City of Lakewood

Hazard Mitigation Plan

Draft

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EXECUTIVE SUMMARY

This Hazard Mitigation Plan for the City of Lakewood, California covers each of the major natural hazards that pose a risk to the City. The primary objectives of this plan are to reduce the negative impacts of possible future disasters on the community, to save lives and reduce injuries, minimize damage to buildings and infrastructure (especially critical facilities) and minimize economic losses. This mitigation plan is a planning document, not a regulatory document.

This Hazard Mitigation Plan meets FEMA's planning requirements by addressing potential hazards, vulnerability, risk, and identifying prioritized action items to reduce these risks over time as funding becomes available. Hazard means the estimated frequency and potential severity of each different type of potential disaster event. Vulnerability means the value, importance, and fragility of buildings and infrastructure that may be exposed to each type of hazard. Risk means the potential threat to people, buildings and infrastructure, taking into account the probabilities of each type of disaster event. Adoption of a hazard mitigation plan is required for communities to remain eligible for future FEMA mitigation grant funds.

This document is a living document which is updated periodically. Review comments, suggestions, corrections and additions are enthusiastically encouraged from all interested parties. Questions and comments may be sent to:

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1.0 INTRODUCTION

1.1 What is a Hazard Mitigation Plan?

The City of Lakewood is subject to a wide range of natural and human-caused hazards, including: earthquakes, floods, dam failures, windstorms and others. The impact of a hazard event on the Lakewood community may be minor - a few inches of water in a street - or it may be major - with significant damage to important buildings and the potential for injuries or deaths.

The impact of a major disaster on a community can be devastating; economic losses, casualties, disruption, hardship and suffering are often far greater than the physical damages alone. Furthermore, recovery from major disasters often takes many years, and some heavily impacted communities may never fully recover. Completely eliminating the risk from future disaster events in Lakewood is neither technologically possible nor economically feasible. However, substantially reducing the negative impacts of future disasters in Lakewood is achievable with the implementation of a pragmatic and effective hazard mitigation plan.

This Hazard Mitigation Plan addresses all of the natural hazards which pose significant risk to Lakewood. This Hazard Mitigation Plan includes events such as severe weather events and localized storm water flooding that may happen in some locations almost every year. The Hazard Mitigation Plan also includes larger hazard events such as major earthquakes that will affect much or all of the Lakewood community, albeit with much lower probabilities of occurrence in a given year.

This Hazard Mitigation Plan has several key elements.

1. Each hazard that may impact Lakewood significantly is reviewed to determine the probability (frequency) and severity of likely hazard events.

2. The vulnerability of Lakewood to each hazard is evaluated to estimate the likely extent of physical damages, casualties, and economic impacts.

3. A range of mitigation alternatives are evaluated to identify those with the greatest potential to reduce future damage and loss in Lakewood, to protect facilities deemed critical to the community's well being and that are desirable from the City's political and economic perspectives.

1.2 Why is Hazard Mitigation Planning Important for Lakewood?

Hazard mitigation simply means actions that reduce the potential for negative impacts from future disasters. Mitigation actions reduce future damage, losses and casualties**.** Effective mitigation planning will help Lakewood deal with natural and human-caused hazards realistically and rationally. It will help differentiate specific locations in Lakewood where the level of risk varies per hazard type and identify areas where one or more hazards apply. The Hazard Mitigation Plan provides guidance in implementing cost effective ways to reduce such risks. Mitigation planning

strikes a pragmatic middle ground between underestimating the potential for major hazard events on one hand and unnecessarily overreacting to the potential for disasters on the other hand.

The Federal Emergency Management Agency (FEMA) requires each local government entity to adopt a multi-hazard mitigation plan to remain eligible for future pre- or post-disaster FEMA mitigation funding. Thus, an important objective in developing this plan is to maintain eligibility for FEMA funding and to enhance Lakewood's ability to qualify for future FEMA mitigation funding.

FEMA's mitigation planning requirements for communities are based on the Disaster Mitigation Act of 2000, which requires every state and local government to prepare a hazard mitigation plan, which includes the following steps:

1. Conduct an assessment of the natural hazards that pose a threat to the jurisdiction;
2. Determine the potential impact of these hazards;
3. Create a hazard mitigation plan to mitigate these hazards; and
4. Implement the hazard mitigation plan to reduce the impacts of natural disasters.

This Hazard Mitigation Plan is specifically designed to help Lakewood gather the data necessary to compete successfully for future FEMA funding of mitigation projects. FEMA requires that all FEMA-funded hazard mitigation projects be "cost-effective" (i.e., the benefits of a project must exceed the costs). Benefit-cost analysis is thus an important component of mitigation planning, not only to meet FEMA requirements, but also to help evaluate and prioritize potential hazard mitigation projects in Lakewood, regardless of whether funding is from FEMA, state or local government or from private sources. An overview of the current FEMA mitigation grant programs and the principles of benefit-cost analysis of mitigation projects are included in Appendices A and B.

Hazard mitigation planning is applicable to the Lakewood community as a whole, including not only City-owned facilities but also the entire built environment of buildings and infrastructure.

1.3 The Lakewood Hazard Mitigation Plan

This Hazard Mitigation Plan is built upon a quantitative assessment of each of the major hazards that may impact Lakewood, including their frequency, severity, and areas of the City likely to be affected. The hazards addressed include:

- Earthquakes;
- Floods (including dam failures);
- Windstorms;
- Drought;
- Other Hazards (including extreme temperatures, landslides, wildland/urban interface fires, subsidence, and volcanic events).

This Hazard Mitigation Plan includes a quantitative assessment of the vulnerability of buildings, infrastructure, and people to each of these hazards, to the extent possible with existing data. The Hazard Mitigation Plan also includes an evaluation of the likely magnitude of the impacts of future disasters in Lakewood.

The review of the hazards and the vulnerability of the City of Lakewood to these hazards are the foundation of this Hazard Mitigation Plan. From these assessments, situations where buildings, infrastructure, and/or people may be at high risk from one or more hazards are identified whenever possible. These high risk situations then become priorities for future mitigation actions to reduce the negative impacts of future disasters in Lakewood.

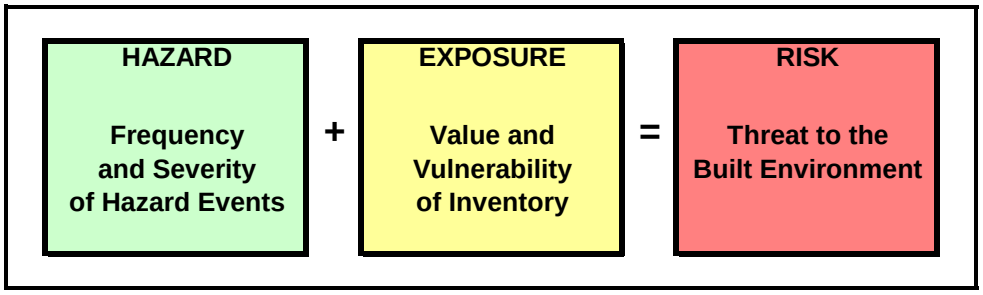
This Hazard Mitigation Plan deals with hazards realistically and rationally and also strikes a balance between suggested physical mitigation measures to eliminate or reduce the negative impacts of future disasters and enhancements in planning to reduce the potential for negative impacts of disasters on new development. Finally, the Hazard Mitigation Plan suggests better emergency planning to help prepare the community to respond to and recover from disasters for which physical mitigation measures are not possible or not economically feasible.

1.4 Key Concepts and Definitions

The central concept of mitigation planning is that mitigation reduces risk. **Risk** is defined as the threat to the built environment posed by the hazards being considered. Risk is the potential for damages, losses and casualties arising from the impact of hazards on the built environment.

The extent of risk depends on the combination of **hazard** and **exposure** as shown in Figure 1.1 below.

Figure 1.1: Hazard and Exposure Combine to Produce Risk



Thus, there are four key concepts that govern hazard mitigation planning: hazard, exposure, risk and mitigation. Each of these key concepts is addressed in turn.

HAZARD refers to natural or human-caused events that potentially may cause damages, losses or casualties (e.g., earthquakes, floods, windstorms etc.). Hazards are characterized by their frequency, severity and by the geographic area affected. Each hazard is characterized differently with appropriate parameters for the specific hazard. For example, tornadoes may be characterized by the enhanced Fujita Scale. Floods may be characterized by the frequency of flooding, flood

depth, and flood velocity. Earthquakes may be characterized by the severity and duration of ground motions.

A hazard by itself may not result in any negative impacts on a community. For example, a highly flood-prone five acre parcel may typically experience several shallow floods per year, with several feet of water expected in a 50-year flood event, and more than six feet of water expected in a 100-year flood event. However, the parcel may be wetlands adjacent to a tidal marsh that floods daily but contains no development (structures or infrastructure) on that parcel. In this case, the frequent flooding does not have any negative impacts on the community. In such circumstances, the very frequent flooding (i.e., high hazard) may be beneficial in providing wildlife habitat.

Hazards do not produce risk, unless there is vulnerable inventory exposed to the hazard. In the context of mitigation planning, "inventory" means the number of people, buildings, and infrastructure exposed to damage from one or more natural or manmade hazards.

EXPOSURE is the quantity, value and vulnerability of the built environment (inventory of buildings and infrastructure) and/or people in a particular location subject to one or more hazards. Inventory is described by the number, size, type, use, occupancy of buildings, and by the infrastructure present. Infrastructure includes roads and other transportation systems, and utilities (potable water, wastewater, storm water, natural gas, electric power, and telecommunications systems).

Inventory varies markedly in its importance to a community and thus varies markedly in its importance for hazard mitigation planning. Some types of facilities are critical facilities and are especially important to a community, particularly during disaster situations. Examples of critical facilities include police and fire stations, hospitals, schools, emergency shelters, and 911 centers. Critical facilities may also include infrastructure elements that are important links or nodes in providing service to large numbers of people such as a potable water source, and an electric power substation. "Links" are elements such as evacuation and emergency access routes, water pipes, electric power lines, telephone cables that connect portions of utility and transportation systems. "Nodes" are locations with important functions, such as pumping plants, substations, or switching offices.

Lakewood's most critical facilities include major city buildings, major medical facilities, and key "components of the utility systems which provide water, electric power, and natural gas to the city.

Hazard mitigation planning inventory requires categorizing by the quantity and value of buildings or infrastructure present and its vulnerability to each hazard under evaluation. For example, a given facility may be vulnerable to both flood and earthquake damage, or only to flood damage or earthquake damage. Depending on the hazard, different measures of vulnerability must be used.

RISK is the threat to the built environment (buildings and infrastructure) and people; the potential for damage, loss, and casualties arising from hazards. Risk results from the combination of

hazard and exposure. When the geographic areas affected by one or more hazards contain people, buildings, and infrastructure vulnerable to damage from the hazard(s). For mitigation planning, evaluation of risk generally emphasizes the built environment and people. However, risk also includes the potential for environmental damage.

Risk is the potential for future damage, loss, or casualties. A disaster event happens when a hazard event is combined with a vulnerable inventory (i.e., when a hazard event strikes vulnerable inventory exposed to the hazard). The highest risk in a community occurs in high-hazard areas (frequent and/or severe hazard events) with large inventories of vulnerable buildings or infrastructure.

However, high risk can also occur with only moderately high hazard, if there is a large inventory of highly vulnerable inventory exposed to the hazard. Conversely, a high hazard area can have relatively low risk if the inventory is resistant to damage (e.g., structures elevated to protect against flooding or strengthened to minimize earthquake damage).

MITIGATION means actions to reduce the risk due to hazards. Mitigation actions reduce the potential for damage, loss, and casualties in future disaster events. Repair of buildings or infrastructure damaged in a disaster is not mitigation because repair simply restores a facility to its pre-disaster condition and does not reduce the potential for future damage, loss, or casualties. Hazard mitigation projects may be initiated proactively before a disaster or after a disaster has already occurred. In either case, the objective of mitigation is always to reduce future damage, loss, or casualties.

Some of the most common types of mitigation projects are shown below in Table 1.1.

Table 1.1: Common Mitigation Projects

Hazard	Mitigation Project Examples
Earthquakes	Perform structural upgrades of vulnerable buildings
Earthquakes	Install non-structural bracing of equipment and contents
Floods	Improve levees or storm water drainage systems
Floods	Enhance dam safety
Windstorms	Provide backup power for critical facilities
General	Enhance emergency planning and mutual aid

The mitigation project list above is not comprehensive; and mitigation projects can encompass a broad range of other actions to reduce future damages, losses, and casualties.

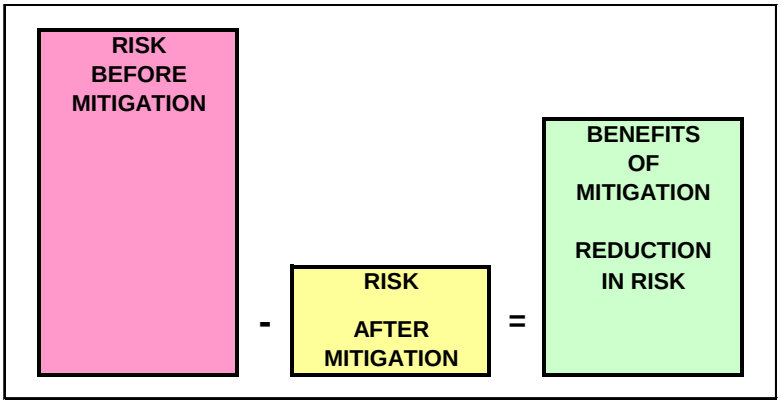
1.5 The Mitigation Process

The key element for all hazard mitigation projects is that they reduce risk. The benefits of a mitigation project are the reduction in risk (i.e., the avoided damage, loss, and casualties attributable to the mitigation project). In other words, benefits are simply the difference in

expected damage, loss, and casualties before mitigation (as-is conditions) and after mitigation. These important concepts are illustrated below in Figure 1-3.

Quantifying the benefits of a proposed mitigation project is an essential step in hazard mitigation planning and implementation. Only by quantifying benefits is it possible to compare the benefits and costs of mitigation to determine whether or not a particular project is economically feasible. Real world mitigation planning almost always involves choosing between a range of possible alternatives, often with varying costs and varying effectiveness of reducing risk.

Figure 1.3: Mitigation Projects Reduce Risk



Quantitative risk assessment is centrally important to hazard mitigation planning. When the level of risk is high, the expected levels of damage and loss are likely to be unacceptable, and mitigation actions have a high priority. Thus, the greater the risk, the greater is the urgency of undertaking mitigation actions.

Conversely, when risk is moderate, both the urgency and the benefits of undertaking mitigation are reduced. It is neither technologically possible nor economically feasible to eliminate risk completely. Therefore, when levels of risk are low and/or the cost of mitigation is high relative to the level of risk, the risk may be deemed acceptable. Therefore, proposed mitigation projects that address low levels of risk or where the cost of the mitigation project is high relative to the level of risk are generally poor candidates for implementation.

The overall mitigation planning process is outlined in Figure 1.4, which outlines the major steps in the hazard mitigation planning and implementation process.

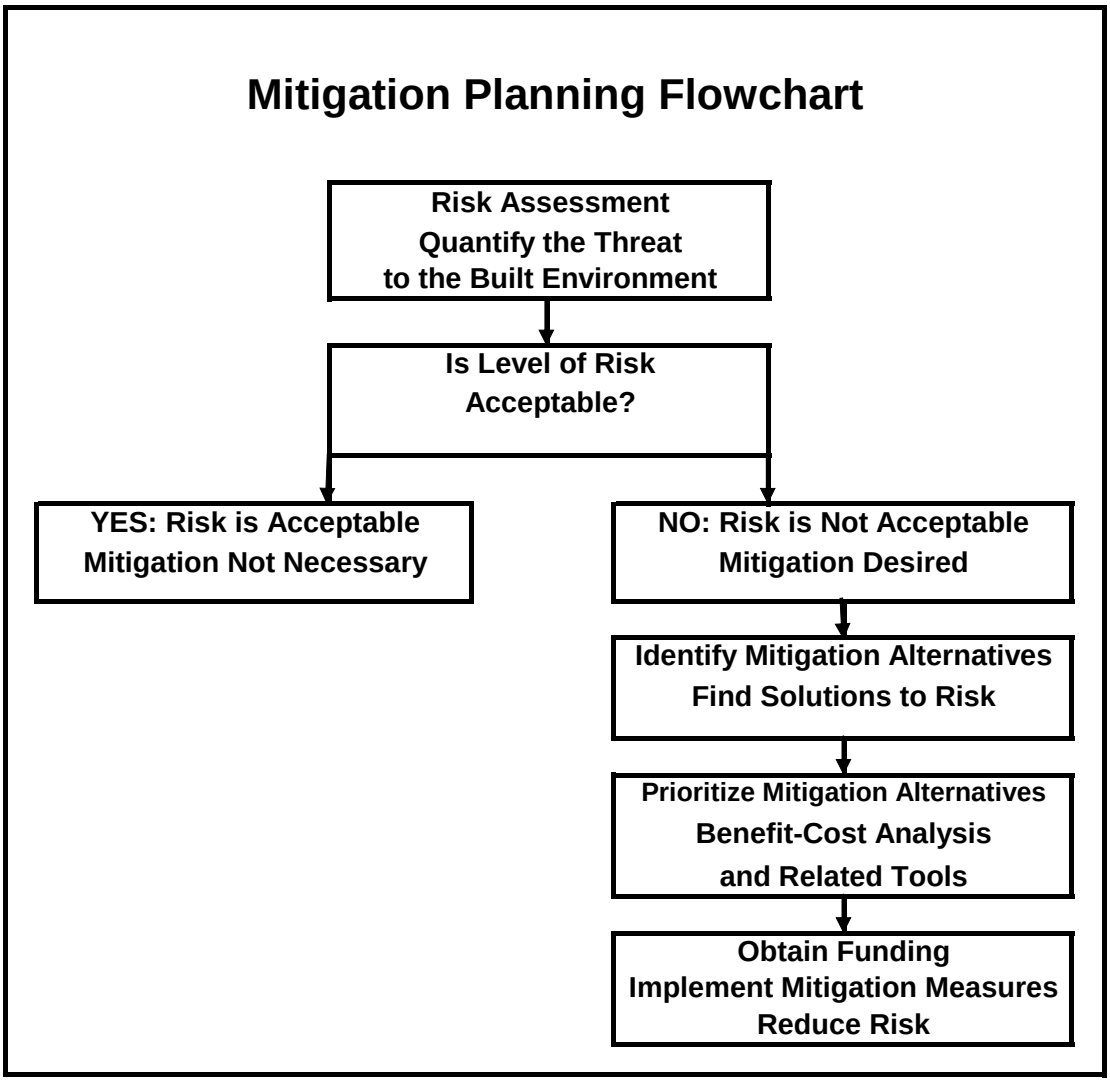
The first steps are quantitative evaluation of the potential hazards (frequency and severity) impacting Lakewood and the inventory (people, buildings, and infrastructure) exposed to these hazards. Together, the hazard and exposure data determine the level of risk for specific locations, buildings or facilities in Lakewood.

The next key step is to determine whether or not the level of risk posed by each of the hazards impacting Lakewood is acceptable or tolerable. Only the Lakewood community can make this

determination. If the level of risk is deemed acceptable or at least tolerable, then mitigation actions are not necessary or at least not a high priority.

On the other hand, if the level of risk is deemed not acceptable or tolerable, then mitigation actions are indicated. In this case, the mitigation planning process escalates to more detailed evaluation of specific mitigation alternatives, prioritization, funding and implementation of mitigation measures. As with the determination of whether or not the level of risk posed by each hazard is acceptable or not, decisions about which mitigation projects are appropriate can be made only by the Lakewood City Council.

Figure 1.4: The Mitigation Planning Process



The logic behind the Mitigation Planning Flowchart is illustrated by a simplified example. Consider two hypothetical unreinforced masonry buildings in Lakewood, both about the same vintage, size and value, with similar values for their contents. The first building is a warehouse

storing construction materials with very low occupancy, while the second building is city-owned with substantial occupancy. The seismic hazard level is identical for the two buildings which are located near each other. The value and vulnerability of the two buildings are also very similar.

The risk, however, is very different for the two buildings. The risk associated with the warehouse is largely limited to physical damage and economic loss. For the city building, the risk includes not only physical damage and economic loss but also safety and the risk of loss of essential public services, including the ability to respond to a disaster event, as well as exposing the City to potential liability.

For the warehouse, the community may decide that the risk is acceptable and that mitigation is not necessary or perhaps a much lower priority. This decision does not mean that the building is not vulnerable or that the risk is zero, but rather that the risk is deemed acceptable because of the very low occupancy of the building.

For the city-owned building, on the other hand, the community would likely decide that the risk is not acceptable because of the safety risk to staff and visitors. In this case, mitigation is desired, and the community might explore several options to reduce the risk, such as: demolish the building and replace it with a new building, implement various retrofit measures, or use the building for a low occupancy function and move the building functions to a safer structure. The selection of a particular mitigation option would likely depend on many factors including economics, available resources, historical preservation issues, and locally-defined social or political priorities.

This simplified example illustrates the importance of defining risk explicitly and quantitatively as the basis for making sound decisions about mitigation.

1.6 The Role of Benefit-Cost Analysis in Mitigation Planning

Communities that are considering whether or not to undertake mitigation projects must answer questions that do not always have obvious answers, such as:

What is the nature of the hazard?

How frequent and how severe are hazard events?

Do we want to undertake mitigation measures?

What mitigation measures are feasible, appropriate, and affordable?

How do we prioritize among competing mitigation projects?

Are our mitigation projects likely to be eligible for FEMA funding?

Benefit-cost analysis is a powerful tool that can help communities provide solid, defensible answers to these difficult socio-political-economic-engineering questions. Furthermore, benefit-cost analysis is required for all FEMA-funded mitigation projects, under both pre-disaster and post-disaster mitigation programs. Thus, communities seeking FEMA funding must understand benefit-cost analysis. Regardless of whether or not FEMA funding is involved, benefit-cost

analysis provides a sound basis for evaluating and prioritizing possible mitigation projects for any natural hazard.

Benefit-cost analysis software, technical manuals and a wide range of guidance documents are available from FEMA at no cost to communities. A Benefit-Cost Analysis Toolkit CD is available from FEMA. The publication What is a Benefit? Draft Guidance for Benefit-Cost Analysis is particularly recommended as a general reference for benefit-cost analysis. This publication includes categories of benefits to count for mitigation projects for various types of buildings, critical facilities, and infrastructure and has simple, standard methods to quantify the full range of benefits for most types of mitigation projects.

The principles of benefit-cost analysis are briefly summarized in Appendix B.

1.7 Hazard Synopsis

The following is a brief review of the major natural and human-caused hazards that may impact Lakewood. Some of the hazards, such as windstorms and earthquakes, may affect all of Lakewood. Other hazards, such as floods, may only affect portions of Lakewood.

Earthquakes. The entire City is at risk from earthquakes, with potential for major damage and casualties, especially for severe earthquakes with a nearby epicenter. However, the level of risk for specific buildings or infrastructure varies depending on the design characteristics of each structure. Earthquake hazards and risks are addressed in Chapter 6.

Floods. Flood risk for the City is generally low because the entire city is included in FEMA Flood Zone X, which includes areas protected from the 100-year flood by levees and other flood control structures, and areas where the 100-year flood depth is less than one foot. However, large portions of the city could be flooded in flood events much larger than the 100-year flood and/or by dam failures upstream. Flood hazards and risks are addressed in Chapter 7.

Windstorms. The entire City is subject to windstorms from Santa Ana winds, thunderstorms or other wind events. Windstorm hazards and risks are addressed in Chapter 8.

Drought. The groundwater portion of the City's water supply is at risk from major prolonged droughts. Drought hazards and risks are addressed in Chapter 9.

Other Hazards. There are several other hazards which could affect Lakewood including wildland/urban interface fires, landslides and debris flows, volcanic events (ash falls), subsidence, and extreme temperatures. For Lakewood, these hazards are generally minor or negligible. Other hazards and risks are addressed in Chapter 10.

In evaluating these natural hazards, it is important to recognize that the risk to Lakewood (i.e., the potential for damage, economic loss, and casualties) varies markedly from one hazard to another. As discussed in Section 1.4, risk depends on the combination of the frequency and severity of

hazard events, and on the value and vulnerability of infrastructure, buildings, and people to each potential hazard. Risk is thus always probabilistic in nature.

Some hazard events, such as severe weather, may happen every year to at least some extent. Other hazard events, such as major earthquakes may affect the city very infrequently, with return periods of several decades. However, the risk from major earthquakes is high, even though the frequency of occurrence is relatively low, because the consequences (damage, economic loss, and casualties) may be very high.

The approximate level of relative risk posed to Lakewood by each of the hazards covered in this mitigation plan is summarized in Table 1.2. This ranking is based on quantitative/qualitative judgment about the likely long-term average annual damage and loss in Lakewood from each hazard, taking into account the probability of major hazard events and the severity of damage and loss when such an event occurs.

Table 1.2: Relative Risk to Lakewood from the Major Hazards

Hazard	Relative Risk to Lakewood
Earthquakes	High
Floods and Dam Failures	Moderate
Drought	Moderate
Extreme Temperatures	Low
Windstorms	Low
Landslides	Very Low
Subsidence	Very Low
Volcanic Events (ash falls)	Very Low
Wildland/Urban Interface Fires	Very Low

The remaining chapters of this hazard mitigation plan include the following:

Chapter 2 provides a brief community profile for Lakewood.

Chapter 3 documents the community involvement and public process involved in developing this hazard mitigation plan.

Chapter 4 outlines the hazard mitigation plan mission statement, goals, objectives, mitigation strategies, and action items.

Chapter 5 documents the formal process of plan adoption, implementation, and maintenance.

Chapter 6 addresses earthquakes hazards.

Chapter 7 addresses floods and dam failures.

Chapter 8 addresses windstorms.

Chapter 9 addresses drought.

Chapter 10 addresses other hazards such as wildfires, landslides, and extreme temperatures.

Appendix A: Synopsis of FEMA Mitigation Grant Programs.

Appendix B: Benefit-Cost Analysis.

Appendix C: Further Documentation of Community Involvement and the Planning Process.

GLOSSARY

Anthropogenic Hazards are human-caused hazards such as dam failures, HAZMAT incidents, and deliberate malevolent actions such as terrorism or vandalism.

Critical Facilities are buildings or other facilities which are particularly important to Lakewood, especially in disaster events. Common examples include medical facilities, fire stations and other emergency response facilities, and lifeline utilities such as water, wastewater and electric power.

Exposure is the quantity, value and vulnerability of the built environment (inventory of buildings and infrastructure) in a particular location subject to one or more hazards. Inventory is described by the number, size, type, use, and occupancy of buildings, and by the infrastructure present.

Hazard refers to natural or anthropogenic events that potentially may cause damage, loss, or casualties (e.g., earthquakes, floods, windstorms, hazardous material spills, etc.).

Inventory, in the context of mitigation planning, means the number of people, the number of buildings, and the amount of infrastructure exposed to damages from one or more natural or manmade hazards.

Links and Nodes are used to characterize utility and transportation systems. **Links** are the elements such as water pipes, electric power lines, telephone lines, evacuation and emergency routes which connection portions of utility or transportation systems. **Nodes** are locations within such systems that serve important functions such as water treatment plants, electric power substations, bridges and interchanges.

Mitigation is defined as the actions that reduce the potential for future damage, loss, or casualties. Common mitigation projects include safe rooms for tornado shelters, seismic retrofits for buildings, flood control projects, and storm water management projects.

Risk is defined as the threat to the built environment and people. Risk is the potential for damage, loss, economic impact, and casualties (deaths and injuries) from natural or anthropogenic

hazards. Risk results from the juxtaposition of hazards with an inventory of buildings or infrastructure which is vulnerable to damage from the hazards. That is, risk results from the combination of hazard and exposure.

Terrorism is broadly inclusive of all deliberate malevolent actions intended to damage property (more serious than minor vandalism) or to inflict casualties or to coerce or intimidate into behavioral or political change.

Vulnerability is a measure of the susceptibility of a building or infrastructure component to damage from a hazard. For example, unreinforced masonry buildings are highly vulnerable to earthquake damage.

2.0 COMMUNITY PROFILE

2.1 Regional Context

The City of Lakewood is located in the greater Los Angeles metropolitan area, approximately 25 miles southeast of the Los Angeles civic center and about ten miles northeast of the Port of Long Beach. Lakewood is located in the South Coast Air Basin of California, a 6,600 square-mile area encompassing Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino counties. The South Coast Air Basin is bounded by the Pacific Ocean to the west and the San Gabriel and San Jacinto Mountains to the north and east. Lakewood, a fully urbanized city, is contiguous to the jurisdictions of Long Beach, Bellflower, and Cerritos which are to the north, La Palma and Cypress to the east, Hawaiian Gardens and Long Beach to the south, and Long Beach to the west. Figure 2-1 illustrates Lakewood's regional location. Lakewood is 9.5 square miles in area. Lakewood's environment, both locally and regionally, is primarily urban.

Figure 2-1: Lakewood in a Regional Context

Source: City of Lakewood, Community Development Department

2.2 Community History

The land encompassed by the City of Lakewood was inhabited by the Gabrielino tribes some 200 years ago. In 1769, the first Spanish settlers arrived by ship from the west coast of Mexico. The expedition eventually settled at the present site of the City of Los Angeles. They named the settlement Our Lady Queen of the Angels *(Nuestra Señora de la Reina de Los Angeles)*. In 1781, as part of the Viceroy's efforts to colonize California, 12 families moved to the Los Angeles area to settle permanently. As a result, Felipe de Neve, the governor at the time, gave the community official status as the territory's second California pueblo.

When land routes from Mexico City through Sonora to California improved, the number of travelers coming into California increased. Those settling the land were given land grants under Spain's authority. This era marked the beginning of the California ranchos.

The area presently occupied by the City of Lakewood was part of the Rancho Los Cerritos Grant. The land was deeded by the King of Spain through the Viceroy in Mexico City to Manuel Nieto in 1794. In 1822, Mexico won its independence from Spain, and in 1835, Los Angeles became the capital of California. In 1848, after the war between Mexico and the United States, California became part of the United States. During this time period, Juan Temple inherited and purchased the remainder of Los Cerritos Rancho from the heirs of Manuel Nieto.

In 1866, Juan Temple transferred the Los Cerritos land title to Benjamin Flint, Thomas Flint, and Llewellyn Bixby. In time, these individuals transferred title of portions of the Rancho Los Cerritos to various holding companies. In 1895, the entire Rancho came under the ownership of Bixby Investment Company who sold it to the Cerritos Sugar Company. In 1897, the Bixbys bought part of the Rancho back and sold 6,979 acres to William A. Clark in the same year. In 1904, a portion of the Los Cerritos Rancho was transferred to Clark's brother, who then registered it as the Montana Land Company.

In 1930, due to gradual purchases and divisions of land owned by the Montana Land Company, the area, which was to become the City of Lakewood, began to develop into a residential community. In 1932, Long Beach City College purchased 30 acres for a college site. Within three years, the college was operating. In 1933, the Montana Land Company constructed the Lakewood Country Club.

In 1934, Charles B. Hopper became the exclusive sales agent and subdivider for Montana Land Company. The first sales office was established on Carson Street where it intersects Lakewood Boulevard at the site of the present Long Beach Airport. Twenty-seven houses comprised Lakewood Village by January of 1936, and already a lively community life had begun. A Chamber of Commerce was organized in June 1937. In September 1937, the first Lakewood newspaper, the "Lakewood Village Citizen," began circulation and was published jointly by the Chamber of Commerce, the P.T.A., and the Lakewood Village Church. The Lakewood Village area was later incorporated into the City of Long Beach.

In the early 1940's, after World War II began, the area received many large defense contracts. One of these recipients, Douglas Aircraft Company, built a 25 million dollar aircraft plant at the

corner of Lakewood Boulevard and Carson Street. As a result, thousands of workers moved to the Lakewood area making Douglas Aircraft Company one of the largest employers in the area.

When World War II ended, Southern California's real estate and business boom was still running strong. Utilizing GI Bill of Rights loan provisions, developers began subdividing land and building homes in mass production. Building to specifications of both the Federal Housing Administration and the Veterans Administration, the builders offered long-term loans with low down payments. The availability of these affordable housing units attracted thousands of returning veterans and industry workers to the Los Angeles and Lakewood areas.

In 1939, the largest Lakewood-area developers, Louis H. Boyar, S. Mark Taper, and Ben Weingart, formed a small corporation. Through FHA guarantees, they secured loans to cover development costs and began building Lakewood-area housing tracts. On 3,375 acres of farmland purchased from the Montana Land Company for $8.9 million dollars, the majority of Lakewood (west of the San Gabriel River) was built. Here, with the assistance of urban planners and architects, they designed a community of 17,000 homes. This area encompasses the present day westerly portion of the City of Lakewood and some areas in the adjacent City of Long Beach (south of Carson Street).

The land encompassing the Lakewood area was historically used for sugar beet farming. However, with the real estate boom of the 1940s and 1950s, construction crews graded the land and paved streets as fast as the last crop could be harvested. In an assembly-line fashion new to the Southern California area, small teams of workers moved down each side of Lakewood's streets with concrete mixing machinery. Power diggers were used for foundation trenches, pre-cut lumber arrived for each house, and conveyor belts were utilized to carry shingles to roofs. Lakewood homes were some of the first to be built with new automatic nailing machines and power door hanging machines. This mass construction of homes was followed by mass sales. Lakewood's homes sold well because of the development's attractive wide streets and concrete curbs, parks and recreation facilities, and other amenities.

The majority of Lakewood's home building activity continued well into the 1950s. During this time, Lakewood was one of the largest real estate projects built in southern California. Most of Lakewood's current housing stock was built by the late 1960s.

On April 16, 1954, Lakewood was incorporated. Immediately, numerous decisions were made by the newly elected City Council. In particular, providing municipal services such as police, fire, sewer, water, and street maintenance was the primary task at hand. To accomplish these goals, Lakewood's decision-makers decided on an innovative technique called the "contract system for municipal services," which has since been known as "The Lakewood Plan." By contracting with the county for many of its municipal services, "The Lakewood Plan" saved, and continues to save, the City thousands of dollars in annual operating expenses. Special county assessment districts fund other municipal services, such as fire and library services. By utilizing existing county service capabilities, staff, and equipment, the City obtains superior municipal services without the pitfalls and expense commonly associated with smaller City-owned and -operated services. Since its inception in 1954, "The Lakewood Plan" has served as a model for many cities throughout Los Angeles County and the State.

2.3 Population and Demographics

Lakewood is the 23rd largest city in Los Angeles County, ranked by population. According to the State of California Department of Finance's Demographic Unit, the population of the City of Lakewood was 81,601 as of January 1, 2015 which is an increase of 1,553 persons from the 2010 population level of 80,048, and an increase of 2,256 persons from the 2000 population level of 79,345.

Lakewood is 9.5 square miles in area. Using the 2010 population figure, there was on average 8,426 persons per square mile. Lakewood's population grew rapidly from the time of incorporation in 1954 to approximately 83,000 people in 1970. After 1970, population growth patterns started to shift. As presented below, between 1970 and 1980, the City's population experienced a decline in growth, which continued through to 1990. However, since 1990, the population has again been increasing. During this period though, the number of housing units in the City continued to increase, from 24,208 in 1970 to 27,310 in 2000.

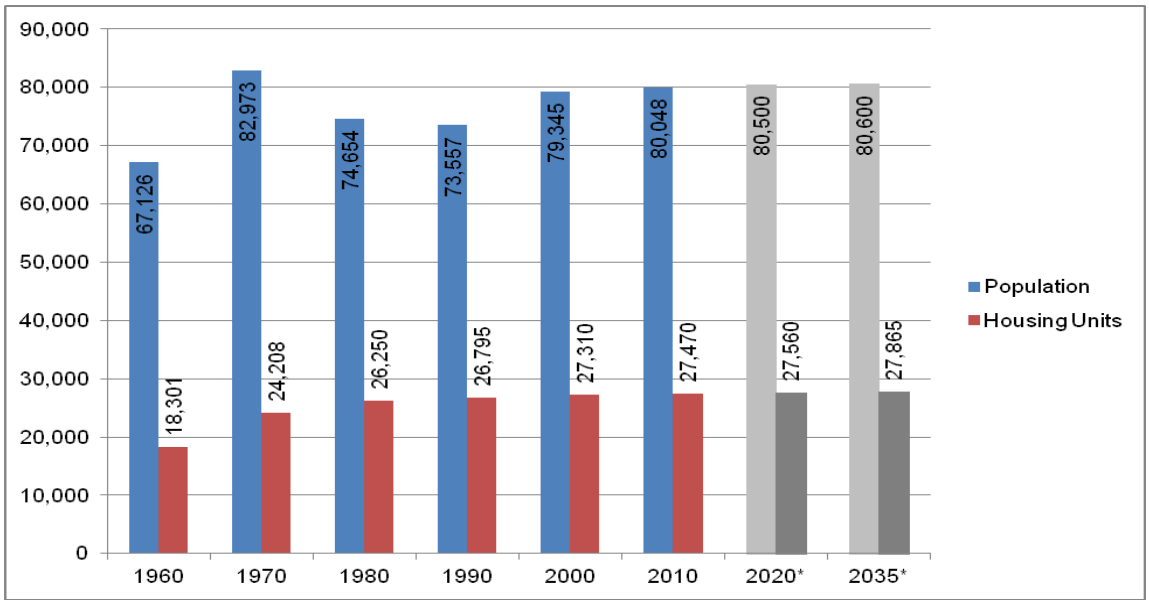
Table 2-1 and Figure 2-2 below illustrate Lakewood's population and housing unit trends. In addition to the over 9,169 dwelling units added to the housing stock over a 50-year period between 1960 and 2010, there has been considerable investment by homeowners upgrading their homes with additional bedrooms and other living spaces to achieve their desire for a larger home. This indicates that, in the future, the current housing stock may accommodate a higher population than it currently does. Further, with the City's current land use and density designations, the City may accommodate the projected population growth through the construction of additional housing units if the characteristics of population growth generate a need for additional housing.

Table 2-1: Lakewood's Population, 1960 to 2000 with Future Projections

Year	Population	Population Density (1)	Housing Units
1960	67,126	10.99 persons/acre	18,301
1970	82,973	13.59 persons/acre	24,208
1980	74,654	12.22 persons/acre	26,250
1990	73,557	12.01 persons/acre	26,795
2000	79,345	12.99 persons/acre	27,310
2010	80,048	13.11 persons/acre	27,470
2020	80,500 (projected)	13.18 persons/acre	27,560
2035	80,600 (projected)	13.20 persons/acre	27,865

Source: U.S. Census (1960-2010), SCAG 2012-35 RTP/SCS (*).
Note: 2020 and 2035 housing unit projections are derived from household projections assuming the 01/2011 vacancy rate of 1.67%.
Note: (1) Lakewood is 6,106.76 acres in area.

Figure 2-2: Lakewood Population and Housing Units Trends and Projections



Source: U.S. Census (1960-2010), SCAG 2012-35 RTP/SCS (*).
Note: 2020 and 2035 housing unit projections are derived from household projections assuming the 01/2011 vacancy rate of 1.67%.

The decrease in population during the 1970's does not correlate with a decrease in housing units. The number of housing units gradually increased over several decades, due to new construction and annexations. At the same time, the reduction in population was due to a decrease in household size. Many of the young couples that moved to Lakewood between 1940 and 1960 to raise their families reverted back to one and two person households as their children moved out of the home. This demographic transition is reflected in the statistics of the average household size, which declined from 3.67 persons in 1960 to 2.91 persons in 2010.

The local population increase projected for the next 20 years will come from an increase in the number of persons per household as more young families move into the City as well as a population increase as some Multiple Family Residential (M-F-R) zoned properties developed with single-family homes are replaced by multiple-family developments.

The population increase in Lakewood could result in more Lakewood residents being exposed to the effects of natural hazards. In the 1987 publication, Fire Following Earthquake issued by the All Industry Research Advisory Council, Charles Scawthorn explains how a post-earthquake urban conflagration could develop. In an urban context, a conflagration may generally be defined as a large uncontrolled fire which spreads well beyond a single building or property. A conflagration could be started by fires resulting from earthquake damage but made much worse by the loss of water pressure in water mains, caused by either lack of electricity to power water infrastructure pumps, and/or loss of water pressure resulting from broken water mains. Higher population densities and other physical impediments may also affect risk. For example, a higher ratio of residents to emergency responders dilutes emergency resources, and narrower roads are more difficult for emergency vehicles to navigate thereby slowing response times.

As Lakewood continues to experience continued in-fill development, there will be increases in population density and increased demand for public services such as roads, water supply, sewer and storm drain systems. Natural hazards do not discriminate, but the impacts in terms of vulnerability and the ability to recover vary greatly among the population. Much of the burden of post-disaster response and recovery is incurred by residents, especially in the first 72 hours after a major disaster. Thus, individual disaster preparation is an essential complement to disaster preparation by public agencies. Special needs populations, including elderly, children, disabled, and individuals for which English is not their native language, are often disproportionately affected by disasters. Special attention to such groups is often included in emergency planning by public agencies.

The 2010 Census data presented in Table 2-2 indicates that 41% of the total Lakewood residents are considered Non-Hispanic White. The remaining ethnic composition of the City includes 30.1% Hispanic or Latino of any race, 16% Asian, and 8.3% Black or African American. Over 3% of the City residents are of two or more races. The race and ethnic composition of Los Angeles County was 47.7% Hispanic, 27.8% Non-Hispanic White, 13.5% Asian, and 8.3% Black or African American. The percentage of the Non-Hispanic Whites population in the City continues to decline as the percentage of other ethnic groups continues to increase.

Table 2-2: Race and Ethnicity, 2010

Race/Ethnicity	Lakewood		Los Angeles County	
Non-Hispanic White	32,774	41.0%	2,728,321	27.8%
Hispanic or Latino (of any race)	24,101	30.1%	4,687,889	47.7%
Asian	12,811	16.0%	1,325,671	13.5%
Black or African American	6,663	8.3%	815,086	8.3%
American Indian and Alaskan Native	234	0.3%	18,886	0.2%
Native Hawaiian and other Pacific Islander	686	0.9%	22,464	0.2%
Some other race	178	0.2%	25,367	0.3%
Two or more races	2,601	3.2%	194,921	2.0%
Total Population	80,048	100.0%	9,818,605	100.0%

Source: U.S. Census (2010)
Note: Hispanic/Latino is an ethnicity and can include members of any race. The data presented here reflect the non-Hispanic population of each race.

Vulnerable populations, including seniors, disabled citizens, women, and children, as well as those people living in poverty, may be disproportionately impacted by natural hazards. Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by encouraging agencies and organizations planning for natural disasters to identify special needs populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

The cost of natural hazards recovery may place an unequal financial responsibility on the general population when only a small proportion may benefit from governmental funds used to rebuild private structures. Discussions about natural hazards that include local citizen groups, insurance

companies, and other public and private sector organizations may help ensure that all stakeholders of the City's population are a part of the decision-making processes.

2.4 Land and Development

Development in Southern California from the earliest days was a cycle of boom and bust. The Second World War, however, dramatically changed that cycle as military personnel and defense workers came to Southern California to fill the logistical needs created by the war effort. The available housing was rapidly exhausted, and existing commercial centers proved inadequate for the influx of people.

Immediately after the war, construction began on the freeway system, permanently changing the face of Southern California and where people chose to live and work. Homes and shopping centers were developed throughout the Los Angeles basin, and within a few decades much of the area was nearly built out. As the Los Angeles basin reached saturation, new development continued to be built around the urban fringe, reaching further and further away from the urban center.

In accordance with Government Code Section 65300, each city in California is required to prepare and adopt a "comprehensive, long-term general plan for the physical development of the city." The General Plan expresses community development goals and embodies public policy relating to future land development, integration of land uses, identification of safety issues (e.g., seismic safety planning), preservation of open space, and public services planning. The General Plan is an important tool used to address environmental challenges relating to transportation and air quality; growth management; conservation of natural resources; clean water, and open space. Lakewood's physical characteristics are nearly identical with that of adjacent cities, and the transition from one city to another is often seamless to most people. Likewise, the threat of exposure to certain natural hazards may also be seamless from one municipality to another.

Lakewood is nearly 100% built-out. Thus, future development/construction will be mostly limited to replacements of existing buildings with newer buildings. All new construction will be fully compliant with National Flood Insurance Program (NFIP) floodplain requirements and in full compliance with the seismic provisions in the current (or future) building codes. Thus, the risks from natural hazards will be minimal for future construction.

2.5 Housing and Community Development

As is the case with much of Southern California, the demand for housing in the City of Lakewood exceeds the available supply. During the recent recession, there has not been a significant number of new housing units built, although during the past two years new development proposals have increased sharply. The City of Lakewood's Housing Element was updated and certified by the California Department of Housing and Community Development (HCD) on October 9, 2013. The Housing Element addressed and established existing and projected housing needs of all economic segments in the community and established goals, policies, objectives, and actions necessary to meet those needs. It also identifies adequate sites for housing production.

HCD makes a periodic evaluation of statewide housing needs based on population trends, demographic changes, migration patterns, etc. The Southern California Association of Governments (SCAG) most recent Regional Housing Needs Assessment (RHNA) for Lakewood quantified the housing needs between 2014 and 2021. The RHNA does not necessarily encourage or promote growth, but rather requires communities to anticipate growth. The RHNA produces information on number of households and housing units, households paying over 30% of income for housing, and projections of future needs.

The regional growth allocation process begins with the California Department of Finance Demographic Unit (DOF) projecting the state population by age group. The projections are used by the HCD to compute the statewide housing demand for an eight-year planning period. In the Southern California region, SCAG's RHNA allocates to each jurisdiction its "fair share" of the future regional housing need. The 2014-2021 housing need allocation for the City of Lakewood is shown in Table 2-3 below. During this planning period, the City is expected to accommodate 403 housing units. Approximately 26.6% of these units should accommodate very low-income future households. Very low-income households earn less than 50% of the median income of the geographic region being analyzed. The policies and programs identified in Lakewood's Housing Element focus on reaching this future demand for housing.

Table 2-3: RHNA Future Housing Needs, 2014-2021

RHNA Allocation	Very Low Income <50% of Median	Low Income 50%-80% of Median	Moderate Income 80%-95% of Median	Above Moderate Income >95% of Median	Total
Housing Units	107	63	67	166	403
	26.6%	15.6%	16.6%	41.2%	100.0%
Breakdown of Very Low Income Allocation into Number of Extremely Low and Very Low Housing Units					
Income Category	**Existing Number of Households**	**Percent**	**Number of Housing Units**		
Extremely Low Income <30% of Median	1,453	44.6%	48		
Very Low Income 30%-50% of Median	1,807	55.4%	59		
Total	3,260	100.0%	107		

Source: SCAG Existing Housing Needs Data Report (2012), Regional Housing Needs Assessment for 5th Cycle Housing Element Update. The allocation of Very Low Income housing units was further broken down by calculating the percentage of existing Extremely Low- and Very Low Income Households and applying that percentage to the Very Low Income RHNA allocation.

As part of the Housing Element update, Lakewood conducted an inventory of its dwelling units. Locations of vacant and underutilized properties were also identified to determine the potential net gain of dwelling units. Table 2-4 below shows existing and build-out figures for dwelling units by Census Tract. The City's housing stock could increase as a result of new development on existing vacant land, recycling of existing poorly maintained parcels and increasing densities on M-F-R-zoned land. Table 2-4 reflects the total potential increase in housing units in the City. It assumes a housing density of five units per acre on R-1 zoned land. For the M-F-R zone, the realistic density is 20 units per acre on lots less than 12,500 square feet, 22 units per acres on lots 12,500 to 25,000 square feet and up to 25 units per acre on recycled sites greater than 25,000

square feet. Densities up to 30 units per acre are allowed on vacant lots greater than 25,000 square feet, although there have not been any proposals of such high density projects since the Housing Element was adopted. As Table 2-4 indicates, the total new units on vacant land (194 units), recycled land (112 units), underutilized church sites (126 units), increasing the density on underutilized M-F-R-zoned parcels (432 units), and potential second units in the R-1 and R-A zones (280 units) could result in a potential net gain of 1,144 units, which would exceed the RHNA allocation for the City of 403 units during the 2014-2021 period.

Table 2-4: Existing and Potential Dwelling Units by Zone

Zoning Designation	Min. Density (Units/ Acre)	Max. Density (Units/ Acre)	Existing Units	New Units on Vacant Land	Net Recycled Units Appendix B	Net Under-utilized Parcel Units Appendix C	Net Underutilized Church Site Units Appendix C	Net Potential Second Units Appendix D	Potential Net Gain of Units
R-1	0.1	8.7	21,386	7				278	285
R-A	0.1	8.7	194	0				2	2
PD-SF	0.1	8.7	551	0					0
M-F-R Less than 12,500 s.f. 12,500 - 25,000 s.f. Over 25,000 s.f.	 6.9 3.4 20	 22 24 30	4,953	187	112	432	126		857
PD-MF Less than 12,500 s.f. 12,500 - 25,000 s.f. Over 25,000 s.f.	 6.9 3.4 20	 22 24 30	140	0					0
MHP	n/a	10	85	0					0
Total	**n/a**	**n/a**	**27,309**	**194**	**112**	**432**	**126**	**280**	**1,144**

Source: Lakewood 2013-2021 Housing Element, Lakewood Community Development Department, March 2013.

The Lakewood Municipal Code allows up to ten (10) mobile homes per acre in Lakewood's Mobile Home Park (MHP) zone. There are 7.9 acres of MHP zoned property in Lakewood and, based on the maximum density allowed under the City's current zoning regulations, up to 79 units are allowed. There are 85 mobile home and/or trailers located in the MHP zone, which exceeds the approved density by six units. Table 2-5 below shows the estimated difference between owner occupied and renter occupied dwelling units in 2000.

Table 2-5: Tenure of Occupied Housing Units, 2010

	No. of Dwelling Units	Percentage of Dwelling Units
Owner Occupied	19,131	72.1%
Renter Occupied	7,412	27.9%
Total	**26,543**	**100%**

Source: 2010 U.S. Census, Lakewood 2013-2021 Housing Element

The better condition of Lakewood's housing stock and quality of life are important factors that homebuyers take into consideration when purchasing in Lakewood as demonstrated by the City's consistently low vacancy rates. Being generally located in the middle of a large metropolitan area, Lakewood's home prices are partially influenced by the cost of housing in the region. Following the recession of the 1990's, median home prices continued to rise along with home prices throughout the region, county, and state. In 1996, the year of the General Plan update, the

median home price in Lakewood was approximately $159,000 when the General Plan was updated and continued to rise until its peak in July 2006 at $550,000. By 2011, Lakewood's median home price had dropped to a low of $352,500. As of December 2015, the median home price in Lakewood had risen to $490,000. Lakewood's residential vacancy rate has generally remained stable at 3.4% over the past three years. Lakewood's residential vacancy rates and median home prices are shown in Table 2-6 below.

Table 2-6: Vacancy Rates and Median Home Prices in Lakewood as of December 2015

Year	Vacancy Rate (1)	Median Home Price (2)
January 1997	2.58	164,000
January 1998	2.58	178,500
January 1999	2.58	197,900
January 2000	2.59	210,000
January 2001	1.67	236,500
January 2002	1.67	268,957 (3)
February 2003	1.67	288,500
May 2004	1.67	420,000
July 2005	1.67	517,000
February 2006	1.67	550,000
February 2007	1.67	515,000
January 2008	1.67	414,500
January 2009	1.67	367,500
January 2010	1.67	390,000
January 2011	1.67	352,500
January 2012	3.38	356,250
January 2013	3.4	425,000
January 2014	3.4	456,000 (4)
December 2014	3.4	438,000 (5)
December 2015	3.4	490,000 (5)

Sources: (1) State of California, Department of Finance, *E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2011- 2015*. Sacramento, California, May 2015. Years previous to current year are DOF historical data. (2) California Association of Realtors. (3) Average provided by GRC Associates study, October 21, 2002. (4) DQ News, December 2014. (5) CoreLogic (Dataquick merged with Corelogic) http://www.corelogic.com/downloadable-docs/dq-news/ca-home-sale-activity-by-city-december-2015.pdf

To ensure that homes and neighborhoods are maintained in acceptable condition, Lakewood engages in activities that promote the quality of life for its citizens. The "Neighborhood Preservation Program" includes community conservation, housing rehabilitation, fix up paint up, and scattered lot acquisition programs. Community Conservation, or code enforcement is dedicated to preserving and improving the environmental quality of the City.

Lakewood's Housing Rehabilitation Program provides deferred loans to qualified low to moderate-income homeowners to make health and safety repairs to their homes. The Fix-Up Paint-Up Grant provides grants to qualified homeowners to paint the exterior of the home and to make other minor exterior repairs. The City of Lakewood uses Community Development Block

Grant funds to provide public service programs for seniors, youth, and physically challenged persons, improvements to public facilities, and community conservation.

The economic recession of the early 1990s contributed to the employment decline in Southern California; but by the mid-1990s, the regional economy began to recover. As shown in Table 2-7 below, SCAG estimated the City's 2003 employment total at 16,700 and increasing to 17,000 jobs in 2005 and to 15,700 in 2008. Due in part to the economic downturn following the "housing bubble," the City's employment total is projected to be 16,800 by 2020, and in 2035, it is projected to be 17,800. This is a projected increase of 6.6 percent between 2003 and 2035. During the same period, the Gateway Cities Subregion is projected to increase by 38 percent and countywide by 10.8 percent.

Table 2-7: Total Employment

Year	Lakewood	Gateway Cities Subregion**	Los Angeles County
2003	16,700	742,000	4,355,000
2005	17,000	746,000	4,397,000
2008	15,700	894,600	4,340,370
2020*	16,800	944,700	4,557,470
2035*	17,800	1,023,900	4,827,470
% Growth 2003-2035*	6.6%	38.0%	10.8%

Source: SCAG 2007 Regional Transportation Plan & SCAG 2012-2035 RTP/Sustainable Communities Strategy growth forecast. Note (*): These rows are based on the growth forecast. Note (**): The Gateway Cities Subregion includes 27 cities in southeastern Los Angeles County, including the City of Lakewood.

As shown in Table 2-8, an examination of the City's income statistics shows that Lakewood's median household income has been consistently above the county median income.

Table 2-8: Median Household Income, 1970-2010

	1970	1980	1990	2000	2010
City of Lakewood	$12,809	$24,752	$48,519	$58,447	$76,348
Los Angeles County	$11,091	$17,563	$39,035	$43,097	$54,828
Percent Difference between Lakewood and L.A. County	15.5%	40.9%	24.3%	35.6%	39.3%

Source: U.S. Census (1970-2000), Lakewood Community Development Department, Claritas Inc., 2010 figure is from 2005-2009 American Community Survey 5-Year Estimates. Note: These figures are expressed in dollars for the year indicated without inflation adjustment. The 2010 figure is expressed in 2009 dollars.

Lakewood has seen a continuous increase in per capita income since 1989. Per capita income is an estimate of total personal income divided by the total population of the geographic area. While this estimate may be used to compare economic areas as a whole, it does not necessarily reflect how income is distributed among residents of the area. In comparison with Los Angeles County and the United States, Lakewood's per capita income has been greater in 1989, 1999, and 2009. Over the past several years, however, Lakewood's per capita income has been slightly less than the overall per capita income of California as shown in Table 2-9 below.

Table 2-9: Per Capita Income

	1989	1999	2009
City of Lakewood	$17,446	$22,095	$28,764
Los Angeles County	$16,149	$20,683	$27,344
State of California	$16,409	$22,711	$29,118
United States	$14,420	$21,587	$27,334

Source: U.S. Census 2005-2009 American Community Survey 5-Year Estimates

Subtle but very measurable changes constantly occur in communities that may result in an increase of potential losses in the event of a major disaster. There are a number of factors that contribute to this increasing loss potential. First, populations continue to increase, placing more people at risk within a defined geographic space. Second, inflation constantly increases the worth of real property and permanent improvements. Third, the amount of property owned per capita increases over time. The preceding information indicates that Lakewood exhibits all of these factors: increased population density, increased median home prices, and continued growth in per capita income.

2.6 Employment and Industry

Lakewood has approximately 370 acres of commercially zoned property. This represents about 6% of Lakewood's total land area. In comparison, about 12% of Long Beach is commercially zoned, Bellflower is 13%, and Cerritos is 15%. This disproportionate share of commercially zoned land represents a significant challenge to Lakewood, as sales tax revenues are a significant funding source for providing municipal services. Lakewood's principal employment activities are related to retail sales and personal services. According to 2010-2014 American Community Survey Five-Year Estimates, there were 39,551 Lakewood residents that were employed which was approximately 48.9% of the City's 2014 population.

2.7 Transportation Systems

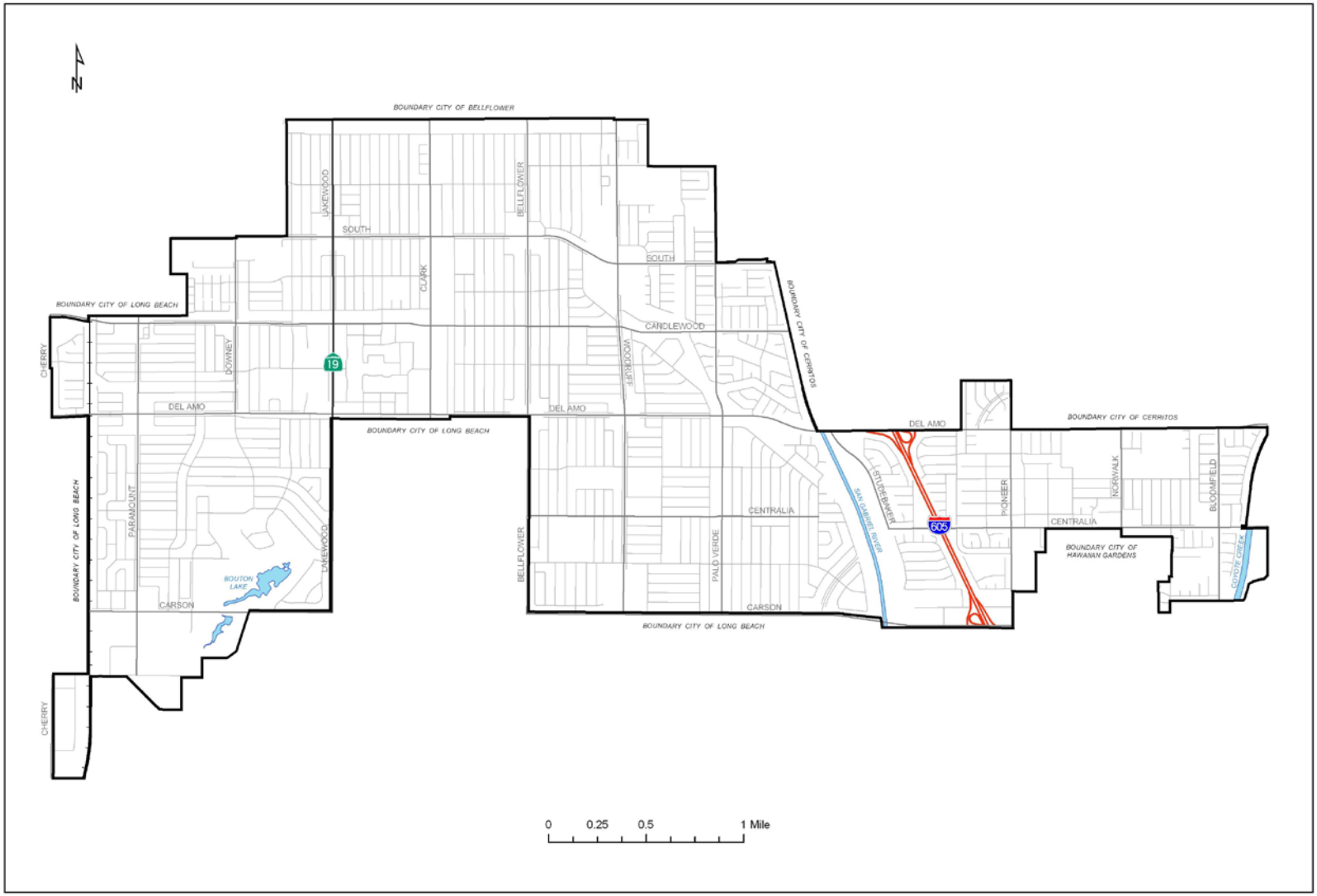
The City of Lakewood is approximately 9.5 square miles in area. Continued population growth in the greater Los Angeles basin directly impacts the demand on the region's transportation systems. Private automobiles are the dominant means of transportation in Southern California and in the City of Lakewood.

The City of Lakewood's regional access is provided from several major and secondary arterials and the regional network of freeways. The City of Lakewood is served directly by the I-605 freeway and via major arterials to the SR-91, I-405, and I-710 freeways, which connect Lakewood to the rest of Los Angeles County. The north/south arterials, Cherry Avenue, Paramount Boulevard, Lakewood Boulevard, Bellflower Boulevard, and Pioneer Boulevard, connect with interchanges on the SR-91 and I-405 Freeways. Lakewood's major east/west arterial roadways are South Street, Del Amo Boulevard, and Carson Street. Access to the I-605 Freeway is provided by all three of these streets, and access to the I-710 Freeway is available directly from Del Amo Boulevard.

The City's road system is comprised of a hierarchical system of major arterial roadways, minor arterial roadways, collector streets, and local streets. Local streets provide direct access to properties and are typically designed to discourage through traffic. Localized flooding may render roads unusable. A severe winter storm has the potential to disrupt the daily driving routine throughout Lakewood and surrounding areas. Natural hazards may disrupt automobile traffic and shut down local and regional transit systems.

The major arterial roadways within Lakewood are shown below in Figure 2.3.

Figure 2.3 – Lakewood's Major Arterial Roadways



Lakewood meets its public transportation needs through a mixture of regional transit systems. Public transportation in the City of Lakewood is offered by three public transit providers: Long Beach Transit District, Metro, and Orange County Transportation Authority (OCTA). In addition, the City offers a free shuttle for seniors and disabled persons called "Dependable, Accessible, Senior and Handicapped Transportation" (DASH). DASH travels within and outside the City's boundaries. Dial-a-Lift is a fee-for-service transit system subsidized by the City to provide affordable transportation for seniors and disabled residents.

Currently, there is no light rail, heavy rail, or railroad passenger service provided to Lakewood. The nearest Amtrak station is located about 12 miles to the east, in the City of Fullerton. The Fullerton station is also utilized by Metrolink commuter trains. A closer Metrolink station is about six miles to the north, in the City of Santa Fe Springs. The closest Metro Green Line light rail station is approximately three miles to the north in the City of Downey, and the closest Metro Blue Line light rail station is approximately 2.5 miles to the west, in the City of Long Beach.

The City's General Plan identifies the location of bicycle routes and the classification of such routes (ie. bike route, bike lane, and bike path) within Lakewood and the relation of those routes with the regional bikeway system.

The City of Lakewood's air travel needs are primarily served by three area airports: Los Angeles International Airport, Long Beach Airport, and John Wayne/Orange County Airport. Los Angeles International Airport provides international air-carrier service, while the Long Beach and John Wayne/Orange County Airports provide less-extensive air-carrier, air taxi, and air-charter services.

Two active Union Pacific Railroad lines traverse the western portion of the City in a north/south direction. One line traverses the northwest corner of the City diagonally and operates several times during the course of a 24-hour period, based on customer needs. The second line is a spur line that normally operates a few times a week and connects with the aforementioned line just north of Candlewood Street. An unused rail line passes a corner of the City near Del Amo Boulevard and the Los Angeles/Orange County line. This rail line was once part of the Pacific Electric system and was later a Southern Pacific Railroad branch line. Metro now owns the right-of-way and is evaluating a potential new transit system connecting southeast Los Angeles County to downtown Los Angeles. This project is known as the West Santa Ana Branch Corridor and stretches about 20 miles from downtown Los Angeles to the City of Artesia. The project is funded in part by Measure R, a one-half cent sales tax approved by Los Angeles County voters in November 2008. The project is contained in Metro's 2009 Long Range Transportation Plan (LRTP) and is expected to start operation in 2027.

2.8 Climate

The City of Lakewood is located in the South Coast Air Basin of California, a 6,600 square-mile area encompassing Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino counties. Bounded by the Pacific Ocean to the west and the San Gabriel and San Jacinto mountains to the north and east, the South Coast Basin is an area of high air pollution potential. The climate of the larger Los Angeles area, including the City of Lakewood, is

generally classified as "Mediterranean;" mild, sunny winters with occasional rain and warm, dry summers. The strength and location of a semi-permanent, subtropical high pressure cell over the eastern Pacific Ocean primarily controls the climate of the basin, along with the moderating effects of the nearby oceanic heat reservoir. The coastal mountain ranges lying along the north and east sides of the Los Angeles coastal basin act as a buffer against the extremes of summer heat and winter cold occurring in desert and plateau regions in the interior. Warm summers, mild winters, infrequent rainfall, moderate daytime onshore breezes, and moderate humidity characterize local climatic conditions.

The terrain features of the Basin make it possible for various microclimates to exist within the Los Angeles region. The pattern of mountains and hills is primarily responsible for the wide variations of rainfall, temperatures, and localized winds that occur throughout the region. Temperature fluctuations have an important influence on basin wind-flow, dispersion along mountain ridges, vertical mixing, and photochemistry. Due to the moderating marine influence that decreases with distance from the ocean, monthly and annual spreads between temperatures are greatest inland and smallest along the coastline. Precipitation is highly variable seasonally. Summers are often dry. There are frequent periods of four to five months without rain. In the winter an occasional storm from the high latitudes sweeps across the coast bringing rain. Annual rainfall is lowest in the coastal plain and inland valleys, higher in the foothills, and highest in the mountains. Because the metropolitan basin is largely built out, water originating in higher elevation communities may have a sudden impact on adjoining communities that are at lower elevations.

The microclimate regime of the basin that influences Lakewood is primarily semi-marine. Although Lakewood is generally beyond the fog belt, it is still under the influence of the ocean most of the time. Annual average daytime temperatures range from 83.8 degrees Fahrenheit in the summer to 66 degrees in the winter. Winters are seldom cold. Frost is rare, and temperatures generally do not fall below 28 degrees Fahrenheit. Mornings in the spring and summer are often cloudy due to the presence of high fog with clear and breezy afternoons. Summers in Lakewood are warmer with less fog than along the coast. The entire area is affected by sea breezes and is seldom extremely hot. The City has lower winter temperatures than the coast. The humidity tends to be lower than coastal areas. Average annual precipitation for Lakewood is 11.54 inches and occurs almost exclusively from late October to early April.

Winds across the Lakewood area are an important meteorological parameter since they control both the initial rate of dilution of locally generated air pollutant emissions as well as their regional trajectory. Predominant wind patterns for the Lakewood area generally follow those of the Basin. During the day, effects of a sea breeze reach inland. During the night, surface radiation cools the air in the mountains and hills, and it flows into the valleys and meanders to the coast producing a gentle "land breeze."

In Lakewood, daytime winds normally occur from the south-southwest as onshore flow from the Pacific finds its way across the coast around either side of the Palos Verdes Peninsula. Average daytime maximum wind speed is approximately 5.7 miles per hour (mph) in the summer, decreasing to 4.7 mph during winter. This directional flow is most dominant in summer and spring. Nighttime predominant wind patterns generally find an east-northeasterly flow from the

general offshore flow enhanced by the regional mountain/valley drainage. This directional flow is also most dominant in fall and winter. Average nighttime speeds range between 2.5 mph in the winter to 1.7 mph in summer. This general flow for the area is interrupted by occasional winter storms and the Santa Ana winds, which may bring much stronger winds to the area in varying directions.

2.9 Lakewood's Geology and Soils

The City of Lakewood is located in an area that is geologically recent. The surface consists of deposits of unconsolidated silt, gravel and sand of fluvial and marine origin. Under this is a thick sequence of Quaternary and Tertiary sedimentary rocks deposited on a basement of metamorphic and crystalline rocks of pre-Tertiary age sometimes referred to as the Catalina schist. In the broad syncline underlying this area, the depth of these sediments has been estimated at 15,000 to 20,000 feet.

These formations are of water-bearing character. The areas near the San Gabriel River have large deposits of sand and gravel, especially in the lower two-thirds of the formations. The remaining upper layers are silt, clay, and fine sand. This water-bearing zone is 800 to 8,000 feet below sea level. This fresh water aquifer is contained between layers of silt and clay. The water-bearing sediments are largely of marine origin. They supply many industrial and municipal wells with individual yields up to 4,000 gallons per minute. Consolidated rock of Pliocene and Miocene age underlies the Quaternary deposits in nearly all the area. The Pliocene is comprised of the Pico formation above and the Repetto formation below it. The lower 600 to 1,000 feet of the upper division of the Pico formation includes several sand layers that are water bearing, but of unknown productivity.

The middle and lower divisions of the Pico formation, the Repetto formation and the Miocene layers are largely siltstone and shale with low permeability. Sand layers at this depth contain saline water, which varies from about 50 to 100% of the salinity of ocean water. These beds are far below the areas normally penetrated by water wells.

The broad synclinal depression beneath the coastal plain includes several local structural features whose axes are roughly parallel and trend to a northwest orientation. The most extensive of these is the Newport-Inglewood Fault Zone, which is a composite belt of anticlinal folds and echelon faults. Some of the warping and deformation has taken place comparatively recently in late Pleistocene or Recent time. The Norwalk Fault and the Cherry Hill Fault, both part of the Newport-Inglewood Fault Zone are within two miles (3.2 kilometers) northeast and southwest of the City, respectively. The Los Alamitos Fault is approximated to cross a corner of the City near the northeast of the intersection of Bellflower Boulevard and Carson Street.

The soils of the Lakewood area are mostly alluvial in nature and were deposited by the San Gabriel River and its tributaries during the recent geologic past. Composition is generally clay and silt loams of various classifications. The soils are relatively impermeable, which causes some subsurface drainage problems and show some heavy concentrations of alkali.

According to the City of Lakewood General Plan Technical Background Report, there are four main soil associations in the City: Ramona-Placentia Soils, Chino Soils, Hanford Soils, and Foster Soils. See Figure 2.4 below for the general location of these soil types. Soil-type information contained in the Lakewood Seismic Safety Element is based upon soil-type interpretation for soils at a depth of five feet or less for the Lakewood area. The data is sufficiently accurate for planning purposes but not for projects involving detailed soil map analyses. This information is summarized as follows:

Ramona-Placentia Association Soils:
The Ramona-Placentia Association soils are primarily located in the western portion (westerly of Lakewood Boulevard) of the City. These soils, along with the Chino Association soils, are known for their expansive characteristics, which in many cases, may result in differential settling of the soil. Consequently, new construction in these areas is required to have stronger foundations and other modifications. The Ramona-Placentia Association soils are as follows:

Ramona Loam: The surface soil consists of 12 to 24 inches of light-textured loam. The subsoil is a compact clay loam or clay. The subsoil may extend to a depth of six feet or more, is semi-cemented in places, closely approaching a hardpan. In such places, it absorbs water slowly, especially after dry periods, but once wet, it softens considerably and retains moisture well.

Ramona Clay Loam: This soil-type exists to a depth of eight to 24 inches and consists of light-textured clay loam. The soil is heavier in the more gently sloping or nearly level situations. It absorbs water slowly when dry, but once wet is permeable and quite retentive. The subsoil is heavy, compact clay loam or clay. The subsoil rests at four to six feet upon a variably textured substratum of loam or clay loam. The substratum usually is more permeable than the subsoil but is generally quite compact. This type as a whole is higher in organic matter than the Ramona Loam, but there usually is not sufficient organic matter to prevent puddling and the formation of clods if the soil is handled when wet or is irrigated by flooding. This type occurs mainly on old alluvial fans and foot slopes. The dense subsoil retards the absorption of moisture, and much of the rainfall is lost in the run-off. The soil is refractory when dry, but when wet, it is permeable and quite retentive of moisture.

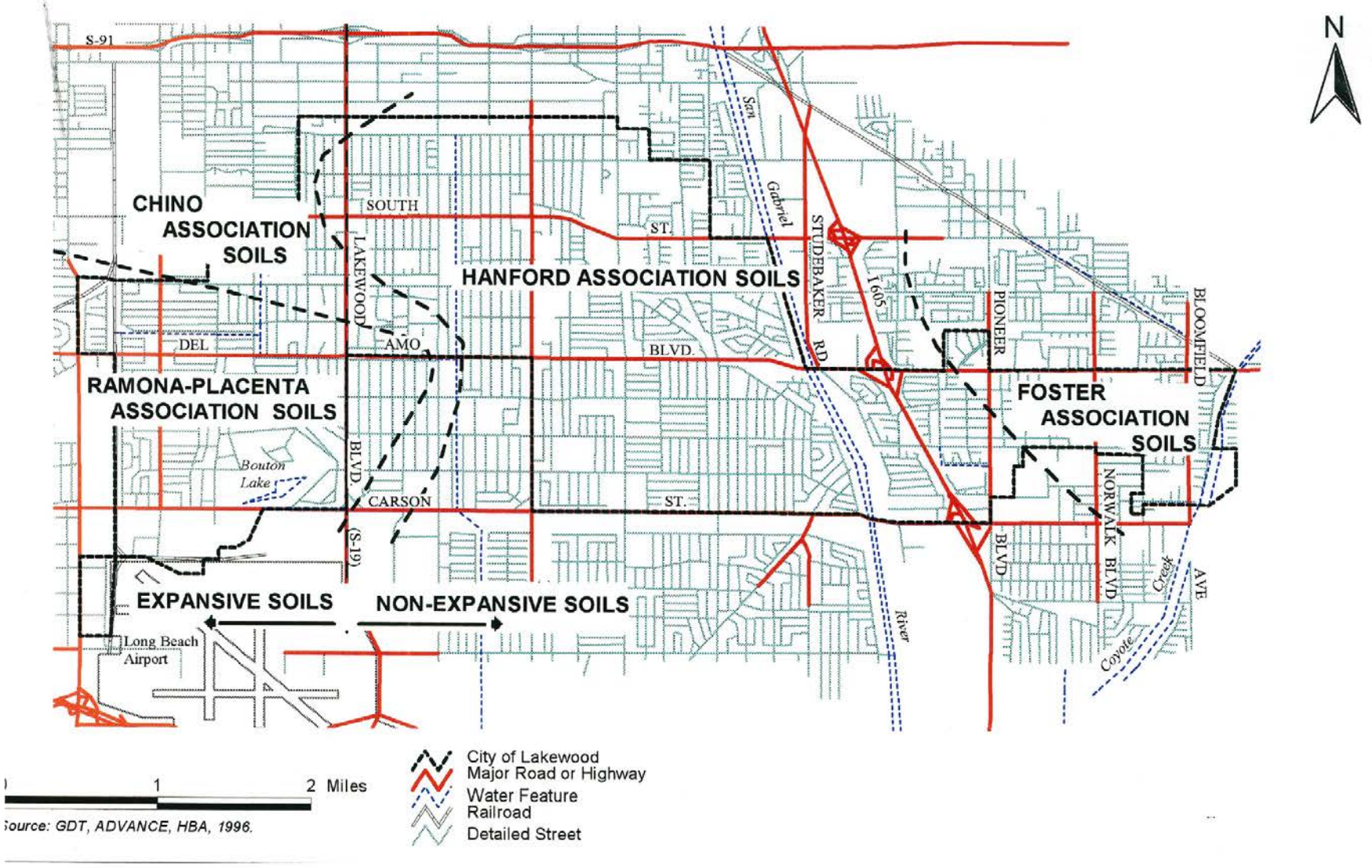
Altamont Clay Loam: This soil type consists of 12 to 18 inches of friable, micaceous clay loam, relatively high in silt. The subsoil has stratified layers of clay, silt, or fine sand, and the material is saturated at depths ranging from three to six feet. Both soil and subsoil are generally free from gravel or coarse, gritty material, and are in well-drained areas that are free from alkali and are readily penetrated by roots.

Organic Soils: This peaty organic soil type is located in Bouton Lake. The lake floor was filled with compacted sandy loam during the construction of the Lakewood golf course. The present day Bouton Lake floor now has a thin layer of organic-rich soil, over a layer of compacted sandy silt. Below this is a thin layer of unknown depth of original organic-rich lake floor sediments.

Chino Association Soils:
The northwestern portion of Lakewood contains soils of the Chino Association. This soil-type, like the Ramona-Placentia Association soils, is known for its expansive qualities, and some special construction requirements (e.g., stronger foundations, etc.) are required.

Chino Silt Loam: This soil-type consists of a friable, micaceous silt loam at a depth varying from one to six feet. Generally below 12 to 18 inches, the subsoil consists of strata of silt, clay, and fine sand. This soil-type contains a moderate to large amount of organic matter. Its silt content prevents cracking to a large extent. The soil absorbs and holds moisture well.

Figure 2.4 – Lakewood Soil Types



Hanford Association Soils:
The Hanford Association Soils are generally found in most of Lakewood between Lakewood Boulevard and Pioneer Boulevard. These soils characteristics are described as follows:

Hanford Fine Sandy Loam: This soil-type consists of relatively light-textured, micaceous fine sandy loam, open and friable in structure, and contains only a moderate proportion of organic matter. The subsoil generally encountered at 12 to 15 inches, consists of variably stratified deposits of sand, silt, and gravel, and has high infiltration capability. The texture of this type is subject to great variation near streamways. In such places, small patches or very narrow strips of sand, fine gravel, fine sand, or silt loam may be included. Gravelly substrata frequently occur. Several of the areas forming level to gently sloping flood plains of the rivers are very large. Nearly all of this type occurs in rather low positions and generally has a relatively shallow water table lying four to ten feet below the surface. A large proportion of this soil type contains alkali in harmful amounts.

Hanford Loam: This soil-type exists to a depth varying from 12 to 72 inches or more and consists of a friable, light-textured, micaceous loam over the flatter alluvial fans and flood plains. The material below 12 inches frequently consists of stratified beds of sand, silt, or gravel. The Hanford loam is generally low in organic matter. The soil and subsoil are open, which absorbs and retains moisture well, except where the subsoil and substratum are loose and porous. Tillage is not difficult at any time. There are no obstructions to deep root development except in low spots where a high water table occurs. Some of the lower-lying portions have a high water table. This is particularly true in the area to the east of the San Gabriel River, north of the City boundary, and south of 212th Street. Where this condition exists and some alkali has accumulated, the liberal use of organic matter and good tillage will remedy the situation.

Foster Association Soils:
Foster Association soils are primarily found in the easterly portion of the City. Foster soils are usually over 60 inches deep, poorly drained, and have moderate subsoil permeability. They have gray or grayish-brown sandy loam surface layers underlain by similar substratum, which may be thinly stratified with variable textures. They are usually mottled and calcareous in the lower part. Some areas have a high water table, which restricts rooting depth. Foster soils have moderate fertility. These soils are used extensively for residential construction.

3.0 COMMUNITY INVOLVEMENT AND PLANNING PROCESS

3.1 Historical Overview

Lakewood has always taken potential hazards into consideration as part of various planning activities. These activities include the General Plan safety element, zoning, capital improvement planning, and updates to the building and safety codes. On August 9, 2011, the Lakewood City Council adopted Resolution No. 2011-52 thereby adopting the City of Lakewood Hazard Mitigation Plan and directing staff to submit the Hazard Mitigation Plan to FEMA for review and approval. FEMA approved the Lakewood Hazard Mitigation Plan on August 15, 2011 and found it to be in conformance with Title 44 of the Code of Federal Regulations pertaining to hazard mitigation plans. FEMA's approval of the plan is valid for five years. Lakewood began the process of updating the Hazard Mitigation Plan in April 2015. The plan update process is described in greater detail below.

3.2 Lakewood Hazard Mitigation Planning Process

The Lakewood Hazard Mitigation Plan was developed in three stages:

- June 2015 – January 2016: Develop Plan Budget, form working group, and select consultant contract.
- January 2016 – August 2016: Seek public input, conduct workshops, update plan, and approve draft plan.
- August 2016: Submit plan for approval

The Lakewood Hazard Mitigation Plan is the product of the input and development by the following contributors:

City Council
Council Member Steve Croft
Council Member Diane DuBois
Council Member Todd Rogers
Council Member Jeff Wood
Mayor Ron Piazza

Executive Management
Howard L. Chambers, City Manager
Lisa Novotny, Assistant City Manager

Community Development
Sonia Dias Southwell, AICP, Director of Community Development

Working Group

Administration – Paolo Beltran, Assistant to the City Manager, extension 2129
pbeltran@lakewoodcity.org

Administrative Services – Michael Aguirre, extension 2605
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Community Development – Paul Kuykendall, Senior Planner, extension 2344
pkuykend@lakewoodcity.org

Public Works – Max Withrow, Assistant Director of Public Works, extension 2502
mwithrow@lakewoodcity.org

Recreation and Community Services – Nancy Hitt, Community Services Manager, extension 2404
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Water Resources – Toyasha Sebbag, Water Administration Manager, extension 2702
tsebbag@lakewoodcity.org

Consultant
Dr. Kenneth Goettel, Goettel & Associates, Inc.
Phone (530) 750-0440, KenGoettel@aol.com

The roles, responsibilities and contributions by the above people to the Lakewood Hazard Mitigation Plan are summarized below.

City Council

The Lakewood City Council approved the contract between the City and Goettel & Associates, Inc. for the update to the Hazard Mitigation Plan as part of the budget process. The City Council also adopts the Plan and authorizes the Plan to be submitted to FEMA for review.

Executive Management

City Manager, Howard Chambers, ensured that the director of each City department assigned a staff member from that department to sit on the Working Group and represent that department during the preparation of the Hazard Mitigation Plan update. Executive Management performed as a conduit between the hazard mitigation planning process and the City Council so that communication to and from staff remained clear.

Community Development

Sonia Southwell, AICP, is Lakewood's Director of Community Development. Ms. Southwell provided direction to staff in the following areas: organized the Hazard Mitigation Team, participated in the consultant selection process, developing the contract with the consultant, and provided general guidance in preparation of the Plan.

Working Group

In November 2015, each department was asked to appoint a representative to serve on the Working Group for the Hazard Mitigation Plan update. The Working Group was responsible for identifying hazard vulnerabilities, methods by which those hazards may be mitigated (action items), estimating timelines for each action item, and prioritizing the action items by the economic feasibility of implementing them.

Consultant

Dr. Kenneth Goettel, Goettel & Associates, Inc., provided guidance to staff for updating the Hazard Mitigation Plan. Dr. Goettel reviewed the vulnerability and risk assessments included in the Hazard Mitigation Plan and provided technical support to the Working Group throughout the planning process including changes of federal requirements that have taken place since approval of the 2011 Hazard Mitigation Plan.

Working Group Meeting #1: December 15, 2015

The update planning process began on December 15, 2015 with a planning start-up meeting. The agenda for this meeting begins on the following page. Attendees at this meeting included:

Administration – Paolo Beltran, Assistant to the City Manager
Community Development – Paul Kuykendall, AICP, Senior Planner
Public Works – Max Withrow, Assistant Director of Public Works
Recreation and Community Services – Nancy Hitt, Community Services Manager
Water Resources – Toyasha Sebbag, Water Administration Manager

The following is a summary of the first meeting.

Lakewood Hazard Mitigation Plan 2016
Hazard Mitigation Plan Working Group Meeting #1
Agenda
December 15, 2015, 4:00 PM – 5:00 PM
Pan Am Room, Lakewood City Hall

1. Hazard Mitigation Plan FAQs

What is a Hazard Mitigation Plan (HMP)?
A HMP identifies potential hazards such as earthquakes, floods and dam failures, windstorms, drought, and other hazards. The HMP assesses the risk level for each hazard and assigns action items to reduce potential damage from such hazards.

Why do we need a HMP?
Having a HMP is a federal requirement. Congress adopted the Robert T. Stafford Act by passing the Disaster Mitigation Act of 2000 (DMA 2000), which requires local agencies (states, counties, cities, school districts, and other public agencies) to prepare updated HMPs every five years. The Act was a result of repetitive claims (i.e. flood insurance claims) in areas where the same disaster happens over and over and because no mitigation was required in the rebuilding process to reduce damages from future disasters.

What does a HMP contain?
Lakewood's HMP is built upon an assessment of each of the major hazards, such as earthquakes, that may impact Lakewood, including their frequency, severity, and areas of the City likely to be affected.

The HMP includes a quantitative assessment of the vulnerability of buildings, infrastructure, and people to each of these hazards, to the extent possible with existing data.

The plan includes an evaluation of the likely magnitude of the impacts of future disasters on Lakewood. The review of the hazards and the vulnerability of the City to these hazards are the foundation of this mitigation plan.

From these assessments, situations where buildings, infrastructure, and/or people may be at high risk from one or more hazards are identified whenever possible. These high risk situations then become priorities for future mitigation actions to reduce the negative impacts of future disasters on Lakewood.

Does Lakewood have a HMP?
Yes. Our HMP was adopted by the City Council on August 9, 2011 and was approved by FEMA on August 15, 2015. The five-year update is due on August 15, 2016.

2. Lakewood Working Group

The HMP Working Group consists of:

Administration – Paolo Beltran, Assistant to the City Manager
Administrative Services – Michael Aguirre
Community Development – Paul Kuykendall, Senior Planner
Public Works – Max Withrow, Assistant Director of Public Works
Recreation and Community Services – Nancy Hitt, Community Services Manager
Water Resources – Toyasha Sebbag, Water Administration Manager

3. Working Group Responsibilities.

Most of the work is already done because:
- We are updating an existing plan.
- Most of the HMP contents came or will come from existing documents, such as our emergency response plan and the general plan.
- We have enlisted the assistance of consultant Ken Goettel and Associates and expect to have an agreement signed before the end of the year with Ken Goettel & Associates, who helped prepare our first HMP. This company has demonstrated expertise in this area as well as knowledge of FEMA HMP requirements and participated in the preparation of our current HMP.

Working group members will help with the plan update by providing data specific to their department, analyzing potential impacts from hazards, identifying ways to reduce those impacts, reviewing and updating the mitigation goals, objectives and action items in the HMP.

There are four main tasks that the City will do in updating the HMP:

1. Document the planning process: committee meetings, public meetings, postings on websites, e-mail notifications. FEMA has added requirements in this category broadening the scope of the outreach. FEMA wants to see that all stakeholders were notified, although it is not necessary that they respond or participate (See the Mitigation Plan Review Tool for a summary and FEMA's Local Mitigation Plan Review Guide starting on page 15 for the details).

Generate a comprehensive e-mail list of the stakeholders in the FEMA specified categories and send them; notice of starting the update, solicitation of participants, notices of public meetings and agendas, brief synopses of the results of the meetings. Maintain records of such outreach efforts for inclusion in the plan or appendices.

2. Review and update the mitigation goals, objectives and action items. The goals and objectives may remain unchanged if appropriate. The action items shall be updated to reflect current priorities. FEMA also requires a summary table

identifying the status of the 2011 Action Items - Completed, Partially Completed, or Not Completed with a stated reason for only partial completion or non-completion. The reasons can include: No longer necessary or lack of funding resources.

3. Document with brief narratives any hazard events that have impacted the city since 2011 - if none, state accordingly.

4. Update the hazard data and maps where necessary. Community Development and our consultant will handle most of this work.

4. HMP Development Schedule

Discussion of a draft calendar ensued.

Working Group Meeting #2: March 9, 2016

Meeting #2 focused on reviewing the Plan's Action Items in terms of completion. Action Items from the previous HMP were reviewed to identify whether each Action Item was a) completed, b) partially completed, or c) not completed. Working Group members were asked to prepare a brief statement on the status of each Action Item for their respective departments. Working Group members were also encouraged to suggest new Action Items or changes to current Action Items. Meeting #2 was conducted via e-mail among the following Working Group members:

Administration – Paolo Beltran, Assistant to the City Manager
Community Development – Paul Kuykendall, AICP, Senior Planner
Public Works – Max Withrow, Assistant Director of Public Works
Recreation and Community Services – Nancy Hitt, Community Services Manager
Water Resources – Toyasha Sebbag, Water Administration Manager

Working Group Meeting #3: July 27, 2016

Meeting #3 focused on the status of reviewing the update, modifications to language in the Goals and Objectives sections, changes to Action Items, and that certain maps and graphics were updated with improved versions. Lastly, next steps for the HMP update process were discussed.

Administration – Paolo Beltran, Assistant to the City Manager
Community Development – Paul Kuykendall, AICP, Senior Planner
Public Works – Max Withrow, Assistant Director of Public Works
Recreation and Community Services – Nancy Hitt, Community Services Manager
Water Resources – Toyasha Sebbag, Water Administration Manager

3.3 Lakewood Hazard Mitigation Plan Community Involvement Process

Public participation and community involvement is a key component to the hazard mitigation planning processes. Citizen participation offers citizens the chance to voice their ideas, interests, knowledge, and opinions. The Federal Emergency Management Agency also requires public input during the development of mitigation plans.

The City of Lakewood Hazard Mitigation Plan integrates a cross-section of citizen input throughout the planning process. To accomplish this goal, a three-pronged public participation process was developed with the following components: (1) develop a working group comprised of knowledgeable individuals representing various City departments; (2) provide the public with opportunities to review and comment on the hazard mitigation planning process and to identify common concerns and ideas regarding hazard mitigation and to discuss specific goals and actions of the mitigation plans. This was achieved by posting the draft document on the City's website, conducting two public workshops, and mailing notice of the draft documents availability to other governmental entities and other interested organizations; and (3) obtain support from the Lakewood City Council by adopting a Resolution approving the draft Hazard Mitigation Plan.

The City of Lakewood is dedicated to involving the public directly in the continual review and updates of the HMP. The HMP will be made available at City Hall for public review, and the public will be afforded opportunity to contribute to future revisions of this Plan. The draft 2016 HMP is also posted on the City's website at:

http://www.lakewoodcity.org/council/planning.asp

Two community workshops were held in 2016. Notices for both workshops were posted online, at the entrance to Lakewood City Hall, in the City Clerk's office, and at two public parks, and notices were mailed to various public and private organizations. Copies of the community workshop notices as well as the mailing labels are contained in Appendix C. The first community workshop was held on Monday, May 9, 2016 at the Centre at Sycamore Plaza. Notices of this community workshop were posted online, at the entrance to Lakewood City Hall, in the City Clerk's office, and at two public parks.

Despite notification of this community workshop, no members of the public or persons representing interested agencies attended. A second community workshop was held on Tuesday August 2, 2016 at the Centre at Sycamore Plaza. Notices of this community workshop were also posted online, at the entrance to Lakewood City Hall, in the City Clerk's office, and at two public parks. Copies of the community workshop notices as well as the mailing labels notices are contained in Appendix C.

The HMP was placed on the agenda for the August 9, 2016 City Council meeting.

4.0 MISSION STATEMENT, GOALS, OBJECTIVES AND ACTION ITEMS

4.1 Overview

The purpose of this Hazard Mitigation Plan is to reduce the impacts of future disasters in Lakewood and to make the City more disaster resistant and disaster resilient by reducing the vulnerability to disasters and enhancing the capability of the City and its citizens to respond effectively to, and recover quickly from, future disasters.

Completely eliminating the risk of all future disasters is neither technologically possible nor economically feasible. However, substantially reducing the negative impacts of future disasters is achievable with the adoption of this Hazard Mitigation Plan and ongoing implementation of risk-reducing action items.

Incorporating risk-reduction strategies and action items into Lakewood's existing programs and decision-making processes will facilitate moving Lakewood toward a safer and more disaster resistant future. This mitigation plan provides the framework and guidance for both short- and long-term proactive steps that can be taken to:

- Protect life safety;
- Reduce property damage;
- Minimize economic losses and disruption; and
- Shorten the recovery period from future disasters.

In addition, the Lakewood Hazard Mitigation Plan is intended to meet FEMA's (Federal Emergency Management Agency) mitigation planning requirements so that Lakewood remains eligible for pre- and post-disaster mitigation funding from FEMA.

The Lakewood Hazard Mitigation Plan is based on a four-step framework that is designed to help focus attention and action on successful mitigation strategies: Mission Statement, Goals, Objectives and Action Items.

- **Mission Statement.** The Mission Statement states the purpose and defines the primary function of the Lakewood Hazard Mitigation Plan. The Mission Statement is an action-oriented summary that answers the question, "Why develop a hazard mitigation plan?"

- **Goals.** Goals identify priorities and specify the direction for reducing the risks from natural and human-caused hazards. The Goals represent the guiding principles, which direct, the community's efforts. The Goals provide focus for recommendations, specific issues, and actions addressed in Objectives and Action Items.

- **Objectives.** Each Goal has Objectives which outline the method, processes, or steps necessary to accomplish the Plan's Goals. Objectives then lead directly to specific Action Items.

- **Action Items.** Action items are specific well-defined activities or projects that work to reduce risk. That is, the Action Items represent the steps necessary to achieve the Mission Statement, Goals and Objectives.

4.2 Mission Statement

The mission of the Lakewood Hazard Mitigation Plan is to:

> **Proactively facilitate and support community-wide policies, practices, and programs that make Lakewood more disaster resistant and disaster resilient.**

Making Lakewood more disaster resistant and disaster resilient requires proactive steps and actions that will:

- Protect life safety,
- Reduce property damage,
- Minimize economic losses and disruption, and
- Shorten the recovery period from future disasters.

This Hazard Mitigation Plan documents Lakewood's commitment to promote sound public policies designed to protect citizens, critical facilities, infrastructure, private property and the environment from natural hazards by increasing public awareness, identifying resources for risk assessment, risk reduction and loss reduction, and identifying specific activities to help make Lakewood more disaster resistant and disaster resilient.

4.3 Mitigation Plan Goals and Objectives

Mitigation plan goals and objectives guide the direction of future policies and activities aimed at reducing risk and preventing loss from disaster events. The goals and objectives listed here serve as guideposts and checklists as the City, other agencies, businesses and individuals begin implementing mitigation action items within Lakewood.

Lakewood's mitigation plan goals and objectives are consistent with the goals established by the State of California Hazard Mitigation Plan. However, the priorities are specific to Lakewood. These goals were developed with extensive input and priority setting by the Lakewood Hazard Mitigation Plan Working Group and the stakeholders and citizens of Lakewood.

Goal 1: Reduce the Threat to Life Safety

Objectives:

A. Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
B. Enhance life safety by improving public awareness of earthquakes and other natural hazards posing life safety risk to the Lakewood community.

Goal 2: Reduce the Threats to Lakewood Buildings, Facilities and Infrastructure

Objectives:

A. Identify buildings, facilities, bridges, and other infrastructure that may be at risk from one or more hazards addressed in the Hazard Mitigation Plan.
B. Conduct risk assessments for at-risk buildings, facilities, bridges, and other infrastructure to determine cost effective mitigation actions to eliminate or reduce risk.
C. Implement mitigation measures for buildings, facilities, bridges, and other infrastructure, which pose an unacceptable level of risk.
D. Ensure that new buildings, facilities, bridges, and other infrastructure in Lakewood are adequately designed and located to minimize damages in future disaster events.

Goal 3: Enhance Emergency Response Capability, Emergency Planning and Post-Disaster Recovery

Objectives:

A. Ensure that critical buildings, facilities, bridges, and infrastructure are capable of withstanding disaster events with minimal damage and loss of function.
B. Enhance emergency planning to facilitate effective response and recovery from future disaster events.
C. Increase collaboration and coordination among Lakewood, nearby communities, utilities, businesses and citizens to ensure the availability of adequate emergency and essential services for the Lakewood community during and after disaster events.

Goal 4: Vigorously Seek Funding Sources for Mitigation Actions

Objectives:

A. Prioritize and fund action items with the specific objective of maximizing mitigation, response and recovery resources.
B. Explore both public (local, state and federal) funding and private sources for mitigation actions.

Goal 5: Increase Public Awareness of Natural Hazards and Enhance Education and Outreach Efforts

Objectives:

A. Develop and implement education and outreach programs to increase public awareness of the risks from natural hazards.
B. Provide information on resources, tools, partnership opportunities and funding sources to assist the community in implementing mitigation activities.
C. Strengthen communication and coordinate participation in public agencies, non-profit organizations, businesses, industry, and the public to encourage and facilitate mitigation actions.

Goal 6: Incorporate Mitigation Planning into Natural Resource Management and Land Use Planning

Objectives:

A. Balance natural resource management, land use planning, and natural hazard mitigation to protect life, property and the environment.
B. Preserve, rehabilitate, and enhance natural systems and habitats, and serve natural hazard mitigation functions.

4.4 Lakewood Hazard Mitigation Plan Action Items

The Mission Statement, Goals and Objectives for Lakewood, as outlined above, are achieved through the implementation of specific mitigation action items. Action items may include the refinement of policies, data collection to better characterize hazards or risk, education, outreach or partnership-building activities, as well as specific engineering or construction measures to reduce risk from one or more hazards to specific buildings, facilities, bridges, and other infrastructure in Lakewood. Many of the high priority action items focus on facilities which are critical or essential for Lakewood. Critical facilities are necessary for emergency response, public safety, recovery activities, and hospitals. Protection of essential utility services such as electric power, water and wastewater is also extremely important to communities, especially after a disaster. Such utilities are often characterized as "lifeline" utilities because they are critical to a community for life safety (e.g., services to hospitals) and for the economic recovery after a disaster.

Lakewood has designated the following facilities as critical facilities as shown in Figure 4-1:

- Lakewood City Hall;
- Los Angeles County Sheriff's Lakewood Station;
- Three Los Angeles County Fire Department stations located in Lakewood; and
- Lakewood Regional Medical Center.

Lakewood has designated the following facilities as essential facilities which are vital to the continued delivery of key government programs or services which may significantly affect the community's ability to recover from a disaster event. The City-owned essential facilities are shown in Figure 4-2:

- Nixon Yard (Lakewood's public works maintenance facility);
- Arbor Yard (Lakewood's water resources maintenance yard);
- Plant #13 (Lakewood's water resources storage facility); and
- Plant #22 (Lakewood's water resources storage facility).

Other City-owned essential facilities include all potable production wells, interconnections with other water agencies, and all related pipelines, pumps, treatment and storage facilities. In addition, non-city owned utility infrastructure, especially the electric substations providing power to Lakewood and Golden State Water Company wells, storage, and treatment facilities are also essential to the Lakewood community.

Figure 4-1: Critical Facilities

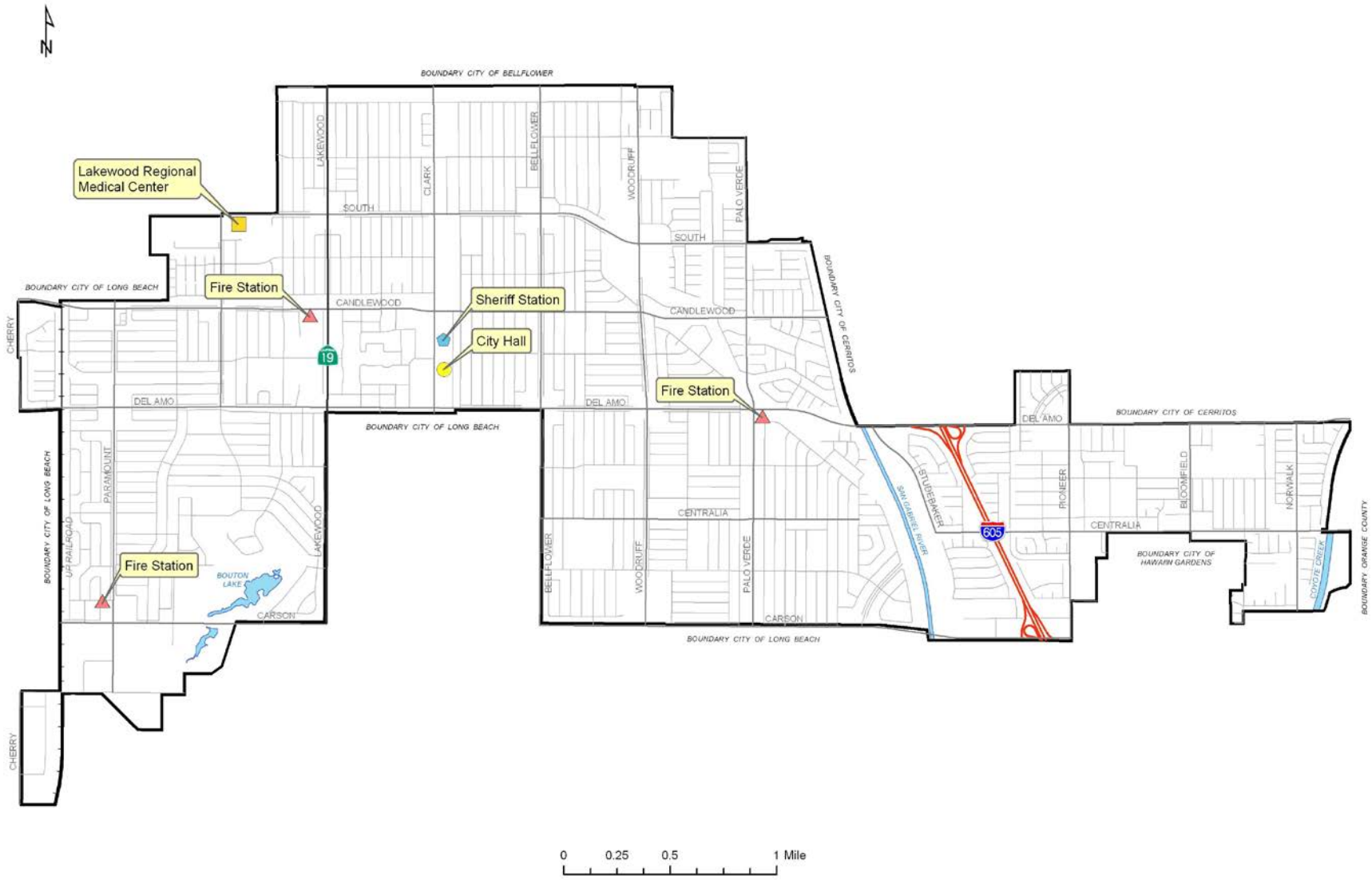
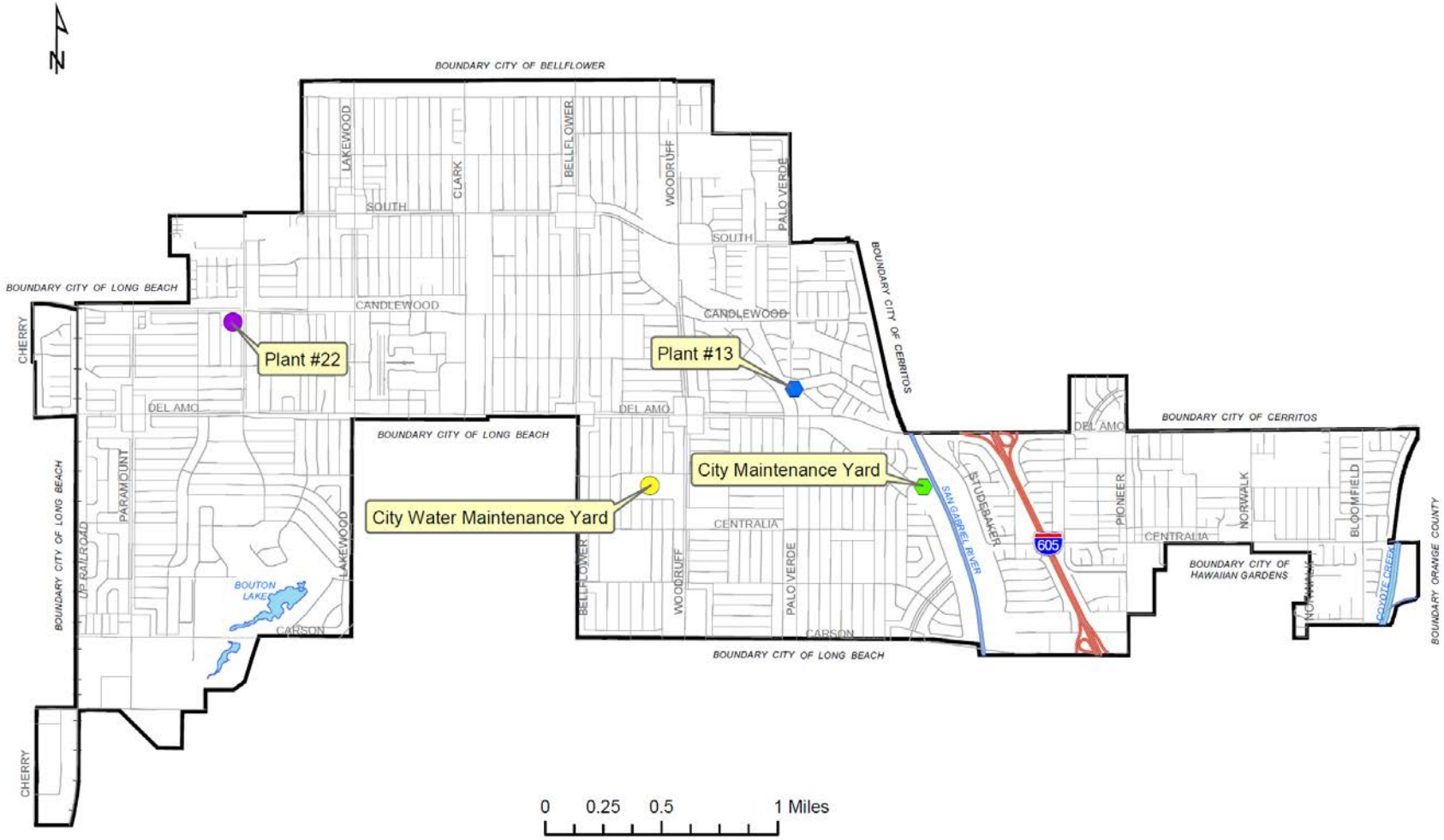


Figure 4-2: Essential Facilities



Action Items identified and prioritized during the development of the Lakewood Hazard Mitigation Plan are summarized in the tables on the following pages. Individual Action Items may address a single hazard (such as floods, or earthquakes) or they may address two or more hazards concurrently. The first group of Action Items relates to multi-hazard items that address more than one hazard, the remaining groups of Action Items for each of the hazards considered in this plan, which are addressed in more detail in Chapters 6 through 10.

The prioritization of mitigation action items has been based on a multi-level assessment process, including:

- The technical evaluation of the severity of each natural hazards, the vulnerability of the city's built environment (buildings and infrastructure) to each hazard, and the level of risk from each hazard for the city's people, buildings and infrastructure.
- The Mission Statement, Goals and Objectives summarized previously in this chapter.
- Qualitative consideration of the likely benefits and costs for each action item.
- The STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, Environmental) presented in Chapter 5.

Based on the technical evaluation of hazards, vulnerability and risk, earthquakes pose the greatest threat to Lakewood's people, buildings and infrastructure. Furthermore, the risks from earthquake appear substantially greater than those from the other natural hazards. Thus, the earthquake hazard mitigation actions have the highest priority.

The high priority for earthquake mitigation actions is reinforced by the highest priority goals:

- Goal 1: Reduce the Threat to Life Safety,
- Goal 2: Reduce the Threats to Lakewood's Buildings, Facilities and Infrastructure, and
- Goal 3: Enhance Emergency Response Capability, Emergency Planning, as well as Post-Disaster Recovery.

Earthquakes pose the greatest threats to life safety and to Lakewood's buildings, facilities and infrastructure as well as being the most likely major disaster requiring City-wide emergency response and post-disaster recovery operations.

Based on this analysis, the priorities for mitigation action items were determined to be:

- Earthquake,
- Multi-Hazard,
- Flood,
- Windstorms, and
- Drought.

The Action Items for floods, windstorms and drought are definitely worthwhile, but have lower priorities because the risks posed by these hazards to Lakewood are progressively lower. The

Action Items for a given natural hazard and for the Multi-Hazard Action Items have been prioritized in large part on their perceived effectiveness in reducing risk.

The City of Lakewood recognizes the importance of benefit-cost analysis in evaluating and prioritizing many types of physical mitigation measures such as structural or nonstructural seismic retrofits, flood mitigation projects and wind mitigation projects. Benefit-cost analyses may be conducted later, once the specific mitigation projects are defined with enough detail, including preliminary designs, cost estimates, and effectiveness in reducing damages and casualties, to enable benefit-cost analyses to be done. Benefit-cost analysis is not applicable to the Action Items which are comprised of studies, planning or education/outreach activities.

The STAPLE/E approach, as outlined in Chapter 5, was used as an important screening tool to ensure that each proposed Action Item passed these criteria. However, STAPLE/E was not used to prioritize between the Action Items which passed this screening.

Table 4-1:
Multi-Hazard Mitigation Action Items

Hazard	Action Item	Coordinating Departments	Timeline	Mitigation Plan Goals Addressed				
				Life Safety	Protect Property	Enhance Emergency Planning	Seek Mitigation Funding Sources	Public Awareness and Outreach
Multi-Hazard Mitigation Action Items								
Short-Term #1	Conduct risk assessments for important city buildings and infrastructure, develop and implement mitigation measures as necessary.	Public Works	1-2 Years	X	X	X	X	X
Short-Term #2	Identify and pursue funding opportunities to develop and implement local and City mitigation activities.	Community Development, Recreation and Community Services	Ongoing	X	X	X	X	X
Short-Term #3	Develop and/or maintain public and private sector partnerships to foster hazard mitigation activities.	Purchasing, Recreation & Community Services	1-2 Years	X	X	X	X	X
Long-Term #1	Supporting inter-agency communication improvements used by public safety provides during disasters or other emergencies.	City Manager's Office, Los Angeles County	1-4 Years	X	X	X		

5.0 PLAN ADOPTION, MAINTENANCE, AND IMPLEMENTATION

5.1 Overview

For a hazard mitigation plan to be effective, it has to be implemented gradually over time as resources become available, continually evaluated, and periodically updated. Only through the development of a systematic approach to analyze the impact of hazards and the implementation of cost-effective mitigation measures will the City be able to accomplish the mitigation action items in this Plan. The following sections outline how Lakewood adopted the process and the plan to implement and maintain the vitality of the Lakewood Hazard Mitigation Plan.

5.2 Plan Adoption

The draft Lakewood Hazard Mitigation Plan was adopted by the Lakewood City Council on August 9, 2016, and the final version of the Hazard Mitigation Plan was adopted on _____. That adoption resolution is included on the following page. This later adoption date is the effective date of Lakewood's Hazard Mitigation Plan. Approval by FEMA means that Lakewood's Hazard Mitigation Plan meets national standards and that Lakewood will be eligible for hazard mitigation funding from FEMA's Hazard Mitigation Grant Program, the Pre-Disaster Mitigation Program, and other FEMA grant programs.

Lakewood has the necessary human resources to ensure this Plan continues to be an active planning document. City staff will work forward in integrating the plan into Lakewood's emergency planning, natural resource planning, land use planning, building code programs, and capital improvement programs. Through this linkage, the plan will be kept active and will be an ongoing working document.

Recent major high-profile disasters, including hurricanes on the Gulf Coast, the 2008 earthquake in China and the 1994 Northridge earthquake, have raised awareness about disasters. These events and the growing understanding of the threats posed to Lakewood from various natural and anthropogenic hazards have raised the interest in hazard mitigation planning and implementation in Lakewood both in the public and private sectors.

Insert Final City Council Adoption Resolution Here

5.3 Implementation

Coordinating Body

The City of Lakewood Hazard Mitigation Plan Working Group will be responsible for coordinating implementation of action items and undertaking the formal review process. In order to make this committee as broad and useful as possible, the Working Group will coordinate with other relevant organizations and agencies in carrying out hazard mitigation activities. The current membership of the Working Group is listed below:

Michael Aguirre - Administrative Services Department, maquirre@lakewoodcity.org

Paolo Beltran - Administration, pbeltran@lakewoodcity.org

Nancy Hitt - Recreation and Community Services, nhitt@lakewoodcity.org

Paul Kuykendall, AICP - Community Development, pkuykend@lakewoodcity.org

Toyasha Sebbag - Department of Water Resources, tsebbag@lakewoodcity.org

Max Withrow - Public Works, mwithrow@lakewoodcity.org

The Working Group will meet at least once a year from the date following Plan acceptance by FEMA. These periodic meetings will provide an opportunity to discuss the progress of the action items, maintain the partnerships that are essential for the sustainability of the Plan and provide a forum for discussion of threats not previously identified by the Plan. Plan implementation and evaluation will be a shared responsibility among all members.

Integration of the Hazard Mitigation Plan into Ongoing Programs, Policies, and Practices

The mission statement, objectives, goals and action items outlined in Chapter 4 of the Lakewood Hazard Mitigation Plan provide a strong framework and guidance for the identified mitigation priorities for Lakewood. However, the Mitigation Plan is a guidance document, not a regulatory document. Implementation of the objectives, goals and action items will be accomplished by integrating the goals and objectives into ongoing City-wide programs, policies, and practices.

Lakewood addresses statewide planning goals and legislative requirements through its General Plan, Public Works projects, and Municipal Code. The Lakewood Hazard Mitigation Plan provides a series of recommendations; many of which are closely related to the goals and objectives of existing programs. The City of Lakewood will implement recommended mitigation action items through existing programs and procedures. For example, the Community Development Department is responsible for administering the Building and Zoning Codes, which include the review, development, and implementation of Building and Zoning Codes that are adequate to mitigate damage by natural hazards. This is to ensure that safety criteria are met for new construction.

Lakewood is nearly 100% built-out. Thus, future development/construction will be mostly limited to replacements of existing buildings with newer buildings. All new construction will be fully compliant with NFIP floodplain requirements and in full compliance with the seismic provisions in the current (or future) building codes. Thus, the risks from natural hazards will be minimal for future construction.

In the course of developing new buildings and facilities, staff examines projects to determine compliance with applicable building and zoning codes. Lakewood contracts with various agencies including the Los Angeles County for a variety of services, including building plan check and inspection services, and fire protection services. This relationship also provides for review against other codes and regulations, such as those pertaining to mechanical, plumbing, and electrical codes, storm water runoff, air quality, health department regulations, and fire department requirements.

Section 8100 of the Lakewood Municipal Code, by reference, adopted the County of Los Angeles 2014 Building Code, incorporating the California Building Code.

Section 8200 of the Lakewood Municipal Code, by reference, adopted the County of Los Angeles 2014 Plumbing Code, which adopts by reference the California Plumbing Code.

Section 8300 of the Lakewood Municipal Code, by reference, adopted the County of Los Angeles 2014 Electrical Code, which adopts by reference the California Electrical Code.

Section 8300 of the Lakewood Municipal Code, by reference, adopted the County of Los Angeles 2014 Mechanical Code, which adopts by reference the California Mechanical Code.

Section 8600 of the Lakewood Municipal Code is the City's Water Conservation in Landscaping ordinance. In response to ongoing drought conditions, Governor Brown issued Executive Order B-29-15 on April 1, 2015, which directed the California Department of Water Resources (DWR) to update the State's Model Water Efficient Landscape Ordinance. The California Water Commission approved the revised Model Ordinance on July 15, 2015. The updated Model Ordinance requires increased water efficiency standards for certain landscapes through practices such as more efficient irrigation systems. The City reviews new and rehabilitated landscape plans in accordance with the revised Model Ordinance.

Existing water conservation measures, recycling and reuse practices will be continued for any new development. With continued conservation measures, no expansion of the capacity of Lakewood's existing potable water supply system is anticipated to be necessary. The goals and action items in the Plan will also be achieved through activities carried out in various projects implemented by Lakewood's Public Works Department and Water Resources Department. Various City departments regularly participate in the planning of such projects. The Working Group will coordinate with the appropriate City departments in identifying areas where the Mitigation Plan action items may be consistent with CIP goals and integrate those action items as appropriate.

Another important aspect of implementation of the Hazard Mitigation Plan is the coordination between hazard mitigation planning and emergency planning. The Hazard Mitigation Plan's synopses of hazards, vulnerability, risk and potential impacts of major disasters will help to ensure that Lakewood's emergency planning is based on realistic scenarios for future disaster events affecting Lakewood.

Lakewood's General Plan Technical Background Report contains a wealth of information that was used throughout the Hazard Mitigation Plan. For example, Section 2.2 of the Hazard Mitigation Plan provides a community history of Lakewood which was extracted directly from Section 1.4 of the General Plan Technical Background Report. This narrative highlights the geographical, historical, and early beginnings of the Lakewood area and provides the Hazard Mitigation Team and others with a historical primer of Lakewood and a geographical understanding of the area prior to early development in the region. The General Plan Technical Background Report is broken down into various sections and subsections to facilitate direct access to information based on the desired topic.

Another example of how information in the General Plan Technical Background Report was incorporated into the Hazard Mitigation Plan is shown in Section 5.2 of the Technical Background Report. This Section provides an in-depth examination of the geological features beneath Lakewood and the potential hazards (liquefaction, landslides, surface rupture, tsunamis, seiches, and dam failures) that are often associated with seismic activity. This information was incorporated into Chapter 6 (Earthquakes) of the Hazard Mitigation Plan.

Starting on Page 5-11 the Table of Contents General Plan Technical Background Report is reproduced at the end of this Chapter to demonstrate its contents and the ease by which certain topics may be located within the document.

Another document used in preparation of the Hazard Mitigation Plan is Lakewood's Housing Element which is part of Lakewood's General Plan. Together with U.S. Census data, the Housing Element includes demographic, economic, and housing data which was incorporated into Chapter 2 of the Hazard Mitigation Plan. Some of this information is used in the Hazard Mitigation Plan to distinguish various vulnerabilities among neighborhoods.

"Fire Follows Earthquakes" is the name of a 1987 publication produced by the All-Industry Research Advisory Council. This document explains how fires in urban areas, ignited due to an earthquake, may spread and form conflagrations that would be difficult to extinguish. A more recent study, "Fire Following Earthquake" prepared by SPA Risk, LLC, provides a scenario-based examination of this danger and what conditions exist that would allow a conflagration to occur. Those conditions were considered by the Hazard Mitigation Working Group while analyzing the vulnerabilities of the City's various facilities. The General Plan also includes lists and maps of all city-owned facilities, as well as Los Angeles County Facilities located within Lakewood. The Hazard Mitigation Working Group reviewed the location, size, and function of each facility in determining which facilities would be classified as critical facilities and essential facilities for hazard mitigation planning purposes.

References to Lakewood's zoning ordinance and the building code are made throughout the Hazard Mitigation Plan. In many instances, the standards currently found in the zoning ordinance and the building code are written to protect life and property and serve as examples of how certain projects are already reviewed to reduce or eliminate vulnerability to natural hazards.

Current and future capital improvement plans are evaluated to determine their vulnerability to various hazards. Capital improvement plans are evaluated pursuant to the California Environmental Quality Act (CEQA). The Initial Study/Environmental Checklists for CEQA projects already include exposure and impact factors as found in the Hazard Mitigation Plan. Projects are evaluated, and mitigation measures assigned as appropriate, for each factor with respect to hazard vulnerability.

A hazard mitigation plan is only useful if it is implemented. The broader Lakewood community must be engaged in the implementation of the mitigation actions identified in the Plan. Some projects may be carried out by City staff or at the volunteer level, while others will require specialized technical expertise, such as the engineering design of seismic mitigation projects. The stakeholders in the planning process will become project partners on specific items.

Lakewood has a proven history of involving multiple partners in planning and mitigation work. These partnerships with private industry, local, state, and federal partners have resulted in comprehensive plans and projects that could not have been completed by any agency alone. This cooperation is also demonstrated by the broad-based makeup of the Hazard Mitigation Working Group.

Cost Effectiveness of Mitigation Projects

As Lakewood considers the implementation of specific mitigation projects, the following questions must be answered:

What is the nature of the hazard?

How frequent and how severe are such hazard events?

Does the City want to undertake mitigation measures?

What mitigation measures are feasible, appropriate, and affordable?

How does the City prioritize between competing mitigation projects?

Are the City's mitigation projects likely to qualify for FEMA funding?

Benefit-cost analysis is a powerful tool that can help communities provide solid, defensible answers to these difficult socio-political-economic-engineering questions. Benefit-cost analysis is required for all FEMA-funded mitigation projects under both pre-disaster and post-disaster mitigation programs. Benefit-cost analysis provides a sound basis for evaluating and prioritizing possible mitigation projects for any natural hazard. Lakewood will use benefit-cost analysis and related economic tools, such as cost-effectiveness evaluation, to the extent practicable in prioritizing and implementing mitigation actions. See Appendix B for details on the Benefit-cost analysis process. Lakewood may also use the STAPLE/E methodology, which facilitates quick

evaluation of mitigation activities in a systematic fashion based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE/E) considerations. The following statements are examples of the process for examining each aspect of the STAPLE/E approach.

STAPLE/E APPROACH

Social:

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly? (Or one segment more favorably?)
- Will the action cause social disruption?

Technical:

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other goals?

Administrative:

- Is the action implementable?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political:

- Is the action politically acceptable?
- Is there public support to implement and to maintain the project?

Legal:

- Who is authorized to implement the proposed action?
- Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a “taking?”
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Could the City be held liable for action or lack of action?
- Could the activity be challenged?

Economic:

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)?
- How will this action affect the fiscal capability of the city?
- Does the action contribute to other goals, such as capital improvements or improved functionality of facilities?
- What benefits will the action provide?

Environmental:

- How will the action impact the environment?
- Will the action require environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

5.4 Plan Maintenance and Updating

This Hazard Mitigation Plan is a living document that reflects the City's ongoing hazard mitigation activities. The implementation timeframe of this Hazard Mitigation Plan and the multi-departmental oversight involved in such implementation requires periodic coordination, evaluation, and refinement. Accordingly, the process of monitoring, evaluating, and updating the Plan is critical to the effectiveness of hazard mitigation. The Hazard Mitigation Plan Working Group will be responsible for the formal updates to this Plan every five (5) years.

5.4.1 Monitoring the Plan

To ensure that this Hazard Mitigation Plan is implemented, it is necessary that it be monitored and evaluated annually. As Lakewood gradually implements the action items within this Plan, remaining action items may evolve or priorities may change. The hazards that exist in Lakewood will continue to exist, but the conditions within the community, such as the building stock and infrastructure, will undoubtedly continue to change. Local, state and federal agencies will conduct or refine studies that may lead to new or better information on specific hazards. For example, flood plan maps are periodically updated, and our understanding of earthquake hazards improves with time. The new information will need to be incorporated not only into this Plan but also into other City planning documents.

The Hazard Mitigation Plan Working Group will be led by the Community Development Department. The Committee will meet at least once a year from the most recent date that this Plan is approved by FEMA.

Members of the Hazard Mitigation Plan Working Group will be responsible for monitoring and reporting on the status of implementation of the mitigation action items as they relate to each of the City's represented departments. The meetings will also allow Committee members to introduce new information relating to hazards facing Lakewood, to identify resources that will aid the City in implementing this Plan, and to seek opportunities to apply for grants that may be used in carrying out mitigation action items.

The central task for plan monitoring, as distinct from plan evaluation, which is covered in the following section, is to document the progress made in achieving mitigation goals and objectives and implementing mitigation action items.

5.4.2 Evaluating the Plan

Hazard Mitigation Plan Working Group meetings that fall on the anniversary of the approval of this Plan will focus on evaluating this Plan. These meetings will provide opportunity to incorporate new information, remove outdated information, and highlight completed action items in future plan updates. The Hazard Mitigation Plan Working Group will evaluate the annual progress of this Plan by means of the following criteria:

1. Do the plans goals, objectives and action items continue to address current and future expected conditions?
2. Do the mitigation action items accurately reflect Lakewood's current conditions and mitigation priorities?
3. Have the technical hazard, vulnerability and risk data been updated or revised?
4. Are current resources adequate for implanting Lakewood's Hazard Mitigation Plan? If not, are there other resources that may be available?
5. Are there any problems or impediments to implementation? If so, what are the solutions?
6. Have other agencies, partners, and the public participated as anticipated? If not, what measures can be taken to facilitate participation?
7. Have there been changes in federal and/or state laws pertaining to hazard mitigation in Lakewood?
8. Have the FEMA requirements for the maintenance and updating of hazard mitigation plans changed?
9. What can Lakewood learn from declared federal and/or state hazard events in communities that share similar characteristics, such as population, geographical area, land use mix, and hazard vulnerability?
10. How have previously implemented mitigation measures performed in recent hazard events? This may include assessment of mitigation action items similar to those contained in this Plan but where hazard events occurred outside of Lakewood.

The results of said evaluation will be considered in formulating recommended revisions which may be used to prioritize funding or to retain new or additional resources in support of the approved goals and mitigation action items. Recommendations may also be made for changes in

policy, goals, and other areas requiring discretionary approval for the next update of this Plan. These recommendations will be presented in report form to the City Manager and/or his designees.

5.4.3 Updating the Plan

The Hazard Mitigation Plan Working Group will be responsible for updating this Plan within five years of the effective date of the current Lakewood Hazard Mitigation Plan. The annual monitoring and evaluation reports, as summarized above, will provide a solid foundation for updating the Lakewood Hazard Mitigation Plan.

The formal update process will be initiated by the Hazard Mitigation Plan Working Group three years from the effective date of the current Lakewood Hazard Mitigation Plan; that is, two years from the expiration date of the current plan. Once the formal plan update is initiated, the Committee will meet quarterly for the first year and then monthly during the final year of plan updating.

5.4.4 Continued Public Participation

During the plan update process, Lakewood will continue to maintain a transparent planning process which includes soliciting comments from other agencies and the public on this Plan. To this end, the Hazard Mitigation Plan Working Group will host at least two (2) public workshops as part of the update process. Notice of said workshops will be posted in not less than three (3) public places in addition to the City's website. Workshops will allow the public to be involved by providing important feedback relating to hazards, goals, and mitigation action items. Copies of the approved Hazard Mitigation Plan will be made available on the City's website and at the Community Development Department. Copies of the in-process draft updates of the mitigation plan will be similarly made available to the public during the update process.

There are several important purposes for facilitating continued public involvement in the maintenance and updating of Lakewood's Hazard Mitigation Plan, including:

- Continue to solicit public input on mitigation actions and priorities,
- Continue and improve education/outreach efforts to raise awareness of natural hazards and the benefits of mitigation, and
- Encourage implementation of mitigation measures by residents and businesses.

REPRODUCTION OF THE TABLE OF CONTENTS OF THE LAKEWOOD GENERAL PLAN TECHNICAL BACKGROUND REPORT

6.0 EARTHQUAKES

The Southern California area, including Lakewood, is one of the most seismically active areas in the United States. This area is subject to large earthquakes on the San Andreas Fault and numerous other related faults. Based on the historical records of the past 200+ years, the area has experienced dozens of earthquakes large enough to cause significant damage. The most significant earthquakes in terms of magnitude (M), damages, and/or proximity to Lakewood include:

- 1857 Fort Tejon earthquake (M7.9) on the San Andreas fault
- 1933 Long Beach earthquake (M6.4)
- 1971 San Fernando (Sylmar) earthquake (M6.6)
- 1987 Whittier Narrows earthquake (M5.9)
- 1991 Landers earthquake (M7.3)
- 1994 Northridge earthquake (M6.7)

The City of Lakewood has not felt the full effect of damaging earthquakes because the most significant earthquakes either happened before Lakewood had significant development or occurred a considerable distance from Lakewood. The following is a brief earthquake "primer" that reviews some basic earthquake concepts and terms.

Contents of Chapter 6

6.1 Earthquake Primer

In the popular press, earthquakes are most often described by their Richter Magnitude (M), which is a measure of the total energy released by an earthquake. In addition to Richter magnitude, there are several other measures of earthquake magnitude used by seismologists, but such technical details are beyond the scope of this discussion.

It is important to recognize that the Richter Magnitude scale is not linear, but rather logarithmic. A M8 earthquake is not twice as powerful as a M4, but rather thousands of times more powerful. A M7 earthquake releases about 30 times more energy that a M6, and a M8 releases about 30 times more energy than a M7 and so on. Thus, great M8 earthquakes may release thousands of times as much energy as do moderate earthquakes in the M5 or M6 range.

The public often assumes that the larger the magnitude of an earthquake, the "worse" the earthquake. Thus, the "big one" is the M8 or M9 earthquake, and smaller earthquakes (M6 or M7) are not the "big one." However, this is true only in very general terms. Larger magnitude earthquakes affect larger

geographic areas, with much more widespread damage than smaller magnitude earthquakes. However, for a given site, the magnitude of an earthquake is not a good measure of the severity of the earthquake at that site. Rather, the intensity of ground shaking at the site depends on the magnitude of the earthquake, the distance from the site to the earthquake, geologic composition, and on the depth of the earthquake.

An earthquake is located by its epicenter; the location on the earth's surface directly above the point of origin of the earthquake. Earthquake ground shaking diminishes (attenuates) with distance from the epicenter and with the depth of the earthquake. Thus, any given earthquake will produce the strongest ground motions near the earthquake with the intensity of ground motions diminishing with increasing distance from the epicenter.

Thus, for a given site, a smaller earthquake (such as a M6.5) which is very close to the site could cause greater damage than a much larger earthquake (such as a M8) which is quite far away from the particular site. For example, the 1933 Long Beach M6.4 earthquake and the 1994 Northridge M6.7 earthquake were moderately sized earthquakes, but caused major damage and casualties because they occurred directly beneath heavily urbanized areas.

Earthquakes at or below M5 are not likely to cause significant damage, even near the epicenter. Earthquakes between M5 and M6 are likely to cause relatively minor damage very near the epicenter. Earthquakes of M6.5 or greater can cause major damage usually concentrated near the epicenter (e.g., the Northridge earthquake). Larger earthquakes of M7+ may cause damage over a wide geographic area with the potential for severe levels of damage near the epicenter. Great earthquakes with M8+ may cause major damage over wide geographic areas.

The intensity of ground shaking varies not only as a function of M and distance but also depends on soil types. Soft soils may amplify ground motions and increase the level of damage. Thus, for any given earthquake, there will be contours of varying intensity of ground shaking. The intensity will generally decrease with distance from the earthquake epicenter, but often in an irregular pattern, reflecting soil conditions (amplification) and direction of the dispersion of the earthquake's energy.

There are many measures of the severity or intensity of earthquake ground motions. An older, but still sometimes used scale is the Modified Mercalli Intensity scale (MMI), which is a descriptive, qualitative scale that relates severity of ground motions to types of damage experienced. MMI ranges from I to XII.

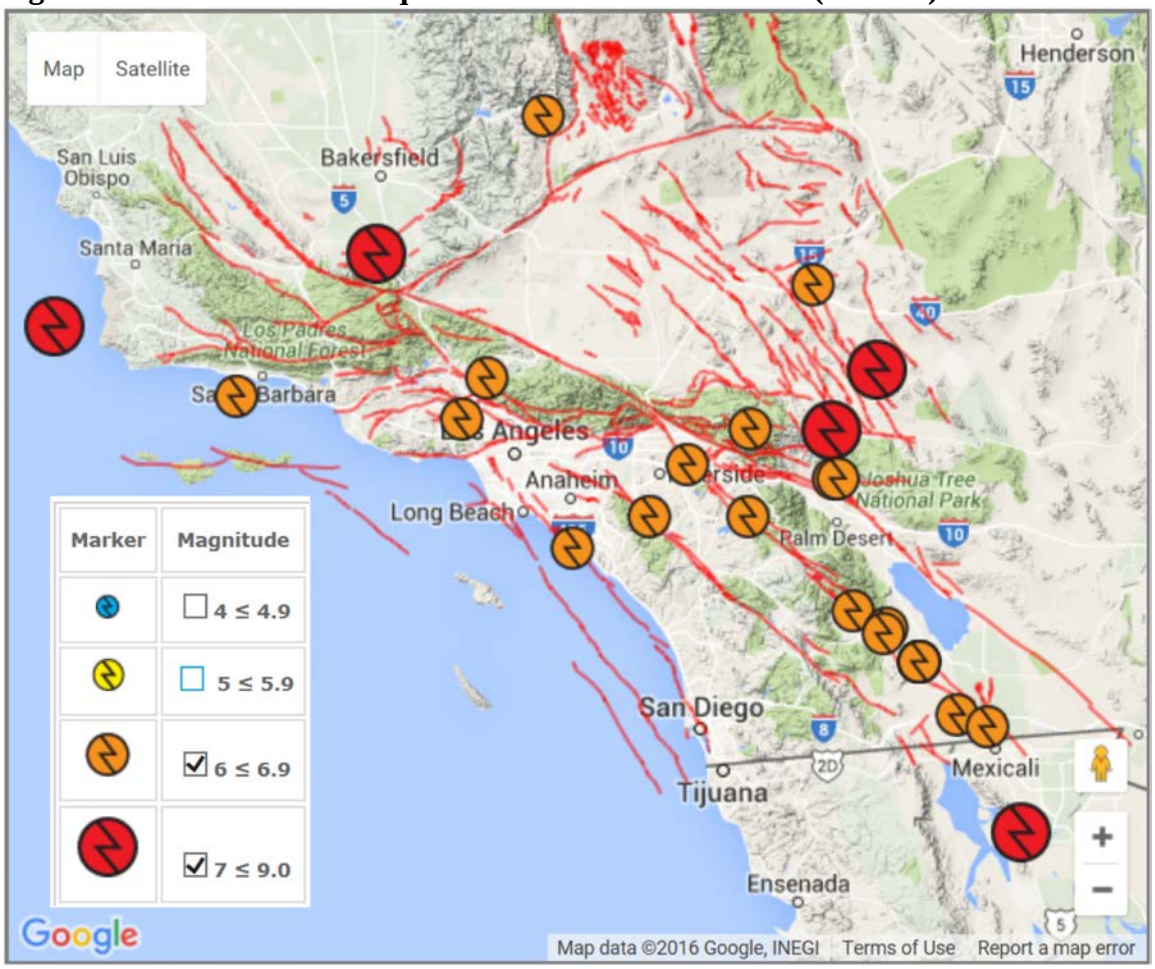
Modern intensity scales use terms that can be physically measured with seismometers, such as the acceleration, velocity, or displacement (movement) of the ground. The most common physical measure, and the one used in the Lakewood Mitigation Plan, is Peak Ground Acceleration or PGA. PGA is a measure of the intensity of shaking relative to the acceleration of gravity (g). For example, a PGA of 1.0 g in an earthquake (an extremely strong ground motion) means that objects accelerate sideways at the same rate as if they had been dropped from the ceiling. A PGA of 0.1 g means that the ground acceleration is 10% that of gravity. Damage levels experienced in an earthquake vary with the intensity and duration of ground shaking and with the seismic capacity of structures. Ground motions of only 1% or 2% g are widely felt by people, hanging plants and lamps swing strongly, but

damage levels are minimal. Ground motions below 10% g usually cause only slight damage. Ground motions between about 10% g and 30% g may cause minor to moderate damage in well-designed buildings with this level of ground shaking and more damage in poorly designed buildings. Only unusually poor buildings would be subject to potential collapse. Ground motions above about 30% g may cause significant damage in well-designed buildings and very high levels of damage, including collapse, in poorly designed buildings. Ground motions above 50% g may cause high levels of damage in most buildings even those designed to resist seismic forces.

6.2 Seismic Hazards for Lakewood

The level of seismic hazard for Lakewood is based on the probability and severity of earthquakes that could affect Lakewood. Earthquakes occur predominantly because of plate tectonics; the relative movement of plates of oceanic and continental rocks that make up the rocky surface of the earth. The level of seismic hazard for Lakewood is high. Southern California, including Lakewood, is one of the most seismically active areas in the United States. Figure 6-1 shows some of the significant earthquakes affecting southern California since the 19th century. As shown in this figure, there have been numerous large earthquakes in this area.

Figure 6-1: Historical Earthquakes in Southern California (M > 6.0)



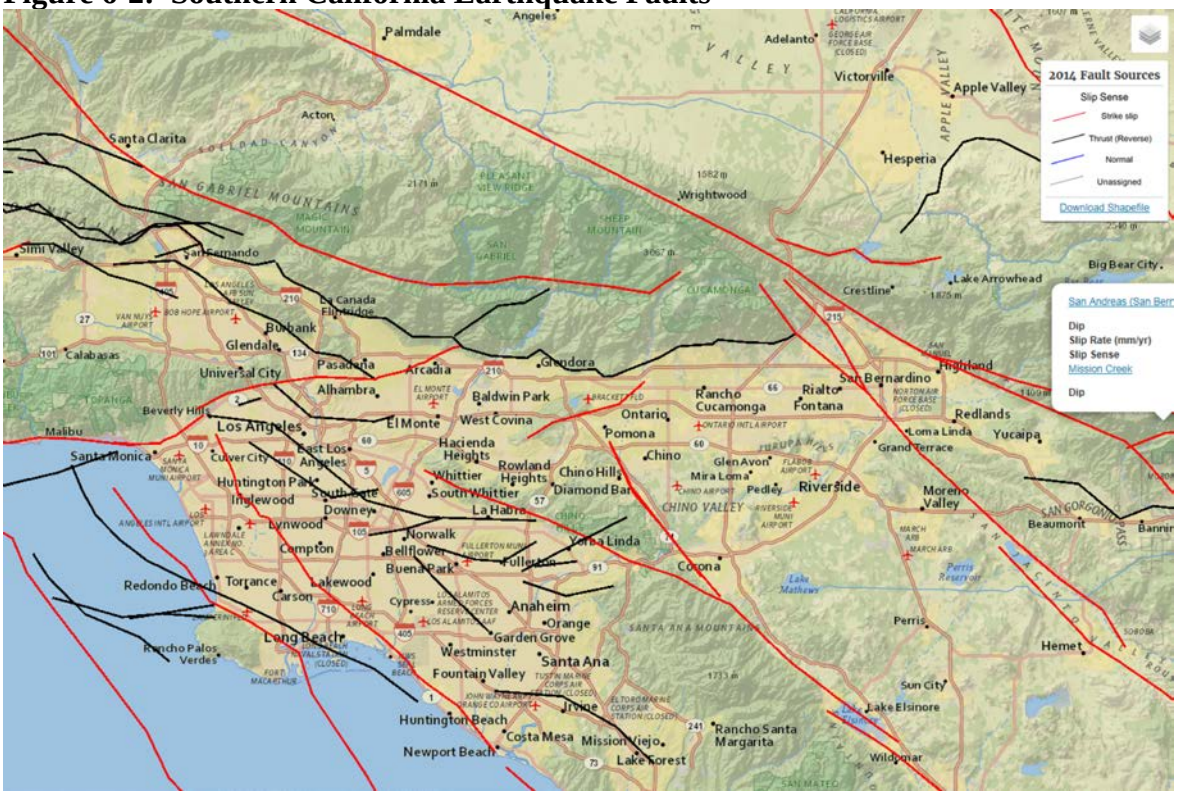
Source: Southern California Earthquake Data Center (http://scedc.caltech.edu/significant/index.html)

Figure 6-1 is from the Southern California Earthquake Data Center interactive website. For clarity, only events with a magnitude of at least 6.0 are shown. Clicking on a given earthquake point on the website brings up information about the event name, magnitude, date and time, depth, and latitude and longitude for each earthquake event. As shown on the above map, there have been several significant earthquakes in Southern California, but none with an epicenter within Lakewood.

There are numerous identified earthquake faults in Southern California as shown on the Figure 6-2. However, earthquakes may occur almost anywhere in Southern California on previously unknown faults. As shown on the above map, there have been many significant earthquakes near Lakewood, but none with an epicenter in the City.

There are numerous identified earthquake faults in Southern California as shown on the Figure 6-2. However, earthquakes may occur almost anywhere in Southern California on previously unknown faults. The major active fault nearest to Lakewood is the Newport-Inglewood Fault, which is about three miles southwest of Lakewood (shown in lime green on Figure 6-2). In addition, the Los Alamitos Fault extends into Lakewood in the vicinity of Bellflower Boulevard and Carson Street. The Los Alamitos Fault is potentially active, but geologic evidence suggests that it has not been active for at least 10,000 years. The recently discovered Puente Hills Fault, located northeast of Lakewood, has a probable return period of about 3,000 years but is not shown on Figure 6-2.

Figure 6-2: Southern California Earthquake Faults



Source: 2014 U.S. Geological Survey (USGS) National Seismic Hazard Maps (http://earthquake.usgs.gov/hazards/qfaults/map/#hazfaults2014)

It is not possible to predict when or where the next earthquake affecting Lakewood will occur. Rather, the current state of knowledge can predict earthquakes only probabilistically. The most recent (2014) National Seismic Hazard Maps, prepared by the United States Geological Survey show contours of earthquake ground motions with various probabilities.

Peak ground acceleration (PGA) is equal to the largest rate of ground acceleration reached during an earthquake at a given location. PGA is typically used to measure the maximum force a building experiences during an earthquake. PGA is measured horizontally and vertically, but peak horizontal acceleration is most commonly used in seismic engineering for buildings. PGA depends on the length of the fault, the magnitude of the event, the depth and distance from the measurement site to the epicenter, duration of the earthquake, and the underlying geology. The various PGA measurements may be shown graphically in the form of a map. These maps are not probability maps, rather they illustrate the peak acceleration as a given level of probability within a given time frame (such as 50 years).

The following two figures show the 2014 USGS earthquake ground motions (PGA, as a percentage of g) with 10% and 2% chances of exceedance within a 50-year time period. These USGS maps show ground motions for rock sites. For soil such as those found in Lakewood, ground motions are higher for low to moderate values of PGA but not for high values of PGA.

Figure 6-3: USGS 2014 Seismic Hazard Map - 10% Chance of Exceedance in 50 Years Peak Ground Acceleration (PGA) as a Percentage of Gravity (g)

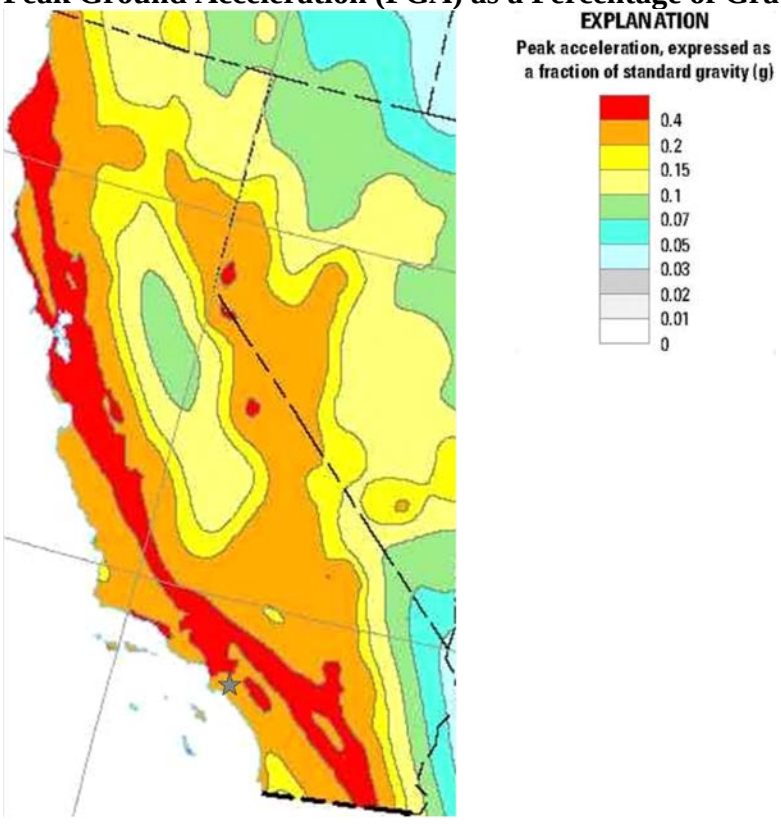
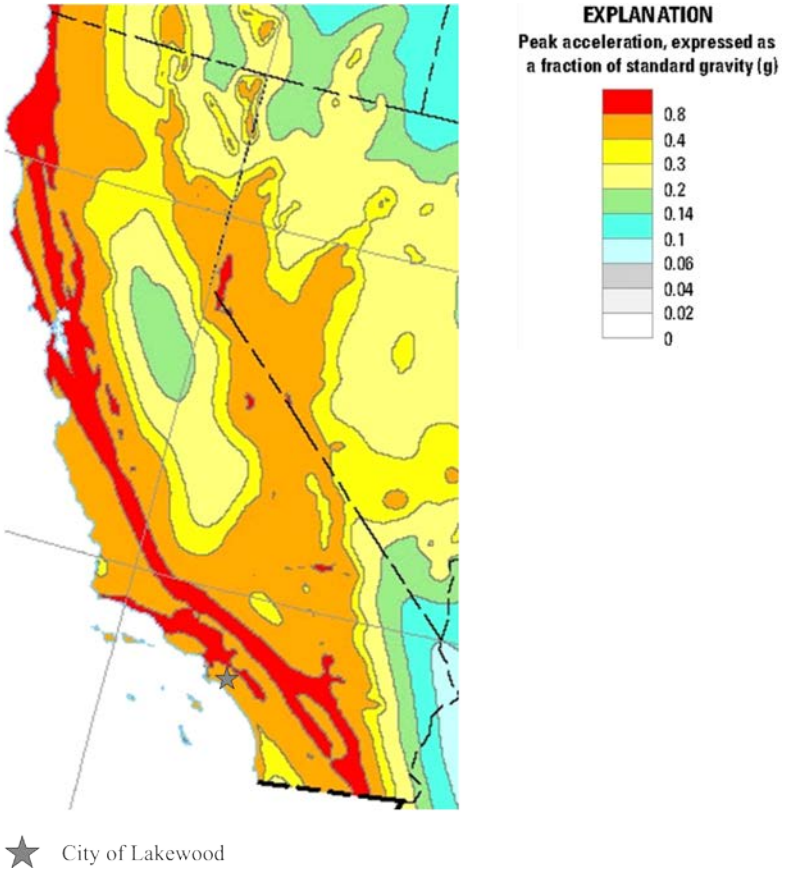


Figure 6-4: USGS 2014 Seismic Hazard Map - 2% Chance of Exceedance in 50 Years Peak Ground Acceleration (PGA) as a Percentage of Gravity (g)

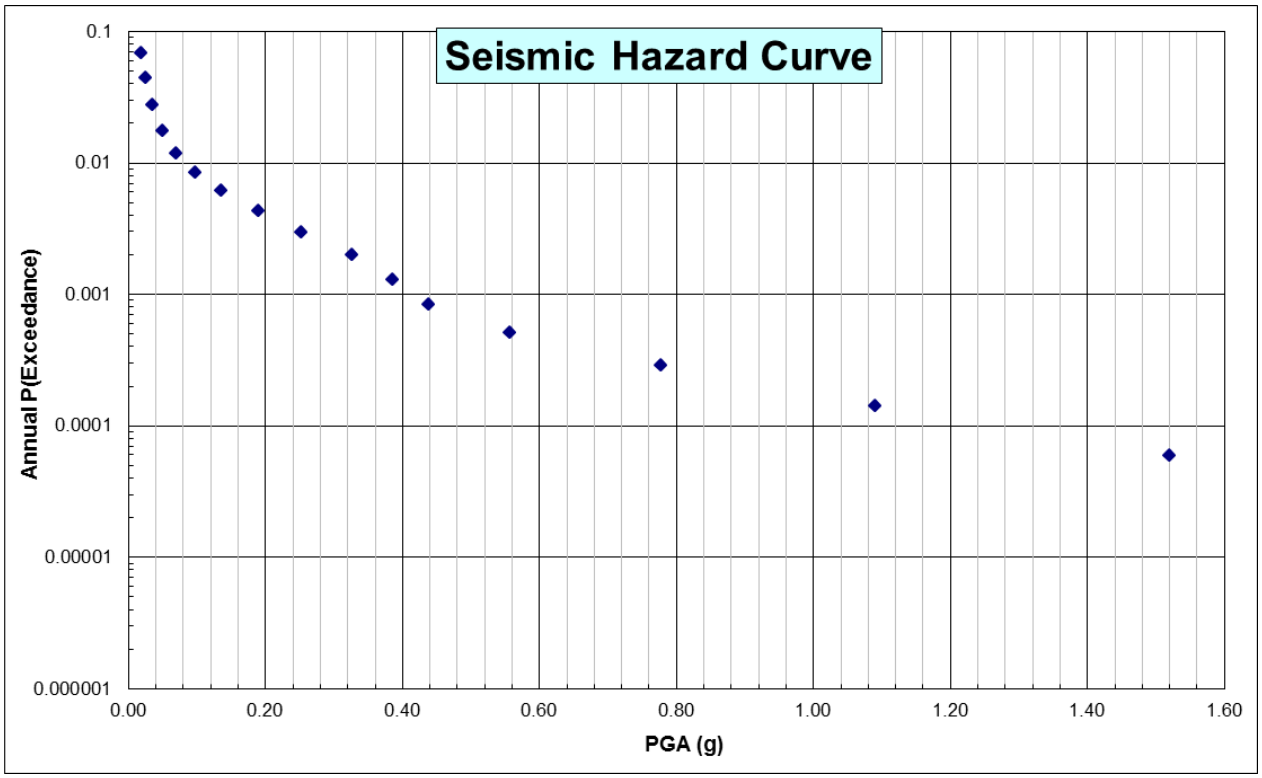


A given site is characterized as a rock, firm soil or soft soil site by the type of rock or soil in the top 100 feet below the ground surface. The USGS national seismic hazard data indicate that the probabilistic earthquake ground motions - for a rock site - at Lakewood's location would be 32% g with a 10% chance of being exceeded in 50 years and 68% g with a 2% chance of being exceeded in 50 years. Taking the firm soil conditions in Lakewood into account, the ground motion with a 10% chance of being exceeded in 50 years increases to 37% g, but the ground motion with a 2% chance of being exceeded in 50 years does not increase. Firm soil sites generally amplify earthquake ground motions but not at very high levels of ground shaking. The fact that Lakewood has firm soil is much better than having soft soils which would further amplify ground motions and increase the likelihood of liquefaction. Lakewood has a lower probability of liquefaction because of the firm soils compared to communities with softer soils.

Figure 6-5 shows the seismic hazard curve for Lakewood. It shows the annual exceedance probability as a function of ground motion. This graph shows the cumulative seismic hazard for Lakewood from possible earthquakes on all of the faults in Southern California, weighted by the probability of earthquakes of various magnitudes on each fault. This hazard curve is calculated based on a firm soil site, which represents most of Lakewood. Figure 6-5 shows the annual probability of earthquake

ground motions exceeding various levels of shaking, expressed as Peak Ground Acceleration (PGA) relative to the acceleration of gravity, g. For example, there is an annual probability of 0.01 (1%) of ground motions of approximately 0.16 g or higher and an annual probability of 0.001 (0.1%) of ground motions of approximately 0.40 g or higher in Lakewood.

Figure 6-5: USGS 2014 Seismic Hazard Curve for Lakewood



Source: http://earthquake.usgs.gov/hazards/products/conterminous/2014/data/

Seismic design requirements in building codes are based on the USGS seismic hazard data shown in the maps and figures above. Historically, under the Uniform Building Code (UBC), seismic design was based on the 10% in 50 years ground motions, which were grouped into seismic zones. For Lakewood, Seismic Zone 4, the design ground motion was 40% of g. Under the current International Building Code (IBC), the seismic design basis is 2/3^{rds} of the 2% in 50 years ground motion, which for Lakewood is also about 40% g. Considering the margin of safety inherent in seismic design, the IBC is designed to provide life safety for new buildings constructed under this code up to the full 2% in 50 years ground motion, or about 60% g for Lakewood.

Seismic hazards for Lakewood can also be characterized by examining the probabilities of earthquakes on specific faults. The 2014 Working Group on California Earthquake Probabilities (WGCEP) is a multi-disciplinary collaboration of leading experts in the field and was led by the U.S. Geological Survey, the Southern California Earthquake Center, and the California Geological Survey. The WGCEP recently completed The Third Uniform California Earthquake Rupture Forecast (UCERF3), which is an update of earthquake probabilities on specific faults in California.

Compared to previous forecasts, the estimated likelihood of moderate-sized earthquakes (magnitude 6.5 to 7.5) is lower, whereas that of larger earthquakes is higher. This change is because of the inclusion of multi-fault ruptures, where earthquakes are not confined to separate individual faults, but can occasionally rupture multiple faults simultaneously. The estimated probabilities of earthquakes of magnitudes equal or greater than 6.7, 7.5 and 8.0 are shown in Table 6-1.

Table 6-1: Estimated Probabilities of M ≥ 6.7 Earthquakes Over the Next 30 Years

Magnitude	Southern San Andreas Fault	San Jacinto Fault	Elsinore Fault
M ≥ 6.7	19.0%	5.0%	3.8%
M ≥ 7.5	17.3%	4.9%	1.0%
M ≥ 8.0	6.8%	2.7%	< 0.1%

Source: http://pubs.usgs.gov/fs/2015/3009/pdf/fs2015-3009.pdf

The above results must be interpreted cautiously. The two faults with the highest probabilities, the Southern San Andreas and the San Jacinto Fault, are located a considerable distance from Lakewood (approximately 50 to 60 miles). Thus, the level of ground shaking (and damage) would be less than those resulting from earthquakes on faults such as the Palos Verdes or Newport-Inglewood Faults, which are much closer to Lakewood.

The two faults nearest to Lakewood, the Los Alamitos Fault and the Puente Hills Fault, have probable return periods of >10,000 years and about 3,000 years, respectively. Thus, the corresponding probabilities of earthquakes within the next 30 years are <0.3% and about 1%, for the Los Alamitos Fault and Puente Hills Fault, respectively.

6.3 Other Aspects of Seismic Hazards in Lakewood

Much of the damage in earthquakes occurs directly because of ground shaking which affects buildings and infrastructure. However, there are several other aspects of earthquakes that can result in very high levels of damage in some locations, including liquefaction, landslides, surface rupture, tsunamis, seiches, and dam failures.

6.3.1 Liquefaction, Settlement, Lateral Spreading, Amplification

Liquefaction is a process where loose, wet sediments lose strength during an earthquake and behave similarly to a liquid. Once a soil liquefies, it will tend to settle and/or spread laterally. With even very slight slopes, liquefied soils tend to move sideways downhill (lateral spreading). Settling or lateral spreading can cause major damage to buildings and buried infrastructure such as pipes.

Figure 6-6 on the following page shows areas in Lakewood where soil conditions suggest the potential for liquefaction, settlement, lateral spreading and/or amplification of earthquake ground motions. These areas of greater earthquake hazard cover most of the City of Lakewood.

6.3.2 Landslides

Earthquakes can also induce landslides, especially if an earthquake occurs during the rainy season and soils are saturated with water. The areas prone to earthquake-induced landslides are largely the same as those areas prone to landslides in general. Areas of steep slopes with loose rock or soils are the most prone to earthquake-induced landslides. Lakewood's topography is flat with no areas of steep slopes. Thus, the potential for earthquake-induced landslides in Lakewood is negligible.

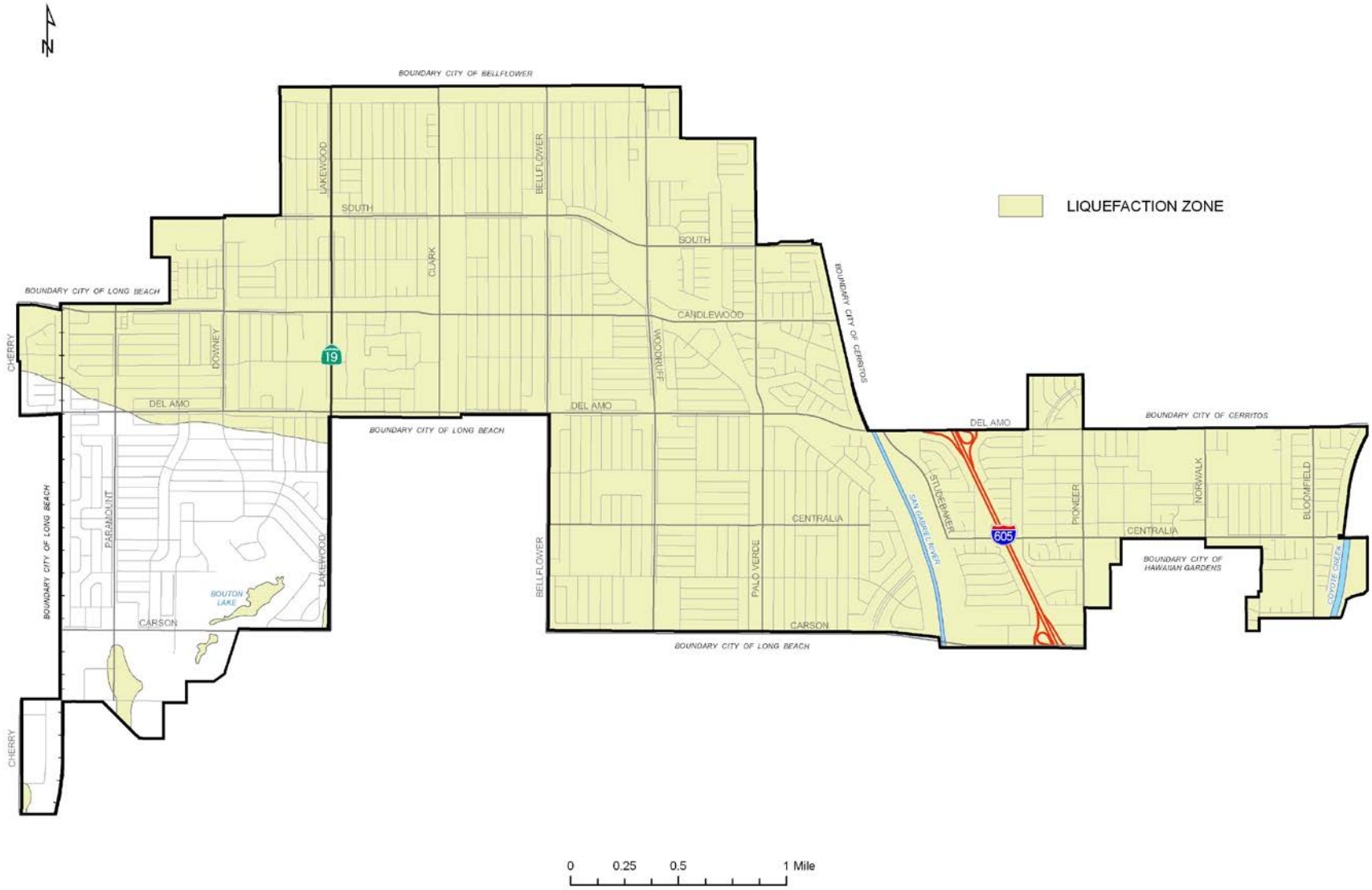
6.3.3 Surface Rupture

Surface rupture occurs when the fault plane upon which movement occurs during an earthquake reaches the surface. Surface ruptures may involve lateral movements, vertical movements or both. Lateral movements may be several feet in earthquakes with magnitudes of 6.5 to 7.0 and 15 feet or more for great earthquakes with magnitudes near or above 8.0. Similarly, vertical movements can be several feet or more.

The occurrence of surface ruptures during an earthquake typically results in very high levels of damage to buildings or infrastructure, with the damage often being so severe that the facility must be demolished and replaced.

In California, areas known to be subject to surface ruptures are designed as Alquist-Priolo Special Study Zones (A-P Zones) and are deemed high risk locations. A-P Zones are subject to strict limits on future construction. There are no designated A-P Zones in Lakewood. The nearest A-P Zone is associated with the Newport-Inglewood Fault Zone, which is approximately three miles southwest of Lakewood. An earthquake on the Los Alamitos Fault could conceivably result in surface rupture. However, given no evidence for any significant earthquakes on this fault for at least 10,000 years, this possibility appears remote. Therefore, the level of earthquake hazard from surface rupture in Lakewood appears negligible.

Figure 6-6: Areas with Potential Liquefaction in Major Earthquakes



Liquefaction and/or lateral spreading do not necessarily occur in all such areas or in all earthquakes. However, in larger earthquakes with strong ground shaking and long duration shaking, liquefaction, and/or lateral spreading may occur in some of the areas shown on maps as being subject to liquefaction. Settlements of a few inches or more and lateral spreads of a few inches to several feet are possible. Even a few inches of settlement or lateral spreading are likely to cause significant to major damage to affected buildings or infrastructure.

6.3.4 Tsunamis and Seiches

Tsunamis, which are often incorrectly referred to as "tidal waves," result from earthquakes which cause a sudden rise or fall of part of the ocean floor. Such movements may produce tsunami waves, which have nothing to do with the ordinary ocean tides. Tsunami waves may be only a few inches high in the deep open ocean waters, far from land, and thus be virtually undetectable except by special monitoring instruments. These waves travel across the ocean at speeds of several hundred miles per hour. When such waves reach shallow water near the coastline, they slow down and can gain great heights.

However, the hazard from tsunamis appears negligible for Lakewood because at its closest point the City is located approximately 3.92 miles from the Pacific Ocean at ground elevations ranging from about 35 feet to 70 feet.

Seiches are another effect of earthquakes which is somewhat analogous to tsunamis. Seiches are the sloshing of inland bodies of water; lakes, rivers, or reservoirs. Large seiches may damage waterfront buildings or infrastructure. Seiches in water reservoirs may be sufficient to result in damage to the facility. Roof damage is the most common. In extreme cases, seiches could cause a reservoir to fail completely. Thus, the water storage reservoirs in Lakewood may be subject to damage from future earthquake induced seiches.

6.3.4 Dam Failures

Earthquakes can also cause dam failures. The most common mode of earthquake-induced dam failure is slumping or settlement of earthfill dams where the fill has not been properly compacted. If the slumping occurs when the dam is full, then overtopping of the dam, with rapid erosion leading to dam failure is possible. Concrete dams may also fail as a result of strong ground motions. In a few cases, earthquake-induced landslides into reservoirs have caused dam failures.

Inundation from dam failures is addressed in Chapter 7 Floods, which includes worst case scenario inundation maps for the two major dams upstream of Lakewood, the Hansen Dam and the Whittier Narrows Dam. Failure of these dams from earthquakes is unlikely, but not impossible, especially if a major earthquake near the dams were to occur when the reservoir was full or nearly full. For Lakewood, the probability of earthquake-induced dam failures appears low, albeit not zero.

6.4 Earthquake Vulnerability and Risk Assessment for Lakewood

To date, Lakewood has not experienced heavy earthquake damage because historical earthquakes were either a significant distance from Lakewood (e.g., 1994 Northridge earthquake) or predated much of the development of Lakewood (e.g., 1933 Long Beach earthquake). The scarcity of historical earthquake damage in Lakewood does not mean that the potential for future damage is low. Rather, given the high level of seismicity in Southern California, the level of earthquake risk for Lakewood is high. There is a significant potential from high levels of damage in Lakewood from earthquakes on the Newport-Inglewood Fault as well as from numerous other active faults in the vicinity of Lakewood.

6.4.1 Historical Earthquakes Affecting Lakewood

The historical record of earthquake damage in Lakewood is very sparse. Prior to the 1950s, Lakewood was predominantly agricultural with limited development. The most significant earthquakes affecting the surrounding area were the M6.6 1971 San Fernando earthquake and the M6.7 1994 Northridge earthquake. The epicenters of these earthquakes were about 39 miles and 36 miles from Lakewood, respectively.

Recorded damage in Lakewood caused by the San Fernando and Northridge earthquakes was minimal; some broken windows, minor nonstructural damage (items falling from shelves) and cracking or toppling of a few poorly built masonry property line walls. Structural damage to buildings and damage to infrastructure was negligible.

As summarized above, Lakewood does not have a history of significant earthquake damage. Nevertheless, the risk of future earthquake damage remains high for Lakewood.

6.4.2 Seismic Vulnerability of Lakewood's Buildings and Infrastructure

The probable impacts of major earthquakes on Lakewood vary markedly with the magnitude and location of the earthquake. However, the entire City would be affected by a major earthquake, including the entire inventory of buildings and infrastructure. For any major earthquake affecting Lakewood, the levels of damage will likely be somewhat higher in the liquefaction potential areas. As shown in Figure 6-6, most of Lakewood is in the zone of potential liquefaction. However, it is important to note that, for any given earthquake, liquefaction effects may or may not be significant and are not likely to occur in the entire area potentially subject to liquefaction.

Buildings

The vulnerability of buildings depends on their structural systems and on the extent to which seismic design was incorporated into the building.

Most wood frame buildings perform relatively well in earthquakes. Damage to wood frame buildings will be concentrated in the most vulnerable types; older buildings with sill plates that are not bolted to the foundation or buildings with cripple-wall foundations. US Census data (Selected Housing

Characteristics, 2005-2007, American Community Survey) indicate that 2.4% of Lakewood's housing units pre-date 1940 and thus may be of these vulnerable structure types. An additional 12.2% of Lakewood's housing units were built in the 1940s and may also be vulnerable to earthquake damage. Overall, perhaps 5% of the City's wood frame residential buildings may be subject to greater than typical damage in future earthquakes.

Other building types likely to experience higher levels of damage include:

- Unreinforced or lightly reinforced masonry buildings,
- Older pre-cast, tilt-up and concrete frame buildings,
- Concrete and steel frame buildings with unreinforced masonry infill walls, and
- Buildings of any structural system with soft first stories.

Given the 1950s or later vintage of the vast majority of Lakewood's building stock, there are likely to be very few unreinforced masonry buildings or concrete and steel frame buildings with unreinforced masonry infill walls. However, there appears to be a significant inventory of 1950s to 1970s public, commercial, and industrial buildings which likely includes more vulnerable tilt-up and concrete frame buildings. Buildings where the first story is significantly taller than upper stories and/or the first story has more or larger window openings than upper stories are described as "soft-story" buildings. This type of structure may be more prone to significant earthquake damage than buildings without soft first stories. Some retail and office buildings in Lakewood are soft story.

A sidewalk survey of several important public buildings and several infrastructure facilities was conducted in July 2016. The facilities examined are summarized in Table 6-2. This brief sidewalk survey did not include examination of structural drawings or engineering analysis of seismic vulnerabilities.

Given that all are or appear to be at least 20 years old, none of these buildings were designed to current or recent seismic codes. Because of the vintage of the buildings and because many of the buildings have significant configurational irregularities in the horizontal and/or vertical planes, many of these buildings may have significant seismic deficiencies. Thus, a rigorous seismic vulnerability assessment is strongly suggested.

Table 6-2: Public Building Sidewalk Survey, July 2016

Facility	Date	Square Feet	Address
Water Yard (Water buildings)	1960's and later	25,000 +/-	5812 Arbor Road
Plant #22			3310 Candlewood Street
LA County Fire Station 45	1958	4,900	4020 Candlewood Street
LA County Library - Iacaboni	2000	24,530	4990 Clark Avenue
Centre at Sycamore Plaza	1984	35,800	5000 Clark Avenue
City Hall	1958, 1984 remodel and expansion	20,000	5050 Clark Avenue
LA County Sheriff's Station	1959, 2008 addition	n/a	5130 Clark Avenue
Burns Community Center	1976	13,000	5510 Clark Avenue
Mayfair Park Swim Pavilion	1992	14,040	5720 Clark Avenue
Biscailuz Park building Biscailuz Park snack bar Park shelter Biscailuz Park building addition	1957 1976 1971 1997	2,000 400 400 2,205	3300 Del Amo Boulevard
LA County Library - Nye	1973	7,500	6600 Del Amo Boulevard
Mae Boyar Park	2009	4,700	6701 Del Amo Boulevard
Biscailuz Park activity building Biscailuz Park control building	1966 1967	864 1,230	2601 Dollar Street
LA County Fire Station 122	1970	4,000	2600 Greenmeadow Road
Nixon Yard (Public Works buildings)	1960's and later	22,000 +/-	6929 Nixon Street
Jose San Martin Park	1957	2,000	5231 Ocana Avenue
Weingart Senior Center	1981	10,800	5220 Oliva Avenue
Plant #13			4964-75 Palo Verde Avenue
Bloomfield Park activity building	1959	4,681	21420 Pioneer Boulevard
LA County Fire Station 94	1961	2,833	6321 Turnergrove Avenue
Youth Center	1957, 1960 addition	5,600	4658 Woodruff Avenue
Palms Park Building	1978	13,500	12305 207th Street

Source: City of Lakewood, Community Development Department

Infrastructure

Utility and transportation infrastructure is also subject to major damage and loss of service in earthquakes, including:

- Water and wastewater systems – damage to treatment plants and pipe breaks (especially in soft soil areas). Service outages may be widespread and long in duration.
- Natural gas systems – pipe breaks (especially in soft soil areas) but typically less damage than for water or wastewater systems. Service outages may be widespread and long in duration.
- Electric power – damage to substation equipment is common. Service outages may be widespread but typically shorter in duration than other utility systems.
- Bridges – damage to older bridges, especially multi-span bridges, may be extensive with disruption of surface transportation routes. Bridges built before the mid-1970s may have a significantly higher risk of suffering structural damage during a moderate to large earthquake

compared with those built after 1980 when design improvements were made. Much of the region's interstate highway system was built in the mid to late 1960's. There are 33 City-owned bridges in Lakewood. Roads crossing the 605 freeway or that are crossed by the 605 freeway are owned by the State of California. Caltrans has retrofitted most bridges on the freeway systems, however, there may be some bridges maintained by Los Angeles County Department of Public Works that have not been retrofitted. A Union Pacific Railroad bridge crosses Cherry Avenue between Del Amo Boulevard and Market Street.

- Dams, especially older dams designed according to lower than current seismic standards, are subject to damage or even complete failure in earthquakes. The worst case consequences include inundation of downstream areas. See Chapter 7 Floods for more details of potential dam failures affecting Lakewood.

Summary of Earthquake Vulnerability for Lakewood

Overall, the vulnerability of the building stock in Lakewood is lower than for many other older communities. Most buildings in Lakewood are post-1940 wood frame residential buildings which generally perform fairly well during an earthquake. There appear to be few profoundly vulnerable building types (such as unreinforced masonry). However, there is a substantial inventory of pre-1980 public, commercial and industrial buildings, which are among the more vulnerable structural types.

Lakewood's water and wastewater systems will likely suffer significant numbers of pipeline breaks in a major earthquake and there will also likely be gas line breaks, although fewer than the number of breaks in the water and wastewater systems. Depending on the level of ground shaking (i.e., the location and magnitude of a future earthquake) and the extent to which liquefaction effects occur, utility outages could range from several hours to several weeks. Damage to the transportation system may include damage to older city- or county-owned bridges.

More quantitative estimates of expected damage to buildings and contents, estimates of casualties, displaced persons, debris amounts, and other consequences of earthquake for one or more scenario earthquakes can be made using FEMA's HAZUS loss estimation software. The accuracy of such HAZUS loss estimates would be improved by using Lakewood-specific inventory data whenever possible.

More quantitative estimates of expected damage to utility and transportation systems (especially bridges) would require specific system-wide risk assessments.

6.5 Significant Earthquake Events Since 2011

According to the Southern California Earthquake Data Center, there have been no significant earthquakes (> M5.5) since adoption of Lakewood's previous Hazard Mitigation in 2011. There are no reports of damage in Lakewood from any other earthquakes.

6.6 Earthquake Mitigation Projects and Action Items

There is a wide variety of possible hazard mitigation projects for earthquakes. The most common projects include: structural retrofit of buildings, non-structural bracing and anchoring of equipment and contents, and strengthening of utility systems, bridges, dams and other infrastructure components.

The seismic hazard (frequency and severity of earthquakes) is high in Lakewood. However, the risk (potential for damage and casualties) is not uniformly distributed through the inventory of buildings and infrastructure in Lakewood. Rather, risk is concentrated in the most vulnerable buildings and infrastructure.

Structural retrofit of buildings should not focus on typical buildings, but rather on buildings that are most vulnerable to seismic damage. Priorities should include buildings on soft soil sites subject to amplification of ground motion and/or liquefaction and especially on critical service facilities such as hospitals, fire and police stations, emergency shelters, and schools.

Non-structural bracing of equipment and contents is often the most cost-effective type of seismic mitigation project. Inexpensive bracing and anchoring may protect very expensive equipment and/or equipment whose function is critical such as medical diagnostic equipment in hospitals, computers, and communication equipment for police and fire services. For utilities, bracing of control equipment, pumps, generators, battery racks and other critical components can be very effective in reducing the impact of earthquakes on system performance. Such measures should almost always be undertaken before considering large-scale structural mitigation projects.

The strategy for strengthening bridges and other infrastructure follows the same principles as discussed above for buildings. The targets for mitigation should not be typical infrastructure but rather specific infrastructure elements that have been identified as being unusually vulnerable and/or are critical links in the lifeline system. For example, vulnerable overpasses on major highways would have a much higher priority than overpasses on lightly traveled secondary streets.

Earthquake mitigation action items from the master mitigation action items table in Chapter 4 are shown below in Table 6-3.

Table 6-3: Earthquake Mitigation Action Items

Hazard	Action Item	Coordinating Departments	Timeline	Mitigation Plan Goals Addressed				
				Life Safety	Protect Property	Enhance Emergency Planning	Seek Mitigation Funding Sources	Public Awareness and Outreach
Earthquake Mitigation Action Items								
Short-Term #1	Secure important nonstructural components, such as communications and IT equipment, building electrical, mechanical and HVAC equipment and building contents (file cabinets, bookcases, shelves) in City buildings to minimize damage, disruption and potential life safety impacts.	Administrative Services, Public Works	1-3 Years	X	X	X	X	X
Short-Term #2	Continue to enhance public education activities, including an earthquake preparedness segment for Lakewood City TV Channel 21, add earthquake preparedness materials to Lakewood Online and distribute materials by mail at City Hall and the Library, and secure a booth at Lakewood's annual Pan American Festival.	Recreation & Community Services	1-3 Years	X	X	X	X	X
Short-Term #3	Complete HAZUS Scenario Earthquake Loss Estimates for several of the earthquake events most likely to substantially impact Lakewood.	Community Development	1-3 Years			X		X
Long-Term #1	Encourage and facilitate retrofitting of vulnerable residential and commercial buildings, including low income and elderly housing.	Community Development	Ongoing	X	X		X	X
Long-Term #2	Conduct seismic risk assessments for important City-owned buildings, bridges, water system and wastewater collection system to identify vulnerabilities, prioritize retrofits, and facilitate retrofitting or replacement of vulnerable structures.	Public Works	Ongoing	X	X	X	X	X

6.6 Earthquake Resource Directory

Local and Regional Resources

Los Angeles County Public Works Department
900 S. Fremont Avenue
Alhambra, CA 91803
Phone: (626) 458-5100
The Los Angeles County Department of Public Works protects property and promotes public safety through Flood Control, Water Conservation, Road Maintenance, Bridges, Buses and Bicycle Trails, Building and Safety, Land Development, Waterworks, Sewers, Engineering, Capital Projects and Airports.

Southern California Earthquake Center (SCEC)
3651 Trousdale Parkway, Suite 169
Los Angeles, CA 90089-0742
Phone: (213) 740-5843
Fax: (213) 740-0011
The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.

State Resources

California Department of Transportation (CalTrans)
120 S. Spring Street
Los Angeles, CA 90012
Phone: (213) 897-3656
CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. Alone and in partnership with Amtrak, CalTrans is also involved in the support of intercity passenger rail service in California.

California Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814
Phone: (916) 653-5656
The California Resources Agency restores, protects and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration and respect for all the communities and interests involved.

California Geological Survey
801 K Street, MS 12-30
Sacramento, CA 95814
Phone: (916) 445-1825
Fax: (916) 445-5718
The California Geological Survey develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources.

California Department of Conservation: Southern California Regional Office
655 S. Hope Street, #700
Los Angeles, CA 90017-2321
Phone: (213) 239-0878
Fax: (213) 239-0984
The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources.

California Emergency Management Agency
3650 Schriever Avenue
Mather, California 95655
Phone: (916) 845-8510
Fax: (916) 845- 8511
The California Emergency Management Agency coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.

Federal and National Resources

Building Seismic Safety Council (BSSC)
1090 Vermont Avenue, NW
Suite 700
Washington, DC 20005
Phone: (202) 289-7800
Fax: (202) 289-1092
The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

Federal Emergency Management Agency, Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607
Phone: (510) 627-7100
Fax: (510) 627-7112
The Federal Emergency Management Agency is tasked with responding to, planning for, recovering from and mitigating against disasters.

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Phone: (202) 566-1600
The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has a number of programs and activities, which provide citizens protection, with flood insurance, prevention with mitigation measures, and partnerships with communities throughout the country.

United States Geological Survey
345 Middlefield Road
Menlo Park, CA 94025
Phone: (650) 853-8300
The USGS provides reliable scientific information to describe and understand the earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect the quality of life.

Western States Seismic Policy Council (WSSPC)
125 California Avenue, Suite D201, #1
Palo Alto, CA 94306
Phone: (650) 330-1101
Fax: (650) 326-1769
WSSPC serves as a resource for information on earthquakes. It is a regional earthquake consortium funded primarily by FEMA. The WSSPC website contains information related to: policy, engineering, and education.

Institute for Business & Home Safety
4775 E. Fowler Avenue
Tampa, FL 33617
Phone: (813) 286-3400
Fax: (813) 286-9960
The Institute for Business & Home Safety (IBHS) is a nonprofit association that engages in communication, education, engineering and research to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.

Publications

Land Use Planning for Earthquake Hazard Mitigation: Handbook for Planners. Wolfe, Myer R. et. aI., (1986) University of Colorado, Institute of Behavioral Science, National Science Foundation.

This handbook provides techniques that planners and others may utilize to help mitigate for seismic hazards. It provides information on the effects of earthquakes, sources on risk assessment, and effects of earthquakes on the built environment. The handbook also gives examples on application and implementation of planning techniques to be used by local communities.

Public Assistance Debris Management Guide. FEMA (July 2000), Washington D.C.

The Debris Management Guide assists local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The "Public Assistance Debris Management Guide" is available in hard copy or on the FEMA website.

7.0 FLOODS

FEMA defines a flood as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from:
- Overflow of inland or tidal waters; or
- Unusual and rapid accumulation or runoff of surface waters from any source; or
- Mudflow; or
- Collapse of subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves for currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

The City of Lakewood is subject to flooding from three distinct flood sources, including:
- Over-bank flooding from the Los Angeles River, San Gabriel River, Coyote Creek and their tributaries,
- Local storm water drainage flooding, and
- Dam failures.

Overall, the level of flood risk for the City of Lakewood is low, in large part because of the extensive flood control measures which have been implemented on the rivers and streams posing flood risks for Lakewood. The City of Lakewood is situated on the coastal plain which is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City to the Pacific Ocean south of the City. Major flooding events in the greater Los Angeles area occur during winter storms with intense rainfall (December through March). Flooding may sometimes be exacerbated by snow-melt runoff from mountain elevations.

Contents of Chapter 7

7.1 Flood History

The current FEMA Flood Insurance Study for Los Angeles County (September 26, 2008) documents the long history of flooding throughout the County.

7.1.1 Los Angeles County

Los Angeles County suffered major floods in 1811, 1815, 1825, 1832, 1861, 1862, 1867, 1876, 1888, 1899, 1890, 1891, 1914, 1921 and 1927. Similar, better-documented floods occurred in 1934, 1938, 1941, 1943, 1952, 1956, 1969, 1978, 1979, 1980, 1983, 1992 and 1994. Construction

of dikes and other flood control measures began in the 19th century and continued into the early 20th century.

Many flood control projects were constructed after the January 1934 and March 1938 flood events, each of which caused more than 100 deaths and widespread property damage. A complex drainage system has been constructed to alleviate flooding in Los Angeles County. The major components of the flood control system are the Los Angeles River, the San Gabriel River, Rio Hondo, Ballona Creek, and Dominguez Channel. In addition, a vast network of storm drains, channels, and debris basins have been constructed by the U.S. Army Corps of Engineers, local agencies and private developers. The Los Angeles County Flood Control District is responsible for maintaining the majority of this flood control system. Many of the larger drainage systems listed above were designed to contain the 1% annual chance flood. However, not all system elements meet the current requirements for certification by providing this level of flood protection.

7.1.2 City of Lakewood

The Los Angeles River is the primary flood threat to the City of Lakewood because the flood control measures for the Los Angeles River provide a lower level of flood protection than those on the San Gabriel River or Coyote Creek. The Los Angeles River originates at the west end of the San Fernando Valley, flows east to Glendale and then south to the Pacific Ocean. The reach of the Los Angeles River which poses risk to Lakewood runs approximately parallel to the 710 Freeway north and west of Lakewood.

The documented flood history for Lakewood is very limited. The area now occupied by Lakewood was probably affected by many of the 19th century and early 20th century flood events. However, the area was almost entirely agricultural or undeveloped during this time period. There are few historical records that document the effects of these floods on the area now occupied by the City of Lakewood. The City of Lakewood was incorporated in 1954. Thus, significant development in Lakewood has occurred almost entirely since the construction of major flood control projects along the Los Angeles River and the other rivers and streams which historically posed flood risk for Lakewood. Since development began in Lakewood, there is almost no history of documented flood events that resulted in significant damages. Flood events have typically been only minor stormwater drainage issues, including flooding in 1953 which is briefly described by D.J. Waldie in his 1997 book (Holy Land: A Suburban Memoir).

The level of flood risk to Lakewood is low, but it is not zero. Lakewood is subject to flooding from events larger than the level of protection provided by flood control projects. There is also flood risk from failures of flood control infrastructure in flood events smaller than their design basis, such as levee failures from underseepage. In addition, there is flood risk from local storm water drainage problems and dam failure events, although the probability of such an occurrence is low.

7.1.3 Flood Events Since Adoption of the 2011 Hazard Mitigation Plan

There have been no dam failures since the adoption of the 2011 Hazard Mitigation Plan that would have otherwise resulted in catastrophic flooding. There have been no significant instances

of localized flooding since the adoption of the 2011 Hazard Mitigation Plan, and the El Nino weather patterns during the winter of 2016 did not bring excessive rain to the Lakewood area as forecasted.

7.2 Flood Hazards: Within FEMA-Mapped Floodplains

7.2.1 Overview

FEMA's current floodplain mapping for Lakewood is documented in the Flood Insurance Study (FIS) for Los Angeles County (September 26, 2008) which includes three Flood Insurance Rate Maps (FIRMs). The FIRM panel numbers covering Lakewood are Panels 1960, 1980 and 2000 of the 2,350 panels that cover Los Angeles County. Nearly all of Lakewood is designated as Zone X. A very small portion of Lakewood, located entirely within the banks of the San Gabriel River, is designed as Zone A; an area subject to inundation in the 1% annual chance flood.

FEMA's flood zone classification has two subcategories for Zone X:

1. Zone X (shaded on FIRM): Areas of 0.2% annual chance flood; areas of 1% annual flood with average depths less than one foot or with drainage areas less than one square mile; and areas protected by levees from 1% annual flood.
2. Zone X (unshaded on FIRM): Areas determined to be outside the 0.2% annual flood.

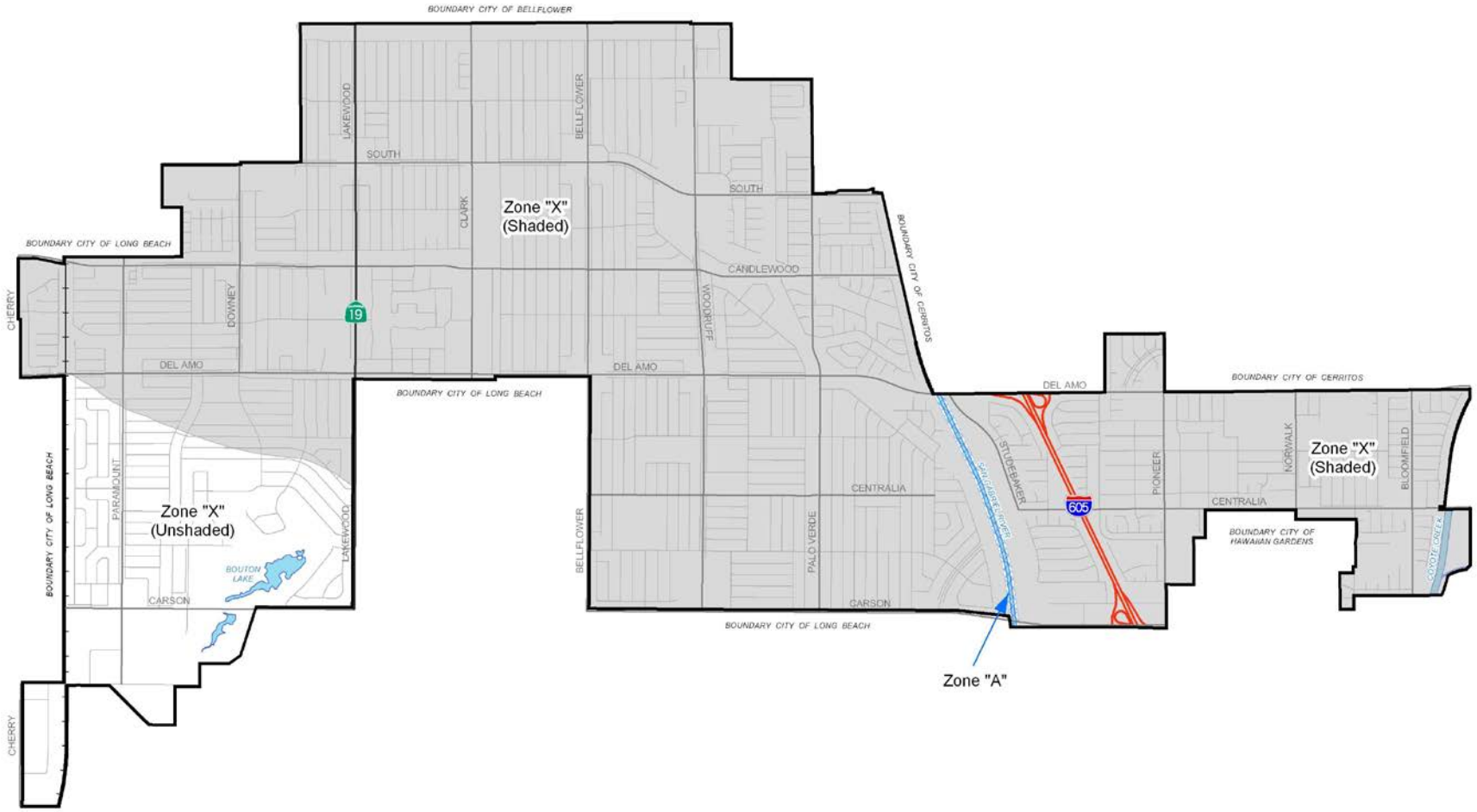
The areas of Lakewood designated by FEMA as Zone X (shaded on FIRM) and Zone X (unshaded on FIRM) are shown in Figure 7-1.

The 1% annual chance flood, which is also known as the 100-year flood, means that there is a 1% chance each year of a flood of this severity or greater. Statistically, a 1% annual chance flood has about a 26% chance of occurring in a 30-year time period. The 0.2% annual flood, which is also known as the 500-year flood, means that there is a 0.2% chance each year of a flood of this severity or greater. Statistically, a 0.2% annual chance flood has nearly a 6% chance of occurring in a 30-year time period. The Zone X (shaded) area includes almost the entire city, except for a small area in the southwest corner of the city, which is designated as Zone X (unshaded) and the area within the banks of the San Gabriel River (Zone A). The Zone X (unshaded) area is in the vicinity of the Lakewood Golf Course and covers approximately two-thirds of the area south of Del Amo Boulevard and west of the portion of Long Beach which extends into Lakewood as far as Del Amo Boulevard.

Based on the FEMA floodplain maps, Lakewood's vulnerability to flooding is relatively low:

- The 100-year floodplain is confined within the levees of the San Gabriel River.
- Much of Lakewood is within the Zone X (shaded) flood hazard areas which include areas within the 500-year (0.2% chance per year) floodplain and/or areas within the 100-year floodplain with flood depths of one foot or less. Given the topography of Lakewood, such flood events would be widespread but predominantly limited to flooding of streets and yards. Some low elevation structures might be inundated but only with very shallow water depths.

Figure 7-1: 2008 FEMA Floodplain Designations for Lakewood



7.2.2 Interpretation of FEMA's Floodplain Mapping for Lakewood

There are several important caveats for the interpretation of FEMA's floodplain mapping. In October 2009, Los Angeles County submitted a levee certification package to FEMA. On April 29, 2014 FEMA provided a letter stating that the key levees providing flood protection for Lakewood are currently certified as fully accredited by FEMA. These levees include those along the Los Angeles River, San Gabriel River and Coyote Creek. This certification will allow Lakewood to enjoy the benefits of reduced flood risk and to avoid flood insurance costs which would otherwise economically impair many Lakewood households. As long as the levees are maintained as outlined in 44 CFR 65.10, the levees will remain accredited.

7.2.3 History of FEMA Floodplain Mapping and Regulation for Lakewood

The complexity of FEMA floodplain regulations is illustrated by the following synopsis of FEMA floodplain and mapping prior to the most recent (2008) updated maps.

Prior to 1992, Lakewood was officially designated by the Federal Insurance Administration (FIA) as a "Zone C" community or a city of minimal flood hazard. This designation of Zone C is equivalent to the current designation of Zone X (unshaded on FIRM). However, as a result of a 1987 Army Corps of Engineers study (the "Los Angeles County Drainage Area [LACDA] Study"), it was determined that the Los Angeles and Rio Hondo River channels provided insufficient protection against a 100-year flood.

In particular, the LACDA Study found that 47 percent of Lakewood's land area could have been impacted by floodwaters resulting from a breakdown of the Los Angeles River during a 100-year storm. The remaining area of the City, which had not been designated as flood-prone was identified as a "Zone C" under FIA standards.

The LACDA Study proposed improvements to the Los Angeles and Rio Hondo Rivers to mitigate identified flooding problems. In addition, new federal Flood Insurance Rate Maps (FIRM) were prepared for Lakewood along with a requirement that owners of designated flood-prone properties purchase flood insurance. Another result of the new FIRM's would have required the adoption of new building code criteria and restrictions for flood-prone properties.

During the latter part of 1991, cities in southeast Los Angeles County concerned about the economic impact of the mandatory flood plain management regulations, formed the "LACDA Alliance." Cities in the Alliance included: Lakewood, Downey, Paramount, Pico Rivera, Bellflower, Carson, and Long Beach. The Alliance worked jointly to obtain Congressional support for both the construction of Los Angeles and Rio Hondo Rivers improvements and relief from the FIRM requirements. In October 1994, the LACDA Alliance's efforts resulted in the establishment of an interim rule to accompany and govern implementation of a new flood zone called "Zone AR," which was applied only to existing urbanized areas such as the LACDA area.

The final rule for the Zone AR greatly modified regulations that would have otherwise limited room additions to homes located in the flood zone because of floor elevation requirements. The final rule also provided a discounted rate on flood insurance. Homeowners in the flood zone were allowed to

purchase flood insurance for nearly half the normal cost, provided that those insurance policies were purchased before the final maps were published by FEMA in June 1998. Improvements to properties in the Zone AR allowed room additions to existing homes to maintain existing first floor elevations. Without this designation, some properties would have required that new room additions be built two to four feet above existing first floor elevations. The Zone AR and accompanying rules established a grace period of ten (10) years in which to make necessary improvements to the LACDA flood control system and to thereby eliminate the potential 100-year flood hazard threat. The Zone AR acted as a temporary overlay flood zone for potential flood hazard areas, which would have otherwise received an AE or AO flood zone designation. The required flood control improvements included raising the access roads adjacent to the levees by up to four feet, constructing parapet walls along the tops of existing flood control channel levees, modifying traffic, railroad, utility, and pedestrian bridges, and armoring the backside of the levees along some portions.

The LACDA project was completed and the formal application for a Letter of Map Revision (LOMR) was submitted by the Los Angeles County Department of Public Works to the Federal Emergency Management Agency (FEMA) for approval. Approval of the LOMR on January 11, 2002 changed the Zone AR areas to Zone X (see Figure 2-2 for the Flood Zone Map). Properties with the Zone X designation are considered to be in an area of minimal flood risk. Consequently, property owners in the new Zone X could voluntarily purchase flood insurance but homeowners with federally-backed mortgages were no longer required to purchase flood insurance by federal regulation.

Lakewood's Zone X designation will continue until a determination concerning the Provisionally Accredited Levees has been made.

The FEMA Flood Insurance Study and Flood Insurance Rate Maps for Lakewood include a large number of terms and acronyms. A glossary of the terms used in flood hazard mapping is available on the FEMA website at:

http://www.fema.gov/pdf/floodplain/nfip_sg_appendix_d.pdf

7.3 Other Flood Hazards: Not Mapped by FEMA

Many areas of the United States outside of mapped floodplains are subject to repetitive, damaging floods from local storm water drainage. Nationwide more than 25% of flood damage occurs outside of FEMA-mapped floodplains.

The FEMA mapped floodplains for Lakewood do not include consideration of local storm water drainage or very small streams. Thus, it is possible for a given location outside of the FEMA mapped floodplain entirely or within the Zone X low risk area to have high flood risk due to flood sources not considered in the FEMA mapping. In most cities, storm water drainage systems are designed to handle only small to moderate size rainfall events. Storm water systems are sometimes designed to handle only two-year or five-year flood events and are rarely designed to handle rainfall events greater than 10-year or 15-year events.

For local rainfall events that exceed the collection and conveyance capacities of the storm water drainage system, some level of flooding commonly occurs. In many cases, local storm water drainage systems are designed to allow minor street flooding to carry off storm waters that exceed the capacity of the storm water drainage system. In larger rainfall events, flooding may extend beyond streets to include yards. In major rainfall events, local storm water drainage flooding may also affect buildings. In extreme cases, local storm water drainage flooding may sometimes result in several feet of water in buildings, resulting in high damage levels.

Heavy rains may result in minor nuisance flooding, but there is no history of significant localized flooding from storm water drainage problems in Lakewood. However, such flooding could occur from unusually heavy rainfall events.

7.4 Vulnerability to Flooding from Dam and Reservoir Failures

The FEMA mapped floodplains discussed above do not consider dam failures. Dam failures are very unlikely to occur for modern, well-engineered dams. However, the probability of failure is not zero. Dam failures are possible in extreme flood events and in major earthquakes. In these situations, the design capacity of a dam may not withstand the flood or seismic forces. The two most catastrophic dam failures in the greater Los Angeles area were the failures of the Saint Francis Dam in 1928 and the Baldwin Hills Dam in 1963.

The Saint Francis Dam, located near Santa Clarita, was built in 1926. It was 180 feet high and 600 feet long. The dam failed in March 1928 because of the sudden failure of the foundation. Over 500 people died, and damage estimates exceeded $20 million (1928 dollars). In 2009 dollars, the damage would be approximately $250 million, before factoring the enormous increase in development since 1928. Considering the increase in development in the region, an equivalent disaster in 2009 would likely result in the deaths of thousands of people and billions of dollars of damage.

The Baldwin Hills Dam, an earthen dam that was located in the West Hollywood Hills, impounded a 19-acre reservoir for water supply. A small crack in the dam quickly widened to a 75-foot wide gash. The reservoir emptied in a little more than one hour. The break caused five deaths, destroyed 65 houses, and damaged 210 houses and apartments. In 2011 dollars, the damage to homes and apartments would likely be above $100 million.

There are two dams upstream of Lakewood that could pose an inundation hazard for portions of Lakewood in the event of catastrophic failure: Hansen Dam and Whittier Narrows Dam. The inundation maps predicting the areas of inundation following a failure of these dams are shown in Figures 7-2 and 7-3. These inundation maps predict worst case scenarios with complete failure of the dams and release of impounded water in a short time period. Failures when dams are less than full or failures which occur more gradually, with time to reduce the volume of impounded water, would result in inundation of smaller areas than those shown on the inundation maps.

The inundation area for failure of the Hansen Dam includes approximately 12 blocks at the extreme northwest corner of Lakewood (Figure 7-2). In this scenario, water depth at the fringe of the inundation area would be shallow, perhaps only one foot or less, and flow velocities would be

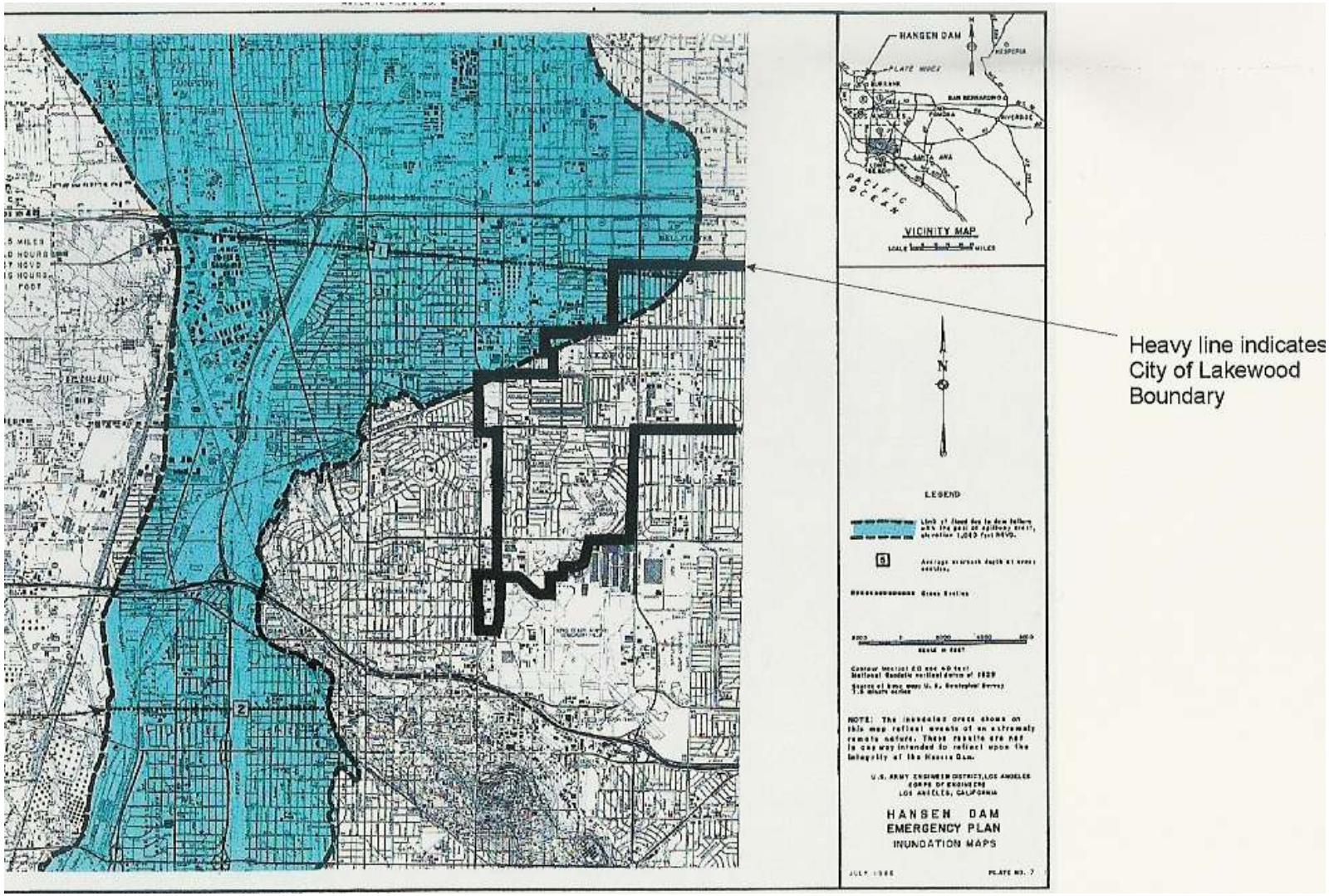
low. Thus, the expected level of damage within Lakewood for the failure of Hansen Dam would be fairly low. A less catastrophic failure of Hansen Dam would probably not affect Lakewood.

The inundation area for failure of the Whittier Narrows dam includes about 80% of Lakewood. Only the southwest corner of the City is excluded from inundation in this scenario (Figure 7-3). The inundation map does not include water depth or velocity information. However, topography and flow conditions indicate that water depths and velocities would be highest near the San Gabriel River and decrease to zero at the mapped inundation area boundary. In a worst case scenario, the catastrophic failure of the Whittier Narrows Dam, damages in Lakewood would be extremely high with a potential for loss of life.

There is no history of any dam failures affecting Lakewood and no reports of any damage. However, as discussed in the preceding paragraphs, failure of the Hansen Dam or the Whittier Narrows Dam, which have low probabilities of occurring, would result in damage in Lakewood. For the failure of the Hansen Dam, damage would be minor and would be limited to about 12 blocks in the extreme northwest corner of Lakewood.

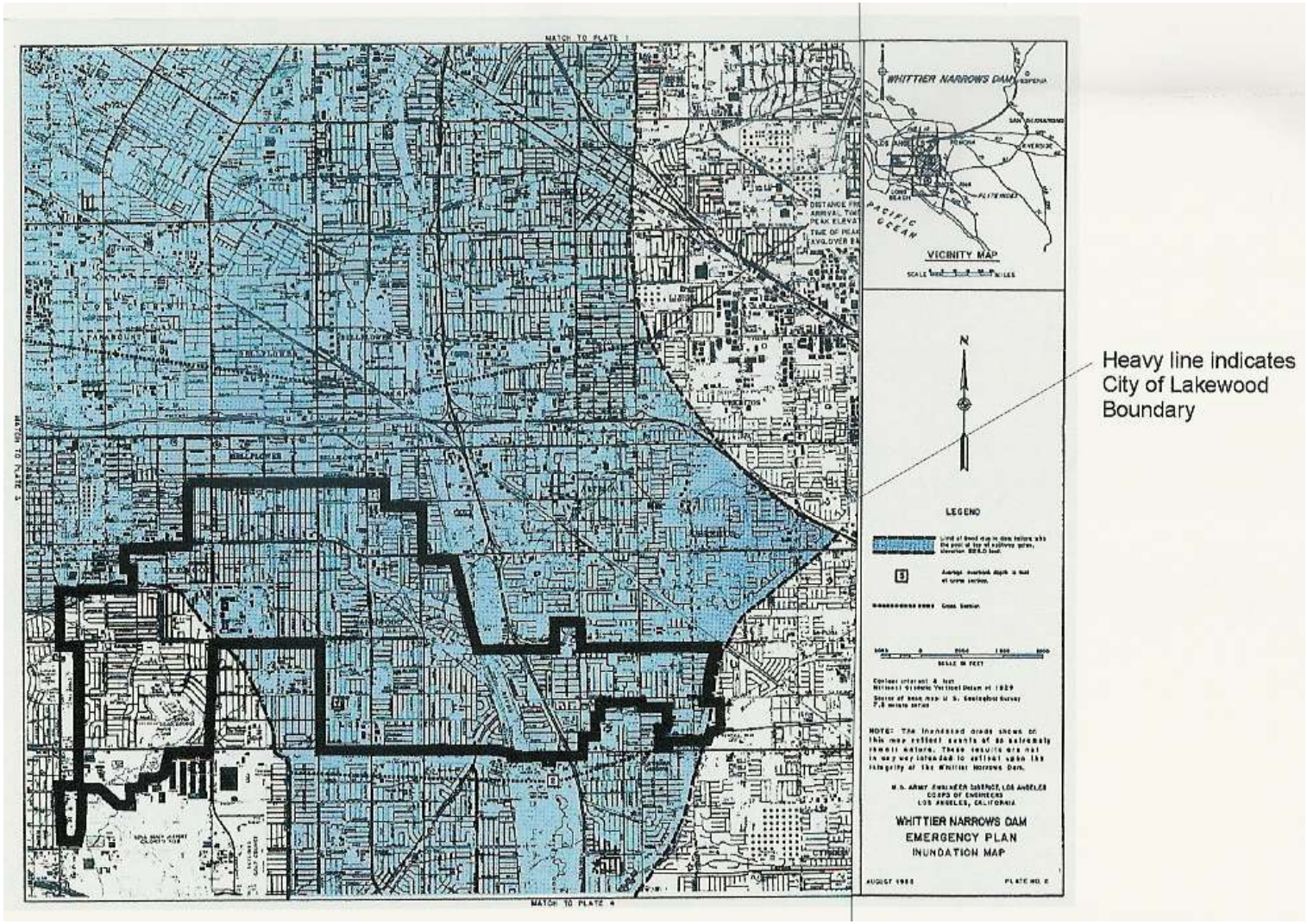
The worst case scenario would be catastrophic failure of the Whittier Narrows dam which could result in inundation of about 80% of Lakewood, if the dam were to fail suddenly when full. For more realistic failures, less of Lakewood would be inundated. However, in the worst case scenario, damage would be widespread, probably reaching into the hundreds of millions of dollars with potential for loss of life. The impacts of this worst case scenario would be widespread damage to buildings and temporary closures of most of the highways (including I-605 and Highway 91), arterials and secondary streets in Lakewood.

Figure 7-2: Hansen Dam Inundation Map



Hansen Dam, Emergency Plan, Inundation Map, U.S. Army Corps of Engineers, July 1986.

Figure 7-3: Whittier Narrows Dam Inundation Map



Whittier Narrows Dam, Emergency Plan, Inundation Map, U.S. Army Corps of Engineers, 1985.

Localized flooding can also result from failures of water storage reservoirs. Flood risk from reservoir failures is highest for large volume tanks and especially in areas where flows from failed reservoirs flow into a relatively narrow channel with buildings. The City of Lakewood water system includes three water storage facilities which include seven welded steel tanks, one partially buried concrete reservoir, and one partially buried pre-stressed concrete reservoir. The Golden State Water Company has two welded steel tanks in Lakewood. The risk of serious flooding from failures of reservoirs is low in Lakewood because of the relatively small size of the reservoirs and due to the flat topography. None of the outflows from potential reservoir failures would flow into narrow channels with buildings.

Furthermore, the probability of reservoir failures in Lakewood has been substantially reduced by seismic retrofits of the reservoirs, which include modification of overflow drains and the installation of flexible couplings for the inlet/outlet pipes.

7.5 Risk Analysis for Lakewood

Risk is defined as threats to property and life-safety; the potential for damage and casualties from hazard events. The level of flood risk for Lakewood is low as documented by the FEMA FIRM maps for the City. However, sufficient data does not exist to facilitate quantitative calculation of the level of risk. Because Lakewood is in Zone X, the quantitative flood hazard data necessary to compute the probability of flooding of various depths as function of location within the City is not available.

Since additional quantitative flood hazard data is unavailable, the risk analysis for Lakewood is limited to the following semi-quantitative observations.

100-Year Flood Event

A 100-year flood event is defined as a 1% annual chance of a flood of this severity or greater each year. Over a 30-year time period, this type of flood event has about a 26% chance of occurring. According to the FEMA Flood Insurance Study and Flood Insurance Rate Maps for Lakewood, the entire City is within Zone X (shaded or unshaded) which indicates that none of the City is expected to flood in a 100-year flood event.

500-Year Flood Event and Other Flood Events Exceeding the Capacity of the Flood Control Systems

A 500-year flood event means that there is a 0.2% annual chance of a flood of this severity or greater each year. Over a 30-year time period, this type of flood event has nearly a 6% chance of occurring. According to the FEMA floodplain map, most of the City is within the 500-year floodplain, with the exception of a small area (Zone X unshaded) in the southwest portion of the City. During a 500-year flood event, the volume of water (stream discharge) and flood elevations in the channels would exceed the capacity of all of the flood control channels servicing Lakewood: the Los Angeles River, the San Gabriel River, and Coyote Creek.

This type of flood event would cause overtopping of the channels and could result in complete breaches of the channel/levee walls. For the Los Angeles River, the peak discharge for a 500-year event is 143,000 cubic feet per second (about five acre-feet per second). Because the Los Angeles River (as well as the San Gabriel River and Coyote Creek) is a deeply incised, concrete-lined channel, most of the flow would remain confined within the channel if the walls were overtopped by extreme floods. Even if the walls were breached, much of the flow would remain within the channel because it is deeply incised below the surrounding land.

Flood depth would be low and extend over broad areas due to the coastal plain on which Lakewood and surrounding cities are situated. This area covers hundreds of square miles and is rather flat and gently sloping to the south. Similarly, the low slopes would cause low flow velocities except in the immediate vicinity of an overtopping or levee breach. Thus, for a 500-year event or any other flood event which exceeds the capacity of the flood control systems, flooding is expected to be widespread but relatively shallow. The area affected would likely be somewhat less than the inundation area for failure of the Whittier Narrows Dam (Figure 7-3). The most likely scenario for Lakewood would be widespread flooding of streets and yards, but with flood levels likely not reaching most structures. Flood depths with the potential for damages to homes and other buildings would be highest in the immediate vicinity of levee overtoppings or breaches, near the San Gabriel River or Coyote Creek because of natural drainage patterns, and in other topographic low spots.

Hansen Dam Failure

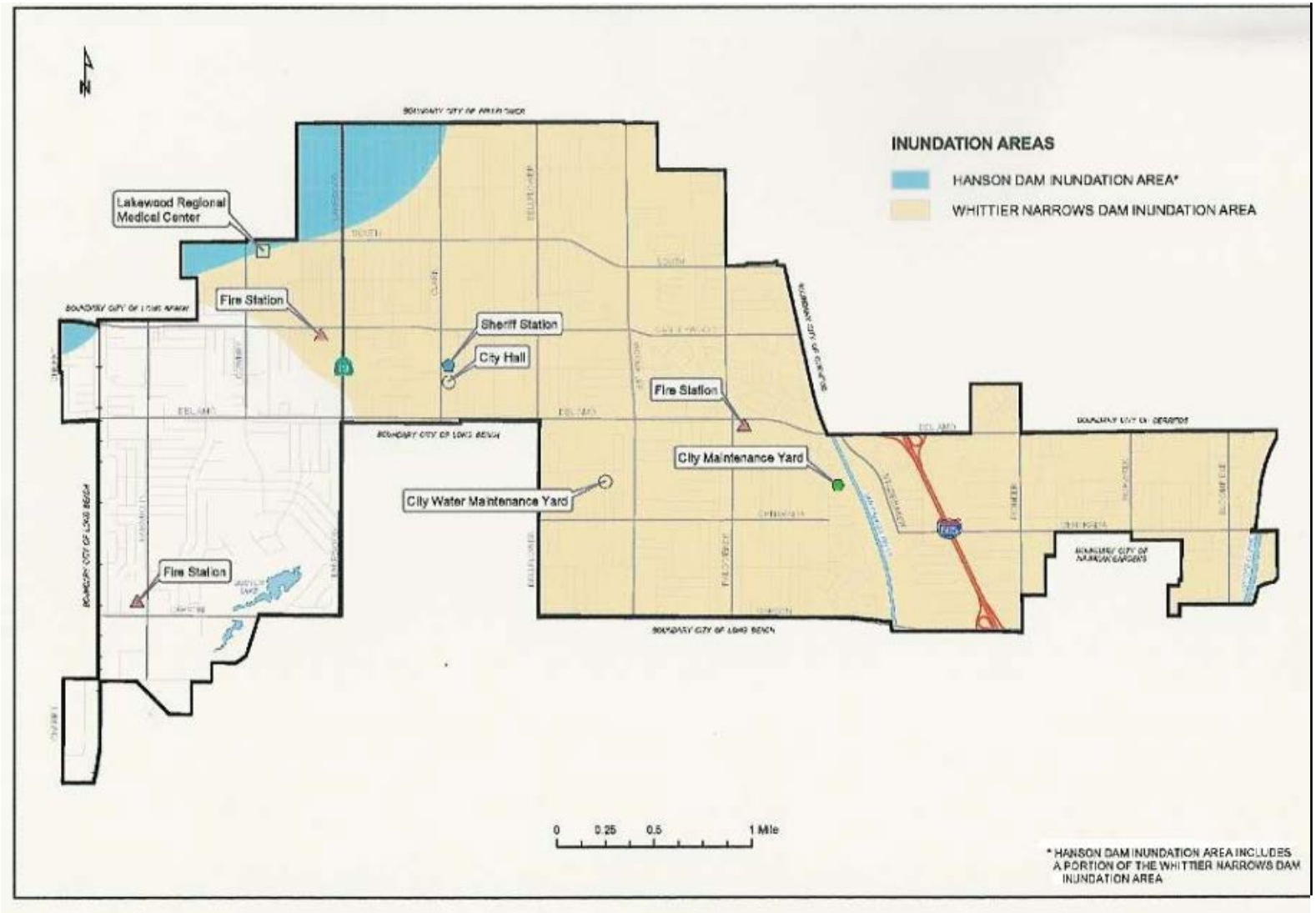
The inundation zone for catastrophic failure of the Hansen Dam includes about a dozen blocks in the extreme northwest corner of Lakewood (Figure 7-2). Because this area is at the fringe of the inundation area, water depths and velocities would be low and flooding would likely only affect streets and yards, with perhaps minor damage to buildings at the lowest elevations in this area.

Whittier Narrows Dam Failure

The inundation zone for catastrophic failure of the Whittier Narrows Dam includes approximately 80% of the City. Due to the absence of detailed dam failure, modeling data including warning times (arrival of flood surge after dam failure), flow depths and velocities, quantitative estimates of damage and casualties cannot be made. However, given the area of the City inundated and the potential for high velocity flows, especially near the San Gabriel River, there is potential for high levels of damage and casualties. Catastrophic failure of the Whittier Narrows Dam appears to be the worst case flood scenario for Lakewood.

The location of critical and essential facilities within the inundation areas for dam failures is shown in Figure 7-4. The critical facilities within the inundation areas include the Lakewood Regional Medical Center, two fire stations, the Sheriff station, City Hall, the Nixon yard and the Water yard. The highest level of risk is for the Water yard and one fire station, both of which are located nearest to the San Gabriel River and thus subject to the greatest flow depths and velocities from failures of the Whittier Narrows Dam. The level of risk for the other facilities is probably low. Flow depths and velocities would probably be too low to cause major damage to the remaining City facilities.

Figure 7-4: Critical and Essential Facilities within Dam Failure Inundation Areas



7.6 Flood Insurance Data

The City of Lakewood participates in the National Flood Insurance Program (NFIP), with 338 flood insurance policies in force. FEMA maintains a nationwide database of flood insurance polices and repetitive loss properties. NFIP insured properties are often given high priority for flood mitigation actions such as elevation or acquisitions (which are always voluntary at the discretion of the owner). However, flood risk for most properties in Lakewood appears too low to justify such flood mitigation actions.

Insurance Summary

NFIP information (current as of August 1, 2016) shows the following policy information for Lakewood:

- Number of polices: 338
- Insurance in force: $104,466,000
- NFIP claims paid: 5
- Total claims amount: $19,091.00
- Number of repetitive loss buildings: None

Structures at Risk

- The entire city of Lakewood has 100-year or greater flood protection from levees. Thus, there are no structures within the FEMA-mapped 100-year floodplain (A Zones).
- However, the entire City of Lakewood is within the FEMA-mapped Zone X (shaded or unshaded; see Section 7.2 above). The Zone X shaded areas, which include areas protected from the 100-year flood by levees and areas within the 500-year floodplain, comprise about 90% of the structures in Lakewood. The remaining 10% of structures are in the Zone X (unshaded) area and are thus outside of the 500-year floodplain.

Staff Resources

- Lakewood's Community Development Director is the designated floodplain manager.
- At present, there is not a certified floodplain manager on staff. Lakewood recognizes that certification is desirable and may be obtained in the future when staff time and resources for training become available.
- The floodplain manager reviews all permits for development within the 100-year floodplain and coordinates with GIS staff to provide information about floodplain management on the City's website.
- There are no known barriers to effective floodplain management in Lakewood, and the City is in full compliance with NFIP requirements.

Compliance History

- Lakewood is in good standing with the NFIP.
- Current violations: NONE
- Last Community Assistance Visit: October 1, 2001
- None are planned because there are no buildable areas within the FEMA-mapped floodplain 100-year floodplain (A-Zones).

Regulation

- Lakewood entered the NFIP in 1979. Community Number is 060130.
- The effective date of the latest FIS and FIRM is September 26, 2008.
- FIRMS are digital.
- Lakewood's Floodplain Management Ordinance was adopted by the City Council on May 26, 1998 (Ordinance No. 98-5). The Floodplain Management Ordinance added Sections 8030 through 8037 to the Lakewood Municipal Code and governs the permitting process. The Floodplain Management Ordinance met NFIP standards when adopted.

Community Rating System (CRS)

- Lakewood is not yet participating in the Community Rating System.
- NFIP Continued Compliance Actions: Not applicable.

Regulation

- Lakewood has adopted the latest FIS and FIRM.

Flood Risk Maps

- The existing flood maps accurately reflect flood risk in Lakewood.

Community Outreach Activities

- Continuous activities include:
  - Letters to property owners and residents, and articles when changes are proposed that affect flood zone boundaries or flood insurance requirements.
  - Flood-related brochures are available at the Community Development Department at Lakewood City Hall, 5050 Clark Avenue, Lakewood, California 90712.
  - The City of Lakewood website (www.lakewoodcity.org) has Flood Insurance Rate Maps, Letter of Map Revision, information on floodplain development, links to FEMA's website, and an on-line information request form to obtain more detail information.

7.7 Common Flood Mitigation Projects

Potential mitigation projects to reduce the potential for future flood losses cover a wide range of possibilities, including:

- Improving flood control systems,
- Enhancing storm water drainage systems,
- Construction of berms or floodwalls to protect critical facilities,
- Elevation or acquisition of highly flood-prone structures, and
- Elevation of utilities and other critical building components or contents.

The following table includes flood mitigation action items from the master Action Items table in Chapter 4.

Table 7.4
Flood Mitigation Action Items

Hazard	Action Item	Coordinating Departments	Timeline	Mitigation Plan Goals Addressed				
				Life Safety	Protect Property	Enhance Emergency Planning	Seek Mitigation Funding Sources	Public Awareness and Outreach
Flood Mitigation Action Items								
Short-Term #1	Develop better understanding of the level of risk posed by dam failures, including warning times, flood depths and velocities.	Finance, City Manager's Office, HMP Committee	1-2 Years	X	X	X	X	X
Short-Term #2	Evaluate and improve notification, evacuation and response planning for dam failures.	City Manager's Office, HMP Committee	1-2 Years	X		X		X
Short-Term #3	Track and map localized flooding events to reduce property damage.	Community Development	1-2 Years		X	X	X	
Long-Term #1	Evaluate critical city water and wastewater infrastructure such as motor control cabinets and pumps to minimize flood losses.	Dept. of Water Resources, Public Works	5 years		X	X	X	
Long-Term #2	Ensure that future critical facilities are at high enough elevations to avoid damage from floods or dam failures.	HMP Committee	Ongoing	X	X	X		

7.8 Flood Resource Directory

County Resources

Los Angeles County Public Works Department
900 S. Fremont Avenue
Alhambra, California 91803
Phone: (626) 458-5100

Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, California 90607
Phone: (562) 699-7411, x2301

State Resources

California Emergency Management Agency
3650 Schriever Avenue
Mather, California 95655
Phone: (916) 845-8510
Fax: (916) 845- 8511

California Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, California 95814
Phone: (916) 653-5656

California Department of Water Resources (DWR)
1416 9th Street
Sacramento, California 95814
Phone: (916) 653-6192

California Department of Conservation: Southern California Regional Office
655 S. Hope Street, #700
Los Angeles, California 90017-2321
Phone: (213) 239-0878
Fax: (213) 239-0984

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)
FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance. FEMA also operates the National Flood Insurance Program. FEMA's mission is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response, and recovery.

Federal Emergency Management Agency, Region IX
1111 Broadway, Suite 1200
Oakland, California 94607
Phone: (510) 627-7100
Fax: (510) 627-7112

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Phone: (202) 566-1600

FEMA's List of Flood Related Websites

This site contains a long list of flood related Internet sites from “American Heritage Rivers" to "The Weather Channel" and is a good starting point for flood information on the Internet.
Contact: Federal Emergency Management Agency, Phone: (800) 480-2520
Website: http://www.fema.gov/nfip/related.htm

National Floodplain Insurance Program (NFIP)
500 C Street, S.W.
Washington, D.C. 20472
Phone: (202) 566-1600

The Floodplain Management Association
P.O. Box 50891
Sparks, Nevada 89435-0891
Phone: (775) 626-6389
Fax: (775) 626-6389

The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of upcoming events, a list of positions available, an index of publications available free or at nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and a catalog of Web links.

The Association of State Floodplain Managers
2809 Fish Hatchery Road
Madison, Wisconsin 53713
Phone: (608) 274-0123

The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and

flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM website includes information on how to become a member, the organization's constitution and bylaws, directories of officers and committees, a publications list, upcoming conference information, association history, and other information.

National Weather Service
520 North Elevar Street
Oxnard, California 93030
Phone: (805) 988- 6615

National Weather Service
Office of Hydrologic Development
1325 East West Highway, SSMC2
Silver Spring, Maryland 20910
Phone: (301) 713-1658
Fax: (301) 713-0963

The National Weather Service Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters. This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.

National Resources Conservation Service
14th and Independence Ave., SW, Room 5105-A
Washington, DC 20250
Phone: (202) 720-7246
Fax: (202) 720-7690

National Resources Conservation Service (NRCS), US Department of Agriculture provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impact of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems within a watershed area. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to set aside land that can serve as a wetland resource or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clear debris from clogged waterways, restore vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more than one property.

USGS Water Resources
6000 J Street, Placer Hall
Sacramento, California 95819-6129

Phone: (916) 278-3000
Fax: (916) 278-3070

The USGS web page offers current US water news, extensive current and historical water data, fact sheets and other publications, various technical resources, descriptions of ongoing water survey programs, local water information, and connections to other sources of water information.

Bureau of Reclamation
Mid Pacific Regional Office
Federal Office Building
2800 Cottage Way
Sacramento California 95825-1898
Phone: (916) 978-5000
Fax (916) 978-5599

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The Bureau provides leadership and technical expertise in water resources development and in water efficiency through initiatives including conservation, reuse, and research. It protects the public and the environment through the adequate maintenance and appropriate operation of Reclamation's facilities, manages Reclamation's facilities to fulfill water user contracts, and protects and/or enhances conditions for fish, wildlife, land, and cultural resources.

US Army Corps of Engineers
P.O. Box 532711
Los Angeles, California 90053-2325
Phone: (213) 452- 3921

The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. The Corps is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation.

Other National Resources

American Public Works Association
2345 Grand Boulevard, Suite 500
Kansas City, Missouri 64108-2641
Phone: (816) 472-6100
Fax: (816) 472-1610

Publications

NFIP Community Rating System Coordinator's Manual
This publication explains the Community Rating System (CRS) and its benefits. It explains the

CRS point system, and what activities communities may pursue to earn points. These points then add up to the "rating" for the community. Flood insurance premium discounts are calculated based upon the "rating." The publication also provides a table on the percent discount realized for each rating (scored 1-10). Application instructions for becoming a CRS community are also included.
Contact: NFIP Community Rating System
Phone: (800) 480-2520 or (317) 848-2898

Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP
This document discusses floodplain processes and terminology. It contains floodplain management and mitigation strategies, as well as information on the NFIP, CRS, Community Assistance Visits, and floodplain development standards.
Contact: National Flood Insurance Program Phone: (800) 480-2520

Flood Hazard Mitigation Planning: A Community Guide, (June 1997).
Massachusetts Department of Environmental Management.
This guide offers a 10-step process for successful flood hazard mitigation. Steps include: mapping hazards, determining potential damage areas, taking an inventory of facilities in the flood zone, determining current actions regarding flooding, identifying gaps in protection, determining feasible actions, coordinating with others, prioritizing actions, developing strategies for implementation, and adopting and monitoring the Plan.
Contact: Massachusetts Flood Hazard Management Program Phone: (617) 626-1250

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February 1987), FEMA-116.
This guidebook offers a table on actions that communities may take to reduce flood losses. It also offers a table with sources for floodplain mapping assistance for the various types of flooding hazards, information on various types of flood hazards with regard to existing mitigation efforts, and options for action (policy and programs, mapping, regulatory, non-regulatory).
Contact: Federal Emergency Management Agency Phone: (800) 480-2520

8.0 WINDSTORMS

The City of Lakewood is subject to several types of damaging windstorms, including Santa Ana Winds, severe thunderstorms (including downbursts), tornadoes, and tropical storms. The most common effects of windstorm events in Southern California and Lakewood in particular are tree falls, which may result in damage to above-ground utility lines and property. Some windstorm events cause damage directly from wind forces. Deaths and injuries are not common but do occur most often from tree falls.

Contents of Chapter 8

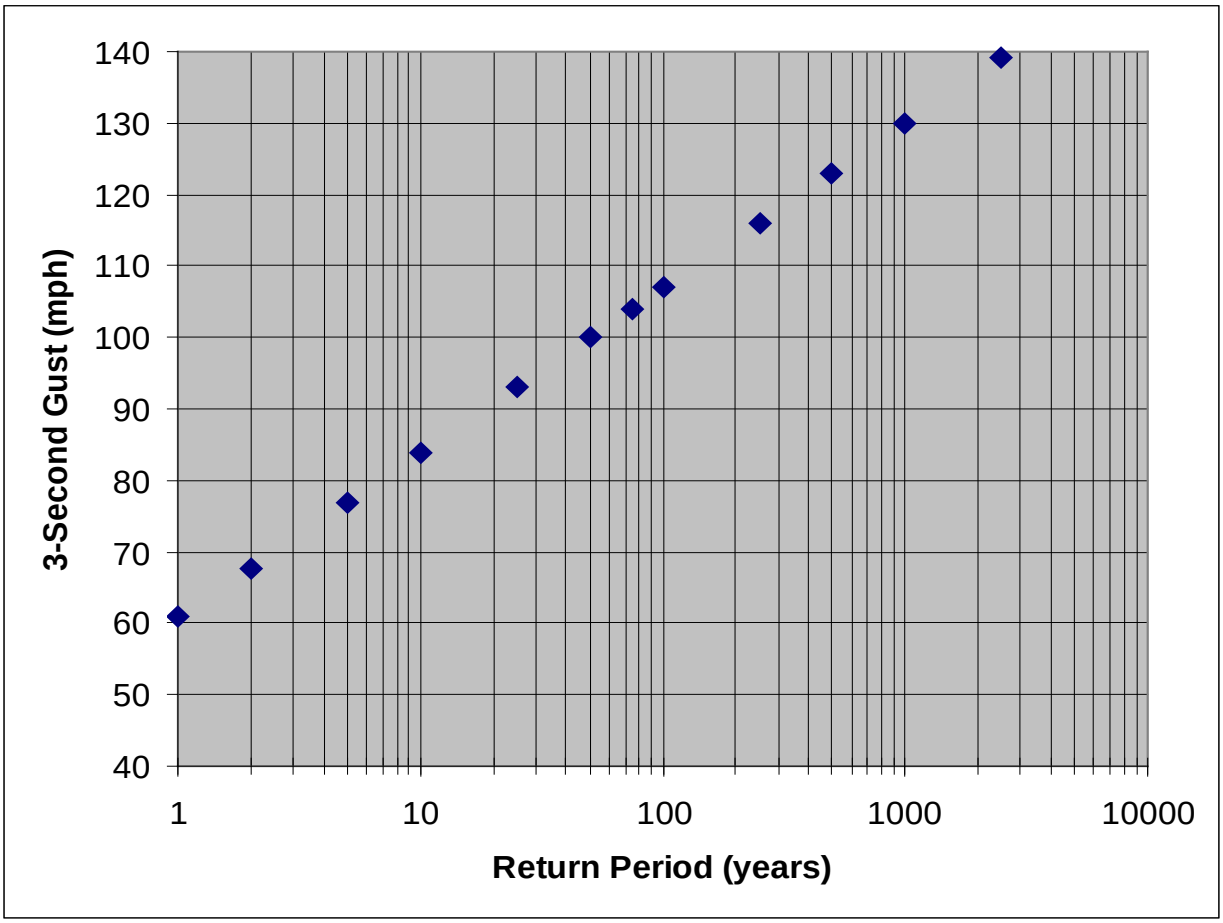
8.1 Wind Hazards for Lakewood

The 2014 County of Los Angeles Building Code Section 1609 covers the application of wind loads to buildings and other structures. The Building Code references ASCE 7-10 (American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures) Chapter 26 which specifies that buildings and structures must withstand a minimum wind speed (3-second gust for the United States) as 110 miles per hour. However, the portion of Los Angeles County generally known as the Los Angeles Basin is designated as a "special wind region." This area is south of the Santa Monica and San Gabriel Mountains and west of the Santa Ana Mountains. The Los Angeles Basin often experiences higher winds than elsewhere, due to the occurrence of Santa Ana winds.

Lakewood is located in the Los Angeles Basin. This special wind region specifies a wind speed (three-second gust) as 100 miles per hour, unless a site-specific wind study by a wind engineer or meteorologist is performed to justify a lower wind speed. The wind hazard curve for Lakewood, based on the design wind speed of 100 mph and the consensus probability relationships used in ASCE 7-10, is shown below in Figure 8-1. The design wind speed of 100 mph has a 50-year return period, which means that there is a 2% chance a year that winds will reach or exceed this speed.

As shown in Figure 8-1, the 50-year return period wind speed for Lakewood is estimated to be 100 mph. For reference, the 10-year and 100-year return period wind speeds are approximately 84 mph and 108 mph respectively. All of these wind speeds are three-second gusts which are typically about 30% higher than sustained wind speeds. Thus, for example, a three-second gust of 100 mph corresponds to a sustained wind speed of about 77 mph.

Figure 8-1: Wind Hazard Curve for Lakewood



8.1.1 Santa Ana Winds

The most significant windstorm events in the greater Los Angeles area are generated from Santa Ana winds. Santa Ana winds are dry down-slope winds that result from high pressure in the high-altitude Great Basin between the Sierra Nevada and the Rocky Mountains. When upper level winds are favorable, the air mass spills out of the Great Basin and is accelerated gravitationally towards the Southern California coast in generall. Wind gusts of 50 to 60 knots (about 57 to 70 mph) are common, and wind speeds can exceed 100 mph in narrow canyons, especially the Santa Ana Canyon, for which the winds are named.

Santa Ana winds often occur during autumn or early spring. The strongest Santa Ana winds typically occur in the autumn and are characterized by very hot, dry conditions. Many of the most serious wildfires in Southern California occur during periods of Santa Ana winds.

To some extent, Santa Ana winds occur every year. The NOAA National Climatic Data Center lists 377 Thunderstorm and High Wind reported events for Los Angeles County for the period from 1950 through March 2016. About 313 of these events are characterized as “high wind”

events. These events combined resulted in one death, 10 injuries, and $55,000 in property damage. The property damage was mostly to roofs and fallen trees.

In Lakewood, there have been five distinct storm events over the past five years. Those storm events generated 69 service requests to Lakewood. The service requests were primarily related to fallen trees and limbs. The estimated response cost per tree is $460 with about two hours spent at each tree location. The City lost approximately 28 trees during the 2015-2016 El Nino storm season. Replacement costs for those trees are estimated at $5,621 or $200.75 per tree.

8.1.2 Thunderstorms

Thunderstorms typically occur several times a year in Lakewood. The Western Regional Climate Center collects data on the average number of days of thunderstorms per year for three locations near Lakewood: Long Beach, Los Angeles, and the Los Angeles International Airport. As of June 2016, the data shows four, six, and four days of thunderstorms per year, respectively.

Thunderstorms may include locally heavy rains and high winds. Winds associated with severe thunderstorms may be high enough to result in tree falls resulting in damage to above ground utility lines and other property. Thunderstorms may also include downbursts, which are instances of downward moving air near the core of thunderstorms. Downbursts are further characterized as "microbursts" or "macrobursts" depending on the scale of the downbursts. Downbursts are defined as straightline winds in excess of 39 mph, which are caused by small-scale strong downdrafts from the base of convective thunderstorms.

Downbursts have been blamed for airline crashes and locally heavy damage; sometimes mimicking the damages caused by small tornadoes. A severe microburst event occurred near Lakewood in the City of Paramount on April 18, 2000. This microburst event was originally characterized as a small tornado and damaged about 30 mobile homes and two industrial buildings, uprooted trees, and resulted in loss of electric power for about 17,000 customers.

8.1.3 Tornadoes

Tornadoes are not common in California. Tornado data compiled by the NOAA National Climatic Data Center lists 44 tornadoes in Los Angeles County from 1950 to 2014, which is less than one tornado per year. The actual number of tornadoes might be somewhat lower than suggested by NOAA data. Some historical events characterized as small tornadoes may have been intense microburst events rather than tornadoes.

The intensity and wind speed of tornadoes is measured using the Enhanced Fujita Scale (previously known as the Fujita Scale). The estimated wind speeds for the Enhanced Fujita Scale are shown in Table 8-1. The wind speeds shown in Table 8-1 are consensus estimates, based on engineering analysis, rather than direct measurements. In 2004, revisions to the Enhanced Fujita Scale lowered the estimated wind speeds indicated in the original Fujita Scale.

Table 8-1: Fujita and Enhanced Fujita Scales for Tornadoes

Enhanced Fujita Scale (2007)	
EF-0	65-85 mph winds
EF-1	86-110 mph
EF-2	111-135 mph
EF-3	136-165 mph
EF-4	166-200 mph
EF-5	>200 mph

Source: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

About 89% of the reported tornadoes in Los Angeles County are categorized as small F0 or F1 tornadoes. Only about 11% of the tornadoes in Los Angeles County are classified as F2 tornadoes. There have been no reported F3 or greater tornadoes in Los Angeles County.

Lakewood experienced an EF-0 "mini-tornado" on March 19, 1991 which resulted in minor damage to several roofs, one building façade and one unreinforced block wall. The path of this wind event and a photograph of roof damage are shown below in Figures 8-2 and 8-3.

Figure 8-2: Path of Wind Damage, March 19, 1991.

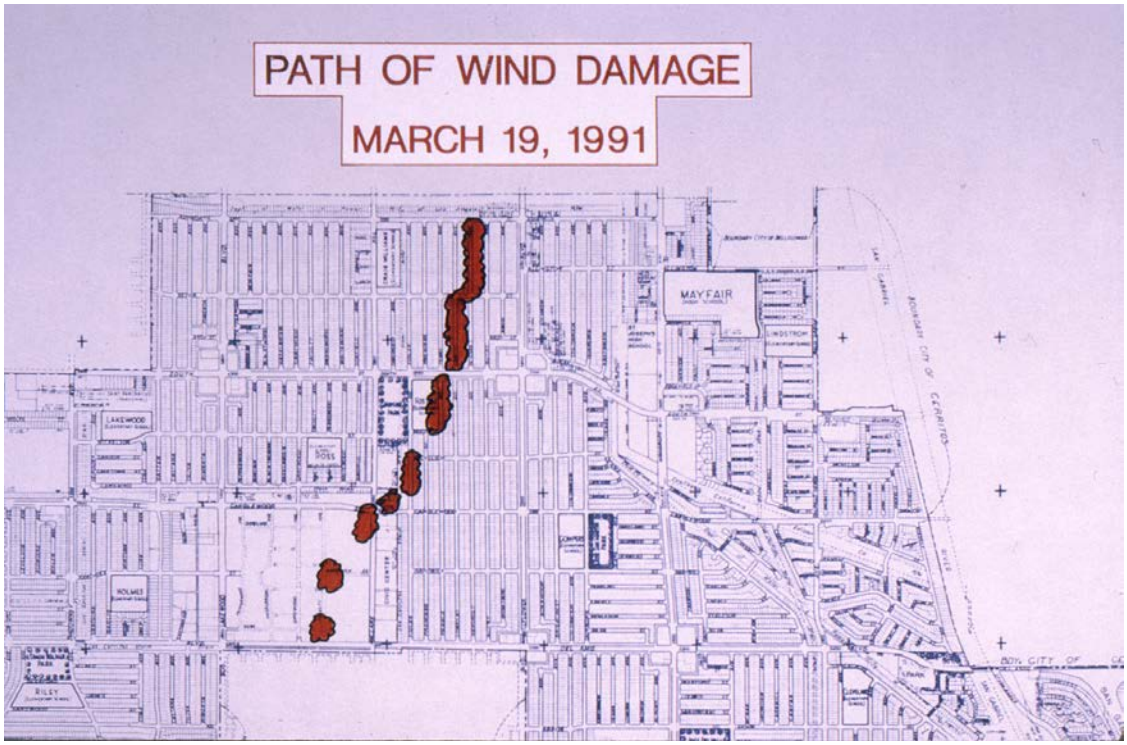


Figure 8-3: Roof Damage from 1991 "Mini-Tornado"

Given the above historical data on the number of tornadoes for Los Angeles County, the relative areas of Los Angeles County and Lakewood, and the average size of the impact area for small tornadoes (much less than one square mile), the return period for a tornado anywhere in Lakewood is probably several thousand years.

8.1.4 Tropical Storms

There are no recorded hurricanes that have hit California, although an 1858 hurricane evidently passed offshore, bringing hurricane force and gale winds to an area stretching from San Diego to Los Angeles (http://en.wikipedia.org/wiki/List_of_California_hurricanes).

Hurricanes rarely occur north of Central Baja because water temperatures are usually too cold to support hurricanes. The cold waters are caused by the north to south moving California current. Furthermore, upper level winds typically move hurricanes off Mexico to the west or northwest away from California.

However, remnants of tropical storms or hurricanes do reach Southern California. These storms may result in significant rainfalls but only rarely include substantial winds. However, since 1900, there have been four tropical cyclones which brought gale force winds (39 mph or higher) to Southern California: an unnamed tropical storm that made land fall near San Pedro in 1930, the remnants of Hurricane Joanne in 1972, the remnants of Hurricane Kathleen in 1976 and the remnants of Hurricane Nora in 1997. Some of these tropical cyclone events included heavy rains with flooding that caused significant damages and some casualties. The 1939 tropical storm had wind speeds of approximately 50 mph and nearly twelve inches of rain. It resulted in 48 deaths at sea and 45 deaths from flooding on land.

The impact of tropical cyclones to Lakewood would most likely be limited to localized flooding from heavy rains.

8.2 Vulnerability and Windstorm Risk Assessment

The level of risk to Lakewood from windstorms (high winds) is low to moderate. The most likely consequence of wind events (Santa Ana winds, thunderstorms (including downbursts, tornadoes, or tropical cyclones) are to above ground utility systems, especially electric power. Most such impacts arise from tree falls; however, in severe events, direct failures of utility lines/poles may also occur.

In addition, falling trees may damage vehicles or buildings, with some such events resulting in casualties (injuries or deaths), as well as property damage. Modern well-built structures typically have little or no damage resulting from wind speeds up to about 100 mph.

Mobile homes and light steel industrial buildings may suffer significant damage at much lower wind speeds. According to Lakewood's 2013-2021Housing Element, there are 88 mobile homes and trailers used for residential purposes within the City, which accounts for 0.3% of Lakewood's housing units. There are also several light steel industrial buildings in the City, including seven such buildings at the Nixon Yard (Lakewood Public Works).

Thus, windstorms affecting Lakewood are most likely to result in localized or widespread power outages, with generally isolated damages to a few buildings and/or vehicles, from either falling trees or direct wind forces. Fatalities or injuries are unlikely, but are possible, especially in more severe windstorm events with large numbers of falling trees.

8.3 Windstorm Events Since Adoption of the 2011 Hazard Mitigation Plan
NOAA reports that there have been 116 windstorm events in Los Angeles County and 42 windstorm events in Orange County since March 1, 2011. However, there have been no windstorms in Lakewood since the 2011 Hazard Mitigation Plan was adopted.

8.4 Windstorm Mitigation Action Items

The most common mitigation measure for windstorms is the enhancement of tree trimming efforts to reduce future damage to above-ground utility lines. In some cases, especially for critical lines, upgrading and/or relocating utility poles or lines may be undertaken to reduce their vulnerability to wind damage.

Undergrounding of utility lines provides nearly complete protection against windstorms, although there is a potential for damage caused by uprooting of trees. There are two drawbacks to undergrounding: 1) costs and 2) serviceability. Utility industry data indicate that failures of underground lines are typically much less common than for above ground lines, but repair time and repair costs are typically much higher. Over the lifetime of utility lines, underground lines may or may not have lower total costs and total outage times depending on local conditions and circumstances.

Localized or widespread power outages are the most common effect of windstorm damage. Adequate reserve power supplies for all critical facilities is an important mitigation measure for windstorms and other natural or human-caused events that result in the loss of grid power.

Lakewood's mitigation action items for windstorms are summarized in Table 8-2.

8.4 References

Fujita, T.T. (1971), Proposed Characterization of Tornadoes and Hurricanes by Area and Intensity, SMRP Research Paper No. 91, The University of Chicago.

Texas Tech University (2004), Wind Science and Engineering Center, Enhanced Fujita Scale (EF-Scale).

Table 8-2:
Windstorm Mitigation Action Items

Hazard	Action Item	Coordinating Departments	Timeline	Mitigation Plan Goals Addressed				
				Life Safety	Protect Property	Enhance Emergency Planning	Seek Mitigation Funding Sources	Public Awareness and Outreach
Wind Storm Mitigation Action Items								
Short-Term #1	Continue to encourage Southern California Edison to maintain vigorous tree trimming programs and encourage building owners to trim vegetation endangering service drops.	Public Works	Ongoing	X	X	X	X	X
Short-Term #2	Gather, publicize, and distribute windstorm preparedness and mitigation brochures from FEMA, California Public Utilities Commission, County of Los Angeles Department of Public Works and Southern California Edison.	City Manager's Office, Public Information Officer	Ongoing	X	X	X	X	X
Short-Term #3	Create a City-wide database of windstorm damages, including service request codes and GIS layers.	Community Development	1-2 Years	X	X	X		

8.5 Windstorm Resource Directory

Federal Resources and Programs

National Oceanic and Atmospheric Administration
National Centers for Environmental Information
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001

National Weather Service
Los Angeles/Oxnard Weather Forecast Office
520 North Elevar Street
Oxnard, CA 93030
Forecast and weather info: (805) 988-6610
Administrative issues: (805) 988-6615

State Resources

California Division of Forestry & Fire Protection
1416 9th Street
PO Box 944246
Sacramento, CA 94244-2460
Phone: (916) 653-5123

Additional Resources

International Society of Arboriculture
P.O. Box 3129
Champaign, IL 61826-3129
Phone: (217) 355-9411
Fax: (217) 355-9516

9.0 DROUGHT

The City of Lakewood's potable water supply system depends predominantly on groundwater, although surface water supply is also available. Lakewood's potable water supply is essential for the viability of the community. Reductions in water supply and/or interruptions of water supply could have profound impact on the residents, the community, and the economy. Water supplies from both groundwater and surface water are subject to reduction during periods of prolonged droughts. Lakewood's climate is arid with average annual precipitation of about 12 inches. Precipitation data for the nearest weather station (Montana Ranch - Lakewood) is available on the Los Angeles County Department of Public Works website: https://dpw.lacounty.gov/wrd/precip/data/index.cfm?cont=precip_daily_total.cfm.

For the approximately 45-year period of record, the mean annual precipitation is 11.31 inches, ranging from a low of 2.27 inches (2002) to a high of 32.9 inches (1998). However, climate change may influence future precipitation patterns and amounts may differ from the historical norms. Most models of climate change suggest that California may be drier in future, which may increase the potential for severe droughts.

Contents of Chapter 9

9.1 Lakewood's Water Supply System

The City of Lakewood is served by two potable water systems. The City of Lakewood generally provides water to areas west of the San Gabriel River, and the Golden State Water Company, a privately held company regulated by the California Public Utilities, provides water to areas east of the San Gabriel River.

9.1.1 Water Supply Customers

The City of Lakewood and the Golden State Water Company provide service to approximately 20,339 and 4,078 accounts, respectively. The City of Lakewood water system accounts are divided as shown in Table 9.1 below.

Table 9.1: Water Accounts by Customer Type

Customer Type	Lakewood Water		Golden State Water	
	Accounts (1)	Percent	Accounts (2)	Percent
Residential Single Family	19,094	94%	4,078	93%
Residential Multiple Family	201	1%	213	5%
Commercial/Industrial/Govt.	685	3%	52	1%
Landscape Irrigation	219	1%	35	1%
Other (incl. recycled)	140	1%	2	0.05%

(1) City of Lakewood's DRAFT 2015 UWMP Update *(April 2016)*

(2) Data provided by City of Lakewood. Residential accounts are all shown under single family but include some multi-family units. Landscape accounts include nine private fire protection meters.

9.1.2 Water Supply Sources

The City of Lakewood water system has four sources of water supply to meet customer needs:

- Groundwater,
- Imported treated surface water,
- Recycled water, and
- Emergency interconnections with other water retailers.

The City of Lakewood currently relies on groundwater for 100% of its potable water supply. Prior to 1991, the Water Resources Department met peak demand for potable water supply with imported water from Metropolitan Water District of Southern California (MWD). The City purchased this supply through two Central Basin Municipal Water District (CBMWD) connections. The installation of the recycled water system for irrigation purposes reduced the use of potable water supply and made the City less dependent on imported surface water.

The City of Lakewood draws groundwater from the Central Groundwater Basin which has been adjudicated by the Los Angeles County Superior Court since 1966. The third Central Basin Judgment Amendment was entered by the Los Angeles Superior Court on December 23, 2013. In it, the Court allows the water rights holders to have direct input into how the Judgment is administered and enforced. The Judgment confirms the State of California Department of Water Resources retirement as the Court appointed Watermaster. Under the new Judgment, the Watermaster is composed of three bodies; one of which is the Water Rights Panel (Panel), the second is the Administrative Body (WRD) to accept pumping reports and summarize records for review by the Panel, and the third body is the Storage Panel which consists of the Water Rights Panel plus the WRD Board of Directors.

The City owns 9,423 acre-feet of groundwater extraction rights and pumped an average of 7,770 acre-feet from 2011 to 2015. Annual water use varies based on weather conditions and implementation of emergency conservation regulation. Recently, average water use has decreased 14 percent as a result of water conservation regulation implementation started in summer 2014. However, historically more water is consumed during dry years than during years with average or above average rainfall.

The City of Lakewood maintains 10 potable production wells to meet average and peak water demand. As of 2015, average daily potable water demand is about 5.5 million gallons, or about 93 gallons per person per day. Recycled water demand is about 8% of total water demand, or about 450,000 gallons per day.

Total water demand in Lakewood has been stable for many years, reflecting the predominantly residential nature of the City and the fact that the City has been nearly built-out for many years. The DRAFT 2015 Urban Water Management Plan projects an increase in water demand of 14% from 2015 through 2035. The projected level of water demand can be met with the City's current groundwater rights.

In addition to its primary groundwater source, the City of Lakewood has three additional water sources; imported treated surface water, recycled water, and emergency interconnections with other retailers.

The City maintains two Central Basin Municipal Water District (CBMWD) connections which can supply Metropolitan Water District (MWD) water to Lakewood. Each connection has a capacity of 15 cubic feet per second; the combined capacity is about 19 million gallons per day or somewhat more than double Lakewood's average daily demand. Thus, in principle, there is sufficient treated surface water supply available to meet 100% of Lakewood's demand.

However, relying on treated surface water has two major drawbacks; price and the possibility that the water supply may be interrupted. CBMWD's current price for treated water is $923 per acre-foot which is more than 3 times Water Replenishment District's (WRD) adjudicated pumping allocation rate of $268 per acre-foot in 2015.

CBMWD/MWD treated surface water is also potentially interruptible because of major disasters such as an earthquake or a major flood.

The current production of recycled water is 502 acre-feet per year. The use of water is limited to irrigation, which reduces demand for potable water. Without infrastructure expansion, recycled water use will remain about 8% of total water demand.

Finally, the City of Lakewood maintains three emergency water interconnections with the Cities of Long Beach and Cerritos, and Golden State Water Company. These emergency interconnections could provide supplemental water to Lakewood for events such as a major water main failure that only affected Lakewood. However, these emergency connections are not reliable sources of water for major natural disasters (i.e., a major earthquake) which damage water systems regionally or during periods of prolonged drought. Such events would almost certainly curtail the availability of water for Lakewood and surrounding water purveyors.

9.2 Effects of Drought on Lakewood's Water Supply

Prolonged droughts, lasting more than five consecutive years would negatively affect Lakewood's water supply from both groundwater and surface water sources.

9.2.1 Groundwater Supply

The annual water rights allocation from the Central Groundwater Basin is 217,367 acre-feet for all Central Basin water rights holders. Lakewood's portion is 9,432 acre-feet. This level of water extraction is sustainable if adequate recharge is maintained. Recharge of the Central Groundwater Basin is accomplished through facilities maintained by the Los Angeles County Department of Public Works (LACDPW). LACDPW operates two spreading grounds in the Central Basin: Rio Honda and San Gabriel River. There are three sources of recharge water for the Central Groundwater Basin:

- Imported surface water from the Metropolitan Water District,
- Local supplies from storm flows and underground flows from the Upper San Gabriel Groundwater Basin, and
- Recycled water from the Los Angeles County Sanitation Districts.

Extraction of the total annual allocated rights from the Central Groundwater Basin may become challenged during periods of prolonged drought due to reductions in available surface water and reduction in local supplies for groundwater recharge.

9.2.2 Surface Water Supply

Surface water supply is critical for Lakewood, even though Lakewood has not drawn directly on surface water supply since 1991. Surface water supply is an essential part of recharging the Central Groundwater Basin and is also Lakewood's primary backup water source if sufficient supplies from groundwater were unavailable. For the purposes of this discussion, surface water supply does not include rivers and lakes within the City.

The California Department of Water Resources (DWR) document titled California's Groundwater Update 2013 – South Coast Hydrologic Region provides summary data on water supplies for the greater Los Angeles Area[1]. From 2005 to 2010, average annual water supply met by groundwater for the Los Angeles planning area were nearly 636,000 acre-feet. Of this, about 3,000 acre-feet (0.53%) were from surface water supplies.

There are four surface water supply sources for the greater Los Angeles area:

- Local surface water,
- Los Angeles Aqueduct,
- Colorado River Aqueduct, and
- State Water Project.

The local surface water sources are reservoirs in the San Gabriel Mountains. The Los Angeles Aqueduct which provides water from the Mono Basin and Owens Valley serves only the City of Los Angeles. The Colorado Aqueduct provides water from the Colorado River. The State Water Project provides water from the Sacramento-San Joaquin Delta.

[1] http://www.water.ca.gov/waterplan/docs/groundwater/update2013/content/hydrologic_region/GWU2013_Ch6_SouthCoast_Final.pdf

These four surface water supply sources are subject to curtailment during periods of prolonged drought. In addition, environmental concerns and regulations affect the proportion of total water that can be used for potable water supply in any given year.

These four surface water supply sources are subject to curtailment during periods of prolonged drought. In addition, environmental concerns and regulations affect the proportion of total water that can be used for potable water supply in any given year.

9.2.3 Drought Events Following Adoption of the 2011 Hazard Mitigation Plan

Since adoption of the 2011 Hazard Mitigation Plan, the State of California has been in an exceptional drought. The drought began in 2012 and since then, the California State Water Resources Control Board (State Water Board) has implemented numerous updates and revisions to statewide drought emergency water conservation regulations. The following outlines the Governor's role to curtail water shortages:

> *1. On January 17, 2014, the Governor issued a proclamation of a state of emergency under the California Emergency Services Act based on drought conditions;*
>
> *2. On April 25, 2014, the Governor issued a proclamation of a continued state of emergency under the California Emergency Services Act based on continued drought conditions;*
>
> *3. On April 1, 2015, the Governor issued an Executive Order that, in part, directs the State Water Board to impose restrictions on water suppliers to achieve a statewide 25 percent reduction in potable urban usage through February, 2016; require commercial, industrial, and institutional users to implement water efficiency measures; prohibit irrigation with potable water of ornamental turf in public street medians; and prohibit irrigation with potable water outside newly constructed homes and buildings that is not delivered by drip or microspray systems;*
>
> *4. On November 13, 2015, the Governor issued an Executive Order that directs the State Water Board to, if drought conditions persist through January 2016, extend until October 31, 2016 restrictions to achieve a statewide reduction in potable usage; and*
>
> *5. On May 9, 2016, the Governor issued an Executive Order that directs the State Water Board to adjust and extend its emergency water conservation regulations through the end of January 2017 in recognition of the differing water supply conditions for many communities.*[2]

As a result of the Governor's April 1, 2015 mandate to reduce statewide water use, the City of Lakewood was given a 20% conservation reduction as compared to the same months in 2013. Therefore, on May 26, 2015, the City Council adopted Urgency Ordinance 2015-6 implementing the State Water Conservation Regulations in conformance with State Water Board's watering restrictions and implemented Phase III of the city's outdoor water conservation restrictions. By the end of 2015, Lakewood exceeded the State's conservation mandate by achieving a 26% cumulative conservation savings as compared to the same seven months in 2013.

[2] DRAFT California Code of Regulations. Article 22.5 Drought Emergency Water Conservation, Section 863. Findings of Drought Emergency

More recently, winter 2016 saw improved hydrologic conditions in parts of California. More rain and snow fell in Northern California and due to California's water storage and conveyance systems, state concerns over supply reliability have eased. However, the unprecedented mandatory state-driven conservation standards in place over the past months have since transitioned to conservation standards based on supply reliability considerations at the local level.

9.3 Drought impacts on the water supply

Lakewood is in a semi-arid region and experiences a Mediterranean climate. Accordingly, Lakewood relies primarily on well water from subsurface aquifers and surface water, rather than Future prolonged droughts would affect the availability of both groundwater and imported water supplies for Lakewood. Climate change may affect water supply statewide through changes in precipitation and volume of surface runoff. These changes include[1]:

- Increasing temperatures, especially in the summer;
- Changes in surface runoff timing, including volume and form; and
- Declining Sierra Nevada snowpack, with reduced spring snowmelt and increased winter runoff.

In addition to the above direct effects on water supply, several other factors may indirectly compound the problem including:

- Increased agricultural demand for water from higher evapotranspiration, and
- Increased water storage to maintain habitat for aquatic species during the dry season.

Climate change appears likely to exacerbate the effects of future droughts and result in reductions in total water supply for California. The extent to which future droughts might impact Lakewood's water supply is difficult to estimate quantitatively. However, a reduction of even a few percentage points is possible during extreme droughts.

As noted above, Urgency Ordinance 2015-6 implemented Phase III of the city's outdoor water conservation restrictions and by the end of 2015 Lakewood exceeded the State's conservation mandate by achieving a 26% cumulative conservation savings as compared to the same seven months in 2013. The conservation restrictions combined with heavy winter storms in Northern California decreased the threat from drought.

In mid-May 2016, the state water board reduced the amount of conservation that communities need to achieve in the months ahead. Because of Lakewood's past conservation success and because Lakewood's water supplies are in good shape with at least a three-year supply on hand, the Lakewood Water Resources Department recommended that specific limits be lifted on the days and amount of time that customers can water. The Lakewood City Council approved that recommendation at its meeting on May 24, 2016. The new rules went into effect on June 1, 2016. The new rules allow customers to water any day of the week and for any length of time, providing there is not significant water run-off from the property on to hardscaping. Under state-mandates, hosing down driveways, sidewalks and other hardscaping is still prohibited, as is washing a car unless a bucket or hose with a shut-off nozzle is used, and irrigating within 48 hours after

measurable rain. Customers are still encouraged to use high-efficiency rotor sprinklers, drip irrigation, and a hose with a shut-off nozzle.

9.3.1 Vulnerability to Drought

The vulnerability to drought is shared uniformly among properties served by the Lakewood Water Resources Department as they are connected to the same water system. However, water that is used for public safety and health purposes could be considered to be more important or sensitive than water used for ornamental or recreational purposes.

Some examples of how water is used for public safety and health purposes include fire hydrants and fire sprinklers, hospitals and medical offices, and sanitation (sanitation includes dish washing, bathing, effluent). Examples of water used for ornamental or recreational purposes include landscape irrigation, swimming pools, and washing cars.

Table 9.2: Drought Vulnerability to Drought

Water Use	Sensitivity to Drought	Category
Fire Hydrants and Fire Sprinklers	High	Safety
Hospital and Medical Offices	High	Health
Sanitation	High	Health
Landscape Irrigation	Low	Aesthetic
Swimming Pools, Water Slides, Spas	Low	Recreation
Washing cars, cleaning hardscaping	Low	Aesthetic

9.3.2 Risks Assessment of Drought

The City's 2015 Urban Water Management Plan's Water Conservation Plan contains six phases of action based on water supply conditions: voluntary phase, which remains in effect during normal supply conditions, to Phase 5 for shortages up to 50 percent. The Water Conservation Plan categorizes the shortages into stages and outlines the conditions for declaration of each stage. The Lakewood City Council can declare a water supply emergency by holding a public hearing and adopting a resolution. The resolution indicates the reason for the water supply emergency and the phase to be implemented. As a result of the recent drought, in 2015 the City Adopted an Emergency Drought Regulation to reduce water use by 20% from June 2015 till October 2016. The City surpassed its State mandated water use with a cumulative water savings of 26%.

Table 9.3: Stages of Water Shortage Contingency Plan

Phase	% Supply Reduction	Water Supply Condition
I	10%	Declaration of Drought by State or Regional Agency Calling for 10% Reduction
II	20%	Declaration of Drought by State or Regional Agency Calling for 20% Reduction
III	30%	Declaration of Drought by State or Regional Agency Calling for 30% Reduction
IV	40%	Halt of artificial recharge of groundwater basin over 3 year period
V	50%	Halt of artificial recharge of groundwater basin over 5 year period

The 2015 Urban Water Management Plan notes that the City Council adopted general water use prohibitions in 1991, and amended the provisions in 2009. Some of these provisions are in effect regardless of water supply conditions. The table below indicates the type of water waste provisions contained in the City's water conservation ordinance and summarizes the prohibitions imposed during the stages of water supply shortages.

Table 8-2: Restrictions and Prohibitions on End Use

Prohibited Water Use	Stage When Prohibition Becomes Mandatory
Use of Potable Water for Street Sweeping	At discretion of City Council
Uncorrected Plumbing Leaks	Normal Water Supply
Operating Decorative Fountains without Recirculating Water System	Normal Water Supply
Installation of Single Pass Cooling Systems Prohibited	Normal Water Supply
Installation of Car Wash without Recirculating Water System	Normal Water Supply
Serving Water at Public Eating Establishments Upon Request Only	Normal Water Supply
Construction or remodeling (50% or more) a commercial kitchen without water conserving spray valves	Normal Water Supply
Lodging Establishments serving customers without an opt out of daily linen service program	Normal Water Supply
Overspray Caused by Irrigation	Phase 1
Street/Sidewalk Cleaning	Phase 1 (Limits Use)
Washing Cars	Phase 1 (Limits Use)
Watering Lawns/Landscape	Phase 1 (Limits Use)
Non-permanent Agriculture	Phase 3 (Limits Use)

As shown in the tables above, water that is used for public safety and health purposes would remain protected due to declarations and required reductions in water consumption. Therefore the overall risk to high sensitive users would remain relatively low because sufficient regulations are in place to prevent water shortages from affecting those users.

9.4 Mitigation Measures for Droughts

9.4.1 Mitigation Concepts

The California Department of Water Resources California Water Plan Update 2013 (Volume 3 Regional Reports, Chapter 5 South Coast Hydrologic Region) lists six emerging strategies for meeting future water demands[3]:

1) Water transfers. Water transfer is the development of water transfer and exchange agreements among water agencies within and outside of the region. Water transfer does not increase total water supply but does provide for the efficient use of existing supplies.

[3] California Water Plan Update 2013, Investing in Innovation & Infrastructure

2) Water Conservation Act of 2009 (SB X7-7). The Act requires each urban retail agency to establish provisions in its urban water management (UWMP) to reduce daily per capita water use 20% by 2020. This is accomplished by implementing water demand measures and best management practices that reduce water use.
3) Conjunctive management and groundwater storage. Conjunctive management refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Surface water and groundwater resources typically differ significantly in their availability, quality, management needs, and development and use costs. Managing both resources together, rather than in isolation, allows water managers to use the advantages of both resources for maximum benefit.
4) Recycled municipal water. Currently, recycled water is being used for not only irrigation but also to recharge the Central Groundwater Basin via the county flood control district's spreading grounds and seawater barrier injection wells. Additionally, the Los Angeles Regional Water Quality Control Board adopted Non-Irrigation General Water Reuse (Order No. R4-2009-0049) that allows for non-irrigation uses of recycled water, such as industrial cooling or dust control during construction.
5) Desalination (Brackish and Sea Water). Desalination has the potential to be a significant source of surface water for California. This supply alternative is unique in that ocean water does not depend on the hydrologic cycle and can be treated to produce fresh water reliably, even during the more frequent and longer droughts projected to be caused by climate change (Committee on Advancing Desalination Technology 2008). However, desalination still remains one of the most expensive options for water supply with a projected cost ranging from $1,600 to $3,000 per acre-foot.
6) Urban runoff management. Urban runoff management primarily addresses management of runoff quantity and water quality, but enhanced management could also increase groundwater recharge and thus increase water supplies.

9.4.2 Lakewood Mitigation Strategies and Action Items

The drought mitigation strategies listed above are potentially available to Lakewood. Some of these strategies are possible for Lakewood to implement directly (e.g., conservation or water transfers). However, implementation of many of these strategies would require multi-jurisdictional cooperation. The City of Lakewood's DRAFT 2015 Urban Water Management Plan Update *(April 2016)* has full details of Lakewood's contingency planning for water shortages.

Enhanced conservation would reduce the need for additional water supplies and/or minimize the effects of future reductions in available water supply. The City of Lakewood's DRAFT 2015 Urban Water Management Plan Update *(April 2016)* has details of Lakewood's existing and potential future water conservation efforts and programs.

Enhancing water transfers and conjunctive water management would enhance the effective use of existing regional water supplies. Enhanced recycling of municipal water and enhanced urban runoff management would increase total water supply availability.

Each of the above measures could provide significant or substantial improvements in the adequacy of future water supplies for Lakewood. The further treatment of waste water could increase the supply for replenishment. In a worst case scenario where extreme drought periods or profound climate change reduces availability of current water supply sources, desalination is a more costly but reliable solution. Lakewood's mitigation action items for drought are shown in Table 9.4.

Table 9.4
Drought Mitigation Action Items

Hazard	Action Item	Coordinating Departments	Timeline	Mitigation Plan Goals Addressed				
				Life Safety	Protect Property	Enhance Emergency Planning	Seek Mitigation Funding Sources	Public Awareness and Outreach
Drought								
Short-Term #1	Continue to enhance Lakewood's existing water conservation measures and programs.	Dept. of Water Resources	1-3 Years			X	X	X
Short-Term #2	Continue existing water transfer agreements with neighboring water utilities.	Dept. of Water Resources	1-3 Years			X		
Long-Term #1	Evaluate options for increased use of recycled water.	Dept. of Water Resources	Ongoing			X		
Long-Term #2	Continue to work with regional water agencies to improve conjunctive water management and urban runoff water management.	Dept. of Water Resources	Ongoing			X		

10.0 OTHER HAZARDS

The four hazards addressed in the previous chapters – earthquake, flood, windstorms, and drought – are the predominant natural hazards which pose threats to Lakewood.

However, there are other natural hazards which pose less significant threats to Lakewood, including: wildland/urban interface fires, landslides or debris flows, volcanic events (ash falls), subsidence, and extreme temperatures. The level of risk from these hazards is negligible, so no action items to mitigate risk are deemed necessary. These potential hazards are evaluated in this chapter.

Contents of Chapter 10

10.1 Other Natural Hazards

10.1.1 Wildland/Urban Interface Fires

Wildland/urban interface fires pose substantial threats for certain communities in Southern California. The risk of wildland/urban fires is high when developed areas are contiguous with wildland areas containing high vegetative fuel loads. Risk is substantially exacerbated by steep topography, which may facilitate rapid fire growth uphill and limit access by fire suppression personnel. Risk is also substantially exacerbated by narrow streets which impede egress by residents during fire events and impede access by fire suppression personnel and apparatus, and by limited water supplies, which are common in low-density developed areas. The City of Lakewood has none of these risk factors for wildland/urban interface fires:

- Lakewood is 99.5% developed. The remaining vacant parcels have little or no vegetation and are surrounded by urban land uses with no direct connection to any wildlands.
- There are no high vegetative fuel load wildland areas within the City limits, adjacent to the City boundaries, or neighboring communities.
- There are no areas of steep slopes or narrow streets which limit egress and access, and no low-density developed areas with limited water supplies for fire suppression.

The risk of wildland/urban interface fires in Lakewood is nonexistent.

10.1.2 Landslides and Debris Flows

Landslides and/or debris flows are possible in areas with steep slopes and unstable soils or rock or loose surficial debris. The topography of Lakewood is essentially flat with gentle slopes. Lakewood has no steep slopes, unstable soils or rock, or loose surficial debris. Thus, the risk of landslides or debris flows in Lakewood is negligible.

10.1.3 Volcanic Events (Ash Falls)

There are many active or potentially active areas of volcanic activity in California. These volcanic areas are generally located in the northern part of the state, the Sierra mountain range, and the eastern desert portions of the state. These volcanoes pose threats ranging from low to very high, although Lakewood is unlikely to be impacted from such eruptions because there are no volcanic areas that extend to Lakewood. Figure 10-1 shows the location and threat level from future volcanic eruptions in California.

The hazard areas nearest to Lakewood include the Salton Buttes in Imperial County and the Amboy Crater in the Lavic Lake Volcanic Field. Each of these areas is over 100 miles from Lakewood. Volcanoes in Eastern California include the Coso Volcanic Field, the Ubehebe Craters in Death Valley and Long Valley near Mono Lake. The time intervals for volcanic activity in these areas ranges from about 250 years (Mono Lake – Long Valley), to about 10,000 years (Amboy Crater – Lavic Lake), to about 16,000 years (Salton Buttes) and to about one million years (Owens Valley – Death Valley).

The Mono Lake – Long Valley area is the most active area, but this area is located about 300 miles from Lakewood. The most recent (last few hundred or few thousand years) volcanic activity in this area was relatively small scale. The Long Valley area had a massive eruption with an estimated volume of about 600 cubic kilometers, about 250 times larger than the 1980 Mount Saint Helens eruption in Oregon about 160,000 years ago. Such massive eruptions could occur again, albeit with an extremely low annual probability. The average return period for such an eruption is presumably several hundred thousand years or longer.

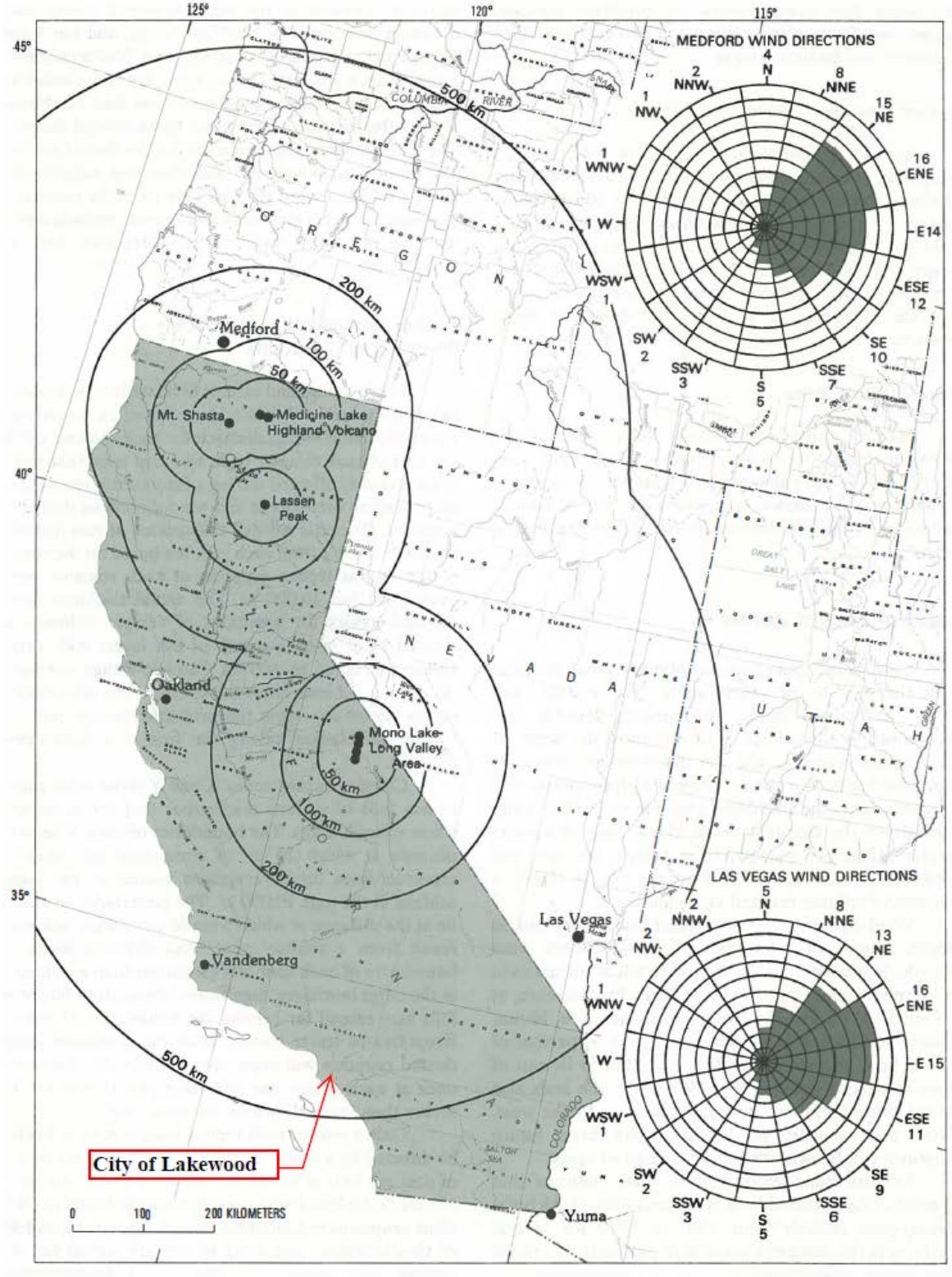
Possible impacts on Lakewood from eruptions in any of these areas would be the result of ash fall. Eruptions in any of these volcanic hazard areas would have essentially no significant impacts on Lakewood unless wind direction is from north to south. As shown in Figure 10-2, 85% of the time the prevailing wind direction is toward the east. Wind direction from the moderate to high volcanic areas south towards Lakewood occurs only 5% of the time. For Lakewood to be directly impacted by ash fall, wind direction during an eruption event would need to be towards the south and the eruption would need to be powerful enough to deposit ash some 270 miles away. Even in this worst case scenario, there would be only small amounts of ash fall in Lakewood. Overall, the risk from volcanic events in Lakewood is limited to possible ash falls with an extremely low probability and negligible risk.

Figure 10-1: Volcanoes in California

Volcanoes of very high to low threat are scattered throughout California, from the Oregon border (north) to Mexico (south). Other older volcanoes in California are of less concern. California's volcano watch list is subject to change as new data on past eruptive activity are collected, as volcanic unrest changes, and as populations in threatened areas grow or decline.

Source: USGS Fact Sheet Fact Sheet 2014-3120: The California Volcano Observatory – Monitoring the State's Restless Volcanoes, Page 1.

Figure 10-2: Volcanoes in California



Source: U.S. Geological Survey Bulletin 1847–Potential Hazard from Future Volcanic Eruptions in California. Pg 12.

10.1.4 Subsidence

In parts of California, most notably in parts of the Santa Clara and San Joaquin Valleys and in the Sacramento – San Joaquin Delta, ground subsidence has been significant. In most cases, subsidence arises from excessive water extraction from compressible aquifer layers. As water is extracted and not replenished naturally or by recharge, layers settle and ground subsidence occurs. In the Delta, subsidence arises from oxidation of peat and wind erosion.

In parts of the Central Valley, subsidence has been over 10 feet since the early 20th century. In most cases, such subsidence occurs gradually over large areas and may not result in significant damage to building foundations or buried utility lines. However, buildings and buried utility lines are subject to damage when subsidence amounts are discontinuous over short distances.

In Lakewood, there are no known areas where subsidence is occurring. Although water purveyors in Southeast Los Angeles County, including Lakewood, have been pumping water from underground aquifers for decades, groundwater levels have remained relatively unchanged over the past 50 years. Groundwater levels have been sustained due to natural recharge as well as artificial recharges (using imported and recycled waters) since the 1960s. Thus, subsidence risk in Lakewood appears negligible.

10.1.5 Extreme Temperatures

Although Long Beach Daugherty Field is in the city of Long Beach, temperature information is listed here as this weather station is adjacent to Lakewood. According to the National Weather Service, the mean monthly high temperatures range from 84^{o} in August to 67^{o} in January. Mean monthly low temperatures range from 65^{o} in August to a low of 46 ^{o} in December.
(http://weather-warehouse.com/WeatherHistory/PastWeatherData_LongBeachDaughertyField_LongBeach_CA_March.html).

Prolonged periods of extreme heat have several negative impacts. Demand for electricity may exceed capacity resulting in brownouts or blackouts. The combination of very high demand and high temperatures results in an increased number of equipment failures (especially lines and transformers), which increase the number of service outages.

Prolonged hot spells also pose health risk for elderly or otherwise frail residents. The greatest risk is to lower income residents without air conditioning or those who have lost air conditioning due to power outages.

Extreme cold periods may also impact the community. Sub-freezing temperatures may result in freezing of domestic water pipes or irrigation lines. Extreme cold spells also may result in damage to buried water distribution pipes. Prolonged cold spells may also pose health risks to those individuals without adequate heating.

Lakewood is subject to extreme heat periods. However, public response to extreme heat situations is for emergency responders and public health staff. There are no obvious mitigation action items to reduce the impacts of extreme heat on the residents of Lakewood. Mitigation measures considered under previous hazard chapters to ensure reserve power supplies for critical

facilities under disaster or other emergency conditions would also be beneficial during extreme heat conditions, which often include localized or widespread power outages.

Lakewood is only marginally susceptible to extreme cold periods. Sub-freezing temperatures may result in generally minor water damage, but given Lakewood's climate, extreme events appear nearly impossible. There are no obvious mitigation action items needed to reduce the impacts of extreme cold on the residents of Lakewood.

10.2 Risk Assessment for Other Natural Hazards

Section 10.1 above reviewed hazard data for five other natural hazards:

- Wildland/urban interface fires,
- Landslides and debris flow,
- Volcanic hazards (ash falls),
- Subsidence, and
- Extreme temperatures.

For most of these hazards, the level of risk posed to Lakewood is negligible. For extreme heat periods, there may be health concerns for some Lakewood residents. However, public responses to extreme heat events fall to emergency responders and public health officials, not to the mitigation planning process. There are no obvious mitigation action items indicated to reduce the impacts of extreme heat on the residents of Lakewood.

Therefore, these other natural hazards are not considered further in the Lakewood Hazard Mitigation plan.

10.3 Other Hazard Events Since Adoption of the Mitigation Plan in 2011

There have been no significant events affecting Lakewood for any of the hazards listed in this chapter since 2011.

10.3 Mitigation Action Items for Other Natural Hazards

Given the low level of risk posed by these natural hazards, no mitigation action items are recommended for these hazards.

APPENDIX A

SYNOPSIS OF FEMA GRANT PROGRAMS

FEMA FUNDING POSSIBILITIES FOR LAKEWOOD

Overview

For public entities, such as the City of Lakewood, funding from the Federal Emergency Management Agency (FEMA) falls into two main categories:

- The post-disaster Public Assistance Program which covers not less than 75% of eligible emergency response and restoration costs for public entities whose facilities suffer damages in a presidential-declared disaster. The Public Assistance Program may also fund mitigation projects for facilities damaged in the declared event.
- Mitigation grant programs either pre-disaster or post-disaster, which typically cover up to 75% of mitigation costs.

FEMA Public Assistance Program

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide funding so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. The PA program is sometimes referred to as the 406 program because it is authorized under Section 406 of the Stafford Act which established FEMA's disaster programs.
Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly-owned facilities and the facilities of certain private non-profit (PNP) organizations. PA funding for Lakewood will become available when:

- There is a presidentially-declared disaster in California,
- Los Angeles County included in the disaster declaration, and
- Public buildings or infrastructure in Lakewood have damage in the declared disaster event.

The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. The PA Program's distinction between repairs and mitigation is important:

- Repairs restore a damaged facility to its pre-disaster condition, with the possible addition of code-mandated upgrades.
- Mitigation measures go beyond repairs to make the facility more resistant to damage in future disaster events.

Under the PA Program, FEMA funding for repairs of damaged facilities and for the other categories of PA assistance are largely automatic, subject only to FEMA's eligibility criteria. However, mitigation measures under the PA Program are at the discretion of FEMA and are not automatically funded. Mitigation measures under PA have to meet eligibility criteria very similar to those for the other FEMA mitigation grant programs, including having a benefit-cost ratio greater than 1.0. However, Public Assistance mitigation projects are automatically determined to

be cost effective and a project-specific benefit-cost analysis is not required if the cost of mitigation is no more than the following percentages of the repair costs:

- 15% of the repair costs for any PA-eligible mitigation project, or
- 100% of the repair costs for categories of mitigation projects defined in the March 30, 2010 version of FEMA Recovery Policy RP9526.1 Hazard Mitigation Funding under Section 406 (Stafford Act).

Further details of FEMA's PA programs are available on FEMA's website at: http://www.fema.gov/site-page/public-assistance-grant-program.

FEMA Mitigation Funding Sources

The FEMA has several mitigation grant programs, which provide federal funds to supplement local funds for specified types of mitigation activities. The FEMA grant programs typically provide 75% funding with 25% local match required. In very limited cases, FEMA grant programs may provide 90% or 100% funding.

FEMA grant programs have specific eligibility requirements and application deadlines. All mitigation projects (but not planning projects or risk assessments) must be cost-effective, which means that a benefit-cost analysis using FEMA software and following FEMA guidance must demonstrate a benefit-cost ratio >1.0.

In 2016, FEMA has three mitigation grant programs:

- Hazard Mitigation Grant Program (HMGP) which is a post-disaster program for which mitigation grants are available for any natural hazard.
- PreDisaster Mitigation (PDM), which is an annual grant program for which mitigation grants are available for any natural hazard.
- Flood Mitigation Assistance (FMA), which is annual grant program for which only flood mitigation measures are eligible.

These grant programs are not entitlement programs, but rather are competitive grant programs, which require strict adherence to the eligibility, application, and documentation requirements. Documentation is especially critical for the PDM and FMA grant programs, which are nationally competitive.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a post-disaster grant program. HMGP funds are generated following a Presidential Disaster Declaration for a given state. The amount of funding is a percentage of total FEMA spending for various other FEMA programs, such as the Individual and Family Assistance and Public Assistance programs. FEMA regulations allow HMGP funds to be spent on any mitigation project in the state, for any hazard regardless of

whether or not an applicant was located in a declared county for a specific presidentially-declared disaster.

HMGP funds are limited to a given state. Each state manages the HMGP process, including setting state priorities. In California, Cal-OES selects the projects to be submitted to FEMA. FEMA reviews applications only to ensure that selected projects meet all of FEMA's eligibility requirements. HMGP is a flexible grant program. Grant funds may be used for any natural hazard and may include hazard mitigation planning, risk assessments, and physical mitigation projects.

The amount of HMGP funding in a given disaster can range from less than $100,000 to more than $1 billion for large disasters (e.g., the Northridge earthquake or Hurricane Katrina). Declared disasters in California are relatively common with several declarations issued each year for wildland/urban interface fires, floods, earthquakes or other disasters. Thus, the total amount of HMGP mitigation funds available to the state will vary from year to year and disaster event to disaster event. HMGP mitigation grants do not have pre-set maximums on grant sizes.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) grant program is a broad program which includes mitigation projects for any natural hazard as well as mitigation planning grants which must result in the development of a Local Hazard Mitigation Plan. PDM is a nationally-competitive annual program. Funding levels in future years will be set by congressional appropriations.

PDM grants cover 75% of the costs of mitigation projects up to a maximum federal share of $3,000,000 per project.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) grant program is limited to flood mitigation projects only. The emphasis is on protecting buildings that are insured through the National Flood Insurance Program (NFIP), with a special emphasis on buildings on FEMA's severe repetitive loss list.

Given the generally low flood risk for properties in Lakewood, the likelihood of receiving a Flood Mitigation Assistance grant appears low. Absent any properties on FEMA's national repetitive loss list, Lakewood would not be eligible for either of FEMA's repetitive flood loss grant program. Thus, none of FEMA's flood mitigation grant programs appear to be good candidates for Lakewood mitigation grant applications.

Mitigation Grant Guidance and Requirements

FEMA's detailed program guidance and the specific requirements for each of the three grant programs are posted on the FEMA website (www.fema.gov): Hazard Mitigation Assistance Guidance, February 27, 2015).

Mitigation Project Grant Applications

All of FEMA's mitigation grant programs are competitive within a given state or nationally. Thus, successful grant applications must be complete and well-documented. The key elements for successful mitigation project grant applications include:

- Project locations within high hazard areas.
- Project facilities which have major vulnerabilities which pose substantial risk of damage, economic impact, and (especially for seismic projects) deaths or injuries.
- For utility mitigation projects, the majority of benefits often stem from reductions in the calculated economic impacts (using FEMA standard methodologies) of the loss of utility services.
- Mitigation project scope and budget must be well-documented.
- The benefits of the project are carefully documented using FEMA benefit-cost software. A benefit-cost analysis meeting FEMA's requirements is very often the most critical step in determining a mitigation project's eligibility and competitiveness for FEMA grants.

A further eligibility requirement for mitigation project grants is that the local applicant must have a FEMA approved local hazard mitigation plan. Lakewood will be continue to be eligible to apply for FEMA mitigation grants once FEMA approves Lakewood's updated Hazard Mitigation Plan.

APPENDIX B

PRINCIPLES OF BENEFIT-COST ANALYSIS

Principles of Benefit-Cost Analysis

Benefit-cost analysis is the tool that provides answers to a central question for hazard mitigation projects: "Is it worth it?" If hazard mitigation were free, individuals and communities would undertake mitigation projects with enthusiasm, and the risks from hazards would soon be greatly reduced. Unfortunately, mitigation is not free and is often expensive. A community must consider the following: Is the investment in mitigation justified? Is it in the best economic interest of the owner (public or private) to accept the risk or invest now in mitigation to reduce future damage? Benefit-cost analysis is used by communities to answer these difficult questions.

In the complicated real world of mitigation projects, there are many factors which determine whether or not a mitigation project is worth the expense and how to determine priorities for multiple mitigation projects. Consider a town which has two flood prone neighborhoods and each neighborhood desires a mitigation project. The two neighborhoods have different numbers of houses, different value of houses, different frequencies and severity of flooding. The first neighborhood proposes storm water drainage improvements at a cost of $3 million. The second neighborhood wants to elevate houses at a cost of $3 million. Which of these projects should be completed? Both? One or the Other? Neither? Which project should be completed first if there is only funding for one? Are there alternative mitigation projects which are more sensible or more cost-effective than the proposed projects?

Such complex socio-political-economic-engineering questions are nearly impossible to answer without completing the type of quantitative flood risk assessment and benefit-cost analysis discussed below.

To determine the value of a given mitigation project, the level of risk exposure without mitigation must be determined. Consider a hypothetical $1,000,000 mitigation project. Project implementation depends on the level of risk before mitigation and on the effectiveness of the project in reducing risk. For example, if the before mitigation risk is low (e.g. a subdivision street has a few inches of water on the street every couple of years or a soccer field in a city park floods every five years), the answer is different than if the before mitigation risk is high (e.g. 100 or more houses are expected to have flooding above the first floor every 10 years or a critical facility is expected to be closed because of flood damages once every five years).

A well-designed mitigation project reduces risk. A poorly designed project may increase risk or transfer risk from one community to another. However, just because a mitigation project reduces risk, does not make it a good project. A $1,000,000 project that avoids an average of $100 per year in flood damages <u>is not</u> cost effective, while the same project that avoids an average of $200,000 per year in flood damages <u>is</u> cost effective.

The principles of benefit-cost analysis are briefly summarized here. The benefits of a hazard mitigation project are the reduction in future damage and loss, that is, the avoided damage and loss that are attributable to a mitigation project. To conduct benefit-cost analysis of a specific mitigation project, the risk of damages and losses must be evaluated twice: before mitigation and after mitigation. The benefit is the difference between the two.

The benefit of a hazard mitigation project is the avoidance of future damage and loss because a mitigation action was implemented.

Because the benefits of a hazard mitigation project accrue in the future, it is impossible to determine the exact benefit. For example, we do not know when a flood will occur or its severity. We do know, however, the probability of future floods. Therefore, the benefits of mitigation projects must be evaluated probabilistically and expressed as the difference between annualized damages before and after mitigation. The following simplified example illustrates the principles of benefit-cost analysis.

To illustrate the principles of benefit-cost analysis, consider a hypothetical single family home located on the banks of a creek. The home is a one story, 1,500 square foot structure, on a post foundation, with a replacement value of $60/square feet (total replacement value is $90,000). The flood hazard data for the adjacent creek (stream discharge and flood elevation data) and elevation data for the first floor of the house can be used to calculate the annual probability of flooding in one-foot increments as shown in Table B-1.1 below.

Table B-1.1: Damages Before Mitigation

Flood Depth (feet)	Annual Probability of Flooding	Scenario Damages and Losses Per Flood Event	Annualized Flood Damages and Losses
0	0.2050	$6,400	$1,312
1	0.1234	$14,300	$1,765
2	0.0867	$24,500	$2,124
3	0.0223	$28,900	$673
4	0.0098	$32,100	$315
5	0.0036	$36,300	$123
Total Expected Annual (Annualized) Damages and Losses			**$6,312**

Flood depths shown in Table B-1.1 are in one-foot increments of water depth above the lowest floor elevation. For example, a three-foot flood means all floods between 2.5 feet and 3.5 feet of water depth above the floor. A 0-foot flood can also cause damage, because this flood depth means water within plus or minus six inches of the floor. Flood levels a few inches below the first floor may still damage flooring and other building elements because of wicking of water.

The scenario (per flood event) damages and losses include expected damages to the building, content and displacement costs if occupants have to move to temporary quarters.

The annualized damages and losses are calculated as the product of the flood probability times the scenario damage. For example, a four-foot flood has slightly less than a 1% chance per year of occurring. If it does occur, about $32,100 in damage and loss is expected. Averaged over time, four-foot floods are thus expected to cause an average of about $315 per year in flood damage. Note that the smaller floods, which cause less damage per flood event, actually cause higher

average annual damage because the probability of smaller floods is so much higher than that for larger floods. Based on this data, the house is expected to average $6,312 per year in flood damage. This expected annual or "annualized" damage estimate does not mean that the house will incur this much damage every year. Rather, in most years there will be no floods, but over time the cumulative damages and losses from a mix of relatively frequent smaller floods and less frequent larger floods is calculated to average $6,312 per year.

The calculated results in Table B-1.1 are the flood risk assessment for this house for the as-is, before mitigation situation. Table B-1.1 shows the expected levels of damages and losses for scenario floods of various depths and also the annualized damages and losses.

The risk assessment shown in Table B-1.2 reflects a high flood risk, with frequent severe flooding which the owner deems unacceptable. Therefore, the owner explores mitigation alternatives to reduce the risk. The example below is to elevate the house four feet.

Table B-1.2: Damages After Mitigation

Flood Depth (feet)	Annual Probability of Flooding	Scenario Damages and Losses Per Flood Event	Annualized Flood Damages and Losses
0	0.2050	$0	$0
1	0.1234	$0	$0
2	0.0867	$0	$0
3	0.0223	$0	$0
4	0.0098	$6,400	$63
5	0.0036	$14,300	$49
Total Expected Annual (Annualized) Damages and Losses			**$112**

By elevating the house four feet, the owner has reduced the expected annual (annualized) damages from $6,312 to $112 (98% reduction) and greatly reduced the probability or frequency of flooding affecting the house. The annualized benefits are the difference in the annualized damages and losses before and after mitigation or $6,312 - $112 = $6,200.

Is this mitigation project worth doing? Common sense says yes, because the flood risk appears high since the annualized damage before mitigation is high ($6,312). The benefit-cost analysis for this project will determine the quantitative answer to this question. One key factor is the cost of mitigation. A mitigation project that is worth doing at one cost may not be worth doing at a higher cost. Although the cost to raise the home is $20,000, this cost occurs once, up front, in the year that the elevation project is completed. The benefits, however, accrue statistically over the lifetime of the mitigation project. Following FEMA convention, we assume that a residential mitigation project has a useful lifetime of 30 years. Money (benefits) received in the future has less value than money received today because of the time value of money. To take the time value of money into account, we need to do what is known as a present value calculation. We compare

the present value of the anticipated benefits over 30 years in the future to the up-front out-of-pocket cost of the mitigation project.

A present value calculation depends on the lifetime of the mitigation project and on what is known as the discount rate. The discount rate may be viewed simply as the interest rate you might earn on the cost of the project if you didn't spend the money on the mitigation project. Let's assume that this mitigation project is to be funded by FEMA, which uses a 7% discount rate to evaluate hazard mitigation projects. With a 30-year lifetime and a 7% discount rate, the "present value coefficient" which is the value today of $1.00 per year in benefits over the lifetime of the mitigation project is 12.41. That is, each $1.00 per year in benefits over 30 years is worth $12.41 now. The benefit-cost results are shown in Table B-1.3.

Table B-1.3: Benefit-Cost Results

Annualized Benefits	$6,200
Present Value Coefficient	12.41
Net Present Value of Future Benefits	$76,942
Mitigation Project Cost	$20,000
Benefit-Cost Ratio	3.85

These results indicate a benefit-cost ratio of 3.85. This mitigation project would be cost-effective and eligible for FEMA funding. Taking into account the time value of money, which is essential for a correct economic calculation, results in lower benefits than if we simply multiplied the annual benefits by the 30-year project useful lifetime.

The above discussion of benefit-cost analysis of a flood hazard mitigation project is intended to illustrate the basic concepts. Very similar principles apply to mitigation projects for earthquakes or any other natural hazards. However, for earthquake projects more engineering input is typically required to evaluate vulnerability, design (at least to the conceptual stage) an appropriate retrofit and generation of a realistic engineering cost estimate.

The role of benefit-cost analysis in prioritizing and implementing mitigation projects in Lakewood is addressed in Chapter 4 (Goals, Objectives, and Action Items) and in Chapter 5 (Plan Adoption, Maintenance and Implementation).

APPENDIX C

COMMUNITY INVOLVEMENT AND PLANNING PROCESS

Mitigation Plan Development

Participation is a key component to the strategic planning process. Citizen participation offers citizens the chance to voice their ideas, interests, and opinions. The Federal Emergency Management Agency also requires public input during the development of a hazard mitigation plan.

The City of Lakewood Hazard Mitigation Plan integrates a cross-section of citizen input throughout the planning process. To accomplish this goal, a public participation process was developed with three components: (1) develop a steering committee comprised of knowledgeable individuals representing various City departments; (2) conduct two public workshops to identify common concerns and ideas regarding hazard mitigation and to discuss specific goals and actions of the mitigation plans; and (3) obtain support from the City to prepare this Plan.

Two community workshops were held in 2016. Notices for both workshops were posted online, in the City Clerk's office, at two public parks, and notices were mailed to various public and private organizations. Copies of the community workshop notices as well as the mailing labels for the notices are contained in this appendix. The community workshops were held on Monday, May 9, 2016 and on Tuesday, August 2, 2016. Both workshops were held at the Centre at Sycamore Plaza. Despite notification of these community workshops, no members of the public or persons representing interested agencies attended. Notice was also given for the August 9, 2016 City Council meeting at which consideration of this Plan took place.

The City of Lakewood is dedicated to involving the public directly in the continual review and updates of the Plan. The Plan will be made available at City Hall for public review. The public will be afforded opportunity to contribute to future revisions of the Plan.

Below are the mailing labels from the distribution list for the Community Workshops:

City of Lakewood
Attention: Mrs. Sonia D. Southwell, AICP
Director of Community Development
5050 Clark Avenue
Lakewood, CA 90712

Kenneth A. Goettel, President
Goettel & Associates, Inc.
1732 Arena Drive
Davis, CA 95618

City of Artesia
Attention: Mr. Okina Dor,
Director of Community Development
18747 Clarkdale Avenue
Artesia, CA 90701

City of Bellflower
Attention: Rowena Genilo-Concepcion,
Planning Manager
16600 Civic Center Drive
Bellflower, California 90706

City of Cerritos
Attention: Mr. Torrey Contreras,
Community Development Director
18125 S. Bloomfield Avenue
Cerritos, California 90703

City of Cypress
Attention: Douglas Hawkins, AICP,
City Planner
5275 Orange Avenue
Cypress, California 90630

City of Hawaiian Gardens
Attention: Mr. Joe Colombo,
Community Development Director
21815 Pioneer Boulevard
Hawaiian Gardens, CA 90716

City of La Palma
Attention: Mr. Douglas Dumhart
Community Development Director
7822 Walker Street
La Palma, California 90623

City of Long Beach
Attention: Amy Bodek, AICP, Director
333 W. Ocean Boulevard, 4th Floor
Long Beach, CA 90802

Long Beach Airport
4100 Douglas Drive
Long Beach, CA 90808

City of Paramount
Attention: Mr. Kevin Chun,
Director of Community Development
16400 Colorado Avenue
Paramount, CA 90723

County of Los Angeles
Department of Regional Planning
Attn: Mr. Richard Bruckner
320 West Temple Street
Los Angeles, California 90012

County of Los Angeles Public Works
Attention: Ms. Gail Farber
900 South Fremont Avenue
Alhambra, CA 91803

County of Los Angeles Public Works
Attention: Linda Lee Miller, PE
Watershed Management Division 11th Floor
P.O Box 1460
Alhambra, CA 91802-1460

County of Los Angeles, Sanitation Dist.
Attention: Mr. Steve Maguin
1955 Workman Mill Road
Whittier, CA 90601

Los Angeles County Fire Department
Attn: Mr. Daryl L. Osby, Fire Chief
1320 North Eastern Avenue
Los Angeles, CA 90063

L.A. County Sheriff - Lakewood Station
Attention: Allen Castellano, Captain
5130 Clark Avenue
Lakewood, CA 90712

NOT USED

Los Angeles County Sheriff
Attention: Mr. Jim McDonnell, Sheriff
4700 Ramona Boulevard
Monterey Park, CA 91754-2169

SCAG - Environmental Planning Division
Attention: Mr. Jacob Lieb
818 W. Seventh Street, 12th Floor
Los Angeles, California 90017

County of Orange
Resources & Development Management
Attn: Mr. Colby Cataloi
300 N. Flower Street
Santa Ana, California 92701

SCAG
Attn: Intergovernmental Review
818 W 7th Street, 12th Floor
Los Angeles, CA 90017-3435

ABC Unified School District
Attention: Dr. Mary Sieu
16700 Norwalk Boulevard
Cerritos, California 90703

Bellflower Unified School District
Attention: Dr. Brian Jacobs
16703 Clark Avenue
Bellflower, California 90706

Long Beach Unified School District
Attention: Christopher J. Steinhauser
1515 Hughes Way
Long Beach, California 90810

Paramount Unified School District
Attention: Dr. Ruth Perez
15110 South California Avenue
Paramount, California 90723

Cerritos Community College
Attention: Dr. Jose Fierro
11110 Alondra Boulevard
Norwalk, CA 90650-6269

Long Beach City College
Mr. Eloy Oakley, Superintendent
4901 East Carson Street
Long Beach, CA 90808-1706

Metro
Development Review
One Gateway Plaza—Mail Stop 99-23-4
Los Angeles, CA 90012-2952

Long Beach Transit
P.O. Box 731
Long Beach, CA 90801

Southern California Edison
Attention: Ms. Adeline Yoong
2800 East Willow Street
Long Beach, CA 90806

Southern California Edison
Local Govt. Affairs
Land Use/Environmental Coordinator
2244 East Walnut Grove Avenue
Rosemead, CA 91770

OCTA
550 South Main Street
Orange, California 92863-1584

Golden State Water Company
Attention: Richard Mathis
11469 Rosecrans Avenue
Norwalk, CA 90050

L.A.D.W.P
Attention: Ms. Marcie Edwards
P.O. Box 51111
Los Angeles, California 90051-0100

Southern California Gas Company
Centralized Correspondence
P.O. Box C, San Dimas, CA 91773

AT&T Government Affairs
300 N. Continental Boulevard
El Segundo, CA 90245

Verizon
Mr. Michael Murray
1 World Trade Center, Suite 206
Long Beach, CA 90831

Union Pacific Railroad
Attn: Mr. Chris Keckeisen
2015 S. Willow Avenue
Bloomington, California 92316

Gabrieleno/Tongva
San Gabriel Band of Mission Indians
Anthony Morales, Chairperson
P.O. Box 693
San Gabriel, CA 91778

Gabrieleno Bank of Mission Indians – Kizh Nation
Andrew Salas, Chairperson
P.O. Box 393
Covina, CA 91723

Gabrielino/Tongva Nation
Sandonne Goad, Chairperson
106 ½ Judge John Aiso Street, #231
Los Angeles, CA 90012

Gabrielino-Tongva Tribe
Conrad Acuna
1999 Avenue of the Stars, Suite 1100
Los Angeles, CA 90067

Gabrielino Tongva Indians of California
Tribal Council
Robert F. Dorame
P.O. Box 490
Bellflower, CA 90707

Gabrielino/Tongva Nation
Sam Dunlap, Cultural Resources Director
P.O. Box 86908
Los Angeles, CA 90086

Gabrielino-Tongva Tribe
Bernie Acuna, Co-Chairperson
1999 Avenue of the Stars, Suite 1100
Los Angeles, CA 90067

Gabrielino-Tongva Tribe
Linda Candelaria, Co-Chairperson
1999 Avenue of the Stars, Suite 1100
Los Angeles, CA 90067

Native American Heritage Commission
Attn: Ms. Debbie Treadway
1556 Harbor Boulevard
West Sacramento, CA 95691

State of California
Governor's Office of Planning & Research
Attn: Scott Morgan
1400 10th Street, PO Box 3044
Sacramento, CA 95812-3044

State of California
Office of Historic Preservation
Attn: Ron Parsons
PO Box 942896
Sacramento, CA 94296-0001

State of California
Department of Fish and Wildlife Region 5
Habitat Conservation Program
Attn: Cindy Halley
3883 Ruffin Road
San Diego, CA 92132

California Highway Patrol
Attn: Ms. Suzann Ikeuchi
701 N. 7th Street
Sacramento, CA 95811

State of California
Housing & Community Development
2020 West El Camino Avenue
Sacramento, CA 95833

State of California
Housing & Community Development
Attn: CEQA Coordinator – Housing Policy Division
1800 Third Street, Room 430
Sacramento, CA 95814

State Water Resources Control Board
Division of Water Quality
Attention: Mr. Frank Roddy
PO Box 806 (1001 "I" Street)
Sacramento, CA 95812-4025

State of California
Department of Toxic Substances Control
Chief of Planning & Environmental Analysis
Attention: Ms. Kathie Schievelbein
PO Box 806 (1001 "I" Street) MS: 11A
Sacramento, CA 95812-0806

Caltrans - District 7
Attention: Ms. Dianna Watson
100 South Main Street
Los Angeles, CA 90012

Below are the Community Workshop Notices:

City of Lakewood
Hazard Mitigation Plan (HMP)
Community Workshop

Monday, May 9, 2016
5:00 p.m. to 6:00 p.m.
The Centre at Sycamore Plaza
Executive Board Room
5000 Clark Avenue
Lakewood, CA 90712

The City of Lakewood will host a community workshop so that residents, stakeholders, and other interested parties may provide input on the update of Lakewood's Hazard Mitigation Plan (HMP).

In 2000, Congress changed the Robert T. Stafford Act by passing the Disaster Mitigation Act of 2000 (DMA 2000). This law requires local, county, and state governments to prepare a HMP. The HMP is used to assess the natural hazards that pose a threat to the City of Lakewood and to determine the potential financial impact of such hazards. The HMP is also used to identify ways to minimize or even eliminate the damage caused by natural hazards.

At this meeting, attendees will learn what a HMP is and what it does. Attendees will also help identify those natural hazards to which Lakewood may be susceptible and the level of risk created by such hazards.

There is no cost to attend this workshop, and it is open to the public!

For further information call Paul Kuykendall at (562) 866-9771, extension 2344, or by e-mail at pkuykend@lakewoodcity.org.

City of Lakewood

Hazard Mitigation Plan (HMP)
Community Workshop

Tuesday, August 2, 2016
5:00 p.m. to 6:00 p.m.
The Centre at Sycamore Plaza
Executive Board Room
5000 Clark Avenue
Lakewood, CA 90712

The City of Lakewood will host a community workshop so that residents, stakeholders, and other interested parties may provide input on the update of Lakewood's Hazard Mitigation Plan (HMP).

In 2000, Congress changed the Robert T. Stafford Act by passing the Disaster Mitigation Act of 2000 (DMA 2000). This law requires local, county, and state governments to prepare a HMP. The HMP is used to assess the natural hazards that pose a threat to the City of Lakewood and to determine the potential financial impact of such hazards. The HMP is also used to identify ways to minimize or even eliminate the damage caused by natural hazards.

At this meeting, attendees will learn what a HMP is and what it does. Attendees will also help identify those natural hazards to which Lakewood may be susceptible and the level of risk created by such hazards.

There is no cost to attend this workshop, and it is open to the public!

For further information call Paul Kuykendall at (562) 866-9771, extension 2344, or by e-mail at pkuykend@lakewoodcity.org.

Below are the minutes from the Hazard Mitigation Plan meetings and community workshops:
Minutes of Tuesday, December 15, 2015

City of Lakewood
2016 Hazard Mitigation Plan Working Group Minutes
December 15, 2015, 4:00 PM – 5:00 PM
Pan Am Room, Lakewood City Hall

Staff Present
Administration – Paolo Beltran, Assistant to the City Manager, extension 2129
Community Development – Paul Kuykendall, AICP, Senior Planner, extension 2344
Public Works – Max Withrow, Assistant Director of Public Works, extension 2502
Recreation and Community Services – Nancy Hitt, Community Services Manager, extension 2404
Water Resources – Toyasha Sebbag, Water Administration Manager, extension 2702

Summary
Mr. Kuykendall started the meeting and gave a brief overview of the purpose of a hazard mitigation plan (HMP) and the HMP development process.

Mr. Kuykendall updated the working group on the progress of the 2016 HMP update. He noted that much of the work is already done because: 1) it is an update of an existing plan; 2) most of the HMP content came or will come from existing documents, such as the City's emergency response plan and the general plan; and 3) the City has contracted with Ken Goettel & Associates to assist in the HMP update.

Mr. Kuykendall noted that there are four main tasks that the City needs to do for the plan update:

1. Document the planning process: committee meetings, public meetings, postings on websites, e-mail notifications.

2. Review and update the mitigation goals, objectives and action items. The goals and objectives would generally remain unchanged from the last HMP. The action items will be updated to reflect current priorities.

3. Document with brief narratives any hazard events that have impacted the city since 2011.

4. Update the hazard data and maps where necessary.

Lastly, Mr. Kuykendall reviewed the HMP update schedule.

Minutes of Wednesday, March 9, 2016 4:00 PM

City of Lakewood
2016 Hazard Mitigation Plan Working Group Minutes
March 9, 2016
Via E-Mail, Lakewood City Hall

Summary
The second meeting of the 2016 Hazard Mitigation Plan Working Group scheduled for Wednesday, February 24, 2016 but had to be cancelled due to calendar conflicts. The focus of the meeting was to discuss the next steps for the 2016 Hazard Mitigation Plan update. In the interest of time, Paul Kuykendall sent an e-mail on March 9, 2016, indicating that the contents of the e-mail and subsequent responses would serve as the second meeting.

The e-mail was sent to Paolo Beltran, Michael Aguirre, Max Withrow, Nancy Hitt, and Toyasha Sebbag. The e-mail noted that FEMA requires a status report on the Action Items contained in the previous plan to identify whether each item was a) completed, b) partially completed, or c) not completed. Chapter 4 of the last Hazard Mitigation Plan was an attachment to the e-mail. The group was asked to review Chapter 4 and prepare a short statement on the status of each of the Action Items and respond back by Thursday March 17, 2016.

On March 14, 2016, Mr. Beltran noted that the Action Item "Supporting interagency communication improvements used by public safety during disasters or other emergencies" is part of an ongoing project. He also noted that the Action Items "Develop better understanding of the level of risk posed by dam failures, including warning times, flood depths, and velocities," "Evaluate and improve notification, evacuation and response planning for dam failures," and "Gather, publicize, and distribute windstorm preparedness and mitigation brochures from FEMA, CPUC, County of Los Angeles Department of Public Works and SCE" required further research. Two days later he noted that there is a lack of resources to implement the two dam failure action items. In response to Mr. Kuykendall's question windstorms and tree trimming, Mr. Beltran noted that Southern California Edison only trims trees if they encroach on the power lines. Otherwise if the tree is on private property the property owner is responsible for it. On public ROW the city or the city contractor trims the trees. If a property owner fails to trim their own trees it becomes a code enforcement issue and is handled through that process accordingly.

On March 17, 2016, Ms. Hitt noted that the Action Item "Identify and pursue funding opportunities to develop and implement local and City mitigation activities" is ongoing and that the city continues to look for funding opportunities for mitigation activities. The city utilizes a grant funded by Area E each year to provide funding for EOC upgrades. For the Action Item "Develop and/or maintain public and private sector partnerships to foster hazard mitigation activities," it is ongoing. The city is currently maintaining Memorandums of Understanding with the following companies: Costco, DS Waters (Sparkletts), Smart & Final, Home Depot, Merrimac Fuel, United Rental and Red Rover (an emergency animal rescue and sheltering group). The city is currently seeking MOU's with Diamond Environmental Services (porta-potties) and an additional rental company. For the Action Item "Continue to enhance public education activities, including an earthquake preparedness segment for Lakewood City TV Channel 21, add earthquake preparedness materials to Lakewood Online and distribute materials by mail at City Hall and the Library, and secure a booth at Lakewood's annual Pan American Festival," it is ongoing. The city is maintaining outreach efforts. An earthquake segment is part of the City TV Channel 21 lineup and is played periodically. Lakewood Online features a page dedicated to Disaster Preparedness and materials are also distributed periodically through Lakewood's e-magazine. Print materials are distributed in flyer racks at City Hall and the libraries, as well as during classes such as Survive for 7 and CERT (Community Emergency Response Team). The Resource Command Vehicle is on hand at several city

events, including the Pan American Fiesta, Civic Center Block Party and Patriot Day, where tours are given and disaster prep materials are available.

On March 15, 2016, Ms. Sebbag submitted the following table:

HAZARD	ACTION ITEM	COORDINATING DEPT	TIMELINE	UPDATE	NOTE
Long-term #1	Evaluate critical city water and wastewater infrastructure such as motor control cabinets & pumps to minimize flood losses	DWR & PW	~~5 years~~ Ongoing	Action Item is part of an on-going project.	Daily our water production crews evaluate critical water facilities and when necessary, annually budgets money to make necessary repairs.
Short-term #1	Enhance Lakewood's existing water conservation measures and programs	DWR	1-3 years	Complete	In May 2015 Lakewood revised our Emergency Water Conservation Ordinance to meet the state water conservation mandate. From July 2015 through December 2015, Lakewood conserved 26% surpassing our 20% conservation mandate.
Short-term #2	Continue existing water transfer agreements with neighboring water utilities	DWR	~~1-3 years~~ Ongoing	Action Item is part of an on-going project.	To date, Lakewood has connections with Long Beach, MWD, and Central Basin and is negotiating to bring another three online with neighboring water agencies.
Long-term #1	Evaluate options for increased use of recycled water	DWR	Ongoing	Ongoing	Lakewood continues to diversify our water resources by utilizing recycled water for outdoor irrigation. In 2015, Lakewood installed 3-recycled fire hydrants that connect to a water wagon. The water from this wagon is used to irrigate our medians that used to be irrigated with potable water.
Long-term #2	Continue to work with regional water agencies to improve conjunctive water management and urban runoff water management.	DWR	~~1-5 years~~ Ongoing	Ongoing	Lakewood is a supporter of the Water Replenishment Districts (WRD) Groundwater Reliability Improvement Program (GRIP). The WRD continues to pursue projects through its Water Independence Now (WIN) program that develop local, sustainable sources of water for use in groundwater replenishment.

Lastly, Mr. Kuykendall solicited the group to suggest new action items or changes to current action items as appropriate.

Minutes of Wednesday, July 27, 2016

City of Lakewood
2016 Hazard Mitigation Plan Working Group Minutes
July 27, 2016

Staff Present
Administration – Paolo Beltran, Assistant to the City Manager, extension 2129
Community Development – Paul Kuykendall, AICP, Senior Planner, extension 2344
Public Works – Max Withrow, Assistant Director of Public Works, extension 2502
Recreation and Community Services – Nancy Hitt, Community Services Manager, extension 2404
Water Resources – Toyasha Sebbag, Water Administration Manager, extension 2702

Summary
Mr. Kuykendall discussed the status of the HMP update and the reviews of the draft document that had been made so far. Mr. Kuykendall then highlighted the more significant changes to the HMP. In addition to annual data being updated, improved readability, and new maps and graphics, references to "buildings and infrastructure" were expanded to "buildings, facilities, bridges, and other infrastructure" in order to make it clear that the HMP pertains to all physical assets.

Changes to Action Items were then discussed. Under "Drought Mitigation Action Items," Short-Term Action Item #1 was reworded from "Enhance Lakewood's existing water conservation measures and programs" to "Continue to enhance Lakewood's existing water conservation measures and programs" to reflect efforts directed at the ongoing drought. Under "Drought Mitigation Action Items," the timeline for Long-Term Action Item #2, "Continue to work with regional water agencies to improve conjunctive water management and urban runoff water management" was changed from "1-5 years" to "ongoing." It was recommended that Earthquake Short-Term Action Item #1 and Long-Term Action Item #2 be combined into a Long-Term Action Item that reads: "Conduct seismic risk assessments for important City-owned buildings, bridges, water system and wastewater collection system to identify vulnerabilities, prioritize retrofits, and facilitate retrofitting or replacement of vulnerable structures."

Finally, Mr. Kuykendall noted that the final draft of the HMP should be ready in the first week of August and that the second community workshop would be Tuesday August 2, 2016 from 5:00 PM to 6:00 PM in the Executive Board Room. He also noted that the final draft would be presented to the City Council on Tuesday August 9, 2016 at 7:30 PM in the Council Chambers, and after approval, the HMP and the FEMA Plan Review Tool worksheet would be sent to OES for review and after that it is sent to FEMA.

City Council Resolution Approving Draft Hazard Mitigation Plan