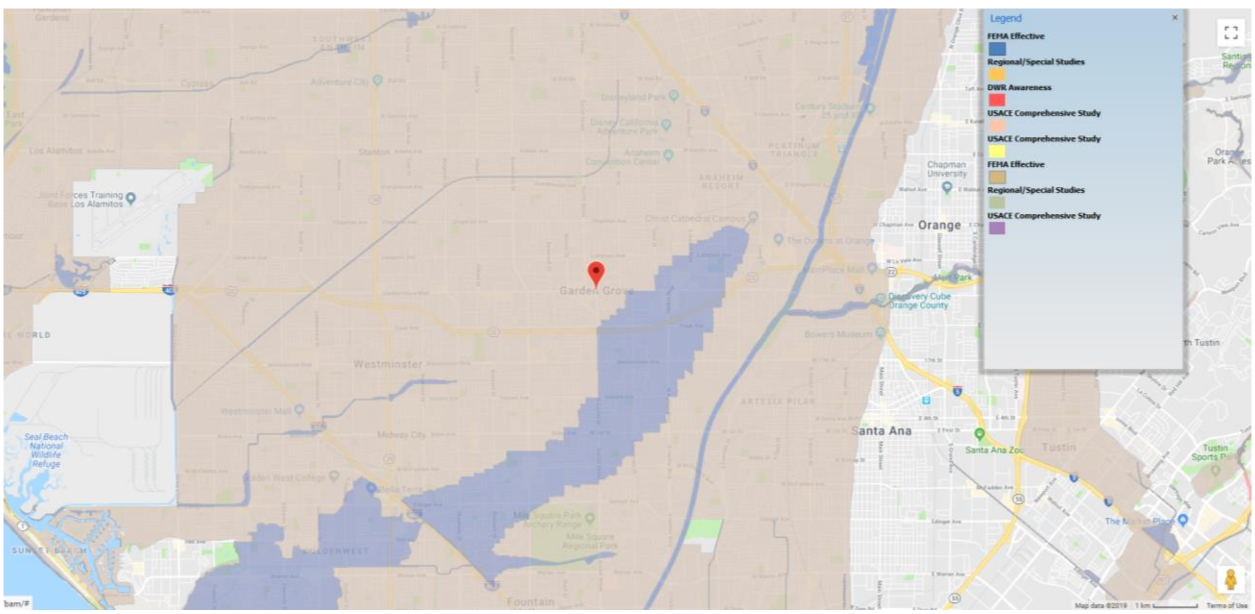
DWR Best Available Maps

The FEMA regulatory maps provide just one perspective on flood risks in Orange County and Garden Grove. Senate Bill 5 (SB 5), enacted in 2007, authorized the California DWR to develop the Best Available Maps (BAM) displaying 100- and 200-year floodplains (i.e., 1% and 0.2% annual chance floods) for areas located within the Sacramento-San Joaquin (SAC-SJ) Valley watershed. SB 5 requires that these maps contain the best available information on flood hazards and be provided to cities and counties in the SAC-SJ Valley watershed. This effort was completed by DWR in 2008. DWR has expanded the BAM to cover all counties in the State and to include 500-year (0.2% annual chance) floodplains.

Different than the FEMA DFIRMs which have been prepared to support the NFIP and reflect only the 100-year event risk, the BAMs are provided for informational purposes and are intended to reflect current 100- and 500-year event risks using the best available data. The 100-year floodplain limits on the BAM are a composite of multiple 100-year floodplain mapping sources. It is intended to show all currently identified areas at risk for a 100-year flood event, including FEMA's 100-year floodplains. The BAM maps are comprised of different engineering studies performed by FEMA, Corps, and DWR for assessment of potential 100- and 500-year floodplain areas. These studies are used for different planning and/or regulatory applications. They are for the same flood frequency; however, they may use varied analytical and quality control criteria depending on the study type requirements.

The value in the BAMs is that they provide a bigger picture view of potential flood risk to the City of Garden Grove than that provided in the FEMA DFIRMs. This provides the community and residents with an additional tool for understanding potential flood hazards not currently mapped as a regulated floodplain. Improved awareness of flood risk can reduce exposure to flooding for new structures and promote increased protection for existing development. By including the FEMA 100-year floodplain, it also supports identification of the need and requirement for flood insurance. These floodplain maps for Garden Grove can be seen in Figure 4-34.

Figure 4-34 City of Garden Grove – Best Available Map



Source: California DWR

Legend explanation: Blue - FEMA 100-Year, Orange – Local 100-Year (developed from local agencies), Red – DWR 100-year (Awareness floodplains identify the 100-year flood hazard areas using approximate assessment procedures.), Pink – USACE 100-Year (2002 Sac and San Joaquin River Basins Comp Study), Yellow – USACE 200-Year (2002 Sac and San Joaquin River Basins Comp Study), Tan – FEMA 500-Year, Grey – Local 500-Year (developed from local agencies), Purple – USACE 500-Year (2002 Sac and San Joaquin River Basins Comp Study).

Extent

In Garden Grove, flood extents are usually measured in depths and velocity of flooding and extent of the floodplain. These extents are traditionally determined by FEMA DFIRM flood maps which show the extent of the 1% and 0.2% annual chance floodplains. Expected flood depths in the City vary, but are expected to be very low to negligible due to the upstream protection from Prado Dam and the levees that protect the City. Flood durations in the City tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Geographical extents of DFIRM flood zones in the City are shown in Table 4-27.

Table 4-27 City of Garden Grove - Geographical Extents of DFIRM Flood Zones

DFIRM Flood Zone	Total Acres	% of Total Acres
1% Annual Chance Flood Hazard	1,179	13.1%
0.2% Annual Chance Flood Hazard	7,228	80.4%
Grand Total	**8,407**	**93.50%**

Source: FEMA 3/21/2019 DFIRM

Past Occurrences

Disaster Declaration History

There have been 19 state and 17 federal disaster declarations due to flooding, as shown in Table 4-28.

Table 4-28 Orange County Disaster Declarations 1950-2019 from Flood

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Flood (including heavy rain and storms)	19	1950, 1955, 1958 (twice), 1969, 1978, 1980, 1982, 1988, 1992, 1993, 1995 (twice), 1997, 1998, 2005 (twice), 2011, 2017	17	1955, 1958, 1969, 1978, 1980, 1982, 1983, 1988, 1992, 1993, 1995 (twice), 1998, 2005 (twice), 2011, 2017

Source: Cal OES, FEMA

NCDC Events

The NCDC tracks flood events for the County since 1996. These are shown in Table 4-29. Mapped events of flooding from heavy rains were shown in Figure 4-11 in Section 4.2.3.

*Table 4-29 Orange County NCDC Flood Events 1/1/1996-5/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Flash Flood	3	0	0	0	0	$1,020,000.00	$0
Flood	1	0	0	3	0	$0	$0
Total	**4**	**0**	**0**	**3**	**0**	**$1,020,000**	**$ 0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

FIS Events

The FIS noted no past events of flooding for the City.

Hazard Mitigation Planning Committee Events

The Santa Ana River, flowing through the heart of Orange County (and next to the City of Garden Grove) to the Pacific Ocean is the City's greatest flood threat. Research of flooding in Orange County and the City illustrates these flood hazard issues, sighting loss of life as well as damage to personal and public property.

One such flood occurred in **1938**, wiping out roads, bridges, and railroads near the river when an 8-foot wall of water swept out of the Santa Ana Canyon. Anaheim, Santa Ana, and Garden Grove were hardest hit, and 34 lives were lost because of the flood. The flood and its damage were a catalyst for construction of Prado Dam, developed as part of the Army Corps of Engineers flood control protection plan. Government officials estimated that today without the protection of Prado Dam, a flood of this magnitude would cause as many as 3,000 deaths and top $25 billion in damages. More than 110 acres would be flooded with 3 feet of water and 255,000 structures damaged as documented by S. Gold, in the Los Angeles Times, in 1999.

Residents also reported damaging floods caused by the Santa Ana River, known as the "Great Floods," as early as 1770. A massive flood recorded on January 7, 1770 is in the Notes of Father John Crespi. Major floods in Orange County on the Santa Ana River have occurred in 1810, 1815, 1825, 1884, 1891, 1916, 1927, 1938, 1969, 1983, and 1993. The greatest flood in terms of water flow was in 1862 with an estimated flow rate of 317,000 cubic feet per second (cfs). This was three times greater than the Great Flood of 1938 estimated at 110,000 cfs. The most damaging flood in terms of cost was the Great Flood of 1969. The City could not provide damage estimates

The HMPC also noted that in the past, 90 structures flooded on the west side of the City. DETAILS? WAS THIS FROM 2011?

It was noted by the HMPC that flood damages within the Westminster-east Garden Grove Watershed, along the East Garden Grove-Wintersburg Channel and Westminster Channel affect residential, commercial, and industrial development within the cities of Westminster, Garden Grove, Santa Ana, Huntington Beach, Seal Beach, and Fountain Valley. The East Garden Grove-Wintersburg Channel was originally constructed in the early 1960s as a mixture of earthen, riprap, and concrete-lined trapezoidal section with short reaches of concrete rectangular and covered box facilities. It was designed to carry 25-year peak discharge. With urbanization growth throughout Orange County, the existing capacity has become deficient and needs to be improved to convey a 100-year peak discharge. The hundreds of homes in the downstream segment of the channel system would be subjected to an estimated 8-feet depth of flooding if a 100-year storm event occurred today. The storms of 2005 in this area eroded the maintenance road atop the levee from 15-feet to 2-feet. Constructing this channel system to its ultimate condition will alleviate the floodplain and mitigate 100-year storm events to containment within the channel thus relieving mandatory flood insurance and will create potential environmental enhancements for the watershed.

Likelihood of Future Occurrences

1% Annual Chance Flood

Occasional—This is the flood that has a 1% chance of being equaled or exceeded in any given year. Portions of the City are located in the 1% annual chance floodplain; however, since the construction of the levees on the Santa Ana River, there has been minimal flood issues in the City.

0.2% Annual Chance Flood

Unlikely—The flood has a 0.2% chance of being equaled or exceeded in any given year. There are large amounts of 0.2% annual chance floodplain in the City.

Climate Change and Flood

Climate change and its effect on flooding near the City has been discussed by two sources:

- CAS
- Cal-Adapt

CAS

According to the CAS, climate change may affect flooding in the City. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Reduced snowpack and increased number of intense rainfall events are likely to put additional pressure on water infrastructure which could increase the chance of flooding associated with breaches or failures of flood control structures such as levees and dams.

Cal Adapt

Cal Adapt future precipitation projections was shown in Figure 4-12 in Section 4.2.3. These could affect flooding in the City.

4.2.11. Flood: Localized/Stormwater

Hazard/Problem Description

According to the HMPC, localized, stormwater flooding also occurs throughout the City. Localized, stormwater flooding occurs throughout the City during the rainy season from November through April. Prolonged heavy rainfall contributes to a large volume of runoff resulting in high peak flows of moderate duration. Flooding is more severe when previous rainfall has created saturated ground conditions. Urban storm drainpipes and pump stations have a finite capacity. When rainfall exceeds this capacity, or the system is clogged, water accumulates in the street until it reaches a level of overland release. This type of flooding may occur when intense storms occur over areas of development.

The City of Garden Grove General Plan Infrastructure Element noted that the City of Garden Grove Public Works Department is responsible for constructing and maintaining flood control channels and storm drains within the City. The system is designed to control the movement of rainwater to a safe location where it can re-charge our natural and man-made water supplies. Most of the collected rainwater is directed to a flood control channel where it flows to the ocean.

Location

According to the City, numerous parcels and roads throughout Garden Grove is subject to flooding in heavy rains and localized flooding. These are delineated in Table 4-30 and also show on Figure 4-35. Flooding of these areas is the primary concern. Additional impacts such as pavement deterioration and other issues are limited due to the 24/7 servicing of problem areas. The frequency and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff.

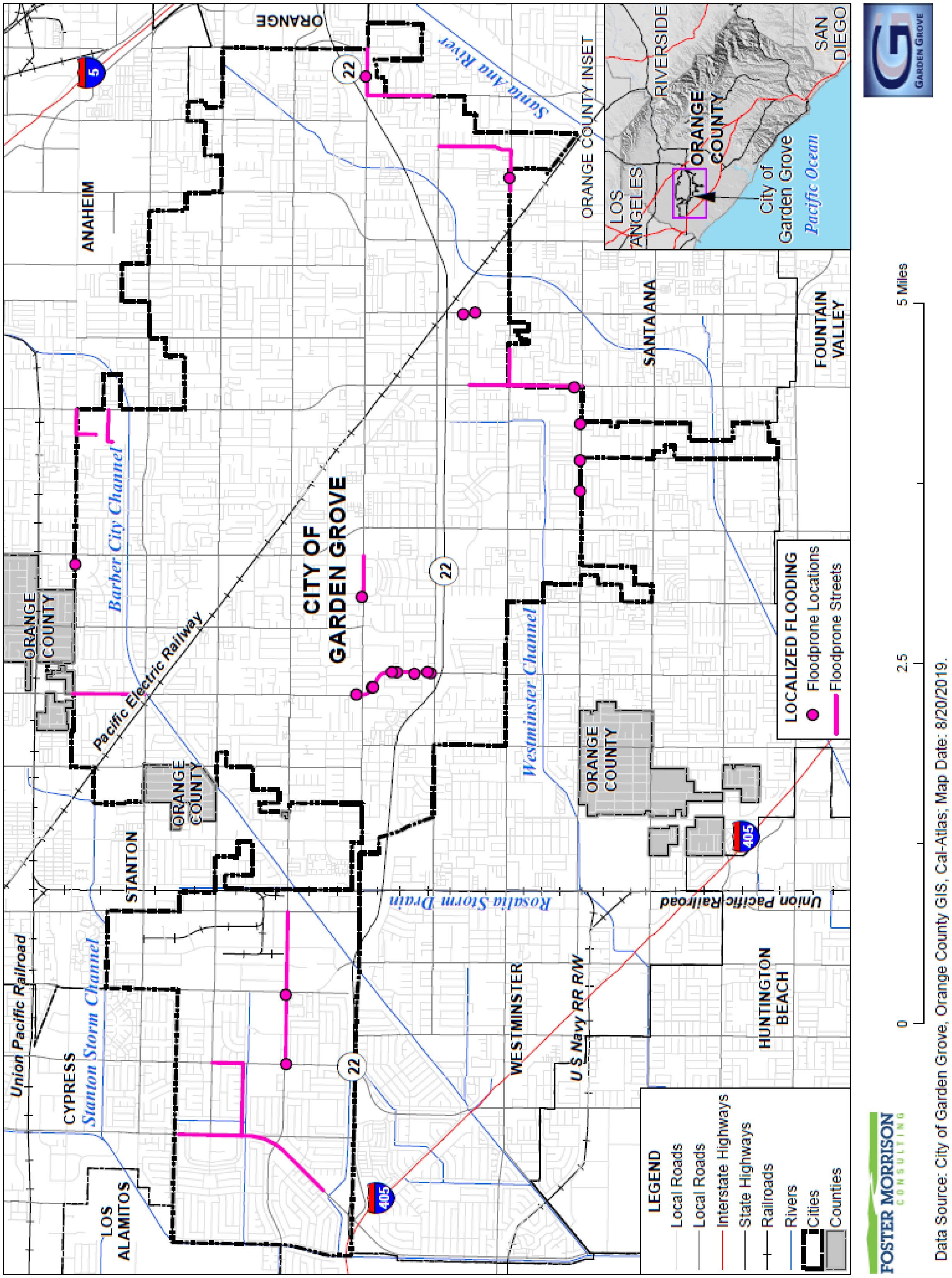
Table 4-30 City of Garden Grove– Localized Flooding Areas

Road/Area Name	Flooding	Pavement Deterioration	Washouts	High Water/ Creek Crossing	Landslides/ Mudslides	Debris	Downed Trees
Magnolia Between Trask and Garden Grove Boulevard	X	X					
Bonzer	X	X					
Garden Grove Boulevard and Fairview	X	X					
Lapson Street between Knott and Western	X	X					
Fairview and Fairview	X	X					
Roxey Drive from Trask to Westminster Ave	X						
Westminster Ave from Roxey to Harper	X						
Westminster Ave from Rosita Pl to Euclid St	X						
Euclid St from Woodbury Td to Hazard Ave	X						
Palma Vista and Steele	X						

Road/Area Name	Flooding	Pavement Deterioration	Washouts	High Water/ Creek Crossing	Landslides/ Mudslides	Debris	Downed Trees
Garden Grove Boulevard from Brookhurst Way to Galway St	X						
Magnolia St from Katella to Orangewood & Bowles Ave	X						
Magnolia St from Garden Grove Blvd to Trask Ave	X						
Springdale St from Chapman Ave to Belgrave Ave	X						
Valley View and Tiffany Ave	X						

Source: City of Garden Grove

Figure 4-35 City of Garden Grove – Localized Flooding Areas



Extent

There is no established scientific scale or measurement system for localized flooding. Localized flooding is generally measured by depth of flooding, velocity of waters, and the area affected. Heavier rains lead to larger affected areas. Localized flooding often happens quickly and has a short speed of onset. Localized flooding often has a short duration.

Past Occurrences

Disaster Declaration History

There have been no state or federal disaster declarations related to localized flooding in the City of Garden Grove, according to Table 4-3.

NCDC Events

The past occurrences of localized flooding are also included in the 1%/0.2% annual chance flood hazard profile in Section 4.2.10.

Hazard Mitigation Planning Committee Events

The City of Garden Grove General Plan Infrastructure Element noted that the City has in the past been subjected to extensive street flooding and occasional property damage, particularly during the 1960's and earlier. Major floods also occurred during 1938, 1969, 1978, and 1983, which affected various parts of the City. During peak winter storms, localized flooding damages properties and hinders travel along certain arterial streets.

The HMPC noted that in 2011, rains fell which caused flooding in the City. Multiple areas in the City had drainage systems overwhelmed. City Public Works responded by cleaning catch basins and screens to prevent flooding, remove downed trees and limbs, and worked to fill sandbags at local fire stations.

Likelihood of Future Occurrences

Highly Likely— Urban storm drainage systems have a finite capacity. When rainfall exceeds this capacity or systems clog, water accumulates in the street until it reaches a level of overland release. Heavy rains causing localized flooding in the City are highly likely to occur. Although the City is considered built out, due to aging infrastructure, this type of flooding will continue to occur during heavy rains.

Climate Change and Localized Flood

While average annual rainfall may decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century, increasing the likelihood of overwhelming stormwater systems built to historical rainfall averages. This makes localized flooding more likely.

4.2.12. Levee Failure

Hazard/Problem Description

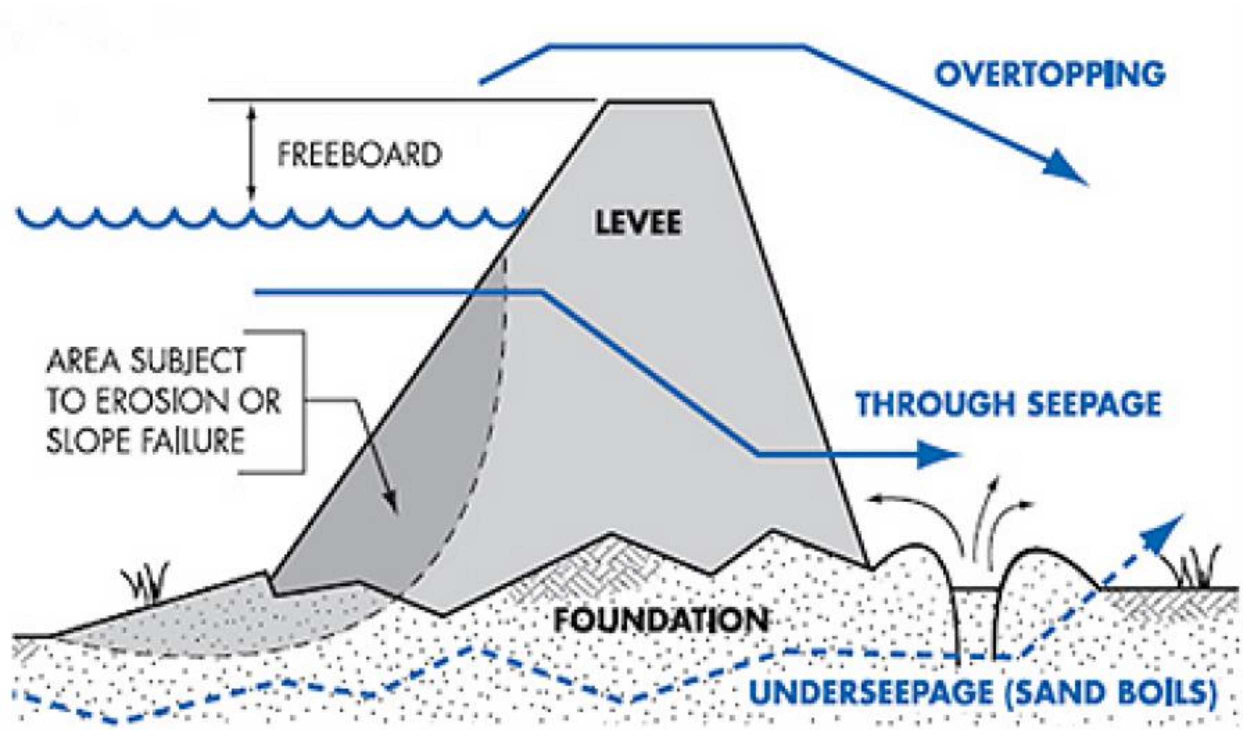
A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower steam channel, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the stream bank, raising the level of the land around the stream. To construct a man-made levee, workers place dirt or concrete along the stream banks, creating an embankment. This embankment is flat at the top, and slopes at an angle down to 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 system failure or overtopping can create severe flooding and high-water velocities. It's important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

Under-seepage refers to water flowing under the levee through the levee foundation materials, often emanating from the bottom of the landside slope and ground surface and extending landward from the landside toe of the levee. Through-seepage refers to water flowing through the levee prism directly, often emanating from the landside slope of the levee. Both conditions can lead to failure by several mechanisms, including excessive water pressures causing foundation heave and slope instabilities, slow progressing internal erosion, and piping leading to levee slumping.

Rodents burrowing into and compromising the levee system is a significant issue in the Planning Area. Erosion can also lead to levee failure. Figure 4-36 depicts the causes of levee failure.

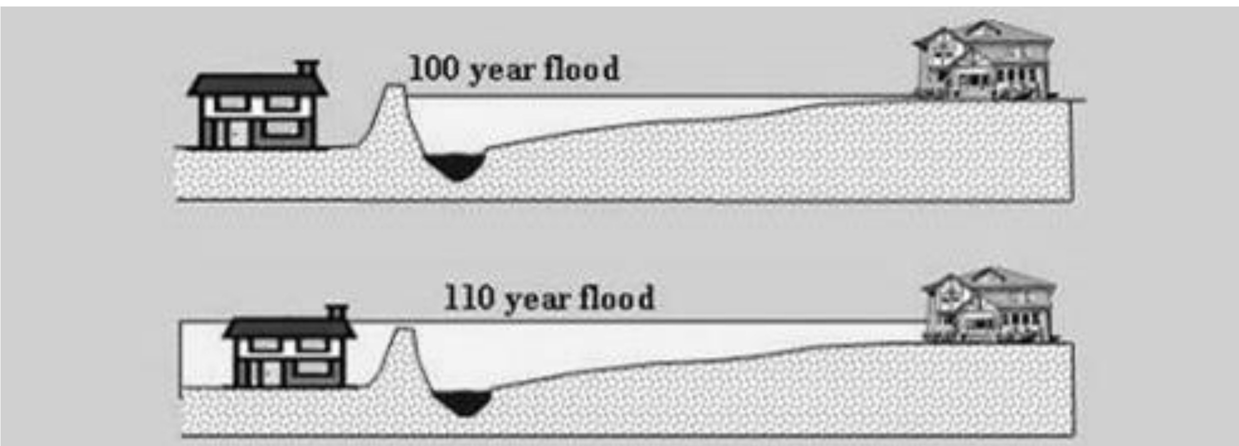
Figure 4-36 Potential Causes of Levee Failure



Source: USACE

Overtopping failure occurs when the flood water level rises above the crest of a levee. As shown in Figure 4-37, overtopping of levees can cause greater damage than a traditional flood due to the often lower topography behind the levee.

Figure 4-37 Flooding from Levee Overtopping



Source: Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR.

Location

The National Levee Database and the Orange County Flood Insurance Study (FIS) were searched for levee locations in the City. No levees exist in the City. Levees exists to the south of the City, which do provide some flood protection within the City limits. These levees are known by the US Army Corps of Engineers (USACE) as the Santa Ana River 1 Levee System. A report on these levees from the USACE Levee Safety Program notes the following about the levee system:

> ***The Santa Ana River 1 Levee System is located on the right/west bank of the Santa Ana River in the state of California, in Orange County, in the cities of Santa Ana, Fountain Valley, and Huntington Beach. The SAR1 Levee System was federally authorized and subsequently constructed by the U.S. Army Corps of Engineers, Los Angeles District (USACE). Construction of the SAR1 Levee System was completed in September 1995 (USACE). The SAR1 Levee System is now entirely operated and maintained by Orange County Flood Control District (OCFCD), which is administered by Orange County Public Works (OCPW) staff. The National Levee Database Number (NLD No.) for the SAR1 Levee System is 3805010039. The SAR1 Levee System has a levee embankment, a trapezoidal channel lined with either reinforced concrete, grouted riprap, or riprap, a rectangular channel lined with reinforced concrete, reinforced concrete floodwalls, reinforced concrete retaining walls, concrete masonry unit (CMU) retaining walls, 28 side-drainage structure pipes, 18 discharge pipes, two side-drain junction structure pipes, four pump stations, numerous utility crossings, 20 bridge crossings, and 14 access ramps. The SAR1 Levee System extends from immediately upstream of Interstate 5 (I-5) (Station 631+00) to slightly downstream of the Pacific Coast Highway (Station 13+40), a distance of approximately 61,760 feet (11.7 miles).***

This levee system can be seen in Figure 4-38. Levee protected areas from the DFIRM were shown on Figure 4-33.

Figure 4-38 City of Garden Grove– Levees in the Planning Area

Source: USACE Levee Safety Program Santa Ana River 1 Levee System Report

Extent

Since there is only one levee outside of the City limits along the Santa Ana River that provides flood protection for a small area within the City, the extent of levee failure in the City is limited. The levee is approximately 10' high. The flood channels are capable of carrying up to the 100-year peak flows with few exceptions. Those areas would be flooded from 2-3 feet. According to the Army Corps of Engineers' predictions, a 500-year breakout will completely inundate the City to a depth of 1.5 to 2 feet of water. This is the result of both local flow and breached Santa Ana River flood flows. The extent of area within the City that falls inside this levee protected area, based on FEMA DFIRMs, can be seen in Table 4-31.

Table 4-31 City of Garden Grove – Geographical Extents of Levee Protected Areas

Levee Protected Areas	Total Acres	% of Total Acres
X Protected by Levee	586	6.5%

Source: DFIRM

Past Occurrences

Disaster Declaration History

There have been no state or federal disaster declarations due to levee failure, according to Table 4-3

NCDC Events

The NCDC does not track levee failure events.

Hazard Mitigation Planning Committee Events

There have been no past occurrences of levee failure affecting the City, or otherwise on this levee system.

Likelihood of Future Occurrences

Unlikely – Due to the limited area within the City protected by a levee, upstream protection from Prado Dam, and the lack of previous levee failures on this levee system, the likelihood of levee failure is unlikely.

Climate Change and Levee Failure

Climate change may affect the amount of precipitation that falls in the City. A discussion of this can be found in Section 4.2.3. However, due to the upstream protection from Prado Dam and the fact that the Santa Ana River sees small flows, climate change is not expected to change the City's risk from levee failure.

4.2.13. Wildfire

Hazard/Problem Description

California is recognized as one of the most fire-prone and consequently fire-adapted landscapes in the world. The combination of complex terrain, Mediterranean climate, and productive natural plant communities, along with ample natural and aboriginal ignition sources, has created conditions for extensive wildfires. Wildland fire is an ongoing concern for Orange County, and to lesser extent given its urban nature, the City of Garden Grove. Historically in California, the fire season extended from early spring through late fall of each year during the hotter, dryer months. However, in recent years, wildfire season is more of a year around event. Fire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, an accumulation of vegetation, and high winds.

Potential losses from wildfire include human life, structures and other improvements, natural and cultural resources, quality and quantity of water supplies, cropland, timber, and recreational opportunities. Economic losses also result. Smoke and air pollution from wildfires can be a severe health hazard. In addition, catastrophic wildfire can create favorable conditions post fire for other hazards such as flooding, landslides and mudflows, and erosion during the rainy season.

Location

Wildfire is part of California's natural ecology. However, its danger and cost have increased as fire-prone areas across the state have seen more development. As mentioned previously, City consists of urban terrain with very little open space, thus the biggest concern from fire, beyond structure fires, is a conflagration occurring especially during high winds. Therefore, an urban (conflagration) fire is mostly the type of fire that might impact the City., especially when combined with high winds. The existence of several petroleum and hazardous materials facilities within the City also contribute to the fire threat.

Generally, there are four major factors that sustain wildfires and allow for predictions of a given area's potential to burn. These factors include fuel, topography, weather, and human actions. In the City of Garden Grove, the fire concern is derived less from wildfires, and more from urban conflagration fires. Fire in an urban area of the City during Santa Ana winds are of greatest concern.

Fuel

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches to dead standing trees, live trees, brush, cured grasses, and other vegetation. Also to be considered as a fuel source are manmade structures, such as homes and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Fuel is the only factor that is under human control.

Topography

An area's terrain and land slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.

Weather

Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will ignite more readily and burn more intensely. Thus, during periods of drought, the threat of wildfire increases. The 2017 Draft Orange County CWPP noted that the weather in the City is known for its generally mild weather and Mediterranean climate, characterized by relatively small changes in seasonal temperature, a dry summer, and a rainy winter. The dominant wind pattern is a daytime sea breeze (onshore) and a nighttime land breeze (offshore).

However, on occasion, a phenomenon known as foehn or Santa Ana winds turns these conditions around. These hot, dry winds blow from the desert to the coast and can fan the flames of small sparks into wildfires that have been observed to move down from a ridge top in 30 minutes, expand to one square mile in an hour, and consume hundreds of residences in one day. The few days each year when all of the high fire danger conditions—low humidity, high temperatures, and hot, dry Santa Ana winds blowing in from the east—are extreme are labeled Red Flag days, and usually occur in the fall months.

These winds are the most treacherous weather factor. The greater a wind, the faster a fire will spread and the more intense it will be. In addition to wind speed, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. These winds can occur at any time of year, but are especially dangerous in the driest months of fall. During these times, fighting a fire becomes far more difficult. Lightning also ignites wildfires, often in difficult to reach terrain for firefighters.

Human Actions

Most wildfires are ignited by human action, the result of direct acts of arson, carelessness, or accidents. Many fires originate in populated areas along roads and around homes, and are often the result of arson or careless acts such as the disposal of cigarettes, use of equipment, or debris burning. Recreation areas that are located in high fire hazard areas also result in increased human activity that can increase the potential for wildfires to occur. Further, areas with a high homeless population can increase the potential for accidental ignitions.

The Threat of Urban Conflagration

Although communities without Wildland Urban Interface are much less likely to experience a catastrophic fire, in Orange County there are scenarios where any community might be exposed to an urban conflagration similar to the fires that occurred following the 1906 San Francisco earthquake. Large fires following an earthquake in an urban region are relatively rare phenomena, but have occasionally been of catastrophic proportions. The two largest peacetime urban fires in history, 1906 San Francisco and 1923 Tokyo, were both caused by earthquakes.

The fact that fire following earthquake has been little researched or considered in the United States is particularly surprising when one realizes that the conflagration in San Francisco after the 1906 earthquake was the single largest urban fire, and the single largest earthquake loss, in U.S. history. The loss over three days of more than 28,000 buildings within an area of nearly 5 square miles was staggering: $250 million in 1906 dollars, or about $5 billion at today's prices.

The 1989 Loma Prieta Earthquake, the 1991 Oakland Hills Fire, and Japan's recent Hokkaido Nansei-oki Earthquake all demonstrate the current, real possibility of a large fire, such as a fire following an earthquake, developing into a conflagration. In the United States, all the elements that would hamper firefighting capabilities are present: density of wooden structures, limited personnel and equipment to address multiple fires, debris blocking the access of fire-fighting equipment, and a limited water supply.

Finally, the April 21, 1982 Anaheim apartment fires in Anaheim illustrated the capability for urban conflagration in Orange County. The fire broke out shortly before dawn and, fueled by Santa Ana winds, quickly swept through a four-block area near Cerritos Avenue and Euclid Street, ultimately destroying 393 apartment units, one house and one business. This incident resulted in both a state proclamation of emergency and a federal disaster declaration. It also led many Orange County cities to enact ordinances restricting the use of flammable shake roofs.

Extent

Fires can have a quick speed of onset, especially during periods of drought. Fires can burn for a short period of time, or may have durations lasting for a week or more. Fire can affect any area of the City. CAL FIRE has mapped areas in California that are at risk to wildfire and categorizes them by risk. It should be noted that CAL FIRE looks at wildfire rather than urban conflagration type fires. Methodologies for this analysis and maps showing extent can be found in Section 4.3.14. GIS analysis was performed to determine what percentages of the City would be at risk to wildfire (using CAL FIRE Fire Hazard Severity Zone data). 100% of all parcels in the Garden Grove Planning Area fall into the Urban Unzoned FHSZ. This can be seen in Table 4-32.

Table 4-32 City of Garden Grove – Wildfire Extents

Fire Hazard Severity Zone	Total Acres	% of Total Acres
Urban Unzoned	8,994	100.0%
Grand Total	**8,994**	**100.0%**

Source: CAL FIRE

Past Occurrences

Disaster Declaration History

There have been 6 federal and 15 state disaster declarations due to fire in Orange County. This can be seen in Table 4-35.

Table 4-33 Orange County Disaster Declarations 1950-2019 from Wildfire

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Fire	6	1967, 1980, 1982 (twice), 1996, 2017	15	1980, 1982, 1996, 2002, 2006, 2007 (four times), 2008 (twice), 2009, 2017 (three times)

Source: Cal OES, FEMA

NCDC Events

The NCDC contains 30 wildfire events for the County. The NCDC did not indicate that any had affected the City of Garden Grove.

*Table 4-34 Orange County NCDC Wildfire Events 1/1/1996-5/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Wildfire	30	0	3	22	0	$31,535,000	$0

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of the City of Garden Grove and outside of Orange County.

CAL FIRE Wildfire History

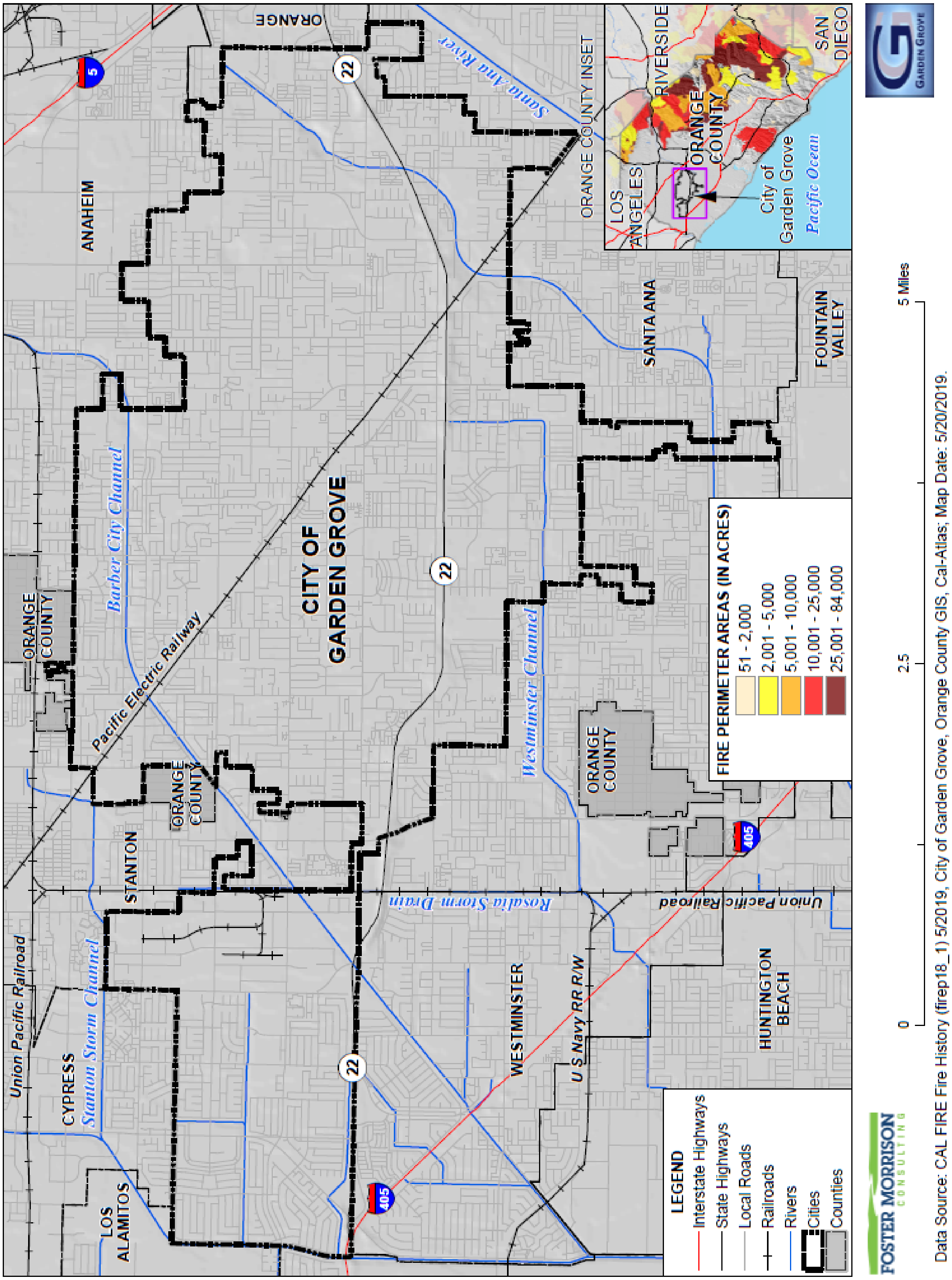
It should be noted that the City sits within a large wildland fire area of Orange County. And while, the City isn't highly prone to wildfire, this section shows the wildfire history in the County.

CAL FIRE, USDA Forest Service Region 5, Bureau of Land Management (BLM), the National Park Service (NPS), Contract Counties and other agencies jointly maintain a comprehensive fire perimeter GIS layer for public and private lands throughout the state. The data covers fires back to 1878 (though the first recorded incident for the County was in 1917). For the National Park Service, Bureau of Land Management, and US Forest Service, fires of 10 acres and greater are reported. For CAL FIRE, timber fires greater than 10 acres, brush fires greater than 50 acres, grass fires greater than 300 acres, and fires that destroy three or more residential dwellings or commercial structures are reported. CAL FIRE recognizes the various federal, state, and local agencies that have contributed to this dataset, including USDA Forest Service Region 5, BLM, National Park Service, and numerous local agencies.

Fires may be missing altogether or have missing or incorrect attribute data. Some fires may be missing because historical records were lost or damaged, fires were too small for the minimum cutoffs, documentation was inadequate, or fire perimeters have not yet been incorporated into the database. Also, agencies are at different stages of participation. For these reasons, the data should not be used for statistical or analytical purposes.

The data provides a reasonable view of the spatial distribution of past large fires in California. Using GIS, fire perimeters that intersect Garden Gove were searched for. None were found to intersect the City boundaries. Figure 4-39 shows fire history for the City, colored by the size of the acreage burned. This map contains fires from 1950 to 2018.

Figure 4-39 City of Garden Grove – Wildfire History 1950 to 2018



Orange County CWPP Events

The 2017 Orange County CWPP identified multiple fires in the County. The list can be seen on Figure 4-40. WHICH IF ANY AFFECTED THE CITY?

Figure 4-40 Orange County – Fires from the 2017 Orange County CWPP

Table 1. Fire History 1915- 2007

Year	Fire Name	Acreage Burned		Year	Fire Name	Acreage Burned
1914	Unknown	16,754		1976	Pendleton	2,111
1915	Unknown	1,794		1977	Mine	4,956
1917	Unknown	3,164		1978	Soquel	5,428
1919	Unknown	2,225		1979	Paseo	3,644
1920	Unknown	2,724		1980	Owl	18,332
1923	Unknown	2,150		1980	Carbon Canyon	14,613
1925	Unknown	8,650		1980	Indian	28,938
1926	Unknown	9,934		1982	Gypsum	20,142
1927	Unknown	1,837		1985	Shell	1,635
1929	Unknown	1,085		1986	Bedford	13,956
1937	Unknown	4,916		1987	Bedford	4,070
1943	Unknown	1,930		1987	Silverado	6,018
1943	Unknown	2,727		1988	Ortega	2,471
1947	Green River	53,079		1989	Ortega	8,170
1952	Indian Potrero	5,604		1989	Assist 108	13,478
1954	Weigand	4,956		1990	Carbon Canyon	6,664
1954	Jameson	7,881		1990	Unknown	11,774
1955	Niger	1,606		1990	Yorba	7,864
1956	Cornwall	3,173		1993	Laguna Fire	14,337
1958	Kelly	2,380		1993	Ortega	21,010
1958	Steward	69,444		1997	Baker	6,320
1959	Talega	3,187		1998	Santiago Canyon	7,760
1961	Unknown	5,273		2002	Green	2,234
1961	Outside Origin #2	5,019		2002	Antonio	1,480
1966	Indian	1,405		2006	Sierra Peak	10,506
1967	Paseo Grande	51,075		2007	Santiago Fire	28,517
1970	Nelson	3,586		2007	Windy Ridge	2,036
1975	Grundy	1,915		2008	Freeway Complex	30,305*

Sources: Orange County Fire Authority Fire History database; Orange County Hazard Mitigation Plan
* Origin of Freeway Complex Fire was in Riverside County; of the 30,305 acres burned, majority was in Orange County

Source: 2017 Orange County CWPP

Hazard Mitigation Planning Committee Events

OTHER EVENTS? DOES THE FIRE DEPARTMENT TRACK IGNITIONS, CALLS, ETC FOR VEGETATION FIRES WITHIN THE CITY THAT THEY CAN PROVIDE? HOW MANY IGNITIONS

DO THEY SEE IN A YEAR? ARE THERE ANY OPEN SPACE OR OTHER AREAS THAT ARE THE GREATEST CONCERN FOR WILDFIRES?

Likelihood of Future Occurrences

Highly Likely — From May to October of each year, Garden Grove faces a fire threat.   Due to its long summers, portions of the City continue to be at risk from wildfire.

Climate Change and Wildfire

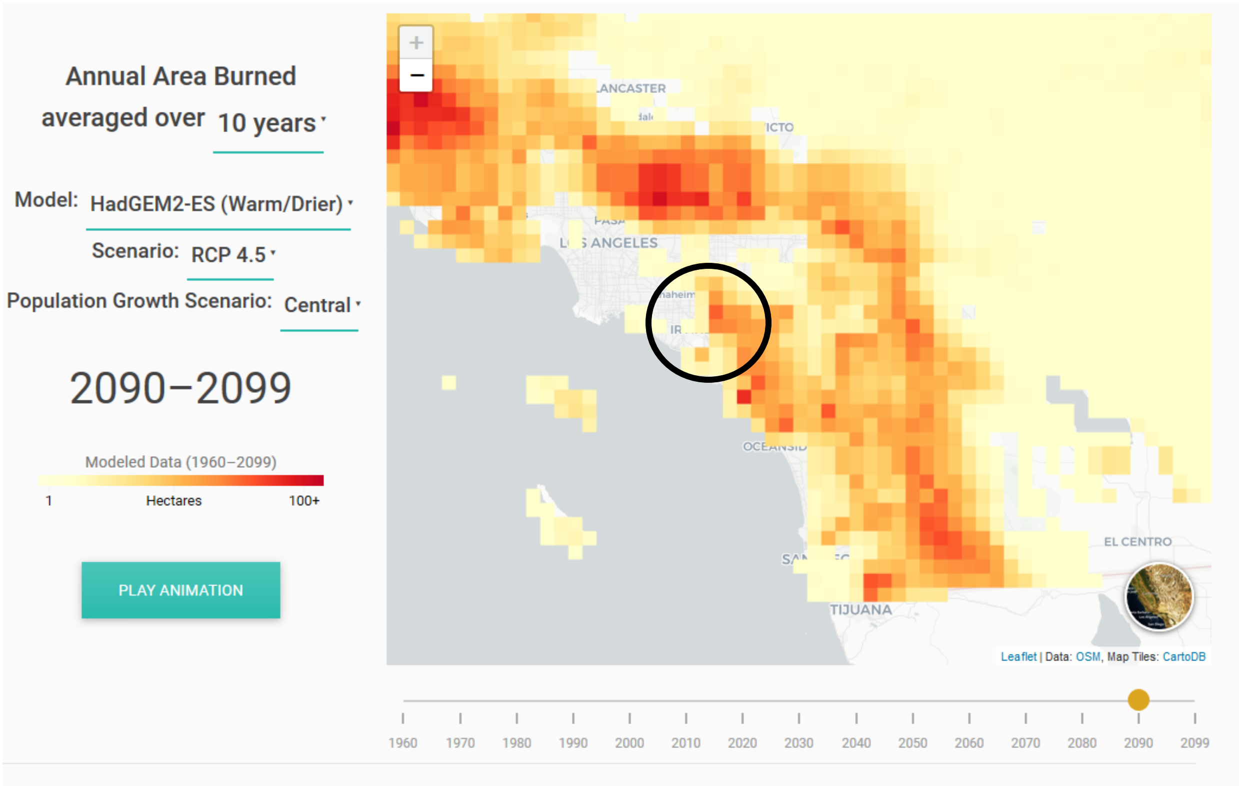
Climate change and its effect on wildfire near the City has been discussed by three sources:

- Cal-Adapt
- Climate Change and Health Report for Orange County

Cal-Adapt Predictions

Warmer temperatures can exacerbate drought conditions. Drought often kills plants and trees, which serve as fuel for wildfires. Warmer temperatures could increase the number of wildfires and pest outbreaks, such as the western pine beetle. Cal-Adapt's wildfire tool predicts the potential increase in the amount of burned areas for the year 2080-2089, as compared to recent (2010) conditions. This is shown in Figure 4-41. Based on this model, Cal-Adapt predicts that wildfire risk in Orange County will increase slightly (and much less than other California counties) in the near term and subside during mid-to late-century. However, wildfire models can vary depending on the parameters used. Cal-Adapt does not take landscape and fuel sources into account in their model. In all likelihood, in Garden Grove, precipitation patterns, high levels of heat, topography, and fuel load will determine the frequency and intensity of future wildfire.

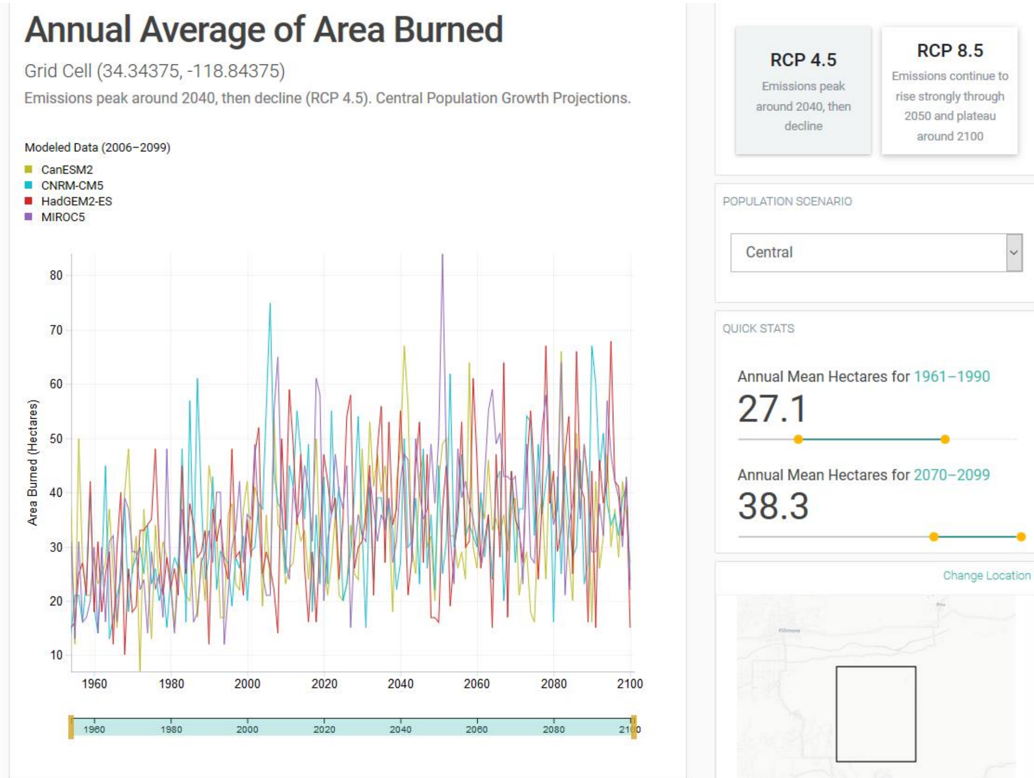
Figure 4-41 City of Garden Grove– Projected Increase in Wildfire Burn Areas

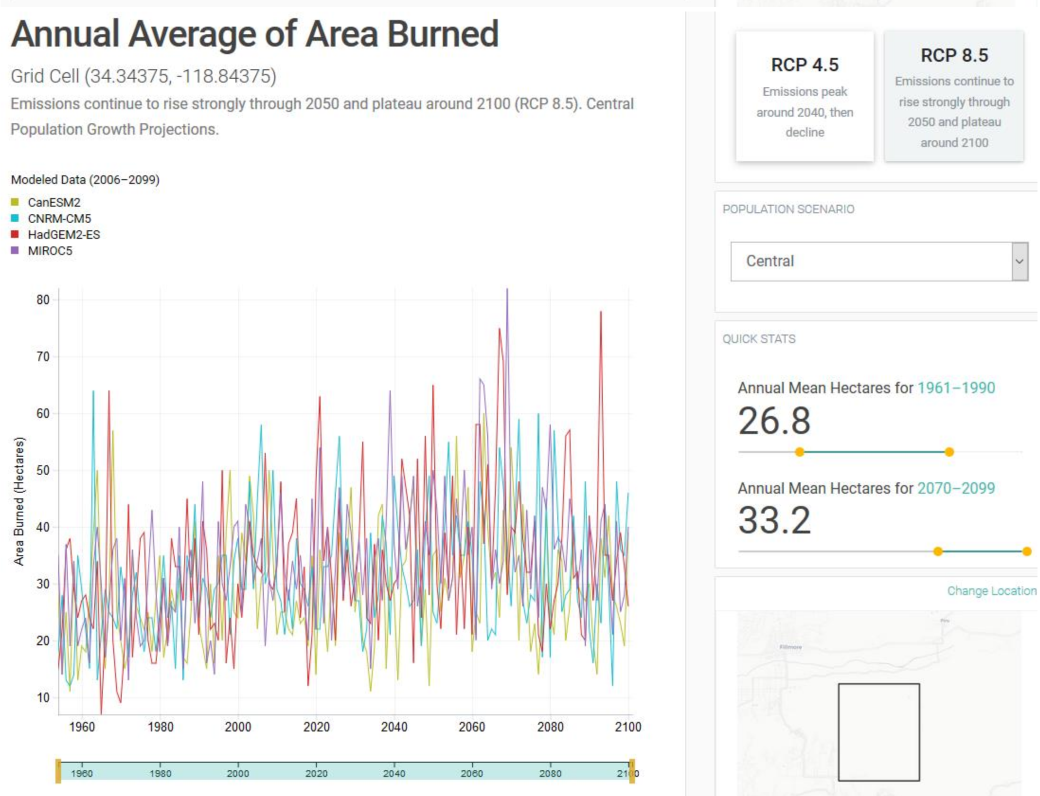


Source: Cal-Adapt - Projected Wildfire Burn Area Increase

Wildfire scenario projections were done by Cal-Adapt, based on statistical modeling from historical data of climate, vegetation, population density, and fire history. The fire modeling ran simulations on five variables on a monthly time step - Large fire presence/absence, Number of fires given presence, Area burned in a grid cell given a fire, High severity burned area given a fire and emissions. These are shown on Figure 4-42. The upper chart shows modeled annual averages of area burned for Garden Grove under the RCP 4.5 scenario, while the lower chart shows modeled annual averages of area burned for Garden Grove under the RCP 8.5 scenario.

Figure 4-42 City of Garden Grove – Future Annual Averages of Acres Burned under RCP 4.5 and 8.5 Scenarios





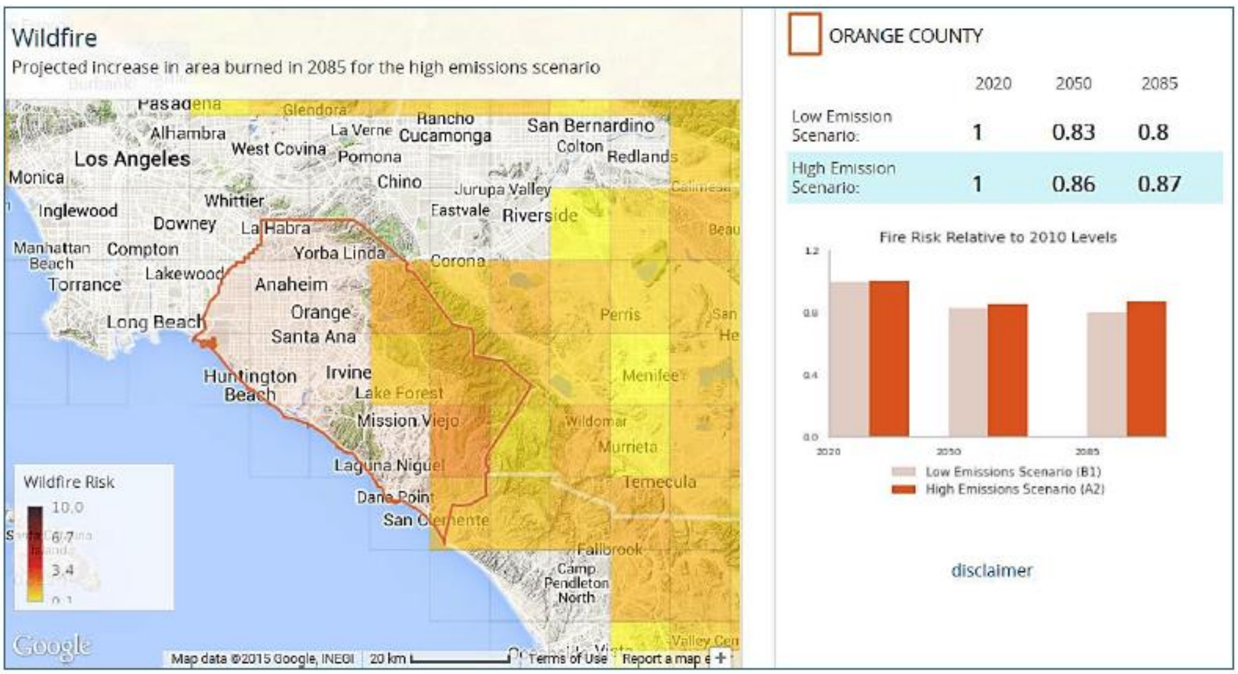
Source: Cal-Adapt – Wildfire: Decadal Averages

Climate Change and Health Report for Orange County Predictions

The map below (Figure 4-43) displays the projected increase or decrease in potential area burned based on projections of the Coupled Global Climate Model (version 3) for the high carbon emissions scenario in 2085. The bar graphs to the right of the map in Figure 4-43 illustrate the projected time trend over the 21st century for both the high and low emissions scenarios.

Note: these data are modeled solely on climate projections and do not take landscape and fuel sources into account. The projections of acreage burned are expressed in terms of the relative increase or decrease (greater or less than 1) from a 2010 baseline for fires that consume at least 490 acres. The 2010 baseline reflects historic data from 1980 to 1989 and trends through 2010.

Figure 4-43 Orange County – Increase in Wildfire Acreage in Future Carbon Emissions Scenarios



Source: Climate Change and Health Report for Orange County

4.2.14. Natural Hazards Summary

Table 4-35 summarizes the results of the hazard identification and hazard profile for the City based on the hazard identification data and input from the HMPC. For each hazard profiled in Section 4.2, this table includes the likelihood of future occurrence and whether the hazard is initially considered a priority hazard for the City based on the hazard profiles.

Table 4-35 Hazard Identification and Initial Determination of Priority Hazards

Hazard	Likelihood of Future Occurrence	Priority Hazard
Climate Change	Likely	Y

Hazard	Likelihood of Future Occurrence	Priority Hazard
Dam Failure	Unlikely	Y
Drought and Water Shortage	Likely	Y
Earthquake	Highly Likely/Occasional	Y
Earthquake: Liquefaction	Occasional	Y
Flood: (100/500 year)	Occasional/Unlikely	Y
Flood: Localized/Stormwater	Highly Likely	Y
Levee Failure	Unlikely	Y
Severe Weather: Extreme Heat	Highly Likely	Y
Severe Weather: Heavy Rains and Storms	Highly Likely	Y
Severe Weather: High Winds	Highly Likely	Y
Wildfire (Conflagration)	Highly Likely	Y

4.3 Vulnerability Assessment

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

With Garden Grove's hazards identified and profiled, the HMPC conducted a vulnerability assessment to describe the impact that each priority hazard would have on the City. The vulnerability assessment quantifies, to the extent feasible using best available data, assets at risk to natural hazards and estimates potential losses.

This vulnerability assessment followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses*. The vulnerability assessment first describes the total vulnerability of the City and values at risk and then discusses vulnerability by hazard.

Data Sources

Data used to support this vulnerability assessment included the following:

- 2014 California Climate Adaptation Strategy
- 2014-2021 City of Garden Grove Housing Element
- 2015 Orange County Local Hazard Mitigation Plan
- 2017 Orange County Draft CWPP
- 2019 Final Draft of the Orange County Regional Water and Wastewater LHMP
- CAL FIRE GIS Datasets
- Cal OES Dam Inundation Data
- Cal-Atlas
- Cal-DWR Disadvantage Community Mapping Tool
- California Adaptation Planning Guide
- California Department of Finance
- California Department of Fish and Wildlife
- California Department of Parks and Recreation Office of Historic Preservation
- California Geological Survey
- California Natural Diversity Database

- California's Sustainable Groundwater Management Act
- City of Garden Grove 2016 Emergency Operations Plan
- City of Garden Grove 2030 General Plan
- City of Garden Grove 2030 General Plan Environmental Impact Report
- City of Garden Grove 2030 General Plan Conservation Element
- City of Garden Grove 2030 General Plan Land Use Element
- City of Garden Grove 2030 General Plan Safety Element
- City of Garden Grove Master Plan of Arterial Highways
- City of Garden Grove Urban Water Management Plan
- FEMA - Understanding Your Risks—Identifying Hazards and Estimating Losses.
- FEMA Disaster Declaration Database
- FEMA Hazus 4.2
- FEMA Orange County Digital Flood Insurance Rate Map 3/21/2019
- FEMA Orange County Flood Insurance Study 3/21/2019
- FEMA NFIP Data for Garden Grove
- HMPC input
- Lake County Assessor's Data
- Lake County Climate and Health Profile Report
- Lake County GIS
- National Drought Mitigation Center Drought Impact Reporter
- National Fire Plan
- National Oceanic and Atmospheric Administration
- National Weather Service
- Orange County Climate Change and Health Report
- Orange County Water District
- Proceedings of the National Academy of Sciences
- Public Health Alliance of Southern California
- U.S. Army Corps of Engineers
- USACE Levee Safety Program Santa Ana River 1 Levee System Report
- U.S. Fish and Wildlife Service Wetlands Mapper
- U.S. Geological Survey
- UNFCCC Conference of Parties Paris Agreement of 2015
- University of California
- US Census Bureau

4.3.1. Garden Grove's Vulnerability and Assets at Risk

As a starting point for analyzing the City's vulnerability to identified hazards, the HMPC used a variety of data to define a baseline against which all disaster impacts could be compared. If a catastrophic disaster was to occur in the City, this section describes significant assets at risk. Data and analysis used in this baseline assessment included:

- Total values at risk;
- City critical facilities;
- Natural, cultural, and historical resources; and
- Growth and development trends.

Total Values at Risk

Parcel Inventory and Assessed Values

This analysis captures the values associated with assessed assets located within the City of Garden Grove. The City GIS parcel and Assessor data dated March 2019, obtained from the City of Garden Grove, was used for the basis of this analysis. This data provided by Garden Grove represents best available data.

Understanding the total assessed value of Garden Grove is a starting point to understanding the overall value of identified assets at risk in the City. When the total assessed values are combined with potential values associated with other community assets such as area populations, public and private critical infrastructure, historic and cultural resources, and natural resources, the big picture emerges as to what is potentially at risk and vulnerable to the damaging effects of natural hazards within the City.

Methodology

The City of Garden Grove's March 2019 Assessor Data and GIS parcel data were used as the basis for the inventory of assessed values for both improved and unimproved parcels within the City. This data provides the land and improved values assessed for each parcel. Other GIS data, such as jurisdictional boundaries, roads, streams, and area features, was also obtained from the City of Garden Grove to support citywide mapping and analysis of values at risk. The citywide Garden Grove GIS parcel data contained 32,306 parcels.

Data Limitations & Notations

Although based on best available data, the resulting information should only be used as an initial guide to overall values in the City. In the event of a disaster, structures and other infrastructure improvements are at the greatest risk of damage. Depending on the type of hazard and resulting damages, the land itself may not suffer a significant loss. For that reason, the values of structures and other infrastructure improvements are of greatest concern. Also, it is critical to note a specific limitation to the assessed values data within the City, created by Proposition 13. Instead of adjusting property values annually, no adjustments are made until a property transfer occurs. As a result, overall property value information is significantly low and does not reflect current market or true potential loss values for properties within the City.

Property Use Categories

Garden Grove provided a General Plan dataset containing a property use code which provides detailed descriptive information about how each property is generally used, such as residential, commercial, or industrial. The property use codes were refined and categorized into the following property use categories and linked back to the Garden Grove Assessor data. The final property use categories for the City of Garden Grove include:

- Civic
- Commercial
- Industrial
- Mixed Use

- Open Space
- Residential
- Unknown

Once property uses were grouped into categories, the number of total and improved parcels and land and improved values were inventoried for the City by property use.

Estimated Content Replacement Values

Garden Grove's assigned property use categories were used to develop estimated content replacement values (CRVs) that are potentially at loss from hazards. FEMA's standard CRV factors were utilized to develop more accurate loss estimates for total assets at risk and for all mapped hazard analyses. FEMA's CRV factors estimate value as a percent of improved structure value by property use. Table 4-36 shows the breakdown of the different property uses in Garden Grove and their estimated CRV factors.

Table 4-36 City of Garden Grove – Content Replacement Factors by Property Use

Garden Grove Property Use Categories	Hazus Property Use Categories	Hazus Content Replacement Values
Civic/Institutional	Civic	100%
Heavy/Light Commercial, Office Professional	Commercial	100%
Industrial	Industrial	150%
Civic Center, Industrial/Commercial, Industrial/Residential, International West, Residential/Commercial	Mixed Use	100%
Parks and Open Space	Open Space	100%
Community / Low / Low Medium / Medium / Medium High Density	Residential	50%
Unknown	Unknown	0%

Source: Hazus 4.2

Garden Grove Values at Risk Results

Values at Risk without Contents

Values associated with land, and improved structure values were identified and summed to determine total assessed values at risk in the Garden Grove Planning Area. Together, the land value and improved structure value make up the majority of assessed values associated with each identified parcel or asset. Improved parcel counts were based on the assumption that a parcel was improved if an improved (or structure) value was present. Information on other values such as personal property values were not readily available for inclusion in this effort.

Table 4-37 shows the total values or exposure for the entire Garden Grove geographic area. Table 4-38 breaks down Table 4-37, and gives detail about how the property use category is broken down. The values for the Garden Grove Planning Area are broken out by property use category and are provided in Table 4-36.

Table 4-37 City of Garden Grove – Count and Value of Parcels at Risk by Summary Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
Civic	86	70	$75,270,828	$135,646,631	$210,917,459
Commercial	548	492	$402,998,354	$309,084,902	$712,083,256
Industrial	346	321	$549,420,092	$423,864,116	$973,284,208
Mixed Use	1,366	1,211	$1,041,636,593	$911,153,234	$1,952,789,827
Open Space	141	35	$33,070,063	$23,064,695	$56,134,758
Residential	29,778	29,281	$6,816,786,934	$3,115,037,261	$9,931,824,195
Unknown	41	1	$179,635	$238,449	$418,084
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$13,837,451,787**

Source: City of Garden Grove March 2019 Parcel/Assessor's Data

Table 4-38 City of Garden Grove– Count and Value of Parcels at Risk by Detailed Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
Civic					
Civic/Institutional	86	70	$75,270,828	$135,646,631	$210,917,459
Civic Total	**86**	**70**	**$75,270,828**	**$135,646,631**	**$210,917,459**
Commercial					
Heavy Commercial	115	94	$84,646,786	$53,378,381	$138,025,167
Light Commercial	339	312	$284,813,188	$223,863,732	$508,676,920
Office Professional	94	86	$33,538,380	$31,842,789	$65,381,169
Commercial Total	**548**	**492**	**$402,998,354**	**$309,084,902**	**$712,083,256**
Industrial					
Industrial	346	321	$549,420,092	$423,864,116	$973,284,208
Industrial Total	**346**	**321**	**$549,420,092**	**$423,864,116**	**$973,284,208**
Mixed Use					
Civic Center Mixed Use	235	198	$78,857,590	$79,880,953	$158,738,543
Industrial/Commercial Mixed Use	48	45	$82,464,919	$64,633,344	$147,098,263
Industrial/Residential Mixed Use 1	59	55	$80,385,692	$56,371,762	$136,757,454
Industrial/Residential Mixed Use 2	95	86	$35,748,759	$29,752,014	$65,500,773
International West Mixed Use	305	251	$338,601,673	$406,201,144	$744,802,817

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
Residential/Commercial Mixed Use 1	62	53	$60,614,117	$32,518,261	$93,132,378
Residential/Commercial Mixed Use 2	417	390	$286,737,166	$197,614,948	$484,352,114
Residential/Commercial Mixed Use 3	145	133	$78,226,677	$44,180,808	$122,407,485
Mixed Use Total	**1,366**	**1,211**	**$1,041,636,593**	**$911,153,234**	**$1,952,789,827**
Open Space					
Parks and Open Space	141	35	$33,070,063	$23,064,695	$56,134,758
Open Space Total	**141**	**35**	**$33,070,063**	**$23,064,695**	**$56,134,758**
Residential					
Community Residential	10	10	$9,451,582	$33,898,085	$43,349,667
Low Density Residential	25,517	25,295	$5,470,966,643	$2,255,850,794	$7,726,817,437
Low Medium Density Residential	846	785	$212,120,801	$136,343,954	$348,464,755
Medium Density Residential	3,403	3,190	$1,123,962,208	$686,370,307	$1,810,332,515
Medium High Density Residential	2	1	$285,700	$2,574,121	$2,859,821
Residential Total	**29,778**	**29,281**	**$6,816,786,934**	**$3,115,037,261**	**$9,931,824,195**
Unknown					
(blank)	41	1	$179,635	$238,449	$418,084
Unknown Total	**41**	**1**	**$179,635**	**$238,449**	**$418,084**
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$13,837,451,787**

Source: City of Garden Grove March 2019 Parcel/Assessor's Data

Values at Risk with Contents

Table 4-39 shows the total values of the Garden Grove Planning Area as shown in Table 4-37, but with estimated content replacement values (CRVs) included (using CRV multipliers from Table 4-36). This table is important as potential losses to the City include structure contents. In addition, loss estimates contained in the hazard vulnerability sections of this Chapter will use calculations based on the total values, including content replacement values. Table 4-40 breaks down Table 4-39, and gives detail about how the property use category is broken down.

Table 4-39 City of Garden Grove – Count and Value of Parcels at Risk by Summary Property Use with Content Replacement Values

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Civic	86	70	$75,270,828	$135,646,631	$135,646,631	$346,564,090
Commercial	548	492	$402,998,354	$309,084,902	$309,084,902	$1,021,168,158
Industrial	346	321	$549,420,092	$423,864,116	$635,796,174	$1,609,080,379
Mixed Use	1,366	1,211	$1,041,636,593	$911,153,234	$911,153,234	$2,863,943,061
Open Space	141	35	$33,070,063	$23,064,695	$23,064,695	$79,199,453
Residential	29,778	29,281	$6,816,786,934	$3,115,037,261	$1,557,518,631	$11,489,342,845
Unknown	41	1	$179,635	$238,449	$0	$418,084
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: City of Garden Grove March 2019 Parcel/Assessor's Data

Table 4-40 City of Garden Grove – Count and Value of Parcels at Risk by Detailed Property Use with Content Replacement Values

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Civic						
Civic/Institutional	86	70	$75,270,828	$135,646,631	$135,646,631	$346,564,090
Civic Total	**86**	**70**	**$75,270,828**	**$135,646,631**	**$135,646,631**	**$346,564,090**
Commercial						
Heavy Commercial	115	94	$84,646,786	$53,378,381	$53,378,381	$191,403,548
Light Commercial	339	312	$284,813,188	$223,863,732	$223,863,732	$732,540,652
Office Professional	94	86	$33,538,380	$31,842,789	$31,842,789	$97,223,958
Commercial Total	**548**	**492**	**$402,998,354**	**$309,084,902**	**$309,084,902**	**$1,021,168,158**
Industrial						
Industrial	346	321	$549,420,092	$423,864,116	$635,796,174	$1,609,080,379
Industrial Total	**346**	**321**	**$549,420,092**	**$423,864,116**	**$635,796,174**	**$1,609,080,379**
Mixed Use						
Civic Center Mixed Use	235	198	$78,857,590	$79,880,953	$79,880,953	$238,619,496
Industrial/Commercial Mixed Use	48	45	$82,464,919	$64,633,344	$64,633,344	$211,731,607
Industrial/Residential Mixed Use 1	59	55	$80,385,692	$56,371,762	$56,371,762	$193,129,216
Industrial/Residential Mixed Use 2	95	86	$35,748,759	$29,752,014	$29,752,014	$95,252,787
International West Mixed Use	305	251	$338,601,673	$406,201,144	$406,201,144	$1,151,003,961

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Residential/Commercial Mixed Use 1	62	53	$60,614,117	$32,518,261	$32,518,261	$125,650,639
Residential/Commercial Mixed Use 2	417	390	$286,737,166	$197,614,948	$197,614,948	$681,967,062
Residential/Commercial Mixed Use 3	145	133	$78,226,677	$44,180,808	$44,180,808	$166,588,293
Mixed Use Total	**1,366**	**1,211**	**$1,041,636,593**	**$911,153,234**	**$911,153,234**	**$2,863,943,061**
Open Space						
Parks and Open Space	141	35	$33,070,063	$23,064,695	$23,064,695	$79,199,453
Open Space Total	**141**	**35**	**$33,070,063**	**$23,064,695**	**$23,064,695**	**$79,199,453**
Residential						
Community Residential	10	10	$9,451,582	$33,898,085	$16,949,043	$60,298,711
Low Density Residential	25,517	25,295	$5,470,966,643	$2,255,850,794	$1,127,925,397	$8,854,742,854
Low Medium Density Residential	846	785	$212,120,801	$136,343,954	$68,171,977	$416,636,719
Medium Density Residential	3,403	3,190	$1,123,962,208	$686,370,307	$343,185,154	$2,153,517,679
Medium High Density Residential	2	1	$285,700	$2,574,121	$1,287,061	$4,146,882
Residential Total	**29,778**	**29,281**	**$6,816,786,934**	**$3,115,037,261**	**$1,557,518,631**	**$11,489,342,845**
Unknown						
(blank)	41	1	$179,635	$238,449	$0	$418,084
Unknown Total	**41**	**1**	**$179,635**	**$238,449**	**$0**	**$418,084**
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: City of Garden Grove March 2019 Parcel/Assessor's Data

Critical Facilities

For purposes of this plan, a critical facility is defined as:

> ***Any facility, including without limitation, a structure, infrastructure, property, equipment or service, that if adversely affected during a hazard event may result in severe consequences to public health and safety or interrupt essential services and operations for the community at any time before, during and after the hazard event.***

A critical facility is classified by the following categories: (1) Essential Services Facilities: (2) At-risk Populations Facilities, (3) Hazardous Materials Facilities.

- **Essential Services Facilities** include, without limitation, public safety, emergency response, emergency medical, designated emergency shelters, communications, public utility plant facilities and equipment, and government operations. Sub-Categories:
  - ✓ Public Safety - Police stations, fire and rescue stations, emergency operations centers
  - ✓ Emergency Response - Emergency vehicle and equipment storage and essential governmental work centers for continuity of government operations.
  - ✓ Emergency Medical - Hospitals, emergency care, urgent care, ambulance services.
  - ✓ Designated Emergency Shelters.
  - ✓ Communications - Main hubs for telephone, main broadcasting equipment for television systems, radio and other emergency warning systems.
  - ✓ Public Utility Plant Facilities - including equipment for treatment, generation, storage, pumping and distribution (hubs for water, wastewater, power and gas).
  - ✓ Essential Government Operations - Public records, courts, jails, building permitting and inspection services, government administration and management, maintenance and equipment centers, and public health.
  - ✓ Transportation Lifeline Systems - Airports, helipads, and critical highways, roads, bridges and other transportation infrastructure (Note: Critical highways, roads, etc. will be determined during any hazard-specific evacuation planning and are not identified in this plan).
- **At Risk Population Facilities** include, without limitation, pre-schools, public and private primary and secondary schools, before and after school care centers with 12 or more students, daycare centers with 12 or more children, group homes, and assisted living residential or congregate care facilities with 12 or more residents.
- **Hazardous Materials Facilities** include, without limitation, any facility that could, if adversely impacted, release of hazardous material(s) in sufficient amounts during a hazard event that would create harm to people, the environment and property

A fully detailed list of all critical facilities in the Planning Area can be found in Appendix E. A summary of critical facilities in the City can be seen on Figure 4-44. A summary of these facilities can be found in Table 4-41, while a more detailed table with critical facility categories and types can be found in Table 4-42.

Figure 4-44 City of Garden Grove – Critical Facilities

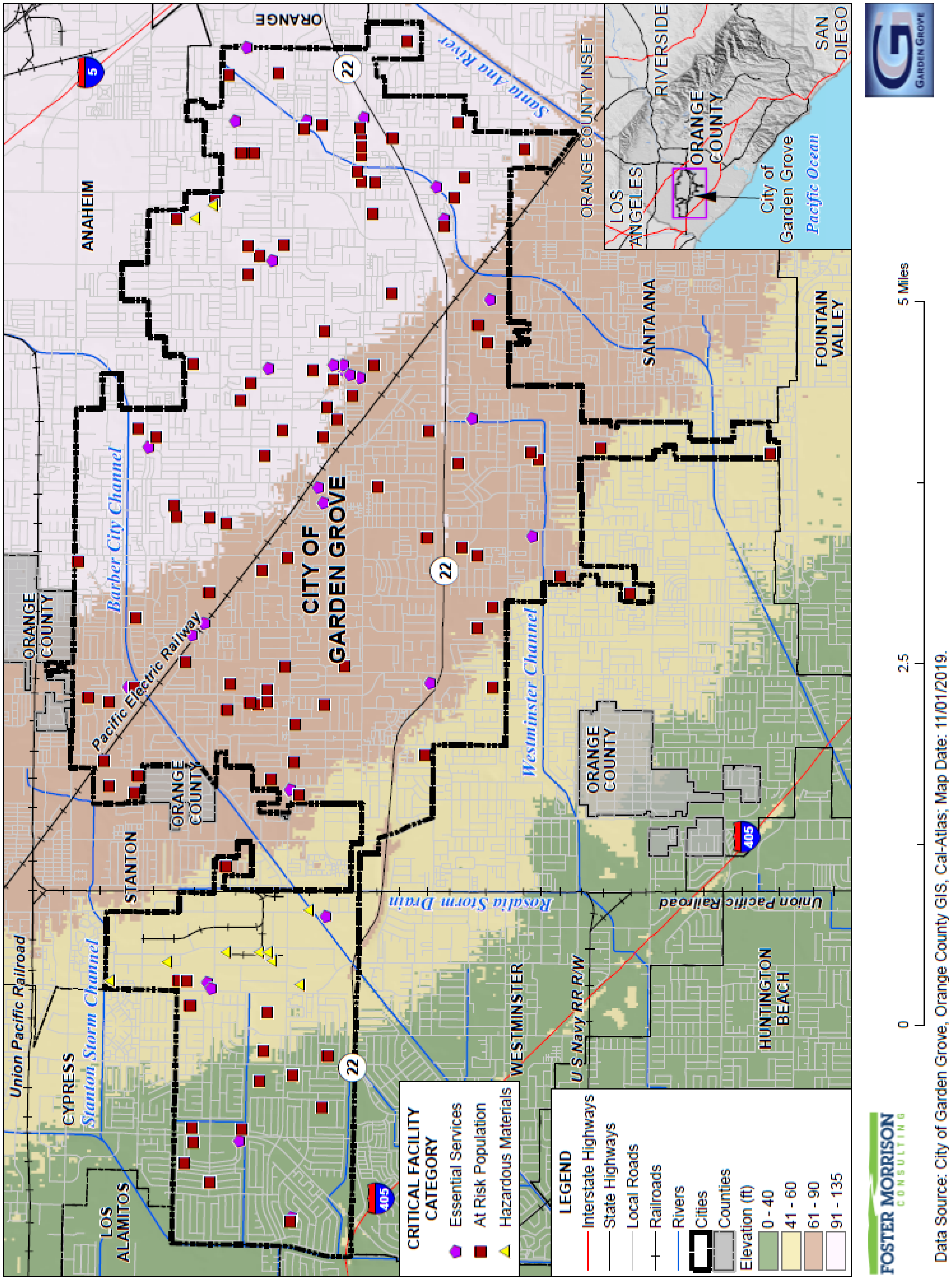


Table 4-41 City of Garden Grove – Critical Facility Summary by Category

Critical Facility Category	Facility Count
Essential Services Facilities	35
At Risk Population Facilities	113
Hazardous Materials Facilities	10
Grand Total	**158**

Source: City of Garden Grove GIS

Table 4-42 City of Garden Grove – Critical Facility Counts by Category and Facility Type

Critical Facility Category	Facility Type	Facility Count
Essential Services Facilities	Fire Station	7
	Government Building	4
	Police Station	1
	Public Building	6
	Public Works Facility	17
	Total	**35**
At Risk Population Facilities	Entertainment	2
	Hospital/Medical	7
	Hotel	3
	Park	21
	Religious Assembly	15
	School	57
	Senior Housing	8
	Total	**113**
Hazardous Materials Facilities	Covered Landfill	2
	Hazmat	8
	Total	**10**
Grand Total		**158**

Source: City of Garden Grove GIS

Natural, Historical, and Cultural Resources

Assessing the vulnerability of the City to disaster also involves inventorying the natural, historic, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.

- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

Natural Resources

The Garden Grove General Plan Conservation Element noted that biological resources in Garden Grove are almost non-existent due to the urban nature of the City and surrounding area. However, incorporation of natural and altered biotic habitats, as well as associated flora and fauna, is important in providing a high quality of life for residents. Parks, vegetated streetscapes, large trees, and neighborhoods support plant life and are home to small animals and birds.

Urban Tree Forest

The City of Garden Grove noted that there are many other assets within the City that are not accounted for within the Assessor Values. One notable asset within the City boundaries includes the City's urban trees that line City streets and parks. The City noted the following valuation of these trees:

- Total number of street trees: 18,800
  - ✓ Total Valuation: $66,116,940
- Diseased Chinese Elms: 125 out of 588
  - ✓ Valuation: $407,500
- Diseased Evergreen Pears: 677
  - ✓ Valuation: $1,570,640

The City noted that the valuation of the diseased trees does not include the removal. Approximate cost per tree including stump grind is $700.00 X 802 which equals $561,400.

Wetlands: Natural and Beneficial Functions

Wetlands are habitats in which soils are intermittently or permanently saturated or inundated. Wetland habitats vary from rivers to seasonal ponding of alkaline flats and include swamps, bogs, marshes, vernal pools, and riparian woodlands. Wetlands are considered to be waters of the United States and are subject to the jurisdiction of the U.S. Army Corps of Engineers as well as the California Department of Fish and Wildlife (CDFW). Where the waters provide habitat for federally endangered species, the U.S. Fish and Wildlife Service may also have authority.

Wetlands are a valuable natural resource for communities providing beneficial impact to water quality, wildlife protection, recreation, and education, and play an important role in hazard mitigation. Wetlands provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation is vital, and reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water.

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flow. Wetlands perform a variety of ecosystem functions including food web support, habitat for insects and other invertebrates, fish and wildlife habitat, filtering of waterborne and dry-deposited anthropogenic pollutants, carbon storage, water flow regulation (e.g., flood abatement), groundwater recharge, and other human and economic benefits.

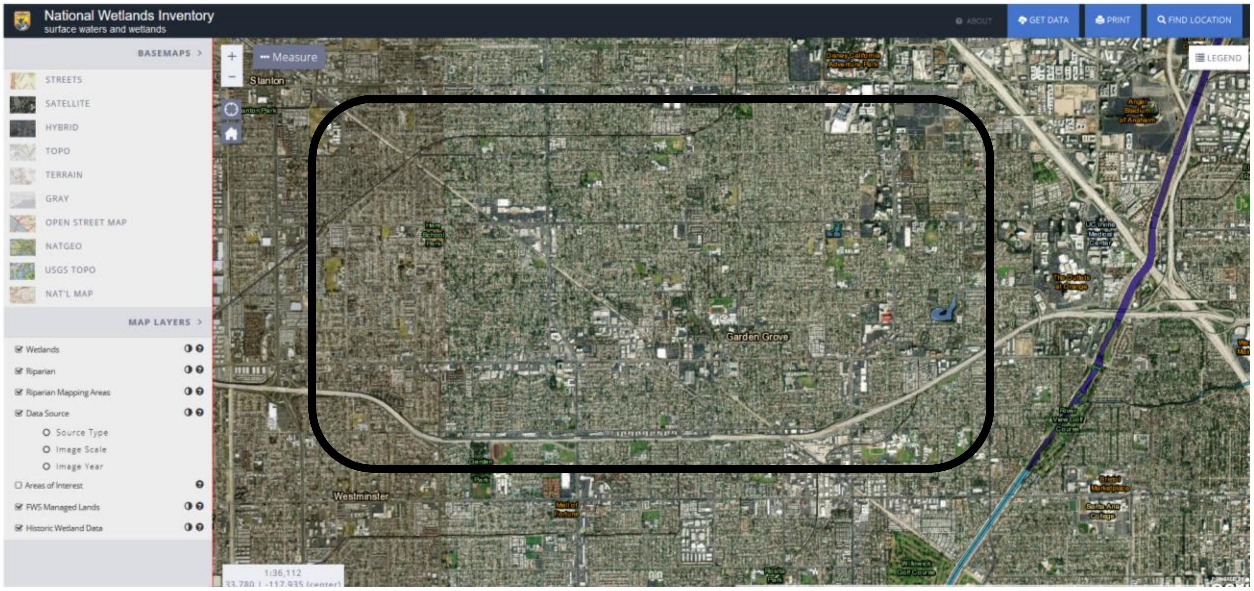
Wetlands, and other riparian and sensitive areas, provide habitat for insects and other invertebrates that are critical food sources to a variety of wildlife species, particularly birds. There are species that depend on these areas during all parts of their lifecycle for food, overwintering, and reproductive habitat. Other species use wetlands and riparian areas for one or two specific functions or parts of the lifecycle, most commonly for food resources. In addition, these areas produce substantial plant growth that serves as a food source to herbivores (wild and domesticated) and a secondary food source to carnivores.

Wetlands slow the flow of water through the vegetation and soil, and pollutants are often held in the soil. In addition, because the water is slowed, sediments tend to fall out, thus improving water quality and reducing turbidity downstream.

These natural floodplain functions associated with the natural or relatively undisturbed floodplain that moderates flooding, such as wetland areas, are critical for maintaining water quality, recharging groundwater, reducing erosion, redistributing sand and sediment, and providing fish and wildlife habitat. Preserving and protecting these areas and associated functions are a vital component of sound floodplain management practices for the City.

Natural site features such as wetlands with native plants and hydric soils have long disappeared and they no longer can function as they should. Landowners are encouraged to plant native plants on their property. These plants will assist with absorption and filtration of water. They will help to hold soils to keep erosion and siltation from occurring in the waterway. Landowners are also encouraged to remove any obstructions which might restrict water conveyance during high water events. The National Wetlands inventory indicates that small wetland areas are located within the City. Wetlands in Garden Grove are shown in Figure 4-45.

Figure 4-45 City of Garden Grove– Wetland Locations



Source: US Fish and Wildlife Service Wetlands Mapper

Critical Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the City. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

There are many federal endangered, threatened, or candidate species in or near Garden Grove. The California Natural Diversity Database was searched for listed species. The quad that contains the City of Garden Grove contained 26 species. These species are listed in Table 4-43.

Table 4-43 City of Garden Grove – Threatened and Endangered Species

Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank
Animals - Amphibians					
Spea hammondii	western spadefoot	None	None	SSC	–
Buteo swainsoni	Swainson's hawk	None	Threatened	–	–
Ardea alba	great egret	None	None	–	–
Charadrius montanus	mountain plover	None	None	SSC	–

Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Threatened	Endangered	–	–
Icteria virens	yellow-breasted chat	None	None	SSC	–
Setophaga petechia	yellow warbler	None	None	SSC	–
Polioptila californica californica	coastal California gnatcatcher	Threatened	None	SSC	–
Laterallus jamaicensis coturniculus	California black rail	None	Threatened	FP	–
Athene cunicularia	burrowing owl	None	None	SSC	–
Contopus cooperi	olive-sided flycatcher	None	None	SSC	–
Pyrocephalus rubinus	vermilion flycatcher	None	None	SSC	–
Animals - Fish					
Oncorhynchus mykiss irideus pop. 10	steelhead - southern California DPS	Endangered	None	–	–
Animals - Insects					
Bombus crotchii	Crotch bumble bee	None	None	–	–
Euphydryas editha quino	quino checkerspot butterfly	Endangered	None	–	–
Animals - Mammals					
Eumops perotis californicus	western mastiff bat	None	None	SSC	–
Animals - Reptiles					
Anniella stebbinsi	southern California legless lizard	None	None	SSC	–
Phrynosoma blainvillii	coast horned lizard	None	None	SSC	–
Plants - Vascular					
Centromadia parryi ssp. australis	southern tarplant	None	None	–	1B.1
Symphyotrichum defoliatum	San Bernardino aster	None	None	–	1B.2
Nasturtium gambelii	Gambel's water cress	Endangered	Threatened	–	1B.1
Atriplex parishii	Parish's brittlescale	None	None	–	1B.1
Juglans californica	southern California black walnut	None	None	–	4.2
Sidalcea neomexicana	salt spring checkerbloom	None	None	–	2B.2
Abronia villosa var. aurita	chaparral sand-verbena	None	None	–	1B.1
Camissoniopsis lewisii	Lewis' evening-primrose	None	None	–	3

Source: California Natural Diversity Database

Legend: CDFW: WL – Watch List; SSC – Species of Special Concern; FP – Fully Protected

Legend: CA Rare Plan Rank:

1A Plants presumed extinct in California and rare/extinct elsewhere

1B.1 Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California

1B.2 Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California

1B.3 Plants rare, threatened, or endangered in California and elsewhere; not very threatened in California

2A Plants presumed extirpated in California, but more common elsewhere

2B.1 Plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California

2B.2 Plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California

2B.3	Plants rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California
3.1	Plants about which we need more information; seriously threatened in California
3.2	Plants about which we need more information; fairly threatened in California
3.3	Plants about which we need more information; not very threatened in California
4.1	Plants of limited distribution; seriously threatened in California
4.2	Plants of limited distribution; fairly threatened in California
4.3	Plants of limited distribution; not very threatened in California

Historical and Cultural Resources

Garden Grove has historically significant homes, public buildings, and landmarks. To inventory these resources, information was collected from a number of sources. The California Department of Parks and Recreation Office of Historic Preservation (OHP) was the primary source of information. The OHP is responsible for the administration of federally and state mandated historic preservation programs to further the identification, evaluation, registration, and protection of California's irreplaceable archaeological and historical resources. OHP administers the National Register of Historic Places, the California Register of Historical Resources, California Historical Landmarks, and the California Points of Historical Interest programs. Each program has different eligibility criteria and procedural requirements.

- The **National Register of Historic Places** is the nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.
- The **California Register of Historical Resources** program encourages public recognition and protection of resources of architectural, historical, archeological, and cultural significance and identifies historical resources for state and local planning purposes; determines eligibility for state historic preservation grant funding; and affords certain protections under the California Environmental Quality Act. The Register is the authoritative guide to the state's significant historical and archeological resources.
- **California Historical Landmarks** are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Landmarks #770 and above are automatically listed in the California Register of Historical Resources.
- **California Points of Historical Interest** are sites, buildings, features, or events that are of local (city or county) significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Points designated after December 1997 and recommended by the State Historical Resources Commission are also listed in the California Register.

Historical resources included in the programs above were reviewed. None of these properties are located in Garden Grove. However, it should be noted that as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

In addition, the City of Garden Grove General Plan Conservation Element noted there are historical properties and areas of locally significance. One prehistoric site has been identified within Garden Grove's municipal boundaries, and an additional twelve historic archaeological sites dating from the early 1900s have been found. The prehistoric site is located under a residential development and consists of shellfish remains from food debris, stone tools and stone flakes from manufacturing stone tools. Archaeological sites are primarily locations of historic trash in association with residences and commercial structure dating from the 1900s. A 1986 historic and architectural inventory documented 132 buildings as locally-significant resources. While these were noted in the report, the HMPC noted that the exact locations have not been catalogued and at this time staff has no idea where they are located. Three structures, the Stanley or Ware House within Heritage Park, the Harry A. Lake House, and the Reyburn House are candidates for nomination to the National Register of Historic Places. The Stanley House is designated as Orange County Historical Site No. 13. The preservation of these locally significant resources will be considered as the City continues to urbanize and as the past traditions merge with future growth.

Growth and Development Trends

As part of the planning process, the HMPC looked at changes in growth and development, both past and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability. Information from the 2014-2021 City of Garden Grove Housing Element, City of Garden Grove General Plan Land Use Element, the US Census Bureau, and the California Department of Finance (DOF) form the basis of this discussion.

Past Growth and Current Population

Founded in the late 1800s and incorporated in 1956, Garden Grove has experienced growth curves that mirror those of centrally located Orange and Los Angeles county communities. The largest population surge occurred in the 1950s, spurred largely by the arrival of World War II veterans looking to establish a home. By 1960, Garden Grove had almost 85,000 residents; by 1970, the population crested 120,000. The 2000 Census indicated that the City had attained a population of 165,196. Based on data collected for the 2010 Census, the City's population is now estimated at 170,883, with slightly more women (51%) than men (49%). Based on 2010 population estimates, Garden Grove is the twenty-sixth largest city in California and the fifth largest city in Orange County, trailing Santa Ana, Anaheim, Huntington Beach, and Irvine. The California Department of Finance estimated the 2019 population to be 175,155.

Future Populations

The City of Garden Grove Housing Element noted that due to the City being built out, future population changes are expected to be small. Population projections for 2020 are expected to be 179,402, and 181,771 in 2030.

Land Use

The City of Garden Grove is a mature and fully built out urbanized city. Most of the land within the City has been developed (over 99 percent) and redevelopment is occurring throughout the City. Some of the land is undergoing a transformation from uses established 40 to 50 years ago into new uses that reflect life today and the changing needs of people within the City. Growth is seen as a positive economic tool and enhanced shopping, dining, and entertainment options would improve the quality of life. There is also a community value to preserve the "hometown feel," and the core residential character of the community.

Table 4-44, General Plan Land Use in 2030, presents a wider calculation of all acreage in the City and maximum potential growth for the different land use designations. The acreages of the various land uses on the General Plan Land Use Diagram are presented, along with number of dwelling units and the amount of non-residential square footage. The values in Table 4-44 include the Focus Area growth anticipated with the General Plan 2030 account for buildout of any vacant or underutilized parcels, and assume buildout of all land uses (as if all parcels had been developed to their maximum).

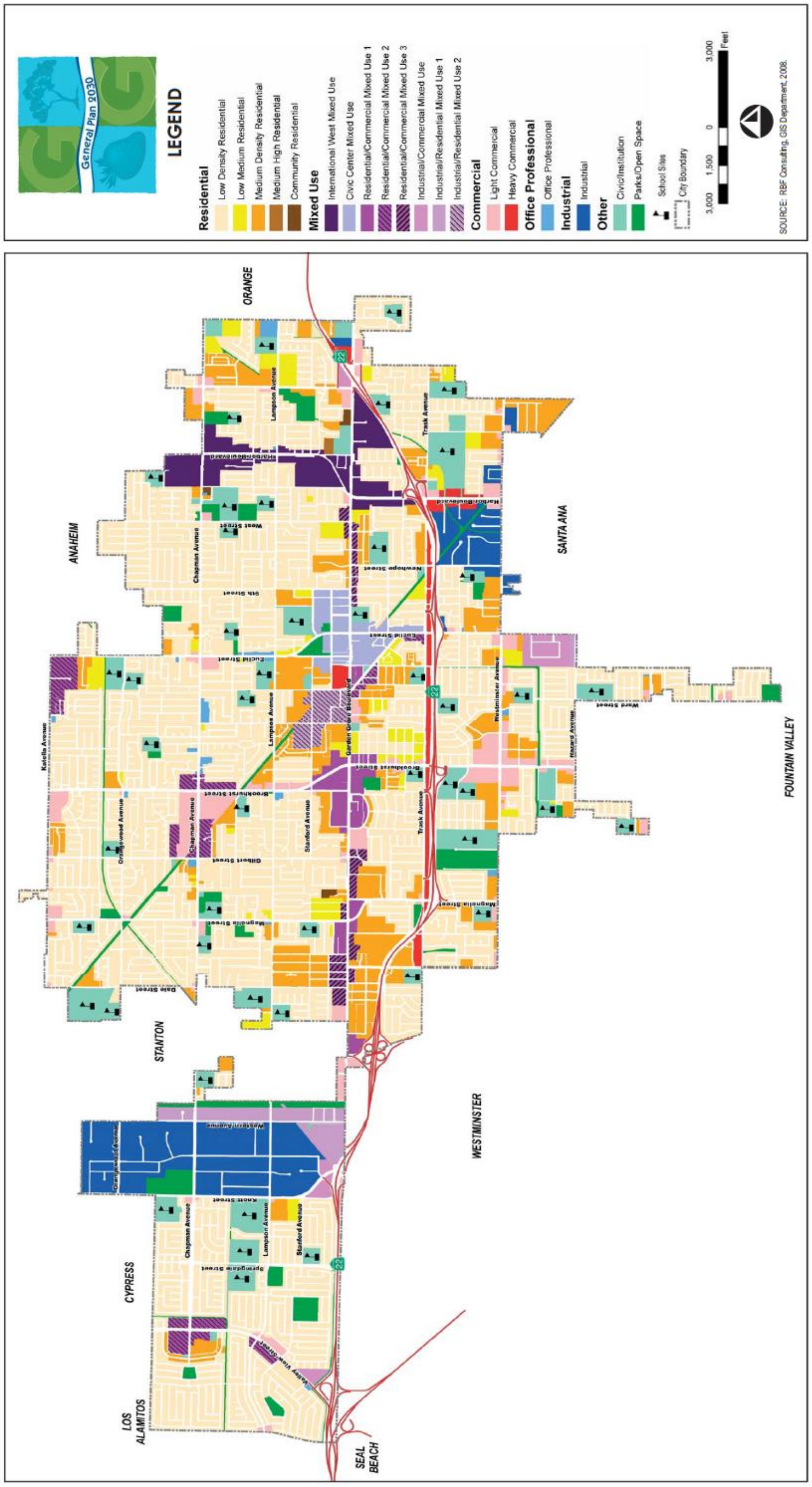
Table 4-44 City of Garden Grove Land Use Designations and Sizes

Land Use Designation	Acres	Floor Area Ratio	Dwelling Units	Square Feet
Low Density Residential (1.0-11.0 du/acre)	4,659.53		27,025	
Low Medium Density Residential (11.1-21.0 du acre)	244.23		3,718	
Medium Density Residential (21.1-32.0 du/acre)	941.53		16,571	
Medium High Density Residential (32.1 –42.0 du/acre)	4.81		152	
Community Residential (42.1-60.0 du/acre)	9.56		430	
Light Commercial	335.42	0.40 to 0.55		4,931,177
Heavy Commercial	91.07	0.56		1,666,144
Office Professional	37.84	0.40		494,493
Civic Center Mixed Use	108.42	0.50	1,025	1,112,510
Industrial/Commercial Mixed Use	73.15	0.50		724,909
Industrial/Residential MU 1	116.25	0.40 to 0.60	600	1,382,431
Industrial/Residential MU 2	61.50	0.50	425	608,429
International West	235.66	0.50 to 2.00	400	6,796,730
Residential/Commercial MU1	116.44	0.50 to 1.00	2,050	2,413,528
Residential/Commercial MU2	139.10	0.50	1,625	1,110,381
Residential/Commercial MU3	67.59	0.50	275	408,755
Industrial	584.00	1.00		19,079,280
Civic/Institutional	720.30	0.50		7,844,067
Parks and Open Space	357.76			
Roads/Infrastructure	2,566.48			
Total	**11,470.53**		**54,296**	**48,572,835**

Source: City of Garden Grove 2030 General Plan Land Use Element

The graphic depiction of the City of Garden Grove's official policy relative to land use is presented on Figure 4-46, General Plan Land Use Diagram. This diagram illustrates the general pattern and relationship of the various land uses in Garden Grove in 2030.

Figure 4-46 City of Garden Grove – Land Use Diagram



Source: City of Garden Grove 2030 General Plan Land Use Element

Vulnerable Populations

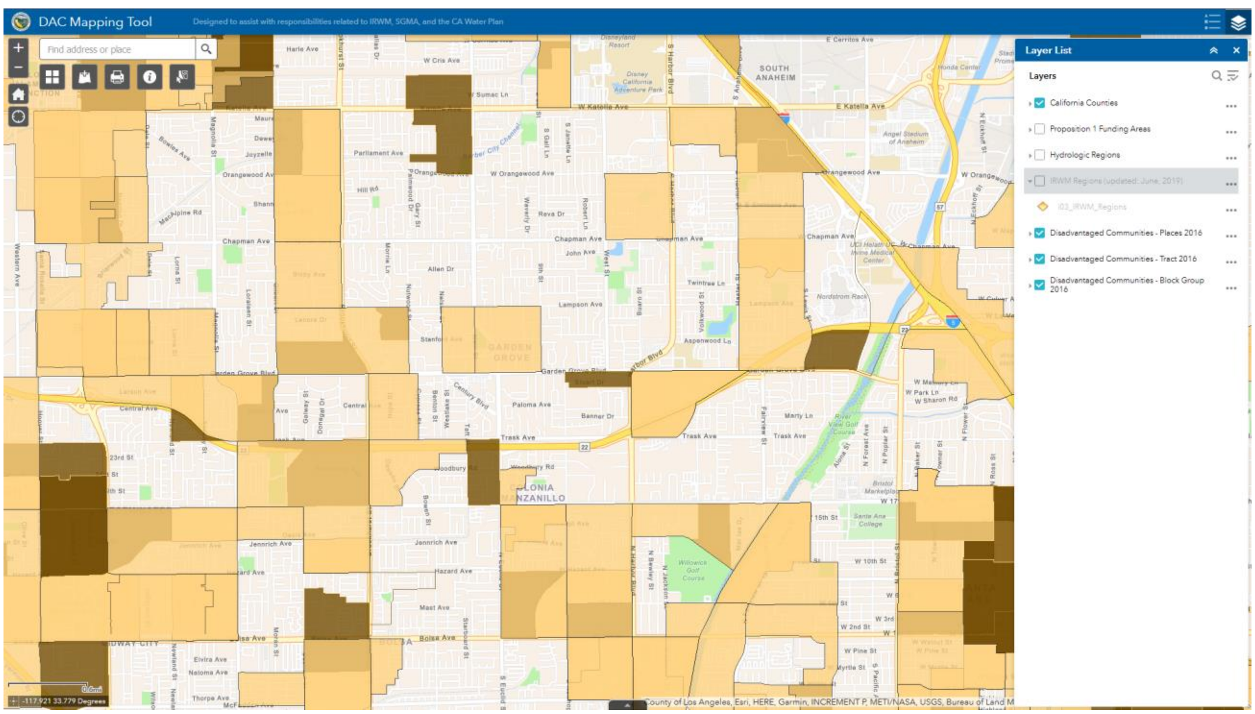
The vulnerable populations discussion is based on the following three sources:

- Cal-DWR Disadvantaged Community Mapping Tool
- City of Garden Grove 2014 - 2021 Housing Element
- HMPC Input

California DWR Disadvantaged Community Mapping Tool

The State of California's Proposition 1 Disadvantaged Community (DAC) Involvement Program is designated to ensure the involvement of DACs as well as Economically Distressed Areas and Underrepresented Communities, which DWR collectively refers to as DACs. The Cal DWR definition for a Disadvantaged Community is a community with an annual median household income (MHI) that is less than 80% of the Statewide annual MHI (PRC Section 75005(g)), and those census geographies with an annual MHI less than 60% of the Statewide annual MHI are considered "Severely Disadvantaged Communities". Those areas in and around Garden Grove considered disadvantaged are shown in Figure 4-47, with the darker areas representing areas of greater economic disadvantage.

Figure 4-47 City of Garden Grove – Disadvantaged Communities



Source: Cal DWR DAC Mapping Tool. Map retrieved 8/12/2019.

City of Garden Grove 2014-2021 Housing Element

A discussion of homelessness in the City was put forth in the 2014-2021 City Housing Element. It stated that the Orange County homeless population includes families and individuals representing every race, age group, and community in the County. As the cost of housing in the County and all of Southern California continues to rise, homelessness has become more prevalent.

Because of the transient nature of homelessness, gauging an estimate of homeless persons in Garden Grove is difficult. In January 2009, Orange County conducted a "point in time" count of homeless persons. The count indicated that there were 8,333 homeless individuals in the County, of whom 6,956 were individuals and 1,377 were homeless families with children. The count reported that 2,509 of the homeless persons were sheltered homeless (in emergency and transitional shelters), and 5,724 were homeless and unsheltered. Using survey data on the length and recurrence of homelessness, the 8,333 point in time count represents an annual estimate of 21,479 unduplicated persons who experience homelessness in Orange County over a year.

Given the City's proportion of population compared with the whole County, it can be estimated that at any point in time there may be approximately 460 homeless persons in Garden Grove. An unsheltered homeless person is a homeless individual who does not reside in an emergency shelter or transitional housing for homeless persons.

The Garden Grove Police Department indicates that managing homeless persons in the City is an ongoing issue. During day shifts police officers have a mental health clinician from the Orange County Mental Health program available to them when they receive a call related to a homeless person. The clinician refers homeless persons to services in the area including the Rescue Mission or Salvation Army, both located in Santa Ana. In addition to the homeless population living in shelters or on the streets, many residents, due to high housing cost, economic hardships, or physical limitations, live on the brink of homelessness yet are housed temporarily through friends or families.

HMPC Input

Garden Grove Medical Center is the only general hospital in the City and has 175 beds. This facility is of concern because of the non-ambulatory nature of some of the occupants. Special planning is imperative to effectively handle the evacuation and relocation of special needs residents. There are six skilled nursing facilities in addition to the hospital; each with between 50 and 75 beds.

The City Planning Team also noted that there is a homeless population that resides in the City. The Garden Grove Police Department (GGPD) has identified the following areas as locations to be checked for homeless populations, in the event of a significant hazard or disaster. The listed intersections contain shopping centers, businesses, drainage areas, and right of ways known to be frequented by homeless:

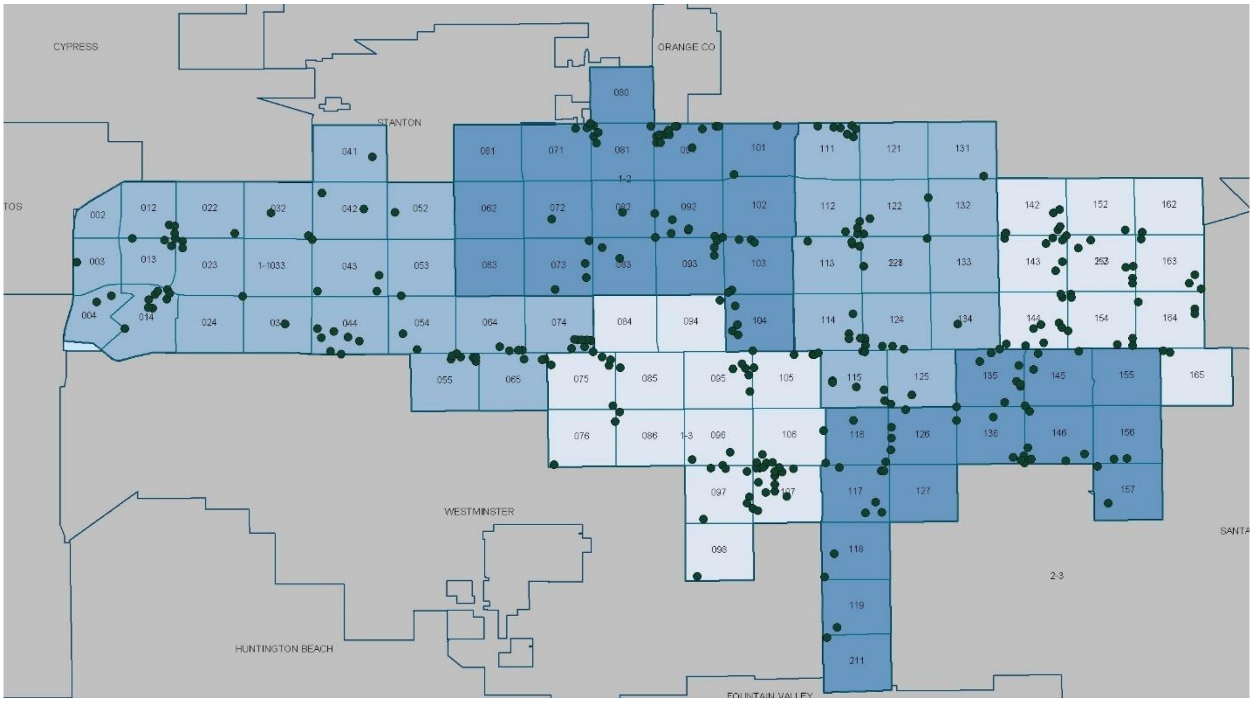
- Knott / Garden Grove
  - ✓ Freeway overpasses, County flood-control channel, and nearby industrial complex
- Hoover / Garden Grove
  - ✓ Railroad right of way
- Chapman / Monarch
  - ✓ Railroad right of way
- Beach / Garden Grove
  - ✓ Freeway overpasses (south of) and drainage ditches to nearby WB 22-freeway on and off-ramps
- Dale / Katella

- ✓ RVs on Dale south of Katella

- ➢ Dale / Garden Grove
  - ✓ Parking alleys in neighborhood south of intersection
- ➢ Magnolia / Katella
  - ✓ Shopping center on southeast corner
- ➢ Gilbert / Katella
  - ✓ Shopping centers on southeast corner
- ➢ Gilbert / Maureen
  - ✓ Residential alleys east of intersection (behind apartment complexes)
- ➢ Kerry / Westminster
  - ✓ South of intersection (near strip mall on southeast corner)
- ➢ Brookhurst Corridor
  - ✓ Any and all shopping centers along the Brookhurst Corridor are known to have a constant flow of pedestrian traffic from the homeless
- ➢ Euclid / Katella
  - ✓ Shopping center on southwest corner of intersection (particularly the west/rear alley)
- ➢ Euclid / Chapman
  - ✓ First Presbyterian Church (north of the intersection) and shopping center on southwest corner
- ➢ Euclid / Garden Grove
  - ✓ Purcell building
- ➢ Euclid / Trask
  - ✓ 7-11 (northeast corner) and Arco / flood control (southwest corner)
- ➢ Euclid / Westminster
  - ✓ Shopping center on northwest corner
- ➢ Newhope / Trask
  - ✓ Freeway overpass and OCTA right of way
- ➢ West / Chapman
  - ✓ Far southeast parking lot of business complex on southeast corner
- ➢ • West / Garden Grove
  - ✓ Liquor store and Laundromat on northeast corner
- ➢ Harbor / Lampson
  - ✓ 7/11 (southeast corner) and liquor store (Lampson west of Harbor)
- ➢ Harbor / Garden Grove
  - ✓ All 4-corners of intersection
- ➢ Harbor / Westminster
  - ✓ All 4-corners of intersection
- ➢ Haster / Chapman
  - ✓ Business centers on all 4-corners of intersection
- ➢ Haster / Lampson
  - ✓ North end of business complex (northwest corner) and Haster Basin Park
- ➢ Haster / Garden Grove
  - ✓ Arco gas station (northwest corner)
- ➢ Fairview / Garden Grove
  - ✓ Fairview south of the intersection (west side of the street)

These can be seen on Figure 4-48.

Figure 4-48 City of Garden Grove – Transient Calls for Service



Source: City of Garden Grove

City Police Officers utilize available resources to conduct welfare checks in the above-mentioned areas to assure individuals are provided disaster relief and any necessary medical aid. Officers are also directed to also coordinate with outside agencies in the event responses are delayed or unable to be adequately provided.

The HMPC also noted that due to the City's proximity to Disney Land, there is a high level of transient populations during peak vacation seasons. The hotel areas of the City attract many Disney Land visitors.

Future Development/Redevelopment

The Garden Grove General Plan Land Use Element noted that the City conducted a vacant land survey in January 2008, which determined that only 32.01 acres of the City's total 11,470.53 acres were vacant. This vacant land represents 0.3 percent of the City's total acreage. A key focus of the General Plan 2030 will be to expand existing areas that will allow the development of mixed use.

Future Development/Redevelopment GIS Analysis

The City of Garden Grove provided 31 areas of future development or redevelopment. These areas were mapped in GIS, and can be seen on Figure 4-49 and detailed in Table 4-45. 6 other projects have been identified for future development, but their locations have not yet been determined. These were noted by the HMPC to be minor residential projects with a few small commercial projects.

Figure 4-49 City of Garden Grove – Future Development Areas

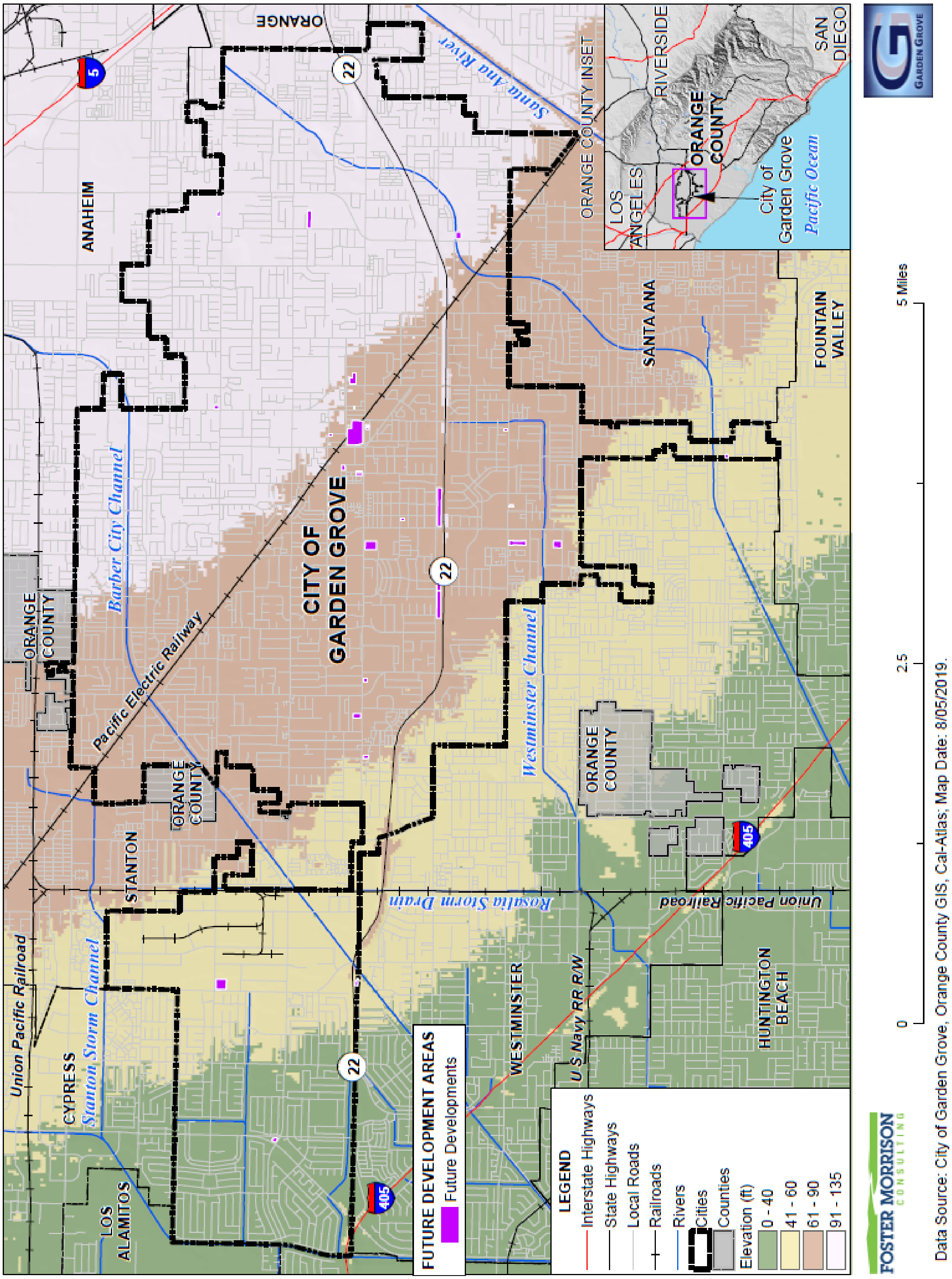


Table 4-45 City of Garden Grove – Future Development Areas by Parcels and Acreage

Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
10080 Garden Grove Blvd	1	0	3.09
12361 Chapman Ave	1	1	0.48
9106 Garden Grove Blvd	1	1	0.48
9861 11th St	1	1	1.76
10052 Central Ave	1	1	0.20
10522 McFadden Ave	1	1	0.35
12900 Euclid St	1	0	1.99
7051 Garden Grove Blvd	1	0	0.52
10531 Garden Grove Blvd	1	1	0.61
10561 Garden Grove Blvd	1	1	0.41
10611 Acacia Ave	1	1	0.58
11001 Chapman Ave	1	1	0.53
10801 Garden Grove Blvd	1	1	10.70
12900 Main St	2	2	0.13
10150 Trask Ave	1	0	5.14
10812 Stanford Ave	1	1	0.23
8562 Garden Grove Blvd	1	1	0.55
8851 Garden Grove Blvd	1	1	1.05
10862 Garden Grove Blvd	1	1	0.22
10872 Garden Grove Blvd	1	0	0.15
10882 Garden Grove Blvd	1	0	0.16
12422 Valley View St	1	1	0.53
12612 Buaro St	1	1	1.91
9444 Trask Ave	1	1	3.50
9670 Trask Ave	1	1	3.00
13650 Harbor Blvd	1	1	1.25
12072 Knott St	2	2	6.38
9892 Westminster Ave	2	2	4.43
10142 Westminster Ave	1	1	0.16
10152 Westminster Ave	1	1	0.17
10691 Westminster Ave	1	1	0.30
Grand Total	**34**	**28**	**50.97**

Source: City of Garden Grove GIS

4.3.2. Garden Grove's Vulnerability to Specific Hazards

The Disaster Mitigation Act regulations require that the HMPC evaluate the risk and vulnerability associated with priority hazards identified in the planning process. This section summarizes the possible impacts and quantifies, where data permits, the City's vulnerability to each of the hazards identified as a priority hazard in Section 4.2.14 Natural Hazards Summary. The priority hazards evaluated further as part of this vulnerability assessment include:

- Climate Change
- Dam Failure
- Drought and Water Shortage
- Earthquake
- Earthquake: Liquefaction
- Flood: (100/500 year)
- Flood: Localized/Stormwater
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms
- Severe Weather: High Winds
- Wildfire (Conflagration)

An estimate of the vulnerability of the City to each identified hazard, in addition to the estimate of likelihood of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**—Very widespread with catastrophic impact.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of City critical facilities, historic structures, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the impact, or vulnerability, of an area to that hazard.

The HMPC identified six hazards in the City for which specific geographical hazard areas have been defined and for which sufficient data exists to support a quantifiable vulnerability analysis. These six hazards are dam failure, earthquake, earthquake liquefaction, flood, levee failure, and wildfire. Because these hazards have discrete hazard risk areas, their risk varies throughout the City. For dam failure, earthquake liquefaction, flood, levee failure, and wildfire, the HMPC inventoried the following, to the extent possible, to quantify vulnerability in identified hazard areas:

- General hazard-related impacts, including impacts to life, safety, and health
- Values at risk (i.e., types, numbers, and value of land and improvements)
- Population at risk
- Critical facilities at risk
- Overall community impact
- Future development trends within the identified hazard area

HMPC used FEMA's loss estimation software, HAZUS-MH, to analyze the City's vulnerability to earthquakes.

The vulnerability and potential impacts from priority hazards that do not have specific mapped areas nor the data to support additional vulnerability analysis are discussed here in more general terms.

4.3.3. Climate Change Vulnerability Assessment

Likelihood of Future Occurrence—Likely
Vulnerability—Medium

This LHMP is concerned with human-induced climate change that has been rapidly warming the Earth at rates unprecedented in the last 1,000 years. Since industrialization began in the 19th century, the burning of fossil fuels (coal, oil, and natural gas) at escalating quantities has released vast amounts of carbon dioxide and other greenhouse gases responsible for trapping heat in the atmosphere, increasing the average temperature of the Earth. Secondary impacts include changes in precipitation patterns, the global water cycle, melting glaciers and ice caps, and rising sea levels. According to the Intergovernmental Panel on Climate Change (IPCC), climate change will "increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" if unchecked.

City of Garden Grove Climate Change Impacts

The discussion on impacts to Garden Grove and Orange County come from three sources:

- Orange County Climate Change and Health Profile Report
- California Adaptation Planning Guide
- Proceedings of the National Academy of Sciences

Orange County Climate Change and Health Profile Report Impacts

According to the Orange County CCHPR, all Californians are vulnerable to the health impacts of climate change. Even if one is fortunate to live, work, study, or play in a place without direct contact with wildfires, flooding, or sea level rise, no one can entirely avoid excessive heat or the indirect effects of extreme weather events. Based on medical reviews of individuals who died during heat waves and other extreme weather events, those who are particularly vulnerable to the direct effects of climate change include the very old and very young, individuals who have chronic medical conditions and psychiatric illness, people taking multiple medications, people without means for evacuation (no access to public transit or private cars), people who are socially isolated, medically fragile people, and people living in institutions. Acclimatization to heat may help reduce risks from heat waves in the healthy general population, but may not be sufficient to protect those with underlying medical conditions.

Researchers have examined the pathways in which increased temperatures and hydrologic extremes can impact health and generally recognize three main pathways: direct exposures, indirect exposures, and socioeconomic disruption. Based on the review of weather-related natural disasters and historical patterns and scientific judgment, public health researchers have suggested the nature and direction of health harms or benefits.

- **Extreme Weather-Related Injury, Mental Health, and Displacement Extreme weather events (storms, flooding)** – These events can cause fatal and nonfatal injuries from drowning, being struck by objects, fire, explosions, electrocution, or exposure to toxic materials. A widespread weather-related natural disaster may destroy or ruin housing, schools and businesses and cause temporary or permanent displacement. Individuals and families may experience post-traumatic stress, depression, and increased risk of suicide.
- **Health impacts of Heat** –Increased temperatures manifested as heat waves and sustained high heat days directly harm human health through heat-related illnesses (mild heat stress to fatal heat stroke) and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable. Increased heat also intensifies the photochemical reactions that produce smog and ground level ozone and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide enhance the growth of plants that produce pollen, which are associated with allergies. Increased temperatures add to the heat load of buildings in urban areas and exacerbate existing urban heat islands adding to the risk of high ambient temperatures.
- **Health Impacts of Drought** – Lack of moisture, already at a severe level in California due to a current multi-year drought and decades of fuel accumulation from historical forestry and fire suppression practices, increases the risk of wildfires. Devastating wildfires impact watersheds and increase the risk of landslides or mudslides, and sediment in run-off that reduce water quality. In addition to fire-related injuries, local and regional transport of smoke, ash, and fine particles increases respiratory and cardiovascular risks. Increasing temperatures and changes in precipitation may lead to intensified drought conditions. Drought decreases the availability and quality of water for humans. This includes reduced water levels to fight wildfires. Drought may increase exposure to health hazards including wildfires, dust storms, extreme heat events, flash flooding, degraded water quality, and reduced water quantity. Drought is discussed in more detail in Section 4.3.5.
- **Vector-borne Illnesses** – Climatic changes alter the range, biogeography, and growth of microbes and the vectors of food, water, and vector-borne illnesses. This includes the changes in aquatic environments that could increase harmful algal blooms and lead to increases in foodborne and waterborne illnesses.
- **Food Insecurity** – Climate change is expected to have global impacts on food production and distribution systems. This can cause food prices to increase, which makes food less affordable and increases food insecurity, obesity, and malnutrition in economically constrained households.

- **Sea Level Rise, Mold, and Indoor Air Quality** – Through sea level rise, saltwater may intrude into coastal aquifers thus reducing quality and quantity of water supply. Coastal erosion can contribute to the loss of recreational venues and pose a variety of hazards to infrastructure and public safety. Water intrusion into buildings can result in mold contamination leading to indoor air quality problems.
- **Socioeconomic Disruption** – Widespread social and economic disruption includes damage to the infrastructure for the delivery of health services and for general economic well-being. Health care facilities, water treatment plants, and roads for emergency responders and transportation for health care personnel can be damaged in climate-related extreme weather events. Increased burden of disease and injury will test the surge capacity of health care facilities. Economic disruption can lead to income loss, income insecurity, food insecurity, housing insecurity, and mental health problems, which in turn may increase substance abuse, suicide and other health problems. Energy production and distribution is also threatened by heat and wildfires through loss of efficiency, generating capacity, and fires disrupting transmission lines. California's ports that provide the gateway to goods for California, national, and international markets are at risk from sea level rise and coastal storms.

In addition to the bulleted points above, drought and extreme heat are also exacerbated by climate change. This will be discussed further in Section 4.3.4 (Drought). All Californians are vulnerable to the health impacts of climate change. Even if one is fortunate to live, work, study, or play in a place without direct contact with wildfires, flooding, or sea level rise, no one can entirely avoid excessive heat or the indirect effects of extreme weather events.

Adaptation Planning Guide Impacts

The California Adaptation Planning Guide (APG) prepared by California OES and CNRA was developed to provide guidance and support for local governments and regional collaboratives to address the unavoidable consequences of climate change.

The APG: Defining Local and Regional Impacts focuses on understanding the ways in which climate change can affect a community. According to this APG, climate change impacts (temperature, precipitation, sea level rise, ocean acidification, and wind) affect a wide range of community structures, functions and populations. These impacts further defined by regional and local characteristics are discussed by secondary impacts and seven sectors found in local communities: Public Health, Socioeconomic, and equity impacts; Ocean and Coastal Resources; Water Management; Forest and Rangeland; Biodiversity and Habitat; Agriculture; and Infrastructure.

The APG: Understanding Regional Characteristics identified the following impacts specific to the South Coast region in which Orange County and the City of Garden Grove part of:

- Increased temperatures
- Reduced precipitation
- Sea level rise
- Reduced tourism
- Reduced water supply
- Wildfire risk
- Public health - heat and air quality
- Coastal erosion

The South Coast is a highly urbanized region. High population density also creates greater vulnerability to climate-related hazards simply because more people are in harm's way. The concentration of population on the coast has the potential to affect public safety, infrastructure, and the integrity of coastal ecosystems. In addition, the urban setting can also amplify public health risks because increased temperatures are even higher due to the urban heat island.

California's Adaptation Guide: Understanding Regional Characteristics provides input on adaptation considerations for the South Coast region. As detailed in this guide, climate change has the potential to disrupt many features that characterize the region, including ecosystems health, sea levels, and the tourist economy. Specific regional impacts include the following:

Public Health, Socioeconomic, and Equity Impact. In the highly populated areas within this region, "urban heat islands" will exacerbate the public health impacts that poor air quality and heat waves have upon the more vulnerable populations of this area. The highest percentages of impervious surfaces are in the urban areas of Los Angeles and San Diego counties, increasing the potential impacts of heat islands (English et al., 2007).

Southern California's urban centers are warming more rapidly than other parts of the state (English et al., 2007). Los Angeles, San Diego, and Orange counties rank first, second, and third in the state in absolute numbers of the elderly and children less than five years of age. These two populations are most likely to suffer from heat-related illnesses and heat events (English et al., 2007).

Because of the significant and varied population in this region, there is also likely to be a significant population that fits into a number of the socially vulnerable categories lacking adaptive capacity. This increases the vulnerability of these populations.

The higher cost of living in some areas of this region means low-income families pay a high percentage of their income on housing and transportation. Increases in food and energy costs may impact low-income residents.

Sea Level Rise. While not a direct impact to Garden Grove, sea level rise has the potential to result in far-reaching impacts on the South Coast region. Sea level rise may affect the region's tourism–the largest value tourist industry in the state (NOEP, 2005)–as well as other considerable assets, including international airports and seaports.

A study by the California Department of Boating and Waterways and San Francisco State University (n.d.) using three example beaches in the region shows considerable loss of recreational and ecological benefits due to sea level rise. A 1.4-meter rise in sea level will increase the population vulnerable to a 100- year coastal storm from 86,000 to 149,300. Most of the population at risk is in Orange County (CCCC, 2007). Areas near Huntington Beach, Seal Beach, the Port of Long Beach, Marina Del Rey, and Port Hueneme also will be of particular concern in the region due to the significant inland penetration of flood waters exacerbated by sea level rise (cal-adapt.org, PIER, 2011).

Sea level rise is expected to affect vulnerable populations along the coast through the immediate effects of flooding and temporary displacement and longer-term effects of permanent displacement and disruption of local tourism. Of particular concern are populations that do not have the resources to prepare for, respond to, and recover from disasters. Impacts could include temporary and/ or permanent displacement; drowning and property damage; and coastal erosion harming recreational activities, tourism, and the tourism industry.

Sea level rise and severe storm surges are a concern for nuclear power plants near the Pacific Ocean, including the San Onofre Nuclear Power Plant in Orange County. Risks associated with this facility include flooding of containment buildings where highly radioactive spent nuclear fuel is stored, loss of generating capacity owing to severe corrosion from the intrusion of seawater, and other damages to the facility due to sea level rise. The plant's cooling practices might be impacted due to rising ocean temperatures. (CDPH, 2008) These impacts could affect populations that live near the facility or rely on the power produced by the facility. Industrial development in the region has left a legacy of brownfields and contaminated waste sites. Some of these will be exposed to coastal flooding due to sea level rise. These sites need to be identified, and priorities for their clean-up may need to be set before contamination spreads.

Water Supply. Two primary sources of water used by the South Coast region are the State Water Project and the Colorado River. In both cases, these water supplies originate in mountain snowpack. Climate change will result in reduced snowpack, which will translate into reduced water supply. Further threatening the regional water supply is the vulnerability of the levees protecting the California Delta, which feeds the State Water Project (DWR, 2011). Jurisdictions in the South Coast must carefully consider the vulnerability of their water supply. Climate change will reduce water supply and subsequently increase costs. Industries reliant on water may be affected, resulting in reduced revenue and employment base.

Wildfire. The South Coast already experiences wildfire. The extent to which climate change is projected to alter existing wildfire risk is variable (Westerling and Bryant, 2006). Wildfire frequency and severity will depend on shifts in vegetation and Santa Ana wind behavior (Miller and Schlegal, 2006; Westerling et al., 2009). Management of fire risk such as prescribed burns may be subject to regulations beyond normal California forest practice. For example, the "High Use" subdistricts of Cal Fire's Southern District (counties of Ventura, Santa Barbara, Los Angeles, San Bernardino, Orange, Riverside, Imperial, San Diego, Monterey, San Luis Obispo, and those portions of Placer and El Dorado counties lying within the authority of the Tahoe Regional Planning Agency) may have additional stipulations with regard to management practice.

Increased temperature and decreased moisture, such as longer drought periods, will increase fire vulnerability in a number of areas. Along with impacts associated with temporary and/or permanent displacement, long-term impacts on the elderly and children under the age of five are of concern. Eye and respiratory illnesses due to air pollution resulting from wildfires, and exacerbation of asthma, allergies, chronic obstructive pulmonary disease (COPD), and other cardiovascular diseases are likely to increase.

Proceedings of National Academy of Sciences Impacts

In addition to the APG, the HMPC provided a report from the Proceedings of the National Academy of Sciences (PNAS) stating that some of the recent fire impacts may have been attributed to climate change. The PNAS report posits that climate influences wildfire potential primarily by modulating fuel abundance in fuel-limited environments, and by modulating fuel aridity in flammability-limited environments. Increased forest fire activity across the western United States in recent decades has contributed to widespread forest mortality, carbon emissions, periods of degraded air quality, and substantial fire suppression expenditures. Those most vulnerable to high levels of ozone and particulate matter include people who work or spend a lot of time outdoors, such as residents of this region who are employees of the tourist industry. Households eligible for energy utility financial assistance programs are an indicator of potential impacts. These households may be more at risk of not using cooling appliances, such as air conditioning, due to associated energy costs.

Future Development

Orange County and the City of Garden Grove in general could see population fluctuations as a result of climate impacts relative to those experienced in other regions, and these fluctuations are expected to impact demand for housing and other development. Other interior western states may experience an exodus of population due to challenges in adapting to heat even more extreme than that which is projected to occur here. While there are currently no formal studies of specific migration patterns expected to impact the Orange County region, climate-induced migration was recognized within the UNFCCC Conference of Parties Paris Agreement of 2015 and is expected to be the focus of future studies.

Climate change, coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental and habitat benefits but also for its ability to sequester carbon, help mitigate the accumulation of greenhouse gas in the atmosphere and slow down the global warming trend. Higher flood risks, especially if coupled with increased federal flood insurance rates, may decrease market demand for housing and other types of development in floodplains, while increased risk of wildfires may do the same for new developments in the urban-wildland interface. Flood risks may also inspire new development and building codes that elevate structures while maintaining streetscapes and neighborhood characteristics.

Climate change will stress water resources. Water is an issue in every region, but the nature of the potential impacts varies. Drought, related to reduced precipitation, increased evaporation, and increased water loss from plants, is an important issue in many U.S. regions, especially in the West. Floods, water quality problems, and impacts on aquatic ecosystems and species are likely to be amplified by climate change. Declines in mountain snowpack are important in the Sierra Nevada Mountains and across the state, where snowpack provides vital natural water storage and supply. The ability to secure and provide water for new development requires on-going monitoring and assurances. It is recommended that the ability to provide a reliable water supply from the appropriate water purveyor, continue to be in the conditions for project approval, and such assurances shall be verified and in place prior to issuing building permits.

Similarly, protecting and enhancing water supply will also need to be addressed. California's Sustainable Groundwater Management Act (SGMA) will contribute to addressing groundwater and aquifer recharge needs. Good groundwater management will provide a buffer against drought and climate change, and contribute to reliable water supplies regardless of weather patterns. California depends on groundwater for a major portion of its annual water supply, and sustainable groundwater management is essential to a reliable and resilient water system. Protection of critical recharge areas should be addressed across the County in the respective Groundwater Management Plans. Further, these plans should include provisions that guide development or curtail development in areas that would harm or compromise recharge areas.

Climate change will affect transportation. The transportation network is vital to the county and the region's economy, safety, and quality of life. While it is widely recognized that emissions from transportation have impacts on climate change, climate will also likely have significant impacts on transportation infrastructure and operations. Examples of specific types of impacts include softening of asphalt roads and warping of railroad rails; damage to roads; flooding of roadways, rail routes, and airports from extreme events; and interruptions to flight plans due to severe weather. Climate change impacts considered in the plan include: extreme temperatures; increased precipitation, runoff and flooding; increased wildfires; and landslides. Although landslides are not a direct result of climate change, these events are expected to increase in frequency due to increased rainfall, runoff, and wildfire. These events have the potential to cause injuries or fatalities, environmental damage, property damage, infrastructure damage, and interruption of operations. During flood events, these trails serve as secondary transportation facilities when roadways are blocked or otherwise impassible. During Hurricane Sandy, bicycles were one of the primary modes used to deliver food and water to residents stranded in their homes due to flood. Including dual or multi-purpose facilities and amenities as part of all new development provides not just desirable community amenities but critical infrastructure for climate resiliency.

Climate change will affect land uses and planning. Climate change coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space, urban greening, green infrastructure, tree canopy expansion and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental, and habitat, and physical and mental health benefits but also for its ability to sequester carbon and cool the surrounding environment.

Climate change will affect Utilities. California is already experiencing impacts from climate change such as an increased number of wildfires, sea level rise and severe drought. Utility efforts to deal with these impacts range from emergency and risk management protocols to new standards for infrastructure design and new resource management techniques. Utilities are just beginning to build additional resilience and redundancy into their infrastructure investments from a climate adaptation perspective, but have been doing so from an overall safety and reliability perspective for decades. Significant efforts are also being made in those areas that overlap with climate change mitigation such as diversification of resources, specifically the addition of more renewables to the portfolio mix, as well as implementation of demand response efforts to curb peak demand. Efforts are also under way to upgrade the distribution grid infrastructure, which should add significant resilience to the grid as well. Next, they will issue a guidance document that expands upon the vulnerability assessments phase and includes plans for resilience solutions including cost/benefit analysis methodologies. The outcomes of this work will help to inform next steps on how infrastructure, the grid and other related operations will be modified to address climate change. New development will have to adapt and incorporate these new approaches as they evolve. Existing and new development will be affected from impacts that include not only diminished capacity from all of the utility assets from generation to transmission and distribution, but also the cost consequences resulting from prevention, replacement, outage, and energy loss. These have the potential for greatly impacting not just residential development but commercial and industrial and all utility users.

Addressing Heat Events. During heat waves in Orange County, a heat alert is issued and news organizations are provided with tips on how vulnerable people can protect themselves. Programs used by health departments to engage with thousands of block captains to check on elderly and other vulnerable residents, along with public cooling places extending their hours, or local businesses welcoming residents into their businesses for purposes of staying cool are examples of programs and services that will be necessary. Other programs to consider that could further involve hospitals and clinics are operating a "heatline" with nurses or other healthcare professionals ready to assist callers with heat-related health problems. In addition, continued funding for weatherization, reduced utility rates and similar programs that offers assistance to elderly, low-income residents to install roof insulation, solar, trees and cool surfaces to save energy and lower indoor temperatures.

4.3.4. Dam Failure Vulnerability Assessment

Likelihood of Future Occurrence—Unlikely
Vulnerability—Extremely High

Dam failure flooding can occur as the result of partial or complete collapse of an impoundment. Dam failures often result from prolonged rainfall and flooding. The primary danger associated with dam failure is the high velocity flooding of those properties downstream of the dam. A dam failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions. Impacts include loss of life, damages to homes, critical facilities, and transportation infrastructure.

Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding. Based on the risk assessment, it is apparent that a major dam failure could have a devastating impact on the Planning Area. Dam failure flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

Dams of Concern

While no dams are located within the City of Garden Grove, there are numerous dams located throughout Orange County. Of these, several dams were initially identified as a potential dam of concern, including

- Prado Dam (in San Bernardino County)
- Seven Oaks Dam
- Santiago Creek
- Villa Park

However, based on the available inundation mapping and other data, only the Prado Dam was actually identified as a dam of concern to the City.

The City of Garden Grove 2016 EOP noted that in the event of a dam failure, flood waters from Prado Dam flow through the relatively narrow, 10-mile long Santa Ana Canyon. The floodway ranges from about 3,000 feet wide in the canyon to over 15 miles wide downstream at the Santa Ana Freeway. For the first 8 miles downstream from the dam, development is primarily agricultural, but included in this area is a mobile home park, a golf course, and a camping area. The highly developed and densely populated inundation zone contains residential, commercial and industrial development with the remaining 30 percent agricultural. The inundation zone involves approximately 110,000 acres and has an impact upon more than one million people.

The greatest flood danger area is between a point 2 miles upstream from Imperial Highway to the Santa Ana Freeway. In a Prado Dam breach event, the 2-mile reach upstream from Imperial Highway would have a surge wave depth and velocity of about 36 feet and 24 feet per second respectively. Between Imperial Highway and the Santa Ana Freeway, depths range from 9 feet to 32 feet with velocities from 5 to 9 feet per second. Because the area below Santa Ana Canyon is heavily developed and on an alluvial cone, the depth and velocity of flows can only be estimated. The inundation zone is easily outlined since most of the perimeter is bordered by high ground.

The HMPC noted that the dam impounds little to no water for much of the year, which may mitigate the potential impacts from a dam failure. During periods of heavy rain, however, the structure is intended to collect water and prevent flooding along the Santa Ana River. In May 2019, a site-specific evaluation was conducted to assess conditions associated with the dam as part of a periodic review of its performance. Risk factors identified indicate the potential for poor spillway performance, which could have adverse impacts to the downstream population, if a significant flood event occurs. As a result of this assessment, the U.S. Army Corps of Engineers has changed Prado Dam's risk characterization from moderate urgency to high urgency.

Values at Risk

Dam inundation layers were available for the City. Dam inundation area, as obtained from Cal OES, was used as the basis of this dam inundation analysis. Only one Cal OES dam inundation area intersects the City: the Prado Dam inundation

Methodology

The City of Garden Grove's March 2019 Assessor Data and GIS parcel data were used as the basis for the inventory of assessed values for both improved and unimproved parcels within the City. GIS was used to create a centroid, or point representing the center of the parcel polygon. The dam inundation areas, obtained from Cal OES, were then overlaid on the parcel layer. For the purposes of this analysis, if the dam inundation layer intersected a parcel centroid, the entire parcel was considered to be in the dam inundation area. The parcels were segregated and analyzed in this fashion for Garden Grove. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessor's database and the GIS parcel layer.

Values at Risk Analysis Results

Only one Cal OES dam inundation area intersects the City: the Prado Dam inundation. While the Santiago Creek and Villa Park dams come close, no City parcels are intersected. The inundation area for these dams can be seen on Figure 4-50. Table 4-46 contains the dam inundation analysis results for Garden Grove. This table shows the total and improved number of parcels, and values at risk to dam failure.

Figure 4-50 City of Garden Grove– Dam Inundation Areas

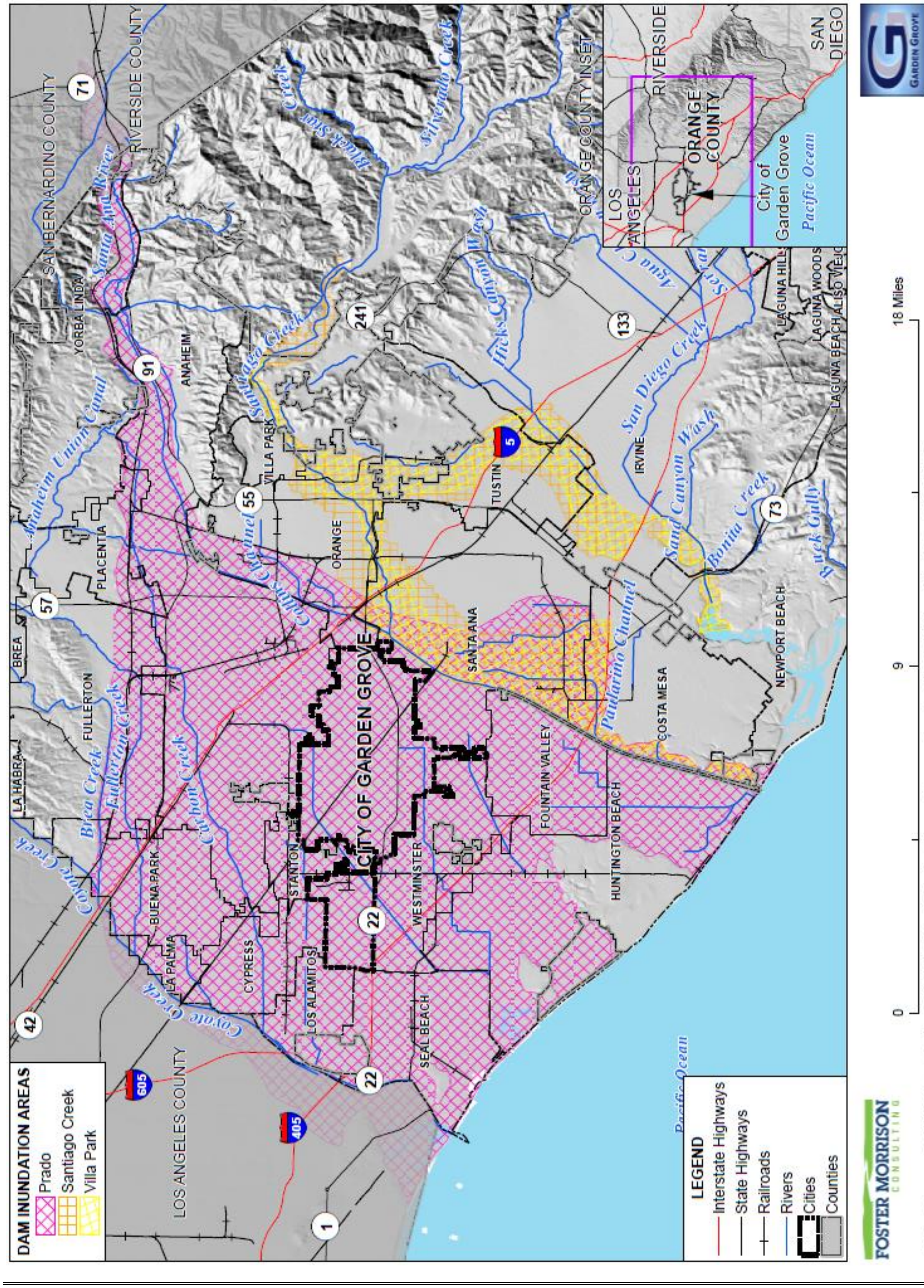


Table 4-46 City of Garden Grove – Count and Value of Parcels in Prado Dam Inundation Area by Property Use

Dam Inundation Area / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Prado Dam						
Civic	86	70	$75,270,828	$135,646,631	$135,646,631	$346,564,090
Commercial	548	492	$402,998,354	$309,084,902	$309,084,902	$1,021,168,158
Industrial	346	321	$549,420,092	$423,864,116	$635,796,174	$1,609,080,379
Mixed Use	1,366	1,211	$1,041,636,593	$911,153,234	$911,153,234	$2,863,943,061
Open Space	141	35	$33,070,063	$23,064,695	$23,064,695	$79,199,453
Residential	29,778	29,281	$6,816,786,934	$3,115,037,261	$1,557,518,631	$11,489,342,845
Unknown	41	1	$179,635	$238,449	$0	$418,084
Prado Dam Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: Cal OES, City of Garden Grove March 2019 Parcel/Assessor's Data

Flooded Acres

Also of interest is the land area affected by Prado Dam inundation area. This section provides an analysis of flooded acres in Garden Grove due to a dam failure broken out by property use.

Methodology

A parcel boundary analysis was performed to obtain total acres and flooded acres by dam inundation area for each parcel. GIS was used to calculate acres flooded by dam inundation area and property use categories. The Garden Grove parcel layer and Cal OES dam inundation areas were intersected. The resulting data tables with flooded acreages were then imported into a database and linked back to the original parcels, including total acres by parcel number. Once this was completed, each parcel contained acreage values for flooded acre by zone type within the parcel.

Limitations

One limitation created by this type of analysis is that improvements are uniformly found throughout the parcel, while in reality, only portions of the parcel are improved, and improvements may or may not fall within the dam inundation portion of a parcel; thus, areas of improvements inundated calculated through this method may be higher or lower than those actually seen in a similar real-world event.

Flooded Acres Analysis Results

The end result of the dam inundation acres analysis is an inventory of the improved and unimproved acres subject to dam failure within the City. Table 4-47 represents a detailed and summary analysis of total acres for the Prado Dam inundation area.

Table 4-47 City of Garden Grove – Prado Dam Inundation Flooded Acres

Dam Inundation Area/ Property Use	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
Prado Dam			
Civic	652	622	7.52%
Commercial	446	390	4.71%
Industrial	606	548	6.63%
Mixed Use	1,196	1,049	12.68%
Open Space	284	161	1.94%
Residential	5,810	5,502	66.51%
Unknown	10	0	0.00%
Grand Total	**9,004**	**8,272**	**100.00%**

Source: Cal OES

Population at Risk

A separate analysis was performed to determine population in the Prado Dam inundation areas. Using GIS, the dam inundation area dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect an inundation area were counted and multiplied by the Census Bureau average household size for the City of Garden Grove (3.76). Results were tabulated and are shown in Table 4-48. According to this analysis, for the entire Planning Area, there is a population of 110,097 in the Prado Dam inundation area.

Table 4-48 City of Garden Grove– Count of Residential Parcels and Population at Risk to the Prado Dam Inundation

Jurisdiction	Prado Dam Inundation Area	
	Improved Residential Parcels	Population
Garden Grove	29,281	110,097

Source: Cal OES, City of Garden Grove March 2019 Parcel/Assessor's Data, US Census Bureau 2010 Estimates

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in the City of Garden Grove to determine critical facilities in the Prado Dam inundation area. Using GIS, the dam inundation area was overlayed on the critical facility GIS layer. Figure 4-51 shows critical facilities, as well as the dam inundation area. Table 4-49 and Table 4-50 provide information by category of critical facilities in the Prado Dam inundation area. Details of critical facility definition, type, name, and address by dam inundation area are listed in Appendix E.

Figure 4-51 City of Garden Grove – Critical Facilities in Prado Dam Inundation Area

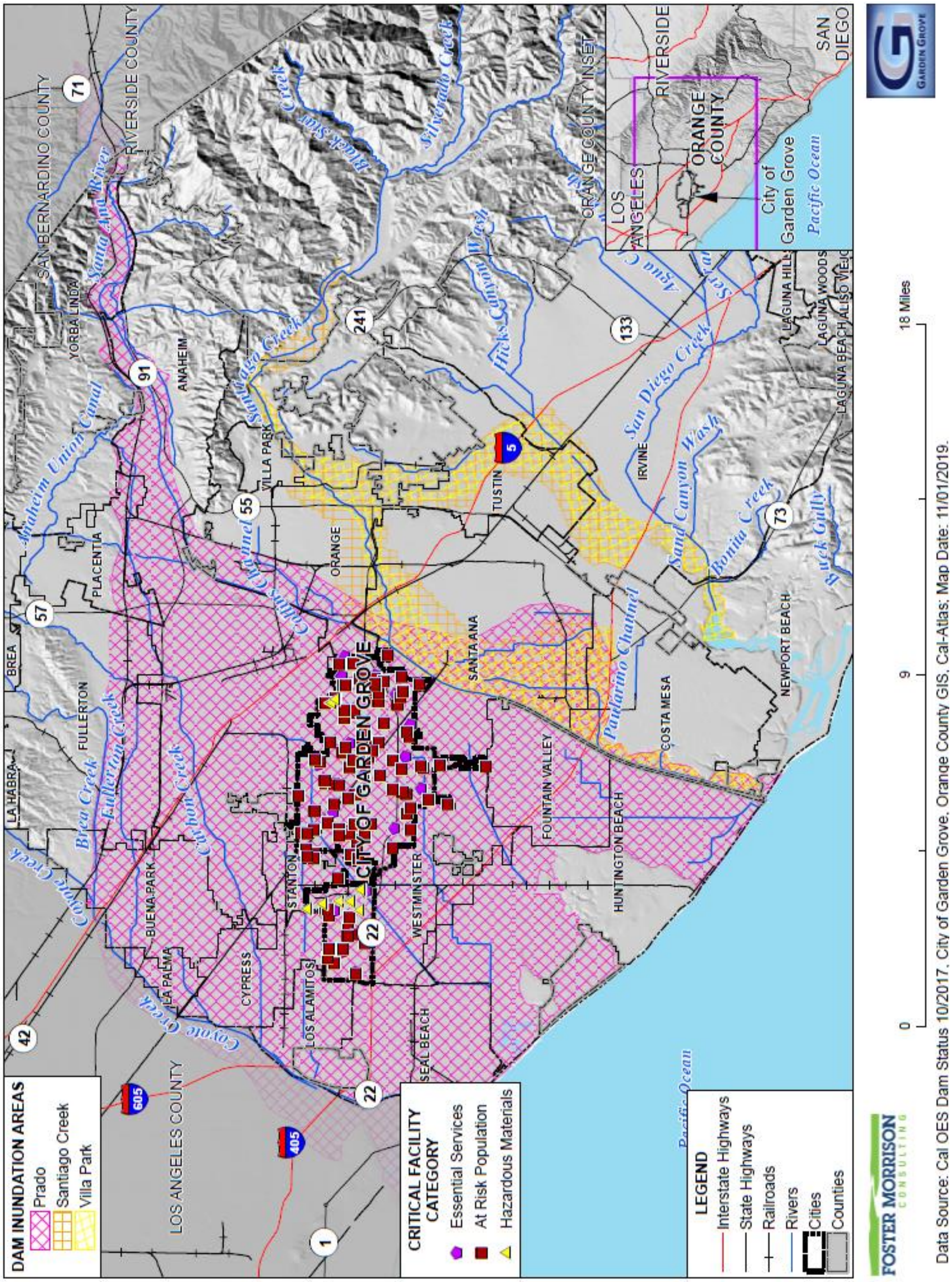


Table 4-49 City of Garden Grove – Critical Facilities Counts in Prado Dam Inundation Area

Dam Inundation Area/ Critical Facility Category	Facility Count
Prado Dam	
Essential Services Facilities	35
At Risk Population Facilities	113
Hazardous Materials Facilities	10
Prado Dam Total	**158**
Grand Total	**158**

Source: Cal OES, City of Garden Grove GIS

Table 4-50 City of Garden Grove – Critical Facility Counts in Prado Dam Inundation Area and Critical Facility Type

Dam Inundation Area/ Critical Facility Category / Critical Facility Type	Facility Count
Prado Dam	
Essential Services Facilities	
Fire Station	7
Government Building	4
Police Station	1
Public Building	6
Public Works Facility	17
Essential Services Facilities Total	**35**
At Risk Population Facilities	
Entertainment	2
Hospital/Medical	7
Hotel	3
Park	21
Religious Assembly	15
School	57
Senior Housing	8
At Risk Population Facilities Total	**113**
Hazardous Materials Facilities	
Covered Landfill	2
Hazmat	8
Hazardous Materials Facilities Total	**10**
Grand Total	**158**

Source: Cal OES, City of Garden Grove GIS

Overall Community Impact

Dam failures and their impacts vary by location and severity of any resulting flood event. Based on the risk assessment, it is evident that a dam failure flood could have potentially devastating economic impacts to certain areas of the City. Impacts that are not always quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities and relocations may be needed.
- Impact on the overall mental health of the community.

Future Development

All of the City falls in the Prado Dam inundation area, as such all new development will fall into the dam inundation. Given the limited development occurring in the City, combined with the limited chance of dam failure, future development is unlikely to be affected by dam failure flooding.

GIS Analysis

Future development areas for the City are broken out into multiple areas. GIS data is maintained by the City of Garden Grove and was made available for this plan. An analysis was performed to quantify parcels within these areas that are also in the Prado Dam inundation area. GIS was used to create a centroid, or point representing the center of the parcel polygon. Those parcels centroids that fall inside the possible future development areas and that were within the Prado Dam inundation area are shown on Figure 4-52 and detailed in Table 4-51.

Figure 4-52 City of Garden Grove – Future Development Areas in Prado Dam Inundation Area

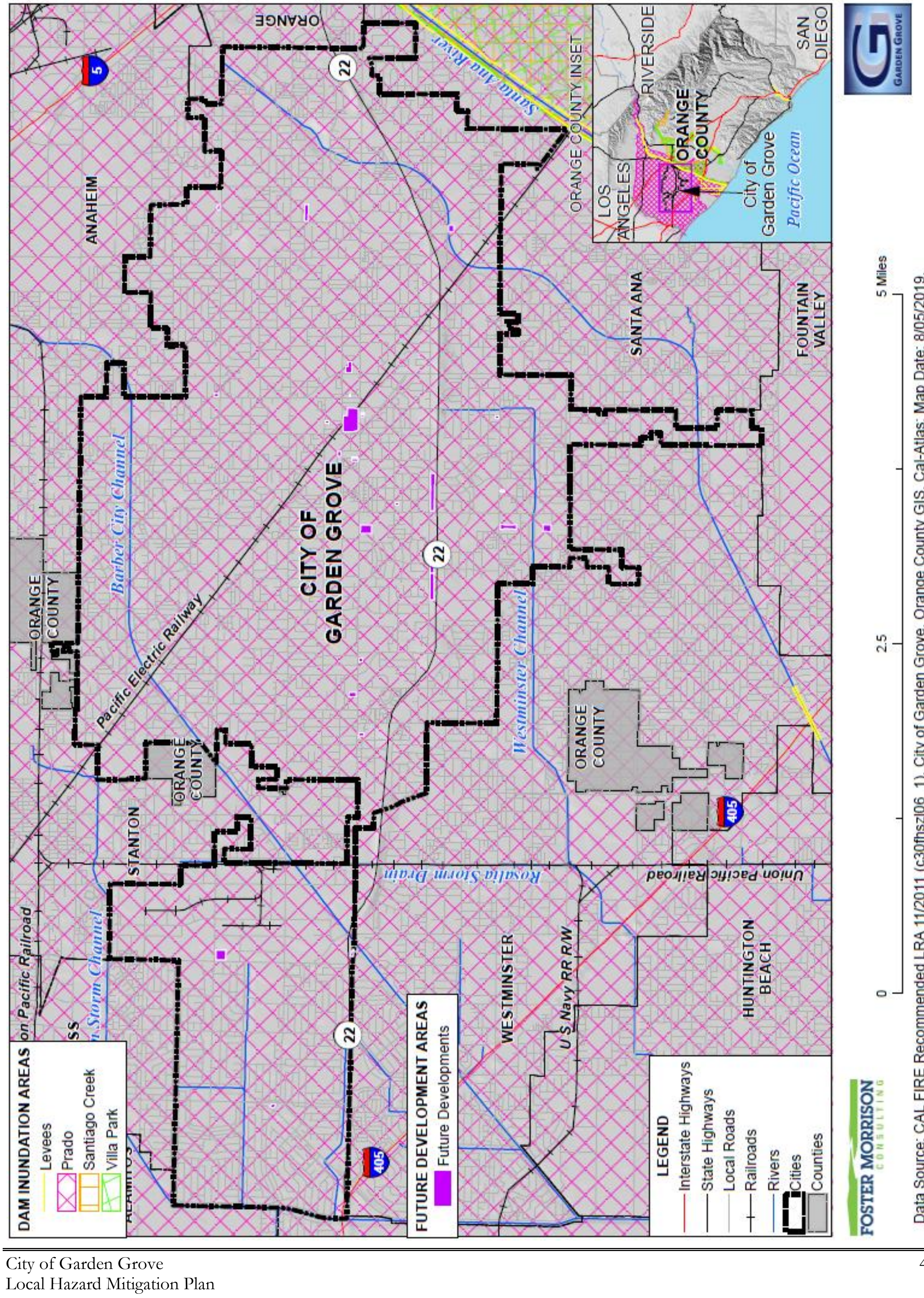


Table 4-51 City of Garden Grove – Future Development Areas in Prado Dam Inundation Area by Parcels and Acres

Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
10080 Garden Grove Blvd	1	0	3.09
12361 Chapman Ave	1	1	0.48
9106 Garden Grove Blvd	1	1	0.48
9861 11th St	1	1	1.76
10052 Central Ave	1	1	0.20
10522 McFadden Ave	1	1	0.35
12900 Euclid St	1	0	1.99
7051 Garden Grove Blvd	1	0	0.52
10531 Garden Grove Blvd	1	1	0.61
10561 Garden Grove Blvd	1	1	0.41
10611 Acacia Ave	1	1	0.58
11001 Chapman Ave	1	1	0.53
10801 Garden Grove Blvd	1	1	10.70
12900 Main St	2	2	0.13
10150 Trask Ave	1	0	5.14
10812 Stanford Ave	1	1	0.23
8562 Garden Grove Blvd	1	1	0.55
8851 Garden Grove Blvd	1	1	1.05
10862 Garden Grove Blvd	1	1	0.22
10872 Garden Grove Blvd	1	0	0.15
10882 Garden Grove Blvd	1	0	0.16
12422 Valley View St	1	1	0.53
12612 Buaro St	1	1	1.91
9444 Trask Ave	1	1	3.50
9670 Trask Ave	1	1	3.00
13650 Harbor Blvd	1	1	1.25
12072 Knott St	2	2	6.38
9892 Westminster Ave	2	2	4.43
10142 Westminster Ave	1	1	0.16
10152 Westminster Ave	1	1	0.17
10691 Westminster Ave	1	1	0.30
Grand Total	**34**	**28**	**50.97**

Source: Cal OES, City of Garden Grove GIS

4.3.5. Drought and Water Shortage Vulnerability Assessment

Likelihood of Future Occurrence—Likely/Occasional
Vulnerability—Medium

Drought is different than many of the other natural hazards in that it is not a distinct event and usually has a slow onset. Drought can severely impact a region both physically and economically. Drought affects different sectors in different ways and with varying intensities. Adequate water is the most critical issue for agricultural, manufacturing, tourism, recreation, and commercial and domestic use. As the population in the area continues to grow, so will the demand for water.

Based on historical information, the occurrence of drought in California, including Orange County and the City of Garden Grove, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users. The vulnerability of Garden Grove to drought is citywide, but impacts vary and may include reduction in water supply and an increase in dry fuels. Impacts to the City would be mostly from secondary risks to drought and water shortage. Additionally, impacts to their urban trees (estimated to be over 8,000) would occur. These trees then become more vulnerable during high wind and severe storm events, which can result in property damage, loss of utilities, and transportation issues. The City has put a value of the trees at $1,570,640.

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. Tracking drought impacts can be difficult. The Drought Impact Reporter from the NDMC is a useful reference tool that compiles reported drought impacts nationwide. Table 4-52 show drought impacts for Orange County from 1850 to August 2019. It would be assumed that the City Planning Area would experience similar impacts, due to the regional nature of drought impacts. The data represented is skewed, with the majority of these impacts from records within the past ten years.

Table 4-52 Orange County Drought Impacts 1850-10/1/2018

Category	Number of Impacts
Agriculture	22
Business and Industry	10
Energy	3
Fire	13
Plants & Wildlife	21
Relief, Response, and Restrictions	76
Society and Public Health	45
Tourism and Recreation	6
Water Supply and Quality	91
Total	**287**

Source: National Drought Mitigation Center

The most significant qualitative impacts associated with drought in the Planning Area are those related to water intensive activities such as fire protection, municipal usage, commerce, tourism, and recreation. The HMPC noted that the Orange County Water District is well positioned and has advanced plans in place for drought and water shortage. Mandatory conservation measures may be implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

The CCHPR for Orange County also discussed how climate change may increase the impact of drought. Lack of moisture, already at a severe level in California due to a current multi-year drought and decades of fuel accumulation from historical forestry and fire suppression practices, increases the risk of wildfires. Devastating wildfires like the Rim Fire of 2013 impact watersheds and increase the risk of landslides or mudslides, and sediment in run-off that reduce water quality. In addition to fire-related injuries, local and regional transport of smoke, ash, and fine particles increases respiratory and cardiovascular risks. Increasing temperatures and changes in precipitation may lead to intensified drought conditions. Drought decreases the availability and quality of water for humans. This includes reduced water levels to fight wildfires. Drought may increase exposure to health hazards including wildfires, dust storms, extreme heat events, flash flooding, degraded water quality, and reduced water quantity. Dust storms associated with drought conditions have been associated with increased incidents of Valley fever, a fungal pathogen.

The HMPC noted that recent drought conditions forced people to remove the grass from their lawns. Many didn't xeriscape or replace the lawns in any way; thus, when it rains, the runoff causes the barren soils to erode from yards into the streets and stormwater system.

The HMPC also noted that approximately 70% of the water supply for the City is from a groundwater aquifer. The City falls within the center of the Aquifer, which is named 8-1. This aquifer has an Operational Range of approximately 500,000 acre-feet of storage - which is about 10 years of water. The HMPC noted that water supply impacts during periods of drought all depends on when the drought starts. If the drought starts during a time of depletion (as was the case in 2014 to 2017 that started when the aquifer only had 100,000 acre-feet) it will be more severe. When it starts with a fuller aquifer, it is not as severe. The groundwater basin belongs to the Orange County Water District. There is a contingency Plan/Desalination Plan. The remaining 30% of the City's water source is from MWDOC. Water from that agency comes through a state water project, making it imported water.

Future Development

Garden Grove's water supply comes from two sources; imported water from Metropolitan Water District of Southern California (Met or M), and local groundwater. Garden Grove's Water Services Division is responsible for maintaining the wells, reservoirs, import water connections, and the distribution systems that deliver water to residents of Garden Grove. According to the HMPC, population growth in the City will add additional pressure to MWDOC and local groundwater supplies during periods of drought and water shortage. To meet the increasing demand for water in the densely populated Southern California Region, the OCWD and the Orange County Sanitation District (OCSD) are working together on a groundwater replenishment system. Civic projects have ordinances to consider the drought and water efficiency landscaping for all property use types in the City.

4.3.6. Earthquake Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely (minor earthquake)/Occasional (major earthquake)
Vulnerability—Extremely High

The City of Garden Grove General Plan Safety element noted that earthquakes pose a substantial danger to property and human safety. Ground shaking is typically the greatest hazard and major cause of damage. The transmission of earthquake waves can cause buildings to collapse, streets to crack, and utility lines to rupture. Strong ground shaking can also cause damage due to falling objects such as bookcases or water heaters, chemical spills, and secondary effects such as fire or explosion. Impacts from earthquake include property damage, critical facility damage, injury, and loss of life.

On any given site, the degree of shaking tends depends on the magnitude of the earthquake, distance to the fault, property of the underlying soils, building design and construction, and building materials. Shaking tends to be strongest on filled soils and in areas where soil depth and moisture content are high.

The HMPC noted that within Orange County, there are several earthquake faults, including the Newport-Inglewood, San Joaquin Hills, Puente Hills, Whittier Hills, and potentially many more unknown faults. These faults have the capability of greatly affecting the City by causing significant damage and disruption to widespread areas. The City's public and private utility systems are generally designed to withstand some disaster damage and function at least at partial capacity. However, major quake-caused structural damage to under/above ground utilities would have a serious impact on response to and recovery from a major disaster. The HMPC is concerned about underground gas lines and other utilities. In 2013, a condition assessment was performed on the reservoirs and had recommended upgrades of the seismic load transfer mechanism at the foundation. One of the greatest potential secondary hazards associated with earthquakes are fires. Old pipelines or lack of water pressure from underground line damage could reduce the effectiveness of conventional firefighting methods. Additionally, the City's goal to increase urban, mixed used developments has brought more multistory residential units that are generally more vulnerable to higher shaking intensities and therefore, pose a greater life safety hazard. Some of these new developments include the Brookhurst Triangle (600 residential units) and Chapman Commons (220 condominium unit). The City currently does not have an inventory of soft story or unreinforced masonry buildings.

Great Shakeout Scenario

The HMPC noted the Great Shakeout Scenario as a source of earthquake information for the City. The Great Shakeout 2019 noted that the Southern California Coast area is highly susceptible to earthquakes and earthquake related effects. Numerous earthquake faults crisscross southern California and no one within the area resides more than 10 miles from an active fault. In addition to damage caused directly by ground shaking and related ground failure, other hazards such as fires can easily start during and shortly after an earthquake.

It also noted that fires may spread quickly in densely-built neighborhoods like the City of Garden Grove, enabling them to sustain for long periods, spread over large areas and, due to broken water pipes and the number of ignitions, simply overwhelm the abilities of firefighters to control them. On the other hand, earthquakes occurring during periods of heavy rain can produce destructive and life-threatening slurry-like debris flows that originate on the steep slopes and gullies of the many rugged mountain areas and can flow into adjacent communities.

The driving force of earthquakes in California is movement along the San Andreas Fault and the many associated faults within the San Andreas Fault System that form the tectonic boundary between the Pacific and North American tectonic plates. Along this boundary, the Pacific Plate is moving slowly to the northwest relative to the North American Plate. The Pacific plate underlies most of the Pacific Ocean, as well as all California west of the San Andreas fault. When most people think of earthquakes in California, the San Andreas Fault is usually the first thing to pop in their minds, and while the San Andreas Fault is the longest fault in the state it is by no means the only one to be concerned with. Many other faults are found directly beneath California cities in some of the most densely populated areas.

Hazus Earthquake Scenarios

Methodologies

Hazus-MH 4.2 was utilized to model earthquake losses for the City. Level 1 analyses were run, meaning that only the default data was used and not supplemented with local building inventory or hazard data. There are certain data limitations when using the default data, so the results should be interpreted accordingly; this is a planning level analysis. Based on data from the City of Garden Grove 2016 EOP and the City of Garden Grove 2030 General Plan Safety Element, six probabilistic Hazus scenarios were created for this Plan:

- Elsinore Fault – 7.0 magnitude event
- Newport-Inglewood Fault – 7.4 magnitude event
- Puente Hills Fault – 7.5 magnitude event
- San Andreas Fault – 8.0 magnitude event
- San Jacinto Fault –7.5 magnitude event
- San Joaquin Fault – 7.3 magnitude event

The methodology for running these probabilistic earthquake scenarios used probabilistic seismic hazard contour maps developed by the U.S. Geological Survey (USGS) for the 2002 update of the National Seismic Hazard Maps that are included with HAZUS-MH. The USGS maps provide estimates of potential ground acceleration and spectral acceleration at periods of 0.3 second and 1.0 second, respectively. The 2,500-year return period analyzes ground shaking estimates with a 2 percent probability of being exceeded in 50 years, from the various seismic sources in the area. The International Building Code uses this level of ground shaking for building design in seismic areas and is more of a worst-case scenario.

For all of these scenarios, default data was used for infrastructure damages. Southern California Edison noted that there are distinguishable differences between the risks to and vulnerability of the gas system compared to the electric system. They noted that the underground natural gas system is more resilient than the aboveground electric system. Above ground electric systems can be damaged by earthquakes, which can cause issues for power companies and their customers. For example, in 2017 the Thomas Fire damaged electric power lines throughout the City of Ventura. Because the City’s water pumps to supply water to firefighters ran on electricity without any other form of backup power, firefighters were unable to get water from the pumps to put out burning residences. If the water pumps had been connected to a backup power system, such as a natural gas generator, firefighters would have been able to access the water.

In contrast, as the natural gas system is mostly underground, it is very resilient to extreme weather events. For example, in 2012, after Superstorm Sandy, the entire natural gas system in the Northeast was essentially intact, allowing residents to support back-up generators, cook, and keep warm. Businesses with natural gas-powered fuel cells were able to operate and compressed natural gas (CNG) buses in New Jersey were used to shuttle residents to safety. Further, when Hurricane Harvey temporarily disabled almost 30% of the nation's refining capacity, CNG shuttles were able to continue operating, and hospitals that had on-site combined heat and power systems were able to provide urgently needed medical attention, despite flooding.

Elsinore Fault

The results of the probabilistic scenario for the Elsinore fault are captured in Table 4-53. A map showing total losses by census tract for this scenario is shown in Figure 4-53. Key losses include the following:

- Total economic loss estimated for the earthquake was $281.17 million, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $280.69 million.
- Over 3 percent of the buildings in the City were at least moderately damaged. 14 buildings were completely destroyed.
- Over 64 percent of the building- and income-related losses were residential structures.
- 12 percent of the estimated losses were related to business interruptions.
- The mid-day and early evening earthquakes caused the most casualties: 1
- No households experienced a loss of electricity or potable water the first day after the earthquake.

Table 4-53 City of Garden Grove – HAZUS-MH 2,500-year Elsinore Fault Earthquake Scenario Results

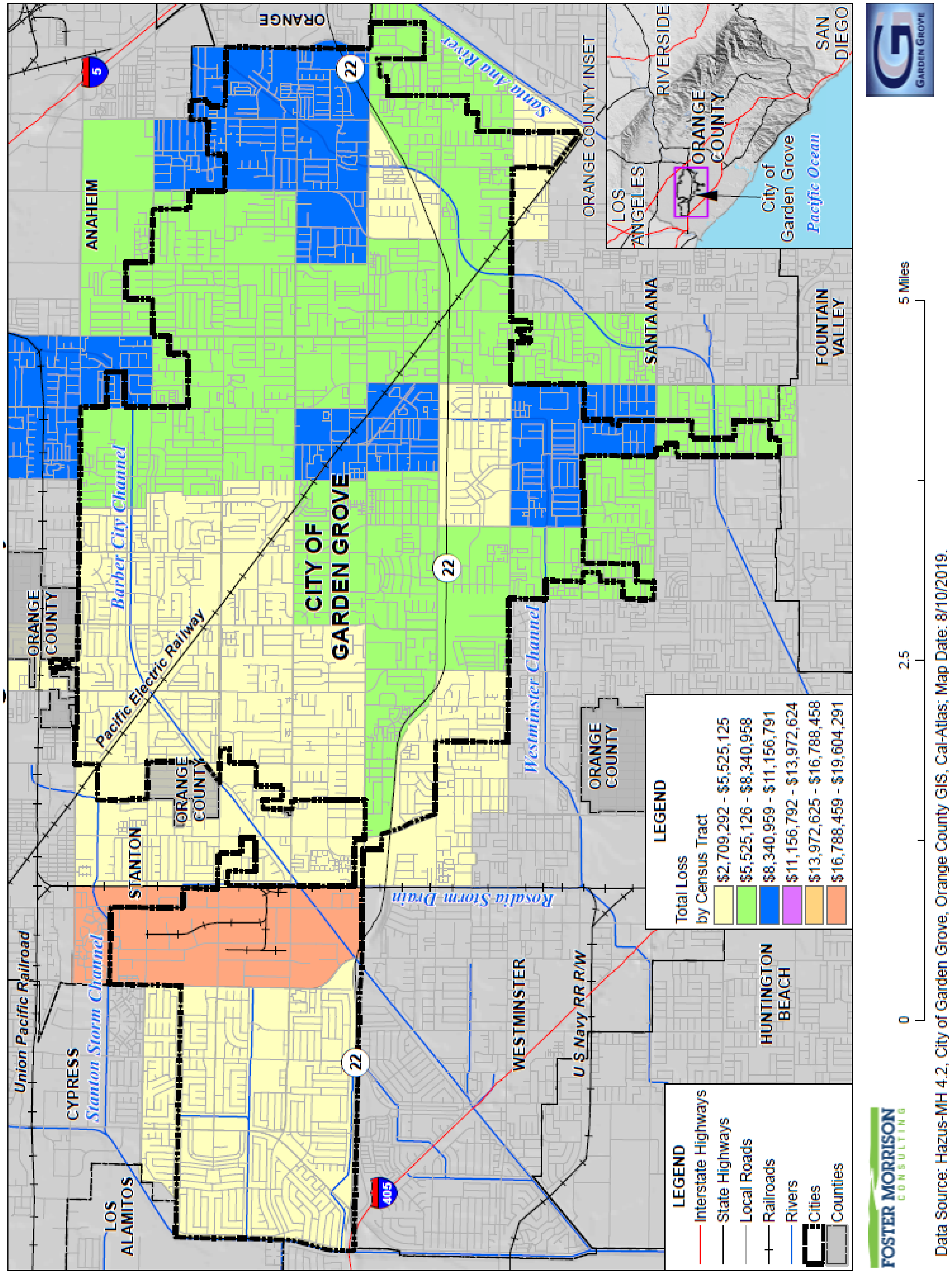
Impacts/Earthquake	7.0 Magnitude Earthquake
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 7,356 Moderate: 1,518 Extensive: 158 Complete: 14
Building Related Loss	$280.69 million
Total Economic Loss	$281.17 million
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 40 Requiring hospitalization: 3 Life Threatening: 0 Fatalities: 0
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 62 Requiring hospitalization: 8 Life Threatening:1 Fatalities: 1

Impacts/Earthquake	7.0 Magnitude Earthquake	
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 45 Requiring hospitalization: 5 Life Threatening: 0 Fatalities: 1	
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.	
Transportation and Utility Lifeline Damage	46 potable water leaks, and 12 breaks 507 wastewater leaks and 23 breaks 338 natural gas leaks and 8 breaks.	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 0 Water loss @ Day 3: 0 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 0 Power loss @ Day 3: 0 Power loss @ Day 7: 0 Power loss @ Day 30: 0 Power loss @ Day 90: 0
Displaced Households	72 displaced households	
Shelter Requirements	68 persons	
Debris Generation	34,000 tons	

Source: Hazus-MH 4.2

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 4 ignitions that will burn about 0.01 sq. mi (0.04% of the region's total area.) The model also estimates that the fires will displace about 107 people and burn about $8 million of building value.

Figure 4-53 City of Garden Grove – Hazus Total Loss Areas from Elsinore Quake Scenario



Newport-Inglewood Fault

The results of the probabilistic scenario for the Newport-Inglewood fault are captured in Table 4-54. A map showing total losses by census tract for this scenario are shown in Figure 4-54. Key losses include the following:

- Total economic loss estimated for the earthquake was $1.96 billion, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $1.95 billion.
- Over 20 percent of the buildings in the City were at least moderately damaged. 670 buildings were completely destroyed.
- Over 58 percent of the building- and income-related losses were residential structures.
- 15 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake caused the most casualties: 57
- 2,632 households experienced a loss of electricity the first day after the earthquake.
- 13,065 households experienced a loss of potable water the first day after the earthquake.

Table 4-54 City of Garden Grove – HAZUS-MH 2,500-year Newport-Inglewood Fault Earthquake Scenario Results

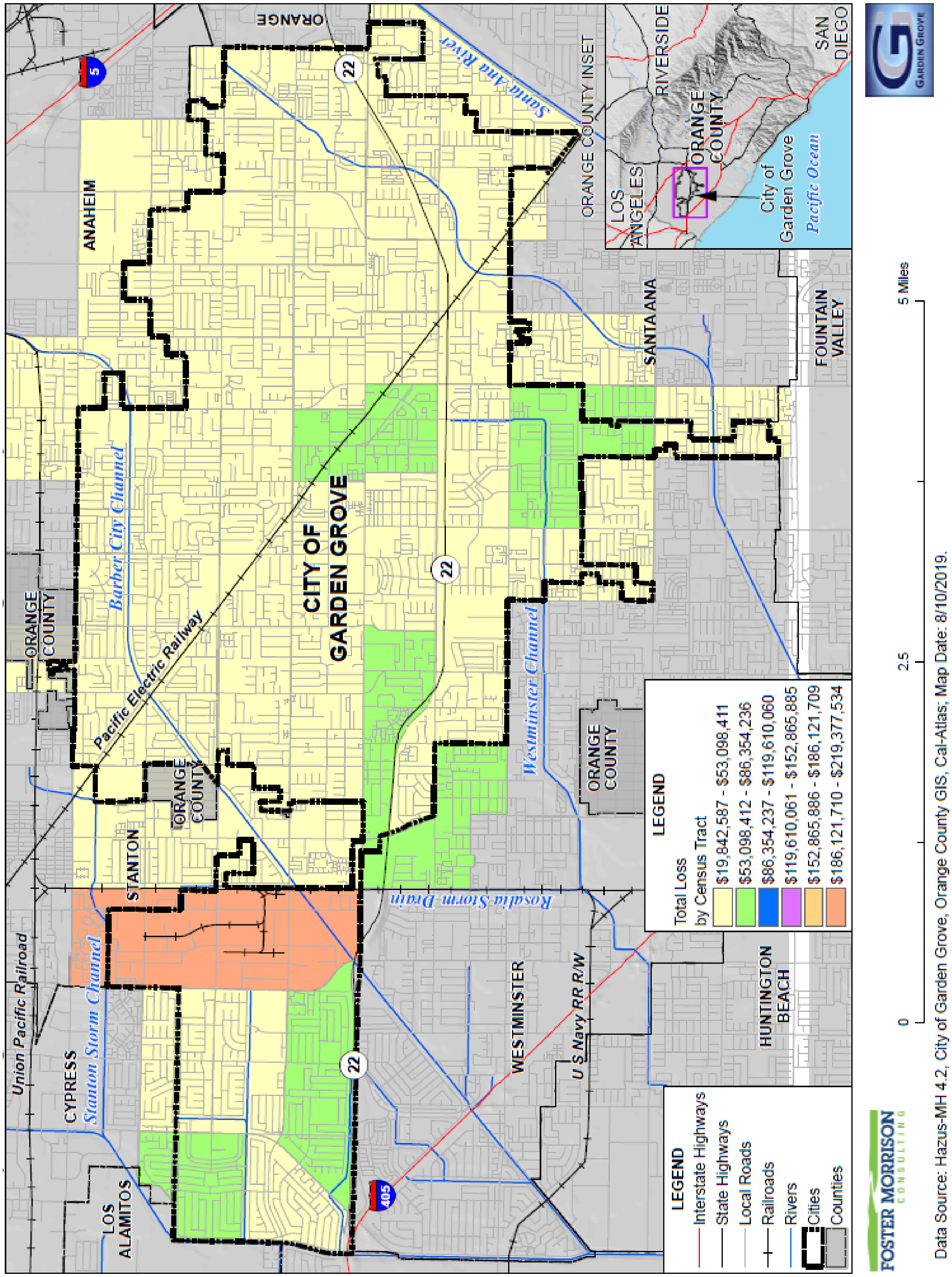
Impacts/Earthquake	7.4 Magnitude Earthquake
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 19,339 Moderate: 8,313 Extensive: 2,126 Complete: 670
Building Related Loss	$1.96 billion
Total Economic Loss	$1.95 billion
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 348 Requiring hospitalization: 62 Life Threatening: 6 Fatalities: 10
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 824 Requiring hospitalization: 200 Life Threatening:30 Fatalities: 57
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 554 Requiring hospitalization: 134 Life Threatening: 30 Fatalities: 36
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.
Transportation and Utility Lifeline Damage	361 potable water leaks, and 90 breaks 182 wastewater leaks and 45 breaks 62 natural gas leaks and 16 breaks.

Impacts/Earthquake	7.4 Magnitude Earthquake	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 13,065 Water loss @ Day 3: 351 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 2,632 Power loss @ Day 3: 1,444 Power loss @ Day 7: 494 Power loss @ Day 30: 79 Power loss @ Day 90: 4
Displaced Households	1,151 displaced households	
Shelter Requirements	1,042 persons	
Debris Generation	361,000 tons	

Source: Hazus-MH 4.2

For this scenario, the Monte Carlo simulation model estimates that there will be 7 ignitions that will burn about 0.01 sq. mi (0.04% of the region's total area.) The model also estimates that the fires will displace about 139 people and burn about $11 million of building value.

Figure 4-54 City of Garden Grove – Hazus Total Loss Areas from Newport-Inglewood Quake Scenario



Puente Hills Fault

The results of the probabilistic scenario are captured in Table 4-55. A map showing total losses by census tract for this scenario are shown in Figure 4-55. Key losses include the following:

- Total economic loss estimated for the earthquake was $2.143 billion, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $2.137 billion.
- Over 20 percent of the buildings in the City were at least moderately damaged. 996 buildings were completely destroyed.
- Over 53 percent of the building- and income-related losses were residential structures.
- 16 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake caused the most casualties: 95
- 8,477of the households experienced a loss of potable water the first day after the earthquake.
- None of the households experienced a loss of electricity the first day after the earthquake.

Table 4-55 City of Garden Grove – HAZUS-MH 2,500-year Puente Hills Earthquake Scenario Results

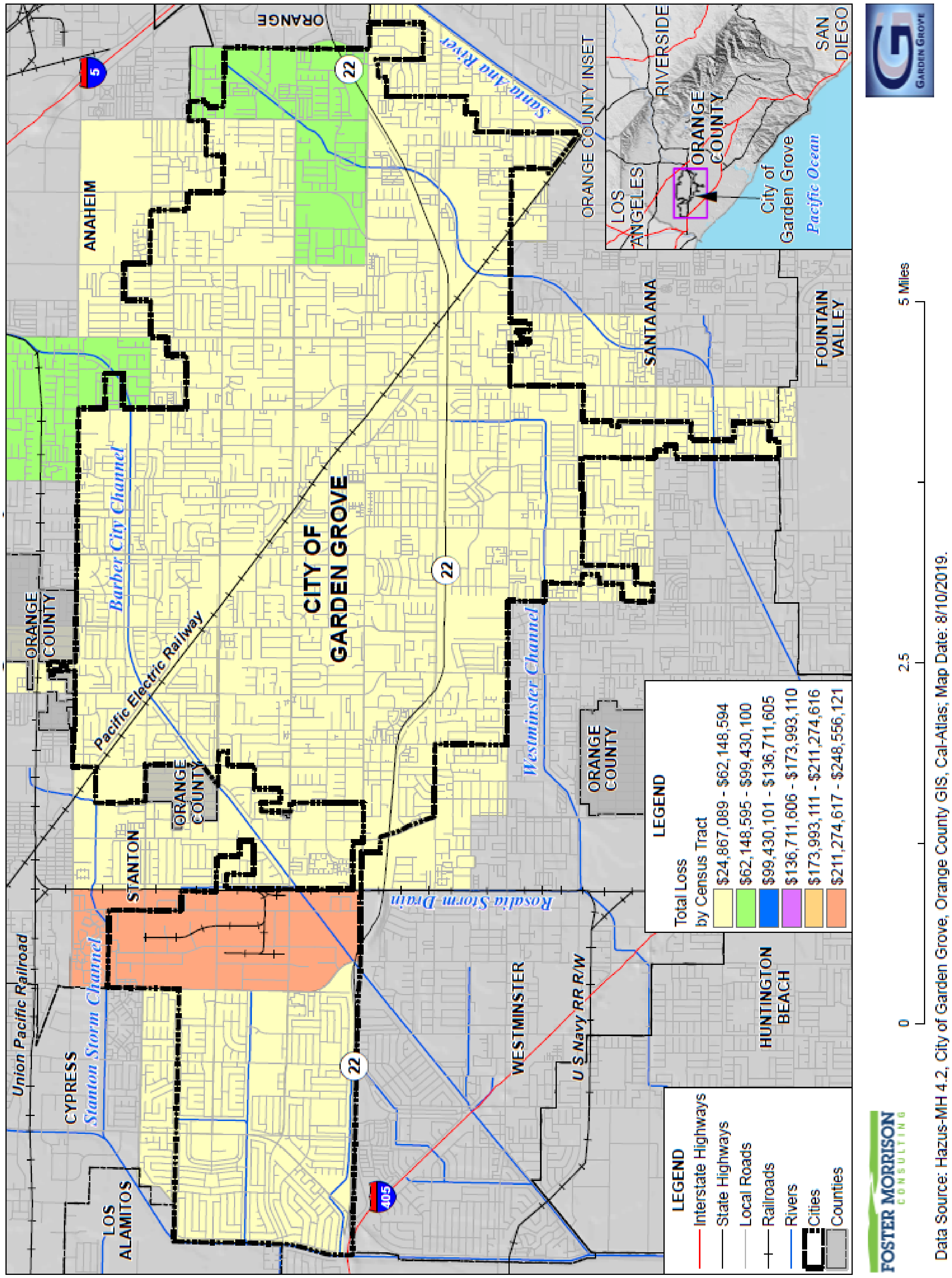
Impacts/Earthquake	7.5 Magnitude Earthquake	
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 18,782 Moderate: 7,913 Extensive: 2,409 Complete: 966	
Building Related Loss	$2,137,130,000	
Total Economic Loss	$2,142,570,000	
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 441 Requiring hospitalization: 89 Life Threatening: 9 Fatalities: 18	
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 1,224 Requiring hospitalization: 320 Life Threatening: 49 Fatalities: 95	
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 804 Requiring hospitalization: 207 Life Threatening: 37 Fatalities: 59	
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.	
Transportation and Utility Lifeline Damage	353 potable water leaks, and 76 breaks 153 wastewater leaks and 38 breaks 53 natural gas leaks and 13 breaks.	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 8,477 Water loss @ Day 3: 0 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 0 Power loss @ Day 3: 0 Power loss @ Day 7: 0 Power loss @ Day 30: 0 Power loss @ Day 90: 0

Impacts/Earthquake	7.5 Magnitude Earthquake
Displaced Households	1,649 displaced households
Shelter Requirements	1,515 persons
Debris Generation	457,000 tons

Source: HAZUS-MH 4.2

For this scenario, the Monte Carlo simulation model estimates that there will be 7 ignitions that will burn about 0.02 sq. mi (0.08% of the region's total area.) The model also estimates that the fires will displace about 214 people and burn about $17 million of building value.

Figure 4-55 City of Garden Grove – Hazus Total Loss Areas from Puente Hills Quake Scenario



San Andreas Fault

The results of the probabilistic scenario are captured in Table 4-56. A map showing total losses by census tract for this scenario are shown in Figure 4-56. Key losses include the following:

- Total economic loss estimated for the earthquake was $205.35 million, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $204.66 million.
- Over 2 percent of the buildings in the City were at least moderately damaged. 31 buildings were completely destroyed.
- Over 58 percent of the building- and income-related losses were residential structures.
- 14 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake caused the most casualties: 2
- None of the households experienced a loss of potable water or electricity the first day after the earthquake.

Table 4-56 City of Garden Grove – HAZUS-MH 2,500-year San Andreas Earthquake Scenario Results

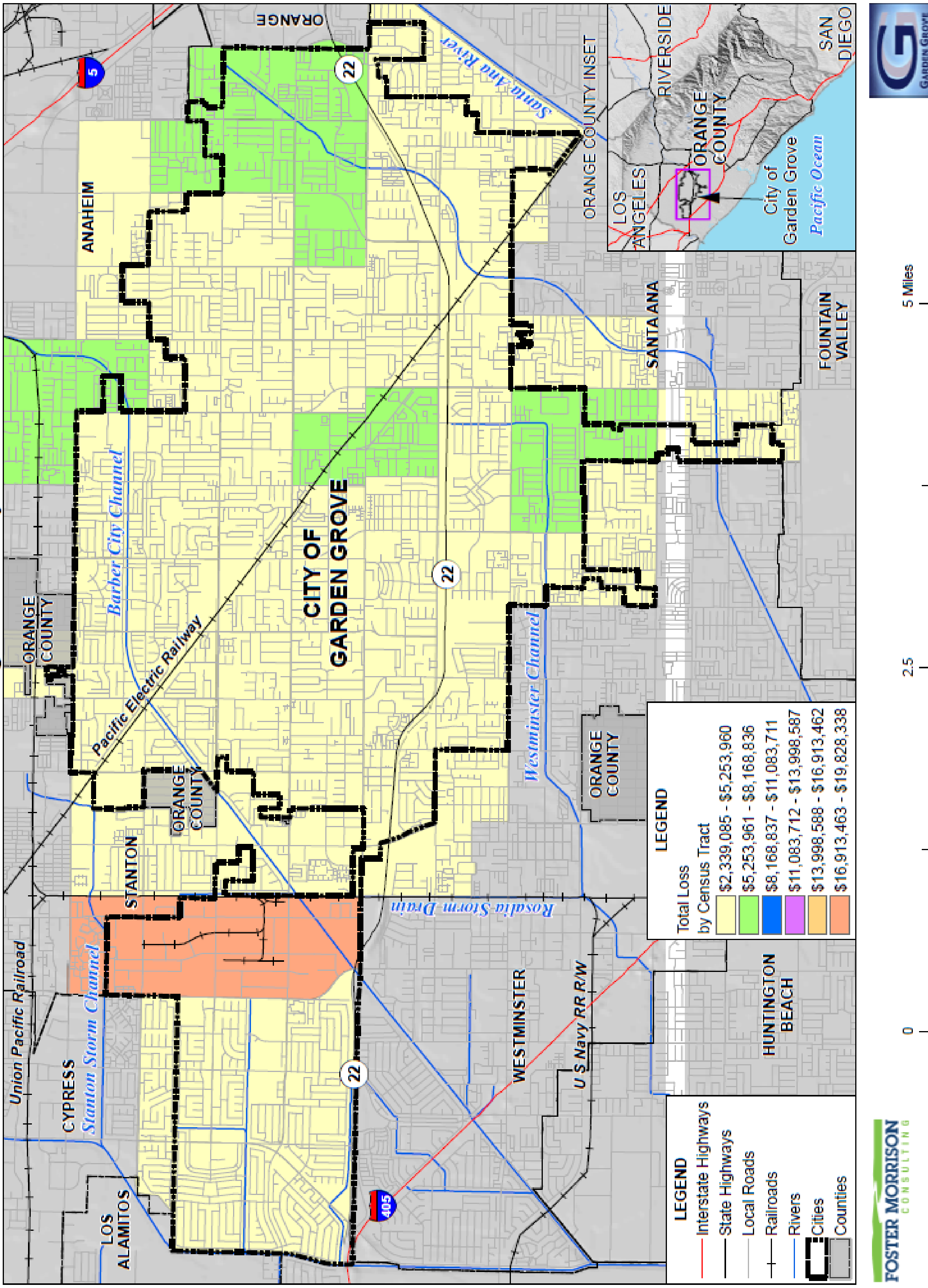
Impacts/Earthquake	8.0 Magnitude Earthquake	
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 5,229 Moderate: 1,082 Extensive: 181 Complete: 31	
Building Related Loss	$204,660,000	
Total Economic Loss	$205,350,000	
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 32 Requiring hospitalization: 3 Life Threatening: 0 Fatalities: 0	
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 57 Requiring hospitalization: 9 Life Threatening: 1 Fatalities: 2	
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 39 Requiring hospitalization: 6 Life Threatening: 1 Fatalities: 1	
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.	
Transportation and Utility Lifeline Damage	63 potable water leaks, and 16 breaks 32 wastewater leaks and 8 breaks 11 natural gas leaks and 3 breaks.	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 0 Water loss @ Day 3: 0 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 0 Power loss @ Day 3: 0 Power loss @ Day 7: 0 Power loss @ Day 30: 0 Power loss @ Day 90: 0

Impacts/Earthquake	8.0 Magnitude Earthquake
Displaced Households	43 displaced households
Shelter Requirements	40 persons
Debris Generation	29,000 tons

Source: HAZUS-MH 4.2

For this scenario, the model estimates that there will be 4 ignitions that will burn about 0.01 sq. mi (0.04% of the region's total area.) The model also estimates that the fires will displace about 105 people and burn about $8 million of building value.

Figure 4-56 City of Garden Grove – Hazus Total Loss Areas from San Andreas Quake Scenario



Data Source: Hazus-MH 4.2, City of Garden Grove, Orange County GIS, Cal-Atlas; Map Date: 8/10/2019.

San Jacinto Fault

The results of the probabilistic scenario are captured in Table 4-57. A map showing total losses by census tract for this scenario are shown in Figure 4-57. Key losses include the following:

- Total economic loss estimated for the earthquake was $113.44 million, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $113.16 million.
- Over 1 percent of the buildings in the City were at least moderately damaged. 4 buildings were completely destroyed.
- Over 60 percent of the building- and income-related losses were residential structures.
- 13 percent of the estimated losses were related to business interruptions.
- The time of the earthquake was irrelevant in causing fatalities, as none were recorded.
- None of the households experienced a loss of potable water or electricity the first day after the earthquake.

Table 4-57 City of Garden Grove – HAZUS-MH 2,500-year San Jacinto Fault Earthquake Scenario Results

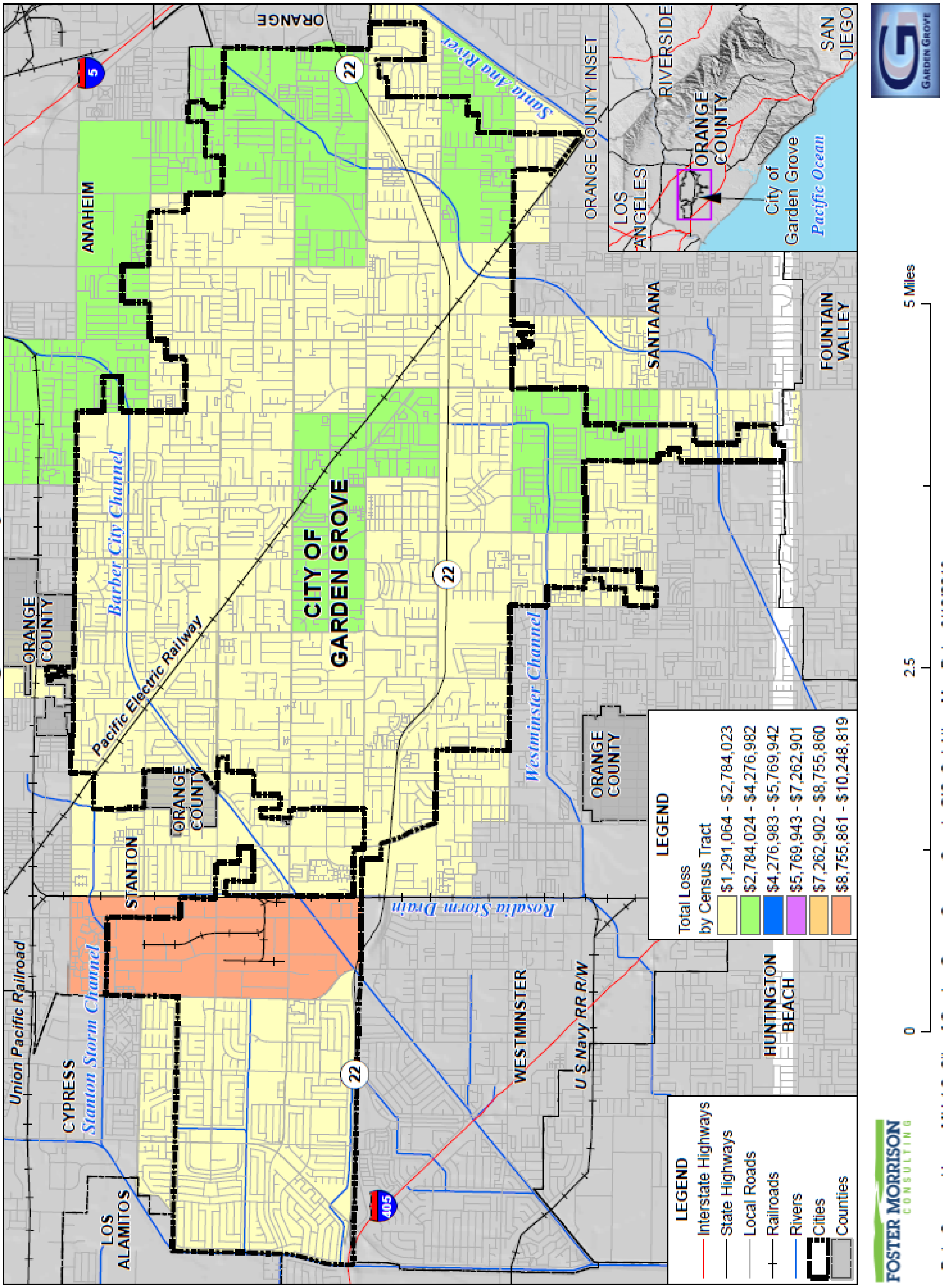
Impacts/Earthquake	7.5 Magnitude Earthquake	
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 3,496 Moderate: 657 Extensive: 68 Complete: 4	
Building Related Loss	$113,440,000	
Total Economic Loss	$113,160,000	
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 16 Requiring hospitalization: 1 Life Threatening: 0 Fatalities: 0	
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 28 Requiring hospitalization: 3 Life Threatening:0 Fatalities: 0	
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 19 Requiring hospitalization: 2 Life Threatening: 0 Fatalities: 0	
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.	
Transportation and Utility Lifeline Damage	30 potable water leaks, and 8 breaks 15 wastewater leaks and 4 breaks 5 natural gas leaks and 1 break.	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 0 Water loss @ Day 3: 0 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 0 Power loss @ Day 3: 0 Power loss @ Day 7: 0 Power loss @ Day 30: 0 Power loss @ Day 90: 0

Impacts/Earthquake	7.5 Magnitude Earthquake
Displaced Households	20 displaced households
Shelter Requirements	19 persons
Debris Generation	14,000 tons

Source: HAZUS-MH 4.2

For this scenario, the Monte Carlo simulation model estimates that there will be 4 ignitions that will burn about 0.01 sq. mi (0.04% of the region's total area.) The model also estimates that the fires will displace about 105 people and burn about $8 million of building value.

Figure 4-57 City of Garden Grove – Hazus Total Loss Areas from San Jacinto Quake Scenario



Data Source: Hazus-MH 4.2, City of Garden Grove, Orange County GIS, Cal-Atlas; Map Date: 8/10/2019.

San Joaquin Fault

The results of the probabilistic scenario are captured in Table 4-58. A map showing total losses by census tract for this scenario are shown in Figure 4-58. Key losses include the following:

- Total economic loss estimated for the earthquake was $2.046 billion, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $2.038 billion.
- Over 21 percent of the buildings in the City were at least moderately damaged. 815 buildings were completely destroyed.
- Over 59 percent of the building- and income-related losses were residential structures.
- 15 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake caused the most casualties: 69
- 15,056 of the households experienced a loss of potable water the first day after the earthquake.
- 9,536 of the households experienced a loss of electricity the first day after the earthquake.

Table 4-58 City of Garden Grove – HAZUS-MH 2,500-year San Joaquin Fault Earthquake Scenario Results

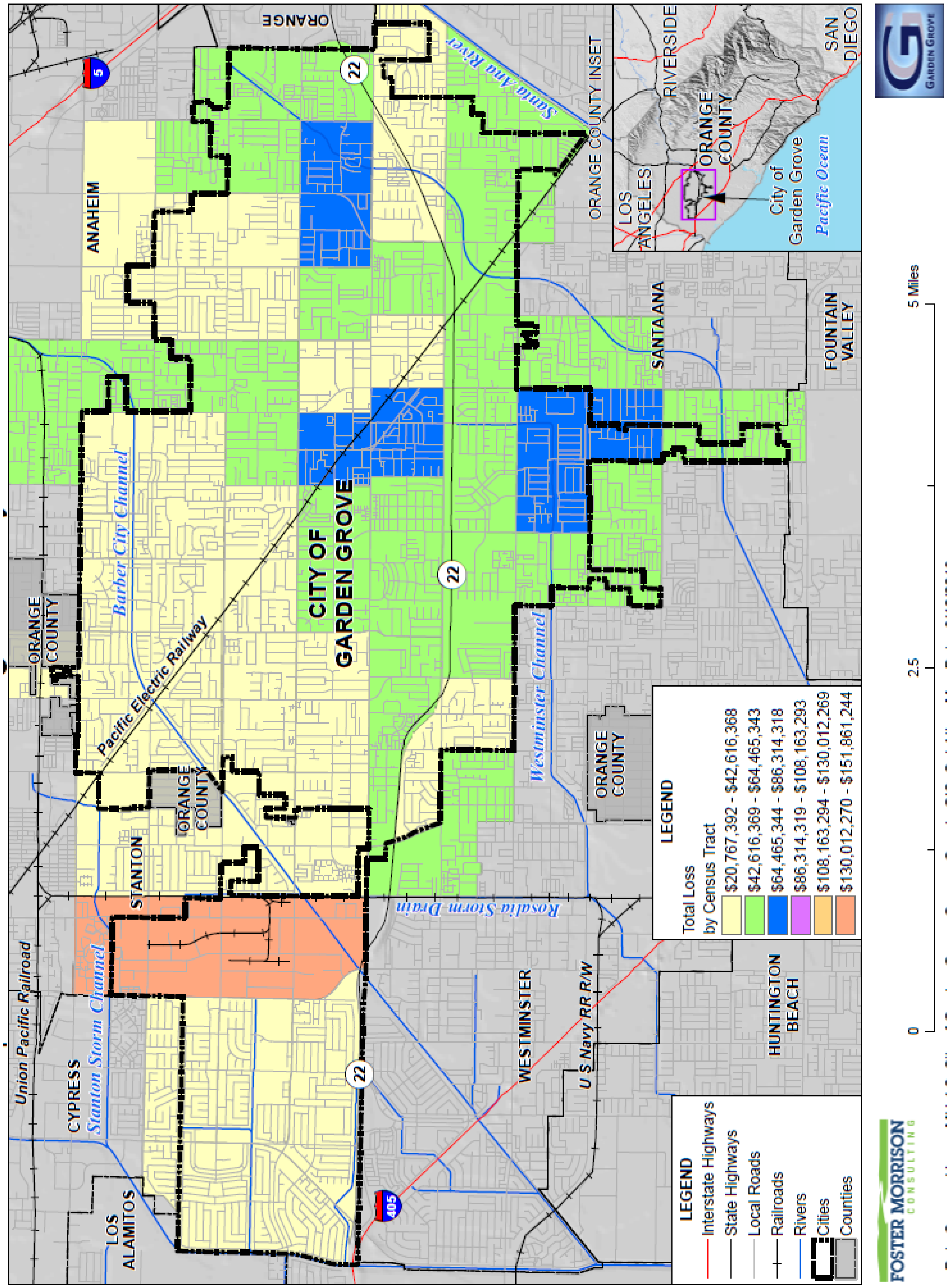
Impacts/Earthquake	7.3 Magnitude Earthquake	
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: 19,580 Moderate: 8,562 Extensive: 2,294 Complete: 815	
Building Related Loss	$2,038,810,000	
Total Economic Loss	$2,046,770,000	
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: 409 Requiring hospitalization: 77 Life Threatening: 7 Fatalities: 13	
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: 957 Requiring hospitalization: 238 Life Threatening:36 Fatalities: 69	
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: 645 Requiring hospitalization: 159 Life Threatening: 35 Fatalities: 44	
Essential Facility Damage (Based upon 83 buildings)	None with at least moderate damage.	
Transportation and Utility Lifeline Damage	385 potable water leaks, and 96 breaks 194 wastewater leaks and 48 breaks 66 natural gas leaks and 17 breaks.	
Households w/out Power & Water Service (Based upon 67,184 households)	Water loss @ Day 1: 15,056 Water loss @ Day 3: 991 Water loss @ Day 7: 0 Water loss @ Day 30: 0 Water loss @ Day 90: 0	Power loss @ Day 1: 9,536 Power loss @ Day 3: 5,238 Power loss @ Day 7: 1,801 Power loss @ Day 30: 291 Power loss @ Day 90: 15

Impacts/Earthquake	7.3 Magnitude Earthquake
Displaced Households	1,350 displaced households
Shelter Requirements	1,264 persons
Debris Generation	379,000 tons

Source: HAZUS-MH 4.2

For this scenario, the Monte Carlo simulation model estimates that there will be 8 ignitions that will burn about 0.15 sq. mi (0.60 % of the region's total area.) The model also estimates that the fires will displace about 1,632 people and burn about $125 million of building value.

Figure 4-58 City of Garden Grove – Hazus Total Loss Areas from San Joaquin Quake Scenario



Comparison of Fault Events

The six Hazus earthquake scenarios for the City of Garden Grove show different amounts of damages and losses. In order to compare these events for the City, Table 4-59 combines the information shown in Table 4-53 through Table 4-58. As shown below, the Puente Hills, San Joaquin, and Newport-Inglewood Fault pose the greatest risk to the City of Garden Grove.

Table 4-59 Comparison of Earthquake Fault Scenarios

Impacts	Count Type	7.0 Elsinore	7.4 Newport-Inglewood	7.5 Puente Hills	8.0 San Andreas	7.5 San Jacinto	7.3 San Joaquin
Residential Buildings Damaged (Based upon 55,000 buildings)	Slight: Moderate: Extensive: Complete:	7,356 1,518 158 14	19,339 8,313 2,126 670	18,782 7,913 2,409 966	5,229 1,082 181 31	3,496 657 68 4	19,580 8,562 2,294 815
Building Related Loss	$	$280,690,000	$1,960,000,000	$2,137,130,000	$204,660,000	$113,440,000	$2,038,810,000
Total Economic Loss	$	$281,170,000	$1,950,000,000	$2,142,570,000	$205,350,000	$113,160,000	$2,046,770,000
Injuries (Based upon 2am time of occurrence)	Without requiring hospitalization: Requiring hospitalization: Life Threatening: Fatalities:	40 3 0 0	348 62 6 10	441 89 9 18	32 3 0 0	16 1 0 0	409 77 7 13
Injuries (Based upon 2pm time of occurrence)	Without requiring hospitalization: Requiring hospitalization: Life Threatening: Fatalities:	62 8 1 1	824 200 30 57	1,224 320 49 95	57 9 1 2	28 3 0 0	957 238 36 69
Injuries (Based upon 5pm time of occurrence)	Without requiring hospitalization: Requiring hospitalization: Life Threatening: Fatalities:	45 5 0 1	554 134 30 36	804 207 37 59	39 6 1 1	19 2 0 0	645 159 35 44
Essential Facility Damage (Based upon 83 buildings)	–	None with at least moderate damage.	None with at least moderate damage.	None with at least moderate damage.	None with at least moderate damage.	None with at least moderate damage.	None with at least moderate damage.

Impacts	Count Type	7.0 Elsinore	7.4 Newport-Inglewood	7.5 Puente Hills	8.0 San Andreas	7.5 San Jacinto	7.3 San Joaquin
Transportation and Utility Lifeline Damage	–	46 potable water leaks, and 12 breaks 507 wastewater leaks and 23 breaks 338 natural gas leaks and 8 breaks.	361 potable water leaks, and 90 breaks 182 wastewater leaks and 45 breaks 62 natural gas leaks and 16 breaks.	353 potable water leaks, and 76 breaks 153 wastewater leaks and 38 breaks 53 natural gas leaks and 13 breaks.	63 potable water leaks, and 16 breaks 32 wastewater leaks and 8 breaks 11 natural gas leaks and 3 breaks.	30 potable water leaks, and 8 breaks 15 wastewater leaks and 4 breaks 5 natural gas leaks and 1 break.	385 potable water leaks, and 96 breaks 194 wastewater leaks and 48 breaks 66 natural gas leaks and 17 breaks.
Households w/out Power & Water Service (Based upon 67,184 households)	–	0 for power and water on Day 1	2,632 for power and 13,065 for water on Day 1	0 for power and 8,477 for water on Day 1	0 for power and water on Day 1	0 for power and water on Day 1	9,536 for power and 15,056 for water on Day 1
Displaced Households	–	72 displaced households	1,151 displaced households	1,649 displaced households	43 displaced households	20 displaced households	1,350 displaced households
Shelter Requirements	–	68 persons	1,042 persons	1,515 persons	40 persons	19 persons	1,264 persons
Debris Generation	–	34,000 tons	361,000 tons	457,000 tons	29,000 tons	14,000 tons	379,000 tons

Source: HAZUS-MH 4.2

EOP Vulnerability Assessment

The City of Garden Grove 2016 EOP provided a vulnerability assessment with detailed earthquake impacts. That is detailed here.

Public Utility Damage

Both public and private utility systems are generally designed to withstand some disaster damage and function at least at partial capacity. However, major quake-caused structural damage to natural gas, electric, sanitation, water, telephone, and petroleum lines could have a serious impact on response to and recovery from a major disaster.

Natural Gas

Orange County has four major gas transmission pipelines that cross the San Andreas Fault. A large earthquake would most likely rupture at least two, causing immediate shut-off and re-routing from the ruptured lines to the remaining intact lines. Delivery would be at approximately 75% of demand, with gas service being rationed to critical business and residential users. Emergency response predictions for the area estimate the ruptured gas lines would be repaired within 3-5 days.

Electricity

It is estimated that damage to electrical generating plants could reduce generating capacity by 50%. The first 72 hours will be the most critical for responders as virtually all facilities are expected to experience some temporary loss of power. When a generator outage does occur, the load may be picked up by other interconnected units. This interconnection may reduce power outage time. Critical users, such as medical facilities, certain public buildings, water wells, and sewage pumping facilities will have restoration priority in a power outage.

Sanitation

Orange County sewage treatment plants are primarily situated on potentially geologically unstable land with high shaking and liquefaction possibilities. At least one of the County's two plants is expected to suffer at least moderate damage from a major earthquake, but some districts can bypass the affected plant and divert sewage to an alternate site for treatment.

The pumping plants pose the most serious problem since an electrical power outage would disable pumping capacity. Another problem is rupture of collection lines causing contamination of groundwater and water wells, as well as presenting potential health hazards to residents.

Communications

Telephone communications are expected to be adversely affected due to overloading as a result of post-earthquake calls within the area and from the outside. This situation may be of some duration due to loss of electrical power and subsequent failure of some auxiliary power sources. Key system failures are anticipated near the San Andreas Fault in areas projected to experience intense ground shaking. It is likely that the City's telephone systems will have systemic failures which are not readily bypassed by alternate traffic routing. Additionally, it is probable that recovery efforts will be delayed because many telephone company employees will have difficulty accessing damaged areas to accomplish repairs.

It is estimated that radio systems will generally operate at 40% effectiveness for the first 12 hours after a large earthquake, increase to 50% for the second 12 hours, and then begin to slowly decline to approximately 40% within 36 hours. The long-term implications are that individual systems gradually will become less useful to the overall recovery effort when supplanted by systems relocated from outside the disaster area. It is unlikely that public safety radio systems would become saturated with non-critical communications from mobile units. However, it is clear that radio traffic densities on redundant (non-emergency designated) channels would increase, particularly when remote base station and repeater failures would tend to limit the number of redundant channels available. Nonetheless, after 12 hours, at which time the number of operable units will have declined (because of exhaustion of emergency fuel) and because recovery efforts will have restored some order, the radio traffic density problem will ease.

The County Radio Amateur Civil Emergency Service (RACES) may be called upon to provide support communications. However, circumstances may limit the response of their registered members.

Commercial Broadcasters

All radio and television facilities are expected to be out of operation in Los Angeles and Orange Counties for 24 hours due to in-house problems, and/or power supply problems, and/or transmission line problems. Elsewhere in the area, a third of the facilities are also expected to be out of service for 24 hours. Only 50% of facilities for the entire area are expected to be in operation.

Collateral Earthquake Hazards

Flooding

With major disruptions in power and communications systems, warning may not be received from dam sites in time to initiate an organized evacuation or broadcast warnings via emergency radio stations. If a credible prediction was initiated, then preparations for a damaging earthquake could begin and residents and business owners, within dam inundation areas, could be directed to assembly areas to wait for official word regarding safe reentry. This method of direction and control could substantially reduce potential loss of life if enough warning is available. More information on flooding can be found in Section 4.3.8.

Liquefaction

Within the City, there are some structures, including residences and businesses, constructed in potential liquefaction areas. As described above, liquefaction is the process in which water saturated sediments lose strength and fail from strong shaking during a moderate to severe earthquake. Structures in these areas could sustain more damage than others with a more stable geological substrata and deeper groundwater table. More information on liquefaction can be found in Section 4.3.7.

Fire

One of the greatest potential secondary hazards associated with earthquakes is fire. Fire may be caused by a variety of factors; including electrical shorting, gas explosions, unsecured water heaters, unsecured kitchen contents landing on hot stoves, chemical fires, etc. As an example, 90% of the damage during the 1906 San Francisco Earthquake was the result of fire. Securing gas appliances and hazardous substances can prevent many fires from occurring. Lack of water pressure from underground line damage could reduce the effectiveness of conventional firefighting methods. Restricted access to fire sites could also delay response, increasing the resulting damage. With the increased potential for numerous fires igniting within minutes of the earthquake, firefighting equipment and personnel could be rapidly overwhelmed. Fire involving hazardous materials generally cannot be controlled using conventional techniques or apparatus and will require particular consideration in the planning process. More information on fire can be found in Section 4.3.14.

Highways

SR-22 runs through the southern border of the City and is a main artery carrying thousands of commuters each day through the area. Additionally, heavy truck traffic travels this route daily carrying hazardous materials, some of which could be radiological in nature. These major routes are vulnerable to damage during an earthquake event.

Other major transport routes and streets within the City are vulnerable to minor and moderate structural damage. Flooding and sewage discharge could cause some streets and highways to be impassable. Fallen rocks, trees, utility lines and poles could not only block traffic but damage vehicles and injure occupants. In areas with multistory buildings, transportation access will be determined by the amount of building debris in the roadways and street width.

The effectiveness of road clearance operations will be determined by the access and availability of equipment to the problem areas, the availability of and access to fuel and maintenance, and the ability to communicate with and mobilize crews to staging locations.

Buildings

The following building types and uses are considered in describing the earthquake threat to the City:

Residential

Single family homes are expected to suffer some structural damage and loss of contents, although not general collapse. Wood frame structures which have natural flexibility will probably sustain less damage than brick and masonry construction. Many newer homes (post 1970) within the City are built of wood frame construction with chicken wire beneath the stucco. This provides added structural cohesiveness. Older structures may require bolting of their foundations and seismic engineering studies to determine other possible safety reduction measures. Multistory residential units are generally more vulnerable to higher shaking intensities, and therefore, pose a greater hazard to life safety.

Mobile homes within the City could be subject to shifting off their foundation supports. Attached awnings, porches, and skirting could be subject to separation, and utilities could be sheared off where they enter the coach. Seldom would actual collapse of the structure itself occur unless nearby trees and power poles toppled.

Schools and Churches

There are many schools and churches in the City which may sustain varying degrees of damage. Schools within the City are generally earthquake resistant and may withstand intensities of up to VII on the Modified Mercalli Scale. Poorly built or designed churches may experience partial collapse while interiors are expected to experience heavy damage.

Businesses and Industrial Facilities

There are five industrial parks covering more than 700 acres in the City. Many of these businesses will suffer major dollar losses due to damaged stock, interruption of business and damage to structures. Many of the older brick and wood joist structures may suffer moderate to severe damage. Well-built ordinary structures will suffer slight to moderate damage at a VII level on the Modified Mercalli Scale. At a level IX, specially designed earthquake resistant structures may suffer serious damage and lesser buildings will be destroyed. Hazardous materials facilities may experience a release and cause long term significant problems including health issues for citizens in the surrounding area.

Medical and Custodial Care Facilities

Garden Grove Medical Center is the only general hospital in the City and has 175 beds. This facility is of concern because of the non-ambulatory nature of some of the occupants. Special planning is imperative to effectively handle the evacuation and relocation of special needs residents. There are six skilled nursing facilities in addition to the hospital; each with between 50 and 75 beds.

Critical care and extended care facilities may suffer loss of power, telephones and sanitation. Damage and interruption of the normal range of activities is expected beginning at a Level VI on the Modified Mercalli Scale. Included in this section are also Residential Care Facilities which house individuals not capable of living on their own but not requiring a skilled nursing facility or acute care. There are four such facilities in the City each with approximately 75 beds. The City must be ready to provide assistance in the event of an evacuation of any of these facilities.

Government Buildings

Government buildings vary in criticality and structural design as do other structures throughout the City. It is vital that certain branches of City government continue to function after the initial shock. While the City's Primary EOC is located at City Hall, fire stations may serve as alternate EOC sites if City Hall is damaged as the result of an earthquake. Alternate locations for seat of government, EOC, etc. are specified in Section 4.7 of the EOP.

Grocery Stores

Because of the fast-paced nature of society, citizens are very dependent upon a ready availability of food. However, following a major earthquake, that source will be severely interrupted. Structural damage notwithstanding, most stores may suffer major damage and disruption inside due to inventory loss. Shelves are not designed to contain products subjected to any appreciable degree of shaking. Clean up will be a major problem before the public may once again have access. Also, since most stores receive deliveries on a daily basis, resuming shipments of supplies may be a serious concern requiring specific logistical support.

Hardware/Building Supply Stores

Following a major earthquake, rescuing trapped people from damaged structures will be the first priority. Hardware and building supply stores should be secured to procure emergency supplies to aid in the rescue efforts. Short term, follow-up reconstruction and shoring to stabilize damaged structures requires initial reliance on the supplies available through these local resources.

Gas Stations

Fuel sources may quickly become quite critical. Special attention will have to be paid to gas stations to ensure that their hazard potential is kept low (from fire or hazardous material incidents through leakage) while, at the same time, remain a viable source of fuel to aid recovery operations.

Pharmacies

Besides the obvious need for medical supplies, a great number of people are also dependent on prescription medications. Unfortunately, pharmacies are as vulnerable to internal damage as grocery stores. Most of their inventory is kept on unprotected shelves, and a great deal of cleanup and restocking may be required before the pharmacies are once again operational.

Overall Community Impact

The overall impact to the community from earthquake includes:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Damage to natural resource habitats and other natural resources;
- Disruption of and damage to public infrastructure and services;
- Loss of water, power, roads, phones, and transportation, which could impact, strand, and/or impair mobility for emergency responders and/or area residents;
- Economic losses (jobs, sales, tax revenue) associated with loss of commercial structures;
- Loss of churches, which could severely impact the social fabric of the community;
- Loss of schools, which could severely impact the entire school system and disrupt families and teachers, as temporary facilities and relocations would likely be needed;
- Impact on the overall mental health of the community; and
-
- Negative impact on commercial and residential property values.

Future Development

Historically, the type of structures that are vulnerable to earthquake aren't located in the City. The City is mostly of single-story structures, but that is changing. The HMPC noted that future development has been and will likely contain multi-family and other larger structures. However, large hotels and multi-story buildings are being built to current code. The HMPC noted that even though built to code, these structures are untested and could be at risk both from earthquake shaking and liquefaction.

4.3.7. Earthquake Liquefaction Vulnerability Assessment

Likelihood of Future Occurrence—Occasional
Vulnerability—Medium

Earthquake is discussed in the Section 4.3.6, but is primarily focused on the vulnerability of buildings and people from earthquake shaking. This section deals with a secondary hazard associated with earthquake – the possible collapse of structural integrity of the ground in liquefaction prone areas. Impacts from liquefaction include property damage, critical facility damage, and life safety issues. The HMPC noted that liquefaction potential is linked to the depth to groundwater table. Generally, the higher the ground water table, the greater potential for liquefaction. The City noted that the depth of the groundwater table is generally too low to create a significant liquefaction potential.

The HMPC also noted that within the City, there are some structures, including residences and businesses, constructed in potential liquefaction areas. Structures in these areas could sustain more damage than others with a more stable geological substrata and deeper ground table. The HMPC also noted that the hotel district is primarily located in a liquefaction zone. This is a concern as these are the tallest structures in the City. The City is also concerned about water facilities being damaged during an earthquake as well as underground tanks and piping.

Total Values at Risk

The City of Garden Grove identified a liquefaction potential layer from the CGS that covers the Planning Area. Liquefaction zones determined by the CGS further identify State regulatory zones that show “Zones of Required Investigation” for liquefaction (and landslide) hazard which categorizes areas as either being inside or outside of the Zone of Required Investigation. This liquefaction potential analysis focuses on determining the potential vulnerability to Garden Grove properties located inside the liquefaction potential zone.

Methodology

Using GIS, the CGS liquefaction potential zone was overlaid on the Garden Grove parcel layer to obtain results. Based on this analysis, if the liquefaction potential zone intersected a parcel centroid, the entire parcel was considered to be in the liquefaction potential zone. The parcels were segregated and analyzed in this fashion for the Garden Grove Planning Area. Once completed, the parcel boundary layer was joined to the Assessors database to obtain additional information on affected parcels. Liquefaction potential zones are shown in Figure 4-59. Table 4-60 illustrates the assessed values at risk to Garden Grove from liquefaction, including contents replacement values as previously described in Table 4-36.

Figure 4-59 City of Garden Grove – CGS Liquefaction Potential Zone

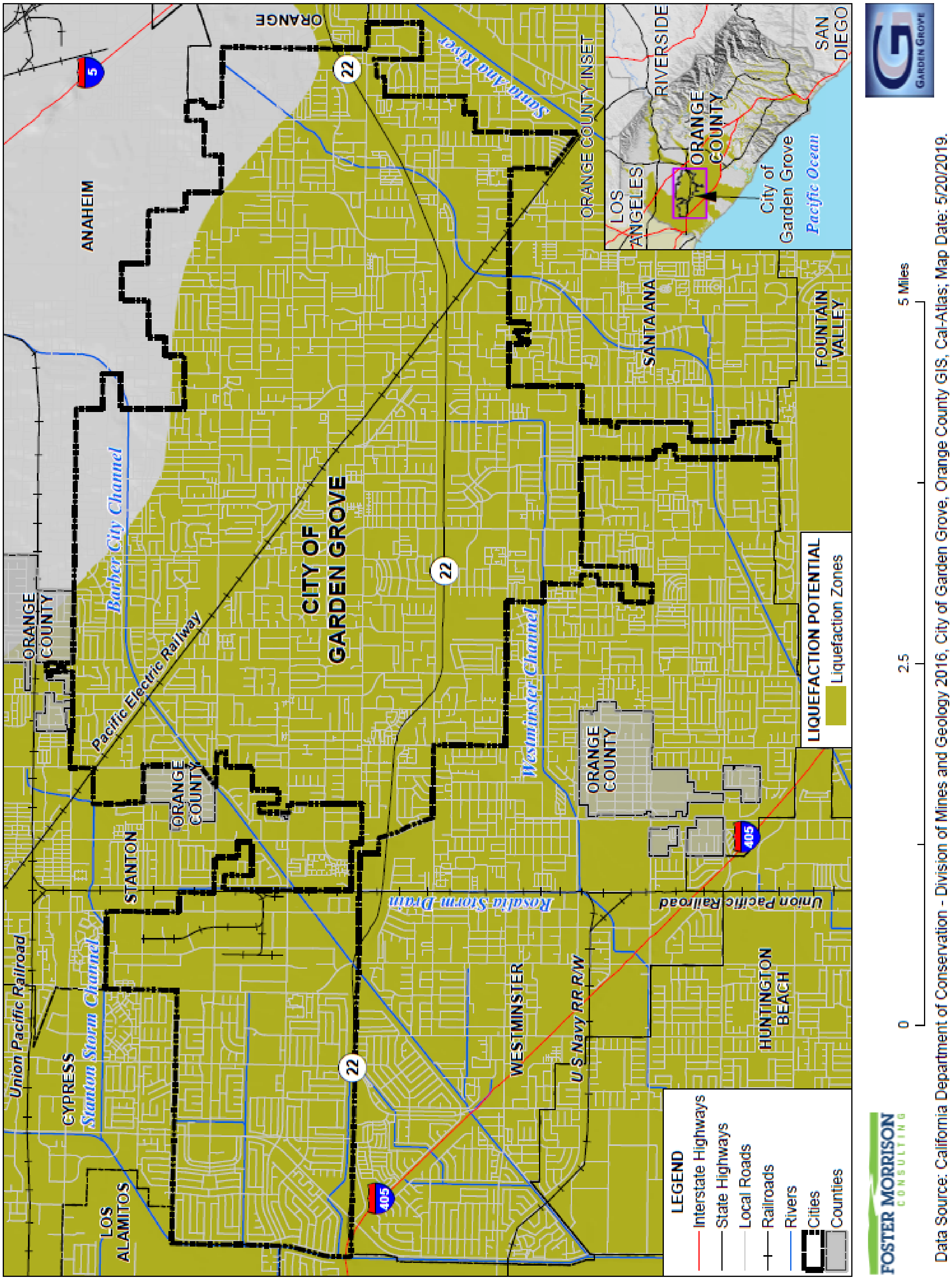


Table 4-60 City of Garden Grove – Count and Value of Parcels in Liquefaction Potential Zone

Liquefaction Potential/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
Inside Liquefaction Potential Zone					
Civic	78	66	$71,415,811	$128,961,426	$200,377,237
Commercial	504	452	$379,146,944	$290,204,483	$669,351,427
Industrial	346	321	$549,420,092	$423,864,116	$973,284,208
Mixed Use	1,316	1,165	$968,195,315	$795,857,929	$1,764,053,244
Open Space	140	34	$31,802,095	$21,589,915	$53,392,010
Residential	27,401	26,921	$6,219,991,152	$2,853,838,179	$9,073,829,331
Unknown	40	1	$179,635	$238,449	$418,084
Inside Total	**29,825**	**28,960**	**$8,220,151,044**	**$4,514,554,497**	**$12,734,705,541**
Outside Liquefaction Zone					
Civic	8	4	$3,855,017	$6,685,205	$10,540,222
Commercial	44	40	$23,851,410	$18,880,419	$42,731,829
Mixed Use	50	46	$73,441,278	$115,295,305	$188,736,583
Open Space	1	1	$1,267,968	$1,474,780	$2,742,748
Residential	2,377	2,360	$596,795,782	$261,199,082	$857,994,864
Unknown	1	0	$0	$0	$0
Outside Total	**2,481**	**2,451**	**$699,211,455**	**$403,534,791**	**$1,102,746,246**
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$13,837,451,787**

Source: CGS, City of Garden Grove March 2019 Parcel/Assessor's Data

Population at Risk

A separate analysis was performed to determine population in liquefaction areas. Using GIS, CGS liquefaction zone datasets were overlayed on the improved residential parcel data. Those parcel centroids that intersect the landslide potential zone were counted and multiplied by the Census Bureau average household size for the City of Garden Grove (3.06). Results were tabulated and are shown in Table 4-61. According to this analysis, for the City there is a population 98,854 in the CGS liquefaction potential zone.

Table 4-61 City of Garden Grove – Improved Residential Parcels and Population at Risk in Liquefaction Potential Zones

Jurisdiction	Inside Liquefaction Zone	
	Improved Residential Parcels	Population
Garden Grove	26,291	98,854

Source: CGS; US Census Bureau 2010 Estimates, City of Garden Grove March 2019 Parcel/Assessor's Data

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in the City of Garden Grove to determine critical facilities in the liquefaction potential zone. Using GIS, the liquefaction potential zone was overlayed on the critical facility GIS layer. Figure 4-60 shows critical facilities in relation to the liquefaction potential zone. Table 4-62 and Table 4-63 provide information by category of critical facilities in the liquefaction potential zone. Details of critical facility definition, type, name, and address by liquefaction potential are listed in Appendix E.

Figure 4-60 City of Garden Grove – Critical Facilities in Liquefaction Potential Zone

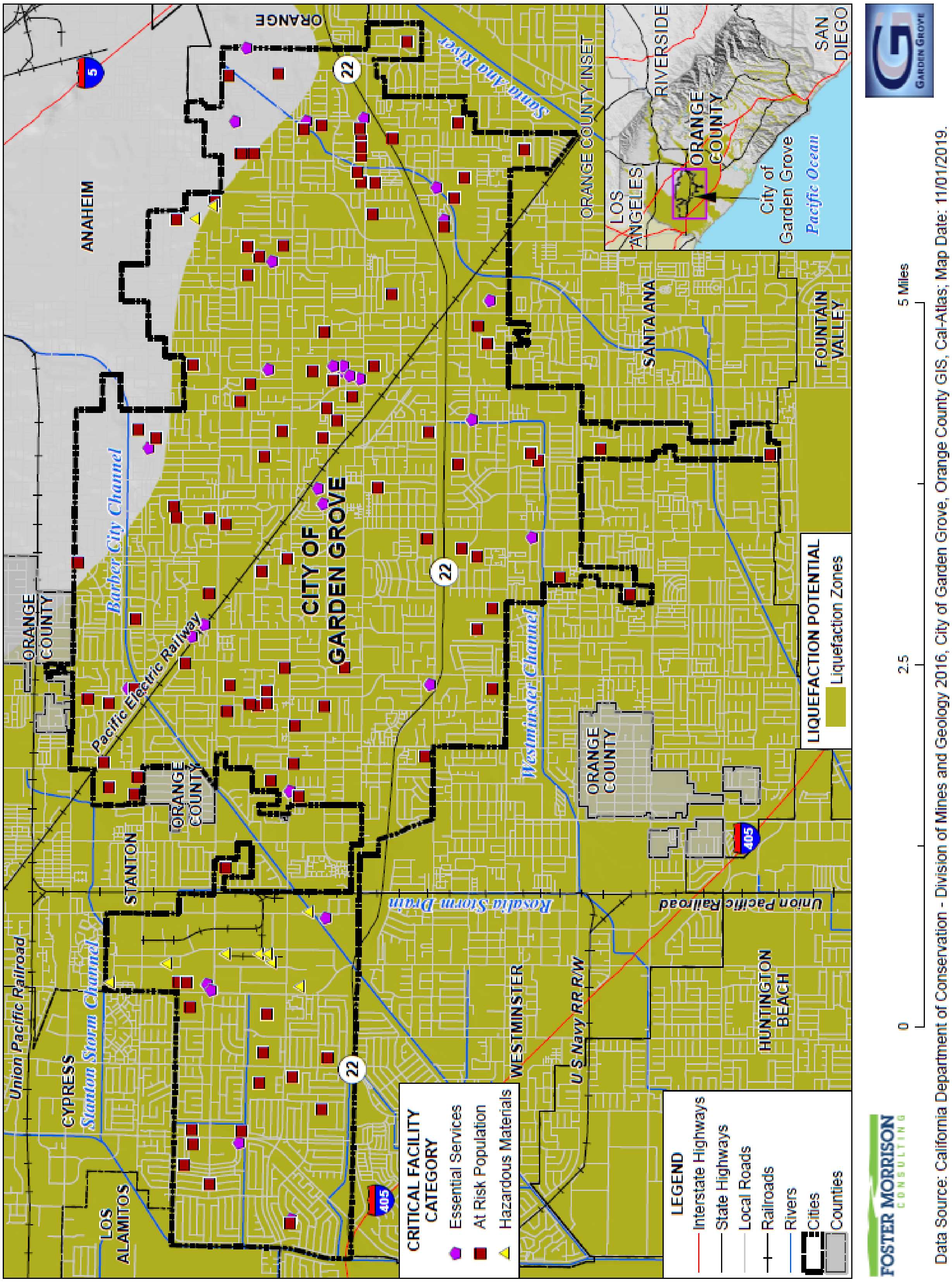


Table 4-62 City of Garden Grove – Critical Facilities Counts Liquefaction Potential Zone

Liquefaction Potential / Critical Facility Category	Facility Count
Inside Liquefaction Potential Zone	
Essential Services Facilities	31
At Risk Population Facilities	102
Hazardous Materials Facilities	9
Grand Total	**142**

Source: CGS, City of Garden Grove GIS

Table 4-63 City of Garden Grove – Critical Facility Counts in Liquefaction Potential Zone by Critical Facility Type

Liquefaction Potential / Critical Facility Category/ Critical Facility Type	Facility Count
Inside Liquefaction Potential Zone	
Essential Services Facilities	
Fire Station	7
Government Building	4
Police Station	1
Public Building	6
Public Works Facility	13
Essential Services Facilities Total	**31**
At Risk Population Facilities	
Entertainment	2
Hospital/Medical	6
Hotel	2
Park	19
Religious Assembly	14
School	51
Senior Housing	8
At Risk Population Facilities Total	**102**
Hazardous Materials Facilities	
Covered Landfill	1
Hazmat	8
Hazardous Materials Facilities Total	**9**
Grand Total	**142**

Source: CGS, City of Garden Grove GIS

Overall Community Impact

The overall impact to the community from earthquake induced liquefaction includes:

- Injury and loss of life
- Commercial and residential structural and property damage;
- Damage to natural resource habitats and other resources, such as timber and rangeland;
- Disruption of and damage to public infrastructure and services;
- Loss of water, power, roads, phones, and transportation, which could impact, strand, and/or impair mobility for emergency responders and/or area residents;
- Economic losses (jobs, sales, tax revenue) associated with loss of commercial structures;
- Loss of churches, which could severely impact the social fabric of the community;
- Loss of schools, which could severely impact the entire school system and disrupt families and teachers, as temporary facilities and relocations would likely be needed;
- Impact on the overall mental health of the community; and
- Negative impact on commercial and residential property values.

Future Development

The City currently does not have an inventory of soft story or unreinforced masonry buildings. The City is mostly comprised of single-story structures, with the exception of multi-story condos and apartments and the many hotels within the hotel district. The HMPC noted that future development will likely include multi-family and other larger structures. Future large hotels and multi-story buildings should be built to code. The HMPC noted that even though built to code, these structures are untested and could be at risk both from earthquake shaking and liquefaction.

Future Development/Redevelopment GIS Analysis

Future development/redevelopment areas identified by the City are broken out into multiple areas. GIS data is maintained by the City of Garden Grove and was made available for this Plan. An analysis was performed to quantify parcels within these future development areas that are also in CGS earthquake liquefaction potential zone. GIS was used to create a centroid, or point representing the center of the parcel polygon for each future development area. Those parcels centroids that intersect the CGS liquefaction potential zone are shown on Figure 4-61 and detailed in Table 4-64.

Figure 4-61 City of Garden Grove– Development Areas in Liquefaction Potential Zone

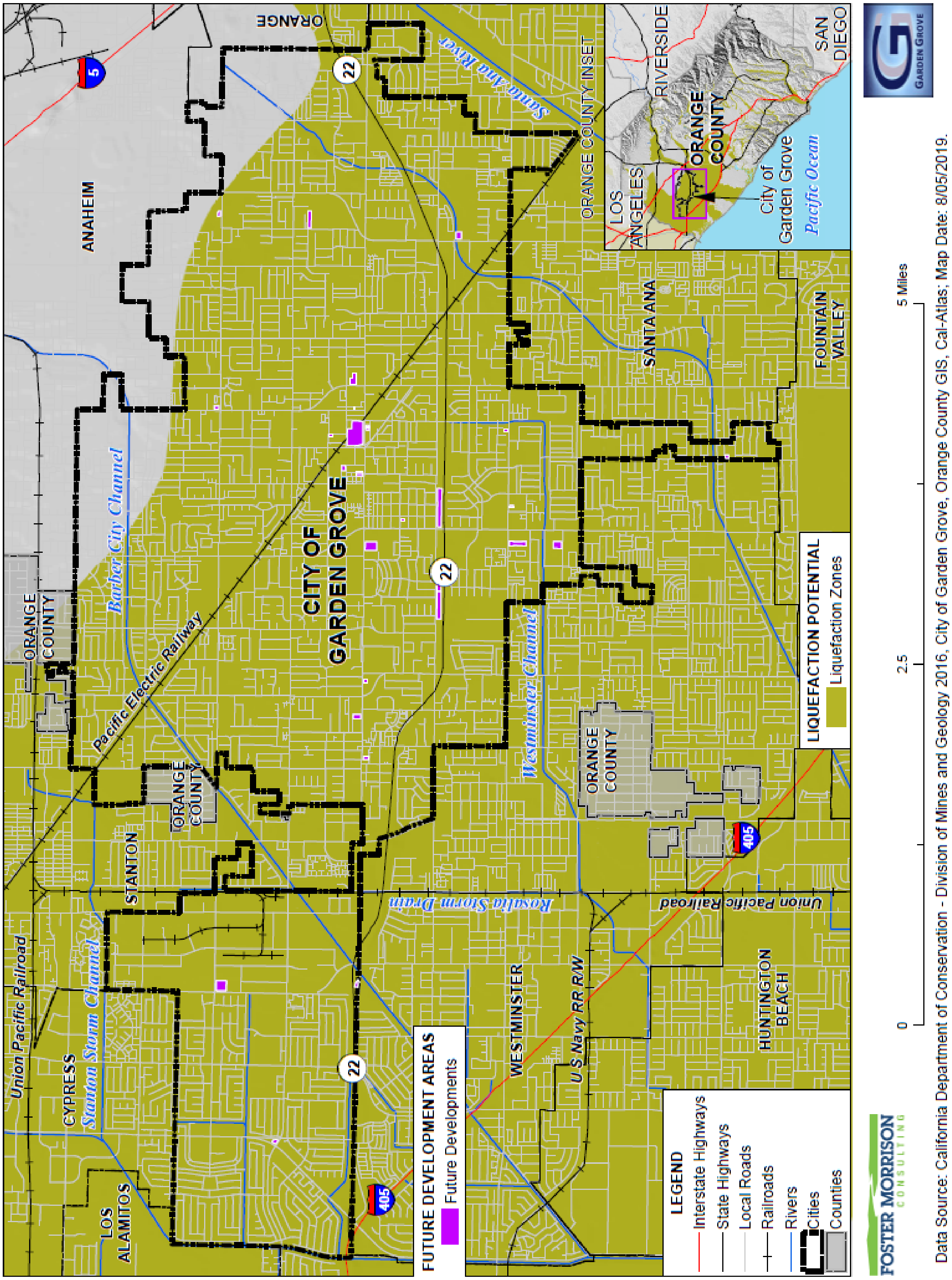


Table 4-64 City of Garden Grove – Development Areas in Liquefaction Potential Zone

Liquefaction Potential / Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
Inside Liquefaction Zone			
10080 Garden Grove Blvd	1	0	3.09
12361 Chapman Ave	1	1	0.48
9106 Garden Grove Blvd	1	1	0.48
9861 11th St	1	1	1.76
10052 Central Ave	1	1	0.20
10522 McFadden Ave	1	1	0.35
12900 Euclid St	1	0	1.99
7051 Garden Grove Blvd	1	0	0.52
10531 Garden Grove Blvd	1	1	0.61
10561 Garden Grove Blvd	1	1	0.41
10611 Acacia Ave	1	1	0.58
11001 Chapman Ave	1	1	0.53
10801 Garden Grove Blvd	1	1	10.70
12900 Main St	2	2	0.13
10150 Trask Ave	1	0	5.14
10812 Stanford Ave	1	1	0.23
8562 Garden Grove Blvd	1	1	0.55
8851 Garden Grove Blvd	1	1	1.05
10862 Garden Grove Blvd	1	1	0.22
10872 Garden Grove Blvd	1	0	0.15
10882 Garden Grove Blvd	1	0	0.16
12422 Valley View St	1	1	0.53
12612 Buaro St	1	1	1.91
9444 Trask Ave	1	1	3.50
9670 Trask Ave	1	1	3.00
13650 Harbor Blvd	1	1	1.25
12072 Knott St	2	2	6.38
9892 Westminster Ave	2	2	4.43
10142 Westminster Ave	1	1	0.16
10152 Westminster Ave	1	1	0.17
10691 Westminster Ave	1	1	0.30
Grand Total	**34**	**28**	**50.97**

Source: City of Garden Grove GIS, CGS

4.3.8. Flood: (1% and 0.2% Annual Chance) Vulnerability Assessment

Likelihood of Future Occurrence—Occasional Unlikely
Vulnerability—High

Floods have been a part of Garden Grove's historical past and will continue to be so in the City's future. During winter months, prolonged precipitation can result in flooding causing damage to property and infrastructure. Predominantly, the effects of flooding are generally confined to areas near the rivers and drainageways. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat. Flood related erosion could cause damages to homes, businesses, and government structures, including damage to ancillary structures, and utilities. Structural foundation undercutting is the most prevalent form of damage to structures. Structures can also be damaged from trees falling as a result of water-saturated soils. Electrical power outages can occur and cause major problems.

The HMPC noted that Orange County's rapid growth and transformation from an agricultural community to an urban community has changed flood control of large flows from mountains and hills to include control of additional runoff produced by development of the plains. Although there is a countywide system of flood control facilities, the majority of these are inadequate for conveying runoff from major storms, such as the Standard Project Flood or the 100-year flood. Within the City, lies a Retarding Basin called "Haster Basin" that is part of the extensive flood control and is located in East Garden Grove-Wintersburg sub-watershed within the Westminster watershed. The City has in the past been subjected to extensive street flooding and occasional property damage, particularly during the 1960s and earlier before flood controls structures (levees and upstream dams) were placed to protect the City. Major floods occurred in 1938, 1969, 1978, and 1983, affecting various parts of the City. The City is subject to potential flooding from several local dams and reservoirs. This includes Prado Dam, Santiago Dam and Villa Park Reservoir, all northeast of the City. In the event of a dam failure, numerous critical facilities are at risk. Floods often result in power outages that have major implications for water and sewer. Extended power outages can disrupt service leading to boil water advisories and sewer spills.

Southern California Edison noted that there are distinguishable differences between the risks to and vulnerability of the gas system compared to the electric system during times of flooding. They noted that the underground natural gas system is more resilient than the aboveground electric system. Above ground electric systems can be damaged by earthquakes, which can cause issues for power companies and their customers. For example, in 2017 the Thomas Fire damaged electric power lines throughout the City of Ventura. Because the City's water pumps to supply water to firefighters ran on electricity without any other form of backup power, firefighters were unable to get water from the pumps to put out burning residences. If the water pumps had been connected to a backup power system, such as a natural gas generator, firefighters would have been able to access the water.

In contrast, as the natural gas system is mostly underground, it is very resilient to extreme weather events. For example, in 2012, after Superstorm Sandy, the entire natural gas system in the Northeast was essentially intact, allowing residents to support back-up generators, cook, and keep warm. Businesses with natural gas-powered fuel cells were able to operate and compressed natural gas (CNG) buses in New Jersey were used to shuttle residents to safety. Further, when Hurricane Harvey temporarily disabled almost 30% of the nation's refining capacity, CNG shuttles were able to continue operating, and hospitals that had on-site combined heat and power systems were able to provide urgently needed medical attention, despite flooding.

Health Hazards from Flooding

According to FEMA, certain health hazards are also common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm, and industrial chemicals. Pastures and areas where cattle and hogs are kept or their wastes are stored can contribute polluted waters to the receiving streams.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e. coli and other disease-causing agents.

The second type of health problem arises after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If a water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Values at Risk

The City of Garden Grove has mapped FEMA flood hazard areas. GIS was used to determine the possible impacts of flooding within the City and how the risk varies across the Planning Area. The following methodology was followed in determining improved parcel counts and values at risk to the 1% and 0.2% annual chance flood events as well as those located within other FEMA flood zones.

Methodology

City of Garden Grove's March 2019 Assessor Data and GIS parcel data were used as the basis for the City inventory of parcels, values, and acres. Orange County, including Garden Grove, has a FEMA effective DFIRM dated 3/21/2019, which was obtained from the National Flood Hazard Layer to perform the flood analysis. The City of Garden Grove flood panels from this 2019 dataset are dated December 3, 2009.

In some cases, there are parcels in multiple flood zones, such as Zone A, Zone X, or Shaded X. GIS was used to create a centroid, or point representing the center of the parcel polygon. DFIRM flood data was then overlaid on the parcel layer. For the purposes of this analysis, the flood zone that intersected a parcel centroid was assigned the flood zone for the entire parcel. The parcels were segregated and analyzed in this fashion for the Garden Grove Planning Area. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessors database and the GIS parcel layer. Analysis on values at risk to floods in the City is provided for Garden Grove Planning Area as previously described in Section 4.3.1 in Table 4-36.

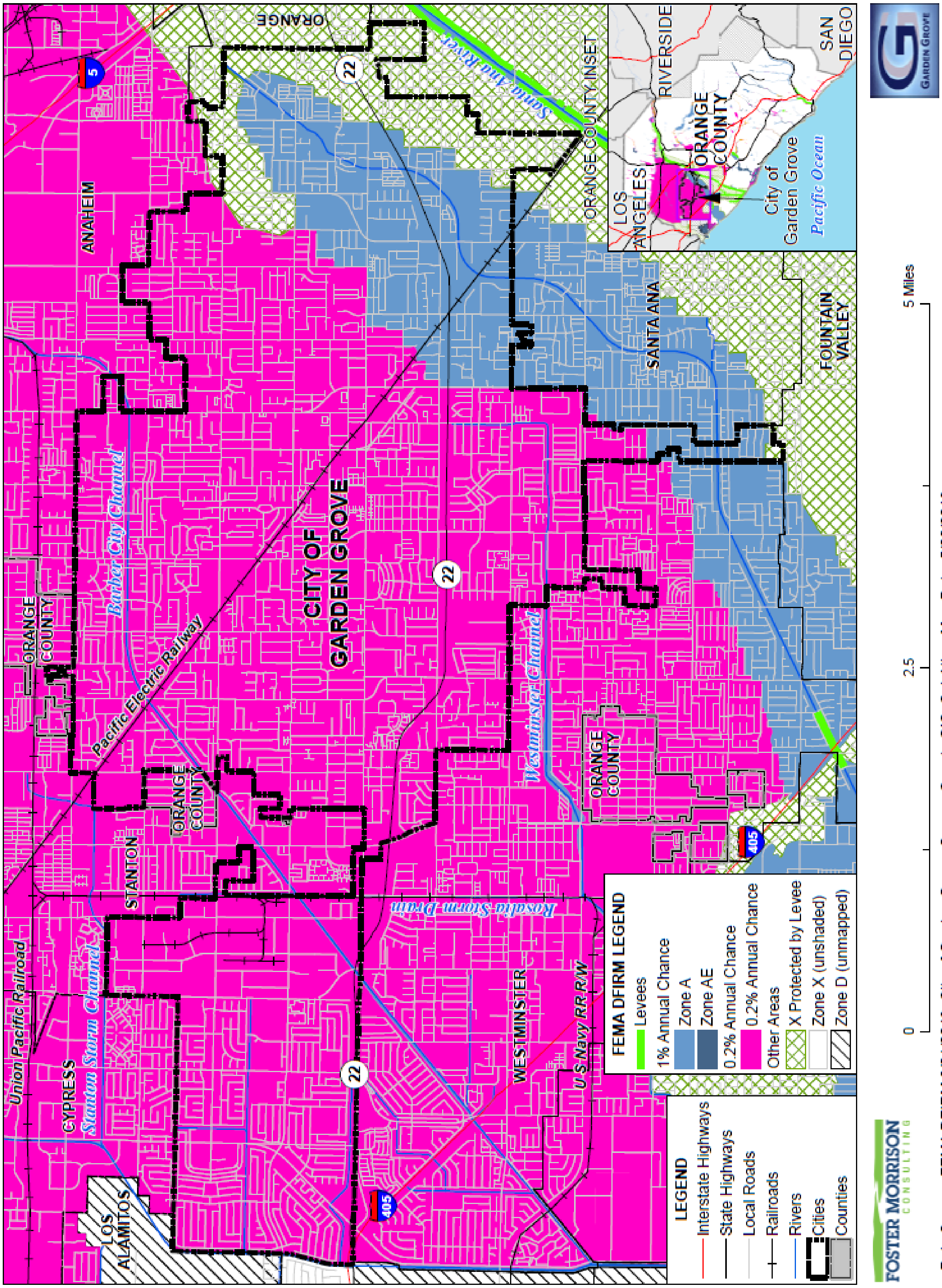
Each of the DFIRM flood zones that begins with the letter 'A' depict the Special Flood Hazard Area, or the 1% annual chance flood event (commonly referred to as the 100-year flood). Table 4-65 explains the difference between DFIRM mapped flood zones within the City and within the flood map extent. The effective DFIRM maps for the Garden Grove Planning Area are shown on Figure 4-62. REMOVE AE FROM MAP LEGEND

Table 4-65 City of Garden Grove (and map extent) - DFIRM Flood Zones

Flood Zone	Description
A	1% annual chance flood: Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown
Shaded X	0.2% annual chance flood: The areas between the limits of the 1% annual chance flood and the 0.2-percent-annual-chance (or 500-year) flood
X Protected by Levee	Areas protected from the 1% annual chance by levees.

Source: FEMA

Figure 4-62 City of Garden Grove– DFIRM Flood Zones



Flood Loss Estimate

The loss estimate for flood is based on the total of improved and contents value. Improved parcels include those with improved structure values identified in the Assessor's database. Only improved parcels and the value of their structure improvements were included in the flood loss analysis. The value of land is not included in the loss estimates as generally the land is not at loss to floods, just the value of improvements and structure contents. The land value is represented in the detailed flood tables, but are primarily present to show the value of the land associated with each flood zone.

The property use categories for the City (derived from general plan land use descriptions) were used to develop estimated content replacement values (CRV) that are potentially at loss from hazards, using FEMA Hazus methodologies as previously described in Section 4.3.1. The CRVs were added to the improved parcel values.

Once the potential value of affected parcels was calculated, a damage factor was applied to obtain loss estimates by flood zone. When a flood occurs, seldom does the event cause total loss of an area or building. Potential losses from flooding are related to a variety of factors including flood depth, flood velocity, building type, and construction. The percent of damage is primarily related to the flood depth. FEMA's flood benefit/cost module uses a simplified approach to model flood damage based on building type and flood depth. The values at risk in the flood analysis tables were refined by applying an average damage estimation of 20% of the total building value. The 20% damage estimate utilized FEMA's Flood Building Loss Table based on an assumed average flood depth of 2 feet. The end result of the flood hazard analysis is an inventory of the numbers, types, and values of parcels subject to the flood hazard.

Limitations

It also should be noted that the resulting flood loss analysis may actually be more or less than that presented in the below tables as the City may include structures located within the 1% or 0.2% annual chance floodplain that are elevated at or above the level of the base flood elevation, according to local floodplain development requirements. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the floodplain due primarily to Proposition 13.

Flooded Acres

In addition to the centroid analysis used to obtain numbers of parcels and assets at risk to flood hazards, parcel boundary analysis was performed to obtain total acres and flooded acres by flood zone for each parcel.

GIS was used to calculate acres flooded by FEMA flood zones and property use categories. The Garden Grove parcel layer and FEMA DFIRM were intersected, and each segment divided by the intersection of flood zone and parcels was calculated for acres. This process was conducted for 1% and 0.2% annual chance flood areas, with each segment being defined by zone type and acres. The resulting data tables with flooded acreages were then imported into a database and linked back to the original parcels, including total acres by parcel number. Once this was completed, each parcel contained acreage values for flooded acres by zone type within the parcel. In the tables below, the 1% and 0.2% annual chance flood zones are summarized and then split out by property use, their total flooded acres, total improved acres, and percent of improved acres that are flooded.

Garden Grove Flood Analysis Results

Table 4-66 and Table 4-67 contain flood analysis results for the Garden Grove Planning Area. These tables show the number of parcels and values at risk to the 1% and 0.2% annual chance event for the City of Garden Grove. Table 4-66 shows a summary of the value of improved parcels by flood zone. Table 4-67 shows the improved parcels by property use category in each flood zone for the City.

Table 4-66 City of Garden Grove – Count and Value of Parcels by FEMA DFIRM 1% and 0.2% Annual Chance Flood Zones*

Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	3,548	3,424	$1,142,677,690	$635,760,196	$482,192,987	$2,260,630,889
0.2% Annual Chance Flood Hazard**	26,691	26,013	$7,214,527,897	$3,961,971,167	$2,864,733,333	$14,041,232,389
X Protected by Levee	2,067	1,974	$562,156,912	$320,357,925	$225,337,948	$1,107,852,792
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: FEMA 3/21/2019 DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data

*With respect to improved parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance floodplain.

Table 4-67 City of Garden Grove – Count and Value of Parcels by Detailed DFIRM Flood Zones and Property Use*

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard						
Zone A						
Civic	18	14	$19,576,176	$28,225,283	$28,225,283	$76,026,742
Commercial	97	86	$62,478,196	$46,179,333	$46,179,333	$154,836,862
Industrial	152	134	$78,875,291	$62,857,735	$94,286,603	$236,019,629
Mixed Use	201	179	$185,720,080	$126,083,651	$126,083,651	$437,887,382
Open Space	19	4	$3,821,064	$2,422,040	$2,422,040	$8,665,144
Residential	3,060	3,007	$792,206,883	$369,992,154	$184,996,077	$1,347,195,130
Unknown	1	0	$0	$0	$0	$0

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Zone A Total	3,548	3,424	$1,142,677,690	$635,760,196	$482,192,987	$2,260,630,889
1% Annual Chance Flood Hazard Total	**3,548**	**3,424**	**$1,142,677,690**	**$635,760,196**	**$482,192,987**	**$2,260,630,889**
0.2% Annual Chance Flood Hazard						
Civic	63	52	$51,717,173	$100,504,380	$100,504,380	$252,725,933
Commercial	402	361	$315,698,626	$245,094,575	$245,094,575	$805,887,776
Industrial	191	185	$462,924,228	$356,314,083	$534,471,125	$1,353,709,432
Mixed Use	1,049	946	$763,814,176	$691,559,109	$691,559,109	$2,146,932,394
Open Space	114	29	$27,218,899	$17,709,268	$17,709,268	$62,637,435
Residential	24,836	24,440	$5,593,140,131	$2,550,789,752	$1,275,394,876	$9,419,324,755
Unknown	36	0	$14,664	$0	$0	$14,664
0.2% Annual Chance Flood Hazard Total	**26,691**	**26,013**	**$7,214,527,897**	**$3,961,971,167**	**$2,864,733,333**	**$14,041,232,389**
X Protected by Levee						
Civic	5	4	$3,977,479	$6,916,968	$6,916,968	$17,811,415
Commercial	49	45	$24,821,532	$17,810,994	$17,810,994	$60,443,520
Industrial	3	2	$7,620,573	$4,692,298	$7,038,447	$19,351,318
Mixed Use	116	86	$92,102,337	$93,510,474	$93,510,474	$279,123,285
Open Space	8	2	$2,030,100	$2,933,387	$2,933,387	$7,896,874
Residential	1,882	1,834	$431,439,920	$194,255,355	$97,127,678	$722,822,960
Unknown	4	1	$164,971	$238,449	$0	$403,420
X Protected by Levee Total	**2,067**	**1,974**	**$562,156,912**	**$320,357,925**	**$225,337,948**	**$1,107,852,792**
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: FEMA 3/21/2019 DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data

*With respect to improved parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance floodplain.

Table 4-68 shows a summary table of loss estimates by flood zone for the Garden Grove Planning Area, and gives potential losses summarized by the 1% and 0.2% annual chance flood event with loss estimate and loss ratios for the Garden Grove Planning Area. The loss ratio is the loss estimate divided by the total potential exposure (i.e., total of improved and contents value for all parcels located in the Planning Area) and displayed as a percentage of loss. FEMA considers loss ratios greater than 10% to be significant and an indicator that a community may have more difficulties recovering from a flood. The City should keep in mind that the loss ratio could increase with additional development in the 1% and 0.2% annual chance floodplain unless development is elevated in accordance with the local floodplain management ordinance.

Loss estimates for the levee protected areas of the City are contained in Section 4.3.10.

*Table 4-68 City of Garden Grove – Flood Loss Estimate Summary**

Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance	3,548	3,424	$1,142,677,690	$635,760,196	$482,192,987	$1,117,953,199	$223,590,640	1.6%
0.2% Annual Chance	26,691	26,013	$7,214,527,897	$3,961,971,167	$2,864,733,333	$6,826,704,392	$1,365,340,878	9.9%
Grand Total	**30,239**	**29,437**	**$8,357,205,587**	**$4,597,731,363**	**$3,346,926,320**	**$7,944,657,591**	**$1,588,931,518**	**11.50%**

Source: FEMA 3/21/2019 DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data

*With respect to improved parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance floodplain.

According to the information in Table 4-66 through Table 4-68, the Garden Grove Planning Area has 3,424 improved parcels and roughly $1.12 billion of structure and contents value in the 1% annual chance floodplain. There are an additional 26,013 improved parcels and roughly $6.83 billion of structure and contents value in the 0.2% annual chance flood event. A loss ratio of 11.5% indicates that the City does have significant assets at risk, and a major flood would be difficult to recover from.

Flooded Acres

Also of interest is the land area affected by the various flood zones. The following is an analysis of flooded acres in the City. The following tables represent a detailed and summary analysis of total acres for each FEMA DFIRM flood zone. Table 4-69 gives detailed information for the Planning Area by summary flood zone and property use. Table 4-70 gives a summary for the entire Planning Area by summary property use and flood zone. Table 4-71 gives a summary of acres in the 1% and 0.2% annual chance floodplains.

Table 4-69 City of Garden Grove – Flooded Acres by DFIRM Flood Zone and Property Use

Flood Zone/ Property Use	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
1% Annual Chance Flood Hazard			
Zone A			
Civic	68	62	5.94%
Commercial	69	61	5.82%
Industrial	137	108	10.29%

Flood Zone/ Property Use	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
Mixed Use	173	151	14.45%
Open Space	40	8	0.78%
Residential	692	657	62.71%
Unknown	0	0	0.00%
Zone A Total	**1,179**	**1,047**	**100.00%**
1% Annual Chance Flood Hazard Total	**1,179**	**1,047**	**100.00%**
0.2% Annual Chance Flood Hazard			
Civic	534	511	7.59%
Commercial	341	299	4.44%
Industrial	452	433	6.43%
Mixed Use	940	862	12.79%
Open Space	220	134	1.98%
Residential	4,733	4,497	66.76%
Unknown	8	-	0.00%
0.2% Annual Chance Flood Hazard Total	**7,228**	**6,736**	**100.00%**
X Protected by Levee			
Civic	49	49	10.02%
Commercial	35	29	5.95%
Industrial	8	8	1.55%
Mixed Use	84	36	7.33%
Open Space	24	19	3.84%
Residential	385	347	71.30%
Unknown	1	0	0.02%
X Protected by Levee Total	**586**	**487**	**100.00%**
Other Areas Total	**586**	**487**	**100.00%**
Grand Total	**8,994**	**8,270**	**100.00%**

Source: FEMA 3/21/2019 DFIRM

Table 4-70 City of Garden Grove – Flooded Acres by Land Use Type and DFIRM Flood Zone

Property Use/Flood Zone	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
Civic			
1% Annual Chance Flood Hazard	68	62	0.75%

Property Use/Flood Zone	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
0.2% Annual Chance Flood Hazard	534	511	6.18%
X Protected by Levee	49	49	0.59%
Civic Total	**652**	**622**	**7.52%**
Commercial			
1% Annual Chance Flood Hazard	69	61	0.74%
0.2% Annual Chance Flood Hazard	341	299	3.62%
X Protected by Levee	35	29	0.35%
Commercial Total	**445**	**389**	**4.71%**
Industrial			
1% Annual Chance Flood Hazard	137	108	1.30%
0.2% Annual Chance Flood Hazard	452	433	5.23%
X Protected by Levee	8	8	0.09%
Industrial Total	**597**	**548**	**6.63%**
Mixed Use			
1% Annual Chance Flood Hazard	173	151	1.83%
0.2% Annual Chance Flood Hazard	940	862	10.42%
X Protected by Levee	84	36	0.43%
Mixed Use Total	**1,196**	**1,049**	**12.68%**
Open Space			
1% Annual Chance Flood Hazard	40	8	0.10%
0.2% Annual Chance Flood Hazard	220	134	1.62%
X Protected by Levee	24	19	0.23%
Open Space Total	**284**	**161**	**1.94%**
Residential			
1% Annual Chance Flood Hazard	692	657	7.94%
0.2% Annual Chance Flood Hazard	4,733	4,497	54.38%
X Protected by Levee	385	347	4.20%
Residential Total	**5,810**	**5,501**	**66.52%**

Property Use/Flood Zone	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
Unknown			
1% Annual Chance Flood Hazard	0	0	0.00%
0.2% Annual Chance Flood Hazard	8	0	0.00%
X Protected by Levee	1	0	0.00%
Unknown Total	**10**	**0**	**0.00%**
Grand Total	**8,994**	**8,270**	**100.00%**

Source: FEMA 3/21/2019 DFIRM

Table 4-71 City of Garden Grove – Flooded Acres Summary by DFIRM Flood Zone

Flood Zone/ Property Use	Total Flooded Acres	Improved Flooded Acres	% of Improved Flooded Acres
1% Annual Chance Flood Hazard	1,179	1,047	12.66%
0.2% Annual Chance Flood Hazard	7,228	6,736	81.45%
X Protected by Levee	586	487	5.89%
Grand Total	**8,994**	**8,270**	**100.00%**

Source: FEMA 3/21/2019 DFIRM

Insurance Coverage, Claims Paid, and Repetitive Losses

The City of Garden Grove joined the NFIP on September 30, 1982. The City does not participate in the CRS program. NFIP insurance data indicates that as of July 19, 2018, there were 1,206 policies in force in the City, resulting in $306,353,500 of insurance in force. Of these, 1,099 are for residential properties and 107 are nonresidential. 1,007 of these are in the A zone and 199 policies are for parcels in the B, C, & X zones.

There have been 59 closed paid losses totaling $354,658,82. 55 of these were for residential properties and 5 were for nonresidential. Of these 60 paid losses, 53 were parcels in the A zone and 6 parcels were in B, C, & X zones, and 1 was unknown. Of the 60 claims, 49 claims were associated with pre-FIRM structures, 0 with post-FIRM structures, and 11 were unknown. There have been 2 substantial damage claims since 1978. There are 4 repetitive loss (RL) properties and 1 severe repetitive loss (SRL) property in the City. Information on the status of these properties was not available for this Plan. CAN YOU PROVIDE AN UPDATE OF WHETHER THESE RL AND SRL PROPERTIES HAVE BEEN MITIGATED?

Based on this analysis of insurance coverage, the City has assets at risk to the 1% annual chance and greater floods. Of the 3,424 improved parcels within the 1% annual chance floodplain, 1,007 (or 29.4 percent) of those parcels maintain flood insurance.

Population at Risk

Those residential parcel centroids that intersect the DFIRM flood zones were counted and multiplied by the 2010 Census Bureau average household factors for the City of Garden Grove (3.06). According to this analysis, there is a total population of 11,306 and 91,894 residents in Garden Grove in 1% annual chance and 0.2% annual chance floodplains, respectively. This is shown in Table 4-72. It should be noted that all of the residents in the 1% annual chance floodplain would also fall in the 0.2% annual chance floodplain.

Table 4-72 City of Garden Grove – Count of Residential Parcels and Population by DFIRM Flood Zone

DFIRM Flood Zone/ Jurisdiction	1% Annual Chance		0.2% Annual Chance	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Garden Grove	3,007	11,306	24,440	91,894

Source: FEMA September 30, 2005 DFIRM, US Census Bureau, City of Garden Grove March 2019 Parcel/Assessor's Data

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in the City of Garden Grove to determine critical facilities in the DFIRM flood zones. Using GIS, the DFIRM flood zones were overlayed on the critical facility GIS layer. Figure 4-63 shows critical facilities, as well as the DFIRM flood zones. Table 4-73 provides summary information of critical facilities in the DFIRM zones by 1% and 0.2% annual chance floodplain. Table 4-74 provides greater detail on which DFIRM floodplain these critical facilities fall in by facility type and count. Details of critical facility definition, type, name, and address by FEMA DFIRM flood zone are listed in Appendix E.

Figure 4-63 City of Garden Grove – Critical Facilities in DFIRM Flood Zones

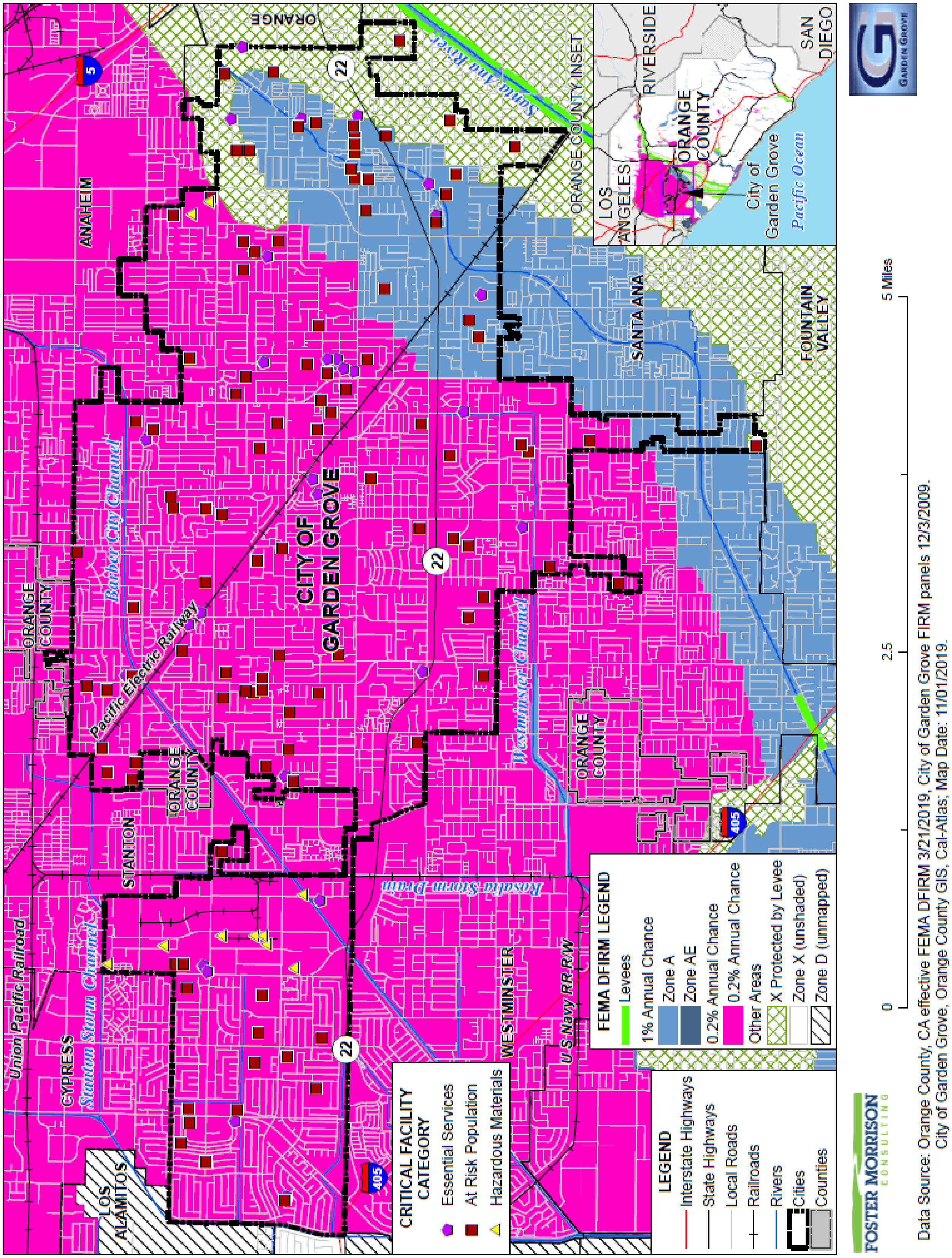


Table 4-73 City of Garden Grove – Critical Facilities in DFIRM Flood Zones Summary

Flood Zone/Critical Facility Category	Facility Count
1% Annual Chance Flood Hazard	
Essential Services Facilities	4
At Risk Population Facilities	18
1% Annual Chance Flood Hazard Total	**22**
0.2% Annual Chance Flood Hazard*	
Essential Services Facilities	27
At Risk Population Facilities	86
Hazardous Materials Facilities	10
0.2% Annual Chance Flood Hazard Total	**123**
Other Areas (X Protected by Levee)	
Essential Services Facilities	4
At Risk Population Facilities	9
Other Areas Total	**13**
Grand Total	**158**

Source: Garden Grove GIS, FEMA DFIRM 3/21/2019

*This count only includes those critical facilities in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood, in actuality, also includes all critical facilities in the 1% annual chance floodplain.

Table 4-74 City of Garden Grove – Critical Facilities in Detailed DFIRM Flood Zones by Category and Facility Type

Flood Zone/ Critical Facility Category / Critical Facility Type	Facility Count
1% Annual Chance Flood Hazard	
Zone A	
Essential Services Facilities	
Fire Station	1
Public Works Facility	3
Essential Services Facilities Total	**4**
At Risk Population Facilities	
Hospital/Medical	5
Hotel	2
Park	2
School	5
Senior Housing	4
At Risk Population Facilities Total	**18**
Zone A Total	**22**

Flood Zone/ Critical Facility Category / Critical Facility Type	Facility Count
1% Annual Chance Flood Hazard Total	**22**
0.2% Annual Chance Flood Hazard*	
Zone X (shaded)	
Essential Services Facilities	
Fire Station	6
Government Building	3
Police Station	1
Public Building	6
Public Works Facility	11
Essential Services Facilities Total	**27**
At Risk Population Facilities	
Entertainment	2
Hospital/Medical	2
Hotel	1
Park	17
Religious Assembly	14
School	46
Senior Housing	4
At Risk Population Facilities Total	**86**
Hazardous Materials Facilities	
Covered Landfill	2
Hazmat	8
Hazardous Materials Facilities Total	**10**
0.2% Annual Chance Flood Hazard Total	**123**
Other Areas	
X Protected by Levee	
Essential Services Facilities	
Government Building	1
Public Works Facility	3
Essential Services Facilities Total	**4**
At Risk Population Facilities	
Park	2
Religious Assembly	1
School	6
At Risk Population Facilities Total	**9**
Other Areas Total	**13**

Flood Zone/ Critical Facility Category / Critical Facility Type	Facility Count
Grand Total	**158**

Source: Garden Grove GIS, FEMA DFIRM 3/21/2019

*This count only includes those critical facilities in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood, in actuality, also includes all critical facilities in the 1% annual chance floodplain.

Overall Community Impact

Floods and their impacts vary by location and severity of any given flood event and will likely only affect certain areas of the City during specific times. Based on the risk assessment, it is evident that floods will continue to have potentially devastating economic impacts to certain areas of the City. However, many of the floods in the City are minor, localized flood events that are more of a nuisance than a disaster. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values;
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed; and
- Impact on the overall mental health of the community.

Future Development

Future development in the City may be built in the floodplain, in conformance to the standards of the floodplain ordinance. The City enforces the floodplain ordinance on new development in Garden Grove.

Future Development/Redevelopment: GIS Analysis

Future development/redevelopment areas for the City are broken out into multiple areas. GIS data is maintained by the City of Garden Grove and was made available for this plan. An analysis was performed to quantify parcels within DFIRM flood zones. GIS was used to create a centroid, or point representing the center of the parcel polygon. Those parcels centroids that fall inside the possible future development areas and that were within the DFIRM flood zones are shown on Figure 4-64 and detailed in Table 4-75.

Figure 4-64 City of Garden Grove– Future Development Areas in DFIRM Flood Zones

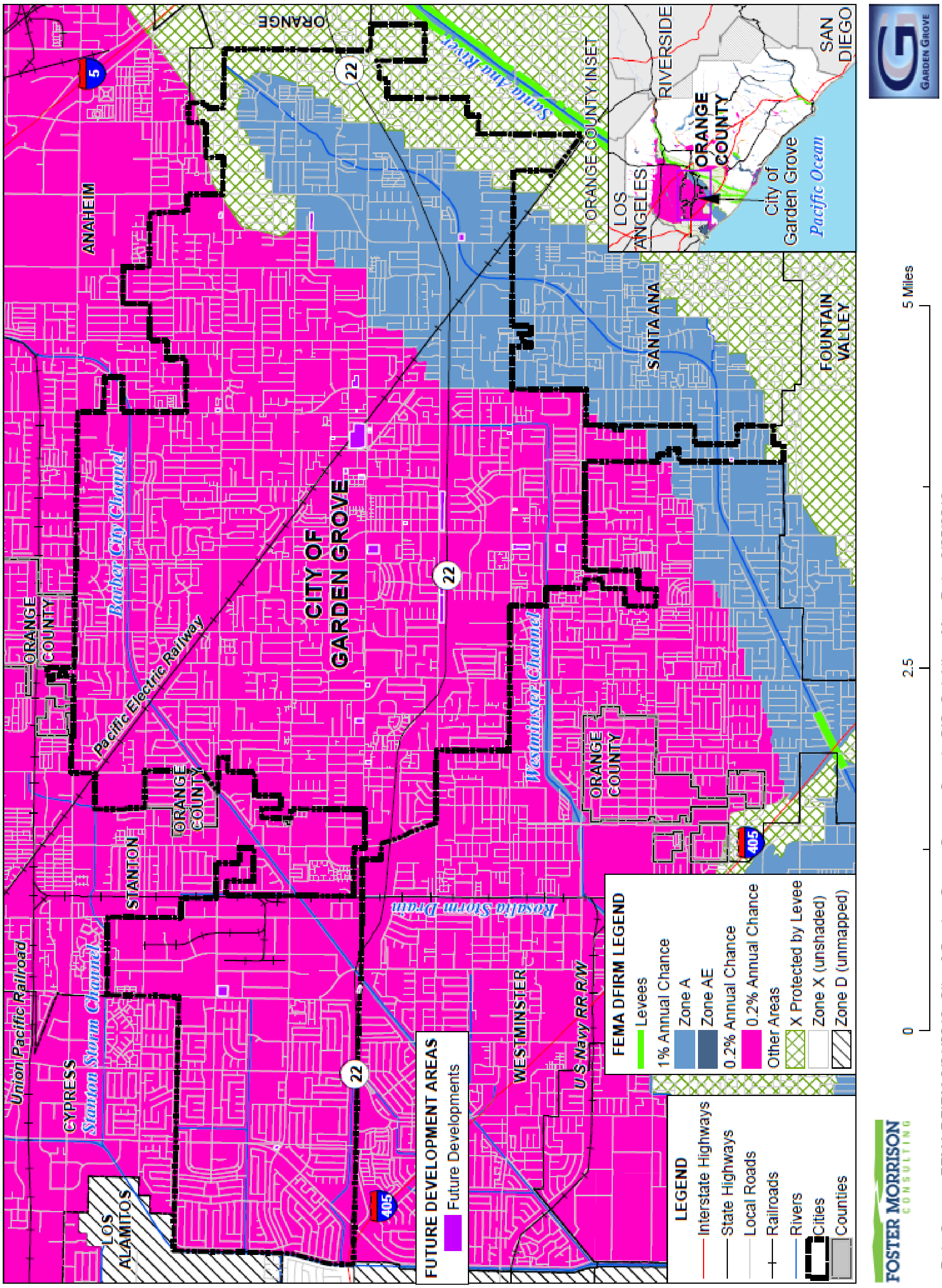


Table 4-75 City of Garden Grove – Future Development Areas in DFIRM Flood Zones by Parcels and Acreage

Flood Zones / Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
1% Annual Change Flood Zone			
10522 McFadden Ave	1	1	0.35
12612 Buaro St	1	1	1.91
13650 Harbor Blvd	1	1	1.25
1% Annual Chance Total	**3**	**3**	**3.51**
0.2% Annual Chance Flood Hazard			
10052 Central Ave	1	1	0.20
10080 Garden Grove Blvd	1		3.09
10142 Westminster Ave	1	1	0.16
10150 Trask Ave	1		5.14
10152 Westminster Ave	1	1	0.17
10531 Garden Grove Blvd	1	1	0.61
10561 Garden Grove Blvd	1	1	0.41
10611 Acacia Ave	1	1	0.58
10691 Westminster Ave	1	1	0.30
10801 Garden Grove Blvd	1	1	10.70
10812 Stanford Ave	1	1	0.23
10862 Garden Grove Blvd	1	1	0.22
10872 Garden Grove Blvd	1		0.15
10882 Garden Grove Blvd	1		0.16
11001 Chapman Ave	1	1	0.53
12072 Knott St	2	2	6.38
12361 Chapman Ave	1	1	0.48
12422 Valley View St	1	1	0.53
12900 Euclid St	1		1.99
12900 Main St	2	2	0.13
7051 Garden Grove Blvd	1		0.52
8562 Garden Grove Blvd	1	1	0.55
8851 Garden Grove Blvd	1	1	1.05
9106 Garden Grove Blvd	1	1	0.48
9444 Trask Ave	1	1	3.50
9670 Trask Ave	1	1	3.00
9861 11th St	1	1	1.76
9892 Westminster Ave	2	2	4.43

Flood Zones / Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
0.2% Annual Chance Total	**31**	**25**	**47.47**
Grand Total	**34**	**28**	**50.97**

Source: City of Garden Grove GIS, FEMA 3/21/2019 DFIRM

4.3.9. Flood: Localized/Stormwater Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Historically, Garden Grove has been at risk to flooding primarily during the winter and spring months when heavy rainfall occurs. Localized flooding also occurs throughout the City at various times throughout the year with several areas of primary concern. In addition to flooding, damage to these areas during heavy storms includes pavement deterioration, washouts, landslides/mudslides, debris areas, and downed trees. The amount and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff. These areas and the types of damage were presented in Table 4-30.

The HMPC noted that heavy rains may produce ponding around storm drains but these events are short in duration and do not typically cause property damage. Impacts include damages to infrastructure, roads, bridges, and public property. Impacts to property and life safety are generally low. The most significant impact to City from localized flooding is street flooding and closures. Most drainage channels in the City are only designed to the 10-year event. Backbone drainage structures supporting the City are provided by the County.

The HMPC noted that localized flooding can cause road damages. The City of Garden Grove 2018 Pavement Management Program Update Final Report noted that the City owns and maintains approximately 361.1 centerline miles of pavements, which includes 74.1 miles of the Master Plan of Arterial Highways (MPAH) streets and 287 miles of local streets, representing a total replacement cost of $565.5 million.

Future Development

The risk of stormwater/localized flooding to future development can be minimized by accurate recordkeeping of repetitive localized storm activity. Mitigating the root causes of the localized stormwater or choosing not to develop in areas that often are subject to localized flooding will reduce future risks of losses due to stormwater/localized flooding. Due to the developed nature of the City, future development should not substantially alter the drainage pattern of the area, and should not substantially increase the rate of surface run-off that will cause flooding on or off site. However, drainage considerations should be addressed for all new development or redevelopment projects.

4.3.10. Levee Failure

Likelihood of Future Occurrence—Unlikely
Vulnerability—Medium

Levee failure flooding can occur as the result of partial or complete collapse of an impoundment, and often results from prolonged rainfall and flooding. The primary danger associated with dam or levee failure is the high velocity flooding of those properties downstream of the breach.

A levee failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to levee failures is generally confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions.

Levees of Concern

The City of Garden Grove 2016 EOP noted that overflow from the Santa Ana River is probable as a result of breaching the levees both upstream and downstream of the City limits, according to the Flood Insurance Study for the City (March 1957) prepared by the Los Angeles District, Army Corps of Engineers. This is the result of breakouts from the Santa Ana River. These levees are certified to protect to the 100-year or 1% annual chance flood. The flood channels are capable of carrying up to the 100-year peak flows with few exceptions. Those areas would be flooded from 2-3 feet. According to the Army Corps of Engineers' predictions, a 500-year breakout will completely inundate the City to a depth of 1.5 to 2 feet of water. This is the result of both local flow and breached Santa Ana River flood flows.

Two major non-levee structures traverse the drainage area and cause restrictions in the movement of the flood flows. The SR-22 Freeway crosses east-west through the City on an embankment ranging from 5-to-25 feet above the local elevation. Running northwest to southeast across the drainage area is the Southern Pacific Railroad track. The track is elevated to 6 feet above ground level. Flows which accumulate behind these elevated portions of road and tracks must travel down slope until they pass over at ground level crossings or through culverts.

A USACE Levee Safety Program Report for the Santa Ana River Levee System noted the following after a 2014 Periodic Inspection:

> ***The Levee Safety Officer (LSO) Out-Brief Meeting was held on March 13, 2015. An engineering determination has concluded that the observed deficiencies would not prevent the system from performing as intended during the next significant runoff event. Therefore, the Dam and Levee Safety Section Chief, who was acting on the behalf of the LSO, Los Angeles District, has determined the overall rating of the SAR1 Levee System to be "Minimally Acceptable."***
>
> ***A "Minimally Acceptable" system rating is defined as, "One or more items are rated Minimally Acceptable or one or more items are rated Unacceptable and an engineering determination concludes that the Unacceptable items would***

not prevent the segment/system from performing as intended during the next significant runoff event."

It should be noted that the majority of the inspection observations observed during the Periodic Inspection and rated as Unacceptable were subsequently repaired by Orange County Public Works.

Levee failure flooding would vary in the City depending on which structure fails and the nature and extent of the failure and associated flooding. This flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

Values at Risk

The City of Garden Grove has mapped FEMA X Protected by Levee flood hazard areas. GIS was used to determine the possible impacts of flooding within the City and how the risk varies across the area that makes up the City. The following methodology was followed in determining improved parcel counts and assets at risk in the X Protected by Levee flood zones.

Methodology

City of Garden Grove's March 2019 Assessor Data and GIS parcel data were used as the basis for the City inventory of parcels, values, and acres. Orange County, including Garden Grove, has a FEMA effective DFIRM dated 3/21/2019, which was obtained from the National Flood Hazard Layer to perform the levee flood analysis.

The loss estimate for levee failure flooding is based on the total of improved and contents value. Improved parcels include those with improved structure values identified in the Assessor's database. Only improved parcels and the value of their structure improvements were included in the flood loss analysis. The value of land is not included in the loss estimates as generally the land is not at loss to floods, just the value of improvements and structure contents. The land value is represented in the detailed levee failure flood tables, but are primarily present to show the value of the land associated with the X Protected by Levee flood zone.

The property use categories for the City (derived from general plan land use descriptions) were used to develop estimated content replacement values (CRV) that are potentially at loss from hazards, using FEMA Hazus methodologies as previously described in Section 4.3.1. The CRVs were added to the improved parcel values.

Once the potential value of affected parcels was calculated, a damage factor was applied to obtain loss estimates by X Protected by Levee flood zone. When a flood occurs, seldom does the event cause total loss of an area or building. Potential losses from levee failure flooding are related to a variety of factors including levee failure flood depth, flood velocity, building type, and construction. The percent of damage is primarily related to the flood depth. FEMA's flood benefit/cost module uses a simplified approach to model flood damage based on building type and flood depth. The values at risk in the flood analysis tables were refined by applying an average damage estimation of 20% of the total building value. The 20% damage estimate utilized FEMA's Flood Building Loss Table based on an assumed average flood depth of

2 feet. The end result of the flood hazard analysis is an inventory of the numbers, types, and values of parcels subject to the levee failure flood hazard.

Values at Risk Analysis Results

Mapped X Protected by Levee areas in the City are shown on Figure 4-65. Table 4-76 and Table 4-77 contain levee failure flood analysis results for the Garden Grove Planning Area. Table 4-76 shows the number of parcels and values by property use in the X Protected by Levee zone within the City of Garden Grove. Table 4-77 shows the levee failure flood loss estimates for the City using the same methodology for loss estimation shown in Section 4.3.9.

Figure 4-65 City of Garden Grove – FEMA DFIRM X Protected by Levee Zone

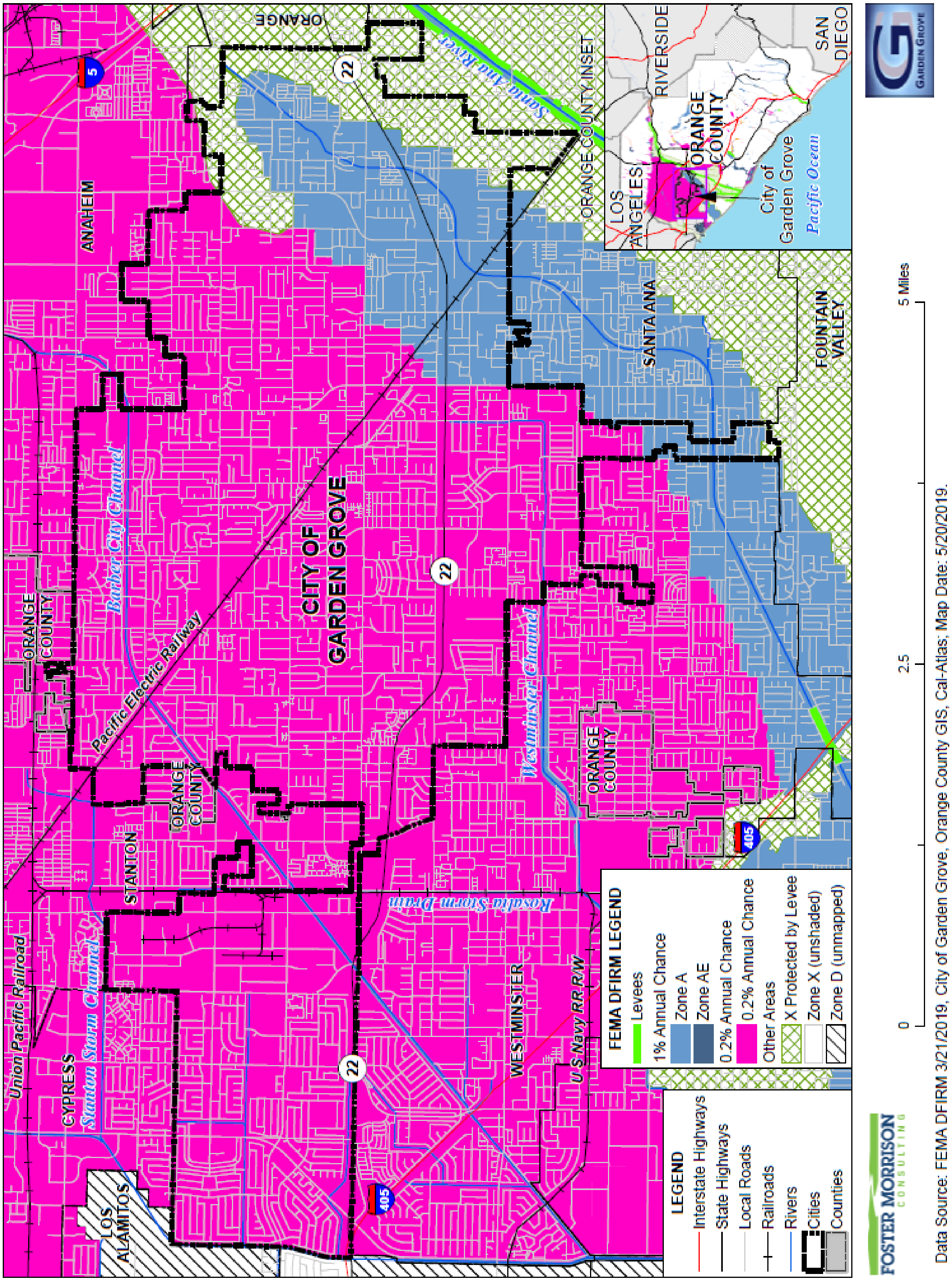


Table 4-76 City of Garden Grove – Count and Value of Parcels by FEMA DFIRM X Protected by Levee Zone by Property Use

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
X Protected by Levee						
Civic	5	4	$3,977,479	$6,916,968	$6,916,968	$17,811,415
Commercial	49	45	$24,821,532	$17,810,994	$17,810,994	$60,443,520
Industrial	3	2	$7,620,573	$4,692,298	$7,038,447	$19,351,318
Mixed Use	116	86	$92,102,337	$93,510,474	$93,510,474	$279,123,285
Open Space	8	2	$2,030,100	$2,933,387	$2,933,387	$7,896,874
Residential	1,882	1,834	$431,439,920	$194,255,355	$97,127,678	$722,822,960
Unknown	4	1	$164,971	$238,449	$0	$403,420
X Protected by Levee Total	**2,067**	**1,974**	**$562,156,912**	**$320,357,925**	**$225,337,948**	**$1,107,852,792**

Source: FEMA 3/21/2019 DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data

Table 4-77 City of Garden Grove – DFIRM X Protected by Flood Loss Estimate Summary

Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
X Protected by Levee	2,067	1,974	$562,156,912	$320,357,925	$225,337,948	$545,695,882	$109,139,176	0.8%

Source: FEMA 3/21/2019 DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data

Population at Risk

Those residential parcel centroids that intersect the X Protected by Levee DFIRM flood zone were counted and multiplied by the 2010 Census Bureau average household factors for the City of Garden Grove (3.06). According to this analysis, there is a total population of 6,896 residents in Garden Grove in levee protected areas. This is shown in Table 4-78.

Table 4-78 City of Garden Grove – Count of Residential Parcels and Population in DFIRM X Protected by Levee Areas

DFIRM Flood Zone / Jurisdiction	Levee Protected Areas	
	Improved Residential Parcels	Population
Garden Grove	1,834	6,896

Source: DFIRM, City of Garden Grove March 2019 Parcel/Assessor's Data, US Census Bureau Average Household Size – 3.76

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in the City of Garden Grove to determine critical facilities in the DFIRM X Protected by Levee flood zones. Using GIS, the DFIRM flood zones were overlayed on the critical facility GIS layer. Figure 4-66 shows critical facilities, as well as the DFIRM flood zones, including X Protected by Levee. Table 4-79 provides summary information of critical facilities in the DFIRM X Protected by Levee zones. Table 4-80 provides greater detail these critical facilities that fall in X Protected by Levee zones by facility type and count. Details of critical facility definition, type, name, and address by FEMA DFIRM X Protected by Levee zones are listed in Appendix E.

Figure 4-66 City of Garden Grove – Critical Facilities in DFIRM X Protected by Levee Flood Zones

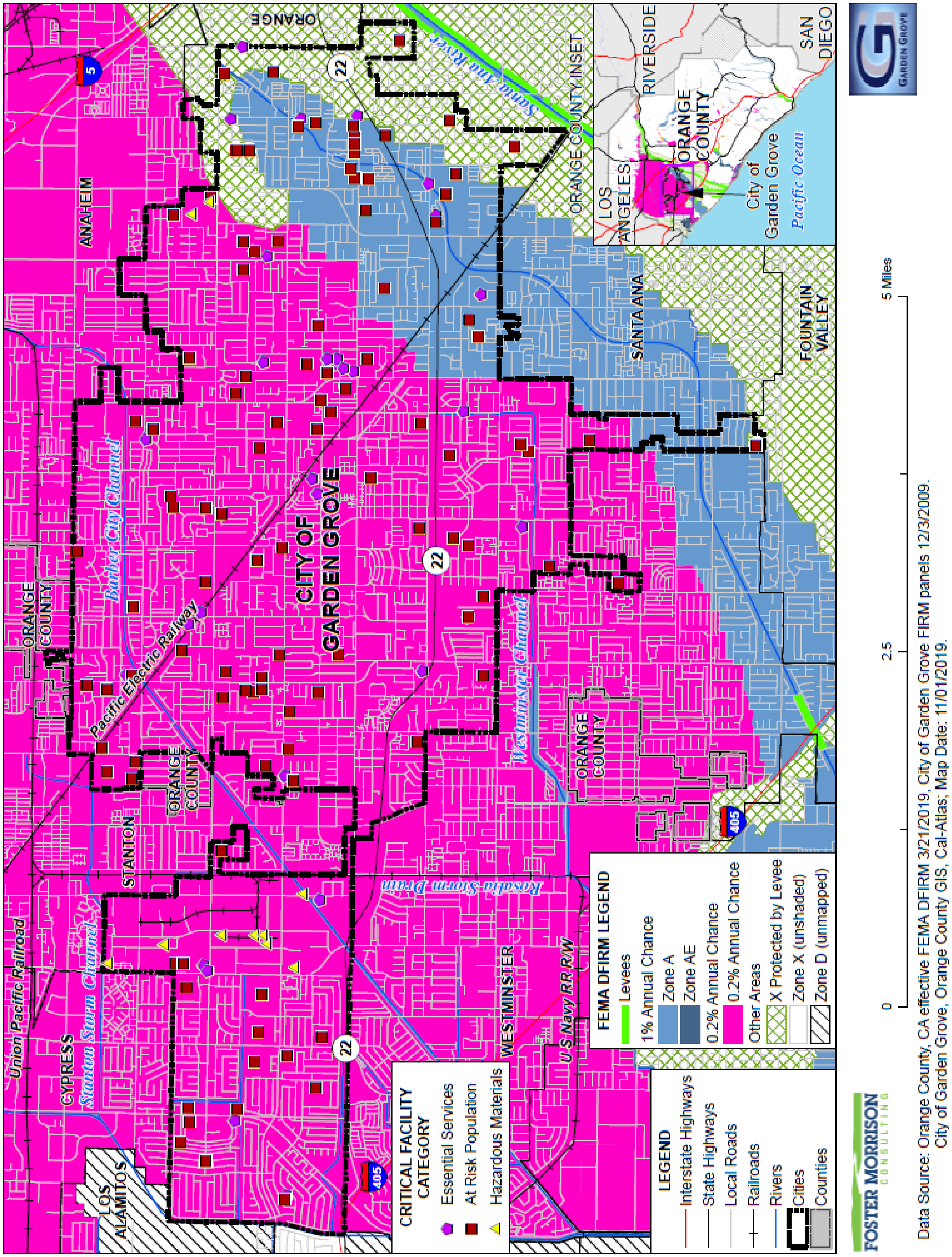


Table 4-79 City of Garden Grove – Critical Facilities in DFIRM X Protected by Levee Flood Zone Summary

Flood Zone/Critical Facility Category	Facility Count
Other Areas (X Protected by Levee)	
Essential Services Facilities	4
At Risk Population Facilities	9
Other Areas Total	**13**

Source: Garden Grove GIS, FEMA DFIRM 3/21/2019

Table 4-80 City of Garden Grove – Critical Facilities in Detailed DFIRM X Protected By Levee Flood Zones by Category and Facility Type

Flood Zone/ Critical Facility Category / Critical Facility Type	Facility Count
X Protected by Levee	
Essential Services Facilities	
Government Building	1
Public Works Facility	3
Essential Services Facilities Total	**4**
At Risk Population Facilities	
Park	2
Religious Assembly	1
School	6
At Risk Population Facilities Total	**9**
Other Areas Total	**13**

Source: Garden Grove GIS, FEMA DFIRM 3/21/2019

Overall Community Impact

Levee failure floods and their impacts vary by location and severity of any given flood event and will likely only affect certain areas of the City during specific times. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values;
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed; and
- Impact on the overall mental health of the community.

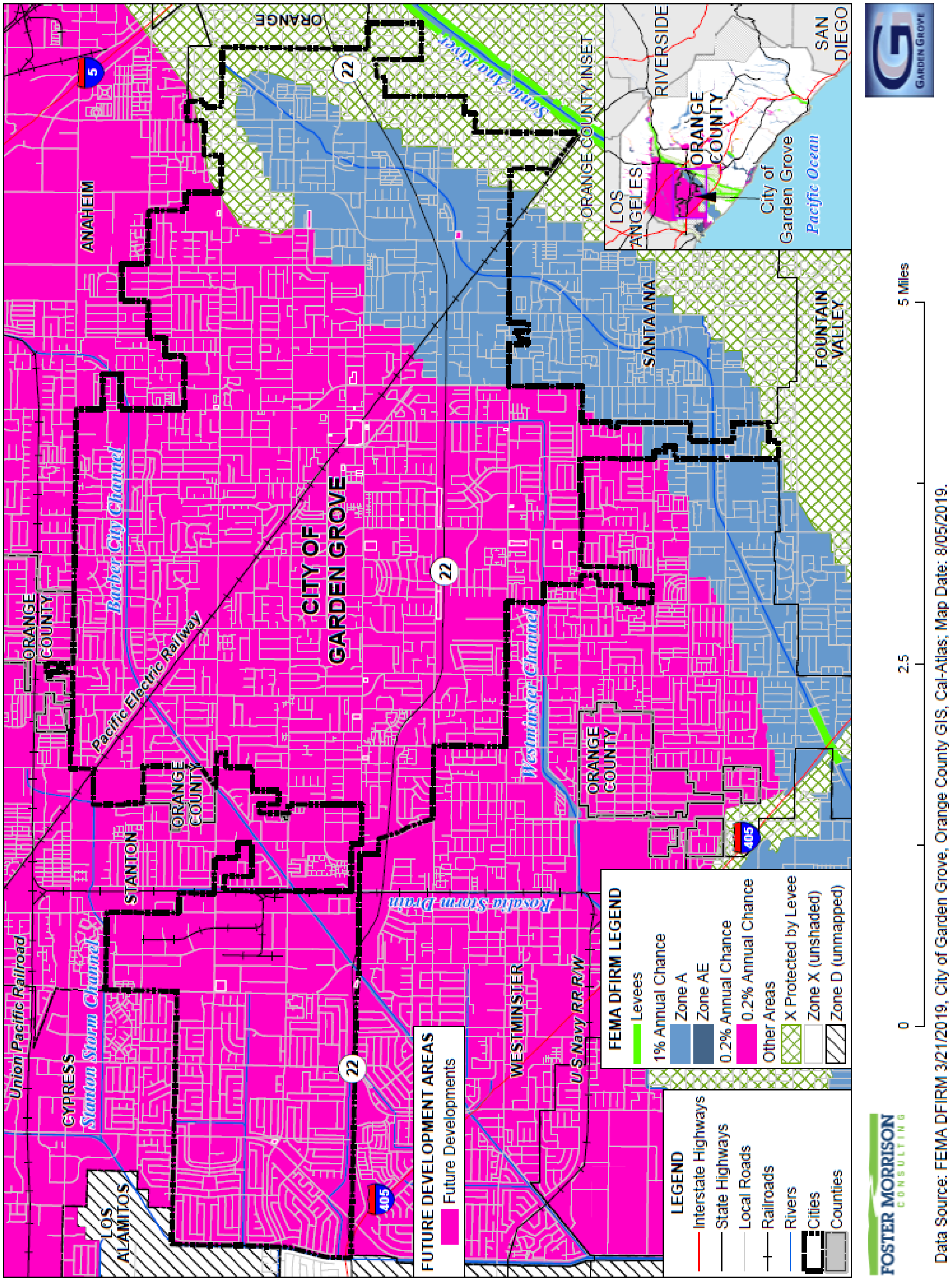
Future Development

Future development in the City may be built in the levee protected areas, as long as it conforms to the standards of the floodplain ordinance. The City enforces the floodplain ordinance on new development in Garden Grove.

Future Development/Redevelopment GIS Analysis

Future development/redevelopment areas for the City are broken out into multiple areas. GIS data is maintained by the City of Garden Grove and was made available for this plan. An analysis was performed to quantify parcels within DFIRM X Protected by Levee flood zones. GIS was used to create a centroid, or point representing the center of the parcel polygon. Those parcels centroids that fall inside the possible future development areas and that were within the DFIRM X Protected by Levee flood zones are shown on Figure 4-67. As shown, no future development is planned in levee protected areas.

Figure 4-67 City of Garden Grove– Development Areas in DFIRM X Protected by Levee Zones



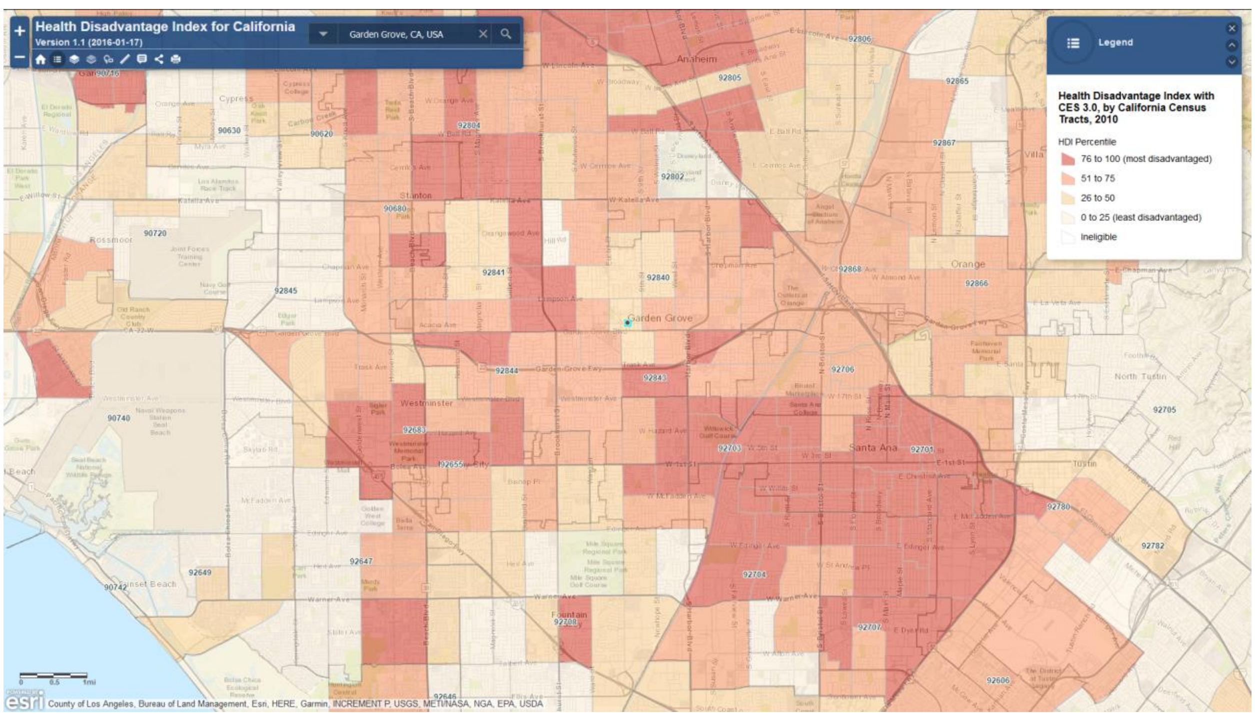
4.3.11. Severe Weather: Extreme Heat Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Extreme heat happens in the City each year. Extreme heat may overload demands for electricity to run air conditioners in homes and businesses during prolonged periods of exposure and presents health concerns to individuals outside in the temperatures. Extreme heat may also be a secondary effect of droughts, or may cause drought-like conditions in a temporary setting. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. Extreme heat, when combined with wind, can lead to (Public Safety Power Shutdown) PSPS events in the larger County area that could extend into the City. Extreme heat in the City taxes the urban forest, and can lead to tree mortality during periods of extended heat.

The Public Health Alliance has developed a composite index to identify cumulative health disadvantage in California. Factors such as those bulleted above were combined to show what areas are at greater risk to hazards like extreme heat. This is shown on Figure 4-68.

Figure 4-68 Health Disadvantage Index by California Census Tract



Source: Public Health Alliance of Southern California

Vulnerable populations to extreme heat include:

- Homeless
- Infants and children under age five

- Elderly (65 and older)
- Individuals with disabilities
- Individuals dependent on medical equipment
- Individuals with impaired mobility

In addition to vulnerable populations, pets and livestock are at risk to extreme heat.

Future Development

As the City shifts in demographics, more residents will become senior citizens. The residents of nursing homes and elder care facilities are especially vulnerable to extreme temperature events, as well as the elderly still living in their own homes. It is encouraged that such facilities have emergency plans or backup power to address power failure during times of extreme heat and in the event of a PSPS) or other interruption in service. Low income residents and homeless populations are also vulnerable. Cooling centers for these populations should be utilized when necessary.

4.3.12. Severe Weather: Heavy Rains and Storms Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

According to historical hazard data, severe weather is an annual occurrence in the City of Garden Grove. Damage and disaster declarations related to severe weather have occurred and will continue to occur in the future. Heavy rain and storms are the most frequent type of severe weather occurrences in the City. Wind and lightning sometimes accompany these storms and have caused damage in the past. Heavy rain and storms can cause power outages and downed trees. The flatter topography in the City makes storms a challenge. Hail and lightning are rare in the City.

Actual damage associated with the primary effects of severe weather has been limited. It is the secondary hazards caused by heavy rains and storms, such as localized floods that have had the greatest impact on the City. The risk and vulnerability associated with these secondary hazards are discussed in other sections of this plan (Section 4.3.8 Flood: 1%/0.2% Annual Chance and Section 4.3.9 Flood: Localized Stormwater).

Future Development

Residential housing that is built in the City must be built to residential code. That code ensures that homes are built to withstand heavy rains and storms. New critical facilities should be built to withstand severe storms and thunderstorm winds. While minimal damages have occurred to critical facilities in the past due to severe storm events, there still remains future risk. With development occurring in the region, future losses to new development may occur.

4.3.13. Severe Weather: High Winds Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

The City of Garden Grove is subject to potentially destructive straight-line winds. High winds and Santa Ana winds are common throughout the area and can happen during most times of the entire year. Straight line winds are primarily a public safety and economic concern. Windstorms can cause damage to structures and power lines which in turn can create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered.

The Santa Ana Winds are a seasonal phenomenon in Southern California occurring between October and March. These Winds are warm, dry, gusty offshore winds that blow from the east or northeast and occur below the passes and canyons of the coastal ranges of Southern California and in Los Angeles Basin. According to San Diego's National Weather Service forecasters, winds must blow at speeds greater than 25 knots (28.8 mph) to be called Santa Ana Winds. They accelerate to speeds of 35 knots (approximately 40 mph) as they move through canyons and passes, with gusts to 50 or 60 knots (between 55 and 70 mph).

Several meteorological conditions contribute to the phenomenon. The Bernoulli Effect accounts for increased speeds when the desert wind is pushed through narrow canyons. Bernoulli's law mathematically describes the relationship between pressure and velocity in the flow of fluids. Although different scenarios may contribute to a Santa Ana Wind, the most common pattern involves a high-pressure region sitting over the great Basin (the high plateau that is west of the Rockies and east of the Sierras). According to most accounts, they are named for either the Santa Ana River Valley where they originate or for the Santa Ana Canyon, southeast of Los Angeles, where they pick up speed.

Winds can affect urban trees, especially when they are already weakened from drought or disease. The impact of Santa Ana Winds would be minimal with regards to personal injuries from trees or utility poles falling. The strong winds, dry weather and drought conditions cause fires to spread quickly which may impact the City's heavily dense industrial areas on Knott Avenue, which extends out close to the 22 freeway and could lead to major transportation issues.

Future losses from straight line winds include:

- Increased wildfire risk
- Downed trees (there is a significant tree population in the City)
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs

The City of Garden Grove 2016 EOP noted that the impact of the Santa Ana Winds on the City would be minimal. Most housing is newer and has wind resistant tiles on its roofs. Very few, if any, billboards exist in the City.

Future Development

Future development projects should consider windstorm hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Whether high winds will occur, where, when, and of what intensity are all factors that evolve over the days and hours before they form and after they do. Development trends in the City are not expected to increase vulnerability to the hazard.

4.3.14. Wildfire Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Risk and vulnerability to the City of Garden Grove from wildfire, fire, and a possible conflagration is a concern, with some areas of the City being at greater risk than others as described further in this section. The City is not generally at great risk from a wildland-urban interface (WUI) fire and the City does not have any WUI areas. Similar to most urban environments, structure fires occur periodically, but are mostly limited in scope. The City noted the greater risk from urban conflagration fires. The biggest fire issue would be some type of conflagration associated with a structure or grass fire combined with Santa Ana winds that would spread through adjacent roofs and eves where embers build up and continue to spread the fire. Also of concern are those fires that can start and spread quickly as a result of another type of disaster such as an earthquake.

While not generally prone to wildland fires, Garden Grove is affected by nearby wildland fires through providing mutual aid. Nearby wildfires can also cause air quality issues in the City that can last for days. The threat of catastrophic wildfires under Santa Ana wind conditions presents risks and impacts to public health and safety, homes, and property at risk from wildfire. The hot and dry periods of late summer and fall in the City, seasonal wind patterns, flammable vegetation, and dense development patterns access all contribute to creating a substantial regional fire threat.

Although the physical damages and casualties arising from wildfires may be severe, it is important to recognize that they also cause significant economic impacts by resulting in a loss of function of buildings and infrastructure. In some cases, the economic impact of this loss of services may be comparable to the economic impact of physical damages or, in some cases, even greater. Economic impacts of loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Fires can also cause major damage to power plants and power lines needed to distribute electricity to operate facilities.

Southern California Edison noted that there are distinguishable differences between the risks to and vulnerability of the gas system compared to the electric system during times of flooding. They noted that the underground natural gas system is more resilient than the aboveground electric system. Above ground electric systems can be damaged by earthquakes, which can cause issues for power companies and their customers. For example, in 2017 the Thomas Fire damaged electric power lines throughout the City of Ventura. Because the City's water pumps to supply water to firefighters ran on electricity without any other form of backup power, firefighters were unable to get water from the pumps to put out burning residences.

If the water pumps had been connected to a backup power system, such as a natural gas generator, firefighters would have been able to access the water.

In contrast, as the natural gas system is mostly underground, it is very resilient to extreme weather events. For example, in 2012, after Superstorm Sandy, the entire natural gas system in the Northeast was essentially intact, allowing residents to support back-up generators, cook, and keep warm. Businesses with natural gas-powered fuel cells were able to operate and compressed natural gas (CNG) buses in New Jersey were used to shuttle residents to safety. Further, when Hurricane Harvey temporarily disabled almost 30% of the nation's refining capacity, CNG shuttles were able to continue operating, and hospitals that had on-site combined heat and power systems were able to provide urgently needed medical attention, despite flooding.

Public Safety Power Shutoff (PSPS)

Recent wildfires in California have started as a result of downed power lines or electrical equipment that come into contact with trees, branches, and other dried fuels. This was the likely cause of the Thomas Fire in Southern California in 2018 that destroyed 1,000 structures and led to a landslide that killed 22 people and the 2018 Camp Fire in the Town of Paradise in Butte County that killed at least 85 people and destroyed 14,000 homes.. During the summer of 2018, at least 17 other major wildfires were triggered by power lines. While the California Public Utilities Commission (CPUC) estimates that only about 10% of fires in California are a result of power lines, the frequency and severity of these wildfires have caused the CPUC to expand its probe into utility companies. As a result, California's three largest energy companies (including Southern California Edison (SCE)), at the direction of the CPUC, are coordinating to prepare all Californians for the threat of wildfires and power outages during times of extreme weather. To help protect customers and communities during extreme weather events, electric power may be shut off for public safety in an effort to prevent a wildfire. This is called a Public Safety Power Shutoff (PSPS).

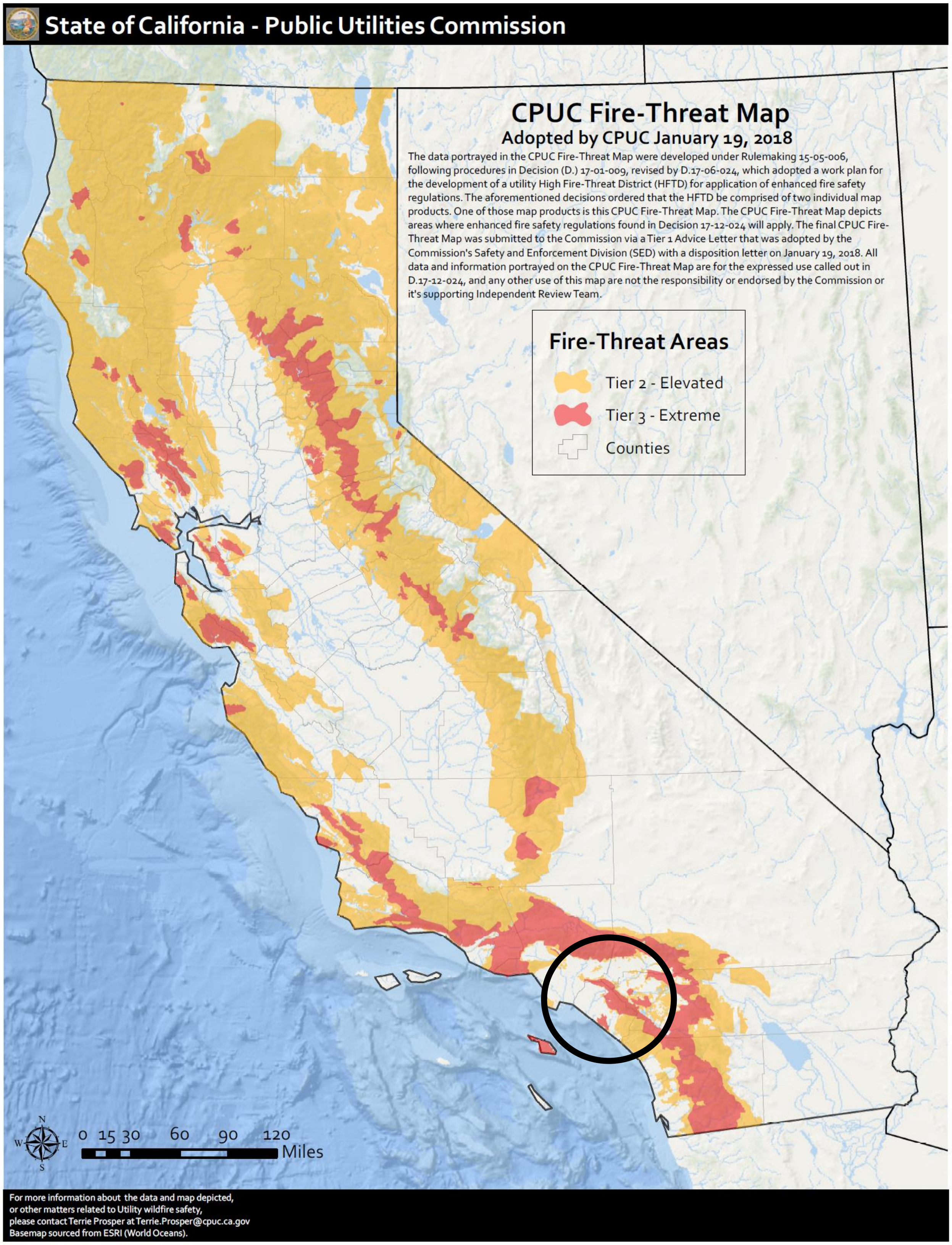
Public Safety Power Shutoff Criteria

When weather forecasts indicate extreme weather conditions, SCE will begin assessing the potential impact to affected areas. SCE plans to analyze historical data to help predict the likelihood of a wildfire occurring, closely monitor weather watch alerts from the NWS, and place incident responders on alert, if needed. While no single factor will drive a Public Safety Power Shutoff, some factors include:

- A Red Flag Warning declared by the National Weather Service
- Low humidity levels generally 20% and below
- Forecasted sustained winds generally above 25 mph and wind gusts in excess of approximately 45 mph, depending on location and site-specific conditions such as temperature, terrain and local climate
- Condition of dry fuel on the ground and live vegetation (moisture content)
- On-the-ground, real time observations from SCE crews

The most likely electric lines to be considered for shutting off for safety will be those that pass through areas that have been designated by the CPUC as at elevated (Tier 2) or extreme (Tier 3) risk for wildfire (seen on Figure 4-69). This includes both distribution and transmission lines. The specific area and number of affected customers will depend on forecasted weather conditions and which circuits SCE needs to turn off for public safety. Although a customer may not live or work in a high fire-threat area, their power may also be shut off if their community relies upon a line that passes through an area experiencing extreme fire danger conditions. This means that any customer who receives electric service from SCE should be prepared for a possible public safety power outage.

Figure 4-69 State of California Tier 2 and 3 Areas



SCE noted that extreme weather threats can change quickly. When possible, SCE will provide customers with advance notice prior to turning off the power, as well as updates until power is restored. Timing of notifications (when possible) are:

- **First Notification**: 2 Days Ahead – If extreme fire conditions are forecast to occur, we will notify potentially affected customers.
- **Second Notification**: 1 Day Ahead – If extreme fire conditions are imminent, we will notify impacted customers again. This may be the last notification sent if it is determined that power will not be shut off.
- **Third Notification**: Power Shutoff – When extreme fire conditions have been confirmed, we will shut off the power in affected areas. We will send a notification to impacted customers.
- **Fourth Notification**: After Restoring Power – After weather conditions return to safer levels, our field teams will check to make sure that power can be safely restored. We will send a notification telling impacted customers that power has been restored.

The HMPC noted that while the City is not expected to be directly affected by as PSPS due to its urban nature, there may be indirect effects when the grid is shut down. Those in affected areas may need to find shelter in areas with power.

Total Values at Risk

It is important to evaluate or quantify the City's risk to wildfire. As detailed above, while the primary concern to the City is from a conflagration or structure fire, there is no data to support such an analysis. Thus, this GIS analysis focuses on the risk of the City to wildfire based on best available data. The City of Garden Grove has mapped CAL FIRE data which provides a variety of fire hazard information for California communities. Utilizing this data from CAL FIRE, GIS was used to determine the possible impacts of wildfire within Garden Grove and how the wildfire risk varies across the Planning Area. Two primary CAL FIRE datasets and associated analysis was used for this Plan:

- Fire Responsibility Areas
- Fire Hazard Severity Zones

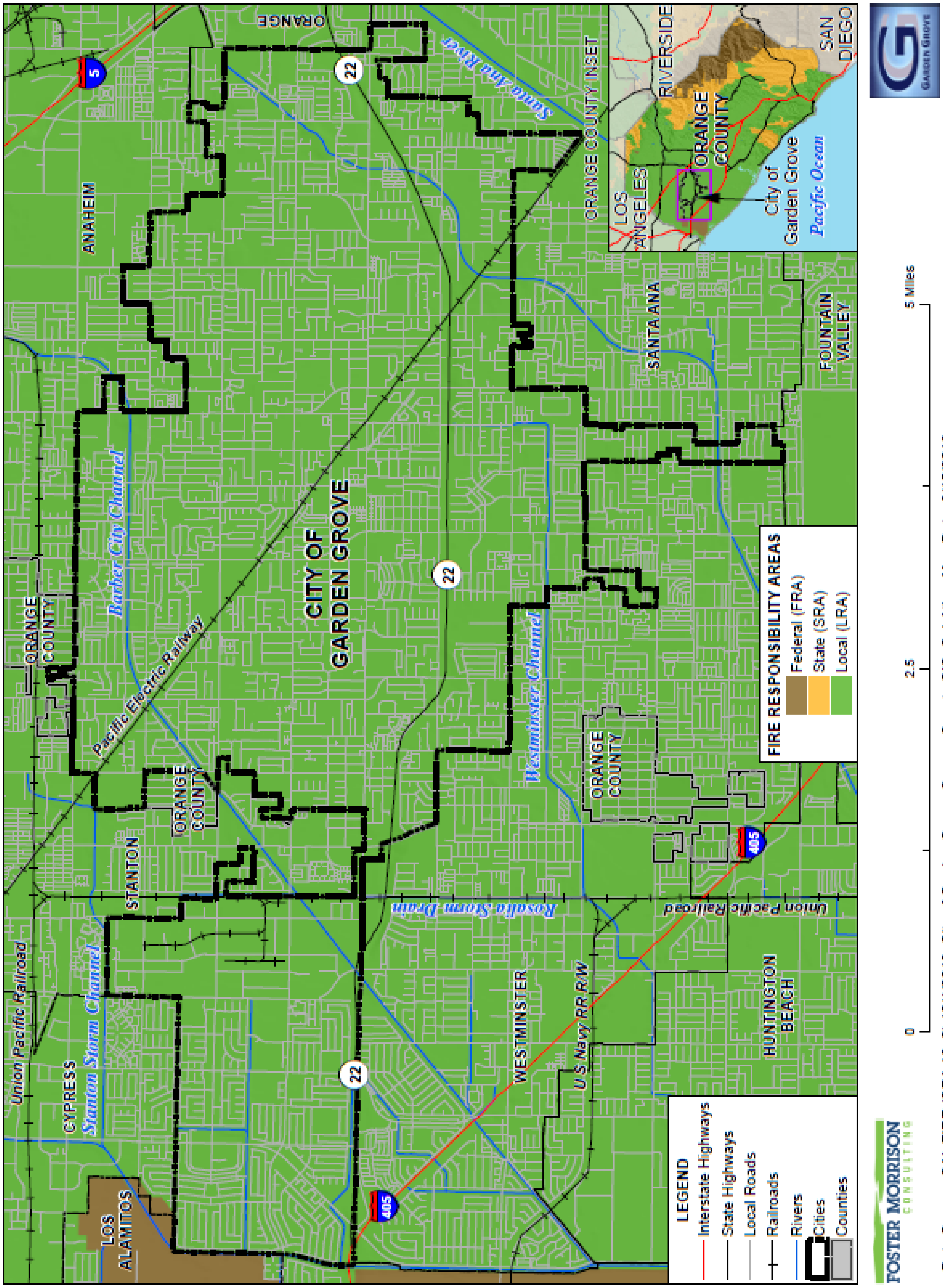
Fire Responsibility Areas

There are numerous wildland fire protection agencies that have responsibility statewide, Countywide, and Citywide, including the USDA Forest Service (FS), the Bureau of Land Management (BLM), and CAL FIRE. CAL FIRE has a legal responsibility to provide fire protection on all SRA lands, which are defined based on land ownership, population density and land use. Fire Responsibility areas are generally categorized by Federal Responsibility Areas (FRA), State Responsibility Areas (SRA) and Local Responsibility Areas (LRA). The Garden Grove Planning Area falls entirely within the Local Responsibility Area.

Methodology

CAL FIRE's Fire Responsibility Area layer was used in this analysis to show Garden Grove's FRA, SRA, and LRA areas. GIS was used to create a centroid, or point representing the center of the Garden Grove parcel polygon. The FRA, SRA, LRA areas were then overlaid on the parcel centroids. For the purposes of this analysis, the wildfire responsibility area that intersected a parcel centroid was assigned for the entire parcel. The Garden Grove Planning Area falls entirely within the Local Responsibility Area and is shown in Figure 4-70. All of the City's assets as shown in Table 4-39 in Section 4.3.1 are located in the Local Responsibility Area.

Figure 4-70 City of Garden Grove– FRA, SRA, and LRA



Fire Hazard Severity Zone Analysis

As part of the Fire and Resource Assessment Program (FRAP), CAL FIRE was mandated to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZ), then define the application of various mitigation strategies to reduce risk associated with wildland fires.

Fire hazard is a way to measure the physical fire behavior so that people can predict the damage a fire is likely to cause. Fire hazard measurement includes the speed at which a wildfire moves, the amount of heat the fire produces, and most importantly, the burning fire brands that the fire sends ahead of the flaming front.

The fire hazard model developed by CAL FIRE considers the wildland fuels. Fuel is that part of the natural vegetation that burns during the wildfire. The model also considers topography, especially the steepness of the slopes. Fires burn faster as they burn up-slope. Weather (temperature, humidity, and wind) has a significant influence on fire behavior. The model recognizes that some areas of California have more frequent and severe wildfires than other areas. Finally, the model considers the production of burning fire brands (embers) how far they move, and how receptive the landing site is to new fires.

In 2007, CAL FIRE updated its Fire Hazard Severity Zone (FHSZ) maps for the State of California to provide updated map zones, based on new data, science, and technology that will create more accurate zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. The zones will provide specific designation for application of defensible space and building standards consistent with known mechanisms of fire risk to people, property, and natural resources. The program is still ongoing with fire hazard severity zone maps being updated based on designated responsibility areas: FRA, SRA, and LRA. New maps are due out in 2019/2020.

Fire Hazard Severity Zone Mapping

The CAL FIRE data, detailing VHFHSZs within the Garden Grove Planning Area, was utilized to determine the locations, numbers, types, and values of land and structures falling within these mapped areas. The following sections provide details on the methodology and results for this analysis.

Methodology

As previously described, CAL FIRE mapped the FHSZs, or areas of significant fire hazard, based on fuels, terrain, weather, and other relevant factors. Zones are designated with Very High and Non-Very High hazard categories. The Recommended LRA FHSZ (c1fhszl06_3) dated September 2008 layer was used to get a complete coverage of Fire Hazards for the City of Garden Grove Planning Area.

Analysis was performed using the FHSZ dataset, and using GIS, the parcel layer was overlaid on these layers. Since it is possible for any given parcel to intersect with multiple categories for purposes of this analysis, the parcel centroid was used to determine which FHSZ to assign to each parcel. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessor's database and the parcel layer. Based on this approach, the FHSZs for the Garden Grove Planning Area were determined and further broken out by property use and included information on both land and improved values.

Fire Hazard Severity Zones and Values at Risk

The City's Fire Hazard Severity Zones are shown in Figure 4-71. Analysis results for the Garden Grove Planning Area is summarized in Table 4-81, which summarizes by total parcel counts, improved parcel counts, and their improved and land values and the estimated contents replacement values based on the CRV factors detailed in Table 4-36.

Figure 4-71 City of Garden Grove – Fire Hazard Severity Zones

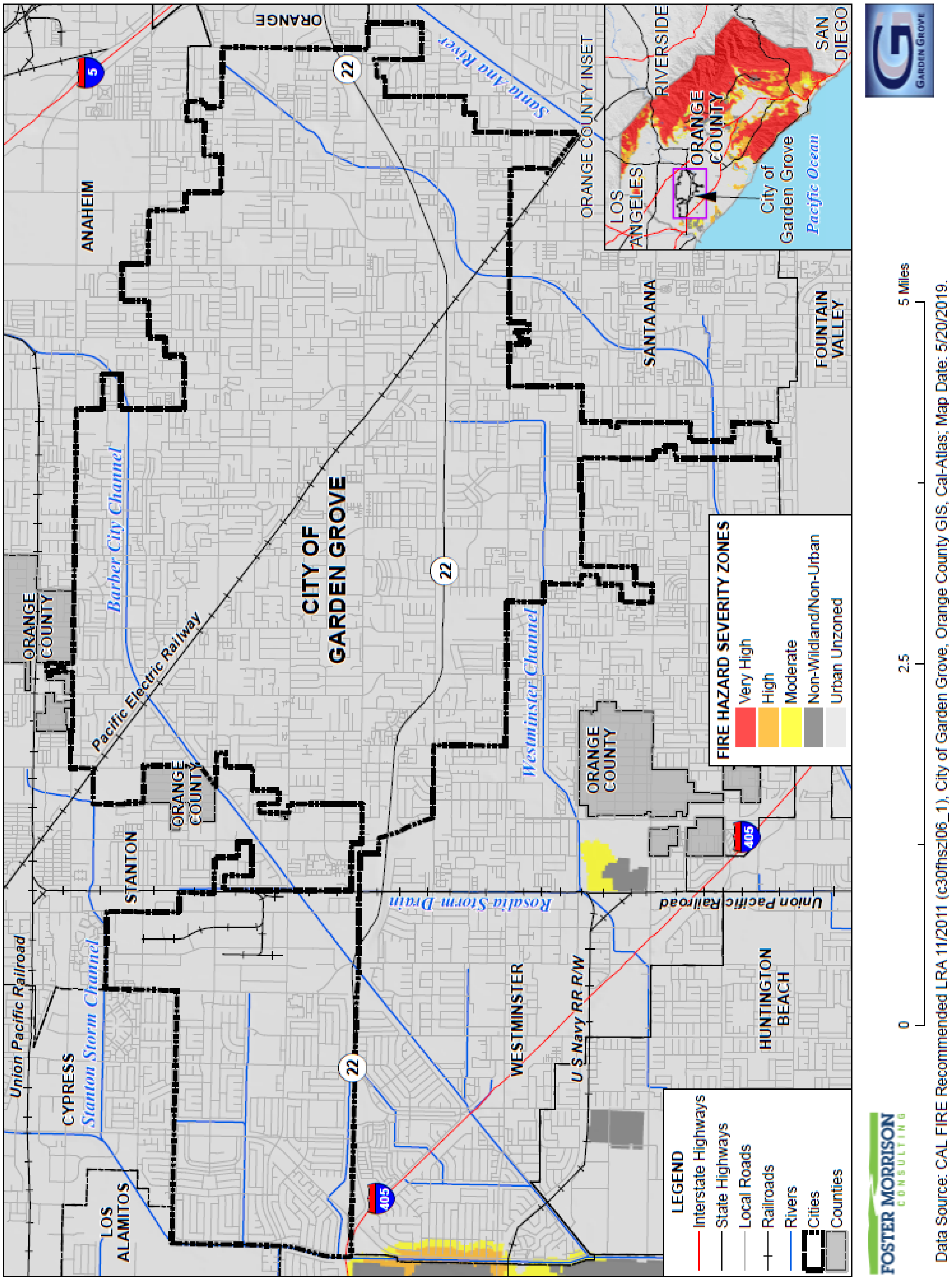


Table 4-81 City of Garden Grove – Count and Value of Parcels by Fire Hazard Severity Zone and Property Use

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Urban Unzoned						
Civic	86	70	$75,270,828	$135,646,631	$135,646,631	$346,564,090
Commercial	548	492	$402,998,354	$309,084,902	$309,084,902	$1,021,168,158
Industrial	346	321	$549,420,092	$423,864,116	$635,796,174	$1,609,080,379
Mixed Use	1,366	1,211	$1,041,636,593	$911,153,234	$911,153,234	$2,863,943,061
Open Space	141	35	$33,070,063	$23,064,695	$23,064,695	$79,199,453
Residential	29,778	29,281	$6,816,786,934	$3,115,037,261	$1,557,518,631	$11,489,342,845
Unknown	41	1	$179,635	$238,449		$418,084
Urban Unzoned Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**
Grand Total	**32,306**	**31,411**	**$8,919,362,499**	**$4,918,089,288**	**$3,572,264,267**	**$17,409,716,070**

Source: CAL FIRE, City of Garden Grove March 2019 Parcel/Assessor's Data

Population at Risk

A separate analysis was performed to determine population in fire hazard severity zones. Using GIS, the CAL FIRE FHSZ datasets were overlayed on the improved residential parcel data. Those parcel centroids that intersect each FHSZ were counted and multiplied by the Census Bureau average household size (3.76) for the City; results were tabulated by jurisdiction and fire hazard severity zones. According to this analysis shown in Table 4-82, all of the population falls within the urban unzoned FHSZ indicating limited risk to wildfire.

Table 4-82 City of Garden Grove– Improved Residential Parcels and Populations at Risk in Very High Fire Hazard Severity Zones

FHSZ/ Jurisdiction	Moderate		High		Very High	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Garden Grove	0	0	0	0	0	0

Source: CAL FIRE, US Census Bureau, City of Garden Grove March 2019 Parcel/Assessor's Data

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in the City of Garden Grove to determine critical facilities in the fire hazard severity zones. Using GIS, the fire hazard severity zones were overlayed on the critical facility GIS layer. Figure 4-72 shows critical facilities, as well as the fire hazard severity zones. Table 4-83 and Table 4-84 provide information by category of critical facilities in the fire hazard severity zones. Details of critical facility definition, type, name, and address by fire hazard severity zone are listed in Appendix E. Again, similar to other City assets, there are no critical facilities at risk to wildfire, all falling within the urban unzoned FHSZs.

Figure 4-72 City of Garden Grove – Critical Facilities in Fire Hazard Severity Zones

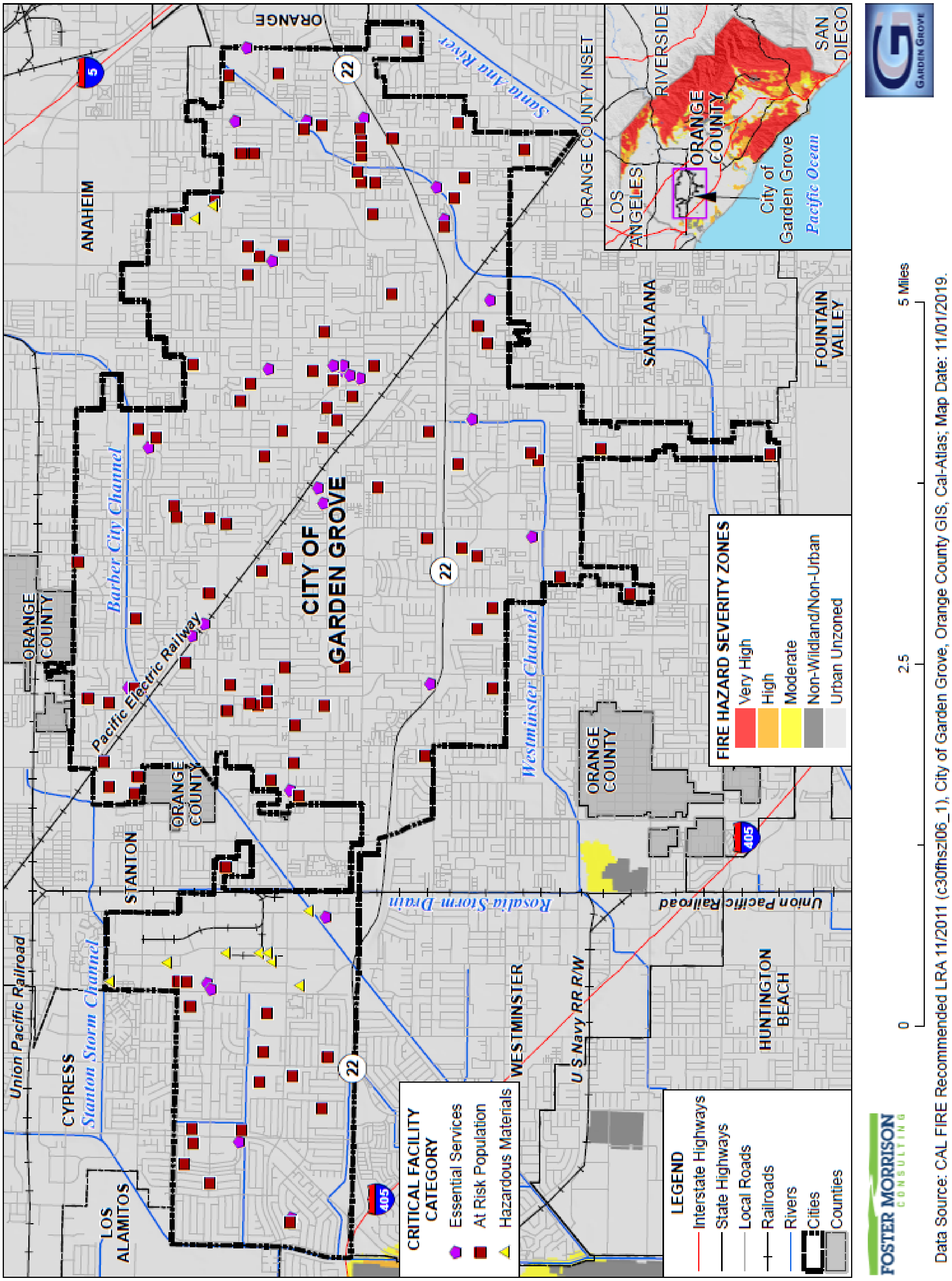


Table 4-83 City of Garden Grove – Critical Facilities Counts by Fire Hazard Severity Zones

Fire Hazard Severity Zone/ Critical Facility Category	Facility Count
Urban/Unzoned	
Essential Services Facilities	35
At Risk Population Facilities	113
Hazardous Materials Facilities	10
Grand Total	**158**

Source: CAL FIRE, City of Garden Grove GIS

Table 4-84 City of Garden Grove – Critical Facility Counts by Fire Hazard Severity Zones and Critical Facility Type

Fire Hazard Severity Zone/ Critical Facility Category/ Critical Facility Type	Facility Count
Urban/Unzoned	
Essential Services Facilities	
Fire Station	7
Government Building	4
Police Station	1
Public Building	6
Public Works Facility	17
Essential Services Facilities Total	**35**
At Risk Population Facilities	
Entertainment	2
Hospital/Medical	7
Hotel	3
Park	21
Religious Assembly	15
School	57
Senior Housing	8
At Risk Population Facilities Total	**113**
Hazardous Materials Facilities	
Covered Landfill	2
Hazmat	8
Hazardous Materials Facilities Total	**10**
Grand Total	**158**

Source: CAL FIRE, City of Garden Grove GIS

Overall Community Impact

The overall impact to the community from a severe wildfire includes:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Decreased water quality in area watersheds;
- Increase in post-fire hazards such as flooding, sedimentation, and mudslides;
- Damage to natural resource habitats and other resources;
- Loss of water, power, roads, phones, and transportation, which could impact, strand, and/or impair mobility for emergency responders and/or area residents;
- Economic losses (jobs, sales, tax revenue) associated with loss of commercial structures;
- Negative impact on commercial and residential property values;
- Air quality can be affected (both with local fires and with fires in the area – the fires in Butte County in 2018 caused air quality issues in the City and the greater Bay Area)
- Loss of churches, which could severely impact the social fabric of the community;
- Loss of schools, which could severely impact the entire school system and disrupt families and teachers, as temporary facilities and relocations would likely be needed; and
- Impact on the overall mental health of the community.

Future Development

As previously stated, population growth in the City is expected to be minimal. This, coupled with the City being in an Urban/Unzoned FHSZ area, makes the likelihood of future development being affected by wildfire low. New development in the City will be built to code, which includes building with fire resistant materials based on fire risk.

Future Development/Redevelopment GIS Analysis

Future development/redevelopment areas for the City are broken out into multiple areas. GIS data is maintained by the City of Garden Grove and was made available for this plan. An analysis was performed to quantify parcels within CAL FIRE FHSZs. GIS was used to create a centroid, or point representing the center of the parcel polygon. Those parcels centroids that fall inside the possible future development areas and that were within the CAL FIRE FHSZs are shown on Figure 4-73 and detailed in Table 4-85. As shown, the entire City and all future development areas fall within the Urban Unzoned FHSZ.

Figure 4-73 City of Garden Grove– Development Areas in CAL FIRE FHSZs

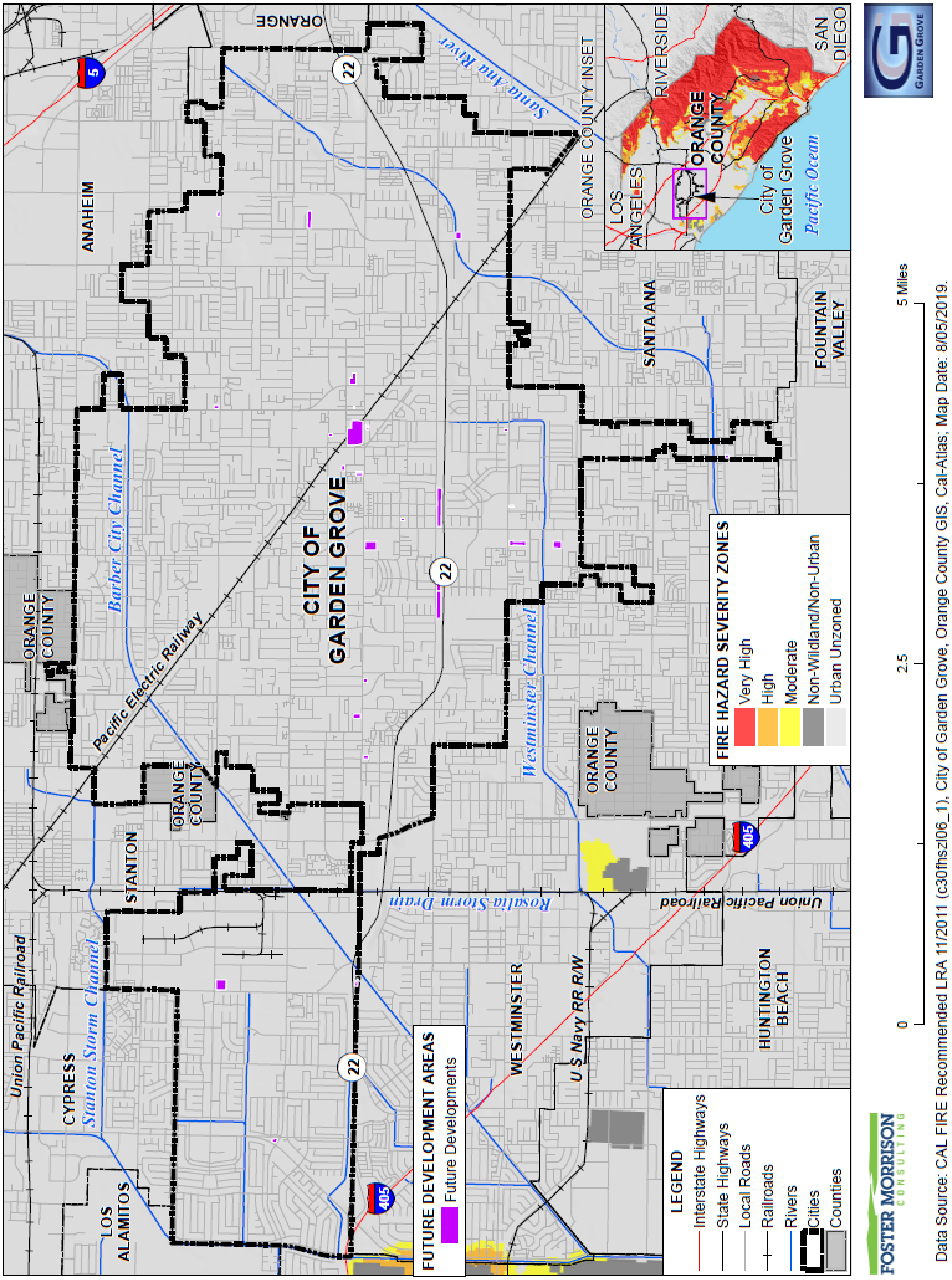


Table 4-85 City of Garden Grove – Future Development Areas in FHSZs by Parcels and Acreages

Future Development Areas	Total Parcel Count	Improved Parcel Count	Total Acres
Urban Unzoned			
10080 Garden Grove Blvd	1	0	3.09
12361 Chapman Ave	1	1	0.48
9106 Garden Grove Blvd	1	1	0.48
9861 11th St	1	1	1.76
10052 Central Ave	1	1	0.20
10522 McFadden Ave	1	1	0.35
12900 Euclid St	1	0	1.99
7051 Garden Grove Blvd	1	0	0.52
10531 Garden Grove Blvd	1	1	0.61
10561 Garden Grove Blvd	1	1	0.41
10611 Acacia Ave	1	1	0.58
11001 Chapman Ave	1	1	0.53
10801 Garden Grove Blvd	1	1	10.70
12900 Main St	2	2	0.13
10150 Trask Ave	1	0	5.14
10812 Stanford Ave	1	1	0.23
8562 Garden Grove Blvd	1	1	0.55
8851 Garden Grove Blvd	1	1	1.05
10862 Garden Grove Blvd	1	1	0.22
10872 Garden Grove Blvd	1	0	0.15
10882 Garden Grove Blvd	1	0	0.16
12422 Valley View St	1	1	0.53
12612 Buaro St	1	1	1.91
9444 Trask Ave	1	1	3.50
9670 Trask Ave	1	1	3.00
13650 Harbor Blvd	1	1	1.25
12072 Knott St	2	2	6.38
9892 Westminster Ave	2	2	4.43
10142 Westminster Ave	1	1	0.16
10152 Westminster Ave	1	1	0.17
10691 Westminster Ave	1	1	0.30
Grand Total	**34**	**28**	**50.97**

Source: CAL FIRE, City of Garden Grove GIS

4.4 Capability Assessment

Thus far, the planning process has identified the natural hazards posing a threat to the City of Garden Grove Planning Area and described, in general, the vulnerability of the City to these risks. The next step is to assess what loss prevention mechanisms are already in place. This part of the planning process is the mitigation capability assessment. Combining the risk assessment with the mitigation capability assessment results in the City's net vulnerability to disasters, and more accurately focuses the goals, objectives, and proposed actions of this plan.

This section presents the City's mitigation capabilities and resources. These are in addition to, and supplement, the many plans, reports, and technical information reviewed and used for this LHMP Update as identified in Chapter 3 and in Chapter 4. Similar to the HMPC's effort to describe hazards, risks, and vulnerability of the City, this mitigation capability assessment describes the City's existing capabilities, programs, and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This assessment is divided into four sections: regulatory mitigation capabilities are discussed in Section 4.4.1; administrative and technical mitigation capabilities are discussed in Section 4.4.2; fiscal mitigation capabilities are discussed in Section 4.4.3; and mitigation education, outreach, and partnerships are discussed in Section 4.4.4. A discussion of other mitigation efforts follows in Section 4.4.5.

4.4.1. City of Garden Grove Regulatory Mitigation Capabilities

Table 4-86 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities. FILL OUT TABLE

Table 4-86 City of Garden Grove Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
General Plan	Y 2008	Plan addresses hazards in the Safety Element. A mitigation strategy is provided. This plan can be used to implement mitigation actions
Capital Improvements Plan	N	Plan is not formalized. Planning Department has a development projects update list. There are capital improvements projects that address hazards.
Economic Development Plan	N	
Local Emergency Operations Plan	Y 2016	Plan addresses hazards in the Safety Element. A mitigation strategy is provided. This plan can be used to implement mitigation actions
Continuity of Operations Plan	Y	Hazards are addressed, but not mitigation is put forth. This plan could be used to implement mitigation actions.
Transportation Plan	N	

Stormwater Management Plan/Program	N	Work with the County on these issues. There are sewer management plans and storm drain ordinances.
Engineering Studies for Streams	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	Y	Version/Year:
Building Code Effectiveness Grading Schedule (BCEGS) Score		Score:
Fire department ISO rating:		Rating:
Site plan review requirements		
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	Y	Ordinance is effective, adequately administered, and enforced.
Subdivision ordinance	Y	Ordinance is effective, adequately administered, and enforced.
Floodplain ordinance	Y	Ordinance is effective, adequately administered, and enforced.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Y	There is a watercourse and drains section related to localized flooding. Ordinance is effective, adequately administered, and enforced.
Flood insurance rate maps	Y	FIRMS are available through FEMA.
Elevation Certificates		
Acquisition of land for open space and public recreation uses		
Erosion or sediment control program		
Other		
How can these capabilities be expanded and improved to reduce risk?		
INSERT		

Source: City of Garden Grove

As indicated in the tables above, Garden Grove has several plans and programs that guide the City's mitigation of development of hazard-prone areas. Starting with the City of Garden Grove General Plan, which is the most comprehensive of the City's plans when it comes to mitigation, some of these are described in more detail below.

City of Garden Grove General Plan (2008)

A general plan is a legal document, required by state law, that serves as a community's "constitution" for land use and development. The plan must be a comprehensive, long-term document, detailing proposals for the "physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Government Code §65300 et seq.). Time horizons vary, but the typical general plan looks 10 to 20 years into the future. The law specifically requires that the general plan address seven topics or "elements." These are land use, circulation (transportation), housing, conservation, open space, noise, and safety. The plan must analyze issues of importance to the community, set forth policies in text and diagrams for conservation and development, and outline specific programs for implementing these policies

Goals and policies related to mitigation from the General Plan are the following:

Infrastructure Element

Goal INFR-3	Storm drain service levels shall be maintained and/or improved throughout the City.
Policy INFR 3.1	Cooperate with local, State, and Federal flood control agencies to reduce the potential for flood damage in the City.
Policy INFR 3.2.	Continue to maintain and replace aging storm drain systems to ensure the provision of these services to all areas of the community
Policy INFR 3.3	Minimize the adverse effects of urbanization upon drainage and flood control facilities.
Policy INFR 3.4	Improve the storm drain system in a way that respects the environment.

Safety Element

Goal SAF-4	Community members must be made aware of potential environmental hazards, how they should prepare for these instances, and how they should respond.
Policy SAF-4.1	Advise and provide information to the public regarding the availability of local area environmental studies, sources of hazard information, and public services.
Policy SAF-4.2	Continue and expand the public awareness programs conducted by the Fire Department, and other agencies as appropriate.
Policy SAF-4.3	Provide the public with information identifying accessible evacuation routes for fire, geologic, and other hazards.

Goal SAF-5	Public harm from fire and health emergencies shall be minimized.
Policy SAF-5-1	Continue to develop and enforce construction and design standards related to fire prevention.
Policy SAF-5.2	Ensure that the City has adequate resources to respond to health and fire emergencies, such as Fire Stations, personnel, and equipment.

Goal SAF-6	Risk associated with seismic activity and geologic conditions to people and property shall be minimized.
Policy SAF-6.1	Avoid or minimize to the greatest extent feasible, hazards resulting from development on unstable ground conditions.
Policy SAF-6.2	Encourage rehabilitation or elimination of structures susceptible to collapse or failure in an earthquake. Historic buildings shall be treated with special consideration in order to ensure their preservation.

Goal SAF-6	Risk associated with seismic activity and geologic conditions to people and property shall be minimized.
Policy SAF-6.3	Ensure that new structures are seismically safe through the proper design and construction. The minimum level of design necessary would be in accordance with seismic provisions and criteria contained in the most recent version of the State and County Codes. Construction shall require effective oversight and enforcement to ensure adherence to the earthquake design criteria.

Goal SAF-7	Minimize injury and loss of life, damage to public and private property and infrastructure, and economic and social disruption caused by inundation and flood hazards.
Policy SAF-7.1	Continue to implement adopted flood control programs and regulations.
Policy SAF-7.2	Improve defensive measures against 100-year, or other State-defined scenario, flood conditions through land use and design, such as increased pervious surfaces, on-site water capture and re-use, minimized building footprints, etc.
Policy SAF-7.3	Continue to monitor regional flood hazard improvements in the Santa Ana River Basin area to understand impacts to the 100-year storms within the City.
Policy SAF-7.4	Encourage methods that place limits on land use activities in flood hazard areas and timely repair and maintenance of necessary flood control structures.

Goal SAF-8	The social and economic impacts that natural and urban disasters have on the community shall be minimized through effective emergency and disaster preparedness.
Policy SAF-8.1	Maintain and update the City's Disaster Preparedness Plan.
Policy SAF-8.2	Provide self-sufficiency practices necessary after a major disaster, such as alternative water sources, food storage, first aid, family disaster plans, etc.
Policy SAF-8.3	Continue with and improve upon disaster preparedness collaboration efforts city- and county-wide.
Policy SAF-8.4	Ensure that adequately trained staff are available to provide essential emergency public services.

Other City Plans/Studies/Programs

City of Garden Grove Master Plan of Drainage (1991)

In July of 1976, the City of Garden Grove adopted a comprehensive master plan of which outlined needed storm drains within all areas of the city. Since then, a number of significant drainage related changes have occurred leading to the preparation of this updated master plan. The most notable change is that of the Orange County Environmental Management Agency's adoption of a new methodology for determining peak discharges. Also, a number of storm drains have been constructed, some with alignments different from those of the original master plan. This updated master plan provides revised peak discharges and sizes for all proposed storm drains and updates the overall plan to account for prior storm drain construction.

The updated master plan has been prepared primarily to serve as a tool for planning future drainage projects. It also has the purpose of assisting in the computation of equitable development drainage acreage fees. To this end, the master plan identifies all needed storm drain facilities in the city. It also presents a construction priority ranking for those proposed drains that have been judged to be strategic toward improving the city's drainage. The study also is intended to be useful in outlining the approximate drainage improvement requirements that may be needed for adjacent private developments.

Hydraulic and hydrologic methods used in the study are discussed as are other specific details on how the study was conducted. Drainage study areas are designated. Drainage facilities for each study area are presented and maps are provided showing the proposed storm drains. Construction and project costs are listed. High priority storm drains are also listed.

City of Garden Grove Urban Water Management Plan (2015)

Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act (Act) require every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an Urban Water Management Plan (UWMP) with the California Department of Water Resources (DWR) every five years in the years ending in zero and five. This UWMP provides DWR with a detailed summary of present and future water resources and demands within the City of Garden Grove’s service area and assesses the City’s water resource needs.

Specifically, the UWMP provides water supply planning for a 25-year planning period in five-year increments and identifies water supplies needed to meet existing and future demands. The demand analysis must identify supply reliability under three hydrologic conditions: a normal year, a single-dry year, and multiple-dry years. The City’s 2015 UWMP updates the 2010 UWMP in compliance with the requirements of the Act as amended in 2009, and includes a discussion of:

- Water Service Area and Facilities
- Water Sources and Supplies
- Water Use by Customer Type
- Demand Management Measures
- Water Supply Reliability
- Planned Water Supply Projects and Programs
- Water Shortage Contingency Plan
- Recycled Water Use

Anaheim/Santa Ana Urban Area Security Initiative Continuity Plan (2010)

Local municipalities in Orange County have entered into an agreement with the Anaheim/Santa Ana Urban Area (ASAUA) Collaborative to develop a Continuity Plan. The plan facilitates the performance of essential functions during all-hazards emergencies or other situations that may disrupt normal operations. Local municipalities that have a Continuity Plan are better equipped to respond to an emergency because there is a plan in place to continue providing services to the community. The ASAUA Collaborative receives grants from the U.S. Department of Homeland Security to develop Continuity Plans for cities in Orange County and has contracted with Willdan Homeland Solutions to execute the development of the plans with city staff.

Public Works Continuity Plan

This Continuity Plan applies to all employees of the City of Garden Grove, Public Works Department for the full spectrum of man-made, natural, and technological emergencies and threats. This plan will be activated and implemented when a credible threat exists or when an event results in significant damage to or the disruption of normal operations of the City of Garden Grove, Public Works Department. Continuity Plans should map out the continuation or rapid restoration of essential operations and failed facilities while utilizing minimum resources.

Mitigation Strategy for Westminster, East Garden Grove Flood Risk Management Study

The Chicago District of the U.S. Army Corps of Engineers (USACE) is preparing a Draft Feasibility Report/Draft Environmental Impact Statement/Draft Environmental Impact Report (Draft IFR) for the Westminster East Garden Grove Orange County, California Flood Risk Management Study. Potential impacts to seasonal wetlands/soft bottom habitat, upland habitat and adjacent fringe wetland have been predicted to require mitigation. The purpose of this document is to describe the process used by the USACE to determine the acreage of mitigation that may be required for the proposed project. Portions of the City fall into the Study Area.

Garden Grove Flood Response Plan

This Plan will assist Law Enforcement, Fire Department, Public Works Department and Emergency Operations Center (EOC) staff in response to impending flooding within the City of Garden Grove. It is designed to provide coordination and improve effectiveness in the appropriate response to the potential flooding.

City of Garden Grove Ordinances

Ordinances related to mitigation in the City of Garden Grove are as follows:

Emergency Services (Chapter 6.08)

The declared purposes of this chapter are to provide for the preparation and carrying out of plans for the protection of persons and property within the City in the event of an emergency; the direction of the emergency organization; and the coordination of the emergency functions of the City with all other public agencies, corporations, organizations, and affected private persons.

As used in this chapter, “emergency” means the actual or threatened existence of conditions of disaster or of extreme peril to the safety of persons and property within the City caused by such conditions as air pollution, fire, flood, storm, epidemic, riot, or earthquake, or other conditions, including conditions resulting from war or imminent threat of war, but other than conditions resulting from a labor controversy, which conditions are or are likely to be, beyond the control of the services, personnel, equipment, and facilities of the City, requiring the combined forces of other political subdivisions to combat.

he Garden Grove Disaster Council is hereby created and shall consist of the following:

- The Mayor, who shall be Chair;
- The Director of Emergency Services, who shall be Vice Chair;
- The Assistant Director of Emergency Services;
- Such Chiefs of Emergency Services as are provided for in a current Emergency Plan of the City, adopted pursuant to this chapter; and
- Such representatives of civic, business, labor, veterans, professional, or other organizations having an official emergency responsibility, as may be appointed by the Director with the advice and consent of the City Council.

It shall be the duty of the Disaster Council and it is empowered to develop and recommend for adoption by the City Council emergency and mutual aid plans and agreements and such ordinances and resolutions and rules and regulations as are necessary to implement such plans and agreements. The Disaster Council shall meet upon call of the Chair or, in his or her absence from the City or inability to call such meeting, upon call of the Vice Chair. Such meetings shall be noticed where required by law.

Watercourses and Drains (Chapter 11.16)

No person shall fill, obstruct, or maintain any fill or obstruction in, any natural watercourse or any channel carrying stormwater unless a permit to do so has been obtained from the City. No person shall construct, reconstruct, alter, repair, install, or maintain any drainage structure in any natural watercourse or channel carrying stormwater unless a permit to do so has been obtained from the City. No person shall do anything to any natural watercourse or any channel carrying stormwater that will in any manner obstruct or interfere with the flow of water through such watercourse or channel, and any property owner, lessee, or tenant of any property through which a natural watercourse or any channel carrying stormwater passes shall keep and maintain the same free from any obstructions that will in any manner prevent or retard the flow of water through such water course or channel, except that a water course or channel may be filled or altered if a permit to do so has been first obtained from the City pursuant to this chapter.

Building Codes (Chapter 18.04)

The California Building Code, 2016 Edition, based on the 2015 International Building Code as published by the International Code Council, including Division II of Chapter 1, and Appendices H, I and J; California Residential Code, 2016 Edition, based on the 2015 International Residential Code as published by the International Code Council, including Division II of Chapter 1, and Appendices H, J and V; California Electrical Code, 2016 Edition, based on the 2014 National Electrical Code as published by the National Fire Protection Association; California Mechanical Code, 2016 Edition, based on the 2015 Uniform Mechanical Code as published by the International Association of Plumbing and Mechanical Officials, including Appendices B and C; California Plumbing Code, 2016 Edition, based on the 2015 Uniform Plumbing Code as published by the International Association of Plumbing and Mechanical Officials, including Appendices A, B, C, D, G, H, and I; California Energy Code, 2016 Edition, as published by the International Code Council; California Historical Building Code, 2016 Edition, based on the 2015 International Building Code as published by the International Code Council; California Fire Code, 2016 Edition, based on the 2015 International Fire Code as published by the International Code Council, including Appendices B, BB, C, CC and D; California Existing Building Code, 2016 Edition, based on the 2015 International Existing Building Code as published by the International Code Council; and the California Green Building Standards Code, 2016 Edition, as published by the International Code Council; as adopted into the California Code of Regulations, Title 24, Parts 2 through 6, and 8 through 11 respectively; International Property Maintenance Code, 2015 Edition as published by the International Code Council; and Uniform Swimming Pool, Spa, and Hot Tub Code, 2015 Edition as published by the International Association of Plumbing and Mechanical Officials; are hereby adopted by reference as the Building Codes and Regulations of the City of Garden Grove, together with amendments set forth in Chapters 12, 14, 24 and 32 below.

Water Efficiency (Section 9.08.040.055, Section 9.12.040.085, and Section 9.16.040.065)

Beginning January 1, 2010, landscape water efficiency provisions shall apply to all planting, irrigation, and landscape-related improvements for projects included within the following categories:

- New landscape installations or landscape rehabilitation projects by public agencies or private non-residential developers, except for cemeteries, with a landscaped area, including pools or other water features, but excluding hardscape, equal to or greater than 2,500 square feet, and which are otherwise subject to a discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature;
- New landscape installations or landscape rehabilitation projects by developers or property managers of single-family and multifamily residential projects or complexes with a landscaped area, including pools or other water features, but excluding hardscape, equal to or greater than 2,500 square feet, and which are otherwise subject to discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature;
- New landscape installation projects by individual homeowners on single-family or multifamily residential lots with a total project landscaped area, including pools or other water features, but excluding hardscape, equal to or greater than 5,000 square feet, and which are otherwise subject to a discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature.

The Water Efficiency Ordinance address all the land use areas (single-family residential, multi-family residential, mixed use, commercial, industrial, and open space)

Floodplain Management (Section 9.16.030.060 – though also discussed in Section 9.08.030.040, Section 9.12.030.050, and Section 19.18.180)

The flood hazard areas of the City of Garden Grove are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety and general welfare. These flood losses are caused by uses that are inadequately elevated, floodproofed or protected from flood damage. The cumulative effect of obstructions in areas of special flood hazards that increase flood heights and velocities also contribute to the flood loss.

The purpose of this section is to promote the public health, safety and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains; electric, telephone and sewer lines; and streets and bridges located in area of special flood hazard;
- Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage;
- Ensure that potential buyers are notified that property is in an area of special flood hazard; and
- Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

In order to accomplish its purposes, this section includes methods and provisions to:

- Restrict or prohibit uses that are dangerous to health, safety and property due to water or erosion hazards, or that result in damaging increases in erosion or flood heights or velocities;
- Require that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction;
- Control the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters;
- Control filling, grading, dredging and other development that may increase flood damage; and
- Prevent or regulate the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

This section shall apply to all areas of special flood hazards within the jurisdiction of the City of Garden Grove.

he areas of special flood hazard identified by the Federal Insurance Administration (FIA) of the Federal Emergency Management Agency (FEMA) in the Flood Insurance Study (FIS) dated February 18, 2004, and accompanying Flood Insurance Rate Maps (FIRMs) and Flood Boundary and Floodway Maps (FBFMs), dated February 18, 2004, and all subsequent amendments and/or revisions, are hereby adopted by reference and declared to be a part of this section. This FIS and attendant mapping are the minimum area of applicability of this section and may be supplemented by studies for other areas that allow implementation of this section and that are recommended to the City of Garden Grove by the Floodplain Administrator.

No structure or land shall hereafter be constructed, located, extended, converted or altered without full compliance with the term of this section and other applicable regulations. Violation of the requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Nothing herein shall prevent the City of Garden Grove from taking such lawful action as is necessary to prevent or remedy any violation.

Land Use and Zoning (Title 9)

The purpose of this code is to provide an orderly set of standards and regulations to ensure the appropriate use of land in the City. This code provides for the development of appropriate patterns, distribution and mixtures of land uses that generally:

- Retain and enhance established residential neighborhoods, commercial and industrial districts, recreational facilities, other amenities and region-serving uses;
- Allow for the infill and recycling of areas at their prevailing scale and character;
- Allow for the intensification of commercial and industrial uses;
- Accommodate expansion of development into vacant and low-use lands within environmental and infrastructure constraints;
- Maintain and enhance significant environmental resources;
- Provide a diversity of areas characterized by differing land use activities, scale and intensity;
- Establish an environment that provides the City's residences and businesses with a high quality of life that is both aesthetic and secure.

4.4.2. City of Garden Grove Administrative/Technical Mitigation Capabilities

Table 4-87 identifies the City personnel responsible for activities related to mitigation and loss prevention in the City. FILL OUT TABLE

Table 4-87 City of Garden Grove Administrative/Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	Y	Planning Department and Building Services work in tandem to review designs before approving. Coordination is effective.
Mitigation Planning Committee	Y	Created for this Plan. It brings together people from other departments.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Drains are cleared and the urban forest is maintained on an as needed basis.
Mutual aid agreements	Y	Countywide mutual aid agreement adhered to and implemented upon type of incident. Coordination is long-standing and is well coordinated.
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Y FT	Staff is trained and adequate. Coordination is effective, but could be improved
Floodplain Administrator	Y FT	Staff is trained and adequate. Coordination is effective, but could be improved

Emergency Manager	Y FT	Currently in process of selecting EOC. Currently looking at training opportunities. Coordination is effective, but could be improved.
Community Planner	Y FT	Staff is trained and adequate. Coordination is effective, but could be improved
Civil Engineer	Y FT	Staff is trained and adequate. Coordination is effective, but could be improved
GIS Coordinator	Y FT	In the Information Technology department. Staff is trained and adequate. Coordination is effective, but could be improved.
Other		
Technical	**Y/N**	**Describe capability** **Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)	Y	The City can use social media platforms to disseminate information. We would also utilize our Reverse 9-1-1 to reach out to the community with vital information during a major event. If for some reason communication is lost at a significant level, we would go into what we call "sectoring" with police units address the community through their Public Address system in their vehicles.
Hazard data and information		
Grant writing		
Hazus analysis	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		
INSERT		

Source: City of Garden Grove

4.4.3. City of Garden Grove Fiscal Mitigation Capabilities

Table 4-88 identifies financial tools or resources that the City could potentially use to help fund mitigation activities. FILL OUT TABLE

Table 4-88 City of Garden Grove Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding		
Authority to levy taxes for specific purposes		
Fees for water, sewer, gas, or electric services		
Impact fees for new development		
Storm water utility fee		

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Incur debt through general obligation bonds and/or special tax bonds		
Incur debt through private activities		
Community Development Block Grant		
Other federal funding programs		
State funding programs		
Other		
How can these capabilities be expanded and improved to reduce risk?		
INSERT		

Source: City of Garden Grove

4.4.4. City of Garden Grove Mitigation Education, Outreach, and Partnerships

Table 4-89 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information. FILL OUT TABLE

Table 4-89 City of Garden Grove Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	CERT-will be under the EOC of the police department and is currently in a standby mode until selection of the EOC.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	Will be done by CERT and the EOC
Natural disaster or safety related school programs	N	
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		
INSERT		

Source: City of Garden Grove

4.4.5. Other Mitigation Efforts

The City has many other mitigation efforts that are being worked towards that have not been previously captured in this capability assessment. They are discussed in detail below by hazard.

Multi-Hazard

The City has diesel generators at the following locations:

- Police Department – Public Safety
- Fire Department 1
- City Hall
- CMC (Natural Gas)
- Municipal Yard

Dam Failure

Though not a direct mitigation effort by the City, there have been modification to the Prado Dam to reduce downstream risk. USACE reported that modifications to Prado Dam were recently completed where the main embankment has been raised from 566 feet, NGVD to elevation 594.4 feet, NGVD. A new outlet works was also constructed to allow for increased release capabilities from the dam. The new outlet works has a maximum controlled release capacity of 30,000 cubic feet per second (cfs), which cannot yet be fully utilized due to the ongoing construction of the Corps of Engineers' Santa Ana River project (Reach 9 Project) to improve the downstream channel. When the Reach 9 Project has been completed, the downstream channel capacity immediately downstream of the dam will increase to over 30,000 cfs. These improvements will enable the dam to take full advantage of the improved channel capacity downstream and will greatly increase the level of flood protection to the communities of Orange County that are located within the Santa Ana River floodplain.

When the water surface elevation in the reservoir reaches 543.0 feet, NGVD uncontrolled releases from the spillway will commence. The spillway is also planned for modification in the future (planned for 2021) where it will be raised 20 feet, up to elevation 563 feet, NGVD. The Interim Water Control Plan will be implemented during this time to reflect operation of the dam using the new outlet works features while the spillway remains at elevation 543.0 feet, NGVD.

Drought and Water Shortage

In order to provide a safe, reliable water supply for Orange County's current and future residents, the Orange County Water District and Orange County Sanitation District are working to diversify Orange County's water supply with the development of the Groundwater Replenishment (GWR) system. This innovative water purification project will provide a new source of locally controlled, high-quality water for north and central Orange County.

During the 2014 to 2017 drought, water use restrictions were implemented via notification. The City worked with residents on methods for reduction of water consumption including drought tolerant plants and more efficient irrigation.

Extreme Heat

The City has a cooling center that is opened when temperatures warrant it.

Flooding, Localized Flooding, and Levee Failure Flooding

To provide quantitative information for flood warning and detection, Orange County began installing its ALERT (Automated Local Evaluation in Real Time) system in 1983. Operated by the County's Environmental Resources Section of Orange County Public Works (OCPW) in cooperation with the National Weather Service, ALERT uses remote sensors located in rivers, channels and creeks to transmit environmental data to a central computer in real time. Sensors have been installed along the Santa Ana River, San Juan Creek, Arroyo Trabuco Creek, Oso Creek and Aliso Creek, as well as other flood control channels and basins. The field sensors transmit hydrologic and other data (e.g., precipitation data, water levels, temperature, wind speed, etc.) to base station computers for display and analysis. In addition, six pump stations (Huntington Beach, Cypress, Seal Beach, Los Alamitos, Harbor-Edinger, and South Park) regulating storm water discharge to flood control channels are also instrumented. Their monitoring system includes automated call-out of operations personnel in the event of a problem.

The Storm Center operated by OCPW is activated when heavy rainfall occurs or is predicted, and/or when storm run-off conditions indicate probable flood damage. The Storm Center monitors the situation on a 24-hour basis, and response may include patrols of flood control channels, and deployment of equipment and personnel to reinforce levees if needed. Storm Center activation and various emergency response actions are based on the following Emergency Readiness Stages:

- Stage I - Mild rainfall (Flood advisory stage)
- Stage II - Heavy rainfall or potential thereof. OCPW Storm Operations Center activated and surveillance of flood control facilities in effect (Flood watch stage)
- Stage III - Continued heavy rainfall or deterioration of facilities. County Public Works Director in charge. County personnel assume assigned emergency duties (Flood warning stage).
- Stage IV - Conditions are or are likely to be beyond County control. Board of Supervisors, or DES/OAC when the Board is not in session, proclaims Local Emergency and assumes special powers. Mutual Aid requested (Flood warning stage)
- Stage V - Damage beyond control of all Local Resources. State forces are required. Governor requested to proclaim State of Emergency (Flood warning stage)
- Stage VI - Damage beyond control of Local and State Resources. Federal forces are required. President requested to declare Major Disaster (Flood warning stage)

The following is a list of storm drain projects undertaken since 1998 in preparation for El Nino storms and other heavy rain events.

YEAR BUILT	PROJECT NO.	DESCRIPTION	AMOUNT
1998	7408	Westminster Avenue Storm Drain from Deodara to Erin and Erin Street Storm Drain from Westminster to Woodbury 72" dia. - 522', 48" dia.-366', 42" dia.-120',36"dia.-67' Gas Tax Funds were used	$636,060
1998	7495	Shannon/ Gilbert Storm Drain 54" dia. - 962', 48" dia. - 1,385', 36" dia. - 67' Gas Tax Funds and Drainage Funds were used	$523,642
1998	7490	Roxey Drive Storm Drain from westminster Ave to Woodbury Rd 48" dia. - 1,080', 42" dia. - 320', 36" dia. - 144' Gas Tax Fund were used	$429,870
1998	7492	Garden Grove Boulevard Storm Drain from Village to Galway 60" dia. - 441', 48" dia. - 200' Gas Tax Funds were used	$202,836
1999	7491	Ninth Street Storm Drain from Chapman to Reva 54" dia. - 492', 48" dia. - 56' Gas Tax Funds and Measure 'M' local Funds were used	$503,207
1999	7493	Lampson Avenue Storm Drain from Beach Blvd to Arrowhead St. 78" dia. - 67', 72" dia. - 465' Gas Tax Funds were used	$780,479
2000	7412	Lampson Avenue Storm Drain from Arrowhwad to Haga 72" dia. - 816', 66" dia. - 746', 54" dia. - 231' Gas Tax Funds were used	$756,744
2001	OCFlood	Bolsa Chica Channel Upgrade Reconstruct deficient rock-lined trapezoidal channel to a wider reinforced concrete rectangular channel. The project was about 2/3 of a mile long.	$4,500,000
2001	OCFlood	Garden Grove Channel Diversion Install 10' diameter pipe under SR 22/405 interchange from Garden Grove Channel north of SR 22 to Bolsa Chica Channel south of the SR 405.	$1,500,000
2001	7411	Westminster Avenue Storm Drain from Taft to Euclid 72" dia, - 834', 66" dia. - 516', 60" dia. - 253' Gas Tax Funds were used	$842,890
2002	7409	Emrys Avenue Storm Drain from West to Buaro/Lampson Int. 72" dia, - 1,713' Gas Tax Funds were used	$937,203
2003	7493	Lampson Avenue Storm Drain from Lorna to Leroy 60" dia. - 2,690', 48" dia. - 64', 42" dia. - 64' Gas Tax Fund were used	$1,665,980
2003	7384	TwinTree/ Haster Storm Drain 48" dia. - 615', 36" dia. - 285', 24" dia. - 1,936'	$607,521
2009	7420	Newland Storm Drain from Westminster Channel to Westminster 7' x 12' RC Box - 90', 102" dia. - 2,200', 36" dia. - 100' Federal Fund, CDBG Fund, and Drainage Funds were used	$2,475,717
2012	OCFlood	Haster Retarding Basin, Pump Station and Recreational Project re-construct existing retarding basin to increase capacity, construct of a storm water pump station and filling in a portion of the basin for additional 2 acre recreation field. Included are; expanded parking lot, jogging trail, shelters, exercise stations, etc..	$25,200,000
2015	7246	Harbor/TwinTree Storm Drain 36"dia. HDPE Pipe=860', 30"dia. HDPE Pipe=240', 24"HDPE=130' EPA and EDA Funds were used	$902,350
		ALL PROJECTS TOTAL	$42,464,499

Chapter 5 Mitigation Strategy

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the mitigation strategy process and mitigation action plan for this 2020 City of Garden Grove Local Hazard Mitigation Plan (LHMP). It describes how the City met the following requirements from the 10-step planning process:

- Planning Step 6: Set Goals
- Planning Step 7: Review Possible Activities
- Planning Step 8: Draft an Action Plan

5.1 Mitigation Strategy: Overview

The results of the planning process, the risk assessment, the goal setting, the identification of mitigation actions, and the hard work of the Hazard Mitigation Planning Committee (HMPC) led to the mitigation strategy and mitigation action plan for this LHMP.

Taking all of the above into consideration, the HMPC developed the following umbrella mitigation strategy for this LHMP:

- **Communicate** the hazard information collected and analyzed through this planning process as well as HMPC success stories so that the community better understands what can happen where and what they themselves can do to be better prepared.
- **Implement** the action plan recommendations of this LHMP.
- **Use/enforce** existing rules, regulations, policies, and procedures already in existence.
- **Monitor** multi-objective management opportunities so that funding opportunities may be shared and packaged, and broader constituent support may be garnered.

5.1.1. Continued Compliance with NFIP

To participate in the National Flood Insurance Program (NFIP), a community must adopt and enforce floodplain management regulations that meet or exceed the minimum requirements of the Program. These requirements are intended to prevent loss of life and property and to reduce taxpayer's costs for disaster relief as well as minimize economic and social hardships that result from flooding. Participation in the NFIP provides a community with access to flood insurance.

Detailed below is a description of the City's flood management program to ensure continued compliance with the NFIP. Also to be considered are the flood mitigation actions contained in this LHMP that support the ongoing efforts by the City to minimize the risk and vulnerability of the community to the flood hazard and to enhance their overall floodplain management program.

Garden Grove's Flood Management Program

The City of Garden Grove has participated in the Regular Phase of the NFIP since September 30, 1982. Since then, the City has administered floodplain management regulations that meet the minimum requirements of the NFIP. Under that arrangement, residents and businesses paid the same flood insurance premium rates as most other communities in the country.

The Community Rating System (CRS) was created in 1990. It is designed to recognize floodplain management activities that are above and beyond the NFIP's minimum requirements. If a community implements public information, mapping, regulatory, loss reduction and/or flood preparedness activities and submits the appropriate documentation to the FEMA, then its residents can qualify for a flood insurance premium rate reduction. The City does not currently participate in the CRS program.

Presently, the City manages its floodplains in compliance with NFIP requirements and implements a floodplain management program designed to protect the people and property of the City. Floodplain regulations are a critical element in local floodplain management and are a primary component in the City's participation in the NFIP. As well, the City's floodplain management activities apply to existing and new development areas, implementing flood protection measures for structures and maintaining drainage systems to help reduce the potential of flooding within the City.

The City will continue to manage their floodplains in continued compliance with the NFIP. An overview of the City's NFIP status and floodplain management program are discussed on Table 5-1.

Table 5-1 City of Garden Grove NFIP Status

NFIP Topic	Comments
Insurance Summary	
How many NFIP policies are in the community? What is the total premium and coverage?	1,206 policies $2,052,183 in premiums $306,353,500 in coverage
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were for substantial damage?	59 claims $354,659 in paid claims 2 substantial damage claims
Repetitive Loss (RL) and Severe Repetitive Loss Properties (SRL)	4 Repetitive Loss Properties 1 Severe Repetitive Loss Properties
How many structures are exposed to flood risk within the community?	3,424 in 1% Annual Chance 26,013 in 0.2% Annual Chance
Describe any areas of flood risk with limited NFIP policy coverage	No known areas exist.
Community Floodplain Administration	
Is the Community Floodplain Administrator or NFIP Coordinator certified?	No.
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	Flood insurance information is available to residents online. The counter staff is trained. There is coordination between the Planning, Building, and Engineering Divisions in the review stage.

NFIP Topic	Comments
What are the barriers to running an effective NFIP program in the community, if any?	Limited assistance from FEMA
Compliance History	
Is the community in good standing with the NFIP?	Yes
Are there any outstanding compliance issues (i.e., current violations)?	No
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?	CAV 6/5/2008
Is a CAV or CAC scheduled or needed?	No
Regulation	
When did the community enter the NFIP?	9/30/1992
Are the FIRMs digital or paper?	Digital
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	Meet minimum requirements.
Provide an explanation of the permitting process.	The applicant first discusses proposed improvements with Planning, who checks zoning, allowable uses, development standards and checks to see if the property is in Flood Zone A. Once the applicant clears planning, then they would submit plans to Building for plan check and eventually permit issuance. If at the beginning of the process it's determined that the improvements require Fire and Engineering review, then the applicant would be directed to discuss the plans/proposal with them to find out what requirements they will need to incorporate into their plans prior to submittal for permits.
Community Rating System (CRS)	
Does the community participate in CRS?	No
What is the community's CRS Class Ranking?	N/A
What categories and activities provide CRS points and how can the class be improved?	N/A
Does the plan include CRS planning requirements?	N/A

Source: FEMA/Garden Grove

5.1.2. Integration of Mitigation with Post Disaster Recovery and Mitigation Strategy Funding Opportunities

Hazard Mitigation actions are essential to weaving long-term resiliency into all community and City recovery efforts so that at-risk infrastructure, development, and other City assets are stronger and more resilient for the next severe storm event. Mitigation measures to reduce the risk and vulnerability of a community to future disaster losses can be implemented in advance of a disaster event and also as part of post-disaster recovery efforts.

Mitigation applied to recovery helps jurisdictions become more resilient and sustainable. It is often most efficient to fund all eligible infrastructure mitigation through FEMA's Public Assistance mitigation program if the asset was damaged in a storm or other hazard event. Mitigation work can be added to project worksheets if they can be proven to be cost-beneficial. Integration of mitigation into post disaster recovery efforts should be considered by as part of post disaster redevelopment and mitigation policies and procedures.

The City's EOP, through its policies and procedures, seek to mitigate the effects of hazards, prepare for measures to be taken which will preserve life and minimize damage, enhance response during emergencies and provide necessary assistance, and establish a recovery system in order to return Garden Grove to its normal state of affairs. Mitigation is emphasized as a major component of recovery efforts.

Mitigation Strategy Funding Opportunities

An understanding of the various funding streams and opportunities will enable the City to match identified mitigation projects with the grant programs that are most likely to fund them. Additionally, some of the funding opportunities can be utilized together. Mitigation grant pre- and post-funding opportunities include the following.

FEMA HMA Grants

Cal OES administers three main types of HMA grants: (1) Hazard Mitigation Grant Program, (2) Pre-Disaster Mitigation Program, and (3) Flood Mitigation Assistance Program. Eligible applicants for the HMA include state and local governments, certain private non-profits, and federally recognized Indian tribal governments. While private citizens cannot apply directly for the grant programs, they can benefit from the programs if they are included in an application sponsored by an eligible applicant.

FEMA Public Assistance Section 406 Mitigation

The Robert T. Stafford Disaster Relief and Emergency Assistance Act provides FEMA the authority to fund the restoration of eligible facilities that have sustained damage due to a presidentially declared disaster. The regulations contain a provision for the consideration of funding additional measures that will enhance a facility's ability to resist similar damage in future events.

Community Development Block Grants

The California Department of Housing and Community Development administers the State's Community Development Block Grant (CDBG) program with funding provided by the U.S. Department of Housing and Urban Development. The program is available to all non-entitlement communities that meet applicable threshold requirements. All projects must meet one of the national objectives of the program – projects must benefit 51 percent low- and moderate-income people, aid in the prevention or clearance of slum and blight, or meet an urgent need. Grant funds can generally be used in federally declared disaster areas for CDBG eligible activities including the replacement or repair of infrastructure and housing damaged during, or as a result of, the declared disaster.

Small Business Loans

SBA offers low-interest, fixed-rate loans to disaster victims, enabling them to repair or replace property damaged or destroyed in declared disasters. It also offers such loans to affected small businesses to help them recover from economic injury caused by such disasters. Loans may also be increased up to 20 percent of the total amount of disaster damage to real estate and/or leasehold improvements to make improvements that lessen the risk of property damage by possible future disasters of the same kind.

Increased Cost of Compliance

Increased Cost of Compliance (ICC) coverage is one of several resources for flood insurance policyholders who need additional help rebuilding after a flood. It provides up to $30,000 to help cover the cost of mitigation measures that will reduce flood risk. ICC coverage is a part of most standard flood insurance policies available under NFIP.

5.2 Goals and Objectives

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Up to this point in the planning process, the HMPC has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals, objectives, and mitigation actions were developed based on these tasks. The HMPC held a series of meetings and exercises designed to achieve a collaborative mitigation strategy as described further throughout this section. Appendix C documents the information covered in these mitigation strategy meetings, including information on goals development and the identification and prioritization of mitigation alternatives by the HMPC.

During the initial goal-setting meeting, the HMPC reviewed the results of the hazard identification, vulnerability assessment, and capability assessment. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the HMPC to formulate planning goals and objectives and to develop the mitigation strategy for the City of Garden Grove Planning Area.

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the City;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- A time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation. Implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals. Objectives define strategies to attain the goals and are more specific and measurable.

HMPC members were provided with the list of sample goals to consider. They were told that they could use, combine, or revise the statements provided or develop new ones, keeping the risk assessment in mind. Each member was given three index cards and asked to write a goal statement on each. Goal statements were collected and grouped into similar themes during the meeting. The goal statements were then grouped into similar topics. New goals from the HMPC were discussed until the team came to consensus. Some of the statements were determined to be better suited as objectives or actual mitigation actions and were integrated into the goals or set aside for later use.

Based on the risk assessment review and goal setting process, the HMPC identified the following goals and objectives, which provide the direction for reducing future hazard-related losses within the City of Garden Grove Planning Area.

Goal 1: Minimize risk and vulnerability of Garden Grove to natural hazards and protect lives and prevent losses to property, economy, public health and safety, and the environment

- Provide protection for existing and future development.
- Promote natural systems protection and management
- Identify strategies for mitigating hazards to reduce adverse impacts and hazard related losses.
- Integrate mitigation efforts into facility maintenance programs to increase life expectancy and performance of structures.
- Establish a City policy for hazard loss reduction

Goal 2: Provide protection for critical facilities to minimize loss of life and injury from hazard impacts

- Minimize impacts to critical facilities, utilities, and services and minimize disruptions.
- Implement technology enhancements for minimizing interruption of critical services and efficiently restoring impacted facilities

Goal 3: Increase community outreach, education, and awareness of risk and vulnerability to hazards and promote preparedness and self-responsibility to reduce hazard-related losses

- Establish a Citywide public information program that utilizes a variety of outreach strategies and mechanisms to reach all Garden Grove residents and visitors
- Inform and educate residents, businesses, visitors, and other stakeholders as to all hazards they are exposed to, where they occur, what they can do to mitigate exposure or damages.
- Maximize use of technologies in public education and awareness activities.

Goal 4: Improve City's capabilities to reduce hazard-related losses and to be prepared for, respond to, and recover from a disaster event

- Continued improvements to emergency services and public safety capabilities.
- Increase the use of shared resources, mutual aid and build partnerships with other agencies and jurisdictions
- Integrate hazard planning and mitigation into routine City functions
- Make better use of technology

- Provide resources and services to at risk populations
- Promote incident stabilization

5.3 Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section 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.

In order to identify and select mitigation actions to support the mitigation goals, each hazard identified in Section 4.1 was evaluated. Only those hazards that were determined to be a priority hazard for purposes of mitigation action development were considered further in the development of hazard-specific mitigation actions.

These priority hazards (in alphabetical order) are:

- Climate Change
- Dam Failure
- Drought & Water Shortage
- Earthquake
- Earthquake Liquefaction
- Flood: 1%/0.2% annual chance
- Flood: Localized/Stormwater
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms (wind, hail, lightning)
- Severe Weather: High Winds
- Wildfire

Note: all hazards profiled as part of this Garden Grove LHMP were determined to be priority hazards for mitigation planning. However, due to the lack of ownership and control over structures contributing to the Dam and Levee Failure hazards, mitigation strategy planning by the City was limited to public education and emergency response actions for these hazards.

It is further important to note that **all the hazards addressed in this plan are included in the City's multi-hazard public education mitigation action as well as in other multi-hazard, emergency management actions.**

Once it was determined which hazards warranted the development of specific mitigation actions, the HMPC analyzed viable mitigation options that supported the identified goals and objectives. The HMPC was provided with the following list of categories of mitigation actions, which originate from the NFIP's Community Rating System:

- Prevention
- Property protection
- Structural projects
- Natural resource protection

- Emergency services
- Public information

The HMPC was provided with examples of potential mitigation actions for each of the above categories. The HMPC was also instructed to consider both future and existing buildings in considering possible mitigation actions. A facilitated discussion then took place to examine and analyze the options. Appendix C provides a detailed review and discussion of the six mitigation categories to assist in the review and identification of possible mitigation activities or projects. Also utilized in the review of possible mitigation measures is FEMA's publication on Mitigation Ideas, by hazard type. Prevention type mitigation alternatives were discussed for each of the priority hazards. This was followed by a brainstorming session that generated a list of preferred mitigation actions by hazard.

5.3.1. Prioritization Process

Once the mitigation actions were identified, the HMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE sustainable disaster recovery criteria; Smart Growth principles; and others, 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)
- Technical: Is the action technically feasible? Does it solve the problem?
- Administrative: Are there adequate staffing, funding, and other capabilities to implement the project?
- Political: Who are the stakeholders? 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?
- 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 DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority. Other criteria used to assist in evaluating the benefit-cost of a mitigation action includes:

- Contribution of the action to save life or property
- Availability of funding and perceived cost-effectiveness
- Available resources for implementation
- Ability of the action to address the problem

The Mitigation Strategy Meeting Handout, which included hazard summaries, mitigation action categories, sample hazard actions, and prioritization criteria is included in Appendix C.

With these criteria in mind, HMPC members were each given a set of nine colored dots, three each of red, blue, and green. The dots were assigned red for high priority (worth five points), blue for medium priority (worth three points), and green for low priority (worth one point). The team was asked to use the dots to prioritize actions with the above criteria in mind. The point score for each action was totaled. Appendix C contains the total score given to each identified mitigation action.

The process of identification and analysis of mitigation alternatives allowed the HMPC to come to consensus and to prioritize recommended mitigation actions. During the voting process, emphasis was placed on the importance of a benefit-cost review in determining project priority; however, this was not a quantitative analysis. The team agreed that prioritizing the actions collectively enabled the actions to be ranked in order of relative importance and helped steer the development of additional actions that meet the more important objectives while eliminating some of the actions which did not garner much support.

Benefit-cost was also considered in greater detail in the development of the Mitigation Action Plan detailed below in Section 5.4. The cost-effectiveness of any mitigation alternative will be considered in greater detail through performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this LHMP.

Recognizing the limitations in prioritizing actions from multiple departments and the regulatory requirement to prioritize by benefit-cost to ensure cost-effectiveness, the HMPC decided to pursue actions that contributed to saving lives and property as first and foremost, with additional consideration given to the benefit-cost aspect of a project. This process drove the development of a determination of a high, medium, or low priority for each mitigation action, and a comprehensive prioritized action plan for the City of Garden Grove Planning Area.

5.4 Mitigation Action Plan

Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This mitigation action plan was developed to present the recommendations developed by the HMPC for how the City of Garden Grove Planning Area can reduce the risk and vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. Emphasis was placed on both future and existing development. The action plan summarizes who is responsible for implementing each of the prioritized actions as well as when and how the actions will be implemented. Each action summary also includes a discussion of the benefit-cost review conducted to meet the regulatory requirements of the Disaster Mitigation Act.

Table 5-2 identifies the mitigation actions, the goals addressed by each action, the lead agency or department for each action, whether the action protects existing or future development, and the mitigation type or category. Following this summary table of mitigation actions, a detailed implementation description is included for each mitigation action identified in the table. The implementation of any mitigation action in this Plan is subject to available funding and desires of the City as the primary implementing agency for this LHMP.

As described throughout this LHMP Update, Garden Grove has many risks and vulnerabilities to identified hazards. Although many possible mitigation actions, as detailed in Appendix C, were brainstormed and prioritized during the mitigation strategy meetings, the resulting mitigation strategy presented in this

Chapter 5 of this LHMP focuses only on those mitigation actions that are both reasonable and realistic for the City to consider for implementation over the next 5-years covered by this Plan. Thus, only a portion of the actions identified in Appendix C have been carried forward into the mitigation strategy presented in Table 5-2. Although many good ideas were developed during the mitigation action brainstorming process, the reality of determining which priority actions to develop and include in this LHMP came down to the actual priorities of the City, individuals and departments based in part on department direction, staffing, and available funding. The overall value of the mitigation action table in Appendix C is that it represents a wide-range of mitigation actions that can be consulted and developed for this LHMP Update during annual plan reviews and the formal 5-year update process.

It is also important to note that the City has numerous existing, detailed action descriptions, which include benefit-cost estimates, in other planning documents and programs, such as community wildfire protection plan/fire plans, climate change plans, and capital improvement budgets and reports. These actions are considered to be part of this LHMP, and the details, to avoid duplication, should be referenced in their original source document. The HMPC also realizes that new needs and priorities may arise as a result of a disaster or other circumstances and reserves the right to support new actions, as necessary, as long as they conform to the overall goals of this LHMP.

Further, it should be clarified that the actions included in this mitigation strategy are subject to further review and refinement; alternatives analyses; reprioritization due to funding availability and/or other criteria; and City Council approval. The City is not obligated by this document to implement any or all of these projects. Rather this mitigation strategy represents the desires of the City to mitigate the risks and vulnerabilities from identified hazards. The actual selection, prioritization, and implementation of these actions will also be further evaluated in accordance with the mitigation categories and criteria contained in Appendix C, and, as always, the availability of funding.

It should be noted that some of these mitigation efforts are collaborative efforts among multiple local, state, and federal agencies. **In addition, the public outreach and education action, as well as many of the emergency services and other multi-hazard actions, apply to all hazards regardless of hazard priority.** Collectively, this Garden Grove multi-hazard mitigation strategy includes only those actions and projects which reflect the actual priorities and capacity of the City to implement over the next 5-years covered by this Plan.

MAKE SURE THAT YOU HAVE WORKSHEETS FOR ALL THE ACTIONS FROM THE ORANGE COUNTY DISTRICT PLAN SPECIFIC TO GARDEN GROVE WATER AND WASTEWATER IN HERE TO COVER THESE ACTIONS IN BOTH PLANS

Table 5-2 City of Garden Grove Mitigation Actions

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Multi-Hazard Actions					
Action 1.Integrate Local Hazard Mitigation Plan into Safety Element of General Plan	1, 2, 3, 4	X	X		Prevention
Action 2.Public Awareness, Education, Outreach, and Preparedness Program Enhancements.	1, 2, 3, 4	X	X	X	Public Information
Action 3.Urban Forest Management Plan	1, 2, 3, 4	X	X		Prevention Natural Resource Protection
Action 4.Information Technology Cloud Infrastructure and Backups	1, 2, 3, 4	X	X		Prevention Emergency Services
Action 5.Identify and Establish/Activate Shelter(s)	1, 2, 3, 4	X	X		Emergency Services
Action 6.Action 6.New Construction and Building Retrofits with Non-cellulose Materials	1, 2, 4	X	X		Prevention Property Protection Structural Projects
Action 7.Building Maintenance Program Focusing on Roofs, Gutters, Drains, and Eves	1, 2, 4	X	X		Prevention Property Protection Structural Projects
Action 8.Backup Generators for Critical Facilities	1, 2, 4	X	X	X	Property Protection Emergency Services
Action 9.Tree Maintenance	1, 2, 4	X	X		Property Protection Natural Resource Protection
Action 10. Southern California Edison's (SCE) Tariff Rule 20A Utility Undergrounding	1, 2, 4	X	X		Prevention Property Protection
Action 11. EOC Update	1, 2, 4	X	X		Prevention Emergency Services

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Climate Change Actions					
Action 12. Ongoing Recycling and Greenhouse Gas Reduction Program	1, 2, 4	X	X		Prevention
Dam Failure, Flood: 1%/0.2% Annual Chance, Localized Flood, Severe Weather: Heavy Rain and Storm Actions					
Action 13. Catch Basin Maintenance Program Enhancements	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 14. Roadway Re-Construct/Bonser Avenue	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 15. MS4 Capacity Upgrade in Target Locations/Garden Grove Blvd Storm Drain	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 16. MS4 Capacity Upgrade in Target Locations - Yockey/Newland Storm Drain Phase 1	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 17. Line B5 Storm Drain Project	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 18. Drainage Master Plan (Update/Implementation)	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Action 19. Stormwater Drainage Improvements Using Updated DFIRMs Maps and Zones Project	1, 2, 4	X	X	X	Property Protection Structural Projects Natural Resource Protection
Drought and Water Shortage Actions					
Action 20. Public Education - Tree Watering during Drought	1, 2, 3, 4		X	X	Public Information

Action Title	Goals Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP	Mitigation Type
Earthquake and Earthquake Liquefaction Actions					
Action 21. Install Seismic Shutoff Valves On all City Facility Above Ground Gas Valves. Seismic Retrofit	1, 2, 4	X	X		Property Protection
Action 22. Conduct a Police Building Seismic Facility Assessment / Evaluate for Seismic Retrofit	1, 2, 4	X	X		Prevention Property Protection
Action 23. Conduct Facility Assessment / Evaluate for Seismic Retrofit	1, 2, 4	X	X		Prevention Property Protection
Severe Weather Actions					
Action 24. Activate and Enhance Cooling Center Locations	1, 2, 3, 4	X	X		Prevention Emergency Services
Action 25. Secure All Roofs and Eves	1, 2, 4	X	X		Property Protection
Wildfire Actions					
Action 26. Turn Off Power to Electrical Outlets / Tamper Proof Covers in Public Areas	1, 2, 4	X	X		Prevention Property Protection Natural Resource Protection
Action 27. Upgrade Wooden Electrical Panels in Parks	1, 2, 4	X	X		Property Protection Natural Resource Protection

Multi-Hazard Actions

Action 1. Integrate Local Hazard Mitigation Plan into Safety Element of General Plan

Hazards Addressed: Multi-hazard (Climate Change, Dam Failure, Drought & Water Shortage, Earthquake , Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds)

Goals Addressed: 1, 2, 3, 4

Issue/Background: Local jurisdictional reimbursement for mitigation projects and cost recovery after a disaster is guided by Government Code Section 8685.9 (AB 2140).

Project Description: Specifically, AB 2140 requires that each jurisdiction adopt a local hazard mitigation plan (LHMP) in accordance with the federal Disaster Mitigation Act of 2000 as part of the Safety Element of its General Plan. Adoption of the LHMP into the Safety Element of the General Plan may be by reference or incorporation.

Other Alternatives: No action

Existing Planning Mechanisms through which Action will be Implemented: Safety Element of General Plan

Responsible Office/Partners: City of Garden Grove Planning Department

Project Priority: High

Cost Estimate: City Staff Time

Benefits (avoided Losses): Incorporation of an adopted LHMP into the Safety Element of the General Plan will help jurisdictions maximize the cost recovery potential following a disaster.

Potential Funding: General Fund

Timeline: At the next General Plan update

Action 2. Public Awareness, Education, Outreach, and Preparedness Program Enhancements

Hazards Addressed: Multi-hazard (Climate Change, Dam Failure, Drought & Water Shortage, Earthquake , Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds)

Goals Addressed: 1, 2, 3, 4

Issue/Background: Garden Grove plays a key role in public outreach/education efforts to communicate the potential risk and vulnerability of their community to the effects of natural hazards. A comprehensive multi-hazard public education program will better inform the community of natural hazards of concern and actions the public can take to be better prepared for the next natural disaster event.

Project Description: A comprehensive multi-hazard outreach program will ascertain both broad and targeted educational needs throughout the community. The County will work with other agencies as appropriate to develop timely and consistent annual outreach messages in order to communicate the risk and vulnerability of natural hazards of concern to the community. This includes measures the public can take to be better prepared and to reduce the damages and other impacts from a hazard event. The public outreach effort will leverage and build upon existing mechanisms, will include elements to meet the objectives of Goal 3 of this LHMP Update, and will consider:

- Using a variety of information outlets, including websites, local radio stations, news media, schools, and local, public sponsored events;
- Creating and distributing (where applicable) brochures, leaflets, water bill inserts, websites, and public service announcements;
- Displaying public outreach information in County office buildings, libraries, and other public places and events;
- Developing public-private partnerships and incentives to support public education activities.

Other Alternatives: Continue public information activities currently in place.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Existing County outreach programs will be reviewed for effectiveness and leveraged and expanded upon to reach the broader region.

Responsible Office: City of Garden Grove

Priority (H, M, L): High

Cost Estimate: Annual costs to be determined, and will depend on the scope and frequency of activities and events as well as volunteer participation

Benefits (Losses Avoided): Increase residents' knowledge of potential hazards and activities required to mitigate hazards and be better prepared. Protect lives and reduce damages, relatively low cost to implement.

Potential Funding: Local budgets, grant funds

Timeline: Ongoing/Annual public awareness campaign

Action 3. Urban Forest Management Plan

Hazards Addressed: Climate Change/Drought & Water Shortage/Extreme Heat/ Heavy Rains and Storm/High Winds

Goals Addressed: 1, 2, 3, 4

Issue/Background: The average tree canopy for a city to combat environmental issues should be a minimum 20%. Garden Grove's canopy is only 7%. Many of the trees need to be replaced and we have nearly 10,000 open tree wells that could be planted. A Urban Forest Management Plan will help us evaluate, plan and protect our trees now and in the future. More trees will make our city look more appealing to developers and business owners.

Project Description: Adopt the Urban Forest Management Plan currently being developed by Davey Resource Group. Secure additional funding to finance the suggested improvements.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Have the City Council adopt the plan and secure additional funding. Educate the public so they understand the importance of planting trees.

Responsible Office/Partners: Garden Grove Trees/Flood Control and Parks Department

Project Priority: High

Cost Estimate: $75,000.00 per year

Benefits (Losses Avoided): An average Gold Medallion with a 5" diameter will remove 101 lbs of CO_2 per year and intercept 213 gallons of runoff, helping to clean the air and reduce polluted runoff into the ocean. Tree lined streets absorb noise and catch the dust in the air.

Potential Funding: General Fund or CIP

Timeline: 5 years

Action 4. Information Technology Cloud Infrastructure and Backups

Hazards Addressed: Multi-hazard (Climate Change, Dam Failure, Drought & Water Shortage, Earthquake , Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds)

Goals Addressed: 1, 2, 3, 4

Issue/Background: Much of the City's digital infrastructure is hosted on-premises. In the event of a major disaster affecting City hall, all digital City services/data would be taken offline until backups can be restored. If the on-premises hardware is destroyed many services/data will be unrecoverable.

Project Description: Migrate critical I.T. services and data to cloud-based (offsite) infrastructure, including backups of essential services/data

Other Alternatives: Store critical backups on cloud-based infrastructure

Existing Planning Mechanism(s) through which Action Will Be Implemented: I.T. is currently performing research on the requirements for migrating critical Police Department services to cloud-based infrastructure.

Responsible Office/Partners: Garden Grove Information Technology

Cost Estimate: To be determined

Benefits (Losses Avoided): Critical digital systems including all City Public Safety applications and data will remain accessible in the event of a major disaster.

Potential Funding: City Budgets, Grants

Timeline: Ongoing

Project Priority: Moderate

Action 5. Identify and Establish/Activate Shelter(s)

Hazards Addressed: Multi-hazard (Dam Failure, Earthquake, Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds). Any hazard resulting in activation of EOC during emergency and/or natural disaster resulting in displacement of residents.

Goals Addressed: 1, 2, 3, 4

Issue/Background: The decision to open a shelter will be made based on the scope and size of an emergency and/or incident. In fast-breaking events, the decision to open a shelter maybe made by first responders in the field before the EOC is able to activate. Based on intelligence gathered, a shelter operation should develop an estimate of sheltering needs including the number of people to be sheltered. The Community Services Department will then determine appropriate shelter location(s). If a shelter location is being considered in a public school facility, District officials will be included in the decision-making process.

The Community Services Department will coordinate mass care with all supporting and other appropriate agencies/organizations. Each mass care agency/organization will manage its own program(s) and maintain administrative and logistical support for its activities.

Project Description: The City of Garden Grove Sheltering Plan is to coordinate the capability to meet basic needs (shelter, food, bulk distribution of emergency supplies, disaster welfare inquiries, and emergency social services) in disaster solutions. Staff will identify a shelter location and activate the shelter when there is a local or regional emergency and/or disaster (i.e. fire, earthquake, flood, etc).

Other Alternatives: A shelter may also be activated on school district and/or private property.

Existing Planning Mechanism(s) through which Action Will Be Implemented: When the EOC is activated, then either the OC Red Cross and/or City Sheltering Plan will be implemented.

Responsible Office/Partners: Community Services Department

Cost Estimate: Unknown; determined on type of emergency and/or natural disaster.

Benefits (Losses Avoided): Provide shelter and care to displaced residents.

Potential Funding: City's operating budget, and other funds available locally, through County and/or State.

Timeline: Upon EOC activation and/or notice of an emergency/natural disaster.

Project Priority: Moderate

Action 6. New Construction and Building Retrofits With Non-cellulose Materials

Hazards Addressed: Fire / Flood

Goals Addressed: 1, 2, 4

Issue/Background: To protect City staff and the citizens of Garden Grove from fire.

Project Description: Insure non-cellulose building materials are used on all building improvements and new construction

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will perform the evaluation process and implement the program.

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $300,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- capital improvement plan Secondary- Operating budget

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 7. Building Maintenance Program Focusing on Roofs, Gutters, Drains, and Eves

Hazards Addressed: Fire / Flood

Goals Addressed: 1, 2, 4

Issue/Background: To protect City staff and the citizens of Garden Grove from fire and flooding.

Project Description: Clean, inspect and repair all roofs, gutters, drains and eves for cleanliness, proper operation and structural integrity.

Other Alternatives: None

E**xisting Planning Mechanism(s) through which Action Will Be Implemented**: Public Works will perform the evaluation process and make necessary improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $250,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- capital improvement plan Secondary- Operating budget

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 8. Backup Generators for Critical Facilities

Hazards Addressed: Multi-hazard (Climate Change, Dam Failure, Drought & Water Shortage, Earthquake , Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds)

Note from SoCalEdison - Therefore, use of natural gas technologies such as combined heat and power systems, natural gas fuel cells, and backup generators strongly align with the goals of Action 8 and should be acknowledged and included as potential solutions addressing this action. DO YOU WANT TO ADD?

Goals Addressed: 1, 2, 4

Issue/Background: In the event of a natural disaster or power outage critical facilities will require back power to provide needed services to the community Critical facilities include six (6) fire stations, one (1) one public safety building / Police Department, one (1) City Hall, one (1) Public Works facility and one (1) Community Meeting Center / Temporary Shelter

Project Description: Remove and replace damaged stand by generators at critical facilities at ten (10) critical facilities

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works Facilities division will manage the installation of new standby generators at critical buildings

Responsible Office/Partners: Phillip Carter-Manager, Steve Sudduth Equipment Supervisor

Cost Estimate: $6,200,000.00

Benefits (Losses Avoided): Provide citizens with necessary services. Life/Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 9.   Tree Maintenance

Hazards Addressed: Climate Change, Extreme Heat, High Winds, Drought and Water Shortage

Goals Addressed: 1, 2, 4

Issue/Background: Many of our trees have reached the end of their lives due to drought stress, disease or repeated damage to the infrastructure. These trees need to be replaced with more appropriate species due to climate change and drought. Treat those trees that may be affected by the ISHB (invasive shot hole borer). Sidewalk and curb and gutter replacement can be completed after removal. Using existing funding will divert money intended for trimming.

Project Description: Begin the removal and replacement of trees according to district and location. Hire an arborist to examine and evaluate those trees that appear to have been infected by the ISHB.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Have city personnel and West Coast Arborists begin the removal and replanting process as current funding allows. Evaluate which trees can receive deferred trimming to allow removal instead.

Responsible Office/Partners: Garden Grove Trees/Flood Control – West Coast Arborists

Project Priority: High

Cost Estimate: $10 – $15 thousand per month.

Benefits (Losses Avoided): Replace trees in a timely manner to avoid more costly removals if the trees topple or fall due to highs winds or storms.

Potential Funding: General fund, CalFire grant

Timeline: On going

Action 10. Southern California Edison's (SCE) Tariff Rule 20A Utility Undergrounding

Hazards Addressed: Overhead Electric/Telecommunication Utility Poles (Earthquake/fire/flood hazard, etc.)

Goals Addressed: 1, 2, 4

Issue/Background: The City receives an annual allotment from SCE's Tariff Rule 20A funding for the undergrounding of electric and telecommunication overhead pole undergrounding. After funding is accumulated, the City proposes project locations to SCE.

Project Description: Due to minimal funding from Tariff Rule 20A, the City is limited in its efforts to underground key corridors with overhead utilities. Additional funding is required.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Southern California Edison Tariff Rule 20A Appropriation / Five-Year Capital Improvement Plan

Responsible Office/Partners: Southern California Edison (Construction/Planning/Rule 20A Appropriation) Garden Grove Public Works Engineering (Planning/Project Selection)

Cost Estimate: Based on Rule 20A Funding Formula (SCE Appropriation)

Benefits (Losses Avoided): Losses Avoided: Public and Private property damage / Overhead Utility hazards

Potential Funding: SCE Funding

Timeline: Long-term Implementation (Once Funding is secured)

Project Priority: High Priority

Action 11. EOC Update

Hazards Addressed: Multi-hazard (Climate Change, Dam Failure, Drought & Water Shortage, Earthquake , Earthquake Liquefaction, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, Severe Weather: Extreme Heat, Severe Weather: Heavy Rains and Storms (wind, hail, lightning), Severe Weather: High Winds)

Goals Addressed: 1, 2, 4

Issue/Background: EOC equipment is antiquated and also does not have the ability to effectively go mobile if both EOC#1 and EOC#2 are down. With GGFD transition to OCFA we currently do not have personnel trained in the ICS modules that are needed. An EOC coordinator was just hired on a part-time basis but will not start until December.

Project Description: EOC Update and Training

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: None exist today…GGFD was lacking current trends and equipment to effectively and efficiently run EOC

Responsible Office/Partners: GGPD and EOC Coordinator

Cost Estimate: $25000-$30000 plus salary position of new EOC Coordinator

Benefits (Losses Avoided): City will be prepared for a major critical incident and minimize the loss of life and property damage.

Potential Funding: Partial Grant Based.

Timeline: 6-12 Months

Project Priority: High

Climate Change Actions

Action 12. Ongoing Recycling and Greenhouse Gas Reduction Program

Hazards Addressed: Climate Change

From SoCalEdison - we recommend that the Draft LHMP include a RNG and waste-to-energy projects as potential solutions for the goals of Action 12 and discuss the co-benefits of emission reductions and organic waste recycling that can be achieved from implementation. DO YOU WANT TO ADD?

Goals Addressed: 1, 2, 4

Issue/Background: Climate change is a top priority for California due to the negative effects that endanger public health and the environment. Today there is growing concern about climate change and global warming and how it could impact our environment and our lives. In California and throughout western North America, signs of a changing climate are evident. Over the last 50 years, winters and springs have been getting warmer, and more precipitation has been falling as rain instead of snow. Less snow has been accumulating in the mountains, flowers have been blooming earlier, and snowmelt has been coming 5 to 30 days earlier in the spring.

These regional changes are consistent with broader global changes. From 1900 through 1970, the average global temperature rose by about 0.1°F (0.06°C) per decade. Since then, the rate of warming has increased markedly, to about 0.5°F (0.3°C) per decade. Going back 1,000 years, observations suggest that the 10 warmest years all occurred after 1990. Much of the warming during the last four decades is due to the increasing atmospheric concentrations of greenhouse gases released by human activities.

Project Description: Continue to implement and seek funding for active, ongoing recycling programs. Recycling combats climate change in several ways. First, it reduces the need to extract raw materials to manufacture new products, which reduces energy use and the release of carbon dioxide and other greenhouse gases into our atmosphere. For example, every 10 pounds of aluminum you recycle prevents 37 pounds of carbon emissions. The State is taking steps to reduce its effects through several legislative acts to increase recycling and local jurisdictions are adopting recycling programs to support the following acts: AB 341 (Mandatory Commercial Recycling), AB 1826 (Mandatory Commercial Organics Recycling), AB 1594 (Green Material Used as Alternative Daily Cover) and SB 1383 (Short-Lived Climate Pollutants: Organic Waste Methane Emissions Reductions).

Other Alternatives: Reduce and Reuse Programs

Existing Planning Mechanism(s) through which Action Will Be Implemented: Climate Action Plan, General Plan

Responsible Office/Partners: Garden Grove Public Works Department, Community Development Department, PIO

Project Priority: High

Cost Estimate: Unknown, costs ranging in millions depending on the measures.

Benefits (Losses Avoided): Human health impacts, Environmental

Potential Funding: Rate mechanisms, Franchise Fees, Grants

Timeline: Near Term

Dam Failure, Flood: 1%/0.2% annual chance, Flood: Localized/Stormwater, Levee Failure, and Severe Weather: Heavy Storms Actions

Action 13. Catch Basin Maintenance Program Enhancements

Hazards Addressed: Flood, Localized Flood, Heavy Rains and Storms

Goals Addressed: 1, 2, 4

Issue/Background: Prevent trash from clogging or entering the storm drains which flow to the ocean. This can contribute to localized flooding during rain events.

Project Description: Install screens and or full capture systems at all possible catch basins. Stencil all catch basins.

Other Alternatives: Monthly cleaning of 948 catch basins – need additional manpower and funding

Existing Planning Mechanism(s) through which Action Will Be Implemented: Trees/Flood control department will manage the installation of any devices and cleaning of the catch basins.

Responsible Office/Partners: Garden Grove Trees/Flood Control Departments

Cost Estimate: $800 to $3,000 per catch basin depending on device and size

Benefits (Losses Avoided): Meet state NPDES standards, property protection

Potential Funding: Primary – state grants, secondary – capital improvement project

Timeline: Continuous – yearly - until completed

Project Priority: High

Action 14. Roadway Re-Construct/Bonser Avenue

Hazards Addressed: Flood, Localized Flood, Heavy Rains and Storms

Goals Addressed: 1, 2, 4

Issue/Background: Prevent loss of life and property. City of Garden Grove topography is relatively flat with a past as being agricultural land. It is now a built-out city with little land offering natural infiltration.

Project Description: Design and construct.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Ongoing collaboration with Finance Department Risk Management Section. Evaluate localized flood history. Assess development of new construction with that of stormwater flood mitigation.

Responsible Office/Partners: City Engineer and Environmental Services/Community Planning and Chief Building Official

Cost Estimate: $2,000,000

Benefits (Losses Avoided): Improved roadway safety for vehicular traffic. Assist in the reduction of claims filed with the city for loss of property. Enhance efforts to prevent loss of life.

Potential Funding: Federal/State/Local

Timeline: 2021 or until completed.

Project Priority: High

Action 15. MS4 Capacity Upgrade in Target Locations/Garden Grove Blvd Storm Drain

Hazards Addressed: Flood/Heavy Rains and Storms

Goals Addressed: 1, 2, 4

Issue/Background: Prevent loss of life and property. City of Garden Grove topography is relatively flat with a past as being agricultural land. It is now a built-out city with little land offering natural infiltration.

Project Description: Design and Construct to increase capacity.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Ongoing collaboration with Finance Department Risk Management Section. Evaluate localized flood history. Assess development of new construction with that of stormwater flood mitigation.

Responsible Office/Partners: City Engineer and Environmental Services/Community Planning and Chief Building Official

Cost Estimate: $2,800,000

Benefits (Losses Avoided): Improved roadway safety for vehicular traffic. Assist in the reduction of claims filed with the city for loss of property. Enhance efforts to prevent loss of life.

Potential Funding: Federal/State/Local

Timeline: 2020 or until completed.

Project Priority: High

Action 16. MS4 Capacity Upgrade in Target Locations - Yockey/Newland Storm Drain Phase 1

Hazards Addressed: Flood/Heavy Rains and Storms

Goals Addressed: 1, 2, 4

Issue/Background: Prevent loss of life and property. City of Garden Grove topography is relatively flat with a past as being agricultural land. It is now a built-out city with little land offering natural infiltration.

Project Description: Design phase.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Ongoing collaboration with Finance Department Risk Management Section. Evaluate localized flood history. Assess development of new construction with that of stormwater flood mitigation.

Responsible Office/Partners: City Engineer and Environmental Services/Community Planning and Chief Building Official

Cost Estimate: $100,000

Benefits (Losses Avoided): Improved roadway safety for vehicular traffic. Assist in the reduction of claims filed with the city for loss of property. Enhance efforts to prevent loss of life.

Potential Funding: Federal/State/Local

Timeline: 2020 or until completed.

Project Priority: High

Action 17. Line B5 Storm Drain Project

Hazards Addressed: 1% and 0.2% Annual Chance Flood

Goals Addressed: 1, 2, 4

Issue/Background: Per the City's Master Plan of Drainage, the recommended top priority storm drain, Line B5 would help alleviate flooding along an almost two mile long section of the city that includes portions of Newland Street, Yockey Street, Magnolia Street and Cannery Street. Frequent localized flooding at Trask & Yockey, Yockey & Dakota, Magnolia & Garden Grove Blvd and annual flooding along Magnolia north of GG Blvd and Stanford Avenue will be eliminated.

Project Description: The initial 1200 feet of the 2 mile long and large diameter (108”) storm drain has been completed to date. The reinforced concrete pipe alignment runs through many residential streets that may have challenges overcoming various utility conflicts due to the storm drain’s large size.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Plan of Drainage

Responsible Office/Partners: Garden Grove Public Works Engineering

Cost Estimate: $30,000,000

Benefits (Losses Avoided): Losses Avoided: Public and Private property damage

Potential Funding: Federal, State, Local Funding

Timeline: Long-term/10-15 years (Once funding is secured)

Project Priority: Top priority per 1991 Master Plan of Drainage

Action 18. Drainage Master Plan (Update/Implementation)

Hazards Addressed: 1% and 0.2% Annual Chance Flood

Goals Addressed: 1, 2, 4

Issue/Background: The City’s Master Plan of Drainage was last updated in September 1991. Most projects recommended by the Master Plan are now outdated and so are the various project priorities and estimates.

Project Description: The City needs to hire a consultant firm to produce a new Master Plan of Drainage, including the identification and prioritization of projects, inclusion of cost estimates, and pertinent data. Once an updated Master Plan of Drainage is adopted by the City, the City would need the necessary funds to implement the Plan according to project priorities.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Plan of Drainage, Capital Improvement Plan

Responsible Office/Partners: Garden Grove Public Works Engineering

Cost Estimate: Master Plan Document ($150K), Master Plan Implementation ($75M)

Benefits (Losses Avoided): Losses Avoided: Public and Private property damage

Potential Funding: Federal, State, Local Funding

Timeline: Long-term/30-40 years for full implementation (Once funding is secured)

Project Priority: High Priority (Flooding Risk)

Action 19. Stormwater Drainage Improvements Using Updated DFIRMs Maps and Zones Project

Hazards Addressed: Flooding

Goals Addressed: 1, 2, 4

Issue/Background: A number of areas in the Flood Zone are susceptible to flooding due to inadequate infrastructure. The City's Master Plan of Drainage addresses the deficiencies through proposed storm drain facilities.

Project Description: Construct the following storm drain lines identified in the City's Master Plan of Drainage that will virtually eliminate flooding within the Flood Zones: H1-H8 ,G6, F9, F11, E3 and E4.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Capital Improvement Plan

Responsible Office/Partners: City of Garden Grove Public Works Department

Cost Estimate: $28,000,000

Benefits (Losses Avoided): Virtually No Flooding - provided downstream county facilities are sized properly

Potential Funding: Gas Tax, General Fund

Timeline: 15-20 Years

Project Priority: High

Drought & Water Shortage Actions

Action 20. Public Education – Tree Watering during Drought

Hazards Addressed, Drought & Water Supply (including Climate Change, Extreme Heat)

Goals Addressed: 1, 2, 3

Issue/Background: It is imperative that trees be watered during a drought. They provide shade, remove carbon dioxide and provide oxygen for our environment. It takes years to recover the benefits when a mature tree is lost.

Project Description: Public outreach to inform citizens the importance of watering our trees and not allowing them to die during a drought. Use city website and other public outreach mechanisms to inform and educate the public.

Other Alternatives: Use inserts in the water bill, channel 3

Existing Planning Mechanism(s) through which Action Will Be Implemented: Coordinate with City Water Dept. and channel 3

Responsible Office/Partners: City Water Department and Channel 3

Cost Estimate: Staff time, Printing costs unknown if used.

Benefits (Losses Avoided): Maintains our tree canopy and minimizes heat island effect.

Potential Funding: None

Timeline: Continuous

Project Priority: High

Earthquake and Earthquake Liquefaction Actions

Action 21. Install Seismic Shutoff Valves On all City Facility Above Ground Gas Valves. Seismic Retrofit

Hazards Addressed: Earthquake and Liquefaction

Goals Addressed: 1, 2, 3

Issue/Background: To protect City staff and the citizens of Garden Grove and promote seismic integrity

Project Description: Have all City owned gas valves evaluated for seismic structural integrity

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will oversee a third party consultant in the evaluation process. At the end of the process capital plans can be made to implement recommended improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $100,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 22. Conduct a Police Building Seismic Facility Assessment / Evaluate for Seismic Retrofit

Hazards Addressed: Earthquake and Liquefaction

Goals Addressed: 1, 2, 3

Issue/Background: To protect City staff and the citizens of Garden Grove it is necessary to have City owned building evaluated for seismic structural integrity

Project Description: Have all City owned Police buildings evaluated for seismic structural integrity

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will oversee a third party consultant in the evaluation process. At the end of the process capital plans can be made to implement recommended improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $300,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 23. Conduct Facility Assessment / Evaluate for Seismic Retrofit

Hazards Addressed: Earthquake and Liquefaction

Goals Addressed: 1, 2, 3

Issue/Background: To protect City staff and the citizens of Garden Grove it is necessary to have City owned building evaluated for seismic structural integrity

Project Description: Have all City owned building evaluated for seismic structural integrity

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will oversee a third party consultant in the evaluation process. At the end of the process capital plans can be made to implement recommended improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $300,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Severe Weather: Extreme Heat and Severe Weather: High Winds Actions

Action 24. Activate and Enhance Cooling Center Locations

Hazards Addressed: Extreme Heat

Goals Addressed: 1, 2, 3, 4

Issue/Background: On days when temperatures are forecasted to reach 95 degrees Fahrenheit and above, the City will provide air conditioned accommodations at city facilities for patrons of all ages.

Project Description: The Community Services Department will assign staff to open cooling center location(s) if the weather is forecast to be over 95 degrees. This determination will be based on the Orange County Register and the online National Weather Forecast.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Cooling Center is activated at a designated city facility, followed by information to residents through press releases and social media posts.

Responsible Office/Partners: Community Services Department

Cost Estimate: Unknown; determined by how many locations and hours the cooling center is made available, at least 2 part-time staff would need to be assigned to each facility.

Benefits (Losses Avoided): Human health impact, including avoiding dehydration.

Potential Funding: City's operating budget

Timeline: Determined by weather forecast

Project Priority: Medium

Action 25. Secure All Roofs and Eves

Hazards Addressed: High Winds

Goals Addressed: 1, 2, 4

Issue/Background: To protect City staff and the citizens of Garden Grove.

Project Description: Have all City owned roofs and eves evaluated for structural integrity

Other Alternatives: None

E**xisting Planning Mechanism(s) through which Action Will Be Implemented**: Public Works will oversee a third party consultant in the evaluation process. At the end of the process capital plans can be made to implement recommended improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $300,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Wildfire Actions

Action 26. Turn Off Power to Electrical Outlets / Tamper Proof Covers in Public Areas

Hazards Addressed: Fire

Goals Addressed: 1, 2, 4

Issue/Background: To protect City staff and the citizens of Garden Grove from fire.

Project Description: Remove openly available electrical access in public areas.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will perform the evaluation process and implement the program.

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $30,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- Operating budget

Timeline: Continuous, until complete

Project Priority: High / Medium

Action 27. Upgrade Wooden Electrical Panels in Parks

Hazards Addressed: Fire (including high wind, drought, and extreme temperatures)

Goals Addressed: 1, 2, 4

Issue/Background: To protect City staff and the citizens of Garden Grove from fire in the event of high winds.

Project Description: Have all City owned electrical panels evaluated for fire safety

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Works will oversee a third party consultant in the evaluation process. At the end of the process capital plans can be made to implement recommended improvements

Responsible Office/Partners: Phillip Carter- Facilities Manager, Joe Flores Building Supervisor.

Cost Estimate: $250,000

Benefits (Losses Avoided): Life / Safety

Potential Funding: Primary- grant funds, Secondary- capital improvement plan

Timeline: Continuous, until complete

Project Priority: High / Medium

Chapter 6 Plan Adoption

Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure buy-in from the City of Garden Grove, raise awareness of the plan, and formalize the plan's implementation. The adoption of this LHMP completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of DMA 2000. This adoption also establishes compliance with AB 2140 requiring adoption by reference or incorporation into the Safety Element of the Garden Grove General Plan.

The Garden Grove City Council has adopted this Local Hazard Mitigation Plan by passing a resolution. A copy of the intended resolution and the executed copy for the City (pending) are included in Appendix D: Adoption Resolution.

Chapter 7 Plan Implementation and Maintenance

Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance of this 2020 City of Garden Grove LHMP is critical to the overall success of hazard mitigation planning. This is Planning Step 10 of the 10-step process. This chapter provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the Plan. The chapter also discusses incorporating the Plan into existing planning mechanisms and how to address continued public involvement.

7.1 Implementation

Once adopted, this LHMP faces the truest test of its worth: implementation. While this Plan contains many worthwhile actions, the City will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

An important implementation mechanism that is highly effective and low-cost is incorporation of the LHMP recommendations and their underlying principles into other plans and mechanisms, such as the general plan, strategic plans, earthquake and stormwater plans, Emergency Operations Plans (EOPS), evacuation plans, and other hazard and emergency management planning efforts for Garden Grove. The City already implements policies and programs to reduce losses to life and property from hazards. This LHMP builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of the City of Garden Grove. Implementation can be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits to each program and the Garden Grove community and its stakeholders. This effort is achieved through the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

Simultaneous to these efforts, it is important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the more costly recommended actions. This could include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the City will be in a better position to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal programs and earmarked funds, benefit assessments, and other state and federal grant programs, including those that can serve or support multi-objective applications.

Responsibility for Implementation of Goals and Activities

Led by the City of Garden Grove Department of Public Works, as the lead department for this LHMP project, the appointed officials and staff appointed to head each department within the City are charged with implementation of various activities in this LHMP. During the annual reviews as described later in this section, an assessment of progress on each of the goals and activities in this LHMP should be determined and noted. At that time, recommendations were made to modify timeframes for completion of activities, funding resources, and responsible entities. On an annual basis, the priority standing of various activities may also be changed. Some activities that are found not to be doable may be deleted from this LHMP entirely and activities addressing problems unforeseen during development of the Plan may be added.

7.1.1. Role of Hazard Mitigation Planning Committee (HMPC) in Implementation and Maintenance

With adoption of this LHMP, Garden Grove, Department of Public Works, will be responsible for the plan implementation and maintenance. The HMPC identified in Appendix A (or a similar committee) will reconvene annually each year to ensure mitigation strategies are being implemented and the City continues to maintain compliance with the NFIP and other applicable mitigation programs. As such, Garden Grove will continue its relationship with the HMPC, and:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure hazard mitigation remains a consideration for City decision makers;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the City implement the Plan’s recommended actions for which no current funding exists;
- Monitor and assist in the implementation and update of this LHMP;
- Report on Plan progress and recommended changes to the City governing board; and
- Inform and solicit input from the public.

The primary duty of the City is to see this LHMP successfully carried out and to report to their governing board and the public on the status of LHMP implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the City website.

7.2 Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate LHMP implementation and to update this Plan as progress, roadblocks, or changing circumstances are recognized.

7.2.1. Maintenance Schedule

The Garden Grove, Department of Public Works, is responsible for initiating Plan reviews. In order to monitor progress and update the status of mitigation strategies identified in this LHMP, the Garden Grove Department of Public Works and the HMPC will revisit this Plan annually each year and following a hazard event to review progress on LHMP implementation. As required by DMA 2000 in order to meet LHMP requirements for local governments, the HMPC will also submit a formal, five-year written update to the State and FEMA Region IX, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With this LHMP anticipated to be fully approved and adopted in mid-2020, the next LHMP Update for the City of Garden Grove will occur in 2025.

7.2.2. Maintenance Evaluation Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in this LHMP. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or
- Increased vulnerability as a result of new development (and/or annexation).
- Increased vulnerability resulting from unforeseen or new circumstances.

Updates to this LHMP will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to infrastructure inventories; and
- Incorporate new action recommendations or changes in action prioritization.

Changes will be made to this LHMP to accommodate actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, City priorities, and/or funding resources. All mitigation actions will be reviewed as well during the monitoring and update of this LHMP to determine feasibility of future implementation. Updating of this LHMP will be by written changes and submissions, as the HMPC deems appropriate and necessary, and as approved by City Council. In keeping with the five-year update process, the HMPC will convene public meetings to solicit public input on this LHMP and its routine maintenance and the final product will be again adopted by the Garden Grove City Council.

Annual Plan Review Process

For this LHMP review process, Garden Grove, Department of Public Works, as lead will be responsible for facilitating, coordinating, and scheduling reviews and maintenance of this LHMP. The LHMP is intended to be a living document. The review of this 2019 LHMP will normally occur on an annual basis each year and will be conducted by the HMPC as follows:

- The Garden Grove Department of Public Works will place an advertisement in the local newspaper advising the public of the date, time, and place for each annual review of the LHMP and will be responsible for leading the meeting to review this LHMP.
- Notices will be mailed to the members of the HMPC, federal, state, and local agencies, non-profit groups, local planning agencies, representatives of business interests, neighboring communities, and others advising them of the date, time, and place for the review.
- City officials will be noticed by email and telephone or personal visit and urged to participate.
- Prior to the review, department heads and others tasked with implementation of the various activities will be queried concerning progress on each activity in their area of responsibility and asked to present a report at the review meeting.
- The local news media will be contacted, and a copy of the current LHMP will be available for public comment on the Garden Grove LHMP website.
- After the review meeting, minutes of the meeting and an annual report will be prepared by the HMPC and forwarded to the news media (public) and all City departments. The report will also be presented to the Garden Grove City Council for review, and a request will be made that the City Council take action to recognize and adopt any changes resulting from the review.
- A copy of the 2020 LHMP will be continually posted on the City's website as will the annual status report.

Criteria for Annual Reviews

The criteria recommended in 44 CFR 201 and 206 will be utilized in reviewing and updating this LHMP. More specifically, the reviews should include the following information:

- City growth or change in the past year.
- The number of substantially damaged or substantially improved structures by flood zone.
- The renovations to City infrastructure including water, sewer, drainage, roads, bridges, gas lines, and buildings.
- Natural hazard occurrences that required activation of the Emergency Operations Center (EOC) and whether or not the event resulted in a presidential disaster declaration.
- Natural hazard occurrences that were not of a magnitude to warrant activation of the EOC or a federal disaster declaration but were severe enough to cause damage in the City or closure of offices, schools, or public services.
- The dates of hazard events descriptions.
- Documented damages due to the event.
- Closures of places of employment or schools and the number of days closed.
- Road or bridge closures and other school access routes due to the hazard and the length of time closed.
- Assessment of the number of City buildings damaged and whether the damage was minor, substantial, major, or if buildings were destroyed.
- Review of any changes in federal, state, and local policies to determine the impact of these policies on the City and how and if the policy changes can or should be incorporated into the LHMP.
- Review of the status of implementation of projects and actions (mitigation strategies) including projects completed will be noted. Projects behind schedule will include a reason for delay of implementation.

7.2.3. Incorporation into Existing Planning Mechanisms

Another important implementation mechanism that is highly effective and low-cost is incorporation of these 2020 LHMP recommendations and their underlying principles into other City plans and mechanisms. Where possible, the City will use existing plans and/or programs to implement hazard mitigation actions. As previously stated in Section 7.1 of this plan, mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. The point is re-emphasized here. As described in this LHMP's capability assessment, the City already implements policies and programs to reduce losses to life and property from hazards. This LHMP builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms. These existing mechanisms include:

- City General and strategic plans
- City Emergency Operations Plans and other emergency management efforts
- City regulations and requirements
- Earthquake Plans
- Flood/stormwater, and Fire protection plans
- Capital improvement plans and budgets
- Other plans and policies outlined in the capability assessment
- Other plans, regulations, and practices with a mitigation focus

HMPC members involved in these other planning mechanisms will be responsible for integrating the findings and recommendations of this LHMP with these other plans, programs, etc., as appropriate. As described in Section 7.1 Implementation, incorporation into existing planning mechanisms will be done through the routine actions of:

- monitoring other planning/program agendas;
- attending other planning/program meetings;
- participating in other planning processes; and
- monitoring community budget meetings for other City program opportunities.

The successful implementation of this mitigation strategy will require constant and vigilant review of existing plans and programs for coordination and multi-objective opportunities that promote a safe, sustainable community.

Examples of incorporation of the LHMP into existing programs and planning mechanisms include:

1. As recommended by Assembly Bill 2140, the City should adopt (by reference or incorporation) this LHMP into the Safety Element of their General Plan. Evidence of such adoption (by formal, certified resolution) shall be provided to CAL OES and FEMA.
2. Integration of flood and stormwater actions identified in this mitigation strategy with the existing and updated City Drainage plan and program. Key people responsible for mitigation of the flood hazards in the City participated on the HMPC. City flood and drainage projects were identified and integrated into this LHMP. Actual implementation of these projects will likely occur through existing and updated City Drainage Plan and Program.
3. Integration of this LHMP into the City's future Climate Adaptation Plan (CAP). It is anticipated that this LHMP will be used to inform the CAP, also included as an action in this mitigation strategy, and conversely risk and vulnerability data and climate adaptation strategies developed for the CAP will be integrated into future updates of this LHMP for the City.
4. Use of the LHMP risk assessment and other information to update the hazard analysis in future updates of the City's Emergency Operations Plans and other emergency planning efforts for the City.

Efforts should continuously be made to monitor the progress of mitigation actions implemented through these other program and planning mechanisms and, where appropriate, their priority actions should be incorporated into updates of this LHMP.

7.2.4. Continued Public Involvement

Continued public involvement is imperative to the overall success of this LHMP's implementation. The update process provides an opportunity to solicit participation from new and existing stakeholders and to publicize success stores from the plan implementation and seek additional public comment. The LHMP maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated City meetings, web postings, press releases to local media, and through public hearings.

Public Involvement Process for Annual Reviews

The public will be noticed by placing an advertisement in the newspaper specifying the date and time for the review and inviting public participation. The HMPC, local, state, and regional agencies will be notified and invited to attend and participate.

Public Involvement for Five-year Update

When the HMPC reconvenes for the update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise this LHMP. In reconvening, the HMPC will identify a public outreach strategy involving the greater public. The strategy will include a plan for public involvement and will be responsible for disseminating information through a variety of media channels detailing the plan update process. As part of this effort, public meetings will be held and public comments will be solicited on the next LHMP update draft.

Appendix A Planning Process

A.1 Lists of HMPC Invites/Stakeholders

Table A-1 LHMP Invite List

Department	Name and Title	Email
City of Garden Grove, City Manager	Scott Stiles, City Manager	sstiles@ci.garden-grove.ca.us
City of Garden Grove, City Manager	Maria Stipe, Deputy City Manager	marias@ci.garden-grove.ca.us
City of Garden Grove, Streets/Environmental	AJ Holmon, Manager	ajh@ci.garden-grove.ca.us
City of Garden Grove, Animal Care Services	Mark Ladney, Supervisor	markla@ci.garden-grove.ca.us
City of Garden Grove, Community Development	Lisa Kim, Director	lisak@ci.garden-grove.ca.us
City of Garden Grove, Building Services	David Dent, Manager	ddent@ci.garden-grove.ca.us
City of Garden Grove, Planning Services	Lee Marino, Manager	leem@ci.garden-grove.ca.us
City of Garden Grove, Building Services	Mike Austin, Supervising Building Inspector	michaela@ci.garden-grove.ca.us
City of Garden Grove, Planning Services	Lorena Soules, Permit Counter Supervisor	lorenas@ci.garden-grove.ca.us
City of Garden Grove, Engineering	Dan Candelaria, Manager	danc@ci.garden-grove.ca.us
City of Garden Grove, Finance	Trevor Smouse, Sr. Program Specialist	trevors@ci.garden-grove.ca.us
City of Garden Grove, Parks and Recreation	John Montanchez, Director	johnmo@ci.garden-grove.ca.us
City of Garden Grove, Parks and Recreation	Mark Freeman, Supervisor	markf@ci.garden-grove.ca.us
City of Garden Grove, Housing	Danny Huynh, Manager	dannyh@ci.garden-grove.ca.us
City of Garden Grove, Police	Tom DaRe, Chief	tomd@ci.garden-grove.ca.us
City of Garden Grove, Police	Amir El-Farra, Police Captain	amire@ci.garden-grove.ca.us
City of Garden Grove, Police	Todd Elgin, Chief	todde@ci.garden-grove.ca.us
City of Garden Grove, Police Admin	Travis Whitman, Captain	travisw@ci.garden-grove.ca.us
City of Garden Grove, IT/GIS	Anand Rao, Director	anandr@ci.garden-grove.ca.us
City of Garden Grove, IT/GIS	Moo Moragraan, Supervisor	moo@ci.garden-grove.ca.us

Department	Name and Title	Email
City of Garden Grove, IT/GIS	Joseph Schwartz , GIS Coordinator	josephs@ci.garden-grove.ca.us
City of Garden Grove, IT/GIS	Cesar Gallo, Webmaster	cesarg@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Bill Murray, Director	wem@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Raquel Manson, Sr. Admin Analyst	rmanson@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Phil Carter, Facilities Manager	philc@garden-grove.org
City of Garden Grove, Public Works	Steve Sudduth, Supervisor	stevesu@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Joe Flores, Supervisor	josephf@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Sam Kim, Manager	samk@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Robert Bermudez, Supervisor	rbermudez@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Brent Hayes, Supervisor	brenth@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Katie Delfin, Sr. Admin Analyst	katiev@ci.garden-grove.ca
City of Garden Grove, Water/Sewer	Amanda Lai, Admin Intern	amandal@ci.garden-grove.ca.us
City of Garden Grove, Community Relations/PIO	Ana Pulido, Supervisor	anap@ci.garden-grove.ca.us
City of Garden Grove, Community Relations/PIO	Veronica Avila, Admin Aide	veronicaa@ci.garden-grove.ca.us
Foster Morrison	Jeanine Foster, Sr. Project Manager	jeanine.foster@fostermorrison.com
Foster Morrison	Chris Morrison	chris.morrison@fostermorrison.com
OES	Victoria LaMar-Haas, Sr. Emergency Services Coordinator	Victoria.Lamar-haas@caloes.ca.gov
OC Public Works	Shane Silsby, Director	shane.silsby@ocpw.ocgov.com
OC Public Works	Ethan Brown	etbrown@ocsd.org
OC Public Works	Chris Crompton, Manager	chris.crompton@ocpw.ocgov.com
OC Public Works	Kevin Onuma, Deputy Director, OC Operations and Maintenance	kevin.onuma@ocpw.ocgov.com
OC Health Care Agency	Donna Boston, Emergency Management Director	dboston@ocsd.org
OC Fire Authority	Kenny Dossey, Fire Divison Chief	KennyDossey@ocfa.org
OC Fire Authority	Marc Stone, Fire Battalion Chief	marcstone@ocfa.org
OC Public Libraries	Stephanie Brown, Administrative Manager	stephanie.brown@occr.ocgov.com
OC Community Resources	Julie Oakley, Deputy Director	julie.oakley@occr.ocgov.com

Department	Name and Title	Email
SCAQMD	Debra Ashby, Sr. Public Info Specialist	dashby@aqmd.gov
OCSD	Derek Harp, Safety and Health Supervisor	dharp@OCSD.com
MWDOC	Kelly Hubbard, WEROC Manager	khubbard@mwdoc.com
MWDOC	Francisco Soto, WEROC Emergency Coordinator	fsoto@mwdoc.com
OCWD	Paula Bouyounes, Risk & Safety Manager	Pbouyounes@ocwd.com
OCWD	Bill Dunivin, Director of Water Production	bdunivin@ocwd.com
OCWD	Patrick Versluis, Director of Water Quality	pversluis@ocwd.com
OC Environmental Health	Anthony Martinez, Program Manager	amartinez@ochca.com
OC Environmental Health	Lauren Robinson	LRobinson@ochca.com
OC Environmental Health	Liza Frias, Director of Environmental Health	lfrias@ochca.com
OC Parks	Kris Beard	kris.beard@ocparks.com
OC Parks	Gary Rivas	gary.rivas@ocparks.com
OCCR-OC Public Libraries	Sherry Toth, Interim County Librarian	sherry.toth@occr.ocgov
FEMA Region IX	Emma Reed, Community Planner	emma.reed@fema.dhs.gov
FEMA Region IX	Asia King, Community Planner	asia.king@fema.dhs.gov
FEMA Region IX	Jesse Carpentier, Community Planner	jesse.carpentier@fema.dhs.gov
CalOES	Emily Winchell, Staff Services Manager	emily.winchell@caloes.ca.gov
CalOES	Leah Greenbaum, Emergency Services Coordinator	leah.greenbaum@caloes.ca.gov
Cal OES	Anthony Roggio, Southern Region Lead Specialist	anthony.roggio@caloes.ca.gov
Cal OES	Abraham Guitierrez, Hazard Mitigation Assistance Branch	Abraham.Gutierrez@caloes.ca.gov
Cal DWR	Ashley Dummer, District Engineer	Ashley.Dummer@waterboards.ca.gov
Cal DWR	Sean McCarthy, Chief	Sean.McCarthy@waterboards.ca.gov
Cal DWR	Anthony Nhan (DDW)	Anthony.Nhan@waterboards.ca.gov
CGS - Earthquake Program	Public Affairs	PAO@conservation.ca.gov
National Weather Service	Alex Tardy, Warning Coordination Meteorologist	alexander.tardy@noaa.gov
Red Cross	Monica Ruzich, Disaster Preparedness Specialist	monica.ruzich@redcross.org
US Army Corps of Engineers	Anne Hutton, Chief Emergency Management	anne.c.hutton@usace.army.mil
So Cal Edison	James Peterson, Government Relations Manager	james.peterson@sce.com

Department	Name and Title	Email
So Cal Edison	Jodie Reyes, Electrical Service Planner	Jodie.Reyes@sce.com
So Cal Gas Co	Hau Tsan	HTsan@semprautilities.com
Cal Trans	Donald Patton, Maintenance Manager	d.skead.patton@dot.ca.gov
OC Vector Control District	Rick Howard, District Manager	rhoward@ocvector.org
Hospital Association of So Cal	Whitney Ayers, Reginonal Vice President	wayers@hasc.org
Independent Special District of Orange County	Saundra Jacobs, President	saundraj@smwd.com
Orange County Business Council	Lauren Martin, Events Manager	lmartin@ocbc.org
Garden Grove Unified School District	David Mora, Communications Specialist	dmora@ggusd.us
Coast Community College District	Bill Kerwin, Director	bkerwin@cccd.edu
City of Anaheim	Tim Adams, Battalion Chief	tadams@anaheim.net
City of Anaheim	A. Long	along@anaheim.net
City of Buena Park	Lance Charnes, Emergency Events Coordinator	lcharnes@bppd.com
City of Cypress	Ariana Kennedy, Senior Management Analyst	akennedy@ci.cypress.ca.us
City of Fountain Valley	Tony Coppolino, Fire Chief	tony.coppolino@fountainvalley.org
City of Los Alamitos	Stacy Smith, Corporal	ssmith@cityoflosalamitos.org
City of Orange	Jennifer Amat, Police Sergeant	jamat@orangepd.org
City of Orange	Robert Stefano	Rstefano@cityoforange.org
City of Santa Ana	Steve Rhyner, Emergency Operations Coordinator	srhyner@santa-ana.org
City of Seal Beach	David Barr, Police Sergeant	dbarr@sealbeachca.gov
City of Seal Beach	Brian Gray, Police Captain	bgray@sealbeachca.gov
City of Stanton	James Box, City Manager	rhall@ci.stanton.ca.us
City of Stanton	Allan Rigg, Public Works Director/City Engineer	Arigg@ci.stanton.ca.us
City of Stanton	Kelly Hart, Community Development Director	khart@ci.stanton.ca.us
City of Tustin	Joe Meyers, Emergency Management Coordinator	Jmeyers@tustinca.org
City of Westminster	Ellen Lopez	elopez@westminster-ca.gov
Chamber of Commerce	Cindy Spindle, CEO/President	ceo@gardengrovechamber.com

Table A-2 HMPC Participant List

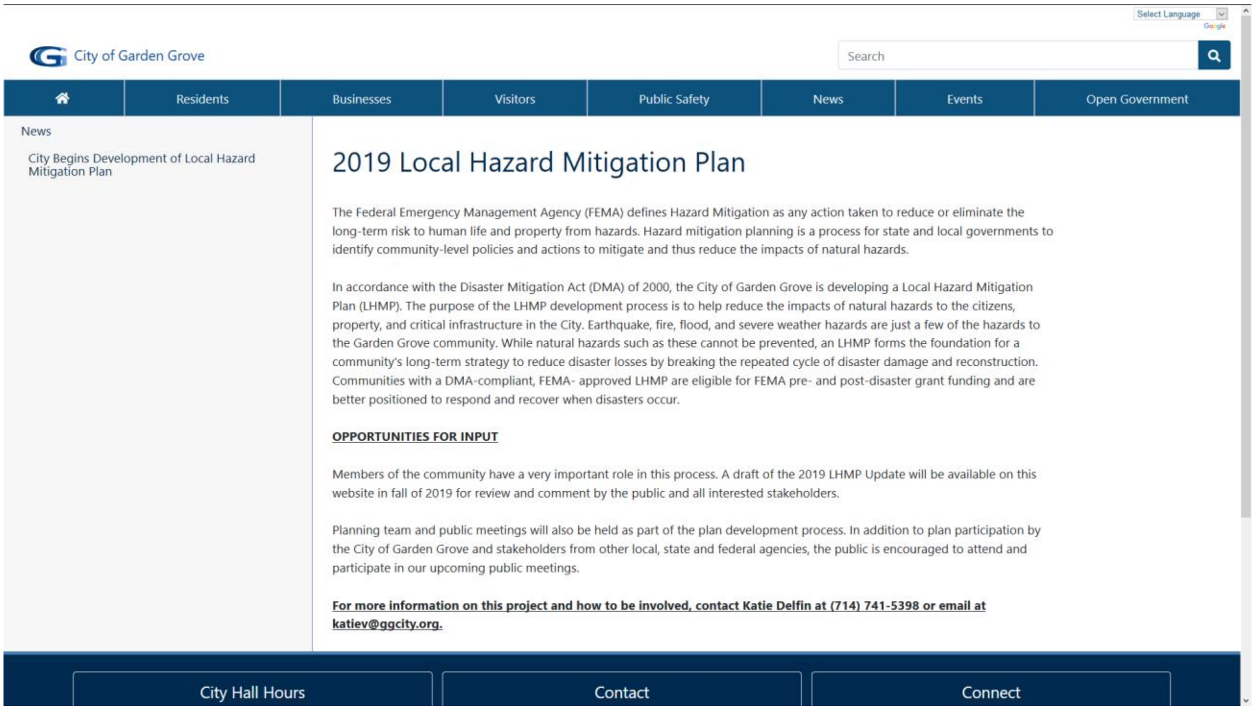
Department	Name and Title	Email
City of Garden Grove, City Manager	Scott Stiles, City Manager	sstiles@ci.garden-grove.ca.us
City of Garden Grove, Streets/Environmental	AJ Holmon, Manager	ajh@ci.garden-grove.ca.us
City of Garden Grove, Community Development	Lisa Kim, Director	lisak@ci.garden-grove.ca.us
City of Garden Grove, Building Services	David Dent, Manager	ddent@ci.garden-grove.ca.us
City of Garden Grove, Planning Services	Lee Marino, Manager	leem@ci.garden-grove.ca.us
City of Garden Grove, Building Services	Mike Austin, Supervising Building Inspector	michaela@ci.garden-grove.ca.us
City of Garden Grove, Planning Services	Lorena Soules, Permit Counter Supervisor	lorenas@ci.garden-grove.ca.us
City of Garden Grove, Finance	Trevor Smouse, Sr. Program Specialist	trevors@ci.garden-grove.ca.us
City of Garden Grove, Parks and Recreation	Mark Freeman, Supervisor	markf@ci.garden-grove.ca.us
City of Garden Grove, Police	Amir El-Farra, Police Captain	amire@ci.garden-grove.ca.us
City of Garden Grove, IT/GIS	Joseph Schwartz , GIS Coordinator	josephs@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Raquel Manson, Sr. Admin Analyst	rmanson@ci.garden-grove.ca.us
City of Garden Grove, Public Works	Phil Carter, Facilities Manager	philc@garden-grove.org
City of Garden Grove, Public Works	Joe Flores, Supervisor	josephf@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Sam Kim, Manager	samk@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Robert Bermudez, Supervisor	rbermudez@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Brent Hayes, Supervisor	brenth@ci.garden-grove.ca.us
City of Garden Grove, Water/Sewer	Katie Delfin, Sr. Admin Analyst	katiev@ci.garden-grove.ca
City of Garden Grove, Community Relations/PIO	Ana Pulido, Supervisor	anap@ci.garden-grove.ca.us
City of Garden Grove, Community Relations/PIO	Veronica Avila, Admin Aide	veronicaa@ci.garden-grove.ca.us
OC Public Works	Kevin Onuma, Deputy Director, OC Operations and Maintenance	kevin.onuma@ocpw.ocgov.com
OC Public Libraries	Stephanie Brown, Administrative Manager	stephanie.brown@occr.ocgov.com
OC Community Resources	Julie Oakley, Deputy Director	julie.oakley@occr.ocgov.com

Department	Name and Title	Email
SCAQMD	Debra Ashby, Sr. Public Info Specialist	dashby@aqmd.gov
MWDOC	Francisco Soto, WEROC Emergency Coordinator	fsoto@mwdoc.com
OC Environmental Health	Lauren Robinson	LRobinson@ochca.com
CalOES	Leah Greenbaum, Emergency Services Coordinator	leah.greenbaum@caloes.ca.gov
Cal DWR	Anthony Nhan (DDW)	Anthony.Nhan@waterboards.ca.gov
So Cal Edison	James Peterson, Government Relations Manager	james.peterson@sce.com
City of Santa Ana	Steve Rhyner, Emergency Operations Coordinator	srhyner@santa-ana.org
City of Stanton	Allan Rigg, Public Works Director/City Engineer	Arigg@ci.stanton.ca.us
City of Garden Grove	Steve Porras	?
City of Garden Grove Fire Department	Paul Whittaker	?
City of Garden Grove	Mark Laong	?
City of Garden Grove	Lia Gountouma	?
City of Garden Grove	William Munroy	?
City of Garden Grove Streets	Albert Eurs	?
South Coast AQMD	Amparo Medina	?
South Coast AQMD	Jesus Orza	?
Orange County Public Works	Penny Law	?
So Cal Gas	Lanae, Public Affairs	?
OC Fire Authority	Jeeter Mcalain	?
Orange County Public Works	Penny Law	?

CAN YOU CONFIRM NAME, ADD TITLE AND EMAIL FOR THE ABOVE IN YELLOW. DIFFICULT TO DETERMINE FROM SIGN-IN SHEET.

THIS LIST WAS DEVELOPED FROM THE SIGN IN SHEETS. ARE THERE PEOPLE THAT SHOULD BE INCLUDED ON THE PLANNING TEAM THAT MIGHT NOT HAVE ATTENDED MEETINGS, BUT MIGHT HAVE CONTRIBUTED TO THE DOCUMENT?

A.2 Website for Hazard Mitigation Plan



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News

City Begins Development of Local Hazard Mitigation Plan

2019 Local Hazard Mitigation Plan

The Federal Emergency Management Agency (FEMA) defines Hazard Mitigation as any action taken to reduce or eliminate the long-term risk to human life and property from hazards. Hazard mitigation planning is a process for state and local governments to identify community-level policies and actions to mitigate and thus reduce the impacts of natural hazards.

In accordance with the Disaster Mitigation Act (DMA) of 2000, the City of Garden Grove is developing a Local Hazard Mitigation Plan (LHMP). The purpose of the LHMP development process is to help reduce the impacts of natural hazards to the citizens, property, and critical infrastructure in the City. Earthquake, fire, flood, and severe weather hazards are just a few of the hazards to the Garden Grove community. While natural hazards such as these cannot be prevented, an LHMP forms the foundation for a community's long-term strategy to reduce disaster losses by breaking the repeated cycle of disaster damage and reconstruction. Communities with a DMA-compliant, FEMA- approved LHMP are eligible for FEMA pre- and post-disaster grant funding and are better positioned to respond and recover when disasters occur.

OPPORTUNITIES FOR INPUT

Members of the community have a very important role in this process. A draft of the 2019 LHMP Update will be available on this website in fall of 2019 for review and comment by the public and all interested stakeholders.

Planning team and public meetings will also be held as part of the plan development process. In addition to plan participation by the City of Garden Grove and stakeholders from other local, state and federal agencies, the public is encouraged to attend and participate in our upcoming public meetings.

For more information on this project and how to be involved, contact Katie Delfin at (714) 741-5398 or email at katiev@ggcity.org.

City Hall Hours | Contact | Connect

A.3 Kickoff Meeting

A.3.1. Kickoff Meeting Invite to Stakeholders

From: Katie Victoria <katiev@ggcity.org>
Sent: Friday, January 25, 2019 5:03 PM
To: Albert Holmon <ajh@ci.garden-grove.ca.us>; Mark Ladney <markla@ci.garden-grove.ca.us>; ddent <ddent@ci.garden-grove.ca.us>; Lee Marino <leem@ci.garden-grove.ca.us>; Dan Candelaria <danc@ci.garden-grove.ca.us>; Tom Schultz <toms@ci.garden-grove.ca.us>; Mark Freeman <markf@ci.garden-grove.ca.us>; Danny Huynh <dannyh@ci.garden-grove.ca.us>; Travis Whitman <travisw@ci.garden-grove.ca.us>; Rachot Moragraan <moo@ggcity.org>; Joseph Schwartz <josephs@ci.garden-grove.ca.us>; Sam Kim <samk@ci.garden-grove.ca.us>; Robert Bermudez <rbermudez@ci.garden-grove.ca.us>; Brent Hayes <brenth@ci.garden-grove.ca.us>; Ana Pulido <anap@ci.garden-grove.ca.us>; Veronica Avila <veronicaa@ci.garden-grove.ca.us>; Raquel Manson <rmanson@ci.garden-grove.ca.us>; Victoria Lamar-haas <Victoria.Lamar-haas@caloes.ca.gov>; shane silsby <shane.silsby@ocpw.ocgov.com>; etbrown@ocsd.org; KennyDossey@ocfa.org; marcstone@ocfa.org; dashby@aqmd.gov; grivera@ocsd.com; dharp@OCSD.com; khubbard@mwdoc.com; fsoto@mwdoc.com; Pbouyounes@ocwd.com; bdunivin@ocwd.com; helen.fried@occr.ocgov.com; emma.reed@fema.dhs.gov; asia.king@fema.dhs.gov; jesse.capentier@fema.dhs.gov; anthony.roggio@caloes.ca.gov; Anthony.Nhan@waterboards.ca.gov; alexander.tardy@noaa.gov; monica.ruzich@redcross.org; anne.c.hutton@usace.army.mil; karen.clark@sce.com; HTsan@semprautilities.com; d.skead.patton@dot.ca.gov; mhearst@ocvcd.org; jpuentes@hasc.org; saundraj@smwd.com; lmartin@ocbc.org; atrudell@ggusd.us; bkerwin@cccd.edu; tadams@anaheim.net; along@anaheim.net; lcharnes@bppd.com; akennedy@ci.cpyress.ca.us; tony.coppolino@fountainvalley.org; ssmith@cityoflosalamitos.org; jamat@orangepd.org; Rstefano@cityoforange.org; srhyner@santa-ana.org; dbarr@sealbachca.gov; jbox@ci.stanton.ca.us; Jmeyers@tustinca.org; elopez@westminster-ca.gov
Cc: Scott Stiles <sstiles@ci.garden-grove.ca.us>; Maria Stipe <marias@ci.garden-grove.ca.us>; Lisa Kim <lisak@ci.garden-grove.ca.us>; John Montanchez <johnmo@ci.garden-grove.ca.us>; Todd Elgin <todde@ci.garden-grove.ca.us>; Anand Rao <anandr@ci.garden-grove.ca.us>; Bill Murray <wem@ci.garden-grove.ca.us>; Paul Whittaker <pwhittaker@ci.garden-grove.ca.us>; Jeanine Foster <jeanine.foster@fostermorrison.com>; Chris Morrison <chris.morrison@fostermorrison.com>
Subject: City of Garden Grove Local Hazard Mitigation Plan: Kickoff Meeting (2/13/2019) Email Invite

The City of Garden Grove is kicking off efforts to develop a Local Hazard Mitigation Plan (LHMP). The purpose of the LHMP process is to help reduce the impacts of natural hazards to the citizens, property, and critical infrastructure in the City. The Disaster Mitigation Act of 2000 (DMA 2000) requires that local governments have a FEMA-approved LHMP in place in order to be eligible for certain pre- and post- disaster mitigation funding to protect communities from future disaster-related losses.

The Public Works Department is taking the lead on coordinating this project and we would like to invite you to take part in the development of this plan as a member of the Hazard Mitigation Planning Committee (HMPC). City and agency participation and coordination is a requirement of an approved plan, as is the inclusion of any hazard data, information, and mitigation projects your department or agency may want to see included in this plan. Thus, your input will be critical to the success of this project. Participation includes:

- Attending and participating in the HMPC meetings (5 anticipated over the next 8-10 months)
- Providing available data/information requested of the HMPC
- Reviewing and providing comments on the plan drafts

A project kickoff meeting will be held at the following location and time:

Wednesday, February 13th from 1pm-4pm in the Public Works Training Room (13802 Newhope Street, Garden Grove, CA 92843**)**

The kickoff meeting will explain the process and how you can be involved. A public stakeholder meeting will also be held the evening of the same day of the kickoff meeting. Details on the public meeting will be forthcoming.

An event invitation will follow. Please RSVP and plan on attending or delegating attendance to this important meeting.

Thank you,

Katie Delfin
Senior Administrative Analyst
Water Services Division
City of Garden Grove
Phone: (714) 741-5398

Sent: Tuesday, February 5, 2019 11:46 AM
To: ajh@ci.garden-grove.ca.us; markla@ci.garden-grove.ca.us; ddent@ci.garden-grove.ca.us; leem@ci.garden-grove.ca.us; danc@ci.garden-grove.ca.us; markf@ci.garden-grove.ca.us; dannyh@ci.garden-grove.ca.us; Chris Morrison <chris.morrison@fostermorrison.com>; Jeanine Foster <jeanine.foster@fostermorrison.com>; travisw@ci.garden-grove.ca.us; moo@ggcity.org; josephs@ci.garden-grove.ca.us; samk@ci.garden-grove.ca.us; rbermudez@ci.garden-grove.ca.us; brenth@ci.garden-grove.ca.us; anap@ci.garden-grove.ca.us; veronicaa@ci.garden-grove.ca.us; rmanson@ci.garden-grove.ca.us; Victoria.Lamar-haas@caloes.ca.gov; Shane.Silsby@ocpw.ocgov.com; etbrown@ocsd.org; KennyDossey@ocfa.org; marcstone@ocfa.org; dashby@aqmd.gov; grivera@ocsd.com; DHarp@OCSD.COM; khubbard@mwdoc.com; FSoto@mwdoc.com; Pbouyounes@ocwd.com; bdunivin@ocwd.com; sherry.toth@occr.ocgov.com; emma.reed@fema.dhs.gov; asia.king@fema.dhs.gov; anthony.roggio@caloes.ca.gov; Anthony.Nhan@waterboards.ca.gov; alexander.tardy@noaa.gov; monica.ruzich@redcross.org; anne.c.hutton@usace.army.mil; karen.clark@sce.com; HTsan@semprautilities.com; d.skead.patton@dot.ca.gov; mhearst@ocvcd.org; jpuentes@hasc.org; saundraj@smwd.com; lmartin@ocbc.org; atrudell@ggusd.us; bkerwin@cccd.edu; tadams@anaheim.net; ALong@anaheim.net; akennedy@ci.cypress.ca.us; lcharnes@bppd.com; Tony.Coppolino@fountainvalley.org; SSmith@cityoflosalamitos.org; jamat@orangepd.org; rstefano@cityoforange.org; SRhyner@santa-ana.org; dbarr@sealbeachca.gov; rhall@ci.stanton.ca.us; JMeyers@tustinca.org; elopez@westminster-ca.gov; skead.patton@dot.ca.gov; khart@ci.stanton.ca.us; Kris.Beard@ocparks.com; pversluis@ocwd.com; lfrias@ochca.com; amartinez@ochca.com; Ashley.Dummer@waterboards.ca.gov; Sean.McCarthy@waterboards.ca.gov; LRobinson@ochca.com; stephanie.brown@occr.ocgov.com; Jodie.Reyes@sce.com; julie.oakley@occr.ocgov.com; Abraham.Gutierrez@caloes.ca.gov; gary.rivas@ocparks.com; Leah.Greenbaum@CalOES.ca.gov; wayers@hasc.org; jesse.capentier@fema.dhs.gov; jesse.carpentier@fema.dhs.gov; cesarg@ggcity.org; james.peterson@sce.com; rhoward@ocvector.org; PAO@conservation.ca.gov; bgray@sealbeachca.gov
Cc: sstiles@ci.garden-grove.ca.us; marias@ci.garden-grove.ca.us; lisak@ci.garden-grove.ca.us; johnmo@ci.garden-grove.ca.us; todde@ci.garden-grove.ca.us; anandr@ci.garden-grove.ca.us; wem@ci.garden-grove.ca.us; pwhittaker@ci.garden-grove.ca.us
Subject: Re: Garden Grove Local Hazard Mitigation Plan: Kickoff Meeting New Date (2/28) and Location

Hi All,

My apologies for the numerous emails, however, the kickoff meeting has been rescheduled due to schedule conflicts of key members. The meeting will now be held on Thursday, February 28th from 1pm-4pm at a new location:

Garden Grove Community Meeting Center
B - Room
11300 Stanford Avenue
Garden Grove, CA 92840

A.3.2. Kickoff Meeting Agenda

City of Garden Grove
Local Hazard Mitigation Plan (LHMP)
HMPC Meeting #1
February 28, 2019

1. Introductions
2. Hazard Mitigation & the Disaster Mitigation Act Planning Requirements
3. The Role of the Hazard Mitigation Planning Committee (HMPC)
4. Planning for Public Input
5. Coordinating with other Agencies
6. Hazard Identification
7. Schedule
8. Data Needs
9. Questions and Answers

A.3.3. Kickoff Meeting Sign-in Sheets

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Kickoff Meeting #1
February 28, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
Jeanne Foster	jeanne.foster@fostermorrison.com	303 717-7171	Foster Morrison
Francisco Soto	FSoto @ mwdoc.com	3236054200	WEROC.
Allen Rigg	arigg@ci.stanton.ca.us	714-890-4203	Stanton
BRENT HAYES		714 290 9318	GG
STEVE PORRAS	stevepo@ggcity.org		GG
Julie Oakley	julie.oakley@ocer.ocgov.com	714 566 3024	County of Orange
Robert Bermudez	rbermudez@garden-grove.org	714-741-5917	GG
Anthony Nhan	Anthony.Nhan@waterboards.ca.gov	(714) 558-4410	DDW
Paul Whittaker	paulwhittaker@ggcity.org	5614	GGFD
Sam Kim	samk@ggcity.org	5534	GG Water
Stephanie Brown	stephanie.brown@ocer.ocgov.com	714-566-3916	County of Orange
Leah Greenbaum	leah.greenbaum@caloes.ca.gov	916 845	Cal OES
STEVE RHYNER	SRHYNER@SANTA-ANA.ORG	714647-5315	SANTA ANA CITY

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Kickoff Meeting #1
February 28, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
Lorena Gomes	Lorenas@ggcity.org	714 741 5310	Building + Safety
MIKE AUSTIN	MICHAELA@GGCITY.ORG	X5172	CEDD. BLDG SAFETY
Supervisor Mark Freeman	markf@GGcity.org	714 741 5212	Recreation Garden Grove
Ana Pulido / PIO	anap@ggcity.org	714-741-5283	CITY OF GG - PUBLIC INFO.
Joseph Schwartz	josephs@ggcity.org	5270	City of GG IT
Lauren Robinson	LRobinson@OCHCA.com	714 4336280	OCHCA-EH
Veronica Avila/Admin Aide	veronicaa@ggcity.org	714 741 5051	City of GG
MARK LADNY	MARKLA @ ggcity.org	714 741 5372	GG
Wm Murray	wm@ " " "	" " 5379	GG
Danny Huynh	dannyh@GGcity.org	714 741 5156	City of GG
Al Hdmod	ashec@garden-grove.CA.US		GG
Lia Gountouma	liag@ggcity.org	(714) 719-1813	City of GG
Katie Delfin	katied@ggcity.org	(714) 741-5398	GG

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Kickoff Meeting #1
February 28, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
Shawn Park/Sr. Analyst	shawnp@ggcity.org	5371	GG City
Scott Stiles/CM			
Derek Harp	dharp@ocsd.com	714 366 5781	OCSD
Raquel Manson	rmanson@ggcity.org	5554	Garden Grove

A.4 Risk Assessment Meetings

A.4.1. Emailed Invites to Risk Assessment Meetings

Garden Grove Local Hazard Mitigation Plan: Planning Team Meeting, Thursday, June 27th

June 19, 2019 3:05 PM

Time: Thursday, June 27, 2019 9:00 AM - 12:00 PM
GMT -08:00 US/Canada Pacific

Location: Garden Grove Courtyard Center (12732 Main St., Garden Grove, CA 92840)

Organizer: Katie Victoria

Invitees: tadams, along, lcharnes, akennedy, tony coppolino, ssmith, jamat, Rstefano, srhyner, dbarr, bgray, rhall, Arigg, Kelly Hart, Jmeyers, elopez, emma reed, asia king, jesse carpentier, emily winchell, Leah@CalOES Greenbaum, anthony roggio, Abraham@CalOES Gutierrez, Ashley Dummer, Sean McCarthy, Anthony Nhan, PAO, alexander tardy, monica ruzich, anne c hutton, James Peterson, Jodie Reyes, HTsan, d skead patton, rhoward, wayers, saundraj, lmartin, dmora, bkerwin, Victoria Lamar-haas, shane silsby, etbrown, KennyDossey, marcstone, Stephanie Brown, Julie Oakley, dashby, dharp, khubbard, FSoto, Janine Schunk, Pbouyounes, bdunivin, pversluis, amartinez, LRobinson, dboston, chris crompton, lfrias, Kris Beard, Gary Rivas, Sherry Toth, Scott Stiles, Maria Stipe, Albert Holmon, Mark Ladney, Lisa Kim, ddent, Lee Marino, Michael Austin, lorenas, Dan Candelaria, Paul Whittaker, John Montanchez, Mark Freeman, Danny Huynh, tomd, Anand Rao, Rachot Moragraan, Joseph Schwartz, Cesar Gallo, Bill Murray, Raquel Manson, Sam Kim, Robert Bermudez, Brent Hayes, Ana Pulido, Veronica Avila, jeanine foster, Chris Morrison, Amanda Lai

Garden Grove LH...ity Definition.docx (15 KB) Download | Briefcase | Remove Garden Grove Ri...ment Worksheet.docx (65.9 KB) Download | Briefcase | Remove
Download all attachments
Remove all attachments

Garden Grove Hazard Mitigation Planning Committee:

You are invited to the second planning team meeting – The Risk Assessment Meeting - for the development of Garden Grove's Local Hazard Mitigation Plan (LHMP). Earlier this year, Garden Grove initiated its hazard mitigation planning effort, with support of Foster Morrison Consulting. Many of you attended the planning team kickoff meeting in February of this year. Over the past few months, the Foster Morrison team has been working to collect data to develop Chapter 4 of our LHMP, the Risk Assessment Chapter.

During this meeting, we will be reviewing the risk assessment data developed to date and will be looking for your feedback in refining and adding to this in-process Risk Assessment Chapter.

Attached are two worksheets on Critical Facilities and Risk Assessment. Please review and be prepared to discuss these items during the meeting.

The meeting will be held on Thursday, June 27 at the Garden Grove Courtyard Center (12732 Main St., Garden Grove, CA 92840) from 9:00 am to 12:00 pm.

Please RSVP and plan on attending or delegating attendance to this Risk Assessment Meeting for the development of this LHMP. Your input is critical to the success of this project.

Thank you,

Katie Delfin
Senior Administrative Analyst
Water Services Division
City of Garden Grove
Phone: (714) 741-5398

A.4.2. Risk Assessment Meeting Agenda

City of Garden Grove
Local Hazard Mitigation Plan (LHMP) Update
Risk Assessment Meeting
June 27, 2019

1. Introductions
2. Status of the DMA Planning Process
3. Review (and discussions/input) of the Risk Assessment
4. Review of Data Needs
5. Questions
6. Next Steps

A.4.3. Risk Assessment Meeting Sign in Sheets

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Risk Assessment Meeting #2
June 27, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
BRENT HAYES		5976	GGSD
ANTHONY NHAN ASSOC. SANITARY ENG.	Anthony.Nhan@Waterboards.ca.gov	(714) 567-7261	DDW
Albert Eurs	alberte@ggcity.org	714 741-5384	GG Streets
Joseph Flores	josephf@ggcity.org	714-741-5383	GG Building Maintenance
AMIR EL FARRA / CAPT PD	AMIRE@GGCITY.ORG	714-741-5202	GGPD
Debra Ashby	dashby@aqmd.gov	909 396-3199	South Coast AQMD
Amparo Medina	maggie.medina40@yahoo.com	760-844-6660	South Coast AQMD
JESUS ORTIZ	JESUSORTIZ@UCSB.EDU	323) 273-9131	SCAQMD
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Trevor Shouse	trevors@ggcity.org	714-741-5652	GGFD
Robert Bermudez	rbermudez@ggcity.org	741-5917	PW
Kevin Onuma	Kevin.onuma@ocpw.ocgov.com	(714) 647-3939	OC Public Works
Phil Carter	philc@garden-grove.org	714-335-6929	PW

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Risk Assessment Meeting #2
June 27, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
Joseph Schwartz GIS	josephs@ggcity.org	5272	I.T.
David Dent	ddent @ ggcity.org	5343	B&S
Katie Delfin	katiev @ ggcity.org	5398	GG
Raquel Manson	rmanson @ggcity.org	5556	GG
Penny Lew	Penny.Lew@ocpw.ocgov.com	714-647-3990	OC Public Works/Flood
James Peterson	james.peterson@sce.com	714-483-0778	SCE
Veronica Avila	veronicaa@ggcity.org	(714)741-5051	GG
Scott Stiles	sstiles@ggcity.org		GG

A.5 Mitigation Strategy Meetings

A.5.1. Email Invites to Mitigation Strategy Meetings

From: Katie Victoria <katiev@ggcity.org>
Sent: Monday, August 19, 2019 12:04 PM
To: sstiles@ci.garden-grove.ca.us; marias@ci.garden-grove.ca.us; shawnp@ci.garden-grove.ca.us; ajh@ci.garden-grove.ca.us; markla@ci.garden-grove.ca.us; lisak@ci.garden-grove.ca.us; ddent@ci.garden-grove.ca.us; leem@ci.garden-grove.ca.us; michaela@ci.garden-grove.ca.us; lorenas@ci.garden-grove.ca.us; danc@ci.garden-grove.ca.us; pwhittaker@ci.garden-grove.ca.us; trevors@ggcity.org; johnmo@ci.garden-grove.ca.us; markf@ci.garden-grove.ca.us; dannyh@ci.garden-grove.ca.us; tomd@ci.garden-grove.ca.us; amire@ci.garden-grove.ca.us; todde@ci.garden-grove.ca.us; travisw@ci.garden-grove.ca.us; anandr@ci.garden-grove.ca.us; moo@ci.garden-grove.ca.us; josephs@ci.garden-grove.ca.us; cesarg@ci.garden-grove.ca.us; wem@ci.garden-grove.ca.us; rmanson@ci.garden-grove.ca.us; philc@garden-grove.org; josephf@ci.garden-grove.ca.us; alberte@ci.garden-grove.ca.us; samk@ci.garden-grove.ca.us; rbermudez@ci.garden-grove.ca.us; brenth@ci.garden-grove.ca.us; amandal@ci.garden-grove.ca.us; anap@ci.garden-grove.ca.us; veronicaa@ci.garden-grove.ca.us; Jeanine Foster <jeanine.foster@fostermorrison.com>; Chris Morrison <chris.morrison@fostermorrison.com>; Victoria.Lamar-haas@caloes.ca.gov; shane.silsby@ocpw.ocgov.com; etbrown@ocsd.org; chris.crompton@ocpw.ocgov.com; penny.lew@ocpw.ocgov.com; kevin.onuma@ocpw.ocgov.com; dboston@ocsd.org; KennyDossey@ocfa.org; marcstone@ocfa.org; stephanie.brown@occr.ocgov.com; dashby@aqmd.gov; dharp@OCSD.com; khubbard@mwdoc.com; fsoto@mwdoc.com; Pbouyounes@ocwd.com; bdunivin@ocwd.com; pversluis@ocwd.com; amartinez@ochca.com; LRobinson@ochca.com; lfrias@ochca.com; kris.beard@ocparks.com; gary.rivas@ocparks.com; sherry.toth@occr.ocgov.com; emma.reed@fema.dhs.gov; asia.king@fema.dhs.gov; jesse.carpentier@fema.dhs.gov; emily.winchell@caloes.ca.gov; leah.greenbaum@caloes.ca.gov; anthony.roggio@caloes.ca.gov; Abraham.Gutierrez@caloes.ca.gov; Ashley.Dummer@waterboards.ca.gov; Sean.McCarthy@waterboards.ca.gov; Anthony.Nhan@waterboards.ca.gov; PAO@conservation.ca.gov; alexander.tardy@noaa.gov; monica.ruzich@redcross.org; anne.c.hutton@usace.army.mil; james.peterson@sce.com; Jodie.Reyes@sce.com; HTsan@semprautilities.com; d.skead.patton@dot.ca.gov; rhoward@ocvector.org; wayers@hasc.org; saundraj@smwd.com; lmartin@ocbc.org; dmora@ggusd.us; bkerwin@cccd.edu; tadams@anaheim.net; along@anaheim.net; lcharnes@bppd.com; akennedy@ci.cypress.ca.us; tony.coppolino@fountainvalley.org; ssmith@cityoflosalamitos.org; jamat@orangepd.org; Rstefano@cityoforange.org; srhyner@santa-ana.org; dbarr@sealbeachca.gov; bgray@sealbeachca.gov; rhall@ci.stanton.ca.us; Arigg@ci.stanton.ca.us; khart@ci.stanton.ca.us; Jmeyers@tustinca.org; elopez@westminster-ca.gov; skead.patton@dot.ca.gov; philc@ggcity.org; stevesu@ci.garden-grove.ca.us
Subject: Reminder - GG Local Hazard Mitigation Plan: Planning Team Meetings Next Week

All,

Please see below email and attachments in advance of next week's Mitigation Strategy meetings:

Chapter 4 – Risk Assessment. First see attached initial DRAFT of the Chapter 4 Risk Assessment document. There are still a few gaps and we are still working to incorporate some additional information. Anything highlighted in yellow are areas where we still need some local input from the planning team. The green highlighting are items for us to complete. Please take some time to review in advance of next week's meetings.

If you have trouble receiving this document due to mailbox size limits, you should also be able to access it via dropbox here: https://www.dropbox.com/sh/lw7fy8x5dxzgq4u/AAB7SEO8L1AuG5eAQSx8co6ua?dl=0.

Prep for next week's meetings. Identify and bring your mitigation projects to the meetings!! These are the two most important meetings for this plan: **Wednesday /Thursday August 28 (1pm – 4 pm) & August 29 (9am – noon). Please make sure everyone attends that has mitigation projects to include in the LHMP Update for all identified priority hazards specific to their jurisdiction. ALL KEY CITY DEPARTMENTS SHOULD BE ATTENDING THESE MEETINGS.** Attached is a **FEMA publication – Mitigation Ideas** that has mitigation ideas organized by hazard. Take a look – it is easy to skim through. I am also attaching the Mitigation Action Worksheet that will need to be completed for each mitigation project/action to be included in the plan - just in case you want to complete for any projects and bring to the meeting.

Please let me know if anyone has questions. Thanks very much and see everyone next week.

Jeanine Foster
Foster Morrison Consulting
(303) 717-7171

From: Katie Victoria <katiev@ggcity.org>
Sent: Monday, August 5, 2019 6:45 PM
To: Katie Victoria; Scott Stiles; Maria Stipe; Shawn Park; Albert Holmon; Mark Ladney; Lisa Kim; ddent; Lee Marino; Michael Austin; lorenas; Dan Candelaria; Paul Whittaker; Trevor Smouse; John Montanchez; Mark Freeman; Danny Huynh; tomd; amire; Todd Elgin; Travis Whitman; Anand Rao; Rachot Moragraan; Joseph Schwartz; Cesar Gallo; Bill Murray; Raquel Manson; Phil Carter; Joseph Flores; Albert Eurs; Sam Kim; Robert Bermudez; Brent Hayes; Katie Victoria; Amanda Lai; Ana Pulido; Veronica Avila; Jeanine Foster; Chris Morrison; Victoria Lamar-haas; shane silsby; etbrown; chris crompton; penny.lew@ocpw.ocgov.com; kevin onuma; dboston; KennyDossey; marcstone; Stephanie Brown; dashby; dharp; khubbard; FSoto; Pbouyounes; bdunivin; pversluis; amartinez; LRobinson; lfrias; Kris Beard; Gary Rivas; Sherry Toth; emma reed; asia king; jesse carpentier; emily winchell; Leah@CalOES Greenbaum; anthony roggio; Abraham@CalOES Gutierrez; Ashley Dummer; Sean McCarthy; Anthony Nhan; PAO; alexander tardy; monica ruzich; anne c hutton; James Peterson; Jodie Reyes; HTsan; d skead patton; rhoward; wayers; saundraj; lmartin; dmora; bkerwin; tadams; along; lcharnes; akennedy; tony coppolino; ssmith; jamat; Rstefano; srhyner; dbarr; bgray; rhall; Arigg; Kelly Hart; Jmeyers; elopez
Subject: Garden Grove Local Hazard Mitigation Plan: Planning Team Meeting DAY 1
When: Wednesday, August 28, 2019 1:00 PM-4:00 PM America/Los_Angeles.
Where: Garden Grove Courtyard Center (12732 Main St., Garden Grove, CA 92840)

The following is a new meeting request:

Subject:	Garden Grove Local Hazard Mitigation Plan: Planning Team Meeting DAY 1
Organizer:	"Katie Victoria" <katiev@ggcity.org>
Location:	Garden Grove Courtyard Center (12732 Main St., Garden Grove, CA 92840)
Time:	Wednesday, August 28, 2019, 1:00:00 PM - 4:00:00 PM GMT -08:00 US/Canada Pacific
Invitees:	sstiles@ci.garden-grove.ca.us; marias@ci.garden-grove.ca.us; shawnp@ci.garden-grove.ca.us; ajh@ci.garden-grove.ca.us; markla@ci.garden-grove.ca.us; lisak@ci.garden-grove.ca.us; ddent@ci.garden-grove.ca.us; leem@ci.garden-grove.ca.us; michaela@ci.garden-grove.ca.us; lorenas@ci.garden-grove.ca.us; danc@ci.garden-grove.ca.us ...

+~+~+~+~+~+~+~+~+~+

Hazard Mitigation Planning Committee:

You are invited to the 3rd and 4th planning team meetings for the development of the City of Garden Grove's Local Hazard Mitigation Plan (LHMP). Earlier this year, the City of Garden Grove kicked-off its hazard mitigation planning effort. A 2nd risk assessment meeting was held in late June.

These upcoming meetings will be held on August 28 and 29, and will begin the most important phase of our LHMP planning process – the Mitigation Strategy. During the first meeting, we will be revisiting the risk assessment data developed to date and will again be looking for your feedback in refining and adding to this in-process Risk Assessment Chapter. We will also be establishing plan goals and objectives. During the second meeting, the planning team will be working to identify and evaluate potential mitigation actions for reducing the community's risk and vulnerability to identified hazards and disasters.

The meetings will be held at the **Garden Grove Courtyard Center** (12732 Main St., Garden Grove, CA 92840) on the following dates and times:

Wednesday, August 28 @ 1-4 pm
Thursday, August 29 @ 9 am -12 pm

Please RSVP and plan on attending or delegating attendance to these important meetings. Everyone with mitigation project ideas should attend. City and agency participation and coordination is a requirement of an approved plan, as is the inclusion of any hazard data, information, and mitigation projects your department or agency may want to see included in the plan. Your continued participation and input is critical to the success of this project.

Thank You!

Katie Delfin
Senior Administrative Analyst
Water Services Division
City of Garden Grove
Phone: (714) 741-5398

A.5.2. Mitigation Strategy Meeting Agenda

City of Garden Grove
Local Hazard Mitigation Plan (LHMP)
Mitigation Strategy Meetings
August 28 & 29, 2019

HMPC Meeting #3:

1. Introductions
2. Status of the DMA Planning Process
3. Risk Assessment Update
4. Develop Plan Goals and Objectives
5. Identify and Review Mitigation Alternatives/Projects

HMPC Meeting #4:

1. Introductions
2. Identify and discuss Mitigation Alternatives/Projects
3. Review Mitigation Selection Criteria
4. Prioritize Mitigation Projects
5. Review of Schedule/Next Steps

A.5.3. Mitigation Strategy Meeting Sign in Sheets

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Mitigation Strategy Meeting #3
August 28, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
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Albert Holman III Mgt.	ash@ggcity.org	(714) 741-5956	Public Works
William E. Murray Jr.	wem@ " "	" " -5379	" "
Robert Bermudez	rbermudez@ggcity.org	741-5917	PW
McALPIN, JEETER	jeetermcalpin@ocfa.org	949-514-7094	OCFA
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Lisa Kim	lisak@ggcity.org	714 741-5148	GG
Scott Stiles	sstiles@ggcity.org	714-741-5100	C.M.
Anthony Nhan	anthony.nhan@waterboards.ca.gov	714 5584410	DDW

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Mitigation Strategy Meeting #3
August 28, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
Veronica Avila	veronicaa@ggcity.org	ext. 5051	Comm. Relations
Rene Camarena	renec@ggcity.org	5173	Comm. Services
JOSEPH FLORES	josephf@ggcity.org	ext. 5383	PUBLIC WORKS
Katie Delfth	kattiev@ggcity.org	5398	GG Water
Raquel Manson	vmanson@ggcity.org	5554	Public Works

SIGN-IN SHEET
City of Garden Grove
LOCAL HAZARD MITIGATION PLANNING PROJECT
HMPC Mitigation Strategy Meeting #4
August 29, 2019

Name/Title	Email Address	Phone	Department/Organization/ Affiliation
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SVETLANA Moure for DAVID DENT	SMOURE@GGCITY.ORG	714.741.5175	BLDG
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Joseph Schwartz	josephs@ggcity.org	5272	IT
JOSEPH FLORES	josephf@ggcity.org	x5383	PW
Veronica Avila	veronicaa@ggcity.org	~~5???~~ 5051	Comm. Relations
Katie Delfin	katiev@ggcity.org	5398	GG-Water
Raquel Manson	rmanson@ggcity.org	~~x~~ 5554	Public works
William E. Murray Jr.	wem@ggcity.org	x5379	PW
AJ Holman III	ajh@ggcity.org	x 5956	PW

A.6 Final Team Meeting

A.6.1. Final Team Meeting Invite

A.6.2. Final Team Meeting Agenda

AGENDA
City of Garden Grove
Local Hazard Mitigation Plan (LHMP)
Final Public Meeting
April 10, 2019

1. Introductions
2. Status of the LHMP Update Process
3. Addressing Public Comments
4. Public Input: Data/Projects
5. Next Steps

A.6.3. Final Team Meeting Sign in Sheet

A.7 Public Involvement

A.7.1. Kickoff Meeting Press Release

GARDEN GROVE

Get Involved!

HELP YOUR COMMUNITY BE HAZARD-READY!

City of Garden Grove, CA: A Local Hazard Mitigation Plan is being developed by the City of Garden Grove. Earthquake, floods, fire, and severe weather are just a few of the hazards to be addressed in the plan. While hazards such as these cannot be prevented, a Hazard Mitigation Plan forms the foundation for a community's long-term strategy to reduce disaster losses by breaking the repeated cycle of disaster damage and reconstruction. Additionally, only communities with a FEMA-approved Hazard Mitigation Plan are eligible to apply for both pre- and post-disaster mitigation grant funding.

Nationwide, taxpayers pay billions of dollars annually helping communities, organizations, businesses, and individuals recover from disaster. Some disasters are predictable and, in many cases, much of the damage can be reduced or even eliminated through hazard mitigation planning.

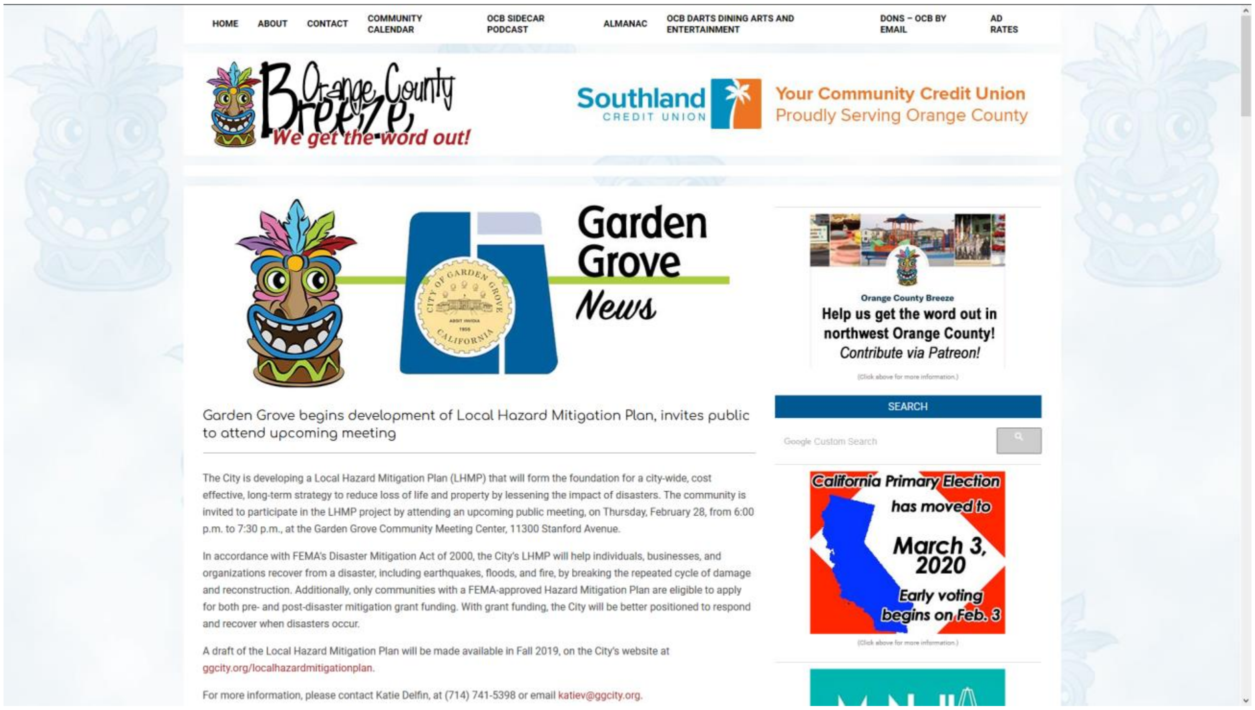
Opportunities for Input

Members of the community have a very important role in this process. A draft of the LHMP Update will be available fall 2019 for review and comment by the public and all interested stakeholders on the City website and in select public libraries. A public meeting on the Draft Plan will also occur in late fall 2019. All interested stakeholders and members of the public are welcome to attend.

For more information on this project and how you can get involved, go to http://ggcity.org/localhazardmitigationplan or contact the following City representative:

Katie Delfin at (714) 741-5398 or email at katiev@ggcity.org

A.7.2. Advertisement on OC Breeze Website



HOME ABOUT CONTACT COMMUNITY CALENDAR OCB SIDECAR PODCAST ALMANAC OCB DARTS DINING ARTS AND ENTERTAINMENT DONS – OCB BY EMAIL AD RATES

Orange County Breeze We get the word out!

Southland CREDIT UNION Your Community Credit Union Proudly Serving Orange County

Garden Grove News

Garden Grove begins development of Local Hazard Mitigation Plan, invites public to attend upcoming meeting

The City is developing a Local Hazard Mitigation Plan (LHMP) that will form the foundation for a city-wide, cost effective, long-term strategy to reduce loss of life and property by lessening the impact of disasters. The community is invited to participate in the LHMP project by attending an upcoming public meeting, on Thursday, February 28, from 6:00 p.m. to 7:30 p.m., at the Garden Grove Community Meeting Center, 11300 Stanford Avenue.

In accordance with FEMA's Disaster Mitigation Act of 2000, the City's LHMP will help individuals, businesses, and organizations recover from a disaster, including earthquakes, floods, and fire, by breaking the repeated cycle of damage and reconstruction. Additionally, only communities with a FEMA-approved Hazard Mitigation Plan are eligible to apply for both pre- and post-disaster mitigation grant funding. With grant funding, the City will be better positioned to respond and recover when disasters occur.

A draft of the Local Hazard Mitigation Plan will be made available in Fall 2019, on the City's website at ggcity.org/localhazardmitigationplan.

For more information, please contact Katie Delfin, at (714) 741-5398 or email katiev@ggcity.org.

Orange County Breeze
Help us get the word out in northwest Orange County!
Contribute via Patreon!

SEARCH

California Primary Election has moved to March 3, 2020 Early voting begins on Feb. 3

A.7.3. Kickoff Meeting – Public Agenda

City of Garden Grove
Local Hazard Mitigation Plan (LHMP)
Public Meeting #1
February 28, 2019

1. Introductions
2. Hazard Mitigation & the Disaster Mitigation Act Planning Requirements
3. Hazard Identification and Profiles
4. Opportunities for Public Participation and Input
5. Schedule
6. Questions and Answers

A.7.4. Kickoff Meeting – Public Sign in Sheets

Note: Meeting was cancelled due to scheduling conflicts

A.7.5. Final Meeting Invite on City Website

A.7.6. Final Review of Plan – Public Agenda

AGENDA
City of Piedmont
Local Hazard Mitigation Plan (LHMP)
Final Public Meeting
April 10, 2019

1. Introductions
2. Status of the LHMP Update Process
3. Addressing Public Comments
4. Final HMPC Input: Data/Projects
5. Next Steps

A.7.7. Final Review of Plan – Public Sign in Sheets

A.7.8. Public Comments Received During the Planning Process

Comment Date	Person Commenting	Comments	How addressed?

Source: City of Garden Grove

A.8 Meeting Handouts

A.8.1. Kickoff Meeting Handouts

City of Garden Grove Hazard Identification and Profiles – 2019

Orange County Disaster Declarations

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2017	California Wildfires	Fire	Fire	DR-4344	10/9/2017	10/10/2017
2017	Canyon 2 Fire	Fire	Fire	FM-5223	–	10/9/2017
2017	Canyon Fire	Fire	Fire	FM-5213	–	9/26/2017
2017	California Severe Winter Storms, Flooding, and Mudslides	Flood	Storms	DR-4305	2/10/2017	3/16/2017
2014	California Drought	Drought	Drought	GP 2014-13	1/17/2014	–
2011	California Winter Storms, Flooding, and Debris and Mud Flows	Flood	Storms	DR-1952	12/21/2010, 12/23/2010, 12/24/2010, 12/30/2010	1/26/2011
2009	49er Fire	Fire	Fire	FM-2832	–	8/31/2009
2008	California Wildfires	Fire	Fire	DR-1810	–	11/18/2008
2008	Freeway Complex Fire	Fire	Fire	FM-2792	–	11/15/2008
2007	California Wildfires	Fire	Fire	DR-1731	–	10/24/2007
2007	California Wildfires	Fire	Fire	EM-3279	–	10/23/2007
2007	Santiago Fire	Fire	Fire	FM-2737	–	10/22/2007
2007	241 Fire	Fire	Fire	FM-2683	–	3/11/2007
2006	Sierra Fire	Fire	Fire	FM-2630	–	2/6/2006
2005	Hurricane Katrina Evacuations	Economic	Hurricane	EM-3248 2005	–	9/13/2005

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2005	California Severe Storms, Flooding, Landslides, and Mud and Debris Flows	Flood	Storms	DR-1585	3/16/2005	4/14/2005
2005	California Severe Storms, Flooding, Debris Flows, and Mudslides	Flood	Storms	DR-1577	1/12/2005	2/4/2005
2003	Exotic Newcastle Disease Epidemic	Agricultural	Disease	GP 2003	1/3/2003	–
2002	Antonio Fire	Fire	Fire	FSA-2405	–	5/14/2002
2001	Energy Emergency	Economic	Greed	GP-2001	1/1/2001	–
1998	1998 El Nino Floods	Flood	Storms	DR-1203	Proclaimed	2/19/1998
1997	Floods (Orange)	Flood	Storms	97-04	12/10/1997	–
1996	California Severe Fires	Fire	Fire	EM-3120	–	10/23/1996
1996	1996 Severe Fires	Fire	Fire	96-04	10/22/1996	–
1995	1995 Severe Winter Storms	Flood	Storms	DR-1046	1/6/95-3/14/95	3/12/1995
1995	1995 Severe Winter Storms	Flood	Storms	DR-1044	1/6/95-3/14/95	1/13/1995
1994	Northridge Earthquake	Earthquake	Earthquake	DR-1008	1/17/1994	1/17/1994
1993	California Fires, Mud & Landslides, Soil Erosion, Flooding	Post Fire Mud & Landslides, Soil Erosion, Flooding	Fires and Storms	DR-1005	10/27/93, 10/28/93	10/28/1993
1993	California Severe Storm, Winter Storm, Mud & Landslides, Flooding	Flood	Storms	DR-979	1/7/93 - 2/19/93	2/3/1993

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1992	California Snow Storm, Heavy Rain, High Winds, Flooding, Mudslide	Flood	Storms	DR-935	2/12/92, 2/19/92	2/25/1992
1989	Mediterranean Fruit Fly	Agricultural	Insect Pest	GP 1989	11/20/1989	–
1988	California Severe Storms, High Tides, Flooding	Flood	Storms	DR-812	1/21/1988	2/5/1988
1987	California Earthquake and Aftershocks	Earthquake	Earthquake	DR-799	10/2/87 - 10/5/87	10/7/1987
1982	Winter Storms	Flood	Flood	DR-677	12/8/82-3/21/83	2/9/1983
1982	Dayton Hills Fire	Fire	Fire	GP	10/10/1982	–
1982	California Urban Fires	Fire	Fire	DR-657	4/21/1982	4/24/1982
1980	California Burs, Timber Fires	Fire	Fire	DR-635	11/18/1980, 11/25/80	11/27/1980
1980	California Severe Storms, Mudslides, Flooding	Flood	Storms	DR-615	2/21/80, 2/7/80, 2/19/80	2/21/1980
1979	Gasoline Shortage	Economic	OPEC	–	5/8/79 - 11/13/79	–
1978	California Landslides	Landslides	Storms	DR-566	10/5/1978	10/9/1978
1978	California Coastal Storms, Mudslides, and Flooding	Flood	Storms	DR-547	3/9/78, 2/27,78, 2/13/78	2/15/1978
1974	Gasoline Shortage	Economic	OPEC	–	2/28/74, 3/4/74, 3/10/74	–
1972	Exotic Newcastle Disease	Agricultural	Disease	–	4/10/72, 5/22/72	–
1969	1969 Storms	Flood	Storms	DR-253	1/23/69-3/12/69	1/26/1969
1967	Woodson Fire	Fire	Fire	–	1/7/1967	–

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1963	High Tides and Heavy Surf	Flood	High Tides	–	Unknown	–
1958	1958 April Storms and Floods	Flood	Storms	DR-82	4/5/1958	4/4/1958
1958	1958 February Storms and Floods	Flood	Storms	CDO 58-03	2/26/1958	–
1955	1955 Floods	Flood	Flood	DR-47	12/22/1955	12/23/1955
1950	1950 Floods	Flood	Flood	OCD 50-01	11/21/1950	–

Source: FEMA, Cal OES

Orange County Disaster Declarations Summary

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Agricultural	3	1972, 1989, 2003	0	–
Drought	1	2014	0	–
Earthquake	2	1987, 1994	2	1987, 1994
Economic	3	1974, 1979, 2001	0	–
Fire	6	1967, 1980, 1982 (twice), 1996, 2017	15	1980, 1982, 1996, 2002, 2006, 2007 (four times), 2008 (twice), 2009, 2017 (three times)
Flood	19	1950, 1955, 1958 (twice), 1969, 1978, 1980, 1982, 1988, 1992, 1993, 1995 (twice), 1997, 1998, 2005 (twice), 2011, 2017	17	1955, 1958, 1969, 1978, 1980, 1982, 1983, 1988, 1992, 1993, 1995 (twice), 1998, 2005 (twice), 2011, 2017
High Tides	1	1963	0	
Hurricane	0	–	1	2005
Landslide	1	1978	1	1978
Post Fire Mud & Landslides, Soil Erosion, Flooding	1	1993	1	1993
Totals	**37**	–	**37**	**–**

Source: Cal OES, FEMA

Orange County NCDC Storm Events 1/1/1950-10/31/2018

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Coastal Flood	6	0	0	0	0	$35,000	$0
Debris Flow	6	1	0	0	0	$318,500	$0
Dense Fog	47	0	0	1	0	$0	$0
Drought	26	0	0	0	0	$0	$0
Dust Devil	1	0	0	0	0	$6,000	$0
Excessive Heat	8	0	0	0	0	$0	$0
Flash Flood	38	2	0	2	0	$63,745,000	$480,000
Flood	33	0	0	3	0	$40,735,000	$242,000
Frost/Freeze	1	0	0	0	0	$0	$0
Funnel Cloud	34	0	0	0	0	$0	$0
Hail	11	1	0	0	0	$75,100	0
Heat	9	1	0	0	0	$0	$0
Heavy Rain	15	1	0	19	1	$36,280,000	$0
Heavy Snow	2	0	0	0	0	$0	$0
High Surf	43	1	0	7	0	$265,000	$0
High Wind	153	1	0	0	0	$633,000	$1,000
Lightning	4	0	0	0	0	$62,000	$0
Rip Current	26	14	18	0	0	$20,000	$0
Storm Surge	2	0	0	0	0	$242,500	$0
Strong Wind	12	0	0	0	0	$468,000	$0
Thunderstorm Wind	34	0	0	0	0	$1,246,000	$20,000
Tornado	32	0	0	0	0	$0	$0
Tsunami	0	0	0	0	0	$0	$0
Waterspout	13	0	0	0	0	$0	$0
Wildfire	30	0	3	22	0	$31,535,000	$0
Winter Storm	3	0	0	0	0	$5,000	$0
Winter Weather	2	0	0	0	0	$0	$0
Total	**316**	**13**	**1**	**20**	**10**	**$204,267,260**	**$400,000**

Source: NCDC

Hazards Comparison List

2015 Orange County LHMP	2018 State of California Plan Applicable Hazards	Proposed 2019 Hazards
Climate Change	Climate Change & Related Hazards	Climate Change
Dam Failure	Dam Failure	Dam Failure
Drought	Droughts and Water Shortage	Drought and Water Shortage
Earthquake	Earthquake	Earthquake
–	Included in Earthquake	Earthquake: Liquefaction
Epidemic	Epidemic/Pandemic/Vector Borne Disease	–
Flood	Riverine, Stream, and Alluvial Flood	Flood: (100/500 year)
–	–	Flood: Localized/Stormwater
Landslide/Mud Flow/Debris Flow	Landslide and Other Earth Movements	Landslides, Mud and Debris Flows
–	Levee Failure and Safety	Levee Failure
–	Severe Weather and Storms	Severe Weather: Extreme Heat
–	Extreme Heat	Severe Weather: Heavy Rains and Storms
–	Severe Weather and Storms	Severe Weather: High Winds
Tsunami	Tsunami and Seiche	–
Wildland/Urban fire	Wildfire	Wildfire

City of Garden Grove Hazard Identification Table

Hazard	Geographic Extent	Probability of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change					
Dam Failure					
Drought and Water Shortage					
Earthquake					
Earthquake: Liquefaction					
Flood: (100/500 year)					
Flood: Localized/Stormwater					
Landslides, Mud and Debris Flows					
Levee Failure					
Severe Weather: Extreme Heat					
Severe Weather: Heavy Rains and Storms					
Severe Weather: High Winds					
Wildfire					

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

City of Garden Grove
2019 Local Hazard Mitigation Plan Update
Risk Assessment Worksheet

Risk and Vulnerability Questions

Localized/Stormwater Flooding

1. Please describe the localized/stormwater flood issue specific to the jurisdiction in paragraph form. In addition, please complete a table similar to the below example detailing types and location of localized/stormwater flooding problems. If available, also provide a map of problem areas.

Text Description:

Table 3 Localized Flooding Areas

Road/Area Name	Flooding	Pavement Deterioration	Washouts	High Water/ Creek Crossing	Landslides/ Mudslides	Debris	Downed Trees

Landslides, Mudslides, and Debris Flow

1. Please describe the landslide, mudslide, and debris flow issues specific to the jurisdiction in paragraph form. In addition, please complete a table similar to the below example detailing types and location of landslide, mudslide, and debris flow problems. If available, also provide a map of problem areas.

Text Description:

Table 2 Landslides, Mudslides, and Debris Flow Areas

Location	Detail Nature and Extent of Landslide Issues

Earthquake Vulnerability

1. Number of unreinforced masonry buildings. If available, please provide an inventory of URM buildings specific to your jurisdiction. Include any tables and/or maps. Is this a layer available in GIS?

2. Number of soft story buildings. If available, please provide an inventory of soft story buildings specific to your jurisdiction. Include any tables and/or maps. Is this a layer available in GIS?

Special Populations

1. Describe the nature and make up of any special populations residing within the jurisdiction. Identify any hazard-related concerns or issues regarding the vulnerability of any special needs populations, such as the elderly, disabled, low-income, or other special (vulnerable) populations. Provide copies of any data, studies etc. related to these populations.

Development Trends

1. Describe development trends and expected growth/development areas and how they relate to hazard areas and vulnerability concerns/issues. Please provide land use and zoning maps and maps and tables detailing areas targeted for future development within your jurisdiction.

CAPABILITY ASSESSMENT

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the tables and questions in the worksheet as completely as possible.

Planning and Regulatory

The following planning and land management tools are typically used by local jurisdictions to implement hazard mitigation activities. Please indicate which of the following your jurisdiction has in place. If your jurisdiction does not have this capability or authority, please indicate in the comments column if a higher level of government has the authority.

Plans	**Y/N Year**	**Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?**
General Plan		
Capital Improvements Plan		
Economic Development Plan		
Local Emergency Operations Plan		
Continuity of Operations Plan		
Transportation Plan		
Stormwater Management Plan/Program		
Engineering Studies for Streams		
Community Wildfire Protection Plan		
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code		
Building Code Effectiveness Grading Schedule (BCEGS) Score		
Fire department ISO rating:		
Site plan review requirements		
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance		
Subdivision ordinance		
Floodplain ordinance		

Natural hazard specific ordinance (stormwater, steep slope, wildfire)	
Flood insurance rate maps	
Elevation Certificates	
Acquisition of land for open space and public recreation uses	
Erosion or sediment control program	
Other	
How can these capabilities be expanded and improved to reduce risk?	

Administrative/Technical

Identify the technical and personnel resources responsible for activities related to hazard mitigation/loss prevention within your jurisdiction. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level government that can provide technical assistance, please indicate so in the comments column.

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission		
Mitigation Planning Committee		
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)		
Mutual aid agreements		
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official		
Floodplain Administrator		
Emergency Manager		
Community Planner		
Civil Engineer		
GIS Coordinator		
Other		
Technical	**Y/N**	**Describe capability Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)		

Hazard data and information
Grant writing
Hazus analysis
Other
How can these capabilities be expanded and improved to reduce risk?

Fiscal

Identify whether your jurisdiction has access to or is eligible to use the following financial resources for hazard mitigation

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding		
Authority to levy taxes for specific purposes		
Fees for water, sewer, gas, or electric services		
Impact fees for new development		
Storm water utility fee		
Incur debt through general obligation bonds and/or special tax bonds		
Incur debt through private activities		
Community Development Block Grant		
Other federal funding programs		
State funding programs		
Other		
How can these capabilities be expanded and improved to reduce risk?		

Other Mitigation Efforts Undertaken by Jurisdiction

PLEASE PROVIDE A LISTING AND BRIEF DESCRIPTION OF ONGOING AND PAST HAZARD MITIGATION PROJECTS UNDERTAKEN BY JURISDICTION.

Education and Outreach

Identify education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information.

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations 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		
StormReady certification		
Firewise Communities certification		
Public-private partnership initiatives addressing disaster-related issues		
Other		
How can these capabilities be expanded and improved to reduce risk?		

National Flood Insurance Program (NFIP) Worksheet

Use this worksheet to collect information on your community's participation in and continued compliance with the NFIP, as well as identify areas for improvement that could be potential mitigation actions.

NFIP Topic	Comments
Insurance Summary	
How many NFIP policies are in the community? What is the total premium and coverage?	
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were for substantial damage?	
How many structures are exposed to flood risk within the community?	
Describe any areas of flood risk with limited NFIP policy coverage	
Staff Resources	
Is the Community Floodplain Administrator or NFIP Coordinator certified?	
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	
What are the barriers to running an effective NFIP program in the community, if any?	
Compliance History	
Is the community in good standing with the NFIP?	
Are there any outstanding compliance issues (i.e., current violations)?	
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?	
Is a CAV or CAC scheduled or needed?	
Regulation	
When did the community enter the NFIP?	
Are the FIRMs digital or paper?	
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	
Provide an explanation of the permitting process.	
Community Rating System	
Does the community participate in CRS?	
What is the community's CRS Class Ranking?	
What categories and activities provide CRS points and how can the class be improved?	
Does the plan include CRS planning requirements?	

Prepared by:	Date	Email	Phone

City of Garden Grove 2019 Hazards

- Climate Change
- Dam Failure
- Drought and Water Shortage
- Earthquake
- Earthquake Liquefaction
- Flood: (100/500 year)
- Flood: Localized/Stormwater
- Landslide, Mud and Debris Flows
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms
- Severe Weather: High Winds
- Wildfire

City of Garden Grove Historic Hazard Worksheet (Past Occurrences)

Please fill out one sheet for each significant hazard event with as much detail as possible. Attach supporting documentation, photocopies of newspaper articles, or other original sources.

Type of event	
Nature and magnitude of event	
Location	
Date of event	
Injuries	
Deaths	
Property damage	
Infrastructure damage	
Crop damage	
Business/economic impacts	
Road/school/other closures	
Other damage	
Insured losses	
Federal/state disaster relief funding	
Opinion on likelihood of occurring again	
Source of information	
Comments	

	Please return worksheets by mail, email, or fax to: Jeanine Foster, Foster Morrison 5628 West Long Place Littleton, CO 80123 fax: (720) 893-0863 email: jeanine.foster@fostermorrison.com
Prepared by:	
Phone:	
Email:	
Date:	

A.8.2. Risk Assessment Meeting Handouts

Hazard Identification & Profiles

Table 4 Garden Grove Hazard Identification

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Negligible	Medium	–
Dam Failure	Significant	Unlikely	Catastrophic	High	Medium
Drought and Water Shortage	Extensive	Likely	Limited	Medium	Medium
Earthquake	Extensive	Highly Likely/Occasional	Catastrophic	High	Low
Earthquake: Liquefaction	Limited	Occasional	Critical	Medium	Low
Flood: (100/500 year)	Extensive	Occasional/Unlikely	Critical	High	High
Flood: Localized/Stormwater	Significance	Highly Likely	Limited	Medium	High
Levee Failure	Limited	Unlikely	Limited	Medium	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Negligible	Low	Medium
Severe Weather: Heavy Rains and Storms	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: High Winds	Extensive	Highly Likely	Limited	Medium	Low
Wildfire (Conflagration)	Extensive	Highly Likely	Catastrophic	Medium	Medium

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal future impact
Medium: moderate future impact
High: widespread future impact

Risk Assessment Methodology

Calculating Likelihood of Future Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrence is categorized into one of the following classifications:

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

Calculating Vulnerability

Vulnerability is measured in general, qualitative terms, and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential:

- **Extremely Low**: The occurrence and potential cost of damage to life and property is very minimal to non-existent.
- **Low**: Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**: Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**: Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have already occurred in the past.
- **Extremely High**: Very widespread and catastrophic impact.

Defining Significance (Priority) of a Hazard

Defining the significance or priority of a hazard to a community is based on a subjective analysis of several factors. This analysis is used to focus and prioritize hazards and associated mitigation measures for the plan. These factors include the following:

- **Past Occurrences**: Frequency, extent, and magnitude of historic hazard events.
- **Likelihood of Future Occurrences**: Based on past hazard events.
- **Ability to Reduce Losses through Implementation of Mitigation Measures**: This looks at both the ability to mitigate the risk of future occurrences as well as the ability to mitigate the vulnerability of a community to a given hazard event.

Risk Assessment Summary: City of Garden Grove Planning Area

Climate Change

- The 2018 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. Climate Change has the potential to alter the nature and frequency of most hazards.
- In Garden Grove, each year it seems to get a bit warmer. Rain events also seem to be of greater intensity. TRUE?
- ANY HMPC INPUT ON CLIMATE CHANGE ISSUES, IMPACTS IN GARDEN GROVE?
- DOES THE CITY HAVE ANY CLIMATE PLANNING DOCUMENTS OR RELATED PROJECTS?
- Likelihood of Future Occurrence: Likely
- Vulnerability: Medium
- Priority Hazard

Dam failure

- According to data provided by Cal OES and National Performance of Dam's data, there are 43 dams in Orange County constructed for flood control, storage, electrical generation, and recreational purposes. Of these, 16 are extremely high hazard, 22 are high hazard, 3 are significant hazard, and 2 are low hazard.
- Of these 43 dams, 3 were identified of concern to the City (Prado Dam, Santiago Creek Dam, and Villa Park Dam).
- Only the Prado Dam shows an inundation of parcels within the City; Santiago Creek and Villa Park, while also having inundation areas, impacts are limited and inundation areas are contained due to the levees present along the Santa Ana River .
- The Orange County LHMP identified a "dam" failure that occurred in the City of Westminster in 1998 associated with a 5 million gallon water storage tank. This did not affect Garden Grove.
- ARE THERE OTHER DAMS OF CONCERN TO THE CITY THAT SHOULD BE NOTED? INSIDE AND OUTSIDE THE COUNTY?
- ARE THERE ANY PAST OCCURRENCES OF DAM FAILURES, OVERTOPPING, OTHER?
- Likelihood of Future Occurrence: Unlikely
- Vulnerability: Extremely High
- Priority Hazard

Drought and Water Shortage

- Historical drought data for the City of Garden Grove and region indicate there have been 5 significant droughts in the last 84 years.
- Since 2012, snowpack levels in California had dropped dramatically. 2015 estimates place snowpack at 5 percent of normal levels. However, snowpack levels increased in 2016 and in 2017 snowpack levels were the highest they've been in 22 years. But then back down again in 2018 and 2019.

- 1 state disaster declaration (2014) for Orange County since 1950. There have been 26 NCDC drought events in Garden Grove; all of these were associated with the 2007-2009 drought that affected the County.
- HMPC – CAN YOU PROVIDE DAMAGES, IMPACTS, OR RESTRICTIONS THAT HAVE OCCURRED IN THE CITY RECENTLY DUE TO DROUGHT CONDITIONS. WHAT HAS BEEN IMPACTED THE MOST (VEGETATION, URBAN TREES, WATER SUPPLY, OTHER)? WHAT IS THE PRIMARY SOURCE OF WATER AND HOW HAS WATER SUPPLY BEEN AFFECTED IN THE CITY DURING PAST DROUGHTS?
- Likelihood of Future Occurrence: Drought - Likely/Water shortage - Occasional
- Vulnerability: Medium
- Priority Hazard

Earthquake

- The General Plan Environmental Impact Report (EIR) noted that there are no known active faults within the City. However, two fault splays associated with the in-active Pelican Hills Fault Zone traverse the central and western portions of the City.
- Additionally, there are several potentially active faults within proximity to the City. According to the EIR, the Newport-Inglewood, Whittier, and Palos Verdes Faults are the most likely to cause high ground acceleration in the City. The San Andres Fault has the highest probability of generating a maximum credible earthquake in California. The Norwalk Fault, though closer to the City, is predicted to generate smaller magnitude earthquake.
- There has been 2 state and fede,ral disaster declarations in Orange County associated with the 1994, 6.7 Northridge EQ and the 1987 5.9 Whitter Narrows EQ. A search of the USGS database shows that there have been 103, 5.0 or greater earthquake events within 90 miles of Garden Grove occurring since 1850. HMPC – WERE THERE ISSUES IN THE CITY FROM THESE OR OTHER HISTORICAL EARTHQUAKES? PROVIDE DETAILS ON IMPACTS, DAMAGES, INJURIES, ETC.
- The USGS National Seismic Hazard Maps provides acceleration and probabilities for various time periods. This data indicates that the expected severity of earthquakes in the City is generally moderate with areas of the region falling in the high to very high categories.
- Likelihood of Future Occurrence: occasional – large, damaging earthquake; Likely – minor earthquake
- Vulnerability: Extremely High
- Priority Hazard

Earthquake - Liquefaction

- Liquefaction hazard maps indicate a majority of the City falls within a liquefaction potential zone. Liquefaction is usually associated with a large earthquake event.
- There have been no disaster declarations in Orange County or any identified past issues of liquefaction within Garden Grove.
- ANY PAST LIQUEFACTION ISSUES TO NOTE IN THE CITY?
- Likelihood of Future Occurrence: Unlikely
- Vulnerability: High
- Priority Hazard

Flood Hazards

100/500 year

- Garden Grove has significant areas mapped in 1% and 0.2% annual chance floodplains.
- Of the 37 state and federal declarations from 1950-present– 19 state and 17 federal declarations were for heavy rains and flooding. Flooding is an ongoing issue for the planning area.
- HMPC - REVIEW RISK ASSESSMENT AND ADD INFORMATION ON MAJOR FLOOD EVENTS. DOES THE CITY HAVE INFORMATION ON PAST FLOOD EVENTS, PROBLEM AREAS, DAMAGES, IMPACTS, ETC.
- WHAT IS THE MOST COMMON TYPE OF FLOODING EXPERIENCED IN THE CITY?
- DOES THE CITY HAVE DATA ON LIKELY FLOOD DEPTHS?
- Likelihood of Future Occurrence: 100-Occasional; 500-Unlikely
- Vulnerability: High
- Priority Hazard

Localized/Stormwater flooding

- Localized flood history in the City – occurs annually
- CAN THE HMPC PROVIDE DETAILS ON THESE AREAS? LOCATIONS, PICTURES/DESCRIPTIONS, DAMAGES, IMPACTS, ETC.
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Priority Hazard

Levee Failure

- Garden Grove has a significant area protected by levees (located outside of the City) and identified on the DFIRM
- DOES THE CITY HAVE MAPS AND INFORMATION ON THE STATUS OF THESE LEVEES? WHAT LEVEL OF PROTECTION DO VARIOUS LEVEE SEGMENTS PROTECTING THE CITY PROVIDE? WHO OWNS/OPERATES THE LEVEES PROTECTING THE CITY?
- ARE FLOOD DEPTHS OF LEVEE BREAKS KNOWN?
- HAVE THERE BEEN ANY HISTORIC LEVEE FAILURES IN ORANGE COUNTY OR AFFECTING THE CITY? DAMAGES?
- Likelihood of Future Occurrence: Unlikely?
- Vulnerability: High
- Priority Hazard

Severe weather

Extreme Heat

- Annual occurrences of hot temperatures. The highest recorded daily extreme was 112°F on June 14, 1917. In a typical year, maximum temperatures exceed 90°F on 24.8 days.
- 19 extreme heat events (NCDC) from 1996-2018; No state or federal disaster declarations

- PLEASE PROVIDE DETAILS ON EXTREME HEAT EVENTS IN THE CITY. WHAT ARE THE BIGGEST CONCERNS, ISSUES, IMPACTS?
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Non-Priority Hazard

Heavy rains and storms (Hail, Lightning, Wind)

- Significant City history: annual occurrences.
- There have been 19 federal and 17 state declarations since 1950 for flooding and heavy rains and storms.
- The NCDC data recorded 101 hail, heavy rain, and flood incidents for Orange County since 1950.
- CAN THE HMPC PROVIDE DETAILS ON HEAVY RAIN AND STORM EVENTS IN THE CITY – IMPACTS, DAMAGES, ETC. PA WORKSHEETS
- Severe storms/heavy rains are the primary cause of most major flooding
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Priority Hazard

High Winds

- Significant City history: annual occurrences
- Of special concern in the City are Santa Ana winds. The NWS defines Santa Ana winds as strong downslope winds that blow through the mountain passes in southern California. Santa Ana winds often bring the lowest relative humidity of the year to coastal Southern California
- No state or federal disaster declarations. The NCDC data recorded 279 high wind and tornado incidents for Orange County since 1955. Of these, 32 were tornadoes and 34 funnel clouds. Tornado events were: F0 or EF0 – 16; F1 or EF1 – 10; F2 or EF2 – 1; F3 or EF3 – 1; Unknown – 4
- CAN THE HMPC PROVIDE INFORMATION ON PAST HIGH WINDS EVENTS AND DAMAGES? WHAT ARE THE PRIMARY CONCERNS TO THE CITY?
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Priority Hazard

Wildfire

- Wildfires occur on an annual basis in California. Catastrophic wildfires have occurred in Orange County and throughout the State. However, the City has limited areas where wildland fires would be a concern – no areas within the City are mapped by Cal Fire as being at risk to wildfire.
- 6 state and 15 federal disaster declarations for Wildfire in Orange County; 30 NCDC wildfire events.
- Any ignition has the potential to become an out of control wildfire.
- However, Cal fire and other data indicate the City at low risk to wildland fires given its urban environment
- Fire risk to the City is focused on an Urban Conflagration based on fires possibly caused by other events such as post earthquake
- DOES THE CITY AND/OR ITS FIRE DEPARTMENT HAVE ANY DATA, INFORMATION, ETC REGARDING THE POTENTIAL FOR AN URBAN CONFLAGRATION IN THE CITY?

- Likelihood of Future Occurrence: Low
- Vulnerability: Low
- Non-Priority Hazard?

Data Needs

Review of Key Items to date:

- Hazard-specific data (from today's risk assessment review)
  - ✓ Historic Hazard Worksheets or list of past hazard occurrences and impacts to City by hazard
  - ✓ Information on key items identified above in the hazard summary
- Risk Assessment Worksheets
- Finalization of Critical Facility definition and GIS layer
- Future Development Areas – clarification on GIS data
- Flood plans or studies
- Watershed plans
- Fire plans
- Drought Plan
- Climate plans
- Earthquake studies
- Inventory of Unreinforced Masonry buildings (URMs)
- Listing of any earthquake retrofits conducted by the City
- Any other plans, studies, data, etc. related to the identified natural hazards to the City

Other Data Items:

- List of any disaster declarations by the City
- For past County/City declarations, summary of damages, PA worksheets, etc.
- Listing of City EOC activations
- Photos of problem areas, past events, etc.

Mitigation Action Worksheet

Mitigation Action/Project Title:	
Hazards Addressed:	
Issue/Background:	
Other Alternatives:	
Existing Planning Mechanism(s) through which Action Will Be Implemented:	
Responsible Office/Partners:	
Cost Estimate:	
Benefits (Losses Avoided):	
Potential Funding:	
Timeline:	
Project Priority:	

Worksheet completed by:	
Name and Title:	
Phone:	

A.8.3. Mitigation Strategy Meeting Handouts

These can be found in Appendix C of this Plan.

A.8.4. Final Meeting Handouts

There were no handouts for the final meetings.

A.8.5. Public Meeting Handouts – Kickoff Meeting

City of Garden Grove 2019 Hazards

- Climate Change
- Dam Failure
- Drought and Water Shortage
- Earthquake
- Earthquake Liquefaction
- Flood: (100/500 year)
- Flood: Localized/Stormwater
- Landslide, Mud and Debris Flows
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms
- Severe Weather: High Winds
- Wildfire

City of Garden Grove Historic Hazard Worksheet (Past Occurrences)

Please fill out one sheet for each significant hazard event with as much detail as possible. Attach supporting documentation, photocopies of newspaper articles, or other original sources.

Type of event	
Nature and magnitude of event	
Location	
Date of event	
Injuries	
Deaths	
Property damage	
Infrastructure damage	
Crop damage	
Business/economic impacts	
Road/school/other closures	
Other damage	
Insured losses	
Federal/state disaster relief funding	
Opinion on likelihood of occurring again	
Source of information	
Comments	

	Please return worksheets by mail, email, or fax to: Jeanine Foster, Foster Morrison 5628 West Long Place Littleton, CO 80123 fax: (720) 893-0863 email: jeanine.foster@fostermorrison.com
Prepared by:	
Phone:	
Email:	
Date:	

A.8.6. Public Meeting Handouts – Final Meeting

Appendix B References

2014 California Climate Adaptation Strategy

2014-2021 City of Garden Grove Housing Element

2015 Orange County Local Hazard Mitigation Plan

2017 Orange County Draft CWPP

2018 State of California Hazard Mitigation Plan

2019 Final Draft of the Orange County Regional Water and Wastewater LHMP FEMA Disaster Declaration Database

2019 Final Draft of the Orange County Regional Water and Wastewater LHMP

CAL FIRE Fire Hazard Severity Zones

CAL FIRE Fire History Database

CAL FIRE GIS Datasets

Cal OES Dam Inundation Data

Cal-Adapt – Extreme Precipitation Events

Cal-Adapt – Precipitation: Decadal Averages Map

Cal-Adapt – Projected Wildfire Burn Area Increase

Cal-Adapt – Temperature: Decadal Averages Map

Cal-Adapt: – Wildfire: Decadal Averages

Cal-Atlas

Cal-DWR Disadvantage Community Mapping Tool

California Adaptation Planning Guide

California Department of Finance

California Department of Fish and Wildlife

California Department of Parks and Recreation Office of Historic Preservation

California Department of Water Resources

California Department of Water Resources – Best Available Maps

California Department of Water Resources Division of Safety of Dams

California Division of Mines and Geology

California Geological Survey

California Natural Diversity Database

California Natural Resource Agency

California's Adaptation Planning Guide: Understanding Regional Characteristics

California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources

California's Sustainable Groundwater Management Act

City of Garden Grove 2016 Emergency Operations Plan

City of Garden Grove 2030 General Plan

City of Garden Grove 2030 General Plan Conservation Element

City of Garden Grove 2030 General Plan Environmental Impact Report

City of Garden Grove 2030 General Plan Land Use Element

City of Garden Grove 2030 General Plan Safety Element

City of Garden Grove General Plan Safety Element

City of Garden Grove Urban Water Management Plan

Climate Change and Health Profile Report - Orange County

Federal Emergency Management Agency

FEMA – Disaster Declaration Database

FEMA - Understanding Your Risks—Identifying Hazards and Estimating Losses.

FEMA Disaster Declaration Database

FEMA Hazus 4.2

FEMA NFIP Data for Garden Grove

FEMA Orange County Digital Flood Insurance Rate Map 3/21/2019

FEMA Orange County Flood Insurance Study 3/21/2019

FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes

HMPC input

Intergovernmental Panel on Climate Change (IPCC)

IPCC 2014 Fifth Assessment Synthesis Report

Lake County Assessor's Data

Lake County Climate and Health Profile Report

Lake County GIS

Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR

Multi-Hazard Identification and Risk Assessment, FEMA 1997

National Climate Assessment

National Drought Mitigation Center

National Drought Mitigation Center Drought Impact Reporter

National Fire Plan

National Institute of Building Science Multi-Hazard Mitigation Council 2017 Interim Report

National Integrated Drought Information System

National Levee Database

National Oceanic and Atmospheric Administration

National Oceanic and Atmospheric Administration's National Climatic Data Center Storm Events Database

National Performance of Dams Program

National Weather Service

NOAA Storm Prediction Center

NOAA's Climate Prediction Center

Orange County Climate Change and Health Report

Orange County Water District

Petersen, M. et al., 2018 One-Year Seismic Hazard Forecast from Induced and Natural Earthquakes - Seis. Res. Lett., doi.org/10.1785/0220180005.

Proceedings of the National Academy of Sciences

Public Health Alliance of Southern California

Science Magazine

Southern California Association of Governments

U.S. Army Corps of Engineers

U.S. Drought Monitor

U.S. Fish and Wildlife Service Wetlands Mapper

U.S. Geologic Survey National Earthquake Information Center Database

U.S. Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977

U.S. Geological Survey

U.S. Geological Survey Open File Report 2015-3009

UNFCCC Conference of Parties Paris Agreement of 2015

University of California

US Army Corps of Engineers

US Census Bureau

Vaisala National Lightning Detection Network

Western Regional Climate Center

Appendix C Mitigation Strategy

City of Garden Grove
Local Hazard Mitigation Plan
Mitigation Strategy Meetings
August 28 & 29, 2019

Table of Contents:

Agenda

Day 1:

Day 2:

Jeanine Foster (jeanine.foster@fostermorrison.com)
Foster Morrison Consulting, Ltd.
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AGENDA

City of Garden Grove
Local Hazard Mitigation Plan (LHMP)
Mitigation Strategy Meetings
August 28 & 29, 2019

HMPC Meeting #3:

1. Introductions
2. Status of the DMA Planning Process
3. Risk Assessment Status
4. Develop Plan Goals and Objectives
5. Identify and discuss Mitigation Alternatives/Actions/Projects

HMPC Meeting #4:

1. Introductions
2. Identify and discuss Mitigation Alternatives/Actions/Projects
3. Review Mitigation Selection Criteria
4. Prioritize Mitigation Projects
5. Review of Schedule/Data Needs

Mitigation Strategy Meetings

Day 1

Hazard Identification & Profiles

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Negligible	Medium	–
Dam Failure	Significant	Unlikely	Catastrophic	High	Medium
Drought and Water Shortage	Extensive	Likely	Limited	Medium	Medium
Earthquake	Extensive	Highly Likely/Occasional	Catastrophic	High	Low
Earthquake: Liquefaction	Limited	Occasional	Critical	Medium	Low
Flood: (100/500 year)	Extensive	Occasional/Unlikely	Critical	High	High
Flood: Localized/Stormwater	Significance	Highly Likely	Limited	Medium	High
Levee Failure	Limited	Unlikely	Limited	Medium	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Negligible	Low	Medium
Severe Weather: Heavy Rains and Storms	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: High Winds	Extensive	Highly Likely	Limited	Medium	Low
Wildfire (Conflagration)	Extensive	Highly Likely	Catastrophic	Medium	Medium

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal future impact
Medium: moderate future impact
High: widespread future impact

Risk Assessment Methodology

Calculating Likelihood of Future Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrence is categorized into one of the following classifications:

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

Calculating Vulnerability

Vulnerability is measured in general, qualitative terms, and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential:

- **Extremely Low**: The occurrence and potential cost of damage to life and property is very minimal to non-existent.
- **Low**: Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**: Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**: Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have already occurred in the past.
- **Extremely High**: Very widespread and catastrophic impact.

Defining Significance (Priority) of a Hazard

Defining the significance or priority of a hazard to a community is based on a subjective analysis of several factors. This analysis is used to focus and prioritize hazards and associated mitigation measures for the plan. These factors include the following:

- **Past Occurrences**: Frequency, extent, and magnitude of historic hazard events.
- **Likelihood of Future Occurrences**: Based on past hazard events.
- **Ability to Reduce Losses through Implementation of Mitigation Measures**: This looks at both the ability to mitigate the risk of future occurrences as well as the ability to mitigate the vulnerability of a community to a given hazard event.

Risk Assessment Summary: City of Garden Grove

Climate Change

- The 2018 State of California Multi-Hazard Mitigation Plan states that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. Climate Change has the potential to alter the nature and frequency of most hazards.
- In Garden Grove, each year it seems to get a bit warmer. Rain events also seem to be of greater intensity.
- ANY HMPC INPUT ON CLIMATE CHANGE ISSUES IN GARDEN GROVE? DOES THE CITY HAVE ANY CLIMATE PLANNING DOCUMENTS OR RELATED PROJECTS?
- Likelihood of Future Occurrence: Likely
- Vulnerability: Medium
- Priority Hazard

Dam failure

- According to data provided by Cal OES and National Performance of Dam's data, there are 43 dams in Orange County constructed for flood control, storage, electrical generation, and recreational purposes. Of these dams, 16 are rated as extremely high, 22 are rated as high hazard, 3 are rated as significant hazard, and 2 are rated as low hazard dams.
- Dams of concern to the City includes only one dam: Prado Dam. The inundation area covers 100% of Garden Grove.
- In a Prado Dam breach event, the 2-mile reach upstream from Imperial Highway would have a surge wave depth and velocity of about 36 feet and 24 feet per second respectively. Between Imperial Highway and the Santa Ana Freeway, depths range from 9 feet to 32 feet with velocities from 5 to 9 feet per second.
- Also looked at Santiago Creek, Villa Park, and Seven Oaks dams identified as possible dams of concern by the HMPC. While these dams also have inundation areas, impacts are limited and inundation areas are contained due to the levees present along the Santa Ana River.
- ARE THERE ANY PAST OCCURRENCES/ISSUES OF DAM FAILURES AFFECTING THIS CITY?
- Likelihood of Future Occurrence: Unlikely
- Vulnerability: Extremely High
- Priority Hazard

Drought and Water Shortage

- Historical drought data for the Garden Grove planning area and region indicate there have been 5 significant droughts in the last 84 years.

- 1 federal and state disaster declaration (2014) for since 1950. There have been 26 NCDC drought events in Orange County. All of these were for the 2014-2016 drought, but no damages, injuries, or losses were reported in the NCDC database.
- Garden Grove's water supply comes from two sources; imported water from Metropolitan Water District of Southern California and local groundwater. WHAT % COMES FROM THESE SOURCES?
- WHAT HAS BEEN IMPACTED THE MOST? HOW HAS WATER SUPPLY BEEN AFFECTED IN THE CITY?
- Likelihood of Future Occurrence: Likely – Drought; Likely– Water Shortage
- Vulnerability: Medium
- Priority Hazard

Earthquake

- According to the City of Garden Grove 2030 General Plan Environmental Impact Report, Section Five – Geology, there are no Alquist Priolo Earthquake Fault Zones located within the City of Garden Grove. However, two fault splays associated with the in-active Pelican Hills Fault Zone traverse the central and western portions of the City in a northwest to southeast trending direction.
- Faults of concern to the City include: Pelican-Hills, Newport-Inglewood, Norwalk, Elsinore, and San Andreus.
- The U.S. Geological Survey (USGS) issues National Seismic Hazard Maps as reports that provide acceleration and probabilities for various time periods. This data indicates that the expected severity of earthquakes in the City is generally moderate with areas of the region falling in the high to very high categories.
- There have been two state and federal disaster declarations in Orange County. The 1994 Northridge Earthquake which was a 6.7-magnitude, with damages estimated at more than $20 billion and 57 deaths and the 1987 5.9-magnitude Whittier Narrows earthquake that killed eight people and damaged thousands of buildings estimated at $100 million.
- The most recent earthquakes in Southern California occurred in a remote area near Ridgeway, California. They included three main shocks of Mw magnitudes 6.4, 5.4, and 7.1 and many perceptible aftershocks.
- Conducting a search of the USGS database, numerous 5.0 M or greater earthquakes have occurred within 90 miles of the City.
- The City has felt ground shaking from many of these earthquakes with epicenters located elsewhere. Actual damages within the City have been limited.
- WERE THERE ISSUES/DAMAGES IN THE CITY FROM THE HISTORICAL EARTHQUAKES?
- IT SOUNDS LIKE THE CITY HAS NEVER CONDUCTED AN INVENTORY OF VULNERABLE EARTHQUAKE STRUCTURES, NOR HAVE THEY CONDUCTED ANY EARTHQUAKE RETROFITS. TRUE?
- Likelihood of Future Occurrence: Occasional – large, damaging earthquake; Highly Likely – minor earthquake
- Vulnerability: High or Extremely High?
- Priority Hazard

Earthquake: Liquefaction

- Liquefaction hazard maps from the General Plan Safety Element (sourced from the CGS) indicate a majority of Garden Grove is subject to liquefaction (all but the far northwestern portion of the City).

- Liquefaction during major earthquakes in liquefaction prone areas can cause severe damage to structures on level ground as a result of settling, titling, or floating.
- There have been no disaster declarations in Orange County associated with liquefaction. No history of damaging earthquakes, including liquefaction-related damage in the City.
- WERE THERE ISSUES/DAMAGES IN THE CITY FROM HISTORICAL EARTHQUAKES? ANY KNOWN ISSUES RELATIVE TO LIQUEFACTION IN THE CITY?
- Likelihood of Future Occurrence: Occasional based on likelihood of large, damaging earthquakes occurring.
- Vulnerability: High
- Priority Hazard

Flood Hazards

100/500 year

- Historically, portions of Garden Grove have always been at risk to flooding. The FIS noted that flooding in the planning area primarily results from prolonged heavy rainfall over tributary areas during the period from November through March. The City of Garden Grove 2016 EOP note that the main source of the flood hazard within the City is the Santa Ana River. While the Santa Ana River does not enter Garden Grove, the floodplain of the River extends into the City. However, with the building of the Prado dam and other upstream flood control structures, flooding from the Santa Ana has been mostly controlled. TRUE?
- 19 state and 17 federal declarations in Orange County were for severe winter weather, storms, heavy rains, or flooding. Flooding is an ongoing issue for the City.
- NEED INFORMATION ON MAJOR FLOOD EVENTS PROBLEM AREAS, DAMAGES, IMPACTS, ETC.
- CHECK EOC ACTIVATIONS. PROVIDE RESULTS OF PA WORKSHEETS POST FLOOD EVENTS.
- WHAT IS THE MOST COMMON TYPE OF FLOODING EXPERIENCED IN THE CITY?
- DOES THE CITY HAVE DATA ON LIKELY FLOOD DEPTHS?
- Likelihood of Future Occurrence: 100-Occasional; 500-Unlikely
- Vulnerability: High?
- Priority Hazard

Localized/Stormwater flooding

- Significant localized flood history in the City – occurs annually.
- The City of Garden Grove General Plan Infrastructure Element noted that the City has in the past been subjected to extensive street flooding and occasional property damage, particularly during the 1960's and earlier. Major floods occurred during 1938, 1969, 1978, and 1983, which affected various parts of the City.
- The City identified one area of localized flooding: Magnolia Between Trask and Garden Grove Boulevard. TRUE? IS THIS THE ONLY AREA OF LOCALIZED FLOODING?
- IDENTIFY LOCALIZED FLOODING PROBLEM AREAS. PROVIDE DETAILS ON PAST OCCURRENCES IN THESE AREAS? PICTURES/DESCRIPTIONS. PROVIDE RESULTS OF PA WORKSHEETS POST FLOOD EVENTS.
- Likelihood of Future Occurrence: Highly Likely

- Vulnerability: Medium
- Priority Hazard

Levee Failure

- The levees on the Santa Ana River south of the City provide protection to certain areas of the City from the 1% annual chance flood (DFIRM – X-protected by levee zone)
- There have been no past occurrences of levee failure affecting the City, or otherwise. TRUE?
- Likelihood of Future Occurrence: Unlikely
- Vulnerability: Medium
- Priority Hazard

Severe weather

Extreme Heat

- Annual occurrences of hot temperatures. The highest recorded daily extreme was 112°F on June 14, 1917. In a typical year, maximum temperatures exceed 90°F on 24.8 days.
- 19 extreme heat events (NCDC) from 1996-2018; No state or federal disaster declarations
- PLEASE PROVIDE DETAILS ON EXTREME HEAT EVENTS IN THE CITY. WHAT ARE THE BIGGEST CONCERNS, ISSUES, IMPACTS?
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Low?
- Non-Priority Hazard?

Heavy rains, snow, and storms

- Significant City history: annual occurrences.
- There have been 19 federal and 17 state declarations since 1950 for flooding and heavy rains and storms.
- The NCDC data recorded 101 hail, heavy rain, and flood incidents for Orange County since 1950.
- CAN THE HMPC PROVIDE DETAILS ON HEAVY RAIN AND STORM EVENTS IN THE CITY – IMPACTS, DAMAGES, ETC. PA WORKSHEETS
- Severe storms/heavy rains are the primary cause of most major flooding
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Priority Hazard

High Winds (and Tornadoes)

- Significant City history: annual occurrences
- Of special concern in the City are Santa Ana winds. The NWS defines Santa Ana winds as strong downslope winds that blow through the mountain passes in southern California. Santa Ana winds often bring the lowest relative humidity of the year to coastal Southern California
- No state or federal disaster declarations. The NCDC data recorded 279 high wind and tornado incidents for Orange County since 1955. Of these, 32 were tornadoes and 34 funnel clouds. Tornado events were: F0 or EF0 – 16; F1 or EF1 – 10; F2 or EF2 – 1; F3 or EF3 – 1; Unknown – 4

- CAN THE HMPC PROVIDE INFORMATION ON PAST HIGH WINDS EVENTS AND DAMAGES? WHAT ARE THE PRIMARY CONCERNS TO THE CITY?
- Likelihood of Future Occurrence: Highly Likely
- Vulnerability: Medium
- Priority Hazard?

Wildfire

- Wildfires occur on an annual basis in California. Catastrophic wildfires have occurred in Orange County and throughout the State. However, the City has limited areas where wildland fires would be a concern – no areas within the City are mapped by Cal Fire as being at risk to wildfire.
- 6 state and 15 federal disaster declarations for Wildfire in Orange County; 30 NCDC wildfire events.
- Any ignition has the potential to become an out of control wildfire.
- However, Cal fire and other data indicate the City at low risk to wildland fires given its urban environment
- Fire risk to the City is focused on an Urban Conflagration based on fires possibly caused by other events such as post earthquake
- DOES THE CITY AND/OR ITS FIRE DEPARTMENT HAVE ANY DATA, INFORMATION, ETC REGARDING THE POTENTIAL FOR AN URBAN CONFLAGRATION IN THE CITY?
- Likelihood of Future Occurrence: Low
- Vulnerability: Medium or High?
- Non-Priority Hazard?

City of Garden Grove Priority Hazards

- Climate Change
- Dam Failure
- Drought & Water Shortage
- Earthquake
- Earthquake Liquefaction
- Flood: 1%/0.2% annual chance
- Flood: Localized/Stormwater
- Levee Failure
- Severe Weather: Heavy Rains and Storms (wind, hail, lightning)
- Severe Weather: High Winds
- Wildfire

Non-Priority Hazards:

- Severe Weather: Extreme Heat

Mitigation Strategy: Goals

The most important element of the LHMP is the resulting mitigation strategy which serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy is comprised of three components:

1. Mitigation Goals
2. Mitigation Actions
3. Action (Implementation) Plan

Mitigation Goals

Up to now, the HMPC has been involved in collecting and providing data for the City of Garden Grove Local Hazard Mitigation Plan. From this information, a Risk Assessment has been developed that describes the risk and vulnerability of the Garden Grove planning area to identified hazards and includes an assessment of the area's current capabilities for countering these threats through existing policies, regulations, programs, and projects.

This analysis identifies areas where improvements could or should be made. Formulating Goals will lead us to incorporating these improvements into the Mitigation Strategy portion of the plan. Our planning goals should provide direction for what loss reduction activities can be undertaken to make the planning area more disaster resistant.

Mitigation Goals are general guidelines that represent the community's vision for reducing or avoiding losses from identified hazards. Goals are stated without regard for achievement, that is, implementation cost, schedule, and means are not considered. Goals are public policy statements that:

- Represent basic desires of the jurisdiction;
- Encompass all aspects of planning area, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

While goals are not specific (quantitative), they should not be so general as to be meaningless or unachievable.

Goals statements will form the basis for objectives. They should be stated in such a way as to develop one or more objectives related to each goal.

The key point in writing goals is to remember that they must deal with results, not the activities that produce those results.

Finally, before we formulate our goals, we should discuss other planning area goals from other regional/county/city programs and priorities. This keeps us from "reinventing the wheel," as well as being consistent with Multi-Objective Management --- or "MOM" --- where communities strive for efficiency by combining projects/needs that are similar in nature or location. Utilizing "MOM" effectively can result in identifying multiple sources of funding that can be "packaged" and broadening the supporting constituency base by including "outcomes" desired by various stakeholder groups.

Types/Sources of other area mitigation plans and programs include:

- General Plans
- Stormwater Program and Plans
- Flood/Watershed Management Plans and Studies
- Drought Plans
- Community Wildfire Protection Plans
- Strategic Fire Plans
- Dam Emergency Action Plans
- Emergency Operations Plans
- Climate Plans
- Other?

Sample Goals from other Plans

Goals from the 2018 California State Hazard Mitigation Plan

1. Significantly reduce life loss and injuries.

2. Minimize damage to structures and property, as well as minimizing interruption of essential services and activities.

3. Protect the environment.

4. Promote community resilience through integration of hazard mitigation with public policy and standard business practices.

Goals from the City of Garden Grove 2030 General Plan

Infrastructure Element

Goal INFR-3: Storm drain service levels shall be maintained and/or improved throughout the City.

Safety Element

Goal SAF-4: Community members must be made aware of potential environmental hazards, how they should prepare for these instances, and how they should respond.

Goal SAF-5: Public harm from fire and health emergencies shall be minimized.

Goal SAF-6: Risk associated with seismic activity and geologic conditions to people and property shall be minimized.

Goal SAF-7: Minimize injury and loss of life, damage to public and private property and infrastructure, and economic and social disruption caused by inundation and flood hazards.

Goal SAF-8: The social and economic impacts that natural and urban disasters have on the community shall be minimized through effective emergency and disaster preparedness.

Goals from the 2015 Orange County and Orange County Fire Authority LHMP

Protect Life and Property

- Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to natural hazards.
- Reduce losses and repetitive damage for chronic hazard events, while promoting insurance coverage for catastrophic hazards.
- Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

Public Awareness

- Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
- Provide information on tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.

Natural Systems

- Balance watershed planning, natural resource management, and land use planning with natural hazard mitigation to protect life, property, and the environment.
- Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.

Partnerships and Implementation

- Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in implementation.
- Encourage leadership within public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities.

Emergency Services

- Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.
- Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
- Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goals from the 2018 Orange County Regional Water and Wastewater HMP

- Goal 1: Minimize vulnerabilities of critical facilities and infrastructure to minimize damages and loss of life and injury to human life caused by hazards.
- Goal 2: Minimize security risks to water and wastewater infrastructure.
- Goal 3: Minimize interruption to water and wastewater utilities.

- Goal 4: Improve public outreach, awareness, education, and preparedness for hazards in order to increase the community resilience.
- Goal 5: Eliminate or minimize wastewater spills and overflows (Wastewater agencies).
- Goal 6: Protect water quality and supply, critical aquatic resources and habitat to ensure a safe water supply.
- Goal 7: Strengthen Emergency Response Services to insure preparedness, response, and recovery during any major or multi-hazard event.

Goals Development

You will each be given 3 sticky notes. On each note you will write what you think the goals for this mitigation planning effort should be. To get you started, provided below are possible goals for this mitigation plan. You may reword these or develop your own. These goal statements should serve as examples. It is vital that our Hazard Mitigation Planning Committee establish its own goals. Use one note card for each goal. The purpose of the goal development is to reach a consensus on plan goals.

- Minimize risk and vulnerability from natural hazards
- Increase communities' awareness of vulnerability to hazards
- Increase the use of shared resources
- Improve communities' capabilities to mitigate losses
- Maintain coordination of disaster plans with changing DHS/FEMA needs
- Maintain FEMA eligibility/position jurisdictions for grant funding
- Maintain/enhance the flood mitigation program to provide 200/500-year flood protection
- Maintain current service levels
- Provide protection for existing buildings from hazards
- Provide protection for future development from hazards
- Provide protection for natural and cultural resources from hazard impacts
- Provide protection for people's lives from hazards
- Provide protection for public health
- Provide protection for critical services (fire, police, etc.) from hazard impacts
- Provide protection for critical lifeline utilities from hazard impacts
- Reduce exposure to hazard related losses
- Reduce the number of emergency incidents
- Make better use of technology

When done, we will:

- Pin/tape them to the wall/easel-chart and arrange them by category
- Combine and reword them into 3-4 goals for the plan.

Mitigation Strategy Meetings
Day 2

Mitigation Strategy: Actions

Mitigation Actions are specific projects and activities that help achieve the goals and accomplish risk reduction in the community.

Categories of Mitigation Measures

PREVENTION: Preventive measures are designed to keep the problem from occurring or getting worse. Their objective is to ensure that future development is not exposed to damage and does not increase damage to other properties.

- Planning
- Zoning
- Open Space Preservation
- Land Development Regulations
  - Subdivision regulations
  - Building Codes
    - Fire-Wise Construction
  - Floodplain development regulations
  - Geologic Hazard Areas development regulations (for roads too!)
- Storm Water Management
- Fuels Management, Fire-Breaks

EMERGENCY SERVICES: protect people during and after a disaster. A good emergency services program addresses all hazards. Measures include:

- Warning (flooding, tornadoes, winter storms, geologic hazards, fire)
  - NOAA Weather Radio
  - Sirens
  - "Reverse 911" (Emergency Notification System)
- Emergency Response
  - Evacuation & Sheltering
  - Communications
  - Emergency Planning
    - Activating the EOC (emergency management)
    - Closing streets or bridges (police or public works)
    - Shutting off power to threatened areas (utility company)
    - Holding/releasing children at school (school district)
    - Ordering an evacuation (mayor)
    - Opening emergency shelters (Red Cross)
    - Monitoring water levels (engineering)
    - Security and other protection measures (police)
- Critical Facilities Protection (Buildings or locations vital to the response and recovery effort, such as police/fire stations, hospitals, sewage treatment plants/lift stations, power substations)

    - Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities and nursing homes
    - Lifeline Utilities Protection
- Post-Disaster Mitigation
- Building Inspections
    - ID mitigation opportunities & funding before reconstruction

PROPERTY PROTECTION: Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- Retrofitting/disaster proofing
    - Floods
        - Wet/Dry floodproofing (barriers, shields, backflow valves)
        - Relocation/Elevation
        - Acquisition
        - Retrofitting
    - High Winds/Tornadoes
        - Safe Rooms
        - Securing roofs and foundations with fasteners and tie-downs
        - Strengthening garage doors and other large openings
    - Winter Storms
        - Immediate snow/ice removal from roofs, tree limbs
        - "Living" snow fences
    - Geologic Hazards (Landslides, earthquakes, sinkholes)
        - Anchoring, bracing, shear walls
        - Dewatering sites, agricultural practices
        - Catch basins
    - Drought
        - Improve water supply (transport/storage/conservation)
        - Remove moisture competitive plants (Tamarisk/Salt Cedar)
        - Water Restrictions/Water Saver Sprinklers/Appliances
        - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
        - Create incentives to consolidate/connect water services
        - Recycled wastewater on golf courses
    - Wildfire, Grassfires
        - Replacing building components with fireproof materials
        - Roofing, screening
        - Create "Defensible Space"
        - Installing spark arrestors
        - Fuels Modification

- ✓ Noxious Weeds/Insects
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators
- ➢ Insurance

NATURAL RESOURCE PROTECTION: Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. These natural and beneficial floodplain functions include the following:

- ➢ storage of floodwaters
- ➢ absorption of flood energy
- ➢ reduction in flood scour
- ➢ infiltration that absorbs overland flood flow
- ➢ groundwater recharge
- ➢ removal/filtering of excess nutrients, pollutants, and sediments from floodwaters
- ➢ habitat for flora and fauna
- ➢ recreational and aesthetic opportunities

Methods of protecting natural resources include:

- ➢ Wetlands Protection
- ➢ Riparian Area/Habitat Protection/Threatened-Endangered Species
- ➢ Erosion & Sediment Control
- ➢ Best Management Practices

Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants. There are three general categories of BMPs:

4. Avoidance: setting construction projects back from the stream.
5. Reduction: Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.
6. Cleanse: Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained

- ➢ Dumping Regulations
- ➢ Set-back regulations/buffers

- Fuels Management
- Water Use Restrictions
- Landscape Management
- Weather Modification

STRUCTURAL: Projects that have traditionally been used by communities to control flows and water surface elevations. Structural projects keep flood waters away from an area. They are usually designed by engineers and managed or maintained by public works staff. These measures are popular with many because they "stop" flooding problems. However, structural projects have several important shortcomings that need to be kept in mind when considering them for flood hazard mitigation:

- They are expensive, sometimes requiring capital bond issues and/or cost sharing with Federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.
- They disturb the land and disrupt natural water flows, often destroying habitats or requiring Environmental Assessments.
- They are built to a certain flood protection level that can be exceeded by a larger flood, causing extensive damage.
- They can create a false sense of security when people protected by a structure believe that no flood can ever reach them.
- They require regular maintenance to ensure that they continue to provide their design protection level.

Structural measures include:

- Detention/Retention structures
- Erosion and Sediment Control
- Basins/Low-head Weirs
- Channel Modifications
- Culvert resizing/replacement/Maintenance
- Levees and Floodwalls
- Anchoring, grading, debris basins (for landslides)
- Fencing (for snow, sand, wind)
- Drainage System Maintenance
- Reservoirs (for flood control, water storage, recreation, agriculture)
- Diversions
- Storm Sewers

PUBLIC INFORMATION: A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, businesses, and local officials about hazards and ways to protect people and property from these hazards. These activities can motivate people to take protection

- Hazard Maps and Data
- Outreach Projects (mailings, media, web, speakers, displays)
- Library Resources
- Real Estate Disclosure
- Environmental Education

Mitigation Strategy: Action Plan

The mitigation action plan describes how the mitigation actions will be implemented, including how those actions will be prioritized, administered, and incorporated into the community's existing planning mechanism. Each participating jurisdiction must have a mitigation action(s) and an action plan specific to that jurisdiction and its priority hazards and vulnerabilities.

Mitigation Criteria

For use in selecting and prioritizing Proposed Mitigation Measures

1. STAPLEE

Social: Does the measure treat people fairly? (different groups, different generations)

- Community Acceptance
- Effect on Segment of Population
- Social Benefits

Technical: Will it work? (Does it solve the problem? Is it feasible?)

- Technical Feasibility
- Reduce Community Risk
- Long Term Solution/Sustainable
- Secondary Impacts

Administrative: Do you have the capacity to implement & manage project?

- Staffing
- Funding Allocated
- Maintenance/Operations

Political: Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support?

- Political Support
- Local Champion
- Public Support
- Achieves Multiple Objectives
- Supported by a broad array of Stakeholders

Legal: Does your organization have the authority to implement? Is it legal? Are there liability implications?

- Existing Local Authority
- State Authority
- Potential Legal Challenges

Economic: Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?

- Benefit of Action
- Cost of Action
- Cost Effective/Economic Benefits
- Economically Viable
- Outside Funding Required

Environmental: Does it comply with Environmental regulations?

- Effect on Land/Water
- Effect on Endangered Species
- Effect on Cultural Resources
- Effect on Hazmat sites
- Consistent with Community Environmental Goals
- Consistent with Environmental Laws
- Environmental Benefits

2. SUSTAINABLE DISASTER RECOVERY

- Quality of Life
- Social Equity
- Hazard Mitigation
- Economic Development
- Environmental Protection/Enhancement
- Community Participation

3. SMART GROWTH PRINCIPLES

- Infill versus Sprawl
- Efficient Use of Land Resources
- Full Use of Urban Resources
- Mixed Uses of Land
- Transportation Options
- Detailed, Human-Scale Design

4. OTHER

- Does measure address area with highest risk?
- Does measure protect …
  - ✓ The largest # of people exposed to risk?
  - ✓ The largest # of buildings?
  - ✓ The largest # of jobs?
  - ✓ The largest tax income?
  - ✓ The largest average annual loss potential?
  - ✓ The area impacted most frequently?

- ✓ Critical Infrastructure (access, power, water, gas, telecommunications)

- ➢ Timing of Available funding
- ➢ Visibility of Project
- ➢ Community Credibility

Mitigation Action Prioritization Instructions

Our Team recommendations are listed on flip-chart paper around the room.

You each have 3 sets of colored dots:

- 3 red dots
- 3 blue dots
- 3 green dots

The red dots are for high priority (5 points each)

The blue dots are for medium priority (3 points each)

The green dots are for low priority (1 point each)

Place your dots on the recommendations, using the different colors to indicate your priority. You may use as many of your dots, of any color, on any recommendation --- or you may spread them out using as few of your dots as you wish. The dots will indicate the consensus of the team.

Use your list of criteria to help you make your determinations.

After the totals are counted, we will discuss them further to confirm or change any of the results as we see fit.

Mitigation Action Worksheet

Jurisdiction:	
Mitigation Action/Project Title:	
Hazards Addressed:	
Issue/Background:	
Project Description:	
Other Alternatives:	
Existing Planning Mechanism(s) through which Action Will Be Implemented:	
Responsible Office/Partners:	
Cost Estimate:	
Benefits (Losses Avoided):	
Potential Funding:	
Timeline:	
Project Priority:	

Worksheet completed by:	
Name and Title:	
Phone:	

Garden Grove
Local Hazard Mitigation Plan
Mitigation Strategy Meetings: Mitigation Actions v/1
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Responsible Department / Staff	Mitigation Action Title	Hazards Addressed	Points/ Worksheet Status
Foster Morrison	Public awareness, education, outreach, and preparedness program enhancements for all hazards (multi-media, educate and clarify various emergency systems, messaging and training; promote self- responsibility)	Multi-hazard	34
Foster Morrison	Incorporate LHMP Update by reference through council adoption into the safety element of the General Plan	Multi-hazard	N/A*
	Evacuation Planning	Multi-hazard	28
	Shelter Annex to EOP	Multi-hazard	9
	Back up generators for critical facilities	Multi-hazard	20
	Establish standalone EOC	Multi-hazard	11
	Identify and establish shelters	Multi-hazard	6
	Cable Channel 3 enhancements	Multi-hazard	6
	Disaster planning for vulnerable populations (e.g., elderly, homeless, visitors, non english speaking, others?)	Multi-hazard	9
	Update and maintain critical facility list and GIS mapping	Multi-hazard	6
	Revise CERT program to include other volunteer/service groups	Multi-hazard	2
	Develop Climate Action Plan	Climate Change	16
	Ongoing recycling and greenhouse gas reduction program	Climate Change	10
	County Basin Management Plan implemented on a localized level	Drought & Water Supply	12
	Continue conservation measures	Drought & Water Supply	12
	Installation of infiltration systems (required for all new construction); Evaluate new areas/opportunities	Drought & Water Supply	12
	Public education – educate the public on the need to water trees	Drought & Water Supply	26
	Reconfigure irrigation systems in public areas to water trees	Drought & Water Supply	0
	Conduct Facility Assessments/evaluate for seismic retrofits (structural and non structural)/Implement retrofits	Earthquake/ Earthquake Liquefaction	36
	New police and fire department facilities built to current seismic standards	Earthquake/ Earthquake Liquefaction	7

Responsible Department / Staff	Mitigation Action Title	Hazards Addressed	Points/ Worksheet Status
	Relocate Public Yard	Earthquake/ Earthquake Liquefaction/ Flood	10
	Install seismic valves on aboveground gas meters	Earthquake/ Earthquake Liquefaction	6
	Earthquake insurance promotion	Earthquake/ Earthquake Liquefaction	9
	Flood insurance promotion	Flood	6
	Line B5 Project, $50M	Flood	18
	Master Drainage Plan update and implementation	Flood/ Heavy Rains and Storms	11
	Catch Basin Maintenance Program enhancements	Flood/ Heavy Rains and Storms	23
	Los Alamitos – dredging of golf course area	Flood/ Heavy Rains and Storms	1
	Update DFIRMs	Flood	6
	Develop Heat Contingency Plan with options for cooling center, transportation, public education	Extreme Heat	5
	Cooling Center Enhancements – additional location, activation, access, transportation	Extreme Heat	31
	Tree Maintenance	Heavy Rains and Storm, High Winds	6
	Implement Urban Tree Management Plan	Climate Change/ Drought and Water Shortage/ Extreme Heat; Heavy Rains and Storm/ High Winds	57
	Undergrounding of utilities for new development	Heavy Rains and Storm, High Winds	0
	Utility undergrounding retrofit program – SCE Rule 20	Heavy Rains and Storm, High Winds	0
	Securing of roofs, eves, etc.	,High Winds	0
	Upgrading Wooden Electrical Panels in Parks	High Winds	3
	Weed abatement Ordinance – implementation and enforcement	Fire	12
	Building Maintenance Program (cleaning roofs, gutters, drains; eve replacements)	Fire	6

Responsible Department / Staff	Mitigation Action Title	Hazards Addressed	Points/ Worksheet Status
	New construction and building retrofits with non-cellulose materials (e.g., gazebos and other standalone structures)	Fire	1
	Mitigation vacant buildings/homes	Fire	1
	Turn power off to electrical outlets/tamper proof covers in public areas	Fire	3

Appendix D Adoption Resolution

Note to Reviewers: When this plan has been reviewed and approved pending adoption by FEMA Region IX, the adoption resolution will be signed by the City and added to this appendix. The intended resolution is provided below:

Resolution # ______

Adopting the Garden Grove Local Hazard Mitigation Plan

Whereas, the City of Garden Grove recognizes the threat that natural hazards pose to people and property within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

Whereas, the U.S. Congress passed the Disaster Mitigation Act of 2000 (“Disaster Mitigation Act”) emphasizing the need for pre-disaster mitigation of potential hazards;

Whereas, the Disaster Mitigation Act makes hazard mitigation grants available to state and local governments;

Whereas, an adopted Local Hazard Mitigation Plan is a requirement for certain funding for mitigation projects under multiple Federal Emergency Management Agency (FEMA) pre- and post-disaster mitigation grant programs; and

Whereas, the City of Garden Grove used the FEMA-prescribed process to prepare this local hazard mitigation plan; and

Whereas, under the California Disaster Assistance Act, as amended by AB 2140, certain disaster funding is available to a local jurisdiction if such jurisdiction has adopted a local hazard mitigation plan into the safety element of its general plan; and

Whereas, the City Council desires that a local hazard mitigation plan be adopted by reference into the Safety Element of the City of Garden Grove General Plan in accordance with AB 2140, as codified in Government Code sections 8685.9 and 65302.6; and

Whereas, the California Office of Emergency Services and FEMA Region IX have reviewed the draft City of Garden Grove Local Hazard Mitigation Plan and approved it contingent upon the City Council adopting the Local Hazard Mitigation Plan; and

Whereas, the City of Garden Grove desires to augment its emergency planning efforts by formally adopting the Local Hazard Mitigation Plan and to comply with the funding eligibility requirements of the Disaster Mitigation Act; and

Whereas, adoption of the Local Hazard Mitigation Plan by the City Council demonstrates the City of Garden Grove's commitment to fulfilling the mitigation goals and objectives outlined in this Local Hazard Mitigation Plan; and

Now, therefore, be it resolved, that the City of Garden Grove adopts the City of Garden Grove Local Hazard Mitigation Plan as an official plan; and

Be it resolved, that the City of Garden Grove adopts the City of Garden Grove Local Hazard Mitigation Plan by reference into the safety element of their general plan in accordance with the requirements of AB 2140, and

Be it further resolved, the City of Garden Grove will submit this adoption resolution to the California Office of Emergency Services and FEMA Region IX officials to enable the plan's final approval in accordance with the requirements of the Disaster Mitigation Act of 2000 and to establish conformance with the requirements of AB 2140.

Passed:____________________
(date)

____
Certifying Official

Appendix E Critical Facilities

Table E-1 City of Garden Grove Critical Facility Inventory

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Eastgate Plaza Shopping Center	Entertainment	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
The Promenade	Entertainment	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
California Urgent Care	Hospital/Medical	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove Hospital	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Garden Grove Medical Plaza	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Grove Medical Arts	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Kaiser Permanente	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Orangegrove Rehab Hospital	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Pacific Haven Healthcare	Hospital/Medical	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Candlewood Suites	Hotel	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Harbor/Chapman Resort Hotels	Hotel	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Holiday Inn Express	Hotel	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Atlantis Play Center	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Bicentennial Park (Spirit of 76)	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Chapman Sports Complex	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Civic Center Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Eastgate Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Edgar Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Faylane Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Gatosky Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Hare School Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Haster Basin Recreation Area	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Jardin De Los Ninos	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Lake School Park	Park	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Magnolia Memorial Park Cemetery	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Magnolia Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Morningside School Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Pioneer Park	Park	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Village Green Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
West Grove Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
West Haven Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Woodbury Park	Park	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Chapman Ave Baptist Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Christ Cathedral Complex	Religious Assembly	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Chua Viet Nam Temple	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Duoc Su Temple	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove Friends Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove United Methodist Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Grace Baptist Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Jehovahs Witnesses Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
OC Grace Garden Grove Seventh Day Adventist Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Orangewood Baptist Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Our Redeemer Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Rejoice Community Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Saint Columban Catholic Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Suh Moon Presbyterian Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
True Jesus Church	Religious Assembly	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Agnes Ware Stanley Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Alamitos Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Anderson Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Barker Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Bolsa Grande High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Brookhurst Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Bryant Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Chapman Adult Education Center	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Clinton-Mendenhall Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Coastline Community College	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Cook Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Doig Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Donald S. Jordan Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Dr. C C Violette Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Dr. Walter C. Ralston Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Dwight D. Eisenhower Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Earl Warren Elementary School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Enders Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Ernest O. Lawrence Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Ethel M. Evans Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Excelsior Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Faylane Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Park Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Genevieve M. Crosby Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Gilbert Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Hilton D. Bell Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Iva Meairs Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
James Irvine Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
John A. Murdy Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Lampson Elementary School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Lincoln Continuation High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Linton T. Simmons Elementary School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Louis G. Zeyen Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Louis Lake Intermediate School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Marie L. Hare Continuation High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Mark Twain School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Merton E. Hill Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Mitchell Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Morningside Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Pacifica High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Parkview Elementary School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Patton Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Peters Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Rancho Alamitos High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Riverdale Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Santiago High School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Skylark Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
St. Callistus School	School	At Risk Population Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
St. Columbans School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
St. Paul's School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Stanford Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Sunnyside Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Thomas Paine Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Wakeham Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Walton Intermediate School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Woodbury Elementary School	School	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Alta Gardens Care Center	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Brookdale Assisted Living	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove Convalescent Hospital	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Park Care Center	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Harbor Grove Senior Apartments	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Sungrove Senior Apartments	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Valley View Gardens	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Valley View Senior Villas	Senior Housing	At Risk Population Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 80	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 81	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 82	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 83	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Station 84	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 85	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Station 86	Fire Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Garden Grove Unified School District	Government Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Orange County Mosquito and Vector Control District	Government Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Social Security Administration	Government Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
United States Post Office	Government Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Police Department & Special Services	Police Station	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
City Hall	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Community Meeting Center (Cooling Center)	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Courtyard Center	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Housing Authority	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Magnolia Park Family Resource Center	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Sports & Recreation Center	Public Building	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Feeder: OC - 5	Public Works Facility	Essential Services Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Lampson PRV	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Lampson Reservoir	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Magnolia Reservoir	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Public Works Municipal Service Center	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Trask Reservoir	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Well 16	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Well 19	Public Works Facility	Essential Services Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Well 24	Public Works Facility	Essential Services Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
Well 25	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Well 26	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Well 27	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Well 29	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone A
Well 30	Public Works Facility	Essential Services Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	X Protected by Levee
West Garden Grove Reservoir	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
West Garden Grove Reservoir Pump Station	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Facility Name	Facility Type	Category	Liquefaction Zone	Dam Inundation Area	Fire Hazard Severity Zone	DFIRM Flood Zone
Westhaven Reservoir	Public Works Facility	Essential Services Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Longsdon Pit North	Covered Landfill	Hazardous Materials Facilities	Outside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Longsdon Pit South	Covered Landfill	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Air Industries	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Coastline Metal Finishing	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Goodwin Ammonia	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Hycor Biomedical	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Microsemi	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Pacific Polymers	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Plastic Industries	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)
Western Propane	Hazmat	Hazardous Materials Facilities	Inside Liquefaction Zone	Prado Dam	Urban Unzoned	Zone X (shaded)

Source: City of Garden Grove GIS, CAL FIRE, Cal OES, CGS