Local Hazard Mitigation Plan

Public Review Draft

June 2020

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CHAPTER 1 – INTRODUCTION

PLAN PURPOSE AND AUTHORITY

Hazard events can lead to injuries or death, affect overall health and safety of a community, damage or destroy public and private property, harm ecosystems, and disrupt key services. Although the hazard event itself often gets the most attention, it is only one part of a larger emergency management cycle.

Emergency planners and responders can take steps during the response, recovery, mitigation, and preparedness phases of the cycle to minimize the harm caused by a disaster. This Local Hazard Mitigation Plan (LHMP) focuses on optimizing the mitigation phase of the cycle. Mitigation involves making a community more resilient to disasters so that when hazard events do ultimately occur, the community suffers less damage and is able to recover more effectively. It differs from preparedness, which involves advanced planning for how best to respond when a disaster occurs or is imminent. For example, a policy to make homes structurally stronger so they suffer less damage during an earthquake is a mitigation action, while fully equipping shelters to accommodate people who lose their homes in an earthquake is a preparedness action. Some activities may qualify as both.

The City of Irvine (City), like other communities, could potentially suffer severe harm from hazard events, and although large disasters may cause widespread devastation, even smaller disasters can have substantial effects. The City cannot make itself completely immune to hazard events, but this LHMP can help make the community a safer place to live, work, and visit. This LHMP provides a comprehensive assessment of the threats that the City faces from natural and human-caused hazard events and a coordinated strategy to reduce these threats. It identifies resources and information that can help community members, City staff, and local officials understand local threats and make informed decisions. The LHMP can also support increased coordination and collaboration between the City, other public agencies, local employers, service providers, community members, and other key stakeholders.

KEY TERMS

Hazard event: An emergency as a result of a natural or human-caused event that has the potential to cause harm.

Federal Authority

The City is not required to prepare an LHMP, but state and federal regulations encourage it. The federal Robert T. Stafford Disaster Relief and Emergency Act, amended by the Disaster Management Act of 2000, creates a federal framework for local hazard mitigation planning. It states that jurisdictions that wish to be eligible for federal hazard mitigation grant funding must prepare a hazard mitigation plan that meets a certain set of guidelines and submit this plan to the Federal Emergency Management Agency (FEMA) for review and approval. These guidelines are outlined in the Code of Federal Regulations, Title 44, Part 201, and discussed in greater detail in FEMA's Local Mitigation Plan Review Tool.

KEY TERMS

Mitigation: Actions that increase resilience and reduce the harmful effects of a hazard.

Resilient: Better able to avoid or lessen the harmful effects of a hazard.

State Authority

California Government Code Sections 8685.9 and 65302.6

California Government Code Section 8685.9 (also known as Assembly Bill 2140) limits the State of California's share of disaster relief funds paid out to local governments to 75 percent of the funds not paid for by federal disaster relief efforts, unless the jurisdiction has adopted a valid hazard mitigation plan consistent with the Disaster Management Act of 2000 and has incorporated the hazard mitigation plan into the jurisdiction's general plan. In these cases, the State may cover more than 75 percent of the remaining disaster relief costs.

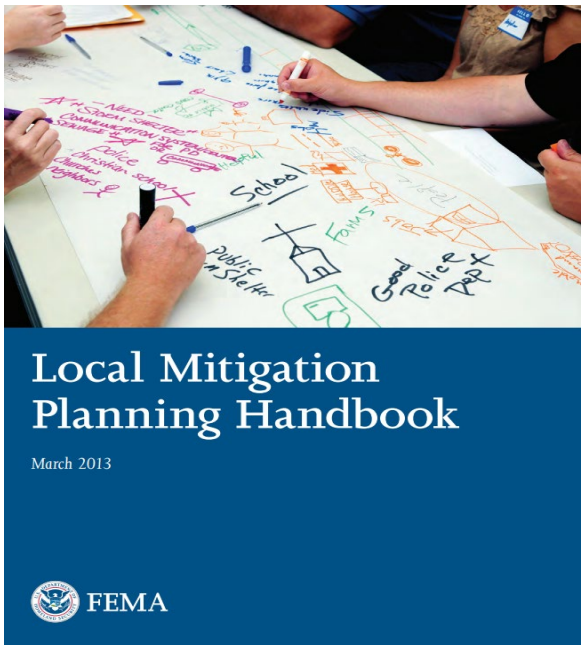
All cities and counties in California must prepare a general plan, which must include a safety element that addresses various hazard conditions and other public safety issues. The safety element may be a stand-alone chapter or incorporated into another section, as the community wishes. California Government Code Section 65302.6 indicates that a community may adopt an LHMP into its safety element if the LHMP meets applicable state requirements. This allows communities to use the LHMP to satisfy state requirements for safety elements. As the General Plan is an overarching long-term plan for community growth and development, incorporating the LHMP into it creates a stronger mechanism for implementing the LHMP.

California Government Code Section 65302 (g)(4)

California Government Code Section 65302 (g)(4), also known as Senate Bill (SB) 379, requires that the safety element of a community's general plan address the hazards created or exacerbated by climate change. The safety element must identify how climate change is expected to affect hazard conditions in the community and include measures to adapt and be more resilient to these anticipated changes.

Because the LHMP can be incorporated into the safety element, including these items in the LHMP can satisfy the state requirement. SB 379 requires that climate change must be addressed in the safety element when the LHMP is updated after January 1, 2017, for communities that already have an LHMP, or by January 1, 2022, for communities without an LHMP.

This LHMP is consistent with current standards and regulations, as outlined by the California Office of Emergency Services (Cal OES) and FEMA. It uses the best available science, and its mitigation actions/strategies reflect best practices and community values. It meets the requirements of current state and federal guidelines and makes the City eligible for all appropriate benefits under state and federal law and practices. Note that while FEMA is responsible for reviewing and certifying this LHMP, and Cal OES is responsible for conducting a preliminary review, it does not grant FEMA or Cal OES any increased role in the governance of the City or authorize either agency to take any specific action in the community.



FEMA's Local Mitigation Planning Handbook, last updated in 2013, is one of the key guidance documents for local communities in preparing hazard mitigation plans.

Plan Organization and Use

The Irvine LHMP is both a reference document and an action plan. It has information and resources to educate readers and decision makers about hazard events and related issues, and a comprehensive strategy that the City and community members can follow up to improve resilience in the City. It is divided into the following chapters:

- **Chapter 1: Introduction.** This chapter describes the background of the Plan, its goals and objectives, and the process used in its development.
- **Chapter 2: Community Profile.** This chapter discusses the history of Irvine, its physical setting and land uses, its demographics, and other important community characteristics.
- **Chapter 3: Hazard Assessment.** This chapter identifies and describes the hazards that pose a threat to Irvine and discusses past and future events as well as the effects of climate change.
- **Chapter 4: Vulnerability Assessment.** This chapter describes the threat of each hazard on Irvine's key facilities and community members, including socially vulnerable individuals.
- **Chapter 5: Mitigation Strategy.** This chapter lists the mitigation actions to reduce Irvine's vulnerability to hazard events, as well as provides an overview of the community's existing capabilities to improve hazard resilience.
- **Chapter 6: Plan Maintenance.** This chapter summarizes the process for implementing, monitoring, and updating the LHMP, as well as opportunities for continued public involvement.

Plan Goals

This Plan was developed to broadly increase resilience in Irvine. The following key goals were developed for the City's LHMP:

- Protect against threats from natural hazards to life, injury, and property damage for Irvine residents and visitors.

- Increase public awareness of potential hazard events.
- Preserve critical services and functions by protecting key facilities and infrastructure.
- Protect natural systems from current and future hazard conditions.
- Coordinate mitigation activities among City departments, neighboring jurisdictions, and with federal agencies, and
- Prepare for long-term change in hazard regimes.

PLANNING PROCESS

State and federal guidance for LHMPs do not require that jurisdictions follow a standardized planning process. FEMA encourages communities to create their own planning process that reflects local values, goals, and characteristics. FEMA does suggest a general planning process the follows these general milestones:

For the City of Irvine, the planning process used to create this plan is describe below:

Hazard Mitigation Planning Committee

The City established a Hazard Mitigation Planning Committee (hereafter referred to as the Committee). The Committee is made up of representatives from key City departments as well as stakeholder members that include representatives from local and regional agencies, and companies that are key to hazard mitigation activities. **Table 1-1** identifies the members that were invited and/or attended Committee meetings. Key stakeholders that attended these meetings included, Irvine Ranch Water District, Irvine Unified School District, and Orange County Fire Authority. Emergency managers from surrounding cities were also invited but did not attend these meetings.

Table 1-1: Irvine Hazard Mitigation Planning Committee

NAME	TITLE	DEPARTMENT
Alex Holt	Senior GIS Analyst	Administrative Services
Alex Salazar	CIP Administrator	Public Works
Alysia Jago	Program Assistant/PIO	City Manager
Andrew Kwon	Safety Specialist	Irvine Ranch Water District
Brian Brown	Senior Buyer	Administrative Services
Casey Gnadt	Public Works Supervisor	Public Works
Chris Koster	Great Park P&D Manager	Community Development
Christine Tully	Senior PSA/EM	Public Safety
Claudia Landeras	Principal Plan Check Engineer	Community Development
Craig Reem	Director, Public Affairs and Communications	City Manager
Daniel Yeh	Fire Captain	Orange County Fire Authority
Dave Klug	Lieutenant, Police Department	Public Safety
Dennis Chiotti	Superintendent, Landscape Maintenance	Public Works
Doug Kind	Manager	Public Works (Facilities)
Jack Brouwer	Professor	UC Irvine
Joe Dillman	Superintendent, Street Maintenance	Public Works
Joe Kirkpatrick	Chief Building Official	Community Development
Jordan Liu	Crime Prevention PSA	Public Safety
Justin Equina	Associate Planner	Community Development
Jaimee Bourgeois	Acting Director of Transportation	Transportation
Kerwin Lau	Planning Services Manager	Community Development
Kevin Bodrogi	GIS Intern	Administrative Services
Linda Fontes	Media Services Coordinator	Administrative Services
Linnea Castaneda	Senior PSA	Public Safety
Lisa Rudloff	Deputy Director, Community Services	Community Services
Lori Thompson	Risk Management Administrator	Administrative Services
Mark Linsenmayer	Director of Transportation	Transportation
Melissa Chao	Senior Planner	Community Development
Melissa Haley	Public Information Officer	City Manager
Mike Morgan	Superintendent (Facilities)	Public Works
Michael Sheeran	GIS Supervisor	Administrative Services
Michael Solorza	Manager, Financial Services	Administrative Services
Molly Mclaughlin	City Clerk	City Manager
Nathan Burke	GIS Intern	Administrative Services
Nick Rycroft	Public Safety Technology Analyst	Public Safety
Peter Hong	Senior Management Analyst	Public Safety
Ray Luna	Plans Examiner	Community Development (Building and Safety)
Robert Simmons	Emergency Management Administrator	Public Safety
Scott Tullius	Public Safety Assistant	Public Safety
Sean McGilura	Facilities Maintenance Supervisor	Public Works
Shane Sherwood	Division Chief	Orange County Fire Authority
Steve Sherwood	Acting City Engineer	Public Works
Shawnn Gallagher	Media Services Coordinator	City Manager
Stacy DeLong	Senior Project Manager	Project Management

Stephen Bayne	Director, Risk Management	Irvine Unified School District
Tom Perez	Project Management CIP Administrator	Public Works
Vu Tran	Senior Civil Engineer	Public Works

The Committee held four meetings throughout the plan development process to lay out the methods and approach for the Plan, draft and review content, make revisions, and engage members of the public.

- **Committee Meeting #1 (**September 26, 2019**):** The Committee members confirmed the project goals and the responsibilities of the Committee. They revised the community engagement and outreach strategy, confirmed and prioritized the hazards to be included in the Plan, and identified critical facilities for the threat assessment.
- **Committee Meeting #2 (**October 29, 2019**):** Members held a detailed discussion about the results of the hazards assessment and mapping that showed the areas facing an elevated risk. The Committee also reviewed the hazard prioritization results.
- **Committee Meeting #3 (**December 3, 2019**):** The Committee reviewed the results of the risk assessment to identify the populations and assets that may face greater harm in a hazard event. The Committee also discussed potential hazard mitigation actions to address vulnerabilities.
- **Committee Meeting #4 (**December 19, 2019**):** The Committee reviewed the draft mitigation measures, made revisions, and assigned priorities.

Invitation to Committee meetings, as well as agendas/materials, were provided via email. **Appendix A** contains copies of invitations, meeting agendas and sign in sheets, and other relevant materials distributed for these meetings.

Public Engagement

Under FEMA guidelines, local hazard mitigation planning processes should create opportunities for members of the public to be involved in plan development—at a minimum, during the initial drafting stage and during plan approval. The Committee chose to go beyond minimum standards and conduct more extensive community outreach to help ensure that the LHMP reflects community values, concerns, and priorities. The Committee developed a community engagement and outreach strategy to guide all public engagement activities. To ensure all residents were aware of the project, the City included a description of the project and ways to get involved in the City's newsletter "Inside Irvine", which is sent to 127,000 mailboxes throughout the City. **Appendix B** contains a copy of the strategy.

Public Meetings

In-person public meetings were a central component of the City's engagement efforts. These meetings provided an opportunity for members of the public to learn about wildfire hazards and the LHMP update. These meetings were in coordination with Orange County Fire Authority and the Irvine Police Department. At these meetings, members of the public could speak directly to City staff and other stakeholders and provide detailed feedback. The City held two public meetings, and notices of each meeting were widely distributed in advance in accordance with City notification requirements, the engagement strategy, legal requirements, and best practices.

- **Public Engagement Opportunity #1 (**October 17, 2019**)** was conducted at Los Olivos Community Center, with 18 people in attendance.
- **Public Engagement Opportunity #2 (**October 30, 2019**)** was conducted at Portola Springs Elementary School, with 55 people in attendance.

Appendix B includes a copy of the flyers used to promote these meetings.

Online Engagement

The City recognized that not all community members are able to attend public meetings and conducted public engagement through social media and online platforms. To assist with engagement the City set up a project website (https://www.cityofirvine.org/irvine-police-department/local-hazard-mitigation-plan) as a simple, one-stop location for community members to learn about the LHMP. The website included information about what an LHMP is and why the City prepared one. It had links to materials and plan documents as they became available and allowed members of the public to receive notifications about upcoming events.

The City also promoted the planning process through the following online methods:

- City Website
- Social Media (Facebook, NextDoor, Twitter)
- Two Community Preparedness Presentations conducted throughout the City
- Distribution of information to their extensive CERT Member List
- Coordination with the **Emergency Preparedness Interagency Collaborative**, which is a group of schools that that meets quarterly to collaborate on emergency preparedness topics.
- Article within the City's periodical newsletter (Inside Irvine) that discusses the LHMP planning process

Based on analytics tracked by the City, Facebook and Twitter posts reached an average of 2,500 accounts and 6,200 impressions, respectively.

A central part of the engagement strategy was an online survey. This survey asked community members about their experience and familiarity with emergency conditions, their level of preparedness for future emergencies, and preferred actions for the City to take to increase resiliency. The City distributed the survey in English, Mandarin, Spanish, Korean, Vietnamese, and Farsi. The survey had responses from 234 individuals, of which 223 were provided in English, five in Mandarin, and 6 in Farsi. A summary of these responses is summarized here:

- Nearly 64% of respondents live in the City of, with an additional 28% that live and work in the City.
- Over 86% of respondents have not been impacted by a disaster in their current residence.
- The top three hazards of concern for respondents were Seismic Hazards, Wildfire, and Human-Caused Hazards.
- Approximately 67% of respondents showed concern regarding climate change affecting future hazards.

Appendix B contains copies of all materials used for public outreach, including the full results of the community survey.

Public Review Draft

On June 16, 2020, the City released a draft copy of the LHMP for public review and comment. The document was posted electronically on the City's website. Unfortunately, during the COVID-19 pandemic incident, City buildings were closed, which prevented the City from allowing residents to review hard copies of the document in person. The City distributed notifications about the public review draft through social media accounts and other online sources.

Plan Revision and Adoption

Following public comment, the City revised the Plan and submitted it to Cal OES and FEMA. The City then made additional revisions to incorporate comments from state and federal agencies, as appropriate and submitted the final draft to City decision-makers. The Irvine City Council adopted the final LHMP on [DAY MONTH, 2020]. **Appendix C** contains a copy of the adoption resolution.

Plan Resources

The City used several different plans, studies, technical reports, datasets, and other resources to prepare the hazard assessment, mapping, threat assessment, and other components of this Plan. **Table 1-2** provides some of the primary resources the Committee used to prepare this Plan.

Table 1-2: Key Resources for Plan Development

Section	Key Resources	Example Uses
Multiple	• Cal-Adapt • California Department of Conservation • California Geological Survey • California Office of Emergency Services • California State Hazard Mitigation Plan • City of Irvine General Plan • FEMA Local Hazard Mitigation Plan Guidance • National Oceanic and Atmospheric Administration • National Weather Service • US Geological Survey • US Census Bureau 2013-2017 American Community Survey	• Science and background information on different hazard conditions. • Records of past disaster events in and around Irvine. • Current and anticipated climate conditions in and around Irvine. • Projections of future seismic conditions and events.
Community Profile	• US Census Bureau 2013-2017 American Community Survey • City of Irvine General Plan Background Reports • California Energy Commission	• Demographic information for Irvine and Orange County. • History of the region. • Economic trends in Irvine. • Commute patterns in Irvine. • Local land use patterns. • Background information on utilities serving Irvine.
Hazard Assessment (Aircraft Incidents)	• Federal Aviation Administration	• Data on aircraft incidents in and around Irvine
Hazard Assessment (Dam Failure)	• Irvine Ranch Water District • Orange County Water District • US Army Corps of Engineers	• Mapping of dam failure inundation areas. • Profiles and conditions of dams in and around Irvine.

Hazard Assessment (Disease and Pest Hazards)	• California Department of Public Health • Centers for Disease Control • World Health Organization	• Science and historical records of disease outbreaks.
Hazard Assessment (Drought)	• Cal Adapt • US Drought Monitor	• Historic drought information • Current drought conditions
Hazard Assessment (Flood Hazards)	• FEMA Map Service Center • Orange County Flood Control District	• Records of past flood events in and around Irvine. • Locations of flood-prone areas in Irvine.
Hazard Assessment (Human-Caused Hazards)	• Global Terrorism Database	• Historical records of terrorism
Hazard Assessment (Hazardous Materials Release Hazards)	• Agency for Toxic Substances and Disease Registry	• Location and dates of past hazardous materials release. • Effects of hazardous materials release.
Hazard Assessment (Seismic Hazards)	• Southern California Earthquake Data Center • The Third California Earthquake Rupture Forecast (UCERF3)	• Locations of fault zones. • Records of past earthquakes.
Hazard Assessment (Severe Weather Hazards)	• California Department of Water Resources • US Drought Monitor • Western Regional Climate Center	• Science and background information of extreme weather events. • Historical record of extreme weather events in and around Irvine.
Hazard Assessment (Wildfire Hazards)	• California Department of Forestry and Fire Prevention • Fire and Resource Assessment Program	• Records of past fire events. • Location of fire hazard zones in and around Irvine.
Note: Sections that are not individually called out in this table relied primarily on sources identified in multiple sections.		

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CHAPTER 2 - COMMUNITY PROFILE

The Community Profile section of the LHMP is a summary of Irvine, including information about the community's physical setting, history, economy and demographics, current and future land uses, and key infrastructure. The Community Profile helps to establish the baseline conditions in Irvine, which inform the development of the hazard mitigation actions in **Chapter 5.**

SETTING AND LOCATION

The City of Irvine is located in southern Orange County, adjacent to the cities of Newport Beach, Lake Forest, Tustin, Santa Ana, Laguna Hills, Laguna Woods, and Laguna Beach. Situated at the foothills of the Santa Ana Mountains to the east, the San Joaquin Hills to the west and south, and the low-lying flatlands of central Orange County to the north, the City has a diverse geographic setting. Located approximately five miles south of the City of Santa Ana (Orange County Seat), the City is in a key job center for both Orange County and southern California.[1]

HISTORY

Southern California and the land that Irvine is situated upon has been inhabited by humans for thousands of years, though sources differ on the earliest presence of humans. Most archaeological evidence establishes prehistoric man in the Irvine area at least 12,000 years ago, possibly even 18,000 years ago. Gabrielino Indians moved into the Irvine area 2,000 years ago, establishing dozens of villages. One village was located near the present San Joaquin marsh and another near the San Joaquin golf course.

Gaspar de Portola, a Spanish explorer, entered the San Joaquin Valley in 1769, abruptly ending the tranquil life of the Gabrielinos. With the Spanish came forts, missions and herds of cattle. The King of Spain began to parcel out lands for missions and for a few large, private land grants. In 1831, after gaining independence from Spain, the Mexican government secularized the missions, assumed control of land holdings and began distributing ranchos to Mexican citizens who applied for grants.

In 1837, San Juan Capistrano mission lands were granted to Don Jose Sepulveda, later becoming Rancho San Joaquin. Rancho Lomas de Santiago was granted to Teodosio Yorba in 1846. In that year, the Mexican army was defeated in the final battle of the Mexican American War. The Treaty of Guadalupe was signed, and California was annexed to the United States.

During the mid-1800s when landholders were forced to reapply to gain valid titles for their ranchos, Rancho de Santa Ana ran into troubles but was eventually divided among sheep rancher claimants, which included James Irvine. By 1878, Irvine eventually acquired his partners' interests stretching his 110,000-acre ranch 23 miles from the Pacific Ocean to the Santa Ana River. In 1886, James Irvine died leaving the ranch in flux, until 1893 when his son, James Irvine, Jr., came into full possession of the ranch. A year later this ranch was incorporated into The Irvine Company. After that, James Irvine, Jr. began shifting ranch operations to field crops, olive and citrus orchards.

During World War I, agriculture had intensified, and by 1918, some 60,000 acres of lima beans were grown on the Irvine Ranch. During World War II, two Marine Corps air facilities were built on land sold to the

government by The Irvine Company. James Irvine, Jr. died in 1947 at the age of 80. Presidency of the company fell to his son Myford, who began opening small sections of the ranch to urban development, until his death in 1959.

In 1959, the University of California asked The Irvine Company for 1,000 acres for a new campus. The Irvine Company agreed, and the State accepted the land and purchased an additional 500 acres. The University's consulting architect, William Pereira, and Irvine Company planners drew up master plans for a city of 50,000 people surrounding the university. The area would include industrial zones, residential and recreational areas, commercial centers and greenbelts. The Irvine Industrial Complex West (now known as The Irvine Business Complex) opened and the villages of Turtle Rock, University Park, Culverdale, the Ranch and Walnut were completed by 1970.

An aerial view of UCI in 1967, being transformed from the Irvine Ranch. Photo courtesy of KCET. https://www.kcet.org/shows/lost-la/terraforming-the-irvine-ranch-and-the-construction-of-uc-irvine

On December 28, 1971, the residents of these communities voted to incorporate a substantially larger city than that envisioned by the original Pereira plan in order to control the future of the area and protect its tax base.

In May 2015, the City of Irvine had a population of more than 250,000, making it one of the 80 most populous cities in America. Its total area has grown to 66 square miles. By 2035, the City is expected to have approximately 318,000 residents.[2]

The City of Irvine has continually been recognized as The Safest City in America for a city of its size. https://legacy.cityofirvine.org/civica/filebank/blobdload.asp?BlobID=27043

DEMOGRAPHICS

The data used in this section comes from the most comprehensive American Community Survey (ACS), administered by the United States Census Bureau (US Census) completed in 2017. Based on this dataset, Irvine's 2017 population was estimated to be 256,877, with a median age of 34, which is 3 years younger than Orange County. Comparatively, the number of senior residents aged 65 and older is less than the rest of Orange County, while Irvine residents are wealthier. In addition, a high proportion of Irvine residents rent compared to Orange County. **Table 2-1** shows the basic demographics for Irvine and Orange County. It should be noted that more recent population estimates place the City's population at approximately 282,572 residents, which is an increase of over 33.3% from the last census in 2010, suggesting the City has experienced significant population growth in the last decade.[3]

TABLE 2-1: BASIC DEMOGRAPHICS, IRVINE AND ORANGE COUNTY (2017)[4]

DEMOGRAPHICS	IRVINE	ORANGE COUNTY
Total population	256,877	3,155,816
Percent of residents that are children (less than 10 years)	12.30%	12.1%
Percent of residents that are senior citizens (65+ years)	9.9%	13.5%
Median age	34.4	37.5
Total households	92,869	1,024,976
Median household income	$95,573	$81,851
Percent of rental households	51.80%	42.6%

Note: Percentage values are rounded to the nearest tenth decimal.

In terms of its racial and ethnic composition, Irvine is a white-majority city with 47.7% percent of all Irvine residents identifying as white. The second largest population is Asian with 41.8% percent of all residents identifying as such. This population makeup contrasts greater Orange County, due to a high proportion of White and Latino populations. **Table 2-2** shows the racial and ethnic composition for all groups in Irvine and Orange County.

TABLE 2-2: RACIAL AND ETHNIC COMPOSITION, IRVINE AND ORANGE COUNTY (2017)[5]

RACE OR ETHNICITY	IRVINE		ORANGE COUNTY	
	POPULATION	PERCENTAGE	POPULATION	PERCENTAGE
White	122,639	47.0%	1,960,484	62.1%
Black or African American	5075	2.0%	53,262	2.4%
American Indian and Alaska Native	332	0.10%	14,468	1.1%
Asian	107,297	41.8%	621,178	21.9%
Native Hawaiian and Other Pacific Islander	463	0.20%	9,620	0.7%
Another race	7,384	2.90%	373,605	12.7%
Two or more races	13,687	5.30%	123,199	3.9%
Latino/Latina (of any race) *	25,025	9.70%	1,079,172	34.2%
Total	**256,877**	**100%**	**3,155,816**	**100%**

* The US Census Bureau does not currently count persons who identify as Latino/Latina as a separate racial or ethnic category. Persons who identify as Hispanic or Latino are already included in the other racial or ethnic categories

Note: Percentage values are rounded to the nearest tenth decimal.

Irvine residents have attained higher education levels in comparison to Orange County. For example, a larger proportion of the population have attained bachelor's and professional degrees, roughly 67.5% of the City's residents versus 39.10% of the County's residents. Other categories also differ, such as a much lower percentage of people not having education past 9th grade and a lower percentage of people not having graduated high school. **Table 2-3** shows all levels of educational attainment of residents 25 years of age or older in both Irvine and Orange County.

Table 2-3: Educational Attainment of Residents 25+ Years of Age in Irvine and Orange County (2017)[6]

EDUCATIONAL ATTAINMENT	IRVINE		ORANGE COUNTY, CA	
	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
Less than 9th grade	3,478	2.10%	181,950	8.5%
9th grade to 12th grade (no diploma)	3,117	1.90%	144,085	6.8%
High school graduate or equivalent	13,746	8.30%	369,128	17.3%
Some college (no degree)	22,472	13.5%	437,417	20.5%
Associate degree	11,181	6.70%	166,462	7.8%
Bachelor's degree	63,193	38.10%	537,600	25.2%
Graduate or professional degree	48,877	29.40%	295,516	13.9%
Total	11,329	100.0%	2,132,158	100%

Note: Percentage values are rounded to the nearest tenth decimal.

Irvine has a wide range of different non-English languages that are spoken at home among its residents, with varying levels of proficiency. Generally, Asian and Pacific Islander languages are the second most-spoken languages in Irvine with a bit more than 41% who are not fluent in English, which is 10% less than the level of English fluency among the Countywide population of Asian and Pacific Islander language speakers. Indo-European languages are the third most-spoken languages in Irvine with a quarter of these speakers unable to fluently speak English. This is like the rest of Orange County, where majority of Indo-European language speakers can speak English fluently. **Table 2-4** shows the most spoken languages in Irvine and the levels of fluency among speakers age 5 and older in Irvine and Orange County.

Table 2-4: English Proficiency and Languages Spoken at Home Among Residents 5 Years or Older in Irvine and Orange County (2015)[7]

EDUCATIONAL ATTAINMENT	IRVINE		ORANGE COUNTY, CA	
	NUMBER OF SPEAKERS	PERCENTAGE NOT FLUENT IN ENGLISH	NUMBER OF SPEAKERS	PERCENTAGE NOT FLUENT IN ENGLISH
English only	122,519	-	1,615,355	-
Spanish	14,257	18.90%	766,744	42.90%
Indo-European*	27,850	25.60%	121,533	26.90%
Asian and Pacific Islander*	67,916	41.20%	430,720	51%
All other languages	8,581	33.70%	32,492	33.30%
Total	241,123	100.0%	2,966,864	100%

Note: Percentage values are rounded to the nearest tenth decimal.

* Census data does not break down the specific languages for these regions

ECONOMY AND COMMUTE PATTERNS

The University of California Irvine is the largest employer in Irvine.

Irvine has a diverse economy of employers from a variety of sectors including pharmaceutical, biotechnology, medical equipment and devices, computer hardware and software, semiconductors, financial services, automotive design, communications and education. With a total employment base of 235,100, the top employer in the City is the University of California Irvine, which employs nearly 20,000 people. The second largest employer is the Irvine Unified School District, with more than 4,700 employees. The next top three employers are Blizzard Entertainment INC., a video game developer; Broadcom, a designer, developer, manufacturer and global supplier of semiconductor and infrastructure software products; and Edwards Lifescience Corp., a medical technology company. **Table 2-5** shows the top five employers in Irvine in 2018.

Table 2-5: Top Employers in Irvine (2018)[8]

EMPLOYER	NUMBER OF EMPLOYEES	PERCENTAGE OF TOTAL EMPLOYMENT
University of California Irvine	19,625	8.3%
Irvine Unified School District	4,709	2.0%
Blizzard Entertainment Inc.	2,622	1.1%
Broadcom Corp.	2,604	1.1%
Edwards Lifescience Corp.	2,575	1.1%

Note: Percentage values are rounded to the nearest tenth decimal.

As of 2017, over 93,000 Irvine residents are employed, with approximately 26,272 (28%) of them working within the City. This local workforce accounts for 9.7% of the entire workforce, with the remaining workforce coming from surrounding cities throughout the region. **Table 2-6** shows the top five cities that contribute to Irvine's workforce, which accounts for over 25% of those employed within the City.

Table 2-6: Top Five Cities-of-origin for Irvine's Workforce (2010)[9]

CITIES-OF-ORIGIN FOR IRVINE'S WORKFORCE	NUMBER	PERCENTAGE
Irvine	26,272	9.7%
Santa Ana	15,313	5.7%
Anaheim	11,899	4.4%
Los Angeles (City)	10,951	4.1%
Huntington Beach	8,177	3.0%
Total	**72,612**	**26.9%**

Note: Percentage values are rounded to the nearest tenth decimal.

While the majority of Irvine's residents commute outside the city for work, most of those residents (55.7%) travel less than 10 miles to reach their place of employment. Approximately 10% of commuters traveled 50 miles or more, with most of those trips heading into the Los Angeles or San Diego areas. The

city boasts convenient freeway, rail and air access to Los Angeles, San Diego, Riverside, and San Bernardino Counties. **Table 2-7** shows the outflow of workers from Irvine to other work sites in the region.

Table 2-7: Work Commute distances for Irvine Residents (2017)[10]

Work Destinations for Irvine Residents	Number	Percentage
Less than 10 miles	52,058	55.7%
10 to 24 miles	16,839	18.0%
25 to 50 miles	14,429	15.4%
Greater than 50 miles	10,176	10.9%
Total	**93,502**	**100.0%**

Note: Percentage values are rounded to the nearest tenth decimal.

DEVELOPMENT TRENDS

Irvine is located within a dense part of southern Orange County that has experienced significant growth and development over the past 30 years. The population of the City has grown by approximately 70,000 residents in the past 10 years. According to the California Department of Finance, the City's 2019 population estimate is approximately 282,000 residents. With land still available and numerous active developments ongoing within the City, population growth is expected to continue throughout the City. **Table 2-8** identifies development activity categorized as follows:

- **Anticipated Development** – development that is anticipated within the general plan, however, no development application has been submitted for review.
- **Development Under Review** – development application that is currently being reviewed by the City. .
- **Approved Development** – development that has been approved by the City and awaiting construction, or residential development that is part of an approved master plan and currently being processed.
- **Development Under Construction** – approved development with issued building permits that is undergoing the construction process.

Based on this information, the City is planning to accommodate nearly 20,000 additional residential units, with nearly 8,000 units currently under construction. In addition, the City is expected to accommodate nearly 8.7 million square feet of new non-residential use and nearly 1,000 new hotel rooms, a majority of which are still in the planning stages. To better determine future development potential the City is currently in the process of updating the General Plan (**Figure 2-1**), which will include updated buildout projections. It is anticipated that during this process the City will identify future development opportunities throughout the City and its Sphere of Influence.

Figure 2-1: Irvine General Plan Land Use Map

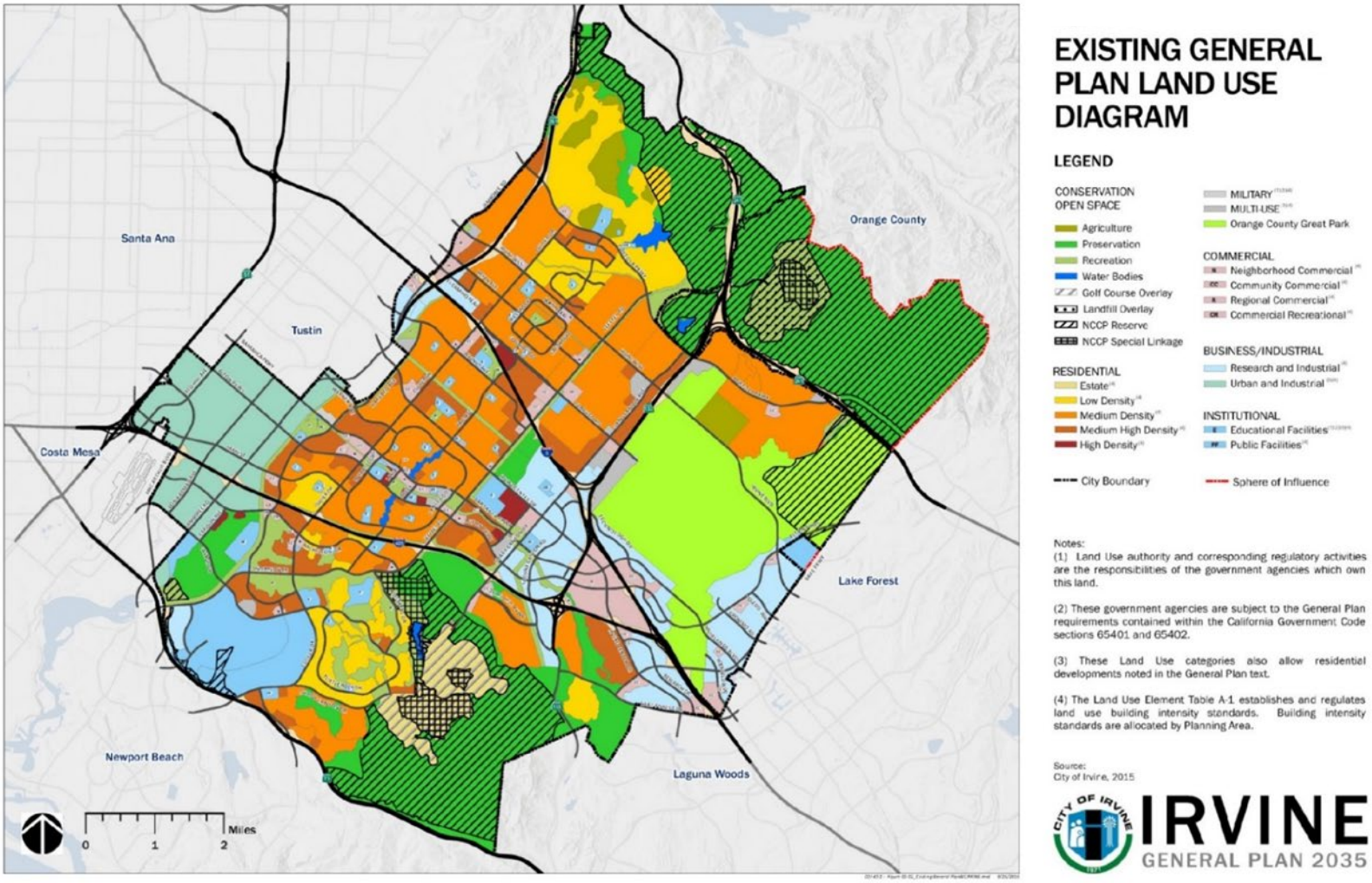

TABLE 2-8: CITY OF IRVINE DEVELOPMENT ACTIVITY

Land Uses	Anticipated Development	Development Under Review	Approved Development	Development Under Construction	Total
Residential	5,598	2,512	3,609	7,863	19,582
Commercial Office Industrial	3,920,000	1,364,600	2,434,000	1,064,000	8,782,600
Hotel	0	0	776	208	984

Source: City of Irvine Notable Development Projects Map, 2020

MAJOR COMMUNITY ELEMENTS

Residential Uses

With a population of approximately 280,000 residents, the City has a diverse residential base. Many existing homes are in master planned communities that have been constructed as far back as the 1970s. Most of the new construction occurring in the City meets the latest standards and requirements, however there are still many neighborhoods like Turtle Rock and Shady Canyon that have older homes or limited transportation routes that increase the risk of hazards like wildfire. Homes in older neighborhoods may require retrofit improvements to reduce some of the risks to the structures, while the City will have to take a more active role in identifying solutions to circulation constraints. In addition, neighborhoods located along stream courses susceptible to flooding (i.e. San Diego Creek) as also areas of concern for the City.

Institutional Uses

Education is a major component of the City's identity. Three major educational institutions are located within the City (UC Irvine, Irvine Valley College, and Concordia University). Combined enrollment for these schools is over 41,000 students, which can greatly increase the City's daytime population, impact roadways, and community services.

Irvine Spectrum

The Irvine Spectrum is one of the City of Irvine's two major business centers. It is comprised of 5,000 acres, 38 million square feet of commercial space, and 3,500 companies that employ nearly 80,000 people. The City's major retail center, the Irvine Spectrum Center, is comprised of 1.2 million square feet and more than 130 stores, restaurants and entertainment venues.[11] This location is major attraction in the City due to its convenient location between I-5 and I-405 and draws a significant amount of visitors and employees from outside the City.

Irvine Business Complex

The Irvine Business Complex is a 2,800-acre area in the western part of the City containing industrial, commercial office, and residential uses. The zoning in this part of the City allows for over 15,000 base residential units, non-residential uses (commercial, office, industrial), and hospitality uses. This area of the City is a major economic hub as a significant of amount of people enter the City every day to work in the businesses within this complex.

Open Space

In addition to the significant development that has occurred within the City, Irvine has taken great steps towards open space preservation and enhancement. Since 1988 the City has preserved over 93,000 acres known as the "Irvine Open Space Preserve" linking the Cleveland National Forest, San Joaquin Marsh, Laguna Coast Wilderness Park, and other resources.[12] The City has actively worked to preserve and manage open space lands and parklands and routinely monitors the health of City trees. The City is

currently updating their tree inventory to better manage these City assets, which are valued at approximately $181 million. Given the nature of the hazards that affect trees within the City and the quality of life benefits that trees provide within the City, active management of this resource is a primary function of the City's Public Works Department.

INFRASTRUCTURE ASSESSMENT

Infrastructure plays a vital role in mitigating the effects of hazard events. When infrastructure fails, it can exacerbate the extent of certain hazards or create complications for rescue workers trying to reach victims. For example, fallen utility poles, as a result of strong winds or seismic activity, can obstruct roadways and prevent emergency vehicles from reaching affected areas. The following are electrical, fossil fuel, hydrologic, and transportation networks of infrastructure in Irvine.

Electricity

Irvine receives its electrical supply from Southern California Edison (SCE). There are seven substations located within the City connecting 220kV and 66 kV powerlines that run both east to west and north to south. These lines bring power to Irvine and the surrounding cities and provide connection to other regional power sources as well.[13] These connections help Irvine access auxiliary electricity sources, should any of its immediate infrastructure fail. However, a larger and more regional failure of the power grid would likely disrupt power transmission to Irvine for an extended time period until power can be restored.

Cabrillo Substation Power Outage

On August 2, 2019 an electrical fire at Southern California Edison (SCE)'s Cabrillo Substation caused a power outage of approximately 28,000 customers including parts of UC Irvine. This event shutdown operations at John Wayne Airport as well as affected 50 City intersections that were either flashing red or completely de-energized. Electricity was completely restored to all Irvine customers by early morning on August 4th.[14]

In response to this incident, the City partially activated the Emergency Operations Center, opened and staffed a care and reception center for residents, a cooling center, sent mass notifications, conducted welfare checks on critical care customers and coordinate traffic management and control at intersections without power (active or back up).

Of the many lessons learned from this incident, the City recognized that residents within the City affected by a power outage may require assistance because they are critical care customers and rely on electricity for medical reasons or they may have limited mobility, which can impact their ability to re-locate to a cooling center.

Since this event the City has actively taken the following steps to address some of the vulnerabilities identified by this incident:

- Applied for a grant to purchase several new emergency generators to power various senior/community centers in the City.

- In the process of installing new emergency power hook-ups at storm/ground water pump stations to allow them to operate during an outage
- Procured 3 additional generators for use as backup power for traffic signals
- Planning to procure three more generators to expand back up power capabilities for traffic signals
- Constructed a field supply cabinet and provided the City's maintenance contractor 24/7 access to additional backup generators, power cables, supplies and fuel
- Tested every Battery Backup System (BBS) in the city
- Procured & Installed 300+ BBS batteries (this project is ~80% complete)
- Designed generator plugs to accommodate quick deployment of generators at traffic signals (this new plug design was deployed at 2 intersections to test)

As a result of this event, the City has identified a need to better prepare for future power failure incidents. This coupled with SCEs Public Safety Power Shutoff program, indicates that energy resilience will become a primary focus for City investment in the foreseeable future.

Public Safety Power Shutoff

The State's investor-owned utilities have general authority to shut off electric power to protect public safety under California law. Utilities exercise this authority during severe wildfire threat conditions as a preventative measure of last resort through Public Safety Power Shut-offs (PSPS).[15]

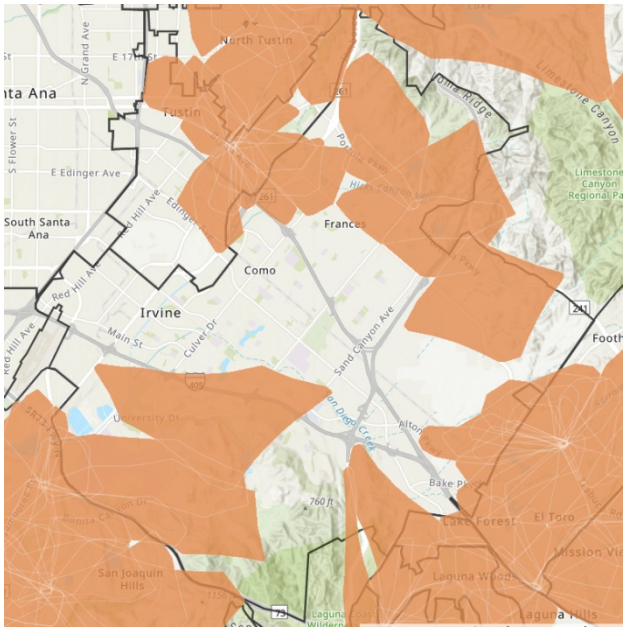

Figure 2-2: SCE Public Safety Power Shutoff Circuits surrounding the City

In 2019, the City began preparation for PSPS events by understanding the potential circuits that could be impacted (**Figure 2-2**) and the City needs and special populations that may be affected by these events. These incidents typically occur during high fire threat conditions (i.e. dry conditions and strong winds) and may affect communities located far away from any fires that are actively occurring. With several SCE circuits in the City that could be affected by future PSPS events residents and businesses are sure to feel the impacts of these events if they do not have alternative options for electricity at their homes and places of business.

These events are anticipated to affect City resources as well, since many of the City's facilities rely on electricity to function. As a result, the City has prioritized back up power generation at City facilities in these affected areas to ensure residents have a safe place to stay during these events.

Fossil Fuel

Petroleum-based infrastructure is prolific throughout southern California. The region's history of oil extraction has led to the development of large refineries and storage sites. The nearest refineries to Irvine are located 21 miles away in the South Bay region of adjacent Los Angeles County. There are six large refineries all located within 2.5 miles of each other, which include:

- Phillips 66, Carson
- Phillips 66, Wilmington
- Tesoro
- Tesoro - Carson
- Valero, Wilmington Asphalt[16]

These refineries are some of the most productive in California, having refined, by some estimates, nearly 1.2 trillion barrels of oil since production in the area began in 1932. [17] Within the City Kinder Morgan owns a petroleum pipeline that connects the greater LA Basin to the San Diego region.

Natural gas production also occurs in the Southern California region and multiple pipelines are in and around the City. Natural gas is provided to Irvine and surrounding jurisdictions by the Southern California Gas Company (SoCalGas). There is one transmission line that bisects the City north to south, and two other lines in the northwest portion of the City. If any of these lines are damaged, it could potentially interrupt the flow and delivery of natural gas to the City. Additionally, natural gas ignites very easily and any rupture in a transmission line could damage properties in the vicinity of the leak and cause fires from the escaped natural gas. The presence of this infrastructure creates unique challenges for the City from an emergency management perspective. Inclusion of hazards associated with damage to this infrastructure is an important element of effective response to future incidents involving natural gas use and transmission.

Water and Wastewater

Water in Irvine is provided by the Irvine Ranch Water District (IRWD). Sixty-five percent of Irvine's overall water supply comes from IRWD's local groundwater wells located west of the 55 Freeway. These wells extract high quality water from the Orange County Groundwater Basin managed by the Orange County Water District (OCWD). Approximately 35 percent of Irvine's drinking water is purchased from the Metropolitan Water District of Southern California (MWD). This imported water comes from the Colorado River via the Colorado River Aqueduct and from Northern California via the State Water Project.[18]

In addition to developing its local groundwater and recycled water systems, IRWD has diversified its water supply reliability by developing water banking projects in Kern County, California. IRWD has constructed a fully operational water banking program that makes it possible for IRWD and its banking partners to store excess water during "wet" hydrologic periods. The stored water is then available for use during "dry"

periods to offset reduced water supplies under periods of severe drought or during periods of supply interruptions.[19]

The Orange County Sanitation District treats Irvine's wastewater. Image from IMEG.

Wastewater in Irvine travels through IRWD's collection system to the Michelson Water Reclamation Plant, where it is treated through the reclamation process for use in landscaping, agricultural irrigation, and other non-potable water uses. However, one part of the City, the Irvine Business Complex, is not within the IRWD collection system. The IBC is in the Orange County Sanitation District (OCSD), tributary zone No. 7, and wastewater generated in the IBC flows to OCSD treatment facilities.[20]

Transportation

Much of the transportation infrastructure in Irvine consists of roadways for automobiles, but there are many modes of travel into and out of the City. In total, there are freeways, buses/shuttles, local commuter trains and longer distance trains. For non-motorized travel the City has an extensive network of pedestrian trails and bicycle paths.

The entryway to the Irvine Station: Catch the Amtrak, Metrolink or OCTA. Photo courtesy of Griffin Structures.

There are 2 Interstates (I), I-5 and I-405 and 5 State Routes (SR): SR 55, SR 73, SR 133, SR 241 and SR 261 that connect Irvine to the greater southern California region. Of these SR transportation facilities, SR55 is the only one that does not charge tolls. All interchanges from these freeways connect to major thoroughfares within the City. **Table 2-9** identifies the freeways that connect to the City of Irvine and the connections to the City's local transportation network.[21]

Table 2-9: City of Irvine Transportation Infrastructure

Freeways in Irvine	Direction	Exits Serving the City of Irvine
I-5	North | South	Jamboree Road, SR 261 interchange,
I-405	North | South	Culver Drive, Jeffrey Road, Shady Canyon Drive, SR 133 interchange, Irvine Center Drive, I-5 interchange (NB|SB)
SR 55	North | South	MacArthur Boulevard
SR 73 (Toll Road)	Northwest| Southeast	Jamboree Road, MacArthur Boulevard/University Drive, Bison Avenue, Bonita Canyon Drive, Newport Coast Drive
SR 133 (Toll Road)	North | South	Irvine Boulevard, I-5 interchange (NB|SB), Barranca Parkway, I-405 interchange (NB|SB), Laguna Canyon Road/Pavona Street, Lake Forest Drive
SR 241 (Toll Road)	Northwest| Southeast	Portola Parkway west, SR 133 interchange
SR 261 (Toll Road)	Northwest| Southeast	Jamboree Road south, Walnut Avenue, Jamboree Road north to I-5, Irvine Boulevard, Portola Parkway

Public transportation options within Irvine are provided by two public transit agencies which operate local bus service. The Orange County Transportation Authority (OCTA) provides 11 routes servicing local Irvine neighborhoods, neighboring cities in Orange County, and one express route that connects to Corona and Riverside in Riverside County. *i*Shuttle is a local service in and around Irvine that connects the Irvine Business Complex to John Wayne International Airport (SNA), as well as providing service around the Irvine Spectrum area.[22]

The Metrolink provides two stops in and around Irvine (Irvine Station and Tustin Station), both of which service the major employment centers of Irvine (Irvine Business Complex and Irvine Spectrum). The Orange County and Inland-Empire-Orange County Lines both run through these stations. These local commuter trains run 7 days a week, with greater frequency during Monday-Friday rush hour. The Orange County line extends from Union Station Terminal in Downtown Los Angeles in Los Angeles County to Oceanside in San Diego County. The Inland Empire Orange County line runs from the City of San Bernardino in San Bernardino County to the City of Oceanside, as well. Travelers can also get access to the COASTER trains, which connect longer commuters through and to the cities of San Diego, other areas of Orange, Los Angeles, Ventura, Santa Barbara and San Luis Obispo counties. Amtrak, a train service that services the entire country, also operates out of the Irvine Station.[23]

While John Wayne International Airport is not located inside the City limits, it does border the City, tucked between SR 55, SR 73 and I-405, on the west edge of the City. John Wayne plays a unique and crucial role in the Orange County community as it is the only airport that provides commercial passenger and air-cargo service and is the primary provider of general aviation services and facilities in the county. It is home to local law enforcement air operations and to medical/mercy flights.[24]

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CHAPTER 3 - RISK ASSESSMENT

This chapter discusses the types of hazards that might reasonably occur in Irvine. It describes these hazards and how they are measured, where in Irvine they may occur, a history of these hazards in and around Irvine, and the future risk they pose. The discussion of future risks includes any changes to the frequency, intensity, and/or location of these hazards as a result of climate change. This chapter also discusses how the Hazard Mitigation Planning Committee (HMPC) selected and prioritized the hazards in this Plan.

HAZARD IDENTIFICATION

FEMA guidance identifies several hazards that communities should evaluate for inclusion in a hazard mitigation plan. Communities may also consider additional hazards for their plans. The HMPC reviewed an extensive list of hazards and excluded the ones that do not pose a threat to Irvine. **Table 3-1** lists the hazards considered and explains the reasoning for inclusion/exclusion. For context, this table also shows if a hazard is recommended for consideration by FEMA, if it is included in the 2018 California State Hazard Mitigation Plan (SHMP), and if it is included in the Orange County Hazard Mitigation Plan (OC HMP).

Table 3-1: Hazard Evaluation for Irvine LHMP

Hazard	Recommended for Consideration	Included in LHMP?	Reason for Inclusion or Exclusion
Agricultural Pests	SHMP	Yes	Irvine has agricultural uses within the City that contribute to the economy. Since agricultural resources are present, the City identified pest as a hazard of concern.
Air Pollution	SHMP	No	Air pollution is a state and regional issue that is addressed through plans and regulations administered by the South Coast Air Quality Management District and/or California Air Resources Board.
Aircraft Incident	SHMP	Yes	The City is located adjacent to John Wayne Airport (located adjacent to the City's northern border). Given this proximity and past incidents associated with aircrafts, the HMPC determined that this hazard should be included in the plan.
Aquatic Invasive Species	SHMP	No	There are no major riparian environments in Irvine where aquatic invasive species could endanger the community.
Avalanche	FEMA guidance SHMP	No	Irvine is not located within avalanche potential zones.
Civil Disturbance or Riot	SHMP	Yes	The HMPC determined that civil disturbances of the degree that would endanger property or life to residents have the potential to occur, especially in locations of the City where large populations visit/congregate (Irvine Spectrum, UCI, etc.).
Climate Change	SHMP OC HMP	Yes	Climate change is discussed as a function of each relevant hazard and is mentioned throughout the Plan.
Coastal Flooding and Storm	FEMA guidance SHMP	No	Irvine is not located along the coast of California. Coastal flooding and storms are not anticipated to impact the community.

Table 3-1: Hazard Evaluation for Irvine LHMP

Hazard	Recommended for Consideration	Included in LHMP?	Reason for Inclusion or Exclusion
Cyber Threats	SHMP	Yes	With the increase in cyber threats occurring throughout California and the nation, the HMPC considers them to be serious in nature requiring evaluation.
Dam Failure	FEMA guidance SHMP OC HMP	Yes	Several dams are located within Irvine and surrounding areas. Due to the proximity to these dams and the potential for inundation to impact the community, the HMPC identified dam failure as a hazard of concern.
Drought	SHMP OC HMP	Yes	Droughts are a recurring and potentially severe hazard in Irvine.
Energy Shortage	SHMP	No	Irvine does not produce its own energy and is not at any more risk of energy shortage than surrounding communities.
Epidemic, Pandemic, Vector Borne Disease	SHMP	Yes	Irvine is in Orange County, which has experienced several health-related incidents in the past. It is within proximity to a major airport, major attractions (i.e. Disneyland, etc.), and educational institutions introduce new opportunities for diseases in the region. The City, along with the rest of the country is currently responding to a global pandemic (COVID-19), which has impacted staff and resources.
Erosion	FEMA guidance SHMP	No	While erosion occurs in certain areas of the City, this hazard is generally associated with other hazards like wildfire, landslide, and flooding. Refer to these hazards for any discussion regarding erosion.
Expansive Soil	FEMA guidance	No	Expansive soils are located within the City. While they exist, the City requires compliance with the California Building Code, which is intended to mitigate hazards associated with this condition.
Extreme Cold	FEMA guidance SHMP	No	Temperatures in Irvine do not fall to a level that would be considered a danger to public safety.
Extreme Heat	FEMA guidance SHMP	Yes	Extreme heat has occurred in Irvine and is expected to be a future recurring issue.
Fault Rupture	FEMA guidance SHMP OC HMP	Yes	There are no known Alquist-Priolo fault zones located within Irvine, however faults have been identified. As a result, the HMPC identifies fault rupture as a potential hazard of concern.
Flooding	FEMA guidance SHMP	Yes	Several stream courses transect the City and are identified within FEMA flood hazard zones. While significant flooding events have not affected properties within the City recently, the presence of these flood zones indicates the potential for future hazards.
Fracking	SHMP	No	Fracking does not occur in Irvine.
Hail	FEMA guidance	No	Hail that is severe enough to pose a threat to people and property is too rare in Irvine to be included.
Hazardous Materials release	SHMP	Yes	The presence of uses storing, manufacturing, disposing, and transporting hazardous materials was identified as a concern for the HMPC. In addition, several major roadways, freeways, and rail lines transecting the City allow for the transport of these materials that could endanger the community if a release into the environment were to occur.

Table 3-1: Hazard Evaluation for Irvine LHMP

Hazard	Recommended for Consideration	Included in LHMP?	Reason for Inclusion or Exclusion
Hurricane	FEMA guidance SHMP	No	Hurricanes do not occur in Irvine.
Infrastructure Failure	SHMP	Yes	Infrastructure failure can pose a threat to people and property in Irvine. Discussion of infrastructure failure is discussed as a function of other hazards.
Landslide	FEMA guidance SHMP	Yes	Areas within the City of Irvine have existing landslides or the potential for landslides to occur. As a result, the HMPC felt it was important to include this hazard in the plan.
Levee Failure	SHMP	No	Levees are not located within the City. Based on this, the HMPC did not identify levee failure as a hazard of concern.
Lightning	FEMA guidance	No	Although lightning does occur occasionally in Irvine, it does not pose a significant threat to people or property.
Liquefaction	FEMA guidance SHMP OC HMP	Yes	According to mapping prepared by the California Geological Survey, portions of the City are located within liquefaction prone areas.
Methane-containing Soils	OC HMP	No	The City does not have methane containing soils that pose a threat to the public health and safety of residents and businesses. However, the City does have two closed landfills that could contribute to the release of methane gas. Further discussion of this is provided in the Hazardous Materials Release hazard profile.
Natural Gas Pipeline Hazards	SHMP	Yes	There are natural gas pipelines running through Irvine that could pose a danger to people and property if they were to breach and release their contents into the community. This hazard is discussed in the Community Profile in Chapter 2 and is discussed in the Infrastructure Failure section.
Oil Spills	SHMP	No	There is no history of oil drilling and extraction within the City. Based on this, the HMPC did not think this hazard needed to be addressed.
Power Failure		Yes	Given prior events that have occurred in the City and the threat of future power loss, the HMPC determined that power failure should be addressed.
Radiological Accidents	SHMP	No	There are no known major sources of radiation in Irvine or the immediate surrounding area that could pose a serious threat to the community.
Sea-level Rise	FEMA guidance SHMP	Yes	While Irvine is not considered a coastal community, their drainage infrastructure connects to the ocean and may be tidally influenced. In the event future sea level rise affects drainage infrastructure, it could impact future flooding within the City.
Seiche	FEMA guidance SHMP	No	There are no major bodies of water in Irvine that could be subjected to seiche.
Seismic Shaking	FEMA guidance SHMP OC HMP	Yes	Irvine is in a seismically active area where shaking can be severe enough to damage property or cause loss of life. For this reason, the HMPC determined it should be addressed in this plan.

Table 3-1: Hazard Evaluation for Irvine LHMP

Hazard	Recommended for Consideration	Included in LHMP?	Reason for Inclusion or Exclusion
Severe Wind	FEMA guidance	Yes	Severe Weather includes discussions regarding extreme heat, severe wind, and rain, which are weather related hazards that are most common in Irvine.
Severe Weather and Storms	FEMA guidance SHMP OC HMP	Yes	Severe Weather includes discussions regarding extreme heat, severe wind, and rain, which are weather related hazards that are most common in Irvine.
Storm Surge	FEMA guidance	No	Irvine is not a coastal community.
Subsidence	FEMA guidance	Yes	The HMPC believed that subsidence could occur with significant groundwater pumping. Subsidence is not discussed as a stand-alone hazard but rather is a function of the geologic hazard discussion.
Mass-Casualty Incident (Terrorism)	SHMP	Yes	The HMPC was concerned about mass-casualty incidents posing a threat to public safety. A discussion of this is in the Human-Caused Hazards section.
Thunderstorm	SHMP	No	Thunderstorms that cause damage and endanger public safety are rare in the Southern California region.
Tornadoes	FEMA guidance SHMP	No	No tornadoes are known to have ever occurred in Irvine.
Transportation Accidents	SHMP	Yes	Due to the presence of major freeways and roadways in and around Irvine, transportation accidents could endanger public safety. A discussion of this is in the Human-Caused Hazards section.
Tree Mortality	SHMP	Yes	The HMPC noted that the City's trees are a significant asset at risk. Tree Mortality is discussed within the Diseases and Pests section of this Chapter.
Tsunami	FEMA guidance SHMP	No	Irvine is not a coastal community.
Urban Fire	SHMP OC HMP	Yes	The HMPC identified urban fires as a risk to property and life in Irvine. A discussion of this topic is included in the wildfire section of the document.
Volcano	SHMP	No	There are no volcanoes near Irvine to reasonably pose a threat.
Wildfire	FEMA guidance SHMP	Yes	The HMPC identified wildfire as a major threat to the developed and undeveloped areas of the City and should be included in the document.

After hazard evaluation and the organizational changes made by the Committee, this Plan discusses 11 broad hazard types with their respective sub-categories:

Hazard Type	Sub-Categories
Aircraft Incident	
Dam Failure	
Diseases and Pests	Agricultural Pests Epidemic/Vector Borne Disease Tree Mortality
Drought	
Flooding (Sea Level Rise)	
Geologic Hazards	Landslide Subsidence
Hazardous Materials Release	
Human Caused Hazards	Mass-Casualty Incident (Terrorism) Civil Disturbance Cyber Threats Transportation Accidents Infrastructure Failure
Seismic Hazards	Fault Rupture Seismic Shaking Liquefaction
Severe Weather	Extreme Heat Severe Wind Rain
Wildfire	

HAZARD SCORING AND PRIORITIZATION

The Committee followed FEMA guidance for hazard mitigation plans and prioritized each of the 11 hazards. In the initial step, it assigned a score of 1 to 4 for each of the 10 hazards. The four criteria are:

Probability: The likelihood that the hazard will occur in Irvine in the future.

Location: The size of the area that the hazard would affect.

Maximum probable extent: The severity of the direct damage of the hazard to Irvine.

Secondary impacts: The severity of indirect damage of the hazard to Irvine.

The Committee assigned a weighting value to each criterion, giving a higher weight to the criteria deemed more important, and multiplied the score for each criterion by the weighing factor to determine the overall score for each criterion. The weighting values were recommended by FEMA:

Probability: 2.0

Location: 0.8

Maximum probable extent: 0.7

Secondary impacts: 0.5

Table 3-2 shows the Criterion Scoring used to assign a score for each criterion.

Table 3-2: Criterion Scoring

Probability		**Maximum Probable Extent (Primary Impact)**	
The estimated likelihood of occurrence based on historical data.		The anticipated damage to a typical structure in the community.	
Probability	Score	Impact	Score
Unlikely—less than a 1 percent chance each year.	1	Weak—little to no damage	1
Occasional—a 1 to 10 percent chance each year.	2	Moderate—some damage, loss of service for days	2
Likely—a 10 to 90 percent chance each year.	3	Severe—devastating damage, loss of service for months	3
Highly likely—more than a 90 percent chance each year.	4	Extreme—catastrophic damage, uninhabitable conditions	4
Location		**Secondary Impact**	
The projected area of the community affected by the hazard.		The estimated secondary impacts to the community at large.	
Affected Area	Score	Impact	Score
Negligible—affects less than 10 percent of the planning area.	1	Negligible—no loss of function, downtime, and/or evacuations	1
Limited—affects 10 to 25 percent of the planning area.	2	Limited—minimal loss of functions, downtime, and/or evacuations	2
Significant—affects 25 to 75 percent of the planning area.	3	Moderate—some loss of functions, downtime, and/or evacuations	3
Extensive—affects more than 75 percent of the planning area.	4	High—major loss of functions, downtime, and/or evacuations	4

After calculating the total impact score for each hazard (sum of the location, maximum probable extent, and the secondary impact). FEMA guidance recommends multiplying the total impact score by the overall probability to determine the final score for each hazard. A final score between 0 and 12 is considered a low-threat hazard, 12.1 to 42 is a medium-threat hazard, and a score above 42 is considered a high-threat hazard. This final score determines the prioritization of the hazards.

Table 3-3 shows the individual criterion scores, the final score, and the threat level for each hazard based on the above prioritization process.

Earthquakes are high priority hazards because they are likely to happen, affect a wide area, and can be very damaging. Source Image: from Jonathan Nourok.

Table 3-3: Hazard Scores and Threat Level

Hazard Type*	Probability	Impact			Total Score	Hazard Planning Consideration
		Location	Primary Impact	Secondary Impacts		
Seismic Hazards [1]	4	4	4	4	64.00	High
Wildfire	4	3	3	3	48.00	High
Drought	3	4	4	4	48.00	High
Diseases and Pests [2]	4	4	2	2	44.80	High
Severe Weather [3]	3	4	2	2	33.60	Medium
Aircraft Incident	3	2	2	2	24.00	Medium
Human Caused Hazards [4]	2	2	3	4	22.80	Medium
Geologic Hazards [5]	2	2	3	3	20.80	Medium
Flooding [6]	2	3	2	2	19.20	Medium
Haz Mat Release	2	3	2	2	19.20	Medium
Dam Failure	2	2	3	2	18.80	Medium

* Climate Change considerations discussed as appropriate within this hazard.
1 Seismic Hazards includes: Fault Rupture, Seismic Shaking, Liquefaction
2 Diseases Pests includes: Agricultural Pests, Epidemic/Vector Borne Diseases, and Tree Mortality
3 Severe Weather includes: Extreme Heat, Severe Wind, Rain
4 Human Caused Hazards includes: Mass-Casualty Incidents (Terrorism), Civil Disturbance, Cyber Threats, and Transportation Accidents, Infrastructure Failure
5 Geologic Hazards includes: Expansive Soils, Landslides, Methane Containing Soils, and Subsidence
6 Flooding includes a discussion regarding sea level rise

HAZARD PROFILES

Aircraft Incident

Description

An aircraft incident refers to when an airborne vehicle, such as an airplane, helicopter, or airship experiences failure to the degree that people on the ground are endangered by the aircraft. This could be the result of human error, inclement weather, deferred maintenance, design flaw, equipment failure, or, in a worst-case scenario, a collision.

Location and Extent

Irvine itself has no airports within its boundaries but numerous regional and international airports are in the City's surroundings and the airways above the City are highly trafficked. The following are airports near Irvine that create air traffic, to include their distance from Irvine's City Center:

- John Wayne Airport (SNA), 4.3 miles, located between the cities of Costa Mesa, Irvine, and Newport Beach.
- Fullerton Municipal Airport (FMA), 19.7 miles
- Long Beach Municipal Airport (LGB), 22.9 miles

- Ontario International Airport (ONT), 41.6 miles
- Los Angeles International Airport (LAX), 42.2 miles

In addition to the public airports that operate in the region, Joint Forces Training Base Los Alamitos is also located within 18 miles of the City. This facility is actively used for military training purposes; however, the frequency of flights is anticipated to be less than the amount from airports like John Wayne.

To better understand the differences between an aircraft accident and aircraft incident, which is based on Title 49 of the Code of Federal Regulations Part 830, §830.2:

An **Accident** is an occurrence associated with the operation of an aircraft that:

- Occurs between when the first boarding person enters the aircraft – with intention of flight – and the last person disembarks.
- Results in death or serious injury, or
- Causes substantial damage to the aircraft.

An **Incident** is an occurrence – other than an accident (no intention of flight) – associated with the operation of an aircraft that affects or could affect the safety of operations.

Past Events

The City of Irvine borders John Wayne Airport, which has suffered numerous accidents/incidents in the past. According to the NTSB, over a 36-year period, aircrafts experienced 62 accidents and 6 incidents during this period. **Table 3-4** provides an overview of the past events that have occurred. Based on this data, less than 10% of individuals involved in an accident suffered an injury. Over this time period, an average of 2 aircraft accidents/ incidents from John Wayne Airport have occurred.

Table 3-4: John Wayne Airport Aircraft Accident Statistics (1982-2018)

Accident	62	91.2%
Incident	6	8.8%
Fatal Accidents	14	22.6%
Fatality Range	1 to 5	N/A
Aircraft Destroyed	13	N/A
Total Fatal Injuries	37	5.1%
Total Serious Injuries	7	1.0%
Total Minor Injuries	16	2.2%
Total Uninjured	666	91.7%

Source: https://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx

Notable historic aircraft accidents within Orange County include the following:

- September 25,1978: A Boeing 727 from LAX to Lindbergh Field (now San Diego International Airport) collided mid-air with a small, private plane during its final approach to the runway. The collision destroyed the small plane and disabled one of the 727's engines, causing it to veer off course and pitch downward, crashing into a residential area in San Diego's North Park neighborhood. 22 homes were destroyed, and 144 people were killed, which included 135 aircraft passengers and crew, two on board the small plane, and seven people on the ground. It is considered the deadliest aviation incident in California history.[25]

- August 31, 1986: A DC-9 jetliner collided with a smaller aircraft. Neither craft was destroyed in the air, but the operability of both aircrafts was compromised, causing them to fall more than 6,000 feet from their flight paths, eventually crashing into a housing tract in Cerritos. 16 homes were destroyed and 15 residents in the area of the impact were killed.[26]

Notable recent aircraft accidents/incidents within Orange County include the following:

- June 30, 2017: A small plane crashed on the 405 Freeway in Costa Mesa near John Wayne Airport shortly after takeoff. No injuries or deaths occurred on the ground, but the freeway was shut down for many hours.
- August 5, 2018: A small plane seemingly exhausted its fuel reserves and crashed into a strip mall parking lot in Santa Ana, CA near SNA. No injuries or deaths occurred on the ground, but four parked vehicles were destroyed.[27]
- February 3, 2019: A pilot of a small plane lost control of the aircraft and crashed into a housing tract in Yorba Linda, CA, destroying two homes and killing four people on the ground.[28]

The remains of a small plane that crashed into a Santa Ana parking lot in 2018. Image from Richard Koehler.

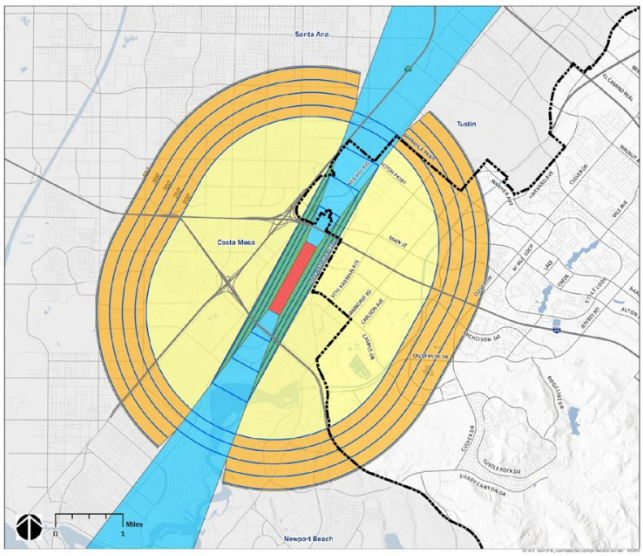
In addition to the aircraft accidents/ incidents that have occurred in Orange County, the City of Irvine has experienced nine accidents/ incidents since 1983 (**Table 3-5**), which suggests that an accident/incident occurs every four years in the City.

Table 3-5: Aircraft Accidents/ Incidents in Irvine

Event Date	Injury Severity	Aircraft Damage
9/14/2009	Non-Fatal	Substantial
8/10/2002	Non-Fatal	Substantial
11/30/1996	Fatal (3)	Destroyed
9/19/1995	Fatal (1)	Destroyed
5/9/1990	Non-Fatal	Substantial
2/26/1986	Fatal (1)	Destroyed
5/27/1984	Non-Fatal	Substantial
4/27/1983	Non-Fatal	Substantial
2/10/1983	Non-Fatal	Substantial

Risk of Future Events

Given the high volume of air traffic in the area, the possibility of an aircraft incident occurring in Irvine will continue to exist. Based on historic events, it is anticipated that future impacts will be similar in nature. A key component to aircraft incident safety is the administration of the Airport Environs Land Use Plan for John Wayne Airport. This plan identifies the height restrictions and safety zones that require land use restrictions to minimize potential impacts. Future land use decisions that adhere to these restrictions and plan accordingly will help reduce future impacts associated with aircraft incidents. While these efforts can assist in reducing impacts on the ground, there is little that can be done to reduce the impacts associated with aircrafts flying overhead under normal flight conditions. The risk associated with these types of incidents is like other parts of Orange County and southern California.



John Wayne Airport Safety Zones

Climate Change Considerations

There is no direct link between aircraft incidents and climate change; it is not anticipated that future hazards would be affected by changing climatic conditions.

Dam failure

Description

Dam failure can result from several causes such as earthquakes, rapidly rising floodwaters, and structural design flaws. These hazards can occur instantaneously or very gradually depending on the source of the failure. Inundation associated with these events have the potential to cause loss of life, damage property, and other ensuing hazards, as well as the displacement of persons residing in the inundation path.

According to the California Division of Safety of Dams (DSOD), a dam falls under their jurisdiction if its height is greater than six feet and impounds more than 50 acre-feet of water, or its height is greater than 25 feet and impounds 15 acre-feet of water. Based on this criteria, 1,537 dams fall under DSOD jurisdiction, 40 of which are located within Orange County.

Location and Extent[29]

The City of Irvine has seven dams that have the potential to inundate areas of the City, if failure were to occur. Of these dams, three of them are located within the City's planning area, while the other four are located outside of the City limits. Descriptions of these dams are provided, below:

- Rattlesnake Canyon Reservoir: located on Rattlesnake creek in the eastern portion of the City, this 79-foot-high earth filled dam is owned by Irvine Ranch Water District. Built in 1959, this facility impounds 1,480-acre feet of recycled water primarily used for irrigation.
- Sand Canyon Reservoir: located adjacent to the Strawberry Farms Golf Club in the western portion of the City, this 58-foot-high earth filled dam is owned by Irvine Ranch Water District. Built in 1912, this facility impounds 768-acre feet of recycled water, primarily used for irrigation.
- Syphon Canyon Reservoir: located in northeastern portion of the City, this 59-foot-high earth filled dam is owned by Irvine Ranch Water District. Built in 1966, this facility impounds up to 535-acre feet of recycled water, primarily used for irrigation.
- Peters Canyon Reservoir: located north of the City of Irvine (approximately 3 miles west of Santiago Dam), this 50-foot earth filled dam is owned by the County of Orange. Built in 1932, this facility impounds up to 626-acre feet of water.
- Santiago Dam: located northeast of the City of Irvine, this 136-foot high earth filled dam is jointly owned by Irvine Ranch Water District and Serrano Water District. Built in 1931, this facility impounds approximately 25,000 acre-feet of water creating the largest freshwater lake contained wholly withing Orange County (Irvine Lake).
- San Joaquin Reservoir: located west of the City (in neighboring Newport Beach), this 224-high earth-filled dam is owned by Irvine Ranch Water District. Built in 1966, this facility impounds over 3,000 acre-feet of recycled water, primarily used for irrigation.
- Villa Park Dam: located north of the City, this 118-foot-high earthen filled dam is owned by the Orange County Flood Control District. Built in 1963, this facility has the capacity to impound over 15,000 acre-feet, which is primarily used for flood control purposes.
- Prado Dam is located approximately 25 miles northeast of the City, along the Santa Ana River in Riverside County. This dam facility poses a great risk to northern Orange County cities. Given the

location of Irvine, current inundation mapping does not indicate that the City would be impacted such an event.

Table 3-6 identifies the DSOD Downstream Hazard Potential Classification used to determine the anticipated impacts associated with a dam inundation event. Dams located in and around Irvine are all classified in the "Extremely High" category, meaning they could cause considerable loss of human life and major impacts to critical infrastructure or property that could lead to economic, environmental, and lifeline losses.

Table 3-6: Criteria for DSOD's Downstream Hazard Potential Classification[30]

Downstream Hazard Potential Classification	Potential Downstream Impacts to Life and Property
Low	No probable loss of human life and low economic and environmental losses. Losses are expected to be principally limited to the owner's property.
Significant	No probable loss of human life but can cause economic loss, environmental damage, impacts to critical facilities, or other significant impacts.
High	Expected to cause loss of at least one human life.
Extremely High	Expected to cause loss of at least one human life and one of the following: result in an inundation area with a population of 1,000 or more; or, result in the inundation of facilities or infrastructure, the inundation of which poses a significant threat to public safety as determined by the department on a case-by-case basis.

Figure 3-1 below identifies the potential inundation areas that could impact the City of Irvine. This figure shows the areas downstream that would be inundated by an unintentional breach from a dam's reservoir. The areas that could flood in the case of a dam breach are not necessarily the same areas that could be inundated by a 100-year or 500-year flood (see Flood Hazard Profile below).

Past Events

While California's dam infrastructure is recent in the state's history, there have already been major catastrophic dam failure events. One of the earliest in Southern California was the failure of the San Francisquito Canyon Dam. The dam experienced a structural failure as a result of insufficient geotechnical engineering by the then-Los Angeles Bureau of Water Works and Supply. At midnight on March 13, 1928, the 205-foot-tall structure gave way, unleashing a 120-foot-high wave of water traveling 18 miles per hour down the canyon. By 5:30 AM, the wave had traveled 54 miles from the dam site to the Pacific Ocean, killing at least 438 people, razing towns, and destroying infrastructure. It was reported that the bodies of victims were recovered from the ocean as far south as the Mexican border. The disaster is considered one of the worst engineering failures in US history.[31]

Another, more recent, dam failure in the region occurred at the Baldwin Hills Dam. On December 14, 1963, a structural failure in the dam caused a breach that unleashed 250 million gallons of reservoir water. Diligent work by maintenance crews detected the developing failure in the dam four hours before it breached, and they, with the cooperation of local law enforcement, were able to successfully evacuate and save nearly 1,500 people downstream from the reservoir. Five lives were lost in the ensuing wave of water, 65 homes were destroyed, and nearly $11 million worth of property damage was incurred.[32] The Baldwin Hills Dam was not rebuilt and is now a grassy basin in Kenneth Hahn Park.[33]

The most recent incident that occurred in California is the Oroville Dam spillway failure that occurred in February 2017. The failure in the concrete chute caused a 60-foot-deep hole to develop in the lower third of the primary spillway as a result of normal operations undertaken to lower the reservoir in advance of a moderately large storm. A subsequent storm in the days after the initial incident and the inability to fully use the primary spillway led to the filling of the reservoir and the use of its unlined (natural) emergency spillway for the first time ever. After two days of usage causing erosion of the unlined hillside and head cutting (erosion upstream towards the earthen dam), concerns regarding the stability of the emergency spillway caused an evacuation of nearly 200,000 people downstream prompting both immediate repairs and a re-evaluation of this dam facility and many others throughout the State of California since.[34]

The City of Irvine has not suffered impacts from a dam inundation event. The closest incident to Irvine involved an extensive episode of winter rains in 2005 causes seepage along Prado Dam causing the Army Corps of Engineers to release significant amounts of water downstream causing evacuations of approximately 3,000 residents. The flooding caused erosion along portions of the Green River golf course adjacent to the river. Since this event, the ACOE has made significant improvements downstream of the dam to increase capacity and reduce future flooding impacts.[35]

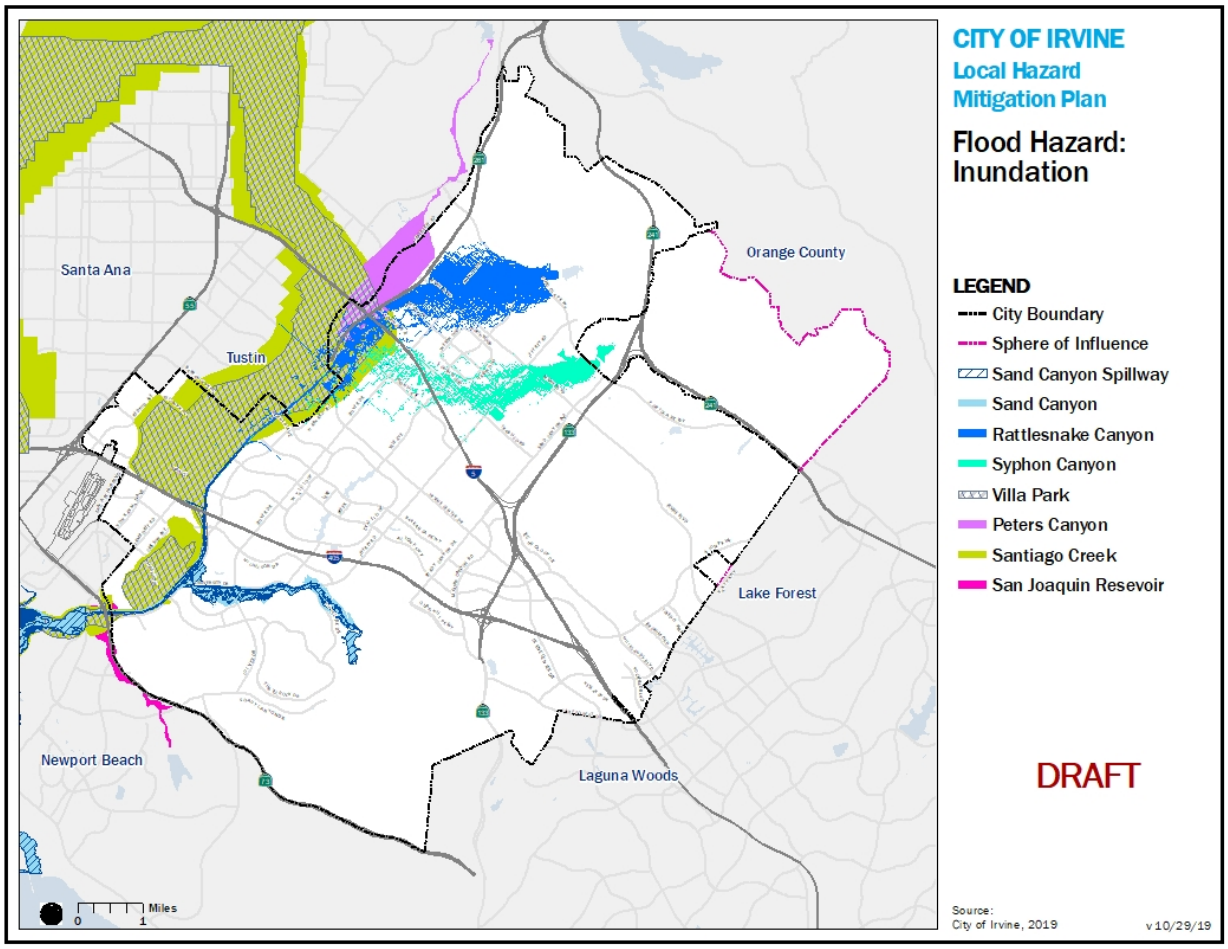
Risk of Future Events

Due to the presence of several dams in and near Irvine many residents and businesses could be at risk of inundation in the case of significant dam failure. All dams identified in Exhibit 3-1 are considered to have an "Extremely High Downstream Hazard classification due to the proximity to homes and businesses. Some of the potential consequences of dam failure from these facilities are death or injury, displacement of people from their homes, damage to existing public and private buildings, damage to infrastructure, loss of services from utilities, loss of government services, and economic losses. The DSOD requires periodic evaluation of dams based on confirmed or unconfirmed safety issues, probability of failure, and the potential consequences. All dams that may impact Irvine currently meet satisfactory conditions regarding dam safety.

Climate Change Considerations

Climate change could increase the risk of a dam failure in the future. More intense rainstorms may increase the likelihood that reservoir infrastructure could become overwhelmed, including the dams that control floodwaters from inundating Irvine and the rest of Orange County. Indirectly, increased climate change-induced rains may cause more erosion which could compromise the structural integrity of the dam or the foundation it sits on. For these reasons, monitoring of changing precipitation regimes and conditions is recommended to ensure future conditions are better understood.

Figure 3-1: Dam Inundation Areas



Diseases and Pests

This section discusses agricultural pests, epidemic/ vector-borne diseases, and tree mortality hazards in the City of Irvine.

Description

A disease is a serious type of illness that affects an organism (trees, the human body, etc.) to the degree that normal activities can become more hampered, difficult, or even impaired. In serious cases, diseases can result in significant damage, or even death. For humans, some diseases only affect the person who is infected—in this case, the disease would be considered non-contagious. For example, a person can be infected with Lyme Disease by interacting with an animal infested with ticks, but the infected person cannot then spread Lyme Disease to another person. Diseases that are spread from one person to the next are described as being contagious. While both types of disease are a hazard of concern for Irvine, contagious diseases are particularly concerning since they can result in multiple cases of the same disease if proper precautions are not enabled.

Pests are organisms whose presence is generally considered a nuisance due to the public health and property damage they can cause. Examples of pests include mice, rats, mosquitoes, and invasive insects that cause damage to natural assets (trees). These organisms can be vectors, or transmitters, of disease which are spread by pests to animals and humans. Occasionally, the disease may spread first to an intermediary, like a domesticated animal, where it may evolve into a form that can survive in humans. These kinds of vector-borne diseases are known as zoonoses. Apart from posing risks to public health, pests can also damage property, such as trees or other landscaped areas, either by directly consuming the plant material or spreading infectious diseases. In serious cases, pests can cause the death of the tree or plant specimen they are infesting.

Agricultural Pests

In areas where agricultural production occurs, the presence of pests can impact the quality and quantity of products harvested. According to the Orange County Agricultural Commissioner the three main pests impacting agriculture in Orange County include the Light Brown Apple Moth, Glassy-winged sharpshooter, and Asian Citrus Psyllid & HLB.

Epidemic/Pandemic/Vector-Borne Disease

There are two general classifications to describe the geographic spread of disease. An epidemic is an infectious disease that spreads beyond a localized area, reaching people throughout a large region. A pandemic is an infectious disease that spreads around the world. When a disease is described as vector-borne it refers to the medium of infection, which is through a third-party organism (i.e. mosquito) known as a vector. Both epidemic and pandemic disease can be described as vector-borne if infection takes place through a vector. The two main factors that influence the spread of disease are the speed at which the pathogen is transmitted from person to person in addition to human behaviors, both individual and societal.

The following are some diseases and pests that could affect the population of Irvine:

- **Influenza (the flu)** is a virus that leads to illness in humans. Symptoms of the flu include fever, cough, headache, sore threat, muscle and joint pain, or runny nose. Given that the flu virus is constantly mutating, it is exceptionally difficult to create a vaccine that protects against all strains of the virus. These variations of the flu can occasionally give rise to particularly deadly strains, such as the H1N1 strain that emerged in 2009. Currently, the flu is one of the common diseases around the world, leading to the deaths of as many as 650,000 people per year.[36]
- **COVID – 19** is the common name used for the Novel Coronavirus Disease 2019, that was first identified Wuhan, China in December 2019. The particular coronavirus associated with COVID-19 is called SARS-CoV-2. Coronaviruses are a large family of viruses that are common in people and many different species of animals, including camels, cattle, cats, and bats. A wide range of COVID-19 symptoms have been reported – ranging from mild symptoms to severe illness, that can appear 2-14 days after exposure to the virus. Symptoms reported include coughing, shortness of breath or difficulty breathing, fever, chills, muscle pain, sore throat, and/or new loss of taste or smell.
- **West Nile Virus** is a disease originally from Africa that was first reported in the U.S. in 1999. West Nile Virus is a vector-borne disease, with transmission occurring as a result of mosquito bites. Most people who are infected do not display symptoms or feel sick. Those who display symptoms most often experience high fever, headache, neck stiffness, tiredness, or tremors. More severe

symptoms include coma and paralysis. Vulnerable populations, primarily the elderly, may die as a result of their infections. There is currently no vaccine for the virus.[37]

- **Zika Virus** is a disease originally from Uganda that began spreading globally in 2016. Zika is a vector-borne disease that is primarily transmitted from person to person via mosquito bites. Most people who are infected do not experience symptoms, when symptoms occur, they potentially include fever, headache, or muscle pain. It is very rare that Zika results in death. Researchers have discovered that Zika Virus infections in pregnant women can sometimes result in microcephaly, a condition where babies are born with small heads. Babies born with microcephaly may die as a result of their physical condition.[38]
- **Mosquitoes** are parasitic insects that feed on the blood of mammals, including humans. They use a needle-like part of their mouth, called the proboscis, to breach the epidermis and reach the blood vessels beneath the skin. As mosquitoes withdraw the blood from their host, they can potentially transfer infectious diseases they are carrying to the host. Only certain diseases may be transmitted by mosquito. The Human Immunodeficiency Virus (HIV), for example, cannot be transferred from human to human since the HIV virus cannot survive in mosquitoes. The Zika or West Nile viruses, on the other hand, are highly transmissible infections via mosquitoes, and this is the most common form of transmission.[39]

An Asian Tiger Mosquito, which may attack during the day, bites its host. Image from San Diego County News Center.

- **Mice and rats** are small rodents that can transmit disease or be a vector for other disease-carrying organisms. The most well-known and historic example of this is Bubonic Plague. In the 14th Century, mice and rats infested with fleas traveled to Europe from Asia. The fleas carried the Bubonic Plague in their bodies and transmitted the infection to human populations as the fleas left the rats and mice for new human hosts.[40]

Tree Mortality

The entirety of a city's trees is generally referred to as an urban forest. These trees may be publicly owned or maintained, such as trees in a public park or street median, or privately owned, such as the ornamental trees found in a property owner's landscaping. Urban forests represent important assets for a city as they provide shade which helps keep the community cool. They also provide aesthetic beauty to a community and are known to help humans feel calm and less stressed. Tree mortality refers to the death of numerous tree specimens in a forest, including urban forests. The death of a tree represents a significant loss since trees are expensive and require extensive time and care to be properly raised. Tree mortality may result from numerous causes, including but not limited to extreme heat, uprooting from severe weather, over- or under-irrigation, or chemical contamination. Like other living beings, trees are also subject to vector-borne disease spread by pests. These diseases can cause the tree to produce misshapen fruit or discolored

leaves. The disease can also kill the tree over an extended period. Pests that cause tree mortality are of concern since they may be difficult to detect and quarantine.

Pests that are currently afflicting trees in Orange County include the following:

- **Asian Citrus Psyllid (ACP):** Carries a plant disease known as Huanglongbing, or citrus-greening disease, which kills citrus trees. Parts of the City of Irvine are in the quarantine area for this pest.
- **Gold Spotted Oak Borer (GSOB)**: Burrow into oak trees which kills the tree over time.
- **Invasive Shot Hole Borer (ISHB):** Burrow into all kinds of native trees in all kinds of settings, including urban areas. These insects carry the Fusarium Dieback fungus which kills the tree.[41]

Asian Citrus Psyllids feed on the leaves and stems of citrus trees. Image from California Citrus Threat.

Location and Extent

Agricultural Pests

Orange County has over 19,000 acres of land under agricultural production. As of 2018, this area contributed over $94 million to the local economy. Within Irvine, approximately 1,323 acres of land are designated for agricultural use, which is scattered throughout the City. There is no extent scale available to determine the severity of an impact. Typically, agricultural pest damage is measured in the amount of losses caused by the pest.

Epidemic/Pandemic/Vector-Borne Disease

While any location in Irvine is susceptible to experiencing the spread of disease, locations where many people gather are more likely to facilitate the spread of disease. These include large employment centers, educational institutions, medical facilities, and shopping centers. In Irvine specifically, there are two large hospitals (Kaiser and Hoag) where high populations of individuals with infectious diseases. In addition, large commercial and employment areas like the Irvine Spectrum, Irvine Business Complex, and UC Irvine are highly trafficked by many different people, which could increase the spread of disease. Vector-borne diseases can only be spread where there is a link between the pest and the human population that could be infected. Areas where pests gather could pose a greater danger to humans who live nearby or visit on a regular basis. Mosquitoes, for example, are known to congregate around pools of standing water as this is where they lay their eggs. Any pools or other bodies of standing water in Irvine likely pose an increased risk to anyone who regularly spends time near these locations of being bitten by a mosquito and potentially being infected by a mosquito-borne disease.

Zoonoses can be spread in any location where there is regular contact between animals and humans. The most common places for zoonoses to develop are livestock farms or other similar agricultural facilities. While Irvine has agricultural uses, these uses do not include significant amounts of animals.

There are few diseases that have a formal measuring scale to evaluate their severity or extent. Among them is Influenza, more commonly known as the flu, which is measured by the Pandemic Influenza Phases

scale established the World Health Organization (WHO). **Table 3-7** describes the various phases of Influenza infection over time.

Table 3-7: Pandemic Influenza Phases[42]

Phase	Description
Phase 1	No animal influenza virus is known to have caused infection in people.
Phase 2	An animal influenza virus has caused infection in people. There is a potential pandemic threat.
Phase 3	An animal influenza virus has caused occasional infections or infections in small groups. There may be limited human-to-human transmission, but nothing large enough to sustain community-level outbreaks.
Phase 4	Human-to-human transmission can sustain community-level outbreaks. There is a significantly higher risk of a pandemic.
Phase 5	Human-to-human transmission in at least two countries in the same region. A pandemic is likely imminent.
Phase 6	Human-to-human transmission in at least two countries in the same region and in at least one other country outside of the region. A pandemic is underway.
Post-peak	Transmission levels are declining below peak levels, although second waves may occur, and transmission could return to previous levels or higher.
Post-pandemic	Transmission levels have returned to normal levels for seasonal influenza outbreaks.

Tree Mortality

Any tree has the potential to be infested by pests that could result in the tree's death. This means all areas of Irvine that are landscaped with trees could experience tree mortality. These areas include parks, landscaped parkways and street medians, schools, as well as private homes or businesses. Trees could also die as a result of other hazards. For example, an exceptionally severe drought that dramatically reduces the amount of water available for landscaping in Irvine could deprive trees of the irrigation they require for their survival. Non-native or non-drought adapted specimens would most likely be the first

trees, however native trees could also be affected, as well. Multiple hazards could also combine to cause tree mortality. For instance, a strong earthquake could result in the failure of several dams, reservoirs, or levees in the area. The sudden inundation with floodwaters that would result, could kill several trees in the City.

There is no universally accepted scale for measuring tree mortality, but the U.S. Forest Service identifies a general model that compares the aggregate number of tree deaths in relation to the aggregate number of trees surviving over a specified period.[43] Additionally, a meta-analysis of tree mortality studies reveals that most trees in urban forests have an average lifespan lasting between 19 to 28 years and that the mortality rate among these trees is 3.5% to 5.1% per year.[44] If tree mortality rates occur at a rate that is higher than this or if newly planted specimens are dying before 19 years it could indicate that the City's trees are being afflicted by disease, pests, or some other issue.

The City is also following the University of California Integrated Pest Management guidelines for shot hole boring pests. **Table 3-8** identifies the damage rating based on invasive pest quantity.

Table 3-8: UC Integrated Pest Management Guidelines for Shot Hole Boring Pests

Damage	Invasive Pest Quantity
Minor	Under 25 Hits
Moderate	Under 75 Hits
High	76+ Hits

Past Events

Agricultural Pests

Irvine has had a long history of agricultural use within the community. However, since incorporation as a City, agricultural uses have been replaced with development. This reduction in agricultural use has reduced the amount of agricultural resources affected by pests. Currently the City is partially located within the quarantine area of the Asian Citrus Psyllid, which main affects citrus trees. However, the City does not track and monitor the impacts of this pest on these resources currently.

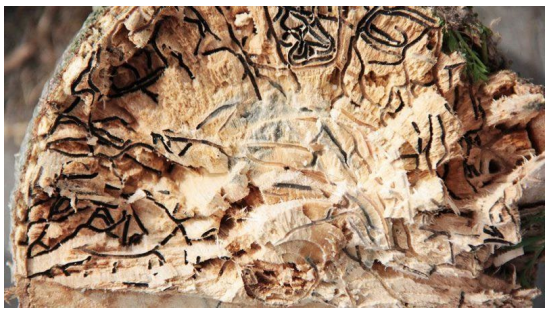
Epidemic/ Vector-Borne Disease

While local information on diseases and pests for Irvine is not available, Orange County has been impacted by localized outbreaks of diseases. The following are notable instances of diseases and pests that have occurred within Orange County:

- H1N1 (Swine flu): The 2009 H1N1 pandemic spread around the world and caused deaths worldwide. Within the context of Orange County, there were 226 cases requiring intensive care and 57 cases where the infection resulted in the death of the patient.[45]
- Measles: A 2015 localized outbreak of the measles began at Disneyland in Anaheim. Patient zero was not discovered, but the most likely cause of the outbreak was a visit to the theme park by a person who was a carrier of measles. This likely lead to measles infections to other visitors who were not vaccinated against the measles virus, the majority of whom were minors. By the end of 2015, OCHCA reported 35 instances of measles infections within the County. By 2016, all cases had been successfully treated and the outbreak was eradicated.[46,47]
- West Nile Virus: In 2014, all of California experienced a sudden outbreak of West Nile Virus infections, with most cases occurring within Orange County. By the end of the year, the California Department of Public Health reported more than 263 cases, though Orange County reports an even higher number of 280.[48] One middle-aged man and two seniors died as a result of being infected. The number of cases decreased dramatically in 2015 to 97 cases, though this was still high compared to the rest of the 2013-2017 period. In 2017, the number of cases had decreased further to 38 and, by 2018, the number of cases continued to fall to 12, the lowest number of West Nile Virus infections since 2012.[49]
- Zika Virus: In 2016 there were 30 reported cases of Zika Virus infections and 12 cases in 2017, an infection rate of 0.9% and 0.4% respectively.[50] All these cases resulted from residents traveling to foreign countries where the virus was active and then were diagnosed with the infection upon their return. There has never been any Zika infection that occurred within California itself.[51]
- COVID-19: In December 2019, COVID -19 was identified in Wuhan, China. As of June 10, 2020, COVID -19 has spread throughout the globe, with over 7 million confirmed cases, and approximately 404,000 deaths worldwide. Within the United States, there are over 2 million confirmed cases and over 114,000 deaths resulting from the virus.[52] Within Orange County 7,614 confirmed cases have been identified and 185 deaths as a result of the virus.[53]

Tree Mortality

GSOB and ISHB were first reported active in Southern California in 2012 and quickly spread across several counties in the state. The ISHB first emerged in coastal areas and then spread inland, with the first specimens at the campus of the University of California, Irvine being identified in 2015. By 2018, they were spread throughout all the County. Currently, there are reported cases of ISHB active in Irvine. For these cases, the City treats infected trees bi-annually.



The ISHB leaves behind small tunnels bored through the trunk of the host tree. Image from Monica Dimson.

The ACP has also been an ongoing risk to citrus trees in Southern California, where more than 500 cases have been reported as of 2018. As of 2019, the California Department of Food and Agriculture maintains a zone of quarantine throughout certain sections of Los Angeles and Orange counties for any citrus trees that are infected with Huanglongbing. This zone of quarantine includes parts of Irvine.[54]

Although advisories are in place, there are no recorded instances of Huanglongbing in Irvine. The current hotspot for this disease is in Anaheim and Garden Grove with a combined 446 trees confirmed positive for the disease.[55]

Risk of Future Events

Agricultural Pests

Future risks associated with agricultural pests are anticipated to occur, however as agricultural uses are eliminated within the City, the impacts are anticipated to be further reduced.

Epidemic/ Pandemic/ Vector-Borne Disease

Irvine is almost certain to continue experiencing influenza infections in the future. The 2018-2019 flu season resulted in 6,050 reported cases, which resulted in 16 deaths. As this disease has no completely effective vaccine, it is impossible to eradicate the illness from recurring in the City. Other diseases, such as the measles, can only be contained as far as the general population continue receiving inoculations against the disease. If residents, workers of, or visitors to Irvine were to stop receiving vaccinations against preventable diseases, it could cause a resurgence of such diseases within the City. Recent cultural trends in Southern California suggest that some members of the general public are not vaccinating their children which corroborates this scenario.[56] While it is not possible to predict whether or not this trend of anti-vaccination will gain traction in Irvine, there are no current indications that significant numbers of people living, working, or visiting the City are not taking the necessary precautions against the threat of preventable disease, including vaccinations.

Vector-borne diseases of concern, like the West Nile or Zika viruses, are not native to California and thus are not expected to gain significant traction in the future. As all cases of Zika Virus infection have occurred among those who have traveled to countries where the risk of infection is high, it can be expected that there will always be some degree of Zika Virus infection in Irvine as long as its residents, workers, and visitors travel to these countries. West Nile Virus infection rates tend to remain low but there are periods when infection rates suddenly rise, usually as a result of larger populations of mosquitoes. If mosquito

control measures are in place and effectively enforced, the infection rates in Irvine are expected to remain low. If large numbers of residents or businesses, however, do not follow proper procedure it is likely that the number of West Nile Virus cases could rise.

Tree Mortality

Given that no known instances of Huanglongbing have been reported in Irvine it is unlikely that a large outbreak would occur in the City. In Southern California, all cases of the disease have affected only citrus trees on private residences. It is anticipated that this same pattern would occur in Irvine, with citrus trees located on private residences being affected.

Regarding invasive pests, the City is more concerned about ISHB, GSOB, and Palm Weevil. The City is currently undergoing a tree inventory that will identify infected trees. Based on the results of this inventory, the City will implement a management program to manage and mitigate impacts associated with these pests. While the likelihood of a large outbreak is small within the City, staff understands that the only effective mitigation is removal of severely infected trees and managing and monitoring those that are still considered viable and managing the spread of the infestation.

Climate Change Considerations

Agricultural Pests

Climate change is expected to modify the historic ranges of agricultural pests and place greater stresses on crops leading to higher susceptibility to future impact.

Epidemic/ Pandemic/ Vector-Borne Disease

Climate change generally will lead to the overall warming of the Southern California climate which may cause insects, pests, and other vectors that carry disease to remain active for an extended part of the year. This possibility increases the threat of exposure to any infectious diseases that these pests carry. Additionally, vectors currently not active in Irvine and Southern California-at-large, may migrate into the area as a result of warmer temperatures. Mosquitoes carrying West Nile Virus and Zika Virus would have an extended range.[57]

Tree Mortality

Tree Mortality is expected to increase under climate change conditions. Climate change will increase the likelihood of more severe and frequent episodes of drought, which could likely reduce the amount of water being used for irrigation for Irvine's urban forest. When trees are under-irrigated, they become weaker and more vulnerable to infestation by pests. In this scenario, trees in Irvine would be more susceptible to infestation by ISHB which could increase the overall mortality rate of trees in the City.[58]

Drought

Description

A drought is a period in which water supplies become scarce. This can occur for a variety of reasons; in California, droughts occur when precipitation is limited for an extended period. Rain arrives in California via atmospheric rivers, channels of moist air located high in the atmosphere. When the atmospheric rivers bring less than usual moisture to California, it can reduce the overall amount of precipitation that falls on the state. Rain also comes to California as a result of the El Niño Southern Oscillation (ENSO) cycle, a

regional meteorological phenomenon in the southern Pacific Ocean consisting of variations in the temperature of the ocean water and air. These variations give rise to two distinct phases known as *El Niño*, the warm and wet phase, or *La Niña*, the dry and cold phase. When the *La Niña* phase is active, it can cause California to receive lower than normal levels of precipitation. A drought may also occur when infrastructure connecting communities to long-distance water sources begins to fail. This can occur due to deferred maintenance or may be the result of a natural disaster. For example, many Southern California cities would experience drought conditions should the State Water Project or Colorado Aqueduct become severed during a powerful earthquake event.

Location and Extent

Given Irvine's location, any drought that is significant enough to reduce water supply to southern California may have an impact on the City. However, City's water supplies are provided by IRWD, which has taken significant steps towards reducing water supply scarcity during a drought, the City may not feel the effects of drought in the same way other cities in southern California may. Approximately 65 percent of the City's water is sourced from groundwater from Orange County Water District. To supplement this water supply IRWD also uses imported water from 'MWD, which is sourced outside of southern California. The location of this water could be subject to a long-distance drought—a drought that occurs when a distant water source becomes less available. Given that most of Irvine's water comes from local groundwater sources, however, this type of event would have to be exceptional or prolonged for the City and its residents to feel the impact.

The U.S. Drought Monitor Classification Scheme is a common scale used to measure the impact of droughts in different communities across the United States. **Table 3-9** describes the category, description, and possible impacts associated with a drought event.

Past Events

Irvine, like the rest of California, has experienced many drought events throughout its history. Each event has been distinct, with varying lengths, severity, and frequency. One of earliest recorded major droughts in state history is known as the "Great Drought" which occurred in 1863 and 1864. This drought killed 46 percent of the cattle in the state and ultimately lead to the decline of cattle ranching in the state.[59] The "Dustbowl Droughts" lasting from 1928 to 1935 caused great impacts to the state's agriculture. The effects of this drought were so severe that it sparked the movement to create some of California's modern water irrigation infrastructure, such as the California Aqueduct. Another drought occurred in 1976 and 1977 which lead to agricultural losses estimated at nearly $1 billion. This drought lead to water-saving practices that are still in effect today across the state. Further water conservation practices were enacted during a drought lasting from 1987 to 1993 which caused agricultural damages at an estimated $250 million each year.[60]

Shasta Lake Reservoir seen during the 1976-1977 drought. Image from Steve Fontanini.

Table 3-9: U.S. Drought Monitor Classification Scheme[61]

Category	Description	Possible Impacts
D0*	Abnormally dry	Slower growth of crops and pastures.
D1	Moderate drought	Some damage to crops and pastures. Water bodies and wells are low. Some water shortages may occur or may be imminent. Voluntary water use restrictions can be requested.
D2	Severe drought	Likely crop and pasture losses. Water shortages are common, and water restrictions can be imposed.
D3	Extreme drought	Major crop and pasture losses. Widespread water shortages and restrictions.
D4	Exceptional drought	Exceptional and widespread crop and pasture losses. Emergency water shortages develop.

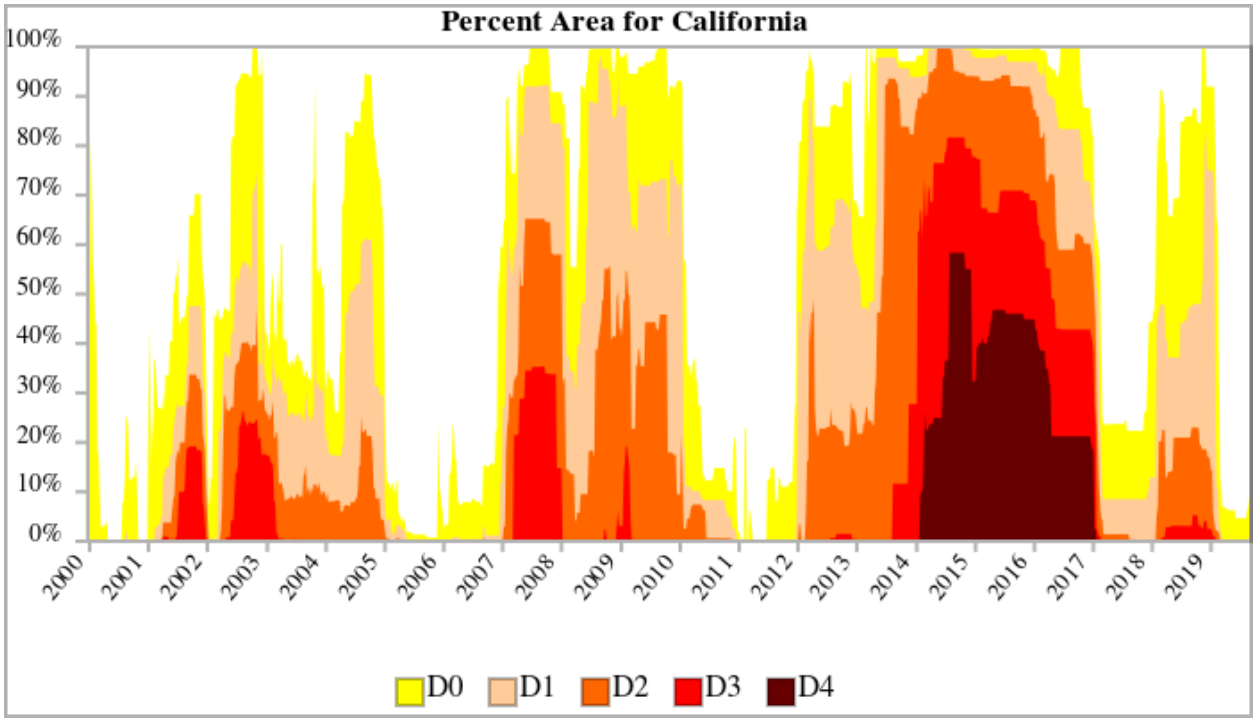
* D0 areas are those under "drought watch" but not technically in a drought. They are potentially heading into drought conditions or recovering from drought but not yet back to normal.

California experienced its most recent drought beginning in 2012 and lasting until 2017. All areas of the state were impacted and by 2014 it was reported as the most severe drought in 1,200 years**. Figure 3-2** illustrates the severity of the drought conditions experienced over the past 19 years. By summer of 2014, almost all of California was experiencing D2 (severe drought) conditions. Irvine, all of Orange County, and more than 75 percent of California was reported as experiencing D4 (Exceptional Drought) conditions. By 2015, emergency water-saving mandates were enacted, which required all jurisdictions to reduce water use by no less than 25 percent. In late 2016 and early 2017, successive heavy rains helped end the drought conditions in the state. The following winter in late 2017 and early 2018, rains did not return in the same quantity and slight drought conditions returned across California. This moderate drought was again abated in the winter season of late 2018 and early 2019 when heavy rains ended any existing drought conditions. As of August 2019, approximately 9 percent of California was experiencing at least D0 (Abnormally Dry) conditions, which were primarily relegated to San Diego, Imperial, San Bernardino, Orange, and Riverside Counties. Irvine is on the edge of these conditions, as depicted in **Figure 3-3** shows statewide drought conditions as of February 4, 2020.

Risk of Future Events

Drought will continue to be a foreseeable event in the future of California, including Irvine. Since most droughts are almost entirely contingent on global weather phenomena, which vary from year to year, it is impossible to predict either the frequency or severity of future drought events in Irvine. Droughts that result from infrastructure failure are equally impossible to predict since the circumstances that lead to infrastructure failure are unique to each situation.

Figure 3-2: Drought History (2000-2019)



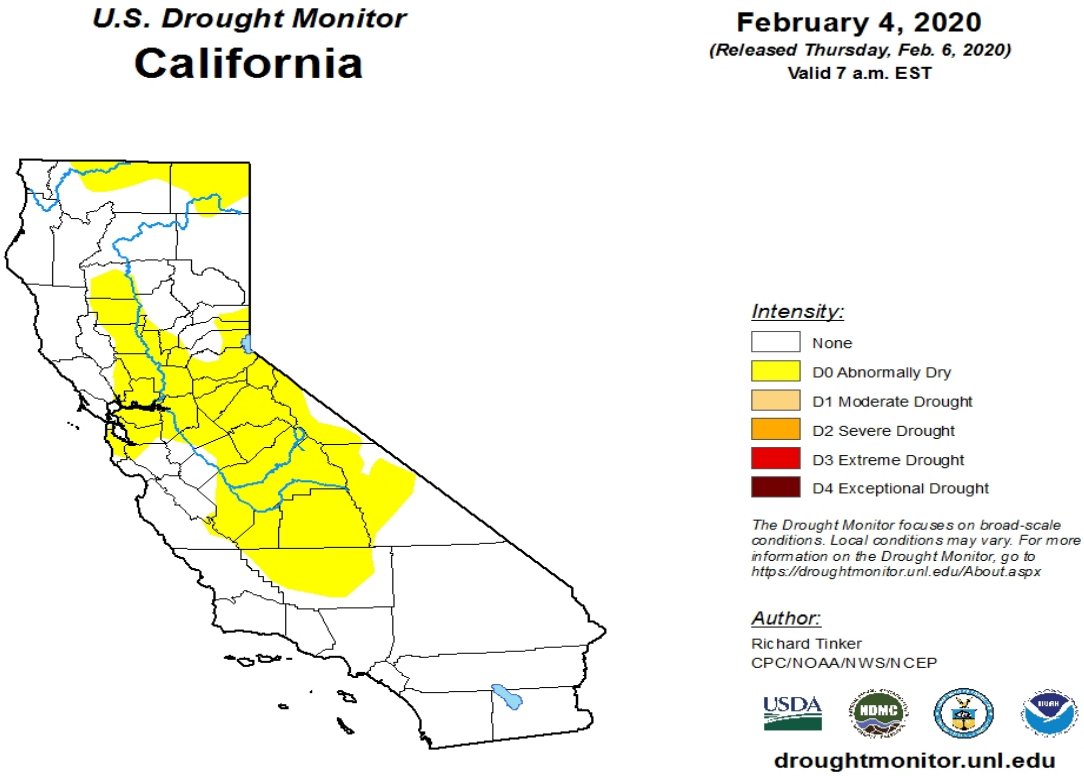
Climate Change Considerations

Climate change is anticipated to abate drought in certain situations but, on the other hand, could also intensify and exacerbate it in other cases. In some cases, climate change-intensified weather patterns, like ENSO, may bring more rain to California and Irvine which would abate drought conditions. In other years, climate change may also prolong the *La Niña* phase of ENSO which could lead to longer periods with no precipitation in California.

Climate change is also expected to increase the average temperature and cause more frequent and prolonged heat waves in California and Irvine. During these events, water supplies may be diverted for cooling functions in the City. Hotter temperatures may also lead to increased surface water evaporation which could lead to greater water consumption. If a drought were to occur during a future heat wave, it could place the water supply under strain.

From a regional perspective, warmer overall temperatures in California are anticipated to lead to a reduction in statewide water supplies. Much of California's water comes from melted snow in the High Sierra. As the average temperature grows warmer with climate change, the amount of precipitation that falls as snow is expected to shift towards rain. As less snow falls, the amount of melted water from the snowpack in the Sierra Nevada will decrease, reducing the water that will flow into the reservoirs and aqueducts that supply Southern California. This could place strain on the City's imported water supply, leading to greater reliance on Orange County's local groundwater. If regional water agencies, like OCWD, do not account for increased groundwater withdrawal, Irvine and the greater Orange County region could experience subsidence as a result.

Figure 3-3: Statewide Drought Conditions as of February 4, 2020



Flooding (Sea Level Rise)

Description

A flood occurs when land that does not normally have bodies of water becomes suddenly inundated with water. Flooding can occur after periods of heavy rainfall, whether it occurs as a single extreme episode or as a series of storms. Drainages and stream courses may flood their banks and shores if their capacity is exceeded by rainwater. When heavy rainfall hits an area where the ground is already saturated, the risk of flooding is high. In developed areas, the presence of pavement and other impervious surfaces means that the ground is less able to absorb water. As a result, rainwater must be carried away in storm channels or waterways.

Floods pose several threats to communities and public safety. Flooding can cause property damage, destroy homes, and carry away vehicles or other large debris. Topsoil and vegetation can be swept away by floodwaters, leading to erosion. Floodwaters may impede the movement of victims fleeing a flood or of first responders attempting to reach people in need of help.

As an inland community that has coastally influenced drainage infrastructure another concern that should be addressed is the potential influence of sea level rise on flood control infrastructure. In the case of

Irvine, a small portion of the flood control infrastructure in the northwestern corner of the City may be influenced by sea level rise in the future.

Location and Extent

Flood events are measured by their likelihood of occurrence. For instance, a 100-year flood is a flood that has a 1 in 100 (1.0 percent) chance of occurring in any given year. A 500-year flood is a flood that has a 1 in 500 (0.2 percent) chance of occurring in any given year. The 100-year flood has been designated as the benchmark for major flood events, and thus 100-year floods are referred to as "base floods."

Floodplains are areas that experience frequent flooding. While it is possible for areas outside of these designated floodplains to experience flooding, the most likely locations to experience future flooding are low-lying areas near bodies of water. FEMA is the governmental body responsible for designating which areas of the United States can be classified as floodplains. The three most common designations are:

- Special Flood Hazard Area: The area within a 100-year floodplain.
- Moderate Flood Hazard Area: The area outside of the 100-year floodplain but within the 500-year floodplain.
- Minimum Flood Hazard Area: The area outside of the 500-year floodplain.

Within these three designations, FEMA has multiple floodplain categories for each unique environment.

Table 3-10 shows these detailed floodplain categories.

Table 3-10: FEMA Flood Plain Categories[62]

Category	Description
A	Within a 100-year flood plain, but the water height of the 100-year flood is not known.
A1-30 or AE	Within a 100-year flood plain and the water height of the 100-year flood is known.
AO	Within a 100-year flood plain, and the water height of the 100-year flood is between one and three feet but not specifically known.
A99	Within a 100-year flood plain, protected by flood protection infrastructure such as dams or levees.
AH	Within a 100-year flood plain, and the water height of the 100-year flood is between one and three feet and is specifically known.
AR	Within a 100-year flood plain, protected by flood protection infrastructure that is not currently effective, but is being rebuilt to provide protection.
V	Within a 100-year flood plain for coastal floods, but the water height of the flood is not known.
V1-30 or VE	Within a 100-year flood plain for coastal floods and the water height of the flood is known.
VO	Within a 100-year flood plain for shallow coastal floods with a height between one and three feet.
B	Within a 500-year flood plain, or within a 100-year flood plain with a water height less than one foot (found on older maps)
C	Outside of the 500-year flood plain (found on older maps)
X	Outside of the 500-year flood plain (found on newer maps)
X500	Within a 500-year flood plain, or within a 100-year flood plain with a water height less than one foot (found on newer maps)
D	Within an area with a potential and undetermined flood hazard.
M	Within an area at risk of mudslides from a 100-year flood event.
N	Within an area at risk of mudslides from a 500-year flood event.
P	Within an area at risk of mudslides from a potential and undetermined flood event.
E	Within an area at risk of erosion from a 100-year flood event.

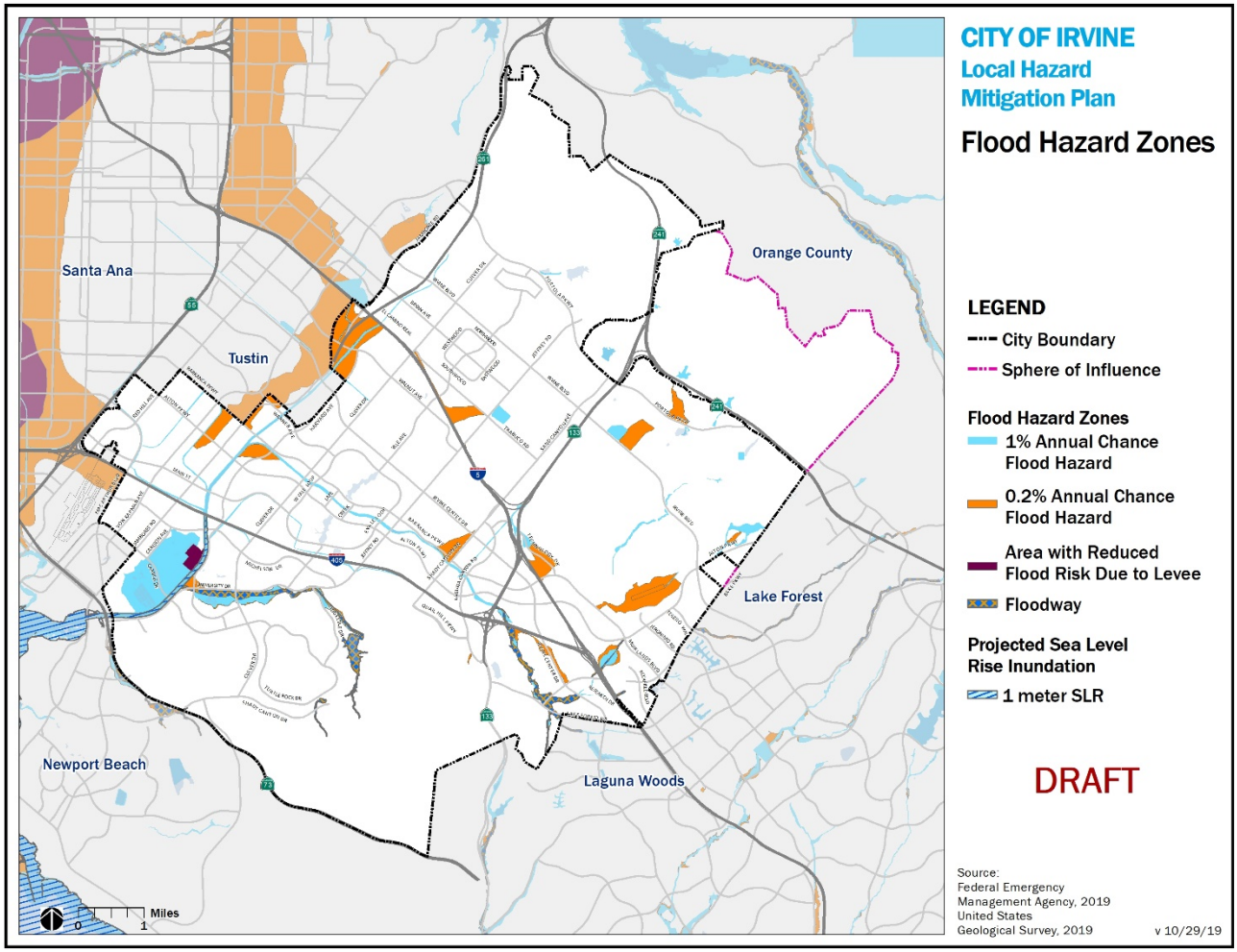
In Irvine the 100-year and 500-year floodplains are not contiguous areas but consist instead of various pockets across the city. Most of these areas fall within the major drainages within the City, which include:

- San Diego Creek
- Serrano Creek
- Borrego Canyon Wash
- Agua Chinon Wash
- Bee Canyon Wash
- Peters Canyon Wash
- Sand Canyon Wash

Figure 3-4 shows the mapped flood hazard zones for 100-year and 500-year flood events in Irvine. This map also depicts the 1-meter sea level rise data, which suggests that sea level rise may affect drainage along San Diego creek. To prevent potential flooding, Irvine has more than a dozen detention or retarding basins, generally located on, or adjacent to drainages within the City. Use of these facilities is intended to reduce downstream erosion by storing water for a limited period. These strategies can also assist with dam inundation impacts.

Floodplain mapping studies are provided by the National Flood Insurance Program. Irvine participates in the program by adopting FEMA-approved floodplain studies, maps, and regulations. These studies may be funded through federal grants; state, city, and regional agencies; and private parties. The program is designed for flood insurance and floodplain management applications.

Figure 3-4: FEMA Flood Zones



Past Events

Southern California is a semiarid region with inconsistent storm seasons and naturally shallow river channels. It was historically prone to floods that affected the entire region after long periods of rain. The largest flood in the Southern California region was in 1938, when several inches of rain fell over three days, causing rivers across the region to overflow. The Santa Ana River overflowed, flooding areas in Fullerton and Anaheim. The Fullerton and Brea dams were constructed in the aftermath of this flood, with money from the Works Progress Administration. Widespread flood-caused destruction across Southern California led numerous local governments to pursue a campaign of concretizing riverbeds, including rivers and creeks in Orange County, to prevent erosion. The following is a list of recorded flood events in Orange County:[63,64,65]

- Between December 1861 to January 1862, a 30-day-long period of rain called the "Noachian Deluge of California" poured across all of California. The Santa Ana River overflowed and spread across all the low-lying areas of Orange County between Anaheim and the Coyote Hills (present-day Fullerton) in a four-foot-deep sea. Twenty deaths were recorded in Orange County alone.

- Heavy rains in January 1916 caused 22 deaths, widespread flooding, and the destruction of several boats moored at Newport Beach.
- The most extensive flooding in Southern California history occurred in late January 1916, when 8 to 58 inches of rainfall were recorded in various measuring stations across the region. Numerous dams breached, resulting in property damage and loss of life. Four people died in Orange County.
- In 1922, heavy rains flooded various rights-of-way across the region, and the Santa Ana River exceeded its normal surface elevation by three feet.
- Heavy rains on New Year's Eve and Day of 1934 impacted cities across Southern California. In total, 45 people lost their lives, and some canyons became inundated with floodwaters 10 feet high.
- A 1937 rainstorm in February deposited 4.25 inches of rain in nearby Long Beach. A few people were killed in the ensuing flooding, and some dams failed across the region.
- In 1938, the deadliest flooding event in Southern California history was caused by a tropical storm. Up to 30 inches of rain fell in the mountain areas, including 22 inches at the point of origin for the Santa Ana River watershed. In Orange County, 45 died, including 43 in Atwood (now part of present-day Placentia).
- In 1939, a tropical storm brought heavy rain to all Southern California, resulting in 45 deaths on land and 48 more deaths at sea.
- In November 1963, heavy rains fell on Southern California. More than three inches were recorded in coastal Orange County locations. The flooding injured 6 people.
- A December 1964 rainstorm caused flooding that killed 40 people across Los Angeles and Orange Counties.
- Heavy storms in November 1965 dropped between 16 and 20 inches of rain in the mountains of Southern California, causing regional flooding and 15 deaths.
- In January and February 1969 rain fell almost continuously from January 18 to January 25, resulting in widespread flooding. Orange County was declared a national disaster area on February 5. A second storm hit on February 21 and lasted until February 25 bringing rain to the already saturated ground. This second storm culminated in a disastrous flood on February 25. The storm resulted in the largest peak outflow from Santiago Reservoir since its inception in 1933. The reservoir at Villa Park Dam reached its capacity for the first time since its construction in 1963; the dam had a maximum inflow of 11,000 cubic feet. The outlet conduit was releasing up to 4,000 cubic feet yet the spillway overflowed at 1:30 p.m. and continued for 36 hours. The maximum peak outflow from the dam reached 6,000 cubic feet. Although the safety of the dam was never threatened the outflow caused serious erosion downstream in the cities of Orange and Santa Ana and in some parks and golf courses. A Southern Pacific Railroad bridge, water and sewer lines, a pedestrian over crossing, and three roads washed out. Approximately 2,000 Orange and Santa Ana residents were evacuated from houses bordering Santiago Creek. In January 1995, flooding inundated the region, causing an estimated $55 million in property damage and prompting a federal disaster declaration.
- In February 1998, all Southern California was impacted by heavy rains when 2 to 5 inches fell across the region. Many roads and bridges were washed away, or destroyed, and widespread power outages occurred. Property damage reached $100 million worth, and two people lost their lives. Irvine was directly impacted by many of these issues during this event.

- In March 2003, 3 to 7 inches of rain fell on Southern California, causing region-wide flooding. Water reached depths of up to three feet on some roadways, causing over 1,000 vehicle collisions.
- In January 2011, California received a Presidential Declaration for the Severe Winter Storms, Flooding, and Debris and Mud Flows that occurred over a nearly three-week period. During this incident, the State of California incurred well over $75 million in damages, of which over $36 million occurred within Orange County. Much of the damage impacted private and public property, as well as critical infrastructure.
- In 2014 heavy rains affecting most of Southern California caused flooding on a section of Bastanchury Road that was nearly a foot deep. Nearby weather stations reported that more than an inch of rain had fallen in a span of three hours.
- In September 2015, flooding of roadways caused severe traffic congestion across Southern California, including Orange County. In the City of Los Angeles, 7,300 people lost power for most of the day, and there more than 500 traffic collisions across the entire region as a result of the road conditions.
- 2017 Winter Storms[66] included three storms over six days inundating southern California. Heavy rains, combined with already saturated soil, produced flash flooding across much of Orange County. Streets flooded with 1 to 3 feet of water in Huntington Beach, Santa Ana, and Newport Beach. The storms resulted in a Presidential Disaster Declaration for 16 counties throughout the state.

Risk of Future Events

There is no indication that the severe rainfall that leads to flooding will abate in the future, either in Irvine or the greater region of Southern California. While Irvine may experience prolonged periods of dry or wet years, flood events will likely continue to impact the city. For areas within the 100-year and 500-year flood hazard zones, the likelihood of flooding to occur on an annual basis is 1% and 0.2%, respectively.

Climate Change Considerations

Climate change is expected to alter the frequency of intense precipitation events throughout California, including Irvine. Intense rainfall is expected to occur more frequently (perhaps twice as often by the end of the 21st century) and potentially drop more rain (up to 40 percent more). These projected changes likely mean that Irvine will experience more frequent and more intense flooding, potentially leading to erosion, dam failure, tree mortality, and other potential hazards.

Geologic Hazards

For the purposes of this plan, geologic hazards include landslides and subsidence.

Description

Landslide

Landslides occur when earth on slopes become destabilized, typically after heavy rains, when the precipitation saturates the soil and makes it less stable, or when significant erosion from rainfall destabilizes the ground. Slopes that have recently burned face a greater risk from rain-induced landslides,

as the fires burn up many of the trees, brush, and other vegetation that help stabilize the earth. Earthquakes may also be a source of landslides as the shaking can destabilize already loosened soils.

Subsidence

Subsidence occurs when the level of the ground decreases, as if the surface is sinking. Subsidence can either be sudden (as in a sinkhole) or happen gradually over time. It can be caused by mining, groundwater pumping, or fossil fuel extraction, creating empty underground spaces that can collapse and cause the soil above to drop. Erosion, natural cave collapses, and seismic activity can also cause subsidence.

Location and Extent

Landslide

There is the potential for landslides in the steeper portions of the foothills of the Santa Ana Mountains to the northeast of the City and the San Joaquin Hills to the southwest of the City. These areas are characterized with steep topography and geologic units that can become unstable. **Figure 3-5** identifies the areas of the City that are considered vulnerable to seismic induced landslides. Even these areas, however, are designated as having a moderately low risk of landslides due to seismic conditions, and a low likelihood of a landslide under other conditions (Dept. of Conservation 1976). While no definitive scale for measuring landslides exists, landslide events are usually measured using the amount of material that is displaced (i.e. the cubic feet of earth that moved). In addition, to these landslide hazards, the California Geological Survey has mapped deep seated landslide hazards, which uses a scale of landslide susceptibility that is based on slope steepness and the strength of the underlying rock, with 0 being no susceptibility and 10 being the highest susceptibility. **Figure 3-6** identifies the deep-seated landslide susceptibility for Irvine. Areas in the foothills of the Santa Ana Mountains and San Joaquin Hills show the greatest susceptibility within the City.

Subsidence

The City identified that the most likely locations for subsidence in Irvine are the low-lying areas that sit on top of the OCWD groundwater basin. Other sections of the city are potentially subject to subsidence in the event of a major earthquake (M_w 5.0 or greater), although Irvine does not have a history of seismically induced subsidence. In terms of extent, subsidence is typically measured by the distance that the ground has sunk from its original elevation (i.e., in feet or inches) or by using the rate of subsidence (i.e., inches or centimeters per year).

There is evidence of subsidence in most of Orange County as a result of excessive groundwater pumping in the first half of the 20th century, prior to the development of the California State Water Project, which siphons water from the Owens Valley.[67] Currently it is estimated that the greater LA Basin (including Orange County) experiences approximately 20 mm of net subsidence seasonally due to groundwater pumping and artificial recharge.[68]

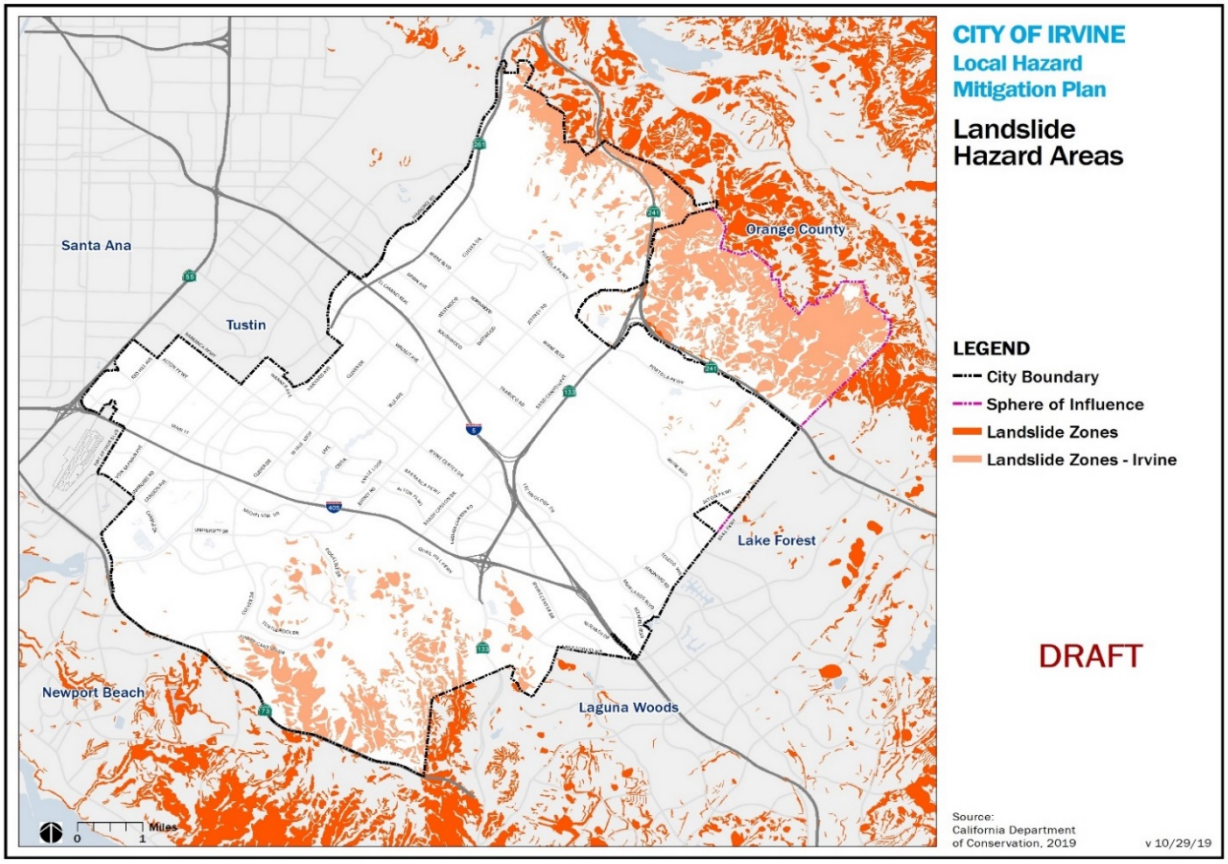
Past Events

Landslide

Major landslides have occurred throughout the Southern California region. For example, landslides were set off by the 1971 San Fernando and 1994 Northridge earthquakes.[69] As a master planned community,

the City of Irvine has taken numerous steps to mitigate landslide hazards as part of the development process. As a result, the City has not experienced significant landslide events.

Figure 3-5: Landslide Hazard Areas



Subsidence

According to data from the USGS, there are records of historical and current subsidence in Orange County as a result of excessive groundwater pumping in the first half of the 20th century, as discussed above. Due to better management practices promoted and monitored by OCWD, the overall risk of subsidence has decreased, though areas of isolated subsidence could still occur.

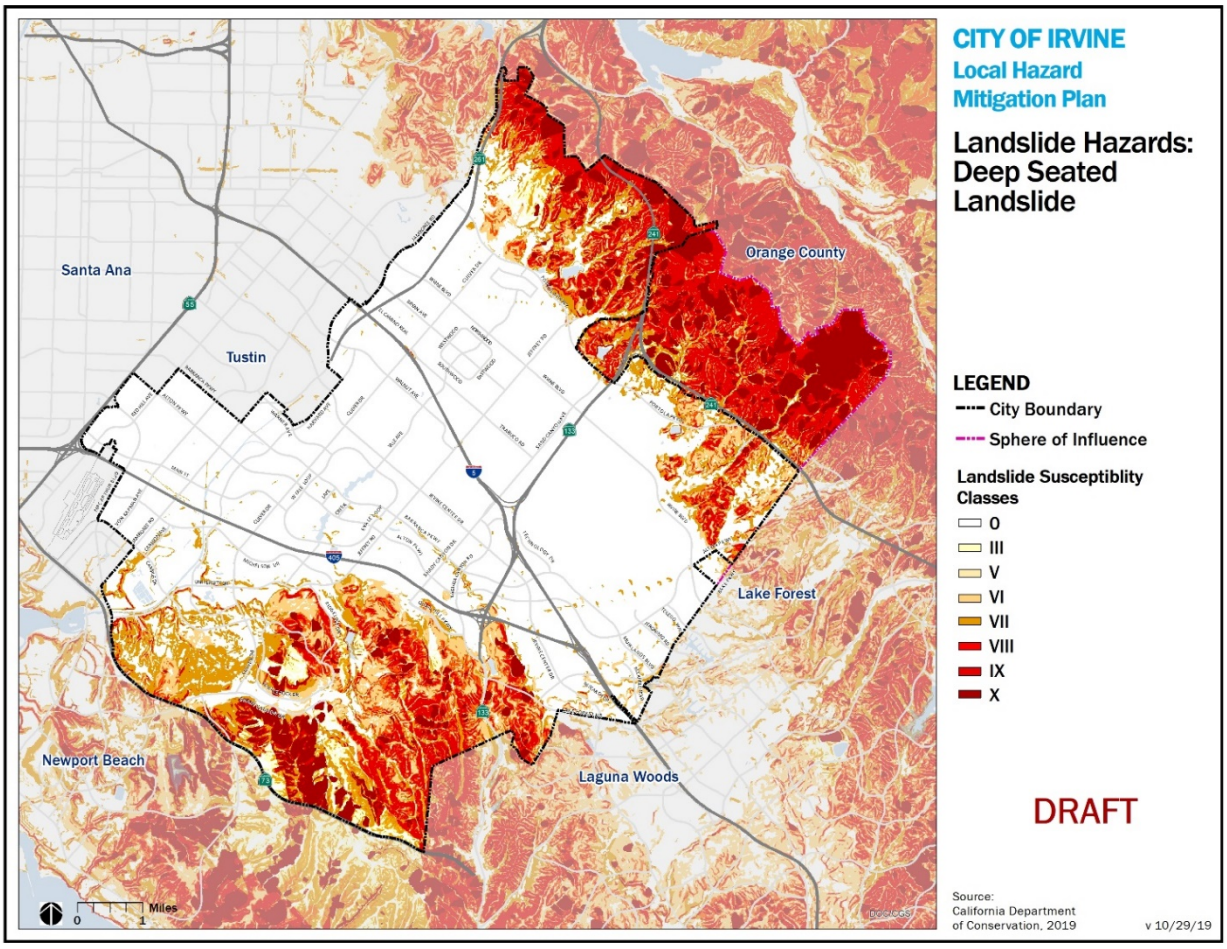
Risk of Future Events

Landslide

Given the topography and geologic units within the foothills of the Santa Ana Mountains and San Joaquin Hills, it is anticipated that landslide risk will remain high in those areas. However, the City requires mitigation of these types of conditions, which reduces landslide potential in the developed areas of the City. Regarding seismic activity, as Figure 3-6 illustrates areas of the foothills of the Santa Ana Mountains and San Joaquin Hills that have the potential to fail during an earthquake. Destabilization of slopes and hills due to intense rainstorms also has the potential to cause future landslides. These can be further

exacerbated after a wildfire, where vegetation becomes loosened and therefore more susceptible to becoming part of a future landslide. Overall the probability of future occurrence within Irvine is considered occasional.

Figure 3-6: Deep Seated Landslide Potential



Subsidence

Since Irvine has not experienced acute subsidence events, it seems unlikely that subsidence will occur in the city's future. The most likely cause of a future event would be linked to an extreme drought in the future that leads to intensified groundwater withdrawals from the groundwater aquifer. In addition, the City's proximity to seismically active faults suggest the potential for a significant earthquake exists, which could lead to seismically induced subsidence in the future.

Climate Change Considerations

Landslide

Due to the variety of factors that lead to landslides, it is possible that climate change could indirectly affect the conditions for landslides. More frequent and more intense rains may cause more moisture-induced landslides. Warmer temperatures and more frequent drought conditions may lead to more fires, which could destabilize soils and make future landslide events more likely.

Subsidence

The relationship between climate change and subsidence is not well established. Nevertheless, it is possible that climate change could indirectly influence subsidence in Irvine. While more intense

rainstorms could potentially recharge underground aquifers, adequate infrastructure would need to be available to accommodate this water, allowing for greater recharge. If this recharge could occur, it could reduce the risk of subsidence. On the other hand, more severe and prolonged periods of drought may encourage more groundwater withdrawals and increase the risk of subsidence.

Hazardous materials Release

For the purposes of this profile, this section discusses hazardous materials release events. Two key facilities identified in this profile are the closed landfills (San Joaquin, Lane Hill) located in the northwest part of the City close to UC Irvine.

Description

Hazardous materials release refers to a hazard event whereby harmful concentrations of hazardous or toxic substances are released into the environment. This occurs when storage containers of hazardous materials leak or fail. This can happen due to industrial accidents, vehicle crashes, as a direct result of other disasters (e.g., a flood or earthquake), or as a deliberate act.

The threat that hazardous materials pose to human health depends on the type of material, frequency and duration of exposure, and whether chemicals are inhaled, penetrate skin, or are ingested, among other factors. Exposure to hazardous materials can result in short- or long-term effects, including major damage to organs and systems in the body, or death. Hazardous waste is any material with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous materials can also cause health risks if they contaminate soil, groundwater, and air, potentially posing a threat long after the initial release.

As part of this analysis, the City also identified the potential environmental justice issues associated with hazardous materials. The mapping prepared uses the CalEnviroScreen[70] data set from the California Environmental Protection Agency (Cal EPA). This dataset helps identify California communities that are most affected by many sources of pollution, and where people are often especially vulnerable to pollution's effects. The dataset uses environmental, health, and socioeconomic information to produce scores for every census tract in the state that are mapped using a scale based on the pollution burden of the location. The higher the percentage, the greater the burden and the higher likelihood of environmental justice concerns.

Location and Extent

Hazardous materials and chemicals are used daily in households and businesses throughout Irvine. In addition to the locations of large industrial uses, sources of hazardous materials can originate from seemingly harmless places such as service stations, dry cleaners, medical centers, and almost any industrial business. Hazardous waste can take the form of liquids, solids, contained gases, or sludge, and can be the by-products of manufacturing processes or simply discarded commercial products, like cleaning fluids and pesticides.

In severe situations, Irvine may also be at risk of hazardous materials release events on a regional level. With the right prevailing wind conditions, airborne toxic material could spread to and impact various parts of the air basin, including areas of Irvine.

Figure 3-7 identifies stationary hazardous materials locations within Irvine that store, use, or produce hazardous materials, regulated by the state. While these locations are fixed, roadways throughout the community are commonly used for the transport of hazardous materials and waste. These facilities are common locations for spills and releases. While there is no extent scale for hazardous materials release, the probability of an incident is anticipated to be occasional (less than 10% chance of occurrence) each year.

Past Occurrences

Irvine has experienced an average of 23 hazardous materials spills reported to the Cal OES Spill Release Reporting database. Most of these incidents involve sewage and petroleum products. **Table 3-11** identifies the yearly releases reported to Cal OES.

Table 3-11: Irvine Spill Release Reporting

Year	Reported Releases
2010	20
2011	22
2012	35
2013	26
2014	19
2015	26
2016	14
2017	22
2018	26

Data collected from https://www.caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/spill-release-reporting

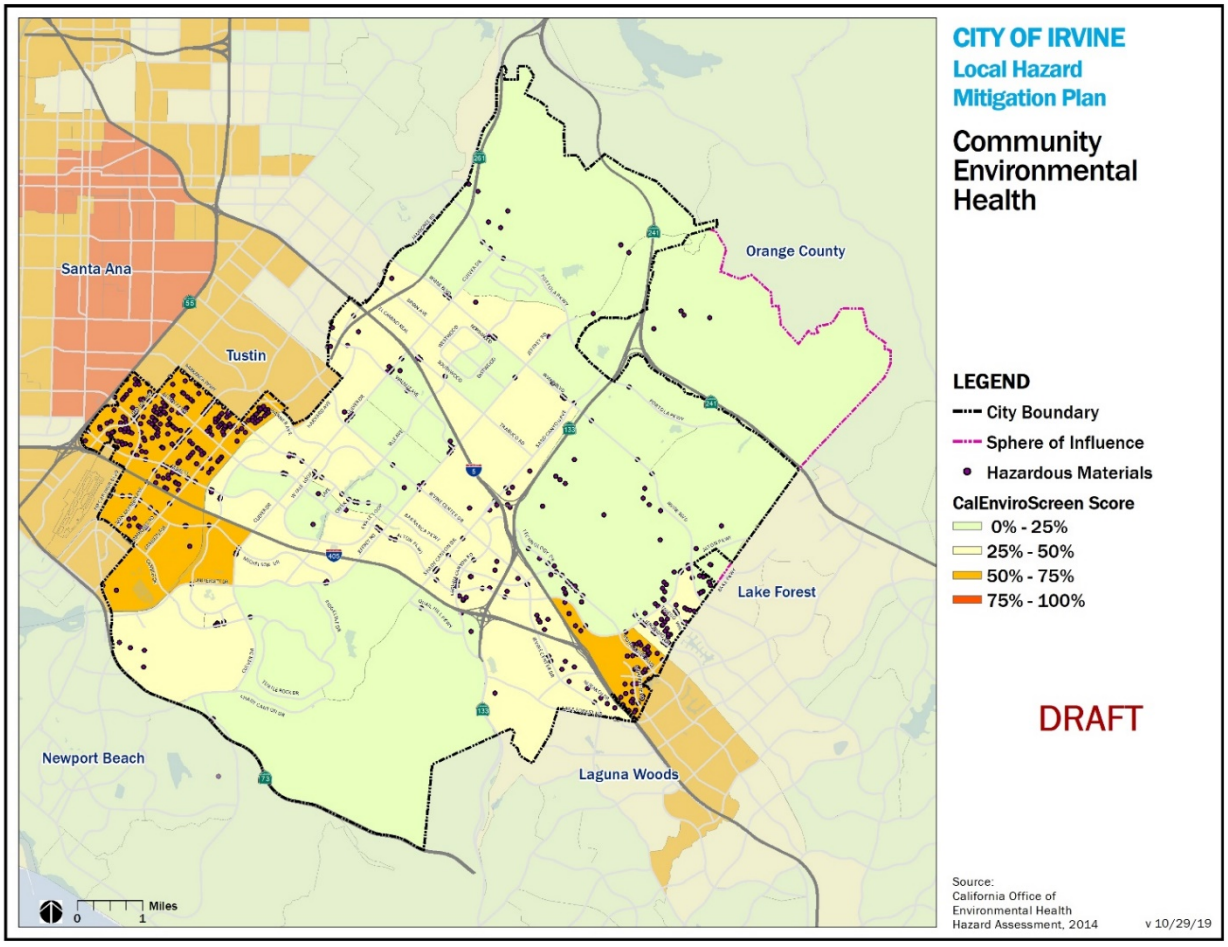
Probability of Future Events

Most of the release events within Irvine have occurred due to human error, malfunctioning equipment, or as a deliberate act. Given this, it is anticipated that future events within Irvine will include minor incidents like past occurrences identified above. A key element identified in Figure 3-6 is the density of hazardous material sites that may contribute to environmental justice issues within the community. Activities to prevent future releases as well as response strategies should take this into consideration.

Climate Change Consideration

Climate-related natural hazard events, such as an intense flood, could cause hazardous materials release associated with transportation crashes or damage to storage containers or vessels containing these substances. Climate-related hazards could also exacerbate the effects and impacts of such events. For example, more intense rains could lead to more runoff from a site that is contaminated with hazardous materials. These issues should be monitored during the 5-year implementation period of this plan.

Figure 3-7: DTSC Hazardous Materials Locations



Human-Caused Hazards

For the purposes of this plan, numerous hazard profiles have been grouped under human-caused hazards. These hazards are transportation accident, mass-casualty incident/terrorism, civil disturbance, cyber threats, and infrastructure failure.

Description

Transportation Accident

A transportation accident is a crash or other failure involving a vehicle, including a car, truck, or train. This can be the result of the vehicle operator making an error or environmental conditions that prevent the vehicle from being safely maneuvered. Examples of transportation accidents include automobile crashes, freight truck collisions, and train crashes or derailments. Aviation transportation accidents are discussed separately under Aircraft Incidents in this Chapter. It should be noted that small-scale incidents, such as a minor collision between automobiles, would not count as a hazard. A large-scale collision, however, that involves multiple vehicles and shuts down a freeway interchange, or key underpass could present a hazard

to Irvine because it could deter first responders from reaching victims or prevent residents from evacuating quickly.

Mass Casualty Incidents/Terrorism

A mass casualty incident describes an incident within the United States in which emergency medical service resources, such as personnel and equipment, are overwhelmed by the number and severity of casualties. The more commonly recognized events of this type include building collapses, train and bus collisions, plane crashes, earthquakes, and other large-scale emergencies. The most common types are generally caused by terrorism, mass-transportation accidents, or natural disasters. Events such as the Oklahoma City bombing in 1995 and the September 11 attacks in 2001 are well-publicized examples of mass casualty incidents.

Terrorism is the use or threat of force to achieve a particular social or political outcome. The goals of terrorism may sometimes be the overturning of a government, the reversal of a public policy, the release of political prisoners, and other such motives. Acts of terror may overlap with acts of war or hate crimes. Generally, terrorism involves an attempt to kill or seriously harm people, or an attempt to disrupt civil society by destroying property or infrastructure, attacking government operations at all levels, interrupting essential public services, creating chaos, or a combination of some or all these goals. Firearms and explosives are the most common weapons used among terrorists. In extreme situations, terrorists may gain access to weapons of mass destruction, which may include bioweapons, chemical agents, radioactive materials, or high-yield explosives. It should be noted that these events are very rare. While incidents of terror caused by foreign individuals or groups receive significant media and public attention, most acts of terror in the United States have been caused by domestic terrorists.

Civil Disturbance

A civil disturbance is an event when the normal operations of the city are either threatened or temporarily interrupted by events such as violent protests, riots, shootings, and armed standoffs. Civil disturbances can occur at a single time or be a string of related events. Property damage of businesses, government facilities, or homes can occur during these events. In extreme situations, death and injury may result from civil disturbances.

Cyber Threats

Cyber threats are when an individual or a group threatens or attempts to disrupt the operations and functioning of the computer systems belonging to private citizens, religious groups, educational institutions, government agencies, or businesses. These threats take the form of online harassment, hacking, or in-person tampering with electronic equipment. Successful cyber threats can lead to service disruptions, infrastructure damage, theft, and in severe instances may cause injury or death.

Infrastructure Failure

Infrastructure failure is when a piece of infrastructure fails in such a way that it creates a threat to people, property, or other community assets. Generally, infrastructure failure is categorized into two threats: active or passive. During an active threat, infrastructure fails, releasing a substance that is harmful or potentially harmful, such as a broken wastewater line that releases untreated sewage. A passive threat involves infrastructure that cannot perform its function. The failure itself is not dangerous, but under the right circumstances, the failure can increase the risks to people or property. For example, a clogged storm drain is not directly dangerous, but can lead to flooding during a storm. Some infrastructure failures may

be both active and passive. For example, a broken power line is directly dangerous (it creates a threat of electrocution, and the wires may spark a wildfire) and creates an indirect risk (the loss of electricity service can be harmful during hot weather).

Infrastructure failures often occur as an effect of a natural hazard, such as floods or high winds. Failures can also occur as a result of human error, deliberate action, or because the infrastructure was not properly maintained and failed as a result of overuse or wear and tear. Some infrastructure failures can directly cause other hazard situations. Utility lines (power lines, water and wastewater pipes, natural gas lines, etc.), flood control and drainage infrastructure, erosion control measures, and other forms of infrastructure can all create hazardous situations in the event of a failure.

Location and Extent

Transportation Accidents

Arterial streets like Harvard Ave, University Dr, Jamboree Rd, Culver Rd, Jeffrey Rd, San Canyon Ave, Main St, Alton Pkwy, Irvine Center Dr, Trabuco Rd, Irvine Blvd, and Portola Pkwy accommodate a large amount of traffic circulation through the City. These roadways in addition to the major interstates/ state routes accommodate local and regional transportation needs throughout Irvine and Orange County. Any one of these major transportation corridors could be the site of a transportation accidents that could affect the community and surrounding areas. Generally, the scale used to measure transportation accidents is the amount of damage to the vehicle and level of injury and/or death caused to people.

Mass Casualty Incidents/Terrorism

Mass Casualty Incidents can occur anywhere, although public spaces and locations where a lot of people congregate (parks, schools, places of worship, government facilities, shopping centers, and areas of public gathering) are most common. Key locations in Irvine may be large shopping centers (i.e. Irvine Spectrum), governmental facilities (i.e. City Hall), universities (i.e. UC Irvine), schools, hospitals (i.e. Kaiser/Hoag), parks (i.e. Orange County Great Park), and large employers in the Irvine Business Complex and Irvine Spectrum.

Acts of terrorism may be located at the locations listed above, however the perpetrators may also choose high value targets such as electric-generating facilities, water treatment plants, dams or reservoirs, railroads, highways, and other facilities that could impact governmental services.

Mass Casualty Incidents and acts of terrorism are typically measured by the fatalities, injuries, and destruction they cause but there is no universally used scale for measuring these events.

Civil Disturbance

Civil disturbances can arise at any time and place for a variety of reasons. There are, however, some places where such events are more likely to emerge, including local, state and federal government centers, jails, police stations, major businesses, university campuses, and places of public assembly. Many of the locations listed in the Mass Casualty Incident/Terrorism description above would be locations for these types of incidents as well.

No definitive scale for measuring civil disturbance events exits, but several metrics may be used individually to determine a civil disturbance event's impact. These measures include:

- Number of facilities affected
- Number of fatalities
- Monetary loss
- Interruptions to communications infrastructure
- Number of people protesting
- Impacts to certain socioeconomic groups[71,72]

Cyber Threats

Since computers are so ubiquitous, a cyber threat could appear in virtually any part of the city. In extreme circumstances, a threat could impact the entire city. Cyber threats vary in their length and severity in impact. A minor threat could simply cause computer systems to slow down for a few minutes and not behave as responsively. On the other hand, a major cyber threat could cause a complete shutdown of critical systems, including those used by banks, healthcare institutions, universities, major businesses, and city government.

Cyber threats are not measured in any scale, but they can be assessed by determining:

- The type of incident (website defacement, denial of service, unauthorized surveillance).
- The use of malicious software.
- The level of security countermeasures that failed in preventing the cyber threat.
- The duration of the cyber threat (a few hours, a few days, several weeks, etc.).[73]

Globally cyber threats are increasing and becoming more sophisticated. The most common types of attacks include:

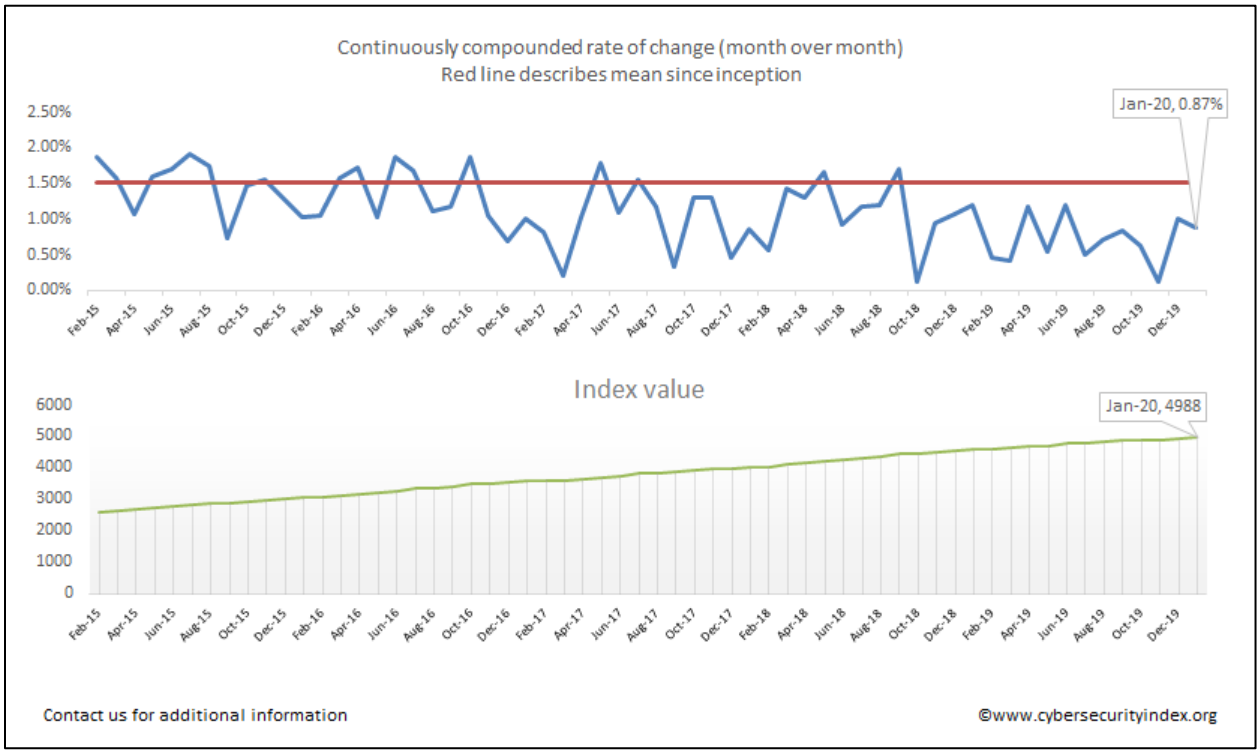
- Phishing
- Ransomware
- Intellectual Property Theft
- Spyware/Malware
- Unpatched Software

To understand the status of cyber threats, the Index of Cyber Security, **Figure 3-8**, can be referenced, which identifies the measure of perceived risk. Since 2015 this index has trended upward and appears to have doubled in this timeframe.

Infrastructure Failure

Infrastructure failure may happen anywhere. The specific risk of any individual piece of infrastructure failing depends on the type of infrastructure, the conditions that it is exposed to, and how well it is maintained. Although no piece of infrastructure is completely safe, infrastructure that is well maintained and protected from degradation as much as possible is less likely to suffer failure. There is no scale for infrastructure failure. Key pieces of infrastructure that serve a critical function to the community are analyzed as part of the threat assessment in Chapter 4.

Figure 3-8: Index of Cyber Security



Past Events

Transportation Accidents

Irvine has experienced several prior transportation accidents, including:

- November 2019, three men were killed and a fourth left in critical condition, when a vehicle crashed into a tree in Irvine.[74]
- July 2017, two women killed, 1 man critically injured after car shears off fire hydrant in Irvine.[75]

Mass Casualty Incidents/Terrorism

The following mass casualty incidents/ terrorism events have occurred within Irvine or it's vicinity, that may be relevant to the community:

- A 1970 bombing of the Stanford Research Institute facility, which caused approximately $500,000 in property damage. No injuries or deaths occurred during this incident.[76]
- A 1970 bombing of a Bank of America Branch, which caused approximately $500,000 in property damage. No injuries or deaths occurred during this incident.[77]
- A teenager was arrested in 2014 who was reported as having threatened terrorist action against event attendees of the U.S. Open of Surfing.[78]
- In May 2015, two Anaheim-based men were arrested at a Transportation Security Administration checkpoint at the Los Angeles International Airport who had reportedly sworn allegiance to the

Islamic State of Iraq and Syria (ISIS). One of these men, Muhanad Badawi, was a student at Fullerton College.[79]

- In December 2015, a mass shooting and terrorist attack committed by a married couple who had reportedly sworn allegiance to ISIS killed 14 people at a medical facility in San Bernardino.[80]

Civil Disturbance

Irvine does not have an extensive history of civil disturbances; the following are some notable events that have occurred in southern California:

- On August 11, 1965 the Watts riots were triggered by the traffic stop that escalated to an argument and eventually a fight between the police officers, the driver, and family members. Community members observing the incident reported that the police had roughed up the drive and kicked a pregnant woman, the crowd of observers quickly grew, transforming the area into combat zone for the next six days.[81]
- On April 29, 1992 a series of riots and civil disturbances occurred in Los Angeles County. The spark that triggered this event was the acquittal of four LAPD police officers for use of excessive force and beating of Rodney King. Rioting occurred across a six-day period across the LA metro area. During these riots, 63 people were killed, 2,383 people were injured, more than 12,000 people were arrested, and over $1 billion in property damage occurred.[82]

Cyber Threats

The City of Irvine has not experienced cyber incidents directly. However, several jurisdictions in southern California and across the country have. Several recent incidents include:

- On December 24, 2019, the City of Seal Beach was the victim of a ransomware attack that affected City computer systems. The attack was targeted at the City's Information Technology service provider, which allowed the hackers to encrypt City computers with the malware, primarily impacting city email and voicemail functions.
- On December 4, 2019 the Cucamonga Valley Water District disclosed a data breach that occurred between August 26, 2019 and October 14, 2019. The breach occurred on a server that is used to accept one-time credit card payments from customers.
- On March 11, 2019, the Orange County Sanitation District was the victim of a phishing data breach. Over 1,000 employee records were accessed as part of the breach through the District deferred compensation plan.

Infrastructure Failure

Irvine has suffered occasional infrastructure failures before, however most of these incidents have been minor and not caused catastrophic harm to businesses and residents. Breakage of underground pipes and/or overhead lines have occurred as the result of failure, human, error, or as the result of other events like severe weather or flooding.

Risk of Future Events

Transportation Accidents

It is a certainty that transportation accidents will continue. While it is possible to guard against such events and implement safety measures, it is impossible to prevent all future events. The large volume of traffic

on streets and highways in and around Irvine also makes it likely that future accidents will occur with the potential to cause delays or detours in and around the City and potential damage critical roadways/infrastructure.

Mass Casualty Incidents/Terrorism

Given that mass casualty incidents and acts of terrorism stem from a variety of factors: economics, societal pressures, mental health, global geopolitics, warfare, and religion, etc.—it is impossible to predict when an incident occurs. While Irvine does not feature facilities of critical national or state importance, it is likely that future incidents would originate domestically and is less likely to attract the attention of international terrorist groups. Incidents of these types are more likely to be conducted by smaller organizations or individuals aligned with greater known organizations, although the effects may be no less significant.

Civil Disturbance

While civil disturbance events may be rare, there is still a possibility that they could occur in the future in Irvine. Given that several civil disturbance events have occurred at college campuses in the past, it is safe to say that locations like UC Irvine may be areas where such events could emerge in the future. Other locations may include the Irvine Spectrum, Irvine Business Complex, and Irvine Great Park, where large groups of people tend to congregate.

Cyber Threats

Due to the integrated nature of technology into the everyday lives of Irvine's residents, businesses, and government operations, it is possible that a cyber threat could emerge in the future. While no cyber threats are publicly known to have disrupted the City's normal operations in the past, the likelihood of a cyber threat affecting the residents, businesses, and/or governmental operations in the future is increasing.

Infrastructure Failure

Infrastructure failure events are expected to continue in Irvine. Events such as clogged or broken storm drains, damaged power lines, and ruptured water and wastewater pipes are likely in the future, particularly as infrastructure ages and new hazards present themselves. More serious but less frequent forms of infrastructure failure may also occur, particularly if key infrastructure is not well maintained.

Climate Change Considerations

Transportation Accidents

Climate change is not likely to impact transportation accidents in the future within Irvine.

Mass Casualty Incidents/Terrorism

The link between mass casualty incidents/terrorism and climate change is not well understood. It has been suggested, however, that the impacts of a changing climate may exacerbate existing social, political, religious, and ethnic tensions. For example, longer, more intense droughts may restrict food supply or place limits on economic growth for cities, regions, or even whole countries. Nevertheless, the likelihood of climate change impacting mass casualty incidents/acts of terrorism in Irvine is negligible, since these changes are more likely to impact developments on the national or international level.

Civil Disturbance

Climate change is not likely to impact future civil disturbances in Irvine.

Cyber Threats

Climate change is not likely to impact cyber threats in the future within Irvine.

Infrastructure Failure

Infrastructure failure that is caused by other hazard types may be affected by climate change. Many infrastructure failure events in are typically caused by some natural hazard (i.e. flooding, high winds, etc..). As discussed in the Severe Weather section, some severe storms are expected to become more intense because of climate change. This in turn may increase the frequency and/or severity of infrastructure failures. Climate change is also expected to increase the number of extreme heat events in Irvine, and as higher temperatures stress mechanical and electrical systems, it is possible that this effect may also increase the frequency or severity of infrastructure failure events.

Seismic Hazards

Seismic hazards of concern in Irvine include fault rupture, liquefaction, and seismic shaking.

Description

Fault Rupture

The shifting and movement of the Earth's tectonic plates are responsible for seismic events. These tectonic plates can pull away from, move toward, or pass by each other. As they do, the plates sometimes lock together. This creates tension, and eventually the built-up tension is released like a springboard. The tension dissipates into the Earth's crust.

The location at which two tectonic plates join is called a fault line. Fault lines are sometimes visible on the Earth's crust as sudden rifts or anomalies in the continuity of the landscape. In California, the major north-south fault line is the San Andreas Fault—where the North American and Pacific Plates meet. Constant friction between the two plates over the millennia, however, has caused the areas where the two plates intersect to become fragmented, creating new, smaller faults.

The area in the immediate vicinity of a fault line is at risk of damage due to the potential for a fault rupture—the deformation or displacement of land on either side of the fault, which may move a few inches to several feet in opposite directions. Any buildings or infrastructure situated around, on top of, or across a fault line could potentially be severely damaged or destroyed. The direction of the fault rupture depends upon the fault type: dip-slip faults produce vertical shearing, strike-slip faults produce horizontal shearing, and oblique-slip faults produce both vertical and horizontal shearing. A fourth kind of fault, called a "blind" fault, produces virtually no visible displacement of land.

Some faults have emerged recently in geologic history. Quaternary faults are faults that have developed any time between the Holocene Era and the present (within the last 1.8 million years). These faults are especially concerning since they are the most likely to be active and cause future earthquakes.

The Alquist-Priolo Earthquake Fault Zoning Act enables the California State Geologist to designate zones surrounding active faults as Alquist-Priolo Special Study Zones, which is a special regulatory zone that

requires additional study, to determine the location of the fault and the limits of the area prohibited from surface construction on top of the known location of an active fault.

Liquefaction

Liquefaction occurs when seismic energy shakes an area with low-density, fine grain soil, like sand or silt, that is also saturated with water. When the shaking motion reaches these areas, it can cause these loosely packed soils to suddenly compact, making the waterlogged sediment behave more like a liquid than solid ground. During liquefaction events, the liquified soil can lose most of its stability which can cause damage to buildings and infrastructure built upon it. In severe cases, some buildings may completely collapse. Pipelines or other utility lines running through a liquefaction zone can be breached during an event, potentially leading to flooding or release of hazardous materials.

Seismic shaking

Seismic shaking is the shaking felt on the surface caused by an earthquake. In most cases, earthquakes are not powerful enough for the shaking to be felt. Particularly powerful earthquakes, however, can generate significant shaking, causing widespread destruction resulting in property damage.

Location and Extent

Fault Rupture

While no active faults (Alquist-Priolo Special Study Zones) are located within Irvine, there are several regional faults within Alquist-Priolo Special Study Zones near the City that could result in seismic hazards should an earthquake occur along one of them. In addition, numerous earthquake faults have been identified within the City (**Figure 3-9**), however they are not considered active (shown movement at the surface in the past 13,000 years) and therefore do not require delineation within a special study zone. Regardless, these faults should be accounted for in future development decisions.

Liquefaction

Soils must be saturated with water for liquefaction to occur. Areas that have high water tables generally have saturated soil, since the distance between the shallowest aquifer and the surface is minimal. Areas with alluvial soils—soft sands, silts, and clays—are also susceptible to liquefaction as these soils are fine grain and generally do not bond together well. Liquefaction events do not have a scale of measurement, however other factors can be used to assess the extent of damage associated with a liquefaction event, such as:

- Soil type
- Strength of seismic shaking in the area of liquefaction
- Size of the affected area
- Degree of destruction as a result of the liquefaction

Liquefaction caused by the 1964 Niigita, Japan earthquake caused these apartment blocks to experience severe leaning. Image from the University of Washington.

Parts of Irvine are in a liquefaction potential zone (**Figure 3-10**, according to the California Geological Survey. This is due to the types of soils in this area, presence of shallow groundwater under the low-lying portions of the City, and proximity to active earthquake faults capable of generating large

earthquakes. In this area of the City the soils are predominantly sandy alluvial soils, and the depth to groundwater in some areas is as shallow as 10 feet beneath the ground surface.[83]

Seismic shaking

The intensity of seismic shaking occurs in relation to the amount of energy discharged by the seismic event which is dictated by the length and depth of the fault. The longer and nearer the surface the fault rupture is, the greater the seismic shaking. In most cases, areas that are nearest to the fault rupture experience the greatest seismic shaking while areas that are more distant experience less shaking. Seismic shaking can damage or destroy structures leading to partial or even total collapse. The shaking of the ground can also damage or destroy underground utilities or pipelines, potentially leading to releases of hazardous materials as well as flooding if water lines are breached.

Southern California, including Irvine, is a highly seismic area as a result of the major faults that run through the region and is subject to experiencing seismic shaking. The intensity of seismic shaking is usually measured with the Modified Mercalli Intensity (MMI) scale, which is based on the amount of observed damage. The MMI scale has replaced the Richter scale which is no longer used since it loses effectiveness when measuring larger earthquakes. Since the degree of shaking, and consequently damage, generally decreases as the seismic energy travels further away from the fault rupture's point of origin, different sections of a city or region can report different MMI measurements in different locations. Given Irvine's size, it is likely that different sections of the City would report different MMI measurements. The MMI scale depicted in **Table 3-12** uses Roman numerals on a 12-point scale to measure each degree of shaking intensity.

Table 3-12: Modified Mercalli Intensity Scale[84]

Intensity	Description	Description
I	Instrumental	Felt only by a very few people, under especially favorable conditions.
II	Feeble	Felt only by a few people at rest, especially on the upper floors of buildings.
III	Slight	Noticeable by people indoors, especially on upper floors, but not always recognized as an earthquake.
IV	Moderate	Felt by many indoors, and by some outdoors. Sleeping people may be awakened. Dishes, windows, and doors are disturbed.
V	Slightly strong	Felt by nearly everyone, and many sleeping people are awakened. Some dishes and windows broken, and unstable objects overturned.
VI	Strong	Felt by everyone. Some heavy furniture is moved, and there is slight damage.
VII	Very strong	Negligible damage in well-built buildings, slight to moderate damage in ordinary buildings, and considerable damage in poorly built buildings.
VIII	Destructive	Slight damage in well-built buildings, considerable damage and partial collapse in ordinary buildings, and great damage in poorly built buildings.
IX	Ruinous	Considerable damage in specially designed structures. Great damage and partial collapse in substantial buildings, and buildings are shifted off foundations.
X	Disastrous	Most foundations and buildings with masonry or frames are destroyed, along with some well-built wood structures. Rail lines are bent.
XI	Very disastrous	Most or all masonry structures are destroyed, along with bridges. Rail lines are greatly bent.
XII	Catastrophic	Damage is total. The lines of sight are distorted, and objects are thrown into the air.

Another scale for measuring seismic shaking is the moment magnitude scale (MMS, denoted Mw or simply M). The MMS measures the energy released by the fault rupture beginning at 1.0 and increases as the energy of the earthquake grows. The MMS is a logarithmic scale, meaning that the difference between numbers on the scale multiplies as they increase. As an example, a 5.0M earthquake is approximately 1.4 times greater than a 4.9M event, 32 times greater than a 4.0M event, and 1,000 times greater than a 3.0M event.

Seismic shaking can also be measured in relationship to force of Earth's gravity (g), or percent g. This method is useful for geographically displaying areas of seismic shaking potential. Percent g is computed by determining the acceleration of the earthquake's motion relative to the force of gravity. The acceleration of gravity is 980 centimeters per second so if, for example, an earthquake's acceleration is measured at 765 centimeters per second, the shaking is modeled as 765/980, or .781 g (78.1% g). **Figure 3-11** shows the predicted intensity of seismic shaking in Irvine using percent g. Darker shaded areas depicted on this map are anticipated to feel earthquakes more intensely than lighter areas.

Figure 3-9: Seismic Hazards: Fault Rupture

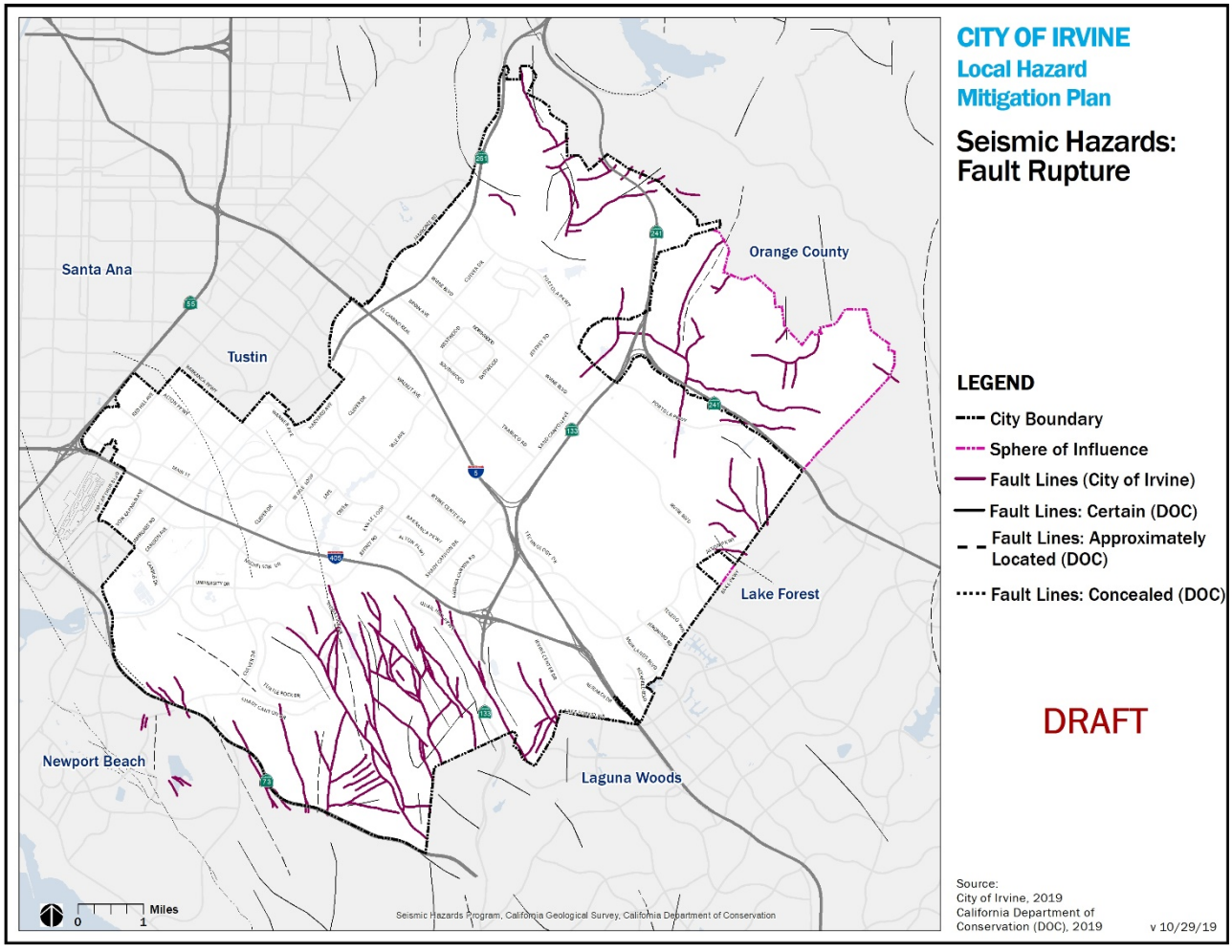
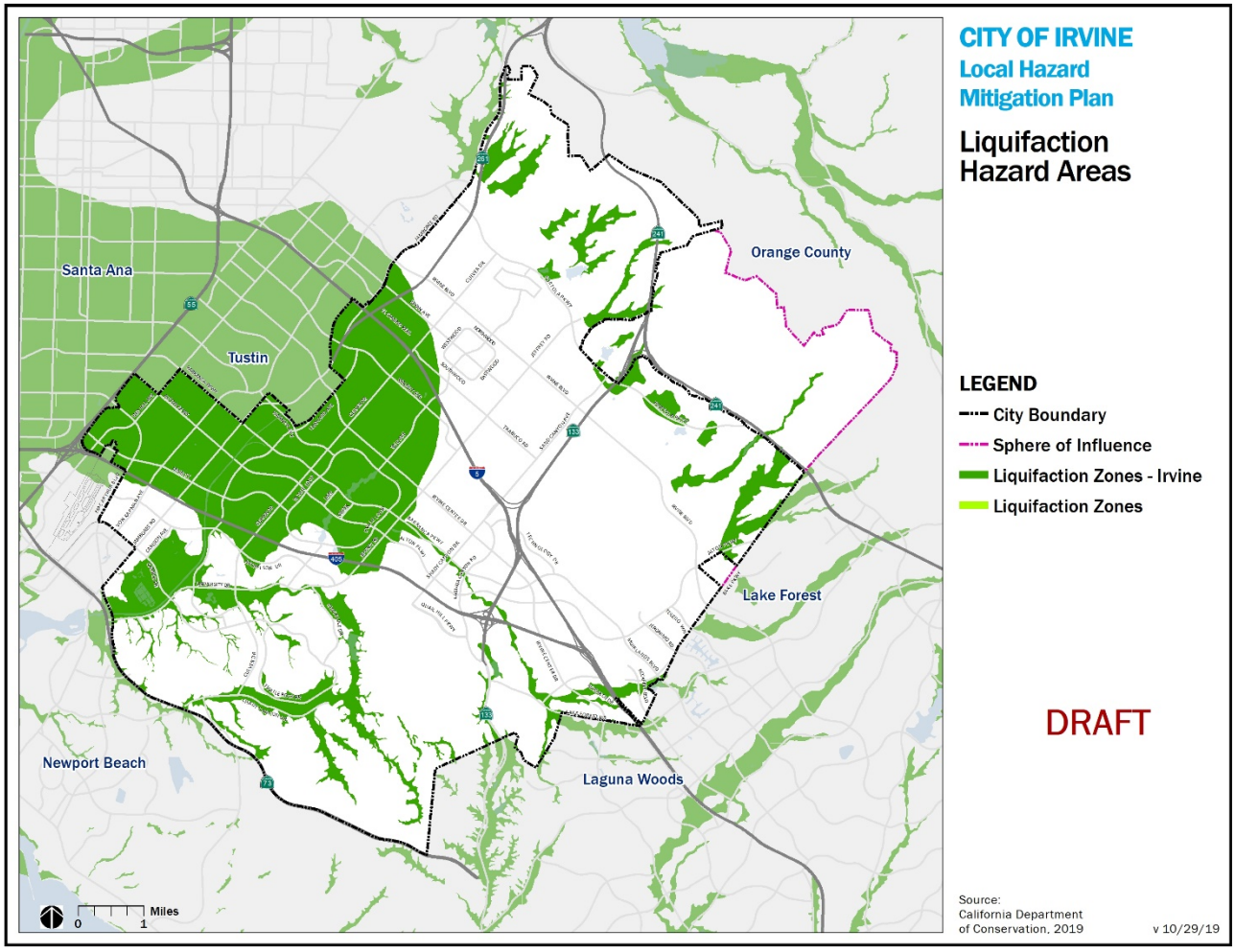


Figure 3-10: Liquefaction Zones



Past Events

Fault Rupture

The largest recent fault rupture near Irvine was the 1994 Northridge earthquake, a 6.7 Mw event approximately 56 miles from Irvine, and the most destructive earthquake in the United States in nearly 100 years. This event killed sixty people, injured more than 7,000, left 20,000 people homeless and damaged more than 40,000 buildings in Los Angeles, Ventura, Orange and San Bernardino Counties. Damage to Angel Stadium occurred as a result of this event.[85] More recently and closer to the City, a 5.1 Mw earthquake occurred in La Habra in 2014. This event caused fault rupturing adjacent to but not directly on the Puente Hills and Whittier faults.[86] Most recently a significant swarm of earthquakes in the Ridgecrest area occurred on July 4th and 5th 2019. Three tremors ranging from 5.4 to 7.1 Mw occurred within the Eastern California shear zone, a region of distributed faulting associated with motion across the Pacific-North America plate boundary, and an area of high seismic hazard.[87]

Liquefaction

There is limited information available on the occurrence of past liquefaction events in Irvine. Since these events occur in conjunction with strong earthquakes, the nearest and most recent liquefaction event

would have occurred near the mouth of the San Gabriel River at Alamitos Bay as a result of the Long Beach Earthquake in 1933. It was reported that pavement buckled, cracks appeared in the ground, and "mud volcanoes" erupted in the Los Alamitos area.[88]

Seismic shaking

Seismic shaking primarily affects unreinforced masonry buildings, as seen here with this Long Beach middle school damaged by the 1933 Long Beach earthquake. Image from Los Angeles Times.

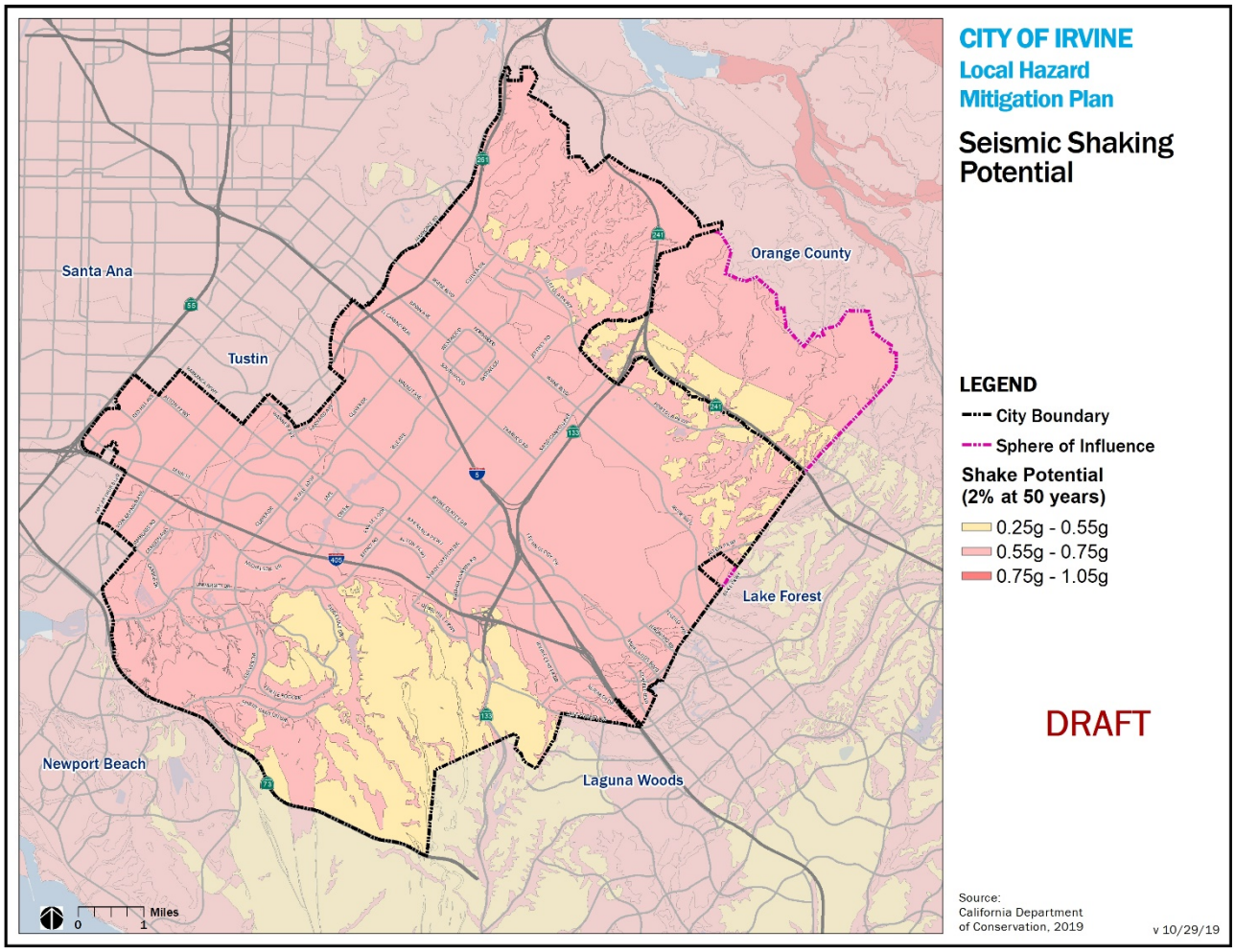
While no significant earthquake has originated within Irvine or Orange County within the last 100 years, Irvine has no doubt felt the shaking of regional earthquakes. The nearest earthquake event to Irvine that caused significant damage throughout the Southern California region was the 1933 Long Beach earthquake. The actual epicenter for the quake was in the City of Huntington Beach, however most of the damage occurred in areas north of the epicenter. The event caused more than $50 million in property damage and resulted in the deaths of 120 people.[89] Since Irvine (the City) did not exist during the time of the earthquake and given that the area was sparsely populated, it is unknown whether or not residents of that time experienced any damage to their property. Most of the deaths and damage from the 1933 Long Beach Earthquake occurred as a result of collapsing unreinforced masonry buildings, none of which existed in Irvine at the time. While farmers in the area most likely felt powerful seismic shaking, it is unlikely that they experienced significant property damage as other more urbanized areas in the region reported. Other strong, regional earthquakes have occurred in the Southern California region, but their epicenters have been so distant from Irvine that seismic shaking generated by the earthquake did not cause significant property damage or harm to the City. **Table 3-13** shows significant earthquakes – magnitude 6.0 M_w or greater – that have occurred within 100 miles of Irvine since the beginning of the 20th century. Authorities made disaster declarations in Orange County for the 1994 Northridge Earthquake and 1987 Whittier Narrows Earthquake, although there was no substantial damage in Irvine from either earthquake.[90,91]

Table 3-13: Significant Earthquakes (6.0+ Mw) Within 100 Miles of Irvine[92]

Event Name	Distance (Miles)*	Magnitude
1933 Long Beach Earthquake	12	6.4
1937 Oasis Earthquake	92	6.0
1948 Desert Hot Springs Earthquake	88	6.0
1971 San Fernando Earthquake	61	6.6
1986 North Palm Springs Earthquake	72	6.0
1992 Joshua Tree Earthquake	87	6.1
1992 Big Bear Earthquake	66	6.3
1994 Northridge Earthquake	56	6.7

* Distance between epicenter and Irvine Civic Center

Figure 3-11: Seismic Shaking Potential



Risk of Future Events

Fault Rupture

Given the presence of faults within the City, it is likely that fault rupture could occur in the future. However, without further study of the fault segments within the City it is difficult to estimate how often seismic events could occur along these segments.

Liquefaction

Due to the types of soil in Irvine and the surrounding area, the City will be perpetually at risk of a liquefaction event if the water table remains as high as it is. Since liquefaction events are triggered by seismic shaking, the probability of a liquefaction event occurring depends on the likelihood of an earthquake. An earthquake could occur along the numerous local faults running through Orange County that may lead to a liquefaction event. The likelihood of one of these local faults experiencing an earthquake powerful enough to trigger a liquefaction event within the next 25 years, however, is exceptionally low. Refer to **Table 3-14** for the probability of a major earthquake occurring in faults close to Irvine. Regional faults, like the San Andreas or San Jacinto, are more likely to experience a significant earthquake within the next quarter-century but may be too distant from Irvine to generate significant

shaking intensity to trigger a liquefaction event. As a result, it is only possible to say that liquefaction could occur in the City but is not possible to say with certainty when and or where a future liquefaction may occur in Irvine.

Seismic shaking

Irvine is in a seismically active area with many faults in the surrounding area and region-at-large. The only known faults that runs through Irvine is the San Joaquin Hills blind thrust fault, traveling in an east west/ southeasterly direction. The fault runs just north of the San Joaquin Hills, with the Irvine Civic Center sitting on top of the inferred location (since it is buried). If an earthquake were to occur on this blind-thrust fault, the rupture would most likely occur underground, reducing the risk to surface structures. There would still be danger, of course, posed by any seismic shaking which could damage buildings or infrastructure. It is almost inevitable that an earthquake will occur along one of the adjacent or regional fault lines and cause a major seismic event. The Third Uniform California Earthquake Rupture Forecast (UCERF3) was released in 2015 and is the most recent assessment of the probability of a major earthquake on various faults between 2015 to 2044. **Table 3-14** shows the results for nearby and regional fault lines for Irvine.

In addition to UCERF3 forecasts, which project the odds of a major earthquake on local and regional faults, the U.S. Geological Survey forecasts the severity of seismic shaking in different locations for various plausible earthquake scenarios. **Table 3-15** shows the anticipated shaking in Irvine from some of these scenarios.

The U.S. Geological Survey scenarios show that the Newport-Inglewood and San Joaquin Hills faults could cause the strongest seismic shaking in Irvine. However, the largest magnitude events are anticipated to come from the more distant San Jacinto and San Andreas faults, which could cause earthquakes that have an overall higher magnitude than the Newport-Inglewood or San Joaquin Hills faults but, due to the former faults' distance from Irvine, the shaking intensity felt in Irvine would be reduced compared to the shaking that would be felt nearer the earthquakes' epicenters. The overall magnitude of potential earthquake scenarios occurring along the Newport-Inglewood and San Joaquin Hills faults is lower than some of the more regional faults but their proximity to Irvine means that the City would be subjected to high intensity shaking from these earthquakes. In other words, these lower magnitude earthquake scenarios may overall be more destructive in Irvine than higher magnitude earthquake scenarios that are more distant. As noted in **Table 3-14**, however, the likelihood of a powerful earthquake occurring along these faults within the next 25 years is exceptionally low.

Climate Change Considerations

Fault Rupture

Generally, there is no known direct connection between fault rupturing and climate change. Some evidence suggests that greater oceanic pressure on tectonic plates as a result of melting land ice could influence the behavior of seismic events, but there is little to indicate that this would play a major factor in any seismic event, including fault rupturing.

Liquefaction

Climate change is anticipated to change the usual precipitation patterns in Southern California. Periods of both rain and drought are anticipated to become more intense and frequent. This means that more

precipitation will likely occur during rainy periods and drought is expected to last even longer. As a result, the groundwater aquifer beneath Irvine and Orange County as a whole, could rise during intense periods of precipitation but, alternatively, longer-lasting drought may lead to more groundwater withdrawal and could lower groundwater elevations. Therefore, climate change could, depending on the circumstances, either increase or decrease the future risk of liquefaction in Irvine.

Seismic shaking

There is no direct link between climate change and seismic activity that could impact Irvine, so climate change is not expected to cause any changes to the frequency or intensity of seismic shaking. Some research indicates that climate change could result in "isostatic rebounds," or a sudden upward movement of the crust as a result of reduced downward weight caused by glaciers. As glaciers are known to melt when global overall temperatures increase, climate change could indirectly lead to an increase in seismicity in Southern California.[93]

Table 3-14: Earthquake Probabilities for Key Faults near Irvine (2015–2044)[94]

Fault	Distance (Miles)*	Probability			
		6.7+ M_w	7.0+ M_w	7.5+ M_w	8.0+ M_w
San Joaquin Hills	0	0.40%	0.38%	0.24%	Negligible
Newport-Inglewood	8	0.95%	0.81%	0.42%	Negligible
Anaheim	10	0.09%	0.07%	<0.01%	Negligible
Peralta Hills	10	0.23%	0.15%	0.06%	Negligible
Richfield	14	0.02%	<0.01%	Negligible	Negligible
Compton	14	0.60%	0.47%	0.04%	<0.01%
Elysian Park	15	<0.01%	<0.01%	<0.01%	Negligible
Yorba Linda	15	0.09%	0.08%	0.03%	<0.01%
Whittier	16	1.45%	1.26%	0.66%	<0.01%
Puente Hills	18	0.66%	0.58%	0.19%	Negligible
Chino	18	1.42%	0.15%	0.08%	Negligible
Elsinore (Glen Ivy)	19	3.19%	1.68%	0.89%	<0.01%
Palos Verdes	19	3.08%	2.80%	0.09%	Negligible
San Jose	26	0.33%	0.23%	0.03%	Negligible
San Jacinto	41	5.06%	5.06%	5.01%	2.76%
San Andreas†	45	19.47%	13.15%	10.16%	3.27%

* Distance between Irvine Civic Center and the nearest point of the fault. All distances are approximate.
† Southern California segments only.
Note: UCERF3 results consist of two individual models (3.1 and 3.2), each of which provides rupture probabilities for each segment of the fault. This table shows the maximum probability for a section of the fault in either model.

Table 3-15: Selected Shaking Scenarios for Irvine[95]

Fault	Magnitude	Distance to Epicenter (Miles)*	MMI in Irvine
Newport-Inglewood	7.2	21	VII (Very strong) – VIII (Destructive)
	7.2	21	VII (Very strong) – VIII (Destructive)
	7.0	20	VI (Strong) – VII (Very strong)
San Joaquin Hills	7.0	10	VIII (Destructive)
Peralta Hills	6.6	15	VII (Very strong)
Whittier	7.0	19	VII (Very strong) – VIII (Destructive)
Chino	6.6	16	VI (Strong)–VII (Very strong)
	6.8	17	VI (Strong)–VII (Very strong)
Palos Verdes	7.4	18	VII (Very strong)
San Jacinto	7.7	40	IX (Violent)
San Andreas	7.9	45	IX (Violent)

*Distance between Irvine Civic Center and the epicenter (the point on the surface above where the fault rupture began).

Severe Weather (Extreme Heat, Severe Wind, Rain)

Description

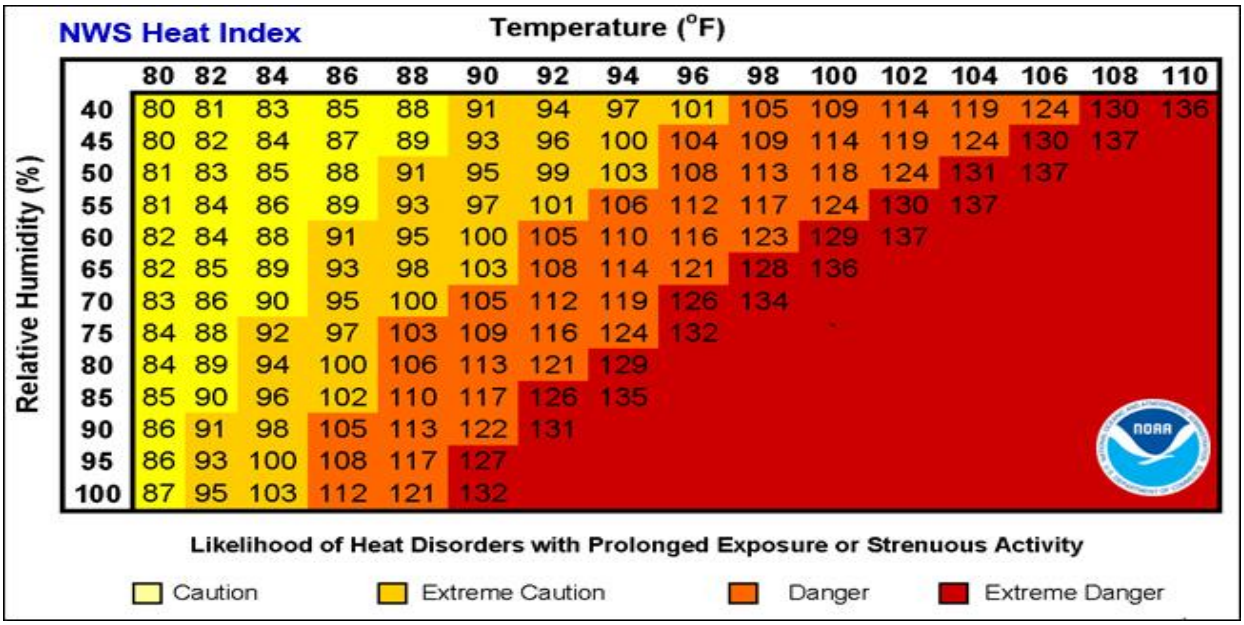
Extreme Heat

Extreme heat is a period when temperatures are abnormally high relative to a designated location's normal temperature range. There are generally three types of extreme heat events:[96]

- Extreme Heat Days: a day during which the maximum temperature surpasses 98 percent of all historic high temperatures for the area, using the time between April and October from 1961 to 1990 as the baseline.
- Warm Nights: a day between April to October when the minimum temperature exceeds 98 percent of all historic minimum daytime temperatures observed between 1961 to 1990.
- Extreme Heat Waves: a successive series of extreme heat days and warm nights where extreme temperatures do not abate. While no universally accepted minimum length of time for a heat wave event exists, Cal-Adapt considers four, successive extreme heat days and warm nights to be the minimum threshold for an extreme heat wave.

Extreme heat events will feel different from region to region since different areas have different historic high temperatures. For example, an extreme heat day on the coast will feel different than an extreme heat day in the High Desert. The reason for this is how humidity plays a factor in the perceived heat that people feel. Humid conditions will make a day feel hotter than non-humid conditions, even though the temperature may be the same. The difference between the perceived temperature and the actual temperature is known as the "heat index." To illustrate the effect of the heat index, a 90-degree day with 50 percent humidity feels like 95°F whereas a 90°F day with 90 percent humidity feels like 122°F. **Figure 3-12** shows National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service Heat Index.

Figure 1-12: NOAA National Weather Service Heat Index



Extreme heat poses several dangers to public health. The human body is vulnerable to long periods of high temperatures and will eventually enter a state of heat exhaustion and dehydration if exposure to heat is extended. If exposure to high temperatures is particularly prolonged to the point that internal body temperature surpasses 105°F, heat stroke may occur, and organ failure and even death may soon follow without intervention.

Heavy Rain

During severe weather events such as strong storms, rain can fall at such a high rate that it cannot drain away fast enough. The resulting heavy rain can cause flooding, leading to inundation and potential damage to buildings, road networks, public areas, utilities, and other critical pieces of infrastructure. In California, heavy rainfall events are often short, intense bursts of rain, but in some cases heavy rain can persist for multiple days.

Rainfall at University of California Irvine.

Severe Wind

Wind is simply the movement of air caused by differences in atmospheric temperature. High pressure air will naturally move to areas of low pressure. Usually, the distance between these high- and low-pressure zones is far, however, on occasion these low- and high-pressure zones may be near one another. When this happens, air will flow dramatically, creating high-speed winds. The most common wind events in southern California are the “Santa Ana” wind conditions that typically occur in the fall and winter.

Santa Ana Wind Events

When winds are fast enough, they can cause property damage to homes, public facilities, utilities, and other infrastructure. They can also uproot or topple mature trees or pick up debris and send it careening through the air. This debris can injure or even kill bystanders who may find themselves stranded outside. High speed winds can also deposit this debris in the middle of rights-of-way, such as roads, freeways, and railways, blocking exit routes for would-be evacuees or impeding access to first responders trying to reach wounded people.

Location and Extent

Extreme Heat

Extreme heat events are not limited to any part of the City. They occur with the same intensity and duration at the same time across all locations in Irvine. The minimum threshold for an extreme heat day in Irvine is 93.2°F. The minimum threshold for a warm night in Irvine is 66.4°F.[97] These thresholds are based on a 2% probability event.

Heavy Rain

The location and size of a rain event varies depending on regional geography as well as regional and global weather events. For example, small precipitation events may occur in only one section of Irvine. In contrast, a large rain event could inundate a majority of Orange County as well as other parts of southern California.

California's precipitation varies from year to year depending on how much moisture the state receives from atmospheric rivers. Atmospheric rivers are corridors along which wet air travels from the tropics to continents. When the moisture arrives in California, it may precipitate as rain or snow. One of the most known atmospheric rivers in California is the "Pineapple Express," which brings moist air from the ocean surrounding Hawai'i to California. During certain years, an immense amount of moisture may be transported along the atmospheric rivers that cross over California, leading to severe rains.[98]

Another weather phenomenon influencing rainfall in southern California is "El Niño," officially referred to as the "Southern Oscillation" or "El Niño-Southern Oscillation (ENSO)". ENSO can cause increased rainfall, particularly during the winter months, which is caused by warming of the surface of the eastern tropical Pacific Ocean, leading to evaporation of warm, moist air into the atmosphere. Winds bring this moisture to the eastern Pacific and the American continents, where it falls as rain. ENSO does not always lead to increased rainfall by default but, in general, it can increase the chances for a winter with higher-than-usual precipitation.[99,100] Rain events are usually measured by amount of precipitation that falls. **Table 3-16** categorizes rain events by the amount of precipitation per hour.

Table 3-16: Measuring Heavy Rain Events	
Rain Type	**Description**
Heavy rain	More than 4 mm per hour but less than 8 mm per hour
Very heavy rain	Greater than 8 mm per hour
Moderate shower	Greater than 2 mm, but less than 10 mm per hour
Heavy shower	Greater than 10 mm per hour, but less than 50 mm per hour
Violent shower	Greater than 50 mm per hour

Source: https://water.usgs.gov/edu/activity-howmuchrain-metric.html
mm = millimeter

Severe Wind

In Southern California, the most common type of severe wind event is called the Santa Ana winds. High pressure over Nevada and Utah, often during the fall and winter months, forces air down from the high desert toward the ocean. As the winds descend, they heat up and increase in speed, sometimes carrying particulate matter and aggravating the respiratory health of those who have allergies.[101,102] Irvine is often affected by Santa Ana winds blowing through the Santa Ana Mountain range. Santa Ana winds are a leading cause of wildfires in California. More information on this is available in the "Wildfire" section.

Generally, winds are measured using the Beaufort scale, developed in 1805, which categorizes wind events on a force scale from 0 to 12 using their speed and impacts. Any wind that is classified as force 9 or above is generally considered to be a severe wind event. **Table 3-17** shows how the Beaufort scale classifies wind events in detail.

Table 3-17: Beaufort Scale		
Force	**Speed (mph)**	**Description**
0	0 to 1	Calm: Smoke rises vertically, and the sea is flat
1	1 to 3	Light air: The direction of wind is shown by smoke drift, but not wind vanes.
2	4 to 7	Light breeze: Wind is felt on the face, leaves rustle, and wind vanes are moved. Small wavelets appear on the ocean, but do not break.
3	8 to 12	Gentle breeze: Leaves and small twigs are in motion, and light flags are extended. Large wavelets appear on the ocean and crests begin to break.
4	13 to 18	Moderate breeze: Dust and loose paper become airborne, and small branches are moved. Small waves appear on the ocean.
5	19 to 24	Fresh breeze: Small trees begin to sway and moderate waves form.
6	25 to 31	Strong breeze: Large branches are in motion, and using an umbrella becomes difficult. Large waves begin to form.
7	32 to 38	Near gale: Whole trees are in motion and walking against the wind can be hard. Foam from breaking waves is blown in streaks.
8	39 to 46	Gale: Walking is difficult, and twigs break off trees.
9	47 to 54	Severe gale: Slight structural damage. Crests of waves begin to topple.
10	55 to 63	Storm: Trees are uprooted and considerable damage to structures. Very high waves form in long, overhanging crests.
11	63 to 72	Violent storm: Widespread damage. Exceptionally high waves form, and the ocean is completely covered in foam.
12	73 and above	Hurricane: Devastating damage. On the ocean, the air is filled with foam and spray.

Source: https://www.weather.gov/mfl/beaufort.

Past Events

Extreme Heat

Local data from within Irvine is generally available using the Tustin Irvine Ranch National Weather Service Cooperative Network station. The data indicates that the average maximum temperature for the area from all years between 1902 and 2003 is 85.2°F, occurring in the month of August.[103] Given that the minimum threshold for an extreme heat day in Irvine is 93.2°F, it is rare that the temperature exceeds this threshold on a regular basis. Still, extreme heat events have occurred in the region which occasionally impact the City as well. Some significant historic extreme heat events include:

- September 1963, the temperature reached 113°F at the now defunct El Toro Air Force Base and the surrounding region was hot as well, including coastal areas. Temperatures in Carlsbad and Oceanside reached 108°F. School children and employees were sent home due to the heat and some agricultural crops were destroyed.
- April 1989, daily high temperature records were set for all weather monitoring stations in Southern California. Los Angeles and Riverside set records at 106°F and 104°F respectively.[104]

More recent extreme heat events have also affected the greater region surrounding Irvine:

- Throughout July 2018, extreme heat waves occurred throughout Southern California, including Irvine. The hottest day of the heat waves occurred on July 6 when temperatures reached 114°F in Santa Ana, CA. A second but less intense extreme heat wave occurred on July 25 where regional temperatures went above 100°F in places like Burbank. While local temperature data for Irvine is not available the weather monitoring station at nearby Long Beach Airport indicates that the temperature reached 95°F that day.[105,106]
- On October 23, 2017, Southern California experienced two extreme heat days. The weather monitoring station at Long Beach Airport indicated that temperatures reached 105°F that day.[107]

Heavy Rain

Irvine and Orange County have experienced heavy rain events that have inundated many communities. Some significant historic events include: [108]

- **1861-1862** - Epic floods caused by rain over 30 days in succession. The Santa Ana River in Anaheim ran 4’ deep and spread in an unbroken sheet to Coyote Hills, 3 miles beyond (present Fullerton). 20 people died in Orange County due to this event.
- **1997** - A stationary line of thunderstorms brought the heaviest rain in 70 years to portions of Orange County. Rain fall totals ranged from 4 inches to 10 inches in some parts of the southland. Newport Beach and Laguna Beach reported respective rainfall totals of 6.00 inches and 5.50 inches, both all-time records for a single day by more than an inch. Widespread flooding in Orange County. Mud slides and coastal erosion.
- **1998** - Up to 3” of rainfall fell over Southern California, causing catastrophic and widespread flooding, especially in Newport Beach and Irvine. Significant property damage occurred in south Orange County, requiring evacuations and swift water rescues. Impacts from this event included landslides, mud slides, sink holes, and damage to roads, bridges, and railroads.

- **2008** - Heavy rain from thunderstorms was produced by a very cold and unstable storm from the north, causing several debris flows. In the Santiago burn area of eastern Orange County, damage was done to homes and businesses.

Severe Wind

There have been several strong wind events recorded in and around Irvine[109] :

- In November 1957, Santa Ana winds exacerbated wildland fires, endangered air traffic, and triggered sandstorms in the Fontana area.
- In April 1962, strong Santa Ana winds howled throughout the region, uprooting trees, causing property damage and interrupting power transmission to customers.
- In November 1996, Santa Ana winds blew at 35 to 45 miles per hour throughout most of southern California, although winds were recorded close to 100 miles per hour in certain areas. In December 1996, gusts were recorded in Fremont Canyon near Tustin at 111 miles per hour. Injuries were recorded in Huntington Beach when a 60-foot tree was uprooted by the winds and fell on top of people.
- In October 1997, a fire caused by scrap metal was carried by 45-mile-per-hour Santa Ana winds throughout the Santa Ana Mountains, causing widespread property damage in eastern Orange County.
- In October 1998, a thunderstorm sent destructive winds through Orange County. Trees everywhere were uprooted and blown onto vehicles and buildings. A power outage affected more than 18,000 utility customers across the communities of Los Alamitos, Rossmoor, Cypress, Tustin, Santa Ana, and Garden Grove.
- In October 2007, winds up to 85 miles per hour blew through Fremont Canyon near Tustin. These winds caused extensive damage to structures and vehicles. The winds also exacerbated existing wildland fires, causing widespread evacuations and the burning of more than 49,000 acres.
- In November 2008, strong Santa Ana winds exacerbated and spread the Freeway Complex Fire, one of the most destructive fires in Southern California history. More than 30,000 acres were burned.

Risk of Future Events

Extreme Heat

Extreme heat events occur annually in Irvine a few times each year. All expectations are that the probability they will occur again in the future is highly likely and anticipated to increase in the future.

Heavy Rain

There is no indication that rainfall or severe rain hazards will abate either in Irvine or the greater region of Southern California in the future. While Irvine may experience prolonged periods of dry or wet years, all expectations are that the probability they will occur again in the future is highly likely and anticipated to increase in the future.

Severe Wind

Given Irvine's history of severe wind events, it is very likely that wind events will continue to impact the city. The most probable source of wind events in the future will likely originate from the Santa Ana winds

or extreme storms. All expectations are that the probability they will occur again in the future is highly likely.

Climate Change Considerations

Extreme Heat

The primary effect of climate change is warmer average temperatures. The hottest years on record have all occurred since the turn of the millennium and 2016 and 2019 are currently the hottest and second hottest years on record respectively.[110] As climate change accelerates in the 21st century, it is anticipated that extreme heat events will become more frequent and intense in California, including Irvine. In Irvine specifically, the projected average number of extreme heat days per year could increase from 4 to 12 assuming global greenhouse gas emissions peak around 2040, then decline. If global greenhouse gas emissions continue to rise until 2100 the number of extreme heat days could increase to as many as 25 days per year. The number of warm nights could increase from 4 to 41 assuming an emissions peak and decline at 2040 but could increase to as many as 86 if emissions continue to rise until 2100. [111]

Heavy Rain

Climate change is expected to alter rainfall patterns in southern California, including Irvine. As the climate warms, rain events are predicted to become more intense. It is likely that Irvine will experience more rain inundation events that lead to flooding and erosion, as well as increase the threat of dam failure, tree mortality, and other potential hazards.

Severe Wind

It is anticipated that the atmospheric rivers that deliver storms to Southern California may intensify as a result of climate change. While the average number of storms in Southern California will remain the same, storms are expected to increase in strength by 10 to 20 percent (Oskin 2014). This increase in storm intensity may also bring more intense winds to the Southern California region, including Irvine. It is not yet known if climate change will affect the frequency or intensity of Santa Ana wind events.

Wildfire

Description

Wildfires are fires that burn in largely undeveloped and natural areas, and they are a regular feature of ecosystems throughout California. These fires help to clear brush and debris from natural areas and are necessary for the health of many ecosystems and the life cycle of various species. However, the common practice since the early twentieth century was to suppress naturally occurring fires in wildland areas, allowing dry plant matter and other fuels to build up.

At the same time, human activity has caused changes in the buffer zone between urbanized and undeveloped areas, known as the wildland-urban interface (WUI). The more natural setting of a WUI can make these zones highly desirable places to live, and in many parts of California, the WUIs have become developed, albeit at lower densities than fully urbanized areas. However, this development activity has brought more people into wildfire-prone areas. The availability of fuel and increasing encroachment into the WUI have made wildfires among the most common and dangerous of all-natural hazards in California. From 1950 to 2012 there have been 178 fire emergencies in the state,

more than any other hazard event. The most destructive and deadliest fire in the state's history is the 2018 Camp Fire in Butte County. This fire destroyed nearly 19,000 structures and killed 85 people.[112]

Wildfires can be sparked by lightning, accidents, or arson. The size and severity of any fire depends on the availability of fuel, weather conditions, and topography, although wildfires in the WUI do not need to be large to be damaging. The 1991 Tunnel Fire in Oakland was relatively small, only 1,600 acres, but was the second deadliest and third most destructive wildfire in California history.[113] The flames from wildfires create serious risks to property and lives. Smoke and other particulate matter from wildfires poses a health risk, even to those not in the immediate vicinity of the blaze. Burned areas can be more susceptible to flooding and landslides, because wildfires destroy the vegetation that helps to slow down water runoff and holds slopes together.

Wildfires have been a regular part of the landscape in the Orange County region. This sign, which used to stand at the Top of the World, showed the localized fire danger. Image from Patrick Nouhailler.

Location and Extent

Wildfires are not measured on a specific scale and are usually classified by size (e.g., acres burned) or impact (buildings destroyed or damaged, injuries or deaths, cost of damage, etc.). The risk of wildfire is classified on a three-tier scale of fire hazard severity zones (FHSZs): very high, high, and moderate. These classes do not correspond to a specific risk or intensity of fire but are qualitative terms that consider many factors. Fire-prone areas are also classified by the agency responsible for fire protection. Federal Responsibility Areas (FRAs) fall to federal agencies such as the US Forest Service, the Bureau of Land Management, and the National Park Service. State Responsibilities Areas (SRAs) fall to the California Department of Forestry and Fire Protection (CAL FIRE), and Local Responsibility Areas (LRAs) fall to local governments.

The topography of the foothills of the Santa Ana Mountains and San Joaquin Hills in Irvine is extremely conducive to wildfires. The community is bordered by natural, undeveloped hillsides/ mountains to the northeast and open space areas to the southwest. In between these two areas is most the City's developed areas. A majority of these natural, undeveloped areas are classified as Very High Fire Hazard Severity Zones (VHFHSZ) by Cal FIRE. In the northeastern portion of the City, this zone extends throughout the Santa Ana Mountain range, which extends into Riverside County to the east. **Figure 3-13** depicts the fire hazard severity zones mapped throughout the City and surrounding areas. These zones range from moderate to extreme fire hazard potential. **Figure 3-14** depicts the Very High Fire Hazard Severity Zones adopted by Cal FIRE and the City. This zone delineates the regulatory requirement that triggers compliance with Government Code Section 65302 (g) 3 [also known as SB 1241].

Past Events

Canyon Fire – a 2017 wildfire that burned in the Anaheim Hills area of Orange County. In total the fire burned 9,217 acres, destroyed 25 structures and damaged another 55. In total, 16,570 people were evacuated from their homes in Anaheim, Orange, and Tustin.[114]

Freeway Complex Fire – a 2008 wildfire that burned parts of Yorba Linda, Anaheim, Brea, Chino Hills, and Diamond Bar. Over 30,000 acres were burned destroying 314 homes, 43 outbuildings, and 4 commercial structures. No fatalities were reported during this event.[115]

Santiago Fire – Began on October 21, 2007 in the foothills north of Irvine and east of the City of Orange. Over 28,000 acres were burned, resulting in the destruction of 14 homes and 24 outbuildings. No fatalities were reported during this event.[116]

Santiago Canyon Fire – dating back to 1889, this massive wildfire is one of the largest in the state's history. Totaling at least 300,000 acres, the conditions that contributed to the fire included a much longer and more severe annual drought than usual.[117]

Risk of Future Events

The history of wildfires in Orange County and the presence of VHFHSZs in and around the community mean that such events are very likely in the future. The risk is expected to remain highest in the foothills of the Santa Ana Mountains and San Joaquin Hills, which have the right conditions for wildfire incidents.

Climate Change Considerations

Climate change is expected to cause an increase in temperatures as well as more frequent and intense drought conditions. This will likely increase the amount of dry plant matter available for fuel, increasing the risk of wildfire statewide. In the foothills of the Santa Ana Mountains and San Joaquin Hills, which are already highly prone to wildfires, climate change is expected to increase the number of acres burned annually. Based on current modeling, the annual average of area burned could increase to 235 hectares, which is an increase of over 45 hectares from the annual mean for 1961-1990.[118] However, increases in fuel supplies could cause wildfires to move faster or spread into more-developed areas, which could increase the threat to Irvine.

Figure 3-13: Fire Hazard Severity Zones

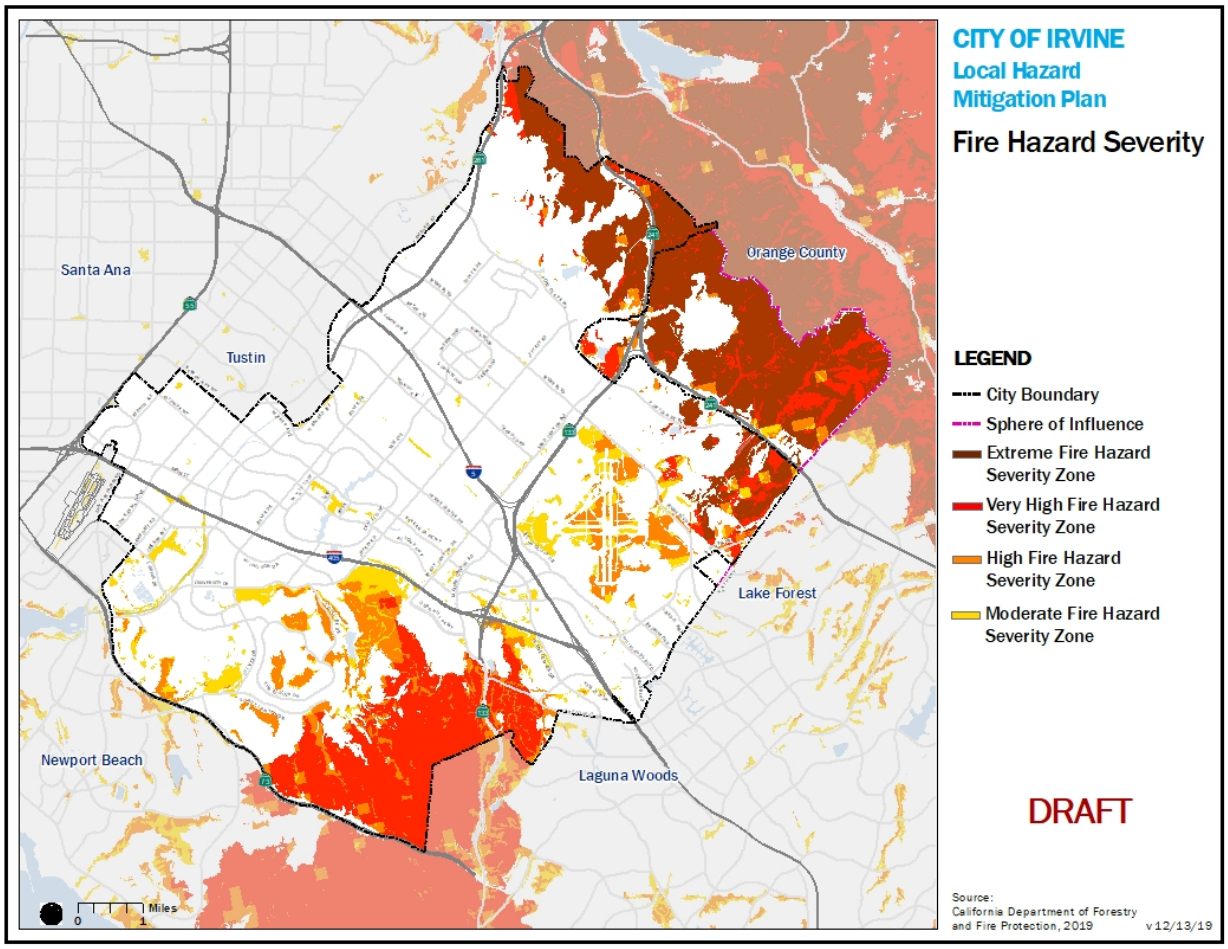
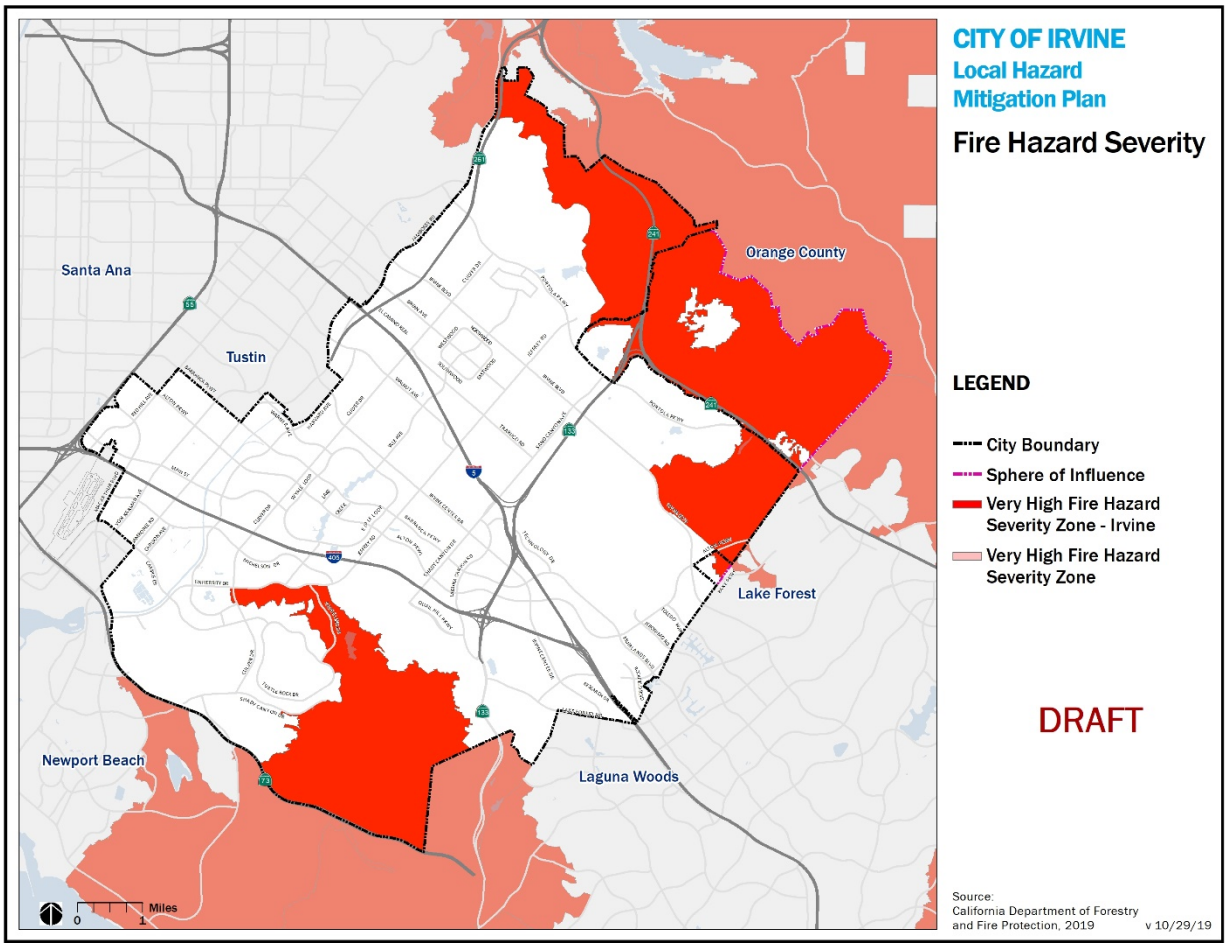


Figure 3-14: Very High Fire Hazard Severity Zones



CHAPTER 4 – THREAT AND VULNERABILITY

The threat assessment process looks at the harm that each hazard event discussed in Chapter 3 may cause in three different areas: the physical threat to key facilities, the threat to vulnerable populations, and the threat to any other community assets.

THREAT ASSESSMENT PROCESS

The threat assessment process looks at the harm that Irvine may experience from a hazard event but does not consider its likelihood, so it gives equal consideration to hazards that are more likely (e.g. earthquakes, flood) as well as hazards that are less probable (e.g. aircraft incident, dam failure).

The threat assessment examines three aspects of each hazard: the physical threat to Critical Facilities (CFs) and Facilities of Concern (FOC), the social threat to vulnerable populations, and the threat to any other assets that may be affected.

CRITICAL FACILITIES AND FACILITIES OF CONCERN

Critical facilities consist of properties and structures that play important roles in government operations and the services they provide to the community. Examples of CFs include local government offices and yards, community centers, public safety buildings like police and fire stations, schools, and any other properties a city has deemed essential for its operations. CFs may also serve dual roles if a city designates them as points of public assembly during an emergency. CFs are often owned by the City, but many are also owned and operated privately, such as some utilities and telecommunication infrastructure.

The Hazard Mitigation Planning Committee identified 213 CFs or FOC in Irvine that fall into 6 different categories based on their function or characteristics. **Table 4-1** shows the number of CFs and FOC in each category, the total estimated value of the facilities in each category, and examples of the facilities in each. **Appendix D** has a complete list of the CFs and FOC. **Figure 4-1** shows the locations of CFs and FOC in Irvine that were mapped. Some facilities were not mapped due to security concerns.

The potential loss value is the total insured value of the CFs that fall within the hazard zone. It is intended to provide the ballpark estimate of the cost of replacement if the property is completely or severely damaged. Actual costs of repair could be smaller or larger than the provided estimate. The data was provided by the City's Property Schedule and therefore, information for facilities not owned by the City are not shown (e.g. bridges, private buildings). In some instances, replacement cost information was not made available. Where this occurs "N/A" has been used within the table.

Table 4-1: Critical Facilities and Facilities of Concern[119]

Category	Number of Facilities		Examples	Potential Loss*
	Critical	Concern		
City Vital Operations	4	1	City Hall, Police Station, Operations Support	$ 99,520,918
City Community Centers	12	0	Community Centers	$ 32,171,675
City Resident Services	4	5	Senior Centers, Animal Shelter, Daycare, Other Community Facilities	$ 13,173,434
City Recreation Support	0	21	Parks, Recreation Amenities, Sports Complexes and support facilities	$ 56,969,379
Bridges	120	0	Overpasses and underpasses within the City	$166,687,247
Schools	0	46	Irvine Unified School District and Tustin Unified School District Facilities	N/A
Total	**140**	**73**	-	**$368,522,653**

*Potential loss data are estimates only, as replacement values for some facilities were not available. Actual losses may be greater than the estimate presented in this table.

Based on the available data provided by the City, there is a minimum of $368,522,653 worth of City-owned assets. The total potential loss value of all City-owned and non-City-owned assets is much higher but is not known due to data limitations. The greatest potential for loss among the City-owned assets comes from the Bridges category, which includes underpasses and overpasses throughout the City. The next category with the greatest potential for loss is the City Vital Operations category, which includes City Hall, the Operations Support facility, Police Station, and Transportation Center. To better understand the magnitude of impacts, this plan identifies representative percentages of potential impact based on the total valuation of City assets. For planning purposes, we identified different tiers of impact that could happen. It is reasonable to assume that impacts would not exceed 50% of the total asset value city-wide. The following are parameters to help understand how much a proposed investment/improvement compares to the existing assets within the City:

- 1% Impact - $3,685,227
- 5% Impact – 18,426,133
- 10% Impact – 36,852,265
- 20% Impact - $73,704,531
- 50% Impact - $184,261,326

The likelihood that all facilities are completely damaged at the same time is extremely remote. Most impacts are anticipated to be isolated to certain locations based on the hazard. This estimate does not include the value of underground infrastructure and surface drainage facilities owned and operated by the City.

VULNERABLE POPULATIONS

Factors such as age, physical and/or mental condition, socioeconomic status, access to key services, and many other factors affect the ability of people to prepare for and protect themselves and their property from a hazard event. Even though some hazard events may impact all parts of Irvine with equal severity, different people may experience the impacts differently. Higher-income households, for instance, are likely more able to afford the cost of retrofitting their homes to resist flooding or, alternatively, move to a location that is less prone to flooding than a lower-income household. As a result, the higher-income household is less likely to experience significant damage during a flood event than the lower-income household, even if the same amount of rain falls on both.

A social threat analysis examines the ways hazard events are likely to impact different demographic populations in Irvine and where these different demographic populations live in the City. This includes an assessment of whether the people in an area of an elevated hazard risk are more likely than the average person to be considered a threatened population. The social threat analysis uses the following criteria to assess the threat to vulnerable populations:

- **Disability status:** Persons with disabilities may often have reduced mobility and experience difficulties living independently. As a result, they may have little or no ability to prepare for and mitigate hazard conditions without assistance from others.
- **Income levels:** Lower-income households are less likely to have the financial resources to implement mitigation activities on their residences. They may also struggle with having the necessary time to find and access educational resources discussing hazard mitigation strategies. Furthermore, lower-income households are less likely to be able to afford moving to areas that are safer or less at risk of being impacted by a hazard. The national poverty limit standard for the U.S. for a four-person family is approximately an income of $26,200 or less. For Orange County, the FY 2020 Low Income Limits for a four-person family according to Housing and Urban Development (HUD) is $102,450.
- **Seniors (individuals at least 65 years of age):** Seniors are more likely to have reduced mobility, physical and/or mental disabilities, and lower income levels, all of which may decrease their ability to prepare for and mitigate a hazard event.

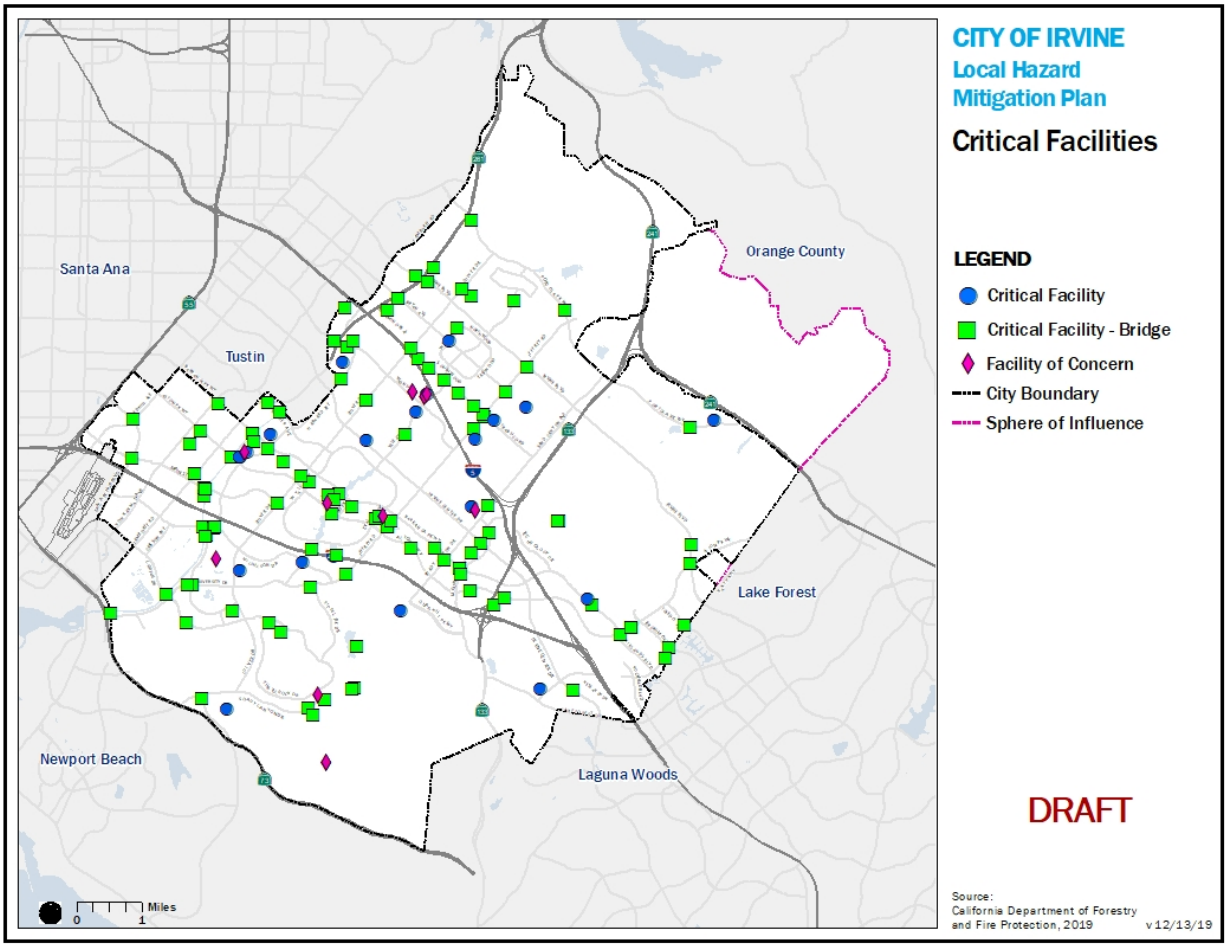
Table 4-2 shows the amounts of people in Irvine who meet at least one of the criteria for threatened vulnerable populations. For more detailed demographic information please refer to **Chapter 2**.

Table 4-2: Irvine Threatened-Population Metrics[120, 121]

Threatened Population Metric	Community-Wide Data
Population	256,877
Households	92,869
Median household income	$95,573
Renter Households	51.80%
Percentage of households with at least one person living with a disability	5.80%
Percentage of households living under poverty limit	28.70%

Percentage of households with one member aged 65+	13.20%
Percentage of households aged 65+ living alone	9.20%

Figure 4-1: Critical Facilities and Facilities of Concern



The social threat analysis also shows the threat other populations may encounter, such as persons experiencing homelessness or persons without access to lifelines (vehicles or communication networks). Since data for these groups are not readily available, there is no definitive way to determine the amount of these persons in areas of elevated risk so this assessment will discuss how these other threatened groups may also be affected on a general level.

Data Limitations and Notes on Vulnerability Tables

Due to data limitations, the data comparing the hazard zone population with the Citywide population comes from two separate sources. The Citywide data comes from the US Census Bureau's American Community Survey and the hazard zone population zone population data comes from ESRI's Business Analyst reports. As a result, there may be minor discrepancies in comparing the two data sets. The data that should be considered correct for this plan is the ACS data reported in Chapter 2.[122, 123,124]

OTHER ASSETS

In addition to the City's designated inventory of CFs/FOC and vulnerable populations, hazard events could threaten other assets that are important to Irvine. These assets may include services, artistic or cultural landmarks, or local economic activities. The threat assessment describes the potential harm to these other assets based on available information.

THREAT PROFILES

Aircraft Incident

Physical Threat

All structures located within the John Wayne Airport AELUP planning boundary are at an elevated risk to aircraft incidents, predominantly associated with landing, take off, and approach activities. Beyond this planning area the risk associated with aircraft incidents is limited to flyover activities above the City. All these incidents have the potential to send the bodies of the aircraft crashing down on any structures or physical assets lying below. Even if the aircraft does not crash within the City it is possible that falling debris could land on and damage structures in the City. An aircraft incident may be an act of terrorism, in which case the target of the terrorists would likely be a government building or a place where many people are gathered. For more information on the threats of terrorist attacks in Irvine, please refer to the Human-Caused Hazards section.

Social Threat

All persons in Irvine may be threatened by an aircraft incident. Typically, populations located near John Wayne Airport would have a higher probability of being impacted versus populations located in the southern portions of the City. Developments located within the John Wayne Airport AELUP planning boundary should have taken the use intensity recommendations and development standards of this plan into consideration, to ensure the density of people and height of buildings within these areas reduce unnecessary exposure to these hazards.

Residents and employees in the impacted area of an aircraft incident may experience property damage or loss, and/or emotional distress as a result of losing family or friends in the crash or having witnessed the event or its aftermath. If future events occur in Irvine, it is assumed that lower-income persons may not be able to recover as easily (afford repairing the damage to their homes, purchasing new automobiles to replace any destroyed, etc.).

Other Threats

Depending on the severity of the aircraft incident, some services in the City could be temporarily disrupted. For example, falling debris from an aircraft incident could damage or destroy a section of the power transmission lines in the City, cutting off power to residents and businesses. Debris could also fall onto a roadway and obstruct the normal flow of traffic through Irvine. A more severe aircraft incident, in which an entire aircraft crashes into a section of the City would likely ignite a blaze impacting the area where the plane went down. Any transmission wires or pipelines in the crash site would likely be affected

to some degree, resulting in partial or complete outages of utilities services to the sections of the City. A severe aircraft incident that occurs at a major employment center in the City would almost certainly result in the closure of the employers located in the area of the crash until authorities deem it safe for employees to return to work. This would result in loss of economic activity in the City.

Dam Failure

Physical Threat

Various factors, such as the amount of water released, the distance between the dam failure site, and the topography of the surrounding land all influence the extent to which physical assets in Irvine are threatened. Some reservoirs, like Peters Canyon Dam or San Joaquin Reservoir, simply hold less water or are in remote locations that reduce the threat to physical assets in the City. Other reservoirs, like Villa Park Dam or Santiago Canyon Dam, have large storage capacities that could potentially lead to widespread inundation or large areas of northern Irvine if the reservoir waters are released due to a dam breach. **Figure 4-2** shows which CFs and FOC would be impacted in each dam failure scenario.

Table 4-3 identifies the physical assets in Irvine that are threatened by the potential failure of the following dams:

- Peters Canyon Dam
- Rattlesnake Canyon
- San Joaquin Reservoir
- Sand Canyon
- Sand Canyon Spillway
- Santiago Dam
- Syphon Canyon
- Villa Park Dam

If any of these dams were to fail at maximum capacity and release the water contained in its reservoir it would threaten a variety of CF and FOC in Irvine.

Table 4-3: Critical Facilities and Facilities of Concern (Dam Failure)

Dam Inundation Area	City Vital Operations		City Community Centers	City Resident Services		City Recreation Support	Bridges	Schools*	Potential Loss**
	CF	FOC	CF	CF	FOC	FOC	CF	FOC	
Peters Canyon Dam	-	-	-	-	-	-	2	-	$ 1,821,720
Rattlesnake Canyon	1	-	-	-	-	-	27	4	$ 47,819,834
San Joaquin Reservoir	-	-	-	-	-	-	1	-	$ 27,053,460
Sand Canyon	-	-	-	-	-	-	10	-	$ 31,225,500
Sand Canyon Spillway	-	-	-	-	-	-	8	-	$ 30,598,520
Santiago Dam	1	-	-	-	-	-	24	-	$ 73,404,574
Syphon Canyon	-	-	-	-	-	-	19	1	$ 42,675,657
Villa Park Dam	-	12	-	-	-	-	20	-	$ 68,922,471

* Replacement Values unavailable

** Based on the City of Irvine insured replacement values

Based on this analysis, the greatest number of facilities impacted by dam inundation would occur as a result of a failure of either Rattlesnake Canyon or Villa Park Dam, both of which could affect 32 facilities within the City. Based on the potential loss estimates the greatest potential loss could occur from failure of the Santiago Dam, which could damage infrastructure valued in excess of $73 million.

Social Threat

Dam Failure hazards in the City would impact a variety of downstream properties. Given the number of dams in the City, **Table 4-4** identifies individual dam impacts from six of the seven dams within the City. Impacts associated with San Joaquin Reservoir are not provided due to limited area of impact. Failure of these dams could cause harm to downstream properties, with the greatest amount of people potentially affected by the Rattlesnake Canyon dam. Both the San Canyon and Villa Park Dams would impact populations that have a lower median household income than the Citywide population. In addition, all dams would impact a higher percentage of populations living with a disability. The Sand Canyon dam has the potential to affect a significant number (42.1%) of households with one member 65+ population. This indicator coupled with a median household income that is nearly half of the City median household income. This suggests that a significant population of residents aged 65+ living in the inundation path of this dam.

Other Threats

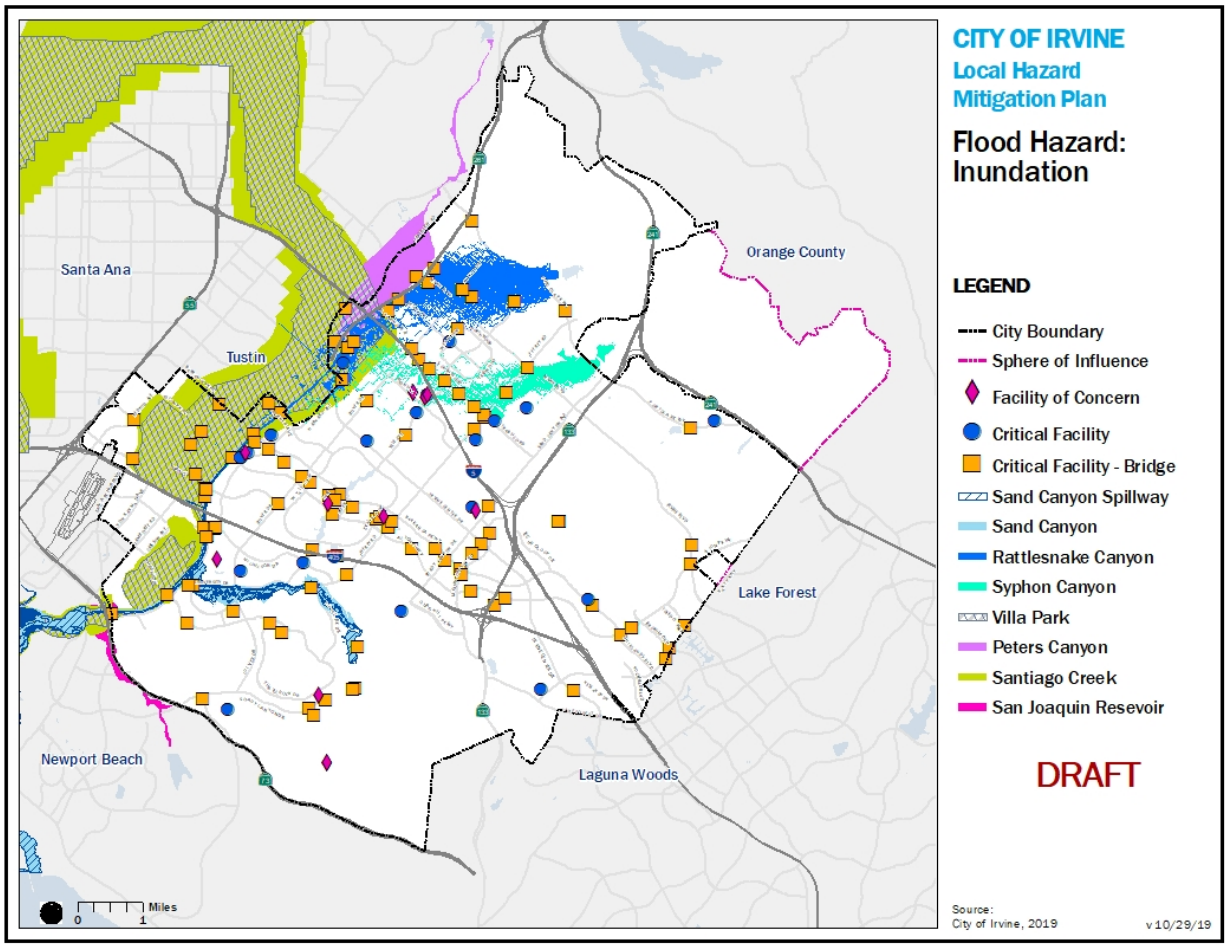
Dam failures are often triggered by other events (seismic shaking, intense rainstorms, etc..). Often when these events occur, there would almost certainly be service disruptions in Irvine. Floodwaters would quickly inundate downstream portions of the City, disrupting utilities, such as water, power, and heating, as well as other services such as communications or transportation infrastructure, especially since most of the facilities vulnerable are bridges within the City. Residents may find that street lighting and traffic signals may be temporarily disabled if the inundation area interferes with the electronic systems that control them. The rapid inundation of water would sweep up any debris, which could block roads, impeding the flow of traffic. Water would most likely inundate roadways and other low-lying, flat areas, such as parking lots, open spaces, and school yards. People's mobility in these areas would likely be restricted or even impossible in severe scenarios. Any unprotected or unhoused mechanical or electronic equipment that is not properly elevated would become waterlogged and inoperable until crews are able to conduct repairs or replacement, if necessary.

TABLE 4-4: Dam Failure Hazard Threatened Populations

Threatened Population Metric	Peters Canyon Dam	Rattlesnake Canyon	Sand Canyon	Santiago Dam	Syphon Canyon	Villa Park Dam	City of Irvine
Population	5,918	15,152	1,312	11,639	14,068	5,870	256,877
Households	2,046	5,263	608	4,181	5,118	2,401	92,869
Median household income	$105,429	$123,600	$52,217	$100,185	$121,700	$88,327	$95,573
Percentage of households with at least one person living with a disability	18.6%	13.9%	14.5%	15.3%	14.9%	15.7%	5.8%
Percentage of households living under poverty limit	11.0%	10.5%	16.4%	15.0%	11.1%	14.2%	13.2%
Percentage of households with one member aged 65+	5.8%	10.3%	42.1%	9.3%	10.3%	8.8%	19.5%

San Joaquin Reservoir and Sand Canyon Spillway are not included in this analysis due to the limited inundation area and lack of downstream impacts.

Figure 4-2: Dam Inundation Physical Threat



Diseases and Pests

Physical Threat

Agricultural Pests

Agricultural pests would not impact physical assets in Irvine. Since agricultural pests would be limited to agricultural properties within the City as well as ornamental plantings (citrus trees, bushes/shrubs, etc.), it is expected that some of these assets could be impacted in the future. This future impact is not anticipated to affect the City's residents or businesses significantly.

Epidemic/ Pandemic/ Vector-Borne Disease

Since diseases only affect the human body there is no possible way that an epidemic, pandemic, or vector-borne disease could directly threaten physical assets in Irvine.

Tree Mortality

A serious outbreak of pests, such as the Gold Spotted Oak Borer, Invasive Shot Hole Borer, or Asian Citrus Psyllid, in Irvine could threaten the City's urban forest, leading to an episode of intense tree mortality. The City recently conducted an inventory of trees (**Figure 4-3**). Many of these trees have been impacted by

invasive pests (Invasive Shot Hole Borer, Gold Spotted Oak Borer, and Palm Weevil). Part of the tree inventory process is the identification of impacted trees that require monitoring and/or removal. Based on the City's current inventory, the City estimates the value of their tree assets at approximately $181 million. Understanding that a portion of this inventory will require replacement every year, trees that are damaged due to pests should be treated as quickly as possible to reduce the threat to healthy trees. If dead trees located within the City are not felled immediately, they may pose a threat to other physical assets when compounded with other hazards. For example, dead trees are more prone to catching fire than living trees, which can intensify the risk that surrounding physical assets could experience flashover.

Social Threat

Agricultural Pests

Properties within Irvine that would experience agricultural pest impacts would predominately be existing agricultural uses. It is anticipated that the property owners would actively monitor agricultural pest issues and coordinate with the Orange County Agricultural Commission. With over 1,300 acres of agricultural land in the City that could generate over $6 million in revenue based on county agricultural production values, any loss in value could impact the local economy.

Epidemic/ Pandemic/ Vector-Borne Disease

To some degree, diseases affect everyone in Irvine, whether the impact is a mild inconvenience or death. There is no one universally applicable social threat from diseases and pests since each disease affects the body differently. Generally, however, seniors, infants, pregnant women and people with weakened immune defenses experience the greatest risk. Lower-income persons may also be more threatened than others by diseases since they may not be able to afford medical treatment. Persons with disabilities or those who live alone may experience greater vulnerability to an illness since they may be unable to access treatment. Pregnant women in Irvine are especially threatened by Zika virus since the virus may cause their infants to be born with *microcephaly,* which is shown to cause health problems for infants, including death.

Tree Mortality

Irvine residents who experience tree mortality on their property may be potentially threatened by decreased property values. Healthy trees add aesthetic beauty to homes and businesses and dying or dead trees may detract from the property's worth. Higher-income property owners in Irvine may be able to absorb the costs of tree loss and afford to replant any lost trees. Lower-income property owners, on the other hand, are less likely to be able to afford the cost of replanting lost trees without assistance.

Tree mortality also reduces the amount of shade in each area, potentially increasing the impacts of urban heat island effect. As a result, groups that are threatened by higher heat levels may be impacted by an onset of tree mortality. Such groups include seniors, children, families with pets, and laborers who spend long periods of time outside. Lower income households who turn to active cooling methods, such as air conditioning, may be burdened by increased energy costs.

Other Threats

Agricultural Pests

Agricultural pests may cause significant issues in conjunction with particular weather conditions. During excessive droughts, plants may be stressed, which can create favorable conditions for pests to thrive. In addition, excessively wet winters and springs could create conditions where plants grow molds and fungus that impact crop yields or require additional treatments by farmers.

Epidemic/ Pandemic/ Vector-Borne Disease

A major outbreak of disease could overwhelm the capacity of medical facilities in Irvine and in the surrounding area, potentially leading to greater inaccessibility of medical services and shortage of medical personnel in the region. A major outbreak could also be expected to incapacitate large amounts of the City's and region's workforce, inhibiting the regional economy of Orange County and Southern California. Services such as telecommunications, utilities, recreation, and commerce may become restricted or even entirely unavailable for a period. Since March 2020, the City and the rest of the world has been dealing with the COVID-19 pandemic incident that has impacted the state and many cities and counties. As a new unknown disease, it has been critically important during these past few months to effectively communicate the risk of infection and procedures to obtain medical help effectively.

Tree Mortality

Urban forestry has been demonstrated to increase mental health and reduce levels of depression and anxiety among residents.[125,126] If large sections of Irvine's urban forest were to suddenly start dying, whether it be from drought or invasive pests, higher levels of stress, and anxiety may result.

Drought

Physical Threat

Since the primary threat from drought is reduced water supply and availability, there are no foreseeable threats to any of the physical assets in the City. It is possible that any water delivery infrastructure is not used or used less than usual may fall into some degree of disrepair if maintenance is deferred. Lower water pressures may cause some aged water pipes to release rust particles into the water supply.

Social Threat

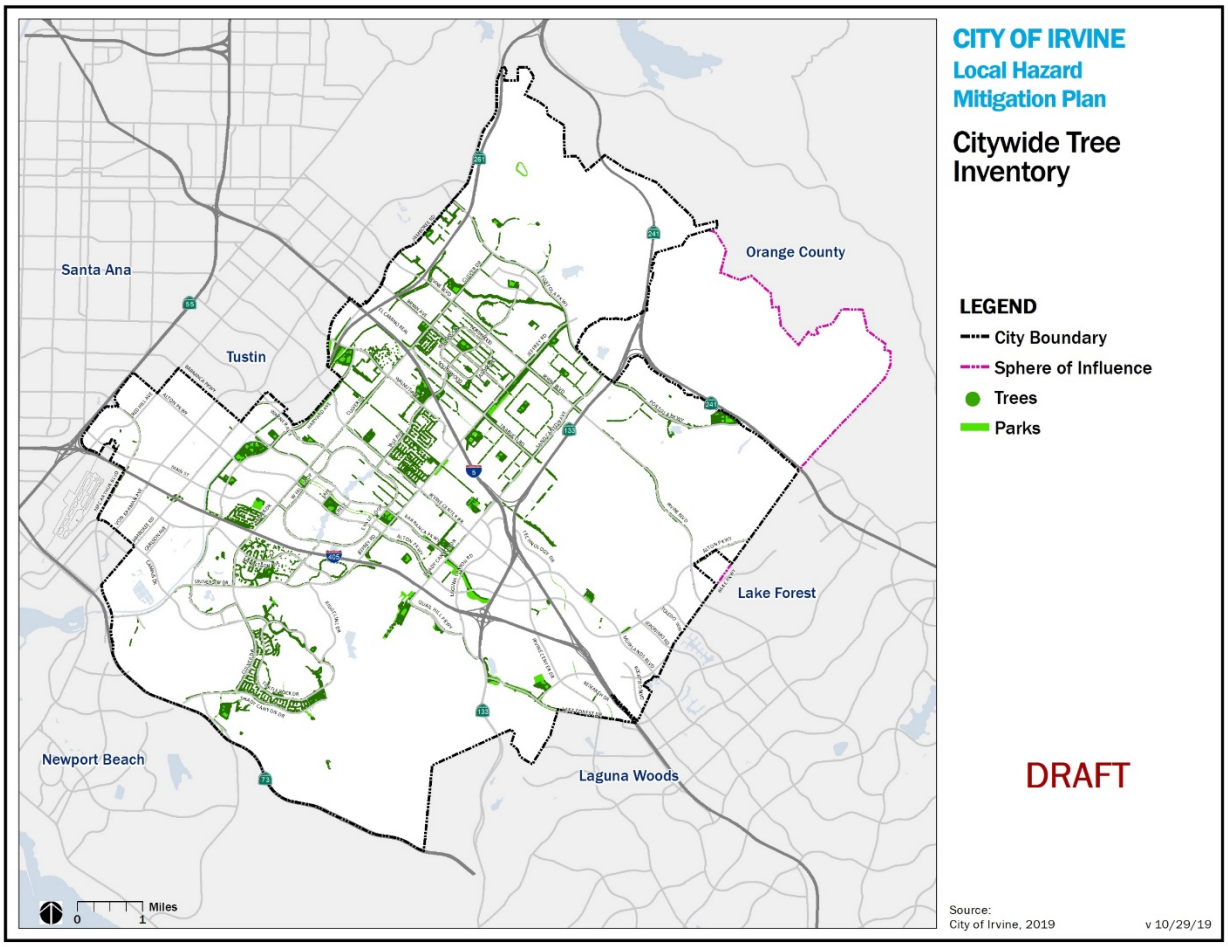
Droughts are unlikely to cause serious social threats to households in Irvine, though residents and business owners in the City may experience financial costs associated with water conservation efforts. Those who have less access to financial resources, such as low-income households or seniors, may be harder hit if higher water fees are imposed during a severe drought event.

Other Threats

A typical drought is not anticipated to lead to any outages in service in Irvine. An exceptional drought, however, may lead to restricted water use for residents or businesses in the City. Trees that are not properly adapted to lower levels of irrigation could perish, which would alter the City's aesthetic appearance. For more specific information on tree health, please refer to Tree Mortality discussion under

Diseases and Pests. Any open spaces with extensive lawns, may start to die, turning brown in color, which could discourage residents from using these parks and open spaces.

Figure 4-3: Irvine Tree Inventory



Flooding (Sea Level Rise)

Physical Threat

Portions of the City are located within the 100-year flood zone (1.0% Annual Chance of Flooding) and the 500-year flood zone (0.2% Annual Chance of Flooding). Any physical assets located within these mapped boundaries can expect to be inundated if enough precipitation were to fall exceeding the storm drain infrastructure design capacity in these areas. Electronic or mechanical equipment on the ground could become waterlogged and nonfunctional. The City has several key underpasses beneath major freeways and rail lines, that if flooded could impact circulation throughout the City. In addition, the City has key locations along Sand Canyon Avenue, Jamboree Road, Culver Drive, and Jeffrey Road that require pump stations to ensure these underpasses do not fill with water. **Figure 4-4** identifies the 100-year and 500-year FEMA flood zone designations. **Table 4-5** identifies the physical assets in Irvine located within the 100-year flood zone. Assets include 55 bridges and 3 City Recreation Support facilities. Potential losses associated with this flood zone could amount to over $130 million. This estimate also includes three assets

that have the potential to be impacted by 1 meter of sea level rise. These three bridges are located along San Diego Creek and have a replacement value of over $40 million. In addition, **Table 4-6** identifies the additional assets located within the 500-year flood zone, which account for six CFs and two FOC that account for over $12.5 million in additional assets exposed to flooding within the City.

Table 4-5 Critical Facilities and Facilities of Concern (100-year Flood)

Category	Number of Facilities		Potential Loss*
	Critical	Concern	
City Vital Operations	-	-	$0
City Community Centers	-	-	$0
City Resident Services	-	-	$0
City Recreation Support	-	3	$17,390,145
Bridges**	55	-	$113,203,067
Schools***	-	-	N/A
Total	55	3	$130,593,212

* Based on the City of Irvine insured replacement values

** Includes three bridges that may be affected by Sea Level Rise ($40,571,700)

*** Replacement Values unavailable

Table 4-6 Critical Facilities and Facilities of Concern (500-year Flood)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	-	-	$0
City Community Centers	1	-	$462,067
City Resident Services	1	-	$2,148,923
City Recreation Support	-	2	$ 1,499,624
Bridges	4	-	$8,450,960
Schools*	-	-	N/A
Total	6	2	$12,561,574

* Replacement Values unavailable

** Based on the City of Irvine insured replacement values

Social Threat

The threat of a flood will primarily affect those residents living within the 100-year and 500-year flood zones. Many of these zones are located along drainages within the City. Floodwaters in these areas are anticipated to rise to more than a maximum of one foot. Flooding of this type would likely inundate curb cuts as well as sidewalks to some extent. Any people in Irvine who walk or bike as their main form of transportation may encounter greater difficulties with their mobility if they do not have access to an alternative means of transportation. Seniors, persons with disabilities, and low-income persons are those most likely to be threatened. **Table 4-7** shows the proportions of Irvine's vulnerable populations who are likely to face a greater threat from a flood event in the City. Based on the analysis in Table 4-6, median household income in the 100-year flood zone is significantly higher than the citywide average. In addition,

households with one member aged 65+ is significantly lower (4.8%) than the citywide average (19.5%). The demographics for the 500-year flood zone are like the 100-year flood zone statistics, with exception to a lower median household income and a higher percentage of households with one member aged 65+.

Additionally, persons who are experiencing homelessness may be caught outside during flood conditions without any shelter. Though floodwaters in Irvine are not expected to exceed a depth of one foot, even a floodwater depth of six inches may render any makeshift structures uninhabitable during the flood event. Possessions such as sleeping bags or electronic devices may be damaged or swept away by the floodwaters.

Other Threats

Flooding may temporarily stop any type of transportation in the City. Debris carried by floodwaters can block roadways, hinder access for vehicles, and potentially affect emergency response services. Rushing water only one foot deep is enough to carry small vehicles. A severe flood situation where the maximum anticipated flood depth of one foot is realized, may prevent people who own smaller vehicles from driving to work, leading to reduced economic activity. Severe flooding that causes serious damage to homes and businesses may also result in reduced economic activity until repair work is completed.

TABLE 4-7: Flood Hazard Threatened Populations

Threatened Population Metric	Flood Hazards (1%)	Flood Hazards (0.2%)	City of Irvine
Population	434	6,031	256,877
Households	98	2,196	92,869
Median household income	$142,463	$92,855	$95,573
Percentage of households with at least one person living with a disability	12.3%	12.7%	5.8%
Percentage of households living under poverty limit	11.6%	11.5%	13.2%
Percentage of households with one member aged 65+	4.8%	10.6%	19.5%

Geologic Hazards

Physical Threat

Landslides

Landslides pose a threat to a variety of City facilities. **Table 4-8** identifies the facilities located within the Deep-Seated Landslide hazard zone identified in **Figure 4-5**. A majority of these landslide hazard zones are in the foothills of the Santa Ana Mountains and San Joaquin Hills. These areas are characterized with steep slopes, which during long periods of rainfall can trigger a landslide. In total, deep seated landslides could cause over $50 million in losses based on the 30 CFs and 7 FOC located in this zone. In addition to this zone, the City also mapped the California Geological Survey's Earthquake Induced Landslide zones (**Figure 4-6**), which identifies a smaller landslide hazard footprint. Additional loss estimation of this hazard zone was not conducted, as the losses are already accounted for in **Table 4-8**.

Figure 4-4: Flood Hazard Zones

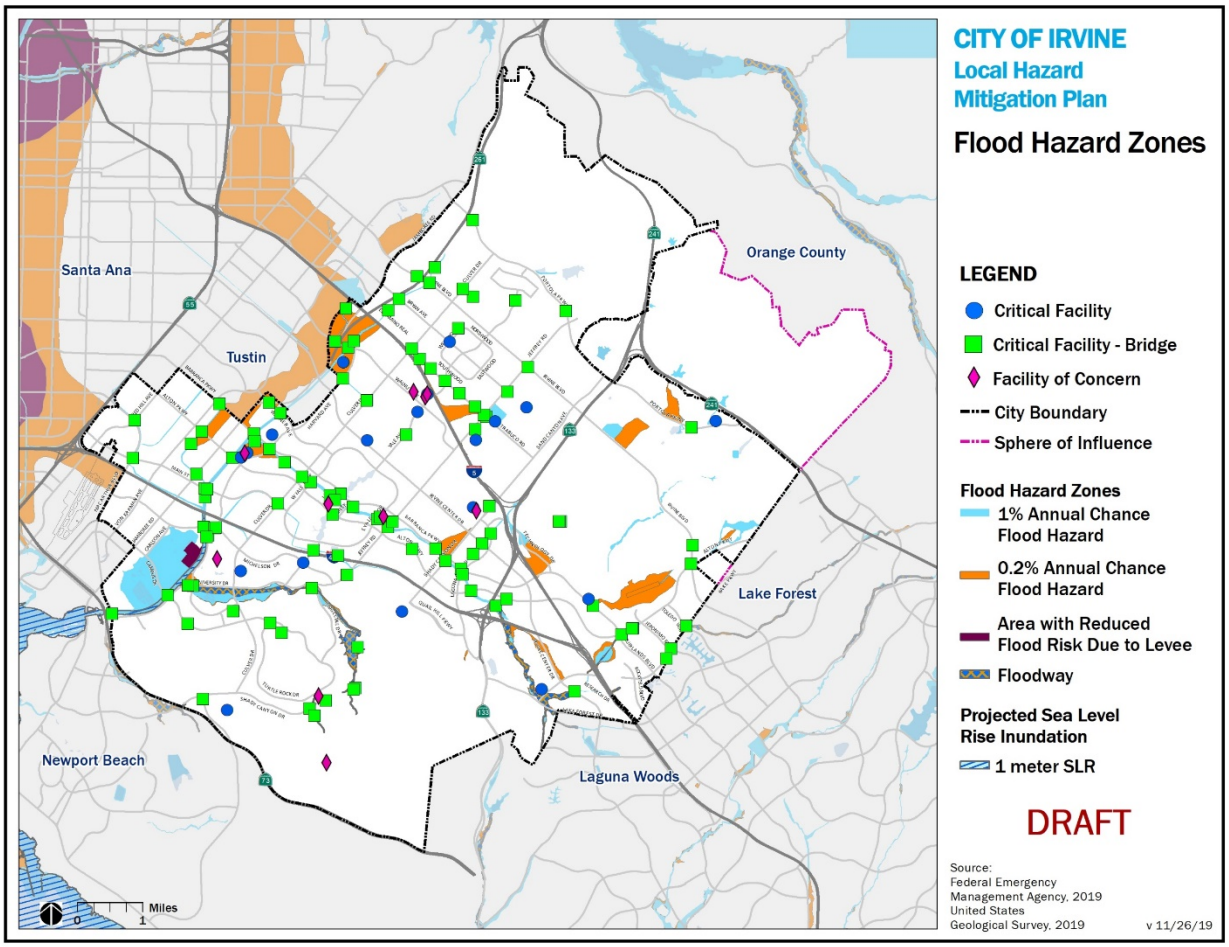


Table 4-8 Critical Facilities and Facilities of Concern (Deep Seated Landslide)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	-	-	$0
City Community Centers	3	-	$17,743,074
City Resident Services	-	2	$1,604,745
City Recreation Support	-	-	$0
Bridges	27	-	$31,346,880
Schools*	-	5	N/A
Total	30	7	$50,694,699

* Replacement Values unavailable

** Based on the City of Irvine insured replacement values

Subsidence

Subsidence can influence both the built and natural environment. Because water lines are gravity driven, a change in elevation as a result of subsidence could make the system more inefficient. Sinking of the

ground could also reduce the distance to the groundwater table, which could raise the risk of contamination from hazardous materials. Subsidence could also irreversibly decrease an aquifer's capacity to store water.[127] Although accurate subsidence mapping data is not available, many important CFs could be gradually affected by subsidence in Irvine and may require further study to examine their function and safety.

Social Threat

Landslides

As shown in **Table 4-9**, there are 2,200 people and 683 households living within a deep-seated landslide hazard zone, which is only a small percentage of the city's population. This population has a significantly higher median household income than the City overall. However, households living under the poverty limit and households with one member aged 65+ are lower than the City overall. These indicators suggest that populations within the landslide hazard zones have high disposable incomes and lower proportions of residents that are retired or living on limited incomes.

Table 4-9: Landslide Hazard Threatened Populations

Threatened Population Metric	Landslide Zones	City of Irvine
Population	2,200	256,877
Households	683	92,869
Median household income	$158,465	$95,573
Percentage of households with at least one person living with a disability	7.8%	5.8%
Percentage of households living under poverty limit	11.0%	13.2%
Percentage of households with one member aged 65+	12.4%	19.5%

Subsidence

Subsidence is a concern for everyone because it could have a significant effect on large-scale systems such as utility infrastructure, open space, and aquifers. In addition, subsidence could affect the safety of homes. Buildings could gradually sink as a result of subsidence, causing minor issues such as cracks or misalignments of doors and windows, or more costly problems such as sinkholes. These issues could impact residents living in older homes, which may not have been built with foundations reinforced with steel. Because insurance companies may not cover damages caused by subsidence or other geologic hazards, lower-income households may find it financially difficult to cope with subsidence.

Other Threats

Landslides

Landslides may block roadways causing long-term disruptions to the roadway network, infrastructure systems and city capabilities. Underground utility lines in slide-prone areas or above-ground lines built on or above them, can be damaged in a landslide, causing service outages. Landslides could affect sensitive ecological areas around the community, causing localized harm to the region's ecosystem, although widespread disruptions are unlikely.

Homes and businesses are typically damaged or destroyed by landslides. In addition to potentially causing significant injuries or fatalities, this can cause economic harm and create a need for long-term emergency sheltering and temporary housing until these buildings can be reconstructed. Utility lines, such as power lines or water pipes, may be broken by a landslide, interrupting important services.

Subsidence

If subsidence occurred in Irvine, the impacts could be widespread. In addition to potentially damaging buildings and other above ground structures throughout the community, subsidence could damage roads and rail lines as well as underground pipes such as water, wastewater, and natural gas. This could create more congestion on Irvine's transportation networks and interrupt key utility services.

Figure 4-5: Deep Seated Landslide Hazards

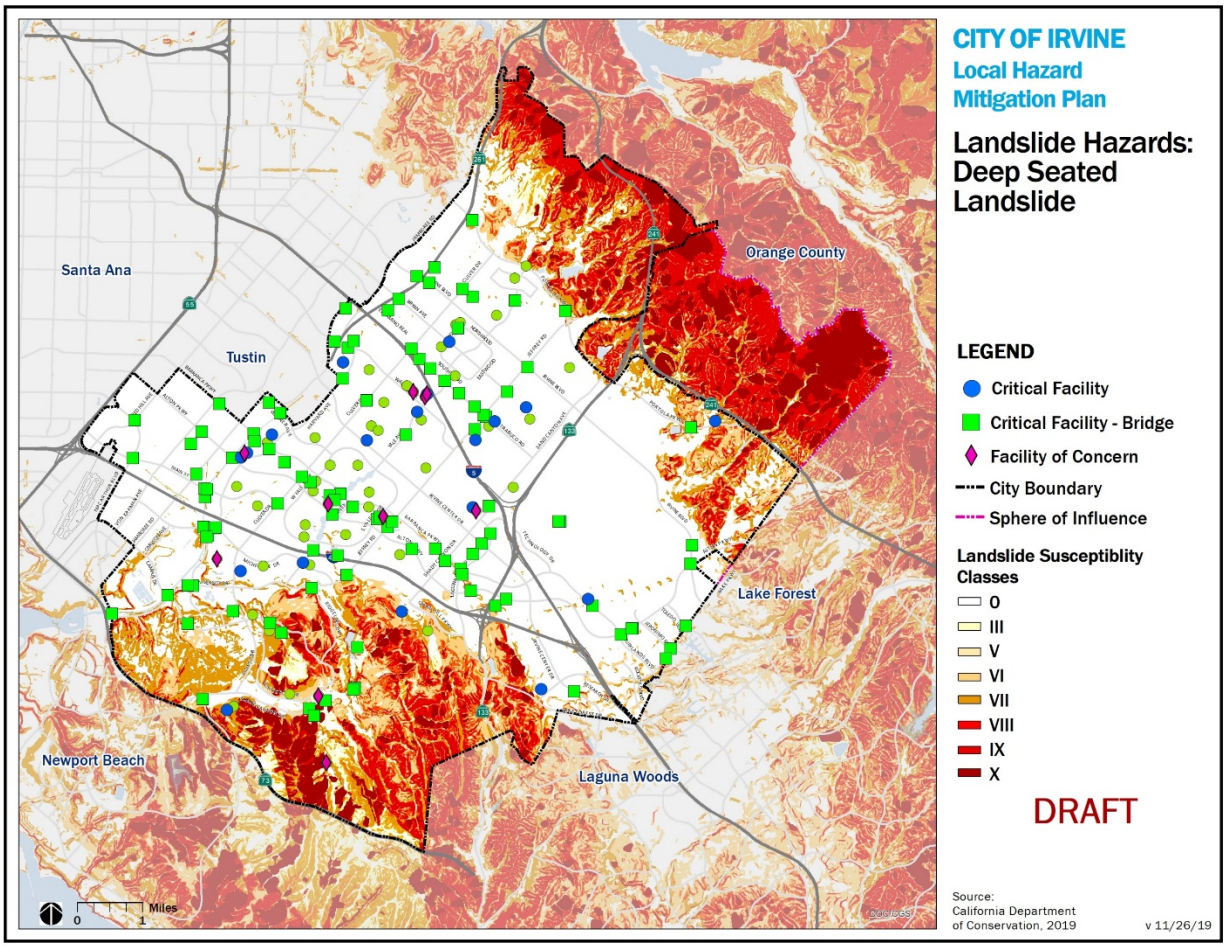
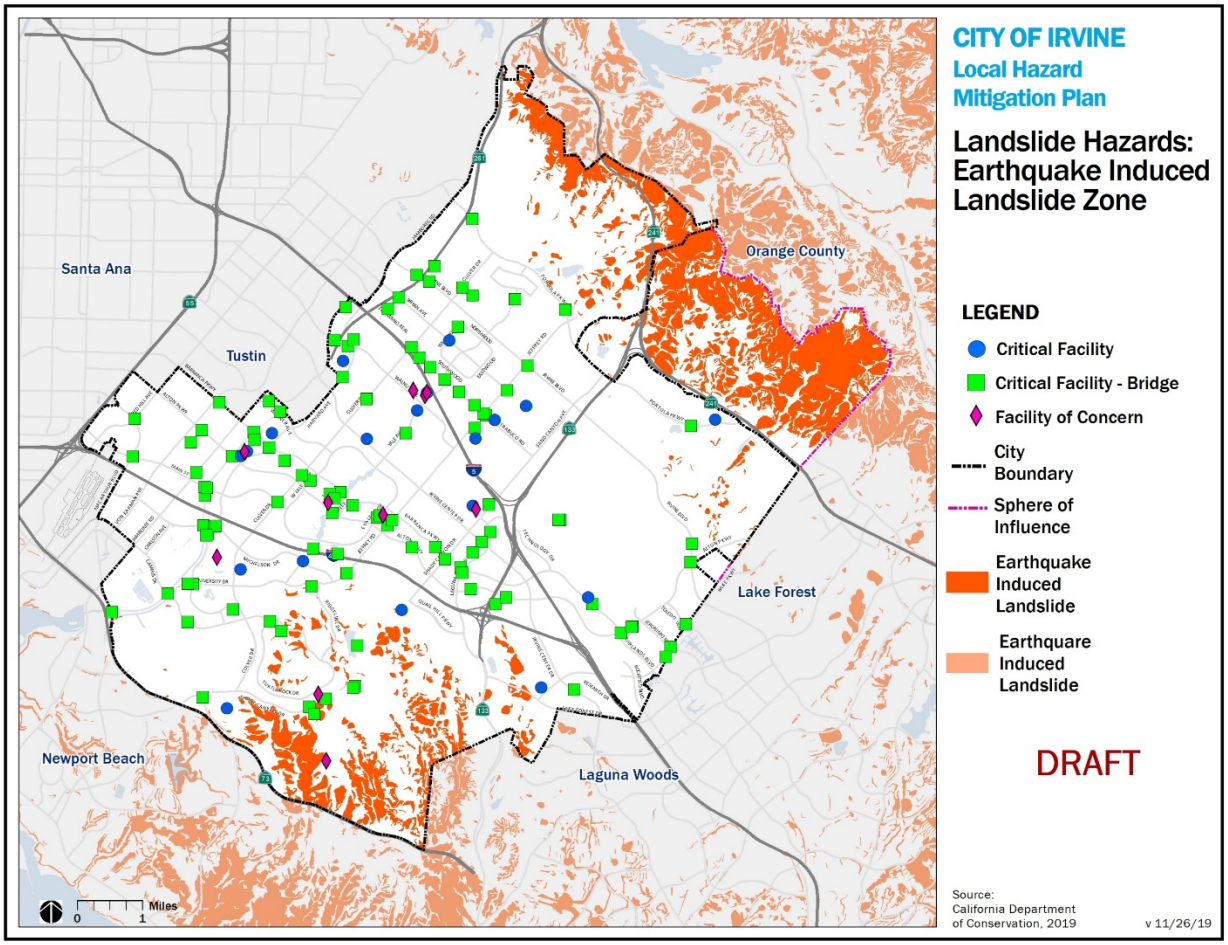


Figure 4-6: Earthquake Induced Landslide Hazards



Hazardous Materials Release

Physical Threat

Hazardous materials can cause damage to physical assets in Irvine if they are released into the environment. Corrosive hazardous materials can damage the exteriors of any buildings or structures designated as a critical facility or facility of concern by the City. Flammable hazardous materials can potentially start fires and may cause any CFs or FOC nearby to flashover. Generally, sites that are closer to the origin for the release of the hazardous materials are more at threat than those that are further away. **Figure 4-7** shows the CFs and FOC in Irvine that are located within 500 feet of hazardous materials sites identified in the City.

Table 4-10 shows the numbers of physical assets in Irvine that are threatened by a hazardous materials release within 500 feet of a site storing or using hazardous materials. 29 CFs composed of Vital City Operations and Bridges are located within 500 feet of a site with hazardous materials. 7 FOC are located within 500 feet of a site with hazardous materials. A total potential loss estimated for these areas is over $90 million.

Table 4-10: Critical Facilities and Facilities of Concern (Haz Mat Buffer 500 feet)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	2	-	$ 42,063,628
City Community Centers	-	-	$ -
City Resident Services	-	1	$359,612
City Recreation Support	-	1	$ 5,094,500
Bridges	27	-	$ 43,369,710
Schools*	-	5	N/A
Total	29	7	$90,887,450

* Replacement Values unavailable
** Based on the City of Irvine insured replacement values

Table 4-11 identifies the number of facilities located within areas of increased pollution as indicated by Cal EPA's Cal Enviroscreen dataset. Identifying census tracts in the 50th percentile or greater. Based on this dataset 23 CFs and one facility of concern are located within these census tracts. Based on this analysis, approximately $41 million in potential losses could occur if a hazardous materials incident were to occur.

Table 4-11: Critical Facilities and Facilities of Concern (Cal Enviro Screen)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	-	-	$ -
City Community Centers	-	-	$ -
City Resident Services	-	1	$108,596
City Recreation Support	-	-	$ -
Bridges	23	-	$ 40,945,230
Schools*	-	-	N/A
Total	23	1	$41,053,826

* Replacement Values unavailable
** Based on the City of Irvine insured replacement values

Social Threat

The threat of a hazardous materials release event affects those who are closest to a source of hazardous materials, including industrial sites, gas stations, gas transmission lines, or sewer mains. **Table 4-12** shows the City's vulnerable populations living within 500 feet of a hazardous materials storage or waste site. Though the population close to a hazardous materials site in the City is small, the median household income is approximately $14,000 less than the rest of the City. This suggests that poorer populations may be living near hazardous materials locations, indicating potential environmental justice concerns should be considered. This data also suggests a disproportionately higher percentage of households with at least

one person living with a disability. This increase could be related to certain locations that cater to populations with a disability or some other criteria.

Figure 4-7: Hazardous Materials Release Physical Threat

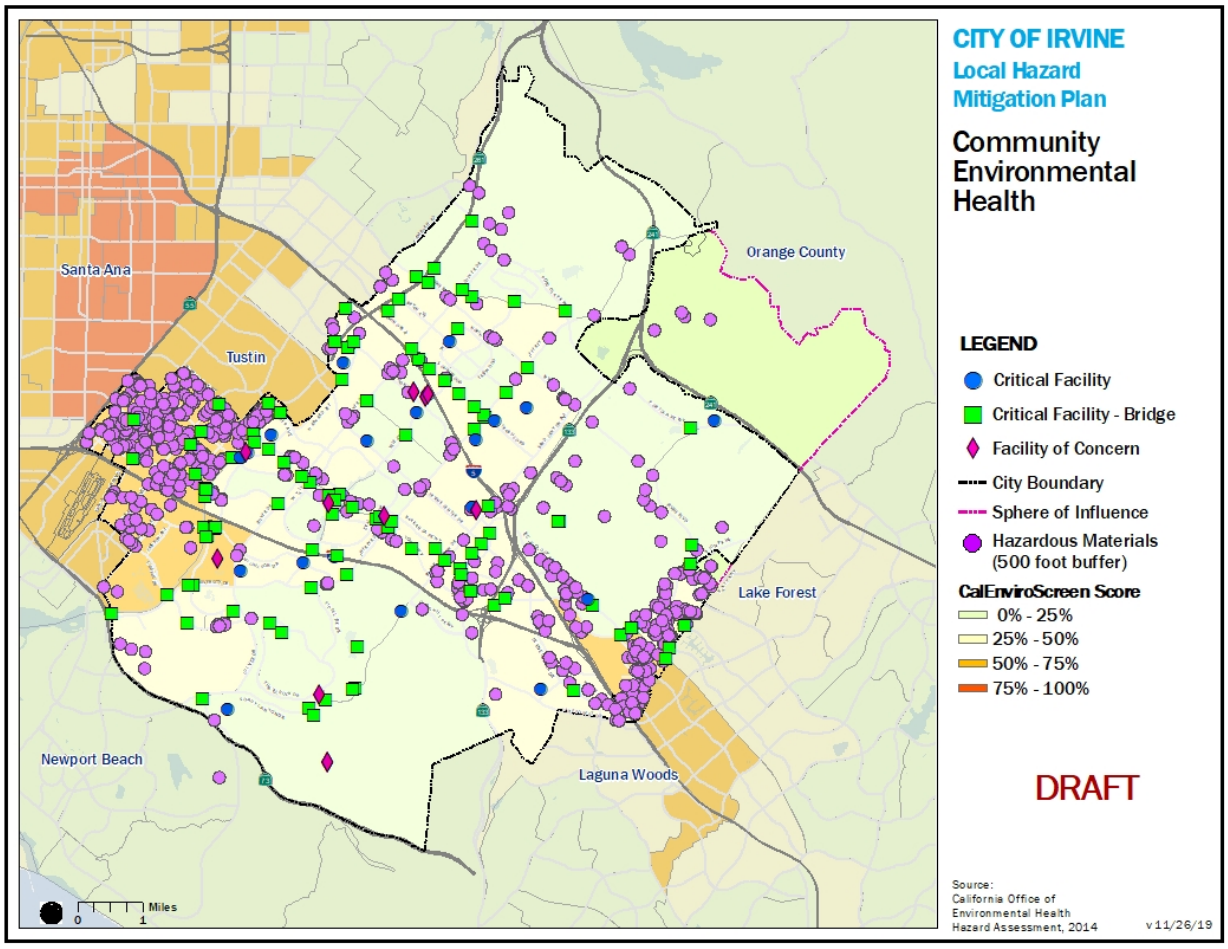


Table 4-12: Hazard Threatened Populations

Threatened Population Metric	Hazardous Materials	City of Irvine
Population	7,476	256,877
Households	3,110	92,869
Median household income	$81,598	$95,573
Percentage of households with at least one person living with a disability	14.2%	5.8%
Percentage of households living under poverty limit	12.3%	13.2%
Percentage of households with one member aged 65+	16.7%	19.5%

Irvine residents living next to major transportation infrastructure, such as highways or major arterial streets, also face a greater threat of being affected by a release of hazardous materials since any trucks or vehicles shipping quantities of hazardous materials may release their contents into the environment if the vehicle is involved in a collision, for example. Specifically, residents in Irvine living near the Irvine Business Complex and John Wayne Airport, as well as the major transportation corridors running through

the City (SR 55, I-5, I-405) are more threatened by a transportation-related hazardous materials release than residents living in other parts of the City.

Groups such as the elderly, low-income persons, or renters face greater risk of exposure since they may not have the financial resources necessary to retrofit their homes against infiltration by hazardous materials or to move away to a home that is further from the potential sources of hazardous materials release events.

Other Threats

Hazardous materials release could threaten the City's and potentially the region's transportation networks. Large areas of the local road or rail systems may be closed to keep people away from areas contaminated with hazardous materials in order to allow remediation and cleanup activities to occur. If a highly corrosive hazardous material is released, it could potentially cause significant damage to the exteriors of any homes or businesses in the area surrounding the release. Hazardous materials could also harm the City's urban forest, resulting in the deaths of several trees.

Human Caused Hazards

Physical Threat

Mass-Casualty Incident (Terrorism)

There is no way to predict which of Irvine's facilities or assets may be impacted by a mass casualty incident/act of terrorism, since the reasoning behind the incident is often complex or not easily understood. Generally, these types of incidents occur at places of political, economic, or cultural importance. If the motives of the perpetrator are to shut down City or regional governmental activity for a period of time, they may instead target pieces of infrastructure, like water systems, utility delivery systems, or transportation networks. In this situation, bridges may become prime locations for these types of activities. The financial losses that may result would depend on the degree of destruction associated with the activity. If the incident involves the destruction of physical assets, the cost to the City or property owners in Irvine would likely be immense.

Civil Disturbance

Like Mass-Casualty Incidents, Civil Disturbance threats to physical assets are hard to predict. Typically these incidents involve protests, marches, or celebrations that can turn into destructive or violent incidents (i.e. riots) causing property damage. Impacts associated with these incidents would likely initiate at the site of origin, which usually occurs at places of political, economic, or cultural importance.

Cyber Threats

Cyber threats would have limited impact on physical assets. The extent of this impact would focus on City-owned computer and network infrastructure.

Transportation Accident

Since each transportation accident is unique it is not possible to quantify the threat to Irvine's physical assets. A common incident involving a collision between two vehicles is unlikely to threaten physical assets in Irvine. A more serious collision involving larger vehicles could pose an increased threat to CFs/FOC, depending on the location. For example, a large freight truck could damage a City-owned building if its

operator mishandles the vehicle and drives it into the building. Such a scenario would be rare and nearly impossible to predict. It is more likely that a vehicle could collide with a utility pole impacting services to neighboring properties or portions of the community. The damage to one pole and potentially any wires carried by it would be minor and the cost to repair or replace the pole would likely be low.

Infrastructure Failure

Infrastructure failure impacts to physical assets would be limited to the infrastructure improvements involved in the incident and any collateral damage that may occur as an effect of the failure. Typical failures could include roadway collapse, bridge collapse, storm drain failure, and/or pipeline rupture. Loss of electricity due to infrastructure failure has occurred within the City. Refer to Chapter 2 for a discussion of this incident.

Social Threat

Mass-Casualty Incident (Terrorism)

Since mass casualty incidents/acts of terrorism could occur anywhere in Irvine, all groups are potentially threatened by the impacts of these incidents; however, the extent of the threat would depend upon the type and magnitude of event. For example, an active shooter situation may be isolated to a single location, whereas a larger-scale incident may affect multiple locations. Some locations are more likely to be targets than others, including but not limited to medical facilities, government buildings, or financial institutions. Populations that frequently visit these areas may face a greater threat than the average person. Seniors, pregnant women, and persons with disabilities, for instance, are more likely to frequently visit the local hospitals than other subpopulations in the City. Should an incident occur at the Hospital or within the community (overwhelming hospital resources), these groups are expected to face an increased impact by the incident.

An incident that occurs at a government building or financial institution may be more likely to threaten seniors or lower-income individuals that rely on in person transactions in place of online options.[128,129] As such, their use of these services in-person may place them in harm's way. An incident that occurs at Irvine City Hall or at any bank in the City can be expected to be more of a threat to these groups. Seniors and persons with limited income may be challenged if there is a need to shelter in place or evacuate during an incident requiring additional services, assistance, and/or medical treatment.

Civil Disturbance

Since civil disturbance could occur anywhere in Irvine, all groups are potentially threatened by the impacts of these incidents. While most residents affected by a civil disturbance would be able to recover from the incident, residents on fixed incomes or living below the poverty limit may have difficulty doing so.

Cyber Threats

Cyber threats may have an impact on residents and businesses throughout the City. While most cyber threats focus on large entities like major corporations and/or governmental agencies, all residents could become a victim of cyber threats.

Transportation Accident

Transportation incidents are expected to threaten any groups who live next to major freeways or thoroughfares throughout the City. While the accident itself would only affect those immediately

involved, the threat to Irvine's vulnerable groups comes from the secondary impacts associated with the accident. For example, transportation accidents often result in the closures of roadways. These closures may result in the temporary suspension of public transit or paratransit services which could impact those populations with limited mobility, such as seniors, lower-income persons, or persons with disabilities. Closures may cause traffic to be re-routed, resulting in an increase in traffic congestion on local roads. Motorists unfamiliar with the area may drive hastily and may collide with pedestrians or cyclists on the road, which include seniors and lower-income persons. In a severe transportation incident, traffic may come to a complete standstill and idle on the roadway, resulting in more air pollution. Groups with respiratory conditions, such as seniors or children with asthma, may have difficulty breathing during the period of the transportation incident.

Infrastructure Failure

Infrastructure failure incidents are expected to threaten any groups who live next to the area of failure. A roadway failure would impact local circulation and any residents and businesses in the vicinity would be directly affected. Similar impacts would occur as a result of pipeline, bridge, and/or storm drain failure. Depending on the size of the failure and the location, the impact to the community can become significant. In some jurisdictions the loss of a bridge re-routes traffic for months while reconstruction occurs. These types of inconvenience can inordinately impact vulnerable populations in similar ways to transportation accidents, as described above. Additional information regarding the August 2019 incident that caused a power outage in the City is located in Chapter 2 of this document. A failure of this type can have a significant effect on vulnerable populations that rely on electricity for health and/or support services.

Seismic Hazards

Physical Threat

Fault Rupture

The City has numerous faults that have been mapped and identified in the San Joaquin Hills and the foothills of the Santa Ana Mountains. **Figure 4-8** identifies these mapped faults with the City's CFs and FOC. Per the mapping, these faults are not considered active as defined by the California Geological Survey, therefore the risk associated with fault rupture is lower than other areas of Orange County and southern California. **Table 4-13** identifies the CFs and FOC located within 500 feet of these mapped fault segments. Based on this table, potential losses associated with fault rupture could amount to over $66 million and affect 4 CFs and 18 FOC.

Table 4-13: Critical Facilities and Facilities of Concern (Fault Rupture)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	-	1	$670,938
City Community Centers	3	-	$25,522,344
City Resident Services	-	-	$0
City Recreation Support	-	16	$39,946,835
Bridges	1	-	$82,880

Schools*	-	1	N/A
Total	4	18	$66,222,997
* Replacement Values unavailable			
** Based on the City of Irvine insured replacement values			

Liquefaction

Liquefaction potential is predominantly located within the northern portion of the City, as well as along stream courses in the Santa Ana foothills and San Joaquin Hills. **Figure 4-9** identifies the areas susceptible to liquefaction and location of CFs and FOC. Give the extent of the liquefaction zone and density of City facilities, this hazard poses the greatest potential loss. Over $233 million in City assets composed of 78 CFs and 30 FOC are located within these areas. **Table 4-14** identifies these potential losses, which includes 70 bridges and 20 schools in the City of Irvine.

Table 4-14 Critical Facilities and Facilities of Concern (Liquefaction)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	2	-	$56,786,352
City Community Centers	4	-	$3,331,110
City Resident Services	2	3	$9,029,015
City Recreation Support	-	7	$31,486,344
Bridges	70	-	$132,520,697
Schools*	-	20	N/A
Total	78	30	$233,153,518

* Replacement Values unavailable
** Based on the City of Irvine insured replacement values

Seismic Shaking

Many physical assets in the City are estimated to experience the same seismic shaking intensity, ranging from 55 to 75% g (shaking intensity in relation to earth's gravity). Therefore, all facilities could potentially be damaged during a significant seismic event, which would likely be extremely costly for the City. If all facilities were to be damaged at the same time during a seismic shaking event, it can be assumed that the City would incur a percentage of the maximum potential loss of its physical assets. Assuming 20% of the City's assets are impacted, this potential loss could amount to over $73 million. Underground physical assets, like pipelines or utilities, could be damaged if nearby faults were to rupture below the surface. In such a scenario, natural gas and water delivery service to Irvine homes and businesses would be out of commission until repairs are completed. **Figure 4-10** identifies CFs and FOC in Irvine that are threatened by seismic shaking.

Social Threat

The risk of a seismic event is a danger to all groups in Irvine though some are more threatened than others.

Fault Rupture

To analyze the social threat associated with fault rupture, the City used two different fault rupture data sets mapped on Figure 4-8. These fault data sets provided by the California Geological Survey and City of Irvine were then mapped and analyzed using a 500-foot buffer around each fault segment. Within these areas there are over 9,000 residents that have a median household income that is over $40,000 higher than the City average. In these areas, there is a higher percentage of persons living with a disability, and lower percentage of households with one member aged 65+.

Table 4-15: Fault Rupture Hazard Threatened Populations

Threatened Population Metric	Fault Rupture (California Geological Survey)	Fault Rupture (City of Irvine)	City of Irvine
Population	9,254	68,786	256,877
Households	3,811	25,769	92,869
Median household income	138,577	$122,160	$95,573
Percentage of households with at least one person living with a disability	10.7%	8.3%	5.8%

Percentage of households living under poverty limit	12.6%	11.0%	13.2%
Percentage of households with one member aged 65+	10.8%	12.0%	19.5%

Figure 4-8: Fault Rupture Physical Threat

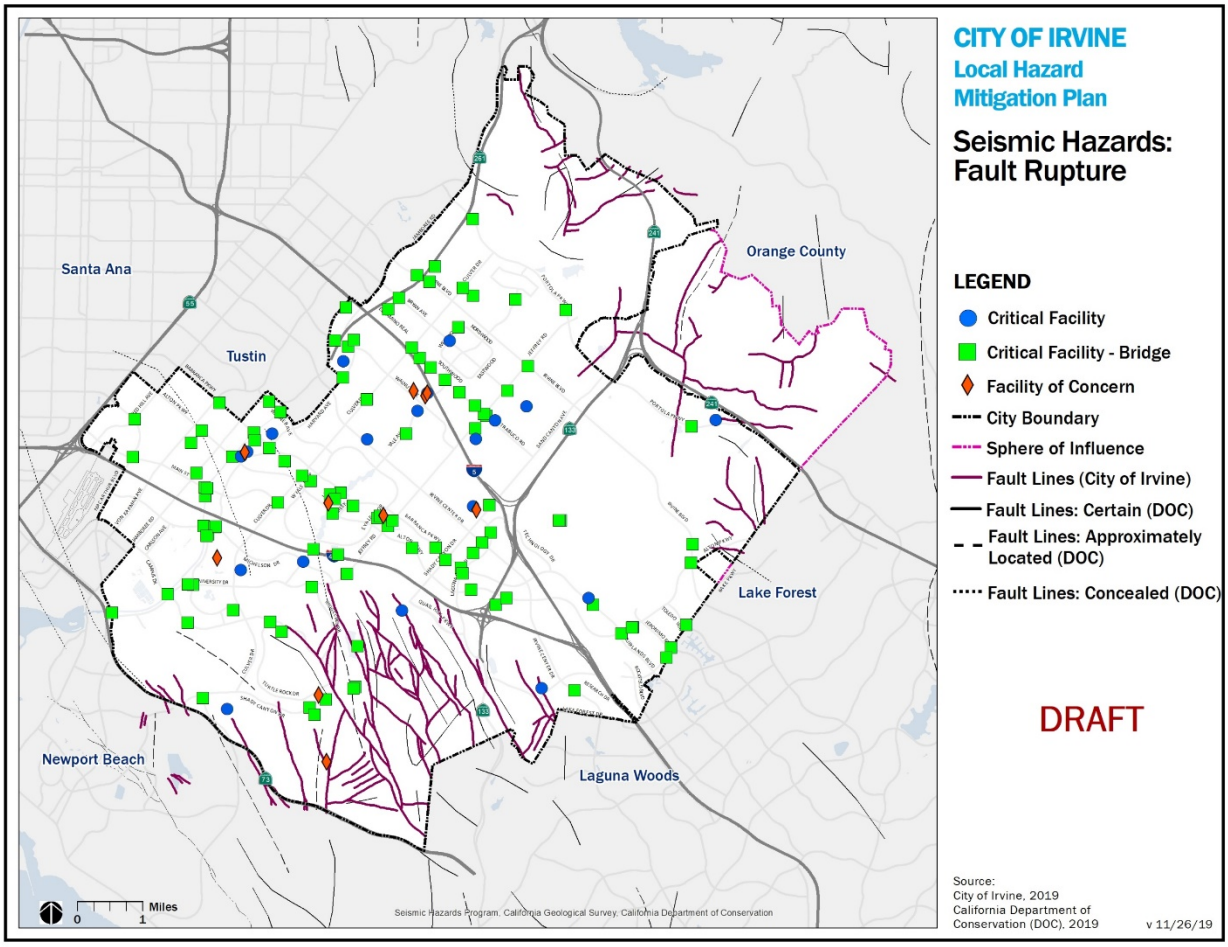
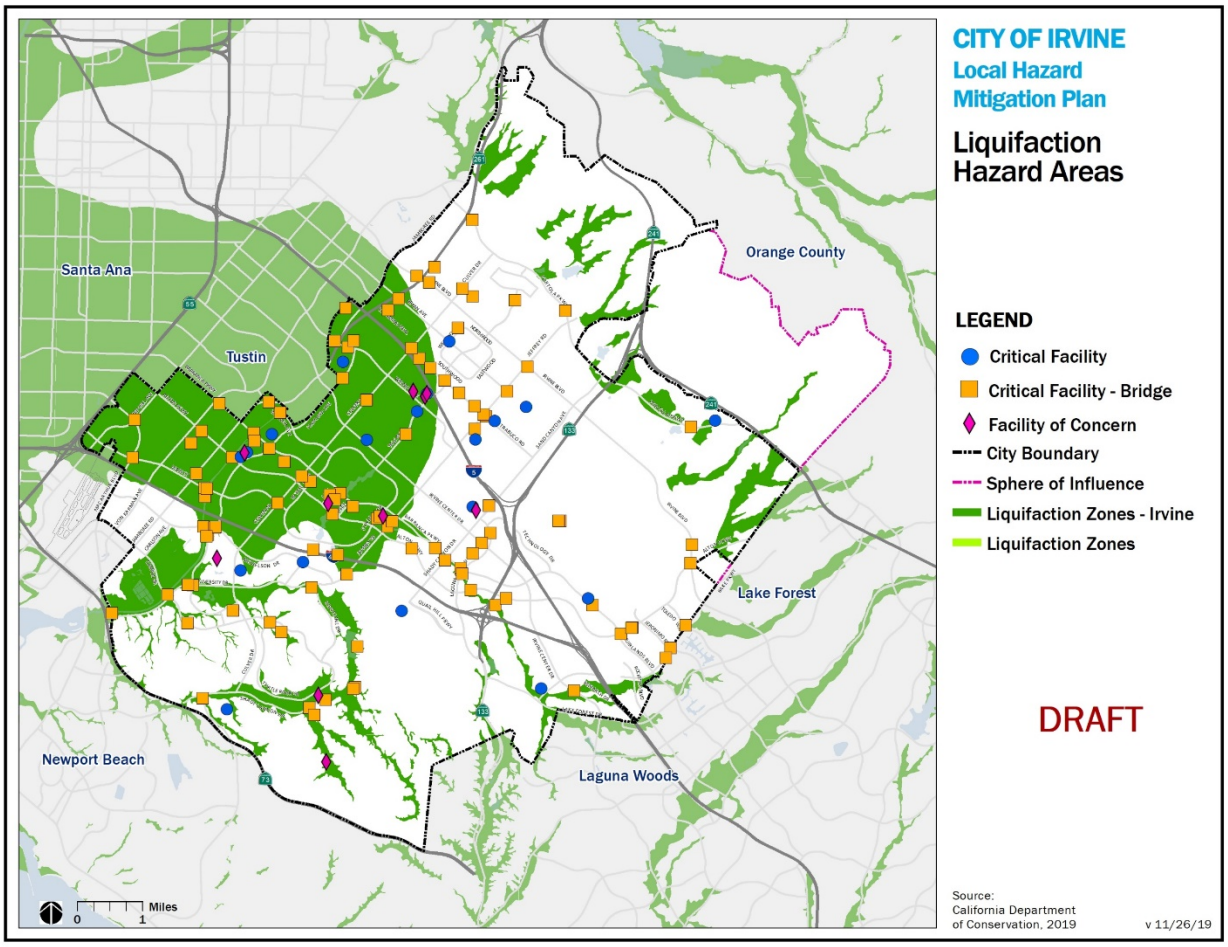


Figure 4-9: Fault Rupture Physical Threat



Liquefaction

Since a large portion of the City is located within a designated zone of liquefaction, a large proportion of the City's population (over 37%) face the threat of impact due to liquefaction. Thankfully, much of the construction that has occurred over the years throughout the City has taken liquefaction into consideration. Newer buildings constructed in these areas are anticipated to contain moderate- and high-income tenants that would have greater amounts of disposable income to use during recovery after an incident. However, lower income residents and residents located in areas of older construction may be impacted greater due to the lack of financial resources need to make repairs and/or the cost associated with retrofitting older buildings. **Table 4-16** compares the populations within the liquefaction hazard zones with city wide populations. This hazard zone covers the largest population and number of households by far, which have a median household income that is approximately $6,000 higher than the Citywide figure. Persons living with a disability is more than double the City average, while households with a member aged 65+ is approximately 6 percent lower than the City average.

Table 4-16: Liquefaction Hazard Threatened Populations

Threatened Population Metric	Liquefaction Zones	City of Irvine
Population	95,782	256,877
Households	33,920	92,869
Median household income	$101,990	$95,573
Percentage of households with at least one person living with a disability	12.8%	5.8%
Percentage of households living under poverty limit	12.0%	13.2%
Percentage of households with one member aged 65+	13.6%	19.5%

Seismic Shaking

Seniors, pregnant women, and persons with disabilities are more threatened by seismic shaking since they may have limited mobility and may be unable to reach shelter in time. Even if these groups reach shelter in time, they may find themselves trapped if furniture or building components have fallen around them. Renters and low-income persons are also more threatened by seismic shaking since these groups may live in homes that are not properly retrofitted to survive the stresses of a seismic event. These groups may not be able to absorb the costs associated with repairing their homes or looking for new housing should their existing housing be too damaged for occupancy. In terms of geography, seismic shaking effects are anticipated to reduce in areas of higher elevation, which tend to have lower population densities and high household incomes.

Other Threats

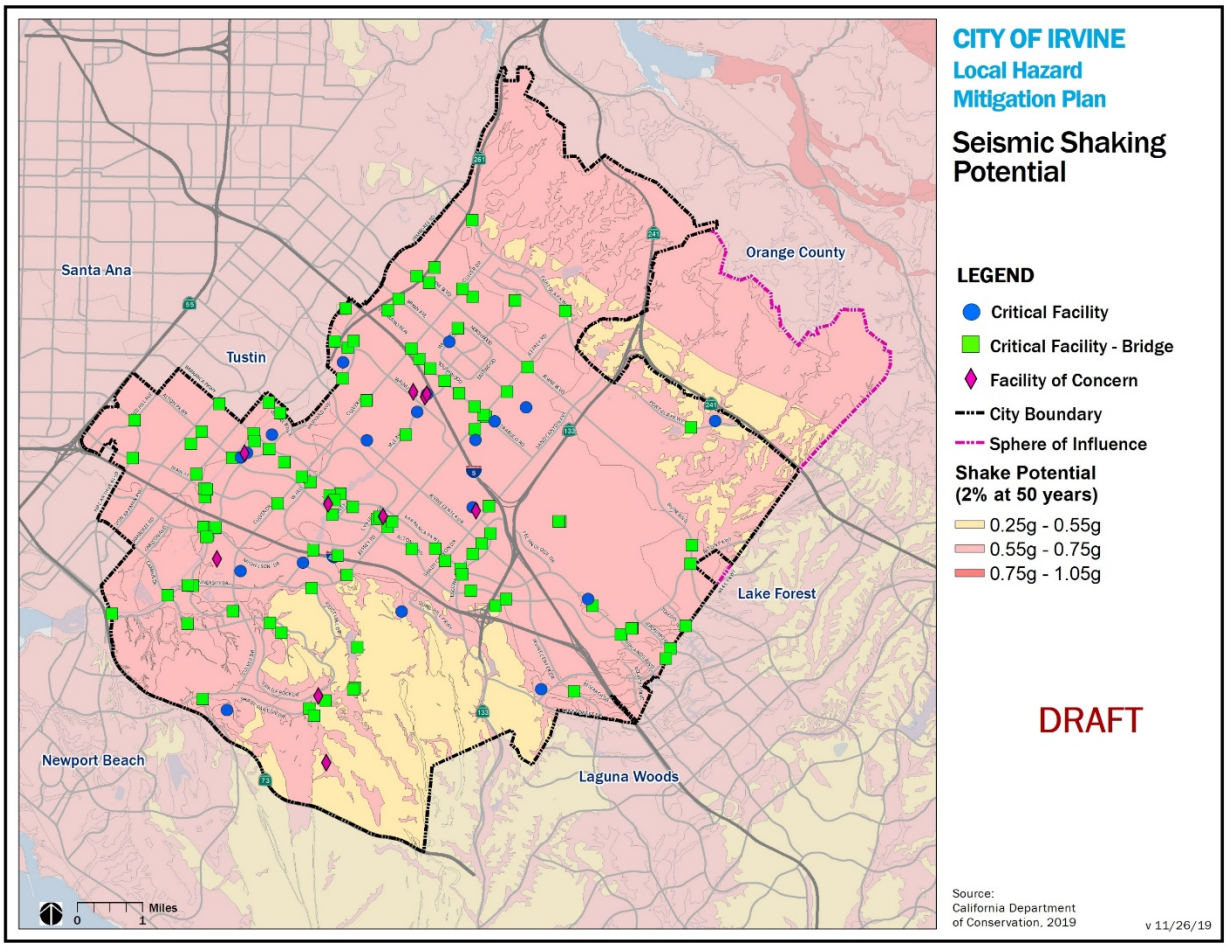
Fault Rupture

Seismic events that cause surface fault rupture tend to damage roads and structures in the areas of impact. The length of rupture is typically a component of the magnitude of the seismic event. The stronger the event, the greater distance that rupture can occur. Within Irvine most of the fault segments identified are not considered active, therefore have a lower likelihood of rupturing. In addition, most of the fault movement occurring in the region is associated with strike slip faulting along the San Andreas, San Jacinto, Whittier Elsinore, and Newport Inglewood fault zones. The faults within the City of Irvine are less likely to rupture in comparison to these faults and if rupture were to occur it would most likely impact small areas.

Liquefaction

Services and mobility may be disrupted during and following a liquefaction event. Sidewalks, roadways, and pipelines may become fractured and disjointed as a result of the liquefying soils. Roads and sidewalks may be usable in some form, but a severe liquefaction event may render them impassible until they are repaired. Broken gas and water pipelines would result in utilities outages in Irvine homes and businesses. Since these are underground, the duration of the outage could likely be extended until the pipelines are excavated and replaced by utility operators. Damage to power lines is unlikely since the power lines themselves are not rigid structures and can move if any of the transmission towers experience slight leaning. Homes may be damaged and mid-rise office buildings in the Centerpointe Complex would likely be rendered unsafe for occupancy if they experience any leaning or structural damage resulting from the liquefaction. This would curtail the City's and region's economic activity.

Figure 4-10: Seismic Shaking Physical Threat



Seismic Shaking

As early earthquake warnings systems become operational soon, it can be expected that utilities will take advantage of these advance warnings to shut off gas, water, and power transmission to control any potential leaks following the seismic shaking. Authorities may have enough time to halt the use of bridges or move workers to a safe distance away from hazardous materials. Workers will cease their activity and take shelter until they can be safely evacuated. Therefore, all services will be non-operational during the seismic shaking and remain inactive until authorities are confident that it is safe to reactivate utilities and to return employees to their workplaces. The length of this time would vary depending on the magnitude of the event. A significant earthquake would likely put utilities out of commission and halt any employment activity in the City for a few hours or several days. The City and the region would lose economic activity that would normally occur during the period of the outage. Structures, like telephone poles or power transmission towers, that are felled by the shaking could potentially block roadways and prevent emergency response teams from reaching victims or evacuees who need assistance.

Severe Weather

Physical Threat

Severe weather could affect all parts of Irvine, so all CFs and FOC are within this hazard zone. The three most common severe weather events that could affect Irvine include extreme heat, severe wind, and rain.

Extreme Heat

Very high temperatures can cause roads to deform and buckle as concrete expands in the heat, especially in weaker spots in the pavement, such as areas that have not been maintained well. Power lines and other sections of the electrical grid are less effective in higher temperatures and may suffer damage due to stress during extreme heat events.

Buildings with dark pavement will absorb more heat than the surfaces with vegetation or lighter materials, which are better at reflecting the sun's energy. This urban heat island effect is strongest during hot periods when the sun is strongest.

Severe Wind

Intense winds likely present the greatest threat to physical structures, particularly from trees or branches that fall on buildings and cause substantial damage. Older structures that have deferred maintenance or have not been retrofitted for high wind conditions may suffer greater damage in comparison to newer/updated structures. Utility lines and wooden utility poles face an elevated threat from wind, as do buildings without reinforced roofs.

Another physical threat associated with severe wind is wildfire impacts and the recent practice of electric utilities conducting Public Safety Power Shutoff activities. During high wind events, these shutoffs may impact structures that rely on electricity for normal operations. See social threats for population impacts that may also occur as a result of these events.

Rain

Rain could damage any structures with poorly constructed roofs and could also erode the soil around building foundations. Heavy rain could also lead to flash flooding which would damage unelevated structures in flood zones. Heavy rains are most likely to cause damage to structures located on slopes, and along stream courses, where the risk of erosion is the highest. Landslides triggered by heavy rains would damage any structures located below the landslide's starting point.

Social Threat

Extreme Heat

Whereas a heat event can be relatively harmless for those with a reliable means for staying hydrated and cool, it can be deadly for others. Young children, the elderly, or people suffering from serious medical conditions are physiologically more vulnerable to heatstroke. Some senior citizens also take medicines that can make it harder for their bodies to maintain a safe internal temperature, creating an additional threat from extreme heat events. Young children may not be aware of the signs of dehydration or ways of protecting themselves from heatstroke.

People living in homelessness are at a high risk of health complications during heat waves, especially if they are unsheltered. According to data counts by the OC Health Care Agency, in 2017, there were approximately 4,800 individuals experiencing homelessness in the county, with over 50 percent unsheltered, approximately 25 percent in emergency shelters, and 20 percent in transitional shelters.[130] During a heat wave, these people are very vulnerable to heatstroke, especially if they are unable to reach a cooling center.

Sudden spikes in heat can catch people by surprise. Stores can rapidly sell out of fans, air-conditioning units, or drinking water during a heatwave. Lower-income households or those with limited mobility may be unable to acquire enough insulation or cooling devices without significant advance preparations. This can be further compounded by the threat of Public Safety Power Shutoff events. During these events, extreme heat impacts may affect larger portions of the City and populations that wouldn't be viewed as vulnerable under normal circumstances.

Severe Wind

Events such as severe winds and winter weather can harm people throughout Irvine but have a greater effect on the safety of homeless persons and persons who work outdoors. Lower-income households, who may not be able to afford homes built or retrofitted to withstand powerful winds, could also have difficulty coping or recovering from heavy winds or storms. This can be further compounded by the threat of Public Safety Power Shutoff events. During these events, extreme heat impacts may affect larger portions of the City and populations that wouldn't be viewed as vulnerable under normal circumstances.

Rain

Rain events pose a threat to any groups in Irvine who are not able to access adequate shelter. People who are homeless most often live in tents or informal structures that may protect against minor rains but are inadequate against a heavy rain event. Heavy rain can lead to flash flooding which could sweep away any informal dwellings located within drainages and stream courses. Additionally, vulnerable populations living in older homes that have outdated building materials may experience damage during significant rain events. If affected groups have limited incomes or lack the resources to make necessary repairs or maintain the structures, retrofit of these structures may be hindered.

Wildfire

Physical Threat

The California Department of Forestry and Fire Protection has mapped Very High Fire Hazard Severity Zones within the City's Local Responsibility Area (LRA). **Figure 4-11** identifies these zones along with the City's CFs and FOC. All structures located within this fire zone are at an elevated risk to wildfire impacts. **Table 4-17** identifies 6 CFs and 1 facility of concern within this zone, which could result in a potential loss of approximately $1.4 million. While these areas have a high degree of vulnerability to wildfire, other areas of the City may also be susceptible due to ember cast. These areas typically referred to as the Wildland Urban Interface (WUI) are vulnerable if the right conditions exist. Typically, the WUI is impacted if adequate fuels are combined with dry conditions and strong winds. Sometime the ignition of a wildfire may occur as a result if power lines located around overgrown trees cause a spark and catch the tree on fire. These types of incidents are the main impetus for the newly established PSPS program that is

occurring throughout the State. The City of Irvine currently has 11 circuits that could be affected by future PSPS events.

Table 4-17: Critical Facilities and Facilities of Concern (Very High Fire Hazard Severity Zone)

Category	Number of Facilities		Potential Loss**
	Critical	Concern	
City Vital Operations	-	-	$0
City Community Centers	-	-	$0
City Resident Services	-	-	$0
City Recreation Support	-	1	$168,300
Bridges	6	-	$1,256,640
Schools*	-	-	N/A
Total	6	1	$1,424,940

* Replacement Values unavailable

** Based on the City of Irvine insured replacement values

Social Threat

Outside of the property owners directly impacted by a wildfire event, wildfires can also impact seniors and persons with disabilities. These groups may have limited mobility, be immuno-compromised, and/or not receive notifications regarding current conditions and evacuation requirements. For example, a senior who lives alone may not be aware that a wildfire is burning close to their residence and they have been ordered to evacuate if those notifications were sent in manner that doesn't reach them. Persons with disabilities may require special mobility devices or caregiver assistance to go outside which may not arrive as quickly as needed. Other groups with increased threat levels include people with lower-incomes, renters, and the homeless. These groups may not possess enough financial resources to rebuild their homes or search for new homes in the aftermath of a fire. According to **Table 4-18**, residents living in the VHFHSZ have a median income that is approximately $30,000 higher than the city-wide figure, more households with at least one person living with a disability, and fewer residents living under the poverty limit.

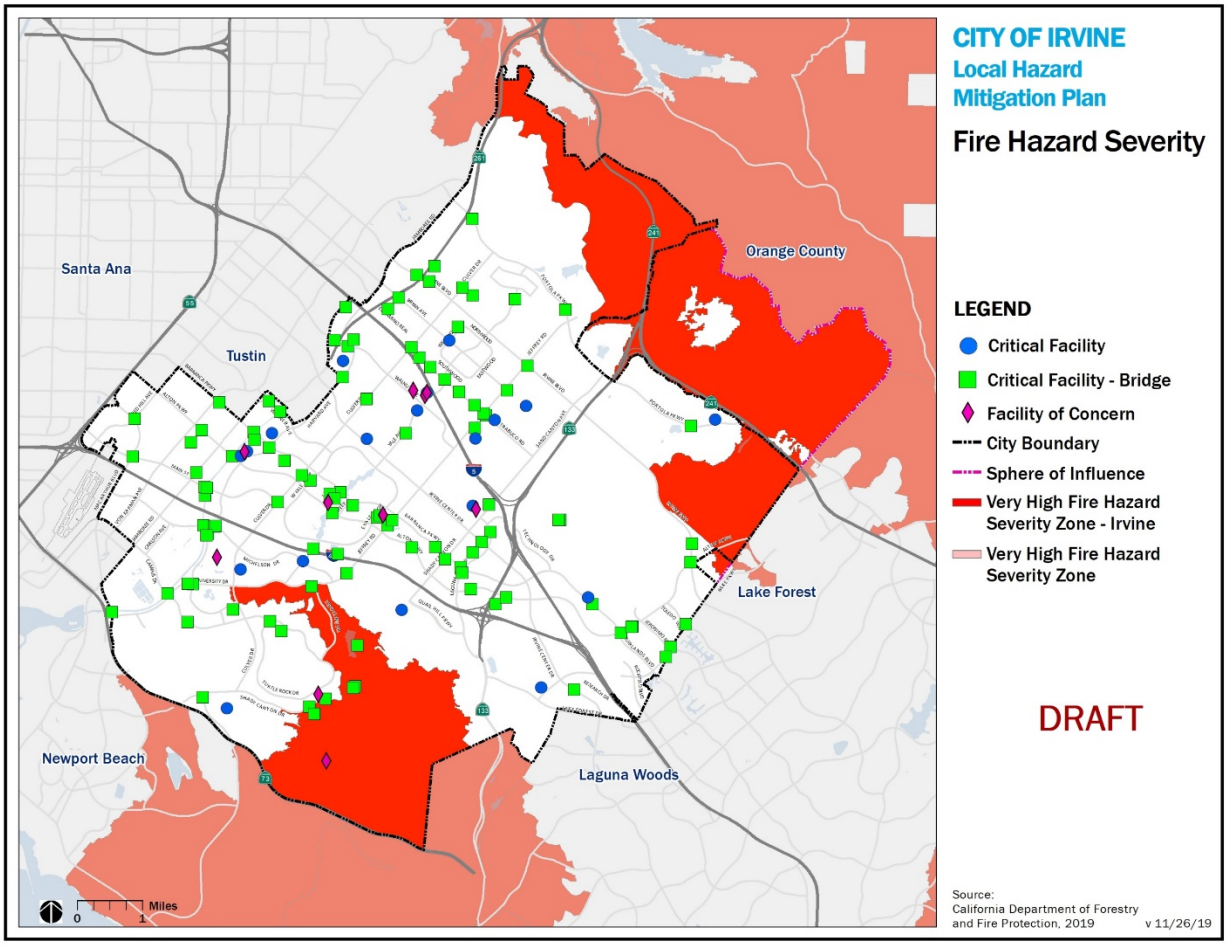
Table 4-18: Very High Fire Hazard Severity Zone Threatened Populations

Threatened Population Metric	Very High Fire Hazard Severity Zone	City of Irvine
Population	5,113	256,877
Households	1,510	92,869
Median household income	$124,738	$95,573
Percentage of households with at least one person living with a disability	9.6%	5.8%
Percentage of households living under poverty limit	7.5%	13.2%
Percentage of households with one member aged 65+	12.5%	19.5%

Other Threats

The issues of Public Safety Power Shutoffs will become a significant issue for many communities throughout California. In Irvine the presence of 11 circuits that have the potential for one of these events may strain current resources during a significant event. Identifying key locations for sheltering and comforting of residents during these events will become a major priority for Irvine. In addition, outreach with residents and businesses to help them prepare for these future events will become an important aspect of the City's overall hazard mitigation strategy.

Figure 4-11: Very High Fire Hazard Severity Zone



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CHAPTER 5 – HAZARD MITIGATION STRATEGY

STRATEGY DEVELOPMENT PROCESS

Irvine's hazard mitigation strategy is a comprehensive set of actions that are intended to reduce the impacts of hazard events. These hazard mitigation actions will help to protect the safety and well-being of residents and visitors, CFs and FOC, other buildings and structures, key services, the local economy, and other important community assets. Some actions will also help with emergency preparedness, allowing for a more effective community response to hazard events. Preparedness actions are not a required component of an LHMP, but they support and complement mitigation activities, and the HMPC chose to include them as part of the overall hazard mitigation strategy.

USE OF HAZARD AND THREAT ASSESSMENT

The HMPC relied in part on the hazard profiles and threat assessments in this Plan to develop the actions in the mitigation strategy. A comprehensive set of mitigation actions that respond to the relevant hazard situations and provide protection to residents, businesses, and community assets in Irvine were prepared. The HMPC took care to ensure that the mitigation actions will help to reduce damage from the most frequent types of hazard events, the most significant that may reasonably occur, and those with the greatest potential to harm the community. The Committee also drafted mitigation actions that will help protect the most vulnerable members of the community and the most vulnerable local assets.

CAPABILITIES ASSESSMENT

As part of the effort to draft mitigation actions, the City completed a capabilities assessment, which included a review of existing policies, personnel, and technical resources that can support hazard mitigation activities in Irvine. The hazard mitigation actions build off the existing success of these resources and leverage their capabilities to support improved resiliency in the community. The capabilities assessment looked at the following types of resources:

- Personnel resources: City employees and volunteers, and employees and volunteers at other agencies.
- Plan resource: Advisory or enforceable plans adopted by the City or other agencies.
- Policy resource: Policies adopted and implemented by the City or other agencies.
- Technical resource: Data and tools available to the City.
- Financial resource: funding mechanisms available to the City that support mitigation activities.

Table 5-1 shows the capabilities assessment for Irvine.

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Table 5-1: Irvine Capabilities Assessment			
Resource Name	**Type of Resource**	**Ability to Support Mitigation**	**Website**
City of Irvine			
City Clerk	Personnel Resource	The City Clerk is the local official who administers democratic processes such as voter registration, elections, access to City records, and all legislative actions, ensuring transparency to the public. The City Clerk acts as a compliance officer for federal, state, and local statutes including the Political Reform Act, the Brown Act, and the Public Records Act. Additionally, they handle release of City Council agendas, invocations at meetings, meeting minutes, and audio/video recording of City Council and Commission meetings. Finally, the City Clerk handles municipal and zoning codes, claims against the city, and requests for appeal. Mitigation activities by the Department include record keeping and document coordination. Updates to City codes that mitigate future hazards would be administered through the office of the City Clerk.	Irvine City Clerk
City Manager's Office	Personnel Resource	The City Manager's office carries out the decisions of City Council and liaises different offices to coordinate. Primary duties of this office include legislative support, policy implementation, budget development and strategic planning, economic development, elections, communication services and legal service functions of the City. In addition, the office provides leadership for the operational departments. Mitigation activities implemented by this office may include direction setting with the City Council and City Departments and prioritization of new initiatives that support mitigation activities within the City.	City Manager's Office
Community Development	Personnel Resource	The Community Development Department provides services, which include: affordable housing, building and safety, code enforcement, development projects map, General Plan updates, Irvine Business Complex, inspector mobile devices, neighborhood services, the online permit system, park development, and City planning and development. Mitigation actions related to the construction of new structures or retrofits or improvements to existing structures may be implemented through future plan-processing by Community Development Department staff. In addition, this department is also responsible for establishing forward thinking goals and policies that affect future development within the City.	Community Development
Community Services	Personnel Resource	The Community Services Department is responsible for a range of services for residents which include: animal care, swimming classes and recreation, seasonal camps, family and child services, class registration (through your Irvine), senior services, teen services, disability services, facility reservations, publication of *Inside Irvine*, The Irvine Fine Arts Center, military services and support, outdoor recreation and leisure, athletic/aquatics, parks and facilities, volunteer services, and special events. The Community Services department can assist with	Community Services

		mitigation activities by tracking the changes in community needs and trends and assisting other Departments in re-programming facilities and community programs to meet those needs.	
Financial Management and Strategic Planning	Personnel Resource/ Financial Resource	Financial Management and Strategic Planning Department is comprised of Administration, Fiscal Services and Budget/Strategic Business Planning divisions that serve the City Council (oversight board agendas, minutes and information), Commissions, City Manager, City departments, employees and residents by providing assistance with accounting services, budget and strategic business planning, treasury and debt administration, purchasing. Financial management and strategic planning functions (and personnel) within the City can assist with mitigation activities by tracking costs associated with hazard events and disasters, identifying grant funding opportunities, and establishing financial risk calculations that can help assist Departments with budgeting of operations, maintenance, and capital improvements.	Financial Management and Strategic Planning
Human Resources & Innovation	Personnel Resource	The Department of Human Resources and Innovation consists of Human Resources, Risk Management, Information Technology, and Geographic Information Systems (GIS). Major functions include recruitment and selection, employee development and training, employee and labor relations (to include Americans with Disabilities Act), benefits administration, wellness, workplace safety, workers' compensation, risk management, technology operations, long-range strategic planning, network infrastructure, and interactive mapping. This department can support mitigation activities by identifying staffing needs and shortfalls and developing plans and agreements with other jurisdictions/agencies to ensure future needs are met. This department also contains the City's GIS staff, which can assist with mapping and analysis of hazard mitigation issues and projects.	Human Resources
Fire Department	Personnel Resource	See OCFA in Orange County section, below	
Irvine Police Department	Personnel Resource	The Irvine Police Department is charged with maintaining public safety in the community. As part of this work, the police department is responsible for conducting emergency preparedness activities, investigating criminal activity, and directing traffic. Mitigation actions that relate to the safe movement of traffic (e.g. during evacuations), the public safety of residents during emergency events, and terrorism-related activities may be implemented through police department staff. As emergency preparedness is part of the department's responsibilities, the police department can also widely implement other types of mitigation actions through coordination with other departments and agencies.	Irvine Police Department
Public Works & Transportation Department	Personnel Resource	The Public Works & Transportation Department develops, builds, and maintains the City's infrastructure to the standards and expectations set forth by the City Council. City inventory includes streetscapes, open space, City parks (community and neighborhood), athletic fields, bike trails, roadways, traffic signals, and more. Mitigation actions that involve constructing or	Public Works

		retrofitting City-owned facilities and infrastructure may be implemented through Public Works Department staff. This department also oversees all facets of transportation management, including traffic management and transit planning, and serves as the staff liaison to the Transportation Commission. The major evacuation routes include major streets that dissect the city north/south and east/west. A map of these routes is located here. Additionally, in the event of an emergency, Irvine streams 24/7 radio information through AM 1640 or online, which is available here. Support for mitigation activities from this department may include assessment of mobility options for residents with Access and Functional Needs, and identification of future transportation projects that can reduce evacuation vulnerabilities or enhance the roadway network so it is less prone to damage during hazard events.	Transportation
Adopted FY Budget	Financial resource	The City adopts their budget every two years, which identifies the funding available for each fiscal year that can be used to support governmental operations. This budget is a key location where future mitigation projects can be identified from a funding perspective.	2019-2021 Budget
Capital Improvement Program	Plan Resource	The Irvine Capital Improvement Program (CIP) is long-range fiscal forecast, which identifies major public improvements to the City's infrastructure over the next 5 years. The Plan is important for planning and managing the City's growth and development, as well as maintaining existing infrastructure. During Plan development, capital projects affecting public health and safety, and/or legal mandates receive the highest priority; emphasis is also placed on projects maintaining service levels or preventing deterioration of facilities. Integration of this Plan into the CIP can assist in mitigation efforts by identifying new funding sources for future improvements. As new grant opportunities become available, the CIP may already have projects consistent with the LHMP that can easily be used for grant submittals. Leveraging these two plans can help secure needed funds to reduce vulnerabilities throughout the City.	Capital Improvement Program
General Plan	Plan Resource	The Irvine General Plan is currently undergoing an update. The General Plan is the long-term, comprehensive blueprint for development and changes in the community. The policies in the general plan address land uses, public safety, environmental protection, and transportation, and others. The general plan serves as a framework for mitigation actions, establishing the overarching policies for mitigation activities. Mitigation actions may be directly incorporated into the general plan as policies and/or implementation actions to provide a stronger enforcement mechanism.	General Plan
Building Code	Plan Resource	The Irvine Building Code and associated standards (Residential Code, Mechanical Code, Electrical Code, etc.) govern how new buildings are constructed. They are published by the state and are adopted by local communities, sometimes with amendments to make the codes more locally applicable. Mitigation actions to construct buildings to a safer standard, allowing them to better resist damage during a hazard event, may be made part of future building code updates.	

Zoning Ordinance	Plan Resource	The Irvine Zoning Ordinance is an implementation tool for the City's general plan. It establishes regulations for land uses throughout the community, including where different types of development and land use activity can occur, how these developments can look, and how they may be operated. Mitigation actions that relate to the siting, construction, and operation of new developments in Irvine may be implemented through the Zoning Code to ensure these locations address risks identified in the plan.	Zoning Code
		Orange County	
Irvine Ranch Water District	Technical Resource	Irvine Ranch Water District (IRWD) is an independent special district serving Central Orange County, California. IRWD provides high-quality drinking water, reliable wastewater collection and treatment, ground-breaking recycled water programs, and environmentally sound urban runoff treatment to more than 380,000 residents. IRWD can assist with mitigation efforts when addressing drought conditions within the City. As the City's primary water provider, IRWD can effectively manage and monitor water use and ensure adequate water supplies during times of severe drought.	Irvine Ranch Water District
Orange County Hazard Mitigation Plan	Plan Resource	The Orange County Hazard Mitigation Plan identifies and describes the hazard events that may occur in the unincorporated areas of Orange County and provides a suite of mitigation actions to help decrease the potential damage from these hazards. Mitigation actions for Irvine that require coordination with the county may be integrated into the County's Hazard Mitigation Plan. Similar mitigation actions in both the county's and Irvine's hazard mitigation plans can lead to a more regionally unified hazard mitigation strategy, which may improve effectiveness.	OCHMP
Municipal Water District of Orange County	Technical Resource	The Municipal Water District of Orange County (MWDOC) is a public agency that is the wholesale water provider for large sections of Orange County, including Irvine via Irvine Ranch Water District. Mitigation actions related to water use may be implemented with support and assistance from MWDOC.	MWDOC
Orange County Fire Authority	Technical Resource	The Orange County Fire Authority (OCFA) provides fire protection and firefighting services to the unincorporated areas of Orange County and many incorporated communities (including Irvine). Fire-related mitigation actions that require coordination with the county may be implemented in collaboration with OCFA staff.	OCFA
Orange County Water District	Technical Resource	The Orange County Water District (OCWD) is the agency responsible for managing groundwater supplies in Orange County, which is a primary source of water supply for Irvine. Mitigation actions related to groundwater supplies, including groundwater recharge, may be implemented with support and assistance from OCWD.	Orange Co Water District
Orange County Sanitation District	Technical Resource	The Orange County Sanitation District (OCSD) is the agency that provides wastewater collection, treatment, and disposal services for approximately 2.6 million people in central and northwest Orange County. Mitigation strategies focused on enhancement of infrastructure within the City may be implemented with support and assistance from OCSD.	OC Sanitation District

Regional, State, and Federal Agencies			
California State Hazard Mitigation Plan	Plan Resource	The California State Hazard Mitigation Plan assesses the types of hazards that may be present in California. It includes descriptions of these hazards, summaries of past hazard events, descriptions of how these hazards may occur in the future, and how these hazards may harm the people and assets of California. Like a local hazard mitigation plan, the State Hazard Mitigation Plan is updated every five years. The Committee can use the State Hazard Mitigation Plan as a source of information to refine the hazard profiles and vulnerability assessments in future Irvine LHMPs.	CA State Hazard Mitigation Plan
Cal-Adapt	Technical Resource	Cal-Adapt is an online tool that provides detailed projections for future climate-related conditions in California, including factors such as temperature, precipitation, and sea level rise. These projections can help inform forecasts of future hazard events and can explain how hazard conditions are expected to change. The Committee can use Cal-Adapt to monitor anticipated changes in future climate conditions and adjust mitigation actions accordingly.	Cal Adapt
California Department of Transportation	Technical Resource	The California Department of Transportation (Caltrans) is the state agency with jurisdiction over designated highways, including State Route 55, and Interstate Routes 405 and 5. Mitigation measures related to ensuring the resiliency of state-designated routes will be implemented through coordination with Caltrans.	*Caltrans*
California Governor's Office of Emergency Services	Technical Resource	The California Governor's Office of Emergency Services (Cal OES) is the state agency responsible for reducing hazards in the state through mitigation activities, conducting emergency planning, supporting emergency response and recovery activities, and acting as a liaison between local and federal agencies on emergency-related issues. Cal OES provides guidance on hazard mitigation planning activities, shares best practices, and distributes funding opportunities. The Committee can work with Cal OES to obtain funding to implement LHMP mitigation strategies and to receive guidance on future updates.	*Cal* OES
Federal Emergency Management Agency	Technical Resource	The Federal Emergency Management Agency (FEMA) is the federal agency responsible for hazard mitigation, emergency preparedness, and emergency response and recovery activities. It provides guidance to state and local governments on hazard mitigation activities, including best practices and how to comply with federal requirements. FEMA also provides funding for hazard mitigation actions through grant programs.	FEMA

Metropolitan Water District of Southern California	Technical Resource	The Metropolitan Water District of Southern California (MWD) is a public agency that supplies water to various water providers throughout the southern California region, many of whom in turn distribute the water to more localized water suppliers. Water used in Irvine that comes from outside Orange County is supplied by MWD. Mitigation actions that involve local water supplies may be implemented through coordination with both MWDOC and MWD. The agency may also provide technical support and other resources for mitigation actions involving water use.	Metropolitan Water District of So CA
Transportation Corridor Agencies	Technical Resource	Comprised of State Routes 73, 133, 241 and 261, The Toll Roads make up over 20 percent of Orange County's major thoroughfare highway system and are the fastest, easiest and most predictable way to get to and around Orange County; all of these routes border or go through Irvine. This agency can play a role in mitigation by identifying hazardous conditions along their network and work with neighboring jurisdictions like Irvine to reduce or eliminate the threat to these hazards.	The Toll Roads
		Private Organizations	
Southern California Edison	Technical Resource	Southern California Edison (SCE) is the electrical service provider for Irvine. SCE also owns the electrical distribution grid in the community. Mitigation actions relating to the resiliency of Irvine's electrical grid will be implemented through coordination with SCE.	Southern CA Edison
Southern California Gas Company	Technical Resource	The Southern California Gas Company (SoCalGas) is the natural gas provider for Irvine and owns the natural gas infrastructure in the community. Mitigation actions that address the resiliency of natural gas infrastructure and services in Irvine will be implemented through coordination with SoCalGas.	SoCalGas

HAZARD MITIGATION STRATEGIES AND ACTIONS

Hazard Mitigation Goals

The goals identified in Chapter 1 help develop policies to protect community members, ecosystems, and other important assets from hazard events. These goals were developed to ensure consistency with the City's General Plan Safety Element, which plays an important role in risk reduction within Irvine. These goals informed the development of mitigation actions and act as checkpoints to help City staff determine implementation progress.

Evaluation of Potential Hazard Mitigation Actions

Based on the hazard profiles, threat assessment, and capabilities assessment; the results of the community survey; discussions among Committee members; and existing best practices, the Committee prepared a set of potential mitigation actions. Next, the Committee evaluated these potential actions using the following criteria:

FEMA requires local governments to evaluate the monetary and non-monetary costs and benefits of potential mitigation actions. Although local governments are not required to assign specific dollar values to each action, they should identify the general size of costs and benefits. The Committee may elect to include measures that have a high cost or low benefits, but such measures should be clearly beneficial to the community and an appropriate use of local resources.

In addition, FEMA directs local governments to consider the following questions as part of the financial analysis:

- What is the frequency and severity of the hazard type to be addressed by the action, and how vulnerable is the community to this hazard?
- What impacts of the hazard will the action reduce or avoid?
- What benefits will the action provide to the community?

The Committee also chose to review and revise the potential hazard mitigation actions using a third set of criteria (**Table 5-2**), known as STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental). The Committee did not formally assess every potential mitigation action under all STAPLE/E criteria but used the criteria to guide and inform discussion. The Committee also discussed how the criteria may be used to evaluate grant applications the City may submit to receive funding for LHMP implementation.

Prioritization

As part of the mitigation actions development and review, the HMPC also prioritized the actions. The prioritization efforts looked at the risks and threats from each hazard, financial costs and benefits, technical feasibility, and community values, among others. Committee members were asked to identify their priority actions through a voting exercise. Items prioritized by at least three Committee members are considered high priority, and those prioritized by one or two members are considered medium priority. Actions not prioritized by any Committee member are considered low priority.

Cost Estimates

To meet the cost estimation requirements of the hazard mitigation planning process, the Committee identified relative cost estimates based on their understanding of the mitigation action intent and their experience developing identical or similar programs/implementing projects. Three cost categories based on the City's typical cost criteria were used for budgeting purposes:

- Low cost ($): $100,000 or less
- Medium cost ($$): $100,001 to $999,999
- High cost ($$$): Greater than $1,000,000

Based on the criteria and evaluation processes used during Plan development, the Committee prepared a prioritized list of mitigation actions to improve Irvine's resilience to hazard events. **Table 5-3** lists the mitigation actions as well as the prioritization of each action and other details related to implementation. In addition to mitigation action and strategies, several preparedness activities were identified and denoted with a letter "P."

Table 5-2: STAPLE/E Criteria

Issue	Criteria
Social	• Is the action socially acceptable to Irvine community members? • Would the action treat some individuals unfairly? • Is there a reasonable chance of the action causing a social disruption?
Technical	• Is the action likely to reduce the risk of the hazard occurring, or will it reduce the effects of the hazard? • Will the action create new hazards, or make existing hazards worse? • Is the action the most useful approach for Irvine to take, given the goals of the City and of community members?
Administrative	• Does the City have the administrative capabilities to implement the action? • Are there existing City staff who can lead and coordinate implementation of the measure, or can the City reasonably hire new staff for this role? • Does the City have enough staff, funding, technical support, and other resources to carry out implementation? • Are there administrative barriers to implementing the action?
Political	• Is the action politically acceptable to City officials and to other relevant jurisdictions and political entities? • Do community members support the action?
Legal	• Does the City have the legal authority to implement and enforce the action? • Are there potential legal barriers or consequences that could hinder or prevent implementation of the action? • Is there a reasonable chance that implementation of the action would expose the City to legal liabilities? • Could the action reasonably face other legal challenges?
Economic	• What are the monetary costs of the action, and do the costs exceed the monetary benefits? • What are the start-up and maintenance costs of the action, including administrative costs? • Has funding for action implementation been secured, or is a potential funding source available? • How will funding the action affect the City's financial capabilities? • Could implementation of the action reasonably burden the Irvine economy or tax base? • Could there reasonably be other budgetary and revenue impacts to the City?
Environmental	• What are the potential environmental impacts of the action? • Will the action require environmental regulatory approvals? • Will the action comply with all applicable federal, state, regional, and local environmental regulations? • Will the action reasonably affect any endangered, threatened, or otherwise sensitive species of concern?

Table 5-3: Irvine Hazard Mitigation Actions

Mitigation Action		Potential Funding Sources*	Responsible Department	Relative Cost**	Time frame	Priority
Preparedness activities						
P1	Conduct regular emergency preparedness drills and training exercises for City staff.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	Medium (1)
P2	Continue agreements with local school districts to ensure that school facilities can act as evacuation sites during major emergencies.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
P3	Work with local businesses and organizations to conduct regular workplace emergency preparedness drills.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
P4	Expand participation in the Irvine Community Emergency Response Team (CERT) program for residents and businesses.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	Medium (1)
P5	Ensure that community evacuation plans include provisions for community members who do not have access to private vehicles or are otherwise unable to drive.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	Medium (1)
P6	Continue to ensure effective emergency notifications through multiple media formats, in at least English, Spanish, Mandarin, Farsi, Korean, and Vietnamese; about pending, imminent, or ongoing emergency events. Ensure that information is accessible to persons with disabilities and functional needs.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	Medium (1)
P7	Maintain at least one emergency power-generating station in all critical facilities that the City could use as an emergency public assembly area, such as City Hall, Community Centers, and any others that the City may so designate in the future.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
P8	Update the Irvine Emergency Operations Plan to identify backup power and communications locations for critical facilities.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
P9	Continuously update response procedures for first responder departments to properly address new hazard events as they emerge.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
P10	Ensure that the City has an adequate supply of sandbags for residents and businesses, including prefilled sandbags for individuals who may be unable to fill them on their own.	General Fund, Grants (EMPG, HSGP)	Public Safety	N/A	Ongoing	N/A
Multiple hazards						
1.01	Explore the feasibility of connecting critical facilities Civic Center, key Community Centers) to a microgrid power-supply network. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$$	2022	High (7)

1.02	Install energy-efficient equipment to increase the longevity of the fuel supply for backup generators. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works (Facilities)	$$$	TBD	Low
1.03	Conduct routine updates of the Facility Conditions Assessment for City-owned infrastructure, buildings, lift stations, and other utilities and coordinate with other agencies to ensure inspections of other important infrastructure. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Building and Safety	$$	Ongoing	Medium (1)
1.04	Repair, as feasible, all major deficiencies discovered by inspections to prevent collapse, failure, or damage in the event of a natural disaster. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Building and Safety	$$-$$$	As Needed	High (7)
1.05	Incentivize public and private utility operators to harden their lines passing through the City from potential breaches. Encourage adoption of supervisory control and data acquisition (SCADA) to allow instantaneous shut down of line breaches. Use mitigation grants to incentivize entities to partner with the City to complete these projects. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety (Emergency Management)	$	Ongoing	Low
1.06	Install and harden emergency backup power at Civic and Community Centers, and other critical facilities as the city may determine necessary. Prioritize installations for facilities that serve as key cooling/warming centers, and evacuation centers and promote the use of resilient backup power generation for these locations.. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Building and Safety, Community Services	$$$	2025	High (3)
1.07	Conduct a feasibility assessment of installation of backup energy systems (solar, battery, fuel cell, natural gas generator) at key critical facilities within the City. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Building and Safety	$$	TBD	Low
1.08	Work closely with community groups to increase awareness of hazard events and resiliency opportunities among socially vulnerable community members. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	CERT, Public Information Officers	$	Ongoing	Medium (1)
1.09	Avoid building new City-owned key facilities in mapped hazard areas. If no feasible sites outside of mapped areas exist, ensure that such facilities are hardened against hazards beyond any minimum building requirements/ mitigation standards. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Development	$	Ongoing	Medium (1)
1.10	Coordinate with Caltrans to monitor bridges within the City and develop recommendations for upgrade/retrofit when deemed	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$	As Needed	Medium (2)

	necessary. (Hazards addressed: All)					
1.11	Closely monitor changes in the boundaries of mapped hazard areas resulting from land use changes or climate change and adopt new mitigation actions or revise existing ones to ensure continued resiliency. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	GIS	$	Ongoing	Low
1.12	Integrate policy direction and other information from this Plan into other City documents, including the General Plan, Emergency Operations Plan, and Capital Improvements Program. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	All Departments	$	Ongoing	Medium (1)
1.13	Monitor funding sources for hazard mitigation activities. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety (Emergency Management)	$	Ongoing	Low
1.14	Expand the City's all hazards early warning alert system to better inform Irvine residents, visitors, and businesses, prior to or during hazard events. (Hazards addressed: All)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety (Emergency Management)	$$	2024	High (4)
1.15	Collaborate with UCI on the use and expansion of their existing power to gas microgrid system into other parts of the community.	General Fund, PDM/ HMGP Grants, Other Grants	All Departments	$$$	TBD	Low
Aircraft Incident						
2.01	Coordinate with the Federal Aviation Administration on flight paths over the City and potential changes that may increase vulnerability to aircraft incidents.	General Fund, PDM/ HMGP Grants, Other Grants	All Departments	$	Ongoing	Low
2.02	Coordinate with SNA on future improvements and enhancements that may impact City infrastructure and/ or function.	General Fund, PDM/ HMGP Grants, Other Grants	All Departments	$	As Needed	Low
Dam Failure						
3.01	Coordinate with dam owners/operators, state, and federal agencies to collectively identify threats to the City and the region and identify ways to retrofit/strengthen the dams under their control.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Public Safety	$	As Needed	High (3)
3.02	Identify potential flood improvements that also reduce the threat to dam failure and/or inundation.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Public Safety	$	TBD	Low
3.03	Conduct regular trainings and exercises with Irvine Ranch Water District on dam failure notifications and evacuations.	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety	$	As Needed	Low

Diseases and Pests (Agricultural Pests, Epidemic/Vector Borne Diseases, Tree Mortality)						
4.01	Coordinate with surrounding jurisdictions, local health care providers, businesses, schools, the Orange County Health Care Agency, the California Department of Public Health, and the Centers for Disease Control to inform community members about current public health trends or issues, free and low-cost healthcare options, treatments, and where to find local healthcare facilities. (Hazards addressed: Epidemic/Vector Borne Diseases)	General Fund, PDM/ HMGP Grants, Other Grants	Public Information Officers	$	Ongoing	Medium (2)
4.02	Cooperate with the Orange County Mosquito and Vector Control District to inform community members on best practices for mosquito-proofing homes and businesses and how to avoid mosquito bites. (Hazards addressed: Epidemic/Vector Borne Diseases)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Services, Public Information Officers	$	As Needed	Low
4.03	Participate in exercises conducted by the operations area surrounding diseases and pest issues. (Hazards addressed: Diseases and Pests)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$	As Needed	Low
4.04	Continue to work with residents, business owners, and utilities to remove dead, dying, and diseased trees weakened by disease/pests. (Hazards addressed: Tree Mortality)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$$	Ongoing	Low
Drought						
5.01	Coordinate closely with Irvine Ranch Water District on water use and water conservation efforts throughout the City.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Public Information Officers	$	As Needed	Medium (1)
5.02	Update "Division 7 - Sustainability in Landscaping "of the Irvine Municipal Code of Ordinances and the Master Streetscape & Landscape Design Manual to reflect the latest advances in best practices in landscape design that reduce water use within the City.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Development, City Clerk	$-$$	TBD	Low
5.03	Encourage drought tolerant native landscaping, low-flow water fixtures beyond the state minimum code, and daytime watering restrictions on properties throughout the city to reduce water consumption.	General Fund, PDM/ HMGP Grants, Other Grants	Building and Safety, Public Works, Public Information Officers	$	Ongoing	Low
5.04	Use drought-tolerant plants when installing new or retrofitting City-owned landscapes. Limit turf that is not drought tolerant to recreational fields and lawns, and only in instances where no feasible drought-tolerant alternatives exist.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Services	$$-$$$	As Needed	Medium (1)
Flooding (Sea Level Rise)						
6.01	Investigate permeable paving and use landscaped swales for new and replacement of City-owned hardscaped areas.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works	$	TBD	Low

6.02	Encourage the use of porous surfaces on new and significantly retrofitted residential and commercial developments to reduce runoff.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Community Development, Public Works	$	Ongoing	Low
6.03	Conduct frequent cleanings of storm drain intakes, especially before and during the rainy season.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works	$$	Ongoing	Low
6.04	Update the City's Master Plan of Drainage on a regular basis to incorporate new data and/or address emerging issues.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works, GIS	$	TBD	Low
6.05	Analyze if new critical facilities can be built a minimum of 1 foot higher than the anticipated 500-year flood elevation height, to determine where it is feasible.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works, Community Development, GIS	$-$$	TBD	Low
6.06	Retrofit roadway medians to capture storm water during rain events.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works, GIS	$$$	Ongoing	Low
6.07	Prioritize retrofit improvements along major arterials/ roadways throughout the City.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works, GIS	$$$	Ongoing	Low
6.08	Evaluate City assets and resources to ensure effective response (accepting evacuees) during a tsunami evacuation incident.	General Fund, PDM/ FMA/ HMGP Grants, Other Grants	Public Works, Community Services	$	2023	High (4)
Geologic Hazards (Subsidence, Landslides)						
7.01	Coordinate with Irvine Ranch Water District and the Navy on subsidence monitoring in areas of active groundwater extraction and work with water utilities to develop strategies based on the amount and severity of subsidence occurring.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, GIS	$	Ongoing	Low
7.02	Consider reducing land use densities in areas of significant landslide threat and identify strategies for existing development downstream of these hazard areas.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development	$	TBD	Low
Hazardous Materials Release						
8.01	Discourage new sensitive land uses, including schools, parks, childcare centers, adult and senior assisted living facilities, and community centers, from locating near identified hazardous material facilities. Discourage or prohibit new hazardous material facilities from locating near sensitive land uses.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development	$	Ongoing	Low

8.02	Pursue full alignment of the General Plan with policies and actions outlined in state and regional plans such as the California Accidental Release Prevention (CalARP) Program and the Orange County Fire Authority Hazardous Materials Area Plan.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development, Orange County Fire Authority	$	TBD	Low
8.03	Continuously inspect businesses and other properties storing hazardous materials and create an inventory of storage locations that require updates, maintenance, or renovation.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development, Orange County Fire Authority	$	Ongoing	Low
8.04	Continue to work with solid waste service contractors to educate residents and businesses on safe disposal of small quantities of hazardous materials.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Public Information Officers	$	Ongoing	Low
8.05	Actively monitor existing landfills within the City and Sphere of Influence and coordinate with State and Federal agencies, if conditions at these facilities change or new issues are identified.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development	$	Ongoing	Low
8.06	Coordinate with hazardous materials generators/operators (So Cal Gas, Edison, etc.…) regularly to understand changes to operations within the City.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Orange County Fire Authority	$	Ongoing	Low
Human-Caused Hazards (Mass-Casualty Incidents, Civil Disturbance, Cyber Threats, Infrastructure Failure)						
9.01	Coordinate with the Orange County Intelligence Assessment Center (OCIAC) to monitor potential incidents resulting in civil disturbance events (riots, mass shootings, etc.). (Hazards addressed: Mass-Casualty Incidents, Civil Disturbance)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, Orange County Fire Authority	$	Ongoing	Medium (1)
9.02	Disseminate information on cyber threats or potential terrorist activity to City staff and continually follow up with information on further developments in the situation. (Hazards addressed: Human-Caused Hazards)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, Orange County Fire Authority	$	Ongoing	Low
9.03	Regularly update cyber security software and educate business owners and residents on current internet-based threats. (Hazards addressed: Cyber Threats)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, IT, Orange County Fire Authority, Public Information Officers	$	Ongoing	Low
9.04	Retrofit all critical facilities, City administration buildings, and other buildings the City may deem to be important in the future with counterterrorism design elements and building materials. (Hazards addressed: Human-Caused Hazards)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, Orange County Fire Authority	$$-$$$	2025	High (8)

9.05	Coordinate and enhance datasets for schools, hospitals, and other critical facilities with the School District, Hospitals, and other key entities within the City to better respond to mass-casualty and terrorism incidents. (Hazards addressed: Mass-Casualty Incidents)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, Orange County Fire Authority	$	2023	Medium (1)
9.06	Establish and routinely update a confidential inventory of critical infrastructure and ensure development activities coordinate with future resilience enhancements by utility providers. (Hazards addressed: Infrastructure Failure)	General Fund, PDM/ HMGP Grants, Other Grants	Community Development, GIS, Public Safety (Emergency Management)	$	2024	Medium (2)
Seismic Hazards (Fault Rupture, Seismic Shaking, Liquefaction)						
10.01	Encourage the installation of resilient (seismically appropriate) piping for new or replacement pipelines, in close coordination with local water, natural gas, and other providers.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Development	$	Ongoing	Medium (1)
10.02	Assess soft story conditions for apartment buildings constructed prior to 1980.	General Fund, PDM/ HMGP Grants, Other Grants	Community Development (Building and Safety)	$$	TBD	Low
10.03	Conduct an educational campaign and incentives to encourage the use of reinforced chimneys, anchored rooftop-mounted equipment, window film, and other preventative measures to reduce damage at private buildings.	General Fund, PDM/ HMGP Grants, Other Grants	Building and Safety, Public Information Officers	$	TBD	Low
10.04	Educate community groups and industry representatives assist in outreach to residents and businesses to obtain earthquake insurance through the California Earthquake Authority.	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety (Emergency Management), Public Information Officers	$	Ongoing	Low
10.05	To the extent feasible, construct all new and significantly retrofitted City-owned facilities to remain operational in the event of a major earthquake.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Development, Community Services	$$$	Ongoing	Medium (1)
10.06	Improve local understanding of the threat of a major earthquake by conducting a city-wide scenario modeling potential loss of life and injuries, destroyed and damaged structures, and interruptions to key services.	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety (Emergency Management), Public Information Officers	$	2023	High (4)
10.07	Retrofit key critical City facilities with seismically rated window film treatments that ensure glass windows do not shatter during a strong seismic event. Promote retrofit of key community facilities not owned by the City.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works (Facilities), Community Services	$$$	Ongoing	Medium (2)

10.08	In coordination with Caltrans, update facilities condition assessments for bridges along evacuation routes to identify bridges that need seismic retrofitting. Consider pursuing highest standard improvement options (e.g., replacement instead of retrofitting) for bridges with seismic deficiencies.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$	TBD	Low
10.09	Pursue ground improvement projects, such as constructing a high strength capping layer, soil mixing, stone columns, soil wicks, chemical and pressure grouting, and other soil improvement techniques that reduce liquefaction susceptibility for key critical facilities in the event of an earthquake.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Community Development	$$$	TBD	Low
10.10	Incentivize utilities to install flexible jointing and pipelines across fault segments located within the City. Ensure these pipelines have the necessary countermeasures to ensure breakage of lines is kept to a minimum and adequate shut off mechanisms to reduce exposure of pipeline contents to residents and businesses.	General Fund, PDM/ HMGP Grants, Other Grants	All Departments	$	Ongoing	Low
Severe Weather (Extreme Heat, Severe Wind, Rain)						
11.01	Notify residents through public service announcements a couple of days in advance of a severe weather event. Focus on media methods that target vulnerable populations, such as elderly, sick, lower-income, or persons with limited mobility to better ensure they have adequate time to prepare. (Hazards addressed: Severe Weather)	General Fund, PDM/ HMGP Grants, Other Grants	Public Safety, Community Services (PIOs)	$	As Needed	High (3)
11.02	Implement a tree-planting program to diversify tree age and increase shaded areas in the City to reduce the effects of the urban heat island effect. (Hazards addressed: Extreme Heat)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$$-$$$	TBD	Low
11.03	Expand use of public facilities (libraries, community centers, etc.) as warming/cooling centers for vulnerable populations during extreme weather events, and assess facility needs in order to automatically open these facilities as extreme weather centers when conditions require. (Hazards addressed: Severe Weather)	General Fund, PDM/ HMGP Grants, Other Grants	Community Services (PIO)	$$	2024	High (3)
11.04	Promote passive cooling design (brise soleil, long roof overhangs, locating windows away from southern facades, etc.) in new developments during the design review process. (Hazards addressed: Extreme Heat)	General Fund, PDM/ HMGP Grants, Other Grants	Community Development, Public Works	$	Ongoing	Low

11.05	Upgrade HVAC within City facilities to more efficient systems that may include split systems or decentralized systems that allow for heating and cooling the spaces needed, not entire buildings. (Hazards addressed: Extreme Heat)	General Fund, PDM/ HMGP Grants, Other Grants	Community Development, Public Works	$$-$$$	TBD	Low
11.06	Evaluate the long-term capacity of designated cooling centers and shelters in the City to provide enough relief from extreme heat. Assess the need to expand services as the frequency, length, and severity of future heatwaves potentially change as a result of climate change. (Hazards addressed: Extreme Heat)	General Fund, PDM/ HMGP Grants, Other Grants	Community Services	$$	TBD	Low
11.07	Conduct outreach to residents and businesses prior to the severe winds (Santa Ana Wind events) on proper tree maintenance and identification of potentially hazardous trees. (Hazards addressed: Severe Wind)	General Fund, PDM/ HMGP Grants, Other Grants	Public Works, Public Safety, Public Information Officers	$	Ongoing	Low
Wildfire						
12.01	Promote the proper maintenance and separation of power lines and efficient response to fallen power lines.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Public Information Officers	$	Ongoing	High (4)
12.02	Remove highly flammable vegetation in Very High, High, and Moderate Fire Hazard Severity Zones and replant with fire-adapted specimens.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Public Works	$$	Ongoing	High (9)
12.03	Create a hillside weed abatement pilot program using goats or other livestock to reduce fuel loads in fire-prone areas.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Community Services, Public Works, CERT, Public Information Officers	$	TBD	Medium (1)
12.04	Routinely participate in the update of the Orange County Community Wildfire Preparedness Plan for areas within the Very High, High, and Moderate Fire Hazard Severity Zones.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Public Works, Public Safety (Emergency Management)	$	Ongoing	Medium (1)
12.05	Create a rapid response plan from among Irvine's and Orange County's first responders to secure hospital, nursing and assisted living facilities, especially those located within fire hazard severity zones.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority	$	2025	Medium (1)

12.06	Reinforce and regularly inspect fire retardant infrastructure such as sprinklers, fire hose terminals, and fire suppression systems in City facilities.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority	$$	Ongoing	Medium (1)
12.07	Coordinate with partners to clear dead vegetation in flood control facility footprints, railroad rights-of-way, parks, and open spaces, especially during and after a drought episode.	General Fund, PDM/ HMGP Grants, Other Grants	Public Works	$	Ongoing	Low
12.08	Expand the fire hazard prevention awareness campaign to residents in the High and Very High Fire Hazard Severity Zones.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Public Safety, Public Works, CERT, Public Information Officers	$	2023	High (3)
12.09	Work with OCFA on home preparedness assessments to assist more residents in understanding and addressing their wildfire risk.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Public Works, Community Services, Community Development, Public Information Officers	$	Ongoing	Low
12.10	Require all new development in Very High, High, and Moderate Fire Hazard Severity Zones to use noncombustible building materials such as masonry, brick, stucco, concrete, steel, or others as appropriate. Establish zones of defensible space around homes in Very High, High, and Moderate Fire Hazard Severity Zones.	General Fund, PDM/ HMGP Grants, Other Grants	Orange County Fire Authority, Community Development	$	Ongoing	High (3)

*** Relative Cost Categories:**

$ Less than $100,000

$$ $100,001 to $999,999

$$$ Greater than $1,000,000

NATIONAL FLOOD INSURANCE PROGRAM

Irvine participates in the National Flood Insurance Program (NFIP), which was created by Congress in 1968 to provide flood insurance at subsidized rates to homeowners who live in flood-prone areas. Individual communities have the option to participate in the NFIP, although property owners who live in nonparticipating communities with flood-prone areas will not be able to buy flood insurance through the program. Additionally, nonparticipating communities with mapped flood plains cannot receive federal grants or loans for development activities in flood-prone areas and cannot receive federal disaster assistance to repair flood-damaged buildings in mapped flood plains.[131] Irvine has participated in NFIP since 1980. [132]

Although participation is not a dedicated hazard mitigation action, Irvine will continue to participate in NFIP and comply with the program's requirements through continued enforcement of the City's Floodplain Management regulations (Municipal Code Chapter 5-2, Floodplain District). This district applies to all areas identified as flood-prone within the City. This District identifies the purpose of the regulation, the methods of reducing flood losses, basis for establishing flood hazard areas, development permit requirements, duties and responsibilities of the City's Floodplain Administrator, the development standards that apply in flood-prone areas, and required documentation and analysis for construction within these areas. As part of the City's efforts to comply with NFIP, Irvine will make updates and revisions to the Floodplain Management regulations to minimize the threat of harm from flood events. These updates and revisions may be promoted by changes in local demographics, shifts in land uses, changes to flood regimes such as frequency and intensity of flood events, and other factors that may warrant municipal action. The City will also continue to incorporate any changes to the locations and designations of mapped flood plains into future planning documents, including future updates to this Plan.

The City of Irvine contains Special Flood Hazard Areas that include **192 policies in force**. Total insurance coverage for these policies amounts to **$62,074,600**, however no repetitive loss properties were identified by the City's Floodplain Administrator. In addition, the City has participated in the voluntary Community Rating System (CRS) since 1991. The City currently meets all the requirements for a **Class 9 Community** within the CRS, which equates to a 5% reduction in floodplain premiums through the NFIP.

CHAPTER 6 – PLAN MAINTENANCE

For this LHMP to remain effective and useful to the community of Irvine, it must remain up to date. An updated version of the LHMP will continue to guide hazard mitigation activities in Irvine and will help keep the City eligible for state and federal hazard mitigation funding. The HMPC has structured this LHMP so individual sections can easily be updated as new information becomes available and as new needs arise, helping to keep this Plan current.

This chapter discusses how to update this Plan to keep it in compliance with applicable state and federal requirements. This chapter also describes how the City can incorporate the mitigation actions described in Chapter 5 into existing programs and planning mechanisms and how public participation will remain an important part of Plan monitoring and future update activities.

COORDINATING BODY

The HMPC will remain responsible for maintaining and updating the Plan, including evaluating the Plan effectiveness, as needed. Members of the HMPC will also coordinate implementation of the Plan through their respective positions. Table 1-1 contains a list of current members. In future years, staff and representatives (either current Committee members or other individuals) from the following City Departments should be included in maintenance and update activities:

- City Clerk
- City Manager's Office
- Community Development
- Community Services
- Financial Management and Strategic Planning
- Human Resources & Innovation
- Police
- Public Works
- Transportation

As appropriate, staff from other organizations who sat on the Committee during the preparation of this Plan should be invited to participate in plan maintenance and update activities. Other organizations that should be asked to participate in this process are:

- Irvine Ranch Water District
- Irvine Unified School District
- Orange County Fire Authority
- Tustin Unified School District

The staff member currently serving as the HMPC leader (the person responsible for coordinating future updates), is in the Police Department. He/ she will serve as the project manager during the update process

or designate this role to another staff member. The HMPC leader or their designee will coordinate maintenance of this Plan, lead the formal Plan review and evaluation activities, direct the Plan update, and assign tasks to other members of the HMPC to complete these activities. Such tasks may include collecting data, developing new mitigation actions, updating mitigation actions, making presentations to City staff and community groups, and revising sections of the Plan.

PLAN IMPLEMENTATION

The effectiveness of the Plan depends on successful implementation of the mitigation actions. This includes integrating mitigation actions into existing City plans, policies, programs, and other implementation mechanisms. The mitigation actions in this Plan are intended to reduce the damage from hazard events, help the City secure funding, and provide a framework for hazard mitigation activities. Committee members prioritized the hazard mitigation actions in **Table 5-3** in Chapter 5. These priorities will guide implementation of these actions through new or existing City mechanisms as resources are available. The LHMP project manager is responsible for overseeing the implementation, promotion, and maintenance of this Plan, as well as being responsible for facilitating meetings and other coordinating activities related to Plan implementation and maintenance.

The key City Plans that should incorporate content from this LHMP include:

- Irvine General Plan Safety Element – this element should incorporate relevant mapping and analysis in the Safety Element to ensure the goals and policies of this plan are reinforced throughout future developments and projects proposed within the City.
- Irvine Emergency Operations Plan – The EOP focuses on the effective preparedness and response to hazard events that occur within the City. Incorporation of relevant content from this plan into the EOP ensures consistency regarding the hazards addressed in both plans.
- Irvine Capital Improvements Program – The CIP identifies key infrastructure investments throughout the City that may include hazard mitigation elements. Incorporation of this plan into the CIP may assist with enhancing infrastructure investment through additional funding and/or modification of improvements to include hazard mitigation elements.

This integration of the LHMP into the Irvine General Plan also allows the City to comply with AB 2140 requirements as identified in Chapter 1 of this plan.

PLAN MAINTENANCE PROCESS

The City's plan maintenance process will rely on the Irvine Mitigation Implementation Handbook, located in **Appendix E**. The handbook is intended to function as a stand-alone document that gives concise and accessible guidance to jurisdiction staff for implementing and maintaining the Plan. A key component of the handbook is the specific mechanisms that the jurisdiction can use to integrate this plan into other City planning mechanisms.

PLAN MONITORING AND EVALUATION

When members of the Committee are not updating the Plan, they should meet at least once a year to go over mitigation action implementation and evaluate the Plan's effectiveness. These meetings should include:

- Discussion of the timing of mitigation action implementation.
- Mitigation action implementation evaluation, and determination of success.
- Mitigation action prioritization revisions, if deemed necessary.
- Mitigation action integration into other mechanisms, as needed.

The first of these meetings will be held in the 2020-2021 fiscal calendar year. To the extent possible, Committee meetings should be scheduled at an appropriate time in the City's annual budgeting process, which will help ensure that funding and staffing needs for mitigation actions are considered.

When the Committee meets to evaluate the Plan, members should consider these questions:

- What hazard events, if any, have occurred in Irvine in the past year? What were the impacts of these events on the community? Were the impacts mitigated, and if so, how?
- What mitigation actions have been successfully implemented? Have any mitigation actions been implemented but not successfully, and if so, why?
- What mitigation actions, if any, have been scheduled for implementation but have not yet been implemented?
- What is the schedule for implementing future mitigation actions? Is this schedule reasonable? Does the schedule need to be adjusted for future implementation, and are such adjustments appropriate and feasible?
- Have any new issues of concern arisen, including hazard events in other communities or regions, that are not covered by existing mitigation actions?
- Are new data available that could inform updates to the Plan, including data relevant to the hazard profiles and threat assessments?
- Are there any new planning programs, funding sources, or other mechanisms that can support hazard mitigation activities in Irvine?

PLAN UPDATES

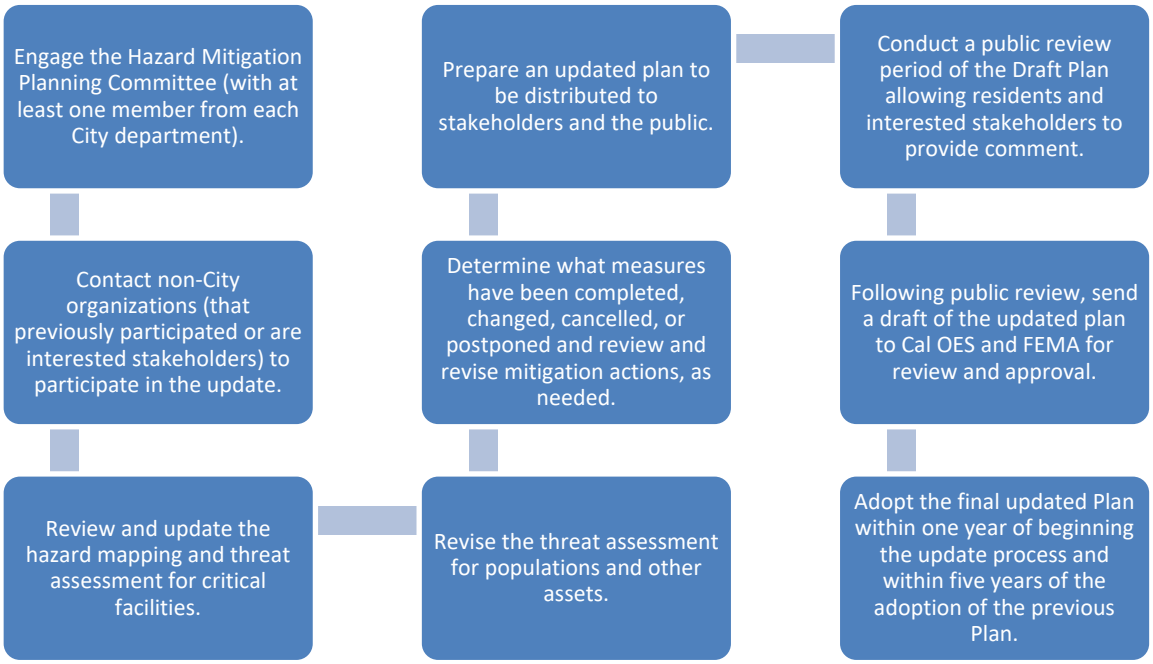
The information in this Plan, including the hazard profiles, threat assessments, and mitigation actions, are based on the best available information, practices, technology, and methods available to the City and Committee at the time this Plan was prepared. As factors change, including technologies, community demographics and characteristics, best practices, and hazard conditions, it is necessary to update the Plan so that it remains relevant. Additionally, Title 44, Section 201.6(d)(3) of the Code of Federal Regulations requires that LHMPs be reviewed, revised, and resubmitted for approval every five years to remain eligible for federal benefits.

UPDATE METHOD AND SCHEDULE

The update process should begin no later than four years after this Plan is adopted, allowing a year for the update process before the Plan expires. The LHMP project manager or their designee may also choose to begin the update process sooner, depending on the circumstances. Some reasons for accelerating the update process may include:

- A presidential disaster declaration for Irvine or an area that includes part or the entire city.
- A hazard event that results in one or more fatalities in Irvine.

The update process will add new and updated methods, demographic data, community information, hazard data and events, considerations for threat assessments, mitigation actions, and other information, as necessary. This helps keep the Plan relevant and current. The Committee will determine the best process for updating the Plan, which should include the following steps:



UPDATE ADOPTION

The Irvine City Council is responsible for adopting this Plan and all future updates. As previously mentioned, adoption should occur every five years. To ensure the plan remains active, the City should begin the update process at least one year prior to expiration. If the City has a grant application that relies on the LHMP, update to the plan should occur no later than 18 months before expiration. Adoption should take place after FEMA notifies the City that the Plan is Approved Pending Adoption. Once the City Council adopts the Plan following its approval by FEMA, the adopted plan should be transmitted to FEMA.

CONTINUED PUBLIC INVOLVEMENT

The City will continue to keep members of the public informed about the Committee's actions to review and update the LHMP. The Committee will develop a revised community engagement strategy that reflects the City's updated needs and capabilities. The updated strategy should include a tentative schedule and plan for public meetings, recommendations for the use of the City website and social media accounts, and content for public outreach documentation. The Committee will also distribute annual progress reports via the City's quarterly publication "Inside Irvine", which will provide Irvine community members a description of any actions taken by the City and ways that residents and businesses can help further the City's goals. These updates are anticipated to occur after the annual HMPC meeting conducted by the City.

POINT OF CONTACT

The Hazard Mitigation Planning Committee leader for Irvine is the primary point of contact for this Plan and future updates. At the time of writing, the HMPC leader is Robert Simmons, available at rsimmons@cityofirvine.org | (949) 724-7235

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