CITY OF LONGBEACH

Department of Disaster Preparedness and Emergency Communications
2990 Redondo Ave, Long Beach, CA 90806
(562) 570-9250

October 18, 2022

R-25
REVISED

HONORABLE MAYOR AND CITY COUNCIL
City of Long Beach
California

RECOMMENDATION:

Adopt a Resolution to submit the 2022 Natural Hazard Mitigation Plan (Plan) in accordance with the Federal Disaster Mitigation Act of 2000 – Public Law 106-390; and, authorize the City Manager, or designee, to amend and update the Plan annually or as requested by the Federal Emergency Management Agency. (Citywide)

DISCUSSION

In October 2000, the Federal Disaster Mitigation Act of 2000 (Mitigation Act) was signed into law. Pursuant to the Mitigation Act, the Federal Emergency Management Agency (FEMA) requires local, county and state government to submit a Natural Hazard Mitigation Plan (NHMP) to FEMA in order to be eligible for grant-funding for pre-disaster mitigation projects and expanded post-disaster relief or emergency assistance funding. The FEMA-approved mitigation planning process includes identifying natural hazards, determining potential impacts, developing mitigation measures for those hazards, and implementing measures to reduce the impacts of those hazards.

The 2022 Natural Hazard Mitigation Plan update serves to reduce the loss of life and property by mitigating potential risks and minimizing the impact of natural hazards. The NHMP provides a specific evaluation of seven hazards identified as posing significant threats to the community: earthquake; drought; flood; severe weather; tsunami; sea-level rise; and dam failure. As the cost of damages from disasters to metropolitan areas across the country continue to increase, the City of Long Beach (City) recognizes the importance of identifying effective ways to reduce vulnerability to disasters. Mitigation plans assist communities in reducing risk from hazards by identifying resources, providing information, and creating strategies for risk reduction, while helping to guide and coordinate mitigation activities. Planning for the mitigation of natural hazards is an integral element of the City's overall disaster preparedness plans.

The City initiated the planning process to formally update the NHMP in August 2021. A steering committee, facilitated by a consultant group, was established and included representation from Disaster Preparedness, Public Works, Long Beach Airport, the Port of Long Beach, Police, Fire, Development Services, Parks, Recreation, and Marine, Water, Health and Human Services, Energy Resources, and Human Resources/Risk Management. Subject matter experts from Los Angeles County Office of Emergency Management and local colleges and universities also participated on the steering committee to provide insight and assistance. The steering committee, along with the consultant, worked to review the current Plan's goals, objectives, and natural hazard vulnerabilities and updated the plan where necessary.

A key aspect of the hazard mitigation planning process is outreach to stakeholders and the public, including residents, businesses, local government representatives and organizations with an interest in hazard mitigation planning. The City provided a range of opportunities for the public to participate in the planning process including the circulation of a public survey on the risks of natural disasters, press release, announcement advertising the availability of the draft plan online and physically at library branches, and a presentation to our Disaster Preparedness Community Partner Organizations. Additionally, the department launched a permanent Hazard Mitigation Plan webpage to provide educational information and allow residents to participate in the update process.

Once adopted by Council, the Plan will be submitted to California Office of Emergency Services (Cal OES) and FEMA for review and approval.

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. City staff will update the plan on a biannual basis to reevaluate recommendations, monitor the impacts of mitigation actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies.

This matter has been reviewed by Deputy City Attorney Arturo D. Sanchez and Budget Management Officer Nader Kaamoush on September 28, 2022.

TIMING CONSIDERATIONS

City Council action is requested on October 18, 2022, to ensure the City can promptly submit the plan to Cal OES and FEMA for review and approval in order to maintain grant eligibility.

FISCAL IMPACT

There is no fiscal impact from the approval of the NHMP. The consultant costs related to this project were funded by federal Homeland Security grant funds. The submittal of the plan to FEMA enables the City to be eligible for FEMA mitigation project grant funding, as well as disaster relief and emergency assistance funding. To implement some of the projects outlined in the NHMP, funding sources will need to be identified. These funding sources may include grants, capital improvement funds, or other City funds. This recommendation has no staffing impact beyond the normal budgeted scope of duties and is consistent with existing City Council priorities. There is no local job impact associated with this recommendation.

SUGGESTED ACTION:

Approve recommendation.

Respectfully submitted,

REGINALD I. HARRISON
DIRECTOR, DISASTER PREPAREDNESS
AND EMERGENCY COMMUNICATIONS

APPROVED:

THOMAS B. MODICA
CITY MANAGER

ATTACHMENTS - Resolution
Attachment A

RESOLUTION NO.

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LONG BEACH TO SUBMIT AN UPDATED NATURAL HAZARD MITIGATION PLAN IN ACCORDANCE WITH THE FEDERAL DISASTER MITIGATION ACT OF 2000 (PUBLIC LAW 106-390)

WHEREAS, the Federal Disaster Management Act of 2000 required every local, county and state government to submit a Natural Hazard Mitigation Plan to the Federal Emergency Management Agency by November 1, 2004, in order to be eligible for pre- and post-disaster grants and funding; and

WHEREAS, disaster resiliency, the ability to "bounce back" quickly from an natural disaster (such as earthquake, flood, severe weather, or tsunamis) with minimal permanent, intolerable damage or disruption of natural, economic, social or structural systems and without massive amounts of outside assistance, is frequently included as another component of community sustainability; and

WHEREAS, sustainability emphasizes planning as a primary approach to involve local citizens, obtain broad input, and develop real goals and action plans on how to mitigate against damage caused by the hazards facing every California community; and

WHEREAS, there are actions that can be undertaken to address hazards, no matter how large or small, that can support disaster resiliency and sustainability in our community; and

WHEREAS, the City of Long Beach's Plan focuses on potential impacts of earthquake, drought, tsunami, flooding, climate change/sea-level rise, severe weathers, and dam failure, and includes an assessment of these hazards, a plan to mitigate them, and methods of monitoring, evaluating, and updating the Plan;

OFFICE OF THE CITY ATTORNEY
CHARLES PARKIN, City Attorney
333 West Ocean Boulevard, 11th Floor
Long Beach. CA 90802-4664

NOW, THEREFORE, the City Council of the City of Long Beach resolves as follows:

Section 1. That the City Council of the City of Long Beach does hereby authorize and support updating the Natural Hazard Mitigation Plan, affirming goals and objectives to ensure the health, safety and welfare of its citizens in the event of a natural disaster.

Section 2. That the City Manager is granted the authority to amend and update the plan annually and submit an updated Plan every five years to the City Council for its review, prior to submission to the Federal Emergency Management Agency.

Section 3. This resolution shall take effect immediately upon its adoption by the City Council, and the City Clerk shall certify to the vote adopting this resolution.

I hereby certify that the foregoing resolution was adopted by the City Council of the City of Long Beach at its meeting of ____________________________, 2022, by the following vote:

Ayes: Councilmembers: ____

____

____

____

Noes: Councilmembers: ____

____

Absent: Councilmembers: ____

____

Recusal(s): Councilmembers: ____

____

City Clerk

OFFICE OF THE CITY ATTORNEY
CHARLES PARKIN, City Attorney
333 West Ocean Boulevard, 11th Floor
Long Beach, CA 90802-4664

CITY OF LONG BEACH

Natural Hazard Mitigation Plan

Public Review Draft | September 2022

TETRA TECH

City of Long Beach Hazard Mitigation Plan

September 2022

PREPARED FOR

City of Long Beach Department of Disaster Preparedness and Emergency Communications

2990 Redondo Avenue
Long Beach, California 90806

562.570.9250

PREPARED BY

Tetra Tech

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This update of the City of Long Beach Hazard Mitigation Plan was funded through a grant from the Urban Area Security Initiative (UASI) Program. The City of Long Beach selected Tetra Tech, Inc. through its standard procurement protocol to assist with development and implementation of the plan.

Tetra Tech Project #103s7714

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DEFINITIONS AND ACRONYMS

°F—Degrees Fahrenheit

0.2 percent-annual-chance flood—The flood that has a 0.2 percent chance of being equaled or exceeded in any given year; often referred to as the 500-year flood

1 percent-annual-chance flood—The flood that has a 1 percent chance of being equaled or exceeded in any given year; often referred to as the 100-year flood

AB—Assembly Bill

ADA—Americans with Disabilities Act

asset—Any man-made or natural feature that has value, including people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks

base flood—The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1 percent annual chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

basin—The area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds."

benefit/cost analysis—A systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

benefit—A net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit/cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

BRIC—Building Resilient Infrastructure and Communities

CAL FIRE—California Department of Forestry and Fire Protection

Cal OES—California Office of Emergency Services

capability assessment—An analysis of a community's capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out.

CCR—California Code of Regulations

CDBG-DR—Community Development Block Grant Disaster Recovery grants

CDC—Centers for Disease Control and Prevention

CEQA—California Environmental Quality Act

CFR—Code of Federal Regulations

cfs—Cubic feet per second

CIP—Capital Improvement Program

climate change—A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Community Rating System (CRS)—A voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

critical facilities—Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs.

CWA—Clean Water Act

dam failure—An uncontrolled release of impounded water due to a partial or complete breach in a dam (or levee) that impacts its integrity.

dam—Any artificial barrier or controlling mechanism that can or does impound or divert water.

debris flow—Dense mixtures of water-saturated debris that move down-valley, looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

DFIRM—Digital Flood Insurance Rate Map

Disaster Mitigation Act (DMA; Public Law 106-390)—The latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving certain federal financial assistance.

drought—The cumulative impacts of long periods of dry weather. These can include deficiencies in surface and subsurface water supplies and general impacts on health, well-being, and quality of life.

EAP—Emergency action plan

earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

ecosystem services—An ecosystem service is any positive benefit that wildlife or ecosystems provide to people. The benefits can be direct or indirect—small or large.

EMPG—Emergency Management Performance Grant

EPA—U.S. Environmental Protection Agency

epidemic—The spread of an infectious disease beyond a local population, reaching people in a wider geographical area. Several factors determine whether an outbreak will become an epidemic: the ease with which the disease spreads from vectors, such as animals, to people, and the ease with which it spreads from person to person.

ESA—Endangered Species Act

exposure—Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

extent—The extent is the size or location of an area affected by a hazard. For hazards that do not have a clearly defined extent, the definition expands to the strength or magnitude (severity) of the hazard. For hazards that do not have mapping in this plan, extent is addressed by the severity discussion of the hazard profile.

extreme heat—Temperatures that hover 10 ºF or more above the average high temperature for a region and last for several days.

FBI—Federal Bureau of Investigation

federal disaster declaration—Declarations for events that cause more damage than state and local governments and resources can handle without federal government assistance. A federal disaster declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, to help disaster victims, businesses, and public entities.

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

flash flood—A flood that occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM)—The official maps on which the Federal Emergency Management Agency delineate the Special Flood Hazard Area.

Flood Insurance Study—A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

FMA—Flood Mitigation Assistance grant program

freeboard—The margin of safety added to the base flood elevation.

frequency—How often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

g—Gravity (%g, percent acceleration force of gravity)

geographic information system (GIS)—A computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

goal—A general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

greenhouse gases—Methane, nitrous oxide and other gases that trap heat and warm the Earth, as a greenhouse traps heat from the sun.

ground shaking—The result of rapid ground acceleration caused by seismic waves passing beneath buildings, roads, and other structures.

hazard—A source of potential danger or adverse condition that could harm people and/or cause property damage.

HMGP—Hazard Mitigation Grant program

hazardous material—A substance or combination of substances (biological, chemical, radiological, and/or physical) that, because of its quantity, concentration, or physical, chemical or infectious characteristics, has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

Hazards U.S. Multi-Hazard Loss Estimation Program (Hazus)—A GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus software program assesses risk in a quantitative manner to estimate damage and losses associated with natural hazards.

high-hazard dam—Dams that can cause loss of human life from the failure or improper operation of the dam.

HSGP—Homeland Security Grant Program

intensity—The measure of the effects of a hazard.

inventory—The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs, and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

IPCC—Intergovernmental Panel on Climate Change

liquefaction—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

local government—Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

magnitude—The measure of the strength of an earthquake.

meteorological drought—Precipitation at levels below normal over a period of time. Meteorological measurements are the first indicators of drought and are usually region-specific.

mitigation actions—Specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

mitigation—A preventive action taken in advance of an event to reduce or eliminate risk to life or property.

Mw—Moment Magnitude Scale

N/A—Not applicable

NASA—National Aeronautics and Space Administration

NCEI—National Centers for Environmental Information

NEHRP—National Earthquake Hazard Reduction Program

NFIP—National Flood Insurance Program

NMDC—National Drought Mitigation Center

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

pandemic—An epidemic of infectious disease that has spread through human populations across a large region, multiple continents, or worldwide.

peak ground acceleration (PGA)—A measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

PGA—Peak Ground Acceleration

ppm—Part per million

preparedness—Actions that strengthen the capability of government, people, and communities to respond to disasters.

probability of occurrence—A statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

repetitive loss property—Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced—Four or more paid flood losses in excess of $1000.00; or two paid flood losses in excess of $1000.00 within any 10-year period since 1978; or three or more paid losses that equal or exceed the current value of the insured property.

recurrence interval —The recurrence interval (sometimes called the return period) is based on the probability that the given event will be equaled or exceeded in any given year.

residual risk—The risk that remains after controls are accounted for.

risk—The estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

risk assessment—The process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards

risk ranking—Process to score and rank hazards based on the probability that they will occur and the impact they will have if they do.

riverine—Of or produced by a river. Riverine floodplains have readily identifiable channels.

Robert T. Stafford Act—The statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs (Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107). Signed into law November 23, 1988; amended by the Disaster Relief Act of 1974 (Public Law 93-288).

SEMS—Standardized Emergency Management System

SFHA—Special Flood Hazard Area

significant-hazard dam—Dams that can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns, but not necessarily loss of life.

special flood hazard area—The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community’s flood problems

stakeholder—Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

surface fault rupture—An offset of the ground surface when fault rupture extends to the Earth’s surface.

terrorism—The unlawful use or threatened use of force or violence against people or property with the intention of intimidating or coercing societies or governments. Terrorism is either foreign or domestic, depending on the origin, base, and objectives of the terrorist or organization.

transportation incident—A major incident related to a means of transportation such air, rail or highway travel resulting in death, serious injury, or extensive property loss or damage.

USDA—U.S. Department of Agriculture

USDM—U.S. Drought Monitor

USGS—U.S. Geological Survey

vulnerability—Assessment of how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions.

watershed—An area that drains downgradient from areas of higher land to areas of lower land to the lowest point.

zoning ordinance—Ordinance that designates allowable land use and intensities for a local jurisdiction.

EXECUTIVE SUMMARY

HAZARD MITIGATION OVERVIEW

Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to minimize the loss of life, injury, and property damage that can result from a disaster. The City of Long Beach has developed a hazard mitigation plan to reduce risks from disasters to the people, property, economy, and environment within the city. The plan complies with federal and state hazard mitigation planning requirements to establish eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs.

PLAN DEVELOPMENT APPROACH

The City of Long Beach Department of Disaster Preparedness and Emergency Communications managed the development of the *City of Long Beach Hazard Mitigation Plan.* The planning area for the hazard mitigation plan was defined as the entire incorporated area of the city.

A planning team facilitated the development of this plan, consisting of staff from several departments of the City and a contract consultant. A 24-member steering committee of local stakeholders oversaw the plan development. Coordination with other local, state, and federal agencies involved in hazard mitigation occurred throughout the planning process. The planning team and Steering Committee reviewed previous City planning documents, the 2018 *State of California Multi-Hazard Mitigation Plan*, and existing programs that may support hazard mitigation actions.

The planning team implemented a multi-media public involvement strategy that was approved by the Steering Committee. This plan was drafted during the COVID-19 pandemic, limiting in-person public outreach events, and under an expedited project timeline. Public outreach efforts included a hazard mitigation survey, the use of social media, distribution of city-wide public notice, and a public comment period for review of the draft hazard mitigation plan.

Based on the review of existing plans and programs, the input received through the public involvement strategy, the direction of the Steering Committee, and the findings of a new, detailed risk assessment, this hazard mitigation plan meets federal hazard mitigation planning requirements. The plan is currently in draft form; upon completion, it will be submitted to the Long Beach City Council for formal adoption, and to the California Governor’s Office of Emergency Services and FEMA Region 9 for approval.

RISK ASSESSMENT

Risk assessment is the process of measuring the potential loss of life resulting from hazards, as well as personal injury, property damage and environmental damage. The assessment determines a community's overall vulnerability to hazard events. The Steering Committee used the risk assessment to gauge the potential impacts of hazards identified as "hazards of concern" for this plan. For this plan, risk assessment models for hazards of concern were based on current data and technologies. The assessment of each hazard of concern includes discussion of the following:

- Hazard identification and profile
- The exposure of population, property, and the environment to of hazards
- The estimated cost of potential damage, where applicable

Based on the risk assessment, the hazards of concern were ranked for the risk they pose to the planning area.

Additional hazards, identified as "hazards of interest," are identified and briefly described in this plan, but full risk assessments were not conducted for these hazards. Risk was not ranked for the identified hazards of interest.

GOALS AND OBJECTIVES

The Steering Committee determined the following goals for this hazard mitigation plan:

1. Protect health and safety.
2. Invest in property protection.
3. Promote policies that embrace mitigation
4. Create a healthy and equitable environment.
5. Ensure equitable and inclusive mitigation measures.

The Steering Committee identified the following objectives for the hazard mitigation plan:

1. Identify and reduce the health and safety impacts of hazards throughout the city, including areas where vulnerable populations live or work.
2. Improve and promote systems that provide early warning communications during and prior to an emergency or disaster.
3. Develop strategies to reduce public health risk from natural and non-natural hazards.
4. Improve community engagement and outreach by organizations and agencies that provide services to vulnerable populations.
5. Implement mitigation programs that promote reliability of critical assets and lifeline systems to minimize impacts from hazards and expedite recovery following an emergency or disaster.
6. Consider known hazards when identifying sites for new facilities, substantial retrofits, and utility systems.
7. Promote appropriate mitigation of all public and privately owned property.

8. Form partnerships to leverage and share resources with businesses, local institutions, and community-based organizations.
9. Partner with the private sector, including small businesses, to promote structural and non-structural hazard mitigation as part of standard business practices.
10. Educate businesses and institutional partners about contingency planning, targeting small businesses and those located in high-risk areas.
11. Advance understanding about the relationship between climate change and natural hazards due to more frequent and extreme weather events.
12. Increase social resilience by improving knowledge of current and future hazards and promoting community-based mitigation strategies.
13. Encourage mitigation and resiliency strategies throughout the City, including vulnerable neighborhoods.
14. Integrate climate adaptation and resiliency strategies in citywide planning, with attention to neighborhoods most vulnerable to climate change.
15. Improve public outreach and access to hazard information, data, and maps to enhance understanding of natural hazards and the risk they pose.
16. Improve public knowledge of natural and non-natural hazards and protective measures so individuals appropriately mitigate against, prepare for, respond to, and recover from such hazards.

MITIGATION ACTION PLAN

Mitigation actions presented in this plan are designed to reduce or eliminate losses resulting from hazard events. The development process resulted in the identification of 50 mitigation actions. Several of these actions are within the current capabilities of the City of Long Beach, resulting in a high priority for implementation over the next five years. Table ES-1 summarizes the actions and their priority for implementation and for seeking grant funding.

IMPLEMENTATION AND MAINTENANCE

Plan implementation will occur over the next five years as City departments begin to implement the actions identified in this plan. Full implementation of the recommendations will require time and resources. The measure of the plan's success will be its ability to adapt to changing conditions. The framework established by this plan prioritizes actions whose benefits exceed their cost.

The Steering Committee developed a plan maintenance strategy that includes annual progress reporting, a strategy for continued public involvement, a commitment to plan integration with other relevant plans and programs, and continued oversight from a plan maintenance steering committee.

Table ES-1. Mitigation Action Plan

Action Number and Description
Actions Led by Long Beach Development Services (DS)
Action DS-1—Use data from Long Beach Building Resiliency Program study to develop inventory of vulnerable buildings throughout the City.
Action DS-2—Review and conduct studies of combined riverine/coastal flooding and increased severity of rainfall events on watershed flooding to understand the potential cumulative impacts.
Action DS-3—Update or augment, as necessary, floodplain regulations that address the fact that sea level rise will increase the height of floodwaters and the inland extent of floodplains in Long Beach.
Action DS-4—Enhance and expand urban forest programs for new and existing buildings, streets, and public spaces to improve air quality while reducing extreme heat.
Action DS-5—Update Public Safety Element and Seismic Safety Element of the City's General Plan, linking this Hazard Mitigation Plan.
Action DS-6—Structure City codes and policies regarding hazard assessments and the regulation of new development with State requirements.
Action DS-7—Establish preventive measures for existing development in areas vulnerable to natural hazards.
Action DS-8—Maintain supplies and training associated with use of ATC-20 standards (building inspections following disaster).
Action DS-9—Implement the adaptation actions identified in the Climate Action and Adaptation Plan to improve the ability of Long Beach and its residents and businesses to adapt to climate change and related impacts now and in the future. Identified impacts include extreme heat, air quality, drought, sea level rise, and flooding
Action DS-10—Continue to maintain good standing and compliance under the NFIP through implementation of floodplain management programs that, at a minimum, meet the NFIP requirements: • Enforce the flood damage prevention ordinance. • Participate in floodplain identification and mapping updates. Provide public assistance/information on floodplain requirements and impacts.
Actions Led by Long Beach Police Department (PD)
Action PD-11—Install or upgrade generators at all police department facilities that are capable of running 100% of the facility's equipment, lights, etc.
Action PD-12—Install or upgrade communications technology to include redundancy in normal communications, traditional analog backups, and fixed satellite systems at 400 W Broadway, 3205 Lakewood Blvd, 1835 Santa Fe Ave, 4891 Atlantic, 3800 Willow, 7290 Carson St, and 1400 Canal.
Actions Led by Long Beach Department of Health and Human Services (HHS)
Action HHS-13—Assess plans and develop plan/protocol between the City's health and fire departments to utilize emPOWER data (federal data set of individuals who have medical equipment paid for through Medicaid/Medicare) to prioritize evacuation of individuals with electrical dependent medical equipment
Action HHS-14—Assess and expand the list of predesignated shelter locations and family assistance/reunification centers
Action HHS-15—Enhance and expand the accessibility of cooling centers for severe weather.
Actions Led by Long Beach Energy Resources Department (ER)
Action ER-16—Conduct a feasibility study for a seismic retrofit/replacement of Long Beach Energy Resources buildings.
Action ER-17—Back-up generator procurement for the Long Beach Energy Resources 570 building where the call center, dispatch office, and operations center are located.
Action ER-18—Perimeter protection evaluation of the oil islands for tsunami or other potential high tide events.
Action ER-19—Assess and update drainage flows of the oil properties and the Long Beach Energy Resources facility.
Actions Led by Long Beach Fire Department (FD)
Action FD-20—Evaluate and develop sustainable emergency food and water storage capabilities (i.e., refrigeration units) and caches (potable water and meals ready-to-eat) for both emergency workers and civilian victims.
Action FD-21—Install or upgrade generators at all fire department facilities that are capable of running 100% of the facility's equipment, lights, etc.
Action FD-22—Increase standard shoring capabilities of Fire Department resources by creating an extensive cache of lumber and Paratech equipment, to assist with infrastructure structural shoring capabilities following an earthquake.

Action Number and Description
Action FD-23—Evaluate and increase satellite capabilities to store and deliver fuel during fuel shortages/disruptions due to natural disaster.
Action FD-24—Evaluate and create continuity plans for communication by developing secondary and tertiary communication plans, including upgrades to radio communications, via towers for UHF, VHF, and digital radio transmissions. Establish a satellite phone cache for emergency usage.
Action FD-25—Evaluate and develop a cache of personal protective equipment for City personnel operating in impacted tsunami zones (foul weather gear, waders, boots, etc.)
Action FD-26—Increase Fire Department fleet capabilities to incorporate more alternatives to transportation besides fire engines, fire trucks, and fire rescues; to include all-terrain and 4x4 capable vehicles.
Action FD-27—Evaluate and upgrade fire prevention protocols for building inspections based on climate trends.
Actions Led by Long Beach Water Department (WD)
Action WD-28—Install/Implement an Earthquake Early Warning System at the Long Beach Water Department's Treatment Plant and Operations Center
Action WD-29—The Long Beach Water Department's Engineering Division will complete a Water Main Lining Pilot Project at Alley East of Cherry between 15th and Pacific Coast Highway, at 15th and Pacific Coast Highway and Sherman Place, and at 17th between Cherry and Alley East of Sherman. This pilot project will use trenchless technology (cast-in-place pipe) to rehabilitate old pipes while reducing the impact of construction and carbon footprint for the duration of materials' 50-year life expectancy. Findings from the pilot will include a better understanding of the environmental and economic impacts of this new technology.
Action WD-30—Strengthen raw water intakes to prevent damage from erosion, flood debris, and earthquakes
Action WD-31—Enlarge culverts to better handle flood surges
Action WD-32—Develop Sewer Master Plan. The Long Beach Water Department's Engineering Division will complete sewer lift station rehabilitation. This type of infrastructure hardening will contribute to sea-level rise resilience as well as operational improvements.
Action WD-33—The Long Beach Water Department's Engineering Division will complete two new wells at Groundwater Treatment Plant to draw water from the Central Basin. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency.
Action WD-34—The Long Beach Water Department's Engineering Division will complete new West Coast Basin Well 1 at 2950 Redondo Ave. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency.
Action WD-35—The Long Beach Water Department's Engineering Division will complete rehabilitating two wells: Comm 15 and 18, at Heartwell Park, 6800 E Carson Street. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency.
Action WD-36—The Long Beach Water Department's Engineering Division will complete rehabilitating two wells: Comm 14 and Citizen 10, at Heartwell Park, 2939 Airport Way. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency.
Action WD-37—The Long Beach Water Department's Water Resources Division will complete a citywide Well Asset Management Plan. This plan will help inform future groundwater well production, which reduces reliance on imported water and improves drought resiliency.
Action WD-38—The Long Beach Water Department's Water Resources Division will complete Groundwater Augmentation Study. This study will help inform future groundwater well production, which reduces reliance on imported water and improves drought resiliency.
Actions Led by Long Beach Public Works Department (PW)
Action PW-39—Complete Westside Storm Drainage Project. To include reinforced concrete box, reinforced concrete pipe storm drain conduit and appurtenances, new catch basins and local depressions.
Action PW-40—Olympic Plaza Stormwater Rehabilitation Project. To include resurfacing/re-establishment of center crown along Olympic Plaza, addition of two catch basins, installation of an 18-inch storm drain main, and construction of a trench drainage system. Support to be provided by Los Angeles County.
Action PW-41—Inventory and flood-proof vulnerable sewer pump stations.
Action PW-42—Develop inventory of backup power resources (generators) for critical City facilities
Action PW-43—Complete Americans with Disabilities Act building upgrades in City-owned facilities and sidewalks.

Action Number and Description
Action PW-44—Conduct a local seismic retrofit of 2nd Street Bridge over San Gabriel River and Studebaker Road Bridge over Southern California Edison.
Action PW-45—Replace Ravenna Rd Bridge over Rivo Alto Canal with a bridge that meets current seismic standards.
Action Led by Long Beach Airport (AIR)
Action AIR-46—Upgrade the existing generator and electrical systems at Long Beach Airport.
Action Led by Harbor Department of Long Beach (HD)
Action HD-47—Identify, improve, and plan Port Cargo Infrastructure seismic and other hazard retrofit and replacement strategies to oil terminals, cargo facilities, and cargo equipment.
Actions Led by Disaster Preparedness & Emergency Communications (DPEC)
Action DPEC-48—Expand public outreach for hazard mitigation and emergency preparedness through use of the City website, social media platforms, and community meetings and events.
Action DPEC-49—Provide equitable access to emergency preparedness information including, availability in multi-lingual formats (including ASL), accommodations for those affected by the technology divide, and targeted outreach for those in historically underserved areas. Efforts will be tracked internally to ensure compliance.
Action DPEC-50—Develop a city-wide evacuation plan to aid in the evacuation of residents and their pets.
Action DPEC-51—Maintain and expand warning and alert systems to ensure equity and accessibility to all residents.
Action DPEC-52—Ensure all response plans during emergency operations center activations are created with an equity lens: providing supplies, equipment, and personnel to historically vulnerable and underserved areas of the City.

PART 1—PLANNING PROCESS AND COMMUNITY PROFILE

1. INTRODUCTION TO HAZARD MITIGATION PLANNING

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

Hazard mitigation is defined as any action taken to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves long- and short-term actions implemented before, during and after disasters. Hazard mitigation activities include planning efforts, policy changes, programs, studies, improvement projects, and other steps to reduce the impacts of hazards.

The federal Disaster Mitigation Act (DMA) of 2000 emphasizes planning for disasters before they occur. The DMA requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Regulations developed to fulfill the DMA's requirements are included in Title 44 of the Code of Federal Regulations (44 CFR).

The responsibility for hazard mitigation lies with many, including private property owners, commercial interests, and local, state and federal governments. The DMA encourages cooperation among state and local authorities in pre-disaster planning. The planning network called for by the DMA helps local governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk-reduction projects.

The DMA also promotes sustainability in hazard mitigation. To be sustainable, hazard mitigation needs to incorporate sound management of natural resources and address hazards and mitigation in the largest possible social and economic context.

1.1.2 Purposes for Planning

The City of Long Beach prepared this DMA-compliant hazard mitigation plan to identify resources, information, and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and the intent of the City and its residents to mitigate hazards. The plan will help guide mitigation activities throughout the planning area. It was developed to meet the following needs:

- Meet or exceed program requirements specified under the DMA
- Enable the City of Long Beach to apply for federal grant funding to reduce hazard risk through mitigation
- Fulfill state and federal requirements for hazard mitigation planning

- Create a risk assessment that focuses on the hazards of concern in the city planning area
- Coordinate existing plans and programs so that high-priority projects to mitigate potential disaster impacts are funded and implemented

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All residents, businesses and employees of the City of Long Beach are the beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the City. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the plan by key stakeholders helped to ensure that the outcomes will be mutually beneficial. The plan's goals and recommendations lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 CONTENTS OF THIS PLAN

This hazard mitigation plan is organized into three primary parts:

- Part 1—Planning Process and Community Profile
- Part 2—Risk Assessment
- Part 3—Mitigation Strategy

Appendices provided at the end of the plan include information or explanations to support the main content of the plan.

2. PLAN UPDATE—WHAT HAS CHANGED

Preparation of the *2022 City of Long Beach Hazard Mitigation Plan* continues the hazard mitigation planning process that has been in place in the City of Long Beach for decades. The City of Long Beach is a leader in the regional discussion of hazards, hazards mitigation, and disaster recovery. This is the third update to the City's initial 2005 hazard mitigation plan (previously updated in 2017). The previous plan update reconciled changes or enhancements made to the plan as required by FEMA for local hazard mitigation plan updates. This section reconciles changes and enhancements to the 2017 update.

2.1 THE 2017 PLAN

Long Beach's 2017 hazard mitigation plan provided direction for reducing the potential for loss of life, property damage, and environmental degradation from natural disasters, while accelerating economic recovery from those disasters. The update of the previous hazard mitigation plan was facilitated by a planning team made up of City staff from various departments, working with a contract consultant. The 2017 plan identified five main goals:

- **Protect Life and Property**—Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to losses from natural, human-caused, and technological hazards. Improve hazard assessment information to make recommendations for avoiding new development in high hazard areas and encouraging preventive measures for existing development in areas vulnerable to natural, human-caused, and technological hazards.
- **Enhance Public Awareness**—Develop and implement education and outreach programs to increase public awareness of the risks associated with natural, human-caused, and technological hazards. Provide information on tools; partnership opportunities, and funding resources to assist in implementing mitigation activities.
- **Preserve Natural Systems**—Support management and land use planning practices with hazard mitigation to protect life. Preserve, rehabilitate, and enhance natural systems to serve hazard mitigation functions.
- **Encourage Partnerships and Implementation**—Strengthen communication and coordinate participation with public agencies, citizens, non-profit organizations, businesses, and industry to support implementation. Encourage leadership within the City and public organizations to prioritize and implement local and regional hazard mitigation activities.
- **Strengthen 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 hazard mitigation activities where appropriate, with emergency operations plans and procedures.

The 2017 plan assessed seven hazards of concern:

- Earthquake
- Flood
- Windstorm
- Tsunami
- Public health
- Technological and human-caused
- Drought

The plan identified and prioritized 217 actions to be implemented by the City over the 5-year performance period of the plan. The plan included a maintenance strategy that included annual reviews of the plan as well as procedures for continuing public involvement.

2.2 WHY UPDATE?

2.2.1 Federal Eligibility

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. This provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. The Robert T. Stafford Act requires that jurisdictions have current hazard mitigation plans to pursue and receive certain federal grant funding.

2.2.2 Changes in Development

Tracking previous and future growth in potential hazard areas provides an overview of increased exposure to hazards within a community. Hazard mitigation plan updates must be revised to reflect changes in development within the planning area during the previous performance period of the plan, as stated in 44 CFR Section 201.6(d)(3). The plan must describe changes in development in hazard-prone areas that increased or decreased vulnerability since the last plan was approved. If no changes in development impacted overall vulnerability, then plan updates may validate the information in the previously approved plan. The intent of this requirement is to ensure that the mitigation strategy continues to address the risk and vulnerability of existing and potential development and takes into consideration possible future conditions that could impact vulnerability.

According to the California Office of Finance, the population of the City of Long Beach decreased by 1.14 percent during the performance period of the 2017-2022 plan. The total number of housing units increased by 1.6 percent for the same time frame, and the average number of persons per household decreased from 2.92 to 2.87. The vacancy rate decreased from 1.3 percent to 0.8 percent over the performance period. The change in demographics for household types over the performance period was as follows:

- Single Detached: +0.59 percent
- Single Attached: -4.28 percent
- 2 to 4 Units: +3.01 percent
- Five or More Units: +2.39 percent
- Mobile Homes: +6.3 percent

The City has adopted a general plan that governs land-use decisions and policymaking, as well as a building code and specialty ordinances based on state and federal mandates. This hazard mitigation plan update assumes that some new development over the performance period occurred in hazard areas. All such new development would have been regulated pursuant to local programs and codes, such as the International Building Code and flood damage prevention requirements of the National Flood Insurance Program (NFIP). Therefore, it is assumed that hazard vulnerability did not measurably increase, even if exposure did.

A comprehensive review of permitting since completion of the previous plan can help to identify recent development trend and anticipated future development. Table 2-1 summarizes development trends in the performance period since the preparation of the previous hazard mitigation plan, as well as expected future development trends.

2.2.3 New Analysis Capabilities

The risk assessment for this updated hazard mitigation plan provides more detailed information than the previous plan on exposed population and building counts for each hazard of concern. It focuses on all property and populations in the City, unlike the previous plan's focus on critical facilities and special populations. This update also increases the level of detail in the loss estimate modeling for dam failure, earthquake, flood, and tsunami hazards—the estimates are presented at the community planning area level in addition to citywide findings. This enhanced risk assessment allows for a more detailed understanding of the City's risk associated with natural hazards.

2.3 CHANGES IN THE UPDATED PLAN

The City used the current update process to make significant changes to the format and content of the hazard mitigation plan. The plan was re-packaged in its entirety to improve readability and to better align with DMA requirements for hazard mitigation plans. A renewed effort was made to establish a plan maintenance and implementation protocol that clearly defines the City's commitment to the plan's ongoing success. Some of the major differences between the current and previous plans are as follows:

- Goals and objectives were identified for the updated plan to better align with existing City plans and programs and identified state priorities.
- The list of evaluated hazards was updated based on the most current community experience and concerns.

Table 2-1. Recent and Expected Future Development Trends

<table>
<tr><th>Criterion</th><th colspan="6">Response</th></tr>
<tr><td>Land annexed since last hazard mitigation plan</td><td colspan="6">None</td></tr>
<tr><td>Land targeted for annexation in next five years</td><td colspan="6">None</td></tr>
<tr><td>Areas targeted for development or major redevelopment in the next five years, and whether any of the areas interface with known hazard risk areas.</td><td colspan="6">• Three mixed use projects undergoing entitlements currently.
• 6201 E Appian Way - Yacht Club Expansion - undergoing entitlements currently
• The Land Use Element (which was adopted in 2019) identified eight major areas of change which encompass 13% of land area in the City. These changes are planned over 20 to 30 years.
• Coastal Areas interface with the Sea Level Rise hazard area:
○ Over the next 20 to 30 years the plan is to revitalize Belmont Pier Complex and Alamitos Bay Landing, SEAP (Southeast Area Specific Plan)
○ Redevelopment of Peninsula, Belmont Shore and Naples areas
○ New construction of the Belmont Pool
• Most of the city is in either a liquefaction or earthquake zone:
○ Anaheim Corridor Zoning Implementation Plan (ACZIP) – Zone Change is underway that will allow potential development in the next 5 years. Development standards will allow this area to be ACZIP. Project area is roughly bounded by Magnolia Ave to the west, Pacific Coast Highway to the north, 10th Street to the south, and Ximeno Ave to the east.
• Areas identified as Methane Gas zone:
○ Rezoning effort and drafting of new development standards of this specific area will lead to potential redevelopment in the next 5 years. Project area is roughly bounded by Magnolia Avenue to the west, Pacific Coast Highway to the north, 10th Street to the south, and Ximeno Avenue to the east.
○ Midtown Specific Plan – Continued redevelopment of area
○ Downtown Specific Plan – Continued redevelopment of area</td></tr>
<tr><td rowspan="5">Number of permits for new construction issued in the City since the preparation of the previous hazard mitigation plan</td><td></td><td>2017</td><td>2018</td><td>2019</td><td>2020</td><td>2021</td></tr>
<tr><td>Single Family</td><td>67</td><td>126</td><td>100</td><td>215</td><td>301</td></tr>
<tr><td>Multi-Family</td><td>9</td><td>8</td><td>41</td><td>7</td><td>12</td></tr>
<tr><td>Other (commercial, mixed use, etc.)</td><td>29</td><td>35</td><td>37</td><td>12</td><td>11</td></tr>
<tr><td>Total</td><td>105</td><td>169</td><td>178</td><td>234</td><td>324</td></tr>
<tr><td>Number of new construction permits for each hazard area (or qualitative description of where development has occurred).</td><td colspan="6">Land development was citywide. Major development areas were downtown and Midtown. In terms of hazards – the general city is largely in a liquefaction zone and coastal areas have sea level rise exposure.</td></tr>
<tr><td>Level of buildout in the City, based on a buildable lands inventory.</td><td colspan="6">The City is largely built out, with some vacant lots.</td></tr>
</table>

- A new review was conducted of existing plans and programs that are relevant for hazard mitigation.
- The risk assessment was updated using the best available data, including updated general building stock and critical facility databases.
- A new risk ranking protocol was employed to assist in establishing mitigation priorities.
- The protocol for prioritizing actions was updated and included a qualitative benefit-cost review.
- The strategy for plan maintenance and implementation was revised and updated to encourage greater coordination and planning for hazard mitigation funding opportunities.

Table 2-2 indicates the major changes between the two plans as they relate to 44 CFR planning requirements.

Table 2-2. Plan Changes Crosswalk

44 CFR Requirement	2017 Plan	2022 Plan Update
§201.6(b): 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 non-profit interests to be involved in the planning process; and** **(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.**	Throughout the project, the City followed its traditional approach to developing policy documents, including preparation of the First Draft Plan, then making the First Draft Plan available to the public and outside agencies electronically as well as in a Stakeholder Workshop. The workshop involved a brief presentation on the background of the planning process as well as a review of the Mitigation Actions Matrix. Attendees were encouraged to ask questions and make recommendations to the Matrix and overall Plan. The Second Draft Plan incorporated the input from the Stakeholder Workshop. The Third Draft Plan included any amendments following distribution of the Second Draft Plan to the Planning Team. The Third Draft Plan was made available to the public, outside agencies, and to the City Council members in advance of the City Council public meeting. Following the Council meeting, the Final Draft Plan was prepared including discussions and decisions at the City Council meeting.	Two groups played significant roles in the planning process for the 2022 plan update: • A planning team, made up of discipline leads from the City and technical consultant, made all milestone decisions on plan process and content. • Those milestone decisions were vetted and validated through an oversite Steering Committee made up of City staff and outside stakeholders. Both groups reviewed existing plans and programs that could support or enhance the outcomes from this plan and identified and participated in a robust public engagement strategy.
§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.	The Plan includes a qualitative risk assessment of seven hazards of concern that included earthquake, flood, windstorm, tsunami, public health, technological and human-caused, and drought. This risk assessment was prepared following the following five steps: identify hazards, profile hazards, inventory critical assets, assess risks, and assess vulnerability of future development.	A comprehensive risk assessment for the planning area that looks at nine hazards of concern: climate change, dam failure, drought, earthquake, flood, severe weather and tsunami. This was a quantitative assessment that used the best available data and science with the Hazus (version 5.0) risk assessment software and geographic information system (GIS) analysis. Chapter 15 includes profiles for other hazards of interest to the City that were not fully assessed or ranked (building collapse, civil unrest, cybersecurity threats, hazardous materials, pipelines, methane gas eruptions, public health incidents, terrorism, and transportation incidents).

44 CFR Requirement	2017 Plan	2022 Plan Update
§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 plan includes Hazard Identification and Risk Assessment (HIRA) profiles of each hazard of concern that include discussion on the extent and location of each hazard. These profiles included information on past occurrences and the probabilities of future events for each hazard.	Comprehensive risk assessments of each hazard of concern are presented in Chapters 8 through 14. Each chapter includes the following: • Hazard profile, including maps of extent and location, historical occurrences, frequency, severity, and warning time • Secondary hazards • Exposure of people, property, critical facilities, and the environment • Vulnerability of people, property, critical facilities, and the environment • Future trends in development • Scenarios • Issues The hazards are compared to each other via a risk ranking methodology described in Chapter 16.
§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). This description shall include an overall summary of each hazard and its impact on the community.	Each hazard profile in the plan includes a vulnerability assessment that qualitatively discusses the impacts of each hazard on the City.	Vulnerability was assessed for all hazards of concern. The Hazus computer model was used for the dam failure, earthquake, flood, and tsunami hazards. These were Level-2 (user-defined) analyses using coordinating agency and local data. Critical facilities and assets were defined and inventoried. Outputs were generated for other hazards by applying an estimated damage function to affected assets when available. The asset inventory was extracted from the Hazus model. Best available data were used for all analyses.
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.	The plan contains a section in the flood hazard profile that provides the definition of repetitive loss and states that the City had 33 repetitive loss properties at the time of that plan update.	The description of the National Flood Insurance Program and repetitive loss discussion was enhanced to meet new DMA and CRS planning requirements. The update includes an analysis of repetitive loss properties. National Flood Insurance Program capability is also assessed.
§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 area.	The hazard profiles include a qualitative discussion on the types of assets exposed to each hazard but does not include any spatial analysis or structure counts.	An evaluation of the numbers and types of buildings exposed was generated for each hazard of concern. The steering committee defined "critical facilities" as they pertain to the planning area, and these facilities were inventoried by exposure. Each hazard chapter provides a discussion of future development trends as they pertain to the hazard.
§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) and a description of the methodology used to prepare the estimate.	The plan estimates vulnerability by referring to historical losses and does not do loss estimation modeling. Hazus was utilized for earthquake.	Dollar loss estimations were generated for all hazards of concern. These were generated by Hazus for the dam failure, earthquake, flood, and tsunami hazards. For the other hazards, loss estimates were generated by estimating loss as a percentage of exposed property value. The asset inventory was the same for all hazards and was generated in the Hazus model.

44 CFR Requirement	2017 Plan	2022 Plan Update
§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.	The plan provides a demographic overview oof the City that discusses land use and development, but this discussion is not specific to each hazard of concern.	There is a discussion on future development trends as they pertain to each hazard of concern. This discussion looks predominantly at the existing land use and the current regulatory environment that dictates this land use. This plan update also provides a city-wide view of development trends during the performance period of the 2017 plan.
§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.	Part 3 of the plan is the mitigation strategy section of the plan. The plan provides a set of action items to reduce risk from natural hazards through education and outreach programs, and to foster the development of partnerships. Further, the plan provides for the implementation of preventive activities, including programs that restrict and control development in areas subject to damage from natural hazards.	An action plan was developed (Chapter 19) via a facilitated process that included: • Risk ranking • Capability assessment • Action alternative review • Action selection • Action prioritization • Action category analysis.
§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.	The Planning Team developed five mitigation goals to avoid or reduce long-term vulnerabilities to hazards. These general principles clarify desired outcomes.	Chapter 17 identifies five goals and 16 objectives. Objectives were selected that meet multiple goals, and actions were selected and prioritized based on meeting multiple objectives. All of these planning components were new for this plan update.
§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.	Based on the risk assessment, goals and objectives, existing literature/resources, and input from participating entities, mitigation activities were identified for each hazard. Activities were 1) qualitatively evaluated against the goals and objectives, and other criteria; 2) identified as high, medium, or low priority; and 3) presented in a series of hazard-specific tables. The plan does not clearly identify other alternatives considered beyond those identified.	A hazard mitigation catalog was developed from which recommended actions were selected. A table in the action plan section analyzes each action by mitigation type to illustrate the range of actions selected.
§201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the program's requirements, as appropriate.	Actions FLD-9 to FLD-12 address issues associated with participation in the NFIP.	Section 6.4.7 includes an assessment of capabilities related to NFIP requirements. The action plan in Chapter 19 includes actions supporting continued compliance and good standing under the program.

44 CFR Requirement	2017 Plan	2022 Plan Update
§201.6(c)(3)(iii): [The mitigation strategy shall describe] 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.	Actions were ranked as high, medium or low based on a set of criteria established by the planning team. These rankings can be associated with prioritization.	Each of the recommended actions is prioritized using a qualitative methodology that looked at the objectives the project will meet, the timeline for completion, how the project will be funded, the impact of the project, the benefits of the project and the costs of the project. This prioritization scheme is detailed in Section 19.3.
§201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a 5-year cycle.	The plan includes the identification of a process for scheduling, monitoring, evaluating, and updating the mitigation plan within a 5-year cycle.	Chapter 20 includes a detailed plan maintenance strategy centered on an annual progress report by the City over the 5-year performance period of the plan. This is an entirely new strategy from the 2017 plan.
§201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	The plan maintenance section of the plan includes an “implementation through existing programs” section developed to meet this requirement	The detailed plan maintenance strategy in Chapter 20 includes the following: • Annual review and progress reporting • Defined role for steering committee • Plan update triggers • Plan incorporation guidelines • Strategy for continuing public involvement • Grant coordination protocol.
§201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	The plan maintenance section of the plan includes an “continued public involvement” section developed to meet this requirement	Chapter 20 details a comprehensive strategy for continuing public involvement
§201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commission, Tribal Council).	The plan maintenance section of the plan includes an “Plan Adoption” section developed to meet this requirement	Appendix E includes formal adoption documentation.

3. PLAN DEVELOPMENT APPROACH

3.1 FORMATION OF THE PLANNING TEAM

This update of the City of Long Beach Hazard Mitigation Plan was managed by the City of Long Beach Department of Disaster Preparedness and Emergency Communications. The City selected Tetra Tech to assist with development and implementation of the plan. The Tetra Tech lead planner reported directly to the City of Long Beach project manager. A small planning team was formed to lead the planning effort, made up of the following members:

- Reggie Harrison, Director of Disaster Preparedness, City of Long Beach
- Francisco Soto, Disaster Preparedness Officer, City of Long Beach
- Rebecca Lopez, Disaster Preparedness Analyst, City of Long Beach
- Rob Flaner, Tetra Tech, Project Manager
- Bart Spencer, Tetra Tech, Lead Project Planner
- Carol Baumann, Tetra Tech, Risk Assessment Lead
- Desmian Alexander, Tetra Tech, Planner
- Nate Stueve, Tetra Tech, Planner
- Megan Brotherton, Tetra Tech, Planner

The planning team coordinated regularly during the project to track plan development milestones and to set meeting content for the project steering committee.

3.2 DEFINING THE PLANNING AREA

The planning area consists of the entire area within the Long Beach city limits. Relevant planning area characteristics are described in Chapter 4. The risk assessment for this hazard mitigation plan is performed for the entire planning area and for each Zip code in the city. The defined planning area and Zip codes are shown in Figure 3-1.

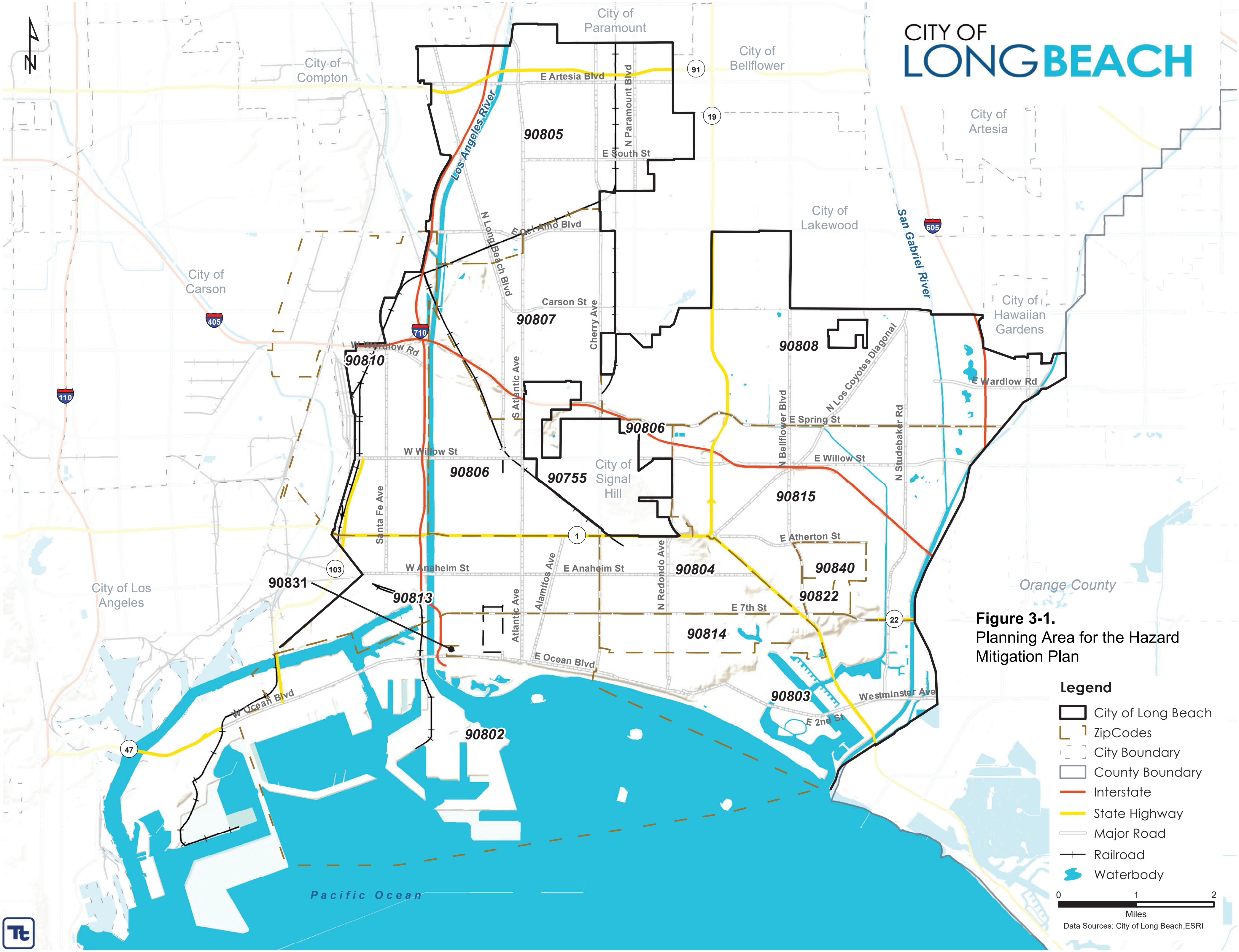

Figure 3-1.
Planning Area for the Hazard Mitigation Plan

3.3 THE STEERING COMMITTEE

A steering committee was formed to oversee the development of this plan. The members of this committee included key City of Long Beach staff, residents, and other stakeholders from within the planning area. The planning team assembled a list of candidates representing interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. The team confirmed a committee of 24 members at a planning kickoff meeting. Table 3-1 lists the Steering Committee members.

Table 3-1. Steering Committee Members

Name	Department, Agency, or Organization	Title
Reggie Harrison	Disaster Preparedness	Director
Francisco Soto	Disaster Preparedness	Disaster Preparedness Officer
Rebecca Lopez	Disaster Preparedness	Disaster Preparedness Analyst
Willie Owens	Public Works	Superintendent, Street Maintenance Division
Karl Zittel	Long Beach Airport	Airside Operations Manager
Joel Aguilar	Port of Long Beach	Deputy Chief Harbor Engineer
Steve Choi	Port of Long Beach	Director of Safety and Security
Belinda Ramirez	Port of Long Beach	Chief Information Security Officer
Eric Matusak	City of Long Beach Police	Lieutenant
David Khorram	Development Services	Superintendent of Building and Safety
Alison Spindler Ruiz	Development Services	Acting Planning Bureau Manager
Gina Casillas	Development Services	Planner
Jennifer Ly[a]	Development Services	Planner
Mark Berne	Parks, Recreation, and Marine	Safety Officer
Morgan Venter	Long Beach Water	Assistant Administrative Analyst
Gabriela Hurtado	Health and Human Services	Medical Countermeasures and Vaccine Preventable Disease Supervisor
Sandy Wedgeworth	Health and Human Services	Bureau Manager
James Farley	City of Long Beach Fire Department	Battalion Chief
Brian Lam	Energy Resources	Safety and Facilities Officer
Derek Law	Human Resources	City Safety Officer
Brian La Sota	Los Angeles County Office of Emergency Management	Emergency Management Coordinator
Allyson Joy	California State University Long Beach	Emergency Manager
Vincent Rodriguez	Technology and Innovation	Business Systems Specialist

a. Resigned from Steering Committee.

Leadership roles and ground rules were established during the Steering Committee's initial meeting on August 12, 2021. The Steering Committee met six times from August 2021 through June 2022. The planning team facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the planning process. All meetings were open to the public. Agendas and meeting summaries are provided in Appendix A.

3.4 COORDINATION WITH STAKEHOLDERS AND AGENCIES

Stakeholders are the individuals, departments, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan. Opportunities for involvement in the hazard mitigation planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to join the Steering Committee.
- **Agency Notifications**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - American Red Cross, Los Angeles Region
  - California Department of Water Resources
  - California Office of Emergency Services
  - FEMA Region 9
  - Los Angeles County Office of Emergency Management
  - The Port of Long Beach
  - The Long Beach Airport
  - Long Beach Water
  - California State University at Long Beach
  - U.S. Geological Survey Natural Hazard Risk Reduction Unit

  These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. Some of them supported the effort by attending meetings or providing feedback on issues.
- **Pre-Adoption Review**—All the agencies listed above were provided an opportunity to review and comment on this plan during the public comment period. Each agency was sent an e-mail message informing them that draft portions of the plan were available for review. In addition, the complete draft plan was sent to the California Governor’s Office of Emergency Services (Cal OES) and FEMA for a pre-adoption review to ensure program compliance.

Stakeholder contributions to the planning process included the following:

- FEMA Region 9 provided planning guidance and data from the National Flood Insurance Program
- The U.S. Geological Survey provided ShakeMaps for earthquake analyses
- The U.S. Army Corps of Engineers provided information on the Whittier Narrows Dam failure hazard
- Cal OES provided planning guidance and reviewed the draft and final versions of the plan

3.5 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.6(b)(3)). Chapter 6 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions, including an assessment of all City of Long Beach regulatory, technical, and financial capabilities to implement hazard mitigation actions. In addition, the following programs and plans can affect mitigation within the planning area:

- City of Long Beach Emergency Operations Plan
- Long Beach Municipal Code
- Long Beach Capital Improvement Program
- Long Beach General Plan
  - Air Quality Element, Part 1 and Part 2
  - Conservation Element
  - Historic Preservation Element
  - Housing Element
  - Land Use Element and Map
  - Local Coastal Program
  - Mobility Element
  - Noise Element
  - Open Space and Recreation Element
  - Public Safety Element
  - Seismic Safety Element
  - Urban Design Element
- 2017 Los Angeles County Fire Code (Title 32 of the Los Angeles County Code)
- Los Angeles County Code
- California Fire Code
- 2019 California Building Code
- California Clean Air Act
- California State Hazard Mitigation Plan (2018)
- Title 24 California Energy Code 2019 Edition
- California Green Building Standards 2019 Edition

3.6 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)).

3.6.1 Strategy

The strategy for involving the public in this plan, as approved by the Steering Committee, emphasized the following elements:

- Use social media, such as Instagram, Facebook, and Twitter.
- Post a public survey online to determine if the public's perception of risk and support of hazard mitigation has changed since the previous planning process.
- Provide opportunity for members of the public to review a draft version of the updated plan.
- Distribute a city-wide press release.

Media Releases and Social Media

The City of Long Beach released notices to local media with information about the planning process (see Figure 3-2). The City also conducted a social media campaign, providing information on Instagram about the hazard mitigation survey and other details relevant to the planning process (see Figure 3-3). As of March 2022, over 1,200 unique accounts were reached through these Instagram posts.

Public Survey

The hazard mitigation plan survey (see Figure 3-4) was developed by the planning team to be distributed to the public. The Steering Committee provided guidance for the questions and approved the final survey. The survey was used to gauge level of knowledge about preparedness activities to reduce risk and loss from the hazards.

This survey was designed to help identify areas vulnerable to one or more hazards. The answers to its questions helped guide the Steering Committee in determining planning actions and mitigation strategies. Surveys were distributed at public libraries, and a link to a web-based version of the survey was publicized. The complete survey and results can be found in Appendix A.

Public Review of the Draft Plan

A 14-day public comment period was initiated on {__DATE__}. During this comment period, the public was asked to review the proposed draft of the hazard mitigation plan and provide comments to the planning team by {__DATE__}. A virtual public meeting was held on {__DATE__} to explain the draft plan and receive comments. The public comment period was advertised in a press release to all media outlets and in a social media blast through outlets used by the City.

CITY OF LONG BEACH

SELECT LANGUAGE

PRESS RELEASE

City of Long Beach
Public Information Office
411 W. Ocean Blvd,
Long Beach, CA 90802

3/3/2022

FOR IMMEDIATE RELEASE Press Release # 30322-4

Subject: **Public Invited to Participate in City's 2022 Hazard Mitigation Plan Update**

Contact: Reginald Harrison
562.570.9460
Reginald.Harrison@longbeach.gov
Director
Disaster Preparedness and Emergency Communications

Long Beach, CA – The City of Long Beach is inviting members of the public to participate in the development of the City's updated Hazard Mitigation Plan. Residents are encouraged to share their knowledge of local hazards through a public survey, available online and in-person at all Long Beach Public Library locations, now through March 31, 2022.

"Preparing for natural disasters is a critical part of the City's recovery and long-term planning efforts," said Mayor Robert Garcia. "We encourage residents and business owners to complete this survey so we can assess the emergency preparedness needs of our community and best prepare for the future."

The survey, available in English, Spanish, Khmer and Tagalog, is designed to gauge the level of knowledge community members have about hazards that are most relevant to Long Beach and their preparedness for disasters. Information provided in the surveys will be used by the City's Department of Disaster Preparedness and Emergency Communications to support the development of strategies and actions to reduce the risk of death, injuries and property damage resulting from a disaster, which will be outlined in the updated Hazard Mitigation Plan.

Figure 3-2. City of Long Beach Hazard Mitigation Planning Process Press Release

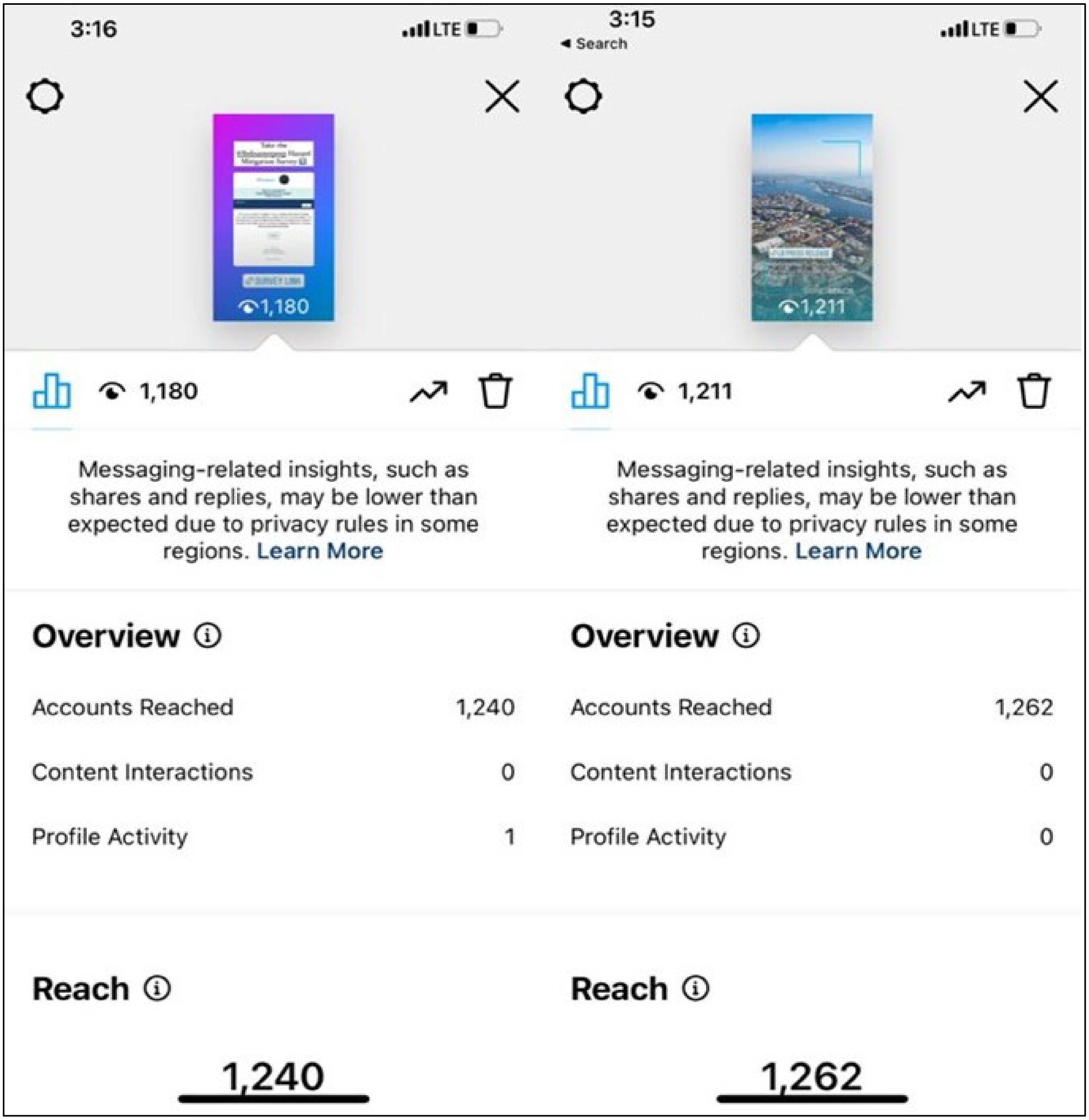

Figure 3-3. City of Long Beach Hazard Mitigation Plan Instagram Posts

Figure 3-4. Sample Page from City of Long Beach Public Survey

3.6.2 Public Involvement Results

Survey Results

Completed surveys were received from 102 respondents. Survey results were provided to the Steering Committee. Detailed results are provided in Appendix A. Key results are summarized as follows:

- Respondents reported experiencing or being affected by natural hazards as follows:
  - Earthquake, 66 percent
  - Drought, 43 percent
  - Climate change, 41 percent
  - Public health hazards, 41 percent
- Respondents reported experiencing or being affected by non-natural hazards as follows:
  - Civil unrest, 58 percent
  - Hazardous materials incident, 6 percent
  - Cyber events, 6 percent

- Overall results showed earthquake as the natural hazard of highest concern, followed by climate change, drought, severe weather, flood, tsunami, and flooding caused by dam failure.
- The internet was identified by the highest number of respondents as the best method to receive emergency preparedness information, followed by government sources, social media and TV.
- 20 percent of respondents stated that they have flood insurance and 37 percent stated that they have earthquake insurance.
- 84 percent indicated that disclosure of natural hazard information would have influenced their decision to purchase or move into a home.
- 67 percent of respondents stated that a property tax break would encourage them to spend money to protect their home against disasters; over 58 and 51 percent stated that insurance premium discounts or grant funding, respectively, would encourage them to do so.
- Over 81 percent of respondents either somewhat or strongly agreed that it is important to provide educational programs that encourage community members to take action to reduce their exposure and risks to natural hazards.
- If a natural disaster were to strike tomorrow, over 58 percent responded that they feel confident they know how to protect themselves during an earthquake.
- 56 percent keep an emergency kit with spare food and water for themselves and their family, but 35 percent are unsure where to go if they need to evacuate their home.
- The printed and online survey was available in English, Spanish, Khmer, and Tagalog, but all survey responses were completed in English.

Public Comment Period Results

{TO BE COMPLETED AFTER PUBLIC COMMENT PERIOD CLOSES.}

3.7 PLAN DEVELOPMENT MILESTONES

Table 3-2 summarizes important milestones in the planning process.

Table 3-2. Plan Development Milestones

Date	Event	Description	Attendance
2021			
	Request for proposals to develop hazard mitigation plan	• City releases a request for proposals to facilitate development of the City's hazard mitigation plan.	N/A
	Consultant selection	• City selects Tetra Tech as its technical support consultant	N/A
8/12	Kickoff meeting with consultant and City staff	• Makeup of Steering Committee • Planning overview • Public involvement strategy • Previous plan review • Action items and next steps	25
8/19	Steering Committee Meeting #1	• Project overview • Overview of Steering Committee process • Previous plan review homework • Public involvement strategy • Action items and next steps	25
9/9	Steering Committee Meeting #2	• Previous plan review • Hazards of concern • Goal setting • Public involvement strategy	24
10/14	Steering Committee Meeting #3	• Planning process • Hazard analysis • Public engagement	24
11/11	Steering Committee Meeting #4	• Planning process • Risk assessment • Public engagement	22
2022			
2/10	Steering Committee Meeting #5	• Planning process • Risk assessment • Public engagement	25
3/31	Public Outreach	• Public survey closed and results tabulated	N/A
6/3	City Review	• Draft plan submitted for internal City staff review	N/A
{?/?}	Steering Committee Meeting #5	• Draft plan review • Comments and questions	
{?/?}	Public Outreach	• Initiate 2-week final public comment period for review of the draft plan	
{?/?}	Public Meeting	• Describe and receive comments on the draft plan	
{?/?}	Public Outreach	• Closure of 2-week final public comment period	
{?/?}	Plan Review	• Plan sent to Cal OES for review and forwarded to FEMA for review	
{?/?}	Approval Pending Adoption	• Approval pending adoption received from FEMA Region 9	
{?/?}	Plan adopted by City Council	• Plan is finalized with the City Council's adoption	
{?/?}	Final Approval	• FEMA granted final approval of the adopted plan.	

4. CITY OF LONG BEACH PROFILE

The City of Long Beach lies on San Pedro Bay, east of the southern portion of Los Angeles and surrounding the city of Signal Hill. According to the U.S. Census, the city has a total area of 51.4 square miles—50.3 square miles of land and 1.1 square miles of water.

4.1 HISTORICAL OVERVIEW

The City of Long Beach was originally incorporated in 1888. After a short period of disincorporation, the City was reincorporated on December 3, 1897. Since 1921, Long Beach has been governed as a charter city, operating under a council-manager form of government.

The known history of the land that is today Long Beach dates back to the 1500s, when Native Americans occupied the area. Indigenous Californians made up villages and tribal affiliations with rich cultures and traditions. The Tongva tribe lived across what is now Southern California. In addition to two other major settlements in Long Beach, excavations on the Long Beach State University campus revealed that the Tongva tribe lived in Puvungna, a large village and important ceremonial site.

In 1542, Spanish explorer Juan Rodriguez Cabrillo officially claimed the land for Spain. In the late 1700s, the Spanish-owned land was rewarded to two Spanish soldiers and divided as Rancho Los Cerritos and Rancho Los Alamitos.

Developer William Wilmore built new homes and a school in the 1880s and named the area Wilmore City. Soon after, the growing population voted to incorporate the city as the City of Long Beach.

The discovery of oil in Long Beach and Signal Hill in 1921 triggered a rapid growth, with a million-dollar-per-month construction boom in downtown. The city also became a popular seaside resort and port city, with the boardwalk entertainment area known as The Pike attracting many visitors. Growth stalled, however, when a 6.4-magnitude earthquake in 1933 hit the downtown area, taking 120 lives and causing $50 million in damage. This disaster gave birth to the California Field Act of 1933, which requires earthquake-resistant design and construction for all public schools. Surviving buildings from that era have been designated in 16 historic districts, with around a hundred structures designated as historic landmarks (City of Long Beach Development Services n.d.).

Two waves of Cambodian refugees arrived in Long Beach in 1975 and 1981. As a result, the city has the largest population of Cambodians in the nation (United Cambodian Community 2020).

In 1975, Long Beach began a 25-year multi-billion dollar downtown redevelopment program, and the first Downtown Plan was adopted in 2000. The plan was updated and adopted in 2012. Between 2012 and 2019, nearly 3,500 new housing units and more than 200 businesses were established (League of Cities Planning Commissioner Acadamy n.d.).

4.2 PHYSICAL SETTING

4.2.1 Climate

Long Beach has a Mediterranean climate, with mild, dry summers and cool winters. Table 4-1 lists the historical monthly temperature and precipitation averages for the planning area. The warmest month of the year is August, with an average maximum temperature of 96 ºF; the coldest month of the year is December, with an average minimum temperature of 37 ºF. Temperatures vary up to 36 ºF between daytime and nighttime in summer, and about 46 ºF in winter. The annual average precipitation is 11.7 inches. Precipitation generally occurs from November through March with the winter months having the highest amount of rainfall. Precipitation during the summer is infrequent, and rainless periods of several months are common.

Table 4-1. Long Beach Historic Weather Averages and Records

Date	Temperatures				Average Precipitation
	Average Low	Average High	Record Low (Year)	Record High (Year)	
January	37°	83°	25° (1963)	93° (2003)	2.62”
February	39°	82°	33° (1965)	92° (2016)	2.71”
March	42°	84°	33° (1964)	98° (1988)	1.74”
April	46°	89°	38° (1975)	105° (1989)	0.67”
May	51°	89°	40° (1964)	104° (2004)	0.21”
June	55°	90°	47° (1967)	109° (1981)	0.05”
July	60°	94°	51° (1960)	109° (2018)	0.03”
August	60°	96°	55° (1978)	105° (1967)	0.06”
September	57°	99°	50° (1965)	111° (2010)	0.18”
October	50°	96°	39° (1972)	111° (1961)	0.38”
November	42°	88°	34° (1958)	101° (1966)	1.16”
December	37°	81°	28° (1990)	92° (1958)	1.85”

4.2.2 Soils

A 1903 federal soil survey identifies 17 soil types in the Los Angeles basin as listed in Table 4-2.

Table 4-2. Identified Soil Types in the Los Angeles Basin

Soil	% of Total Survey Area	Soil	% of Total Survey Area	Soil	% of Total Survey Area
Placentia sandy loam	18.1	**Oxnard loam**	5.4	**Maricopa gravelly loam**	1.6
Fresno sand	15.9	**Fresno fine sand**	4.4	**Galveston clay**	1.3
Santiago silt loam	10.8	**Maricopa sandy loam**	3.8	**Dune sand**	0.9
Fresno fine sandy loam	10.6	**Los Angeles sandy loam**	2.5	**River wash**	0.5
San Joaquin black adobe	10.3	**Fullerton sandy adobe**	1.9	**Peat**	0.3
Oxnard sand	9.8	**Sierra adobe**	1.9		

Source: Mesmer, 1903

4.2.3 Geology

California is divided into large geomorphic provinces defined by similar topography and geologic structure. The Los Angeles basin lies between the Transverse Ranges geomorphic province to the north and the Peninsular Ranges geomorphic province to the south. The boundary between the two provinces is generally the Santa Monica-Hollywood-Raymond fault system along the south edge of the Santa Monica Mountains (Bilodeau, et al. 2007).

The Transverse Ranges geomorphic province is characterized by east-west trending mountains, valleys, and faults that extend eastward from the Channel Islands to the eastern end of the San Bernardino Mountains. The most active faults in the Transverse Ranges are east-west trending faults. Dominant features within the City of Long Beach are small hills and mesas associated with the Newport-Inglewood structural zone (Randell, et al. 1983)

Northwest-trending faults and folds passing through the city generally parallel the active Newport-Inglewood structural zone, which is recognized as a groundwater barrier and a structural crude oil trap. Other buried faults and structures within the city include the Wilmington oil field structural complex, and the Wardlow-Airport, Richfield, and Los Alamitos faults. Major folds in the city include the buried Wilmington anticline and the Long Beach (Signal Hill) anticline, which lies along the Newport-Inglewood structural zone (Randell, et al. 1983).

The city lies rests on top of 14,000 feet of Miocene and Pliocene sediments and an undetermined thickness of pre-Miocene basement rocks. Pleistocene to recent surficial geologic units overlie these oil-producing zones. These rock units include the San Pedro Formation, terrace deposits, the Palos Verdes sand, alluvial and coastal deposits, and made land (Randell, et al. 1983).

Foundation-related geotechnical characteristics of surficial geologic units in the city vary from stiff to hard consistency and low compressibility in terrace deposits, to generally low-strength and moderate compressibility in made land (Randell, et al. 1983).

4.3 SENSITIVE RESOURCES

Long Beach is a coastal city and port that is home to several historic resources, with more than 100 historic landmarks and 18 historic districts. The Historic Preservation Element of the City's 2030 General Plan provides the following overview of the City's goals regarding historic resources (City of Long Beach 2010):

- Maintain and support a comprehensive, citywide historic preservation program to identify and protect Long Beach's historic, cultural, and archaeological resources
- Protect historic resources from demolition and inappropriate alterations through the use of the City's regulatory framework, technical assistance, and incentives
- Maintain and expand the inventory of historic resources in Long Beach
- Increase public awareness and appreciation of the City's history and historic, cultural, and archaeological resources.
- Integrate historic preservation policies into City's community development, economic development, and sustainable-city strategies.

4.4 ATTRACTIONS AND EDUCATION

As a full-service charter city, Long Beach is home to the Queen Mary, Aquarium of the Pacific, several museums and theaters, a highly rated school district, and Long Beach Airport. The City also has two historic ranchos, five hospitals, 12 libraries, five golf courses, 169 parks, miles of beaches, marinas, bike paths and a Bike Share program. Educational resources in the planning area include one public school district, several private schools, California State University Long Beach, and Long Beach City College.

4.5 DEVELOPMENT PROFILE

The City of Long Beach 2019 General Plan Land Use Element governs the types of land uses and development in the city. Current City land use policies define "PlaceTypes," which de-emphasize specific uses and focus on the form and character of Long Beach's neighborhoods and districts. Figure 4-1 shows designated PlaceTypes as of 2019.

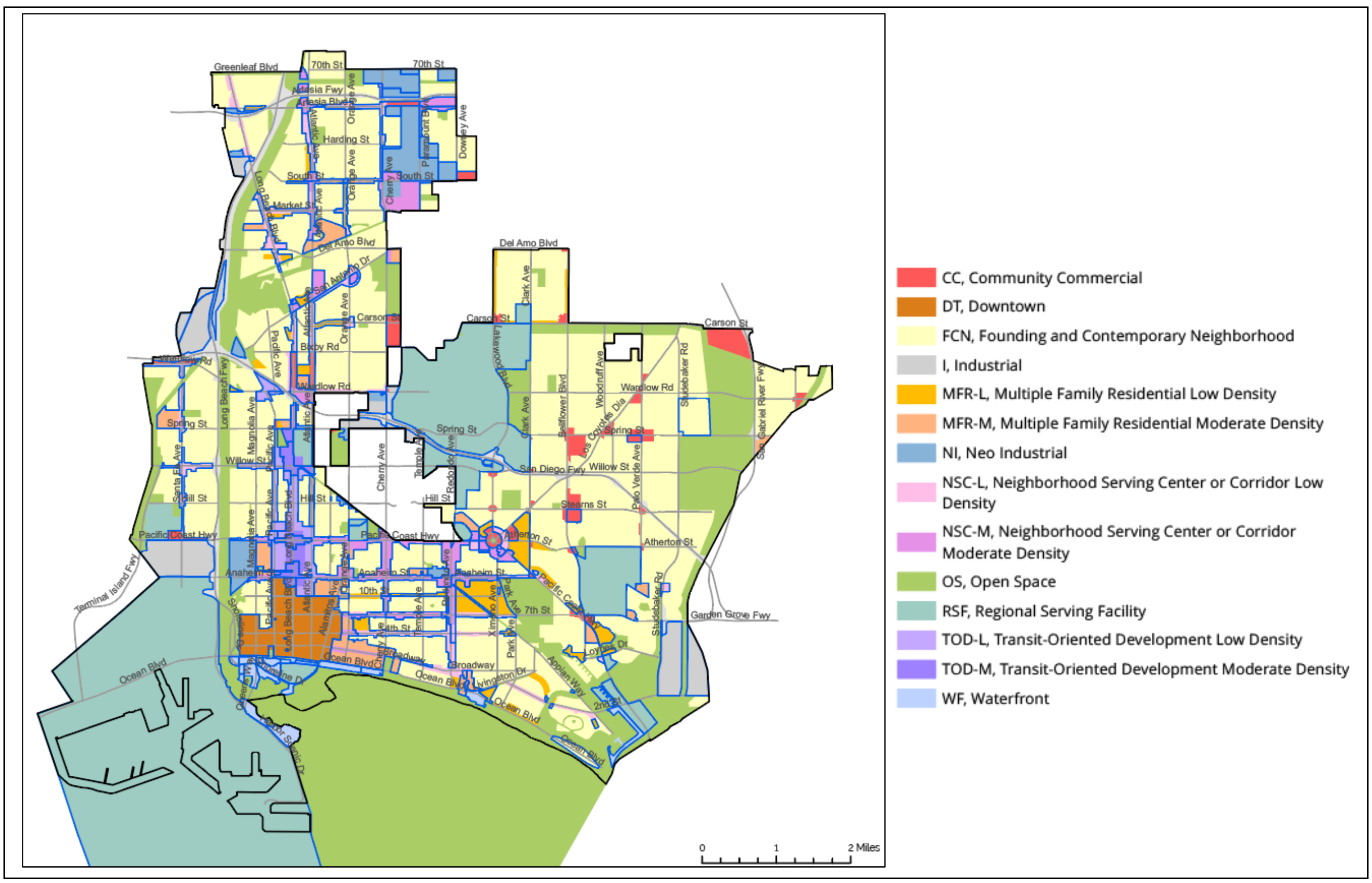

Figure 4-1. Designated PlaceTypes (Land Use)

4.5.1 Building Stock

According to assessor records, there are 113,000 buildings in the planning area, with a total replacement value of $98.5 billion. The City's housing stock, predominantly characterized by single-family detached dwelling units, makes up 93 percent of the total building stock. Table 4-3 shows the distribution of buildings by type of use.

Table 4-3. Distribution of Buildings in the Planning Area by Use Type

Use Type	Number of Buildings	Replacement Value
Residential	105,404	$48,879,255,980
Commercial	5,844	$33,482,966,822
Industrial	1,097	$5,361,522,792
Agricultural	18	$79,905,404
Religion	416	$1,625,212,393
Government	349	$2,526,813,786
Education	312	$6,530,102,851
Total	**113,440**	**$98,485,780,029**

4.5.2 Critical Facilities

Critical facilities—those that are essential to the health and welfare of the population (or have a potential to impact public health and welfare)—are especially important after a hazard event. The risk assessment for each hazard in this plan discusses that hazard's potential impact on critical facilities. For some hazards, potential damage to critical facilities was estimated using the Hazards U.S. (Hazus) computer model developed by FEMA. For this reason, the list of critical facilities was categorized using the following lifeline categories defined in the Hazus model:

- **Safety and Security**—Law Enforcement/Security, Search and Rescue, Fire Services, Government Service, Responder Safety, and Imminent Hazard Mitigation
- **Food, Water and Sheltering**—Evacuations, Schools, Food/Potable Water, Shelter, Durable Goods, Water Infrastructure, and Agriculture
- **Health and Medical**—Medical Care/Hospitals: Patient Movement, Public Health, Fatality Management, Health Care, and Supply Chain
- **Energy**—Power (Grid), Temporary Power and Fuel
- **Communications**—Infrastructure, Alerts, Warnings, Messages, 911 and Dispatch, Responder Communications and Financial Services
- **Transportation**—Highway/Roadway, Mass Transit, Railway, Long Beach Airport, Maritime and Pipeline, Port of Long Beach
- **Hazardous Materials**—Facilities, Hazardous Debris, Pollutants and Contaminants

General locations of critical facilities in the planning area are shown on Figure 4-2 and Figure 4-3. Table 4-4 summarizes the number of critical facilities by Hazus-defined category, based on the best data available on critical facilities at the time of this plan. This information is subject to change as new information about critical facilities becomes available during the performance period for this plan.

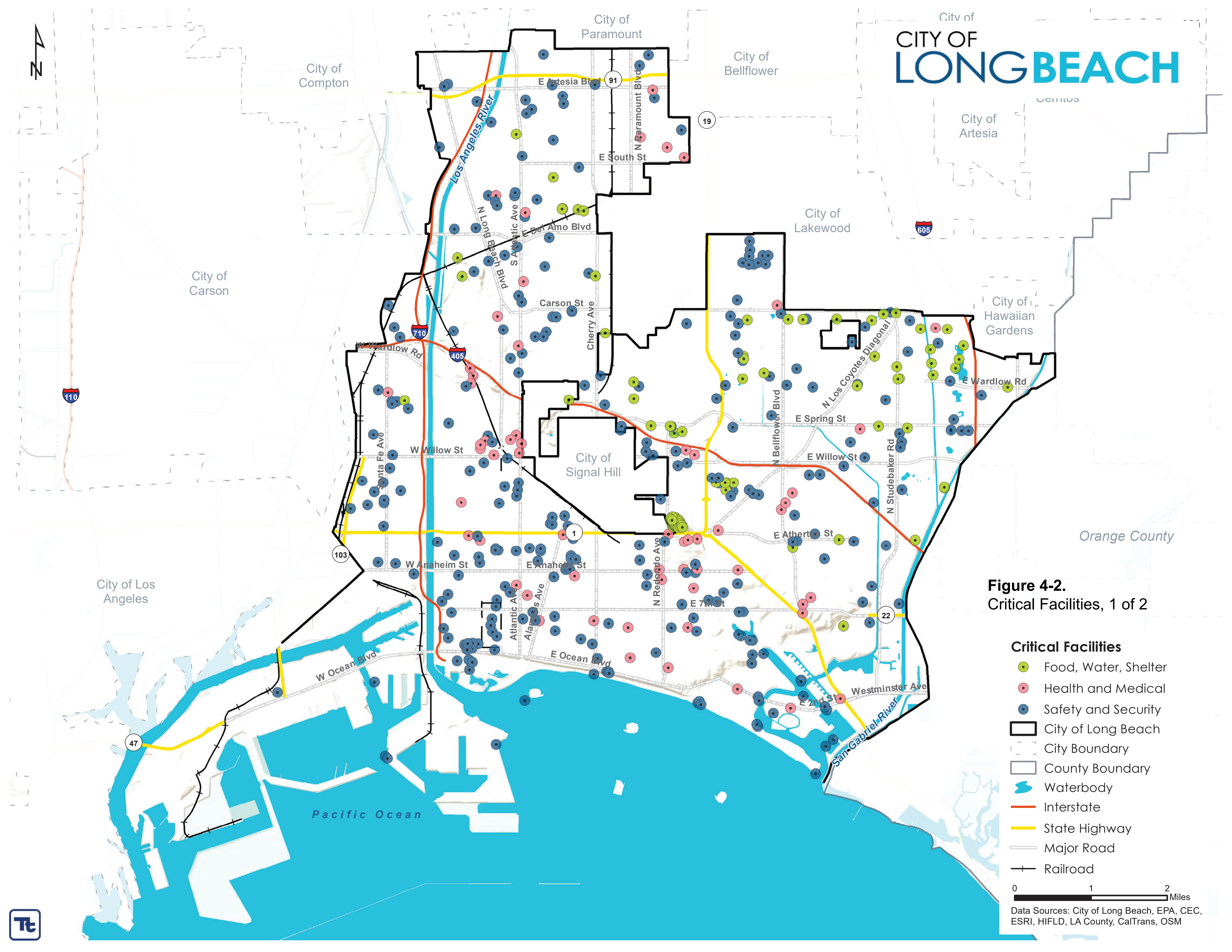

Figure 4-2.
Critical Facilities, 1 of 2

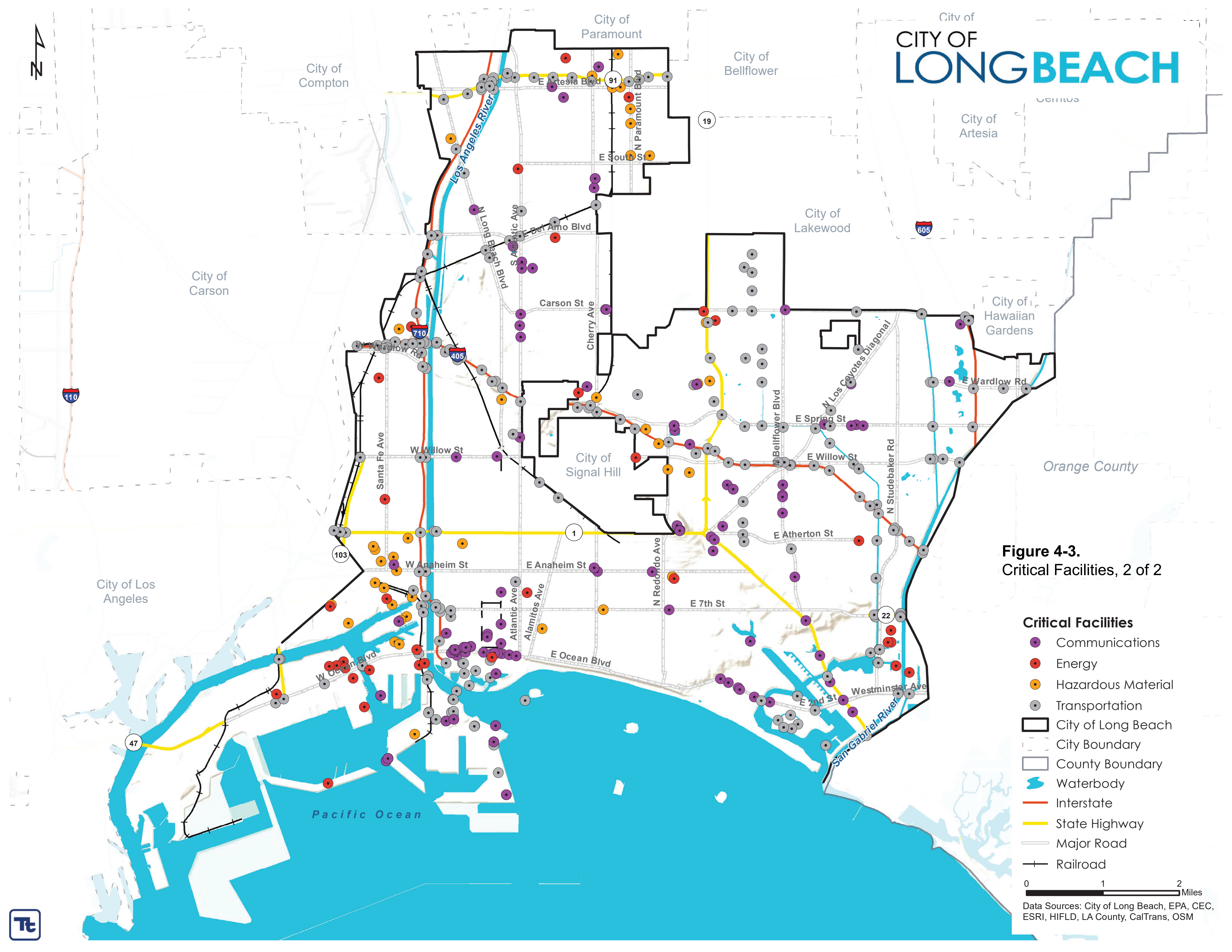

Figure 4-3.
Critical Facilities, 2 of 2

Table 4-4. Planning Area Critical Facilities

Category	Types of Facilities Included	Number in Planning Area
Communications	Banks	170
Energy	Electric substations, power plants	34
Food, Water & Sheltering	Affordable rental housing, water wells	81
Hazardous Materials	none identified	41
Health and Medical	Health care facilities, hospitals	60
Safety and Security	Correctional facilities, fire stations, government buildings, schools, sheriff station	301
Transportation	Bridges, Metrolink station	234
Total		**921**

4.5.3 Development Trends

Tracking previous and future growth in potential hazard areas provides an overview of increased exposure to a hazard within a community. Identifying previous and future development trends is achieved through a comprehensive review of permitting since completion of the previous plan and in anticipation of future development.

The City's General Plan governs land use decision and policymaking. This hazard mitigation plan will work together with the General Plan to support wise land use in the future by providing vital information on the risk associated with hazards within the city. The City of Long Beach will incorporate by reference the hazard mitigation plan in its General Plan. This will ensure that all future trends in development can be established with the benefits of the information on risk and vulnerability to hazards identified in this plan.

Most remaining vacant parcels in the City are relatively small or constrained by access issues or surrounding development. In addition, the City of Long Beach experienced a population increase of 0.2 percent from 2010 to 2020, as reported by the U.S. Census. Due to the constraints on developable land and the small increase in population, it can be reasonably assumed that Long Beach will experience a slower growth rate moving forward.

The General Plan Land Use Element directs the long-term physical development of the City by guiding use, form, and the characteristics of improvements on the land. Long Beach must address development pressures so that the needs of present and future residents and businesses are met most efficiently. The Land Use Element responds to many conditions the community can anticipate, including:

- Accommodating a population expected to reach 484,485 by 2040, a 3.2 percent increase from the 2012 population.
- Creating opportunity for 28,524 housing units to accommodate population growth and to address overcrowding of existing Long Beach households.

The City of Long Beach 2013-2021 Housing Element has identified sufficient residential sites, zoned at the appropriate densities, to accommodate the housing production and affordability targets of 7,048 units laid out in the Regional Housing Needs Assessment. In keeping with the principles and policies established in the City's 2010 Strategic Plan and Land Use Element of the General Plan, new high-density residential and mixed-use development is to be focused on key locations, allowing for the preservation of existing and stable neighborhoods. Appropriate and feasible housing densities are allowed, with appropriate development standards and design guidelines, along transit corridors, in the downtown and greater downtown areas, and in proximity to major employment and activity centers.

4.6 DEMOGRAPHIC PROFILE

4.6.1 Population Estimates

Current and Historical Population

The California Department of Finance estimated the population of Long Beach to be 460,682 as of January 1, 2022. Table 4-5 shows past population estimates from 2000 to 2020. The risk assessments included in this hazard mitigation plan, performed with FEMA's Hazus computer program, use a planning area population of 468,894, based on 2020 Census data by Zip code maintained by the City.

Table 4-5. Annual Population Data

Year	Population	Year	Population	Year	Population
2000	461,522	**2007**	465,017	**2014**	473,321
2001	463,689	**2008**	463,250	**2015**	474,439
2002	465,795	**2009**	462,211	**2016**	474,439
2003	469,713	**2010**	462,257	**2017**	474,530
2004	472,013	**2011**	465,184	**2018**	474,257
2005	470,781	**2012**	469,164	**2019**	472,870
2006	467,586	**2013**	471,330	**2020**	472,052

Source: California Department of Finance Historical Population Estimates

Between 2000 and 2020, California's population grew by 17.5 percent while the planning area's population increased by 2.3 percent. Figure 4-4 shows the planning area's annual population growth rates from 2000 to 2020 compared to those of the state. Long Beach has experienced negative growth in several years over that period.

Source: California Department of Finance Historical Population Estimates

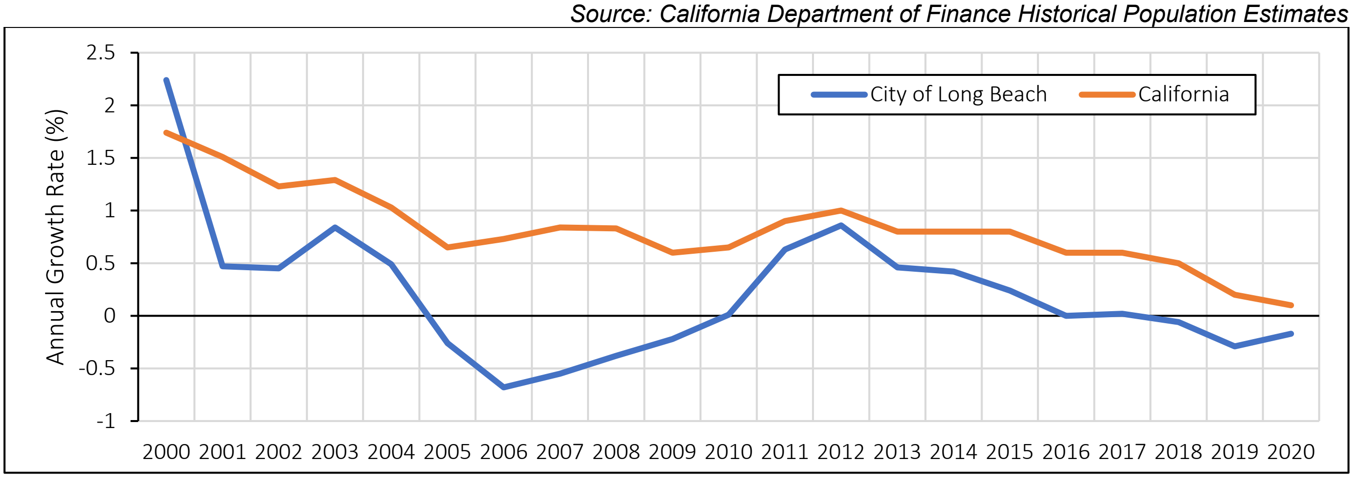

Figure 4-4. California and City of Long Beach Population Growth

Projected Future Population

According to population projections by the California Department of Finance, Los Angeles County's population should increase to 10,335,448 by 2040 (California Department of Finance, 2020). This represents a 0.76 percent increase from the 2020 population. This is in line with the County's 2035 General Plan Land Use Element.

4.6.2 Demographic Indicators for Social Vulnerability

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. People living near or below the poverty line, the elderly, individuals with disabilities, women, children, ethnic minorities, and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations.

Indicators from Census data are commonly used to assess social vulnerability. For the social vulnerability demographic profile component for this plan, the following indicators were selected:

- **Population Under 15 Years of Age—**Children, especially in the youngest age groups, often cannot protect themselves during a disaster because they lack the necessary resources, knowledge, or life experiences to effectively cope with the situation. Hazard mitigation planning needs to be tailored such that the community is prepared to ensure that children are safe during disaster events and that families with children have access to necessary information and tools.
- **Population Over 65 years of Age—**People 65 years old and older are likely to require financial support, transportation, medical care, or assistance with ordinary daily activities, especially during disasters. They are more likely to be vision, hearing, and/or mobility impaired, more likely to experience mental impairment or dementia, and more likely to live in assisted-living facilities where emergency preparedness is at the discretion of facility operators. Hazard mitigation needs to account for such needs.
- **People of Color—**Social and economic marginalization of certain racial and ethnic groups, including real estate discrimination, has resulted in greater vulnerability of these groups to all types of hazards. Based on data from a number of studies, African Americans, Native Americans, and populations of Asian, Pacific Islander, or Hispanic origin are likely to be more vulnerable than the broader community. Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during disaster events. Post-disaster recovery often exhibits cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. Hazard mitigation plans need to identify the spatial distribution of these population groups and direct resources to reduce their vulnerability to hazards.
- **Limited English-Speaking Households—**For populations with limited English proficiency, disaster communication may be difficult, especially in communities for whom translators and accurate translations of advisories may be scarce. Such households are likely to rely on relatives and local social networks (i.e., friends and neighbors) for information for preparing for a disaster event.

- **Persons with Disabilities—**Persons with disabilities or other access and functional needs are more likely to have difficulty responding to a hazard event than the general population. Family, neighbors, and local government are the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. Emergency managers need to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with access and functional needs allows emergency management personnel and first responders to anticipate the services needed by that population.
- **Families Below the Poverty Level—**Economically disadvantaged families have limited ability to absorb losses due to hazard impacts. Wealth enables families to absorb and recover from losses more quickly, due to insurance, savings, and often the availability of low-cost credit. People with lower incomes tend not to have access to these resources. At the same time, poorer families are likely to inhabit poor quality housing and reside in locations that are most vulnerable to hazard events. Economically disadvantaged neighborhoods are also likely to have relatively poor infrastructure and facilities, which exacerbate the disaster consequences for community members there.

These indicators were selected based on the availability of datasets at a small enough resolution to determine probable characteristics of populations within identified hazard areas. The following sections estimate the age, race, language, and disability indicators for the planning area; poverty levels are presented in Section 4.7.1.

Age Distribution

The overall age distribution for the planning area is shown in Figure 4-5. Based on the 2019 five-year estimates from the U.S. Census Bureau's American Community Survey, 12.6 percent of the planning area's population is 65 or older and 17.9 percent is 14 or younger.

Race, Ethnicity, Language

At the federal level, race and ethnicity in the United States are categorized separately. The most recent U.S. Census officially recognized six racial categories: White American, Black or African American, Native Americans and Alaska Native, Asian American, Native Hawaiian and Other Pacific Islander, and "two or more races." In completing the census form, each person is asked to choose from among these racial categories, so all Americans are included in the numbers reported for those categories.

Separately, the Census Bureau classifies respondents as "Hispanic or Latino" or "Not Hispanic or Latino," identifying Hispanic and Latino, the largest minority group in the nation, as an ethnicity not a race. Hispanic and Latino Americans have ethnic origins in a Spanish-speaking country or Brazil. Latin American countries are, like the United States, racially diverse. Consequently, no separate racial category exists for Hispanic and Latino Americans, as they do not constitute a race or a national group. However, the U.S. Supreme Court has unanimously held that, in law, the term "race" is not limited to Census designations but extends to all ethnicities, which may include Jewish, Arab, Italian, Hungarian, Laotian, Zulu, etc.

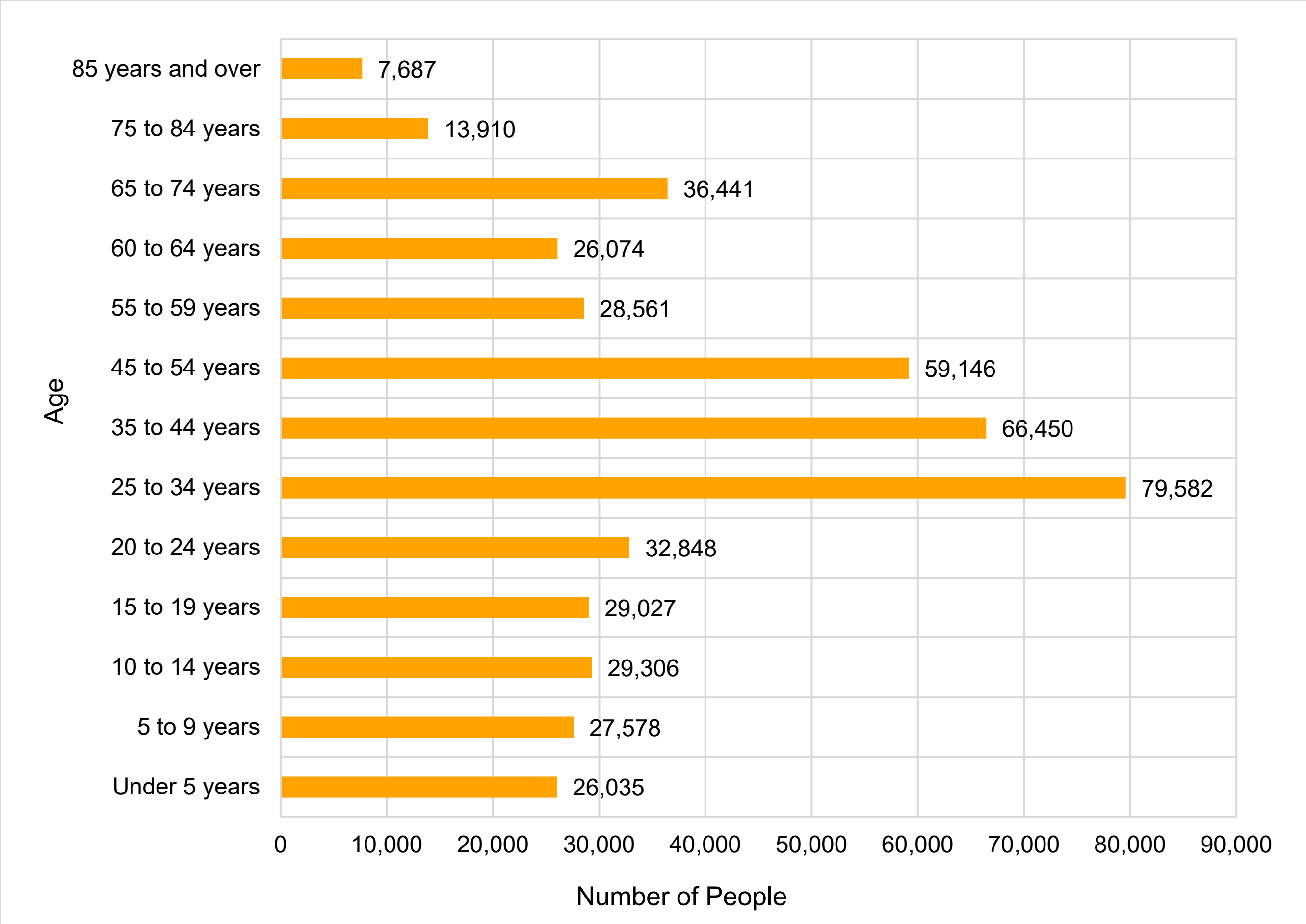

Figure 4-5. Long Beach Age Distribution

Any racial category may contain people of Hispanic or Latino ethnicity. For example: the White or European-American race category contains Non-Hispanic Whites and Hispanic Whites; the Black or African American category contains Non-Hispanic Blacks and Hispanic Blacks; the Asian-American category contains Non-Hispanic Asians and Hispanic Asians.

According to the 2019 5-year estimates from the U.S. Census Bureau's American Community Survey, the racial composition of Long Beach is 51.2 percent white. The City's next largest identified ethnic population is Asian at 13.1 percent. Other identified populations are Black or African American at 12.7 percent; 16.5 percent of the population identifies as "some other race." Figure 4-6 shows the racial distribution in the City. The census ethnicity breakdown shows that 42.6 percent of the Long Beach population is Hispanic or Latino ethnicity, compared to 18.4 percent nationwide. Figure 4-7 shows the ethnic distribution in the City.

The City of Long Beach has a 25.2 percent foreign-born population. Census data indicate that a little less than half of the population—46.1 percent—speak a language other than English at home, including 34 percent of the total population who speak Spanish at home; another 9.3 percent speak an Asian or Pacific Islander language at home. The census estimates that 16.3 percent of the residents speak English "less than very well."

Source: U.S. Census, 2019a

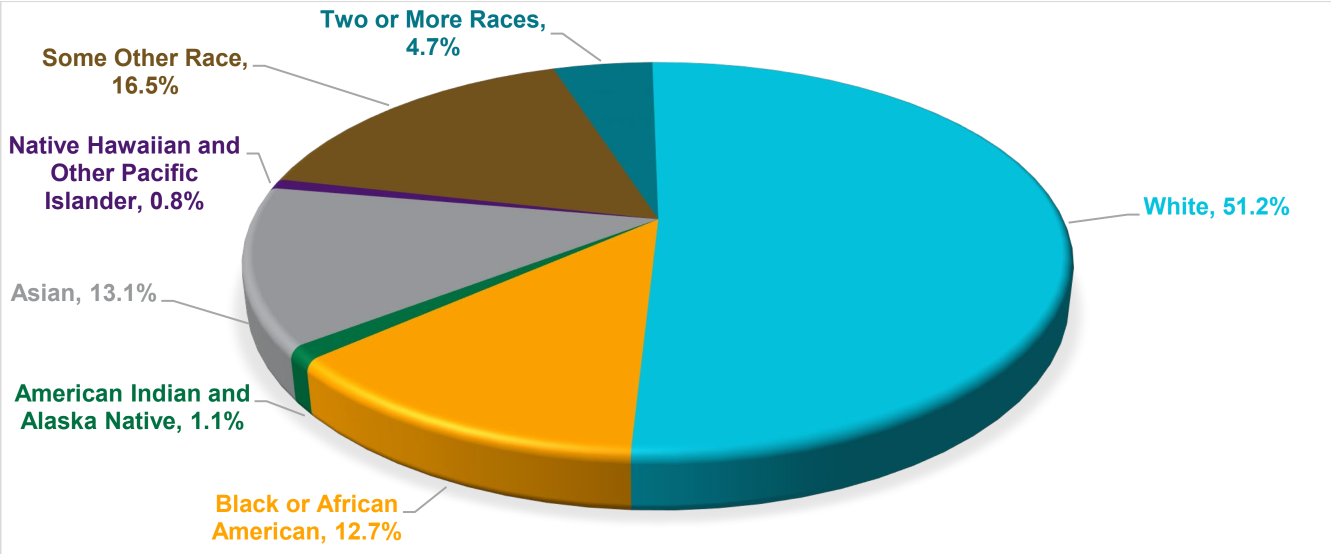

Figure 4-6. Long Beach Race Distribution

Source: U.S. Census, 2019a

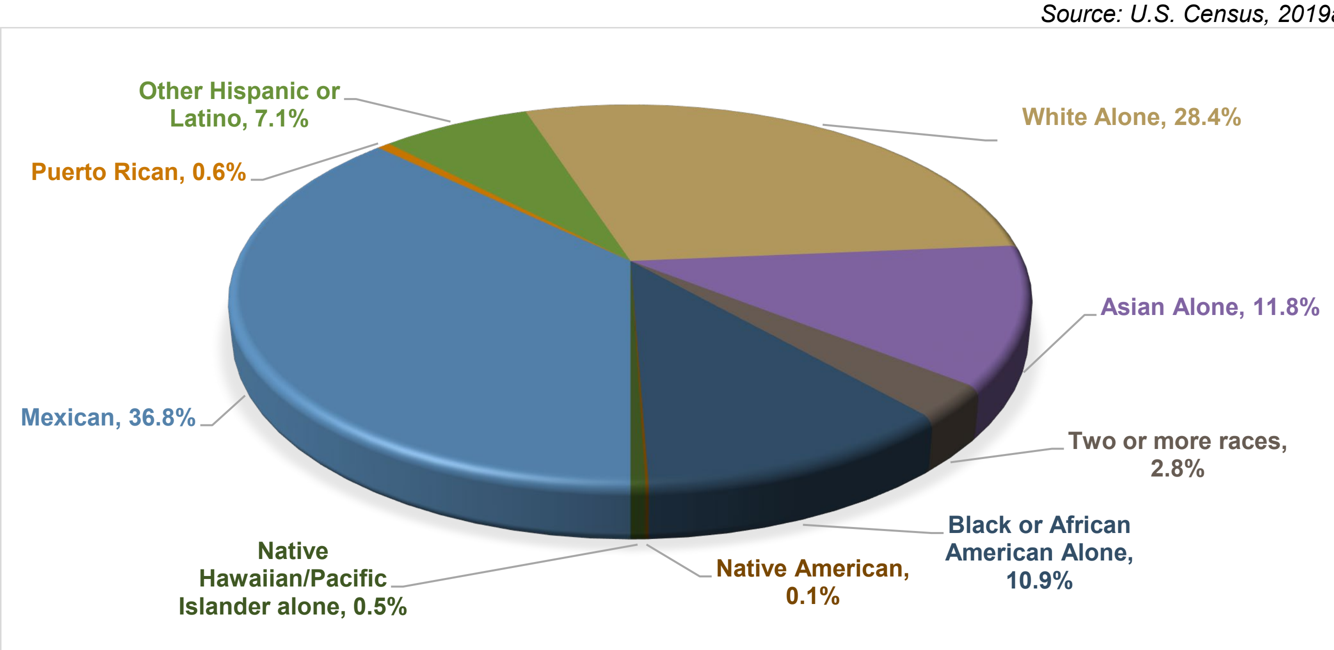

Figure 4-7. Long Beach Ethnicity Distribution

Individuals with Disabilities or Access and Functional Needs

According to the 2020 5-year American Community Survey, 10.1 percent of the residents in Long Beach live with one or more disabilities. This equates to 46,512 individuals. This includes 2.7 percent with a self-care disability, 2.2 percent with vision difficulty, 2.4 with hearing difficulty, 4.0 percent with cognitive difficulty, and 5.2 percent with ambulatory difficulty. Additional residents with access and functional needs may be unreported.

4.7 ECONOMY

4.7.1 Income

People living in California must be prepared financially to overcome the inherent risks associated with residing in the state. For the most part, individuals and families are expected to prepare for, respond to and recover from disasters with their personal resources. People with median and low incomes may not recover from a major disaster, and those who are economically disadvantaged likely will not recover. In urban areas such as Los Angeles County, the economically disadvantaged often live-in older homes or apartments that may not have been retrofitted or kept current with building codes that would mitigate some of the damage from the disasters prevalent to the area. Renters have no control over the strength and stability of the buildings they live in. All people have a great deal to lose during a disaster, but those economically disadvantaged will lose the most due to their inability to recover.

About 14.7 percent of persons in the planning area live at or below the federal poverty level, compared to 13.4 percent in Los Angeles County and 11.9 percent statewide. The 2021 federal poverty level is $26,500 for a family of four, $21,960 for a family of three, $17,420 for a family of two, and $12,880 for one person. The risk assessment for this hazard mitigation plan identifies “very low income” families that live in mapped hazard areas, defined by U.S. Department of Housing and Urban Development (HUD) as families earning 50 percent or less of the median family income. The average number of persons per household in Long Beach is 2.74, so the risk assessment uses 2021 HUD median family income for a family of three. In Los Angeles County, this equates to $53,200.

4.7.2 Industry, Businesses, and Institutions

Figure 4-8 shows the breakdown of employment sectors in the planning area. The following is an alphabetical list of the principal employers in the planning area (City of Long Beach 2021).

- Aquarium of the Pacific
- Boeing
- California State University Long Beach
- Frontier Communications
- Long Beach City College
- Long Beach Convention Center
- Long Beach Memorial Hospital
- Long Beach St. Mary’s Hospital
- Long Beach Transit
- Long Beach Unified School District
- Metropolitan Transportation Authority (Metro Rail/Blue Line)
- Port of Long Beach
- Long Beach Airport
- Southern California Edison

4.7.3 Employment Trends

According to the 5-year American Community Survey, 246,500 people, or 66 percent of the City of Long Beach’s population 16 years old or older, are in the labor force. Of the working-age population, 71.1 percent of men and 61.1 percent of women are in the labor force.

Source: (American Community Survey 5-Year Estimates 2020)

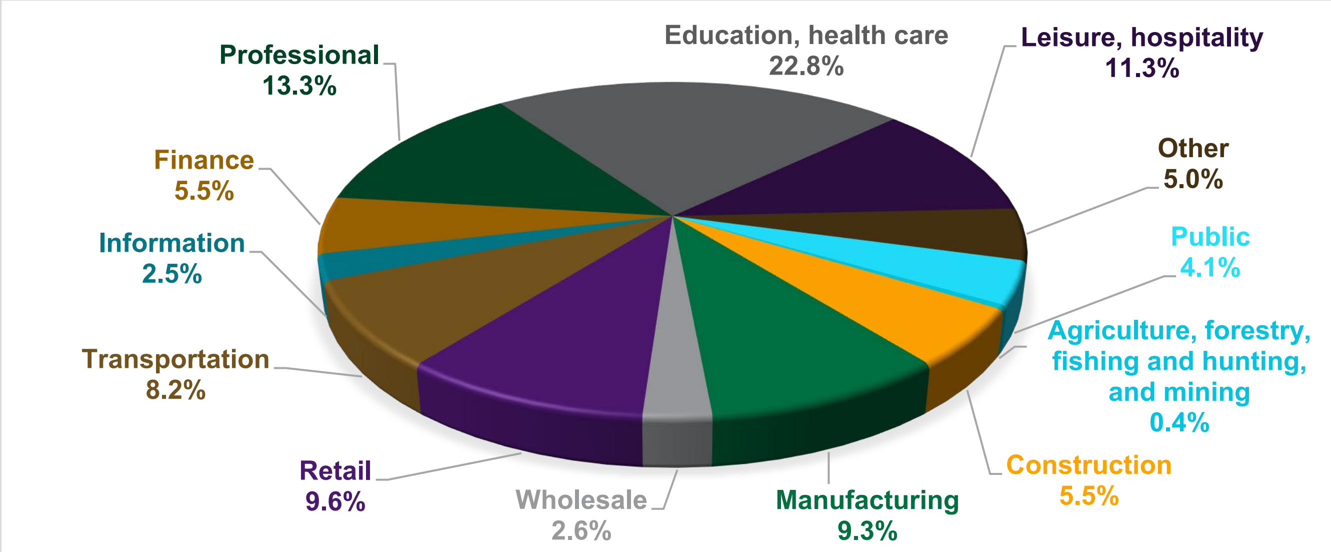

Figure 4-8. Long Beach Principal Employment Sectors

Figure 4-9 compares unemployment rates for California, Los Angeles County, and the City of Long Beach from 2010 through 2020. The data represents mid-year (June) samples for unemployment provided by the U.S. Department of Labor Bureau of Labor Statistics and 1-year estimates by the U.S. Census Bureau. The City of Long Beach unemployment rate fell from 13.7 percent in 2010 to 4.7 percent in 2019 but increased sharply in 2020 with the Covid-19 pandemic. In several years, the City unemployment rate has been slightly higher than the state and county.

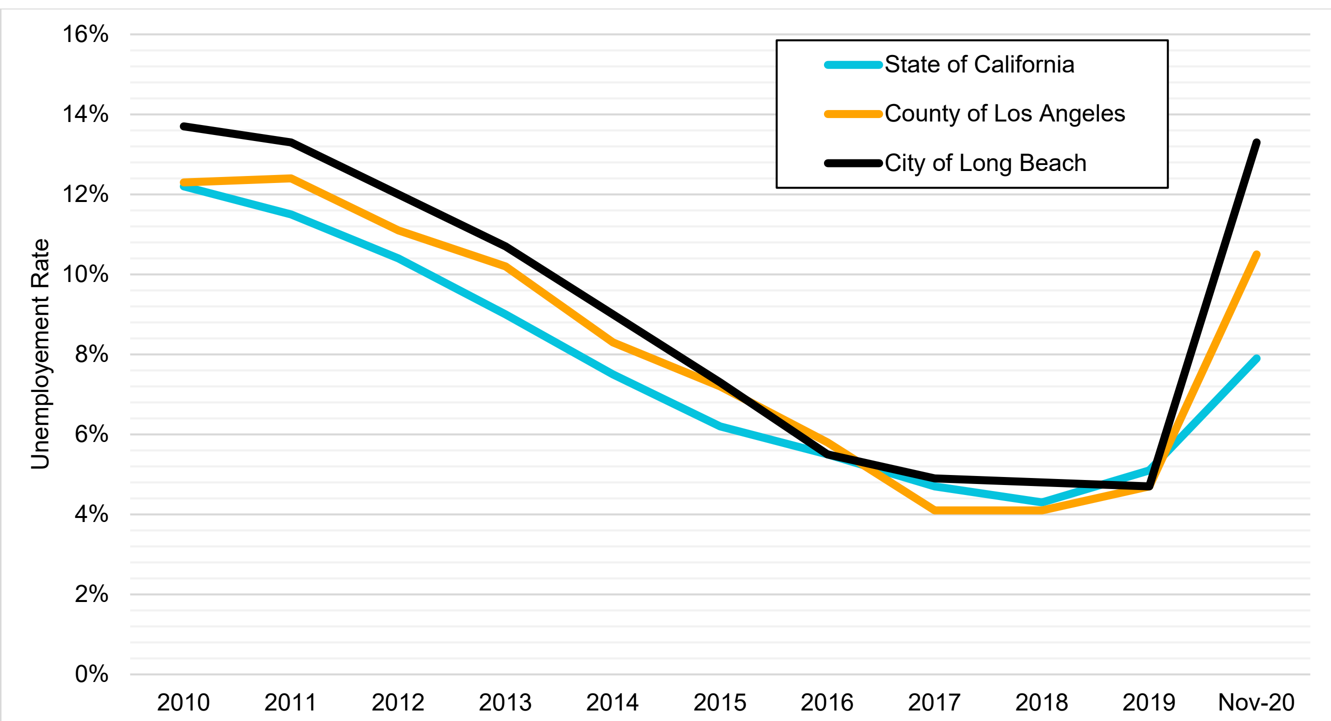

Figure 4-9. 10-Year Unemployment Rates for Long Beach, California, and Los Angeles County

The 2019 U.S. Census Bureau estimates 32.8 percent of the City's population work and live in Long Beach; 67.2 percent commute to other places. In 2019, 48.3 percent of Long Beach commuters spent more than 30 minutes to travel to work.

4.8 HEALTH AND HUMAN SERVICES

The City of Long Beach has operated its own public health department for more than 100 years. It is one of only three city-run health departments in California. The Long Beach Department of Health and Human Services is responsible for public health in the City of Long Beach and coordinates with the Los Angeles County Department of Public Health (LAC DPH) during significant events such as a public health emergency.

5. HAZARDS ADDRESSED IN THIS PLAN

5.1 MAJOR PAST HAZARD EVENTS

Federal disaster declarations are typically issued for hazard events that cause more damage than state and local governments can respond to and recover from without federal assistance. They put local response, reimbursement, and recovery programs into motion to assist public entities' disaster victims. The City has been included in disaster declarations for Los Angeles County. Since 1969, federal disaster declarations have been issued for 30 disasters affecting Los Angeles County, as listed in Table 5-1. While these events may not have directly impacted the City of Long Beach, they are an indication of the frequency and types of hazard events typical for the geographic region.

Table 5-1. Federal Disaster Declarations for Los Angeles County

Type of Event	FEMA Disaster DR#	Incident Period
Wildfires	4569	September 4- November 17, 2020
COVID-19 Pandemic	4482	January 20, 2020 - continuing
Wildfires, Flooding, Mudflows, and Debris Flows	4353	December 4, 2017-January 19, 2018
Severe Winter Storms, Flooding, and Mudslides	4305	January 18-23, 2017
Severe Winter Storms, Flooding, and Debris and Mud Flows	1884	January 17-February 6, 2010
Wildfires	1810	November 13-28, 2008
Wildfires, Flooding, Mud Flows, and Debris Flows	1731	October 21, 2007-March 31, 2008
Severe Freeze	1689	January 11-17, 2007
Severe Storms, Flooding, Landslides, and Mud and Debris Flows	1585	February 16-23, 2005
Severe Storms, Flooding, Debris Flows, and Mudslides	1577	December 27, 2004-January 11, 2005
Wildfires, Flooding, Mud Flow and Debris Flow	1498	October 21, 2003-March 31, 2004
Severe Winter Storms and Flooding	1203	February 2-April 30, 1998
Severe Winter Storms, Flooding Landslides, Mud Flow	1046	February 13-April 19, 1995
Severe Winter Storms, Flooding, Landslides, Mud Flows	1044	January 3-February 10, 1995
Northridge Earthquake	1008	January 17-November 30, 1994
Fires, Mud/Landslides, Flooding, Soil Erosion	1005	October 26, 1993-April 22, 1994
Severe Winter Storm, Mud and Landslides, and Flooding	979	January 5-March 20, 1993
Fire During a Period of Civil Unrest	942	April 29-May 28, 1992
Rain/Snow/Windstorms, Flooding, Mudslides	935	February 10-18, 1992
Severe Freeze	894	December 19, 1990-January 3, 1991
Fires	872	June 26-July3, 1990
Severe Storms, High Tides and Flooding	812	January 17-22, 1988
Earthquake and Aftershocks	799	October 1-November 20, 1987

Type of Event	FEMA Disaster DR#	Incident Period
Coastal Storms, Floods, Slides and Tornados	677	January 21-March 30, 1983
Brush and Timber Fires	635	November 27, 1980
Severe Storms, Mudslides and Flooding	615	January 8, 1980
Coastal Storms, Mudslides and Flooding	547	February 15, 1978
San Fernando Earthquake	299	February 9, 1971
Forest and Brush Fires	295	September 29, 1970
Severe Storms and Flooding	253	January 26, 1969

Many natural hazard events do not trigger federal disaster declarations but have significant impacts on the communities they affect. These events are also important to consider in establishing recurrence intervals for hazards of concern.

5.2 IDENTIFIED HAZARDS OF CONCERN

The Steering Committee considered the full range of natural hazards that could affect the planning area and then selected those that present the greatest concern for risk assessment in this plan. The process incorporated a review of state and local hazard planning documents as well as information on the frequency of, magnitude of, and costs associated with hazards that have struck the planning area or could do so. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Based on the review, this plan includes risk assessments for the hazards of concern listed in Table 5-2.

Table 5-2. Hazards Addressed in This Hazard Mitigation Plan

Hazards of Concern	Hazards of Interest
• Earthquake • Severe Weather • Flood • Dam Failure • Tsunami • Climate Change (sea-level rise) • Drought	• Civil Unrest • Cybersecurity Threats • Hazardous Materials • Methane Gas Eruptions • Public Health Incidents: Pandemics, Epidemics • Terrorism

Risk assessments for each hazard of concern are described in hazard-specific chapters in Part 2 of this volume of the hazard mitigation plan. The hazards are presented in order of risk ranking, which is described in Chapter 16. An additional chapter provides a profile of the other "hazards of interest" listed in Table 5-2. These are defined as hazards that may impact the planning area but whose risk is difficult to quantify due to a lack of data or well-established assessment parameters. That chapter provides a profile of these hazards but does not assess them to the same level of detail as the primary hazards of concern. The hazards of interest are not included in the risk ranking for this plan. Hazards not addressed at all in this plan are considered to have no direct or indirect impacts on the City.

6. REGULATIONS AND PROGRAMS

Existing laws, ordinances, plans and programs at the federal and state level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). This chapter presents the relevant information for laws, plans and programs at the federal, state, and local levels.

6.1 FEDERAL AND STATE

Federal and state programs have been identified that may interface with the mitigation actions developed for this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan. State and federal regulations and programs that need to be considered in hazard mitigation are constantly evolving. For this plan, a review was performed to determine which regulations and programs are currently most relevant to hazard mitigation planning. The findings are summarized in Table 6-1 and Table 6-2. Short descriptions of each program are provided in Appendix B.

6.2 CITY OF LONG BEACH

This section identifies local programs, plans, and studies that can support or enhance the core capabilities of the City. Each can be leveraged by the City to support or enhance the implementation of mitigation actions identified in this plan. These programs, plans and studies are hereby integrated into this hazard mitigation plan by reference—mitigation actions identified in any of them are considered to be fully integrated into this hazard mitigation plan by reference.

6.2.1 General Plan

The Long Beach General Plan is a policy document that establishes the goals, policies, and directions the City will take to achieve the vision of the community and guide future development. It is both a strategic and long-term document, broad in scope and specific in nature. It is implemented by decisions that direct the allocation of public resources and that shape private development, which affects the lives of the residents and business community.

Table 6-1. Summary of Relevant Federal Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
Americans with Disabilities Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Civil Rights Act of 1964	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Clean Water Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Community Development Block Grant Disaster Resilience Program	Action Plan Funding	This is a potential alternative source of funding for actions identified in this plan.
Community Rating System	Flood Hazard	This voluntary program encourages floodplain management activities that exceed the minimum National Flood Insurance Program requirements.
Disaster Mitigation Act	Hazard Mitigation Planning	This is the current federal legislation addressing hazard mitigation planning.
Emergency Relief for Federally Owned Roads Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Emergency Watershed Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Endangered Species Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Federal Energy Regulatory Commission Dam Safety Program	Dam Failure Hazard	This program cooperates with a large number of federal and state agencies to ensure and promote dam safety.
National Dam Safety Act	Dam Failure Hazard	This act requires a periodic engineering analysis of most dams in the country
National Environmental Policy Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
National Flood Insurance Program	Flood Hazard	This program makes federally backed flood insurance available to homeowners, renters, and business owners in exchange for communities enacting floodplain regulations
National Incident Management System	Action Plan Development	Adoption of this system for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards is a prerequisite for federal preparedness grants and awards
Presidential Executive Order 11988 (Floodplain Management)	Flood Hazard	This order requires federal agencies to avoid long and short-term adverse impacts associated with modification of floodplains
Presidential Executive Order 11990 (Protection of Wetlands)	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable presidential executive orders.
U.S. Army Corps of Engineers Dam Safety Program	Dam Failure Hazard	This program is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act.
U.S. Army Corps of Engineers Flood Hazard Management	Flood Hazard, Action Plan Implementation, Action Plan Funding	The Corps of Engineers offers multiple funding and technical assistance programs available for flood hazard mitigation actions

Table 6-2. Summary of Relevant State Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
AB 32: The California Global Warming Solutions Act	Action Plan Development	This act establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020
AB 70: Flood Liability	Flood Hazard	A city or county may be required to partially compensate for property damage caused by a flood if it unreasonably approves new development in areas protected by a state flood control project
AB 162: Flood Planning	Flood Hazard	Cities and counties must address flood-related matters in the land use, conservation, and safety and housing elements of their general plans.
AB 747: General Plans—Safety Element	Hazard Mitigation Planning	The safety elements of cities' and counties' general plans must address evacuation routes and include any new information on flood and fire hazards and climate adaptation and resiliency strategies.
AB 2140: General Plans—Safety Element	Hazard Mitigation Planning	This bill enables state and federal disaster assistance and mitigation funding to communities with compliant hazard mitigation plans.
AB 2800: Climate Change—Infrastructure Planning	Action Plan Development	This act requires state agencies to take into account the impacts of climate change when developing state infrastructure.
Alquist-Priolo Earthquake Fault Zoning Act	Earthquake Hazard	This act restricts construction of buildings used for human occupancy on the surface trace of active faults.
California Coastal Management Program	Flood, Landslide, Tsunami and Wildfire Hazards	This program requires coastal communities to prepare coastal plans and requires that new development minimize risks to life and property in areas of high geologic, flood, and fire hazard.
California Department of Water Resources	Flood Hazard	This state department is the state coordinating agency for floodplain management.
California Division of Safety of Dams	Dam Failure Hazard	This division monitors the dam safety program at the state level and maintains a working list of dams in the state.
California Environmental Quality Act	Action Plan Implementation	This act establishes a protocol of analysis and public disclosure of the potential environmental impacts of development projects. Any project action identified in this plan will seek full California Environmental Quality Act compliance upon implementation.
California General Planning Law	Hazard Mitigation Planning	This law requires every county and city to adopt a comprehensive long-range plan for community development, and related laws call for integration of hazard mitigation plans with general plans.
California Multi-Hazard Mitigation Plan	Hazard Mitigation Planning	Local hazard mitigation plans must be consistent with their state's hazard mitigation plan.
California Residential Mitigation Program	Earthquake Hazard	This program helps homeowners with seismic retrofits to lessen the potential for damage to their houses during an earthquake.
California State Building Code	Action Plan Implementation	Local communities must adopt and enforce building codes, which include measures to improve buildings' ability to withstand hazard events.
Disadvantaged and Low-Income Communities Investments	Action Plan Funding	This is a potential source of funding for actions located in disadvantaged or low-income communities.
Division of the State Architect's AB 300 List of Seismically At-Risk Schools	Earthquake Hazard, Action Plan Development	The Division of the State Architect recommends that local school districts conduct detailed seismic evaluations of seismically at-risk schools identified in the inventory that was required by AB 300.
Governor's Executive Order S-13-08 (Climate Impacts)	Action Plan Implementation	This order includes guidance on planning for sea-level rise in designated coastal and floodplain areas for new projects.
Senate Bill 92: Public Resources Portion of Biennial Budget Bill	Dam Failure Hazard	This bill requires dams (except for low-risk dams) to have emergency action plans that are updated every 10 years and inundation maps updated every 10 years, or sooner if specific circumstances change.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
Senate Bill 97: Guidelines for Greenhouse Gas Emissions	Action Plan Implementation	This bill establishes that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for California Environmental Quality Act analysis.
Senate Bill 99: General Plans: Safety Element: Emergency Evacuation Routes	Action Plan Implementation	This bill requires the safety element must include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes.
Senate Bill 379: General Plans: Safety Element—Climate Adaptation	Action Plan Implementation	This bill requires cities and counties to include climate adaptation and resiliency strategies in the safety element of their general plans.
Senate Bill 1000: General Plan Amendments—Safety and Environmental Justice Elements	Action Plan Implementation	Under this bill, review and revision of general plan safety elements are required to address only flooding and fires (not climate adaptation and resilience), and environmental justice is required to be included in general plans.
Senate Bill 1035: Fire, Flood, and Adaptation Safety Element Updates	Action Plan Implementation	Clarifies that revisions to the Safety Element to address fire hazards, flood hazards, and climate adaptation and resilience strategies all must occur upon each revision to a Housing Element or Local Hazard Mitigation Program.
Standardized Emergency Management System	Action Plan Implementation	Local governments must use this system to be eligible for state funding of response-related personnel costs.

The General Plan is prepared and maintained by the City's Department of Development Services and must comply with the California General Planning Law, which specific planning elements that are required or optional. The Long Beach General Plan consists of the following elements:

- Air Quality
- Conservation
- General Plan Maps and Descriptions
- Historic Preservation Element
- Housing Element
- Land Use Element and Map
- Local Coastal Program
- Mobility Element
  - Bicycle Master Plan
  - CX3 Pedestrian Plan
  - Downtown and TOD Pedestrian Master Plan
- Noise
- Open Space and Recreation Element
- Public Safety
- Seismic Safety
- Urban Design Element

6.2.2 Title 21 and Title 22—Zoning

The City of Long Beach's Zoning Code is found in Title 21 and Title 22 of the City's codes. Title 22, the Transitional Zoning Code, was adopted by the Long Beach City Council in 2020. Title 22 was established to facilitate a substantial update to make the City's Zoning Regulations consistent with the City's 2019 General Plan Update, as required by state law. As the City transitions from Title 21 to Title 22, all regulations contained within Title 22 apply to zones established in Title 22.

In the case of a regulation not specified in Title 22, the regulations contained in Title 21 continue to apply. If uncertainty arises concerning the content or application of Title 22, the City's zoning administrator is authorized to determine which provisions of either Title 21 or Title 22 are applicable. The Classification of Use procedure, which is set forth in Chapter 21.25 of Title 21, shall be used to resolve discrepancies.

6.2.3 Multi-Hazard Related Activities of City Departments

Several city departments perform activities and collect data related to hazard mitigation issues. The following is a summary of key city activities related to hazard and risk management:

- Development Services Department
  - Oversees building permits, plan check status, building codes, building inspections, zoning information, land use entitlements
- Department of Disaster Preparedness and Emergency Communications
  - Supports centralized planning, coordination and management of disaster preparedness, mitigation, response and recovery (Disaster Preparedness Bureau)
  - Helps protect lives and property through effective communications (Emergency Communications Center)
- Public Works Department
  - Provides repair, rehabilitation and general upkeep of city streets, public trees, sidewalks, and city structures. Provides emergency support services throughout the city
- Water Department
  - Provides drinking water throughout the city and manages distribution pipelines and fire hydrants
  - Provides wastewater collection service throughout the city and manages sewer infrastructure

6.2.4 Consolidated Plan

As a jurisdiction that receives U.S. Department of Housing and Urban Development (HUD) funds for housing and community development activities, the City of Long Beach is required to prepare a comprehensive five-year plan for using those funds. This "consolidated plan" is developed with the goals of securing decent housing, providing a suitable living environment, and expanding economic opportunities. An annual action plan is prepared to show how the HUD funds will be expended during the year in a way that addresses the needs, priorities and objectives contained in the City's Consolidated Plan.

The current consolidated plan covers the five-year period ending September 30, 2022. It describes the City's plan to create a viable urban community that offers decent affordable housing, a suitable living environment and expanding economic opportunities, especially for low and moderate income persons. The activities the City will undertake to achieve its stated objectives are described in this document, which was approved by the Long Beach City Council and HUD in 2017. Development of the next five-year consolidated plan is currently underway.

The City of Long Beach is an entitlement jurisdiction for Community Development Block Grant (CDBG) HOME Investment Partnership Program, and Emergency Solutions Grant (ESG) funds. In response to combating the effects of COVID-19, HUD allocated special CDBG funds for Entitlement Entities. This allocation was authorized in the 2020 Coronavirus Aid, Relief, and Economic Security (CARES) Act. The City of Long Beach received $3.6 million in Community Development Block Grant-Coronavirus (CDBG-CV) funding and $1.8 million in Emergency Solutions Grant-Coronavirus (ESG-CV) funding to allocate to activities that address COVID-19 related community needs.

6.2.5 Beacon Program

The Beacon Program, sponsored by the Institute for Local Government and Statewide Energy Efficiency Collaborative, recognizes efforts by local governments to reduce greenhouse gas emissions, save energy, and promote sustainability. In 2018, the City of Long Beach was awarded a Silver Level Beacon Award recognizing its actions to address climate change, promote energy innovation and create more sustainable communities.

6.2.6 Tree Planting Program

Long Beach Sustainability supports the growth of Long Beach's urban forest through the City's tree planting programs. Through these programs, Long Beach residents can have a tree planted in their parkway and/or a fruit tree planted in their front yard for free.

All residents are encouraged to apply; those not in a priority neighborhood are placed on a waitlist. Waitlist requests are fulfilled as space is available each month. Applications are prioritized based on *CalEnviroScreen* score, which identify California communities that are most affected by many sources of pollution and where people are especially vulnerable to pollution's effects.

The initiative was funded through a $671,200 grant from the Port of Long Beach in 2012 to plant 6,000 trees by 2020. The I Dig Long Beach initiative subsequently received a $1.3 million grant from CAL FIRE to plant 10,000 new trees by 2022.

6.2.7 Urban Water Management Plan

The California Urban Water Management Planning Act requires each urban water supplier in the state that directly or indirectly provides water for municipal purposes to more than 3,000 customers or supplies more than 3,000 acre-feet of water annually to prepare an urban water management plan.

The Long Beach Water Department is an urban water supplier as defined by the Act, serving roughly half a million people, the economy, and public sector agencies of the City of Long Beach. In its 2015 Urban Water Management Plan, the Department determined that the most significant factors altering water use between 2015 and 2040 will be the increase in water demand from the multi-family sector and the decrease in water use attributable to water conservation efforts.

6.3 LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

The Los Angeles County Flood Control Act, adopted by the California Legislature in 1915 after a disastrous regional flood took a heavy toll on lives and property, established the Los Angeles County Flood Control District and empowered it to provide flood protection, water conservation, recreation and aesthetic enhancement within its boundaries. The Flood Control District is governed, as a separate entity, by the County of Los Angeles Board of Supervisors.

In 1984, the Flood Control District entered into an operational agreement with the Los Angeles County Department of Public Works transferring planning and operational activities to the Department of Public Works. Watershed Management Division is the planning and policy arm of the Flood Control District. Public Works Flood Maintenance and Water Resources Divisions, respectively, oversee its maintenance and operational efforts.

The Flood Control District encompasses more than 3,000 square miles, 85 cities and 2.1 million land parcels. It includes almost all drainage infrastructure within incorporated and unincorporated areas in every watershed, including 500 miles of open channel, 2,800 miles of underground storm drains, and an estimated 120,000 catch basins. The District includes portions of the City of Long Beach.

6.4 CAPABILITY ASSESSMENT

The planning team performed an inventory and analysis of existing authorities and capabilities called a “capability assessment.” A capability assessment creates an inventory of a jurisdiction’s codes, programs and policies, and evaluates its capacity to carry them out. It presents a toolkit for implementing the hazard mitigation plan and for identifying opportunities to increase the City’s core capabilities to support mitigation actions. The assessment identifies potential gaps in core capabilities. Filling those gaps may eventually become mitigation actions in the plan. Assessment findings were shared with City departments as they developed the recommended mitigation actions. If a department identified an opportunity to add or expand a capability, then doing so has been identified as a mitigation action. The City views each core capability to be fully adaptable as needed to meet the best interests of the City. This adaptability is an overarching City capability that is acknowledged by this reference.

6.4.1 Planning and Regulatory Capabilities

Jurisdictions have the ability to develop policies and programs and to implement rules and regulations to protect and serve residents. Local policies are typically identified in a variety of community plans, implemented via a local ordinance, and enforced through a governmental body. An assessment of planning and regulatory capabilities is presented in Table 6-3.

Table 6-3. Planning and Regulatory Capability

	Local Authority	Other Jurisdiction Authority	State Mandated	Integration Opportunity?
Codes, Ordinances and Requirements				
Building Code	Yes	No	Yes	No
Comment: City of Long Beach Municipal Code, Title 18 – Long Beach Building Standards Code, Chapter 18.40 – Building Code (ORD-19-0031 § 1(Exh. A), 2019))				
Zoning Code	Yes	No	Yes	No
Comment: City of Long Beach Municipal Code, Title 21 – Zoning code, Chapter 21.10 – General Provisions (Ord. C-6533 § 1 (part), 1988)				
Subdivisions	Yes	No	Yes	No
Comment: City of Long Beach Municipal Code, Title 20 – Subdivisions (Ord. C-5975 § 1 (part), 1983)				
Stormwater Management	Yes	No	Yes	Yes
Comment: City of Long Beach Municipal Code, Title 8 – Health and Safety, Chapter 8.96 – Stormwater and Runoff Pollution Control (ORD-15-0029 § 1, 2015)				
Post-Disaster Recovery	No	No	No	No
Comment:				
Real Estate Disclosure	No	Yes	Yes	No
Comment: State of California Natural Hazards Disclosure Act, effective 6/1/1998 (California Civil Code Section 1003) states that real estate sellers and brokers are legally required to disclose if a property being sold lies within one or more state or locally mapped hazard areas.				
Growth Management	Yes	No	Yes	Yes
Comment: City of Long Beach Municipal Code, Division VII. – Planned Development District and Specific Plan Procedures (ORD-16-0009 § 2, 2016)				
Site Plan Review	Yes	No	No	No
Comment: City of Long Beach Municipal Code, Division V. – Site Plan Review (Ord. C-6533 § 1 (part), 1988)				
Environmental Protection	Yes	Yes, Los Angeles County	Yes	Yes
Comment: Gateway Cities Council of Governments (Los Angeles County and 27 cities including Long Beach) was one of two sub-regions that developed its own Sustainable Communities Strategy for incorporation into the Southern California Association of Governments 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy.				
Emergency Management	Yes	No	Yes	Yes
Comment: City of Long Beach Municipal Code, Title 2 – Administration and Personnel, Chapter 2.17 – Department of Disaster Preparedness and Emergency Communications (ORD-18-0016 § 1, 2018)				
Climate Change	Yes	No	Yes	Yes
Comment: City of Long Beach Municipal Code, Title 22 – Transitional Zoning Code, Chapter 22.25 – Special Use Incentive (A-Series Zones), 22.25.050 Climate Mitigation and Adaptation Incentives (ORD-20-0046 § 1(Att. A), 2020)				
Planning Documents				
General Plan	Yes	No	Yes	Yes
Is the plan compliant with Assembly Bill 2140? *Yes*				
Comment: The City of Long Beach General Plan is a policy document required by State law that establishes goals, policies, and directions the City will take to achieve the community vision and guide future development. The Land Use Element was updated in 2019. The Housing Element was updated in 2014. The Public Safety Element was updated in 2002.				
Capital Improvement Plan	Yes	No	No	Yes
Comment: The CIP identifies and provides two types of expenditures. The first covers strategic improvements to the City's existing infrastructure and the second involves one-time projects designed to address important community needs. A budget is adopted each fiscal year.				
Floodplain Management Plan	No	No	No	No
Comment:				

	Local Authority	Other Jurisdiction Authority	State Mandated	Integration Opportunity?
Stormwater Plans	Yes	No	No	No
Comment: The objective of the City's Stormwater Management Plan is to prohibit non-stormwater discharge and reduce the discharge of pollutants in an effort to limit adverse impact to the ocean and coastal region.				
Habitat Conservation Plan	No	No	No	No
Comment:				
Economic Development Plan	Yes	No	No	No
Comment: Economic Development Blueprint, Adopted 2017				
Community Wildfire Protection Plan	No	No	No	No
Comment:				
Response/Recovery Planning				
Emergency Operations Plan	Yes	No	Yes	Yes
Comment: The Emergency Operations Plan (EOP) outlines the planned response by the City of Long Beach to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies. Updated 2015				
Threat and Hazard Identification and Risk Assessment	No	Yes, Los Angeles/Long Beach Urban Areas Security Initiative	No	No
Comment: Los Angeles/Long Beach Urban Areas Security Initiative, consisting of agencies representing the City of Los Angeles, the City of Long Beach, and the County of Los Angeles, developed a threat and hazard identification and risk assessment.				
Terrorism Plan	No	Yes, Los Angeles Operational Area	No	No
Comment: Los Angeles Operational Area Terrorism Plan				
Post-Disaster Recovery Plan	No	No	No	No
Comment:				
Continuity of Operations Plan	No	No	No	No
Comment:				
Public Health Plan	No	Yes, Los Angeles County	No	No
Comment: Community Health Improvement Plan, 2015-2020; Pre-hospital Care Policy Ref. No. 842.1 Minimum EMS Resource Guidelines for Mass Gatherings and Special Events				

6.4.2 Integration Opportunity

The assessment looked for opportunities to integrate this mitigation plan with the planning and regulatory capabilities identified. Capabilities were identified as integration opportunities if they can support or enhance the actions identified in this plan or be supported or enhanced by components of this plan. The City considered actions to implement this integration. The column in Table 6-3 labeled "Integration Opportunity" identifies capabilities that can support or be supported by components of this plan. Where "yes" is indicated in this column, the City has considered actions to integrate these capabilities with the plan.

6.4.3 Administrative and Technical Capabilities

Legal, regulatory, and fiscal capabilities provide the backbone for successfully developing a mitigation strategy; however, without appropriate personnel, the strategy may not be implemented. Administrative and technical capabilities focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation. These resources include technical experts, such as engineers and scientists, as well as personnel with capabilities that may be found in multiple departments, such as grant writers. An assessment of administrative and technical capabilities is presented in Table 6-4.

Table 6-4. Administrative and Technical Capability

Staff/ Personnel Resources	Available (Yes or No)	Department or Agency (Positions)
Planners or engineers with knowledge of land development and land management practices	Yes	Development Services
Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Yes	Development Services
Planners or engineers with an understanding of natural hazards	Yes	Development Services, Water, Public Works
Floodplain manager	Yes	Public Works
Surveyors	Yes	Development Services
Personnel skilled or trained in GIS Applications	Yes	Technology and Innovation Services
Scientist familiar with local natural hazards	No	
Emergency manager	Yes	Disaster Preparedness and Emergency Communications
Grant writers	Yes	Various Departments
Staff with expertise or training in benefit/cost analysis	Yes	Various Departments

6.4.4 Fiscal Capabilities

Assessing a jurisdiction's fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. This assessment identifies both outside resources, such as grant-funding eligibility, and local jurisdictional authority to generate internal financial capability, such as through impact fees. An assessment of fiscal capabilities is presented in Table 6-5.

Table 6-5. Fiscal Capability

Financial Resources	Accessible or Eligible to Use (Yes or No)
Community Development Block Grants	Yes
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Water, Sewer, Gas or Electric Service ***If yes, specify:*** The City has its own Water and Gas departments.	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	Yes
Incur Debt through Private Activity Bonds	Yes
Withhold Public Expenditures in Hazard-Prone Areas	Yes
State-Sponsored Grant Programs	Yes
Development Impact Fees for Homebuyers or Developers	Yes
Other ***If yes, specify:***	No

6.4.5 Participation in Other Programs

Other programs, such as the Community Rating System and Firewise USA, can enhance a jurisdiction's ability to mitigate, prepare for, and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum requirements set forth by local, state, and federal regulations in order to create a more resilient community. These programs complement each other by focusing on communication, mitigation, and community preparedness to save lives and minimize the impact of natural hazards on a community. Classifications under various community mitigation programs are presented in Table 6-6.

Table 6-6. Community Classifications

	Participating (Yes or No)	ID or Classification	Date Classified
FIPS Code	Yes	0603743000	N/A
DUNS Number	Yes	112281097	N/A
Community Rating System	Yes	Class 8	April 5, 2021
Building Code Effectiveness Grading Schedule	N/A	N/A	N/A
Public Protection Classification	No	N/A	N/A
Firewise	No	N/A	N/A
Storm Ready	No	N/A	N/A
Tsunami Ready	No	N/A	N/A

6.4.6 Development and Permitting Capability

Jurisdictions regulate land use through the adoption and enforcement of zoning, subdivision and land development ordinances, building codes, building permit ordinances, floodplain, and stormwater management ordinances. When effectively prepared and administered, these regulations can lead to hazard mitigation. Development and permitting capabilities are presented in Table 6-7.

Table 6-7. Development and Permitting Capability

Criterion	Response
Does your jurisdiction issue development permits?	Yes
• **If no, who does? If yes, which department?**	Development Services
Does your jurisdiction have the ability to track permits by hazard area?	Yes (Flood Hazard Only)
Does your jurisdiction have a buildable lands inventory?	Yes

6.4.7 NFIP Compliance

Flooding is the costliest natural hazard in the United States and, with the promulgation of recent federal regulation, homeowners throughout the country are experiencing increasingly high flood insurance premiums. Community participation in the NFIP opens up opportunity for additional grant funding associated specifically with flooding issues. Assessment of the jurisdiction's current NFIP status and compliance provides planners with a greater understanding of the local flood management program, opportunities for improvement, and available grant funding opportunities. Information on NFIP compliance is presented in Table 6-8.

6.4.8 Public Outreach Capability

Regular engagement with the public on issues regarding hazard mitigation provides an opportunity to directly interface with community members. Assessing this outreach and education capability illustrates the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement. An assessment of education and outreach capabilities is presented in Table 6-9.

Table 6-8. National Flood Insurance Program Compliance

Criterion	Response
What local department is responsible for floodplain management?	Public Works
Who is your floodplain administrator? (department/position)	Public Works/City Engineer
Are any certified floodplain managers on staff in your jurisdiction?	No
What is the date that your flood damage prevention ordinance was last amended?	November 19, 2019
Does your floodplain management program meet or exceed minimum requirements? ***If exceeds, in what ways?***	Meets
When was the most recent Community Assistance Visit or Community Assistance Contact?	August 13, 2018
Does your jurisdiction have any outstanding NFIP compliance violations that need to be addressed? ***If so, state what they are.***	No
Are any RiskMAP projects currently underway in your jurisdiction? ***If so, state what they are.***	No
Do your flood hazard maps adequately address the flood risk within your jurisdiction? ***If no, state why.***	Yes
Does your floodplain management staff need any assistance or training to support its floodplain management program? ***If so, what type of assistance/training is needed?***	No
Does your jurisdiction participate in the Community Rating System (CRS)? ***If yes, is your jurisdiction interested in improving its CRS Classification?*** ***If no, is your jurisdiction interested in joining the CRS program?***	Yes Yes N/A
How many flood insurance policies are in force in your jurisdiction?[a] ***What is the insurance in force?*** ***What is the premium in force?***	2,169 $605,010,100 $2,626,126
How many total loss claims have been filed in your jurisdiction?[a] ***What were the total payments for losses?***	339 $2,532,541

a. According to FEMA statistics as of February 28, 2022

Table 6-9. Education and Outreach

Criterion	Response
Do you have a Public Information Officer or Communications Office?	Yes
Do you have personnel skilled or trained in website development?	Yes
Do you have hazard mitigation information available on your website? • **If yes, please briefly describe.**	Yes Various brochures and resources for the community to get information.
Do you utilize social media for hazard mitigation education and outreach? • **If yes, please briefly describe.**	Yes Information on how to reduce risks from various hazards.
Do you have any resident boards or commissions that address issues related to hazard mitigation?	No
Do you have any other programs already in place that could be used to communicate hazard-related information? • **If yes, please briefly describe.**	Yes Community Emergency Response Organization
Do you have any established warning systems for hazard events? • **If yes, please briefly describe.**	Yes Alert systems

6.4.9 Adaptive Capacity

An adaptive capacity assessment evaluates a jurisdiction's ability to anticipate impacts from future conditions. By looking at public support, technical adaptive capacity, and other factors, jurisdictions identify their core capability for resilience against issues such as sea level rise. The adaptive capacity assessment provides jurisdictions with an opportunity to identify areas for improvement by ranking their capacity high, medium, or low. The community's adaptive capacity for the impacts of climate change is presented in Table 6-10.

Table 6-10. Adaptive Capacity for Climate Change

Adaptive Capacity Assessment Questions	Jurisdiction Rating
Technical Capacity	
Jurisdiction-level understanding of potential climate change impacts	High
***Comment*:** Climate Action and Adaption Plan (CAAP) Chapter 3: Understanding Climate Change in Long Beach	
Jurisdiction-level monitoring of climate change impacts	Medium
Comment: CAAP Dashboard in development, 1 full-time City staff person is dedicated part-time to monitoring climate change impacts	
Technical resources to assess proposed strategies for feasibility and externalities	Medium
Comment: Some ability to assess exists but not enough staff to do it well	
Jurisdiction-level capacity for development of greenhouse gas emissions inventory	Low
Comment: Only 1 full-time City staff who is dedicated part-time to greenhouse gas inventory	
Capital planning and land use decisions informed by potential climate impacts	High
Comment: Addressed in Land Use Element Appendix 7: Land Use Policies Addressing Climate Change and Sustainability.	
Participation in regional groups addressing climate risks	Medium
Comment: Southern California Association of Governments, Gateway Cities Council of Governments, International Council for Local Environmental Initiatives	
Implementation Capacity	
Clear authority/mandate to consider climate change impacts during public decision-making processes	Medium
Comment: CAAP Governance in progress, CAAP for final adoption	
Identified strategies for greenhouse gas mitigation efforts	Medium
Comment: Addressed in CAAP Chapter 6: Mitigation Actions	
Identified strategies for adaptation to impacts	High
Comment: Addressed in CAAP Chapter 4: Adaptation Actions	
Champions for climate action in local government departments	Medium
Comment: CAAP Governance Model in development, See "LEED for Cities and Communities"	
Political support for implementing climate change adaptation strategies	Medium
Comment: Much support from elected officials, city manager, but funding and departmental dedicated resources are needed	
Financial resources devoted to climate change adaptation	Low
Comment: Funding still needs to be devoted to most adaptation actions in the plan in order to make projects come to fruition, new funding Youth Climate Corps, lack of funding for City capacity	
Local authority over sectors likely to be negative impacted	Low
Comment: Lack of authority over private sector or Port of Long Beach	

Adaptive Capacity Assessment Questions	Jurisdiction Rating
Public Capacity	
Residents' knowledge and understanding of climate change risks	Medium
Comment: CAAP has conducted outreach/engagement in its development. Office of Sustainability regularly distributes information and hosts events on climate change topics.	
Residents' support of adaptation efforts	High
Comment: Residents highly support climate adaptation efforts	
Residents' capacity to adapt to climate impacts	Medium
Comment: Dependent on City location, some have more capacity than others to adapt	
Local economy current capacity to adapt to climate impacts	Medium
Comment: Disaster preparedness resources through City, including Department of Disaster Preparedness and Emergency Communications and Fire Department; Green Business Program provides resources for local businesses to be more sustainable.	
Local ecosystems capacity to adapt to climate impacts	Medium
Comment: Addressed in the Land Use Element pg. 47-50 and Goal No.9	

City of Long Beach Hazard Mitigation Plan

PART 2—RISK ASSESSMENT

7. RISK ASSESSMENT METHODOLOGY

The risk assessments in this plan describe the risks associated with each identified hazard. Hazards were categorized as one of two types: hazards of concern (hazards whose monetary impacts can be measured) and hazards of interest (hazards whose monetary impacts cannot be measured). The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - A summary of past events that have impacted the planning area
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity descriptions
  - Warning time likely to be available for response
- **Determine exposure to each hazard**—Exposure was assessed by overlaying hazard maps with an inventory of structures, facilities, and systems to decide which of them would be exposed to each hazard.
- **Assess the vulnerability of exposed facilities**—Vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus were used for this assessment for the dam failure, earthquake, flood, and tsunami hazards. Outputs similar to those from Hazus were generated for other hazards, using data generated through GIS.

The risk assessments performed for this plan evaluated risk countywide and for individual incorporated areas.

7.1 RISK ASSESSMENT TOOLS

7.1.1 Mapping

National, state, county, and city databases were reviewed to locate available spatially based data relevant to this planning effort. Maps were produced using geographic information system (GIS) software to show the spatial extent and location of hazards when such datasets were available. The maps are included in the hazard profile chapters. Data used for this plan represents the best science currently available.

7.1.2 Modeling

Overview

FEMA developed the standardized GIS-based software program Hazards U.S. (Hazus) to estimate losses caused by earthquakes, hurricanes and floods and identify areas that face the highest risk and potential for loss. Hazus is used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facilities, transportation and utility infrastructure, and multiple models to estimate potential losses from natural disasters. The program maps and calculates hazard data and damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities
- Provides a way to save data so that they can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve
- Facilitates review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated
- Supports grant applications by calculating benefits using FEMA definitions and terminology
- Produces hazard data and loss estimates that can be used in communication with local stakeholders
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation

Levels of Detail for Evaluation

Hazus provides default data for inventory, vulnerability, and hazards; these default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. These data are derived from national databases and describe in general terms the characteristic parameters of the planning area
- **Level 2**—More-accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics, and building inventory, as well as data on utilities and critical facilities. This information is needed in a GIS format
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area

7.2 RISK ASSESSMENT APPROACH

7.2.1 Hazard Profile Development

Hazard profiles were developed through web-based research and review of previously developed local and state reports and plans. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others.

7.2.2 Assessment of Exposure and Vulnerability

Earthquake, Dam Failure, Flood, and Tsunami

Community exposure and vulnerability to the following hazards were evaluated using Hazus:

- **Earthquake**—A Level 2 analysis was performed to assess earthquake exposure and vulnerability for four scenario events and one probabilistic event:
  - A Magnitude-7.5 event on the Compton fault with an epicenter 12.5 miles north-northwest of Long Beach.
  - A Magnitude-7.2 event on the Newport-Inglewood fault with an epicenter at the intersection of I-405 and California Avenue in Long Beach.
  - A Magnitude-7.4 event on the Palos Verdes fault with an epicenter 11 miles south of Long Beach.
  - The standard Hazus 100-year probabilistic event.
- **Dam Failure, Flood, and Tsunami**—A Level 2 user-defined analysis was performed for general building stock and for critical facilities. Current mapping for the planning area was used to delineate hazard areas for flood, dam failure, and tsunami and estimate potential losses. To estimate damage that would result from these inundation-based hazards, Hazus uses pre-defined relationships between water depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting inundation depth data and known property replacement cost values, dollar-value estimates of damage were generated.

Climate Change (Sea-Level Rise) and Severe Weather

Historical datasets were not adequate to model future losses for these hazards of concern. However, areas and inventory susceptible to some of the hazards of concern were mapped by other means to evaluate exposure. A qualitative analysis was conducted for other hazards using the best available data and professional judgment.

Drought

The risk assessment methodologies used for this update focus on damage to structures. Because drought does not impact structures, the risk assessment for this hazard was more limited and qualitative than the assessment for the other hazards of concern.

7.3 SOURCES OF DATA USED

7.3.1 Building and Cost Data

Replacement cost is the cost to replace the entire structure with one of equal quality and utility. Replacement cost is based on industry-standard cost-estimation models published in the 2021 edition of *RS Means Square Foot Costs*. It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure. The construction class and number of stories for single-family residential structures also factor into determining the square foot costs.

Replacement cost values and detailed structure information derived from parcel and building footprints data were loaded into Hazus. When available, an updated inventory was used in place of the Hazus defaults for critical facilities and infrastructure.

7.3.2 Hazus Data Inputs

The following hazard datasets were used for the Hazus Level 2 analysis conducted for the risk assessment:

- **Earthquake**—Earthquake ShakeMaps and probabilistic data prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. National Earthquake Hazard Reduction Program (NEHRP) soils and liquefaction zones data from the California Department of Conservation were also integrated into the Hazus model.
- **Tsunami**—Tsunami hazard area data, provided by the California Geological Survey and the USGS 1-meter digital elevation model data were used to develop inundation depth grids that were integrated into the Hazus model.
- **Flood**—The effective Digital Flood Insurance Rate Map (DFIRM) for the planning area was used to delineate flood hazard areas and estimate potential losses from the FEMA 1 percent annual chance and 0.2 percent annual chance (100- and 500-year) flood events. Using the DFIRM floodplain boundaries and base flood elevation information, and the U.S. Geological Survey (USGS) USGS 1-meter digital elevation model data, flood depth grids were generated and integrated into the Hazus model.
- **Dam Failure**—Dam failure inundation area boundaries and depth grid data for the Cogswell, Morris, Puddingstone, and San Gabriel No. 1 Dams were provided by the California Department of Water Resources. Data for the Whittier Narrows dam were provided by the U.S. Army Corps of Engineers. The individual dam depth grids were combined using the maximum depth where the dam inundation areas overlapped, and the combined depth grid was integrated into the Hazus model.

7.3.3 Other Local Hazard Data

Locally relevant information on hazards was gathered from a variety of sources. Data sources for specific hazards were as follows:

- **Climate Change**—Sea level rise data were provided by USGS's Our Coast, Our Future (OCOF) tool. An exposure analysis was performed using that tool's 25-centimeter rise with 100-year storm and 50-centimeter rise with 100-year storm.
- **Drought**—No GIS format drought hazard area datasets were identified for Long Beach.
- **Severe Weather**—No GIS format severe weather area datasets were identified for Long Beach.

7.3.4 Data Source Summary

Table 7-1 summarizes the data sources used for the risk assessment for this plan.

Table 7-1. Hazus Model Data Documentation

Data	Source	Date	Format
Property parcel data	Los Angeles County Assessor	2021	Digital (GIS)
Secured Basic File Abstract (contains building information such as use code, year built, square footage, and number of stories.)	Los Angeles County Assessor	2021	Digital (GIS)
LARIAC 5 building footprints	Los Angeles County	2017	Digital (GIS)
Building replacement (square foot) costs	RS Means	2021	Digital (pdf)
Whittier Narrows Dam western embankment breach pool elevation (239.9 feet NAVD)	U.S. Army Corps of Engineers	2018	Digital (GIS)
California dam breach inundation maps (inundation boundaries and depth grids)	California Department of Water Resources	2018-21	Digital (GIS)
ShakeMap – Compton M7.5	USGS	2017	Digital (GIS)
ShakeMap – Newport-Inglewood Alt 1 M7.2	USGS	2017	Digital (GIS)
ShakeMap – Palos Verde M7.4	USGS	2017	Digital (GIS)
NEHRP soils	California Department of Conservation	2015	Digital (GIS)
Seismic hazard zone maps for liquefaction	California Geological Survey	2017	Digital (GIS)
Digital Flood Insurance Rate Map (DFIRM) – Los Angeles County effective 6/2/2021	FEMA	2021	Digital (GIS)
USGS Coastal Storm Modeling System (v3.0) sea level rise data	Our Coast Our Future	2018	Digital (GIS)
Tsunami hazard area Los Angeles	California Geological Survey; California Governor's Office of Emergency Services	2021	Digital (GIS)

7.4 LIMITATIONS

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

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk.

8. EARTHQUAKE

8.1 GENERAL BACKGROUND

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

8.1.1 Earthquake Location

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter.

8.1.2 Earthquake Geology

Tectonic Plates

The Earth's crust, which is the rigid outermost shell of the planet, is broken into seven or eight major tectonic plates (depending on how they are defined) and many minor plates. Where the plates meet, they move in one of three ways along their mutual boundary: convergent (two plates moving together), divergent (two plates moving apart), or transform (two plates moving parallel to one another). Earthquakes, volcanic activity, mountain-building, and oceanic trench formation occur along these plate boundaries. Subduction is a geological process that takes place at convergent boundaries of tectonic plate, in which one plate moves under another. Regions where this process occurs are known as subduction zones, and they have the potential to generate highly damaging earthquakes.

California is seismically active because of movement of the North American Plate, east of the San Andreas Fault, and the Pacific Plate to the west, which includes the state's coastal communities. The transform (parallel) movement of these tectonic plates against one another creates stresses that build as the rocks are gradually deformed. The rock deformation, or strain, is stored in the rocks as elastic strain energy. When the strength of the rock is exceeded, rupture occurs along a fault. The rocks on opposite sides of the fault slide past each other as they spring back into a relaxed position. The strain energy is released partly as heat and partly as elastic waves called seismic waves. The passage of these seismic waves produces the ground shaking in earthquakes.

Faults

Geologists have found that earthquakes reoccur along faults, which are zones of weakness in the earth's crust. When a fault experiences an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake can still occur. In fact, relieving stress along one part of a fault may increase it in another part.

Faults are more likely to have future earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve the accumulating tectonic stresses. Geologists classify faults by their relative hazards. "Active" faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). "Potentially active" faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years) (California Department of Conservation 2019).

Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. The majority of the seismic hazards are on well-known active faults. However, inactive faults, where no displacements have been recorded, also have the potential to reactivate or experience displacement along a branch sometime in the future. An example of a fault zone that has been reactivated is the Foothills Fault Zone. The zone was considered inactive until evidence of an earthquake (approximately 1.6 million years ago) was found near Spenceville, California. Then, in 1975, an earthquake occurred on another branch of the zone near Oroville, California (now known as the Cleveland Hills Fault). The State Division of Mines and Geology indicates that increased earthquake activity throughout California may cause tectonic movement along currently inactive fault systems.

8.1.3 Earthquake-Related Hazards

According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect people's normal activities. This includes the following:

- **Surface Faulting**—Displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 20 kilometers.
- **Ground Motion (shaking)**—The movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by sudden slip on a fault or sudden pressure at the explosive source and travel through the earth and along its surface.
- **Landslid**e—A movement of surface material down a slope.
- **Liquefaction**—A process by which water-saturated sediment temporarily loses strength and acts as a fluid. Earthquake shaking can cause this effect.
- **Tectonic Deformation**—A change in the original shape of a material due to stress and strain.
- **Tsunami**—A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or violent underwater volcanic eruptions.

8.1.4 Earthquake Classifications

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

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. Magnitude is commonly expressed by ratings on the moment magnitude scale (M_W), the most common scale used today. The moment magnitude scale is a more accurate measure of earthquake size than the better-known Richter scale (M_L) (U.S. Geological Survey 2021). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved, and the force required to move it). The scale is as follows:

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Intensity

The most commonly used intensity scale is the modified Mercalli intensity scale. Ratings of the scale as well as the perceived shaking and damage potential for structures are shown in Table 8-1. The modified Mercalli intensity scale is generally represented visually using a USGS product called a ShakeMap (see Section 8.1.6), which shows the expected ground shaking at any given location produced by an earthquake with a specified magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A ShakeMap shows the variation of ground shaking in a region immediately following significant earthquakes (for technical information about ShakeMaps see (USGS 2021)).

Table 8-1. Mercalli Scale and Peak Ground Acceleration Comparison

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

a. PGA = peak ground acceleration. Measured in percent of g, where g is the acceleration of gravity
Sources: (USGS 2021); (USGS 2011)

8.1.5 Ground Motion

Earthquake hazard assessment is based on expected ground motion. During an earthquake when the ground is shaking, it also experiences acceleration. The peak acceleration is the largest increase in velocity recorded by a particular station during an earthquake. Estimates are developed of the annual probability that certain ground motion accelerations will be exceeded; the annual probabilities can then be summed over a time period of interest.

The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. PGA is measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 8-1 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

8.1.6 USGS Earthquake Mapping Programs

ShakeMaps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that map ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking caused by the earthquake, rather than on characteristics of the earthquake source, such as magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth’s crust.

A ShakeMap shows the extent and variation of ground shaking immediately across the surrounding region following significant earthquakes. Such mapping is derived from peak ground motion amplitudes recorded on seismic sensors, with interpolation where data are lacking based on estimated amplitudes. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. In addition to the maps of recorded events, the USGS creates the following:

- Scenario ShakeMaps of hypothetical earthquakes of an assumed magnitude on known faults.
- Probabilistic ShakeMaps, based on predicted shaking from all possible earthquakes over a 10,000-year period. In a probabilistic map, information from millions of scenario maps are combined to make a forecast for the future. The maps indicate the ground motion at any given

point that has a given probability of being exceeded in a given timeframe, such as a 100-year (1-percent-annual chance) event.

National Seismic Hazard Map

National maps of earthquake shaking hazards provide information for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown, et al. 2001). The USGS updated the National Seismic Hazard Maps in 2018. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps. The 2018 map, shown in Figure 8-1, represents the best available data as determined by the USGS.

Source: (USGS 2018)

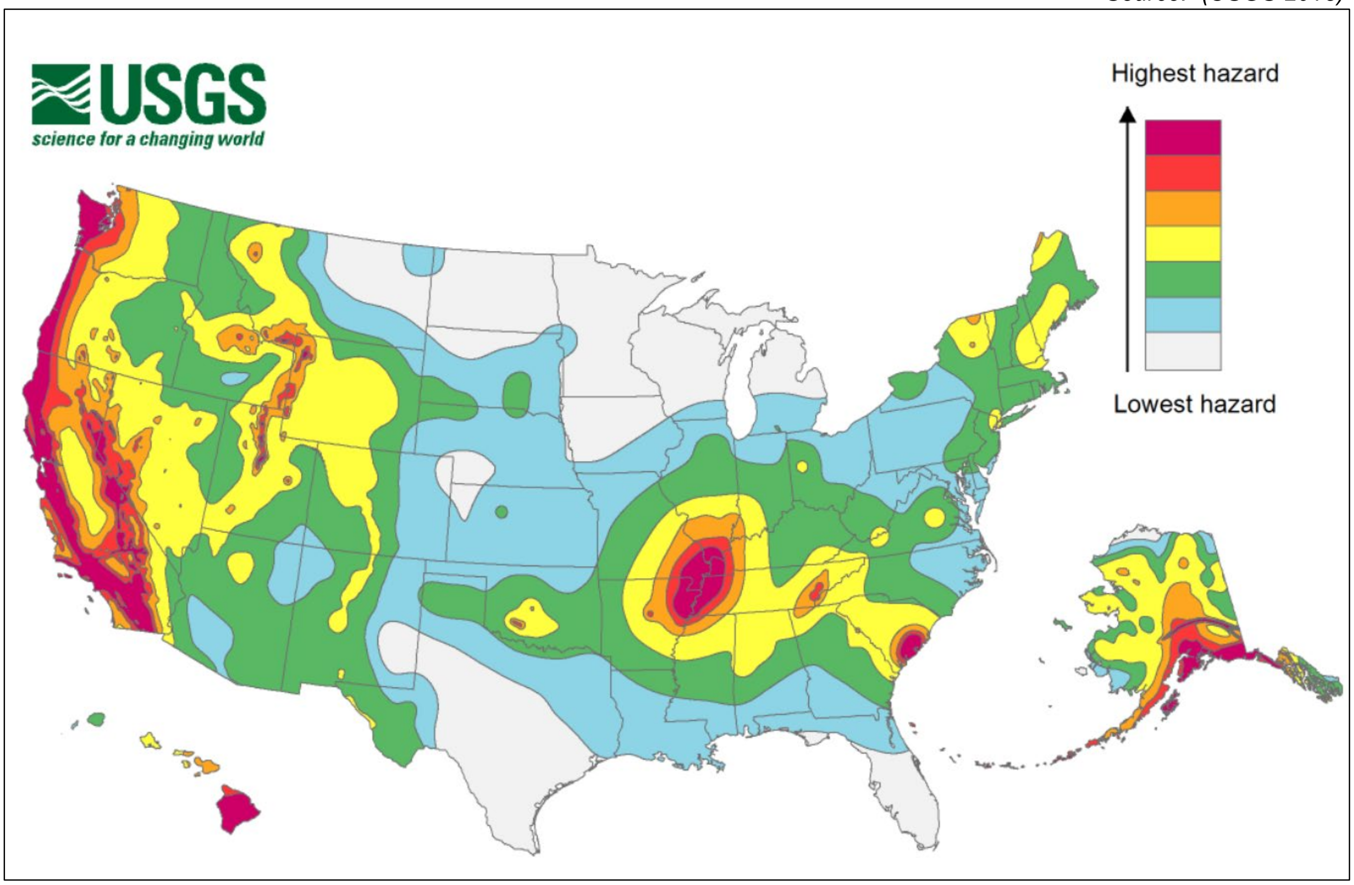

Figure 8-1. 2018 USGS National Seismic Hazard Map

8.1.7 Liquefaction and Soil Types

Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into the ground.

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. NEHRP soil types define the locations that will be significantly impacted by an earthquake. Table 8-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 8-2. NEHRP Soil Classification System

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

8.1.8 Secondary Hazards

Earthquakes can cause large and sometimes disastrous mudslides. Building and road foundations can lose load-bearing strength and may sink into what was previously solid ground. Earthen dams and levees are highly susceptible to seismic events, and the impacts of their failures can be considered secondary risks for earthquakes.

Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment.

8.2 HAZARD PROFILE

8.2.1 Past Events

Long Beach was included in three Los Angeles countywide FEMA declarations for earthquakes: the 1994 Northridge Earthquake (DR-1008), the 1987 Whittier Narrows Earthquake (DR-799), and the 1971 San Fernando Earthquake (DR-299). The largest earthquake to directly affect the planning area was the 1933 Long Beach Earthquake. Table 8-3 lists the 4.0 or greater magnitude earthquakes that have occurred within 100 miles of Long Beach. The following sections provide summary descriptions of the most significant of these events.

Table 8-3. Earthquakes Within 100-mile Radius of Long Beach (4.0 and greater)

Date	Magnitude	Epicenter Location	Fault Line
02/26/2022	4.0	Near Santa Paula	Unknown
09/17/2021	4.3	Near Carson	Unknown
04/05/2021	4.0	Near Lennox	(Likely) Newport-Inglewood fault
09/19/2020	4.5	Near South El Monte	Unknown
07/30/2020	4.2	Near Pacoima	Unknown
04/04/2020	4.9	Southeast of Anza	Unknown
01/02/2020	4.0	Near Oxnard	Unknown
06/05/2019	4.3	South of San Clemente Island	Unknown
06/05/2019	4.3	South of San Clemente Island	Unknown
05/08/2018 Cabazon Earthquake	4.5	Near Cabazon	Unknown
04/05/2018 Santa Cruz Island Earthquake	5.3	Near Santa Cruz Island	Unknown
01/25/2018 Trabuco Earthquake	4.0	Near Trabuco Canyon	Unknown
03/29/2014 Brea Earthquake	5.1	Near Brea, CA	Puente Hills fault
03/16/2010 Pico Rivera Earthquake	4.4	Pico Rivera, CA	(Likely) Puente Hills fault
05/18/2009 Inglewood	4.7	Inglewood, CA	Newport-Inglewood fault
07/29/2008 Chino Hills Earthquake	5.4	Near Chino Hills, CA	Whittier fault
01/17/1994 Northridge Earthquake	6.7	20 miles west-northwest of Los Angeles	Northridge Thrust fault
06/28/1991 Sierra Madre Earthquake	5.8	12 miles northeast of Pasadena, CA	Clamshell-Sawpit Canyon fault
02/28/1990 Upland Earthquake	7.9	30 miles east of Los Angeles	San Jose fault
06/12/1989 Montebello	4.8 / 4.5	6 miles west of Montebello	(Likely) Puente Hills fault
01/18/1989 Malibu Earthquake	5.0	20 miles south of Malibu, CA	Unknown
12/03/1988 Pasadena Earthquake	5.0	Below City of Pasadena, CA	Raymond fault
06/26/1988 Upland Earthquake	7.9	30 miles east of Los Angeles	San Jose fault
06/10/1988 Tejon Ranch Earthquake	6.8	Northeast of Frazier Park, CA	Unknown
10/01/1987 Whittier Narrows Earthquake	5.9	Southeast of Pasadena	Puente Hills fault
01/01/1979 Malibu Earthquake	5.2	South of Malibu, CA	Unknown
02/21/1973 Point Mugu Earthquake	5.3	Near Oxnard, 45 miles west of Los Angeles	San Fernando fault
02/09/1971 San Fernando Earthquake	6.5	Near Sylmar, CA	San Fernando fault
12/4/1948 Desert Hot Springs Earthquake	6.0	Near Desert Hot Springs, 100 miles east of Los Angeles	S. Branch San Andreas fault
3/10/1933 Long Beach Earthquake	6.4	3 miles south of Huntington Beach, CA	Newport-Inglewood fault

Source: (Southern California Earthquake Data Center 2022)

2010 Pico Rivera Earthquake

Pico Rivera was the epicenter of a magnitude 4.4 earthquake on March 16, 2010, which occurred at 4:04 a.m. The earthquake struck about 1.5 miles northeast of Pico Rivera at a depth of 11.7 miles, which is considered shallow. The USGS stated that the quake was likely from the Puente Hills thrust fault. The epicenter was about 4.5 miles south of the epicenter of the 1987 Whittier Narrows earthquake. Both earthquakes exhibited thrust faulting. However, the 2010 earthquake strike rotated clockwise, suggesting that a different thrust system was activated. There were no injuries or major damage, but plenty of people felt the shaking. It was reported to have been felt from San Bernardino County to Santa Monica, and as far south as San Diego. California Institute of Technology seismologists stated the quake indicated stresses building up for an even bigger earthquake.

1994 Northridge Earthquake

The 1994 Northridge Earthquake was the costliest seismic event in California since the 1906 San Francisco Earthquake. The infrastructure of the metropolitan area was severely disrupted. Freeways collapsed, power systems for the city and linked communities as far away as Oregon were temporarily blacked out, and communications were disrupted. The California *State Hazard Mitigation Plan* reports the Northridge Earthquake caused over $40 billion of disaster losses, 57 deaths, and 11,846 injuries (Cal OES, 2018).

Officially lasting approximately 30 seconds, and with a magnitude of 6.7, this earthquake caused significant damage to buildings. Of 57 fatalities attributed to this quake, 16 were a result of the collapse of a single structure—the Northridge Meadows apartment building. The ground motion was measured throughout Southern California, including intensity readings of 1.82 g near the Ventura Freeway in the Tarzana area. Ground motions as strong as 1.21 g were measured as far away as Inglewood (approximately 25 miles from Northridge). One “g” of ground motion is enough to make unsecured buildings move off their foundations.

According to the USGS and the Southern California Earthquake Center, the Northridge Earthquake raised nearby mountains by as much as 70 centimeters. The fault, which was previously unknown, appears to be truncated by the fault that broke in the similarly sized 1971 San Fernando Earthquake, the two faults abutting at a depth of 5 miles. The Northridge Earthquake caused many times more damage than the 1971 event, primarily because its fault is directly under the densely populated valley, whereas the 1971 fault lies under the mountains.

1933 Long Beach Earthquake

The 1933 Long Beach Earthquake occurred on Sunday, March 10, 1933, at 5:54 pm. The 6.4-magnitude earthquake hit on the Newport-Inglewood fault off the coast of Newport Beach. The earthquake was felt for 15 seconds in 10 counties of Southern California and resulted in $50 million in damage ($1.07 billion in 2021 dollars).

In addition to structural damage, Long Beach experienced 127 breaks in water distribution mains. Nineteen fires were reported in Long Beach during the night of the earthquake, with seven the result of broken gas lines. Liquefaction also occurred along much of the sparsely populated coast between the cities of Newport Beach and Long Beach.

Many residents, having lost their homes, took shelter in parks. A portion of the U.S. Navy’s Pacific Fleet had just returned to its home base in Long Beach Harbor after a six-month cruise, and the Navy sent ashore emergency supplies and about 2,000 sailors and Marines. The Army also sent men and supplies, from Fort McArthur in San Pedro. The National Guard set up food kitchens and served meals in every park in the city. Water was trucked in for those in areas where water mains had broken (City of Long Beach 2017).

8.2.2 Location

Major Faults

The City of Long Beach is in a seismically active region at the junction of Southern California's Transverse and Peninsular Ranges. These two ranges experience ongoing seismic activity associated with the lateral movement of the North American and Pacific tectonic plates. The San Andreas Fault system, located approximately 55 miles northeast of the City, delineates the boundary where these two plates meet. The following sections describe significant faults in or near the planning area.

Compton

The Compton thrust fault (blind) extends below the western Los Angeles Basin, lying entirely within Mesozoic metamorphic basement (Shaw and Suppe 1996). Most of the thrust fault is a ramp that rises to the southwest from depths of 3 to 6 miles. The ramp connects the Central Basin Decollement, a thrust flat below the Los Angeles Basin, with shallower parts of the thrust fault near its tip below the Palos Verdes Peninsula. The Compton blind thrust fault is active and has generated at least six large-magnitude earthquakes (Mw 7.0 to 7.4) during the past 14,000 years, with an estimated thrust fault slip rate of 1.2+0.5, -0.3 millimeters per year (Leon, Dolan, et al. 2009).

Newport Inglewood Fault

The Newport-Inglewood fault is partly within Long Beach city limits and roughly parallels Interstate 405. This right-lateral strike-slip fault extends for 47 miles from Culver City through Inglewood to Newport Beach. From there, the fault extends east-southeast into the Pacific Ocean where it is known as the Rose Canyon Fault. The fault passes through a line of hills extending from Signal Hill to Culver City.

An earthquake along the Newport-Inglewood fault could impact Long Beach more severely than a San Andreas induced earthquake. The fault has a slip rate of approximately 00.024 inches per year and is predicted to be capable of a 6.0 to 7.4 magnitude earthquake on the moment magnitude scale (Southern California Earthquake Data Center n.d.). A 6.5-magnitude earthquake could produce severe ground shaking lasting from 12 to 18 seconds.

Palos Verdes Fault

The Palos Verdes Fault is an active northwest-southeast trending right-lateral strike-slip fault with onshore and offshore sections from northern Santa Monica Bay, across the Palos Verdes Peninsula, and across the San Pedro shelf and slope. The fault can be split into five sections along its approximate 60-mile length: Santa Monica Bay, Palos Verdes Hills, San Pedro Shelf, San Pedro Slope, and Lasuen Knoll (Conrad, et al. 2015). This fault is estimated to produce earthquakes from 6.0 to 7.0 in magnitude (Southern California Earthquake Data Center n.d.).

San Andreas Fault

The San Andreas Fault, passing 55 miles to the northeast of Long Beach, is considered most likely to produce a large seismic event within the next 100 years. Geologic evidence suggests that a major earthquake (7.5 to 8.5 Richter magnitude) has a 50 percent chance of occurring within the next 30 years. An earthquake of this magnitude is comparable to the 1906 San Francisco earthquake and has the potential for causing considerable damage across Southern California. Perceived shaking from an earthquake of this magnitude would be strong to severe.

Whittier/Elsinore Fault

The Elsinore fault zone is one of the largest in southern California though historically one of the quietest. The southeastern extension of the Elsinore fault zone, the Laguna Salada fault, ruptured in 1892 in a magnitude 7 quake, but the main trace of the Elsinore fault zone has only seen one historical event greater than magnitude 5.2: the magnitude 6 earthquake of 1910 near Temescal Valley, which produced no known surface rupture and did little damage.

At its northern end, the Elsinore fault zone splays into two segments: the Chino fault and the Whittier fault. At its southern end, the Elsinore fault is cut by the Yuha Wells fault from what amounts to its southern continuation: the Laguna Salada fault. Several of the fault strands that make up the Elsinore fault zone possess their own names. Northwest of Lake Elsinore are the Glen Ivy North and Glen Ivy South faults. Two parallel fault strands heading southeast from Lake Elsinore are the Wildomar fault (the more easterly) and the Willard fault. This fault zone can produce an earthquake with a magnitude of 6.5 to 7.5 (Southern California Earthquake Data Center n.d.).

NEHRP Soil Type and Liquefaction Mapping

Figure 8-2 shows NEHRP soil classifications in Los Angeles County. Figure 8-3 shows areas that have been identified as susceptible to liquefaction.

8.2.3 Frequency

California experiences hundreds of earthquakes each year, most with magnitudes below 3.0 and minimal damage. Earthquakes that cause moderate damage to structures occur several times a year. According to the USGS, a strong earthquake measuring greater than Magnitude 5.0 occurs statewide every two to three years, and major earthquakes of more than Magnitude 7.0 occur once a decade. The San Andreas Fault has the potential for experiencing major to great events.

Based on the most recent earthquake forecast model for California, scientists estimate that in the next 30 years the Los Angeles region has a 60-percent probability of an earthquake of Magnitude 6.7 or greater, a 46-percent probability of an earthquake of Magnitude 7 or greater, and a 31 percent probability of an earthquake of Magnitude 7.5 (USGS n.d.).

The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) predicts the probability of an earthquake of Magnitude 6.7 or greater over the next 30 years as shown in Figure 8-4. The UCERF3 also defined the following recurrence intervals for the deterministic earthquake scenarios used for the risk assessment in this hazard mitigation plan:

- Compton M7.45 = 1,906.49 years
- Puente Hills M6.95 = 3,094.92 years
- Whittier M6.98 = 1,402.56 years
- 100-Year Probabilistic = 1 percent annual chance

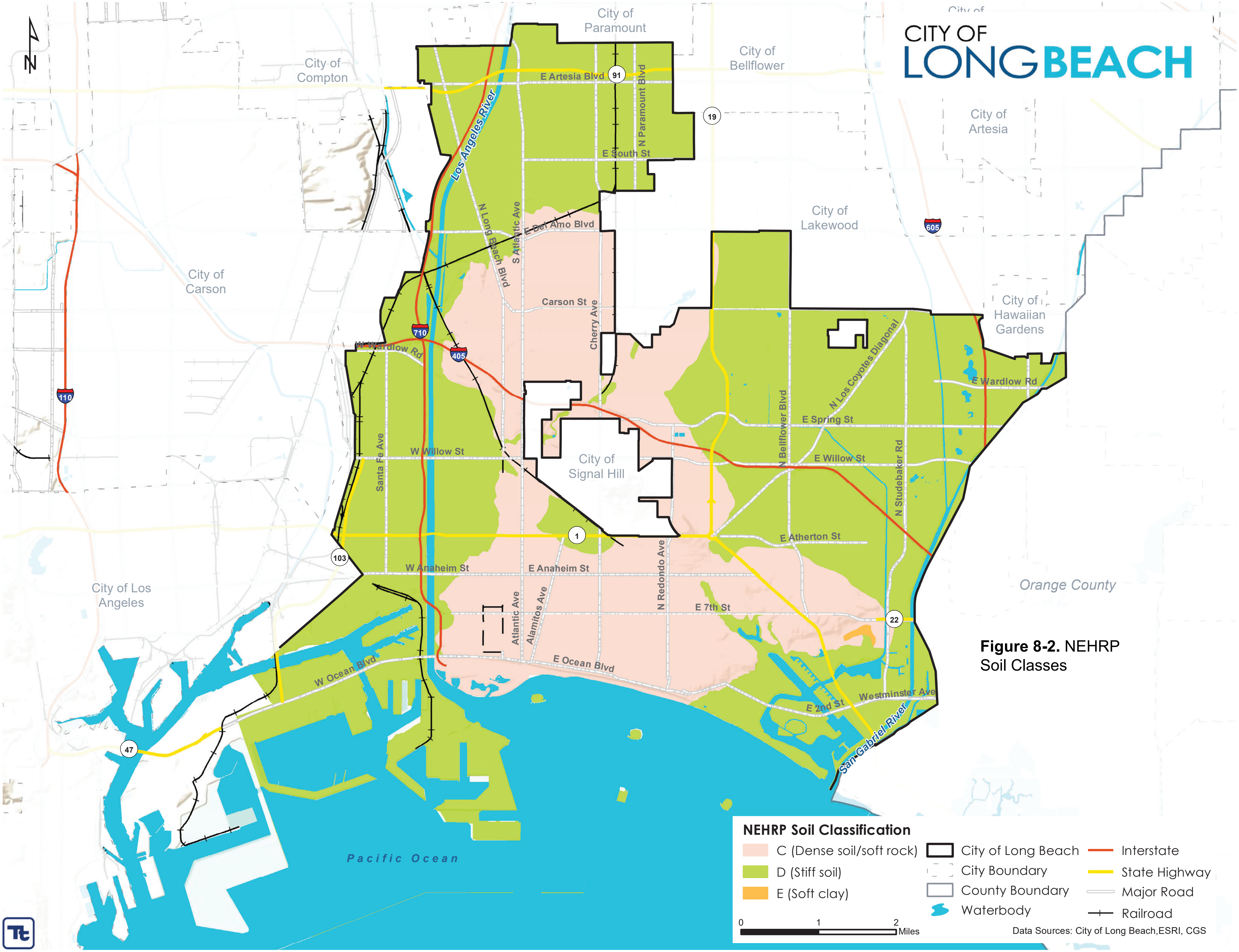

Figure 8-2. NEHRP Soil Classes

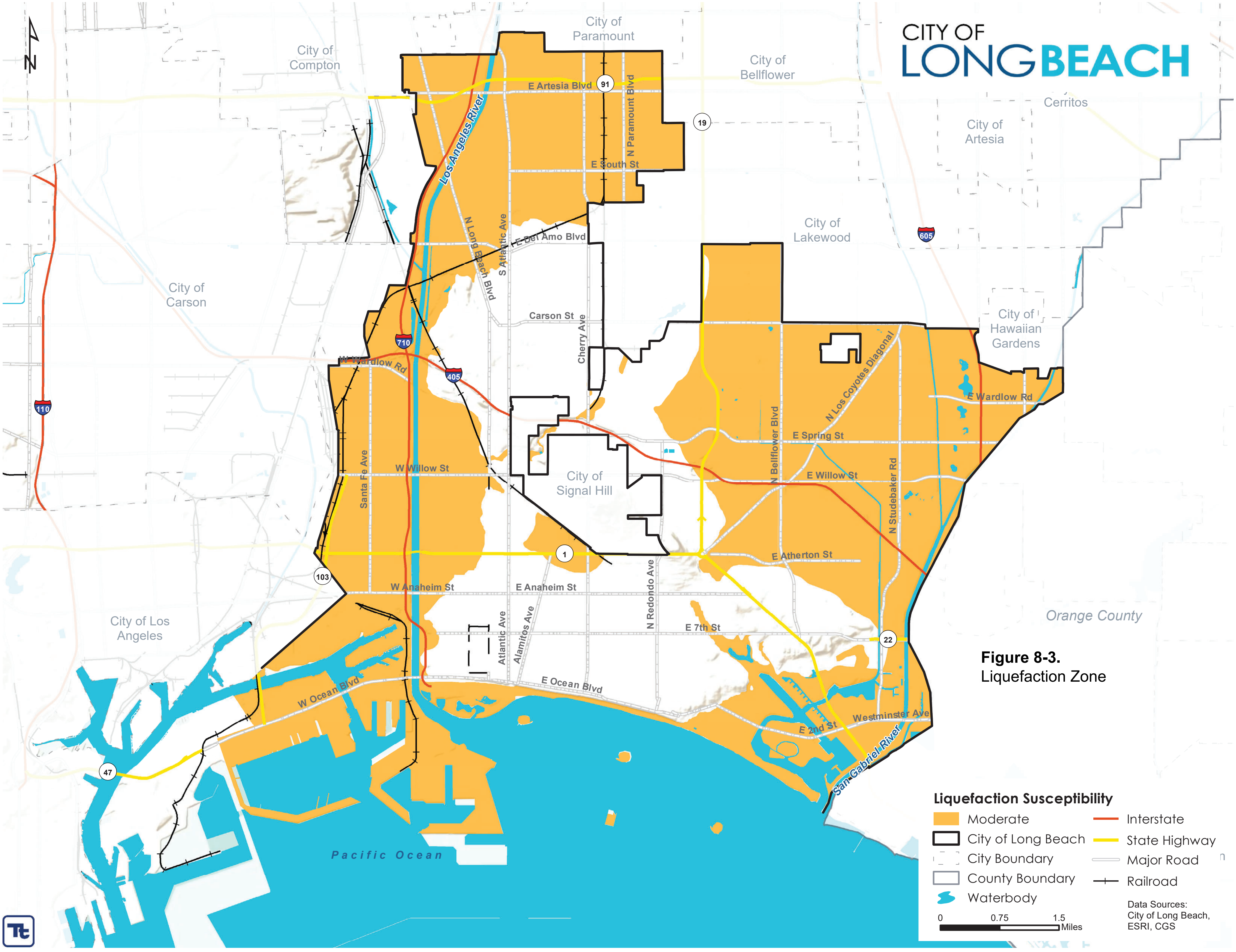

Figure 8-3.
Liquefaction Zone

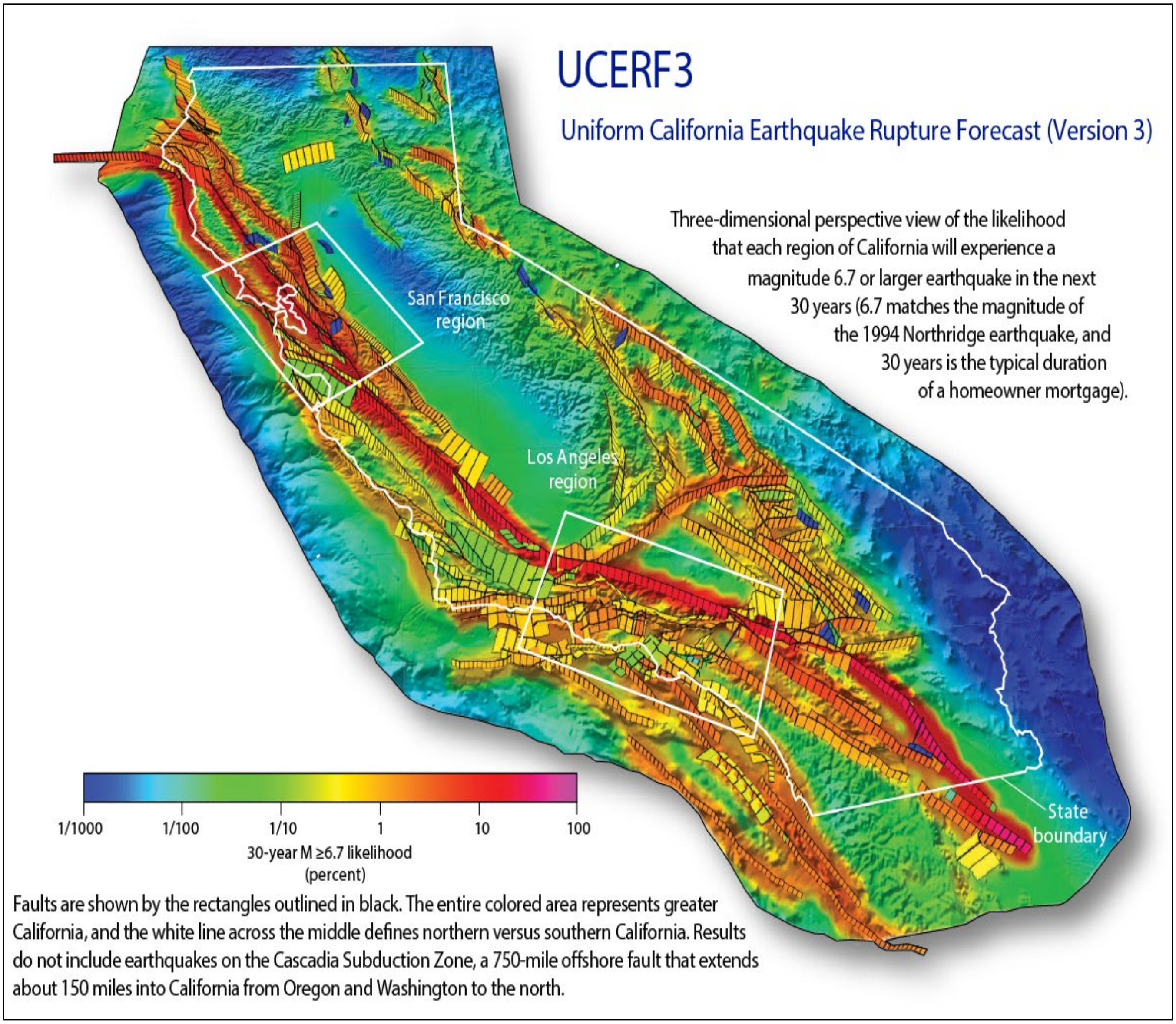

Figure 8-4. UCERF3 Forecast for Magnitude 6.7 or Larger Earthquake in the Next 30 Years

8.2.4 Severity

The USGS has created ground motion maps based on current information about fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The maps were most recently updated in 2014 with new seismic, geologic, and geodetic information on earthquake rates and ground shaking, representing the best currently available data. The 2014 map for California shows that for Long Beach and the greater Los Angeles area, the PGA with a 10-percent probability of exceedance in 50 years is 0.2g to 0.4g (see Figure 8-5). USGS scenario based and probabilistic ShakeMaps also indicate expected ground acceleration for earthquake events that have the potential to occur for a given area.

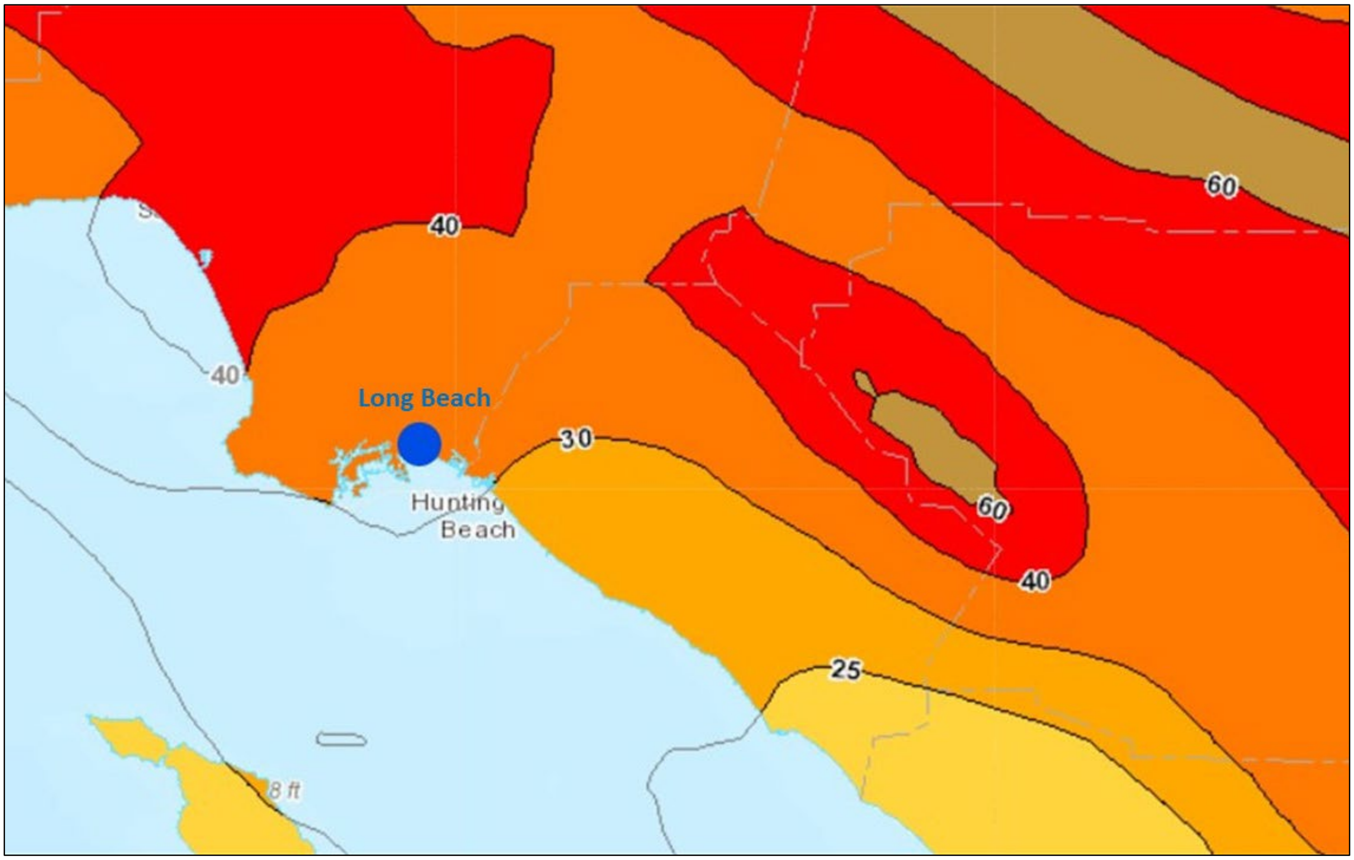

Figure 8-5. PGA with 2-Percent Probability of Exceedance in 50 Years

8.2.5 Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that detect the lower energy compressional waves (P waves) that precede the secondary waves (S waves) experienced as an earthquake. Earthquake early warning systems may provide a few seconds' or a few minutes' notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, pause hazardous or high-risk work, or initiate protective automated systems in structures or critical infrastructure.

New technology is being developed for early warnings. For example, MyShake is a global smartphone seismic network for early warning that can keep users informed about earthquakes. It monitors for earthquakes using data from smartphone sensors.

AlertLongBeach is an emergency notification system used by the City of Long Beach to issue emergency alerts to residents and businesses. In the event of an emergency, severe weather, or any incident that impacts city operations, a text message and/or voice message is sent to the cell number and/or email address that users specify. The system has the capacity to send thousands of messages within minutes via phone, e-mail, and text.

8.3 EXPOSURE

The entire planning area is exposed to the earthquake hazard, so an earthquake has the potential to affect the entire population of 468,894, all 105,404 buildings in the planning area, with a total replacement value of $98.5 billion, all of the planning area's identified critical facilities, and the entire environment of the planning area.

8.4 VULNERABILITY

Earthquake vulnerability data for the risk assessment was generated using a Hazus Level 2 (user-defined) analysis for the scenario events listed in Table 8-4. Summary findings of the risk assessment, showing vulnerability results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

Table 8-4. Earthquakes Modeled for Risk Assessment

Event	Focal Depth	Epicenter Location	Map Figure
100-Year Probabilistic Event	N/A	N/A	Figure 8-6
M-7.5 Compton Fault Scenario	7.4 miles	13 miles north of Long Beach waterfront	Figure 8-7
M-7.2 Newport Inglewood Fault Scenario	6.0 miles	3.3 miles north of Long Beach waterfront	Figure 8-8
M-7.4 Palos Verdes Fault Scenario	5.4 miles	10 miles south of Long Beach waterfront	Figure 8-9

8.4.1 Population

Depending on the severity of the earthquake some people may be directly injured or killed. In addition, homes and businesses may be damaged, resources and supplies may be scarce, business interruptions may keep people from working, utilities may have outages, schools may be temporarily closed, and road closures may cause extra time and travel. All of these indirect effects could impact people who suffered no direct harm from the earthquake. Thus, the entire population must deal with the consequences of earthquakes to some degree.

Estimated Impacts on Persons and Households

Impacts on persons and households in the planning area were estimated for the scenario events assessed through the Level 2 Hazus analysis. Table 8-5 summarizes the results.

Table 8-5. Estimated Earthquake Impact on Persons and Households

Earthquake Scenario	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
100-Year Probabilistic Event	129	105
M-7.5 Compton Fault Scenario	2,259	1,890
M-7.2 Newport Inglewood Fault Scenario	1,053	864
M-7.4 Palos Verdes Fault Scenario	307	268

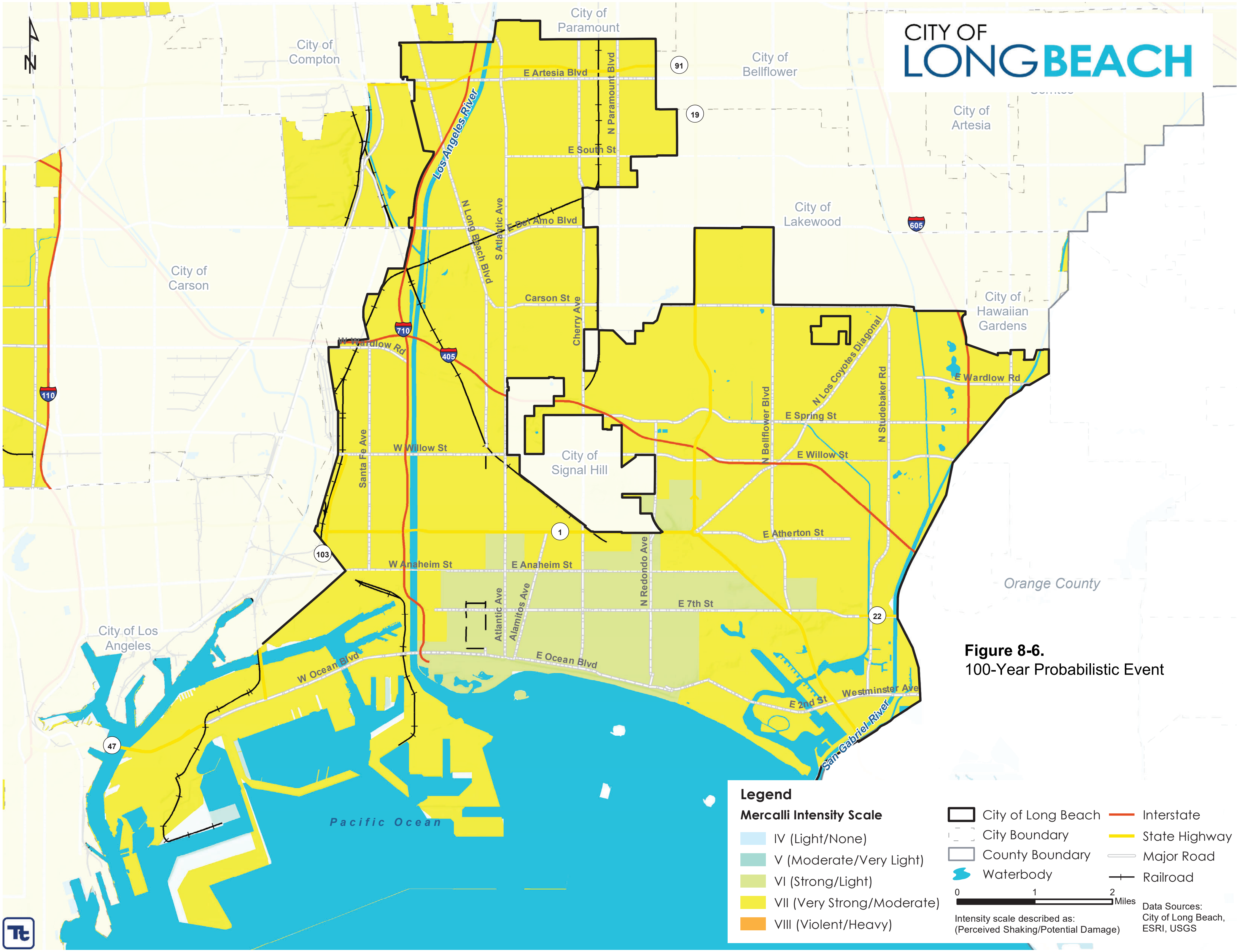

Figure 8-6.
100-Year Probabilistic Event

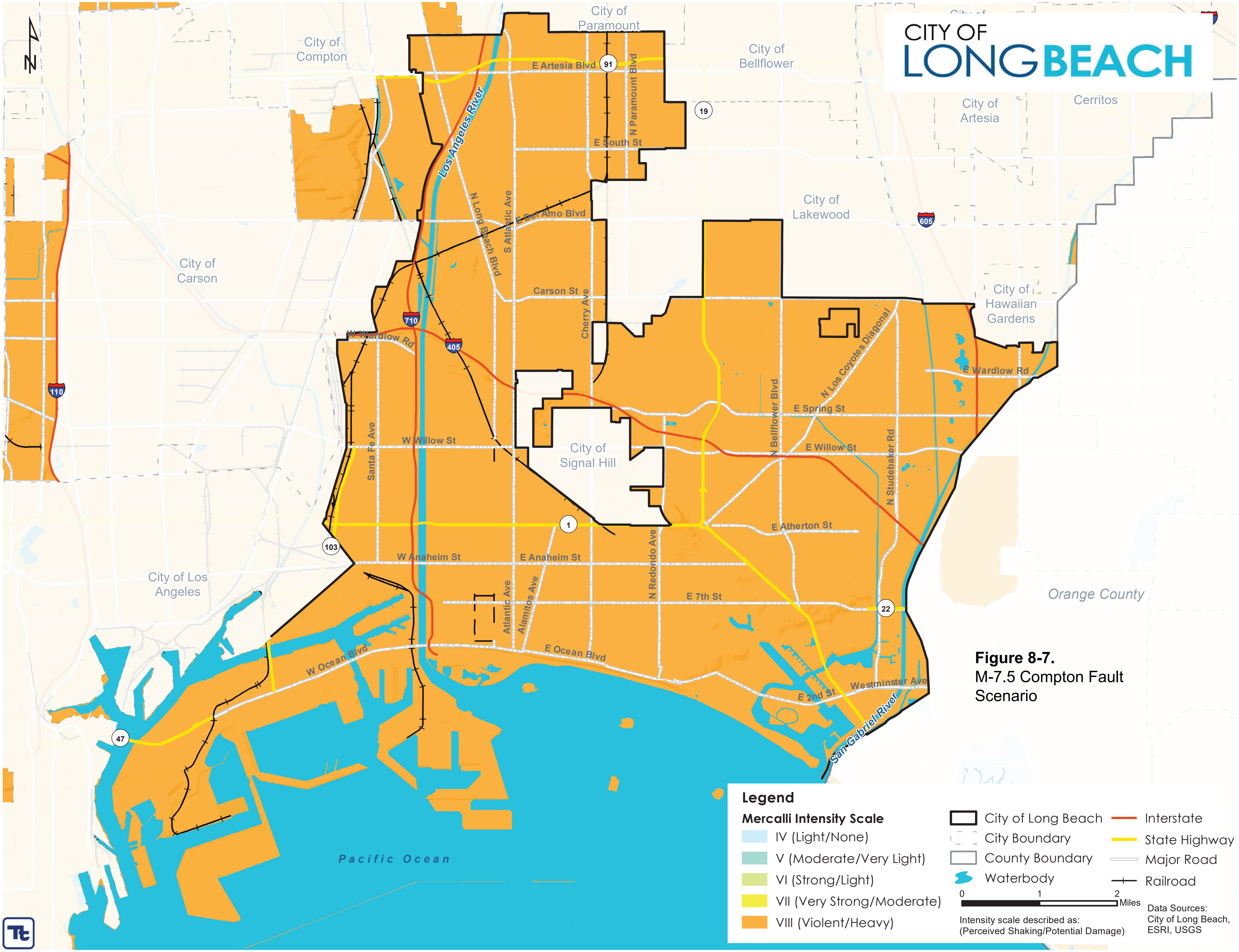

Figure 8-7.
M-7.5 Compton Fault Scenario

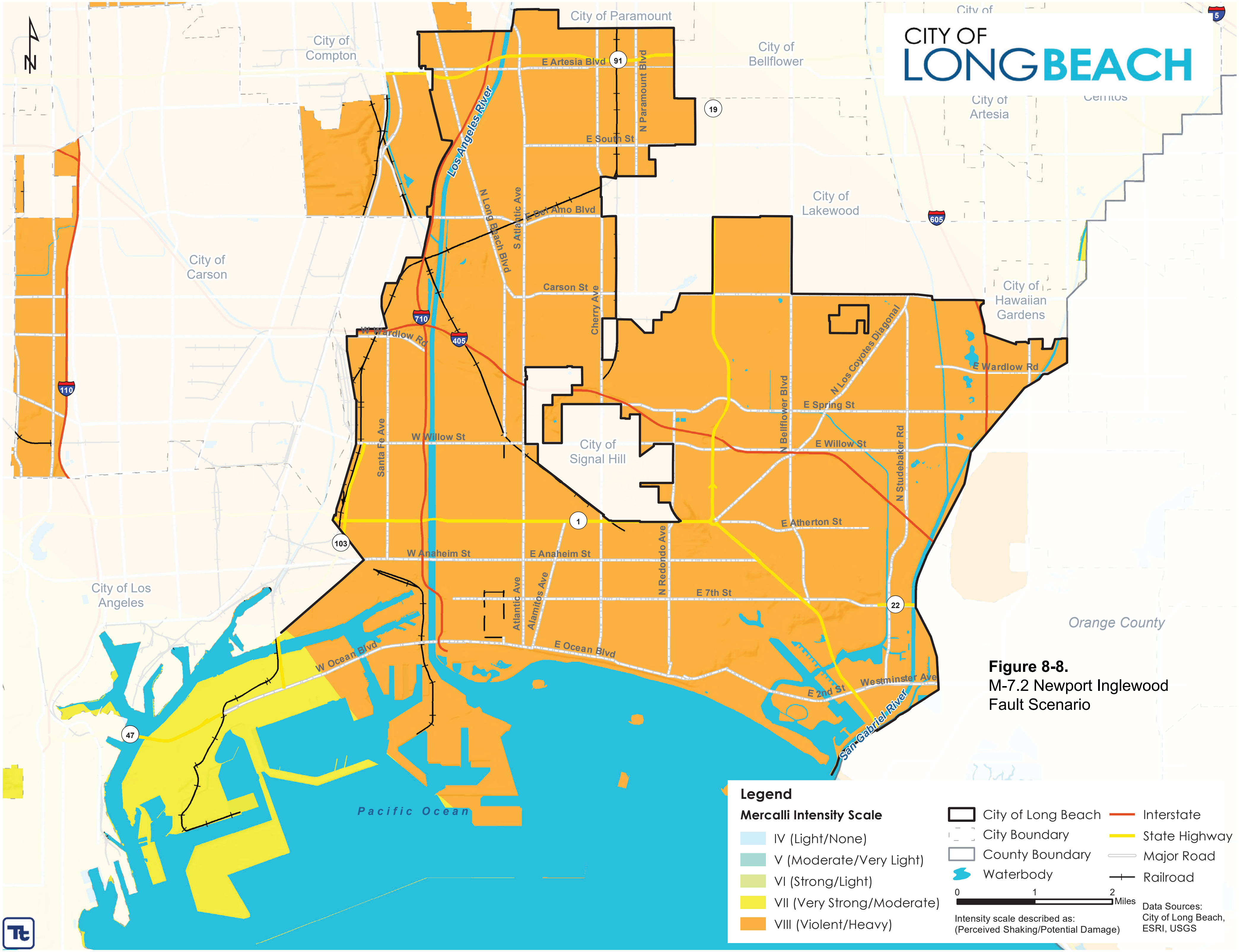

Figure 8-8.
M-7.2 Newport Inglewood Fault Scenario

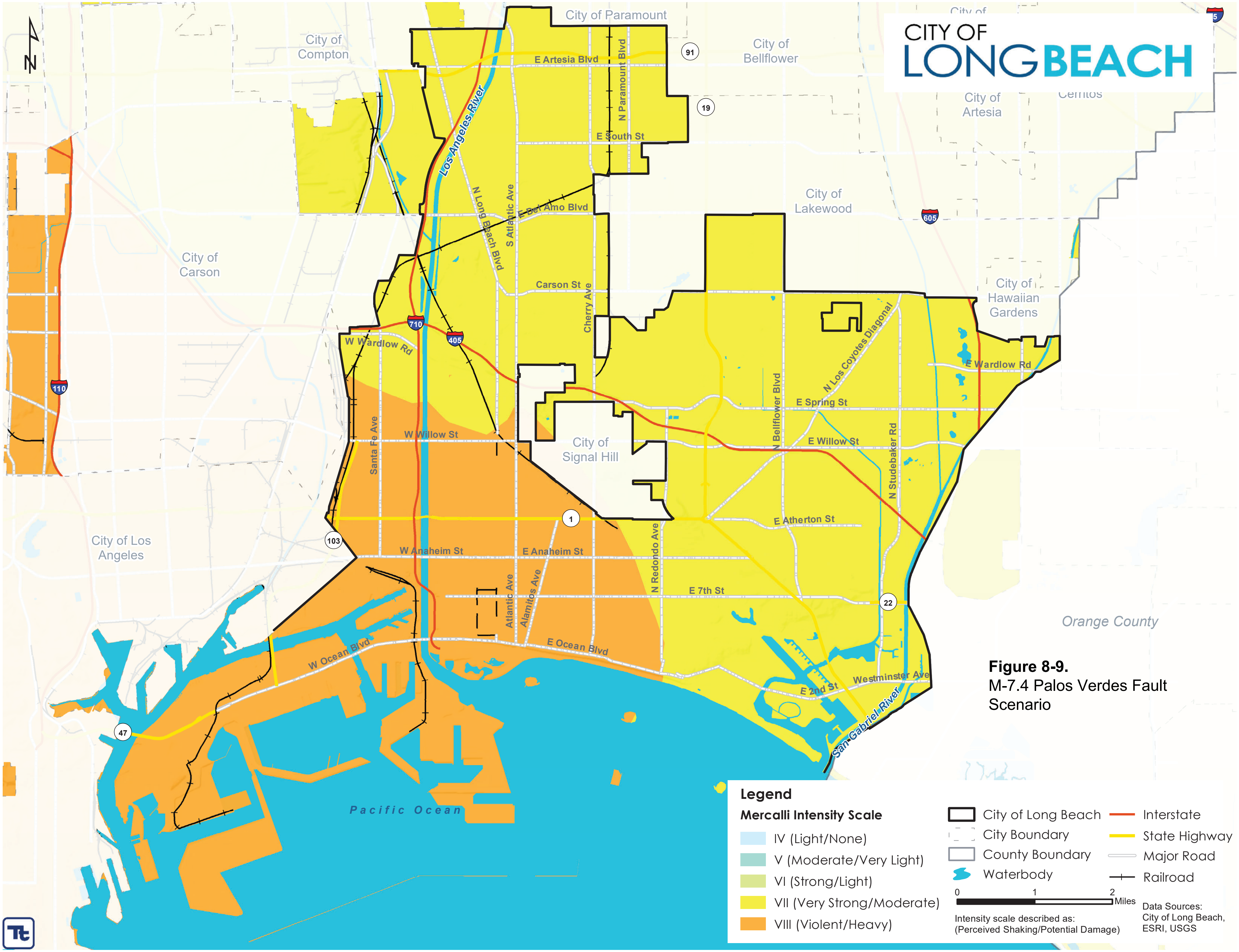

Figure 8-9.
M-7.4 Palos Verdes Fault Scenario

8.4.2 Property

Building Age

Table 8-6 identifies significant milestones in building and seismic code requirements that directly affect the structural integrity of development. Using these time periods, the planning team used Hazus to identify the number of structures in the planning area by date of construction.

Table 8-6. Age of Structures in Long Beach

Time Period	Number of Current Structures Built in Period	Significance of General Time Frame
Pre-1933	24,463	Before 1933, there were no explicit earthquake requirements in building codes. State law did not require local governments to have building officials or issue building permits.
1933 – 1940	7,814	In 1940, the first strong motion recording was made.
1941 – 1960	49,374	In 1960, the Structural Engineers Association of California published guidelines on recommended earthquake provisions.
1961 – 1975	14,731	In 1975, significant improvements were made to lateral force requirements.
1976 – 1993	12,545	In 1994, the Uniform Building Code was amended to include provisions for seismic safety.
1994 – present	4,513	Seismic code is currently enforced.
Total	**113,440**	

The number of structures does not reflect the number of total housing units, as many multi-family units and attached housing units are reported as one structure. Only about 4 percent of the planning area's structures were constructed after the Uniform Building Code was amended in 1994 to include seismic safety provisions. Approximately 22 percent were built before 1933 when there were no building permits or seismic standards.

Loss Potential

Property losses were estimated through the Level 2 Hazus analysis for the assessed earthquake fault scenarios. Table 8-7 shows the estimates for damage to structures and building contents with the percent of total replacement value. The Hazus analysis also estimated the amount of earthquake-caused debris in the planning area for the assessed events, as summarized in Table 8-8.

Table 8-7. Loss Estimates for Fault Scenarios

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
100-Year Probabilistic Event	$2,201,733,787	$1,060,313,187	$3,262,046,974	3.3%
M-7.5 Compton Fault Scenario	$14,187,969,475	$6,088,362,433	$20,276,331,908	20.6%
M-7.2 Newport Inglewood Fault Scenario	$11,560,268,636	$4,795,335,597	$16,355,604,232	16.6%
M-7.4 Palos Verdes Fault Scenario	$6,332,305,262	$2,534,458,619	$8,866,763,880	9.0%

Table 8-8. Estimated Earthquake-Caused Debris

	Debris to Be Removed (tons)
100-Year Probabilistic Event	312
M-7.5 Compton Fault Scenario	4,422
M-7.2 Newport Inglewood Fault Scenario	3,767
M-7.4 Palos Verdes Fault Scenario	2,260

8.4.3 Critical Facilities

Level of Damage

Hazus classifies the vulnerability of critical facilities to earthquake as no damage, slight damage, moderate damage, extensive damage, or complete damage. Hazus was used to assign a category to each critical facility in the planning area for the three earthquake fault scenarios. Figure 8-10 through Figure 8-13 summarize the results.

Time to Restore Critical Facilities to Functionality

Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, Hazus may estimate that a facility has 5 percent chance of being fully functional at Day 3, and a 95-percent chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for the three scenario events assessed. The results are summarized in Figure 8-14 through Figure 8-17.

8.4.4 Environment

Secondary hazards associated with earthquakes will likely have damaging effects on the environment. It is possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

8.5 FUTURE TRENDS IN DEVELOPMENT

Since all of the planning area is located within earthquake hazard zones, all future development will, to some extent, be exposed to the earthquake hazard. The City of Long Beach will strictly enforce all seismic building codes and design standards to prevent loss of life and property from earthquakes. Public education, cooperation with the development community, and individual preparedness are essential.

The City's General Plan has policies directing land use and dealing with issues of geologic and seismic safety. This plan provides the capability to protect future development from the impacts of earthquakes. Deficiencies identified by development reviews can be identified as mitigation actions to increase the capability to deal with future trends in development.

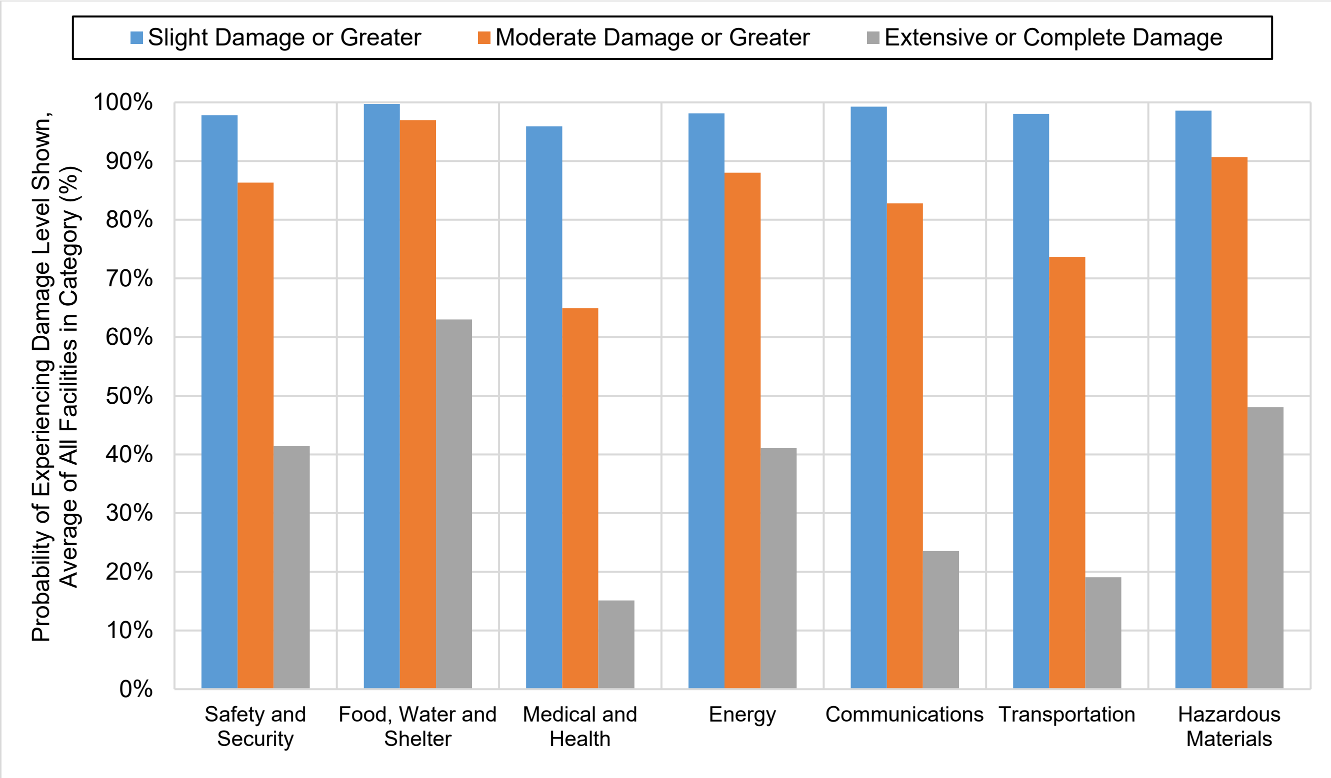

Figure 8-10. Critical Facility Damage Potential, Compton Fault Scenario

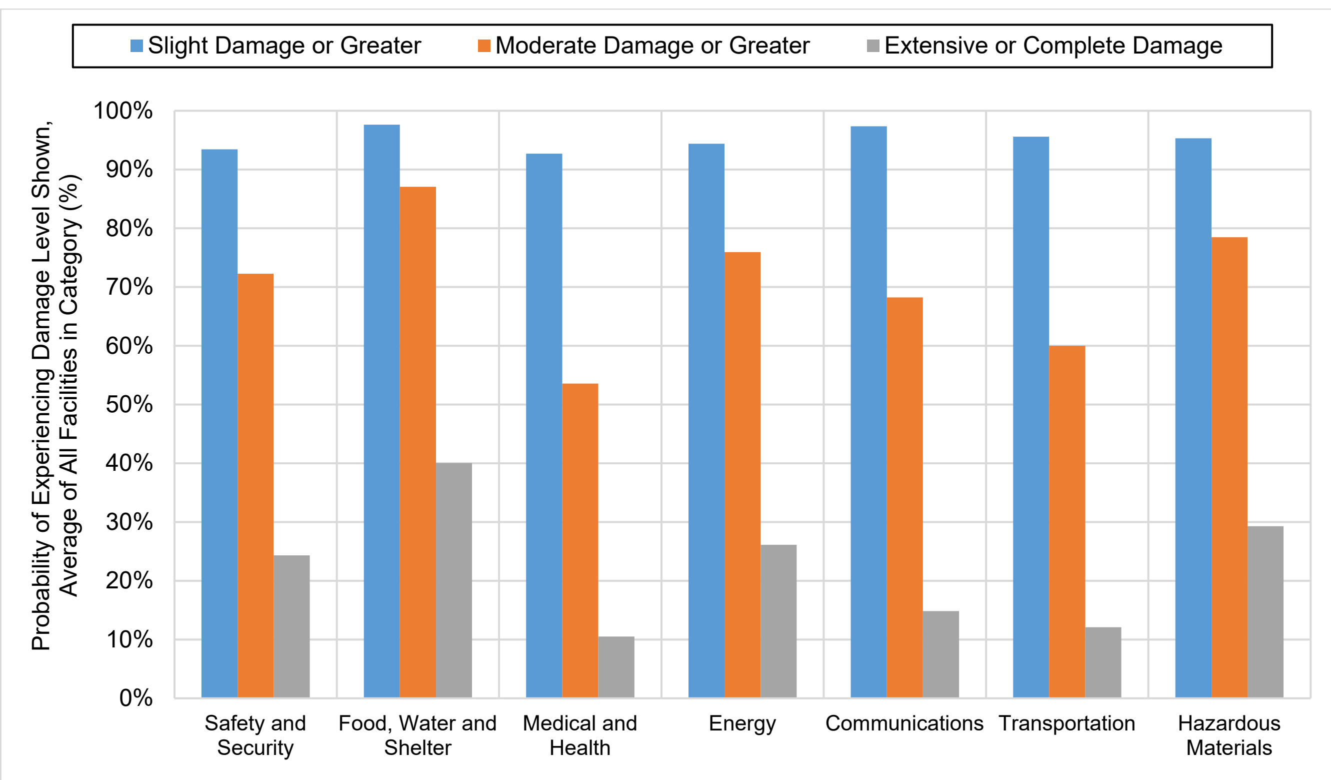

Figure 8-11. Critical Facility Damage Potential, Newport Inglewood Fault Scenario

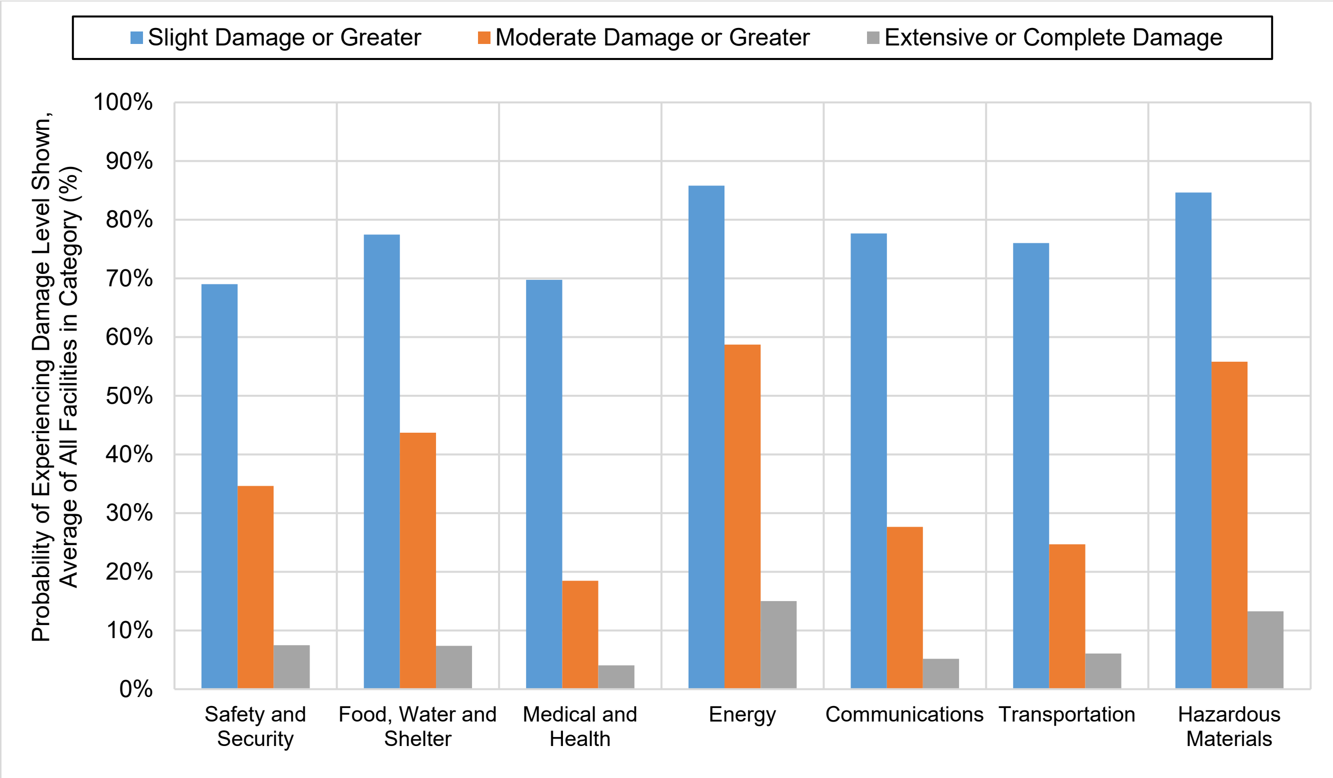

Figure 8-12. Critical Facility Damage Potential, Palos Verdes Fault Scenario

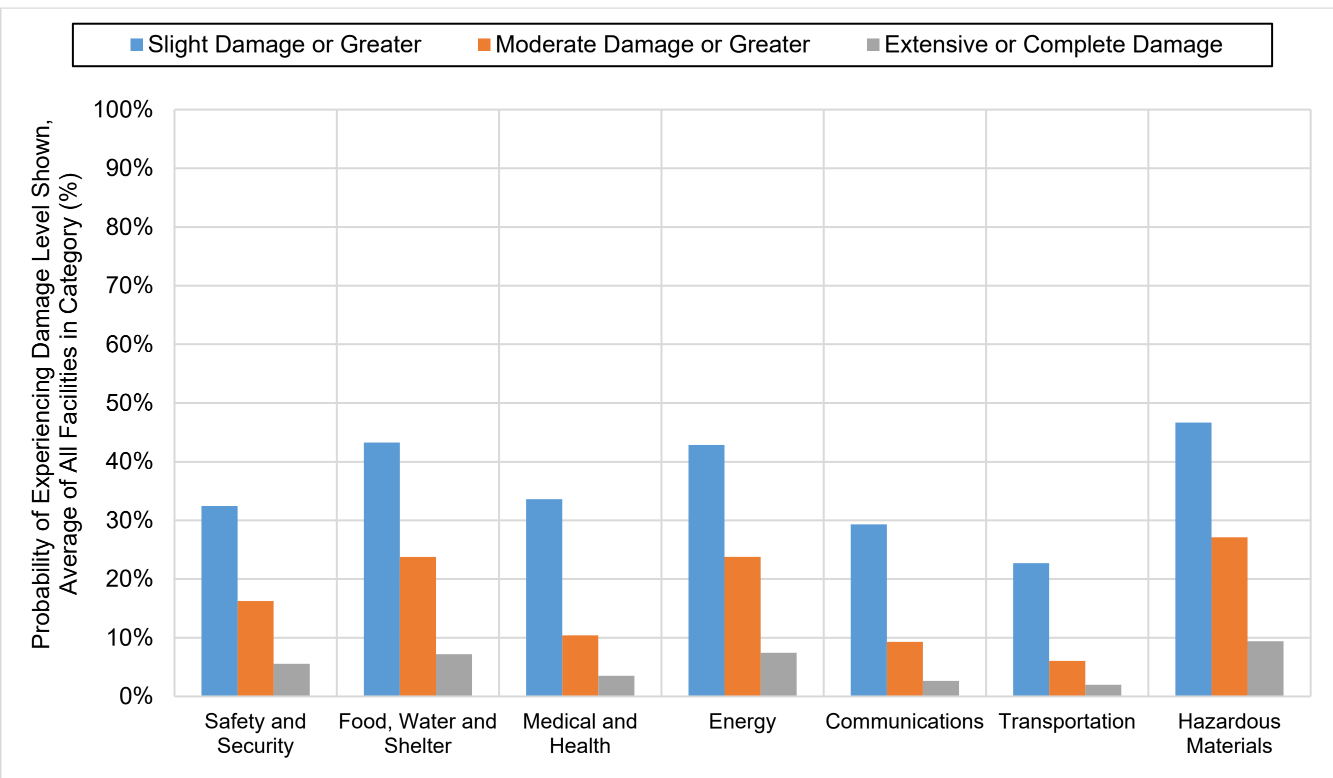

Figure 8-13. Critical Facility Damage Potential, 100-Year Probabilistic Earthquake

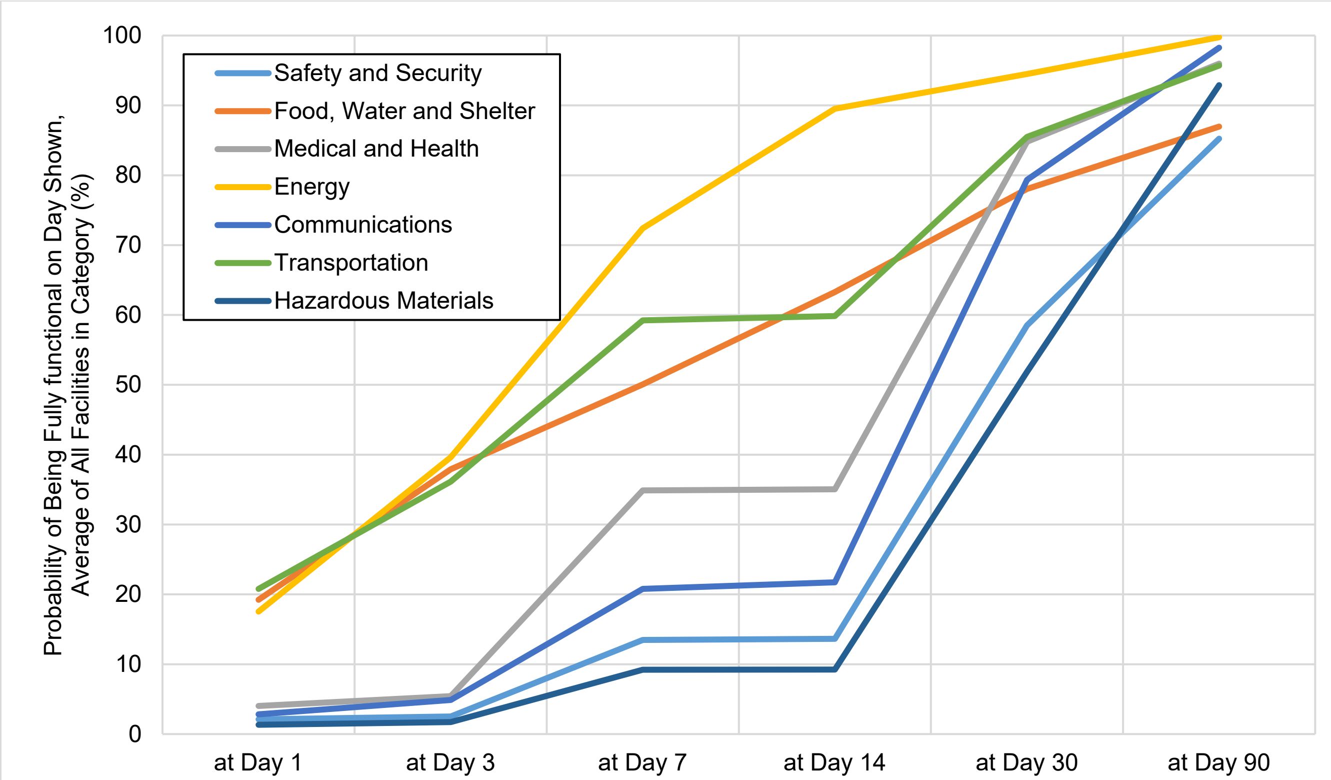

Figure 8-14. Critical Facility Functionality, Compton Fault Scenario

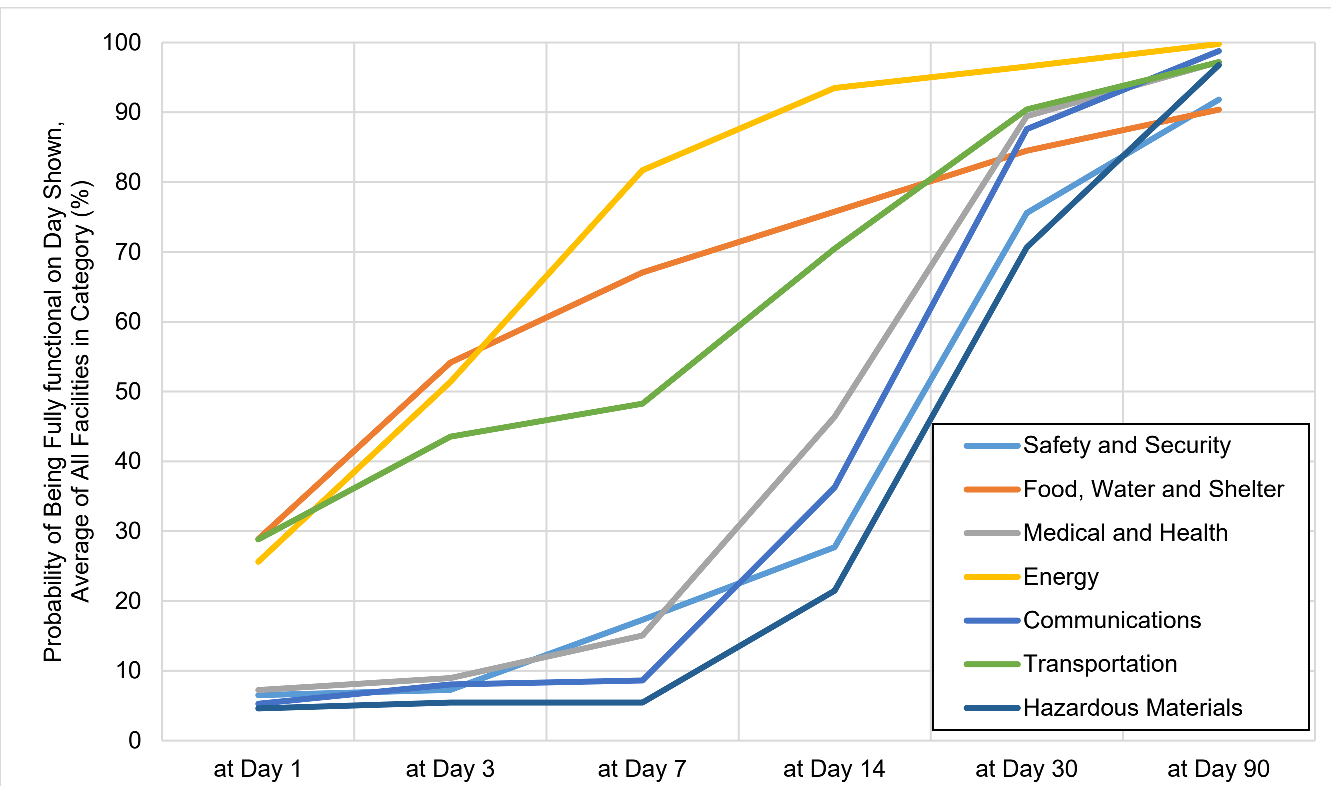

Figure 8-15. Critical Facility Functionality, Newport Inglewood Fault Scenario

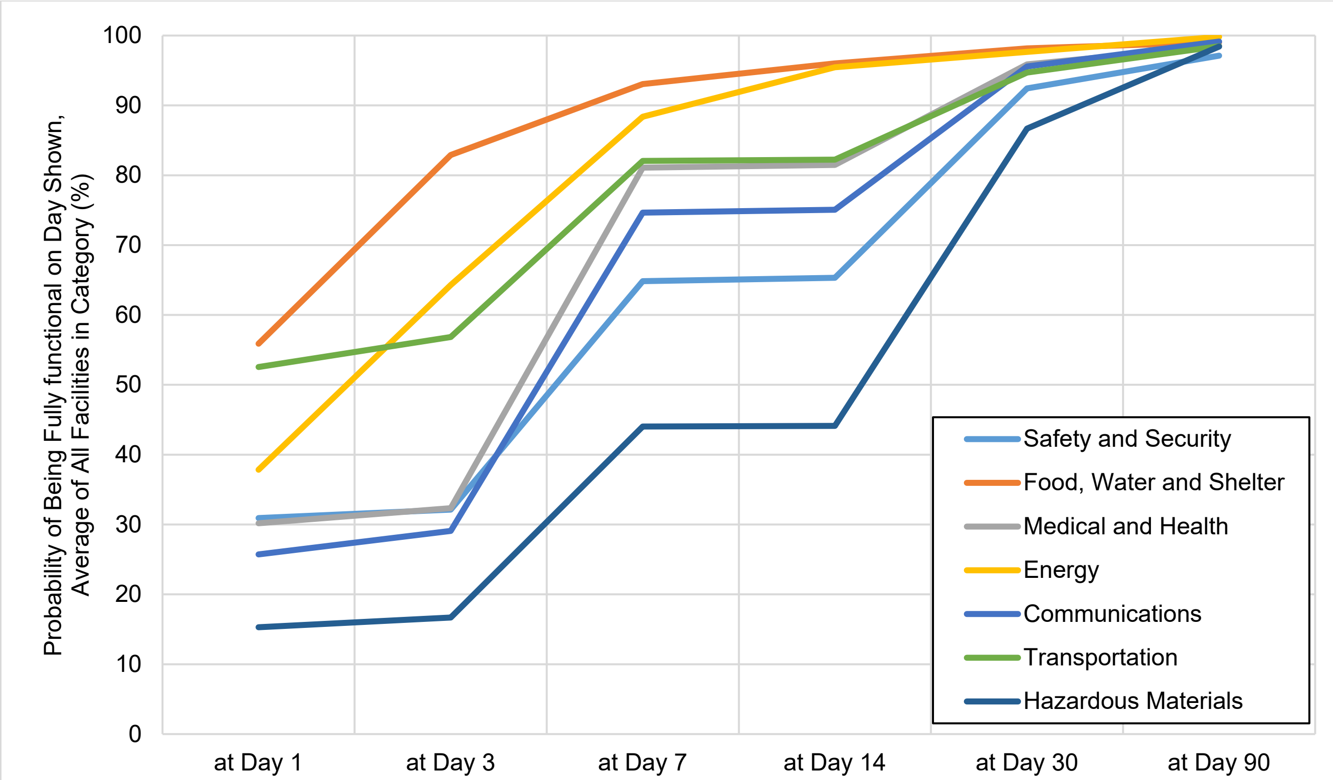

Figure 8-16. Critical Facility Functionality, Palos Verdes Fault Scenario

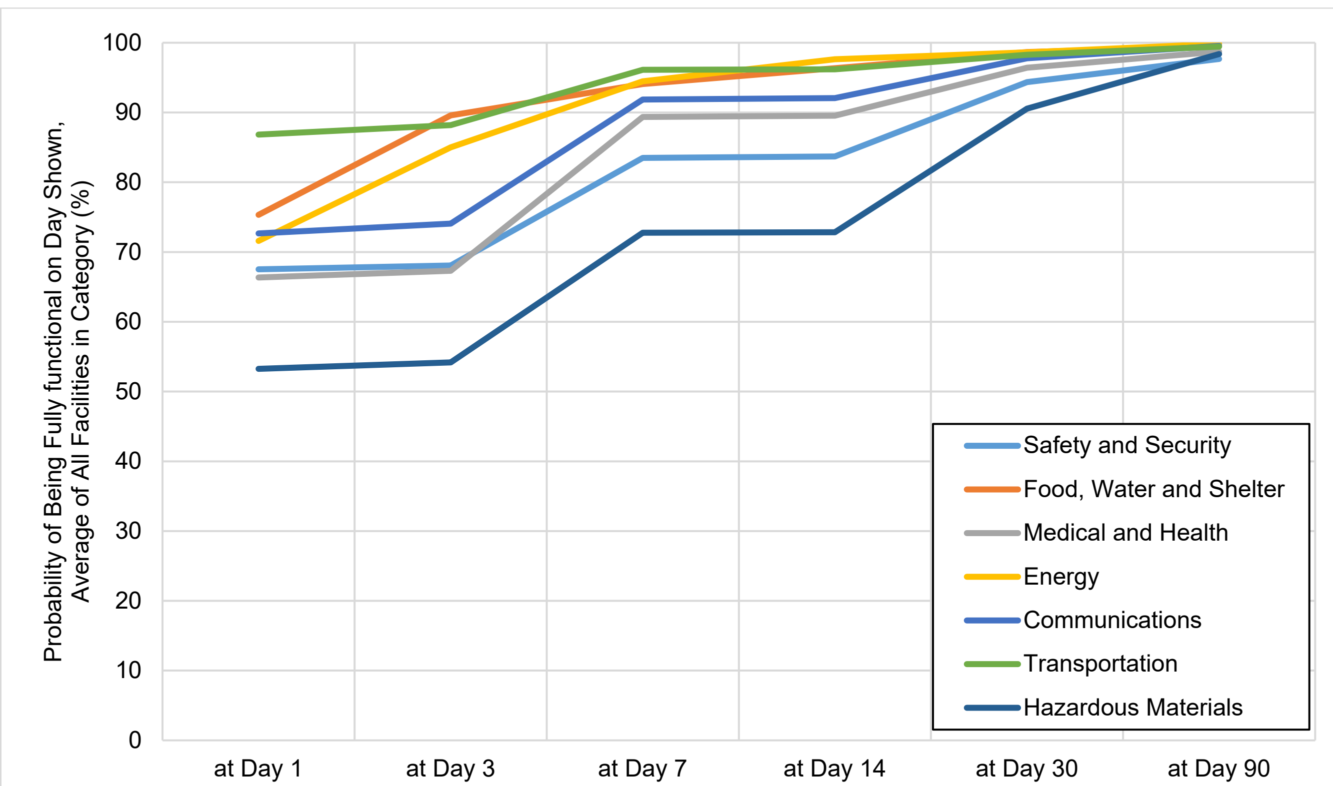

Figure 8-17. Critical Facility Functionality, 100-Year Probabilistic Earthquake

8.6 SCENARIO

With the abundance of fault exposure in southern California, the potential scenarios for earthquake activity are many. Any earthquake above a magnitude of 5.0 or greater on faults near the planning area would have significant impacts throughout the city. With the added factor of the liquefaction potential throughout the entire city, structural failure of buildings, damage to utilities such as water pipes and wells, and sources of power are inevitable. Potential warning systems could give approximately 40 seconds notice that a major earthquake is about to occur but would not provide enough warning other than to duck, cover and hold on for personal safety.

8.7 ISSUES

Important issues associated with an earthquake include the following:

- More than 80 percent of the planning area's building stock was built prior to 1975, when seismic provisions became uniformly applied through building code applications.
- More information is needed on the exposure and performance of soft-story construction within the planning area.
- Based on the modeling performed for this plan, some critical facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.
- Emergency management personnel for critical facilities should create or enhance continuity of operations plans to use the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that consider the probable impacts from earthquakes in the design and construction of new or enhanced facilities.

  Failure of the Whittier Narrows Dam as a result of an earthquake would severely affect the planning area. Warning and evacuation plans and procedures should be reviewed and updated to reflect the dam's risk potential associated with earthquake activity in the region.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Levee failures would happen at multiple locations, increasing the impacts of the individual events.

9. SEVERE WEATHER

9.1 GENERAL BACKGROUND

9.1.1 Extreme Heat

In most of the United States, extreme heat is defined as a period (two to three days) of high heat and humidity with temperatures above 90 ºF. In extreme heat, evaporation is slowed, and the body must work extra hard to maintain a normal temperature, which can lead to death by overworking the human body. Extreme heat can cause heat exhaustion, in which the body becomes dehydrated, resulting in an imbalance of electrolytes. Without intervention, heat exhaustion can lead to collapse and heatstroke. Heatstroke occurs when perspiration cannot occur, and the body overheats. Without intervention, heatstroke can lead to confusion, coma, and death.

Extreme heat often results in the highest number of annual deaths among all weather-related hazards. Older adults, children, and sick or overweight individuals are at greater risk from extreme heat. According to the California Climate Adaptation Strategy, heat waves have claimed more lives in California than all other declared disaster events combined. It can take several days of oppressive heat for a heat wave to have a significant or quantifiable impact. Heat waves do not strike victims immediately, but their cumulative effects slowly cause harm to vulnerable populations.

Excessive heat is the primary weather-related cause of death in the United States, claiming over 100 lives each year. In a 30-year record of weather fatalities across the nation (1990-2019), excessive heat claimed more lives each year than floods, lightning, tornados, and hurricanes (Erdman 2021). Extreme heat events do not typically impact buildings; however, losses may be associated with the urban heat island effect and overheating of heating, ventilation, and air conditioning systems. These extreme heat events can lead to drought, impact water supplies, and lead to an increase in heat-related illnesses and deaths.

Legislation has been introduced in California to rate and name heat waves. The categorization would help communities take measures to reduce the number of heat-related fatalities (Washington Post 2021).

9.1.2 Fog

Fog is a cloud near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. This occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents and airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States, but it is known to be substantial. Fog can occur almost anywhere during any season and is classified based on how it forms, which is related to where it forms. Certain seasons are more likely to have foggy days or nights based on a number of factors, including topography.

Although fog seems like a minor hazard, it can have significant impacts. Heavy fog can impair the vision of drivers, resulting in vehicle accidents that can cause injury and death.

9.1.3 High Winds

Windstorms are generally short-duration events involving straight-line winds or gusts of over 50–60 mph, strong enough to cause property damage. Damage from such winds accounts for half of all severe weather reports in the lower 48 states. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. The Beaufort Wind Chart (Table 9-1) provides terminology and a description of potential wind impacts at different levels.

Table 9-1. Beaufort Wind Chart

Beaufort Number	Range (mph)	Terminology	Description
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke.
2	4-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	Fresh breeze	Smaller trees sway
6	25-31	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use is difficult.
7	32-38	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Sever gale	Light structure damage.
10	55-63	Storm	Trees uprooted. Considerable structural damage.
11	64-73	Violent storm	Widespread structural damage.
12	74-95	Hurricane	Considerable and widespread damage to structures.

Source: (NWS n.d.)

The following types of damaging winds represent a hazard within the planning area:

- **Santa Ana Winds**—In Southern California, strong, dry, gusty winds known as Santa Ana winds form when air from a region of high pressure over the desert region of the southwestern U.S. flows westward toward low pressure areas off the California coast. As the wind flows over the Sierra Nevada and Santa Ana mountains, dropping from high elevation to sea level, it becomes compressed and heats up, and its relative humidity drops. Gaps in mountains form wind tunnels that strengthen these winds as they pour warm air east to west through the canyons. Santa Ana winds may occur year-round but are most common from September through March. A Santa Ana wind event can yield sustained winds of 40 miles per hours; isolated wind gusts of over 80 miles per hour have been recorded.
- **Downdrafts**—A downdraft is a small-scale column of air that rapidly sinks toward the ground.

- **Downbursts**—A downburst is a strong downdraft with horizontal dimensions larger than 2.5 miles, resulting in an outward burst or damaging winds on or near the ground. Downburst winds may sometimes produce damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts**—Microbursts are small, concentrated downbursts that produce an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph.
- **Tornados**—Tornados are formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density, and wind flow. Tornados have occurred in the planning area but are not common.

Windstorms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, and other damage. Wind speeds as low as 32 mph can cause structural damage, and winds of 100 mph can destroy wood-frame structures. They can also cause direct losses to buildings, people, and vital equipment. There are direct consequences to the local economy resulting from windstorms and the associated physical damage and interrupted services.

Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. As positive and negative forces impact a building's doors, windows, and walls, the result can be roof or building component failures and considerable structural damage. The effects of winds are magnified in the upper levels of multi-story structures.

Debris carried along by extreme winds can contribute directly to loss of life and indirectly to the failure of protective building envelopes. Falling trees and branches can damage buildings, power lines, and other property and infrastructure. Tree limbs breaking in winds of only 45 mph can be thrown over 75 feet, so overhead power lines can be damaged even in relatively minor windstorm events. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds. Utility lines brought down by summer thunderstorms have also been known to cause fires, which start in dry roadside vegetation. Electric power lines falling down to the pavement create the possibility of lethal electric shock.

Downed trees and power lines, and damaged property also can be major hindrances to emergency response and disaster recovery. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric service and from extended road closures.

9.1.4 Thunderstorms

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or a tornado. Approximately 10 percent of the 100,000 thunderstorms that occur nationally every year are classified as severe.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

There are four types of thunderstorms:

- **Single-Cell Thunderstorms**—Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm**—A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods, and weak tornados. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line**—A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornados, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm**—A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornados.

Lightning, which occurs in all thunderstorms, is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a “bolt.” This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000 ºF. The rapid heating and cooling of air near the lightning causes thunder.

In the United States, about 100 people are struck and killed by lightning each year. Lightning also causes forest and brush fires and deaths and injuries to livestock and other animals. According to the National Lightning Safety Institute, lightning causes more than 26,000 fires in the United States each year. The institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $6 billion per year. Impacts can be direct or indirect. “Lightning sieges” are extreme lightning events in which lightning strikes multiple points at once.

9.1.5 Secondary Hazards

Extreme heat can exacerbate drought conditions and poor air quality. During summer months, stagnant atmospheric conditions trap humid air and pollutants near the ground and closer to residents. Ozone, a major component of smog, is created in the presence of sunlight via reactions between chemicals in gasoline vapors and industrial smokestacks. Hot weather can increase ozone levels. High ozone levels often cause or worsen respiratory problems.

High winds can quickly cause or spread wildfires, inundating nearby areas with heavy smoke. Erosion along coastal areas can be affected when high winds associated with winter storms increase the intensity of the surf.

9.2 HAZARD PROFILE

9.2.1 Past Events

Table 9-2 summarizes extreme heat, fog, high wind and thunderstorm events in the Los Angeles County coastal area as recorded in the NCEI Storm Events Database or reported by local news sources. These events often cover many coastal communities and may not be specific to Long Beach.

9.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Wind events are most damaging to areas where trees and power lines can be knocked down. Extreme heat events may be exacerbated in the City where reduced air flow, reduced vegetation, and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding less urbanized areas. Regions near the coast are more likely to experience fog.

9.2.3 Frequency

Table 9-3 summarizes search results from the National Center for Environmental Information Storm Events Database for Los Angeles County storm events over the 20-year period from 2002 through 2022. Based on these results, wind and thunderstorm events are likely to happen every year, significant heat events once every three years, and major fog events once every 20 years.

Table 9-2. Recent Severe Weather Events in Long Beach and Coastal Los Angeles County

Date[a]	Event Type	Deaths or Injuries	Property Damage
January 18, 2017	Thunderstorm	0	Downed power lines and trees. Water damage to city owned buildings.
Intense rain and winds toppled trees and downed wires in multiple parts of Long Beach. Parks, Recreation, and Marine administration building sustained damage.			
February 2, 2019	Microburst/Tornado	0	Downed power lines and trees
Intense rain and winds toppled trees and downed wires in multiple parts of Long Beach. A microburst or tornadic-like winds hit the Aircraft Manor neighborhood, reported by a number of residents.			
January 9, 2018	Microburst	0	Tree fell into a house
A sudden explosion of gusty winds knocked a tree into a house in Long Beach.			
January 31, 2016	High Winds	0	Unknown
Strong, sustained winds of 41 mph impacted the coast of Los Angeles County.			
September 3, 2007	Excessive Heat	8	None
A combination of above normal temperatures and relative humidity produced excessive heat across the coastal plain of Los Angeles County. Heat index values between 105 and 112 ºF were reported.			
December 28, 2004	Tornado	0	Downed trees and damaged roofs
On the coastal plain of Los Angeles County, weak tornados were reported in Long Beach, Inglewood and Whittier. The tornados produced only minor damage, including downed trees and damaged roofs.			
January 6, 2003	High Winds	0	Downed power lines and trees
Powerful Santa Ana winds buffeted Ventura and Los Angeles counties. Northeast winds gusting up to 75 mph knocked down numerous trees and power lines across the area.			
November 25, 2002	High Winds	0	Downed power lines and trees
Powerful Santa Ana winds buffeted Los Angeles and Ventura counties. Thousands were left without power as the winds snapped power lines. Many communities reported numerous trees were blown down.			
November 3, 2002	Dense Fog	41	194 damaged vehicles
Dense fog contributed to a major collision on Interstate 710 in Los Angeles County. In total, 194 vehicles were involved in the accident. Forty-one people were injured.			
March 13, 2002	High Winds	0	Boat sank
Gusty northwest winds between 30 and 40 mph knocked a 16-foot boat into the breakwater in Long Beach Harbor. No one was injured, but the boat sank.			
February 13, 2001	High Winds	0	Boat sank
A powerful Pacific storm brought heavy rain and gusty winds to Central and Southern California. Across coastal and valley areas of Ventura and Los Angeles counties, southeast winds of 30 to 50 mph developed and produced some damage. The worst wind damage was in San Pedro Harbor where several docks were damaged and one boat was sunk.			
March 5, 2000	Thunderstorm Winds	0	Downed power poles
A severe thunderstorm struck the City of Long Beach. Downburst winds, gusting up to 70 mph, blew down numerous power poles near the intersection of Stearn Street and Redondo Lane.			

a. Not all events are reported; therefore, severe weather event frequency may be significantly higher.
Source: (National Climatic Data Center 2022); (Press-Telegram 2018); (LB Report 2019)

Table 9-3. Los Angeles County Severe Weather Events, January 2002 – February 2022

Event Types Included[a]	Total Number of Events	Number of Days with: Event	Event and Death or Injury	Event and Property Damage	Average Years Between Days with Event
High Wind					
High Wind, Marine High Wind, Marine Strong Wind, Marine Thunderstorm Wind, Strong Wind, Thunderstorm Wind, Tornado	374	223	2	0	<1
Excessive Heat					
Excessive Heat, Heat	17	7	1	0	3
Thunderstorm					
Hail, Heavy Rain, Lightning, Marine Thunderstorm Wind, Thunderstorm Wind	40	30	2	2	<1
Fog					
Dense Fog, Freezing Fog	1	1	1	0	20

a. Event types are the categories available for search in the National Center for Environmental Information Storm Events Database
Source: National Center for Environmental Information Storm Events Database

9.2.4 Severity

Extreme Heat

The Los Angeles basin is experiencing hotter weather and more heat waves. Over the past 100 years, the average annual maximum temperature has warmed by 5.0° F, and the average annual minimum temperature has warmed by 4.2 °F. The greatest rate of change was during the summer for both maximum and minimum temperature, with late fall and early winter having the least rates of change. There was also an increase in heat wave duration. Heat waves lasting longer than six days occurred regularly after the 1970s, but were nonexistent from 1906 until 1956, when the first six-day heat wave was recorded (Tamrazian, et al. 2008). Climate change is likely to bring hotter temperatures, more hot days, and more frequent heat waves. As the population ages and climate change brings more extreme heat events, rates of heat-related impairments and deaths may rise.

Fog

While fog is not likely to damage property or lead to large impacts on the population within the planning area, reduced visibility caused by fog can impact transportation in the planning area. Highway accidents involving fog are often chain-reaction collisions involving dozens or even hundreds of vehicles, frequently accompanied by high casualty figures. The November 2002 fog event that led to a multi-vehicle accident on Interstate 710 in Los Angeles County resulted in 41 injuries.

High Winds

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities and trees. The predicted wind speed given in wind warnings issued by the National Weather Service (NWS) is for a one-minute average; gusts may be 25 to 30 percent higher. Lower wind speeds are still high enough to knock down trees and power lines and cause other property damage.

Thunderstorms

Thunderstorms have multiple associated events that present hazards to people and property. Records for Los Angeles County from 2002 through 2022 show the following levels of severity:

- Hail of 1 inch or more in diameter was recorded on five occasions
- Winds associated with thunderstorms were recorded up to 78 mph
- Lightning on three occasions led to one death and 10 injuries

9.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe weather event. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of a storm. Some storms may come on quickly, with only a few hours of warning time. The Los Angeles/Oxnard Weather Forecast Office of the NWS monitors weather stations and issues watches and warnings to alert government agencies and the public of possible or impending weather events for Long Beach when appropriate. The watches and warnings are broadcast over NOAA weather radio, posted on the NWS website, and forwarded to the local media for retransmission using the Emergency Alert System.

9.3 EXPOSURE

All people and property and the entire environment of the planning area is exposed to some degree to the severe weather hazard.

9.4 VULNERABILITY

9.4.1 Population

Vulnerability by Type of Weather

Population vulnerabilities to specific types of extreme weather event are as follows:

- **Extreme Heat**—Individuals with physical or mobility constraints, cognitive impairments, economic constraints, or social isolation are typically at greater risk from the adverse effects of excessive heat events. The average summertime mortality for excessive heat events is dependent upon the methodology used to derive such estimates. Certain medical conditions, such as heat stroke, can be directly attributable to excessive heat, while others may be exacerbated by excessive heat, resulting in medical emergencies.
- **Fog—**Fog-related injuries and fatalities typically result from the challenging driving conditions fog creates. Low visibility and wet or slippery conditions, coupled with speeding motorists, can result in deadly single or multi-vehicle accidents.
- **High Winds**—Damaging winds can cause injuries and fatalities in a number of ways. Downed trees may fall on homes or cars, killing or injuring those inside. Objects that are not secured can be picked up in wind events and become projectiles. Structures that collapse or blow over during damaging wind events may kill or injure those inside. Electric power lines falling to the pavement create the possibility of lethal electric shock. High winds can spread wildfires in

surrounding areas and blow heavy smoke into the planning area, causing health and respiratory issues.

- **Thunderstorms (and associated lightning and hail)**—Thunderstorm-related deaths and injuries in the planning area are most likely to result from accompanying wind and heavy rain. Most injuries and deaths associated with lighting strikes occur when people are outdoors; however, almost one-third of lightning-related injuries occur indoors. Males are five times more likely than females to be struck by lighting and people between the ages of 15 and 34 account for 41 percent of all lightning strike victims (CDC 2013).

9.4.2 Property

Loss estimations for the severe weather hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 1 percent, 3 percent and 5 percent of the replacement value of exposed structures:

- Loss of 1 percent of planning area replacement value—$469.2 million
- Loss of 3 percent of planning area replacement value—$1.4 billion
- Loss of 5 percent of planning area replacement value—$2.35 billion

These estimates allow emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure.

Provisions for wind loads in structure building codes have continued to evolve over recent decades. Older buildings constructed to previous codes with less stringent wind load requirements are considered to be especially vulnerable to the extreme weather hazard, with structures in poor condition or in particularly vulnerable locations at greatest risk for damage. The frequency and degree of damage depends on specific locations.

9.4.3 Critical Facilities

All critical facilities are vulnerable during severe weather events, especially those that lack backup power generation capabilities. When facilities supplying power to planning area land line telephone systems are frequently disrupted, significant issues arise with communication in the planning area. In addition, some facilities are particularly vulnerable to specific types of severe weather events:

- **Extreme Heat and Fog**—Extreme heat and fog are generally not a threat to damage facilities or infrastructure.
- **High Winds**—Critical facilities in the direct path of high winds would be particularly vulnerable. Facilities located near trees or power lines that are likely to fall are also vulnerable. Roads and other transportation infrastructure could be blocked by downed trees or other debris.
- **Thunderstorms**—Facilities located in areas prone to localized or major flooding are vulnerable. Transportation systems are vulnerable to disruption from flooding or secondary hazard such as landslides.

9.4.4 Environment

The environment is highly vulnerable to severe weather events. Natural habitats such as streams and trees exposed to the elements during a severe storm risk major damage. Prolonged rains can saturate soils and lead to slope failure. Flood events caused by severe weather can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

9.5 FUTURE TRENDS IN DEVELOPMENT

Because all of the planning area is exposed to the extreme weather hazard, the decrease in exposed population and increase in property since the last hazard mitigation plan update is equal to the citywide trend over that time period: a 1.4-percent decrease in population, a 0.08-percent increase in number of general building stock structures. However, since the majority of this growth was new development, the increase in vulnerability to extreme weather is considered to be minimal due to the influence of strong codes and code enforcement within the planning area.

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. All planning partners that have permit authority have adopted the International Building Code. This code is equipped to deal with the impacts of extreme weather events. Land use policies identified in comprehensive plans within the planning area also address many of the secondary impacts (flood and landslide) of the extreme weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of extreme weather.

9.6 SCENARIO

Impacts of severe storms can be significant, particularly when secondary hazards of flood and landslide occur. A worst-case event would involve thunderstorms with prolonged high winds. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on nearby steep slopes. Significant erosion and landslides along the coast may occur, further increasing the vulnerability of residents living in coastal areas. Flooding and landslides could obstruct roads and bridges, isolating residents. Fog after the storm, resulting from the heavy moisture still in the area, could increase traffic accidents as visibility worsens.

9.7 ISSUES

Important issues associated with severe weather in the planning area include the following:

- The most common direct impact from severe weather events is loss of power. Power outages that disrupt land line service could cause significant communication disruption.
- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as damaging winds.
- Redundancy of power supply must be evaluated, especially for critical facilities.

- Climate change may cause more severe weather patterns that could impact vulnerable populations within the planning area. Increased frequency and intensity of storms may result in greater damage.
- Detailed spatial analysis is needed to locate the most vulnerable populations, followed by focused public education and outreach mitigation activities for these populations.
- The risk associated with the severe weather hazard overlaps the risk associated with other hazards such as earthquake and flood. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

10. FLOOD

10.1 GENERAL BACKGROUND

Flooding is any overflowing of water onto land that is normally dry, due to rain, ocean waves, or the failure of a dam or levee. Floods are the most common of all weather-related natural disasters. They kill more people in the United States each year than tornados, hurricanes, or lightning (NOAA n.d.). Areas near rivers or streams are at risk from floods during heavy rain or periods of upstream snowmelt. In urban areas, where buildings, highways, driveways, and parking lots reduce the ground's ability to absorb rainfall, the resulting increase in runoff can overwhelm constructed storm drain systems, resulting in flooding on nearby roads and buildings.

10.1.1 Types of Flooding

Floodplain Flooding

A floodplain is the area next to a water body (e.g., a river, creek, lake, or ocean) that becomes flooded when that water body overflows. The sections below describe riverine and coastal floodplains.

Riverine Floodplains

Riverine flooding is the overbank flooding of rivers and streams. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers.

Riverine floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

The frequency and severity of flooding for river systems are based on discharge probability. The discharge probability is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for different discharge levels and storm surge levels. These measurements reflect statistical averages only; it is possible for multiple floods with a low probability of occurrence (such as a 1-percent-annual-chance flood) to occur in a short time period. For riverine flooding, the same flood event can have flows at different points on a river that correspond to different probabilities of occurrence.

Coastal Floodplains

Coastal floodplains are adjacent to the ocean and other tidally influenced areas. Like riverine floodplains, coastal floodplains may be broad or narrow, depending on local topography and natural flood defenses such as dune systems or tidal wetlands. Coastal floods are usually caused by coastal storms that, when combined with normal tides, push water toward the shore. This is commonly referred to as storm surge. The result can be waves that extend further inland, causing damage to development that would not normally be subject to wave action.

Urban Stormwater Runoff Flooding

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces.

Urban areas use drainage systems that are designed to remove surface water as quickly as possible during rain events to prevent flooding on streets and other developed areas. These closed conveyance systems channel water away from the urban area to surrounding streams, bypassing natural processes of water filtration through the ground, containment, and evaporation of excess water.

Urban stormwater flooding is flooding in areas other than delineated floodplains that occurs when the storm system outfalls are inadequate to discharge all the runoff from a heavy rainfall into a body of water. When local conditions cannot accommodate intense precipitation, water accumulates and causes flooding. Flooding of this nature generally occurs in areas with flat gradients. The problem increases with urbanization and associated paved surfaces that keep runoff from infiltrating into the ground.

In addition, because drainage systems reduce the amount of time surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development of the surrounding area.

Flash Floods

The National Weather Service defines a flash flood as follows (National Weather Service 2009):

> “a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within 6 hours of the causative event (e.g., intense rainfall, dam failure). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters”

Flash floods can tear out trees, undermine buildings and bridges, and scour new channels. In urban areas, flash flooding is an increasingly serious problem due to removal of vegetation and replacement of ground cover with impermeable surfaces such as roads, driveways, and parking lots. The greatest risk from flash floods is occurrence with little to no warning. Major factors in predicting potential damage are intensity and duration of rainfall, and steepness of watershed and streams.

Levee Failures

Levees are a basic means of providing flood protection along waterways. They confine floodwaters to a main river channel, and their failure can lead to inundation of surrounding areas. Levees can fail due to structural failures, foundation failures of underlying soils, or overtopping by flood flows. Heavy rains can cause flooding behind a levee, or overtopping could occur from a storm event larger than what the levee was built for. Contributing factors include poor construction materials, seepage through or under the levee, burrowing rodents, and improper repairs. Seismic activity can impact levees as well, especially those constructed on the soft soils that are typical in floodplains. Lack of adequate and regular maintenance to correct these problems may contribute to failure of a levee. Most failures result from several of these factors.

10.1.2 FEMA Regulatory Flood Zones

FEMA defines flood hazard areas through statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on Flood Insurance Rate Maps (FIRMs), which are official maps of a community on which the Federal Insurance and Mitigation Administration has delineated special flood hazard areas (SFHAs). Digital versions of FIRMs are called DFIRMs.

The SFHA is the land area on a DFIRM covered by floodwaters of the “base flood,” which is the flood with a 1 percent chance of occurrence in any given year (also called the 1 percent annual chance flood). A structure within the SHFA (also called the 1 percent annual chance floodplain) has a 26 percent chance of undergoing flood damage during the term of a 30-year mortgage. The base flood is the regulatory standard adopted by federal agencies and most states to administer floodplain management programs. In SFHAs, National Flood Insurance Program (NFIP) floodplain management regulations must be enforced, and flood insurance is mandatory.

Common Flood Map Zones

DFIRMS show the boundaries of floodways and floodplains, as well as expected floodwater elevations at specific sites during the base flood. They define the following specific flood-related areas:

- River flood hazard zones:
  - **Zone A (also known as Unnumbered A-zones)**—SFHAs where no base flood elevations or depths are shown because detailed hydraulic analyses have not been performed.
  - **Zones A1-30 and AE**—SFHAs that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base flood elevations are shown within these zones.

   - **Zone AH and AO—**SFHAs subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to ponding (Zone AH) or shallow sheet flow flooding on sloping terrain (Zone AO).
   - **Zone B and X (shaded)—**Zones where the land elevation as been determined to be above the base flood elevation, but below the 500-year flood elevation. These zones are not SFHAs.
   - **Zones C and X (unshaded)—**Zones where the land elevation has been determined to be above both the base flood elevation and the 500-year flood elevation. These zones are not SFHAs.
- Coastal flood hazard zones:
   - **Zone VE, V1-30—**SFHAs along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base flood elevations derived from detailed hydraulic analysis are shown within these zones.
   - **Zone AE**—where flood elevation includes wave heights less than 3 feet.

Mapping of Levee-Protected Areas

FEMA can accredit levee systems that meet federal certification requirements. Areas protected by these levees are considered to have reduced flood risk due the presence of the levee. FEMA's mapping shows these areas as Zone X. These are considered to be "awareness" zones that depict the "residual risk" associated with the levee systems. Residual risk is the risk that remains after controls are accounted for. The protection level for any flood control facility is based on its design level of protection. A facility with 100-year design effectiveness loses that effectiveness for events with greater than a 100-year probability. This is residual risk.

Federal flood insurance for properties in these areas is available through the NFIP's lower-cost Preferred Risk Policy. While not federally required, it is strongly recommended, as there is still a risk.

Mapping of Areas at Risk from Wave Action

Studies in coastal areas of the United States have found that wave heights as low as 1.5 feet can cause significant damage to structures built without consideration of coastal hazards. DFIRMs recently published also include a line showing the limit of moderate wave action (LiMWA), the inland limit of the area expected to receive 1.5-foot or greater breaking waves during the 1-percent annual-chance flood event beyond the coastal VE zones and into the AE zone (Figure 10-1).

The addition of LiMWA area to DFIRMs allows communities and individuals to better understand flood risks to their properties. The LiMWA area alerts property owners on the coastal side of the line that being within Zone AE, their properties may be affected by 1.5-foot or higher breaking waves and may therefore be at significant risk during a 1-percent-annual-chance flood event (FEMA 2021). While not formally defined in NFIP regulations or mapped as a flood zone, the area between Zone VE and the LiMWA is called the Coastal A Zone. This area is subject to flood hazards associated with floating debris and high-velocity flow that can erode and scour building foundations and, in extreme cases, cause foundation failure (FEMA n.d.).

Source: (FEMA 2021)

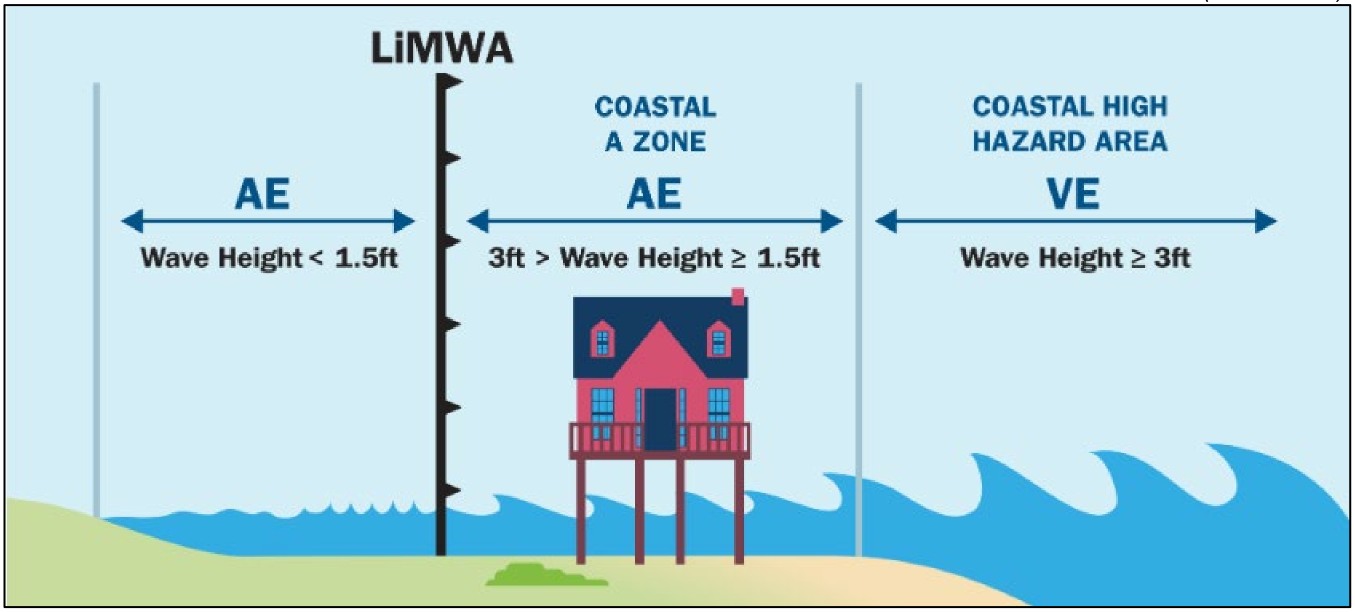

Figure 10-1. Limit of Moderate Wave Action

10.1.3 Floodplain Ecosystems and Beneficial Functions

Floodplains can support ecosystems that are rich in plant and animal species. Wetting of the floodplain soil releases a surge of nutrients left over from the last flood or caused by the rapid decomposition of organic matter accumulated since then. Microscopic organisms thrive, and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients falls away quickly, but the surge of new growth endures. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, trees that grow in floodplains tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

Floodplains have many natural beneficial functions, and disruption of them can have long-term consequences for entire regions. Some well-known, water-related functions of floodplains (noted by FEMA) include:

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Surface water quality maintenance
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperatures of water
- Provide groundwater recharge
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species.

10.1.4 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; riverine floodplain land is fertile and suitable for farming; transportation by water is easily accessible; land is flatter and easier to develop; and there is value placed in ocean views. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels or causing erosion of natural flood protection systems such as dunes. Flood potential can be increased in several ways: reducing a stream's capacity to contain flows; increasing flow rates or velocities downstream; and allowing waves to extend further inland. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

10.1.5 Secondary Hazards

The most problematic secondary hazard for flooding is bank erosion. In many cases the threat and effects of erosion are worse than actual flooding. This is especially true on the upper courses of rivers where there are steep gradients. Floodwaters in these reaches may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or drainage sewers.

10.2 HAZARD PROFILE

10.2.1 Federal Flood Programs Participation

National Flood Insurance Program

The City of Long Beach participates in the National Flood Insurance Program (NFIP), has adopted regulations that meet the program's requirements, and is currently in good standing with program requirements. Within the city, 2,418 flood insurance policies provide $674 million in coverage at a combined annual premium of $2.9 million. FEMA statistics show 337 claims have been paid on these policies, for a total of $2,508,698, an average of $7,444 per claim.

The City entered the NFIP on September 15, 1983; its latest FIRM was issued April 21, 2021. Structures permitted or built in the City before then are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." Post-FIRM structures are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Pre-FIRM structures are more vulnerable to flooding because they do not meet code or are located in hazardous areas.

The Community Rating System

As of October 1, 2021, The City of Long Beach participates in the Community Rating System (CRS) with a Class 8 rating. This entitles residents in a SFHA to a 10 percent discount on flood insurance and residents in non-SFHA areas to a 5 percent discount.

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property

The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. Studies have found that many of these properties are outside any mapped 1 percent annual chance (100-year) floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA has identified 20 repetitive loss properties in the City of Long Beach currently, four of which have been mitigated.

10.2.2 Principal Flooding Sources in City of Long Beach

In southern California, most flooding is the result of heavy precipitation over several days. Short streams and steep watersheds emptying onto lowlands in heavily populated areas may produce large volumes of water in short periods, and damage can be severe. The following sections describe the primary flood types and flood hazard areas in the city.

The City of Long Beach lies within the Colorado Lagoon-Frontal Alamitos Bay Watershed, the Lower Los Angeles River Watershed and the Lower San Gabriel River Watershed.

The Lower San Gabriel River Watershed covers the cities of Norwalk, Artesia, Bellflower, Cerritos, Diamond Bar, Downey, Hawaiian Gardens, La Mirada, Lakewood, Long Beach, Norwalk, Pico, Rivera, Santa Fe Springs, and Whittier, all within the Los Angeles County Flood Control District. The San Gabriel River receives drainage from 689 square miles of eastern Los Angeles County in the San Gabriel Mountains. The watershed consists of extensive areas of vegetation along the banks of the river and woodland habitats in its upper reaches. Much of the watershed of the West Fork and East Fork of the river is set aside as wilderness area; other areas in the upper watershed see heavy recreational use. The upper watershed contains a series of flood control dams. Further downstream, toward the middle of the watershed, are large spreading grounds used for groundwater recharge.

The watershed is hydraulically connected to the Los Angeles River through the Whittier Narrows Reservoir (normally only during high storm flows). The lower part of the river flows through a concrete-lined channel in a heavily urbanized portion of the county before becoming a soft bottom channel once again near the ocean in the City of Long Beach.

Land use in the watershed is diverse and ranges from open space in the upper watershed to urban land uses in the middle and lower parts of the watershed as seen in Figure 10-2. Large power poles line the river along the channelized portion; nurseries, stable areas, and storage facilities are in these areas (State Water Resources Control Board, 2021).

Source: State Water Resources Control Board, 2021

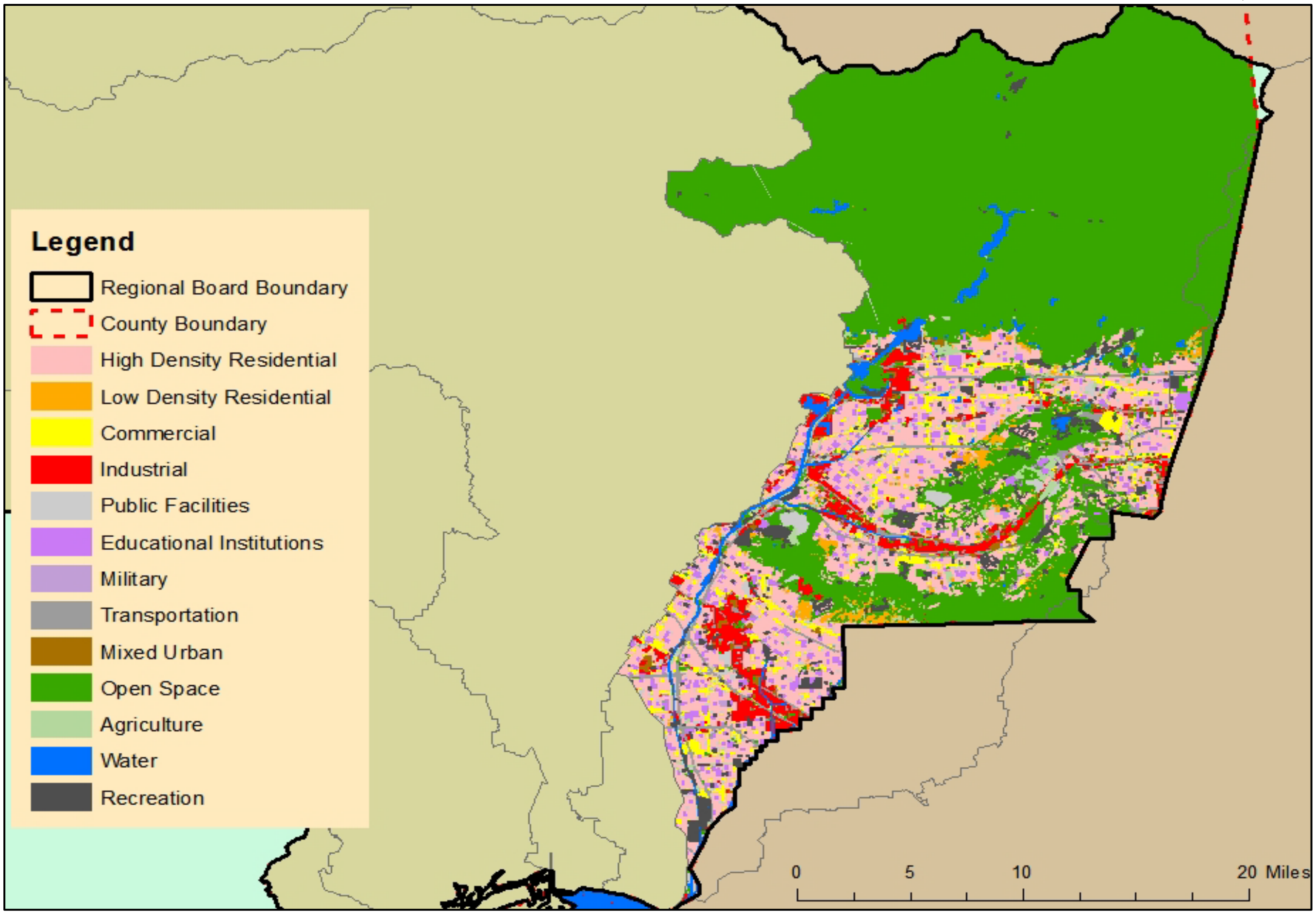

Figure 10-2. Land Use in the San Gabriel River Watershed

10.2.3 Flood Control System

Long Beach has a complex storm drainage system, which is composed of streets and gutters, catch basins and underground pipes, ditches, streams and creeks, pump stations, and channels. This system carries stormwater away from homes and businesses to designated drainage areas, such as the Los Angeles and San Gabriel Rivers.

The primary agencies responsible for flood control are the City of Long Beach, the Los Angeles County Flood Control District, and the U.S. Army Corps of Engineers. Each agency exercises jurisdiction over its own flood control facilities, which include open flood control channels, levee segments, flood control basins, storm drains, debris basins, detention basins and spreading grounds. The primary flood control facilities with potential to impact the City are the Santa Fe Dam and Reservoir and Whittier Narrows Dam.

Typically, City and County storm drains are designed according to criteria identified in a design criteria manual to carry flow from design storms. The combination of storm drainpipe and street conveyance of stormwater typically strives to provide capacity for up to a 25-year storm.

Los Angeles County Drainage Area Project

In 1915, the State Legislature created the Los Angeles County Flood Control District to control floods and conserve water. Early bond issues financed construction of 14 dams in the San Gabriel Mountain, flood channel modifications, and construction of debris basins to trap sediment. In 1936, federal legislation made the Corps of Engineers a participant in Los Angeles County's flood protection program. The Corps' Los Angeles River, San Gabriel River and Ballona Creek projects included the construction of five flood storage reservoirs or basins, 24 debris basins, 95 miles of main channels, 191 miles of tributary channels and two jetties.

This regional flood control system is described in the Los Angeles County Drainage Area (LACDA) study. It includes the Los Angeles River, San Gabriel River, Rio Hondo Channel and Ballona Creek. Flood control facilities in the LACDA system fall into the following general categories:

- Debris basins, found at the mouth of canyons, trap debris carried by floodwaters, leaving relatively clean water to flow unimpeded in downstream channels.
- Flood control reservoirs control and reduce stream flow so that downstream main channel capacities are not exceeded. The Corps of Engineers operates five major reservoirs:
  - Hansen Dam Reservoir—25,446 acre-feet
  - Lopez Dam Reservoir—441 acre-feet
  - Santa Fe Dam Reservoir—30,887 acre-feet
  - Sepulveda Dam Reservoir—17,425 acre-feet
  - Whittier Narrows Dam Reservoir—34,947 acre-feet

  Locally operated facilities include 15 flood control and water supply reservoirs in the upper watershed areas of the LACDA basin. Combined, these local reservoirs have a maximum combined capacity of 109,146 acre-feet.

Improved channels speed the passage of flood flows through local communities and into the main stem river system. Improved tributary channels include Arroyo Seco and Compton Creek. Main channel improvements pass the controlled or partially controlled flows to the ocean. The Los Angeles River is improved along most of the reach below Sepulveda Dam; its sides and bottom are generally lined with concrete or grouted rock. Sepulveda and Hansen Dams regulate flows to the main channel of the Los Angeles River. In total, the LACDA system has over 100 miles of main stem channel, over 370 miles of tributary channels, 129 debris basins, 15 flood control and water conservation dams, and five flood control dams.

Levees

Figure 10-3 shows the location of major levees in the planning area vicinity. Table 10-1 lists all levee systems shown for the planning area on the FEMA FIRM and the Corps of Engineers National Levee Database.

Source: (U.S. Army Corps of Engineers 2016)

Figure 10-3. Regional Levee System Locations

Table 10-1. Provisionally Accredited Levees in the City of Long Beach

Levee Name	Levee Location	Owner	Corps of Engineers Levee ID	FIRM Panels
Coyote Creek/Carbon Creek 2	Long Beach, Hawaiian Gardens	USACE	3805010021	06037C1980F, 06037C2000F, 06059C0108J, 06059C0104J, 06059C0109J
Coyote Creek/Carbon Creek 1	Los Alamitos, Cypress	USACE	3805010020	06037C1990F, 06059C0116J, 06059C0114K, 06059C0112J, 06059C0108J, 06059C0104J, 06059C0118J
Dominguez Channel Levee System	Carson	State of California	1905057100	06037C1955F, 06037C1945F, 06037C1935F, 06037C1944G, 06037C1963G, 06037C1942G, 06037C1961G
LA County Levee 124	Long Beach	State of California	1905081008	06037C1988F, 06037C1988G
LA County Levee 126	Long Beach	State of California	1905057213	06037C1955F
LA County Levee 97	Long Beach	State of California	1905057133	N/A
LA River/Compton Creek 1	Long Beach	USACE	3805010026	06037C1955F, 06037C1965F, 06037C1962F, 06037C1964F, 06037C1963G, 06037C1964G 06037C1961G
LA River/Compton Creek 2	Lynwood	USACE	3805010033	06037C1639F, 06037C1643F, 06037C1955F, 06037C1815F, 06037C1820F, 06037C1810F, 06037C1960F, 06037C1805F, 06037C1638G
LA River/Rio Hondo Diversion 1	Paramount	USACE	3805010044	06037C1639F, 06037C1643F, 06037C1829F, 06037C1955F, 06037C1664F, 06037C1663F, 06037C1815F, 06037C1820F, 06037C1830F, 06037C1980F, 06037C1810F, 06037C1840F, 06037C1837F, 06037C1839F, 06037C1645F, 06037C1990F, 06037C1988F, 06037C1970F, 06037C1962F, 06037C1960F, 06037C1964F, 06037C1805F, 06059C0113J, 06059C0114K, 06059C0112J, 06059C0111J, 06037C1964G, 06037C1988G, 06037C1966G, 06037C1968G, 06037C1967G, 06037C1969G
San Gabriel River 1	Norwalk	USACE	3805010031	06037C1829F, 06037C1664F, 06037C1663F, 06037C1820F, 06037C1830F, 06037C1835F, 06037C1980F, 06037C1810F, 06037C1840F, 06037C2000F, 06037C1843F, 06037C1668F, 06037C1841F, 06037C1837F, 06037C1839F, 06037C1645F, 06037C1990F, 06037C2076F, 06037C1988F, 06037C1970F, 06037C1960F, 06037C2060F, 06059C0227K, 06059C0113J, 06059C0116J, 06059C0114K, 06059C0226K, 06059C0112J, 06059C0108J, 06059C0104J, 06059C0106J, 06059C0111J, 06059C0118J, 06059C0231K, 06037C2076G, 06037C1988G, 06037C2057G, 06037C1967G, 06037C1969G
San Gabriel River/Coyote Creek 1	Long Beach	USACE	3805010018	06037C1990F, 06037C2076F, 06037C1988F, 06059C0227K, 06059C0113J, 06059C0114K, 06059C0226K, 06059C0112J, 06059C0111J, 06037C2076G, 06037C1988G
San Gabriel River/Coyote Creek 2	Left Bank (San Gabriel) Right Bank (Coyote Creek)	Los Angeles County	3805010035	06059C0116J, 06037C2000F, 06059C0108J, 06059C0106J, 06037C1980F, 06037C1837F, 06037C1835F, 06037C1843F, 06037C1668F, 06037C1841F, 06037C1990F, 06059C0104J, 06037C1839F, 06037C1663F, 06037C1830F, 06059C0112J, 06037C1829F, 06037C1840F, 06037C1664F

The Los Angeles County Department of Public Works is the local sponsor of the San Gabriel River/Compton Creek (SGR/CC2) Levee System, which extends 16 miles from near San Gabriel River Parkway in the City of Pico Rivera to the confluence of the San Gabriel River with Coyote Creek near Willow Street in the City of Long Beach. The SGR/CC2 Levee System consists of an earthen levee embankment and a trapezoidal channel with either riprap, grouted stone, reinforced concrete, or shotcrete on the riverward slope. The area along the levees contains residential, commercial, industrial, and civic improvements.

A periodic inspection of the SGR/CC2 Levee System in November 2016 noted major deficiencies and remedial actions required. The major deficiencies included non-compliant vegetation growth, encroachments, erosion/bank caving, depressions and rutting through the access road and landward slope, animal control problems indicated by the number of burrows, riprap revetment displacement, revetments of the grouted riverward slope, missing floodwall joint material, vegetation and obstructions of the outlet/inlet, encroachments to interior drainage, damaged fencing, missing or unpermitted flap gates, broken trash rack, and settling and tilting of concrete structures. The Los Angeles District Levee Safety Officer rated the system “minimally acceptable” because the deficiencies would not prevent it from performing as intended during the next significant runoff event. Los Angeles County Department of Public Works was required to correct the minimally acceptable rated items so that they do not deteriorate further and become unacceptable.

The Compton Creek and Dominguez Channel levees are parts of the LACDA. The Los Angeles County Flood Control District analyzed the Compton Creek and Dominguez Channel levees to determine if they meet the federal requirements for flood protection. While the levees are structurally sound, they were found to no longer be able to contain FEMA’s 1 percent annual chance flood. As a result, FEMA will designate these areas as a flood zone, requiring mandatory flood insurance. The Flood Control District has begun analysis to develop improvement alternatives to address flood capacity that include habitat restoration, aesthetic, and recreational improvements (City of Long Beach n.d.).

Long Beach Municipal Urban Stormwater Treatment Project

The Long Beach Municipal Urban Stormwater Treatment (LB-MUST) Project is being designed to divert and treat polluted stormwater runoff prior to entering the Los Angeles River or being reused as an alternative water source. Diverted water will be treated at the treatment facility, with an initial capacity to treat 2 million gallons per day and potential expansion to treat 4 million gallons per day. Portions of the treated water will sustain vegetation in the wetlands.

Construction for the treatment facility began in November 2021 and completion of the entire site is scheduled to take approximately 2 years. Current facility construction is designated to the fenced project area, located next to the Los Angeles River. Development of the project wetland, which will be located east of the treatment facility, will also occur during this timeframe (City of Long Beach 2021).

10.2.4 Past Events

The County of Los Angeles and the communities within the county have experienced 15 flooding events since 1969 for which federal disaster declarations were issued, as summarized in Table 10-2. Many flood events do not trigger federal disaster declaration protocol but have significant impacts on their communities.

Table 10-2. History of Flood Disaster Declaration Events

Incident Date(s)	Declaration #	Type of event
December 4, 2017-January 31, 2018	DR-4353	Wildfires, flooding, mudflows, debris flow
January 18-23,2017	DR-4305	Severe winter storms, flooding, and mudslides
January 17-February 6, 2010	DR-1884	Severe winter storms, flooding, and debris and mud flows
February 16-23, 2005	DR-1585	Severe storms, flooding, landslides, and mud and debris flows
December 27, 2004-January 11, 2005	DR-1577	Severe storms, flooding, debris flows, and mudslides
February 2-April 30, 1998	DR-1203	Severe winter storms, and flooding
February 13-April 19, 1995	DR-1046	Severe winter storms, flooding landslides, mud flow
January 3-February 10, 1995	DR-1044	Severe winter storms, flooding, landslides, mud flows
January 5-March 20, 1993	DR-979	Severe winter storm, mud and landslides, and flooding
February 10-18, 1992	DR-935	Rain/snow/wind storms, flooding, mudslides
January 17-22, 1988	DR-812	Severe storms, high tides and flooding
January 21-March 30, 1983	DR-677	Coastal storms, floods, slides and tornados
January 8, 1980	DR-615	Severe storms, mudslides and flooding
February 15, 1978	DR-547	Coastal storms, mudslides and flooding
January 26, 1969	DR-253	Severe storms and flooding

Source: (FEMA 2022)

The following are significant flood events in the County of Los Angeles:

- **January 2, 2018, Wildfires, Flooding, Mud/Debris Flows—**A series of storms caused flooding, mud flows and debris flow after the 2017 wildfires had severely burned areas within the counties of Los Angeles, San Diego, Santa Barbara, and Ventura counties.
- **January 18 – 23, 2017, Winter Storms—**A series of storms affected Southern California, including one that dropped nearly 2.5 inches of rain in 3 hours. It caused roads to be flooded, homes to be threatened by mudslides, and traffic to become clogged on many freeways and surface streets. According to the Los Angeles Department of Water and Power, at least 10,000 customers were without power.
- **January 18 – 22, 2010, Winter Storms—**A series of storms brought heavy rain, gusty winds and flash flooding to Southern California. Rainfall totals ranged from 4 to 8 inches over coastal areas. Water was chest high in places, which stranded many vehicles and flooded numerous businesses.
- **2004 – 2005 Flooding Events—**Los Angeles County saw up to 37.25 inches of rain in the winter of 2004/2005—the highest recorded seasonal rainfall since 1883-1884. Over 70 flood insurance claims were filed. Storms in January and February 2005 prompted state and federal disaster declarations. Mud flows, rockslides, and small stream and urban flooding caused considerable damage to roads and homes. Nine people died, including two deaths caused by mud and rockslides.

10.2.5 Location

The September 26, 2008, City of Long Beach DFIRM is FEMA’s official delineation of SFHAs in the planning area. Figure 10-4 shows the SFHAs delineated in that mapping.

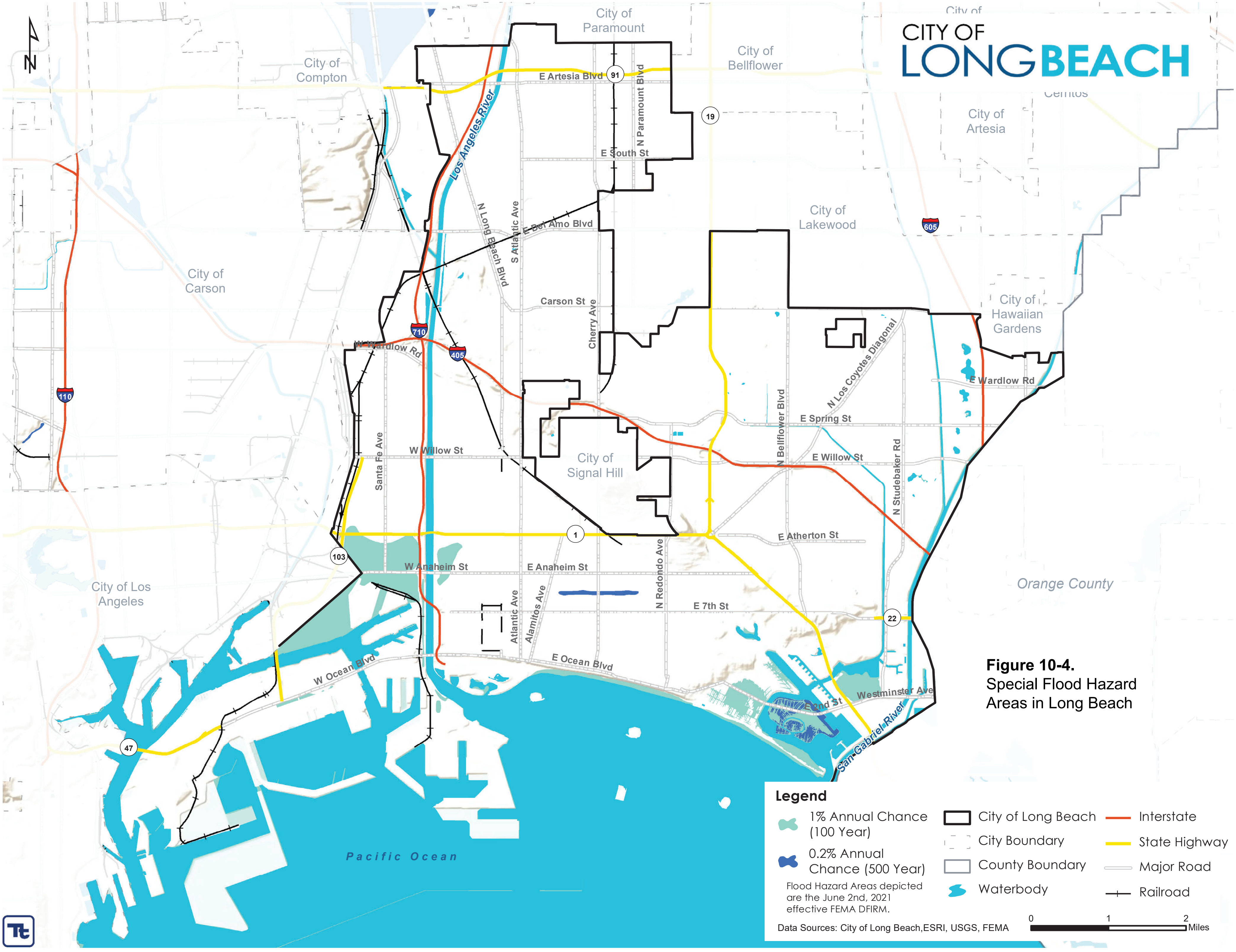

Figure 10-4.
Special Flood Hazard Areas in Long Beach

10.2.6 Frequency

Records of past flooding specific to the City of Long Beach were not available to support this assessment. However, significant flood events occurred in Los Angeles County in 1914, 1916, 1927, 1934, 1938, 1941, 1943, 1952, 1956, 1966, 1969, 1978, 1980, 1983, 1993, 1995, 1998, 2005, 2010, and 2017. Each of these events was likely to have impacted the City of Long Beach to some degree. Large floods occur every 5 to 6 years in Los Angeles County.

Flood frequency is often evaluated by examining peak discharges. There is no discharge data for flooding sources in the planning area, but upstream discharges could impact Long Beach. According to FEMA's December 21, 2018, Flood Insurance Study, the San Gabriel River peak flow with a 1-percent annual chance at the Whittier Narrows Flood Control Basin at Siphon Road is 90,000 cubic feet per second. The USGS reported a maximum observed daily flow of 21,200 cubic feet per second at the Rio Hondo Bl/Whittier Narrows Dam gauge on October 1, 1966.

10.2.7 Severity

Flooding in Long Beach has the potential for significant damage, especially as development in the floodplain has increased dramatically. The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high-velocity flows and transporting debris and sediment. Table 10-3 summarizes impacts and estimated costs of recent federally declared flood disasters in Los Angeles County.

Table 10-3. Estimated Losses from Recent Disaster-Declared Floods in Los Angeles County

Incident Period	Financial Assistance Received[a]	Damage
December 4, 2017-January 31, 2018	$5.1 million Individual Assistance	• 1,004 residences destroyed • 55 residences suffered major damage • 51 residences suffered minor damage • 206 additional residences were affected
January 18-January 23, 2017	$113 million Public Assistance	• Damage to roads and bridges • 10,000 residents without power
January 17-February 6, 2010	$50.6 million Public Assistance	• Businesses flooded • Vehicles stranded • Large amount of debris removal needed
December 27, 2005-January 11, 2006	$218.9 million Individual and Public Assistance	• Roads and structures damaged by mud, rockslides, flooding • 70 residential insurance claims filed • 9 storm-related deaths

a. Dollar amounts in the year of occurrence and for all areas affected

10.2.8 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

Each watershed has unique qualities that affect its response to rainfall. A hydrograph, which is a graph showing stream flow in relation to time, is a useful tool for examining a stream's response to rainfall. Once rainfall starts falling over a watershed, runoff begins, and the stream begins to rise. Water depth in the stream channel (stage of flow) will continue to rise in response to runoff even after rainfall ends. Eventually, the runoff will reach a peak and the stage of flow will crest. It is at this point that the stream stage will remain the most stable, exhibiting little change over time until it begins to fall and eventually subside to a level below flooding stage.

The potential warning time a community has to respond to a flooding threat is a function of the time between the first rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time to the time that a community has to take actions to protect lives and property. Another element that characterizes a community's flood threat is the length of time floodwaters remain above flood stage.

Long Beach has developed a flood warning system designed to provide at least one hour of advance warning of flooding. Flood watches (when conditions are conducive to flooding) and flood warnings (when flooding is imminent) are issued via Alert Long Beach, the City's Emergency Notification System; LBTV Cable Channel 8; and TV, radio, and mobile public address capabilities (City of Long Beach n.d.).

The Los Angeles County flood threat system consists of a network of precipitation gages stream gages at strategic locations in the county that constantly monitor and report stream levels (see Figure 10-5). This information is provided to the National Weather Service (NWS) and National Oceanic and Atmospheric Administration. In addition to this program, data and flood warning information is provided by the NWS.

Wireless Emergency Alerts from the NWS are notices about potentially hazardous weather that are sent out to all compatible cell phones in affected areas. All of this information is analyzed to evaluate the flood threat and possible evacuation needs. The NWS issues watches, and warnings as follows when forecasts indicate rivers may approach bank-full levels:

- Minor Flooding—Minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding—Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding—Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

When a watch is issued, the public should prepare for the possibility of a flood. When a warning is issued, the public is advised to stay tuned to a local radio station for further information and be prepared to take quick action if needed. A warning means a flood is imminent, generally within 12 hours, or is occurring. Local media broadcast NWS warnings.

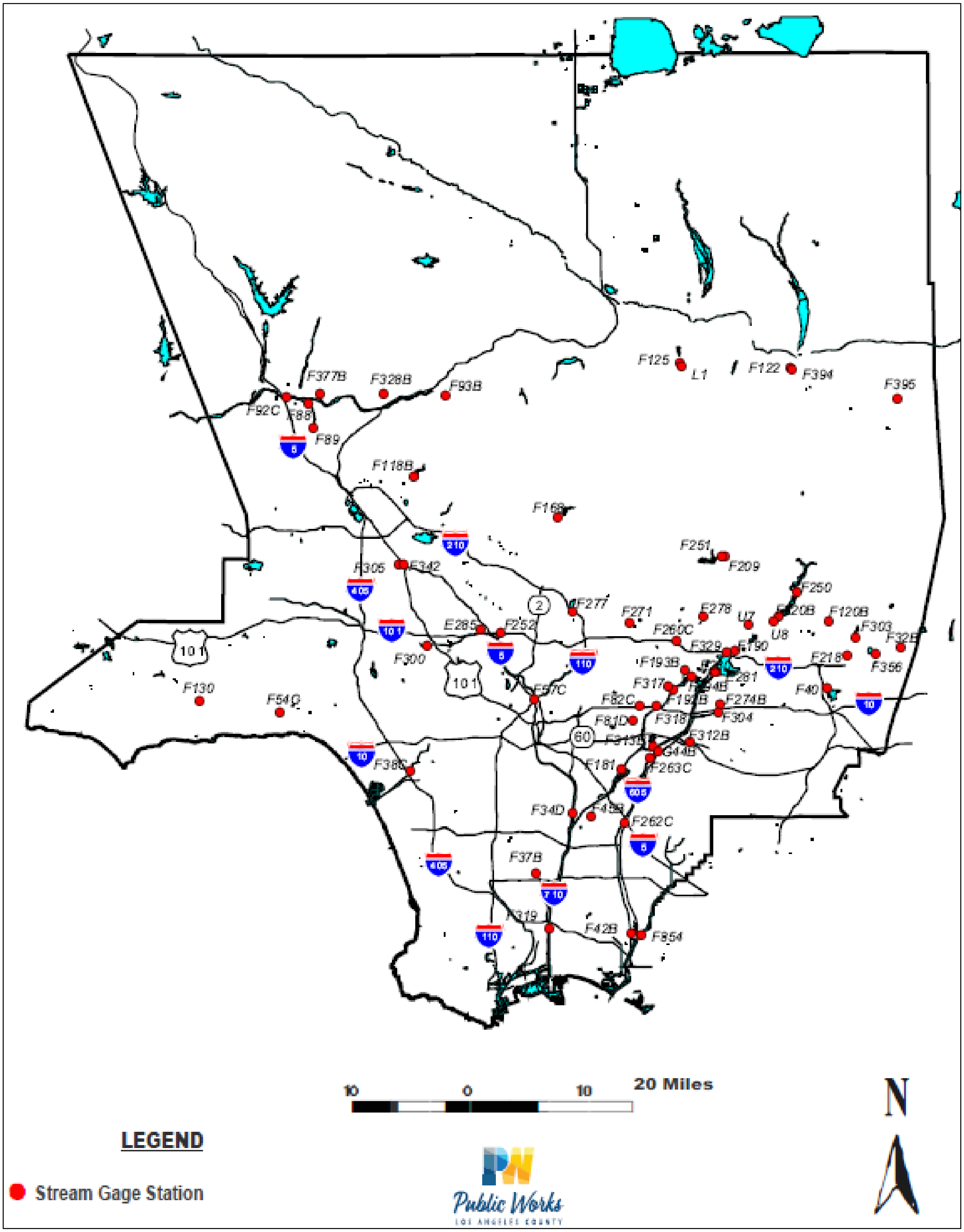

Figure 10-5. Stream Gage Locations in Los Angeles County

10.3 EXPOSURE

FEMA mapping of the 1 percent annual chance and 0.2 percent annual chance floods was used to perform the exposure analysis. Summary findings of the risk assessment, showing exposure results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

10.3.1 Population and Property

Table 10-4 summarizes the estimated population living in the evaluated flood hazard area and the estimated property exposure. The distribution of exposed structures by use category is shown in Figure 10-6 and Figure 10-7.

Table 10-4. Exposed Population and Property in Evaluated Flood Hazard Zones

	1% Annual Chance Flood Zone	0.2% Annual Chance Flood Zone
Population		
Population Exposed	6,248	10,427
% of Total Planning Area Population	1.3%	2.2%
Property		
Acres of Inundation Area	7,675	7.803
Number of Buildings Exposed	3,084	4,254
Value of Exposed Structures	$2,176,293,551	$2,666,235,372
Value of Exposed Contents	$2,118,762,390	$2,378,377,135
Total Exposed Property Value	**$4,295,055,941**	**$5,044,612,507**
Total Exposed Value as % of Planning Area Total	*4.4%*	*5.1%*

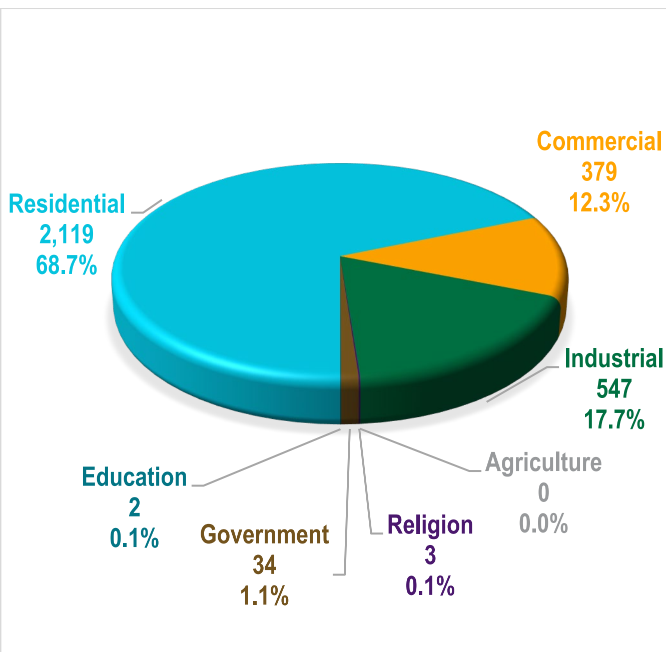

Figure 10-6. Exposed Structures in 1% Annual Chance Flood Zone by Occupancy Class

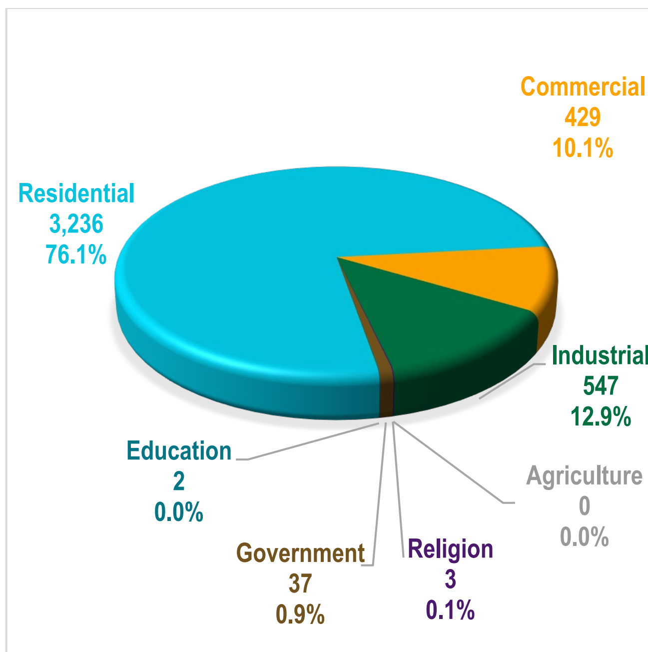

Figure 10-7. Exposed Structures in 0.2% Annual Chance Flood Zone by Occupancy Class

10.3.2 Critical Facilities

Figure 10-8 and Figure 10-9 show critical facilities located in the 1 percent-annual-chance and 0.2 percent-annual-chance floodplains, respectively, by facility type.

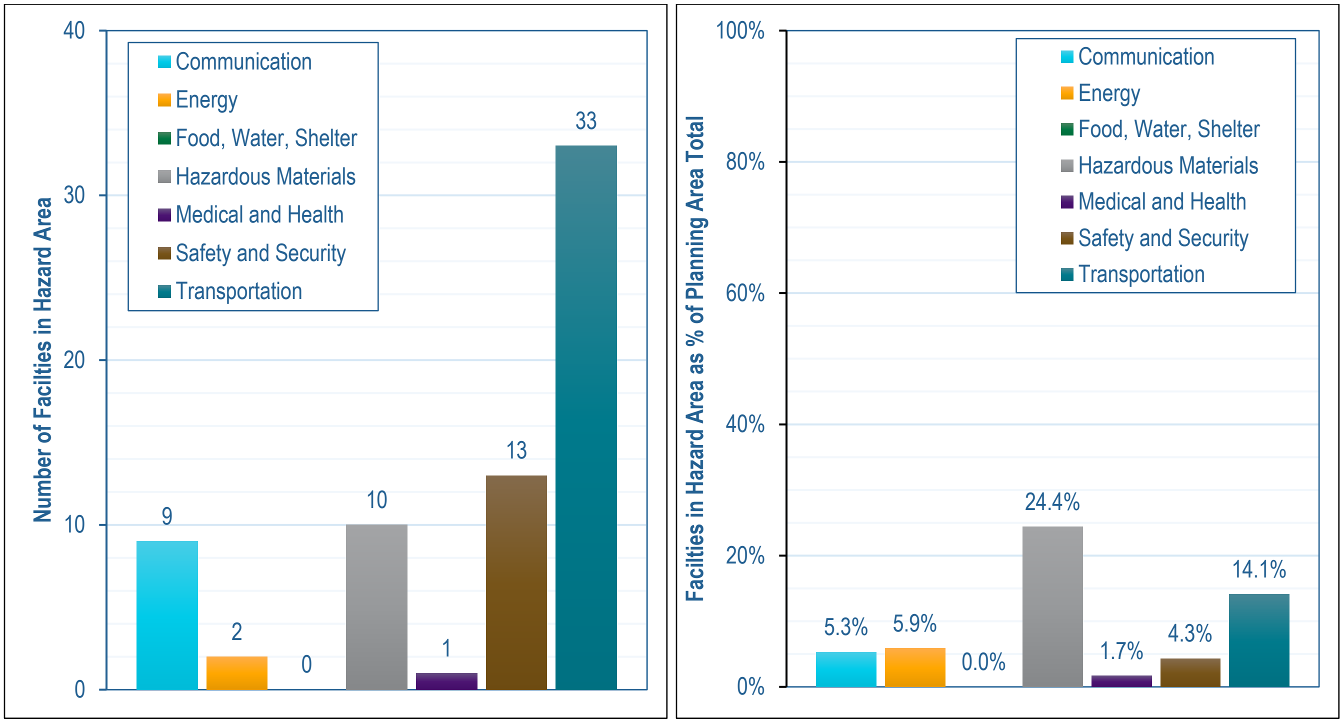

Figure 10-8. Critical Facilities in 1% Annual Chance Floodplain

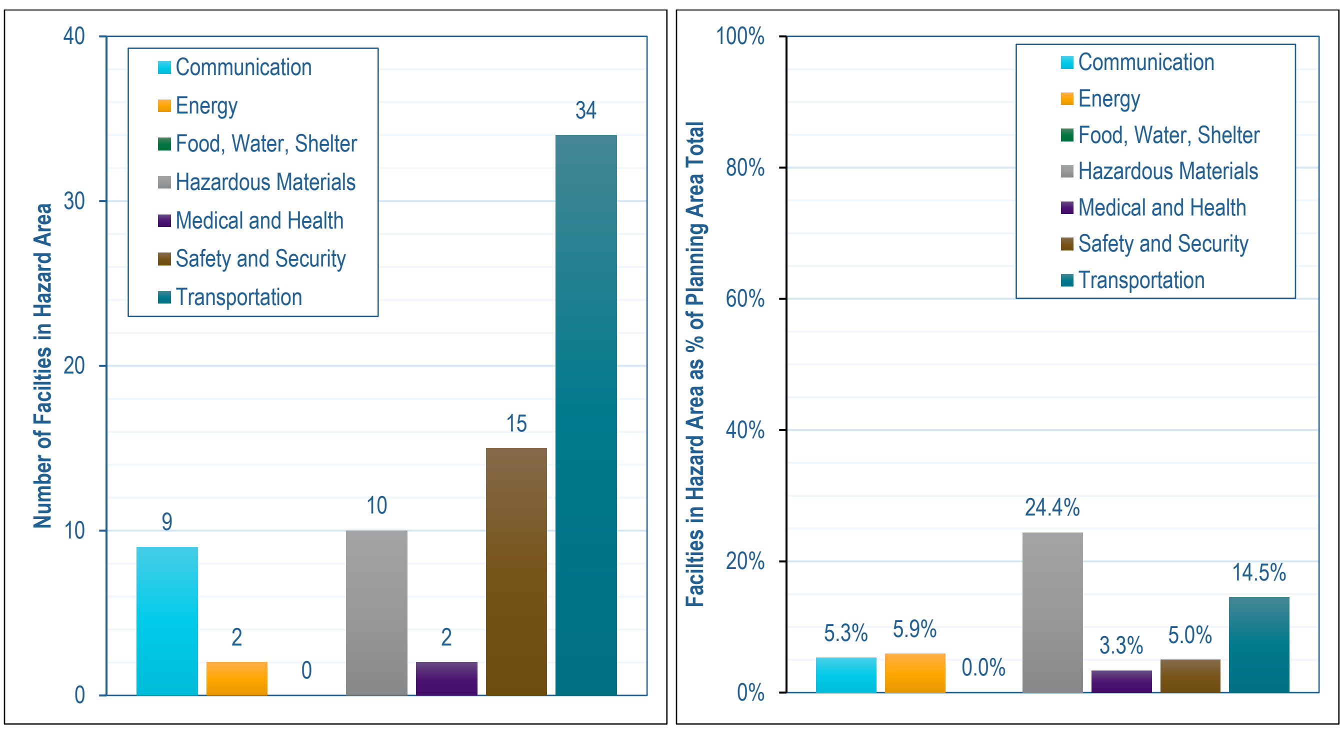

Figure 10-9. Critical Facilities in 0.2% Annual Chance Floodplain

The following main arterial roads in the planning area pass through the assessed flood hazard area and are exposed to flooding:

- Interstate 710
- East Pacific Coast Highway (Highway 1)
- Terminal Island Freeway (Highway 103)
- West Anaheim Street
- Santa Fe Avenue
- East 2nd Street
- East Ocean Boulevard

Some or parts of these roads may be above the flood level; still, in severe flood events these roads may be blocked or damaged, preventing access to some areas.

10.3.3 Environment

Parks and open spaces are considered to be wise uses within designated flood hazards areas. The following parks and open spaces are within the assessed flood hazard area:

- City Beach
- Long Beach
- Bluff Park
- Mother's Beach

10.4 VULNERABILITY

Summary findings of the risk assessment for flood, showing vulnerability results for the entire planning area, are provided below. Appendix C provides a detailed breakdown of results by Zip code.

10.4.1 Population

Flood impacts on persons and households were estimated for each event through the Level 2 Hazus analysis. Table 10-5 summarizes the results.

Table 10-5. Estimated Flood Impacts on Households and Residents

	1% Annual Chance Flood Zone	0.2% Annual Chance Flood Zone
Displaced Population	3,091	5,519
Number of Residents Requiring Short-Term Shelter	251	402

10.4.2 Property

Table 10-6 summarizes Hazus estimates of flood damage in the planning area. The debris estimate includes only structural debris and building finishes; it does not include additional debris that may result from a flood event, such as from trees, sediment, building contents, bridges, or utility lines.

Table 10-6. Estimated Impact of a 0.2 Percent Annual Chance Flood Event in the Planning Area

	1% Annual Chance Flood Zone	0.2% Annual Chance Flood Zone
Structure Debris (Tons)	8,272	8,650
Buildings Impacted	1,975	2,295
Total Value (Structure + Contents) Damaged	$186.9 million	$189.7 million
Damage as % of Total Value	0.2%	0.2%

10.4.3 Critical Facilities

Significant Facilities Affected

Significant critical facilities predicted by Hazus to be affected by the 1 percent-annual-chance flood include the following:

- 2 fire stations
- 1 power plant
- 18 bridges
- 10 hazardous materials facilities

Estimated Damage

Hazus was used to estimate the number of critical facilities affected by flooding and the resulting percent of damage to the building and contents. Figure 10-10 compares the predicted number of affected facilities to the number of exposed facilities, for the 1 percent and 0.2 percent-annual chance flood events. Results for the 1 percent-annual-chance-event are as follows:

- All exposed hazardous materials and health and medical facilities would be affected
- About half of exposed energy, transportation, and safety and security facilities would be affected

Figure 10-11 shows the estimated damage to critical facilities for both modeled flood events. For the 1 percent-annual-chance-event, the average amount of damage to structures, measured as a percentage of total value, ranges from 1.4 to 17.1 percent of total value and average damage to contents ranges from 11.6 to 47.1 percent, depending on critical facility category.

10.4.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, flooding can impact the environment in negative ways.

- Fish can wash into roads or over dikes into flooded fields, with no possibility of escape.
- Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses.
- Human development such as bridge abutments and levees can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.
- Flooding may disrupt normal drainage systems in cities and can overwhelm sewer systems, causing raw sewage to spill into the flooded area.
- Severe flooding can destroy buildings that may contain toxic materials (paints, pesticides, gasoline, etc.) releasing these materials into the local environment.

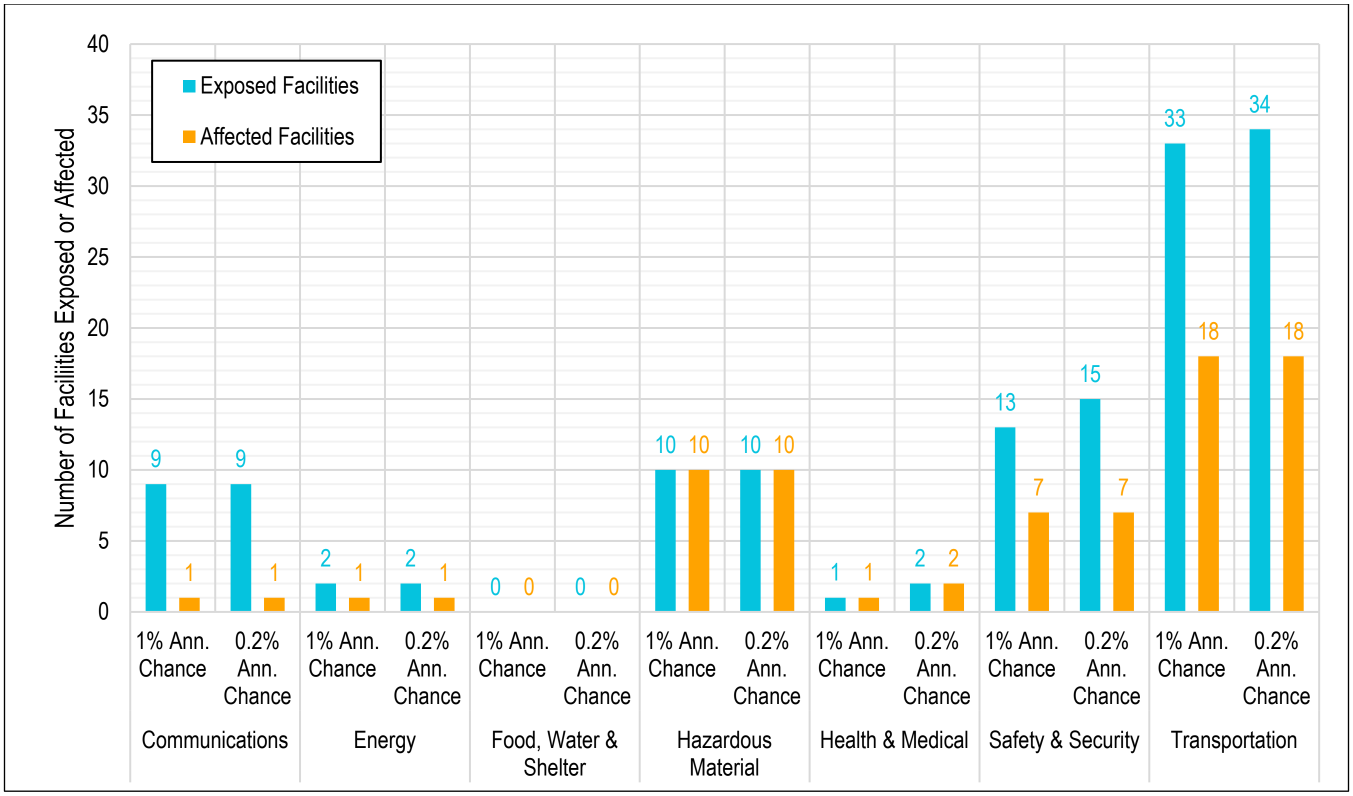

Figure 10-10. Critical Facilities Affected by the 1% and 0.2% Annual Chance Floods

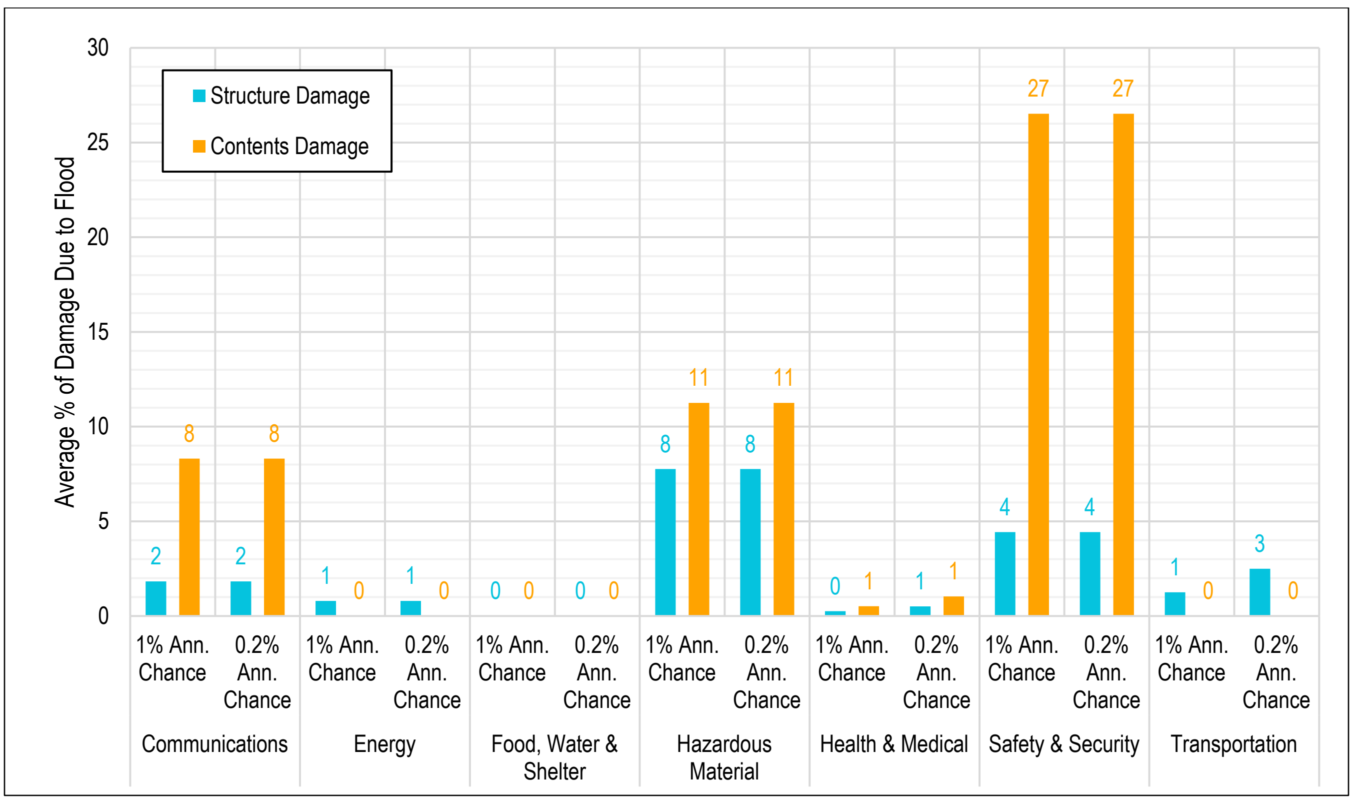

Figure 10-11. Average Damage to Critical Facilities from 1% and 0.2% Annual Chance Floods

Loss estimation platforms such as Hazus are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

10.5 FUTURE TRENDS

According to the California Department of Finance, the population of the greater Los Angeles County region is expected to increase over the next 45 years. The City of Long Beach has limited potential for expansion through annexation, as it is surrounded by other incorporated cities. It is anticipated that future growth in the City will be managed through redevelopment, which creates an opportunity to correct past land use decisions, especially with regards to development within floodplains.

While regulated floodplains for the City have not been clearly identified, the City will be well-equipped to manage growth in floodplains with its flood damage prevention ordinance, its building code, and the Safety Element of its General Plan. Proper application of these tools requires accurate hazard mapping. Flood mapping should be taken into account as future land use decisions are made for areas impacted by flooding.

10.6 SCENARIO

The major flooding causes in the City of Long Beach are short-duration, high-intensity storms. Water courses in the City can flood in response to a succession of intense winter rainstorms, usually between early November and late March. A series of such weather events can cause severe flooding in the City due to the large percentage of impervious area and the age and capacity of the drainage system.

A worst-case scenario is a series of storms that flood numerous drainage basins in a short time, such as those projected by USGS in the CA ARkStorm Scenario (USGS 2018). This could overwhelm response and floodplain management capabilities within the city. Major roads could be blocked, preventing critical access for many residents and critical functions. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. In the case of multi-basin flooding, floodplain management resources would not be able to make repairs quickly enough to restore critical facilities and infrastructure. Additionally, as the grounds become saturated, groundwater flooding issues typical for the City would be significantly enhanced.

10.7 ISSUES

The planning team has identified the following flood-related issues relevant to the planning area:

- Ongoing flood hazard mitigation will require funding from multiple sources
- A coordinated hazard mitigation effort between jurisdictions affected by flood hazards across Los Angeles County will benefit future mitigation for the flooding hazard
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods

- A lack of concern regarding flood risk by property owners can translate to the lack of political will to make changes
- The residual risk from flood control structures such as levees and channels should be communicated to the public
- The potential impact of climate change on flood conditions needs to be better understood
- The capability for flood threat recognition and warning needs to be enhanced
- Flood warning capability should be tied to flood phases
- There needs to be enhanced modeling to better understand the true flood risk
- Floodplain restoration/reconnection opportunities should be identified as a means to reduce flood risk
- Post-flood disaster response and recovery actions need to be solidified
- Staff capacity is required to maintain the City’s existing level of floodplain management
- Floodplain management actions require interagency coordination
- Open spaces (infiltration) have decreased substantially, with no plans to reverse this trend. More impervious surface leads to more runoff

11. DAM FAILURE

11.1 GENERAL BACKGROUND

11.1.1 Definition and Classification of Dams

A dam is an artificial barrier that can store water, wastewater, or liquid-borne materials for many reasons—flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control. Many dams fulfill a combination of these functions. They are an important resource in the United States. In California, dams are regulated by the State of California Division of Safety of Dams. Additional regulatory oversight of dams is cited in Chapter 6 and described in Appendix B.

The California Water Code (Division 3) defines a dam as any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that either:

- Has a height of more than 6 feet and it impounds 50 acre-feet or more of water, or
- Has a height of 25 feet or higher and impounds more than 15 acre-feet of water

Dams can be classified according to their purpose, the construction material or methods used, their slope or cross-section, the way they resist the force of the water pressure, or the means used for controlling seepage. Materials used to construct dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, plastic, rubber, and combinations of these.

11.1.2 Causes of Dam Failure

Partial or full failure of dams has the potential to cause massive destruction to the ecosystems and communities located downstream. Partial or full failure can occur as a result of one or a combination of the following reasons (FEMA 2016):

- Overtopping caused by floods that exceed the dam capacity (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams

- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides)

Many dam failures in the United States have been secondary results of other disasters. The most common causes are earthquakes, landslides, extreme storms, equipment malfunction, structural damage, foundation failures, and sabotage. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

11.1.3 Planning Requirements

State of California

All dams whose inundation areas may impact the planning area have emergency action plans (EAPs) on file. The EAPs must include the following (Cal OES 2021):

- Emergency notification flow charts
- Information on a four-step response process
- Description of agencies' roles and actions in response to an emergency incident
- Description of actions to be taken in advance of an emergency
- Inundation maps
- Additional information such as revision records and distribution lists

After the EAPs are approved by the state, the law requires dam owners to send the approved EAPs to relevant stakeholders. Local public agencies can then adopt emergency procedures that incorporate the information in the EAP in a manner that conforms to local needs and includes methods and procedures for alerting and warning the public and other response and preparedness related items (Cal OES 2021).

Federal Energy Regulatory Commission

Dams that fall under the jurisdiction of the Federal Energy Regulatory Commission (FERC) also have specified planning requirements. FERC has the largest dam safety program in the United States. It cooperates with a large number of federal and state agencies to ensure and promote dam safety and, more recently, homeland security. FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans are designed to serve as an early warning system if there is a potential for, or a sudden release of water from, a dam failure or accident to the dam. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows and procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that in emergency situations everyone knows what to do, thus saving lives and minimizing property damage.

11.1.4 Rating Dam Hazards

Dam failure can be catastrophic to all life and property downstream. California's Division of Safety of Dams has developed a hazard potential classification system for state-jurisdiction dams, as shown on Table 11-1. This system is modified from federal guidelines, which recommend three-tier classification. The California system adds a fourth hazard classification of "extremely high." Dams classified as extremely high hazard may impact highly populated areas or critical infrastructure or have short evacuation warning times.

Table 11-1. State of California Downstream Hazard Potential Classification

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

Source: California Division of Safety of Dams, 2020

11.1.5 Secondary Hazards

Dam failure can cause secondary hazards of landslides, bank erosion, and destruction of downstream habitat. Dam failure may worsen the severity of a drought by releasing water that might have been used as a potable water source.

11.2 HAZARD PROFILE

11.2.1 Past Events

There have been no dam failure events that have directly impacted the City of Long Beach. According to the Association of State Dam Safety Officials, "no one knows precisely how many dam failures have occurred in the U.S., but they have been documented in every state. From January 2005 through June 2013, state dam safety programs reported 173 dam failures and 587 incidents—episodes that, without intervention, would likely have resulted in dam failure." The historical record indicates that California has had about 45 failures of non-federal dams. Below is a partial list of significant dam failures in California.

Oroville Dam, 2017

In February 2017, heavy rain in Northern California caused the water level in the Oroville Dam to rise to a dangerous level. The state released water down the main spillway to relieve some of the pressure. On February 7, a crack in the spillway appeared and soon grew into a 250-foot crater. To prevent further damage, officials shut off water to the main spillway, but the reservoir continued to fill. The state released small amounts of water – which eroded the spillway's hole by another 50 feet and began to erode the hillside. The erosion threatened to undercut the entire dam, which could cause a collapse and send a 30-foot wall of water into the valley and communities below; 188,00 people were ordered to evacuate the Feather River basin. Officials further released 100,000 cubic feet per second of water down the main spillway, damaging it further. The dam held, and the reservoir eventually dropped below 850 feet.

1994 Pacoima Dam

The Pacoima Dam was damaged during the 1994 Northridge earthquake. The dam received enormous ground accelerations, which reached a peak level of twice the force of gravity (Los Angeles Times 1994). The dam's location was approximately 8 miles from the epicenter. Thirteen additional dams in the greater Los Angeles area moved or cracked during the earthquake, however, none were severely damaged, in part due to completion of retrofitting pursuant to the 1972 State Dam Safety Act.

1971 Multiple Dams, San Fernando Earthquake

On February 9, 1971, the San Fernando earthquake (also known as the Sylmar earthquake) occurred in the foothills of the San Gabriel Mountains. Damage was reported to the following dams:

- **Lower San Fernando Dam—**Perched above the densely populated San Fernando Valley, the 142-foot-high, 2,100-foot-long Lower San Fernando Dam held a reservoir 1.6 miles long, and up to 130 feet deep. The quake shook loose a massive slide in the upstream slope of the Lower San Fernando Dam that lowered the crest about 30 feet and carried away much of upstream concrete facing of the dam. Eighty-thousand people were evacuated from an 11-square-mile area while the water behind the earthen dam was lowered over a three-day period. The dam could not be repaired to safely hold its water supply and the $33 million Los Angeles Dam was built to replace it in 1975-76.
- **Van Norman Dam—**Van Norman Lake reportedly sank 1 foot, causing the evacuation of several thousand people from their homes south of the dam in Mission Hills. A 60-foot section of the concrete dam at the lake's southern edge collapsed, and portions were reported as still crumbling during the evacuation. The dam held back more than 6 billion gallons of water.
- **Hansen Dam—**The Hansen Dam, located on Sepulveda Boulevard in Lakeview Terrace, suffered cracks during the earthquake.

1963 Baldwin Hills Reservoir Collapse

On December 14, 1963, the dam at the head of Cloverdale Road broke in the Baldwin Hills section of Los Angeles. Lost homes, ruined property, and even death resulted from a river of rushing water from the broken dam. Automobiles, fragments of houses, and chunks of concrete were carried along the flood's path and deposited on the ruins of Village Green. Eighteen persons were rescued by helicopter and flown out to a safety.

1928 St. Francis Dam

The most catastrophic dam failure in California's history was that of the St. Francis Dam in Los Angeles County in March 1928. This failure resulted in the deaths of more than 450 people and destruction of nearly 1,000 homes and buildings. Numerous roads and bridges were destroyed or damaged beyond repair. California's Division of Safety of Dams came into existence as a direct result of this catastrophe.

11.2.2 Location

List of High-Hazard Dams

According to California's Division of Safety of Dams, four dams rated as extremely high hazard under California's hazard potential classification system have inundation areas that extend into the planning area. These dams are listed in Table 11-2, along with a fifth dam rated "very high" hazard by the U.S. Army Corps of Engineers. The locations of these dams are shown on Figure 11-1.

Table 11-2. High-Hazard Dams with Inundation Areas that Include Areas in Long Beach

Name	ID Number	Owner	Year Built	Dam Type[a]	Crest Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Downstream Hazard[b]	Condition Assessment
Cogswell	CA00190	L.A. County Dept. Public Works	1935	ROCK	585	266	8,969	Extremely High	Satisfactory
Morris	CA00216	L.A. County Dept. Public Works	1935	GRAV	750	245	27,500	Extremely High	Satisfactory
Puddingstone	CA00194	L.A. County Dept. Public Works	1928	ERTH	2,698	137	16,342	Extremely High	Satisfactory
San Gabriel No. 1	CA00200	L.A. County Dept. Public Works	1938	ERRK	1,520	320	44,183	Extremely High	Satisfactory
Whittier Narrows	CA10027	U.S. Army Corps of Engineers	1957	ERTH	—	56	66,702	Very High	—

a. ERRK = earth and rock. ERTH = earth. GRAV = gravity. ROCK = rock fill

b. Hazard rating for the Whittier Narrows Dam is from the U.S. Army Corps of Engineers' National Inventory of Dams. All other ratings are by the State of California's Division of Safety of Dams

Sources: California Division of Safety of Dams, 2021; U.S. Army Corps of Engineers National Inventory of Dams, 2021

Inundation Mapping

A key element of EAPs required for dams in California is a map defining the potential downstream inundation should the dam fail. As required by California Water Code section 6161, the Division of Safety of Dams approves inundation maps prepared by licensed civil engineers and submitted by dam owners for extremely high, high, and significant hazard dams and their critical appurtenant structures. Inundation maps approved by Division of Safety of Dams provide general information for emergency planning and are used to develop emergency action plans. Evacuation zones and timing are determined by local emergency managers who are responsible for specific evacuation planning.

Digital data indicating worst-case inundation areas for the dams listed in Table 11-2 were used for the Hazus-based quantitative assessment of dam failure risk for this hazard mitigation plan. The assessment of exposure and vulnerability to the dam failure hazard used a combined dam failure inundation area consisting of the mapped worst-case inundation areas of all five dams. This combined area is shown in Figure 11-1.

11.2.3 Frequency

Large-scale dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes and excessive rainfall. A Stanford University study found an average of about 10 dam failures per year nationwide over a period of record from 1848 through 2017 (Stanford University 2018). Since no recorded failures have occurred on a dam that impacted the planning area, no estimate of frequency or probability of future occurrence can be developed based on the historical record. Although the 2017 Oroville event raised public concern about dam failure, the probability of such failures remains low in today's regulatory environment.

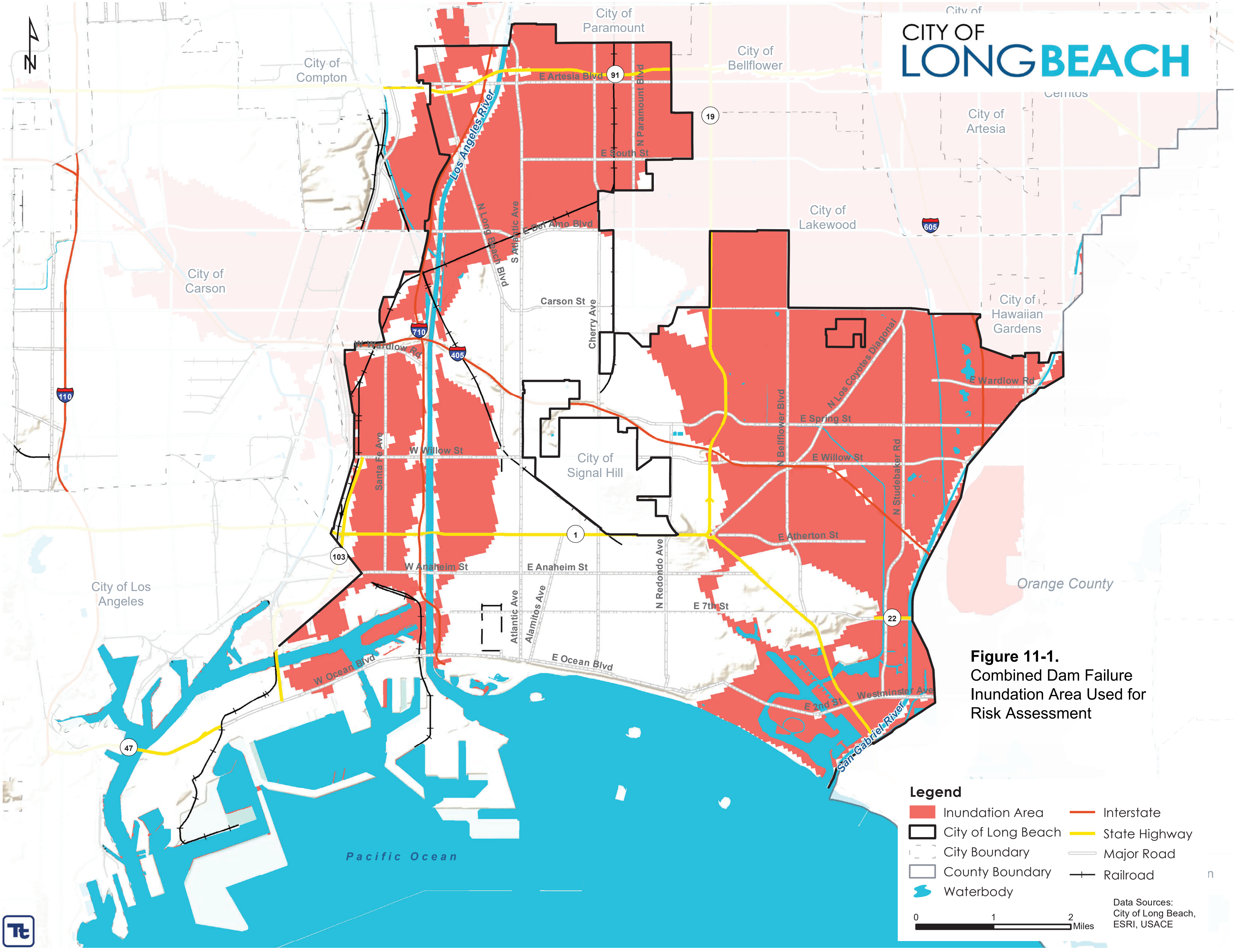

Figure 11-1. Combined Dam Failure Inundation Area Used for Risk Assessment

All dams face a “residual risk” of failure, which represents the risk that conditions may exceed those for which the dam was designed. For example, dams may be designed to withstand a probable maximum precipitation, defined as “the maximum depth of precipitation at a location for a given duration that is meteorologically possible” (Sarkar and Maity 2020). The chance of a precipitation event of a greater magnitude than that represents residual risk for such dams. This represents a theoretical probability of future occurrence for a dam failure event, though the probability of an event exceeding the assumed maximum is not generally calculated as part of dam design.

11.2.4 Severity

In May 2016, the Corps of Engineers changed the risk characterization of the Whittier Narrows Dam from high urgency to very high urgency. New findings identified premature opening of the automatic spillway gates, backward erosion piping of the foundation and overtopping of the dam as the risk-driving failure modes.

Based on a Dam Safety Modification Study on the structure, the Whittier Narrows Dam was given the classification of Dam Safety Action Class 1, which identifies it as “one of the highest priority dam safety projects in the Corps of Engineers portfolio of dams.” The Corps considers the incremental risk—the combination of life or economic consequences with the likelihood of failure—to be very high.

An estimated 1.25 million people live in municipalities downstream of the Whittier Narrows Dam within the mapped dam failure inundation area, which extends 19.6 miles from the dam to the Pacific Ocean. An estimated 680,000 to 970,000 people would be directly affected by a peak maximum flood inundation, depending on the time of day (U.S. Army Corps of Engineers 2020).The City of Long Beach lies partly within the mapped inundation area, about 18 miles downstream of the dam, and is at risk in the event of a failure.

11.2.5 Warning Time

The potential for personal injury or loss of life in the event of a dam failure is affected by the amount of warning time and the capacity of evacuation routes available to those living in inundation areas. Warning time depends on the cause of the failure. In case of extreme precipitation, evacuations can be implemented with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. The USGS Earthquake Hazards Program has several dam-safety related earthquake programs, including dam-specific earthquake monitoring programs in California to help monitor safety concerns following seismic events.

A dam’s structural type affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until the reservoir is empty or the erosion stops. Concrete dams also tend to begin with a partial breach. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers 2014).

11.3 EXPOSURE

Summary findings of the risk assessment for dam failure, showing exposure results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

11.3.1 Population and Property

Table 11-3 summarizes the estimated population and property exposure in the combined dam failure inundation area used for this assessment. The distribution of exposed structures by occupancy class is shown in Figure 11-2.

Table 11-3. Exposed Population and Property in Dam Failure Inundation Zone

Population	
Population Exposed	239,904
% of Total Planning Area Population	51.2%
Property	
Inundated area (acres)	33,278
Number of Buildings Exposed	59,772
Value of Exposed Structures	$26,872,414,347
Value of Exposed Contents	$20,047,855,360
Total Exposed Property Value	**$46,920,269,707**
Total Exposed Value as % of Planning Area Total	47.6%

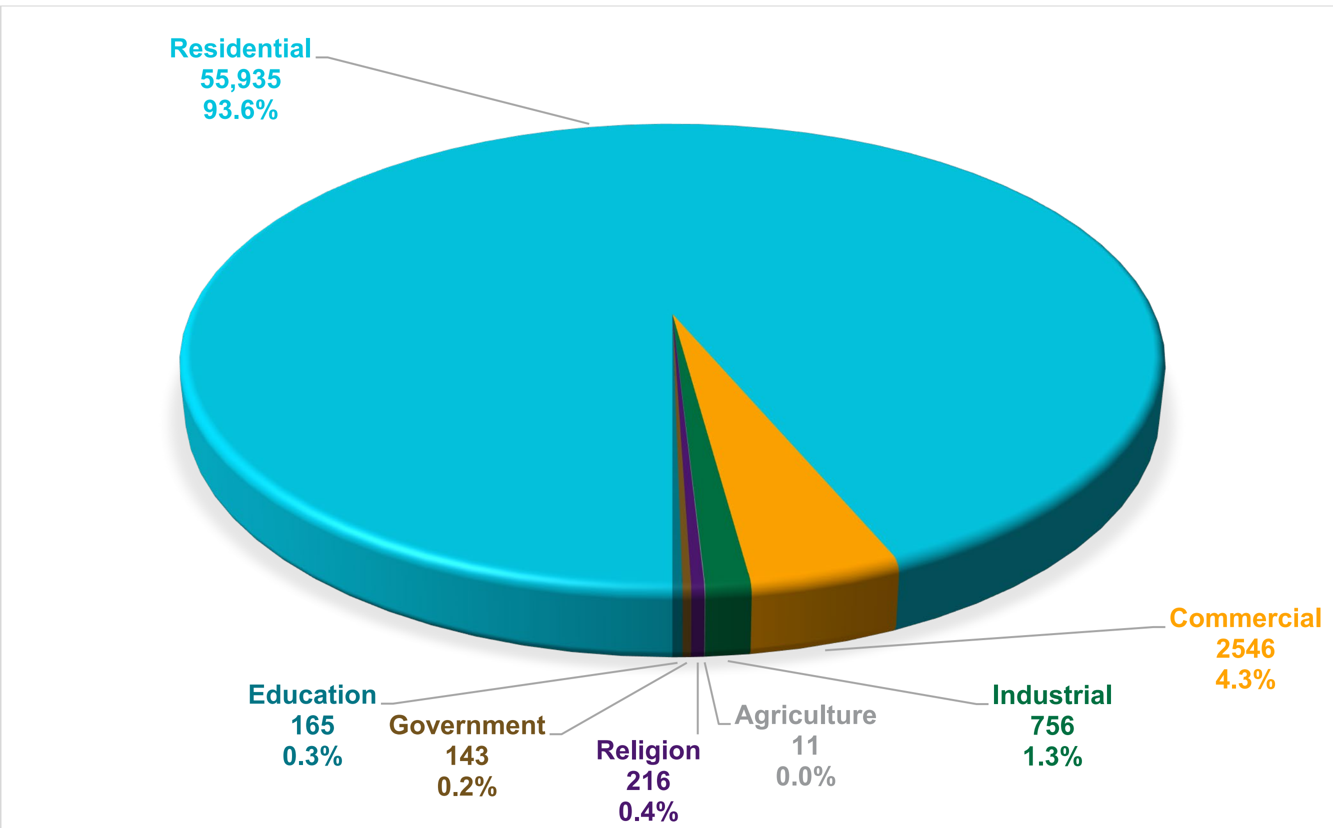

Figure 11-2. Exposed Structures in Dam Failure Inundation Zone by Occupancy Class

11.3.2 Critical Facilities

Figure 11-3 summarizes critical facilities located in the dam failure inundation zone by category. The total count of critical facilities in the dam failure inundation zone (454) represents 49 percent of the planning area total of 921. Figure 11-4 and Figure 11-5 show the location of critical facilities within the combined inundation area.

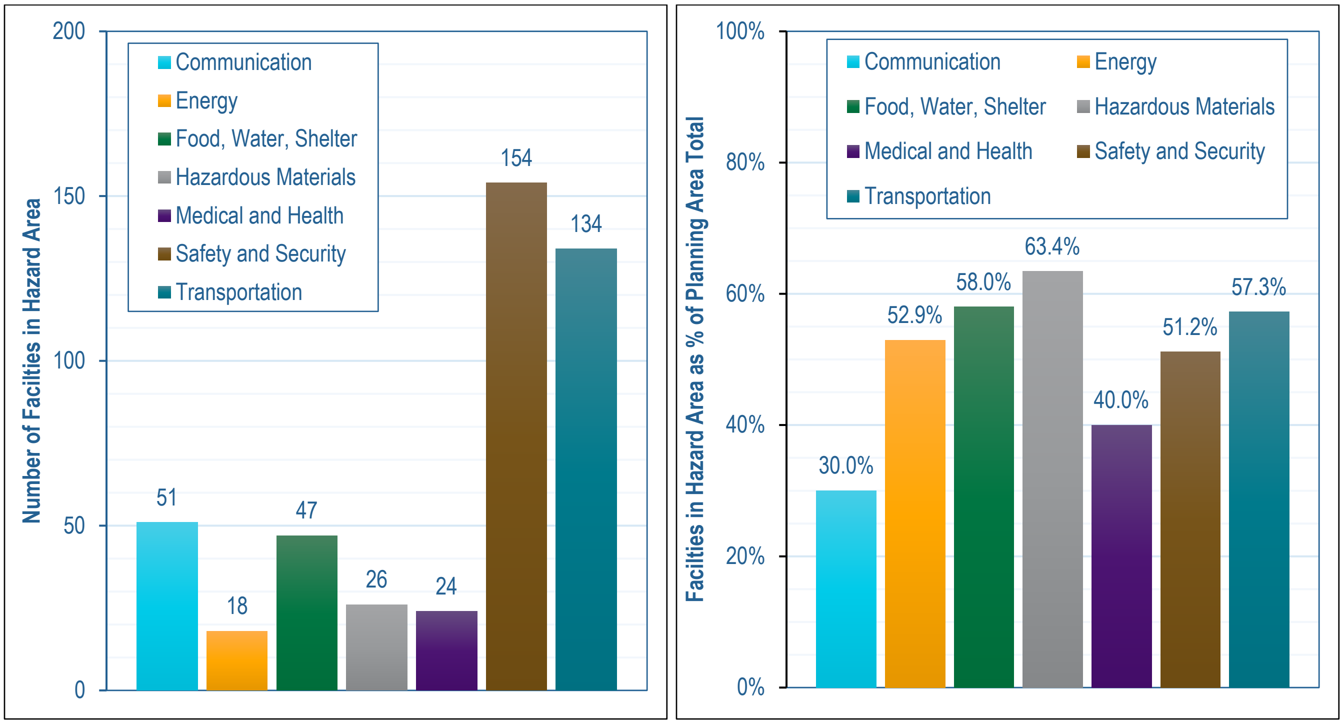

Figure 11-3. Critical Facilities in Dam Failure Inundation Zones and Citywide

11.3.3 Environment

Almost all environmental areas of the planning area are within the mapped dam failure inundation zone.

11.4 VULNERABILITY

Summary findings of the risk assessment for dam failure, showing vulnerability results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

11.4.1 Population

Estimated Impacts on Persons and Households

Vulnerable populations include anyone downstream from a dam failure who is incapable of escaping the area within the allowable time frame. Those who live on properties closest to the dam would have the least amount of time to evacuate.

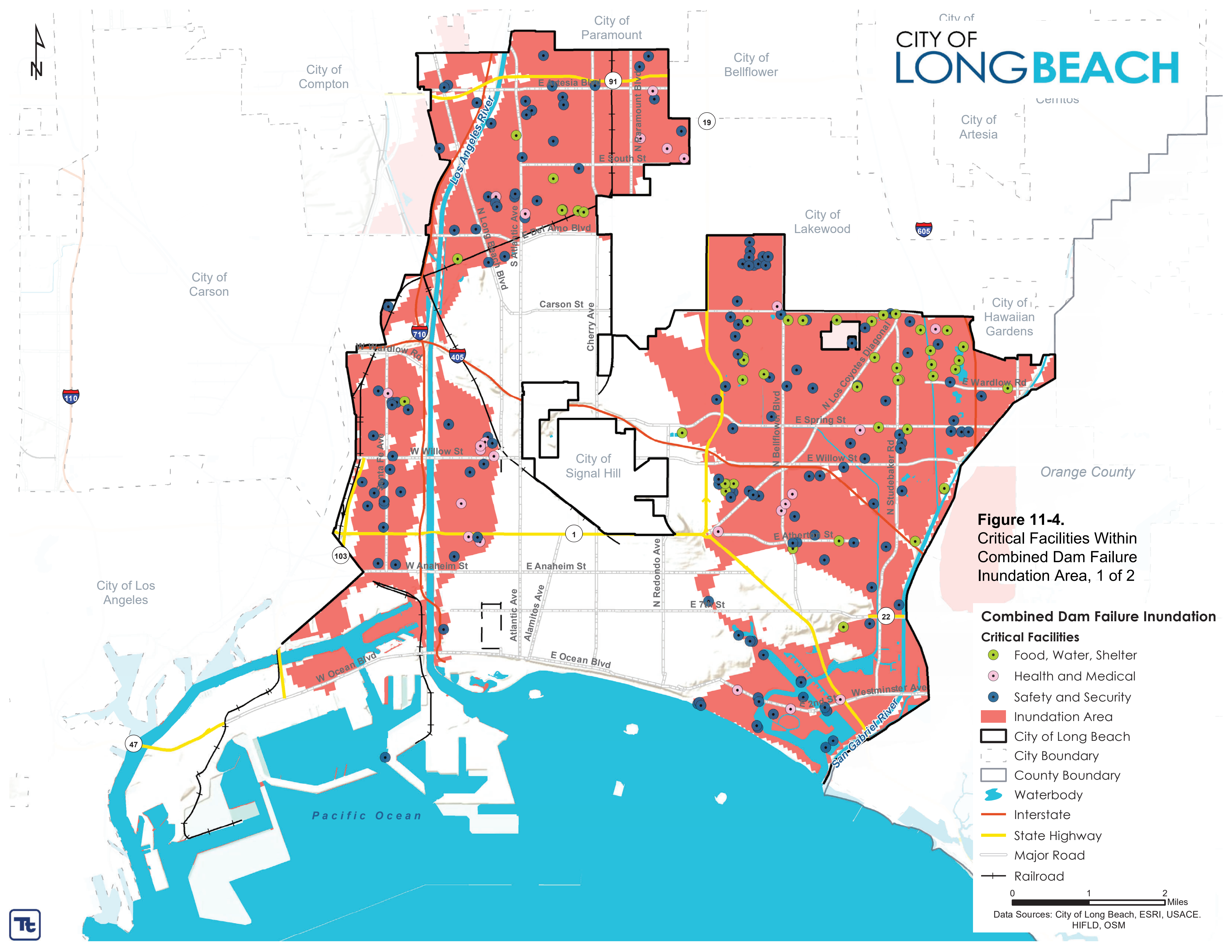

Figure 11-4.
Critical Facilities Within Combined Dam Failure Inundation Area, 1 of 2

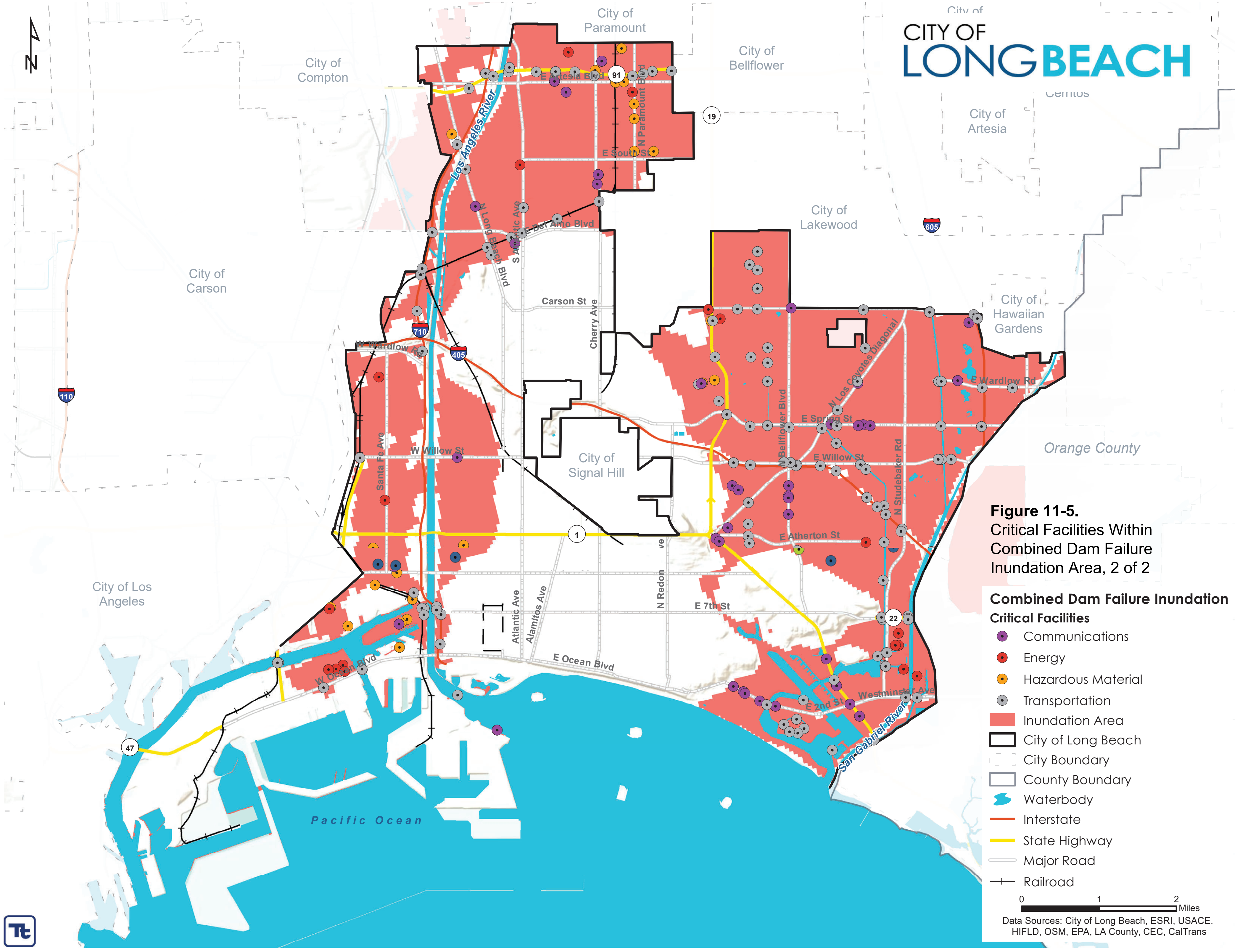

Figure 11-5.
Critical Facilities Within Combined Dam Failure Inundation Area, 2 of 2

Impacts on all exposed persons and households were estimated through Hazus as follows.:

- Number of Displaced Residents: 239,793
- Number of Residents Requiring Short-Term Shelter: 8,624

11.4.2 Property

Hazus calculates losses to structures from dam failure inundation by looking at depth of flooding and type of structure. Using historical flood insurance claim data, Hazus estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, local data on facilities was used instead of the default inventory data provided with Hazus. The Hazus analysis also estimated the quantity of debris that would be caused by a dam failure. Hazus-estimated dam failure impacts on structures in the planning area are shown in Table 11-4.

Table 11-4. Loss Estimates for Dam Failure

Number of Structures Impacted	57,612
Estimated Loss	
Structures	$10.7 billion
Contents	$10.6 billion
Total	***$21.3 billion***
% of Total Planning Area Replacement Value	21.6%
Debris	2.7 million tons

11.4.3 Critical Facilities

Hazus was used to estimate the level of potential damage to critical facilities exposed to the dam failure inundation risk, using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities. Figure 11-6 summarizes the Hazus results.

Transportation routes are vulnerable to dam inundation and have the potential to be destroyed, trapping evacuees in the dam inundation zone. This includes all roads, railroads, and bridges in the path of the dam inundation. Bridges in need of repair may be vulnerable during a dam failure and not withstand the water surge. Critical electrical, communications, gas and water infrastructure also could be damaged.

11.4.4 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals.

11.5 FUTURE TRENDS IN DEVELOPMENT

The City of Long Beach has no areas targeted for expansion of the city limits. All future development within the city will be the development “buildable” lands within the existing city limits or redevelopment. Future land use will be directed by the City’s General Plan and zoning ordinance. The City participates in the National Flood Insurance Program (NFIP) and has adopted codes and standards as required for that participation.

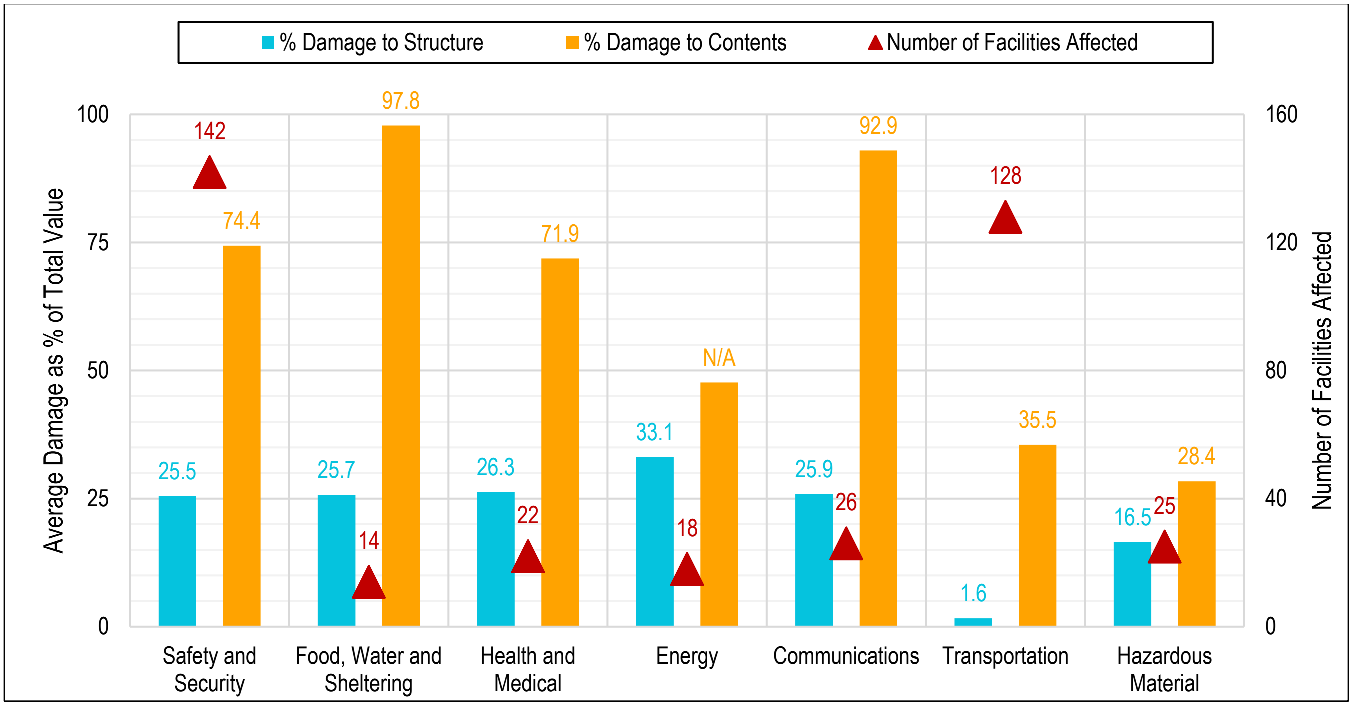

Figure 11-6. Estimated Damage to Critical Facilities from Dam Failure

While the potential risk from dam failure inundation is mentioned in the Safety Element, it is not currently addressed as a stand-alone hazard. Neither the City's General Plan nor the zoning ordinance cites policy or regulation within identified dam failure inundation areas. Dam failure is considered to be a low-probability but high-consequence event. The risk is significant, and future updates to the General Plan and zoning ordinance should consider addressing that risk.

The probability of flooding associated with changes in dam operational parameters in response to extreme rainfall events is higher than the probability of dam failure. Dam designs and operations are based on hydrographs from historical records. If these hydrographs change significantly over time due to effects of climate change, current dam designs and operations may become overwhelmed. Specified release rates and impound thresholds may have to be changed, which could result in increased discharges downstream of these facilities, thus increasing probability and severity of inundation

11.6 SCENARIO

A worst-case dam failure scenario for the City of Long Beach would be the "probable maximum flood" as depicted on the Emergency Action Plan for the Whittier Narrows Dam. The probable maximum flood is defined as the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions. A probable maximum flood event for Whittier Narrows Dam could impact over 47 percent of the structures within the City of Long Beach. Flooding could occur along both sides of the San Gabriel River where it passes through Long Beach but would probably be most severe on the east side of the river channel (City of Long Beach General Plan 2004).

11.7 ISSUES

The most significant issue associated with dam failure involves the exposed population and property throughout the city. Depending on the amount of water behind the dam, inundation from a failure could be catastrophic. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- The City has no current policies or standards to address the risk associated with a dam failure.
- Federally regulated dams have emergency action plans to follow in the unlikely event of failure. The protocol for notifying downstream residents of imminent failure is the responsibility of the City of Long Beach and the Los Angeles Sheriff’s Department.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.
- California’s AB 2800 enacts legislation that will require engineers and climate scientists to collaborate to help the state design and build infrastructure that will withstand the unavoidable impacts of a changing climate.

12. TSUNAMI

12.1 GENERAL BACKGROUND

A tsunami is a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs, arriving at shorelines over an extended period. Tsunamis can be induced by earthquakes, landslides, and submarine volcanic explosions (see Figure 12-1). Tsunamis are typically classified as local or distant, depending on the location of their source in comparison to where waves occur:

- The waves nearest to the generating source represent a local tsunami. Such events have minimal warning time, leaving few options except to run to high ground after a strong, prolonged local earthquake. Damage from the tsunami adds to damage from the triggering earthquake due to ground shaking, surface faulting, liquefaction, and landslides.
- The waves far from the generating source represent a distant tsunami. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement evacuation plans if a warning is received.

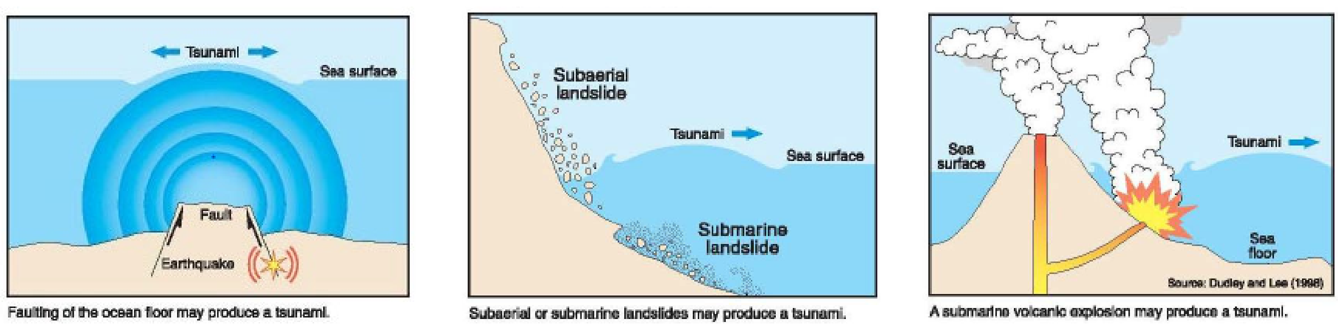

Figure 12-1. Common Sources of Tsunamis

Historical records suggest that tsunami wave heights on the order of 15 to 60 feet on the West Coast could be generated by a powerful earthquake near the coast. Significant damage would result from the ground shaking, tsunami wave forces, and impacts associated with debris.

12.1.1 Tsunami Characteristics

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 600 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. The inundation area for a tsunami event is often described as runup as illustrated in Figure 12-2.

Source: (UNESCO 2007)

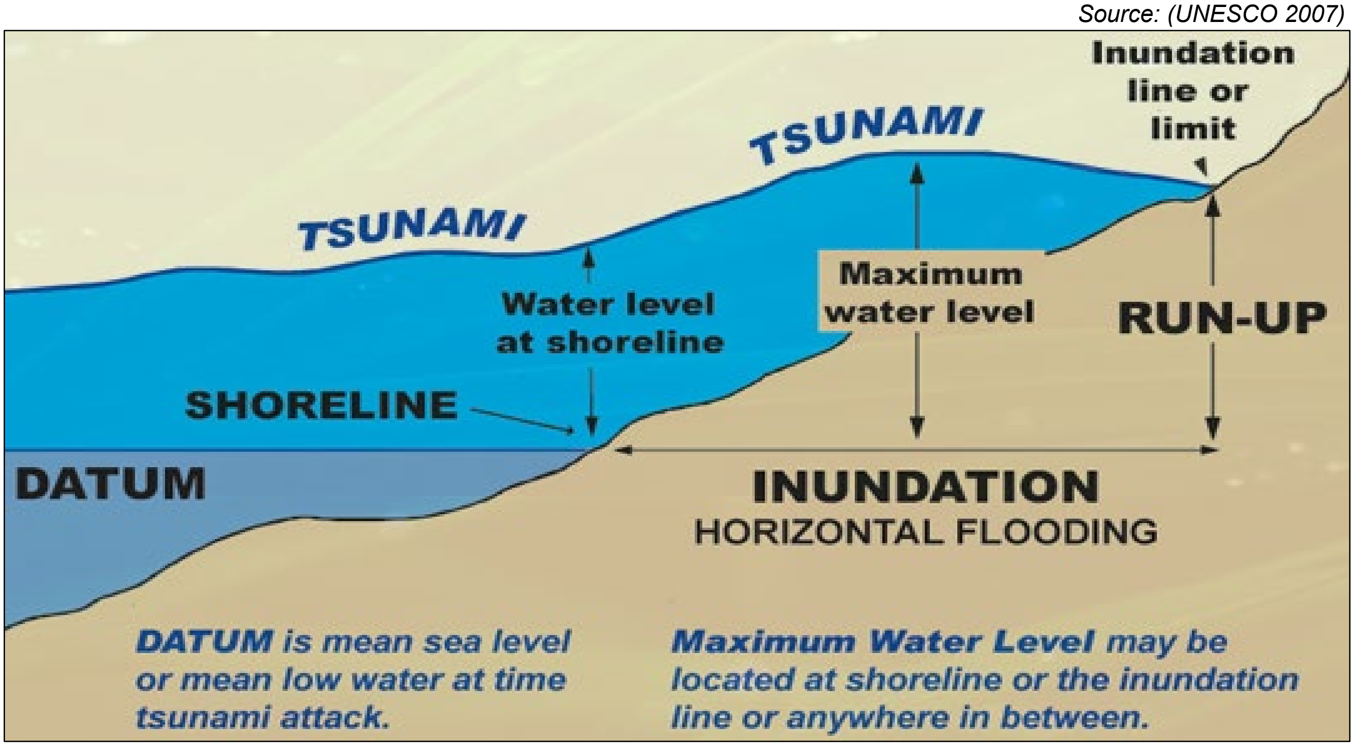

Figure 12-2. Runup Distance and Height in Relation to the Datum and Shoreline

12.1.2 Secondary Hazards

A major tsunami in the planning area would result in flooding near the coastline.

12.2 HAZARD PROFILE

12.2.1 Past Events

The California Department of Conservation maintains a list of tsunamis in the state. Table 12-1 lists known tsunami events that have struck the planning area since 1859.

Table 12-1. Tsunami Events in Long Beach

Date	Description
October 4, 1925	A wave was recorded at the Long Beach sea-level recorder with an amplitude of 1.1 foot. The period was regular at 63 minutes and it continued for five days of the record examined. It was not recorded at nearby La Jolla. There was no earthquake to provide a source. This was probably a seiche from a remote meteorological source.
March 11, 1933	There was a magnitude 6.3 earthquake at Long Beach, but the sea-level recorders at Long Beach and Santa Monica both showed wave activity beginning to emerge before the earthquake and continuing more than 36 hours later. The emergent nature of the two readings, the early arrival times, and the long duration of the waves (36 hours at Long Beach and Santa Monica) indicate a meteorological source with perhaps some seiches set up by the earthquake.
April 1, 1946	A magnitude 7.3 earthquake in the East Aleutian Islands (Alaska) triggered a tsunami that struck California. A feeble undertow was reported by swimmers in Long Beach.
May 22, 1960	A magnitude 9.5 earthquake in Central Chile triggered a tsunami that reached Long Beach. $500,00 - $1,000,000 in damage in Long Beach and Los Angeles harbors. Gasoline spewed from ruptured boats, causing a fire hazard. One dock broke loose at Sunset Beach, near Long Beach, but there was no damage to the boats.
March 28, 1964	A magnitude 9.2 earthquake off the Gulf of Alaska triggered a tsunami that reached the City of Long Beach. 8 docks with a value of $100,000 were destroyed in Long Beach Harbor. The tsunami was registered on tide gages at Long Beach and Port San Luis, California with amplitudes of 0.12 meters.
March 11, 2011	FEMA Disaster Declaration No. DR-1968. A magnitude 8.9 earthquake near Honshu, Japan generated a tsunami significantly affecting California. Long Beach Marina-Shoreline, maximum observed amplitude 0.6 to 0.7 meters, approximate time of peak amplitude March 11, 1000 [local time], 8-10 knots current velocity (velocity estimates were gathered from eyewitness accounts and preliminary video evaluations, and therefore may be overestimated). Couple boats and a dock destroyed; debris boom destroyed.
January 15, 2022	A tsunami advisory was issued for Southern California beaches after an underwater volcano erupted near the island nation of Tonga in the South Pacific. In Los Angeles, the max elevation above mean low water was 2.04 meters. Long Beach did not experience damages as a result of this tsunami.

Sources: FEMA, NOAA Storm Events Database, California Department of Conservation, NCEI/WDS Historical Tsunami Database

More than 80 tsunamis have been recorded or observed in California, according to state records; however, many of these events were small and led to little or no damage. All tsunamis from the past century have been distant, not local. That is, they have all resulted from earthquakes across the Pacific basin (as opposed to earthquakes near the American coastline). Noteworthy tsunamis in California include the following:

- **December 21, 1812 (Local Tsunami)**—A tsunami struck the Santa Barbara and Ventura coastlines not long after an earthquake was felt in the area. The tsunami inundated lowland areas and damaged local ships. Some debate exists as to whether the tsunami was earthquake-induced, or the result of a submarine landslide triggered by the earthquake.
- **April 1, 1946 (Distant Tsunami)—**An M-8.8 earthquake in the Aleutian Islands generated a tsunami that caused damage along the coast of California.
- **March 11, 2011 (Distant Tsunami)**—An M-9.0 earthquake in Tohuku, Japan generated a moderate tsunami in California. While the tsunami did not cause significant flooding, it did lead to one death and more than $100 million in damages to 27 harbors statewide. The most significant damage occurred in Crescent City and Santa Cruz.

12.2.2 Location

The California Department of Conservation maintains detailed tsunami inundation maps for the state. These maps are generated through computer modeling of the areas most likely to be affected by a tsunami event and serve as an important preparedness tool. The tsunami hazard areas identified in the mapping are based on a suite of tsunami sources, both local and distant, and does not, therefore, represent risk from a single sources event. Tsunami risk areas are shown in Figure 12-3.

12.2.3 Frequency

Typically, four or five tsunamis occur every year in the Pacific basin, most of them minor. Those that are most damaging have historically been generated in the Pacific waters off South America rather than in the northern Pacific. The National Tsunami Hazard Mitigation Program rates the risk to the U.S. west coast from the tsunami hazard as high to very high (Dunbar and Weaver 2015). Since 1950, there have been 12 tsunami events to impact the City of Long Beach (one every six years), six of which had known impacts (one every 12 years) (National Centers for Environmental Information n.d.).

12.2.4 Severity

A tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of the tsunami. At some locations, the advancing turbulent wave front will be the most destructive part of the tsunami wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping away items on the surface and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris, resulting in further destruction. Ships and boats, unless moved away from shore, may be forced against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater (National Tsunami Warning Center 2021).

12.2.5 Warning Time

Visible Indications

Tsunamis are difficult to detect in the open ocean; with waves generally less than 3 feet high. The first visible indication of an approaching tsunami may be either a rise or drop in water surface levels (National Tsunami Warning Center 2021):

- A drop in water level (draw down) can be caused by the trough preceding the advancing, large inbound wave crest. Rapid draw down can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.
- The advancing tsunami may initially arrive as a strong surge increasing the sea level. This can be similar to the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, 3 to 6 feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, other debris, and hazardous materials. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

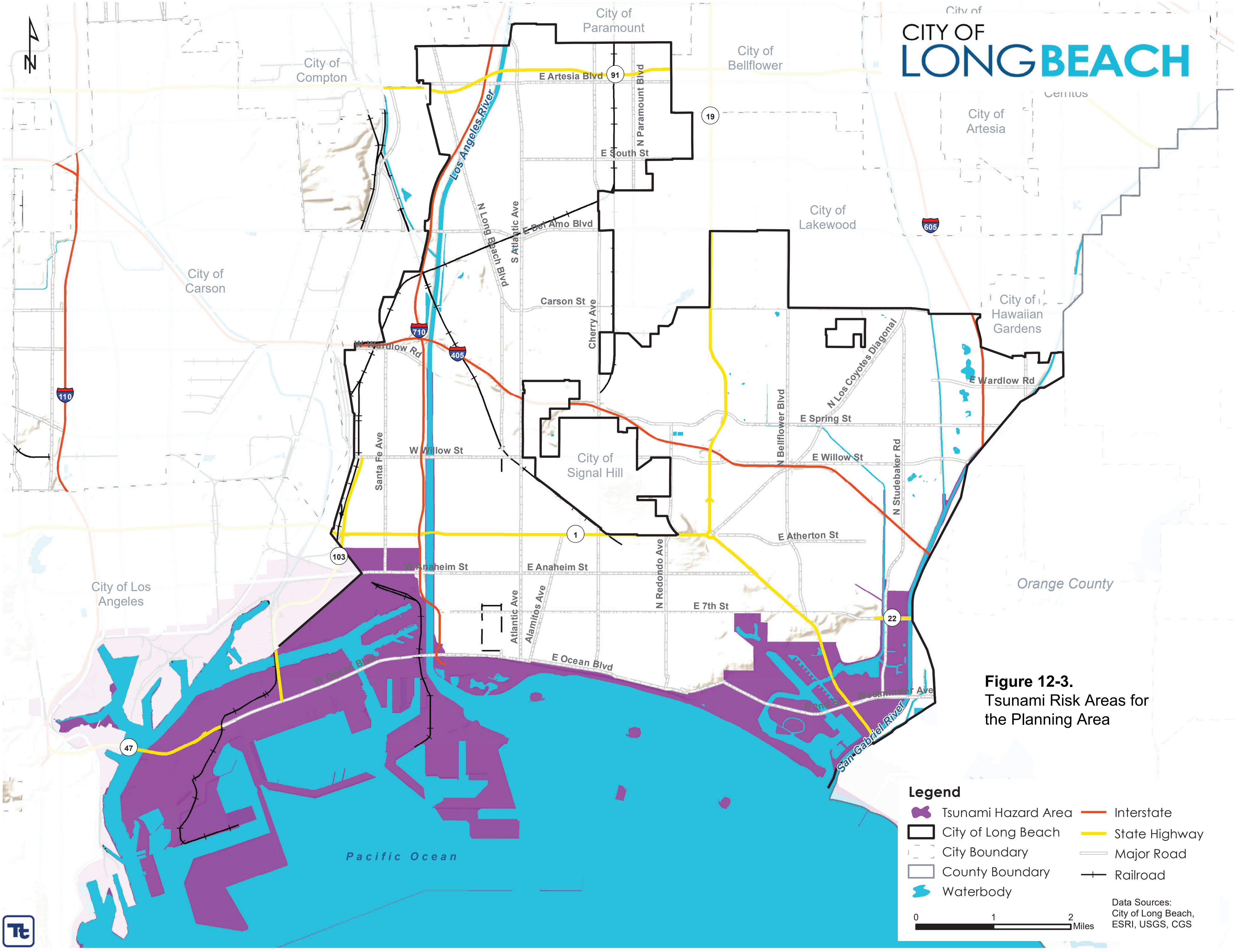

Figure 12-3.
Tsunami Risk Areas for the Planning Area

Estimated Travel Times

The NOAA National Center for Environmental Information website provides maps that show estimated travel times to coastal locations for various tsunami-generating events. Figure 12-4 shows one example of the travel time for a tsunami generated in Aburatsu, Japan to reach the planning area—approximately 13 hours.

Source: (NOAA n.d.)

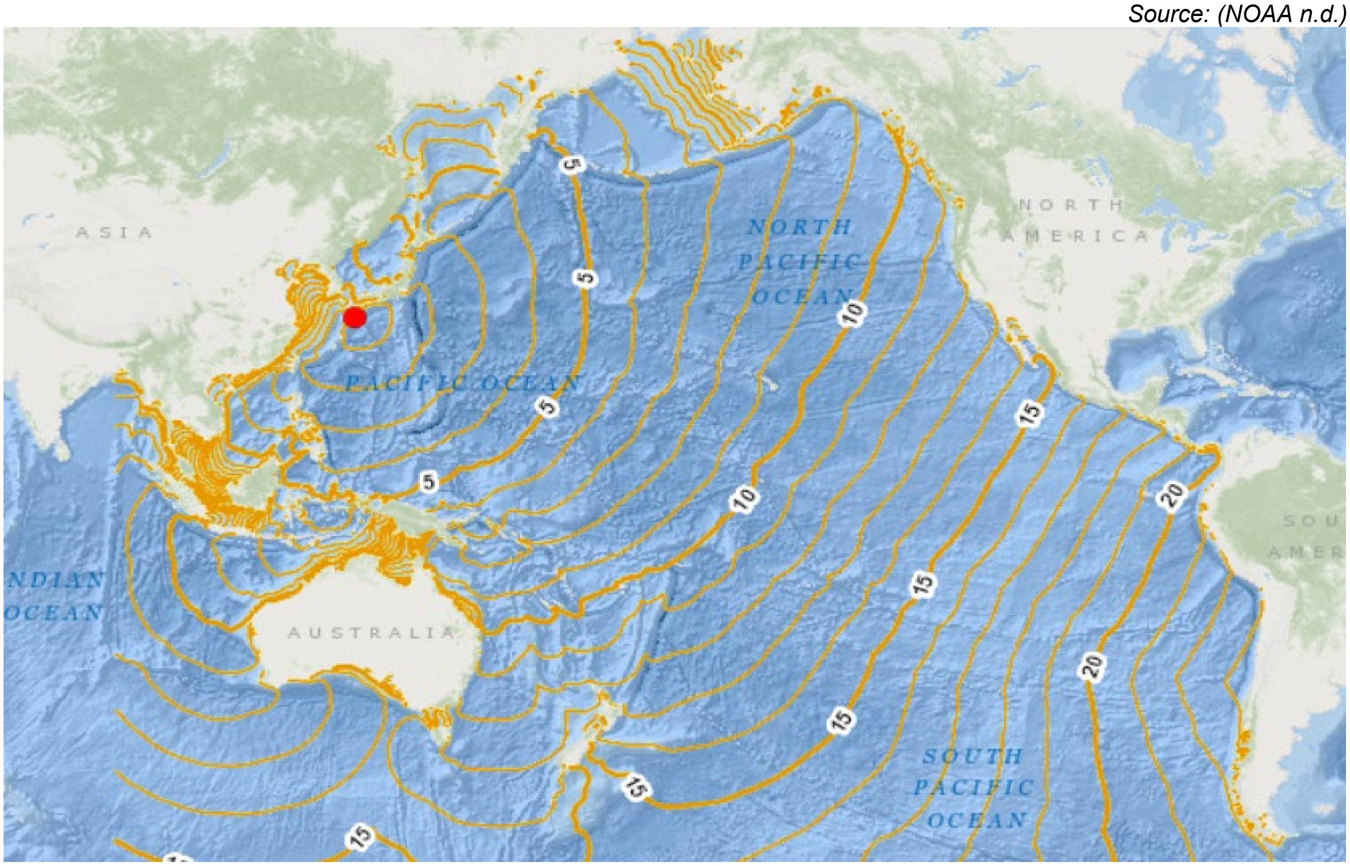

Figure 12-4. Potential Tsunami Travel Times in the Pacific Ocean, in Hours

Tsunami Warning System for the Pacific Ocean

The tsunami warning system for the Pacific Ocean is a cooperative effort among 26 nations. The National Weather Service operates two regional information distribution centers for this system: The Pacific Tsunami Warning Center in Ewa Beach, Hawaii; and the National Tsunami Warning Center covering the California coast in Palmer, Alaska. The warning centers issue tsunami watches, warnings, and advisories. When a Pacific basin earthquake of magnitude 6.5 occurs or an earthquake is widely felt along the North American coast, the following actions occur:

- Data is interpolated to determine epicenter and magnitude of the event.
- If the earthquake is of the right type, depth, magnitude, and is far away from California coast, a TSUNAMI WATCH is typically issued for the California coastline.

- A TSUNAMI WATCH is upgraded to a TSUNAMI WARNING if tsunami wave heights are forecast to be 1 meter or larger. A TSUNAMI ADVISORY is issued if tsunami wave heights are forecast to be 0.3 meters to less than 1 meter.
- Tsunami travel times are calculated, and the warning is transmitted to disseminating agencies who relay it to the public.
- The National Tsunami Warning Center will cancel/expire watches, warnings, or advisories if tide gauges and buoys indicate no significant tsunami was generated or if tsunami waves no longer meet the criteria for at least 3 hours.

This system is not considered to be effective for communities close to the tsunami source, because the first wave would arrive before the data could be processed and analyzed, and communications systems may be impacted by the precipitating event. In this case, strong ground shaking would provide the first warning of a potential tsunami and evacuations should begin immediately.

12.3 EXPOSURE

Exposure and vulnerability to tsunami hazard were assessed by overlaying the mapped inundation area in Figure 12-3 with planning area features including general building stock and critical facilities. Summary findings of the risk assessment, showing exposure results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

12.3.1 Population and Property

Table 12-2 summarizes the estimated population living in the evaluated tsunami inundation areas and the estimated property exposure. Figure 12-5 shows the structure type of buildings in the inundation area. Residential properties make up 88 percent of this exposure.

Table 12-2. Exposed Population and Property in Evaluated Tsunami Inundation Areas

Population	
Population Exposed	31,315
% of Total Planning Area Population	6.7%
Property	
Acres of Inundated Area	13,086
Number of Buildings Exposed	10,624
Value of Exposed Structures	$6,400,135,318
Value of Exposed Contents	$4,913,062,346
Total Exposed Property Value	**$11,313,197,664**
Total Exposed Value as % of Planning Area Total	*11.5%*

12.3.2 Critical Facilities

Figure 12-6 shows critical facilities located in the tsunami inundation zone by facility type. The total count of critical facilities in the inundation zone (195) represents 21 percent of the planning area total of 921.

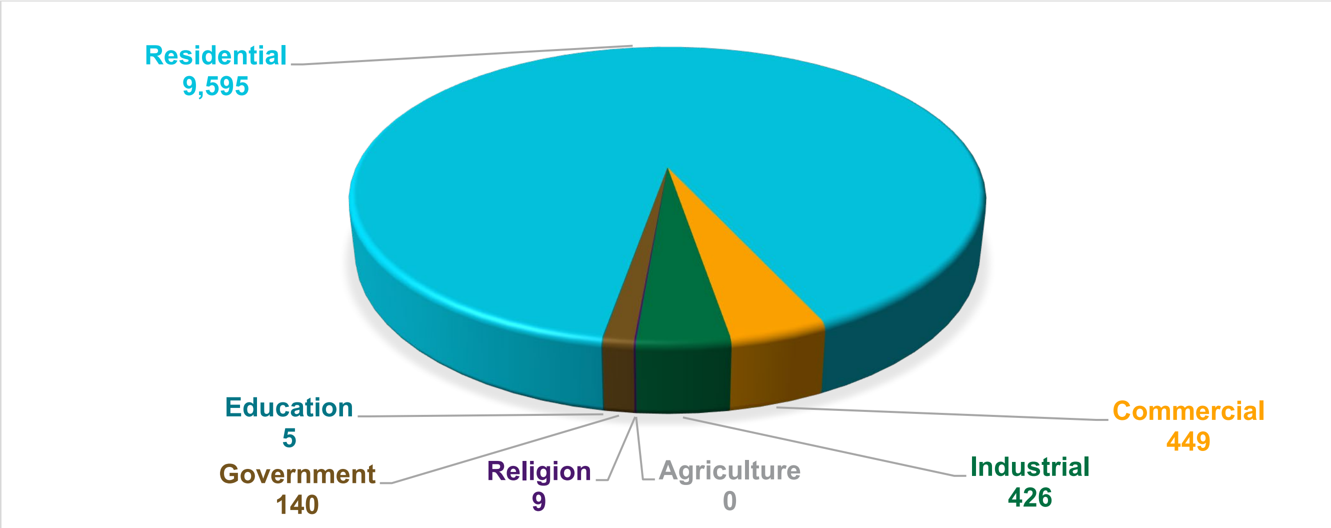

Figure 12-5. Number of Structures within the Tsunami Inundation Area by Occupancy Class

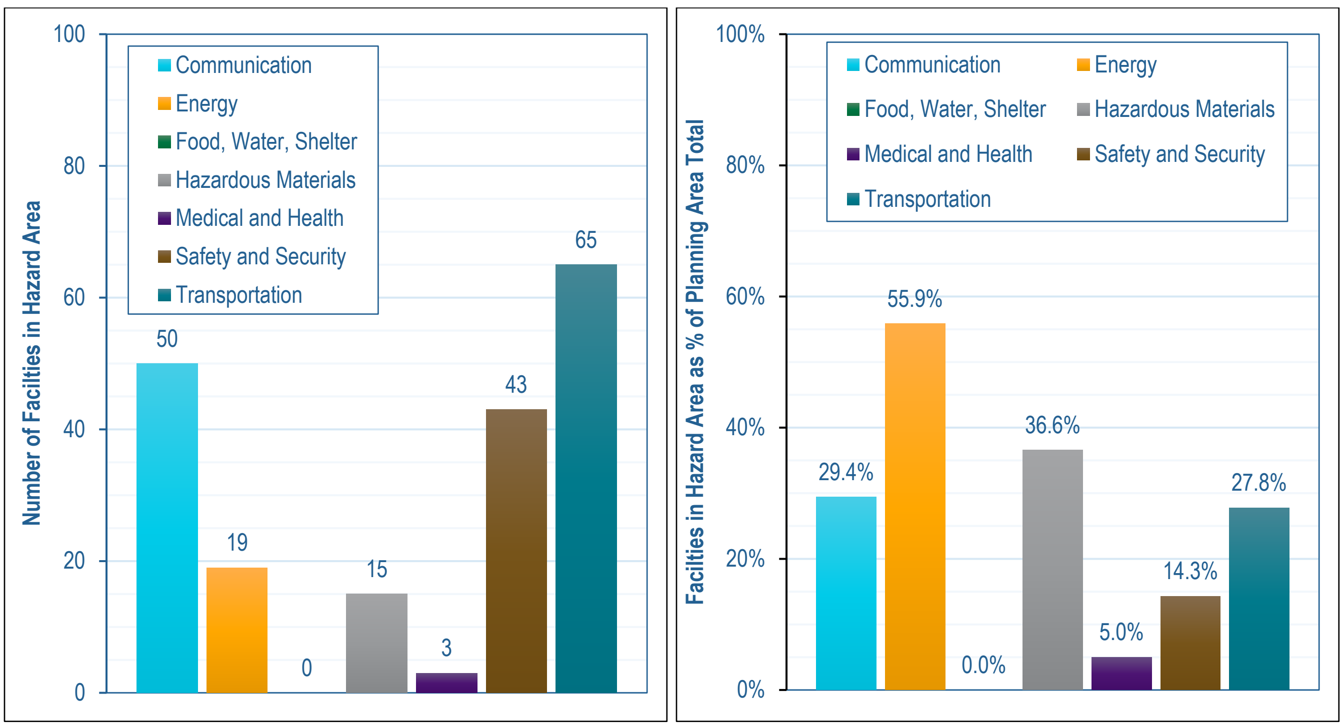

Figure 12-6. Critical Facilities in Tsunami Inundation Zones and Countywide

Hazardous Material Facilities

The planning area includes 13 structures in the tsunami hazard areas that contain hazardous materials. Containers holding these materials can rupture and leak into the surrounding area during a tsunami event, having a disastrous effect on the environment as well as community members.

Roads

Roads are the primary resource for evacuation to higher ground before and during a tsunami. Blocked or damaged roads can prevent access or cause isolation for community members and emergency service providers. Geospatial analysis indicates the following major roads pass through the tsunami inundation areas and may be exposed to the tsunami hazard:

- 2nd Street
- Appian Way
- East 7th Street
- East and West Shoreline Drive
- East Livingston Drive
- East Ocean Boulevard
- Interstate 710
- North Studebaker Road
- Pacific Coast Highway (Highway 1)
- Santa Fe Avenue
- Seaside Freeway (Highway 47)
- South Harbor Scenic Drive
- West Anaheim Street

Bridges

Geospatial analysis identified 27 bridges that would be exposed to the tsunami hazard. Bridges exposed to tsunami events can be extremely vulnerable because of the forces transmitted by the wave run-up and by the impact of debris carried by the wave action.

Water/Sewer/Utilities

Water and sewer systems can be affected by the flooding associated with tsunami events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can enter drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastes to spill into homes, neighborhoods, rivers, and streams. The forces of tsunami waves can damage aboveground utilities by knocking down power lines and radio/cellular communication towers. Power generation facilities can be severely impaired by both the impact of the wave action and the inundation of floodwaters.

12.3.3 Environment

All waterways and beaches would be exposed to the effects of a tsunami; inundation of water and introduction of foreign debris could be hazardous to the environment. All wildlife inhabiting the area also is exposed.

12.4 VULNERABILITY

Summary findings of the risk assessment for tsunami, showing vulnerability results for the entire planning area, are provided in the sections below. Appendix C provides a detailed breakdown of results by Zip code.

12.4.1 Population

Tsunami impacts on persons and households were estimated through the Level 2 Hazus analysis. Table 12-3 summarizes the results.

Table 12-3. Estimated Tsunami Impacts on Residents

Displaced Population	23,047
Number of Residents Requiring Short-Term Shelter	1,302

12.4.2 Property

Property Impacted

The impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats, and river deltas. The most vulnerable are those in the front line of tsunami impact and those that are structurally unsound. The Hazus analysis indicated that 71 percent of the exposed structures (7,586 structures) would be impacted by the modeled scenario event.

Damage Estimates

Table 12-4 summarizes Hazus estimates of tsunami damage in the planning area. The estimated damage value is associated with the tsunami wave only; it does not include additional damage that may occur as a result of debris battering structures as the tsunami wave rushes in and out of the inundation area or fires caused by an earthquake and tsunami event. The debris estimate includes only structural debris and building finishes; it does not include additional debris that may result from a tsunami event, such as from boats, trees, sediment, building contents, bridges, or utility lines.

Table 12-4. Estimated Impact of a Tsunami Event in the Planning Area

Structure Debris (tons)	91
Buildings Impacted[a]	7,586
Structure Value Damaged	$1.77 billion
Content Value Damaged	$1.89 billion
Total Value Damaged	**$3.66 billion**
Damage as % of Total Value	3.7%

a. "Impacted" assumes floodwater over lowest finished floor

Structures that were built to current floodplain regulations in the tsunami inundation area may have some level of protection, particularly if they were built to withstand wave action. An estimated 86 percent of the housing units were built before the city entered the National Flood Insurance Program and began enforcing floodplain regulations. It is unknown how many of these structures are located in tsunami inundation areas. In addition to structure damage, ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore.

12.4.3 Critical Facilities

Damage Estimates

Figure 12-7 shows the estimated damage to critical facilities from a tsunami event. The average amount of damage to structures, measured as a percentage of total value, ranges from 6 to 36 percent of total value and average damage to contents ranges from 48 to 90 percent, depending on critical facility category.

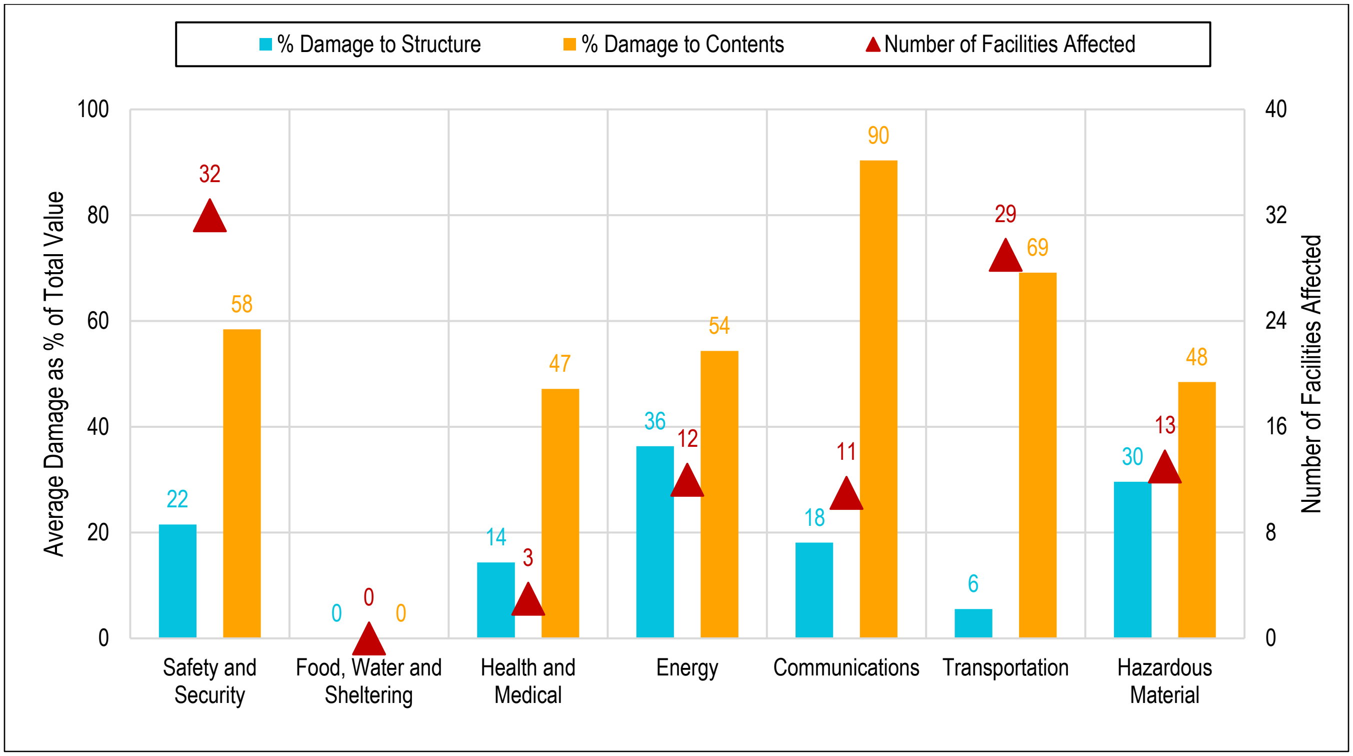

Figure 12-7. Critical Facility Damage in the Tsunami Inundation Zone

Vulnerable Infrastructure

In addition to the vulnerable critical facilities identified by the Hazus analysis, the following infrastructure is also generally vulnerable to damage:

- **Water Proximate Infrastructure**—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.
- **Flood Control Systems**—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.
- **Utility Systems—**Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers, and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

12.4.4 Environment

Environmental impacts on local waterways and wildlife would be most significant in areas closest to the point of impact. Areas near gas stations, industrial areas and facilities storing hazardous materials are vulnerable. The vulnerability of aquatic habit and associated ecosystems in low-lying areas close to the coastline is high. Tsunami waves can carry destructive debris and pollutants that can have devastating impacts on all facets of the environment. A tsunami event has the potential to alter the shoreline, depending on the force of the run-up.

Most environmental and ecological impacts from tsunamis derive from direct damage from the waves, which can physically remove vegetation and wildlife, increase sediment load, and smother vegetation that is not physically carried away. Other environmental impacts from tsunamis include chemical changes from saltwater intruding into freshwater sources; eutrophication (enrichment) of water from increased runoff; and decomposition of vegetation, wildlife, rotting property (boats or buildings) and unrecovered remains. Non-biodegradable waste, such as plastics, can lead to a buildup in marine debris, and toxic wastes, if inadequately stored, may be released into the environment. Lastly, exotic wildlife may be introduced or may escape into the local ecosystem.

12.5 FUTURE TRENDS IN DEVELOPMENT

The City is equipped to handle future growth within tsunami inundation areas. The inundation maps provided by the California Department of Conservation offer jurisdictions a way to guide development away from tsunami-prone areas. Additionally, the City has committed to integrating its general plan to this hazard mitigation plan. By coordinating the general plan, the City will be better able to make wise land use decisions as future growth impacts tsunami hazard areas.

New standards for building designs in Alaska, Washington, Oregon, California, and Hawaii that account for tsunami loads and effects have recently been adopted by the American Society of Civil Engineers (ASCE 7-16, Chapter 6), referenced in the 2018 International Building Code (IBC), and included in California’s state building code (2019 State of California Building Code Appendix M). This will help to promote structures more resilient to the impacts from tsunami as new development occurs within identified tsunami risk areas.

12.6 SCENARIO

A worst-case-scenario for the Long Beach coastline would be a nearshore tsunami caused by a significant off-shore seismic event. These types of events are not likely, but should one occur, damage could exceed what is estimated in the risk assessment for this hazard mitigation plan. Historical records suggest that tsunami wave heights on the order of 9 to 13 feet could be generated by such an event (LA County OEM 2006). A local source tsunami presents a high risk to people, as there would not be time to initiate evacuation; the first surge could arrive in minutes. Strong ground shaking preceding the tsunami could damage buildings, communications and electric utility infrastructure, roads, and bridges, further impairing the community’s ability to evacuate safely.

12.7 ISSUES

The planning team has identified the following issues related to the tsunami hazard for the planning area:

- To truly measure and evaluate the probable impacts of tsunamis on planning, hazard mapping based on probabilistic scenarios must continue to be updated regularly. The science and technology in this field are emerging. Accurate probabilistic tsunami mapping will need to be a key component for tsunami hazard mitigation programs to be effective.
- Present building codes and guidelines do not adequately address the impacts of tsunamis on structures. The City should review its building code and consider requirements for tsunami-resistant construction standards in vulnerable areas.
- As tsunami warning technologies evolve, the tsunami warning capability within the planning area will need to be enhanced to provide the highest degree of warning to planning partners with tsunami risk exposure.
- Special attention will need to be focused on the vulnerable communities in the tsunami zone and on hazard mitigation through public education, outreach, and warning capabilities. This issue may be especially important for visitors to the planning area.
- Risk from tsunami inundation is not subject to the State of California real estate disclosure law at this time.
- Structures in the planning area built before the City entered the NFIP may not be designed to resist tsunami forces.
- With future impacts from climate change, the issue of sea level rise may become an important consideration as probable tsunami inundation areas are identified through future studies.

13. CLIMATE CHANGE

13.1 GENERAL BACKGROUND

"Climate change" refers to alterations in the long-term patterns of temperature, precipitation, humidity, wind, and seasons that play a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. These shifts may result from natural processes (e.g., cyclical ocean patterns like El Niño, La Niña and the Pacific Decadal Oscillation, volcanic activity, changes in the sun's energy output, variations in Earth's orbit), but they can also be driven by human activity. Many of the changes observed in Earth's climate since the early 20th century have been attributed to human activity.

13.1.1 Greenhouse Gases

The well-established worldwide warming trend of recent decades and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth's atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming.

Emissions of these gases come from a variety of sources, such as fossil fuel combustion for energy and transportation, wastewater treatment, agricultural production, livestock, landfills, and changes in land use. According to the National Aeronautics and Space Administration (NASA), carbon dioxide concentrations in the atmosphere measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and have risen dramatically since then, surpassing 400 ppm in 2013 for the first time in recorded history (see Figure 13-1). The latest carbon dioxide measurement taken in February 2022 was 418 ppm (NASA 2022).

Table 13-1 provides the 2015 greenhouse gas inventory for the City of Long Beach. Transportation is the largest source of CO_2, accounting for 50 percent of the total emissions in 2015. Figure 13-2 shows emissions by economic sector in California for 2019, the most current data. As with Long Beach, transportation is the largest source of CO_2 for the state.

13.1.2 How Climate Change Affects Hazard Mitigation

Climate change will affect the people, property, economy, and ecosystems of the planning area in a variety of ways. Consequences of climate change include increased flood vulnerability and increased heat-related illnesses. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

Source: (NASA 2022)

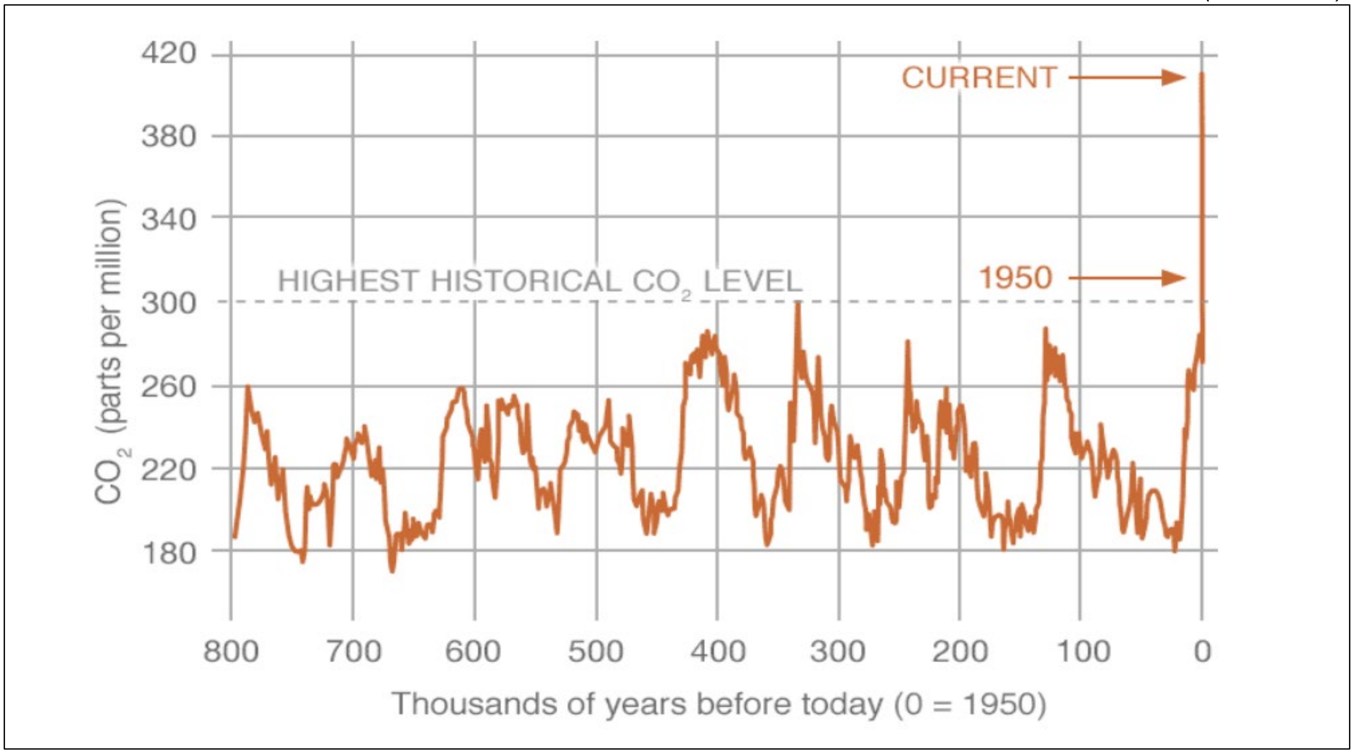

Figure 13-1. Global Carbon Dioxide Concentrations Over Time

Table 13-1 City of Long Beach 2015 Greenhouse Gas Inventory

Sector	Metric Tons CO_2 Emissions per Year	Percentage
Energy	**1,377,291**	**44%**
Residential	428,245	14%
Commercial	300,818	10%
Manufacturing/Construction	399,089	13%
Energy Industries	219,899	7%
Fugitive Emissions (oil/natural gas)	29,240	1%
Transportation	**1,546,326**	**50%**
On-road Transportation	1,213,601	39%
Railways	11,883	<1%
Waterborne Navigation	301,345	10%
Aviation	4,550	<1%
Off-road Transportation	14,947	<1%
Waste	**176,851**	**6%**
Solid Waste	173,259	6%
Wastewater	3,592	<1%
Total	**3,100,468**	**100%**

Source: (City of Long Beach Climate Action and Adaptation Plan 2019)

Source: (California Air Resources Board 2022)

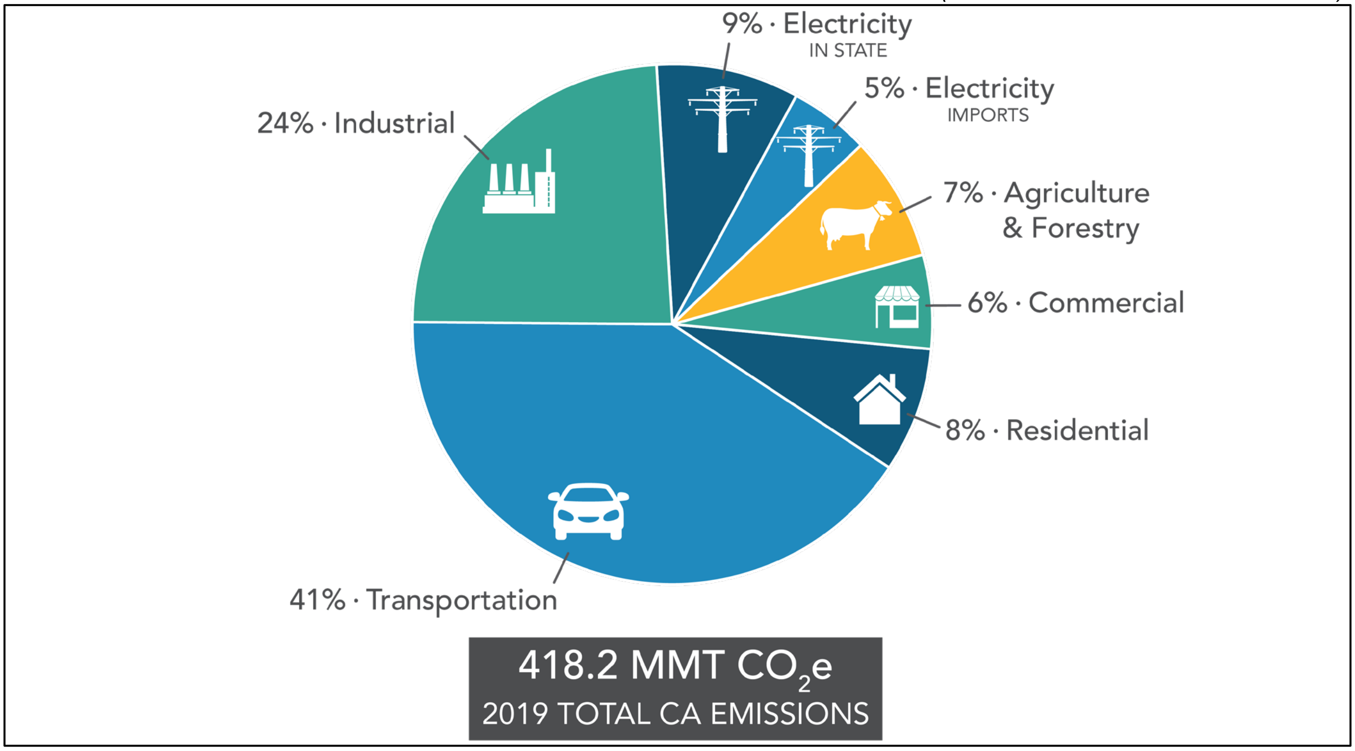

Figure 13-2. California's 2019 Greenhouse Gas Emission Inventory by Sector

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every 5 years for the past 100 years, then it can be expected to continue to flood an average of once every 5 years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be the 100-year flood might strike more often, leaving many communities at greater risk. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis.

13.1.3 Current Indicators of Climate Change

Global Indicators

The major scientific agencies of the United States—including NASA and the National Oceanic and Atmospheric Administration (NOAA)—have presented evidence that climate change is occurring. NASA summarizes key evidence as follows (National Aeronautics and Space Administration 2022):

- **Global Temperature Rise**—The planet's average surface temperature has risen about 2.12 ºF since the late 19th century, a change driven largely by increased carbon dioxide emissions into the atmosphere and other human activities. Most of the warming occurred in the past 40 years, with the seven most recent years being the warmest. The years 2016 and 2020 are tied for the warmest year on record.
- **Warming Oceans**—The ocean has absorbed much of the worlds' increased heat, with the top 300 feet of ocean showing warming of more than 0.6 ºF since 1969. Earth stores 90 percent of its extra energy in the ocean.
- **Shrinking Ice Sheets**—The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 279 billion tons of ice per year between 1993 and 2019, and Antarctica lost about 148 billion tons of ice per year.
- **Glacial Retreat**—Glaciers are retreating almost everywhere around the world—including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.
- **Decreased Snow Cover**—Satellite observations reveal that the amount of spring snow cover in the northern hemisphere has decreased over the past five decades and that snow is melting earlier.
- **Sea Level Rise**—Global sea level rose about 8 inches in the last century. The rate in the last two decades is nearly double that of the last century and is accelerating slightly every year.
- **Declining Arctic Sea Ice**—Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.
- **Extreme Events**—The number of record high temperature events in the United States has been increasing since 1950, while the number of record low temperature events has been decreasing. The U.S. has also witnessed increasing numbers of intense rainfall events.
- **Ocean Acidification**—Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 7 to 10 billion tons per year.

California Indicators

Monitoring and research efforts across California have generated data that describe changes already underway in the state. Notable examples across the state include the following (California Office of Environmental Health Hazard Assessment 2018):

- Dissolved oxygen in coastal waters is declining throughout the south coast survey region
- Since 1950, the northern Sierra Nevada showed an overall snowpack decline of 7.4 inches.
- Unusually warm waters occurred in the Pacific Ocean in 2014-2015, leading to widespread impacts on marine life. This marine heat wave first appeared as a large area of exceptionally high sea surface temperatures in the Gulf of Alaska in November 2013 and later extended along the entire west coast of North America.
- The surface area of seven Sierra Nevada glaciers has decreased dramatically since the beginning of the 20th century. In 2014, the size of these glaciers ranged from 14 to 52 percent of their 1903 area.

- Sea level has risen by about 7 inches since 1900 at San Francisco and by about 6 inches since 1924 at La Jolla.
- Since 1906, the fraction of annual snowmelt runoff that flows into the Sacramento River between April and July has decreased by about 9 percent.
- Compared to the 1930s, forests across much of California today have lower densities of large trees, and higher densities of small trees. Water stress, which increases in a warming climate, poses a greater risk to large trees than to small trees.
- Annual tree mortality in California forests increased in 2014, and steep increases in mortality followed in subsequent years; the highest number, 62 million tree deaths, was recorded in 2016.
- Future droughts may be hotter, as warm temperatures coincide with periodic dry years; 2016 and 2020 were the warmest years on record.
- Heat-related deaths and illnesses in California increased dramatically in 2006 following a record-breaking heat wave. At least 140 deaths occurred between July 15 and August 1. Deaths related to this heat wave were largely attributed to elevated nighttime temperatures.
- The number of acres burned by wildfires statewide has been increasing since 1950. Large fires affecting 1,000 acres or more account for most of the area burned each year.

13.1.4 Projected Future Impacts

Climate change projections contain inherent uncertainty, largely because they depend on projections of future greenhouse gas emissions. Uncertainty about future greenhouse gas emissions is addressed by assessing multiple scenarios—low-emissions or high-emissions. In low-emissions scenarios, greenhouse gas emissions are assumed to be reduced substantially from current levels. In high-emissions scenarios, greenhouse gas emissions generally are assumed to increase or continue at current levels. Uncertainty in outcomes is generally addressed by averaging a variety of model outcomes. Despite this uncertainty, climate change projections present valuable information to help guide decision-making for possible future conditions.

Global and National Projections

The Intergovernmental Panel on Climate Change, which includes more than 1,300 scientists from the United States and other countries, project that Earth's average temperatures will raise 2.5 to 10 ºF over the next century. The Third and Fourth *National Climate Assessment Reports* indicate the following (National Aeronautics and Space Administration 2022):

- **Change continuing through this century and beyond**—Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the Earth's climate is to those emissions.
- **Temperatures continuing to rise**—Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.
- **Lengthening frost-free season and growing season**—The lengths of the frost-free season and the corresponding growing season have been increasing nationally since the 1980s, with the largest increases in the western United States, affecting ecosystems and agriculture. Across

the United States, the growing season is projected to continue to lengthen. Increases of a month or more in the lengths of the frost-free and growing seasons are projected across most of the United States by the end of the century, with slightly smaller increases in the northern Great Plains. The largest increases in the frost-free season (more than eight weeks) are projected for the western United States, particularly in high elevation and coastal areas. The increases will be smaller if heat-trapping gas emissions are reduced.

- **Changing precipitation patterns**—Average U.S. precipitation has increased since 1900. Some areas have had increases greater than the national average, and some areas have had decreases. More winter and spring precipitation is projected over this century for the northern United States, with less for the Southwest. The recent trend toward increased heavy precipitation events will continue, even where total precipitation is expected to decrease, such as the Southwest.
- **More droughts and heat waves—**Droughts in the Southwest and heat waves everywhere are projected to become more intense, and cold waves less intense everywhere. Summer temperatures are projected to continue rising, and a reduction of soil moisture, which exacerbates heat waves, is projected for much of the western and central United States in summer. By the end of this century, what have been once-in-20-year extreme heat days (one-day events) are projected to occur every two or three years over most of the nation.
- **Stronger and more intense hurricanes**—The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of the strongest (Category 4 and 5) hurricanes, have all increased since the early 1980s. The relative contributions of human and natural causes to these increases are still uncertain. Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm.
- **Arctic Ocean likely ice-free in summer**—The Arctic Ocean is currently expected to become essentially ice free in summer before 2050.
- **Sea level rising 1 to 8 feet by 2100**—Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 8 feet by 2100. This is the result of added water from melting land ice and the expansion of seawater as it warms. In the next several decades, storm surges and high tides could combine with sea-level rise and land subsidence, resulting in increased flooding in many regions. Sea-level rise will continue past 2100 because the oceans take a very long time to respond to temperature conditions at the Earth’s surface. Figure 13-3 shows the projected rate of global sea-level rise under different future rates (low to high) of greenhouse gas emissions and global warming.

Projections for California

According to *California’s Fourth Climate Change Assessment*, the state can expect the following climate change impacts (State of California 2022):

- By 2100, the average annual maximum daily temperature is projected to increase by 5.6 to 8.8 ºF.
- By 2100, the water supply from snowpack is projected to decline by two-thirds.
- By 2050, agricultural production could face climate-related water shortages of up to 16 percent in certain regions.
- By 2100, the frequency of extreme wildfires will increase, and the average area burned statewide would increase by 77 percent.

Source: (National Oceanic and Atmospheric Administration 2022)

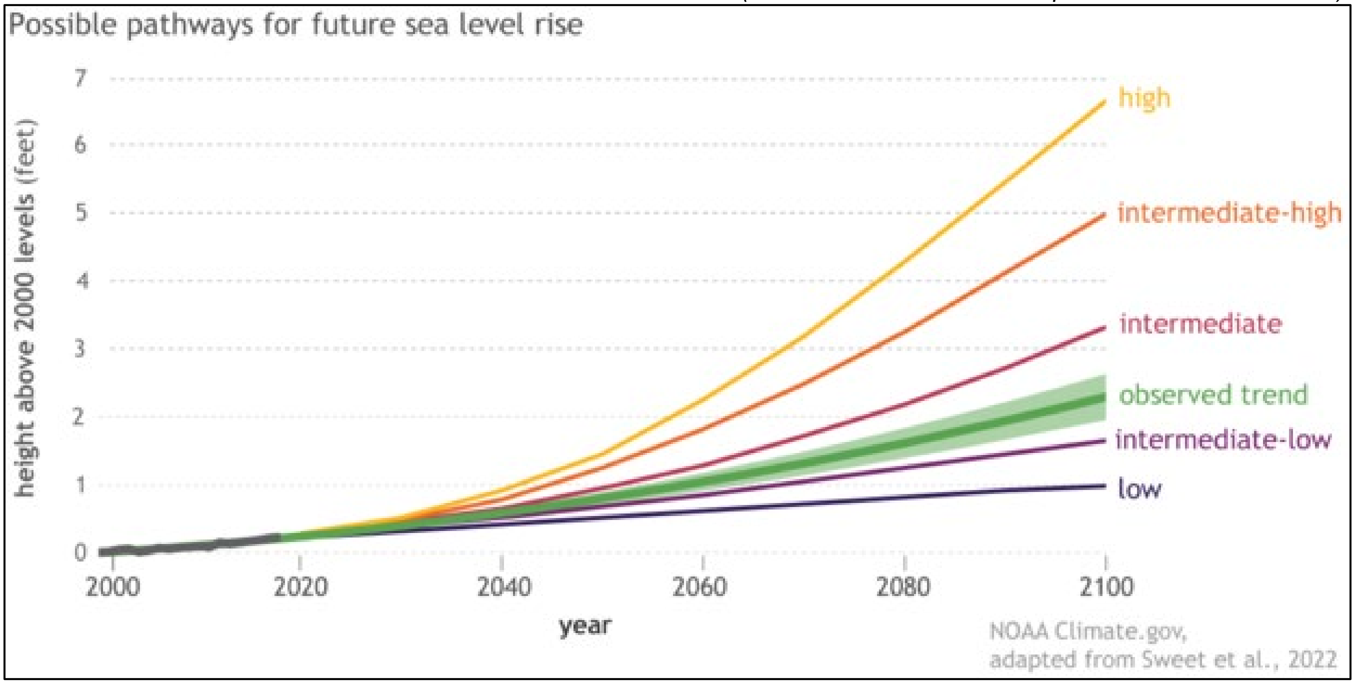

Figure 13-3. Possible Pathways for Future Sea Level Rise

- By 2100, 31 to 67 percent of Southern California beaches may completely erode due to sea-level rise.
- By 2100, the miles of highways susceptible to coastal flooding in a 100-year storm event will triple.
- By 2050, heat waves in cities could cause 2 to 3 times more heat-related deaths.

13.1.5 Responses to Climate Change

General Approaches—Mitigation and Adaptation

Communities and governments worldwide are working to address, evaluate and prepare for climate changes that are likely to impact communities in coming decades. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term "mitigation" can be confusing, because its meaning changes across disciplines:

- Mitigation in emergency management—as generally addressed in this hazard mitigation plan—is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters.
- Mitigation in climate change discussions is defined as a human intervention to reduce impacts on the climate system. It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.

In this chapter, mitigation is used as defined by the climate change community. In the other chapters of this plan, mitigation is primarily used in an emergency management context.

Adaptation refers to adjustments in natural or human systems in response to actual or anticipated effects of climate change. These adjustments may moderate harm or exploit beneficial opportunities. Mitigation and adaptation are related, as the world's ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some initiatives and actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions.

Societies across the world need to adapt to climate change. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Adaptive capacity goes beyond human systems. Some ecosystems can adapt to change and buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water, releasing it through the year; floodplains can absorb water during peak flows; coastal ecosystems can attenuate waves and reduce erosion. Other ecosystem services—such as food provision, timber, materials, medicines, and recreation—can provide buffers in the face of changing conditions. Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services.

Climate Action and Adaptation Plan

The City of Long Beach has released its first proposed Climate Action and Adaptation Plan (CAAP). The CAAP will help reduce greenhouse gas emissions and make the city more sustainable and resilient to climate change impacts. The CAAP process reviewed the most up-to-date science and local climate projections for the main climate change impacts (extreme heat, sea level rise, and precipitation) and two secondary impacts (air quality and drought).

The 40 listed adaptation actions in the CAAP are organized into four climate impacts: extreme heat, air quality, drought, and sea level rise and flooding. These actions establish an initial roadmap to withstand the impacts. Over time, as understanding of climate change science evolves and local impacts are observed, the City of Long Beach will evaluate the need for adjusting existing actions and adding new ones. This will take place through regular CAAP monitoring and reporting and future CAAP updates.

13.2 SEA-LEVEL RISE

13.2.1 California Sea Level Rise

Sea level rise increases the risks coastal communities face from coastal hazards (floods, storm surges, and coastal erosion). Global models indicate that California will see substantial sea level rise during this century, with the exact magnitude depending on such factors as global emissions, the rate at which oceans absorb heat, melting rates and movement of land-based ice sheets, and local coastal land subsidence or uplift.

13.2.2 Local Sea Level Rise Projections

In a 2018 vulnerability assessment, the City of Long Beach determined that the following subareas are exposed to sea level rise and coastal flooding:

- **Southeastern Subarea**—The areas exposed earliest to future annual king tides (sea level rise of 11 inches) include parts of Marina Pacifica, the Los Cerritos Wetlands Complex, and the Alamitos Bay shoreline of the Peninsula. There are no major roads exposed during this scenario, but the Bayshore Walk along the Peninsula is exposed. With higher levels of sea level rise, Belmont Shore, Naples, the Peninsula, and the Marina Pacifica area are projected to experience king tide flooding, including the beaches and parks that provide active recreation and boating access.
- **Downtown Subarea**—Parts of the Shoreline Marina, Rainbow Harbor, and Golden Shore Marine Reserve are projected to be exposed to future annual king tides. The Golden Shore Marine Reserve is projected to be flooded by king tides combined with 11 inches of sea level rise. The edges of the Marina and Harbor start to experience king tide flooding at 11 inches; at higher levels of sea level rise, the pedestrian paths and parks also flood. Alamitos Beach also experiences king tide flooding, resulting in a narrowing of the beach, particularly with higher levels of sea level rise. Assets in this area that may be impacted include the Aquarium of the Pacific, the bike path around Shoreline Marina, and the sewer lift stations associated with the comfort stations around the Marina.
- **Western Subarea**—The Western Subarea, which is largely an industrial area, is not anticipated to experience flooding due to king tides until end-of-century (37 and 66 inches of sea level rise). The flood pathways would likely come through the Harbor District area. Adaptation efforts by the Harbor District may provide flood protection benefits for West Long Beach, and ongoing coordination between the Harbor District and City of Long Beach is recommended. Assets in West Long Beach that are at risk include a potable water facility, two police facilities, and a health resource center serving individuals experiencing homelessness. Within the Harbor District, there are also two potable facilities, a solid waste facility, and multiple fire stations.

Two event-based scenarios were identified for the sea level rise risk analysis in this plan:

- Sea level rise of 25 cm with 100-year storm surge—The inundation area is the area that would be inundated with 25 cm of chronic sea level rise scenario and a 1 percent annual chance coastal flood event (see Figure 13-4).
- Sea level rise of 50 cm with 100-year storm surge— The inundation area is the area that would be inundated with 50 cm of chronic sea level rise scenario and a 1 percent annual chance coastal flood event (see Figure 13-5).

Property Impacts

Table 13-2 lists planning area property impacts for the modeled scenarios. Figure 13-6 shows current building occupancy class in the affected areas.

Table 13-2. Estimated Property Exposure for Sea Level Rise Scenarios

	25-cm SLR + 100-Year Storm	50-cm SLR + 100-Year Storm
Number of Buildings Exposed	4,615	5,764
Value of Exposed Structures	$1,933,163,879	$2,846,906,702
Value of Exposed Contents	$1,240,732,476	$2,103,350,735
Total Exposed Property Value	**$3,173,896,355**	**$4,950,257,437**
Total Exposed Value as % of Planning Area Total	***3.22%***	***5.03%***

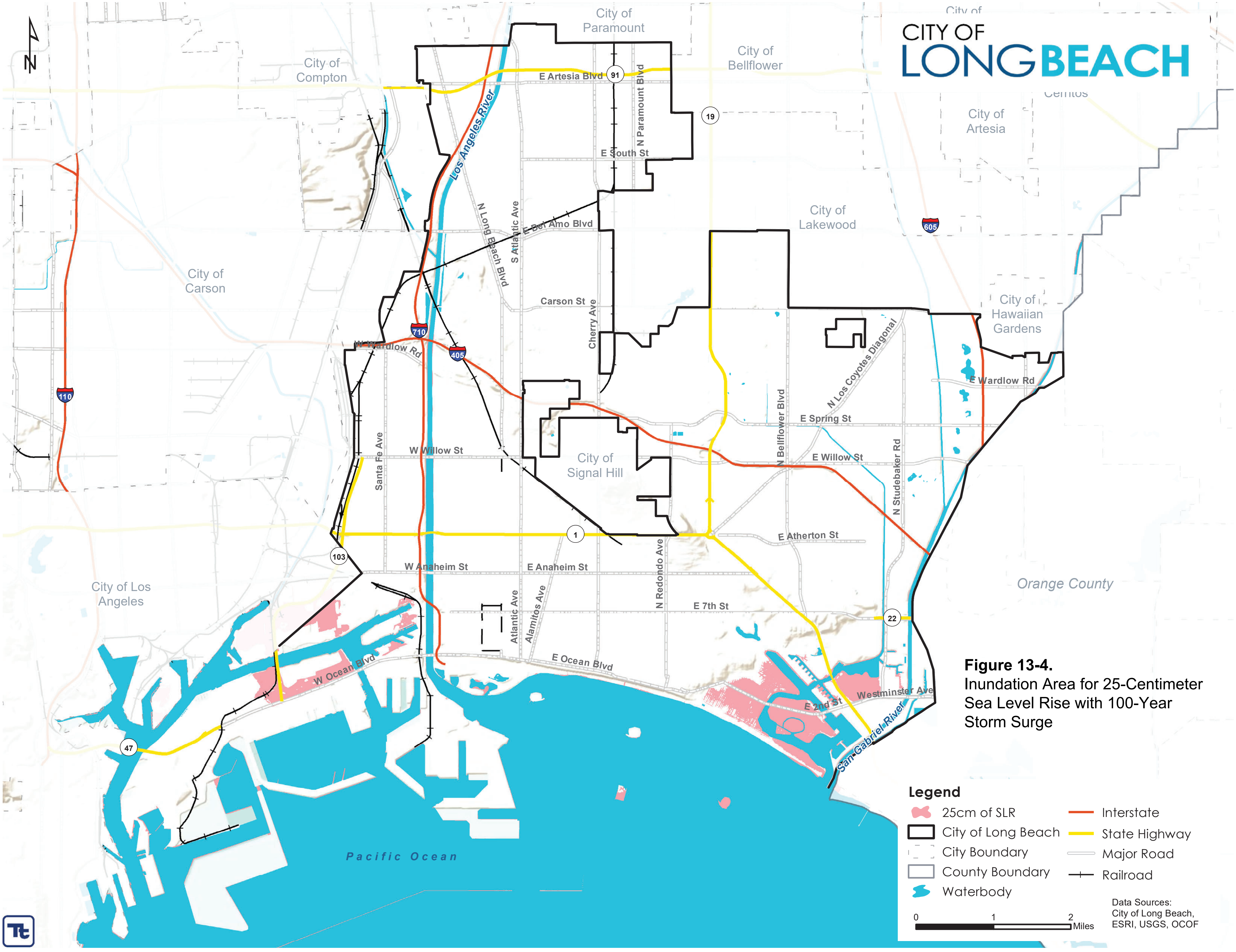

Figure 13-4.
Inundation Area for 25-Centimeter Sea Level Rise with 100-Year Storm Surge

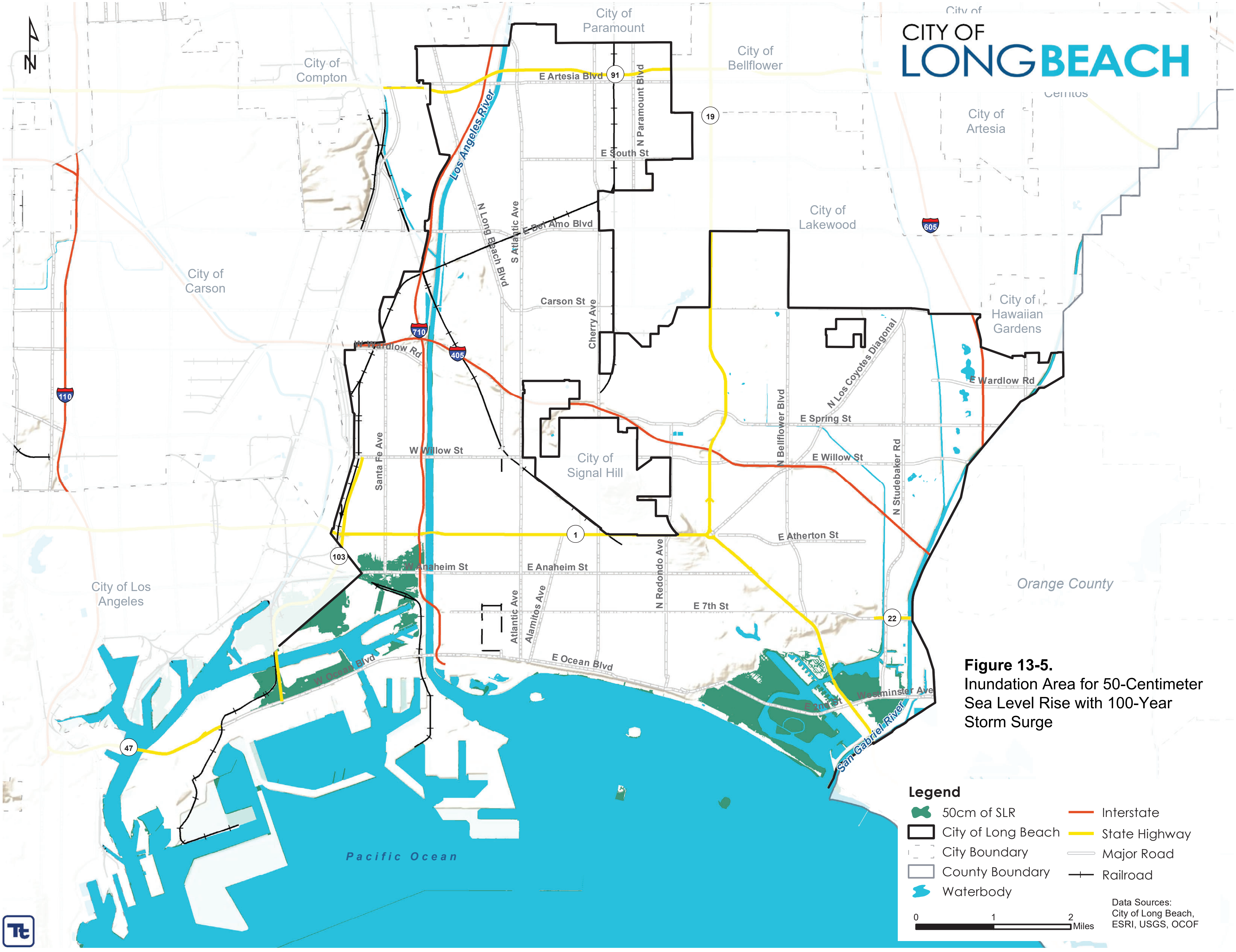

Figure 13-5.
Inundation Area for 50-Centimeter Sea Level Rise with 100-Year Storm Surge

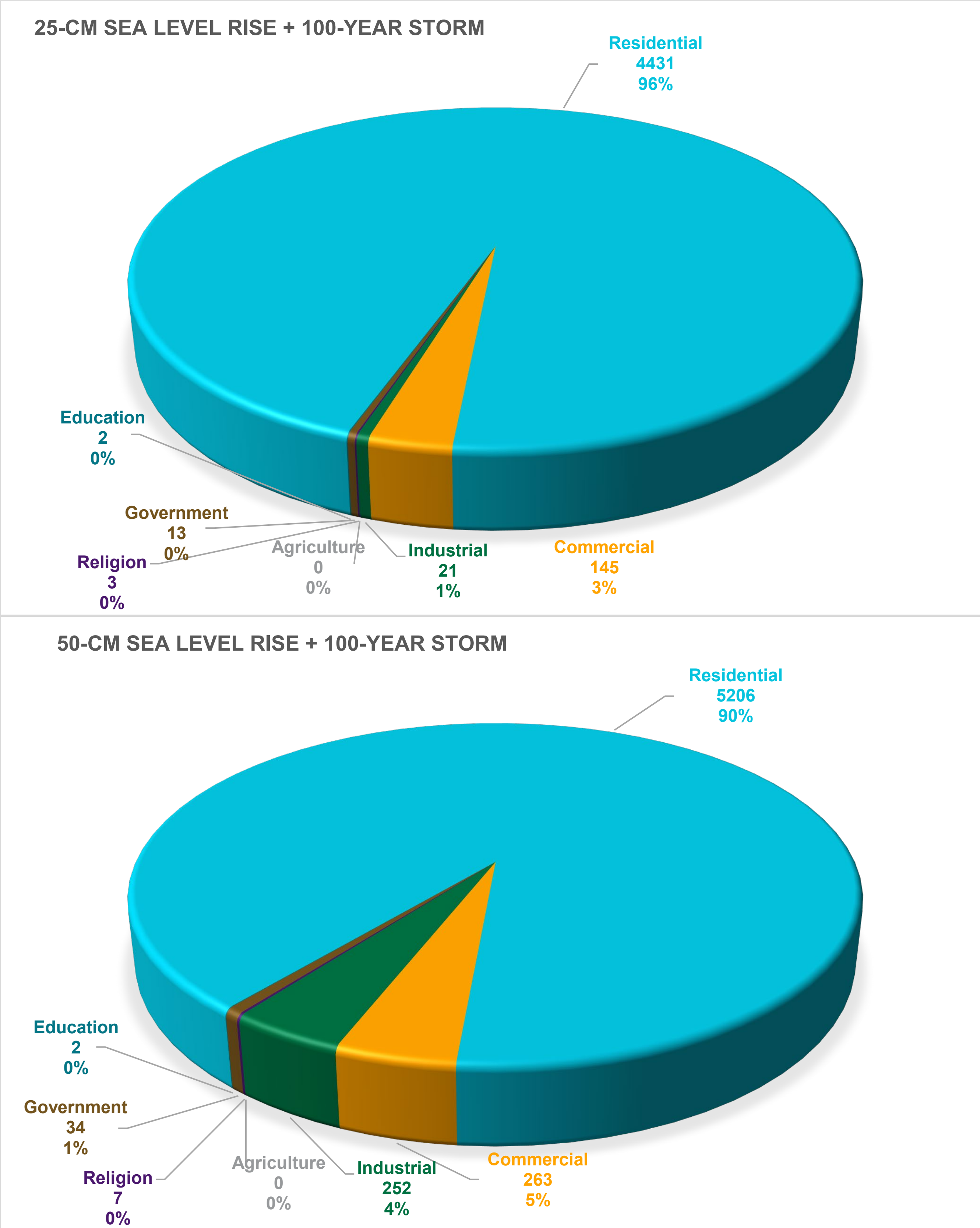

Figure 13-6. Building Occupancy Classes in the Sea Level Rise Exposure Area

13.3 POTENTIAL IMPACT ON HAZARDS OF CONCERN

The following sections provide information on how each hazard of concern identified for this plan may be impacted by climate change and how these impacts may alter current exposure and vulnerability to these hazards for the people, property, critical facilities, and environment in the planning area.

13.3.1 Dam Failure

Climate Change Impacts on the Hazard

On average, changes in California's annual precipitation levels are not expected to be dramatic; however, small changes may have significant impacts for water resource systems, including dams. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all its designed margin of safety, also known as freeboard (the height of the dam above the expected highest water level).

If the freeboard of a dam is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. The California Division of Safety of Dams has indicated that climate change may result in the need for increased safety precautions to address higher winter runoff, frequent fluctuations of water levels, increased potential for sedimentation, and debris accumulation from changing erosion patterns and increases in wildfires. Climate change also may impact the ability of dam operators to estimate extreme flood events (California Department of Water Resources 2022).

A strategy called Forecast Informed Reservoir Operations is being developed and tested in California as a way to inform decisions to retain or release water by allowing flexibility in operating policies and rules with enhanced monitoring and improved weather and water forecasts (Center for Western Weather and Water Extremes n.d.).

Dams are constructed with safety features known as "spillways," which allow for controlled release of water in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Climate change could increase the probability of design failures.

Exposure and Vulnerability

The following summarizes changes in exposure and vulnerability to the dam failure hazard resulting from climate change:

- **Population**—Population exposure and vulnerability to the dam failure hazard are unlikely to change as a result of climate change.
- **Property**—Property exposure and vulnerability to the dam failure hazard are unlikely to change as a result of climate change.
- **Critical facilities**—The exposure and vulnerability of critical facilities are unlikely to change as result of climate change. Dam owners and operators are sensitive to the risk and may need to

alter maintenance and operations to account for changes in the hydrograph and increased sedimentation. Critical facility owners and operators in levee failure inundation areas should always be aware of residual risk from flood events that may overtop the levee system.

- **Environment**—The exposure and vulnerability of the environment to dam and levee failure are unlikely to change as a result of climate change. Ecosystem services may be used to mitigate some factors that could increase the risk of design failures, such as increasing the natural water storage capacity in watersheds above dams.

13.3.2 Drought

Climate Change Impacts on the Hazard

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure

With a warmer climate, droughts could become more frequent, more severe, and longer lasting. According to the National Climate Assessment, “higher surface temperatures brought about by global warming increase the potential for drought. Evaporation and the higher rate at which plants lose moisture through their leaves both increase with temperature. Unless higher evapotranspiration rates are matched by increases in precipitation, environments will tend to dry, promoting drought conditions” (U.S. Climate Resilience Toolkit 2021).

Because changes in precipitation patterns are still uncertain, the potential impacts and likelihood of drought are uncertain. DWR has noted impacts of climate change on statewide water resources by charting changes in snowpack, sea level, and river flow. As temperatures rise and more precipitation comes in the form of rain instead of snow, these changes will likely continue or grow even more significant. DWR estimates that parts of the state will experience a 48- to 65-percent loss in snowpack by the end of the century compared to historical averages (California Department of Water Resources 2022). Projections for the planning area show a significant decline in projected snow water equivalent in April snowpack. Increasing temperatures may also increase net evaporation from reservoirs, which would reduce water availability for ecosystems and human use (Mount, Escriva-Bou and Sencan 2021).

Exposure and Vulnerability

The following summarizes changes in exposure and vulnerability to the drought hazard resulting from climate change:

- **Population**—Population exposure and vulnerability to drought are unlikely to increase as a result of climate change. While greater numbers of people may need to engage in behavior change, such as water saving efforts, significant life or health impacts are unlikely.
- **Property**—Property exposure and vulnerability may increase as a result of increased drought resulting from climate change, although this would most likely occur in non-structural property such as crops and landscaping. It is unlikely that structure exposure and vulnerability would increase as a direct result of drought, although secondary impacts of drought, such as wildfire, may increase and threaten structures.
- **Critical facilities**—Critical facility exposure and vulnerability are unlikely to increase as a result of increased drought resulting from climate change; however, critical facility operators may be sensitive to changes and need to alter standard management practices and actively manage resources, particularly in water-related service sectors
- **Environment**—The vulnerability of the environment may increase as a result of increased drought resulting from climate change. Prolonged or more frequent drought resulting from climate change may stress ecosystems in the region, which include many special-status species.

13.3.3 Earthquake

Climate Change Impacts on the Hazard

The impacts of global climate change on earthquake probability are unknown, although scientists have identified tiny earthquakes triggered by the change of fault stress loads from rain and snow. Similarly, long-term drought can result in a significant change in the stress load on the Earth’s crust.

Pumping of groundwater from underground aquifers by humans, which is exacerbated during times of drought, has also been shown to impact patterns of stress loads by “unweighting” the Earth’s crust. A 2014 study looked at the effects of groundwater extraction in California’s Central Valley on seismicity on the adjacent San Andreas Fault. The researchers found that such extractions can promote lateral changes in stress to the two sides of the San Andreas, which move horizontally against each other along the boundary of two major tectonic plates. This could cause them to unclamp and slip, resulting in an earthquake (National Aeronautics and Space Administration 2019).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events.

Exposure and Vulnerability

Because impacts of climate change on the earthquake hazard are not well understood, increases in exposure and vulnerability of the local resources are not able to be determined.

13.3.4 Flood

Climate Change Impacts on the Hazard

Scientists project greater storm intensity with climate change, resulting in more direct runoff and flooding. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. What is currently considered a 1-percent-annual-chance (100-year) flood also may strike more often, leaving many communities at greater risk. Going forward, model calibration must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted.

Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied on to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas to contribute to peak storm runoff. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality.

Exposure and Vulnerability

The following summarizes changes in exposure and vulnerability to the flood hazard resulting from climate change:

- **Population and Property**—Population and property exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change, resulting in flooding in areas where it has not previously occurred.
- **Critical facilities**—Critical facility exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change, resulting in risk to facilities that have not historically been at risk from flooding. Changes in the management and design of flood protection critical facilities may be needed as additional stress is placed on these systems. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local sewers and storm drains.
- **Environment**—The exposure and vulnerability of the environment may increase as a result of climate change impacts on the flood hazard. Changes in the timing and frequency of flood events may have broader ecosystem impacts that alter the ability of already stressed species to survive.

13.3.5 Severe Weather

Climate Change Impacts on the Hazard

The science for linking the severity of specific severe weather events to climate change is still evolving; however, some trends provide an indication of how climate change may be impacting these events:

- An increase in average surface temperatures can lead to more intense heat waves. Evidence suggests that heat waves are already increasing, especially in western states. Extreme heat days in the planning area are likely to increase.
- Climate change impacts on fog are difficult to predict because fog is driven my multiple factors; however, studies have shown that shoreline fog in California has decreased about 30 percent in the past 60 years (Inside Climate News 2021).
- Climate change impacts on winds are not well understood. Until recently, scientists had predicted rapid inland warming would weaken one of the primary drivers for Santa Ana winds and reduce their frequency. But a 2021 study found that bouts of hot Santa Ana winds are not declining and could even be increasing (Science 2021).
- Climate change may increase the frequency and intensity of thunderstorms and lightning. Thunderstorms occur when the heating of the Earth’s surface by sunlight and infrared radiation causes water to condense as buoyant air rises. As land surface warms, stronger updrafts are more likely to produce lightning (Environmental Journal 2021).

Exposure and Vulnerability

The following summarizes changes in exposure and vulnerability to the severe weather hazard resulting from climate change:

- **Population and Property**—Population and property exposure and vulnerability would be unlikely to increase as a direct result of climate change impacts on the severe weather hazard.
- **Critical facilities**—Critical facility exposure and vulnerability would be unlikely to increase as a result of climate change impacts on the severe weather hazard; however, critical facility owners and operators may experience more frequent disruption to service provision. For example, more frequent and intense storms may cause more frequent disruptions in power service.
- **Environment**—Exposure and vulnerability of the environment would be unlikely to increase; however, more frequent heat events and more intense rainfall may place additional stress on already stressed systems.

13.3.6 Tsunami

Climate Change Impacts on the Hazard

The impacts of global climate change on tsunami probability are unknown. Even if climate change does not increase the frequency with which tsunamis occur, it may result in more destructive waves. As sea levels continue to rise, tsunami inundation areas would likely reach farther into communities than current mapping indicates.

Exposure and Vulnerability

The following summarizes changes in exposure and vulnerability to the tsunami hazard resulting from climate change:

- **Population, Property, and Critical Facilities**—Population, property, and critical facility exposure and vulnerability to the tsunami hazard may increase as a result of climate change related sea level rise. As sea levels rise, tsunami impact areas may reach into parts of the community that were previously believed to be outside of the tsunami risk area. This reach will depend on the size of the tsunami, the local topography, and the extent of sea level rise.
- **Environment**—Exposure and vulnerability of the environment to tsunamis may be impacted by the effects of climate change. Sea level rise could alter the shape of existing shoreline, putting different structures and ecosystems closer to the shoreline and potential tsunami impacts. These assets would not have the same protection against tsunamis due to a shorter period to adapt. Additionally, ice crust melt could lead to a rise of the earth's crust, especially at higher latitudes, causing more submarine landslides and a greater vulnerability to tsunamis.

13.4 ISSUES

The major issues for climate change are the following:

- Planning for climate-change-related impacts can be difficult due to inherent uncertainties in projection methodologies.
- Average temperatures are expected to continue to increase in the planning area, which may lead to a host of primary and secondary impacts, such as an increased incidence of heat waves.
- Expected changes in precipitation patterns are still poorly understood and could have significant impacts on localized flooding in the planning area.
- Heavy rain events may result in flooding after stormwater management systems are overwhelmed.

14. DROUGHT

14.1 GENERAL BACKGROUND

Drought is a significant decrease in water supply relative to what is typical in a given location. It is a normal phase in the climate cycle of most regions, originating from a deficiency of precipitation over an extended period of time, usually a season or more. This leads to a water shortage for some activity, group or environmental sector. Drought can be characterized based on the following:

- Meteorological measurements such as rainfall deficit compared to normal or expected rainfall
- Agricultural impacts due to reduced rainfall and water supply (e.g., crop loss, herd culling, etc.)
- Hydrological measurements of stream flows, groundwater, and reservoir levels relative to normal conditions
- Direct and indirect socio-economic impacts on society and the economy (e.g., increased unemployment due to failure of an industry because of drought)

Droughts are climatic patterns that occur over long periods of time as the result of many causes. Global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast result in warm, dry air and reduced precipitation. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of global weather systems.

Temperature and precipitation changes are expected to worsen droughts and reduce snowpack and access to imported water, all while increasing demand for water (City of Long Beach Climate Action and Adaptation Plan 2020).

14.1.1 Monitoring and Rating Drought

NOAA Drought Indices

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The ***Palmer Crop Moisture Index*** measures short-term drought weekly to assess impacts on agriculture.
- The ***Palmer Z Index*** measures short-term drought on a monthly scale.

- The ***Palmer Drought Index*** is based on long-term weather patterns. The intensity of drought in a given month is dependent on current weather plus the cumulative patterns of previous months. Weather patterns can change quickly, and the Palmer Drought Severity Index can respond fairly rapidly.
- The ***Palmer Hydrological Drought Index*** quantifies hydrological effects (reservoir levels, groundwater levels, etc.), which take longer to develop and last longer. This index responds more slowly to changing conditions than the Palmer Drought Index.
- The ***Standardized Precipitation Index*** considers only precipitation. A value of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months.

Maps of these indices show drought conditions nationwide at a given point in time. They are not necessarily indicators of any given area's long-term susceptibility to drought. The most current versions of the maps at the time of this plan's preparation are shown on Figure 14-1.

U.S. Drought Monitor

The U.S. Drought Monitor (USDM) is a map that is updated weekly to show the location and intensity of drought across the country. The USDM uses a five-category system (National Integrated Drought Information System 2022):

- D0—Abnormally Dry
  - Short-term dryness slowing planting, growth of crops
  - Some lingering water deficits
  - Pastures or crops not fully recovered
- D1—Moderate Drought
  - Some damage to crops, pastures
  - Some water shortages developing
  - Voluntary water-use restrictions requested
- D2—Severe Drought
  - Crop or pasture loss likely
  - Water shortages common
  - Water restrictions imposed
- D3—Extreme Drought
  - Major crop/pasture losses
  - Widespread water shortages or restrictions
- D4—Exceptional Drought
  - Exceptional and widespread crop/pasture losses
  - Shortages of water creating water emergencies

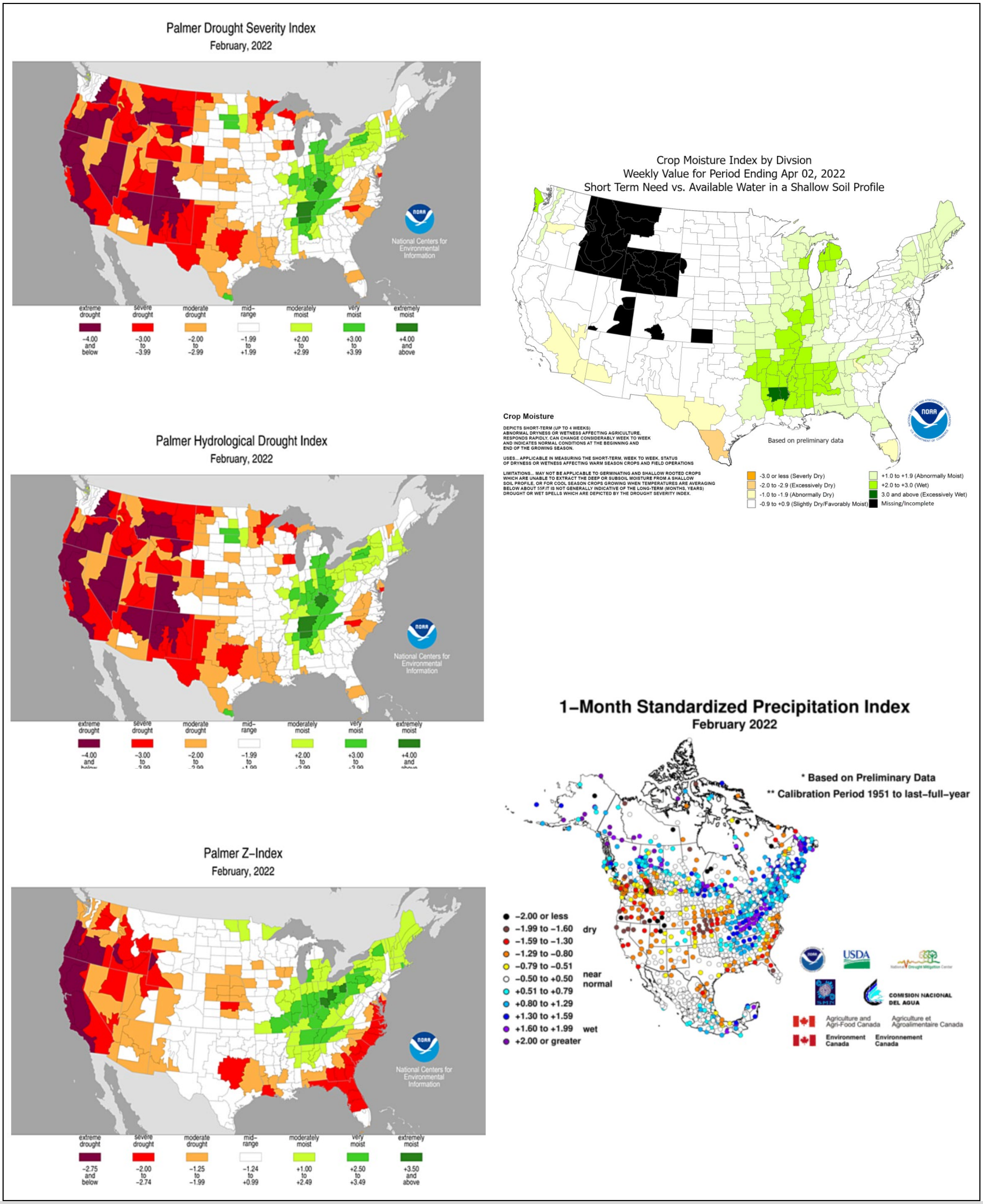

Figure 14-1. Example Drought Index Maps (February and April 2022)

The USDM categories show experts' assessments of conditions related to drought. These experts check variables including temperature, soil moisture, water levels in streams and lakes, snow cover, and meltwater runoff. They also check whether areas are showing drought impacts such as water shortages and business interruptions. Associated statistics show what proportion of various geographic areas are in each category of dryness or drought, and how many people are affected. U.S. Drought Monitor data go back to 2000.

14.1.2 Drought Impacts

Drought can have a widespread impact on the environment and the economy, although it typically does not result in loss of life or damage to structures, as do other natural disasters.

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

- **Economic Impacts**—These impacts of drought cost people (or businesses) money. Farmers' crops are destroyed; low water supply necessitates spending on irrigation or drilling of new wells; water-related businesses (such as sales of boats and fishing equipment) may experience reduced revenue.
- **Environmental Impacts**—Plants and animals depend on water. When a drought occurs, their food supply can shrink, and their habitat can be damaged.
- **Social Impacts**—Social impacts include public safety, health, conflicts between people when there is not enough water to go around, and changes in lifestyle.

The demand that society places on water systems and supplies—such as expanding populations, irrigation, and environmental needs—contributes to drought impacts. Drought can lead to difficult decisions regarding the allocation of water, as well as stringent water use restrictions, water quality problems, and inadequate water supplies for fire suppression. There are also issues such as growing conflicts between agricultural uses of surface water and in-stream uses, surface water and groundwater interrelationships, and the effects of growing water demand on uses of water.

Vulnerability of an activity to drought depends on its water demand and the water supplies available to meet the demand. The impacts of drought vary between sectors of the community in both timing and severity:

- **Water supply—**The water supply sector encompasses urban and rural drinking water systems that are affected when a drought depletes groundwater supplies due to reduced recharge from rainfall.
- **Agriculture and commerce—**Impacts on the agriculture and commerce sectors include the reduction of crop yield and livestock sizes due to insufficient water supply for crop irrigation and maintenance of ground cover for grazing.
- **Environment, public health, and safety—**The environmental, public health, and safety sector focuses on wildfires that are both detrimental to the forest ecosystem and hazardous to the public. It also includes the impact of desiccating streams, such as the reduction of in-stream habitats for native species.

14.1.3 California Drought Response

Defined Drought Stages

During critically dry years, the California State Water Resources Control Board can mandate water entitlements on water right holders to address statewide water shortages. Table 14-1 shows the state drought management program stages mandated to water right holders.

Table 14-1. State Drought Management Program

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

Future Water Conservation in California

California's 2018 Water Plan Update projects that water demand in the state will increase through 2050. The Department of Water Resources predicts a modest decrease in agricultural water use and an urban water use increase of 1 to 7 million acre-feet per year (DWR, 2018). The 2018 update explores ways to increase agricultural and urban water use efficiency.

Assembly Bill 1668 and Senate Bill 606 are jointly designed to overhaul California's approach to conserving water. Both bills were enacted with contingencies toward each other—addressing water conservation and drought resilience across the state. Both were adopted in response to the governor's Executive Order B-37-16 "Making Water Conservation a California Way of Life" which directs permanent changes to use water more wisely, eliminate water waste, strengthen local drought resistance, and improve agricultural water use efficiency and drought planning. With an aim to make water conservation a way of life in California, Executive Order B-37-16 requires the following:

- The State Water Resources Control Board will maintain urban water use reporting requirements and prohibitions on wasteful practices such as watering during or after rainfall, hosing off sidewalks and irrigating ornamental turf on public street medians.
- The state will continue its work to coordinate a statewide response on the bark beetle outbreak in drought-stressed forests that has killed millions of trees across California.

SB 606 requires the State Water Resources and Control Board and DWR to adopt water efficiency regulations, outlines requirements for urban water suppliers, including urban drought risk assessments, and implements penalties for violations. The law contains directives on water shortage planning and water loss reporting for urban wholesale water suppliers and offers a bonus incentive for potable reuse water.

AB 1668 requires the State Water Resources Control Board, in coordination with the DWR, to adopt water efficiency standards and regulations; drought and water shortage contingency plan guidance; specified standards for per capita daily indoor residential water use; and performance measures for commercial, industrial, and institutional water use.

Long-term urban water use efficiency standards must be established by June 30, 2022. Those standards will include components for indoor residential use, outdoor residential use, water losses and other uses. Regarding indoor residential use, the new laws set a standard of 55 gallons per person, per day through January 1, 2025. After that date, the amount will be incrementally reduced over time.

The legislation also specifies penalties on local water suppliers for violations to these standards. Starting in 2027, local water suppliers' failure to comply with the Water Resources Control Board's adopted long-term standards could result in fines of $1,000 per day during non-drought years and $10,000 per day during declared drought emergencies and certain dry years.

14.1.4 Secondary Hazards

The secondary impact most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Drought is also often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion.

14.2 HAZARD PROFILE

14.2.1 Local Water Supply

The City of Long Beach relies on a combination of local groundwater, imported water, recycled water, and desalination to meet its water needs. The Long Beach Water Department has the rights to pump 32,692 acre-feet per year of groundwater from the Central Basin Aquifer. The Water Department also purchases imported water as one of the 26 member agencies of the Metropolitan Water District. The district imports water to Southern California from two primary sources: the Colorado River and runoff from the western slopes of the northern Sierra Nevada Mountains. Figure 14-2 shows the Long Beach Water Department Service Area. The Water Department's Urban Water Management Plan complies with California's Urban Water Management Planning Act, promoting water conservation and ensuring that water is being used wisely.

14.2.2 Past Events

The California Department of Water Resources has historical state hydrologic data back to the early 1900s (DWR, 2017). The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920, 1922 to 1924 and 1928 to 1934. The following sections describe droughts in California since then, all of which impacted the City of Long Beach to some degree.

<u>2020 to Present</u>

California's most recent drought has set new records. The California Department of Water Resources reported that the 2020-2021 water year was the driest on record since 1924. In October 2021, the governor issued a proclamation applying the state's drought state of emergency to all counties not previously included. In addition, the proclamation required local water suppliers to implement water shortage contingency plans that are responsive to local conditions and prepare for the possibility of a third dry year.

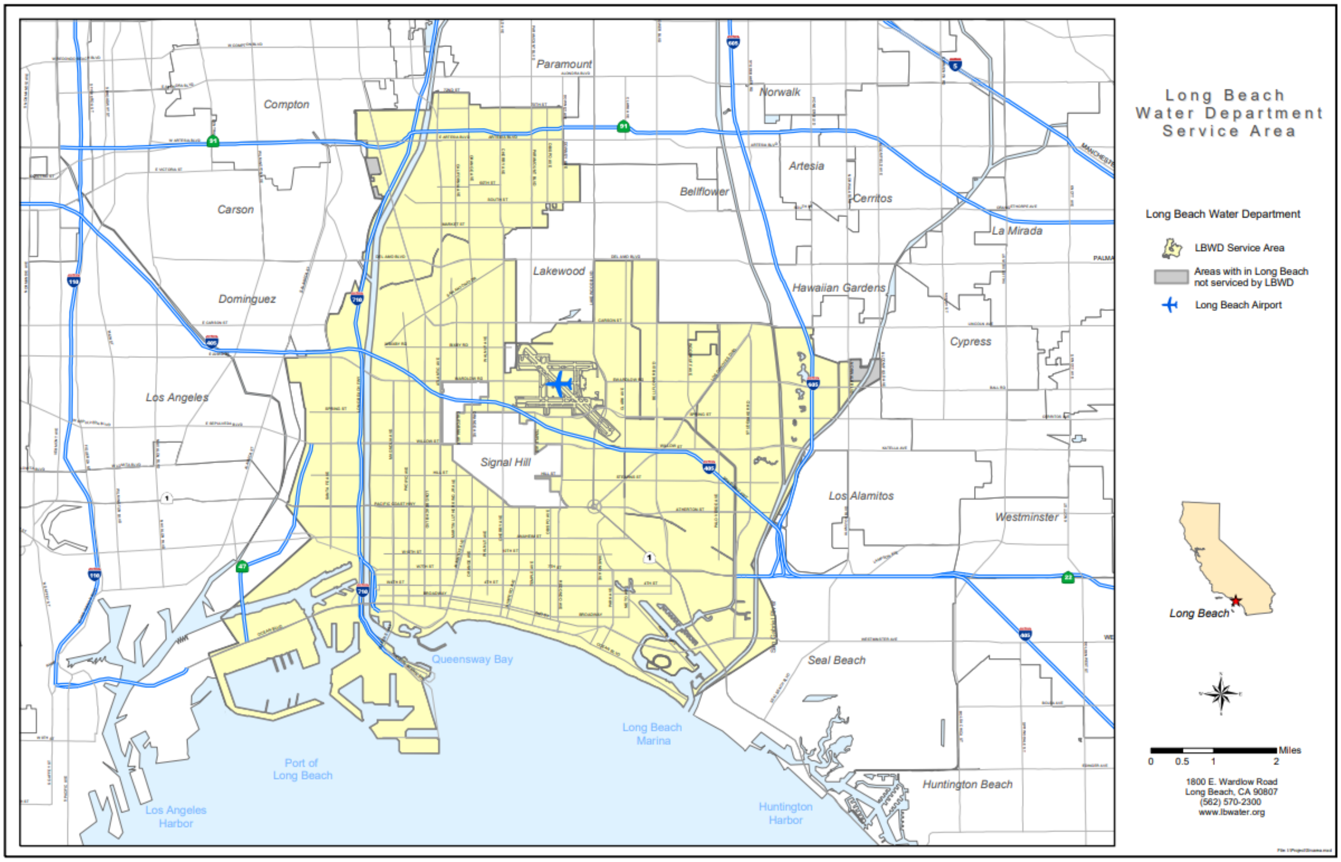

Figure 14-2. Long Beach Water Department Service Area

2012 to 2016

California's 2012-2016 drought set several records for its time:

- The period from 2012 to 2014 ranked as the driest three consecutive years for statewide precipitation.
- 2014 set new climate records for statewide average temperatures and for record-low water allocations in the State Water Project and federal Central Valley Project.
- 2013 set minimum annual precipitation records for many communities.

On January 17, 2014, the governor declared a state of emergency for drought throughout California. This declaration followed release of a report that stated that California had experienced the least amount of rainfall in its 163-year history. Californians were asked to voluntarily reduce their water consumption by 20 percent. Drought conditions worsened into 2015. On April 1, 2015, following the lowest snowpack ever recorded, the governor announced actions to save water, increase enforcement to prevent wasteful water use, streamline the state's drought response, and invest in new technologies to make California more drought resilient. The governor directed the State Water Resources Control Board to implement mandatory water reductions in cities and towns across California to reduce water usage by 25 percent on average.

The statewide hydrologic drought from 2012 through 2016 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.

On April 7, 2017, the governor ended the drought state of emergency in most of California, following unprecedented water conservation and plentiful winter rain and snow.

2007 to 2009

The governor proclaimed a statewide drought emergency on June 4, 2008 after spring 2008 was the driest spring on record and snowmelt runoff was low. On February 27, 2009, the governor proclaimed a state of emergency for the entire state as the severe drought conditions continued widespread impacts and the largest court-ordered water restriction in state history (at the time).

1987 to 1992

California received precipitation well below average levels for four consecutive years. By February 1991, all 58 counties in California were suffering from drought conditions. Urban areas as well as rural and agricultural areas were impacted.

1976 to 1977

California had a severe drought due to lack of rainfall during the winters of 1976 and 1977. 1977 was the driest period on record in California to that time, with the previous winter recorded as the fourth driest. The cumulative impact led to widespread water shortages and severe water conservation measures throughout the state. Only 37 percent of the average Sacramento Valley runoff was received. A federal disaster declaration was declared, but it did not apply to Los Angeles County.

14.2.3 Location

Drought is a regional phenomenon. Drought that affects the planning area would affect the entirety of the area simultaneously and has the potential to impact every person directly or indirectly in the city as well as adversely affect the local economy.

14.2.4 Frequency

Drought has a high probability of occurrence in the planning area. From January 2000 to March 2022, some part of Los Angeles County experienced a USDM rating of D1 or higher in 685 out of 1,161 weeks—nearly two-thirds of the weeks (see Figure 14-3). The planning area has also been included in USDA drought disaster declarations in eight of the last ten years. Historical drought data for the planning area indicate there have been four significant multi-year droughts in the last 35 years (1987 to 2022), amounting to a severe drought every 9 years on average.

Source: U.S. Drought Monitor 2022

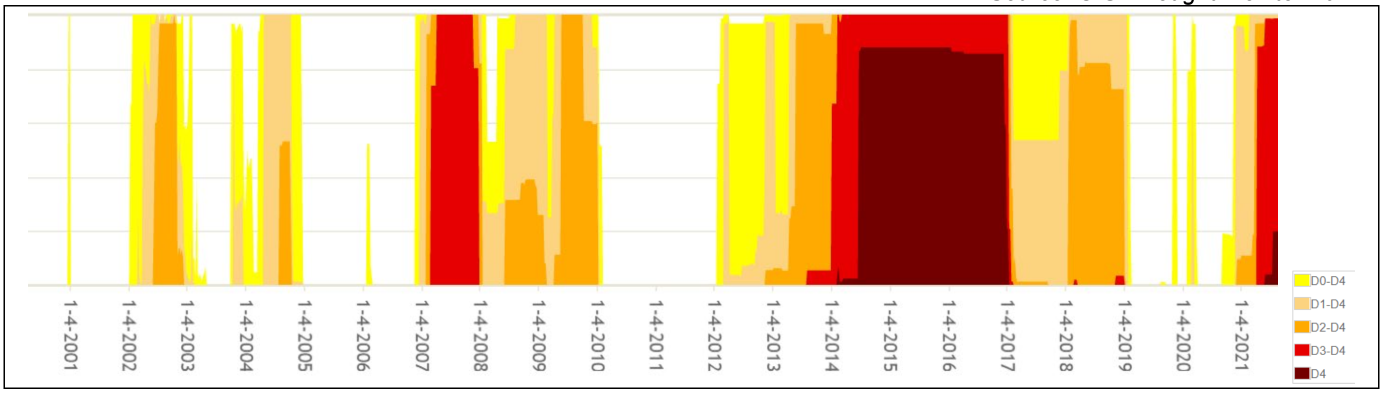

Figure 14-3. Percent of Los Angeles County Affected by USDM Ratings, 2000 –2022

14.2.5 Severity

The severity of any given drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts.

U.S. Drought Monitor Ratings

Los Angeles County has a history of severe droughts. As shown in Figure 14-3, at least part of the county has experienced extreme (D3) or exceptional (D4) droughts more than once since 2000.

Drought Impact Reporter

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and staff of government agencies. The database is being populated beginning with the most recent impacts and working backward in time.

The Drought Impact Reporter indicates 171 impacts from drought that specifically affected Los Angeles County from 2010 through March 2022 (National Drought Mitigation Center 2022). Most (96 percent) are based on media reports. The following are the reported numbers of impacts by category (some incidents are assigned to more than one impact category):

- Agriculture—38
- Business and Industry—15
- Energy—3
- Fire—16
- Plants and Wildlife—32
- Relief, Response, and Restrictions—89

- Society and Public Health—47
- Tourism and Recreation—12
- Water Supply and Quality—100

14.2.6 Warning Time

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions.

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature. These include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

At this time, scientists do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades.

14.3 EXPOSURE AND VULNERABILITY

All of the City of Long Beach is exposed and vulnerable to drought. Drought can affect a wide range of economic, environmental, and social activities. Its impacts can span many sectors of the economy because water is integral to the ability to produce goods and provide services. The impacts can reach well beyond the area undergoing physical drought. Vulnerability of an activity to drought depends on its water demand and the water supplies available to meet the demand.

14.3.1 Population

Drought can affect people’s health and safety, including health problems related to low water flows, poor water quality, or dust and pollution. Drought may also lead to loss of life (National Drought Mitigation Center 2022). Other possible impacts include recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and hygiene; compromised food and nutrition; and increased incidence of illness and disease (CDC 2020). Droughts can also lead to reduced local firefighting capabilities.

14.3.2 Property

No structures will be directly affected by drought conditions. Droughts can have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

14.3.3 Critical Facilities

Critical facilities as defined for this plan will continue to be operational during droughts. The risk to the planning area’s critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

14.3.4 Environment

Groundwater and Streams

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest. Where stream flows are reduced, development that relies on surface water may seek to establish new groundwater wells, which could further increase groundwater depletion.

Other Potential Losses

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects. The following are potential impacts of drought:

- Wildlife habitat may be degraded through the loss of wetlands, lakes and vegetation. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity.
- Drought conditions greatly increase the likelihood of wildfires, the major threat to timber resources.
- Scenic resources in the City are vulnerable to the increased likelihood of wildfires associated with droughts.
- Drying up or dying off of urban forests could reduce ecological and eco-tourist values.
- Any shortage of water supply can have significant economic impacts.

14.4 FUTURE TRENDS IN DEVELOPMENT

The City of Long Beach has a General Plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. This plan provides the capability at the local level to protect future development from the impacts of drought. The City of Long Beach reviewed its General Plan under the capability assessment performed for this effort. Deficiencies identified by this review can be addressed by mitigation actions to increase the capability to deal with future trends in development.

14.5 SCENARIO

An extreme, multiyear drought associated with record-breaking rates of low precipitation and high temperatures—such as the most recent drought across the State of California—is the worst-case scenario. Combinations of low precipitation and high temperatures could occur over several consecutive years. Intensified by such conditions, water use could exceed the reserve supply in the planning area. If such conditions persisted for several years, the economy of the City could experience setbacks, especially in water dependent industries.

14.6 ISSUES

The planning team has identified the following drought-related issues:

- Identification and development of alternative water supplies
- Large residential populations stressing the water supply
- Utilization of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased multi-year drought and durations due to climate change, and the associated need to consider long-term conservation measures
- Loss of much of the water transported from aqueducts to leaks and evaporation
- Recycled water opportunities
- The capture and storage of urban runoff
- Dead or dying trees as a result of drought conditions are more susceptible to falling during severe storm events

15. HAZARDS OF INTEREST

The Steering Committee selected a limited number of hazards of interest to include in this plan update. Hazards of interest are hazards whose monetary impacts cannot be measured. The sections below provide short profiles of each hazard of interest, including a qualitative discussion of their potential impact in the City of Long Beach. No formal risk assessment was performed, and the hazards are not included in the risk ranking.

15.1 CIVIL UNREST

The spontaneous disruption of normal, orderly activities in urban areas, or the outbreak of rioting or violence that is of a large nature, is referred to as civil unrest. Civil unrest can be spurred by specific events or can be the result of long-term displeasure with authority. Civil unrest is usually distinguished by the need for outside assistance from law enforcement and/or fire services. Civil unrest may be precipitated or manifested in a number of ways, including but not limited to the following:

- Spontaneous reactions to verdicts in high-profile trials
- Spontaneous reactions to organized sporting event outcomes
- Organized reactions or demonstrations
- Local population demonstrations
- Transient population demonstrations

As a result of civil unrest, impacts may include the following:

- Targeting of public facilities
- Targeting of private highly visible establishments
- Hit and run tactics
- Diversion tactics masking other motives
- Indiscriminate acts of arson and vandalism

While the motivation behind civil unrest may be known, the exact extent and type of activity that will occur is less certain. During an outbreak of civil unrest, the potential for multiple incidents is very high. The threat to law enforcement and other responding personnel can be severe due to the fervor and defiance of authority that typically accompany acts of civil disturbance. Securing of critical infrastructure and services is necessary and may include a need for law enforcement escorts for maintenance and inspection crews.

15.2 CYBERSECURITY THREATS

15.2.1 Hazard Overview

Cyberterrorism and cyberattacks are terms for cybersecurity threats that are often used interchangeably, though they are not the same. All cyberterrorism is a form of cyberattack, but not all cyberattacks are cyberterrorism.

Public and private computer systems can experience a variety of cyberattacks, from blanket malware infection to targeted attacks on system capabilities. Cyberattacks specifically seek to breach information technology security measures designed to protect an individual or organization. The initial attack is followed by more severe attacks to cause harm, steal data or for financial gain. Organizations are prone to different types of attacks that can be automated or targeted.

Any facility that relies on computers, computer systems and programs for their operations could be a target. Generally, attacks last minutes to days, but large-scale events and their impacts can last much longer. As information technology continues to grow in capability and interconnectivity, cyber threats become increasingly frequent and destructive. Cyber threats differ by motive, attack type and perpetrator profile. Motives range from the pursuit of financial gain to political or social aims. Cyber threats are difficult to identify and comprehend. Types of threats include using viruses to erase entire systems, breaking into systems and altering files, using someone's personal computer to attack others, or stealing confidential information. The spectrum of cyber risks is limitless, with threats having a wide range of effects on the individual, community, organizational, and national threat.

Ransomware

The FBI defines ransomware as a type of malicious software, or malware, that prevents you from accessing your computer files, systems, or networks and demands you pay a ransom for their return. Businesses should have a business continuity plan in case of a ransomware attack.

Cyberterrorism

The FBI is the lead federal agency for investigating cyberterrorism. In order for a cyberattack to be considered terrorism, the attack must be premeditated and politically motivated against information, computer systems, computer programs, or data. "Cyberterrorism may be carried out by state and non-state actors which have the capability to steal, alter, or destroy the nations sensitive data and, in the worst of cases, to manipulate from afar the process control systems that are meant to ensure the proper functioning of portions of the nations' critical infrastructure" (FBI, *The Cyber Threat and the FBI's Cyber Program*). Critical infrastructure and the nation are becoming more vulnerable to cyberattacks as their dependency on computer networks and systems grows.

The following list is of cyber-attacks in Los Angeles County:

- **February 8, 2021** – A hacker exploited a vulnerability in a desktop sharing platform to access a water utility's treatment plant industrial control system. The hacker increased the quantity of a chemical used in the water treatment process to a dangerous level. An employee of the utility noticed inconsistencies and immediately reduced the chemical levels to normal and notified the IT department.

- **December 11, 2021**—UKG Kronos was a victim of a ransomware attack that incapacitated Long Beach Fire Department Staffing Program, Telestaff, for approximately 2 months.
- **April 30, 2018**—In Pasadena, City employee email accounts were compromised through a phishing scheme. Hackers used access to accounts to send out fraudulent emails to city contacts. The City immediately disabled accounts and changed passwords of all city employees, and advised residents and associates to take caution when opening emails from city.
- **November 22, 2017—**500 Los Angeles Superior Court employees received fraudulent emails leading to fake websites asking for account credentials. Less than a dozen employees fell for the phishing scam. A 31-year old Texas resident was found to responsible for the hacking.
- **June 27th, 2017**—The Los Angeles County Board of Supervisors website homepage displayed pro-ISIS propaganda. The website was one of four U.S. websites hacked the same way.
- **December 2016**—A virus locked the Los Angeles Community College District's computer network as well as its email and voicemail systems. After consulting with cyber-security experts and law enforcement, the District paid a $28,000 cyber-ransom in bitcoin. The district had a cyber-security insurance policy to cover such attacks.
- **December 18, 2016**—In Los Angeles County the possible exposure of 750,000+ personal data resulted from a phishing email which deceived 108 county officials into entering email and passwords. A Nigerian hacker was responsible for the attack. There has been no evidence that confidential information was breached.
- **May 2016**—Cyber-attack on Los Angeles County employees targeted 1,000 county employees with a phishing email. A Nigerian national was charged with the crime.
- **December 2014—**A cyberattack by a (suspected) Korean group against Sony Pictures published embarrassing private emails and threatened to attack theaters if they showed a satire depicting Korean leader Kim Jong Un.
- **September 2014**—A months-long cyber-attack on the University of California, Los Angeles hospital system compromised personal information for up to 4.5 million people.

15.2.2 Local Considerations

The major issues for cybersecurity threats include the following:

- Encourage local businesses to adopt information technology and telecommunications recovery plans to prepare for and prevent cyberterrorism and cyberattacks.
- Develop continuity of operations plans for the City and work with the private sector to create business continuity plans in the event of a ransomware attack.

15.3 HAZARDOUS MATERIALS

15.3.1 Hazard Overview

A hazardous material is a substance or combination of substances that, because of quantity, concentration, or physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or an increase in serious illness, or otherwise pose a hazard to human life, property, or the environment. Hazardous material releases can pose a risk to life, public health, air quality, water quality and the environment. They may result in the evacuation of a facility or an entire neighborhood. In addition to the immediate risk, long-term public health and environmental impacts may result from sustained exposure to certain substances.

Title 49 of the Code of Federal Regulations lists thousands of hazardous materials, including gasoline, insecticides, household cleaning products, and radioactive materials. Even the natural gas used in homes and businesses is a dangerous substance when a leak occurs. According to the California State Hazard Mitigation Plan, hazardous materials are substances that are flammable, combustible, explosive, toxic, noxious, corrosive, an oxidizer, an irritant or radioactive. State-regulated substances that have the greatest probability of adversely impacting communities are listed in the CCR, Title 19.

Hazardous materials are present in facilities that produce, store, or use them:

- Water treatment plants use chlorine to eliminate bacterial contaminants.
- Hazardous materials are transported along interstate highways and railways daily.
- The natural gas used in homes and businesses is a dangerous substance when a leak occurs.
- Many businesses, through intentional action, lack of awareness or accidental occurrences, have contamination in and around their property.

Hazardous materials are likely accidently released or spilled numerous times each day. Eliminating these widespread substances would be nearly impossible, but the threat of accidental releases or spills may be reduced by mitigation.

15.3.2 Local Considerations

Responding to the Hazardous Materials Risk

The following mitigation efforts for hazardous substances are implemented through state and federal regulation:

- Process hazard analysis through the California Division of Occupational Safety and Health
- Policies and procedures, hazard communication, and training
- Placarding and labeling of containers
- Hazard assessment
- Security
- Process and equipment maintenance
- Mitigating techniques (flares, showers, mists, containment vessels, failsafe devices)
- Use of inherently safer alternative products
- Emergency plans and coordination
- Response procedures

Oversight

The Long Beach Certified Unified Program Agency has been in effect since July 1, 1997. This unified program combines the following Fire Department and Health Department programs related to hazardous materials management into one agency function in the City of Long Beach:

- Hazardous Waste Generator Inspection Program (Health)
- Tiered Permit Program (Health)
- Hazardous Materials Inspection/Business Plan Program (Fire)
- California Accidental Risk Prevention Program (Health)
- Above Ground Storage Tank (AST) Spill Prevention Program (Fire)
- Underground Storage Tank (UST) Program/AST Program
- Tank Monitoring/Installs and Removals (Fire)
- Site Mitigation (Fire):
  - Review of soil sampling reports related to UST, AST, clarifier and hydraulic lift removals and upgrades
  - Site Characterization (Phase II)
  - Site Remediation (Phase III)
- Other soil only projects non-UST related (Fire)

15.4 METHANE GAS ERUPTIONS

15.4.1 Hazard Overview

Gas leakage from hydrocarbon infrastructure is a major concern because the primary component of natural gas is methane, a potent greenhouse gas. Concerns arise for all well types, including abandoned wells. Previous work in Pennsylvania found that 470,000 to 750,000 abandoned wells in the state emit 0.04 to 0.07 million tons of methane per year, equivalent to 5 percent to 8 percent of Pennsylvania's total annual human-caused methane emissions (Energy Research and Development Division 2020).

Regular monitoring of oil and gas wells is only mandatory during the active lifetime of the well, resulting in millions of unmonitored inactive wells (no longer producing). As such, emissions reported by the industry and state's greenhouse gas inventories currently only provide a lower estimate of atmospheric methane emissions because not all leaks are identified and quantitative data on release rates are rare (Energy Research and Development Division 2020).

Because California has around 120,000 abandoned and plugged wells, there is an interest in quantifying methane emissions from those wells. Emission inventories from oil and gas production and distribution are reported by the California Air Resources Board. While the abandoned wells are not included in the California Greenhouse Gas Inventory, the state has recently passed legislation that requires idle wells to be more rigorously tested and repaired (Energy Research and Development Division 2020).

Oil and gas wells represent a category of subsurface infrastructure that can act as leakage pathways connecting oil and gas reservoirs, groundwater aquifers, and the atmosphere. The integrity of these wells can be compromised through a wide range of processes and contribute to groundwater contamination, greenhouse gas emissions, and air quality degradation (Kang, et al. 2019).

15.4.2 Local Considerations

Past Events

Eruptions of methane and other natural gases have occurred within the last few years. On October 23, 2015, Southern California Gas informed the state of a natural gas leak at its Aliso Canyon natural gas storage facility. The leak was controlled on February 11, 2016, and has been described as the largest documented leak of methane in the United States. The California Air Resources Board's updated estimate indicates that the incident resulted in a total emission of 99,650 metric tons of methane (± 9,300) (California Air Resources Board 2016).

Location

Methane gas wells are located across Southern California. Due to long-time oil and gas drilling in the region, several wells exist in the area that may be prone to leakage. An analysis of state records by the Los Angeles Times and the Center for Public Integrity identified nearly 1,000 deserted wells across Los Angeles (Olalde and Menezes 2020). If not plugged and cleaned up, many of these wells will likely expose individuals to toxic gases, complicate redevelopment, and pose threats of explosions.

The Long Beach City Council adopted the Construction in the Vicinity of Oil/Gas Wells Ordinance (LBMC18.78) and Methane Gas Mitigation Ordinance (LBMC18.79) on June 8, 2021. Each ordinance seeks to clarify City regulations related to construction in accordance with the Long Beach Municipal Code (City of Long Beach 2021). The City has created a spatial map that includes information on methane gas zones and oil wells throughout the city. Figure 15-1 shows the methane gas mitigation zones throughout the City.

Frequency

Methane gas eruptions occur frequently from several sources. The 2019 California Methane Survey measured emissions from more than 272,000 potential sources of methane emissions in California using aircraft sensing, including 88 percent of the ~225,000 oil and gas wells (all statuses) in the state. Although there was a relatively high detection limit (2 to 10 kilograms per hour), the researchers were able to identify emissions from 107 wells, including one abandoned and unplugged well (Energy Research and Development Division 2020).

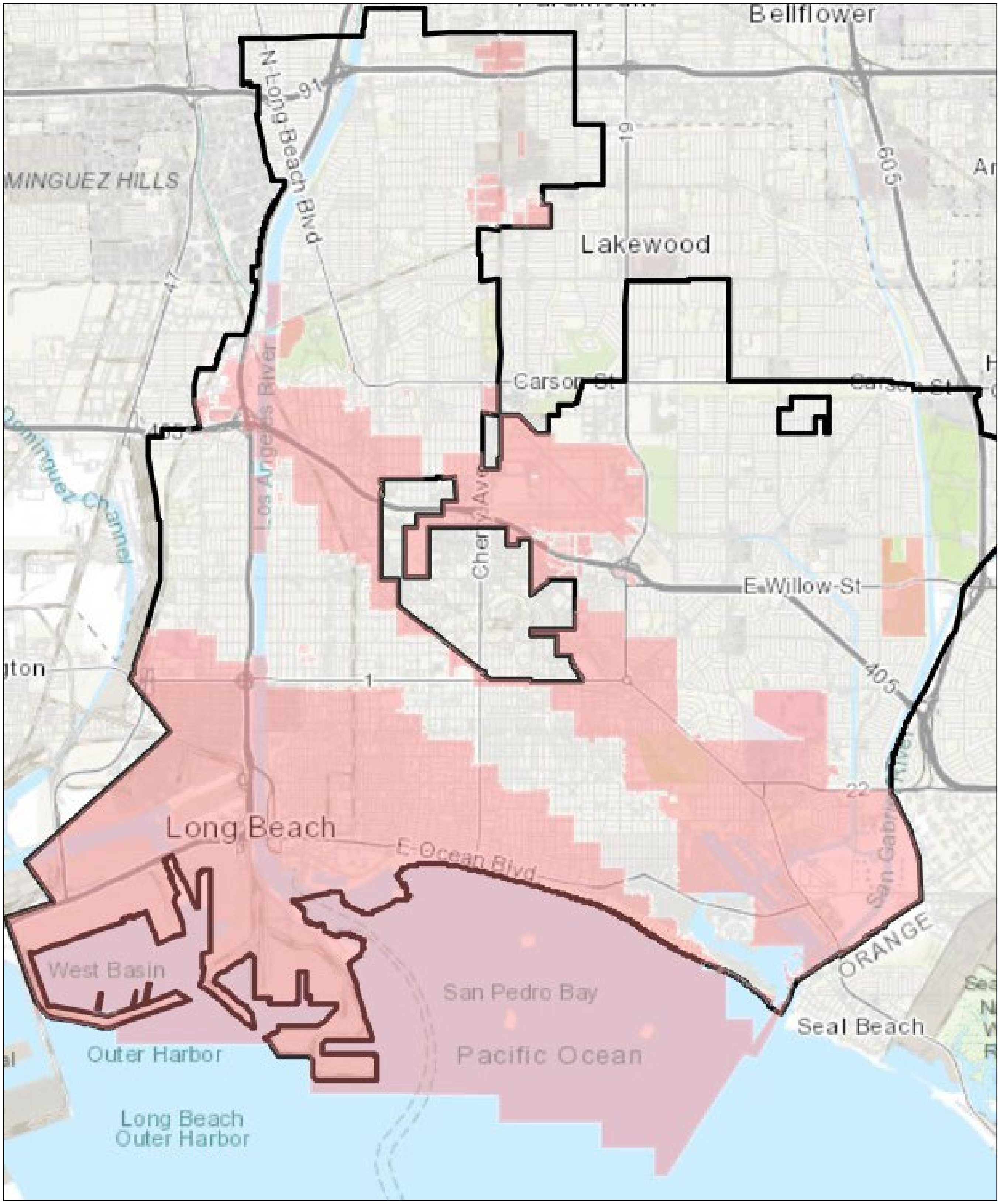

Figure 15-1. Long Beach Methane Gas Mitigation Zone Map

15.5 PUBLIC HEALTH INCIDENTS: PANDEMICS, EPIDEMICS

15.5.1 Hazard Overview

Widespread public health emergencies, referred to as pandemics, occur when a disease emerges to which the population has little immunity. Public health experts worry about a pandemic caused by a disease that spreads among species. Depending on the nature of such a disease, between 25 and 35 percent of the population can become ill. This level of disease activity would disrupt all aspects of society and severely affect the economy. The ongoing COVID-19 pandemic is well known, and the 20th century saw three significant pandemics, the most notable of which was the 1918 Spanish influenza pandemic that was responsible for 20 to 40 million deaths around the world.

Vaccines, antibiotics, and improved living conditions resulted in dramatic declines in communicable diseases in the latter part of the 20th Century. However, infectious diseases have become an increasing threat to all persons in Los Angeles County due to a variety of factors such as:

- Population growth—Overcrowding, aging, migration
- Methods of food production—Large scale, wide distribution, importation
- Environmental changes—Drought, encroachment of humans on wild areas, global warming
- Microbial adaptation—Resistance to antibiotics, re-assortment of genetic material
- Changes in health care—Drugs causing immunosuppression, widespread use of antibiotics
- Human behavior—Travel, diet, sexual behavior, compromised immune systems

The Long Beach Department of Health and Human Services (DHHS) is responsible for public health in the City of Long Beach. Long Beach DHHS will coordinate with Los Angeles County Department of Public Health (LAC DPH) during a public health emergency, whether in the city or throughout the county or state. Long Beach DHHS will serve as the lead agency for a pandemic response in Long Beach and would work closely with the County to ensure that:

- Planning efforts are consistent throughout the county
- Official information is provided to cities in a timely manner
- Pharmaceutical distribution is conducted across the county

Outbreaks of infectious diseases following floods, tornados, earthquakes, and other disasters are not uncommon in the developing world but are rare in developed countries. Most post-disaster disease is produced by poor sanitation, a lack of safe drinking water and contaminated food.

<u>Known Risks</u>

COVID-19

The impacts from the COVID-19 global pandemic will be long term and change the way society as a whole views, prepares for and responds to pandemics. Throughout the pandemic, various mitigation methods have been implemented by local, national, and global agencies. Mask mandates for the public and vaccination mandates for various employment sectors were issued, with mixed results. Many people complied with the mandates, but others voiced their resistance to mandates by partaking in demonstrations, protests, and celebrity media coverage. While health agencies strongly recommend vaccination, local news outlets have reported on studies that show the decline in effectiveness of COVID-19 vaccines over time (Los Angeles Times 2021).

In early 2022, the National COVID-19 Preparedness Plan was released with focuses on four key goals (The White House 2022):

- Protect against and treat COVID-19
- Prepare for new variants
- Prevent economic and educational shutdowns
- Continue to lead efforts to vaccinate the world and save lives

The Long Beach Department of Health and Human Services has provided extensive information and resources to help individuals, communities, and the county during the COVID-19 pandemic. The COVID-19 Public Health website recommends steps for individuals to take to reduce the risk of COVID-19 (County of Los Angeles Public Health n.d.), such as the following:

- Vaccines
- Masks
- Avoiding crowds and public indoor spaces
- Being tested
- Maintaining distance from others
- Socializing with a small number of friends and relatives
- Being willing to change plans to avoid risk areas
- Washing or sanitizing hands
- Staying home when sick
- Following travel guidance from the Centers for Disease Control and Prevention (CDC)

Vector-Borne Diseases

A vector-borne disease results from an infection transmitted to humans and other animals by blood-feeding arthropods, such as mosquitoes, ticks, and fleas. The following are recently prevalent vector-borne diseases in the United States:

- **West Nile Virus**—West Nile virus (WNV) is a disease caused by the bites of infected mosquitoes. The virus survives in nature in several types of birds and is transmitted by the bites of mosquitoes that feed on infected birds. WNV spreads during warm weather months when mosquitoes are most active. While not all mosquitoes carry this virus, the type of mosquito that spreads this virus is found throughout Los Angeles County. According to the CDC, approximately 80 percent of people who are infected with West Nile virus will show no symptoms. Up to 20 percent have symptoms such as fever, headache, and body aches, nausea, vomiting, and sometimes swollen lymph glands or a skin rash on the chest, stomach and back. About 1 percent of people infected with WNV will develop severe illness, with symptoms that can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. There were three deaths from WNV (neuroinvasive infections) in Los Angeles County in 2019

- Zika Virus—Zika is a mosquito-borne disease. The most common symptoms are fever, rash, joint pain, and conjunctivitis (red eyes). The illness is usually mild, with symptoms lasting for several days to a week. However, Zika virus infection during pregnancy can cause serious birth defects. Zika virus is not spread through casual contact but can be spread by infected men to their sexual partners.

Zoonotic Diseases

A zoonotic disease is a disease that normally exists in animals but can be transmitted from animals to people. The following are past or present prevalent zoonotic diseases:

- **Viral Hemorrhagic Fevers—**Viral hemorrhagic fevers are caused by several families of viruses that affect multiple systems in the body. Characteristically, the overall vascular system is damaged and the body's ability to regulate itself is impaired. These symptoms are often accompanied by hemorrhage (bleeding).
- **Anthrax—**Anthrax is a disease caused by a naturally occurring bacterium. Humans can become infected by handling products from infected animals or by breathing in anthrax spores from infected animal products (such as wool). Anthrax can be treated successfully with antibiotics. Anthrax can be used as a weapon, as happened in the United States in 2001, when it was spread through the postal system by sending letters with powder containing anthrax spores.
- **Ebola—**Ebola is a virus common in Central African countries. A 2014 outbreak was the largest and deadliest Ebola outbreak ever recorded, impacting health care systems across the globe time. It was also the first time Ebola made it to the United States and Europe. Prior to 2014, only 2,200 cases of Ebola had been recorded. Of these, 68 percent were fatal. Twenty percent of new Ebola infections were linked to burial traditions in which family and community members wash and touch dead bodies before burial.
- **Severe Acute Respiratory Syndrome—**Severe Acute Respiratory Syndrome (SARS) is a is a zoonotic viral respiratory disease caused by the SARS coronavirus (SARS-CoV). The virus is thought to be transmitted most readily by respiratory droplets produced when an infected person coughs or sneezes. SARS symptoms include a high fever, headache, and an overall feeling of discomfort and body aches. Some people also have mild respiratory symptoms at the outset. About 10 to 20 percent of patients have diarrhea and may develop a dry cough. Most patients develop pneumonia. SARS was first reported in Asia in February 2003. Within several months, the illness spread to more than two dozen countries in Asia, Europe, South America, and North America. In the United States, only eight people had laboratory evidence of SARS-CoV infection. As of May 2005, the CDC reported there was no remaining sustained SARS transmission anywhere in the world.

Foodborne Diseases

Foodborne disease infections come from bacterial and parasitic pathogens in food sources. In 2015, the CDC's "FoodNet" identified 20,098 laboratory-confirmed infections, as well as 4,598 hospitalizations and 77 deaths related to these infections. Recent cases of foodborne disease include:

- In April 2017, a contained outbreak of the botulism was confirmed in California, linked to a cheese sauce.
- In May 2018, Hickory Harvest Foods announced a recall of organic nut mix, potentially infected by listeria monocytogenes.
- In 2018, a strain of *Escherichia coli* bacteria caused the reported illness of 210 people across 36 states in the US, carried on romaine lettuce from Arizona.
- On November 20, 2018, the CDC and FDA investigated a second outbreak of E. coli O157:H7 infections linked to romaine lettuce.
- Three outbreaks of E. coli O157:H7 in the fall of 2019 were attributed to contaminated romaine lettuce.
- As of December 18, 2020, a total of 40 people infected with the outbreak strain of E. coli O157:H7 were reported from 19 states, including California.

Waterborne Diseases

Waterborne diseases are caused by drinking dirty or contaminated water. In a 2017 report, 42 drinking water-associated outbreaks were reported to CDC for the 2013 – 2014 period, resulting in at least 1,006 cases of illness, 124 hospitalizations, and 13 deaths.

- Legionella was responsible for 57% of outbreaks and 13% of illnesses.
- Chemicals/toxins and parasites together accounted for 29% of outbreaks and 79% of illnesses.
- Eight outbreaks caused by parasites resulted in 289 (29%) cases, among which 279 (97%) were caused by Cryptosporidium and 10 (3%) were caused by Giardia duodenalis.
- Chemicals or toxins were implicated in four outbreaks involving 499 cases, with 13 hospitalizations, including the first outbreaks associated with algal toxins.

The following are prevalent waterborne diseases:

- **Cholera—**Cholera is an acute, diarrheal illness caused by infection of the intestine with the toxigenic bacterium *Vibrio cholerae*. An estimated 2.9 million cases and 95,000 deaths occur each year around the world. The infection is often mild or without symptoms but can sometimes be severe. Approximately 10 percent of infected persons will have severe disease characterized by profuse watery diarrhea, vomiting, and leg cramps. In these people, rapid loss of body fluids leads to dehydration and shock. Without treatment, death can occur within hours.
- **Hepatitis A—**Hepatitis A is a vaccine-preventable, communicable disease of the liver caused by the hepatitis A virus. It is usually transmitted person-to-person through the fecal-oral route or consumption of contaminated food or water.
- **Dysentery—**Dysentery is any episode in which the loose or watery stools contain visible red blood. It is most often caused by *Shigella* species or *Entamoeba histolytica*. Other symptoms of dysentery can include painful stomach cramps, nausea or vomiting, and fever. Dysentery is highly infectious and can be passed on if precautions are not taken, such as properly and regularly washing your hands.

Influenza

Influenza (flu) is a contagious respiratory illness caused by influenza viruses. Symptoms can include fever, headache, extreme tiredness, dry cough, sore throat, and muscle aches. Depending on the season, age, and prior health conditions flu can be serious and/or life-threatening. Flu season in Los Angeles County is typically the first week of October through the end of March but can circulate throughout the year.

The 2020-2021 season (beginning October 1, 2020) in Los Angeles County had significantly lower influenza activity than previous influenza seasons. This was attributed to more people receiving the flu vaccine, many schools and businesses holding virtual classes and meetings instead of in-person, and fewer people traveling.

15.5.2 Hazard Profile

The severity of public health hazards is dependent upon the hazard and the population exposed to it. As the population increases, so does the risk of exposure to hazards. The key to reducing the disease hazard is isolation so that the exposed population does not continue to spread the hazard to the uninfected population. For disease and weather-related public health hazards, promoting education and personal preparedness will help to mitigate and reduce the severity of the hazard.

15.5.3 Local Considerations

Past Events

The following recent public health alerts and advisories were issued by the Los Angeles County Health Alert Network:

- October 29, 2020—Wound botulism cases associated with heroin
- October 7, 2020—CDC Health Advisory: HIV clusters and outbreaks across the US among people who inject drugs
- August 20, 2020—CDPH Health Advisory: Resurgence of *Candida auris* in healthcare facilities
- July 17, 2020—LAC DPH Health Advisory: Resurgence of *Candida auris* in Los Angeles County
- July 6, 2020—CDC Health Advisory: Serious adverse health events associated with methanol-based hand sanitizers
- July 4, 2020—LAC DPH Health Advisory: Increasing COVID-19 cases
- June 23, 2020—CDC Health Advisory: The CDC is notifying healthcare providers about a significant increase in penicillin- and ciprofloxacin-resistant meningococci in the United States
- May 14, 2020—CDC Health Advisory: Multisystem Inflammatory Syndrome in children (MIS-C) associated with COVID-19
- May 12, 2020—LAC DPH Health Alert: Pediatric Multi-System Inflammatory Syndrome potentially associated with COVID-19
- March 20, 2020—Long Beach activated the Emergency Operations Center

- March 17, 2020—Disaster Preparedness hosted a community partners briefing on novel coronavirus
- March 14, 2020—First community-spread case of COVID-19 in Long Beach
- February 6, 2020—The Health Department received the first list of returned travelers from Wuhan, China. CDC and state guidance for returned travelers was to conduct passive surveillance to ensure they were properly quarantining and asymptomatic

This list summarizes historical disease outbreak events in the United States:

- In Los Angeles County, as of January 28, 2021, there have been 16,107 COVID-19 deaths and 1.1 million cases of COVID-19
- In the United States during the 2009 H1N1 influenza pandemic, there were 12,271 deaths, 59,979,608 confirmed cases of the disease and 270,435 people hospitalized due to the illness. In California, there were 4,134 people hospitalized due to the illness and 596 deaths
- There were two confirmed cases of SARS in California during the worldwide outbreak in 2002-2003, neither of them in Long Beach.

Issues

Important issues associated with the public health hazards include the following:

- Prevention through vaccination and personal emergency and disaster preparation will help to reduce the impacts of public health hazards.
- Response personnel need to be integrated in a unified command.
- City employees must be advised and trained on public health issues and planning.
- Up-to-date and functional all-hazard contingency planning should be carried out.
- A system needs to be in place for informing the public with a unified message about the public health hazard.
- Health agencies and facilities require surge capacity management and adaptation to the rising number and needs of the region.

15.6 TERRORISM

15.6.1 Hazard Overview

The Federal Bureau of Investigation (FBI) defines terrorism as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." Some acts of terrorism rise to the level of a disaster, and some are more localized to a business or city. Long Beach is home to businesses and government agencies, transportation infrastructure, historic sites, and cultural facilities that are vulnerable to a terrorist attack. Due to the hardening of previous terrorism targets, a recent trend is for terrorists to pursue soft targets. Soft targets are open public areas, e.g., shopping malls, concert or sports venues, hotels, restaurants, bars, nightclubs, movie theaters, transportation centers, and places where numerous people or tourists gather that remain relatively unprotected. A variety of political, social, religious, cultural, and economic factors underlie terrorist activities. Terrorists typically target civilians with a goal of instilling fear to advance their agenda. The media interest generated by terrorist attacks makes this a high visibility threat.

15.6.2 Local Considerations

Past Incidents

The following is a compilation of previous terrorism events in the County of Los Angeles:

- **April 26, 2019**—A man was arrested for multiple terrorism-related charges after he planned to denotate a bomb at a Long Beach rally. He was eventually convicted in federal court.
- **August 21, 2019**—A man was arrested for threatening to conduct a shooting at the Long Beach Airport Marriott. When he was arrested, the man had multiple firearms and hundreds of rounds of ammunition in his home.
- **March 31, 2020—**A man attempted to ram a train into the USNS Mercy, going over 250 yards before stopping and causing damage to the pavement. No one was injured in the incident. He thought the COVID-19 pandemic was an attempt at a government takeover.
- **November 1, 2013—**A man entered the checkpoint at the LAX Airport and fired his rifle, killing one Transportation Security Administration officer and injuring six others. The motivation behind the attack was an anti-government agenda.
- **February 3-12, 2013**—A former LAPD officer went on a killing spree targeting police officers and their families throughout Southern California. The former officer was eventually killed in a shootout and fire.
- **September 16, 2010**—A Hawaiian Airlines flight was delayed for nearly two hours after someone phoned in a bomb threat. The Los Angeles Police Department bomb squad and canine team searched the plane, which was due to leave LAX for Honolulu with 225 people onboard. The Boeing 767 was carefully inspected, and passengers and luggage were rescreened.
- **September 7, 2010**—Law enforcement authorities investigated a written threat found on a Thai Airways aircraft that landed at LAX. After landing shortly, Flight 794 was taken to a remote area of the airport, where crew members and passengers were interviewed. Bomb technicians searched the plane and authorities screened the luggage. The flight originated in Bangkok, Thailand.
- **June 19, 2010**—A man falsely claiming to be carrying an explosive at LAX prompted the closure of the Tom Bradley Terminal before police shot him with a stun gun and took him into custody. The incident began when the suspect grabbed a passenger's luggage outside of the terminal, ran inside and claimed the package contained a bomb. The terminal was evacuated for 20 minutes as officers pursued the man inside the facility. The package he was carrying did not contain explosives.
- **September 16, 2005—**Fire officials responded to a fire at the high-rise condominium home of the director of Los Angeles Animal Services, after residents observed smoke coming from a recyclables/janitorial closet. First responders recovered an improvised incendiary device consisting of a 4-inch-long tube labeled "TOXIC" and using a cigarette as a fuse. The device, which had been placed next to a stack of newspapers in the recyclables/janitorial closet, had malfunctioned and only scorched the concrete floor of the closet. The Animal Liberation Front claimed responsibility for this incident.

- **July 7, 2005**—Fire officials responded to a vehicle fire in the driveway of a private residence in Los Angeles, California. In extinguishing the fire, authorities recovered a partially melted plastic gasoline container from behind the vehicle's left front wheel. The car belonged to a representative for the Animal Care Technicians Union, which represents employees for the Los Angeles Animal Services (LAAS). LAAS and its affiliates have been targeted by local animal rights extremists, and the LAAS union representative had been placed on a "targets" list of individuals profiled by extremists.
- **2005 Disruption of Plot to Attack Military and Jewish Targets**—Officers with the Torrance Police Department arrested suspects during a commercial armed robbery in progress at a Los Angeles area gas station. Their arrest, and subsequent local and FBI investigation, revealed that the suspects were conducting the armed robberies to raise money for an alleged terrorist plot targeting U.S. military facilities, Israeli government facilities, and Jewish synagogues in the greater Los Angeles area.
- **August 22, 2003**—Vandalism and Destruction of Property—Individuals associated with the Earth Liberation Front (ELF) carried out acts of vandalism in Los Angeles, damaging roughly 125 vehicles and one commercial building. Much of the damage was caused by spray-painted graffiti, although in two cases, individuals set fire to vehicles. Some of the graffiti associated the vehicles with "terrorism."
- **July 2002**—Attack by Lone Gunman at LAX—An attacker opened fire with a handgun at LAX while standing in line at the ticket counter of El Al, killing two persons and wounding four others before an airline security officer shot and killed him. The FBI assumed the primary responsibility for the investigation due to the possible terrorist connection, and in March 2003, the attack was determined a terrorist crime, with the gunman acting alone and not part of an identified group.
- **December 31, 1999**—Attempted Terrorist Attack on LAX—An Algerian national and suspected member of the Armed Islamic Group (GIA) was stopped as he came across the U.S.-Canadian border into Washington State on December 14, 1999. He had a trunk filled with explosives and timing devices and a plan to detonate a suitcase bomb at LAX. The Algerian said he picked LAX because, "it was sensitive politically and economically." He was arrested at Port Angeles, Washington.

Issues

The major issues for terrorism include the following:

- Continue regular and redundant emergency response training for field level responders (public works) and public information staff in order to respond quickly in the event of a terrorism related disaster.
- Conduct terrorism awareness training for all local government employees to recognize threats or suspicious activity in order to prevent an incident from occurring.
- Further develop City response capabilities based on the terrorism threat.
- Enhance existing infrastructure and buildings to prevent or mitigate terrorism incidents.
- Participate in regional training exercises in support of local, state and national preparedness.
- Develop continuity of operations plans for the City and work with the private sector to create business continuity plans to be followed in the event of a terrorism emergency.

- Review and revise existing automatic aid and mutual aid agreements with other public works agencies to ensure mutual aid is available.
- Implement a public emergency information line for 24-hour contact during an emergency.
- Coordinate with all school districts in the City to ensure their emergency preparedness plans include preparation for terrorism incidents.
- Build a comprehensive emergency management capability within the City.
- Prepare and present terrorism risk and preparedness information to the public through meetings, town hall gatherings, and preparedness fairs.

16. RISK RANKING

FEMA requires all hazard mitigation plans to include mitigation actions based on local risk, vulnerability, and community priorities. For this plan, risk was calculated by multiplying probability by impact on people, property, and the economy. The risk estimates were generated using methodologies promoted by FEMA. The Steering Committee reviewed, discussed, and approved the methodology and results.

Numerical ratings of probability and impact were based on the hazard profiles and exposure and vulnerability evaluations presented in this plan. Using that data, the City ranked the risk of all the hazards of concern described in this plan. When available, estimates of risk were generated with data from Hazus or GIS. For hazards of concern with less specific data available, qualitative assessments were used. As appropriate, results were adjusted based on local knowledge and other information not captured in the quantitative assessments. The hazards of interest described in Chapter 15 were not ranked because quantitative data for ranking is not generally available for those hazards.

Risk ranking results are used to help establish mitigation priorities and inform the development of a mitigation action plan. The action plan includes mitigation actions, at a minimum, to address each hazard with a "high" or "medium" risk ranking. Actions that address hazards with a low or no hazard ranking are optional.

16.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor =2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

Figure 16-1 summarizes the probability assessment for each hazard of concern for this plan.

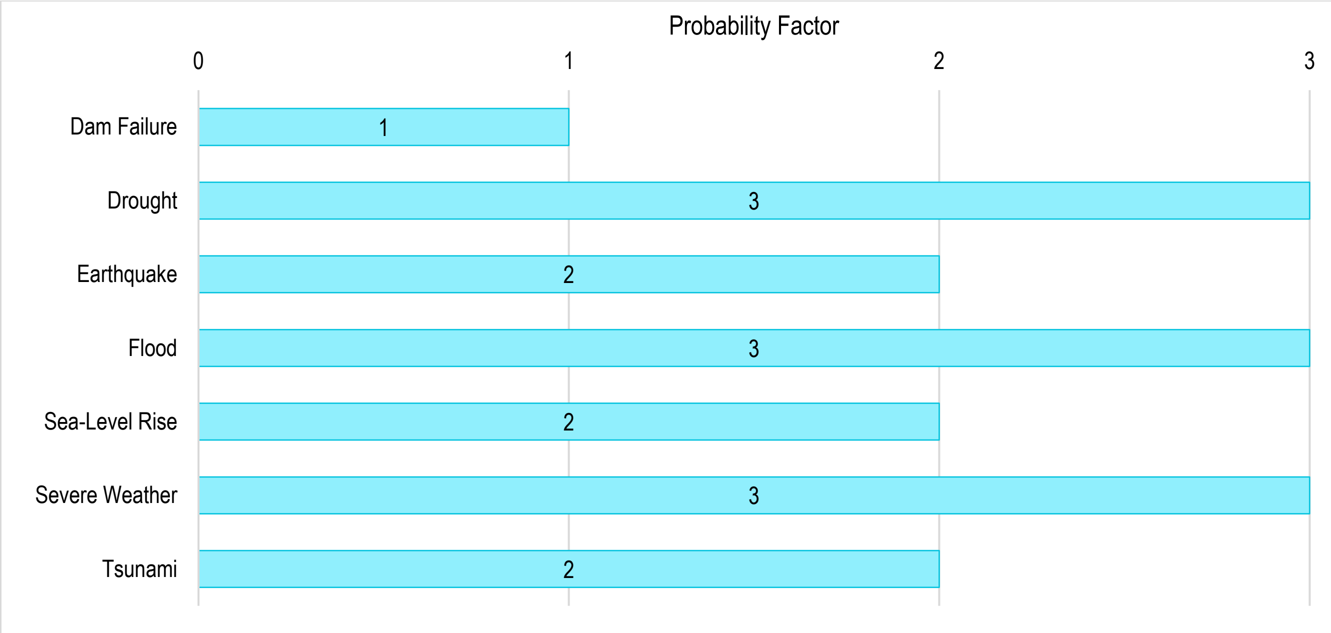

Figure 16-1. Probability Factors for Hazards of Concern

16.2 IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. Impact factors were assigned as follows:
  - High—50 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—25 percent to 49 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—25 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0)

  These quantitative values may be subjectively modified based on known experience.
- **Property**—Values were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—30 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium—15 percent to 29 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low—14 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)

- **Economy**—Values were assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total replacement value of the property exposed to the hazard. For some hazards, vulnerability was considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates were generated for the earthquake and flood hazards using Hazus.
  - High—Estimated loss from the hazard is 20 percent or more of the total exposed property value (Impact Factor = 3)
  - Medium—Estimated loss from the hazard is 10 percent to 19 percent of the total exposed property value (Impact Factor = 2)
  - Low—Estimated loss from the hazard is 9 percent or less of the total exposed property value (Impact Factor = 1)
  - No impact—No loss is estimated from the hazard (Impact Factor = 0)

The impact rating for drought was limited to economic impacts and was more qualitative than the assessment for the other hazards of concern. This is because drought does not impact structures or increase human mortality.

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the operations was given a weighting factor of 1. Figure 16-2 and Figure 16-3 summarize the unweighted and weighted impact factors, respectively, for each hazard.

16.3 RISK RATING AND RANKING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors for people, property, and operations, as summarized in Figure 16-4. Based on these ratings, a priority of high, medium, or low was assigned to each hazard. Figure 16-5 shows the hazard risk ranking.

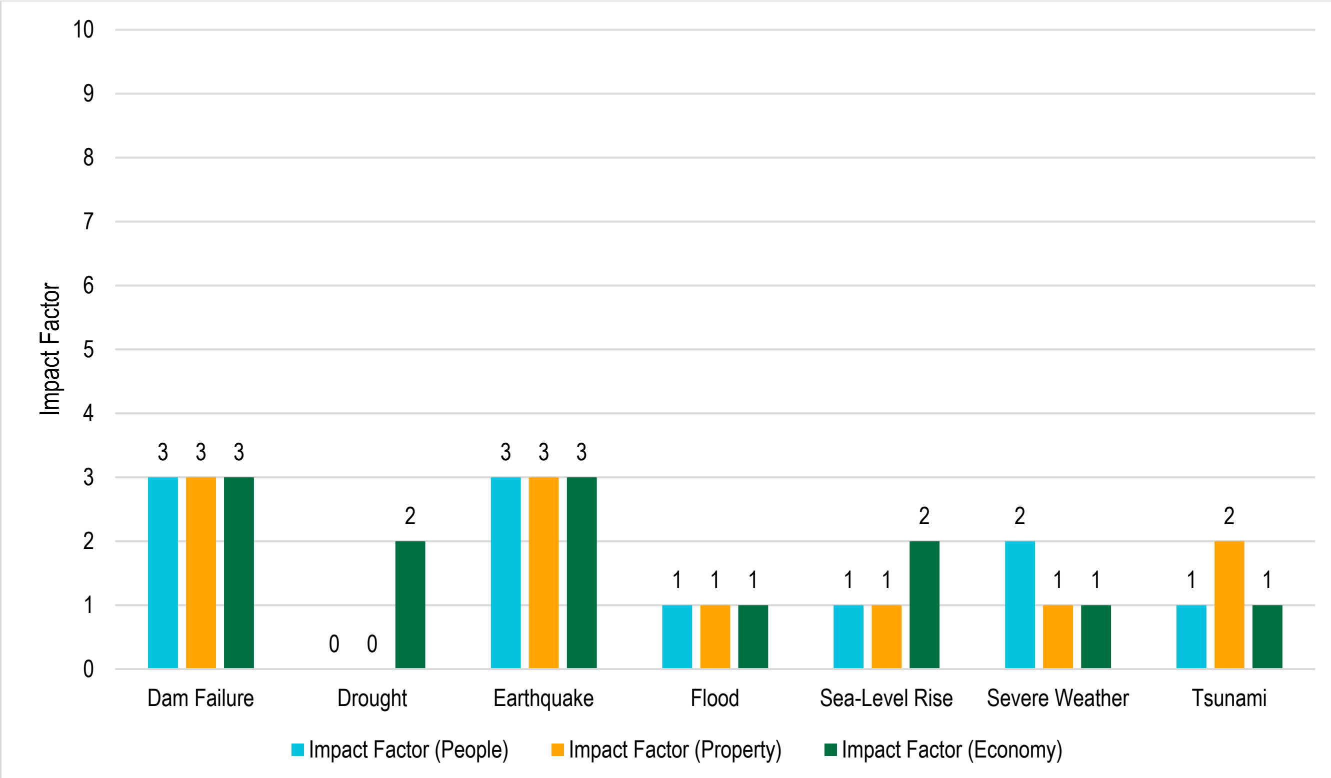

Figure 16-2. Impact Factors for Hazards of Concern

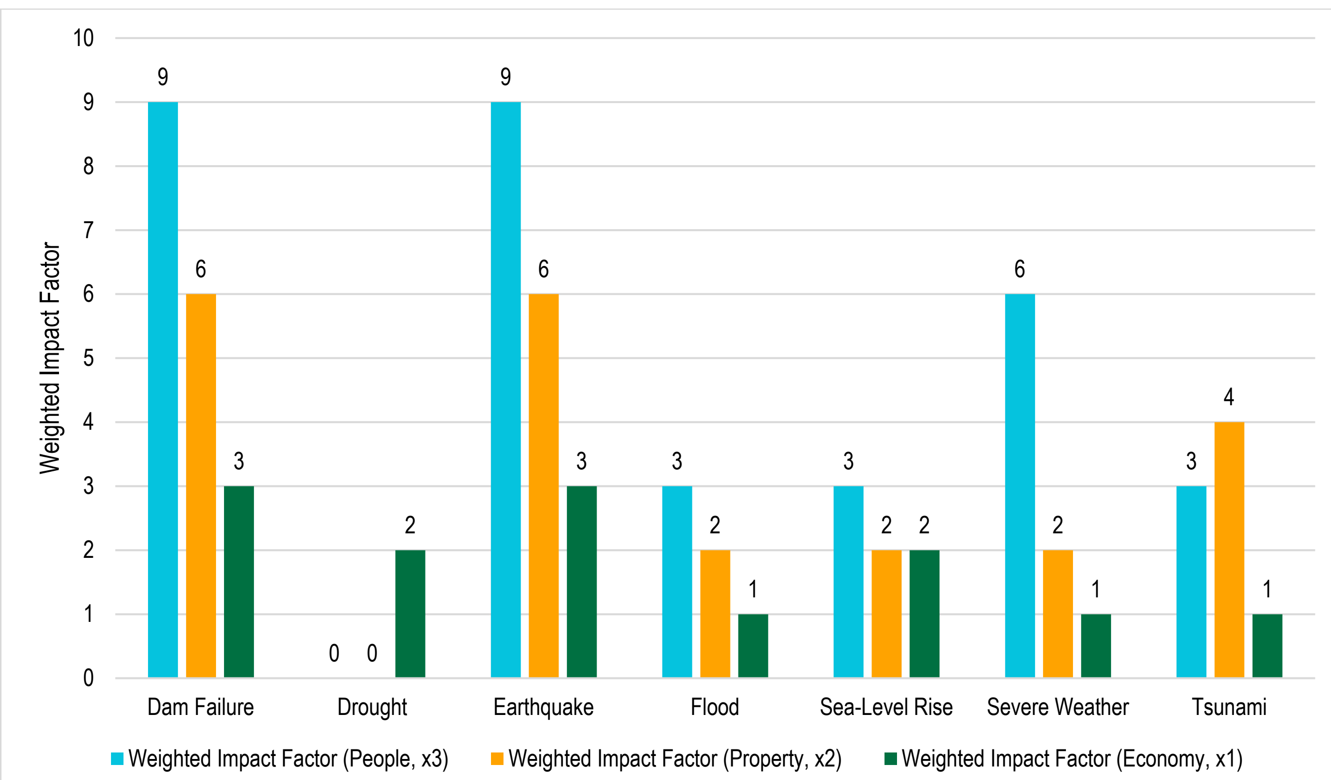

Figure 16-3. Weighted Impact Factors for Hazards of Concern

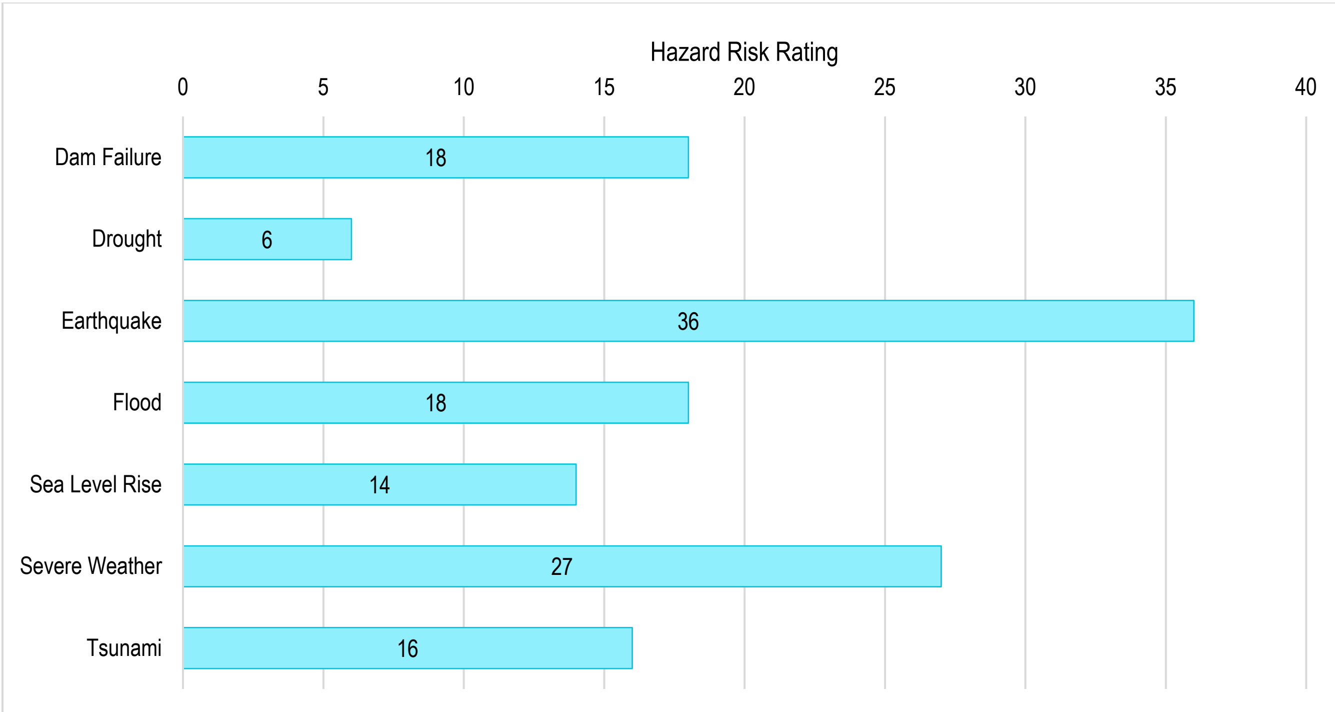

Figure 16-4. Total Risk Rating for Hazards of Concern

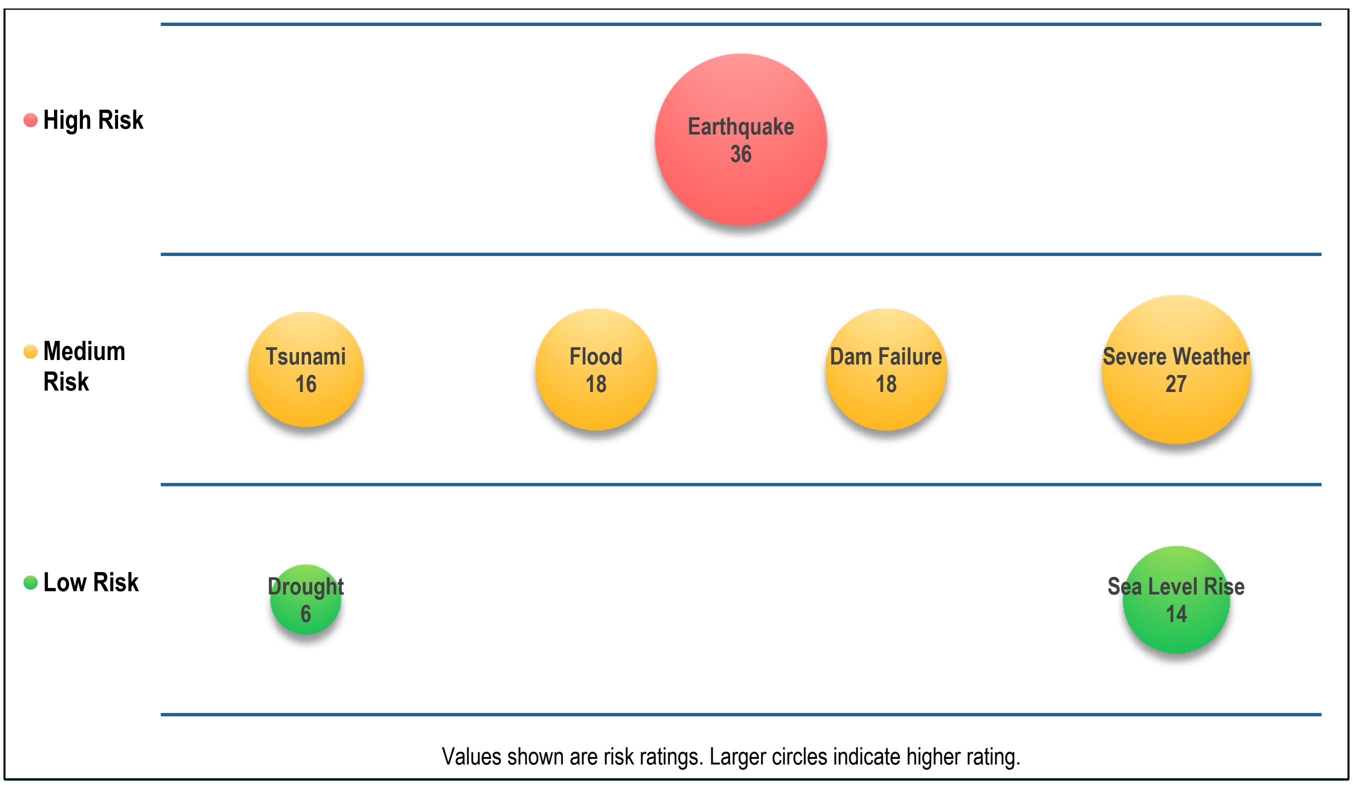

Figure 16-5. Hazard Risk Ranking

PART 3—MITIGATION STRATEGY

17. GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee established a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The goals, objectives, and actions in this plan all support each other. Goals were selected by the Steering Committee. Objectives were selected that meet multiple goals. Actions were prioritized based on ability to accomplish multiple objectives.

17.1 GOALS

The Steering Committee determined the following goals for the Hazard Mitigation Plan:

1. Protect health and safety.
2. Invest in property protection.
3. Promote policies that embrace mitigation
4. Create a healthy and equitable environment.
5. Ensure equitable and inclusive mitigation measures.

17.2 OBJECTIVES

The Steering Committee reviewed example objectives and identified the following objectives for this plan, based on approval by more than 50 percent of committee members:

1. Identify and reduce the health and safety impacts of hazards throughout the city, including areas where vulnerable populations live or work.
2. Improve and promote systems that provide early warning communications during and prior to an emergency or disaster.
3. Develop strategies to reduce public health risk from natural and non-natural hazards.
4. Improve community engagement and outreach by organizations and agencies that provide services to vulnerable populations.
5. Implement mitigation programs that promote reliability of critical assets and lifeline systems to minimize impacts from hazards and expedite recovery following an emergency or disaster.
6. Consider known hazards when identifying sites for new facilities, substantial retrofits, and utility systems.
7. Promote appropriate mitigation of all public and privately owned property.

8. Form partnerships to leverage and share resources with businesses, local institutions, and community-based organizations.
9. Partner with the private sector, including small businesses, to promote structural and non-structural hazard mitigation as part of standard business practices.
10. Educate businesses and institutional partners about contingency planning, targeting small businesses and those located in high-risk areas.
11. Advance understanding about the relationship between climate change and natural hazards due to more frequent and extreme weather events.
12. Increase social resilience by improving knowledge of current and future hazards and promoting community-based mitigation strategies.
13. Encourage mitigation and resiliency strategies throughout the City, including vulnerable neighborhoods.
14. Integrate climate adaptation and resiliency strategies in citywide planning, with attention to neighborhoods most vulnerable to climate change.
15. Improve public outreach and access to hazard information, data, and maps to enhance understanding of natural hazards and the risk they pose.
16. Improve public knowledge of natural and non-natural hazards and protective measures so individuals appropriately mitigate against, prepare for, respond to, and recover from such hazards

18. MITIGATION BEST PRACTICES AND ADAPTIVE CAPACITY

18.1 MITIGATION BEST PRACTICES

Catalogs of hazard mitigation best practices were developed that present a broad range of alternatives to be considered for use in the mitigation action plan, in compliance with 44 CFR (Section 201.6(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan. The catalogs present alternatives that are categorized in two ways:

- By who would have responsibility for implementation:
  - Individuals (personal scale)
  - Businesses (corporate scale)
  - Government (government scale)
- By what the alternative would do:
  - Manipulate the hazard
  - Reduce exposure to the hazard
  - Reduce vulnerability to the hazard
  - Increase the ability to respond to or be prepared for the hazard

The catalogs are lists of what could be considered to reduce risk from natural hazards in the planning area. They include practices that will mitigate current risk from hazards or help reduce new risk resulting from climate change. Hazard mitigation actions recommended in this plan were selected from an analysis of the best practices presented in the catalogs. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process and are consistent with the established goals and objectives. Actions were selected out of the catalogs based on an analysis of the City's ability to implement them. Best practices in the catalog that are not included in the action plan were omitted for one or more of the following reasons:

- The action is not feasible
- The action is already being implemented
- The City does not have the capability to implement the action
- There is an apparently more cost-effective alternative
- The action does not have public or political support

The collections for each hazard are presented in Table 18-1 through Table 18-6.

Table 18-1. Alternatives to Mitigate the Dam Failure Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Relocate out of dam failure inundation areas • **Reduce vulnerability to the hazard:** ❖ Elevate home to appropriate levels • **Increase the ability to respond to or be prepared for the hazard:** ❖ Learn about risk reduction for the dam failure hazard ❖ Learn the evacuation routes for a dam failure event ❖ Educate yourself on early warning systems and the dissemination of warnings	• **Manipulate the hazard:** ❖ Remove dams ❖ Harden dams • **Reduce exposure to the hazard:** ❖ Replace earthen dams with hardened structures • **Reduce vulnerability to the hazard:** ❖ Flood-proof facilities within dam failure inundation areas • **Increase the ability to respond to or be prepared for the hazard:** ❖ Educate employees on the probable impacts of a dam failure ❖ Develop a continuity of operations plan	• **Manipulate the hazard:** ❖ Remove dams ❖ Harden dams • **Reduce exposure to the hazard:** ❖ Replace earthen dams with hardened structures ❖ Relocate critical facilities out of dam failure inundation areas ❖ Consider open space land use in designated dam failure inundation areas • **Reduce vulnerability to the hazard:** ❖ Adopt higher floodplain standards in mapped dam failure inundation areas ❖ Retrofit critical facilities within dam failure inundation areas • **Increase the ability to respond to or be prepared for the hazard:** ❖ Map dam failure inundation areas ❖ Enhance emergency operations plan to include a dam failure component ❖ Institute monthly communications checks with dam operators ❖ Inform the public on risk reduction techniques ❖ Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas ❖ Consider the probable impacts of climate change in assessing the risk associated with the dam failure hazard ❖ Establish early warning capability downstream of listed high hazard dams ❖ Consider the residual risk associated with protection provided by dams in future land use decisions

Table 18-2. Alternatives to Mitigate the Drought Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Drought-resistant landscapes ❖ Reduce water system losses ❖ Modify plumbing systems (through water saving kits) • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Drought-resistant landscapes ❖ Reduce private water system losses • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation	• **Manipulate the hazard:** ❖ Groundwater recharge through stormwater management • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Identify and create groundwater backup sources ❖ Water use conflict regulations ❖ Reduce water system losses ❖ Distribute water saving kits • **Increase the ability to respond to or be prepared for the hazard:** ❖ Public education on drought resistance ❖ Encourage recycling ❖ Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers ❖ Develop drought contingency plan ❖ Develop criteria "triggers" for drought-related actions ❖ Improve accuracy of water supply forecasts ❖ Modify rate structure to influence active water conservation techniques

Table 18-3. Alternatives to Mitigate the Earthquake Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area (off soft soils) • **Reduce vulnerability to the hazard:** ❖ Retrofit structure (anchor house structure to foundation) ❖ Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) ❖ Build to higher design • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice "drop, cover, and hold" ❖ Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event ❖ Keep cash reserves for reconstruction ❖ Become informed on the hazard and risk reduction alternatives available. ❖ Develop a post-disaster action plan for your household	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate or relocate mission-critical functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Build redundancy for critical functions and facilities ❖ Retrofit critical buildings and areas housing mission-critical functions • **Increase the ability to respond to or be prepared for the hazard:** ❖ Adopt higher standard for new construction; consider "performance-based design" when building new structures ❖ Keep cash reserves for reconstruction ❖ Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. ❖ Develop a continuity of operations plan	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate critical facilities or functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure ❖ Provide redundancy for critical functions ❖ Adopt higher regulatory standards • **Increase the ability to respond to or be prepared for the hazard:** ❖ Provide better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (e.g., tax incentives, information) ❖ Include retrofitting and replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components such as pipe, power line, and road repair materials ❖ Develop and adopt a continuity of operations plan ❖ Initiate triggers guiding improvements (such as <50% substantial damage or improvements) ❖ Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. Develop a post-disaster action plan that includes grant funding and debris removal components.

Table 18-4. Alternatives to Mitigate the Flood Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures • **Increase the ability to respond to or be prepared for the hazard:** ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication with outside, 72-hour self-sufficiency during and after an event	• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • **Reduce exposure to the hazard:** ❖ Locate critical facilities or functions outside hazard area ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Build redundancy for critical functions or retrofit critical buildings ❖ Provide flood-proofing when new critical infrastructure must be located in floodplains • **Increase the ability to respond to or be prepared for the hazard:** ❖ Keep cash reserves for reconstruction ❖ Support and implement hazard disclosure for sale of property in risk zones. ❖ Solicit cost-sharing through partnerships with others on projects with multiple benefits.	• **Manipulate the hazard:** ❖ Maintain drainage system ❖ Institute low-impact development techniques on property ❖ Dredging, levee construction, and providing regional retention areas ❖ Structural flood control, levees, channelization, or revetments. ❖ Stormwater management regulations and master planning ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • **Reduce exposure to the hazard:** ❖ Locate or relocate critical facilities outside of hazard area ❖ Acquire or relocate identified repetitive loss properties ❖ Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. ❖ Adopt land development criteria such as planned unit developments, density transfers, clustering ❖ Institute low impact development techniques on property ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure, bridge replacement program ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt regulatory standards such as freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. ❖ Stormwater management regulations and master planning. ❖ Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities. • **Increase the ability to respond to or be prepared for the hazard:** ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) ❖ Incorporate retrofitting or replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Consider participation in the Community Rating System ❖ Maintain and collect data to define risks and vulnerability ❖ Train emergency responders ❖ Create an elevation inventory of structures in the floodplain ❖ Develop and implement a public information strategy ❖ Charge a hazard mitigation fee ❖ Integrate floodplain management policies into other planning mechanisms within the planning area. ❖ Consider the probable impacts of climate change on the risk associated with the flood hazard ❖ Consider residual risk associated with structural flood control in land use decisions ❖ Enforce National Flood Insurance Program ❖ Adopt a Stormwater Management Master Plan

Table 18-5. Alternatives to Mitigate the Severe Weather Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Insulate house ❖ Provide redundant heat and power ❖ Insulate structure ❖ Plant appropriate trees near home and power lines ("Right tree, right place" National Arbor Day Foundation Program) • **Increase the ability to respond to or be prepared for the hazard:** ❖ Trim or remove trees that could affect power lines ❖ Promote 72-hour self-sufficiency ❖ Obtain a NOAA weather radio. ❖ Obtain an emergency generator.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Relocate critical facilities (such as power lines) underground ❖ Reinforce critical facilities (such as power lines) to meet performance expectations ❖ Install tree wire • **Increase the ability to respond to or be prepared for the hazard:** ❖ Trim or remove trees that could affect power lines ❖ Create redundancy ❖ Equip facilities with a NOAA weather radio ❖ Equip vital facilities with emergency power sources.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Develop an urban heat island reduction program that includes an urban forest program or plan • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure such as locating utilities underground ❖ Trim trees back from power lines ❖ Designate snow routes and strengthen critical road sections and bridges • **Increase the ability to respond to or be prepared for the hazard:** ❖ Support programs such as "Tree Watch" that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. ❖ Establish and enforce building codes that require all roofs to withstand snow loads ❖ Increase communication alternatives ❖ Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. ❖ Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines ❖ Provide NOAA weather radios to the public ❖ Consider the probable impacts of climate change on the risk associated with the severe weather hazard ❖ Review and update heat response plan in light of climate change (heat events) projections

Table 18-6. Alternatives to Mitigate the Tsunami Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area • **Reduce vulnerability to the hazard:** ❖ Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though. • **Increase the ability to respond to or be prepared for the hazard:** ❖ Develop and practice a household evacuation plan ❖ Educate yourself on the risk exposure from the tsunami hazard and ways to minimize that risk ❖ Understand tsunami warning signs and signals	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate structure or mission critical functions outside of hazard area whenever possible • **Reduce vulnerability to the hazard:** ❖ Mitigate personal property for the impacts of tsunami • **Increase the ability to respond to or be prepared for the hazard:** ❖ Develop and practice a corporate evacuation plan ❖ Educate employees on the risk exposure from the tsunami hazard and ways to minimize that risk	• **Manipulate the hazard:** ❖ Build wave abatement structures (e.g., the "Jacks" looking structure designed by the Japanese) • **Reduce exposure to the hazard:** ❖ Locate structure or functions outside of hazard area whenever possible ❖ Harden infrastructure for tsunami impacts ❖ Relocate identified critical facilities located in tsunami high hazard areas • **Reduce vulnerability to the hazard:** ❖ Adopt higher regulatory standards that will provide higher levels of protection to structures built in a tsunami inundation area ❖ Utilize tsunami mapping to guide development away from high risk areas through land use planning • **Increase the ability to respond to or be prepared for the hazard:** ❖ Use probabilistic tsunami mapping and land use guidance from the state when published ❖ Provide incentives to guide development away from hazard areas ❖ Improve the tsunami warning and response system ❖ Provide community members with tsunami inundation maps ❖ Join NOAA's Tsunami Ready program ❖ Develop and communicate evacuation routes ❖ Enhance the public information program to include risk reduction options for the tsunami hazard

18.2 ADAPTIVE CAPACITY

Adaptive capacity is defined as "the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2014). This term is typically used while discussing climate change adaptation; however, it is similar to the alternatives presented in the tables for building local capacity. The following are general alternatives that can be considered to build capacity for adapting to current and future risks:

- Incorporate climate change adaptation into relevant local and regional plans and projects.
- Establish a climate change adaptation and hazard mitigation public outreach and education program.
- Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation and mitigation strategy development and regional approaches.
- Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.
- Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special-needs residents in planning and implementation.
- Ask local employers and business associations to participate in local efforts to address climate change and natural hazard risk reduction.

- Conduct a communitywide assessment and develop a program to address health, socioeconomic, and equity vulnerabilities.
- Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.
- Use performance metrics and data to evaluate and monitor the impacts of climate change and natural hazard risk reduction strategies on public health and social equity.
- Develop coordinated plans for mitigating future flood and related impacts through concurrent adoption of updated general plan safety elements and local hazard mitigation plans.
- Update safety elements to reflect existing hazards and projected climate change impacts on hazards.
- Implement general plan safety elements through zoning and subdivision practices that restrict development in floodplains and other natural hazard areas.
- Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, drought).
- Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.
- Promote economic diversity.
- Incorporate consideration of climate change impacts as part of infrastructure planning and operations.
- Conduct a climate impact assessment on community infrastructure.
- Identify gaps in legal and regulatory capabilities and develop ordinances or guidelines to address them.
- Identify and pursue new sources of funding for mitigation and adaptation activities.
- Hire new staff or provide training to current staff to ensure an adequate level of administrative and technical capability to pursue mitigation and adaptation activities.

19. MITIGATION ACTION PLAN

19.1 STATUS OF PREVIOUS PLAN ACTIONS

19.1.1 Mitigation Actions

The 2017 City of Long Beach Hazard Mitigation Plan identified 217 mitigation actions for implementation. These actions were reviewed for the current update, and for each action it was determined whether the action had been completed, was in progress or had not been started. Incomplete actions were reviewed to determine if they should be carried over to the 2022 update or removed due to changes in priorities, capabilities, or feasibility.

Appendix D lists the status of all 217 actions from the 2017 plan. Of the identified actions, 181 (83 percent) have been started or completed, 10 (5 percent) are carried over to the 2022 update, and 26 (12 percent) have been withdrawn. The reasons for withdrawal of actions ranged from the action no longer being considered feasible to the action being identified in the 2022 planning process as an ongoing core capability.

19.1.2 Plan Incorporation Actions

As a demonstration of progress in local hazard mitigation efforts, 44 CFR 201.6(c)(4)(ii) requires plan updates to describe completed steps to incorporate the mitigation plan into other planning mechanisms as appropriate. The maintenance strategy for the 2017 City of Long Beach Hazard Mitigation Plan called for incorporation into other planning mechanisms. Of the 217 mitigation actions in the 2017 plan, two actions relate to incorporation of the mitigation plan into other planning mechanisms. These actions called for integration in the City's General Plan and the City's Emergency Operations Plan. Both of these are ongoing actions.

19.2 ACTION PLAN

The Steering Committee reviewed the collections of hazard mitigation alternatives and selected 44 actions to be included in the hazard mitigation action plan. The selection of actions was based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives. Table 19-1 lists the recommended hazard mitigation actions that make up the action plan.

Table 19-1. Hazard Mitigation Action Plan Matrix

Benefits New or Existing Assets	Objectives Met	Estimated Cost	Sources of Funding	Timeline[a]
Actions Led by Long Beach Development Services (DS)				
Action DS-1—Use data from Long Beach Building Resiliency Program study to develop inventory of vulnerable buildings throughout the City. *Hazards Mitigated:* Earthquake				
Existing	5, 11, 12	25,000	General Fund	Short-term
Action DS-2—Review and conduct studies of combined riverine/coastal flooding and increased severity of rainfall events on watershed flooding to understand the potential cumulative impacts. *Hazards Mitigated:* Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	3, 12, 13	$150,00	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action DS-3—Update or augment, as necessary, floodplain regulations that address the fact that sea level rise will increase the height of floodwaters and the inland extent of floodplains in Long Beach. *Hazards Mitigated:* Tsunami, Flood, Dam Failure, Climate Change, Severe Weather				
New and Existing	1, 7, 12	$75,000	General Fund	Short-term
Action DS-4—Enhance and expand urban forest programs for new and existing buildings, streets, and public spaces to improve air quality while reducing extreme heat. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New and Existing	3, 8, 12, 14	$250,000	Grant Funding (HMGP, BRIC)	Short-term
Action DS-5—Update Public Safety Element and Seismic Safety Element of the City's General Plan, linking this Hazard Mitigation Plan. *Hazards Mitigated:* Earthquake, Tsunami, Severe Weather				
New and Existing	1, 12	$50,000	General Fund	Short-term
Action DS-6—Structure City codes and policies regarding hazard assessments and the regulation of new development with State requirements. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Sea Level Rise, Severe Weather, Drought				
New and Existing	6, 7, 8, 12	$12,500	General Fund	Short-term
Action DS-7—Establish preventive measures for existing development in areas vulnerable to natural hazards. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Sea Level Rise, Severe Weather, Drought				
New and Existing	6, 7, 8, 12	$12,500	General Fund	Short-term
Action DS-8—Maintain supplies and training associated with use of ATC-20 standards (building inspections following disaster). *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	3	$50,000	General Fund	Short-term
Action DS-9—Implement the adaptation actions identified in the Climate Action and Adaptation Plan to improve the ability of Long Beach and its residents and businesses to adapt to climate change and related impacts now and in the future. Identified impacts include extreme heat, air quality, drought, sea level rise, and flooding				
New and Existing	1, 3, 7, 10, 11, 12, 14, 16	$75,000	Grant Funding (HMPG, BRIC)	Long-term
Action DS-10—Continue to maintain good standing and compliance under the NFIP through implementation of floodplain management programs that, at a minimum, meet the NFIP requirements: • Enforce the flood damage prevention ordinance. • Participate in floodplain identification and mapping updates. • Provide public assistance/information on floodplain requirements and impacts. *Hazards Mitigated:* Flood				
New and Existing	4, 6, 7, 8, 15, 16	Low	Staff Time, General Funds	Short-term

Benefits New or Existing Assets	Objectives Met	Estimated Cost	Sources of Funding	Timeline[a]
Actions Led by Long Beach Police Department (PD)				
Action PD-11—Install or upgrade generators at all police department facilities that are capable of running 100% of the facility's equipment, lights, etc. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Severe Weather				
Existing	2, 3, 11	$500,000	Grant Funding (HMGP, BRIC)	Long-term
Action PD-12—Install or upgrade communications technology to include redundancy in normal communications, traditional analog backups, and fixed satellite systems at 400 W Broadway, 3205 Lakewood Blvd, 1835 Santa Fe Ave, 4891 Atlantic, 3800 Willow, 7290 Carson St, and 1400 Canal. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Climate Change, Severe Weather				
New and Existing	2, 10	$100,000	Grant Funding (HMGP, BRIC, FMA)	Long-term
Actions Led by Long Beach Department of Health and Human Services (HHS)				
Action HHS-13—Assess plans and develop plan/protocol between the City's health and fire departments to utilize emPOWER data (federal data set of individuals who have medical equipment paid for through Medicaid/Medicare) to prioritize evacuation of individuals with electrical dependent medical equipment *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	1, 3, 10	$100,000	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action HHS-14—Assess and expand the list of predesignated shelter locations and family assistance/reunification centers *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	1, 3, 11, 13, 14	$75,000	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action HHS-15—Enhance and expand the accessibility of cooling centers for severe weather. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
Existing	1, 3, 10	$25,000	Grant Funding (HMGP, BRIC)	Ongoing
Actions Led by Long Beach Energy Resources Department (ER)				
Action ER-16—Seismic retrofit/replacement of Long Beach Energy Resources buildings 550 and 560. *Hazards Mitigated:* Earthquake				
Existing	5, 8	$4 M	Grant Funding (HMGP, BRIC)	Long-term
Action ER-17—Back-up generator procurement for the Long Beach Energy Resources 570 building where the call center, dispatch office, and operations center are located. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Severe Weather				
Existing	3, 9	$300,000	Grant Funding (HMGP, BRIC)	Long-term
Action ER-18—Perimeter protection evaluation of the oil islands for tsunami or other potential high tide events. *Hazards Mitigated:* Tsunami, Flood, Dam Failure, Climate Change, Severe Weather				
New and Existing	5, 11, 12	$100,000	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action ER-19—Assess and update drainage flows of the oil properties and the Long Beach Energy Resources facility. *Hazards Mitigated:* Tsunami, Flood, Dam Failure, Climate Change, Severe Weather				
Existing	12, 13	$250,000	General Fund	Long-term
Actions Led by Long Beach Fire Department (FD)				
Action FD-20—Evaluate and develop sustainable emergency food and water storage capabilities (i.e., refrigeration units) and caches (potable water and meals ready-to-eat) for both emergency workers and civilian victims. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Climate Change, Severe Weather, Drought				
New	1, 3, 10	$250,000	Grant Funding (HMGP, BRIC, FMA)	Long-term
Action FD-21—Install or upgrade generators at all fire department facilities that are capable of running 100% of the facility's equipment, lights, etc. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Severe Weather				
New and Existing	1, 10	$500,000	Grant Funding (HMGP, BRIC)	Long-term

Benefits New or Existing Assets	Objectives Met	Estimated Cost	Sources of Funding	Timeline[a]
Action FD-22—Increase standard shoring capabilities of Fire Department resources by creating an extensive cache of lumber and Paratech equipment, to assist with infrastructure structural shoring capabilities following an earthquake.				
Hazards Mitigated: Earthquake				
New and Existing	3, 5, 10	$300,000	General Fund	Short-term
Action FD-23—Evaluate and increase satellite capabilities to store and deliver fuel during fuel shortages/disruptions due to natural disaster.				
Hazards Mitigated: Earthquake, Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	5, 10	$50,000	General Fund	Long-term
Action FD-24—Evaluate and create continuity plans for communication by developing secondary and tertiary communication plans, including upgrades to radio communications, via towers for UHF, VHF, and digital radio transmissions. Establish a satellite phone cache for emergency usage.				
Hazards Mitigated: Earthquake, Tsunami, Flood, Dam Failure, Climate Change, Severe Weather, Drought				
New and Existing	2, 11, 15, 16	$25,000	General Fund	Short-term
Action FD-25—Evaluate and develop a cache of personal protective equipment for City personnel operating in impacted tsunami zones (foul weather gear, waders, boots, etc.)				
Hazards Mitigated: Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	1, 3	$50,000	Grant Funding (HMGP, BRIC, FMA)	Long-term
Action FD-26—Increase Fire Department fleet capabilities to incorporate more alternatives to transportation besides fire engines, fire trucks, and fire rescues; to include all-terrain and 4x4 capable vehicles.				
New	1, 5	$500,000	Grant Funding (HSGP, HMGP)	Long-term
Action FD-27—Evaluate and upgrade fire prevention protocols for building inspections based on climate trends.				
Hazards Mitigated: Climate Change, Severe Weather				
New and Existing	12	$50,000	General Fund	Long-term
Actions Led by Long Beach Water Department (WD)				
Action WD-28—Install/Implement an Earthquake Early Warning System at the Long Beach Water Department's Treatment Plant and Operations Center				
Hazards Mitigated: Earthquake				
New and Existing	1, 2, 3, 5	$100,000	Grant Funding (HMGP, BRIC)	Long-term
Action WD-29—The Long Beach Water Department's Engineering Division will complete a Water Main Lining Pilot Project at Alley East of Cherry between 15th and Pacific Coast Highway, at 15th and Pacific Coast Highway and Sherman Place, and at 17th between Cherry and Alley East of Sherman. This pilot project will use trenchless technology (cast-in-place pipe) to rehabilitate old pipes while reducing the impact of construction and carbon footprint for the duration of materials' 50-year life expectancy. Findings from the pilot will include a better understanding of the environmental and economic impacts of this new technology.				
Hazards Mitigated: Earthquake, Dam Failure, Severe Weather, Flood, Sea Level Rise, Tsunami, Climate Change, Drought				
New and Existing	5, 10, 11	$3 M	General Fund	Long-term
Action WD-30—Strengthen raw water intakes to prevent damage from erosion, flood debris, and earthquakes				
Hazards Mitigated: Earthquake, Tsunami, Flood, Severe Weather				
New and Existing	5, 11, 13	$1.5 M	General Fund	Short-term
Action WD-31—Enlarge culverts to better handle flood surges				
Hazards Mitigated: Tsunami, Flood, Dam Failure, Severe Weather				
Existing	1, 5, 11, 13	$200,000	General Fund	Short-term
Action WD-32—Develop Sewer Master Plan. The Long Beach Water Department's Engineering Division will complete sewer lift station rehabilitation. This type of infrastructure hardening will contribute to sea-level rise resilience as well as operational improvements.				
Hazards Mitigated: Tsunami, Climate Change, Severe Weather				
New and Existing	12, 13	$150,000	Grant Funding (HMGP, BRIC)	Short-term

Benefits New or Existing Assets	Objectives Met	Estimated Cost	Sources of Funding	Timeline[a]
Action WD-33—The Long Beach Water Department's Engineering Division will complete two new wells at Groundwater Treatment Plant to draw water from the Central Basin. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New and Existing	1, 11, 13	$8 M	Grant Funding (HMGP, BRIC)	Long-term
Action WD-34—The Long Beach Water Department's Engineering Division will complete new West Coast Basin Well 1 at 2950 Redondo Ave. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New	1, 11, 13	$5 M	Grant Funding (HMGP, BRIC)	Long-term
Action WD-35—The Long Beach Water Department's Engineering Division will complete rehabilitating two wells: Comm 15 and 18, at Heartwell Park, 6800 E Carson Street. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New	1, 11, 13	$8 M	Grant Funding (HMGP, BRIC)	Long-term
Action WD-36—The Long Beach Water Department's Engineering Division will complete rehabilitating two wells: Comm 14 and Citizen 10, at Heartwell Park, 2939 Airport Way. This project will result in increased groundwater protection by reducing reliance on imported water and thereby improving drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New and Existing	1, 11, 13	$8 M	Grant Funding (HMGP, BRIC)	Long-term
Action WD-37—The Long Beach Water Department's Water Resources Division will complete a citywide Well Asset Management Plan. This plan will help inform future groundwater well production, which reduces reliance on imported water and improves drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New and Existing	1, 11, 13	$8 M	Grant Funding (HMGP, BRIC)	Long-term
Action WD-38—The Long Beach Water Department's Water Resources Division will complete Groundwater Augmentation Study. This study will help inform future groundwater well production, which reduces reliance on imported water and improves drought resiliency. *Hazards Mitigated:* Climate Change, Severe Weather, Drought				
New and Existing	1, 11, 13	$8 M	Grant Funding (HMGP, BRIC)	Long-term
Actions Led by Long Beach Public Works Department (PW)				
Action PW-39—Complete Westside Storm Drainage Project. To include reinforced concrete box, reinforced concrete pipe storm drain conduit and appurtenances, new catch basins and local depressions. *Hazards Mitigated:* Flood, Dam Failure, Severe Weather				
New and Existing	1, 5, 12, 13	$10,900,000	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action PW-40—Olympic Plaza Stormwater Rehabilitation Project. To include resurfacing/re-establishment of center crown along Olympic Plaza, addition of two catch basins, installation of an 18-inch storm drain main, and construction of a trench drainage system. Support to be provided by Los Angeles County. *Hazards Mitigated:* Flood, Dam Failure, Severe Weather				
New and Existing	1, 5, 13	$640,000	Grant Funding (HMGP, BRIC, FMA)	Short-term
Action PW-41—Inventory and flood-proof vulnerable sewer pump stations. *Hazards Mitigated:* Tsunami, Flood, Dam Failure, Severe Weather				
New and Existing	1, 10, 12	$300,000	General Fund	Short-term
Action PW-42—Develop inventory of backup power resources (generators) for critical City facilities *Hazards Mitigated:* Earthquake, Tsunami, Flood, Severe Weather				
New and Existing	10, 13	$100,000	Grant Funding (HMGP, BRIC)	Short-term
Action PW-43—Complete Americans with Disabilities Act building upgrades in City-owned facilities and sidewalks. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Dam Failure, Climate Change, Severe Weather				
New and Existing	1	$500,000	Grant Funding (HMGP, BRIC, FMA)	Short-term

Benefits New or Existing Assets	Objectives Met	Estimated Cost	Sources of Funding	Timeline[a]
Action PW-44—Conduct a local seismic retrofit of 2nd Street Bridge over San Gabriel River and Studebaker Road Bridge over Southern California Edison. *Hazards Mitigated:* Earthquake				
Existing	1, 3, 5, 6, 8	$42,000,000	GAS, Infrastructure Bill, Grant Funding (HMGP, BRIC)	Short-term
Action PW-45—Replace Ravenna Rd Bridge over Rivo Alto Canal with a bridge that meets current seismic standards. *Hazards Mitigated:* Earthquake				
Existing	1, 3, 5, 6, 8	$2,600,000	GAS, Infrastructure Bill, Grant Funding (HMGP, BRIC)	Short-term
Action Led by Long Beach Airport (AIR)				
Action AIR-46—Upgrade the existing generator and electrical systems at Long Beach Airport. *Hazards Mitigated:* Earthquake, Tsunami, Flood, Severe Weather				
Existing	3, 11, 13	$2 M	Grant Funding (HMGP, BRIC)	Short-term
Action Led by Harbor Department of Long Beach (HD)				
Action HD-47—Identify, improve, and plan Port Cargo Infrastructure seismic and other hazard retrofit and replacement strategies to oil terminals, cargo facilities, and cargo equipment. *Hazards Mitigated:* Earthquake, Tsunami				
New and Existing	5, 6, 11, 12	$4,000,000	Grant Funding (HMGP, BRIC)	Long-term
Actions Led by Disaster Preparedness & Emergency Communications (DP)				
Action DP-48—Expand public outreach for hazard mitigation and emergency preparedness through use of the City website, social media platforms, and community meetings and events. *Hazards Mitigated:* Earthquake, Severe Weather, Tsunami, Climate Change, Cybersecurity Threats, Public Health Incidents, Terrorism				
New and Existing	2, 4, 8, 10, 12, 13, 15, 16	$100,000	General Fund, Grant Funding (UASI, SHSP, EMPG)	Ongoing
Action DP-49—Provide equitable access to emergency preparedness information including, availability in multi-lingual formats (including ASL), accommodations for those affected by the technology divide, and targeted outreach for those in historically underserved areas. Efforts will be tracked internally to ensure compliance. *Hazards Mitigated:* Earthquake, Severe Weather, Tsunami, Climate Change, Cybersecurity Threats, Public Health Incidents, Terrorism				
New and Existing	2, 4, 8, 10, 12, 13, 15, 16	$150,000	General Fund, Grant Funding (UASI, SHSP, EMPG)	Ongoing
Action DPEC-50—Develop a city-wide evacuation plan to aid in the evacuation of residents and their pets. *Hazards Mitigated:* Earthquake, Flood				
New and Existing	5, 8, 13	$80,000	Grant Funding (UASI, SHSP, EMPG)	Short-term
Action DPEC-51—Maintain and expand warning and alert systems to ensure equity and accessibility to all residents. *Hazards Mitigated:* Earthquake, Severe Weather, Tsunami, Climate Change, Cybersecurity Threats, Public Health Incidents, Terrorism				
New and Existing	1, 2, 4, 13	$150,000	Grant Funding (UASI, SHSP, EMPG)	Ongoing
Action DPEC-52—Ensure all response plans during emergency operations center activations are created with an equity lens: providing supplies, equipment, and personnel to historically vulnerable and underserved areas of the City. *Hazards Mitigated:* Earthquake, Dam Failure, Severe Weather, Flood, Tsunami				
New	1, 5, 13, 16	$50,000	General Fund, Grant Funding (HSGP, HMGP)	Ongoing

a. Short-term = Completion within 5 years; Long-term = Completion within 10 years; Ongoing= Continuing new or existing program with no completion date

19.3 ACTION PLAN PRIORITIZATION

The actions recommended in the action plan were prioritized based on the following factors:

- Cost and availability of funding
- Benefit, based on likely risk reduction to be achieved
- Number of plan objectives achieved

- Timeframe for project implementation
- Eligibility for grant funding programs

Two priorities were assigned for each action:

- A high, medium, or low priority for implementing the action
- A high, medium, or low priority for pursuing grant funding for the action

The sections below describe the analysis of benefits and costs and the assignment of the two priority ratings.

19.3.1 Benefit/Cost Review

The action plan must be prioritized according to a benefit/cost analysis of the proposed actions (44 CFR, Section 201.6(c)(3)(iii)). For this hazard mitigation plan, a qualitative benefit-cost review was performed for each action by assigning ratings for benefit and cost as follows:

- Cost:
  - **High**—Existing funding will not cover the cost of the action; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
  - **Medium**—The action could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the action would have to be spread over multiple years.
  - **Low**—The action could be funded under the existing budget. The action is part of or can be part of an ongoing existing program.
- Benefit:
  - **High—**Action will provide an immediate reduction of risk exposure for life and property.
  - **Medium—**Action will have a long-term impact on the reduction of risk exposure for life and property, or action will provide an immediate reduction in the risk exposure for property.
  - **Low—**Long-term benefits of the action are difficult to quantify in the short term.

To assign priorities, each action with a benefit rating equal to or higher than its cost rating (such as high benefit/medium cost, medium benefit/medium cost, medium benefit/low cost, etc.) was considered to be cost-beneficial. This is not the detailed level of benefit/cost analysis required for some FEMA hazard-related grant programs. Such analysis would be performed at the time a given action is being submitted for grant funding.

19.3.2 Implementation Priority

The priority for implementing each action was assigned based on the following definitions:

- **High Priority**—An action that meets multiple objectives, has benefits that exceed costs, and has a secured source of funding. Action can be completed in the short term (1 to 5 years).
- **Medium Priority**—An action that meets multiple objectives, has benefits that exceed costs, and is eligible for funding though no funding has yet been secured for it. Action can be completed in the short term (1 to 5 years) once funding is secured. Medium-priority actions become high-priority actions once funding is secured.

- **Low Priority**—An action that will mitigate the risk of a hazard, has benefits that do not exceed the costs or are difficult to quantify, has no secured source of funding, and is not eligible for any known grant funding. Action can be completed in the long term (1 to 10 years). Low-priority actions are generally “wish-list” actions. They may be eligible for grant funding from programs that have not yet been identified.

19.3.3 Grant Pursuit Priority

The priority for pursuing grant funding for each action was assigned based on the following definitions:

- **High Priority**—An action that meets identified grant eligibility requirements, has high benefits, and is listed as high or medium implementation priority; local funding options are unavailable or available local funds could be used instead for actions that are not eligible for grant funding.
- **Medium Priority**—An action that meets identified grant eligibility requirements, has medium or low benefits, and is listed as medium or low implementation priority; local funding options are unavailable.
- **Low Priority**—An action that has not been identified as meeting any grant eligibility requirements.

19.3.4 Prioritization Summary for Mitigation Actions

Table 19-2 lists the priority of each recommended action.

Table 19-2. Mitigation Action Priority

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Cost?	Is Project Grant-Eligible?	Can Project Be Funded Under Existing Programs/ Budgets?	Implementation Priority[a]	Grant Pursuit Priority[a]
1	3	Low	Low	Yes	No	Yes	High	Low
2	3	Low	High	No	Yes	No	Low	Medium
3	3	Medium	Low	Yes	No	Yes	High	Low
4	4	Low	High	No	Yes	No	Low	Medium
5	2	Low	Low	Yes	No	Yes	High	Low
6	4	Low	Low	Yes	No	Yes	High	Low
7	4	Low	Low	Yes	No	Yes	High	Low
8	1	Low	Low	Yes	No	Yes	Low	Low
9	8	Low	High	No	Yes	No	Low	Medium
10	6	Low	Low	Yes	No	Yes	Low	Medium
11	3	High	High	Yes	Yes	No	Medium	High
12	2	Medium	High	No	Yes	No	Low	Medium
13	3	Low	High	No	Yes	No	Low	Medium
14	5	Medium	High	No	Yes	No	Low	Medium
15	3	High	High	Yes	Yes	No	Medium	High
16	2	High	High	Yes	Yes	No	Medium	High
17	2	High	High	Yes	Yes	No	High	High
18	3	Low	High	No	Yes	No	Low	Medium
19	2	Low	High	No	Yes	No	Low	Medium
20	3	Medium	High	No	Yes	No	Low	Medium
21	2	High	High	Yes	Yes	No	Medium	High
22	3	Medium	Low	Yes	No	Yes	High	Low

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Cost?	Is Project Grant-Eligible?	Can Project Be Funded Under Existing Programs/ Budgets?	Implementation Priority[a]	Grant Pursuit Priority[a]
23	2	Low	Low	Yes	No	Yes	Medium	Low
24	4	Low	Low	Yes	No	Yes	High	Low
25	2	Medium	High	No	Yes	No	Low	Medium
26	2	Low	High	No	Yes	No	Low	Medium
27	1	Medium	Low	Yes	No	Yes	Low	Low
28	4	Medium	High	No	Yes	No	Low	Medium
29	3	Low	Low	Yes	No	Yes	High	Low
30	3	Medium	Low	Yes	Yes	Yes	High	Medium
31	4	Medium	Low	Yes	Yes	Yes	High	Medium
32	2	Low	High	No	Yes	No	Low	Medium
33	3	Medium	High	No	Yes	No	Low	Medium
34	3	Medium	High	No	Yes	No	Low	Medium
35	3	Medium	High	No	Yes	No	Low	Medium
36	3	Medium	High	No	Yes	No	Low	Medium
37	3	Low	High	No	Yes	No	Low	Medium
38	3	Low	High	No	Yes	No	Low	Medium
39	4	Medium	High	No	Yes	No	Low	Medium
40	3	Medium	High	No	Yes	No	Low	Medium
41	3	Medium	High	No	Yes	No	Low	Medium
42	2	Low	High	No	Yes	No	Low	Medium
43	1	Low	High	No	Yes	No	High	Medium
44	5	High	High	Yes	Yes	No	High	Low
45	5	High	High	Yes	Yes	No	Medium	High
46	3	High	High	Yes	Yes	No	Medium	High
47	4	High	High	Yes	Yes	No	Low	High
48	8	Low	Low	Yes	Yes	No	Medium	Medium
49	8	Low	Low	Yes	Yes	No	Medium	Medium
50	3	Low	High	No	Yes	No	Low	Medium
51	4	Medium	Medium	Yes	Yes	No	Medium	Medium
52	4	Low	High	No	Yes	No	Low	Medium

a. See the introduction to this plan for explanation of priorities.

19.4 CLASSIFICATION OF ACTIONS

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Mitigation types used for this classification are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters, and shatter-resistant glass.

- **Public Education and Awareness**—Actions to inform residents and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers, and school-age and adult education.
- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, wetland restoration and preservation, and green infrastructure.
- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls, and safe rooms.
- **Climate Resilience**—Actions that incorporate methods to mitigate and/or adapt to the impacts of climate change. Includes aquifer storage and recovery activities, incorporating future conditions projections in project design or planning, or actions that specifically address jurisdiction-specific climate change risks, such as sea level rise or urban heat island effect.
- **Community Capacity Building**—Actions that increase or enhance local capabilities to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Includes staff training, memorandums of understanding, development of plans and studies, and monitoring programs.

Table 19-3 shows the classification based on this analysis.

Table 19-3. Analysis of Mitigation Actions

Hazard Type	Action Addressing Hazard, by Mitigation Type[a]							
	Prevention	Property Protection	Public Education & Awareness	Natural Resource Protection	Emergency Services	Structural Projects	Climate Resilience	Community Capacity Building
High-Risk Hazards								
Earthquake	6, 7, 50	16, 43, 44, 45, 46	47, 48		8, 11, 12, 13, 14, 17, 120, 21, 22, 23, 26, 28, 46, 51, 52	29, 30		1, 5, 13, 24, 41, 48, 49, 50
Medium-Risk Hazards								
Dam Failure	3, 6, 7	40, 43			8, 12, 13, 14, 20, 23, 25, 26, 52	19, 29, 31, 39, 40		2, 13, 18, 24
Severe Weather	3, 6, 7, 9, 25	41, 43	48, 49		8, 11, 12, 13, 14, 15, 16, 20, 21, 23, 25, 26, 46, 51, 52	19, 29, 30, 31, 32, 39, 40	4, 33, 34, 35, 36	2, 4, 5, 9, 18, 12, 24, 32, 37, 38, 42, 48, 49
Low-Risk Hazards								
Drought	6, 7				15, 20	26, 29	4, 33, 34, 35, 36	4, 25, 37, 38
Flood	3, 6, 7, 8, 50	41, 43	10		8, 11, 12, 13, 14, 17, 20, 21, 23, 25, 26, 46, 52	19, 29, 30, 31, 39, 40		2, 10, 13, 18, 24, 42, 50
Sea Level Rise	6, 7					29		
Tsunami	3, 6, 7	41, 43, 47	48, 49		8, 11, 12, 13, 14, 17, 20, 21, 23, 25, 26, 46, 51, 52	19, 29, 30, 31, 32		2, 5, 13, 18, 25, 32, 42, 48, 49

20. PLAN ADOPTION, IMPLEMENTATION AND MAINTENANCE

20.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). DMA compliance and its benefits cannot be achieved until the plan is adopted. This plan was submitted for a pre-adoption review to Cal OES and FEMA prior to adoption. Once pre-adoption approval was provided, the City of Long Beach formally adopted the plan. A copy of the resolution is provided in Appendix E.

20.2 PLAN IMPLEMENTATION

The effectiveness of the hazard mitigation plan depends on its implementation and the incorporation of its action items into existing local plans, policies, and programs. Together, the action items in the plan provide a framework for activities that the City of Long Beach can implement over the next five years. The planning team and the Steering Committee have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

The City of Long Beach Department of Disaster Preparedness and Emergency Communications will have lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

20.3 PLAN MAINTENANCE

Plan maintenance is the formal process for achieving the following:

- Ensuring that the hazard mitigation plan remains an active and relevant document and that the City maintains its eligibility for applicable funding sources
- Monitoring and evaluating the plan annually and producing an updated plan every five years
- Integrating public participation throughout the plan maintenance and implementation process
- Incorporating the mitigation strategies outlined in this plan into existing planning mechanisms and programs, such as any relevant comprehensive land-use planning process, capital improvement planning process, and building code enforcement and implementation

To achieve these ends, a hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A method and schedule for monitoring, evaluating, and updating the mitigation plan within a 5-year cycle
- An approach for how the community will continue public participation in the plan maintenance process
- A process by which local governments will incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate

Table 20-1 summarizes the plan maintenance strategy. The sections below further describe each element.

Table 20-1. Plan Maintenance Matrix

Approach	Timeline	Lead Responsibility
Integration into Other Planning Mechanisms		
Create a linkage between the hazard mitigation plan and the City's general plan or similar plans identified in the core capability assessments	Continuous over the 5-year performance period of the plan	City of Long Beach Planning Department
Plan Monitoring		
Track the implementation of actions over the performance period of the plan	Continuous over the 5-year performance period of the plan	Department of Disaster Preparedness and Emergency Communications
Plan Evaluation		
Review the status of previous actions; assess changes in risk; evaluate success of integration	Upon initiation of hazard mitigation plan update, comprehensive general plan update, or major disaster	Department of Disaster Preparedness and Emergency Communications
Grant Monitoring and Coordination		
As grant opportunities present themselves, the City will consider options to pursue grants to fund actions identified in this plan	As grants become available	Department of Disaster Preparedness and Emergency Communications
Plan Update		
Begin the process, at a minimum, every 5 years to develop a comprehensive update of the plan.	Every 5 years or upon comprehensive update to General Plan or major disaster; funding and organizing for plan update will begin in FY 2026/2027	Department of Disaster Preparedness and Emergency Communications
Continuing Public Participation		
Keep a website maintained, hold public meeting review once a year (these meetings are also televised and on public notices in community newspaper), and receive comments through the website. The website and comments will be maintained over the course of the plan.	Continuous over the 5-year performance period of the plan	Department of Disaster Preparedness and Emergency Communications

20.3.1 Integration with Other Planning Mechanisms

It is the intent of the City of Long Beach to fully integrate the hazard mitigation plan into existing plans and programs, such as comprehensive land-use planning processes, capital improvement planning, and building enforcement implementation. The hazard mitigation plan's format allows sections to be reviewed and updated as new data becomes available, resulting in a plan that remains current and relevant.

The City of Long Beach, through adoption of a General Plan and zoning ordinance, has planned for the impact of natural hazards. The process of updating this hazard mitigation plan provided the opportunity to review and expand on policies in these planning mechanisms. The information on hazard, risk, vulnerability, and mitigation contained in this hazard mitigation plan is based on the best science and technology available at the time this plan was prepared. The General Plan and the hazard mitigation plan are complementary documents that work together to achieve the goal of reducing risk exposure. The General Plan is an integral part of this plan. An update to the General Plan may trigger an update to the hazard mitigation plan.

The City of Long Beach will create a linkage between the hazard mitigation plan and the General Plan by identifying a mitigation action as such and giving that action a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- City of Long Beach General Plan
- Climate action/Adaptation plans
- Resilience plans
- Recovery plan
- Emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Master fire protection plans

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be integrated via the update process.

20.3.2 Plan Monitoring

The City of Long Beach Department of Disaster Preparedness and Emergency Communications will be the lead agency responsible for monitoring the plan by tracking the status of all recommended mitigation actions in the action plan.

20.3.3 Plan Evaluation

The plan will be evaluated by how successfully the implementation of identified actions has helped to achieve the goals and objectives identified of the plan. This will be assessed by a review of the changes in risk that occur over the performance period and by the degree to which mitigation goals and objectives are incorporated into existing plans, policies and programs. Plan evaluation will be the responsibility of the City of Long Beach Department of Disaster Preparedness and Emergency Communications . The Long Beach Mayor and City Council may recommend changes to the hazard mitigation plan based on evaluation findings.

20.3.4 Midterm Progress Report

Completion of a midterm progress report would be an effective tool to position the City for future updates. This report will provide the City with a streamlined approach for fulfilling update requirements delineated in 44 CFR 201.6(d)(3) during the next plan update initiative. Any trigger of a comprehensive update to the *City of Long Beach Hazard Mitigation Plan* as described in Section 20.3.6 will require completion of a performance period progress report.

The objective of the progress report will be to evaluate the progress of individual actions at the midterm of the performance period of this plan. The progress report will be completed two and a half years from the date of plan approval by FEMA, or upon initiation of an accelerated plan update as described under Section 20.3.6, whichever occurs first. The review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Reevaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation

The City has created a template to guide its departments in preparing a progress report (see Appendix F). This report will be used as follows:

- Posted on a website dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to City Council to inform council members of the progress of actions implemented during the reporting period

Progress reporting is not a requirement specified under 44 CFR. However, it may enhance the City's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize the City's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with other stakeholders within the planning area.

20.3.5 Grant Monitoring and Evaluation

The City of Long Beach Department of Disaster Preparedness and Emergency Communications will identify grant funding opportunities. Once these opportunities are identified, City agency stakeholders will convene in a short meeting to review the hazard mitigation plan and pursue a strategy to capture that grant funding. The Department of Disaster Preparedness and Emergency Communications will assume lead responsibility for planning and facilitating grant opportunity meetings. Review of the hazard mitigation plan at these meetings can include the following:

- Discussion of any hazard events that occurred during the prior year and their impact on the planning area
- Impact of potential grant opportunities on the implementation of mitigation actions
- Re-evaluation of the action plans to determine if the timeline for identified actions needs to be amended (such as changing a long-term action to a short-term action because of funding availability)
- Recommendations for new actions
- Impact of any other planning programs or initiatives that involve hazard mitigation

20.3.6 Plan Update

FEMA requires the hazard mitigation plan to be revised and resubmitted for review and approval by Cal OES and FEMA prior to the five-year anniversary date of the plan's adoption in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). To meet this timeline, the Department of Disaster Preparedness and Emergency Communications will implement the Steering Committee's plan revision process at least one year prior to the anniversary date of the adoption. This cycle may be accelerated to less than five years based on the following triggers:

- A federal disaster declaration that impacts the City of Long Beach
- A hazard event that causes loss of life
- A comprehensive update of the City of Long Beach general plan

The hazard mitigation plan five-year revision will, at a minimum, include the following elements:

- The revision process will be convened through a new steering committee
- The hazard risk assessment will be reviewed and, if necessary, revised using best available information and technologies
- The action plan will be reviewed for any actions completed, ongoing, or withdrawn, and will be reconciled to account for changes in the risk assessment or new policies identified under other plans (such as the general plan)
- The draft plan revision will be sent to appropriate departments and divisions for comment
- The public will be given an opportunity to comment on the revised plan prior to adoption

- The Long Beach City Council will adopt the updated plan once the reviews by Cal OES and FEMA have been conducted

20.3.7 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through a City website and by providing copies of biennial progress reports on the City website and through posting them in locations throughout the City for the public to review. The website will house the final plan and provide information regarding the plan, plan implementation, and the beginning of the revision process. Copies of the plan will be distributed to local libraries. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new steering committee. This strategy will be based on the needs and capabilities of the City of Long Beach at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

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City of Long Beach Hazard Mitigation Plan

Appendix A. Public Outreach Materials

STEERING COMMITTEE MEETINGS

CITY OF LONG BEACH

City of Long Beach
Hazard Mitigation Plan
Project Kickoff Meeting
12 AUG 2021 -1400
Virtual Conference Call Meeting

Welcome and Introductions

- Group Introductions
  - City of Long Beach – Reggie Harrison
  - Tetra Tech – Rob Flaner

Project Overview – Rob Flaner

- Work plan
- Timeline
- Important milestones
- Value Adds

Committees – Rob Flaner & Bart Spencer

- Core Planning Team
- Steering Committee
  - Purpose
  - Expectations
  - Organization
  - Ground rules

Plan Review – Rob Flaner

- Homework!
- Review prior HMP
  - What needs to be updated?
- Review CA State Hazard Mitigation Plan
  - Hazards of concern for Long Beach
  - State plan's goals and objectives-Are they consistent with Long Beach's Plan?

Public Involvement Strategy – Rob Flaner

- Press release announcing commencement of the plan update process
- Update the HMP website with information on the plan update
- Additional Outreach Capabilities (suggestions welcomed)
  - Website
  - Survey-Should we do one again?
  - Press/media
  - Social Media

Action Items and Next Steps – Rob Flaner

- Risk Assessment Document and Data Request
- Confirm Hazards of Concern
- Confirm Guiding Principle (aka mission statement), Goals and Objectives
- Confirm Critical Facilities definition

Adjourn

City of Long Beach LHMP Steering Committee Kickoff Meeting

Date/Time of Meeting:	Thursday, August 12, 2021, 2:03 PM (Start Time)
Location:	Digital
Subject:	Steering Committee Kickoff Meeting
Project Name:	City of Long Beach Local Hazard Mitigation Plan Update
In Attendance	**City of Long Beach:** Francisco Soto, Rebecca Lopez, Reginald Harrison, Evan Zeisel, Belinda Ramirez, Allyson Joy, Gabriela Hurtado, Larissa Lomen, Alison Spindler-Ruiz, Joel Aguillar, Mark Berne, Vincent Rodriguez, Brian McPhail, Steve Choi, David Khorram, Brian LeSoto, Brian Lam, James Farley, Jennifer Ly, Karl Zittel **Tetra Tech:** Rob Flaner, Bart Spencer, Jeana Gomez, Carol Baumann, Des Alexander
Not Present:	N/A
Summary Prepared by:	Des Alexander
Quorum – Yes or No	N/A

Welcome and Introductions

- Reginald Harrison thanked everyone for their participation in the LHMP process. He spoke about the importance of updating the LHMP regularly and on-schedule – given the expenses associated with natural disasters, it is a high priority that the City remains eligible for relevant grant funding by having an updated LHMP.
- Both Long Beach Steering Committee members and Tetra Tech staff introduced themselves to one another.

Project Overview

- Rob Flaner went over the steps of the LHMP process. He introduced the 5 phases of emergency management, defining mitigation and how it is applied to long-term risk to life and property. He discussed the Disaster Mitigation Act and how it affects access to mitigation funds (no plan, no money).
    - $5.7 billion in funding this year for mitigation actions.
    - The plan must meet all DMA provisions, so following the process will be crucial. Cal OES and FEMA are very process-oriented, so following the process will assist in getting the plan approved.
    - Benefits of HMPs include collaboration, eligibility for grant funds, increased understanding of risks/vulnerabilities, reducing negative impacts, and encouraging sustainable actions.
- Rob introduced the 8 phases of the planning process and went over how Tetra Tech approaches each phase. The schedule projects a 12-month time frame, with a target date for submittal to CalOES/FEMA is in mid-April 2022. If the City has an approved plan by September 2022, the City would be eligible for that year's BRIC funding cycle.
    - The City is eligible this year, but since the plan is to expire in March 2022, FEMA would withhold any funds earned until the plan was approved.

- The plan would be submitted pre-adoption and would be returned Approved Pending Adoption; the City Council would need to approve the plan and submit the resolution to FEMA.
  - If any substantive changes occurred, there would need to be another public comment period and another submittal.
- The LHMP process would add value to the City through following CRS script (could improve CRS score); training on doing a Benefit Cost Analysis; and access to Tetra Tech's BATool for plan maintenance.

Committees

- Rob introduced the ground rules of the steering committee. Public access will be provided to some aspects of this process, so the process needs to be organized around a firm set of rules and standards (quorum, leadership, attendance, public comment protocol, standard meeting dates/times, etc).
- Francisco Soto stated that there are 17 confirmed steering committee members.
- Quorum is typically 50% + 1, but there are no strict FEMA requirements.
- Francisco Lopez agreed to be the Chair and Rebecca Lopez will be the Vice Chair.
- Alternates are permitted to attend and are given full voting rights.
- Tetra Tech will provide sample agendas to City for them to choose which meetings will be open vs. closed. Francisco Soto will provide City's public comment protocol to Tetra Tech. The charter will be written as the Chair as the designated spokesperson for the plan.
- Meetings will take place on the 2nd Thursday of the month from 2 – 4 PM.
- Tetra Tech will provide a charter to the City to be posted on the LHMP website.

Plan Review

- Homework for SC: Review 2017 City of Long Beach LHMP (likes/dislikes, changes to address) and the 2018 CA State HMP (goals, consistency with LBC plan, hazards of concern).
- Des Alexander will send the links to both plans.
  - These will be discussed at the next meeting.

Public Involvement Strategy

- The public outreach strategy was discussed. This will involve multiple media types and will be deployed in 2 phases – early in the process to gauge public perception of risk and at the end of the process to allow for comment on the Draft Plan.
- Media mediums to be used include press releases, a website, social media, a survey, public meetings, an ESRI Story Map, and some open SC meetings.
- The strategy will be led by Jeana Gomez and she will coordinate those efforts moving forward.
- Update process will become the basis for the continuing public involvement requirement of the plan maintenance strategy.

Action Items and Next Steps

- CPT will provide a data wish-list request to the City.
- SC will confirm the Hazards of Concern for the plan, set the goals/objectives and confirm the definition for Critical Facilities/Infrastructure at the next meeting.
- Rob Flaner asked about getting information from Port of LB and need for an NDA.
  - Joel Aguilar says they have a standard nondisclosure agreement that he will provide.

Final Questions/Comments

- Joel Aguilar asked about liquefaction analysis and stated that they have their own data for assessing core facilities.
- Jennifer Ly stated that the City performed analysis as part of their CAP process and the updated General Plan, and the current Safety Element update will be good sources of data. City also recently updated their Land Use Element, and the Housing Element is on track to be adopted by the end of the year. Information from the Noise Element may also be used. There is a social vulnerability layer (Cool Cities LA, Cal EnviroScreen) to the CAP that can also be provided.
- Joel Aguilar asked about avenues for providing data to Tetra Tech. Carol Baumann said she can set up a OneDrive folder and provide access to City officials.

Adjourn

- Next Meeting: Thursday, September 9, 2021 from 2PM to 4PM
- End time: 3:31 PM

CITY OF LONG BEACH

City of Long Beach
Hazard Mitigation Plan
2nd Steering Committee Meeting
9 SEP 2021 -1400
Virtual Conference Call Meeting

Welcome and Introductions

- Group Introductions
    - Review/Approve Meeting Summary

Plan Review – Rob Flaner

- Prior LB Plan
    - What did you like?
    - What did you not Like?
- CA State HMP
    - Are the LB Goals consistent with the State Goals
    - What Hazards of Concern does the State Plan say LB is susceptible to?
- Los Angeles County Plan
    - What Hazards did it assess?
    - Other observations

Hazards of Concern-Rob Flaner

- Natural Hazards?
- Non-natural Hazards?
- Hazard Scenarios?

Goal Setting – Rob Flaner

- Linear Goal Setting-What is it?
- Mission/Vision Statement-Do we want one
- Review/Confirm Goals

Public Involvement Strategy – Jeana Wiser

- Outreach Strategy
    - Phase 1-Early in the process to gage the Public's perception of Risk
    - Phase 2-At the end of the process to allow for Public Comment
- Multi-Media Approach
    - Survey
    - Social Media
    - Story-Map

Action Items and Next Steps – Rob Flaner

- Risk Assessment Update
- Goal Setting-Objectives
- Define Critical Facilities/ Infrastructure
- Status of Prior actions

Adjourn

City of Long Beach LHMP Steering Committee Kickoff Meeting

Date/Time of Meeting:	Thursday, September 9, 2021, 2:02 PM (Start Time)
Location:	Digital
Subject:	Steering Committee Kickoff Meeting
Project Name:	City of Long Beach Local Hazard Mitigation Plan Update
In Attendance	**City of Long Beach:** Reggie Harrison, Francisco Soto, Rebecca Lopez, Jennifer Ly, Karl Sittel, Joel Aguilar, Steve Choi, Belinda Ramirez, Evan Zeisel, David Khorram, Alison Spindler Ruiz, Mark Berne, Morgan Venter, Gabriela Hurtado, James Farley, Brian Lam, Derek Law, Brian La Sota, Allyson Joy, Vincent Rodriguez **Tetra Tech:** Rob Flaner, Bart Spencer, Jeana Wiser, Des Alexander
Not Present:	Willie Owens, Brian McPhail, Sandy Wedgeworth
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome and Introductions

- Francisco Lopez completed the roll call and quorum was achieved
- Rob Flaner reintroduced himself for those who were not on the 1st call. He explained that Bart Spencer will lead calls in the future, and reintroduced other members of the Tetra Tech team.
- There were no revisions made to the minutes from the previous meeting. A motion to approve the minutes was made by Gabriela Hurtado and seconded by Francisco Soto.
- Rob explained the goals for the meeting – confirming the hazards of concern, completing goal/objective setting, and discussing the public outreach strategy.

Plan Review

- Current LB Plan
  - There was a lot of discussion on perceived inadequacies in the public health section. Gabriela Hurtado said that the health hazards were very barebones with no previous data, and that this needs to be improved given COVID pandemic. She said the City has data that can investigate impacts of public health emergencies within Long Beach, discussing public health actions in a mitigation context has been challenging.
  - Reggie Harrison also said city would be remiss to not address public health, and that a potential mitigation action could focus on public outreach to build trust in impacted areas
    - Rob stated that prior to last year, FEMA did not fund public health disaster events. He said it is also difficult to compare these events to disasters like flood and earthquake that affect property and infrastructure. Exposure and analysis typically looks at physical environment; explained that public health is typically looked at as a "hazard of interest" in plans without a HAZUS analysis.
  - David Khorram did not see information regarding oil wells and potential for explosions in the event of earthquakes and other eruptions. The City just created a GIS data layer

for methane exposure that can be used in the analysis. Building collapse (like FL condo collapse) is also an issue due to old building stock and sea exposure. Funding to support a study of building vulnerability could be valuable.
        - Rob stated that liquefaction will be assessed, oil wells could be added as a standalone hazard, building collapse would be challenging to assess given the current hazard assessment methodologies – if data is available, then hazard profile can be completed, need to do research
    - Jennifer Ly stated that climate change needs to be bolstered in plan update and extreme heat is not discussed – major power outage in 2015 due to heat
        - Alison Spindler Ruiz discussed transportation infrastructure at risk due to extreme heat
            - Rob explains that severe weather aggregates extreme heat, high wind, and other intense weather phenomenon
    - Joel Aguilar stated that the tsunami section was not consistent with Port study. New data from CA geologic study can be used for tsunami assessment, but if there is better data through Port then that can be used.
        - Palos Verdes fault should be discussed in LHMP, given port impacts
- CA State HMP
    - Alison Spindler-Ruiz stated that this plan had lots of health equity information that was missing from LB plan
    - Climate adaptation efforts mentioned and could be good to mention in plan update, goals also align with City's goals
- LA County Plan
    - Question: Homelessness has been a problem for flood control districts; can this be listed as a hazard?
        - Rob stated that homelessness can be listed as a vulnerability factor in hazard profiles

Hazards of Concern

- Rob explained to the committee that including non-natural hazards is not required by FEMA, but can be included to acknowledge other local plans in place to deal with them
- The LHMP must discuss climate change due to state requirements
    - Sea Level Rise has been treated as a standalone hazard in the past, so it can be one for this plan.
- Planning area defined as the city limits
- Hazards of Concern for Long Beach LHMP
    - Natural hazards – dam failure, drought, earthquake, flood, severe weather (extreme heat, high winds, thunderstorms, fog), tsunami, methane gas eruptions (oil wells), building collapse (age, discuss in earthquake), climate change
    - Human caused – terrorism, cyber, public health, hazardous materials (AES battery storage), pipelines (natural gas), transportation, civil unrest
- A motion to approve the hazards of concern was made by Francisco Sosa, seconded by David Khorram. This was approved by the committee.

Goal Setting

- Tabled until next meeting

Public Involvement Strategy

- Jeana and Francisco have been working together due to expedited process (March 2022 submittal)
- Jeana showed slide show about strategy – leveraging existing capacities of City, language translation (received from Francisco, starting with public survey), public input opportunities throughout the process, 2 phases of public involvement
- Media release will announce project and highlight website – Jeana will get that up and running with Francisco
    - Public survey will be advertised through community partner events
    - StoryMap will be set up throughout plan process
- Phase 2 will take place during public comment period
    - StoryMap, draft plan review, all risk data will be made available
- Public survey in survey monkey
    - 15 questions to assess risk perception
    - Jeana will work with Francisco in development and expects to have draft to show at the next meeting
- StoryMap example from Oakland displayed, showed Hazard Mapper and other capabilities
- Jennifer Ly explained that the planning department has done community outreach and can share strategies on engagement. She also added that speaking more about climate change piece can help in outreach process, highlighting images could also be helpful
- Rob explained that continuing public outreach can be set up throughout this process, can be part of plan maintenance post update
- Vincent Rodriguez stated that his office will send data for analysis and StoryMap within the next two weeks
    - Needs Esri account to log-in for StoryMap creation

Action Items and Next Steps

- Next meeting – October 14, 2021 from 2 -4 PM

Final Questions/Comments

- None from the committee

Adjourn

- 4:01 PM

City of Long Beach
Hazard Mitigation Plan
Steering Committee Meeting #3 - *Virtual Conference Call Meeting*
14 OCT 2021

Welcome – Francisco Soto

- General announcements and information
- Roll call
- Review and approval of meeting summary of Steering Committee #2

Planning Process – Bart Spencer

- Team member updates
- Mission statement
- Goal setting
- Objective setting

Hazard Analysis – Carol Bauman

Public Engagement – Rob Flaner

- Strategy discussion
- Survey presentation & distribution discussion
- Storymap update

Adjourn

City of Long Beach LHMP Steering Committee Kickoff Meeting

Date/Time of Meeting:	Thursday, October 14, 2021, 2:04 PM (Start Time)
Location:	Digital
Subject:	Steering Committee Meeting #3
Project Name:	City of Long Beach Local Hazard Mitigation Plan Update
In Attendance	**City of Long Beach:** Rebecca Lopez, Francisco Soto, James Farley, Andre Balanji (alt. for Gabriela Hurtado), Bryan La Sota, Karl Zittel, Belinda Ramirez, Carline Hua, Steve Choi, Evan Zeisel, David Khorram, Jennifer Ly, Lian Mae Tualla, Willie Owens, Mark Berne, Morgan Venter, Vincent Rodriguez, Sandy Wedgeworth, Joel Aguillar **Tetra Tech:** Rob Flaner, Bart Spencer, Carol Baumann, Des Alexander, Nate Stueve
Not Present:	Reggie Harrison, Brian McPhail, Alison Spindler Ruiz, Brian Lam, Derek Law, Allyson Joy
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome

- Roll call was taken by Des Alexander. Quorum was achieved.
- Motion to approve meeting summary by Francisco Soto and seconded by David Khorram. No opposition was raised.
- Public engagement discussion was moved to beginning of the discussion due to a conflicting engagement

Planning Process

- Bart stated that Jeana Wiser had to step away from the process, so for now he and Rob will be covering the public engagement piece. Bart also welcomed new staff member Nate Stueve to the Tetra Tech team and LHMP process.
- Bart showed the sample goals and objectives to the committee. The goals are the "swimlanes" that form direction of the plan and objectives serve as measures of success that prioritize action items. These will be sent to the committee, who will provide feedback and will discuss them at the next meeting. Bart requested that feedback be submitted within the next two weeks.
  - Early discussion revolved around earthquake retrofits, climate change adaptation.

Hazard Analysis

- Carol showed the committee the draft matrix, which shows the hazards of concern, the types of analysis that will be done for each hazard, and the scenarios/data sources that will be used for the analysis. The matrix will be updated throughout the process as more conversations occur.

- Tetra Tech is working to set up a meeting with the Port to discuss their work on earthquake analysis.
- A question was raised regarding the analysis included in the public health hazard – Bart stated that FEMA does not require public health be assessed (not a natural hazard), but they do encourage jurisdictions to look at all hazards. Rob stated that since public health cannot be assessed the way the natural hazards are, it will be included in the "hazards of concern" chapter. This chapter will be a qualitative look at the hazard.
- The planning department is currently updating their safety element and questions emerged regarding evacuation routes for undeveloped areas and evacuation routes for several hazards. Rob stated that the LHMP is not responsible for dictating response or preparedness functions; evacuation routes are typically covered in EOPs, not mitigation plans. Core capability assessment and adaptive capacity assessment (for climate change) is part of the process, but it does not go into evacuation-related issues.

Public Engagement

- Multilingual survey has been developed on SurveyMonkey and will be submitted to the committee for comment (English, Spanish, Tagalog). The results of the survey will be used to prioritize action items for the city.
- Engagement with the City has begun on the creation of the StoryMap. This will include geospatial data that maps local hazards. This will be a "living" platform, designed to be updated continually.

Action Items and Next Steps

- Next meeting – November 11, 2021 from 2 – 4 PM

Final Questions/Comments

- Planning department asked about coordination between Oakland's LHMP, and their safety element given Tetra Tech's involvement. Bart stated that given the accelerated timeline, there was not alignment between the LHMP update and the safety element update.

Adjourn

- 2:48 PM

City of Long Beach
Hazard Mitigation Plan
Steering Committee Meeting #4 - *Virtual Conference Call Meeting*
11 NOV 2021 – Veterans Day

Welcome – Francisco Soto

- General announcements and information
- Roll call
- Review and approval of meeting summary of Steering Committee #3

Planning Process – Bart Spencer

- Planning update
- Finalize goal setting
- Finalize objective setting

Risk Assessment – Carol Baumann

- Progress update

Public Engagement – Rob Flaner

- Survey update
- StoryMap update

Adjourn

City of Long Beach LHMP Steering Committee Kickoff Meeting

Date/Time of Meeting:	Thursday, November 11, 2021, 2:03 PM (Start Time)
Location:	Digital
Subject:	Steering Committee Meeting #4
Project Name:	City of Long Beach Local Hazard Mitigation Plan Update
In Attendance	**City of Long Beach:** Reggie Harrison, Francisco Soto, Rebecca Lopez, Karl Sittel, Joel Aguilar, Steve Choi, Belinda Ramirez, David Khorram, Jennifer Ly, Alison Spindler Ruiz, Mark Berne, Morgan Venter, James Farley, Brian Lam, Vincent Rodriguez, Lian Mai Tualla, Gina Casillas **Tetra Tech:** Rob Flaner, Bart Spencer, Carol Baumann, Des Alexander, Nate Stueve
Not Present:	Willie Owens, Brian McPhail, Evan Zeisel, Gabriela Hurtado, Sandy Wedgeworth, Derek Law, Brian La Sota, Allyson Joy
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome

- Francisco Soto welcomed everyone to the call and completed the roll call. Quorum was achieved.
- After reviewing the summary from the 3rd steering committee meeting, no comments or corrections were made. A motion to approve the summary was made by James Farley and seconded by Rebecca Lopez. No objections were raised.

Planning Process

- Bart Spencer provided an update on the status of the LHMP. Right now, Tetra Tech is doing a lot of behind the scenes work on the analyses and profiling, with many conversations occurring with relevant departments.
- Bart Spencer presented the draft goals and objectives to the committee. During the goal discussion, Jennifer Ly commented that climate adaptation and resiliency need to be listed. Francisco said that the objective that covers both will be included under the "Create a Healthy and Equitable Environment" goal. He said that all other comments submitted by the committee were included in the new draft.
    - A motion to accept the goals was made by Francisco Soto and seconded by Rebecca Lopez. No objections were raised.
- No comments were made on the objectives.
    - A motion to accept the objectives was made by Francisco Soto and seconded by Rebecca Lopez. No objections were raised.

Risk Assessment

- Carol Baumann updated the committee on her work with the hazard analysis. She said she had received many GIS data sources from Vincent Rodriguez, and that she met separately with the

Port of Long Beach to discuss their available data. The Port is currently pulling their critical facilities data to add to Tetra Tech's structure inventory, which will be a key part of the assessment. Carol also stated that she will work with Francisco on hazard scenarios and hopes to show the scenarios list to the committee at the next meeting.

- Vincent Rodriguez asked if there will be more data requests that he will need to field.
    - Carol thinks he is done on his end, but she will collaborate with County, other sources on any gaps. She will also coordinate with Francisco Soto on how to get any missing data from specific departments.
- Alison Spindler Ruiz asked about potential overlaps between the LHMP process and the safety element update's compliance, specifically around SBC379 (climate adaptation/vulnerability), emergency routes, and residential development in hazard areas. The safety element not updated since 1975 but requirements must be put in place by end of 2021.
    - Regarding emergency routes, Rob stated that evacuation planning is not part of the LHMP process but is rather a preparedness or response function. However, data from the HMP can be used to determine evacuation routes. Francisco Soto stated that Long Beach Police Department has a separate plan for evacuation routes and that the City plan will be updated soon.
    - Regarding SBC379, Rob stated that when Tetra Tech finishes the core capability assessment an adaptive capacity evaluation will be completed afterwards. Departments provide this ranking (High, Medium, or Low) and if something is ranked low, it should have an action in the plan that addresses it. This will be centric on sea level rise analysis, which will dial in on vulnerability. Rob will email Alison after the meeting on language that can be included to satisfy pending requirements.

<u>Public Engagement</u>

- Rob Flaner provided an update on the current public engagement efforts. As of 11/11 there were only 7 responses to the public survey. Francisco Soto stated that that is because the survey has not yet been released; it will be opened to the public early next week.
    - Committee members should reach out to Francisco by end-of-week if they have changes to include
    - Languages other than English: Spanish, Tagalog, Khmer
- Rob Flaner also provided an update on the StoryMap. Tetra Tech is building a public-facing, interactive platform that will include a hazard mapper that allows the public to view how their homes intersect with different hazard areas; information on action items and the draft plan; and other information relevant to the plan. This platform is GIS-based on an Esri platform and will evolve as the plan evolves.
    - Rob stated that Tetra Tech wants to debut content by the next meeting
    - Francisco will include links/images of the StoryMap with this meeting's minutes in an email to the committee
    - Next steps: Plan virtual public meeting to display content once StoryMap and surveys are complete.

<u>Other Discussion Items</u>

- Alison Spindler Ruiz informed the committee that Jennifer Ly is leaving the City of Long Beach, so Gina Casillas will be replacing her on the committee. Bart Spencer stated that Tetra Tech needs her email address for future communications and to maintain records. He stated that

FEMA & CalOES care a lot about the process of producing the LHMP, so it is important for the committee and Tetra Tech to maintain accurate records.

- Francisco Soto stated that he wants to present to the Board or Commission on the LHMP, so he wants committee members to reach out to him to discuss anything they want addressed. He is also currently working on consolidating/reconciling the action items (over 300) from the previous LHMP. This will require assistance from several departments, so he will be reaching out to committee members regarding this information.

Adjourn

- End time: 2:39 PM

City of Long Beach
Hazard Mitigation Plan
Steering Committee Meeting #5 - *Virtual Conference Call Meeting*
February 10, 2022

Welcome – Francisco Soto

- General announcements and information
- Roll call
- Review and approval of meeting summary of Steering Committee #4

Planning Process – Bart Spencer

- Planning update
- Action Items preliminary discussion

Risk Assessment – Carol Bauman & Nate Stueve

- Hazard & Risk Analysis update
- Story Map update and preview

Public Engagement – Rob Flaner

- Survey update
- Website update

Adjourn

City of Long Beach LHMP Steering Committee Meeting #5

Date/Time of Meeting:	Thursday, February 10, 2021, 2:06 PM (Start Time)
Location:	Digital
Subject:	Steering Committee Meeting #5
Project Name:	City of Long Beach Local Hazard Mitigation Plan Update
In Attendance	**City of Long Beach:** Reggie Harrison, Francisco Soto, Rebecca Lopez, Willie Owens, Karl Zittel, Joel Aguilar, Belinda Ramirez, Eric Matusak, Alison Spindler Ruiz, Gina Casillas, Lian Mae Tualla, Mark Berne, Morgan Venter, Gabriela Hurtado, James Farley, Brian La Sota, Vincent Rodriguez, Dale Wiersma (for David Khorram), Megan O'Keefe, Alexander Angotti **Tetra Tech:** Bart Spencer, Rob Flaner, Carol Baumann, Nate Stueve, Des Alexander
Not Present:	Richard Barrata, David Khorram, Sandy Wedgeworth, Brian Lam, Derek Law, Allyson Joy
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome

- Francisco Soto opened the meeting by taking roll call. Quorum was achieved.
- Mr. Soto asked the committee to review and approve the previous meeting's summary. After hearing no corrections or discussion, a motion to approve the meeting summary was brought by Mr. Soto and seconded by Rebecca Lopez. The summary was approved.

Planning Process

- Bart Spencer explained the process for putting together the plan, specifically internal review processes and communications. Mr. Spencer explained that Tetra Tech is working to have a draft to give the City soon, with the plan to have the plan completed by April.
- Mr. Spencer stated that the committee should start to think of action items for the next five years of the LHMP. Action items can be as varied as plan updates, equipment purchases, changes to codes/standards, infrastructure improvements, etc. The goal is to phrase action items in a way to make them attractive for grant funding sources.
- Mr. Spencer advised the committee to look at current City plans (i.e., capital improvement) to look for projects that have not yet been started. The committee should seek "low-hanging fruit" projects that can be completed within the five year life of the LHMP.
- Rob Flaner also stated that any actions that the City of Long Beach wants to carry over from the previous LHMP can be prioritized first. Also, each hazard ranked as "high" needs to have at least one action item.

Risk Assessment

- Carol Baumann provided an update to the committee on the risk assessment. Ms. Baumann received sea level rise data from Mr. Soto and is in the process of creating point-location data for city structures.
- Ms. Baumann is also looking at replacement costs for structures exposed to hazards, based on structure usage and square footage. The City provided a population GIS layer that used council district boundaries and 2010 Census population. To determine growth rate, Ms. Baumann calculated the difference between the 2010 and 2020 Census population stats and then applied the rate to the district boundaries to update population numbers. After some discussion, Tetra Tech agreed to use zip code boundaries rather than council districts.
- The building stock analysis will focus on critical facilities using the FEMA Lifelines Construct.
- Following the Risk Assessment update, Nate Stueve previewed the StoryMap with the steering committee. The StoryMap is built on a Long Beach platform so that it can be continually updated throughout the life of the plan, using the best-available data to visualize hazard risk for Long Beach staff and the City's residents.
- The StoryMap includes important definitions, as well as the LHMP's overview, goals, objectives, and a copy of the public engagement survey.
- Mr. Stueve said that the StoryMap link is designed to work on desktops, laptops, smartphones, and tablets. However, the map's content is not able to be translated into another language without building a second platform. He also said that he can put together an instruction guide for the StoryMap, as well set the default map to only have a few layers turned on.
- Questions/Comments from the Steering Committee
    - Alison Spindler Ruiz commented that the City has already calculated sea level rise replacement costs for a separate plan, so it will be helpful to see the Hazus analysis for consistency purposes.
    - Reggie Harrison expressed concern about the language translation limitations of the story map. The City will have internal conversations about how translation of the software can be completed.
    - Vincent Rodriguez agreed to send Tetra Tech a GIS layer of Long Beach's zip codes.

Public Engagement

- Mr. Stueve walked through the survey questions with the committee. The committee advised that Question 1 be changed from regions to zip codes. All updates will be included and sent to the committee ASAP.

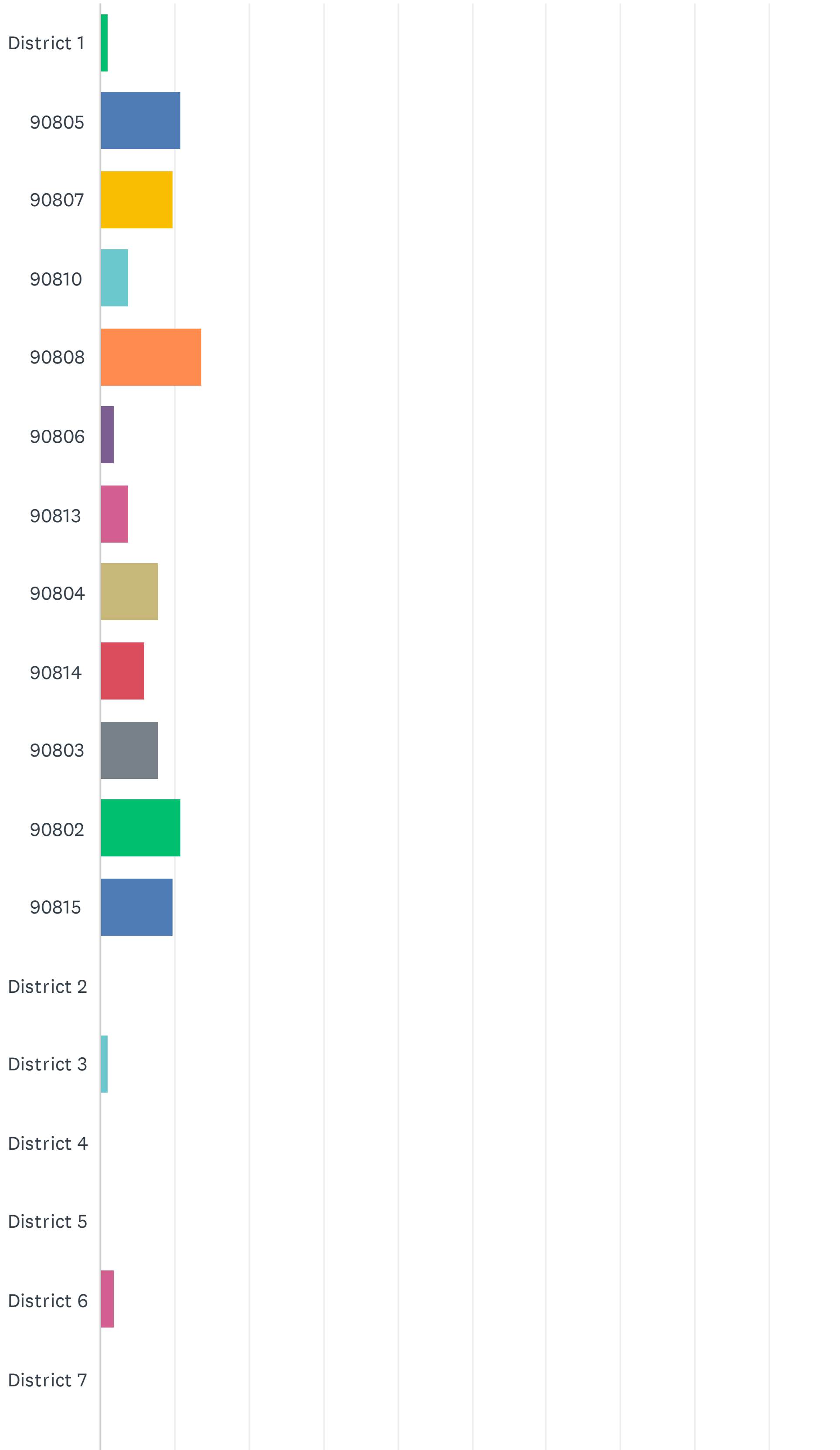
Adjourn

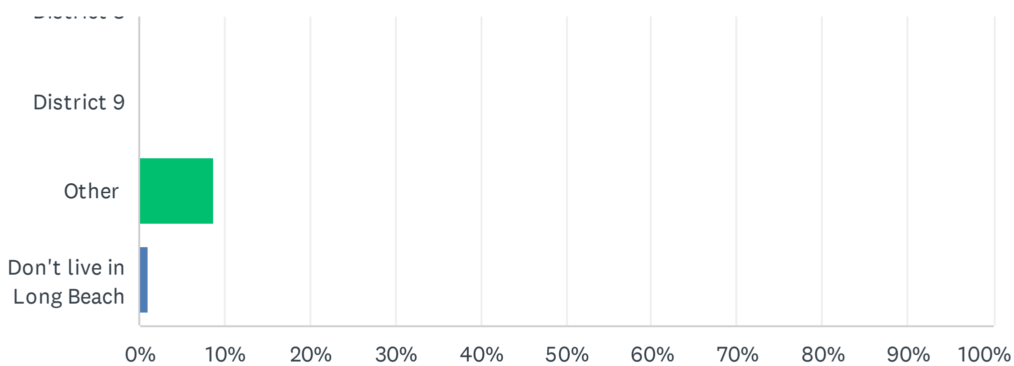
- End time: 4:29 PM

SURVEY RESULTS

Q1 Which zip code in Long Beach do you live in? (Check one)

Answered: 102 Skipped: 0

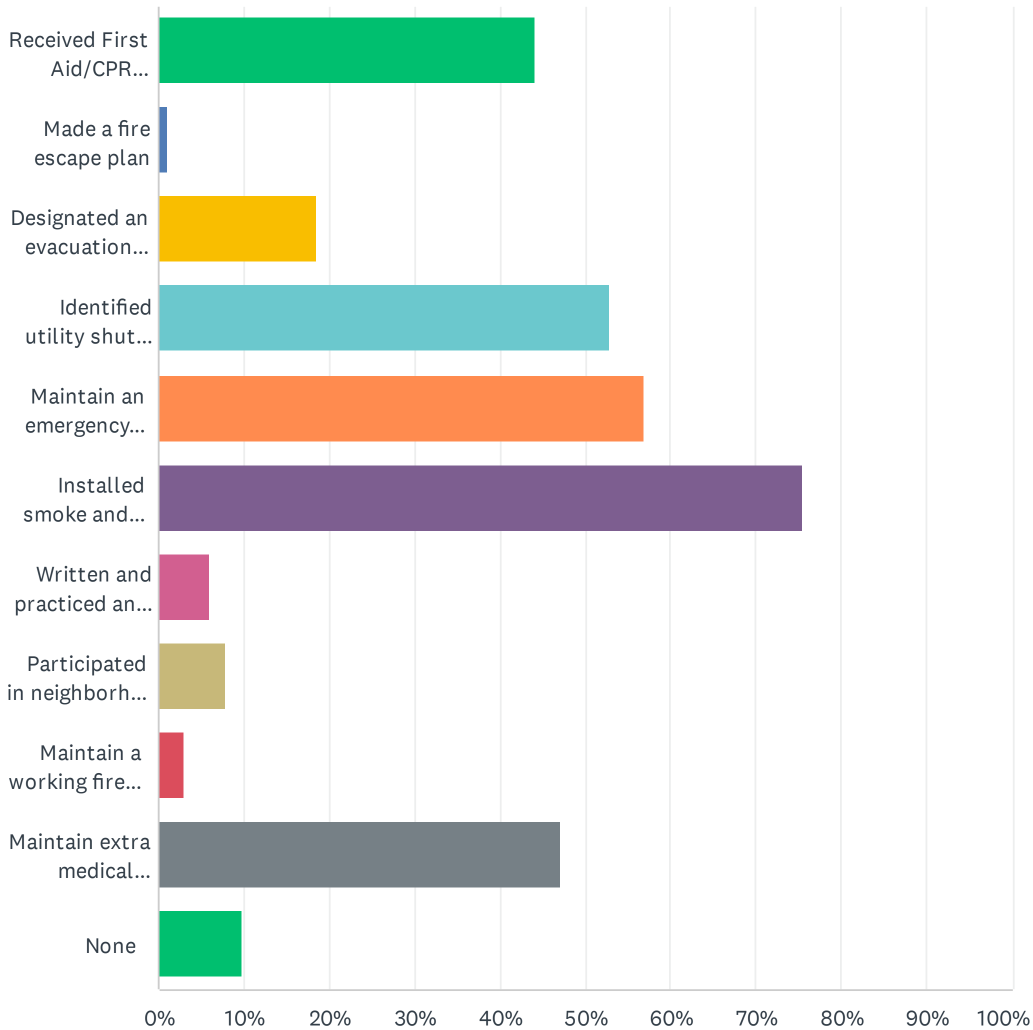




ANSWER CHOICES	RESPONSES	
District 1	0.98%	1
90805	10.78%	11
90807	9.80%	10
90810	3.92%	4
90808	13.73%	14
90806	1.96%	2
90813	3.92%	4
90804	7.84%	8
90814	5.88%	6
90803	7.84%	8
90802	10.78%	11
90815	9.80%	10
District 2	0.00%	0
District 3	0.98%	1
District 4	0.00%	0
District 5	0.00%	0
District 6	1.96%	2
District 7	0.00%	0
District 8	0.00%	0
District 9	0.00%	0
Other	8.82%	9
Don't live in Long Beach	0.98%	1
TOTAL		102

Q2 What steps has your household taken to prepare for a disaster? (Check all that apply)

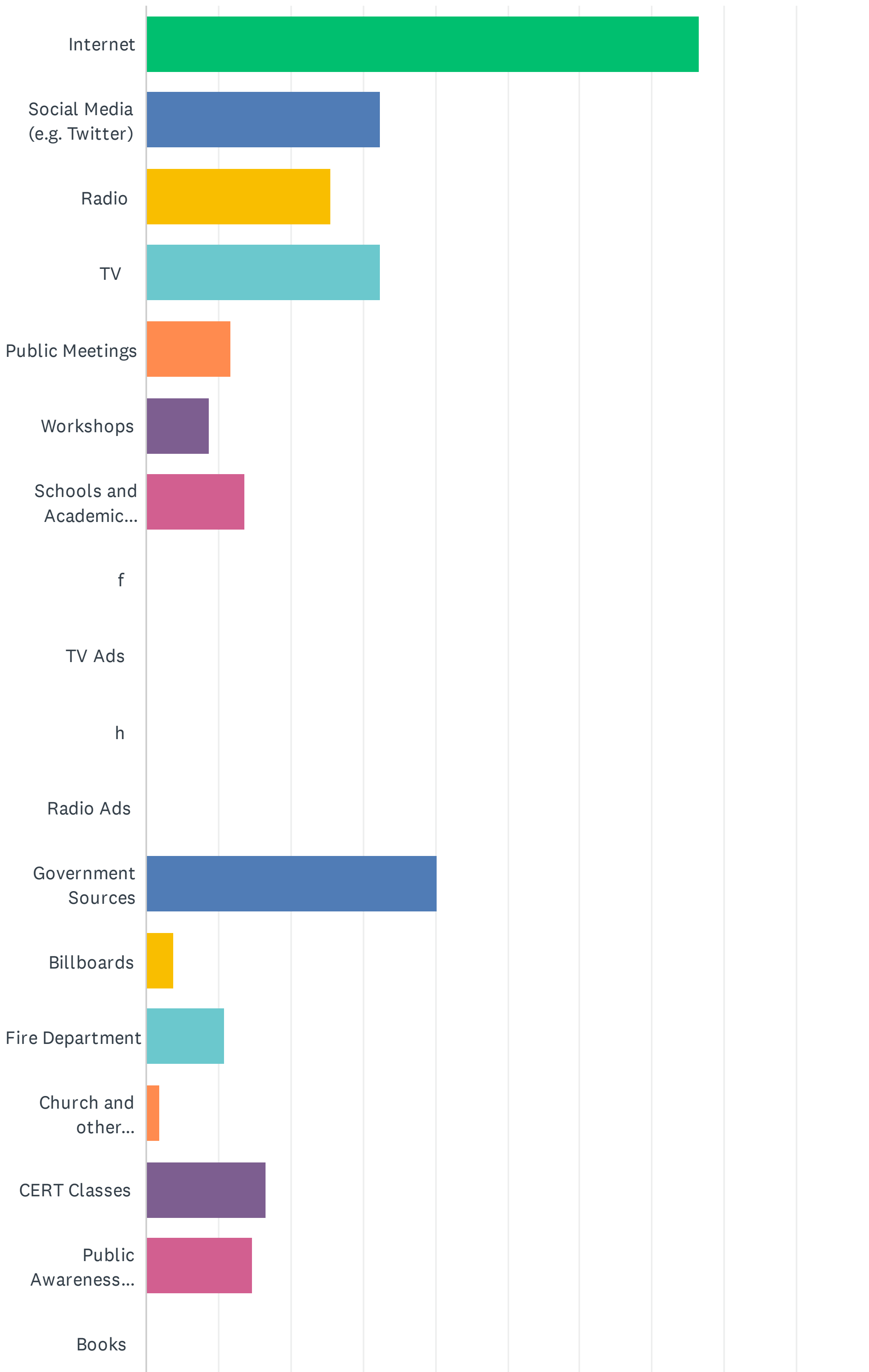
Answered: 102 Skipped: 0

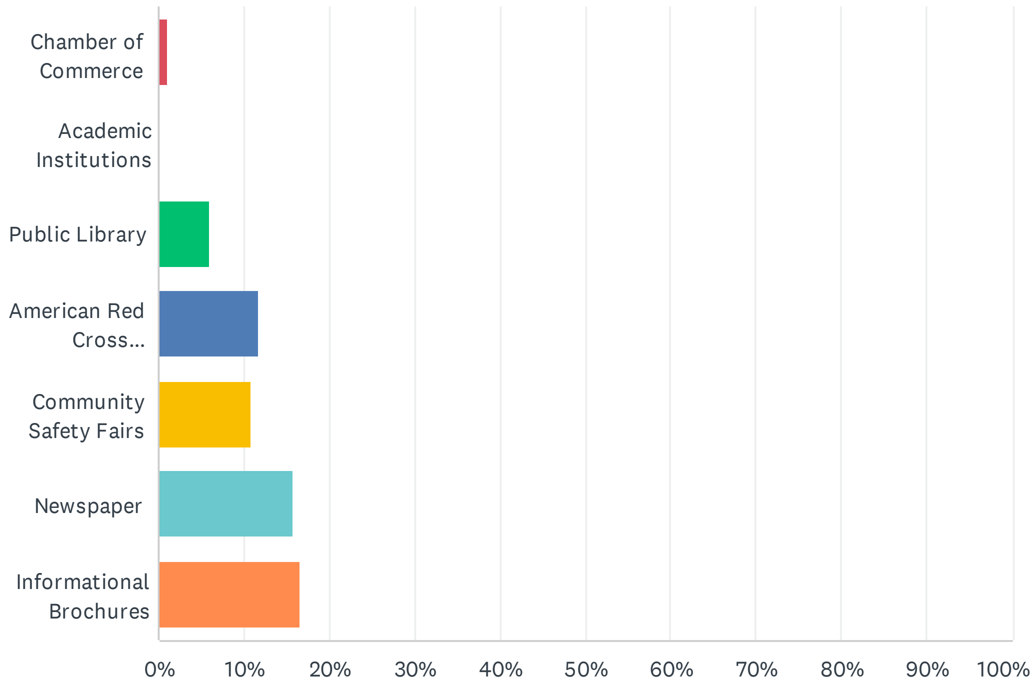


ANSWER CHOICES	RESPONSES	
Received First Aid/CPR training	44.12%	45
Made a fire escape plan	0.98%	1
Designated an evacuation meeting place	18.63%	19
Identified utility shutoff locations	52.94%	54
Maintain an emergency supply kit (e.g. batteries, flashlights, battery-powered radio, food/water)	56.86%	58
Installed smoke and carbon monoxide detectors, and maintain a working fire extinguisher at home	75.49%	77
Written and practiced an individual or family disaster plan (e.g. earthquake, fire, tsunami, etc.)	5.88%	6
Participated in neighborhood preparedness and planning	7.84%	8
Maintain a working fire extinguisher at home	2.94%	3
Maintain extra medical supplies (e.g. first aid kit, medications)	47.06%	48
None	9.80%	10
Total Respondents: 102		

Q3 How do you get information about emergency preparedness? (Check all that apply)

Answered: 102 Skipped: 0

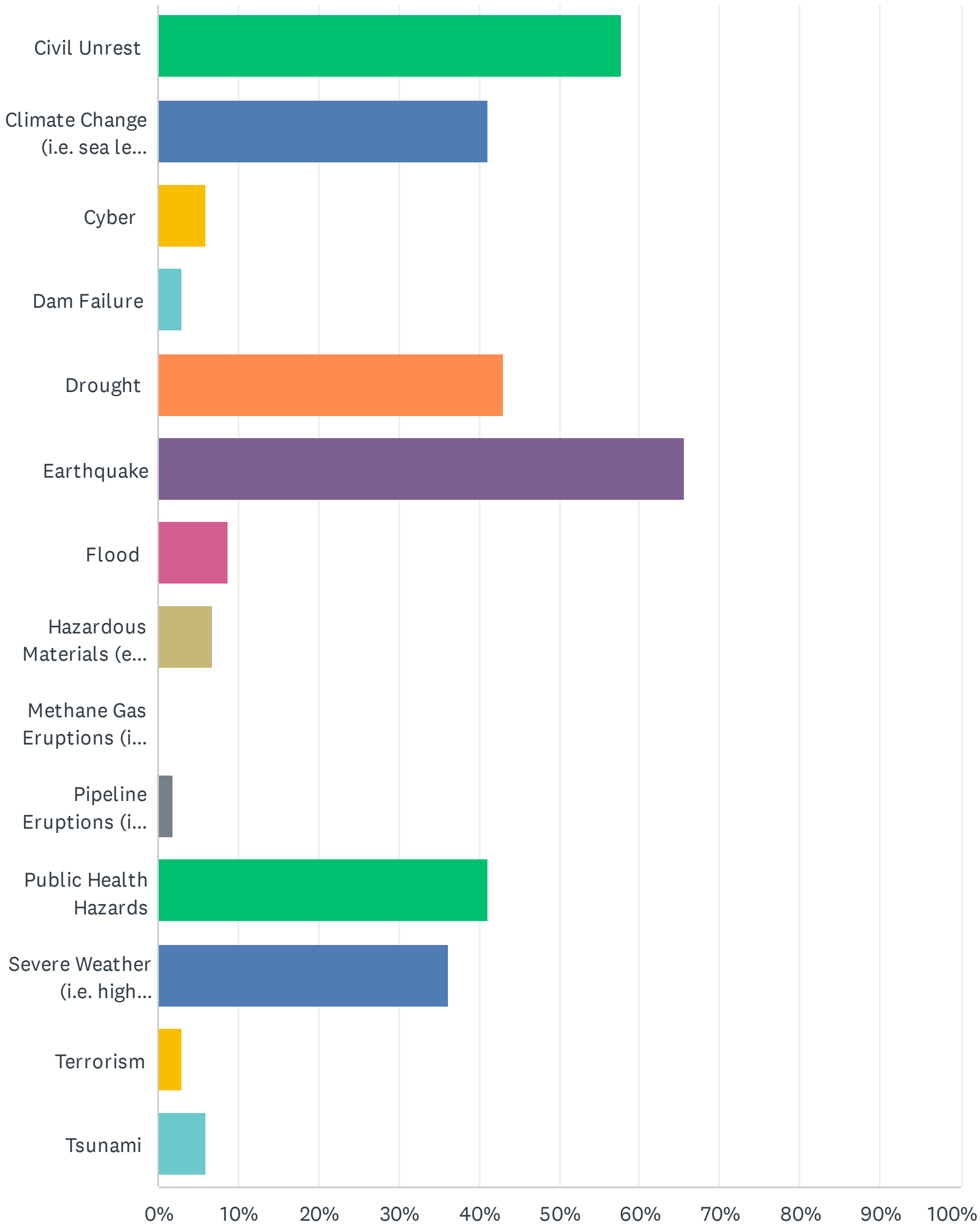



Chamber of Commerce
Academic Institutions
Public Library
American Red Cross...
Community Safety Fairs
Newspaper
Informational Brochures
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
Internet	76.47%	78
Social Media (e.g. Twitter)	32.35%	33
Radio	25.49%	26
TV	32.35%	33
Public Meetings	11.76%	12
Workshops	8.82%	9
Schools and Academic Institutions	13.73%	14
f	0.00%	0
TV Ads	0.00%	0
h	0.00%	0
Radio Ads	0.00%	0
Government Sources	40.20%	41
Billboards	3.92%	4
Fire Department	10.78%	11
Church and other faith-based groups	1.96%	2
CERT Classes	16.67%	17
Public Awareness Campaign (e.g. Flood Awareness Week)	14.71%	15
Books	0.00%	0
Chamber of Commerce	0.98%	1
Academic Institutions	0.00%	0
Public Library	5.88%	6
American Red Cross Information	11.76%	12
Community Safety Fairs	10.78%	11
Newspaper	15.69%	16
Informational Brochures	16.67%	17
Total Respondents: 102		

Q4 Which of the following natural and human-caused hazard events have you experienced or been affected by within Long Beach? (Check all that apply)

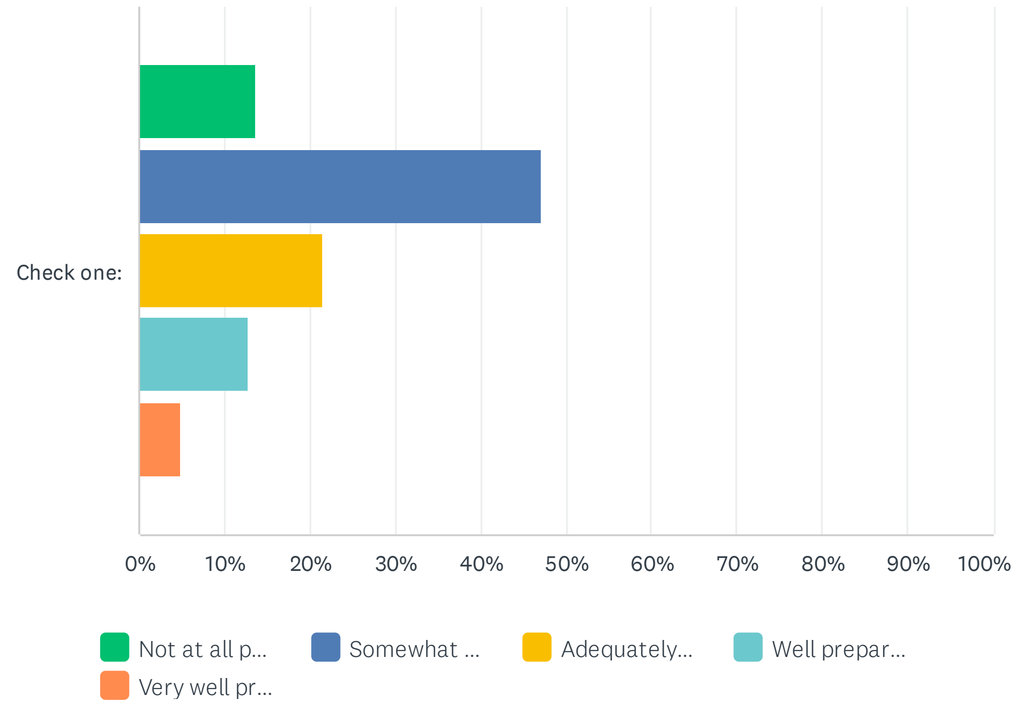
Answered: 102 Skipped: 0



ANSWER CHOICES	RESPONSES	
Civil Unrest	57.84%	59
Climate Change (i.e. sea level rise, extreme heat)	41.18%	42
Cyber	5.88%	6
Dam Failure	2.94%	3
Drought	43.14%	44
Earthquake	65.69%	67
Flood	8.82%	9
Hazardous Materials (e.g. AES battery storage)	6.86%	7
Methane Gas Eruptions (i.e. oil wells)	0.00%	0
Pipeline Eruptions (i.e. natural gas)	1.96%	2
Public Health Hazards	41.18%	42
Severe Weather (i.e. high winds, thunderstorms, fog)	36.27%	37
Terrorism	2.94%	3
Tsunami	5.88%	6
Total Respondents: 102		

Q5 How prepared is your household to deal with a hazard event? Check one:

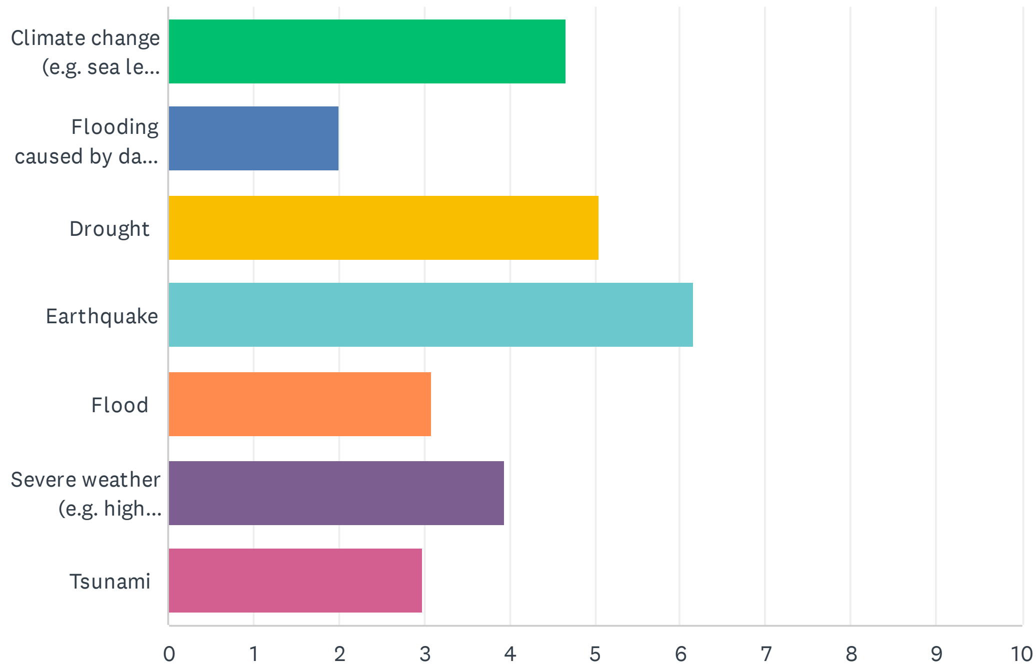
Answered: 102 Skipped: 0



	NOT AT ALL PREPARED	SOMEWHAT PREPARED	ADEQUATELY PREPARED	WELL PREPARED	VERY WELL PREPARED	TOTAL	WEIGHTED AVERAGE
Check one:	13.73% 14	47.06% 48	21.57% 22	12.75% 13	4.90% 5	102	2.48

Q6 Please rank the below natural hazards from 1 (most concerning) to 7 (least concern/not concerned at all):

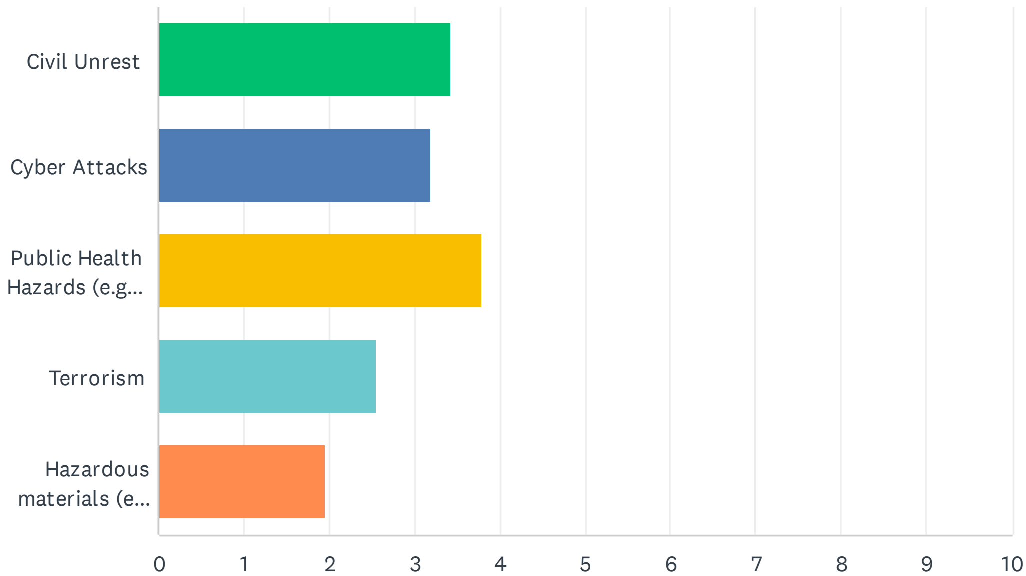
Answered: 79 Skipped: 23



	1	2	3	4	5	6	7	TOTAL	SCORE
Climate change (e.g. sea level rise, extreme heat)	17.33% 13	20.00% 15	22.67% 17	14.67% 11	9.33% 7	9.33% 7	6.67% 5	75	4.67
Flooding caused by dam failure	4.00% 3	0.00% 0	4.00% 3	8.00% 6	8.00% 6	20.00% 15	56.00% 42	75	2.00
Drought	17.33% 13	25.33% 19	28.00% 21	13.33% 10	8.00% 6	6.67% 5	1.33% 1	75	5.05
Earthquake	53.25% 41	25.97% 20	11.69% 9	5.19% 4	2.60% 2	0.00% 0	1.30% 1	77	6.17
Flood	0.00% 0	8.00% 6	4.00% 3	20.00% 15	33.33% 25	26.67% 20	8.00% 6	75	3.09
Severe weather (e.g. high winds, thunderstorms, fog)	4.11% 3	8.22% 6	20.55% 15	32.88% 24	20.55% 15	6.85% 5	6.85% 5	73	3.95
Tsunami	5.13% 4	7.69% 6	10.26% 8	6.41% 5	19.23% 15	30.77% 24	20.51% 16	78	2.99

Q7 Please rank the below human-caused hazards from 1 (most concerning) to 5 (least concern/not concerned at all):

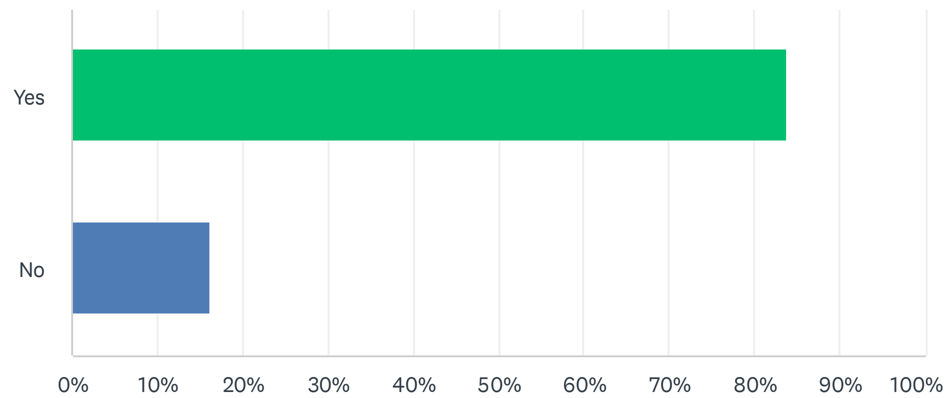
Answered: 76   Skipped: 26



	1	2	3	4	5	TOTAL	SCORE
Civil Unrest	27.14% 19	25.71% 18	21.43% 15	15.71% 11	10.00% 7	70	3.44
Cyber Attacks	15.71% 11	24.29% 17	28.57% 20	27.14% 19	4.29% 3	70	3.20
Public Health Hazards (e.g. Pandemic)	40.54% 30	21.62% 16	18.92% 14	14.86% 11	4.05% 3	74	3.80
Terrorism	13.70% 10	13.70% 10	19.18% 14	20.55% 15	32.88% 24	73	2.55
Hazardous materials (e.g. Battery storage)	4.05% 3	9.46% 7	14.86% 11	22.97% 17	48.65% 36	74	1.97

Q8 Would the disclosure of natural hazard information influence your decision to purchase or move into a home (house, condo, apartment, etc.) today? (Check one)

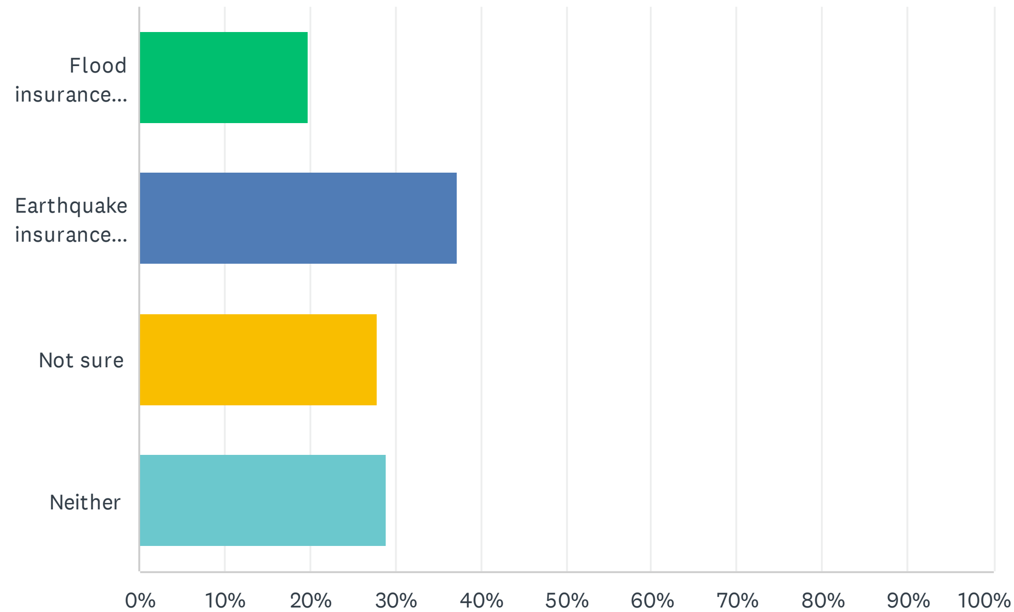
Answered: 86 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	83.72%	72
No	16.28%	14
TOTAL		86

Q9 To the best of your knowledge, does the home in which you live have: (Check all that apply)

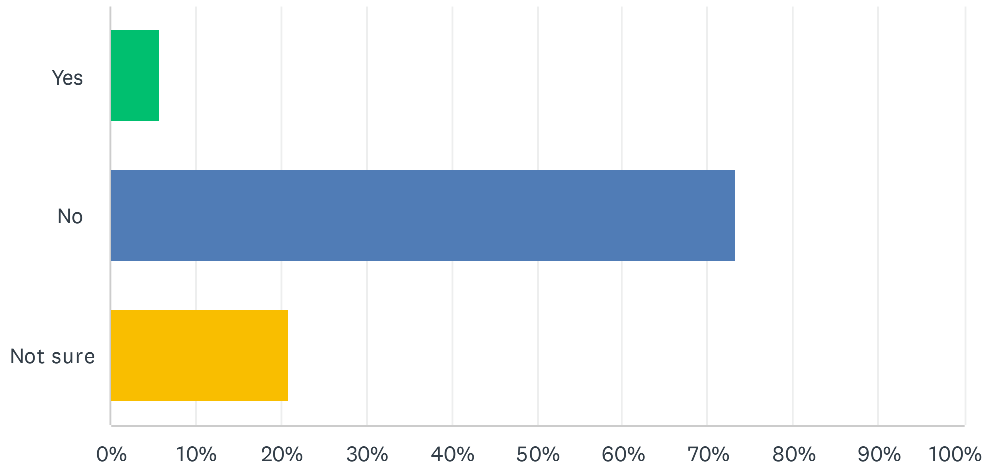
Answered: 86 Skipped: 16



ANSWER CHOICES	RESPONSES	
Flood insurance policy	19.77%	17
Earthquake insurance policy	37.21%	32
Not sure	27.91%	24
Neither	29.07%	25
Total Respondents: 86		

Q10 Have you ever had difficulty obtaining homeowners or renters insurance due to risks from natural hazards? (Check one)

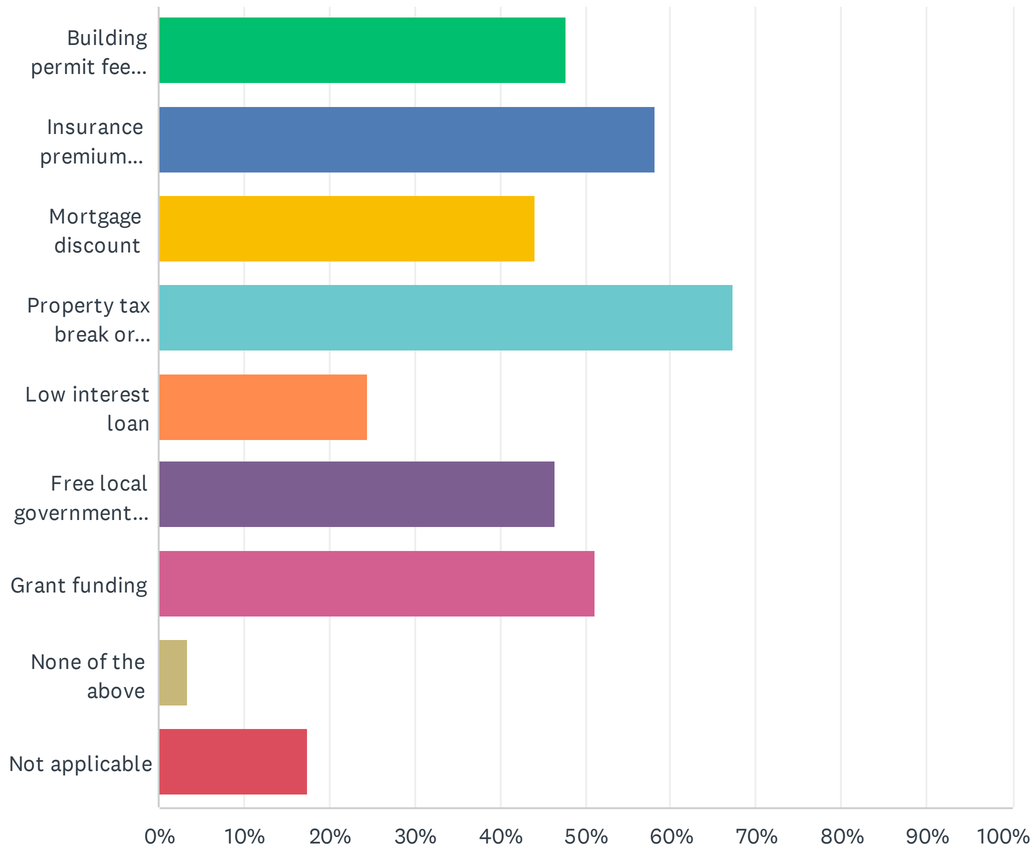
Answered: 86   Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	5.81%	5
No	73.26%	63
Not sure	20.93%	18
TOTAL		86

Q11 Which incentives would encourage you to retrofit your home to protect against natural disasters? (Check all that apply)

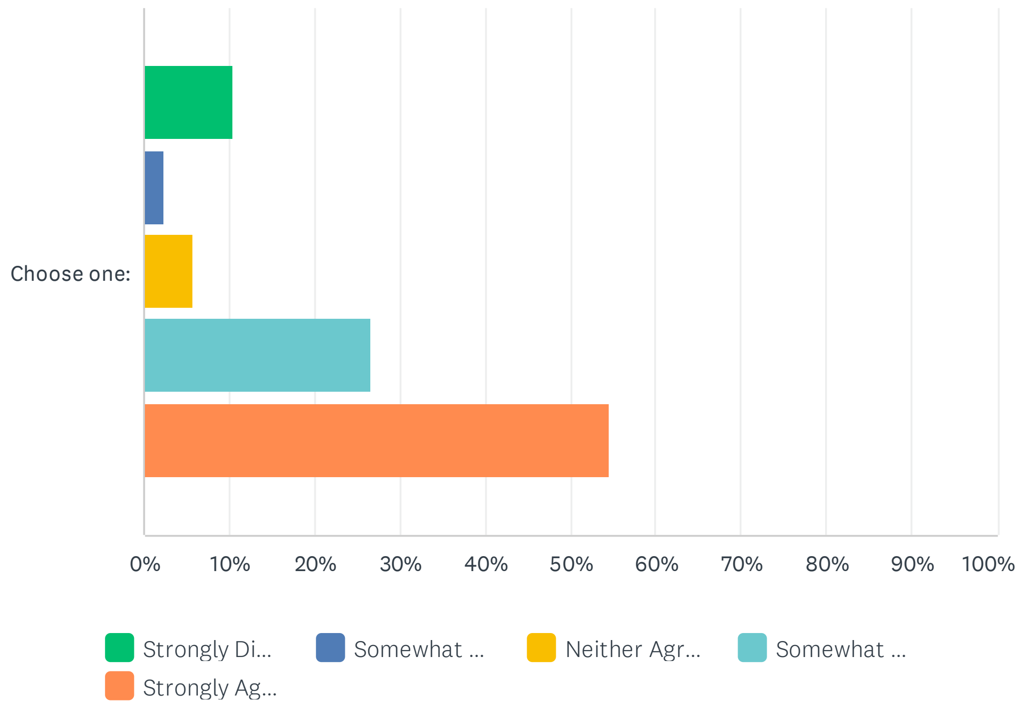
Answered: 86 Skipped: 16



ANSWER CHOICES	RESPONSES	
Building permit fee waiver	47.67%	41
Insurance premium discount	58.14%	50
Mortgage discount	44.19%	38
Property tax break or incentive	67.44%	58
Low interest loan	24.42%	21
Free local government technical assistance	46.51%	40
Grant funding	51.16%	44
None of the above	3.49%	3
Not applicable	17.44%	15
Total Respondents: 86		

Q12 Please indicate how you feel about the following statement: (Check one)"I think it is important to provide education and programs that promote community members to take action to reduce their exposure and risks to natural hazards."

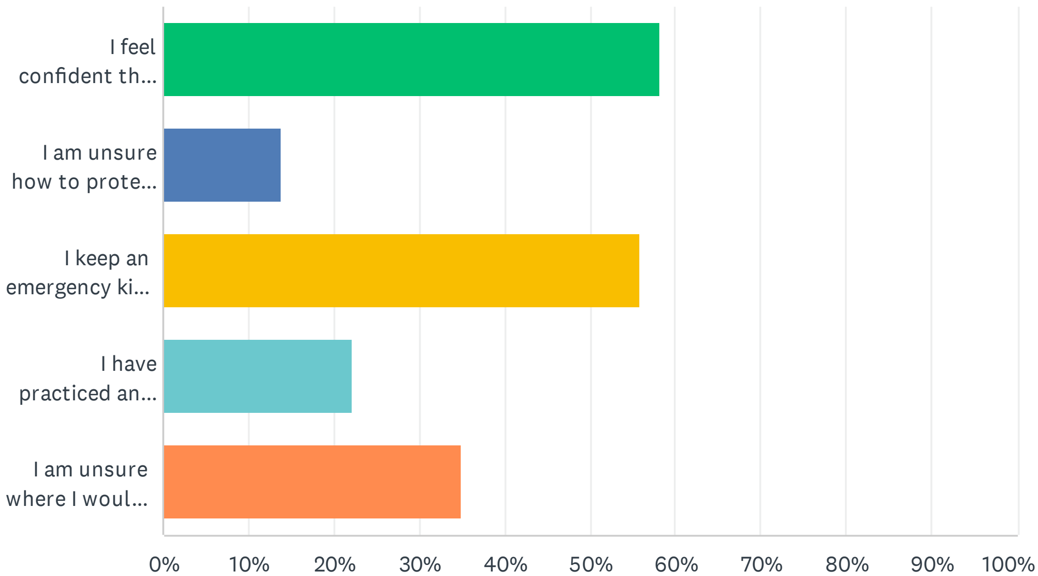
Answered: 86 Skipped: 16



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Choose one:	10.47% 9	2.33% 2	5.81% 5	26.74% 23	54.65% 47	86	4.13

Q13 If a natural disaster such as a large earthquake were to strike tomorrow... (Check all that apply)

Answered: 86   Skipped: 16



ANSWER CHOICES	RESPONSES	
I feel confident that I know how to protect myself during an earthquake	58.14%	50
I am unsure how to protect myself during an earthquake	13.95%	12
I keep an emergency kit with spare food and water for myself and my family	55.81%	48
I have practiced an evacuation plan and/or know where I and my family would go if we needed to evacuate our home	22.09%	19
I am unsure where I would go if I needed to evacuate my home	34.88%	30
Total Respondents: 86		

Appendix B. Summary of Federal and State Agencies, Programs and Regulation

B. Summary of Federal and State Agencies, Programs and Regulation

Existing laws, ordinances, plans and programs at the federal and state level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). The following federal and state programs have been identified as programs that may interface with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan. Information presented in this section can be used to review local capabilities to implement the actions found in the action plan presented in Chapter 19.

FEDERAL

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency alert, officials must use a combination of warning methods to ensure that all residents have all necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or other visual alerts. Two technical documents for shelter operators address physical accessibility needs of people with disabilities, as well as medical needs and service animals.

The ADA intersects with disaster preparedness programs in regards to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (e.g., vehicles with wheelchair lifts or paratransit buses). Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Civil Rights Act of 1964

The Civil Rights Act of 1964 prohibits discrimination based on race, color, religion, sex or nation origin and requires equal access to public places and employment. The Act is relevant to emergency management and hazard mitigation in that it prohibits local governments from favoring the needs of one population group over another. Local government and emergency response must ensure the continued safety and well-being of all residents equally, to the extent possible. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. Numerous issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The CWA is important to hazard mitigation in several ways. There are often permitting requirements for any construction within 200 feet of water of the United States, which may have implications for mitigation projects identified by a local jurisdiction. Additionally, CWA requirements apply to wetlands, which serve important functions related to preserving and protecting the natural and beneficial functions of floodplains and are linked with a community's floodplain management program. Finally, the National Pollutant Discharge Elimination System is part of the CWA and addresses local stormwater management programs. Stormwater management plays a critical role in hazard mitigation by addressing urban drainage or localized flooding issues within jurisdictions.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of FEMA, the Small Business Administration, and the U.S. Army Corps of Engineers. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective.

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger. CDBG-DR funding is a potential alternative source of funding for actions identified in this plan.

Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The discount partially depends on location of the property. Properties outside the special flood hazard area receive smaller discounts: a 10-percent discount if the community is at Class 1 to 6 and a 5-percent discount if the community is at Class 7 to 9. The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation’s flood risk; over 66 percent of the NFIP’s policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Emergency Relief for Federally Owned Roads Program

The U.S. Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs (Office of Federal Lands Highway, 2016). Eligible activities under this program meet some of the goals and objectives for this plan and the program is a possible funding source for actions identified in this plan.

Emergency Watershed Program

The U. S. Department of Agriculture Natural Resources Conservation Service administers the Emergency Watershed Protection Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. Emergency Watershed Protection is an emergency recovery program. Financial and technical assistance are available for the following activities (Natural Resources Conservation Service, 2016):

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded banks
- Correct damaged drainage facilities
- Establish cover on critically eroding lands
- Repair levees and structures
- Repair conservation practices.

This federal program could be a possible funding source for actions identified in this plan.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- Endangered means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- Threatened means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- Critical habitat means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- Section 4: Listing of a Species—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or U.S. citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- Section 7: Consultation—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- Section 9: Prohibition of Take—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- Section 10: Permitted Take—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- Section 11: Civil Lawsuits—Civil actions initiated by any U.S. citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors seismic research and applies it in performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

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

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Inspection Act in 1972, creation of the National Dam Safety Program in 1996, and reauthorization of the program through the Dam Safety Act in 2006. National Dam Safety Program, administered by FEMA requires a periodic engineering analysis of the majority of dams in the country; exceptions include the following:

- Dams under jurisdiction of the Bureau of Reclamation, Tennessee Valley Authority, or International Boundary and Water Commission
- Dams constructed pursuant to licenses issued under the Federal Power Act
- Dams that the Secretary of the Army determines do not pose any threat to human life or property.

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

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. The National Environmental Policy Act established the Council on Environmental Quality, whose regulations (40 CFR Parts 1500-1508) set standards for compliance. Consideration and decision-making regarding environmental impacts must be documented in an environmental impact statement or environmental assessment. Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and an unbiased presentation of direct, indirect, and cumulative environmental impacts. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities that enact floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. NFIP participation is limited to local governments that possess permit authority and have the ability to adopt and enforce regulations that govern land use.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent-annual-chance flood and the 0.2-percent-annual-chance flood. Base flood elevations and the boundaries of the flood hazard areas are shown on Flood Insurance Rate Maps, which are the principle tool for identifying the extent and location of the flood hazard. Flood Insurance Rate Maps are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under the local floodplain management program. In recent years, Flood Insurance Rate Maps have been digitized as Digital Flood Insurance Rate Maps, which are more accessible to residents, local governments and stakeholders.

NFIP participants must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 1-percent-annual-chance flood.

- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

In California, the Department of Water Resources (DWR) is the coordinating agency for floodplain management. DWR works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, participating in statewide flood hazard mitigation planning, and facilitating annual statewide workshops. Compliance is monitored by FEMA regional staff and by DWR.

National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards. The NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency responder disciplines. These cases necessitate coordination across a spectrum of organizations. Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, technological hazards, and human-caused hazards) regardless of size or complexity.

Although participation is voluntary, federal departments and agencies are required to make adoption of NIMS by local and state jurisdictions a condition to receive federal preparedness grants and awards. The content of this plan is considered to be a viable support tool for any phase of emergency management. The NIMS program is considered as a response function, and information in this hazard mitigation plan can support the implementation and update of all NIMS-compliant plans within the planning area.

Presidential Executive Order 11988, Floodplain Management

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. It requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values of floodplains. The requirements apply to the following activities (FEMA, 2015a):

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

Presidential Executive Order 11990, Protection of Wetlands

Executive Order 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The requirements apply to the following activities (National Archives, 2016):

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers operates and maintains approximately 700 dams nationwide. It is also responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety. The Corps maintains the National Inventory of Dams, which contains information about a dam's location, size, purpose, type, last inspection and regulatory status (U.S. Army Corps of Engineers, 2017).

U.S. Army Corps of Engineers Flood Hazard Management

The following U.S. Army Corps of Engineers authorities and programs related to flood hazard management:

- The Floodplain Management Services program offers 100-percent federally funded technical services such as development and interpretation of site-specific data related to the extent, duration and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.
- For more extensive studies, the Corps of Engineers offers a cost-shared program called Planning Assistance to States and Tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50 percent of the cost.
- The Corps of Engineers has several cost-shared programs (typically 65 percent federal and 35 percent non-federal) aimed at developing, evaluating and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed:
    - ➢ The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.

- Larger scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65 percent federal and 35 percent non-federal.
- Watershed management planning studies can be specifically authorized and are cost-shared at 50 percent federal and 50 percent non-federal.

- The Corps of Engineers provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fight activities and cost share in the repair of flood protective structures. Assistance is provided in the flowing categories:
  - Preparedness—The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; for rehabilitation of flood control and hurricane protection structures. Funding for Corps of Engineers emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state and federal agencies.
  - Response Activities—Public Law 84-99 allows the Corps of Engineers to supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fight efforts require a project cooperation agreement signed by the public sponsor and the sponsor must remove all flood fight material after the flood has receded. Public Law 84-99 also authorizes emergency water support and drought assistance in certain situations and allows for “advance measures” assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.
  - Rehabilitation—Under Public Law 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20-percent cost to the eligible non-federal system owner. All systems considered eligible for Public Law 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged.

These authorities and programs are all available to support any related mitigation actions.

STATE

AB 32: The California Global Warming Solutions Act

This bill identifies the following potential adverse impacts of global warming:

> “… the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.”

AB 32 establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020 (a reduction of approximately 25 percent from forecast emission levels), with further reductions to follow. The law requires the state Air Resources Board to do the following:

- Establish a program to track and report greenhouse gas emissions.
- Approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions from sources of greenhouse gas emissions.
- Adopt early reduction measures to begin moving forward.
- Adopt, implement and enforce regulations—including market mechanisms such as “cap and-trade” programs—to ensure that the required reductions occur.

The Air Resources Board has adopted a statewide greenhouse gas emissions limit and an emissions inventory, along with requirements to measure, track, and report greenhouse gas emissions by the industries it determined to be significant sources of greenhouse gas emissions.

AB 70: Flood Liability

This bill provides that a city or county may be required to contribute a fair and reasonable share to compensate for property damage caused by a flood to the extent that it has increased the state’s exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project, unless the city or county meets specified requirements.

AB 162: Flood Planning

This California State Assembly Bill passed in 2007 requires cities and counties to address flood-related matters in the land use, conservation, and safety and housing elements of their general plans. The land use element must identify and annually review the areas covered by the general plan that are subject to flooding as identified in floodplain mapping by either FEMA or the state Department of Water Resources (DWR). During the next revision of the housing element on or after January 1, 2009, the conservation element of the general plan must identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for the purpose of groundwater recharge and stormwater management. The safety element must identify information regarding flood hazards, including:

- Flood hazard zones
- Maps published by FEMA, DWR, the U.S. Army Corps of Engineers, the Central Valley Flood Protection Board, and the Governor’s Office of Emergency Services (Cal OES)
- Historical data on flooding
- Existing and planned development in flood hazard zones.

The general plan must establish goals, policies and objectives related to flooding risks, including:

- Avoiding or minimizing the risks of flooding new development
- Evaluating whether new development should be located in flood hazard zones

- Identifying construction methods to minimize damage.

AB 162 establishes goals, policies and objectives related to flooding risks. It establishes procedures for the determination of available land suitable for urban development, which may exclude lands where FEMA or DWR has concluded that the flood management infrastructure is not adequate to avoid the risk of flooding.

AB 747: Required Information for General Plan Safety Elements

This bill requires California communities with general plans to address evacuation routes in the safety element of the general plan. Information on the evacuation routes and their capacity, safety and viability under a range of emergency scenarios must be provided. For communities that have not adopted a local hazard mitigation plan, the safety element must be updated with this information by January 1, 2022. For those with a local hazard mitigation plan, the requirement applies upon the next revision of the hazard mitigation plan on or after January 1, 2022. Communities that have adopted a local hazard mitigation plan, emergency operations plan, or other document that fulfills the goals and objectives of this law may comply with this requirement by summarizing and incorporating by reference the other plan or document in the safety element.

In subsequent revisions to the safety element, communities also will be required to identify new information relating to flood and fire hazards and climate adaptation and resiliency strategies applicable to the city or county that was not available during the previous revision of the safety element. These subsequent updates must occur upon each revision of the general plan housing element or local hazard mitigation plan and not less than once every eight years.

AB 2140: General Plans—Safety Element

This bill provides that the state may allow for more than 75 percent of public assistance funding under the California Disaster Assistance Act only if the local agency is in a jurisdiction that has adopted a local hazard mitigation plan as part of the safety element of its general plan. The local hazard mitigation plan needs to include elements specified in this legislation. In addition, this bill requires Cal OES to give preference for federal mitigation funding to cities and counties that have adopted local hazard mitigation plans. The intent of the bill is to encourage cities and counties to create and adopt hazard mitigation plans.

AB 2800: Climate Change—Infrastructure Planning

This California State Assembly bill passed in 2016 and until July 1, 2020, requires state agencies to take into account the current and future impacts of climate change when planning, designing, building, operating, maintaining, and investing in state infrastructure. The bill, by July 1, 2017, and until July 1, 2020, requires an agency to establish a Climate-Safe Infrastructure Working Group to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act's main purpose is to prevent construction of buildings used for human occupancy on the surface trace of active faults. Before a new project is permitted, cities and counties require a geologic investigation to demonstrate that proposed buildings will not be constructed on active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as liquefaction or seismically induced landslides. The law requires the State of California Geologist to establish regulatory zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. All seismic hazard mitigation actions identified in this plan will seek full compliance with the Alquist-Priolo Earthquake Fault Zoning Act.

California Department of Water Resources

In California, the DWR is the coordinating agency for floodplain management. The DWR works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, participating in statewide flood hazard mitigation planning, and facilitating annual statewide workshops. Compliance is monitored by FEMA regional staff and by the DWR.

California Division of Safety of Dams

California's Division of Safety of Dams (a division of the DWR) monitors the dam safety program at the state level and maintains a working list of dams in the state. When a new dam is proposed, Division engineers and geologists inspect the site and the subsurface. Upon submittal of an application, the Division reviews the plans and specifications prepared by the owner to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for the known geologic conditions. After approval of the application, the Division inspects all aspects of the construction to ensure that the work is done in accordance with the approved plans and specifications. After construction, the Division inspects each dam to ensure that it is performing as intended and is not developing problems. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California. Over 1,200 dams are inspected by Division engineers on a yearly schedule to ensure performance and maintenance of dams (California Division of Safety of Dams, 2017).

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970, shortly after the federal government enacted the National Environmental Policy Act, to institute a statewide policy of environmental protection. CEQA requires state and local agencies in California to follow a protocol of analysis and public disclosure of the potential environmental impacts of development projects. CEQA makes environmental protection a mandatory part of every California state and local agency's decision-making process.

CEQA establishes a statewide environmental policy and mandates actions all state and local agencies must take to advance the policy. Jurisdictions conduct analysis of the project to determine if there are potentially significant environmental impacts, identify mitigation measures, and possible project alternatives by preparing environmental reports for projects that requires CEQA review. This environmental review is required before an agency takes action on any policy, program, or project. Any project action identified in this plan will seek full CEQA compliance upon implementation.

California General Planning Law

California state law requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The general plan expresses the community's goals, visions, and policies relative to future land uses, both public and private. The general plan is mandated and prescribed by state law (Cal. Gov. Code §65300 et seq.), and forms the basis for most local government land use decision-making.

The plan must consist of an integrated, internally consistent set of goals, policies, and implementation measures. In addition, the plan must focus on issues of the greatest concern to the community and be written in a clear and concise manner. City and county actions, such as those relating to land use allocations, annexations, zoning, subdivision and design review, redevelopment, and capital improvements, must be consistent with the plan.

California Multi-Hazard Mitigation Plan

Under the DMA, California must adopt a federally approved state multi-hazard mitigation plan to be eligible for certain disaster assistance and mitigation funding. The intent of the State of California Multi-Hazard Mitigation Plan is to reduce or prevent injury and damage from hazards in the state through the following:

- Documenting statewide hazard mitigation planning in California
- Describing strategies and priorities for future mitigation activities
- Facilitating the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meeting state and federal statutory and regulatory requirements

The plan is an annex to the State Emergency Plan, and it identifies past and present mitigation activities, current policies and programs, and mitigation strategies for the future. It also establishes hazard mitigation goals and objectives. The plan will be reviewed and updated annually to reflect changing conditions and new information, especially information on local planning activities. Under 44 CFR Section 201.6, local hazard mitigation plans must be consistent with their state's hazard mitigation plan.

California Residential Mitigation Program

The California Residential Mitigation Program was established in 2011 to help Californians strengthen their homes against damage from earthquakes. The program is a joint powers authority created by Cal OES and the California Earthquake Authority, which is a not-for-profit, publicly managed, privately funded provider of home earthquake insurance to California homeowners and renters.

Earthquake Brace + Bolt was developed to help homeowners lessen the potential for damage to their houses during an earthquake. A residential seismic retrofit strengthens an existing older house, making it more resistant to earthquake activity such as ground shaking and soil failure. The seismic retrofitting involves bolting the house to its foundation and adding bracing around the perimeter of the crawl space. Most homeowners hire a contractor to do the retrofit work, and owners of houses in Zip codes with house characteristics suitable for this type of retrofit are eligible for up to $3,000 toward the cost. A typical retrofit by a contractor may cost between $3,000 and $7,000, depending on the location and size of the house, contractor fees, and the amount of materials and work involved. If the homeowner is an experienced do-it-yourselfer, a retrofit can cost less than $3,000.

California State Building Code

California Code of Regulations Title 24 (CCR Title 24), also known as the California Building Standards Code, is a compilation of building standards from three sources:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions
- Building standards authorized by the California legislature that constitute extensive additions not covered by the model codes adopted to address particular California concerns

The state Building Standards Commission is authorized by California Building Standards Law (Health and Safety Code Sections 18901 through 18949.6) to administer the processes related to the adoption, approval, publication, and implementation of California's building codes. These building codes serve as the basis for the design and construction of buildings in California. The national model code standards adopted into Title 24 apply to all occupancies in California, except for modifications adopted by state agencies and local governing bodies. Since 1989, the Building Standards Commission has published new editions of Title 24 every three years.

On January 1, 2014, California Building Code Accessibility Standards found in Chapter 11B incorporated the 2010 Americans with Disabilities Act (ADA) Standards as the model accessibility code for California. The purpose was to ensure consistency with federal guidelines. As a result of this incorporation, the California standards will fully implement and include 2010 ADA Standards within the California Building Code while maintaining enhanced levels of accessibility already provided by existing California accessibility regulations.

Disadvantaged and Low-income Communities Investments

Senate Bill (SB) 535 directs state and local agencies to make investments that benefit California's disadvantaged communities. It also directs the California Environmental Protection Agency to identify disadvantaged communities for the purposes of these investments based on geographic, socio-economic, public health, and environmental hazard criteria. Assembly Bill (AB) 1550 increased the percent of funds for projects located in disadvantaged communities from 10 to 25 percent and added a focus on investments in low-income communities and households. This program is a potential alternative source of funding for actions identified in this plan.

Division of the State Architect's AB 300 List of Seismically At-Risk Schools

In 2002, California's Division of the State Architect completed an inventory of public school buildings built before 1978 that identifies buildings with characteristics that might make them unsafe in future earthquakes. This inventory provides a list of potentially at-risk schools known as the AB 300 list (the inventory was authorized by Assembly Bill 300 in 1999). Using available information on school buildings' dates of construction, seismic retrofits, and structural systems (wood-frame, concrete shear wall, or steel moment frame, etc.), the inventory categorized California public school buildings into one of two categories: those expected to perform well in future earthquakes; and those that are not expected to perform well and require more detailed seismic evaluation.

The Division of the State Architect recommends that public schools on this list undergo detailed seismic evaluations to determine if they pose life safety risks, but the state has neither required nor funded school districts to do this.

Governor's Executive Order S-13-08

Governor's Executive Order S-13-08 enhances the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. There are four key actions in the executive order:

- Initiate California's first statewide climate change adaptation strategy to assess expected climate change impacts, identify where California is most vulnerable, and recommend adaptation policies. This effort will improve coordination within state government so that better planning can more effectively address climate impacts on human health, the environment, the state's water supply and the economy.
- Request that the National Academy of Science establish an expert panel to report on sea level rise impacts in California, to inform state planning and development efforts.
- Issue interim guidance to state agencies for how to plan for sea level rise in designated coastal and floodplain areas for new projects.
- Initiate a report on critical infrastructure projects vulnerable to sea level rise.

Senate Bill 92: Public Resources Portion of Biennial Budget Bill

The State of California updated its requirements regarding emergency action plans (EAPs) via Senate Bill 92, which became effective in June 2017 as part of the state Legislature's biennial budget process. The bill required dam owners to submit EAPs to Cal OES and the Department of Water Resources for approval by January 1, 2018 (for extremely high hazard dams), January 1, 2019 (for high-hazard dams), and January 1, 2021 (for significant hazard dams). The EAPs were to include the following (California Government Code Section 8589.5; Cal OES, 2018):

- Emergency notification flow charts
- Information on a four-step response process
- Description of agencies' roles and actions in response to an emergency incident
- Description of actions to be taken in advance of an emergency
- Inundation maps
- Additional information such as revision records and distribution lists

After the EAPs are approved by the state, the law requires dam owners to send the approved EAPs to relevant stakeholders. Local public agencies can then adopt emergency procedures that incorporate the information in the EAP in a manner that conforms to local needs and includes methods and procedures for alerting and warning the public and other response and preparedness related items (State of California, 2018).

SB 92 also requires dams other than low-risk dams to have current inundation mapping, which must be updated every 10 years, or sooner if specific circumstances change. EAPs also must be updated every 10 years. It provides DWR with enforcement tools, including fines and operational restrictions for failure to comply. Cal OES is required by the law to work with state and federal agencies, dam owners, planners, and the public to make dam inundation maps available to community members interested in learning their dam failure inundation risk.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

Senate Bill 97, enacted in 2007, amends CEQA to clearly establish that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for CEQA analysis. It directs the Governor's Office of Planning and Research to develop draft CEQA guidelines for the mitigation of greenhouse gas emissions or their effects by July 1, 2009 and directs the California Natural Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010.

Senate Bill 99: Evacuation Route Planning

Senate Bill 99, enacted in 2019, requires that cities' and counties' general plans address evacuation routes from any hazard area identified in the safety element. Under this law, the safety element must include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes. Each city or county must update its safety element with the new information upon the next revision of its housing element on or after January 1, 2020.

Senate Bill 379: General Plans: Safety Element—Climate Adaptation

Senate Bill 379 builds upon the flood planning inclusions into the safety and housing elements and the hazard mitigation planning safety element inclusions in general plans outlined in AB 162 and AB 2140, respectively. SB 379 focuses on a new requirement that cities and counties include climate adaptation and resiliency strategies in the safety element of their general plans beginning January 1, 2017. In addition, this bill requires general plans to include a set of goals, policies and objectives, and specified implementation measures based on the conclusions drawn from climate adaptation research and recommendations.

Senate Bill 1000: General Plan Amendments—Safety and Environmental Justice Elements

In 2016, Senate Bill 1000 amended California's Planning and Zoning Law in two ways:

- The original law established requirements for initial revisions of general plan safety elements to address flooding, fire, and climate adaptation and resilience. It also required subsequent review and revision as necessary based on new information. Senate Bill 1000 specifies that the subsequent reviews and revision based on new information are required to address only flooding and fires (not climate adaptation and resilience).
- Senate Bill 1000 adds a requirement that, upon adoption or revision of any two other general plan elements on or after January 1, 2018, an environmental justice element be adopted for the general plan or environmental justice goals, policies and objectives be incorporated into other elements of the plan.

Senate Bill 1035: Fire, Flood, and Adaptation Safety Element Updates

Senate Bill 1035 clarifies that revisions to a community's General Plan Safety Element—to address fire hazards, flood hazards, and climate adaptation and resilience strategies—must occur upon each revision to a Housing Element or Local Hazard Mitigation Program.

Standardized Emergency Management System

CCR Title 19 establishes the Standardized Emergency Management System (SEMS) to standardize the response to emergencies involving multiple jurisdictions. SEMS is intended to be flexible and adaptable to the needs of all emergency responders in California. It requires emergency response agencies to use basic principles and components of emergency management. Local governments must use SEMS by December 1, 1996, to be eligible for state funding of response-related personnel costs under CCR Title 19 (Sections 2920, 2925 and 2930). The roles and responsibilities of Individual agencies contained in existing laws or the state emergency plan are not superseded by these regulations. This hazard mitigation plan is considered to be a support document for all phases of emergency management, including those associated with SEMS.

City of Long Beach Hazard Mitigation Plan

Appendix C. Detailed Risk Assessment Results

Exposure and Estimated Loss

Jurisdiction	Estimated Exposure					Economic Impact						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Zip Code 90802	42,525	100%	11,283	$12,555,654,893	100%	37.62	12	7	$46,470,580	$27,264,642	$73,735,222	0.6%
Zip Code 90803	32,849	100%	11,659	$8,165,722,867	100%	18.62	13	5	$86,885,050	$39,100,741	$125,985,790	1.5%
Zip Code 90804	39,045	100%	7,615	$5,898,611,853	100%	16.71	10	8	$41,772,982	$25,107,537	$66,880,519	1.1%
Zip Code 90805	95,610	100%	18,133	$14,450,879,171	100%	61.81	32	33	$625,616,860	$281,050,480	$906,667,339	6.3%
Zip Code 90806	41,547	100%	8,157	$7,082,584,420	100%	22.01	12	13	$194,347,739	$94,615,365	$288,963,104	4.1%
Zip Code 90807	32,687	100%	9,772	$8,037,885,102	100%	14.52	8	5	$136,946,378	$68,743,054	$205,689,432	2.6%
Zip Code 90808	38,395	100%	13,462	$10,569,261,412	100%	29.24	8	4	$319,601,208	$145,523,140	$465,124,348	4.4%
Zip Code 90810	30,604	100%	5,890	$6,861,632,043	100%	25.25	7	7	$277,592,884	$135,748,736	$413,341,620	6.0%
Zip Code 90813	53,238	100%	8,396	$10,398,406,550	100%	51.93	13	15	$265,392,804	$143,721,026	$409,113,830	3.9%
Zip Code 90814	19,359	100%	5,739	$3,388,248,062	100%	6.35	5	2	$14,694,643	$8,608,979	$23,303,623	0.7%
Zip Code 90815	40,937	100%	13,180	$10,307,061,812	100%	24.99	9	5	$185,705,645	$86,200,643	$271,906,288	2.6%
Other	2,098	100%	154	$769,831,842	100%	2.69	0	0	$6,707,014	$4,628,845	$11,335,859	1.5%
TOTAL	**468,894**	100%	**113,440**	**$98,485,780,029**	100%	**311.75**	**129**	**105**	**$2,201,733,787**	**$1,060,313,187**	**$3,262,046,974**	3.3%

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip cod
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.

Jurisdiction	Estimated Exposure					Economic Impact						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Zip Code 90802	42,525	100%	11,283	$12,555,654,893	100%	682.88	131	75	$1,511,503,367	$613,230,861	$2,124,734,228	16.9%
Zip Code 90803	32,849	100%	11,659	$8,165,722,867	100%	245.36	201	77	$877,958,492	$355,215,516	$1,233,174,007	15.1%
Zip Code 90804	39,045	100%	7,615	$5,898,611,853	100%	273.74	125	101	$801,059,111	$347,039,025	$1,148,098,136	19.5%
Zip Code 90805	95,610	100%	18,133	$14,450,879,171	100%	715.61	777	790	$2,603,396,762	$1,069,132,276	$3,672,529,038	25.4%
Zip Code 90806	41,547	100%	8,157	$7,082,584,420	100%	303.44	230	247	$1,060,506,443	$471,629,656	$1,532,136,099	21.6%
Zip Code 90807	32,687	100%	9,772	$8,037,885,102	100%	286.83	79	48	$978,710,869	$406,249,378	$1,384,960,247	17.2%
Zip Code 90808	38,395	100%	13,462	$10,569,261,412	100%	384.08	199	113	$1,454,055,823	$680,063,739	$2,134,119,563	20.2%
Zip Code 90810	30,604	100%	5,890	$6,861,632,043	100%	307.33	158	169	$1,257,424,569	$490,235,058	$1,747,659,626	25.5%
Zip Code 90813	53,238	100%	8,396	$10,398,406,550	100%	723.42	125	146	$1,889,905,919	$949,801,655	$2,839,707,575	27.3%
Zip Code 90814	19,359	100%	5,739	$3,388,248,062	100%	104.59	66	33	$326,238,627	$133,292,108	$459,530,735	13.6%
Zip Code 90815	40,937	100%	13,180	$10,307,061,812	100%	344.20	166	92	$1,301,085,546	$516,565,716	$1,817,651,263	17.6%
Other	2,098	100%	154	$769,831,842	100%	50.75	3	1	$126,123,947	$55,907,446	$182,031,392	23.6%
TOTAL	**468,894**	100%	**113,440**	**$98,485,780,029**	100%	**4,422.22**	**2,259**	**1,890**	**$14,187,969,475**	**$6,088,362,433**	**$20,276,331,908**	20.6%

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip code
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.

Jurisdiction	Estimated Exposure					Economic Impact						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Zip Code 90802	42,525	100%	11,283	$12,555,654,893	100%	575.99	58	33	$1,200,580,523	$472,405,035	$1,672,985,558	13.3%
Zip Code 90803	32,849	100%	11,659	$8,165,722,867	100%	232.45	126	49	$820,583,511	$331,004,695	$1,151,588,206	14.1%
Zip Code 90804	39,045	100%	7,615	$5,898,611,853	100%	261.38	73	58	$733,961,741	$313,282,211	$1,047,243,952	17.8%
Zip Code 90805	95,610	100%	18,133	$14,450,879,171	100%	517.36	285	290	$1,814,870,459	$683,745,252	$2,498,615,711	17.3%
Zip Code 90806	41,547	100%	8,157	$7,082,584,420	100%	278.74	136	147	$970,650,246	$425,088,875	$1,395,739,121	19.7%
Zip Code 90807	32,687	100%	9,772	$8,037,885,102	100%	246.29	37	22	$816,557,985	$331,527,762	$1,148,085,747	14.3%
Zip Code 90808	38,395	100%	13,462	$10,569,261,412	100%	291.79	67	38	$1,048,664,615	$474,578,969	$1,523,243,584	14.4%
Zip Code 90810	30,604	100%	5,890	$6,861,632,043	100%	281.53	87	93	$1,091,558,003	$408,308,421	$1,499,866,423	21.9%
Zip Code 90813	53,238	100%	8,396	$10,398,406,550	100%	628.55	57	66	$1,571,811,862	$771,136,548	$2,342,948,410	22.5%
Zip Code 90814	19,359	100%	5,739	$3,388,248,062	100%	98.88	36	18	$287,081,271	$116,256,835	$403,338,106	11.9%
Zip Code 90815	40,937	100%	13,180	$10,307,061,812	100%	308.46	88	49	$1,101,836,480	$424,643,099	$1,526,479,579	14.8%
Other	2,098	100%	154	$769,831,842	100%	45.71	2	1	$102,111,940	$43,357,895	$145,469,835	18.9%
TOTAL	**468,894**	100%	**113,440**	**$98,485,780,029**	100%	**3,767.11**	**1,053**	**864**	**$11,560,268,636**	**$4,795,335,597**	**$16,355,604,232**	16.6%

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip code
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.

Jurisdiction	Estimated Exposure					Economic Impact						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Zip Code 90802	42,525	100%	11,283	$12,555,654,893	100%	529.59	24	13	$1,014,731,843	$390,905,991	$1,405,637,834	11.2%
Zip Code 90803	32,849	100%	11,659	$8,165,722,867	100%	117.94	37	14	$426,207,822	$156,673,797	$582,881,619	7.1%
Zip Code 90804	39,045	100%	7,615	$5,898,611,853	100%	120.29	4	4	$290,289,746	$114,348,497	$404,638,243	6.9%
Zip Code 90805	95,610	100%	18,133	$14,450,879,171	100%	191.10	66	67	$774,336,196	$287,361,304	$1,061,697,499	7.3%
Zip Code 90806	41,547	100%	8,157	$7,082,584,420	100%	158.81	70	73	$508,891,296	$200,110,998	$709,002,294	10.0%
Zip Code 90807	32,687	100%	9,772	$8,037,885,102	100%	88.88	2	1	$270,372,885	$104,650,779	$375,023,664	4.7%
Zip Code 90808	38,395	100%	13,462	$10,569,261,412	100%	108.48	15	8	$449,593,150	$180,869,045	$630,462,195	6.0%
Zip Code 90810	30,604	100%	5,890	$6,861,632,043	100%	200.82	54	59	$719,062,463	$258,296,324	$977,358,787	14.2%
Zip Code 90813	53,238	100%	8,396	$10,398,406,550	100%	531.01	15	18	$1,229,475,689	$600,727,648	$1,830,203,338	17.6%
Zip Code 90814	19,359	100%	5,739	$3,388,248,062	100%	55.02	6	3	$131,366,597	$50,838,746	$182,205,343	5.4%
Zip Code 90815	40,937	100%	13,180	$10,307,061,812	100%	125.77	13	7	$462,679,937	$172,890,712	$635,570,650	6.2%
Other	2,098	100%	154	$769,831,842	100%	32.04	1	0	$55,297,639	$16,784,777	$72,082,415	9.4%
TOTAL	**468,894**	100%	**113,440**	**$98,485,780,029**	100%	**2,259.75**	**307**	**268**	**$6,332,305,262**	**$2,534,458,619**	**$8,866,763,880**	9.0%

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip code
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Building Exposure						
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	5	0	0.0%	$35,229,253	$35,229,253	$70,458,507	0.6%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	2,238	6,136	18.7%	$975,497,634	$645,488,487	$1,620,986,121	19.9%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	3	0	0.0%	$47,760,201	$47,760,201	$95,520,402	1.4%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	831	112	0.2%	$1,104,776,929	$1,377,254,916	$2,482,031,845	23.9%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	1	0	0.0%	$1,234,970	$1,234,970	$2,469,940	0.1%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	6	0	0.0%	$11,794,563	$11,794,563	$23,589,126	0.2%
Other	2,098	154	18	$769,831,842	0	0	0.0%	$0	$0	$0	0.0%
Total	**468,894**	**113,440**	**105,404**	**$98,485,780,029**	**3,084**	**6,248**	**1.3%**	**$2,176,293,551**	**$2,118,762,390**	**$4,295,055,941**	**4.4%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Percent of residential buildings exposed multiplied by the Estimated Populatio
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1

Jurisdiction	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Zip Code 90802	0	0	0	1	$221,136	$221,136	$442,272	0.0%
Zip Code 90803	1,575	3,065	246	1,431	$30,203,927	$29,836,901	$60,040,828	0.7%
Zip Code 90804	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90805	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90806	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90807	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90808	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90810	5,024	0	0	2	$16,630,641	$18,104,428	$34,735,069	0.5%
Zip Code 90813	1,423	25	5	534	$24,690,230	$51,500,055	$76,190,285	0.7%
Zip Code 90814	7	0	0	1	$174,224	$904,185	$1,078,409	0.0%
Zip Code 90815	244	0	0	6	$2,631,254	$11,794,560	$14,425,814	0.1%
Other	0	0	0	0	$0	$0	$0	0.0%
Total	**8,272**	**3,091**	**251**	**1,975**	**$74,551,413**	**$112,361,265**	**$186,912,678**	**0.2%**

Notes:

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	4,698	0	3	0	0	0	2	0	5
Zip Code 90803	1,521	2,105	119	0	0	3	9	2	2238
Zip Code 90804	0	0	0	0	0	0	0	0	0
Zip Code 90805	119	0	0	0	0	0	0	0	0
Zip Code 90806	129	0	0	0	0	0	0	0	0
Zip Code 90807	14	0	0	0	0	0	0	0	0
Zip Code 90808	81	0	0	0	0	0	0	0	0
Zip Code 90810	99	0	3	0	0	0	0	0	3
Zip Code 90813	799	14	253	547	0	0	17	0	831
Zip Code 90814	23	0	1	0	0	0	0	0	1
Zip Code 90815	192	0	0	0	0	0	6	0	6
Other	0	0	0	0	0	0	0	0	0
Total	**7,675**	**2,119**	**379**	**547**	**0**	**3**	**34**	**2**	**3084**

Notes:

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Building Exposure						
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	5	0	0.0%	$35,229,253	$35,229,253	$70,458,507	0.6%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	3,136	8,707	26.5%	$1,369,726,802	$850,940,125	$2,220,666,927	27.2%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	131	611	1.6%	$46,406,020	$27,695,999	$74,102,019	1.3%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	3	0	0.0%	$47,760,201	$47,760,201	$95,520,402	1.4%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	972	1,108	2.1%	$1,154,083,563	$1,403,722,024	$2,557,805,587	24.6%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	1	0	0.0%	$1,234,970	$1,234,970	$2,469,940	0.1%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	6	0	0.0%	$11,794,563	$11,794,563	$23,589,126	0.2%
Other	2,098	154	18	$769,831,842	0	0	0.0%	$0	$0	$0	0.0%
Total	**468,894**	**113,440**	**105,404**	**$98,485,780,029**	**4,254**	**10,427**	**2.2%**	**$2,666,235,372**	**$2,378,377,135**	**$5,044,612,507**	**5.1%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Percent of residential buildings exposed multiplied by the Estimated Populatio
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1

Jurisdiction	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Zip Code 90802	0	0	0	1	$221,132	$221,132	$442,265	0.0%
Zip Code 90803	1,779	5,165	351	1,671	$31,439,369	$30,994,410	$62,433,779	0.8%
Zip Code 90804	10	116	18	47	$98,167	$172,208	$270,375	0.0%
Zip Code 90805	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90806	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90807	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90808	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90810	5,024	0	0	2	$16,630,673	$18,104,459	$34,735,132	0.5%
Zip Code 90813	1,586	238	33	567	$24,744,604	$51,575,769	$76,320,372	0.7%
Zip Code 90814	7	0	0	1	$174,223	$904,182	$1,078,405	0.0%
Zip Code 90815	244	0	0	6	$2,631,252	$11,794,560	$14,425,812	0.1%
Other	0	0	0	0	$0	$0	$0	0.0%
Total	**8,650**	**5,519**	**402**	**2,295**	**$75,939,419**	**$113,766,720**	**$189,706,139**	**0.2%**

Notes:

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	4,698	0	3	0	0	0	2	0	5
Zip Code 90803	1,613	2,987	132	0	0	3	12	2	3136
Zip Code 90804	19	110	21	0	0	0	0	0	131
Zip Code 90805	119	0	0	0	0	0	0	0	0
Zip Code 90806	129	0	0	0	0	0	0	0	0
Zip Code 90807	14	0	0	0	0	0	0	0	0
Zip Code 90808	81	0	0	0	0	0	0	0	0
Zip Code 90810	99	0	3	0	0	0	0	0	3
Zip Code 90813	817	139	269	547	0	0	17	0	972
Zip Code 90814	23	0	1	0	0	0	0	0	1
Zip Code 90815	193	0	0	0	0	0	6	0	6
Other	0	0	0	0	0	0	0	0	0
Total	**7,803**	**3,236**	**429**	**547**	**0**	**3**	**37**	**2**	**4254**

Notes:

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Building Exposure						
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	35	73	0.2%	$113,188,211	$109,771,570	$222,959,781	1.8%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	6,393	18,020	54.9%	$2,859,026,375	$1,742,066,507	$4,601,092,882	56.3%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	480	2,417	6.2%	$366,472,892	$275,048,484	$641,521,376	10.9%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	17,510	92,263	96.5%	$7,660,390,083	$5,946,744,628	$13,607,134,711	94.2%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	4,378	23,203	55.8%	$1,594,217,433	$1,020,395,907	$2,614,613,340	36.9%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	460	1,628	5.0%	$145,208,576	$82,221,374	$227,429,950	2.8%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	13,291	38,189	99.5%	$5,283,339,680	$3,742,372,177	$9,025,711,857	85.4%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	5,043	26,436	86.4%	$2,789,340,646	$2,306,445,453	$5,095,786,100	74.3%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	1,182	2,440	4.6%	$1,437,008,087	$1,631,578,928	$3,068,587,015	29.5%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	235	806	4.2%	$110,034,369	$66,572,140	$176,606,510	5.2%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	10,677	33,264	81.3%	$4,455,492,503	$3,050,580,992	$7,506,073,495	72.8%
Other	2,098	154	18	$769,831,842	88	1,166	55.6%	$58,695,491	$74,057,200	$132,752,691	17.2%
Total	**468,894**	**113,440**	**105,404**	**$98,485,780,029**	**59,772**	**239,904**	**51.2%**	**$26,872,414,347**	**$20,047,855,360**	**$46,920,269,707**	**47.6%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Percent of residential buildings exposed multiplied by the Estimated Populatio
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatic
(6) Calculated using a user-defined (UDF) analysis in Hazus5.1

Jurisdiction	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Zip Code 90802	1,179	73	3	35	$24,219,688	$41,411,804	$65,631,492	0.5%
Zip Code 90803	115,988	18,005	756	6,323	$1,053,501,079	$902,760,830	$1,956,261,909	24.0%
Zip Code 90804	22,354	2,417	83	447	$77,196,675	$131,838,224	$209,034,899	3.5%
Zip Code 90805	1,312,167	92,263	3,005	17,091	$3,869,762,044	$3,965,683,297	$7,835,445,341	54.2%
Zip Code 90806	39,867	23,203	792	4,341	$416,653,398	$392,152,435	$808,805,833	11.4%
Zip Code 90807	7,847	1,628	64	460	$59,609,614	$37,271,412	$96,881,025	1.2%
Zip Code 90808	337,977	38,109	1,496	13,275	$2,085,025,966	$2,075,127,050	$4,160,153,016	39.4%
Zip Code 90810	7,681	26,436	951	3,497	$93,448,599	$164,330,586	$257,779,186	3.8%
Zip Code 90813	12,117	2,440	78	1,148	$204,878,038	$441,848,750	$646,726,788	6.2%
Zip Code 90814	2,390	806	31	230	$34,585,179	$30,261,215	$64,846,394	1.9%
Zip Code 90815	834,624	33,247	1,318	10,677	$2,767,860,453	$2,319,360,100	$5,087,220,553	49.4%
Other	20,126	1,166	47	88	$37,260,305	$72,106,700	$109,367,005	14.2%
Total	**2,714,318**	**239,793**	**8,624**	**57,612**	**$10,724,001,039**	**$10,574,152,402**	**$21,298,153,441**	**21.6%**

Notes:

Jurisdiction	Acres of Inundation Area	Number of Structures in Inundation Area (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	11,599	18	6	3	0	0	8	0	35
Zip Code 90803	2,363	6,182	172	3	0	7	26	3	6393
Zip Code 90804	100	435	40	0	0	1	2	2	480
Zip Code 90805	4,660	16,072	1,107	196	6	71	29	29	17510
Zip Code 90806	1,261	4,117	245	0	1	7	4	4	4378
Zip Code 90807	244	453	7	0	0	0	0	0	460
Zip Code 90808	4,755	12,950	240	11	1	53	11	25	13291
Zip Code 90810	3,071	4,744	224	15	3	27	15	15	5043
Zip Code 90813	1,351	306	319	528	0	7	21	1	1182
Zip Code 90814	88	227	5	0	0	0	3	0	235
Zip Code 90815	3,555	10,421	176	0	0	38	22	20	10677
Other	231	10	5	0	0	5	2	66	88
Total	**33,278**	**55,935**	**2546**	**756**	**11**	**216**	**143**	**165**	**59772**

Notes:

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Building Exposure						
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	2,822	10,842	25.5%	$2,197,266,953	$1,795,172,252	$3,992,439,205	31.8%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	6,587	18,475	56.2%	$3,044,546,814	$1,868,940,707	$4,913,487,521	60.2%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	0	0	0.0%	$0	$0	$0	0.0%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	626	40	0.1%	$903,363,708	$1,101,953,763	$2,005,317,471	19.3%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	362	1,243	6.4%	$181,739,858	$105,509,743	$287,249,601	8.5%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	227	715	1.7%	$73,217,984	$41,485,882	$114,703,866	1.1%
Other	2,098	154	18	$769,831,842	0	0	0.0%	$0	$0	$0	0.0%
Total	**468,894**	**113,440**	**105,404**	**$98,485,780,029**	**10,624**	**31,315**	**6.7%**	**$6,400,135,318**	**$4,913,062,346**	**$11,313,197,664**	**11.5%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Percent of residential buildings exposed multiplied by the Estimated Populatio
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1

Jurisdiction	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Zip Code 90802	44	5,933	498	1,214	$585,159,204	$750,435,723	$1,335,594,927	10.6%
Zip Code 90803	43	16,111	729	5,548	$973,506,737	$824,877,708	$1,798,384,445	22.0%
Zip Code 90804	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90805	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90806	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90807	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90808	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90810	0	0	0	0	$0	$0	$0	0.0%
Zip Code 90813	0	11	2	463	$115,427,306	$251,605,161	$367,032,466	3.5%
Zip Code 90814	2	853	46	229	$80,528,908	$51,518,374	$132,047,282	3.9%
Zip Code 90815	1	138	27	132	$18,902,172	$13,240,580	$32,142,752	0.3%
Other	0	0	0	0	$0	$0	$0	0.0%
Total	**91**	**23,047**	**1,302**	**7,586**	**$1,773,524,326**	**$1,891,677,546**	**$3,665,201,872**	**3.7%**

Notes:

Jurisdiction	Acres of Hazard Area	Number of Structures in Hazard Area (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	9,100	2,678	46	21	0	0	76	1	2822
Zip Code 90803	2,578	6,338	202	3	0	9	31	4	6587
Zip Code 90804	0	0	0	0	0	0	0	0	0
Zip Code 90805	0	0	0	0	0	0	0	0	0
Zip Code 90806	108	0	0	0	0	0	0	0	0
Zip Code 90807	0	0	0	0	0	0	0	0	0
Zip Code 90808	0	0	0	0	0	0	0	0	0
Zip Code 90810	24	0	0	0	0	0	0	0	0
Zip Code 90813	937	5	194	402	0	0	25	0	626
Zip Code 90814	130	350	6	0	0	0	6	0	362
Zip Code 90815	206	224	1	0	0	0	2	0	227
Other	1	0	0	0	0	0	0	0	0
Total	**13,086**	**9,595**	**449**	**426**	**0**	**9**	**140**	**5**	**10624**

Notes:

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Sea Level Rise of 25cm with 100-year Storm Surge (3) – Estimated Exposure						
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	13	0	0.00%	89,028,087	110,168,171	199,196,258	1.59%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	4,589	12,916	39.32%	1,796,568,624	1,074,796,193	2,871,364,816	35.16%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	0	0	0.00%	0	0	0	0.00%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	0	0	0.00%	0	0	0	0.00%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	0	0	0.00%	0	0	0	0.00%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	0	0	0.00%	0	0	0	0.00%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	0	0	0.00%	0	0	0	0.00%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	0	0	0.00%	0	0	0	0.00%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	13	0	0.00%	47,567,168	55,768,113	103,335,281	0.99%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	0	0	0.00%	0	0	0	0.00%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	0	0	0.00%	0	0	0	0.00%
Other	2,098	154	18	$769,831,842	0	0	0.00%	0	0	0	0.00%
Total	**468,894**	**113,440**	**105,404**	**98,485,780,029**	**4,615**	**12,916**	**2.75%**	**1,933,163,879**	**1,240,732,476**	**3,173,896,355**	**3.22%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Sea level rise data provided by Our Coast Our Future (OCOF)
(4) Percent of residential buildings exposed multiplied by the Estimated Populatio

Jurisdiction	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	0	3	10	0	0	0	0	13
Zip Code 90803	4,431	140	0	0	3	13	2	4,589
Zip Code 90804	0	0	0	0	0	0	0	0
Zip Code 90805	0	0	0	0	0	0	0	0
Zip Code 90806	0	0	0	0	0	0	0	0
Zip Code 90807	0	0	0	0	0	0	0	0
Zip Code 90808	0	0	0	0	0	0	0	0
Zip Code 90810	0	0	0	0	0	0	0	0
Zip Code 90813	0	2	11	0	0	0	0	13
Zip Code 90814	0	0	0	0	0	0	0	0
Zip Code 90815	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0
Total	**4,431**	**145**	**21**	**0**	**3**	**13**	**2**	**4,615**

Notes:

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Sea Level Rise of 50cm with 100-year Storm Surge (3)						
					Estimated Exposure						
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Zip Code 90802	42,525	11,283	10,504	$12,555,654,893	14	0	0.00%	90,993,848	112,133,931	203,127,779	1.62%
Zip Code 90803	32,849	11,659	11,269	$8,165,722,867	5,374	15,143	46.10%	2,174,256,613	1,289,170,241	3,463,426,854	42.41%
Zip Code 90804	39,045	7,615	7,026	$5,898,611,853	0	0	0.00%	0	0	0	0.00%
Zip Code 90805	95,610	18,133	16,655	$14,450,879,171	0	0	0.00%	0	0	0	0.00%
Zip Code 90806	41,547	8,157	7,372	$7,082,584,420	0	0	0.00%	0	0	0	0.00%
Zip Code 90807	32,687	9,772	9,097	$8,037,885,102	0	0	0.00%	0	0	0	0.00%
Zip Code 90808	38,395	13,462	13,020	$10,569,261,412	0	0	0.00%	0	0	0	0.00%
Zip Code 90810	30,604	5,890	5,492	$6,861,632,043	0	0	0.00%	0	0	0	0.00%
Zip Code 90813	53,238	8,396	6,676	$10,398,406,550	365	0	0.00%	575,677,979	699,057,432	1,274,735,410	12.26%
Zip Code 90814	19,359	5,739	5,450	$3,388,248,062	11	39	0.20%	5,978,262	2,989,131	8,967,393	0.26%
Zip Code 90815	40,937	13,180	12,825	$10,307,061,812	0	0	0.00%	0	0	0	0.00%
Other	2,098	154	18	$769,831,842	0	0	0.00%	0	0	0	0.00%
Total	**468,894**	**113,440**	**105,404**	**98,485,780,029**	**5,764**	**15,182**	**3.24%**	**2,846,906,702**	**2,103,350,735**	**4,950,257,437**	**5.03%**

Notes: (1) 2020 Census population totals for zip codes provided by the City of Long Beach. "Other" includes 90822, 90831, and 90840 zip codes.
(2) Values based off of 2021 tax assessor data provided by Los Angeles County
(3) Sea level rise data provided by Our Coast Our Future (OCOF)
(4) Percent of residential buildings exposed multiplied by the Estimated Populatio

Jurisdiction	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Zip Code 90802	0	3	10	0	0	1	0	14
Zip Code 90803	5,195	150	1	0	7	19	2	5,374
Zip Code 90804	0	0	0	0	0	0	0	0
Zip Code 90805	0	0	0	0	0	0	0	0
Zip Code 90806	0	0	0	0	0	0	0	0
Zip Code 90807	0	0	0	0	0	0	0	0
Zip Code 90808	0	0	0	0	0	0	0	0
Zip Code 90810	0	0	0	0	0	0	0	0
Zip Code 90813	0	110	241	0	0	14	0	365
Zip Code 90814	11	0	0	0	0	0	0	11
Zip Code 90815	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0
Total	**5,206**	**263**	**252**	**0**	**7**	**34**	**2**	**5,764**

Notes:

Critical Facilities Exposure

All Facilities

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Zip Code 90802	59	13	0	4	3	33	35	**147**
Zip Code 90803	13	5	1	0	6	29	21	**75**
Zip Code 90804	15	1	24	2	10	15	0	**67**
Zip Code 90805	13	3	8	10	6	33	33	**106**
Zip Code 90806	3	1	1	2	10	25	12	**54**
Zip Code 90807	11	2	4	2	5	19	10	**53**
Zip Code 90808	9	2	27	3	2	42	28	**113**
Zip Code 90810	0	3	1	1	1	22	33	**61**
Zip Code 90813	7	3	0	15	6	31	12	**74**
Zip Code 90814	1	0	0	0	2	8	0	**11**
Zip Code 90815	23	1	13	2	7	40	49	**135**
Other	16	0	2	0	2	4	1	**25**
Total	**170**	**34**	**81**	**41**	**60**	**301**	**234**	**921**

Dam Failure - Combined Dams

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Zip Code 90802	3	4	0	1	0	2	7	**17**
Zip Code 90803	9	5	1	0	3	19	20	**57**
Zip Code 90804	0	0	0	0	0	1	0	**1**
Zip Code 90805	13	3	8	10	6	32	23	**95**
Zip Code 90806	1	0	0	0	5	5	0	**11**
Zip Code 90807	0	0	0	0	0	0	0	**0**
Zip Code 90808	9	2	25	3	2	38	26	**105**
Zip Code 90810	0	2	1	0	1	19	9	**32**
Zip Code 90813	4	1	0	12	2	4	7	**30**
Zip Code 90814	0	0	0	0	0	1	0	**1**
Zip Code 90815	12	1	10	0	5	29	41	**98**
Other	0	0	2	0	0	4	1	**7**
Total	**51**	**18**	**47**	**26**	**24**	**154**	**134**	**454**

Flood - 1% Annual Chance

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Zip Code 90802	3	1	0	0	0	1	5	**10**
Zip Code 90803	5	0	0	0	1	8	11	**25**
Zip Code 90804	0	0	0	0	0	0	0	**0**
Zip Code 90805	0	0	0	0	0	0	0	**0**
Zip Code 90806	0	0	0	0	0	0	0	**0**
Zip Code 90807	0	0	0	0	0	0	0	**0**
Zip Code 90808	0	0	0	0	0	0	2	**2**
Zip Code 90810	0	0	0	0	0	0	0	**0**
Zip Code 90813	1	1	0	10	0	4	3	**19**
Zip Code 90814	0	0	0	0	0	0	0	**0**
Zip Code 90815	0	0	0	0	0	0	12	**12**
Other	0	0	0	0	0	0	0	**0**
Total	**9**	**2**	**0**	**10**	**1**	**13**	**33**	**68**

Flood - 0.2% Annual Chance

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Zip Code 90802	3	1	0	0	0	1	5	**10**
Zip Code 90803	5	0	0	0	2	9	12	**28**
Zip Code 90804	0	0	0	0	0	0	0	**0**
Zip Code 90805	0	0	0	0	0	0	0	**0**
Zip Code 90806	0	0	0	0	0	0	0	**0**
Zip Code 90807	0	0	0	0	0	0	0	**0**
Zip Code 90808	0	0	0	0	0	0	2	**2**
Zip Code 90810	0	0	0	0	0	0	0	**0**
Zip Code 90813	1	1	0	10	0	4	3	**19**
Zip Code 90814	0	0	0	0	0	0	0	**0**
Zip Code 90815	0	0	0	0	0	1	12	**13**
Other	0	0	0	0	0	0	0	**0**
Total	**9**	**2**	**0**	**10**	**2**	**15**	**34**	**72**

Tsunami Hazard Area

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Zip Code 90802	34	13	0	3	0	10	33	**93**
Zip Code 90803	12	4	0	0	3	25	20	**64**
Zip Code 90804	0	0	0	0	0	0	0	**0**
Zip Code 90805	0	0	0	0	0	0	0	**0**
Zip Code 90806	0	0	0	0	0	0	1	**1**
Zip Code 90807	0	0	0	0	0	0	0	**0**
Zip Code 90808	0	0	0	0	0	0	0	**0**
Zip Code 90810	0	0	0	0	0	0	0	**0**
Zip Code 90813	4	2	0	12	0	3	4	**25**
Zip Code 90814	0	0	0	0	0	4	0	**4**
Zip Code 90815	0	0	0	0	0	1	7	**8**
Other	0	0	0	0	0	0	0	**0**
Total	**50**	**19**	**0**	**15**	**3**	**43**	**65**	**195**

Risk Ranking

	RISK RANK									
	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90803	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90804	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90805	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90806	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90807	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90808	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90810	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90813	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90814	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90815	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Other	Medium	2	100.00%	High	3	9	100.00%	High	3	6
TOTAL	Medium	2	100.00%	High	3	9	100.00%	High	3	6

ING-Earthquake

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	0.59%	Low	1	1	32	Medium
Zip Code 90803	1.54%	Low	1	1	32	Medium
Zip Code 90804	2.56%	Low	1	1	32	Medium
Zip Code 90805	4.40%	Low	1	1	32	Medium
Zip Code 90806	6.02%	Medium	2	2	34	High
Zip Code 90807	3.93%	Low	1	1	32	Medium
Zip Code 90808	4.40%	Low	1	1	32	Medium
Zip Code 90810	6.02%	Medium	2	2	34	High
Zip Code 90813	3.93%	Low	1	1	32	Medium
Zip Code 90814	0.69%	Low	1	1	32	Medium
Zip Code 90815	2.64%	Low	1	1	32	Medium
Other	1.47%	Low	1	1	32	Medium
TOTAL	3.31%	Low	1	1	32	Medium

	RISK RANK									
	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90803	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90804	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90805	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90806	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90807	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90808	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90810	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90813	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90814	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90815	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Other	Medium	2	100.00%	High	3	9	100.00%	High	3	6
TOTAL	Medium	2	100.00%	High	3	9	100.00%	High	3	6

ING-Earthquake

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	16.92%	High	3	3	36	High
Zip Code 90803	15.10%	High	3	3	36	High
Zip Code 90804	17.23%	High	3	3	36	High
Zip Code 90805	20.19%	High	3	3	36	High
Zip Code 90806	25.47%	High	3	3	36	High
Zip Code 90807	27.31%	High	3	3	36	High
Zip Code 90808	20.19%	High	3	3	36	High
Zip Code 90810	25.47%	High	3	3	36	High
Zip Code 90813	27.31%	High	3	3	36	High
Zip Code 90814	13.56%	High	3	3	36	High
Zip Code 90815	17.64%	High	3	3	36	High
Other	23.65%	High	3	3	36	High
TOTAL	20.59%	High	3	3	36	High

	RISK RANK									
	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90803	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90804	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90805	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90806	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90807	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90808	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90810	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90813	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90814	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90815	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Other	Medium	2	100.00%	High	3	9	100.00%	High	3	6
TOTAL	Medium	2	100.00%	High	3	9	100.00%	High	3	6

ING-Earthquake

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	13.32%	High	3	3	**36**	**High**
Zip Code 90803	14.10%	High	3	3	**36**	**High**
Zip Code 90804	14.28%	High	3	3	**36**	**High**
Zip Code 90805	14.41%	High	3	3	**36**	**High**
Zip Code 90806	21.86%	High	3	3	**36**	**High**
Zip Code 90807	22.53%	High	3	3	**36**	**High**
Zip Code 90808	14.41%	High	3	3	**36**	**High**
Zip Code 90810	21.86%	High	3	3	**36**	**High**
Zip Code 90813	22.53%	High	3	3	**36**	**High**
Zip Code 90814	11.90%	High	3	3	**36**	**High**
Zip Code 90815	14.81%	High	3	3	**36**	**High**
Other	18.90%	High	3	3	**36**	**High**
TOTAL	16.61%	High	3	3	**36**	**High**

	RISK RANK									
	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90803	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90804	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90805	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90806	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90807	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90808	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90810	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90813	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90814	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Zip Code 90815	Medium	2	100.00%	High	3	9	100.00%	High	3	6
Other	Medium	2	100.00%	High	3	9	100.00%	High	3	6
TOTAL	Medium	2	100.00%	High	3	9	100.00%	High	3	6

ING-Earthquake

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	11.20%	High	3	3	36	High
Zip Code 90803	7.14%	Medium	2	2	34	High
Zip Code 90804	4.67%	Low	1	1	32	Medium
Zip Code 90805	5.97%	Medium	2	2	34	High
Zip Code 90806	14.24%	High	3	3	36	High
Zip Code 90807	17.60%	High	3	3	36	High
Zip Code 90808	5.97%	Medium	2	2	34	High
Zip Code 90810	14.24%	High	3	3	36	High
Zip Code 90813	17.60%	High	3	3	36	High
Zip Code 90814	5.38%	Medium	2	2	34	High
Zip Code 90815	6.17%	Medium	2	2	34	High
Other	9.36%	Medium	2	2	34	High
TOTAL	9.00%	Medium	2	2	34	High

RISK RANKING-Flood - 100-Year

	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	High	3	0.00%	None	0	0	0.56%	Low	1	2
Zip Code 90803	High	3	18.68%	Medium	2	6	19.85%	Medium	2	4
Zip Code 90804	High	3	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90805	High	3	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90806	High	3	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90807	High	3	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90808	High	3	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90810	High	3	0.00%	None	0	0	1.39%	Low	1	2
Zip Code 90813	High	3	0.21%	Low	1	3	23.87%	Medium	2	4
Zip Code 90814	High	3	0.00%	None	0	0	0.07%	Low	1	2
Zip Code 90815	High	3	0.00%	None	0	0	0.23%	Low	1	2
Other	High	3	0.00%	None	0	0	0.00%	None	0	0
Total	High	3	1.33%	Low	1	3	4.36%	Low	1	2

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	0.00%	None	0	0	6	Low
Zip Code 90803	0.74%	Low	1	1	33	High
Zip Code 90804	0.00%	None	0	0	0	Low
Zip Code 90805	0.00%	None	0	0	0	Low
Zip Code 90806	0.00%	None	0	0	0	Low
Zip Code 90807	0.00%	None	0	0	0	Low
Zip Code 90808	0.00%	None	0	0	0	Low
Zip Code 90810	0.51%	Low	1	1	9	Low
Zip Code 90813	0.73%	Low	1	1	24	Medium
Zip Code 90814	0.03%	Low	1	1	9	Low
Zip Code 90815	0.14%	Low	1	1	9	Low
Other	0.00%	None	0	0	0	Low
Total	0.19%	Low	1	1	18	Medium

RISK RANKING-Flood - 500-Year

	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	0.00%	None	0	0	0.56%	Low	1	2
Zip Code 90803	Medium	2	26.51%	High	3	9	27.19%	High	3	6
Zip Code 90804	Medium	2	1.57%	Low	1	3	1.26%	Low	1	2
Zip Code 90805	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90806	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90807	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90808	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90810	Medium	2	0.00%	None	0	0	1.39%	Low	1	2
Zip Code 90813	Medium	2	2.08%	Low	1	3	24.60%	Medium	2	4
Zip Code 90814	Medium	2	0.00%	None	0	0	0.07%	Low	1	2
Zip Code 90815	Medium	2	0.00%	None	0	0	0.23%	Low	1	2
Other	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Total	Medium	2	2.22%	Low	1	3	5.12%	Low	1	2

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	0.00%	None	0	0	4	Low
Zip Code 90803	0.76%	Low	1	1	32	Medium
Zip Code 90804	0.00%	None	0	0	10	Low
Zip Code 90805	0.00%	None	0	0	0	Low
Zip Code 90806	0.00%	None	0	0	0	Low
Zip Code 90807	0.00%	None	0	0	0	Low
Zip Code 90808	0.00%	None	0	0	0	Low
Zip Code 90810	0.51%	Low	1	1	6	Low
Zip Code 90813	0.73%	Low	1	1	16	Medium
Zip Code 90814	0.03%	Low	1	1	6	Low
Zip Code 90815	0.14%	Low	1	1	6	Low
Other	0.00%	None	0	0	0	Low
Total	0.19%	Low	1	1	12	Low

RISK RANKING-Dam Failure - Combined Dams

	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Low	1	0.17%	Low	1	3	1.78%	Low	1	2
Zip Code 90803	Low	1	54.86%	High	3	9	56.35%	High	3	6
Zip Code 90804	Low	1	6.19%	Low	1	3	10.88%	Medium	2	4
Zip Code 90805	Low	1	96.50%	High	3	9	94.16%	High	3	6
Zip Code 90806	Low	1	55.85%	High	3	9	36.92%	High	3	6
Zip Code 90807	Low	1	4.98%	Low	1	3	2.83%	Low	1	2
Zip Code 90808	Low	1	99.46%	High	3	9	85.40%	High	3	6
Zip Code 90810	Low	1	86.38%	High	3	9	74.26%	High	3	6
Zip Code 90813	Low	1	4.58%	Low	1	3	29.51%	High	3	6
Zip Code 90814	Low	1	4.17%	Low	1	3	5.21%	Low	1	2
Zip Code 90815	Low	1	81.26%	High	3	9	72.82%	High	3	6
Other	Low	1	55.56%	High	3	9	17.24%	Medium	2	4
Total	Low	1	51.16%	High	3	9	47.64%	High	3	6

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	0.52%	Low	1	1	6	Low
Zip Code 90803	23.96%	High	3	3	18	Medium
Zip Code 90804	3.54%	Low	1	1	8	Low
Zip Code 90805	54.22%	High	3	3	18	Medium
Zip Code 90806	11.42%	High	3	3	18	Medium
Zip Code 90807	1.21%	Low	1	1	6	Low
Zip Code 90808	39.36%	High	3	3	18	Medium
Zip Code 90810	3.76%	Low	1	1	16	Medium
Zip Code 90813	6.22%	Medium	2	2	11	Low
Zip Code 90814	1.91%	Low	1	1	6	Low
Zip Code 90815	49.36%	High	3	3	18	Medium
Other	14.21%	High	3	3	16	Medium
Total	21.63%	High	3	3	18	Medium

	RISK RANKING-Tsunami									
	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	25.50%	High	3	9	31.80%	High	3	6
Zip Code 90803	Medium	2	56.24%	High	3	9	60.17%	High	3	6
Zip Code 90804	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90805	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90806	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90807	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90808	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90810	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90813	Medium	2	0.07%	Low	1	3	19.28%	Medium	2	4
Zip Code 90814	Medium	2	6.42%	Low	1	3	8.48%	Low	1	2
Zip Code 90815	Medium	2	1.75%	Low	1	3	1.11%	Low	1	2
Other	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Total	Medium	2	6.68%	Low	1	3	11.49%	Medium	2	4

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	10.64%	High	3	3	**36**	**High**
Zip Code 90803	22.02%	High	3	3	**36**	**High**
Zip Code 90804	0.00%	None	0	0	**0**	**Low**
Zip Code 90805	0.00%	None	0	0	**0**	**Low**
Zip Code 90806	0.00%	None	0	0	**0**	**Low**
Zip Code 90807	0.00%	None	0	0	**0**	**Low**
Zip Code 90808	0.00%	None	0	0	**0**	**Low**
Zip Code 90810	0.00%	None	0	0	**0**	**Low**
Zip Code 90813	3.53%	Low	1	1	**16**	**Medium**
Zip Code 90814	3.90%	Low	1	1	**12**	**Low**
Zip Code 90815	0.31%	Low	1	1	**12**	**Low**
Other	0.00%	None	0	0	**0**	**Low**
Total	3.72%	Low	1	1	**16**	**Medium**

RISK RANKING - Sea Level Rise of 25cm with 100-year Storm S

	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	0.00%	None	0	0	1.59%	Low	1	2
Zip Code 90803	Medium	2	39.32%	High	3	9	35.16%	High	3	6
Zip Code 90804	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90805	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90806	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90807	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90808	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90810	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90813	Medium	2	0.00%	None	0	0	0.99%	Low	1	2
Zip Code 90814	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90815	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Other	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Total	Medium	2	2.75%	Low	1	3	3.22%	Low	1	2

Surge (3)

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	1.59%	Low	1	1	**6**	**Low**
Zip Code 90803	35.16%	High	3	3	**36**	**High**
Zip Code 90804	0.00%	None	0	0	**0**	**Low**
Zip Code 90805	0.00%	None	0	0	**0**	**Low**
Zip Code 90806	0.00%	None	0	0	**0**	**Low**
Zip Code 90807	0.00%	None	0	0	**0**	**Low**
Zip Code 90808	0.00%	None	0	0	**0**	**Low**
Zip Code 90810	0.00%	None	0	0	**0**	**Low**
Zip Code 90813	0.99%	Low	1	1	**6**	**Low**
Zip Code 90814	0.00%	None	0	0	**0**	**Low**
Zip Code 90815	0.00%	None	0	0	**0**	**Low**
Other	0.00%	None	0	0	**0**	**Low**
Total	3.22%	Low	1	1	**12**	**Low**

RISK RANKING - Sea Level Rise of 50cm with 100-year Storm S

	Probability		Impact on People				Impact on Property			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Zip Code 90802	Medium	2	0.00%	None	0	0	1.62%	Low	1	2
Zip Code 90803	Medium	2	46.10%	High	3	9	42.41%	High	3	6
Zip Code 90804	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90805	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90806	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90807	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90808	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90810	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Zip Code 90813	Medium	2	0.00%	None	0	0	12.26%	Medium	2	4
Zip Code 90814	Medium	2	0.20%	Low	1	3	0.26%	Low	1	2
Zip Code 90815	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Other	Medium	2	0.00%	None	0	0	0.00%	None	0	0
Total	Medium	2	3.24%	Low	1	3	5.03%	Low	1	2

urge (3)

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Zip Code 90802	1.62%	Low	1	1	**6**	**Low**
Zip Code 90803	42.41%	High	3	3	**36**	**High**
Zip Code 90804	0.00%	None	0	0	**0**	**Low**
Zip Code 90805	0.00%	None	0	0	**0**	**Low**
Zip Code 90806	0.00%	None	0	0	**0**	**Low**
Zip Code 90807	0.00%	None	0	0	**0**	**Low**
Zip Code 90808	0.00%	None	0	0	**0**	**Low**
Zip Code 90810	0.00%	None	0	0	**0**	**Low**
Zip Code 90813	12.26%	High	3	3	**14**	**Low**
Zip Code 90814	0.26%	Low	1	1	**12**	**Low**
Zip Code 90815	0.00%	None	0	0	**0**	**Low**
Other	0.00%	None	0	0	**0**	**Low**
Total	5.03%	Medium	2	2	**14**	**Low**

Appendix D. Status of Actions Identified in Previous Hazard Mitigation Plan

D. Status of Actions Identified in Previous Hazard Mitigation Plan

The 2017 City of Long Beach Hazard Mitigation Plan action items were reviewed for the current update, and for each action it was determined whether the action had been completed, was in progress, or had not been started. Incomplete actions were reviewed to determine if they should be carried over to the 2022 update or removed from the plan due to a change in priorities, capabilities, or feasibility. The table below lists the status of all actions from the 2017 plan.

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update	
			Check if Yes	Action # in Update
Action MH-1 Continue to integrate the goals and action items from the Hazard Mitigation Plan (Plan) into existing regulatory documents and programs, where appropriate.	✓			
Comment: This is completed on a yearly basis				
Action MH-2 Identify and pursue funding opportunities to develop and implement local mitigation activities.	✓			
Comment: The Earthquake Early Warning system application was submitted in June of 2021 and is currently undergoing the approval process with FEMA. The flood mitigation application was denied by CalOES HMP Grant Program, but is being carried over by Public Works as new action items as they identify funding for it.				
Action MH-3 Monitor and evaluate Citywide mitigation activities. Committee would likely include Fire and Police Chiefs, Directors of Development Services, Technology Services, Public Works, and Disaster Preparedness and Emergency Communications.		✓		
Comment: No longer needed				
Action MH-4 Identify, improve, and sustain collaborative programs to: educate the community, develop or enhance partnerships, coordinate emergency responses, and mitigate the risks of City departments as well as our community. These programs include our public/private partners, local area volunteer organizations and agencies as needed. Partners will provide and share subject matter experts for the development of reasonable mitigation programs and projects.	✓			
Comment: Take part in Community Partner meetings (with businesses and non-profits)				
Action MH-5 Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in the City.	✓			
Comment: Take part in Community Partner meetings (with businesses and non-profits)				
Action MH-6 Update inventory of at-risk City-owned critical facilities including buildings and infrastructure. Develop photo inventories, building asset lists, and equipment lists.	✓			
Comment: Completed during the last plan cycle				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-7 Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhancing public education on a local scale.	✓			
Comment: Yearly community outreach events and CPO meetings				
Action MH-8 Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to residents, public agencies, private property owners, businesses, and schools.	✓			
Comment: Yearly community outreach events and CPO meetings				
Action MH-9 Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.		✓		
Comment: No longer needed				
Action MH-10 Update Public Safety Element and Seismic Safety Element of the City's General Plan			✓	DS-5
Comment: Development Services is currently working on this				
Action MH-11 Ensure SEMS-mandated plans, training and exercises are updated and implemented.	✓			
Comment: Follow state and federal guidelines for plans, training, and exercises				
Action MH-12 Expand Mitigation Plan to include man-made hazards (HAZMAT, terrorism, etc.). Thorough hazard analysis will be completed and the man-made risks will be added.	✓			
Comment: Completed in 2017 Hazard Mitigation Plan				
Action MH-13 Incorporate the building inventory into the hazard assessment.	✓			
Comment: Completed during the last plan cycle				
Action MH-14 Ensure compliance to rebuilding in conformance with applicable codes, specifications, and standards.	✓			
Comment: Implemented before every new construction and update projects				
Action MH-15 Ensure repairs or construction funded by Federal disaster assistance conform to applicable codes and standards.		✓		
Comment: No longer needed				
Action MH-16 Review existing zoning regulations to ensure adequacy in reducing the amount of future development in area with identified hazards.	✓			
Comment: Completed before every new project				
Action MH-17 Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventive measures for existing development in areas vulnerable to natural hazards.			✓	DS-6
Comment: HMP 2015 and 2021				
Action MH-18 Use the Mitigation Plan to help the City's General Plan meet State regulations designed to protect life and property from natural disasters and hazards through planning strategies that restrict development in areas of known hazards. (California Coastal Commission, State Lands Commission)	✓			
Comment: Ongoing				
Action MH-19 Coordinate and integrate natural hazard mitigation activities, where appropriate, with the City's Emergency Operations Plan.	✓			
Comment: Ongoing				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update	
			Check if Yes	Action # in Update
Action MH-20 Identify, improve, and sustain collaborative programs focusing on the real estate and insurance industries, public and private sector organizations, and individuals to avoid activity that increases risk to natural hazards.		✓		
Comment: No longer needed				
Action MH-21 Maintain list of critical facilities at risk from natural hazards events.	✓			
Comment: Completed and maintained on a regular basis by TID and GIS				
Action MH-22 Recommend revisions to requirements for development within the floodplain, where appropriate.	✓			
Comment: Ongoing				
Action MH-23 Encourage construction and subdivision design that can be applied to steep slopes to reduce the potential adverse impacts from development.	✓			
Comment: Ongoing				
Action MH-24 Identify bridges at risk from flood or earthquake hazards, identify enhancements, and implement projects needed to reduce the risks. City owned properties are priority for the City. Advocacy program needed for other agencies to address non-City owned infrastructure.	✓			
Comment: City has developed lists and maps of critical infrastructure. This is an ongoing project. Public Works, Development Services, and GIS team review and edit City maps as necessary. A similar action item has been created for new table.				
Action MH-25 Ensure communication and dissemination of natural hazard mitigation information.	✓			
Comment: Ongoing				
Action MH-26 Review protocol for communications between non-city utility providers and their response teams to assure rapid restoration of services to impacted areas.	✓			
Comment: Ongoing with CPO and County organizations				
Action MH-27 Review strategy to maintain all forms of communications and the facilities required to support communications should natural hazards events cause damages.	✓			
Comment: Yearly communication drills				
Action MH-28 Review Preliminary Damage Assessment process to ensure efficiency and effectiveness.	✓			
Comment: Incorporated into EOP. A PDE process was established in the City's Emergency Operations Plan.				
Action MH-29 Maintain communication lines and response protocols between transportation entities (i.e. Public Works, CalTrans, LA County) to prioritize and identify strategies to deal with road problems and traffic control.	✓			
Comment: Ongoing				
Action MH-30 Provide new home and property buyers with information on quality redevelopment and safe housing development.		✓		
Comment: No longer feasible				
Action MH-31 Review City zoning regulations to ensure adequacy of restrictions to reduce future development in high hazard areas.	✓			
Comment: Ongoing				
Action MH-32 Compile a directory of out-of-area contractors to help with repairs /reconstruction so that restoration occurs in a timely manner.	✓			
Comment: Ongoing				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-33 Partner with other organizations and agencies in the community to identify grant programs and foundations that may support mitigation activities. **Comment:** Ongoing. CPO's meeting, County	✓			
Action MH-34 Allocate City resources and assistance to mitigation projects when and where possible to do so. Use the City's normal budget process to establish the appropriations needed to support mitigation project activities. **Comment:** Currently applying to HMG for funding	✓			
Action MH-35 Identify all organizations within the jurisdiction that have programs or interests in natural hazards mitigation. **Comment:** CPO's	✓			
Action MH-36 Identify new sources of support such as philanthropic foundations, community foundations, and professional organizations such as the Urban Land Institute or American Planning Association who might be able to provide technical or financial support for recovery planning. **Comment:** Ongoing, partnered with the Long Beach Foundation	✓			
Action MH-37 Identify additional opportunities for partnering with citizens, private contractors, and other jurisdictions to increase availability of resources (equipment, staffing, and expertise) for response efforts. **Comment:** Ongoing community outreach	✓			
Action MH-38 Encourage development of additional Community Emergency Response Teams (CERT). Expand team development to include business owners/operators. **Comment:** Ongoing, partnership with LBFD	✓			
Action MH-39 Familiarize public officials of requirements regarding public assistance for disaster response. **Comment:** Ongoing	✓			
Action MH-40 Repeat the Community Hazards Mitigation and Preparedness Questionnaire in five years (must be completed prior to start of next Mitigation Plan update). **Comment:** Conducted during HMP update	✓			
Action MH-41 Develop Debris Management Plan for future disaster events including supporting documentation and contracts. **Comment:** Response activity, future project		✓		
Action MH-42 Enhance weather monitoring to attain earlier severe storm warnings. **Comment:** Coordination with County and NWS	✓			
Action MH-43 Improve communication among the adjoining transportation entities in order to improve coordination of emergency transportation route maintenance. **Comment:** Ongoing, continued meetings with LB Transit	✓			
Action MH-44 Establish a committee to work on animal specific evacuation and sheltering needs. The committee will have representatives from all areas of the City including veterinarians, pet store owners, the Humane Society, animal shelters, the Animal Control Division, other agencies and local interested parties. **Comment:** Worked with County on Animal Evacuation Annex	✓			
Action MH-45 Develop informational literature on recommended disaster response plans and emergency supply kits and for animals/pets and have them available in veterinary clinics and pet stores. **Comment:** Developed brochures and informational material; Pet Preparedness Month	✓			

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-46 Incorporate the training goals and objectives used by Fire/EMS, Police, Public Works, Health and Human Services in order to foster unified command relationships. Combine all City Departments/Teams in the process.	✓			
Comment: Ongoing trainings and exercises				
Action MH-47 Develop mitigation strategies to protect identified at-risk historic properties.	✓			
Comment: Implemented in 2021 HMP				
Action MH-48 Conduct a full review of the Mitigation Plan and Mitigation Action Items every 5 years. Evaluate the successes, failures, progress toward mitigation goals as outlined in the program. Complete the Community Hazards Mitigation and Preparedness Questionnaire. Review best practices, policies and procedures to identify for new mitigation opportunities.	✓			
Comment: Ongoing				
Action MH-49 Establish and implement the National Incident Management System (NIMS) in each agency/department.	✓			
Comment: Ongoing with every plan update				
Action MH-50 Identify water resources management and conservation opportunities.	✓			
Comment: Ongoing, implemented by Water department				
Action MH-51 Develop a strategy to ensure vehicle access routes to key health care facilities will remain accessible immediately after a disaster.		✓		
Comment: Will work on debris management plant				
Action MH-52 Develop inventory of backup power resources (generators) for critical City facilities. Encourage non-city owned and essential facilities (such as hospitals, nursing homes, etc.) to develop a plan to acquire and install emergency generators. Encourage upgrading of resources, as necessary.			✓	PW-39
Comment: Ongoing, working on backup power for shelter sites. Removed non-city owned aspect of this action due to lack of jurisdiction over private facilities.				
Action MH-53 Enhance emergency services to increase the efficiency of mutual aid wildfire response and recovery activities.		✓		
Comment: LB is not affected by wildfires				
Action MH-54 Enhance response capability of City fire, police, and emergency medical services personnel to meet the special needs of our most vulnerable residents including access and functional needs populations.	✓			
Comment: Hired Equity Officer and ADFN coordinators to assist with response planning. The Office of Equity was established in 2020. The City created the role of Citywide Accessibility Coordinator in 2018, this role now manages the Access and Inclusion Bureau.				
Action MH-55 Ensure preventive maintenance programs are in place and appropriately funded to maintain the community's infrastructure and minimize the potential for system failure because of or during a disaster.	✓			
Comment: Ongoing, PW does routine maintenance of infrastructure				
Action MH-56 Publicize the Emergency Management Institute's Independent Study Courses available to the public to include but not limited to Emergency Preparedness USA, Hazardous Material: Citizen Orientation, Animals in Disaster, Disaster Mitigation for Homeowners.	✓			
Comment: Ongoing, community outreach				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-57 Teach CERT classes to interested citizens in the City to assist their neighbors during emergencies. These courses will be taught in various locations throughout the City, utilizing the staff resources including EMS, Fire, Police and external resources including American Red Cross.	✓			
Comment: Ongoing, Fire holds CERT courses and trainings				
Action MH-58 Conduct annual tabletop disaster exercises with police, fire, emergency management, and other disaster response departments and agencies.	✓			
Comment: Ongoing				
Action MH-59 Pre-position first response equipment and personnel at large venues during scheduled events.	✓			
Comment: Ongoing				
Action MH-60 Work with the organizations involved in shelter management (ARC and schools) to share information about local shelters.	✓			
Comment: Ongoing, CPO TTX and meetings				
Action MH-61 Create and make available information to City residents on "shelter-in-place" procedures.	✓			
Comment: Ongoing, conducted by Risk Management				
Action MH-62 Utilize Neighborhood Resource Centers for distribution of natural hazard public awareness materials.	✓			
Comment: Ongoing, community outreach				
Action MH-63 Develop public awareness materials that educate the community on natural and man made hazard preparedness and responses. Share information on how to access resources, materials and self-help agencies available to the public.	✓			
Comment: Ongoing				
Action MH-64 Distribute weather-related disaster preparedness literature to all property owners. Include information on tropical storms, high winds, drought, severe storms, etc.	✓			
Comment: Ongoing				
Action MH-65 Continue to distribute letters to all property owners on the importance of water conservation and availability of water saving devices for homes.	✓			
Comment: Ongoing, Water Dept.				
Action MH-66 Provide business continuity workshops for business owners to learn the importance of disaster mitigation and how to create an emergency operations plan for their businesses.	✓			
Comment: Ongoing, information distribution				
Action MH-67 Train EMS, Fire, Police, Public Works, Health and Human Services and other support personnel in Unified Command using the National Incident Management System (NIMS) model. By understanding the role of each discipline will result in a cohesive performance of their assigned tasks yielding an overall emergency response that is not only effective, but rapid with optimal outcome.	✓			
Comment: Ongoing, TTX and tranings				
Action MH-68 Distribution of information on fire safety, smoke alarms and sprinkler systems to homeowners of structures built before 1980.	✓			
Comment: Ongoing, community outreach				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-69 Maintain and publicize availability of preparedness information and materials at Fire Stations and City Hall. The locations will stock materials that may include: Emergency Preparedness Guidebook, FEMA's Are You Ready, and other brochures on disaster supplies kits and plans, etc.	✓			
Comment: Ongoing				
Action MH-70 Consider expanding the Region I (Local Emergency Preparedness Committee's (LEPC) responsibilities to include mitigation planning and disaster preparedness education activities.		✓		
Comment: Staffing limitations				
Action MH-71 Utilize the media for the distribution and publication of hazard information.	✓			
Comment: Ongoing, social media and press releases				
Action MH-72 Strategize on updating existing emergency preparedness booth to include "how to" mitigation materials. The new booth could include pictures and information, such as those contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, how to elevate critical structures and utilities and information on the NFIP.	✓			
Comment: Ongoing, community outreach				
Action MH-73 Integrate the Mitigation Plan with the Capital Improvement Plans to ensure that development does not encroach on known hazard areas.	✓			
Comment: Ongoing				
Action MH-74 Establish City priorities for restoration of the community's infrastructure/utilities and access to critical public facilities following a disaster.	✓			
Comment: Ongoing, updated annually; critical infrastructure list				
Action MH-75 Enhance Fire Department's Speaker's Bureau to include natural hazard topics.	✓			
Comment: Ongoing, LBFD Community Outreach Team				
Action MH-76 Create and maintain a database with information to track the status of City-owned or occupied facilities repairs or reconstruction.	✓			
Comment: Ongoing, critical infrastructure list				
Action MH-77 Prepare a policy that identifies which types of repairs and/or construction, if any, could temporarily be exempt from local codes or ordinances to expedite post disaster recovery.		✓		
Comment: No longer applicable				
Action MH-78 Determine capacity in local construction and debris landfills to absorb the estimated inflow of disaster/restoration debris and set up contracts or agreements to use these sites.		✓		
Comment: Will develop a debris removal plan				
Action MH-79 Coordinate with American Red Cross to deliver a variety of training courses, including: CPR, Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, babysitting, Healthcare Provider, and pet first-aid at locations throughout the City.	✓			
Comment: Ongoing, run by ARC				
Action MH-80 Develop a program to educate the public on existing disaster-related self-help agencies and resources available within the City.	✓			
Comment: Ongoing, community outreach				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-81 Establish website links with outside disaster relief agencies such as the Hospital and County Social Services. **Comment:** Ongoing, currently in development	✓			
Action MH-82 Post the Mitigation Plan on the City's website. **Comment:** Currently on website	✓			
Action MH-83 Utilize the City's website to share City media releases and create links to share information from agencies such as the American Red Cross, CERT, the LEPC Committee, and volunteer organizations active in disaster relief. **Comment:** Ongoing	✓			
Action MH-84 Educate the public about hazards prevalent to their area. **Comment:** Ongoing	✓			
Action MH-85 Create, update, and deliver multi-media children's programs that teach safety. Examples of information to be used would be similar to that on the FEMA for Kids CD, the Sparky Fire Safety Program, and/or the American Red Cross's Masters of Disasters program. **Comment:** Ongoing, partnered with Red Cross	✓			
Action MH-86 Enhance boater safety materials that are targeted toward severe storms. Distribute the materials at all local marinas in the City. **Comment:** Provide general preparedness information		✓		
Action MH-87 Work with the Visitor and Convention Bureau and business development organization to alert tourists to the potential of natural hazard areas and what to do if a natural hazard occurs during their visit to the City. **Comment:** Ongoing, text to sign up program	✓			
Action MH-88 Develop and distribute press releases to local media organizations (television, newspapers, radio stations, and internet news services) including disaster preparedness information prior to, during and after a foreseeable event. The same information can be released through social media resources. **Comment:** Ongoing, run by Public Affairs	✓			
Action MH-89 Create and deliver public service announcements on personal preparedness as well as mitigation steps and strategies. Develop media plan to share information **Comment:** Ongoing, information shared through LBTV	✓			
Action MH-90 Maintain supplies and training associated with use of ATC-20 standards (building inspections following disaster). **Comment:** Working on Safety Assessment Program training			✓	DS-7
Action MH-91 Promote CERT through the Chamber of Commerce to gain business participation. **Comment:** Ongoing, CERT promoted on City website	✓			
Action MH-92 Develop training on the Mitigation Plan for the Planning Commission and others involved in the development process. **Comment:** Ongoing, training staff as plan is developed. Planning staff is involved in the plan development. No need to carry over.		✓		
Action MH-93 Maintain list of internal training resources by department and share training opportunities. **Comment:** Ongoing, shared by departments as they come up	✓			
Action MH-94 Ensure adequacy and functionality of the alternate ECOC. **Comment:** Ongoing, grant purchases to outfit alternate EOC and backup 9-1-1	✓			

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-95 Build and maintain new Emergency and Operations Center (ECOC).		✓		
Comment: No longer needed				
Action MH-96 Maintain database in existing hazard GIS system of all previous lost properties in the City to be used in future mitigation activities.	✓			
Comment: Ongoing, maintained by DS, PW, and GIS				
Action MH-97 Continue collection of HAZMAT reports from local facilities to enhance and prepare emergency responders in the event of a “secondary impact” incident at these facilities.	✓			
Comment: Ongoing				
Action MH-98 Determine how, when, and under what circumstances government will demolish property or structures	✓			
Comment: Ongoing, maintained by PW				
Action MH-99 Retrofit city owned bridges and tunnels.			✓	PW-41, PW-42
Comment: Carried over as two separate, better defined actions. Large-scale projects to be handled by PW				
Action MH-100 Incorporate new Mitigation Plan Hazard Analysis into the MHFP Threat Assessment update.	✓			
Comment: Updated during the last plan cycle.				
Action MH-101 Update the City’s Emergency Operations Plan to conform with State 3-year review requirements	✓			
Comment: Ongoing, in progress				
Action MH-102 Incorporate the mitigation activities identified in the City’s General Plan into the Mitigation Plan.		✓		
Comment: Determined no longer feasible by Development Services				
Action MH-103 Continue a city wide public outreach and education activities relating to local natural hazards.	✓			
Comment: Ongoing, social media, community outreach activities, and city website				
Action MH-104 Revise the Zoning and/or Subdivision Ordinance to require the utilization of various pervious surfaces within the floodplain in order to reduce storm water runoff. This should include utilizing the use of various pervious surfaces in parking lots in recreational areas near the floodplain.	✓			
Comment: Completed by Development Services in 2019				
Action MH-105 Upgrade the existing generator and electrical systems at Long Beach Airport.			✓	AIR-43
Comment: Still a viable action and will be carried over				
Action MH-106 Install new public address system at Long Beach Airport.	✓			
Comment: Completed in 2022				
Action MH-107 Replace Long Beach Airport’s existing 1,500 gallon Aircraft Rescue Firefighting vehicle with a 3,000 gallon vehicle and replacement of the existing rapid response fire fighting vehicle with a new rapid response vehicle.		✓		
Comment: No longer feasible				
Action MH-108 Complete Americans with Disabilities Act (ADA) building upgrades in various locations throughout the City.			✓	PW-40
Comment: Ongoing				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-109 Complete various structural repairs and improvements to existing critical facilities.			✓	PW-36, PW-37
Comment: Split into two separate actions in the update to better define the actions				
Action MH-110 Design and construct Emergency Communications and Operations Center (ECOC).		✓		
Comment: No longer needed. Yearly maintenance is conducted.				
Action MH-111 Repair residential streets to correct drainage problems and pavement failure.	✓			
Comment: Ongoing, maintained by PW				
Action MH-112 Install Opticom unit on traffic signals at prioritized intersections in order to enhance emergency vehicle response times and operational safety by allowing emergency vehicles to pre-empt signal timing.	✓			
Comment: Completed in 2020				
Action MH-113 Update status of action items in the Hazard Mitigation Plan Matrix on an annual basis.	✓			
Comment: Ongoing, completed on an annual basis				
Action MH-114 Consider incorporating man-made and technological hazards in future updates to the Mitigation Plan.	✓			
Comment: Will be assessed and incorporated into 2021 update				
Action MH-115 Identify opportunities and funding to establish a Hazardous Materials Team.	✓			
Comment: Health has implemented this program and monitors grant opportunities on a yearly basis				
Action MH-116 Develop tabletop exercises with assistance from Public Safety in order to better identify mapping needs for emergency response situations and EOC activations.	✓			
Comment: Ongoing, Work with GIS team periodically to ensure maps have updated information.				
Action MH-117 Coordinate community outreach and education activates with the American Red Cross. Utilize information published by the Red Cross as well as the National Disaster Education Coalition in "Talking About Disasters: Guide for Standard Messages". http://www.disastereducation.org	✓			
Comment: Ongoing, partnership with Red Cross				
Action MH-118 Develop a forum for interagency communication and cooperative planning and preparedness activities (DMPC).	✓			
Comment: Ongoing, Veoci and ALERTLB.				
Action MH-119 Prepare pre-scripted messages for use in emergency response and recovery.	✓			
Comment: Messaging developed as part of the Crisis Communications Plan in 2019.				
Action MH-120 Include Health and Human Services in all City-wide disaster exercises.	✓			
Comment: Ongoing, TTX, trainings, CPO meetings.				
Action MH-121 Identify grant opportunities to fund specialized equipment for public health emergency response activities.	✓			
Comment: Ongoing, HHS Uses state and federal grants.				
Action MH-122 Conduct pharmaceutical dispensing exercises in Long Beach and participate in Operating Area dispensing exercises where possible.	✓			
Comment: Health conducts a yearly MCM exercise.				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-123 Conduct regional forums on public health disasters.	✓			
Comment: No longer feasible due to staff limitations. DPREP has incorporated HHS into Community Partner meetings.				
Action MH-124 Maintain and regularly exercise Health and Human Services staff and functions.	✓			
Comment: The Health Department conducts yearly training on various aspects of response.				
Action MH-125 Train Health and Human Services staff on ICS and SEMS.	✓			
Comment: Ongoing, PHEM oversees their department training and conducts yearly training.				
Action MH-126 Maintain and regularly exercise Health and Human Services staff and functions. Train community on Health and Human Services' role in a disaster.	✓			
Comment: Ongoing, PHEM oversees their department training and conducts yearly training.				
Action MH-127 Train City's first responders and community service partners in the Department of Health and Human Services' disaster response plans.	✓			
Comment: Ongoing, PHEM oversees their department training and conducts yearly training.				
Action MH-128 Prepare Mental Health response plan to disasters. Note: County Mental Health Department is the lead and City of Long Beach will assist in the development and oversight of the plan.	✓			
Comment: DPrep and Health maintain good communication with County Mental Health to ensure resources are in place after a disaster. Not year-specific but Health uses MHOAC to make requests for Mental Health services				
Action MH-129 Develop a Memorandum of Understanding with the American Red Cross on mutual aid with Public Health/City.	✓			
Comment: No longer needed.				
Action MH-130 Enhance public health communications equipment to meet City's first response standards.	✓			
Comment: Ongoing, use of Veoci, social media, and ALERTLB				
Action MH-131 Continue to work with first responders on force protection issues for pharmaceutical distribution sites.	✓			
Comment: Health works with PD to ensure protection during any pharmaceutical transportation. They also conduct yearly exercises.				
Action MH-132 Exercise Health Department evacuation capacity to a disaster event.	✓			
Comment: Ongoing, exercises held periodically				
Action MH-133 Exercise Health Department's Department Operations Center in response to natural disaster evacuation exercise.	✓			
Comment: Health conducts frequent trainings.				
Action MH-134 Maintain Health Department Safety Committee and provide appropriate staff training as determined by City's Safety Department.	✓			
Comment: Ongoing, HHS oversees committee and trainings as appropriate				
Action MH-135 Develop and maintain a platform for intra-departmental and inter-agency cooperation.	✓			
Comment: Ongoing, Health uses Veoci.				
Action MH-136 Develop a process to ensure coordination between PIOs from all City departments.	✓			
Comment: Ongoing, PA coordinates City-wide communications meetings.				
Action MH-137 Upgrade existing USAR capabilities (done through grants).	✓			
Comment: Ongoing, FD receives UASI funds for this purpose.				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update	
			Check if Yes	Action # in Update
Action MH-138 Upgrade existing EOC with technology to better communicate with the operational area and the public.	✓			
Comment: Ongoing, better integration of existing communication methods and upgrades to HAM radio room				
Action MH-139 Encourage all employees to prepare themselves by understanding their local hazards, stocking up with necessary items, and planning for how family members should respond if any number of possible or emergency or disaster events strike.	✓			
Comment: Ongoing, information provided on city website and citywide communications.				
Action MH-140 Acquire, install and/or replace backup generators at city owned critical facilities and essential facilities.	✓			
Comment: Ongoing. PRM is currently installing generators at shelter locations.				
Action MH-141 Continue enforcement of weight and truck travel restrictions especially as they relate hazardous materials transportation. Specifically provide training, equipment, and administrative support to commercial enforcement efforts.	✓			
Comment: Ongoing, managed by PW				
Action MH-142 Prepare a response plan, as well as a training and exercise program for mass casualty incidents involving all modes of transportation to include the investigation of such accidents. Response plans should include all city safety departments. Exercise Plan should include the investigation of large scale incidents.	✓			
Comment: Ongoing, TTX and trainings with City staff. City will begin the development of an evacuation and family assistance center plan.				
Action MH-143 Train city staff in the County of Los Angeles's SNAP program and encourage residents to register for the program.	✓			
Comment: Health does this on an ongoing basis.				
Action MH-144 Complete Harbor Department Climate Change Study to determine expectations to the Port, impacts to critical infrastructure, and develop further mitigation measures for both short term (current infrastructure) and long term mitigation methods (future construction and/or major modifications.		✓		
Comment: No longer feasible				
Action MH-145 Continue pilot Electrical Power Assessment to validate current as built electrical grid, and develop contingencies for repower in event of widespread and prolonged loss.	✓			
Comment: No longer needed.				
Action MH-146 Identify and pursue funding for Harbor District owned bridges that fail to meet current earthquake standards.		✓		
Comment: No longer feasible				
Action MH-147 Identify, improve, and plan Port Cargo Infrastructure seismic and other hazard retrofit and replacement strategies to oil terminals, cargo facilities, and cargo equipment.			✓	HD-44
Comment: Still a viable action and needs to be carried over				
Action MH-148 Develop and identify emergency and contingency fuel supplies and capabilities that can be utilized during regional disruption. Fuel will be needed for emergency and first response vessels/vehicles; salvage vessels: pilot and harbor assist tugs; and for operating backup generators at	✓			
Comment: Ongoing, maintained by Energy Resources				

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Action MH-149 Acquire LAR-IAC4 digital aerial data, Oblique Imagery, and updated building data for the City of Long Beach to better analyze hazards	✓			
Comment: Completed in 2017				
Action MH-150 Create internet interactive-mapping for the public to view potential natural hazards in their area.	✓			
Comment: StoryMap included in 2022 Hazard Mitigation Plan update				
Action MH-151 Safety Officer should survey and maintain an inventory of city facilities with possible of asbestos containing materials so that in the event of a disaster, emergency responders can take proper precautions prior to entering these locations.		✓		
Comment: No longer feasible				
Action MH-152 Update Police Department Emergency Operations Plan to conform to an "all hazards" environment.		✓		
Comment: No longer feasible				
Action MH-153 Design, engineer, create plan and identify resources to replace continuous power source at Fire HA (operations center) via generator.			✓	FD-19
Comment: Still a viable action that needs to be carried over. Modified action description.				
Action MH-154 Develop, equip, and deploy a surge capacity-staffing plan for one additional urban search and rescue (USAR) vehicle.		✓		
Comment: No longer feasible				
Action MH-155 Ensure the completion of the specific assigned portion of the Emergency Operations Directory including resource information and guidelines for incident management.	✓			
Comment: Ongoing, EOC Resource Guide and City Managers Emergency Contacts updated periodically				
Action MH-156 Develop a comprehensive response plan and protocols to define philosophy, resources, guidelines and contacts for large-scale events such as acts of terrorism or regional disasters.	✓			
Comment: Ongoing, plans updated as necessary				
Action MH-157 Develop a Memorandum of Understanding with the American Red Cross on emergency response support services such as Mass Care and Sheltering Operations, Communications, Volunteer Assistance, Training, etc.	✓			
Comment: Ongoing, MOU is no longer needed.				
Action MH-158 Develop a Memorandum of Understanding with the Long Beach Unified School District on emergency response support services such as Feeding Programs for Response Teams, and Mass Care and Sheltering Operations support, Communications, Training, etc.	✓			
Comment: High turnover at LBUSD has put a stop on this project. Verbal agreements have been discussed.				
Action MH-159 Develop an inventory of emergency communications equipment for City departments to use if traditional communications systems fail. Possible equipment to include satellite phones, radios, or other emerging technologies designed to operate in an emergency response scenario.	✓			
Comment: Ongoing, DPREP working with TID to establish inventory lists				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action MH-160 Develop "Whole Community" program to assist community leaders in preparing their neighborhoods from emergencies. Partner with the American Red Cross to provide training on the "Map Your Neighborhood" program as well as other training courses available to the public. Partner with CERT to provide training to create additional teams in these neighborhoods. Provide personal preparedness information to community leaders to assist them in educating their neighbors.	✓			
Comment: Ongoing, The city incorporated the Whole Community approach in all its planning.				
Action MH-161 Establish an agreement with other municipal organizations outside of the impacted disaster area (based on the size and intensity of the event) for the relocation of City support functions (HR, Finance, etc.) to an alternative operating location.	✓			
Comment: DPREP has worked with City departments to update their continuity plans which include working from home.				
Action MH-162 Provide business owners and operators with workshops to learn the importance of hazard mitigation, continuity of operations and how to create an emergency response plan for their businesses.	✓			
Comment: Ongoing, information for businesses and outreach by ED				
Action EQ-1 Update earthquake hazard mapping data for the City and improve technical analysis of earthquake hazards.	✓			
Comment: Additional data will be provided in 2021 update				
Action EQ-2 Identify funding sources for structural and nonstructural retrofitting of buildings projects. Projects structures must be identified as seismically vulnerable.	✓			
Comment: When available, the city applies for hazard mitigation funding.				
Action EQ-3 Conduct seismic strength evaluations of critical facilities in the City to identify vulnerabilities for mitigation of City-owned and occupied, and public infrastructure to meet current seismic standards.	✓			
Comment: Ongoing, Development services conducts evaluation when needed.				
Action EQ-4 Encourage reduction of non-structural and structural earthquake hazards in homes, schools, businesses, and government offices.	✓			
Comment: Ongoing, HMP EEW project and information provided to LBUSD and through ED				
Action EQ-5 Research and evaluate possibility of adopting retrofitting requirement for different classes of structures.	✓			
Comment: Completed in 2018				
Action EQ-6 Rehabilitate bridges and coordinates seismic deficiencies noted in the Los Angeles County's Annual Bridge Inspection Report.		✓		
Comment: Removed as written. Rewritten in the update to better capture the action.				
Action EQ-7 Seek funding to update the City's Seismic Safety Element of the General Plan.	✓			
Comment: Development Services is currently working on this.				
Action EQ-8 Input historical bore locations to complete Earthquake Fault GIS data for use in future Threat Assessments.	✓			
Comment: Additional data will be provided in 2021 update				
Action EQ-9 Encourage seismic retrofitting of unreinforced masonry buildings.	✓			
Comment: Ongoing by Development Services				
Action EQ-10 Encourage and provide technical information for voluntary retrofitting of existing structures.	✓			
Comment: Ongoing through public information.				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update	
			Check if Yes	Action # in Update
Action EQ-11 Invest in an earthquake early warning system to notify first responders of an eminent earthquake threat and ensure that systems are in place to prepare stations (PD/Fire) for an earthquake (open doors, stop elevators, etc.).	✓			
Comment: Ongoing, EEW project submitted for HMP funding				
Action EQ-12 Increase public awareness of earthquake mitigation activities.	✓			
Comment: Ongoing, community outreach and informational materials provided to community.				
Action FLD-1 Develop better flood warning systems. Explore the use of current technology to enhance the system.	✓			
Comment: Ongoing, the City has purchased outdoor warning systems that can serve for this purpose.				
Action FLD-2 Enhance data and mapping for floodplain information within the City and identify and map flood-prone areas outside of designated floodplains.	✓			
Comment: Additional data will be provided in 2021 update				
Action FLD-3 Analyze each repetitive flood property within the City and identify feasible mitigation options.	✓			
Comment: Additional data will be provided in 2021 update				
Action FLD-4 Recommend revisions to requirements for development within the floodplain, where appropriate.	✓			
Comment: No longer needed				
Action FLD-5 Identify surface water drainage obstructions for all parts of the City.	✓			
Comment: Public Works conducts routine maintenance on a drainage prior to any storms.				
Action FLD-6 Continue to compile and coordinate surface water management plans and data throughout the City.	✓			
Comment: Public works updates plans periodically.				
Action FLD-7 Enact a local ordinance that prohibits draining, filling, or construction of buildings, roads, or other infrastructure in designated wetlands. This would help to protect the flood-control function of the wetland, preserve water quality, and ensure adequate in-stream flow.	✓			
Comment: Ongoing by development services.				
Action FLD-8 Research and prepare a policy that identifies measures intended to minimize the risk of coastal erosion. This includes development, construction and daily operations/maintenance measures.	✓			
Comment: Ongoing by development services.				
Action FLD-9 Distribute information on the National Flood Insurance Program to local businesses in or near the floodplain.	✓			
Comment: Ongoing, maintained by Development services.				
Action FLD-10 Coordinate in-house training sessions on the regulations associated with NFIP.		✓		
Comment: Staffing has limited our involvement in this action.				
Action FLD-11 Review the City's floodplain ordinance to be sure it is in full compliance with the NFIP.	✓			
Comment: Ongoing, maintained by DS				
Action FLD-12 Encourage acquisition of and management strategies to preserve open space for flood mitigation, bird habitats, and water quality in the floodplain.	✓			
Comment: Ongoing, maintained by DS				

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Action FLD-13 Identify surface water drainage obstructions for all parts of the City.	✓			
Comment: Ongoing, maintained by public works.				
Action FLD-14 Improve drainage systems for the runways at Long Beach Airport.	✓			
Comment: Ongoing maintenance is conducted.				
Action FLD-15 Perform a feasibility study for assistance in restoring the estuarine ecosystem of the Colorado Lagoon, improving water quality, managing storm water, and supporting environmental education, safe public recreation, and coastal access.		✓		
Comment: A new action item was written to better meet new priorities.				
Action FLD-16 Repair and maintain seawalls in the city	✓			
Comment: Ongoing, maintained by public works.				
Action FLD-17 Complete structural improvements to storm water/urban runoff systems.	✓			
Comment: Ongoing, City has used general fund and has applied for mitigation grants.				
Action FLD-18 Regulate construction in designated floodplains via elevation of structures or flood proofing.	✓			
Comment: Ongoing, regulated by development services.				
Action EM-1 Improve knowledge of earth movement hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	✓			
Comment: Ongoing, maintained by DS				
Action EM-2 Research and evaluate possible landslide warning system.	✓			
Comment: Ongoing, identifying funding opportunities				
Action EM-3 Limit activities in identified potential and historical landslide areas through regulations and public outreach.	✓			
Comment: Landslides are not an issue in Long Beach				
Action EM-4 Improve knowledge of earth movement hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	✓			
Comment: Landslides are not an issue in Long beach.				
Action WS-1 Continue city wide tree trimming programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	✓			
Comment: Ongoing, conducted by PW				
Action WS-2 Encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.		✓		
Comment: Electrical grid is provided by SCE.				
Action WS-3 Increase public awareness of windstorm mitigation activities.	✓			
Comment: Ongoing, social media and community outreach				
Action WS-4 Develop codes relating to wind-resistant building siting and construction.	✓			
Comment: Ongoing, Requirements set by Development Services				
Action TSU-1 Secure funding to contract with a consultant to conduct a technical analysis of the tsunami threat.	✓			
Comment: In 2021, the Geological Survey updated their flood maps related to tsunamis.				
Action TSU-2 Review findings of special research on tsunami threat to Long Beach coastal areas. Amend codes, regulations, and response plans as necessary.	✓			
Comment: Same as above.				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Action # in Update
Action TSU-3 Train regulatory and response staff in tsunami threat.	✓			
Comment: Ongoing, trainings and exercises conducted periodically				
Action TSU-4 Develop and conduct training and exercises relating to tsunami response.	✓			
Comment: Ongoing, trainings and exercises conducted periodically				
Action TSU-5 Develop a warning system in the City to notify residents of impending tsunami activity.	✓			
Comment: Ongoing, purchase of outdoor warning speakers and use of ALERT LB				
Action TSU-6 Develop a tsunami education campaign to prepare residents.	✓			
Comment: Ongoing, social media and community outreach (Tsunami Week)				
Action PH-1 Establish a process for screening potentially contaminated victims of a public health disaster as a pre-admission requirement prior to being allowed into a Red Cross shelter. Victims of an incident that involves any level of contamination (biological, radiological, or chemical) and thus a public health threat will be assessed and triaged at the secured incident site (red zone).	✓			
Comment: Ongoing, maintained by HHS				
Action HC-1 Provide training and equipment to effectively deal with civil disturbances	✓			
Comment: Ongoing, maintained by LBPD				
Action HC-2 Continue to develop an effective information-gathering analysis and sharing capability to enhance event and incident management. Enhance threat assessment sharing and evaluation efforts to deter, prevent, and respond to terrorism events. Evaluate program with training and exercise needs. Sharing should occur between LBPD, LASD, LAPD, USCG, FBI, JRIC, and other regional partners.	✓			
Comment: Ongoing, trainings and exercises conducted periodically				
Action HC-3 Prepare a response plan, as well as a training and exercise program for transportation accidents involving radiological materials. Response plans should include all city safety departments. Training and Exercise Plan should include the investigation of such accidents.	✓			
Comment: LBPD conducts regular trainings with Metro and LB Transit..				
Action HC-4 Provide assistance to CSULB, LBCC, LBUSD and local private schools in the form of planning, training, and exercises for campuses to minimize school violence. Encourage school administrators to utilize the latest construction techniques to reduce the threat of school violence.	✓			
Comment: Ongoing.				
Action HC-5 Heighten Security at public gatherings special events, and critical community facilities and industries.	✓			
Comment: Ongoing, maintained by LBPD				
Action HC-6 Develop and share information with the public on emergency preparedness tips for periods of civil unrest.	✓			
Comment: Ongoing, social media and community outreach				
Action HC-7 Develop and present training curriculum to address technological and human caused threats such as cyber-terrorism, "lone wolf" domestic terrorism, utility infrastructure attacks or other possible threat scenarios.	✓			
Comment: Ongoing, partnership with TID and L:BPD.				

Action Item	Check if Completed	Check if no longer Feasible or Removed	Carried Over to Plan Update	
			Check if Yes	Action # in Update
Action DR-1 Continue to provide property owners, residents and businesses with water conservation tips and information.	✓			
Comment: Ongoing, Long Beach Water Department manages the outreach.				
Action DR-2 Continue to encourage property owners to landscape with drought resistant materials.	✓			
Comment: Ongoing				
Action DR-3 Research and prepare City policy requiring future developments and retrofitting of existing City-owned landscaping to be drought resistant and to utilize reclaimed water.	✓			
Comment: Ongoing, work done by Long Beach Water.				

Appendix E. City of Long Beach Adoption Resolution

E. City of Long Beach Adoption Resolution

TO BE PROVIDED WITH FINAL DRAFT

City of Long Beach Hazard Mitigation Plan

Appendix F. Progress Report Template

F. PROGRESS REPORT TEMPLATE

2022 City of Long Beach Hazard Mitigation Plan
Annual Progress Report

Reporting Period: *(Insert reporting period)*

Background: The City of Long Beach developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the City organized resources, assessed risks from natural hazards within the county, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed online at:

https://www.longbeach.gov/disasterpreparedness/

Summary Overview of the Plan's Progress: The performance period for the *2022 City of Long Beach Hazard Mitigation Plan* became effective in Month Year with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before Month Year. As of this reporting period, the performance period for this plan is considered to be __% complete. The hazard mitigation plan has targeted 47 hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of 47 actions (__%) reported ongoing action toward completion.
- __ out of 47 actions (__%) were reported as being complete.
- __ out of 47 actions (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the *2022 City of Long Beach Hazard Mitigation Plan*. The objective is to ensure that there is a continuing and responsive planning process that will keep the hazard mitigation plan dynamic and responsive to the needs and capabilities of the City. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area

- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Multi-Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on ______, 202_. It was determined through the plan's development process that a steering committee would remain in service to oversee maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

Table 1. Steering Committee Members

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ______________________________
- ______________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each action. Reviewers of this report should refer to the hazard mitigation plan for more detailed descriptions of each action and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the action carried out during the reporting period?*
- If no action was completed, why?
- Is the timeline for implementation for the action still appropriate?
- If the action was completed, does it need to be changed or removed from the action plan?

Table 2. Action Plan Matrix

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				

Completion status legend:
✓= Project Completed
O = Action ongoing toward completion
X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan.*

Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the City Council and to local media outlets, and the report is posted on the City's website. Any questions or comments regarding the contents of this report should be directed to:*

Name
Title
City of Long Beach Department of Disaster Preparedness and Emergency Communications
2990 Redondo Avenue
Long Beach, California 90806
(562) 570-9250
Email: LongBeach-EOC@longbeach.gov

City of Long Beach
411 W. Ocean Blvd.
Long Beach, CA 90802
Visit us at www.longbeach.gov
@LongBeachCity

To request this information in an alternative format or to request a reasonable accommodation, please contact Department of Disaster Preparedness and Emergency Communications at longbeach-eoc@longbeach.gov or (562) 570-9250. A minimum of three business days is requested to ensure availability. Reasonable attempts will be made to accommodate requests made within less than three business days.