SAFETY

DRAFT - March 2024

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The City of Irvine is committed to safeguarding the community from natural and human-caused hazards to help ensure the security of public health and safety, minimize disruption to the economy, and the protection of people and businesses from injury, property damage, and other losses.

VISIONING THROUGH SAFETY

The Safety Element is a mandated component of the General Plan. The City of Irvine experiences various hazard conditions that could potentially impact overall community safety and sense of security. Community safety programs can reduce the potential for loss of life, injuries, and property damage associated with natural and human-caused hazards.

The most significant hazards the City faces include seismic hazards, wildfire, drought, and diseases and pests. The impact of climate change is also likely to intensify many of these risks. This Element provides policies, goals, objectives, and guidelines for avoiding and/or mitigating the harms and protecting the community from unreasonable risks associated with these hazards. The Safety Element focuses on determining the probability and severity of these risks and identifying goals, objectives, policies, and actions to address and prepare for them.

RELATIONSHIP TO OTHER ELEMENTS AND PLANS

Source: Orange County Fire Authority, https://ocfa.org/AboutUs/Departments/OperationsDirectory/Sandbags.aspx

The Safety Element is in alignment with other Elements of the City's General Plan, as required by State law, including the (1) Housing, (2) Land Use, (3) Circulation, and (4) Conservation and Open Space, and (5) Environmental Protection and Climate Action Elements. Policies and plans in the Safety Element are designed to protect existing and planned land uses identified in the Land Use Element (and associated people and properties) from unreasonable risk from natural and human-caused hazards. Potential hazards are identified and associated actions are established to avoid or mitigate impacts to public safety.

- **Land Use Element-** The Land Use Element contains policies to ensure that environmental conditions, including hazards, are considered in all land use decisions. The distribution of residential and other sensitive land uses on the Land Use Policy Map is designed to avoid areas where hazardous conditions have been identified.
- **Circulation Element** – The Circulation Element provides the policy framework for a safe and efficient circulation system, which is critical during response to an emergency or in the event an evacuation is necessary.
- **Conservation and Open Space Element** - The Conservation and Open Space Element identifies the protection of open space areas that may contain hazardous conditions, such as increased risk of wildland fires and landslides.
- **Housing Element** - The Safety Element plays a crucial role in ensuring that housing developments adhere to safety standards and regulations to protect residents from hazards such as earthquakes, floods, and wildfires. It influences land use decisions in the Housing Element by guiding the selection of suitable locations for housing projects, taking into account factors like proximity to emergency services and vulnerability to natural disasters. Additionally, the Safety Element incorporates policies aimed at enhancing community safety and disaster preparedness.

- **Environmental Protection and Climate Action (EPCA) Element** - The partnership between the Safety and EPCA Elements ensures that safety planning considers environmental factors, including heightened hazard conditions linked to climate change. These elements collaborate to address safety issues while advocating for environmental responsibility, ultimately aiming to achieve a resilient and safe urban environment.

Irvine has also prepared a federally certified Local Hazard Mitigation Plan (LHMP) and an adopted Emergency Operations Plan (EOP), both of which allow the City to become eligible for federal grant funding to mitigate the natural hazards discussed therein.

The LHMP, which was adopted in October 2020 and certified by the Federal Emergency Management Agency (FEMA) in December 2020, has been incorporated into the Safety Element in accordance with Assembly Bill (AB) 2140 (Disaster Mitigation Act of 2000). The City's LHMP identifies natural and human-induced hazards that threaten the community and provides resources, information, and strategies to reduce these threats, resulting in overall risk reduction. The LHMP also includes hazard mitigation strategies which include a comprehensive set of mitigation actions that respond to the relevant hazard situations and provide protection to residents, businesses, and community assets in Irvine.

Based on the City's LHMP, there are 11 hazard types, each with subcategories, that have the potential to impact Irvine. The top four hazards posing a threat to Irvine residents and businesses are seismic hazards, wildfires, drought, and diseases and pests. Other hazards listed by the probability of occurrence and level of impact on the City, ranked from highest to lowest, include severe weather, aircraft incidents, human-caused hazards (e.g., infrastructure failure, mass-casualty incident, cyber threats), geologic hazards, flooding, hazardous materials release, and dam failure.

General Plan Element objectives related to the Safety Element are as follows:

Circulation Element: C-2	**EPCA Element: EPCA-2, EPCA-4, EPCA-5**
Housing Element: HE-I, HE-L	**Noise Element: N-1, N-4**
Conservation and Open Space Element: COS-5	**Land Use Element: LU-9**

SCOPE AND CONTENT

The Safety Element is comprised of two sections:

1. Existing Conditions and Areas of Concentration
2. Objectives, Policies, and Implementation Actions

Government Code Section 65302(g) identifies the hazards and associated risks as they pertain to conditions in the City, that are required to be addressed in Safety Elements, which include:

- Seismic risks, including, but not limited to (per Government Code Section 65302[g][1]):
    - seismically induced surface rupture,
    - ground shaking,
    - ground failure,
    - tsunami,
    - seiche,
    - dam failure,
    - slope instability leading to mudslides and landslides, subsidence, liquefaction, and

  - other seismic hazards identified pursuant to Chapter 7.8 (commencing with Section 2690) of Division 2 of the Public Resources Code, and other geologic hazards known to the legislative body;

- Flooding (per Government Code Section 65302[g][2][A], AB 162, and Senate Bill [SB] 1035);
- Drought (per Government Code Section 65302[g][2]);
- Wildland and urban fires (per Government Code Section 65302[g][1] and 65302[g][3][A] and SB 1241);
- Climate change adaptation and resilience, including a vulnerability assessment (per Government Code Section 65302[g][4], SB 379, and SB 246);
- Evacuation routes and locations of identified fire and seismic hazards (per Government Code Section 65302[g][1] and 65302[g][5], SB 99, AB 747, and AB 1409);
- Other required topics, including military installations, peak load water supply requirements, and minimum road widths and clearances around structures (per Government Code Section 65302[g][1]); and
- Natural Infrastructure (per Government Code Section 65302[g][4][C][v] and AB 65).

State law allows communities to add additional safety issues to this list. The City has chosen to address the following safety issues within this Element:

- Diseases and Pests; and
- Airport Hazards.

All issue areas listed above are addressed in this Safety Element, in other General Plan Elements, or in the City's LHMP.

HAZARDS NOT APPLICABLE

Given the City's distance to the ocean, the City has not experienced and is not expected to experience hazardous conditions related to tsunamis. Hazardous conditions related to a seiche within North Lake or South Lake in the Woodbridge community are unlikely given the small size of the lakes and the height of the banks surrounding the lakes. No other enclosed waterbodies where a seiche could occur exist within the City. Additionally, there are no active military installations within or adjacent to the City of Irvine. Therefore, tsunamis and seiches, and military installations do not apply and are not addressed further in this Safety Element.

SUPPORTING TECHNICAL STUDIES

A Climate Vulnerability Assessment (Appendix A) was prepared in compliance with SB 379, and Climate Change Adaptation and Resiliency Strategies were developed with extensive community input. These components have been incorporated into this Element, consistent with SB 379 and SB 246.

An Emergency Evacuation Route Analysis (Appendix B) was prepared and incorporated into this Element. Additional policies were developed in response to the results of the analysis.

EXISTING CONDITIONS AND AREAS OF CONCENTRATION

The following is a summary of existing and projected future conditions for the City's highest priority hazards as identified in the 2020 LHMP, as well as hazards required to be addressed in the Safety Element by State law and the California Governor's Office of Planning and Research (OPR). The discussion of Existing Conditions provides an overview of the current issues pertaining to hazardous conditions and safety issues within the City. The Areas of Concentration discussion describes threats to the City's physical assets (i.e., critical facilities and facilities of concern), people, and City services and systems (e.g., utilities, transportation infrastructure). The Areas of Concentration discussion also identifies the risk of future events for each hazard and how they may be exacerbated by climate change.

PUBLIC SAFETY AND EDUCATION

Existing Conditions

Major emergencies occur periodically in all communities. Proper preparation for emergencies, including mitigation of risks and vulnerabilities specific to Irvine, are essential to minimize disruption, personal injury, and property damage associated with these events. Preventative measures and preparatory responses before an emergency occurs will reduce the time and cost of recovery from these emergencies.

The two primary civic agencies responding to safety hazards in Irvine are the Irvine Police Department and the Orange County Fire Authority. The Irvine Police Department is located at City Hall (1 Civic Center Plaza). The City also has a contract with the Orange County Fire Authority (OCFA) for fire prevention and response services within the City (Figure 1). OCFA stations are scattered throughout the County, with approximately 11 locations in the City of Irvine.

The City's 2023 Standard Plans and Design Manuals provide minimum recommended lane widths in the City to ensure that emergency vehicles can access residences and other development during emergency events. Specifically, the City of Irvine Standard Plans No. 101, 102, 103, and 103A provide for the right-of-way and curb-to-curb design standards for constructing Major, Primary, Secondary highways, and Commuter Streets in the City of Irvine. Standard Plans No. 104, 104A, and Plan No.111 provide design standards that include lane widths for Local Streets, Local Collectors, and Private Ways. The recommended procedures present the ideal lane widths for typical street sections, both at mid-block and at the intersections. Additionally, Standard Plan No. 114 establishes minimum median widths for emergency vehicle median turn-arounds.

Minimum clearance requirements around structures in the City are consistent with the California Building Code, California Fire Code, and other State regulations. For example, AB 3074 establishes an ember-resistant zone within five feet of a structure as part of the defensible space requirements for structures located in specified high-fire hazard areas.

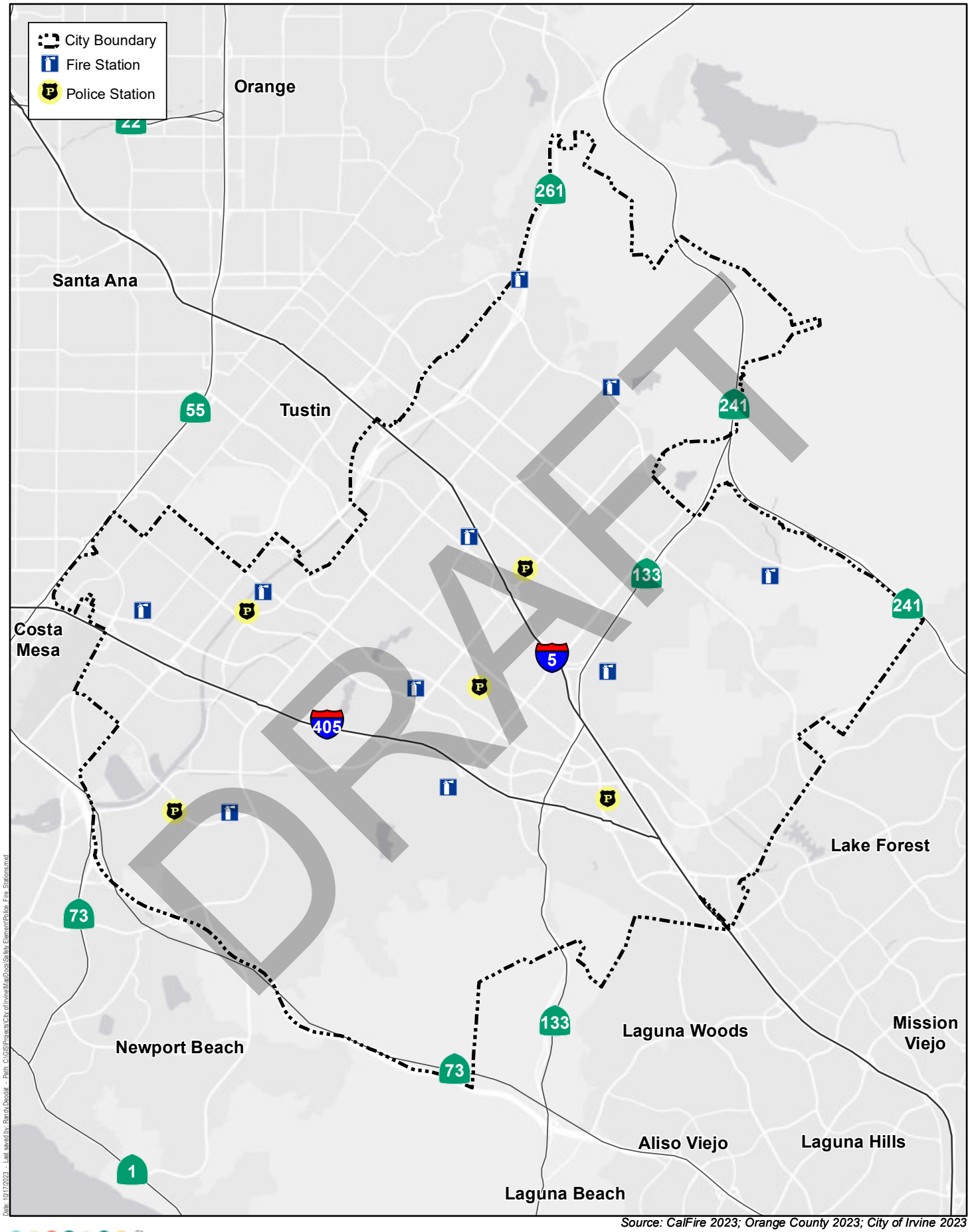
Areas of Concentration

The City's 2020 LHMP identifies natural and human-induced hazards that threaten the community, particularly the City's physical assets (i.e., critical facilities and facilities of concern), vulnerable populations, and City services and infrastructure (e.g., utilities, transportation infrastructure). The City's critical facilities and facilities of concern as mapped in the 2020 LHMP are shown in Figure 2.

The LHMP provides resources, information, and strategies to reduce these threats. The LHMP also identifies hazard mitigation strategies, which include a comprehensive set of mitigation actions to respond to varying hazard situations and provide protection to residents, businesses, and community assets in Irvine. Several mitigation items focus on developing, enhancing, and implementing educational programs that aim to reduce the risk to citizens, public agencies, businesses, and schools.

The LHMP also addresses the potential impacts of changing climate and weather patterns and contains information required pursuant to Gov. Code Section 65302(g)(4)(C). Although changing weather patterns are not a stand-alone hazard, they have the potential to change the characteristics, such as frequency and intensity, of other hazards (e.g., flooding, extreme temperatures) that affect the community.

Figure 1. Police and Fire Stations in Irvine



Source: CalFire 2023; Orange County 2023; City of Irvine 2023

IRVINE 2045 GENERAL PLAN

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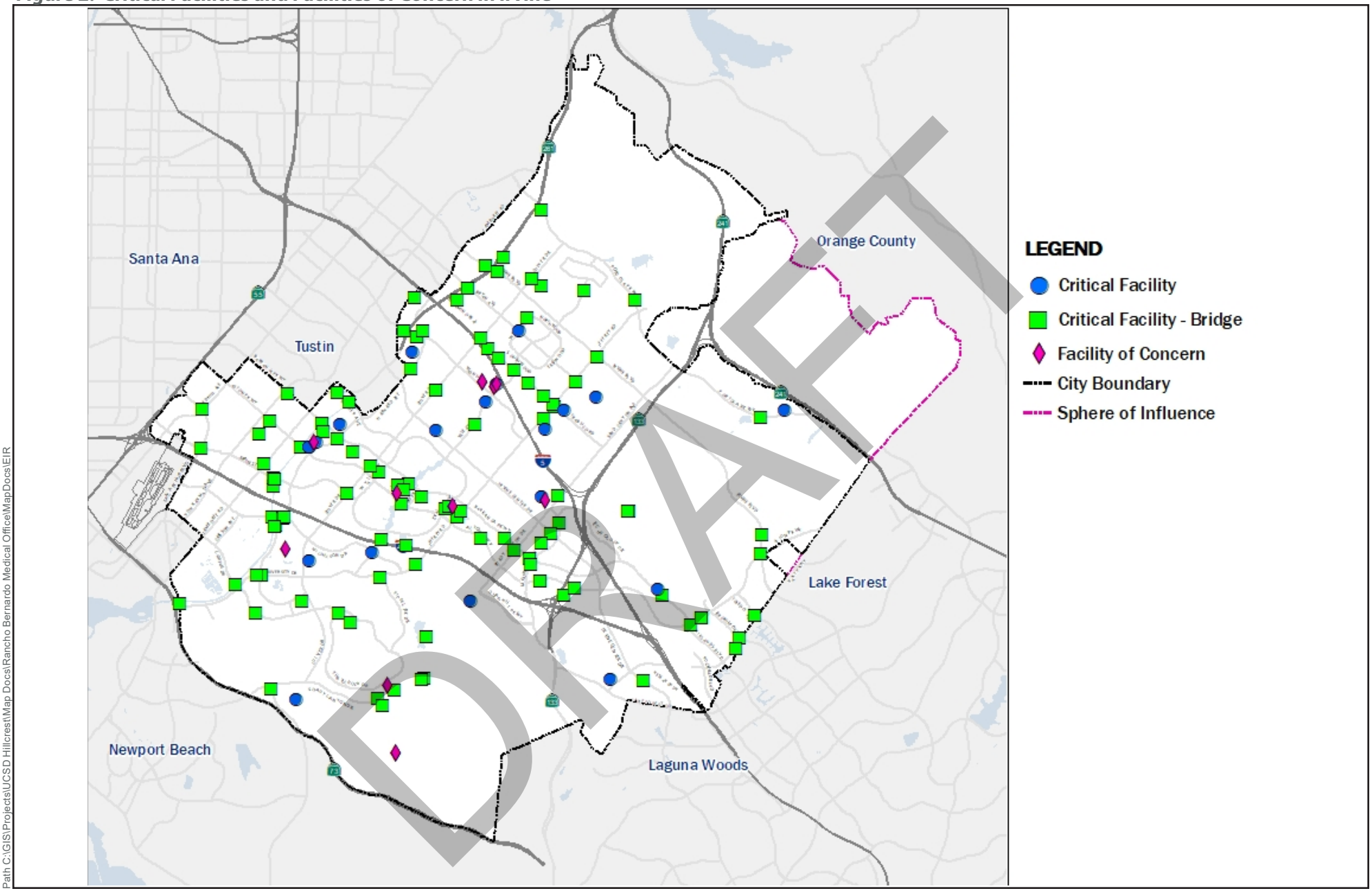
Figure 1

Police and Fire Stations in Irvine

Figure 2. Critical Facilities and Facilities of Concern in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

Figure 2

Critical Facilities and Facilities of Concern in Irvine

SEISMIC HAZARDS

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

Existing Conditions

FAULT RUPTURE

The shifting and movement of the Earth's tectonic plates are responsible for seismic events. The location at which two tectonic plates join is called a fault line. Any buildings or infrastructure situated around, on top of, or across a fault line are subject to severe seismic shaking and could potentially be severely damaged or destroyed.

The U.S. Geological Survey (USGS) and California Geological Survey are the primary agencies providing scientific information related to seismic hazards and geological resources in California. According to the USGS and California Geological Survey, 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, including Newport-Inglewood-Rose Canyon fault zone (approximately 1.5 miles west of Irvine), Pelican Hill fault (approximately 1.5 miles west of Irvine), El Modena fault (approximately 5 miles north of Irvine) and Peralta Hills fault (approximately 5 miles north of Irvine). In addition, numerous faults have been identified within the City; 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.

The San Joaquin Hills blind thrust fault is the only known fault that runs through Irvine and travels in an east-west/southeasterly direction through the City (Figure 3). The location of the fault is thought to run just north of the San Joaquin Hills, with the Irvine Civic Center sitting on top of the inferred location. If an earthquake were to occur on this blind thrust fault, the likelihood of surface rupture would be underground, thereby reducing potential risk to structures (see Seismic Shaking below).

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. During liquefaction events, the liquified soil can lose most of its stability, which can cause damage to buildings and infrastructure; in severe cases, some buildings may completely collapse. Parts of Irvine are in a potential liquefaction zone, according to the California Geological Survey (Figure 3). This is due to the types of soils in this area, the 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.

SEISMIC SHAKING

Seismic shaking is the shaking felt on the Earth's surface caused by an earthquake. In most cases, earthquakes are not powerful enough for the shaking to be felt. However, particularly powerful earthquakes can generate significant shaking, causing widespread destruction, including property damage. Southern California, including Irvine, is a highly seismic area because of the major faults that run through the region and is subject to experiencing seismic shaking. The only known fault that runs through Irvine is the San Joaquin Hills blind thrust fault, which runs just north of the San Joaquin Hills.

Areas of Concentration

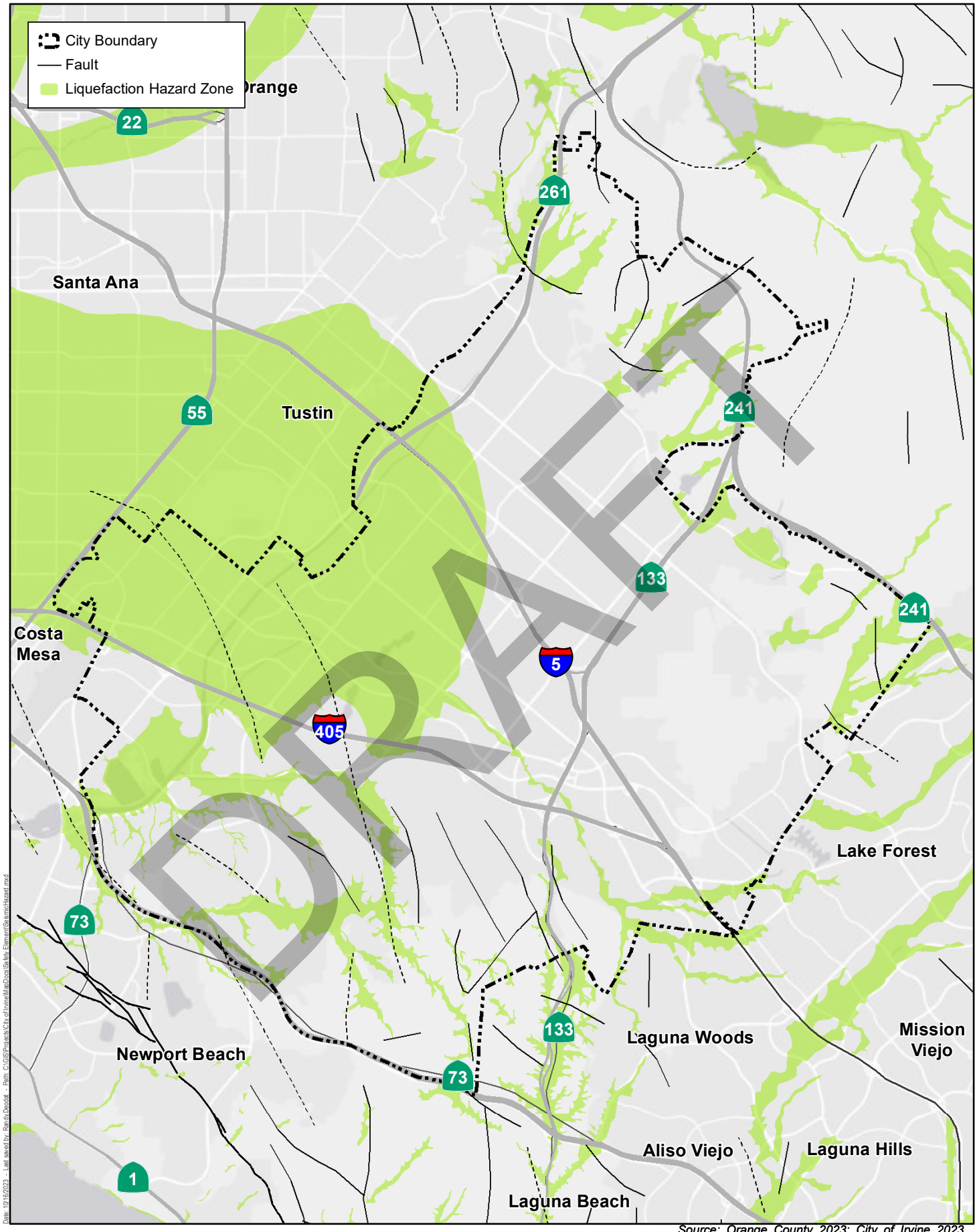
FAULT RUPTURE

As shown on Figure 3, faults beneath the City 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. 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. Additionally, there is no known direct connection between fault rupturing and climate change.

Potential losses associated with fault rupture could affect 4 critical facilities and 18 facilities of concern, including 3 community centers and 16 recreation support facilities (Figure 4). Surface fault rupture also tends to damage roads and structures in the areas of impact. Fault rupture could affect anyone within the City but may especially impact residents within 500 feet of a ruptured fault. The stronger the event, the greater distance that rupture can occur.

Given the presence of faults beneath and near the City, 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 (see *Seismic Shaking* below).

Figure 3. Seismic Hazards in Irvine

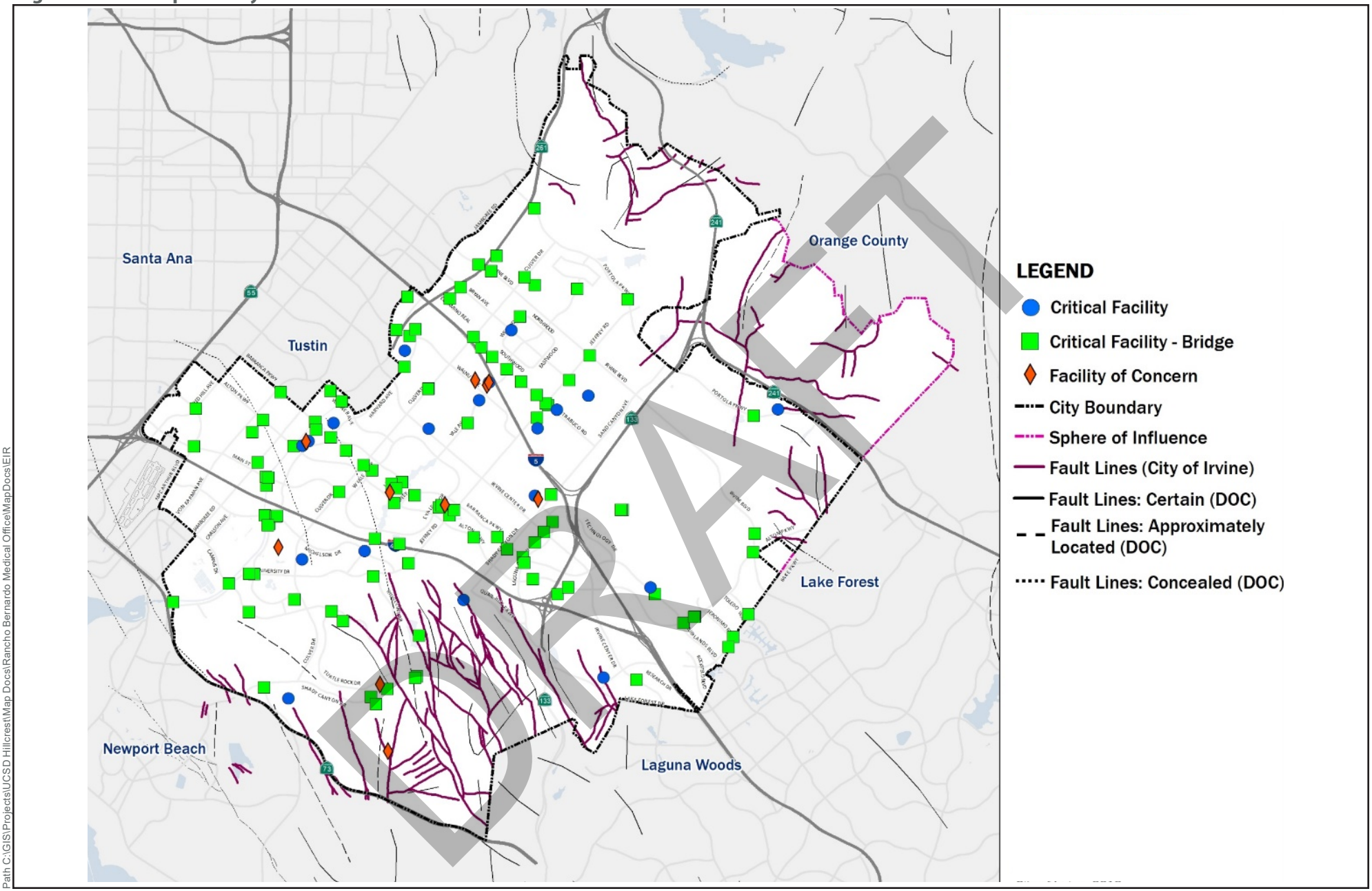


Source: Orange County 2023; City of Irvine 2023

IRVINE 2045 GENERAL PLAN

Figure 3
Seismic Hazards in Irvine

Figure 4. Fault Rupture Physical Threat in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

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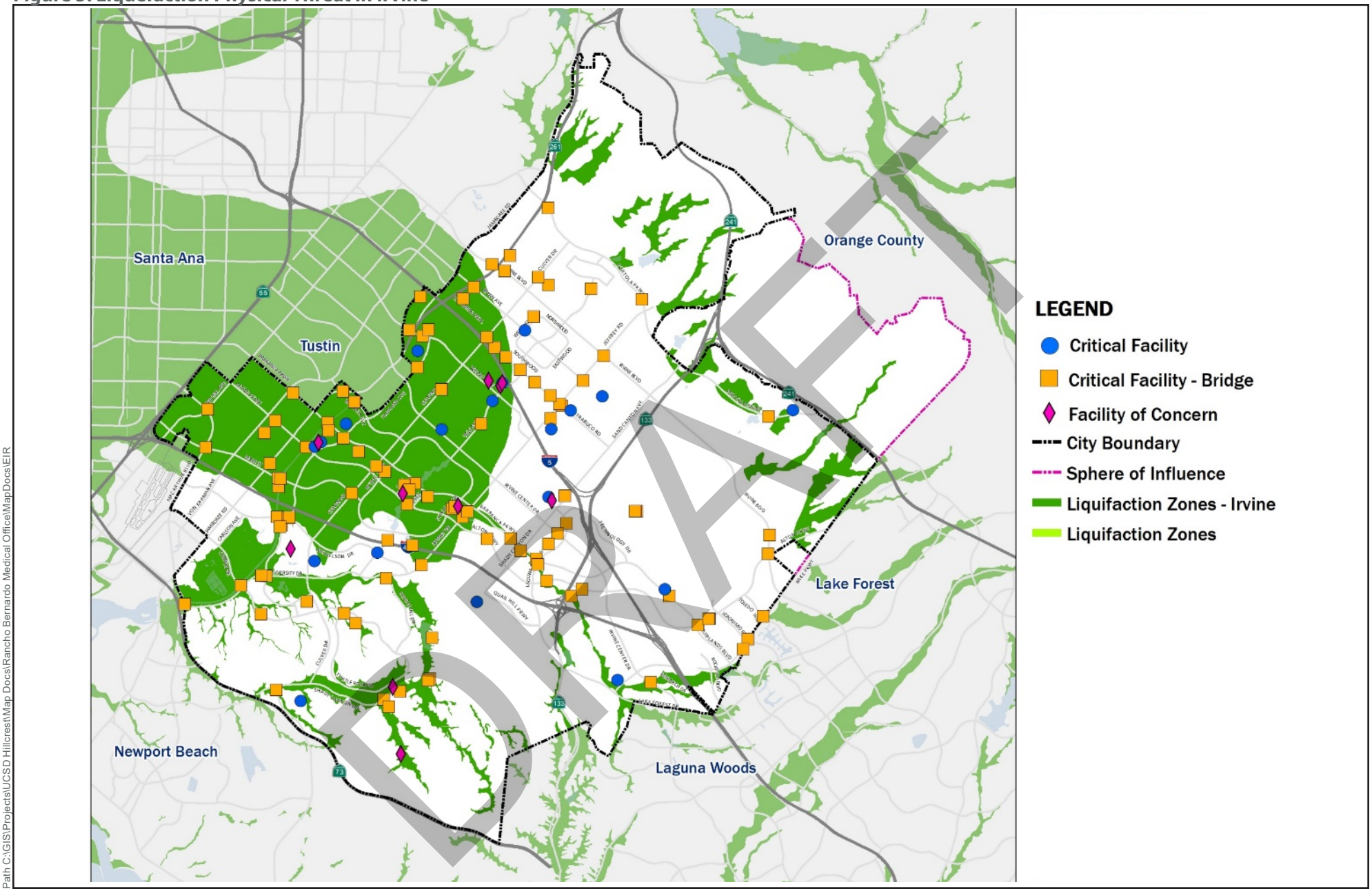
Figure 4
Fault Rupture Physical Threat in Irvine

Figure 5. Liquefaction Physical Threat in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

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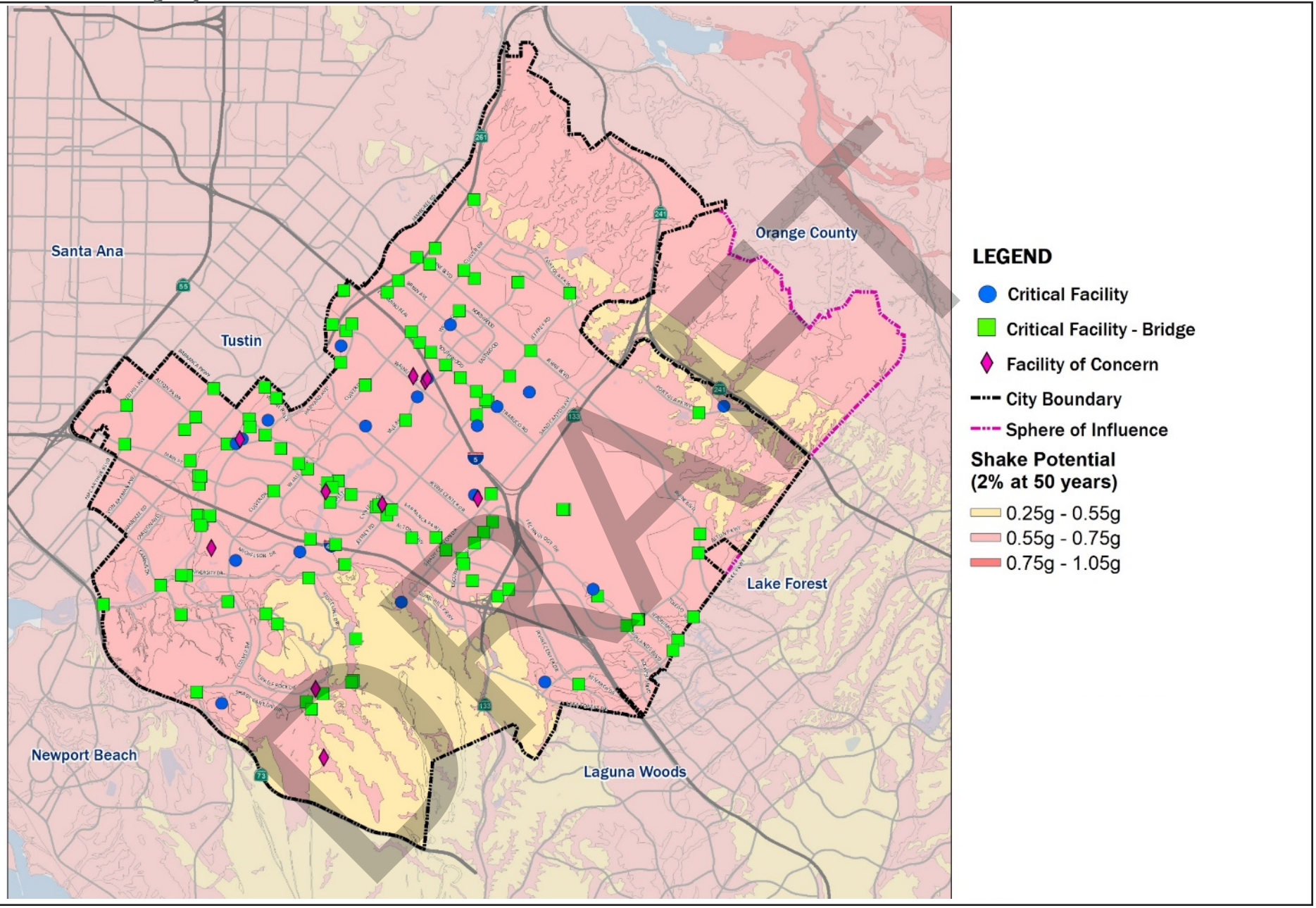
Figure 5

Liquefaction Physical Threat in Irvine

Figure 6. Seismic Shaking Physical Threat in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

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Figure 6

Seismic Shaking Physical Threat in Irvine

Liquefaction

Liquefaction potential is predominantly located within the northwestern portion of the City, as well as along stream courses in the Santa Ana foothills and San Joaquin Hills. Figure 5 identifies the areas susceptible to liquefaction and location of critical facilities and facilities of concern. Given the extent of the liquefaction zone and density of City facilities, this hazard poses the greatest potential loss. City assets composed of 78 critical facilities and 30 facilities of concern are located within these areas, including 70 bridges and 20 schools.

A large proportion of the City's population (over 37 percent) face the threat of impact due to liquefaction. This hazard zone covers the largest population and number of households when compared to other hazard areas. Fortunately, newer construction in these areas have taken liquefaction into consideration. 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 needed to make repairs and/or the cost associated with retrofitting older buildings.

Source: Jim Harding - Flickr: 10A_3419, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=17451100

Services and mobility may be disrupted during and following a liquefaction event. Sidewalks, roadways, and pipelines may become fractured and disjointed because 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 would likely be rendered unsafe for occupancy if they experience any leaning or structural damage resulting from the liquefaction, which would curtail the City's and region's economic activity.

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. An earthquake could occur along the numerous local faults running through Orange County that may lead to a liquefaction event. However, the likelihood of one of these local faults experiencing an earthquake powerful enough to trigger a liquefaction event within the next 25 years is exceptionally low. Regional faults, like the San Andreas or San Jacinto faults, are more likely to experience a significant earthquake within the next 25 years but may be too distant from Irvine to generate significant shaking intensity to trigger a liquefaction event. As a result, although liquefaction could occur in the City, it cannot be determined with certainty when or where a future liquefaction event may occur in Irvine.

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. Alternatively, longer-lasting drought may lead to more groundwater withdrawal and could lower groundwater elevations. Therefore, climate change could either increase or decrease the future risk of liquefaction in Irvine depending on the circumstances.

Seismic Shaking

The only known fault that runs through Irvine is the San Joaquin Hills blind thrust fault, which runs just north of the San Joaquin Hills, with the Irvine Civic Center sitting on top of the inferred location. If an earthquake were to occur on this blind thrust fault, the rupture would most likely occur underground, reducing the risk to surface structures. However, there would still be a danger of damage to buildings or infrastructure posed by any seismic shaking. Many physical assets in the City are estimated to experience the same seismic shaking intensity, ranging from "55 to 75 percent g" (meaning the 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. 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 6 identifies critical facilities and facilities of concern in Irvine that are threatened by 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 higher household incomes.

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. 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. 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, which are felled by the shaking could potentially block roadways and prevent emergency response teams from reaching victims or evacuees who need assistance.

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. The U.S. Geological Survey also forecasts the severity of seismic shaking in different locations for various plausible earthquake scenarios. The U.S. Geological Survey scenarios

show that lower magnitude earthquake scenarios may overall be more destructive in Irvine than higher magnitude earthquake scenarios that are more distant. The likelihood of a powerful earthquake occurring along these faults within the next 25 years is exceptionally low.

In addition, there is no direct link between climate change and seismic activity that could impact Irvine. As such, climate change is not expected to cause any changes to the frequency or intensity of seismic shaking.

GEOLOGIC HAZARDS

Geologic hazards of concern in Irvine include landslides and subsidence.

Source: California Department of Conservation. https://www.conservation.ca.gov/cgs/landslides

Existing Conditions

LANDSLIDE

Landslides occur when earth on slopes become destabilized, typically after heavy rains, when precipitation saturates the soil and makes it less stable, or when significant erosion from rainfall destabilizes the ground. Slopes that have recently burned, as well as areas that have experienced earthquakes, may be more susceptible to landslides.

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 by steep topography and geologic units that can become unstable. Figure 7 identifies the areas of the City that are considered vulnerable to seismic-induced landslides. However, even these

areas are designated as having a moderately low risk of landslides due to seismic conditions and a low likelihood of a landslide under other conditions. Figure 8 identifies the deep-seated landslide susceptibility for Irvine. As shown on Figure 8, areas in the foothills of the Santa Ana Mountains and San Joaquin Hills are the most susceptible to landslides.

SUBSIDENCE

Subsidence occurs when the level of the ground decreases, as if the surface is sinking. Subsidence can either be sudden or can happen gradually over time and can be caused by mining, groundwater pumping, fossil fuel extraction, erosion, natural cave collapses, or seismic activity.

Orange County Water District,
Source: https://www.ocwd.com/what-we-do/groundwater-management/

The most likely locations for subsidence in Irvine are the low-lying areas that sit on top of the Orange County Water District (OCWD) groundwater basin. Although other sections of the City may be subject to subsidence in the event of a major earthquake (magnitude 5.0 or greater), Irvine does not have a history of seismically induced subsidence.

It is also important to note that there is evidence of subsidence in most of Orange County due to excessive groundwater pumping in the first half of the 20th century. In addition, it is estimated that the greater Los Angeles Basin (including Orange County) experiences approximately 20 millimeters of net subsidence seasonally due to groundwater pumping and artificial recharge.

Areas of Concentration

LANDSLIDE

The City mapped the critical facilities and facilities of concern with the California Geological Survey's Earthquake Induced Landslide zones (Figure 9). In addition, Figure 10 identifies the facilities located within the Deep-Seated Landslide hazard zone, which identifies a larger landslide hazard footprint. Most 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 can trigger a landslide during long periods of rainfall. Deep seated landslides could impact the 30 critical facilities and 7 facilities of concern located in this zone.

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. Additionally, households living under the poverty limit and households with one member aged 65+ within the deep-seated landslide hazard zone are lower than the City overall. These indicators suggest that populations within the landslide hazard zones have higher disposable incomes and lower proportions of residents that are retired or living on limited incomes.

Landslides may block roadways causing long-term disruptions to mobility and City capabilities. Utility lines, such as power lines or water pipes, may be broken or damaged by a landslide, interrupting

important services. Homes and businesses can be 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. Landslides could also affect sensitive ecological areas around the community, causing localized harm to the region's ecosystem.

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 to reduce landslide potential in the developed areas of the City, including entire landslide removal and/or landslide stabilization in accordance with approved site-specific geotechnical analyses and recommendations.

Areas near the foothills of the Santa Ana Mountains and San Joaquin Hills also have the potential to fail during an earthquake (Figure 9) or during intense rainstorms when the water adds extra weight that the soil cannot bear. These conditions can be further exacerbated after a wildfire, when rainstorms pass through as the water liquefies unstable, dry soil and burned vegetation. Overall, the probability of future landslides within Irvine is considered occasional.

Due to the variety of factors that lead to landslides, it is possible that climate change could indirectly affect the conditions for landslides. For example, more frequent and intense rain events could subsequently result in moisture-induced landslides. Additionally, warmer temperatures and frequent drought conditions may also lead to more fires, which could destabilize soils and increase the probability of future landslide events.

SUBSIDENCE

If subsidence were to occur in Irvine, it could have a significant effect on large-scale systems such as utility infrastructure, transportation infrastructure, buildings, and aquifers. For example, subsidence could irreversibly decrease an aquifer's capacity to store water. Sinking of the ground could also reduce the distance to the groundwater table, which could increase risk of contamination from hazardous materials. Because water lines are gravity driven, a change in elevation because of subsidence could make the system more inefficient. Although accurate subsidence mapping data is not available, many important critical facilities could be gradually affected by subsidence in Irvine and may require further study to examine their function and safety.

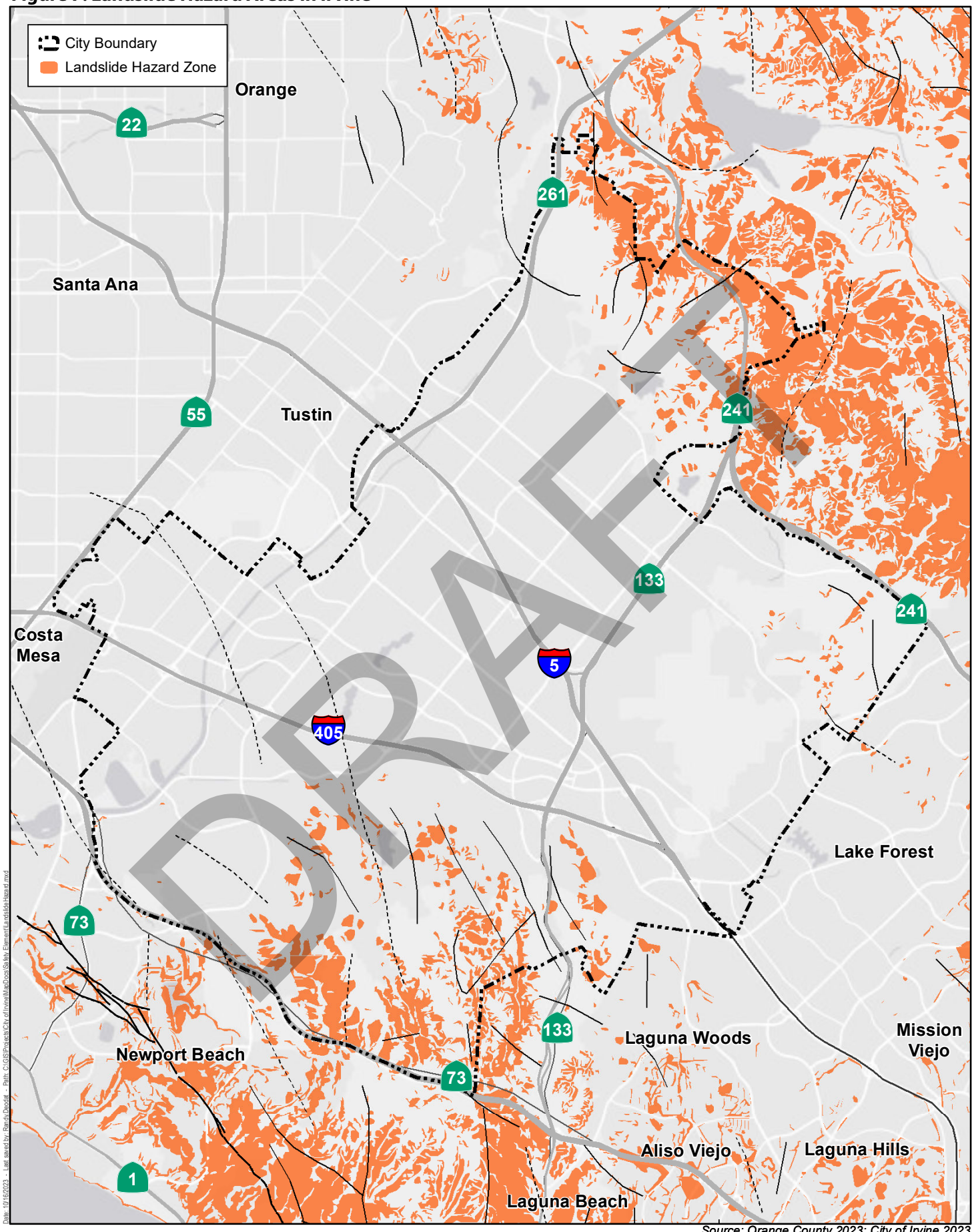
Buildings could gradually sink because of subsidence, causing minor issues such as cracks or misalignments of doors and windows, or more costly problems such as sinkholes. These issues could impact residents living in older homes, which may not have been built with foundations reinforced with steel. 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.

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.

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.

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 and reducing 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.

Figure 7. Landslide Hazard Areas in Irvine



Source: Orange County 2023; City of Irvine 2023

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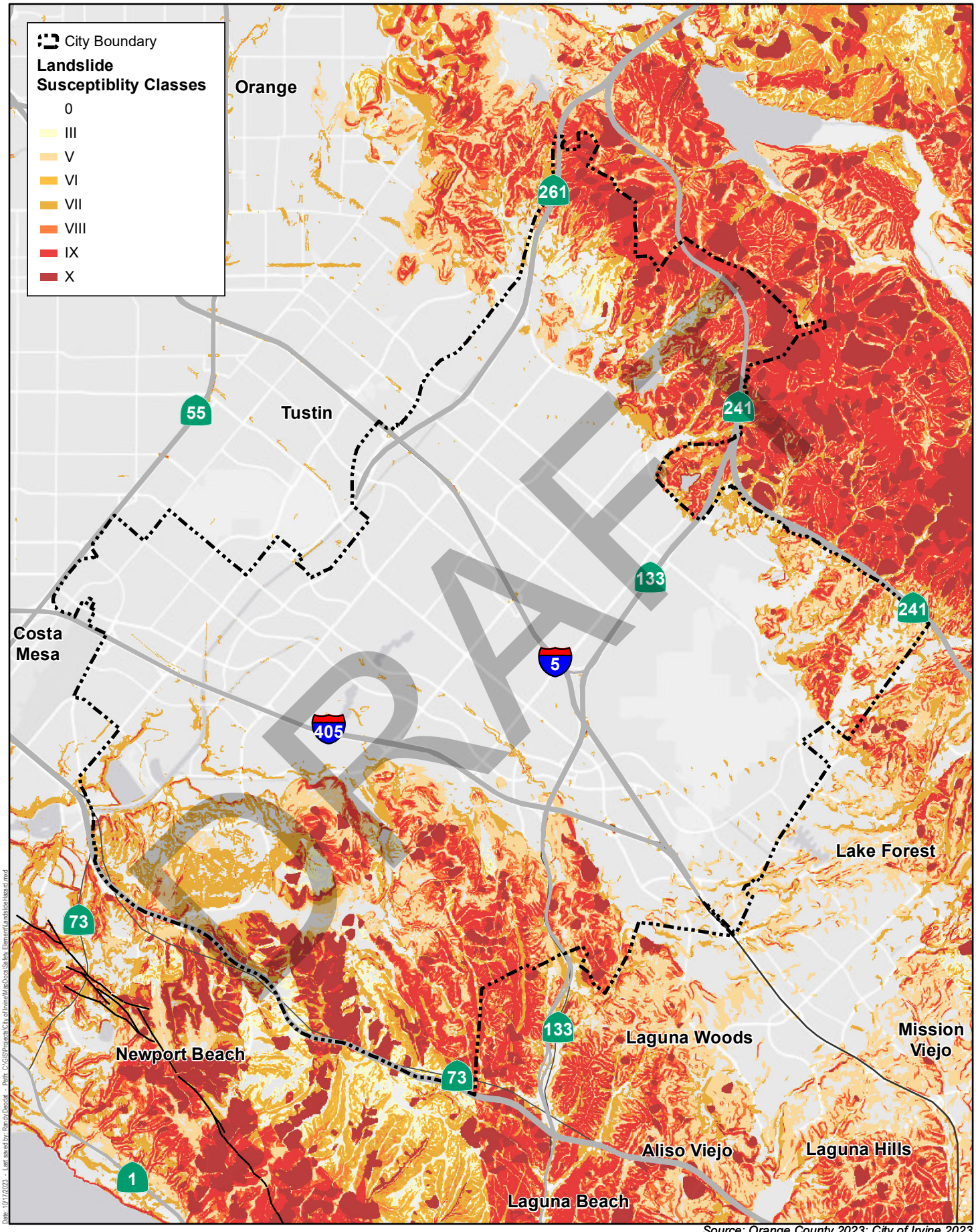
Figure 7

Earthquake Induced Landslide Hazard Areas in Irvine

Figure 8. Deep-Seated Landslide Susceptibility in Irvine



Source: Orange County 2023; City of Irvine 2023

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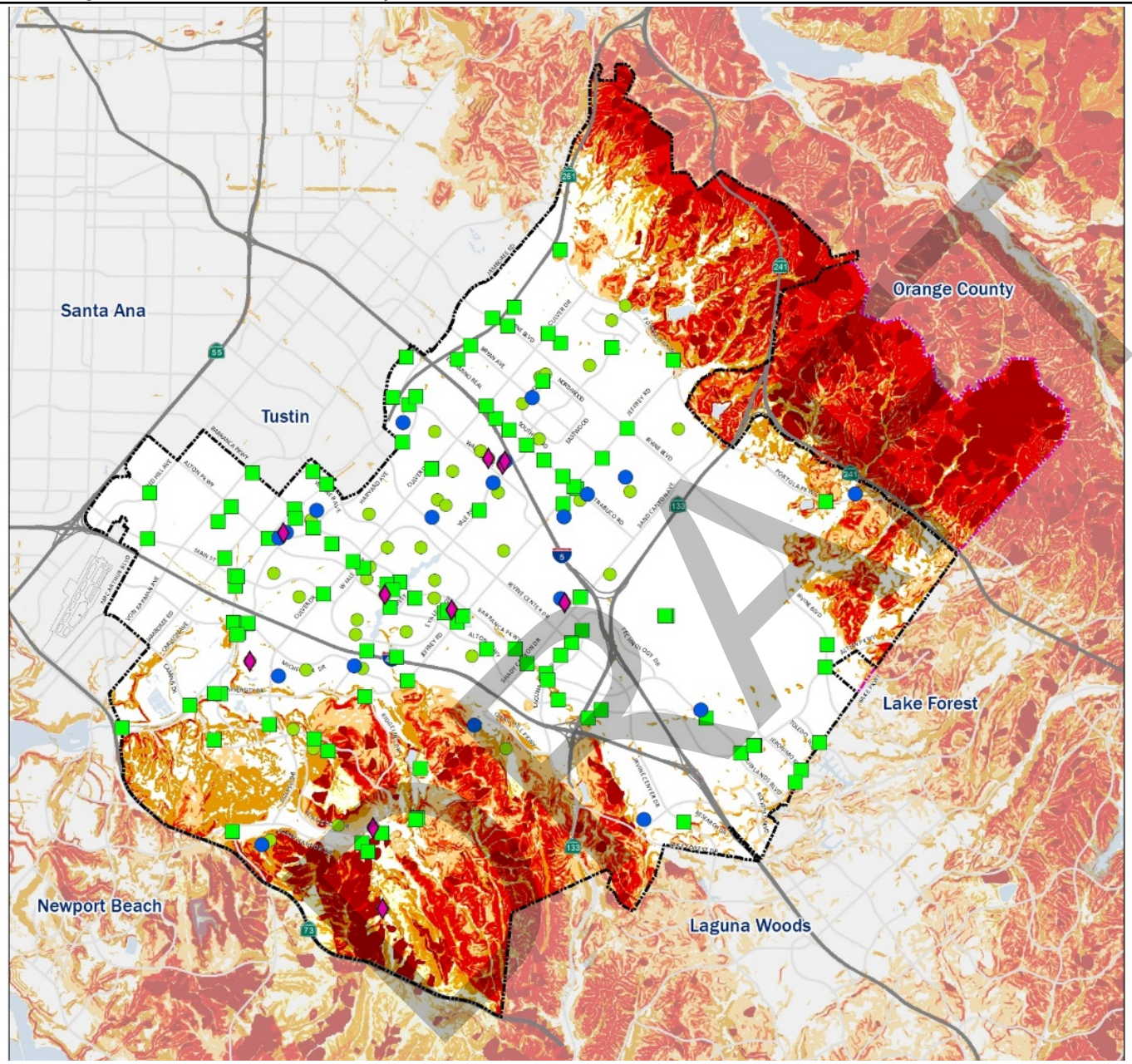
Figure 8

Deep-Seated Landslide Susceptibility in Irvine

Figure 9. Earthquake Induced Landslide Physical Threat in Irvine



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Source: City of Irvine 2020.

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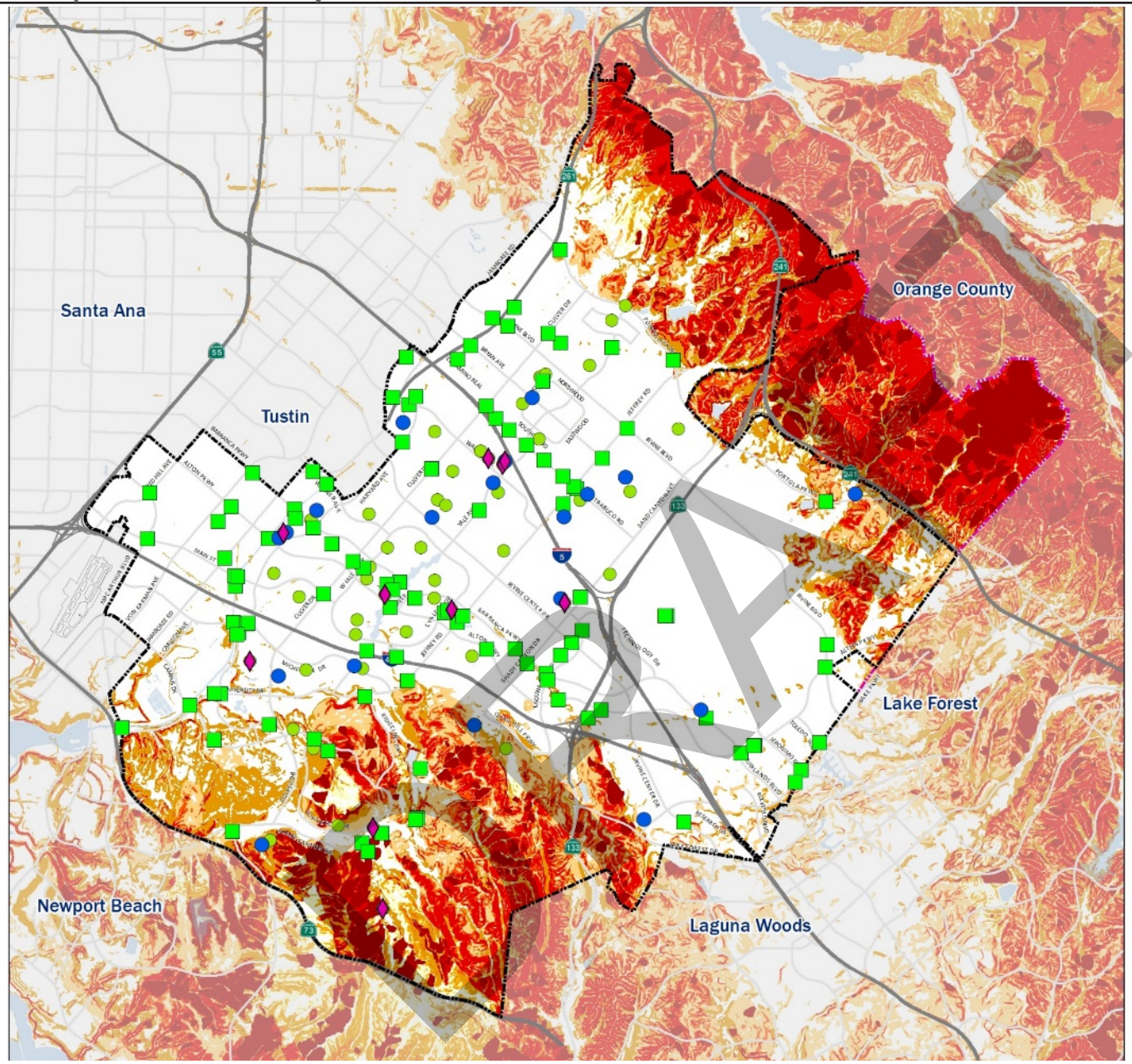
Figure 9

Earthquake Induced Landslide Physical Threat in Irvine

Figure 10. Deep-Seated Landslide Physical Threat in Irvine



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Source: City of Irvine 2020.

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Figure 10

Deep-Seated Landslide Landslide Physical Threat in Irvine

FLOODING

Flooding hazards of concern in Irvine include inland flooding, dam inundation, and coastal inundation related to sea level rise.

Existing Conditions

INLAND FLOODING

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 and can cause property damage, destroy homes, and carry away vehicles or other large debris.

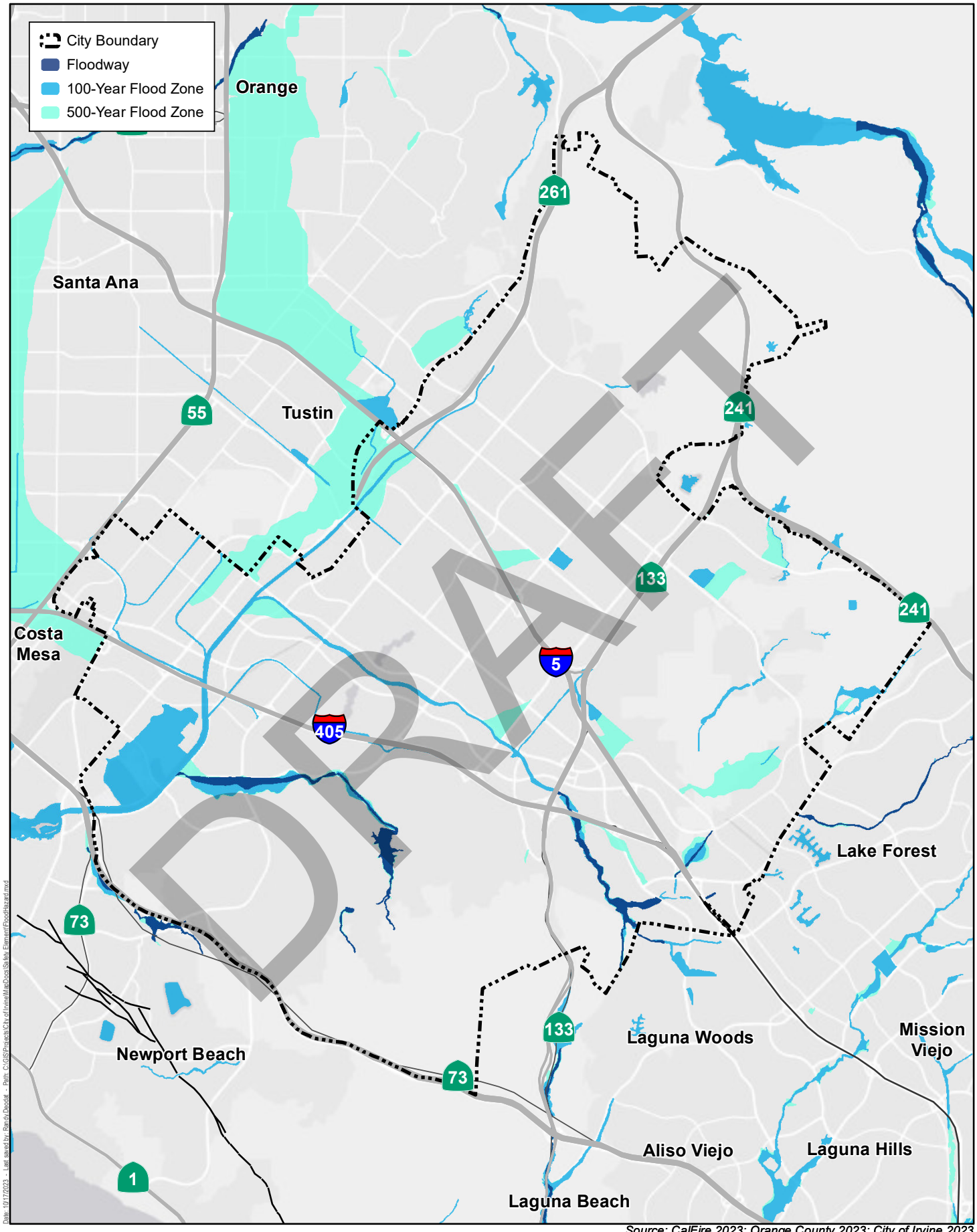
Electronic or mechanical equipment on the ground could become waterlogged and nonfunctional. Flooding could also temporarily stop any type of transportation in the City. Debris carried by floodwaters can block roadways, hinder access for vehicles, and potentially affect emergency response services. Rushing water only one foot deep is enough to carry small vehicles. Key underpasses beneath major freeways and rail lines in the City may become flooded and impact transportation mobility throughout the City.

In addition, flooding in watersheds could impact water quality by bringing more nutrients and total dissolved solids into the water supply. Flood water may have high levels of raw sewage or other hazardous substances. During a flood, underground storage tank systems may become displaced or damaged and release their contents into the environment, causing soil, surface water, and groundwater contamination. Flooding events can generate tons of debris, including building rubble, soil and sediments, green waste (e.g., trees and shrubs), personal property, ash, and charred wood.

The City has limited vulnerability to precipitation-driven flooding and is prepared to adapt to future effects of climate change related to flooding. For example, the City has adopted floodplain management regulations with the purpose of "promoting the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas." The City applies a Floodplain District designation to all areas identified as flood channels and floodplains on maps published by FEMA, the Federal Insurance Administration, and flood insurance rate maps designating the floodplain areas. Any development within this zone is required to incorporate a series of improvements or modifications to ensure the ability of structures to withstand periodic flooding.

Figure 11 shows the 100-year (1-percent annual chance of flooding) and 500-year flood hazard zones (0.2-percent annual chance of flooding) as identified by FEMA.

Figure 11. FEMA Flood Hazard Zones in Irvine



Source: CalFire 2023; Orange County 2023; City of Irvine 2023

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Figure 11

FEMA Flood Hazard Zones in Irvine

DAM INUNDATION

Dam failure can result from several causes such as earthquakes, rapidly rising floodwaters, and structural design flaws. These hazards can occur instantaneously or gradually depending on the source of the failure. Inundation associated with these events has 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.

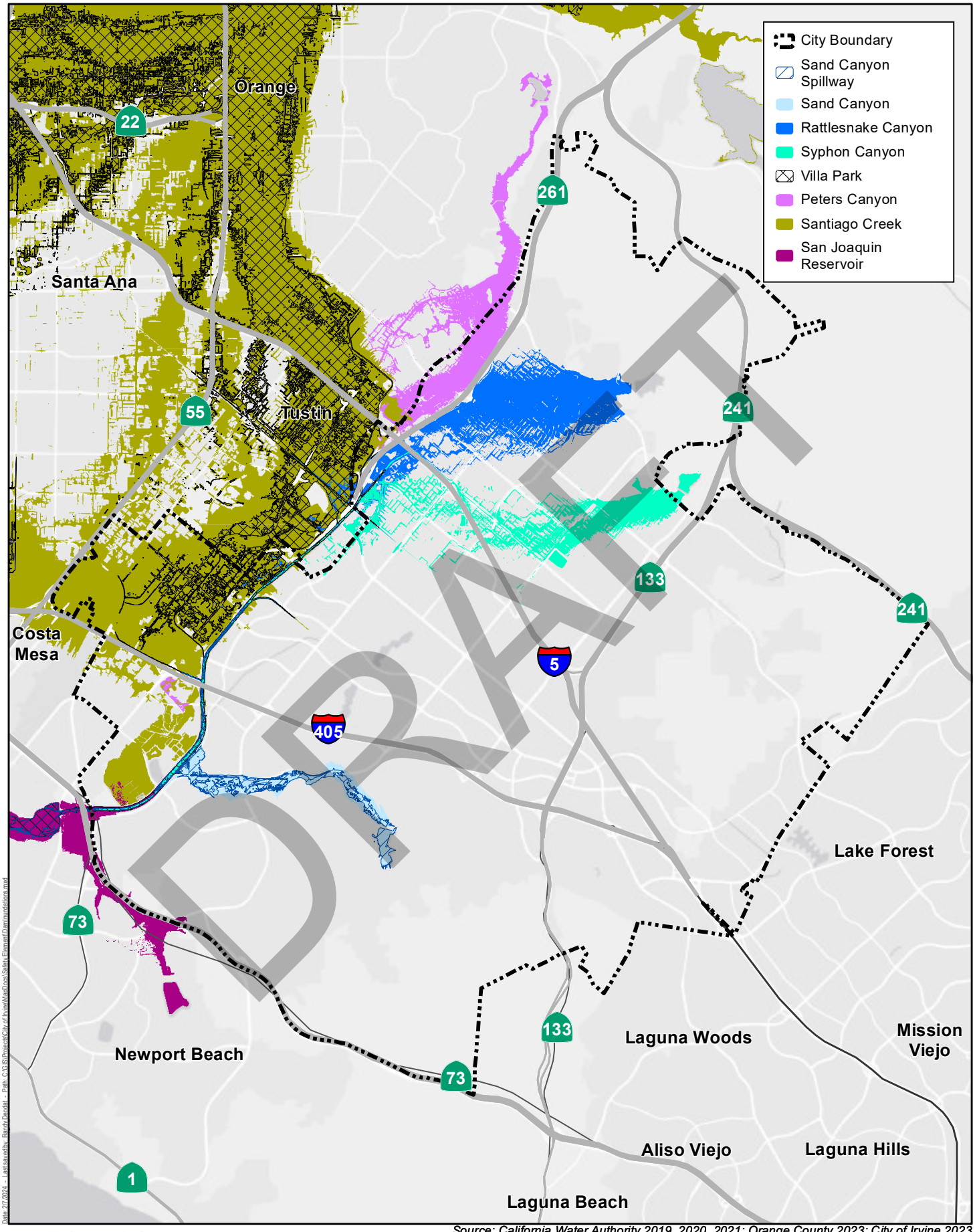
There are seven dams that have the potential to inundate areas of the City if failure were to occur. Of these dams, three of them are located within Irvine and four are located outside of the City limits.

Table 1. Dams with Potential to Inundate Areas of Irvine

Dam Name	Owner/Operator	Year Built	Volume Water Impounded (acre-feet)
Rattlesnake Canyon Reservoir	Irvine Ranch Water District	1959	1,480
Sand Canyon Reservoir	Irvine Ranch Water District	1912	768
Syphon Canyon Reservoir	Irvine Ranch Water District	1966	535
Peters Canyon Reservoir	County of Orange	1932	626
Santiago Dam	Irvine Ranch Water District and Serrano Water District	1931	25,000
San Joaquin Reservoir	Irvine Ranch Water District	1966	>3,000
Villa Park Dam	Orange County Flood Control District	1963	>15,000

Figure 12 below identifies the potential dam inundation areas in and adjacent to 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 (Figure 12).

Figure 12. Dam Inundation Areas in Irvine



Source: California Water Authority 2019, 2020, 2021; Orange County 2023; City of Irvine 2023

IRVINE 2045 GENERAL PLAN

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Figure 12

Dam Inundation Areas in Irvine

SEA LEVEL RISE

Globally, sea levels are rising because of two factors caused by human-induced climate change. The first factor is the thermal expansion of the oceans. As ocean temperatures warm, the water in the ocean expands and occupies more volume, resulting in a rise in sea levels. The second factor contributing to global sea level rise is the additional volume of water added to the oceans from the melting of mountain glaciers and ice sheets on land. It is predicted that if all the ice on earth were to melt, ocean levels would rise by approximately 225-265 feet above present-day levels (USGS 2022). The rate at which sea levels will rise is largely dependent on the feedback loop between the melting of the ice, which changes the land cover from a reflective ice surface, and the open ocean water, which absorbs more of the sun's energy and increases the rate of ice melt.

Areas of Concentration

INLAND FLOODING

Any physical assets located within the mapped flood zone boundaries can expect to be inundated if precipitation exceeds 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 13 identifies the physical assets in Irvine located within the 100-year and 500-year flood zones. Assets within the 100-year flood zone include 55 bridges and 3 recreation support facilities within the City. Assets located within the 500-year flood zone account for 6 critical facilities (including 4 bridges) and 2 recreation support facilities within the City.

The threat of a flood primarily affects those residents living within the 100-year and 500-year flood zones. Many of these zones are located along drainages within the City. Flooding could inundate curb cuts as well as sidewalks. Any people in Irvine who walk, or bike may encounter mobility issues 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. Additionally, persons who are experiencing homelessness may be caught outside during flood conditions without any shelter. 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.

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 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.

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 and a 500-year flood is a flood that has a 1 in 500 (0.2 percent) chance of occurring in any given year. Portions of the City are located within the 100-year flood zone and the 500-year flood zone. The 100-year and 500-year floodplains in

Irvine are not contiguous areas, but rather consist of various pockets across the City, most of which are within major drainages, including San Diego Creek, Serrano Creek, Borrego Canyon Wash, Agua Chinon Wash, Bee Canyon Wash, Peters Canyon Wash, and Sand Canyon Wash. 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. For example, flooding could impact transportation mobility throughout the City if the City's underpasses beneath major freeways and rail lines become flooded. To prevent potential flooding, Irvine has more than a dozen detention or retarding basins, generally located on, or adjacent to, drainages within the City. 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.

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 percent and 0.2 percent, respectively.

Climate change is expected to alter the frequency of intense precipitation events throughout California, including Irvine. Climate models predict that intense rainfall will occur more frequently (perhaps twice as often by the end of the 21st century) and potentially drop more rain (up to 40 percent more). Additionally, the state's streams and rivers will swell more in some years from earlier and faster spring snowmelt caused by higher temperatures. Scientists suggest the combination of these factors could lead to a 50 percent increase in runoff in future years, challenging the capacity of the state's existing reservoirs, canals, levees, and other flood control systems, and increasing the risk of inland flooding. These projected changes likely mean that Irvine will experience more frequent and more intense flooding, potentially leading to erosion, dam failure, landslide, tree mortality, and other potential hazards.

DAM INUNDATION

Various factors, such as the amount of water released, distance from the dam failure site, and the topography of the surrounding land, influence the extent to which physical assets in Irvine are threatened by dam failure. 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, particularly in northern Irvine, if the reservoir waters are released due to a dam breach. Figure 14 shows which critical facilities and facilities of concern would be impacted in each dam failure scenario. Based on this analysis, the greatest number of facilities impacted by dam inundation would occur because of a failure of either Rattlesnake Canyon or Villa Park Dam, both of which could affect 32 facilities within the City.

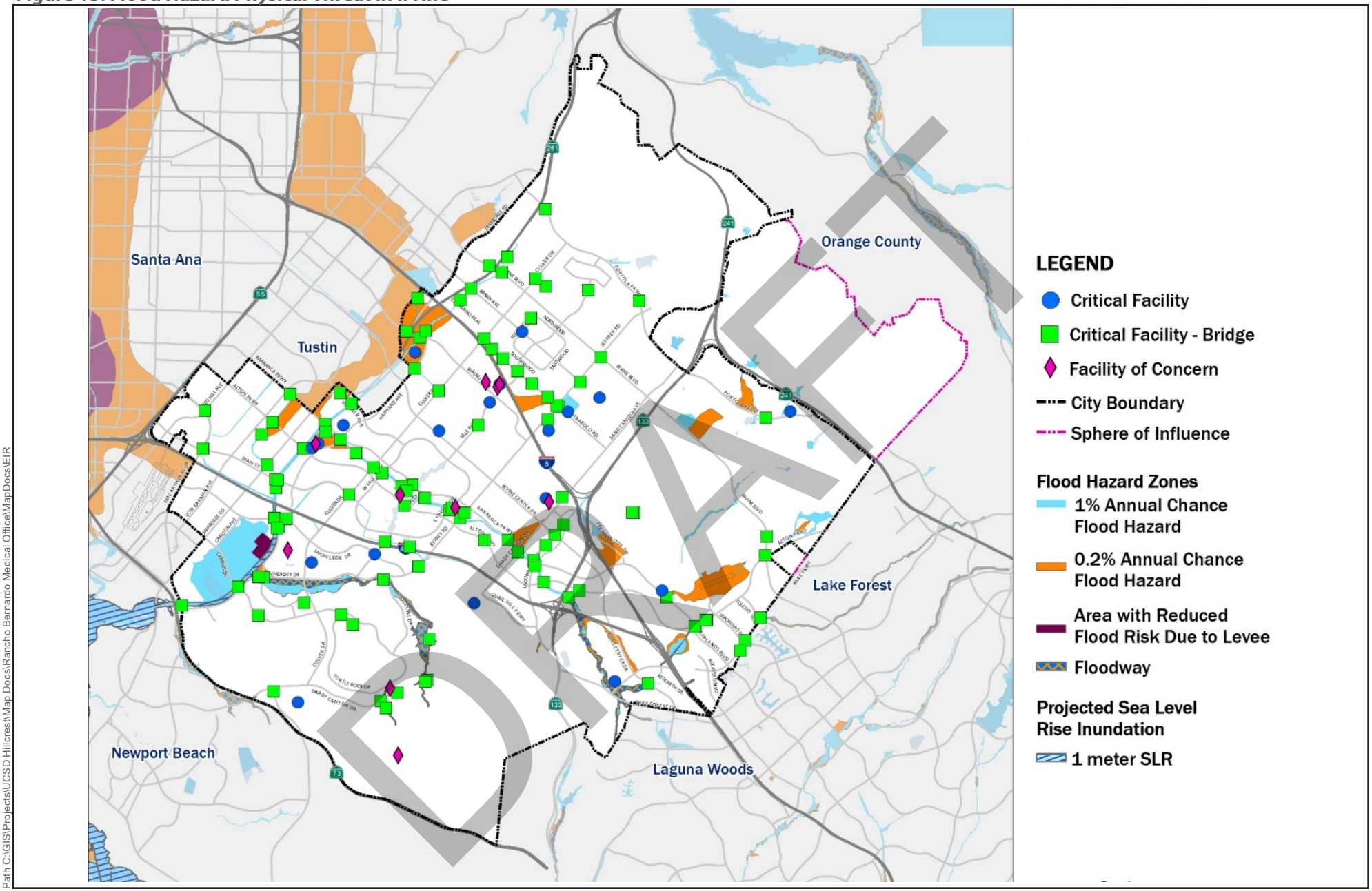
The greatest amount of people would potentially be affected by failure of the Rattlesnake Canyon Dam. Both the Sand Canyon and Villa Park Dams would impact populations that have a lower median household income than the Citywide population. The Sand Canyon dam has the potential to affect a significant number (42.1 percent) of households with one member aged 65+ population. In addition, all dams would impact a higher percentage of populations living with a disability.

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 vulnerable bridges within the City. Street lighting and traffic signals may be temporarily disabled if the inundation area interferes with the electronic systems that control them. Rapid inundation of water may sweep up debris, which could block roads, impeding the flow of traffic. Water would likely inundate roadways and other low-lying, flat areas, such as parking lots, open spaces, and school yards, causing mobility in these areas to 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.

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 Table 1 and Figure 14 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 California Division of Safety of Dams (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 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 13. Flood Hazard Physical Threat in Irvine



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Source: City of Irvine 2020.

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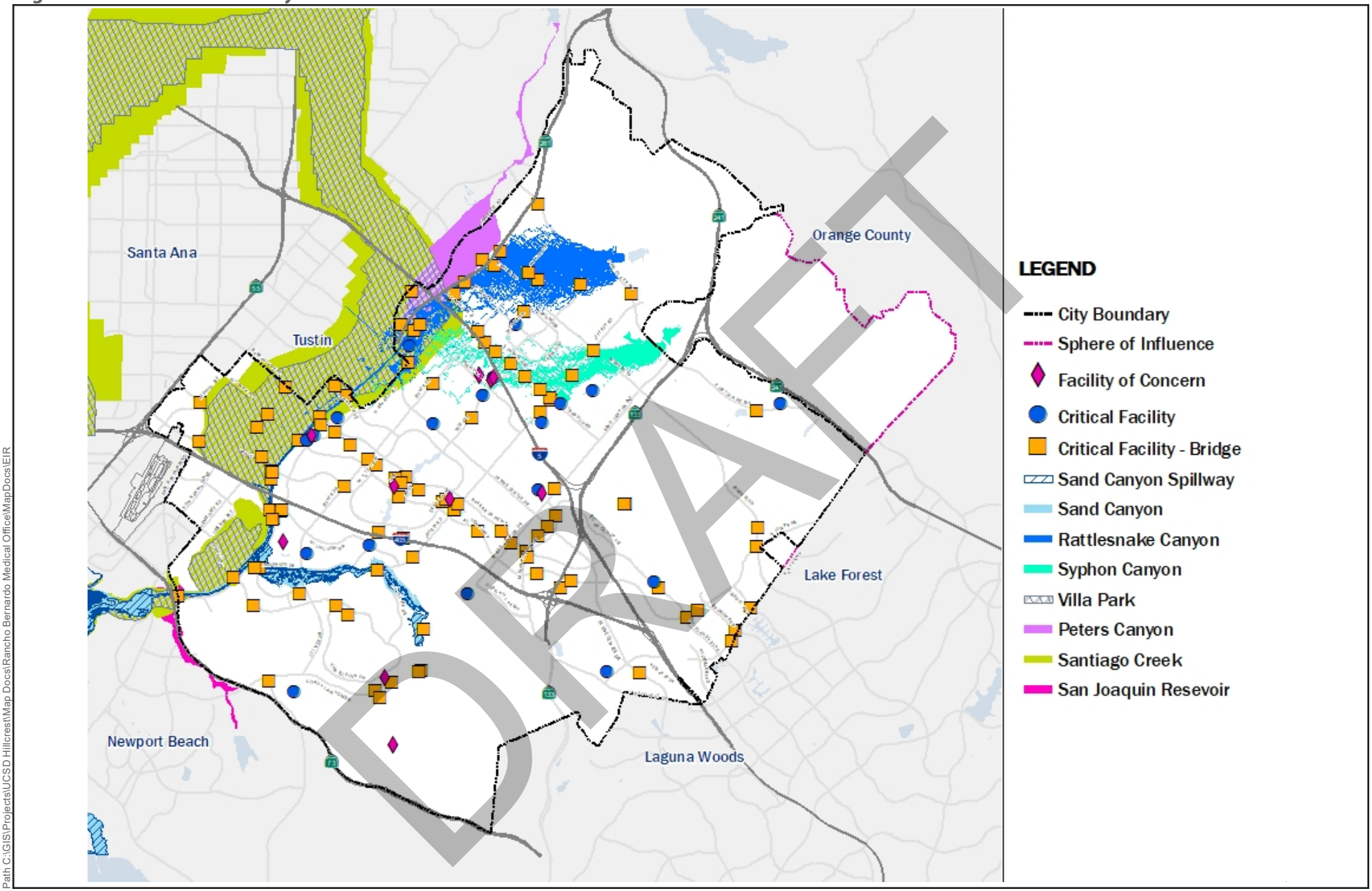
Figure 13

Flood Hazard Physical Threat in Irvine

Figure 14. Dam Inundation Physical Threat in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

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Figure 14

Dam Inundation Physical Threat in Irvine

SEA LEVEL RISE

While Irvine is not considered a coastal community, the City's 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. As an inland community that has coastally influenced drainage infrastructure, the potential influence of sea level rise on flood control infrastructure should be addressed. As identified in the 2020 LHMP, a small portion of the flood control infrastructure in the northwestern corner of the City may be influenced by future sea level rise. Specifically, the USGS Coastal Storm Modeling System (CoSMoS) identifies coastal inundation along San Diego Creek associated with sea level rise and a 100-year storm scenario. However, most of the City would not be affected by this hazard given its inland location. Water pipes, wastewater pipes, and wastewater pump stations have a low- to medium- vulnerability to coastal flooding and high vulnerability to coastal erosion. Therefore, flooding would not have a severe impact on underground pipes or pump stations, but erosion could compromise the functionality of the system.

WILDFIRE

Silverado Fire

Existing Conditions

As previously mentioned, the Orange County Fire Authority provides fire prevention and response services within the City. Wildfires are primarily sparked by lightning, accidents, or arson. 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 of the City's developed area. A majority of these natural, undeveloped areas are classified as Very High Fire Hazard Severity Zones (FHSZ) by the California Department of Forestry and Fire (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 15). The Very High FHSZs delineate the regulatory requirement that triggers compliance with Government Code Section 65302 (g)(3) [also known as SB 1241]. The entire City of Irvine is designated local responsibility area (LRA) – there are no state or federal responsibility areas within the City.

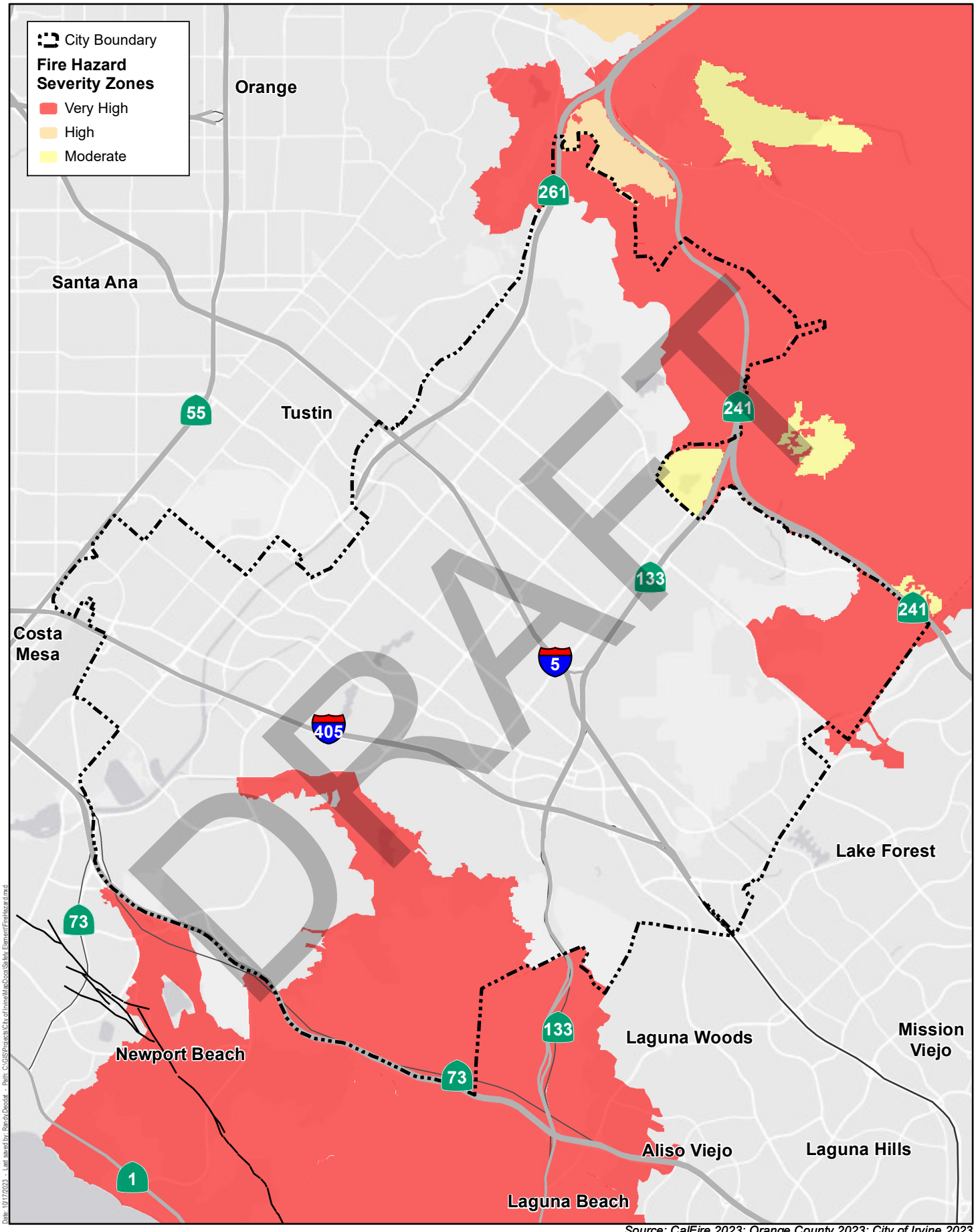
Developed areas of the City adjacent to High or Very High FHSZs are referred to as the Wildland Urban Interface (WUI). Typically, the WUI is impacted if adequate fuels are combined with dry conditions and strong winds. The ignition of a wildfire may occur if power lines located around overgrown trees cause a spark and catch the tree on fire. These types of incidents are the main impetus for the State's Public Safety Power Shutoff (PSPS) program.

Several historical wildfires in the Santa Ana Mountains and San Joaquin Hills have impacted Irvine (Table 2), resulting in evacuations and indirect effects from smoke and traffic congestion.

Table 2. Historic Wildfires in Irvine (1948–2023)

Fire Name	Start Date	Size (acres)
Green River	1948	53,080
Paseo Grande	1967	51,077
Gypsum Fire	October 8, 1982	20,142
Loma Ridge	1984	1,435
Laguna Fire	October 26, 1993	14,338
Baker	October 12, 1997	6,320
Shady Canyon Fire	September 8, 2001	26
Santiago Fire	October 20, 2007	28,430
Fossil Fire	September 14, 2019	16
Silverado	October 25, 2020	12,469
Bond	December 2, 2020	6,681

Figure 15. Fire Hazard Severity Zones in Irvine



Source: CalFire 2023; Orange County 2023; City of Irvine 2023

IRVINE 2045 GENERAL PLAN

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Figure 15
Fire Hazard Severity Zones in Irvine

Areas of Concentration

Figure 16 identifies 6 critical facilities and 1 facility of concern within the Very High FHSZ. While these areas have a high degree of vulnerability to wildfire, other areas of the City may also be susceptible due to ember cast.

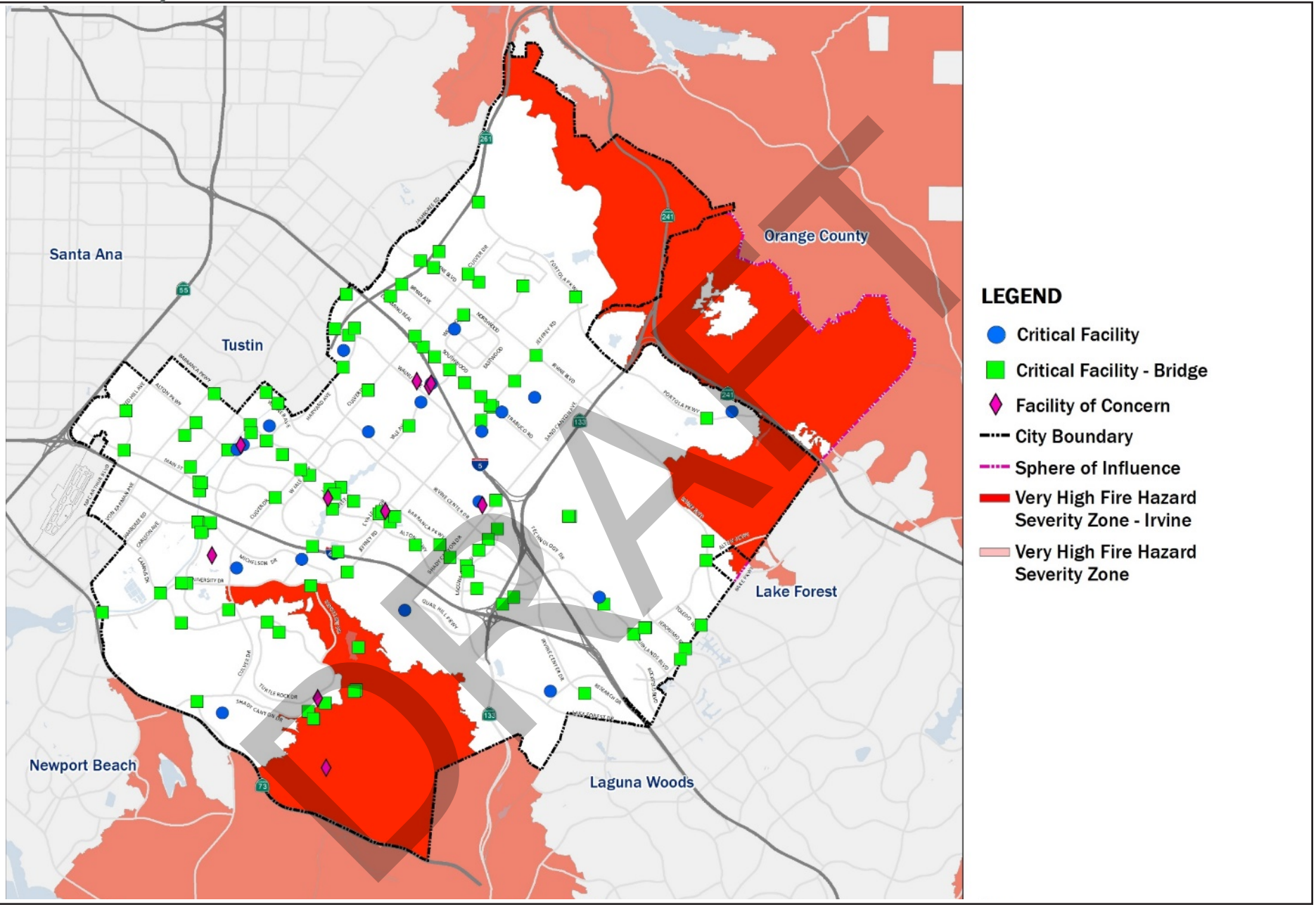
Outside of the property owners directly impacted by a wildfire event, wildfires can also impact seniors and persons with disabilities. These groups may have limited mobility, be immuno-compromised, and/or not receive notifications regarding current conditions and evacuation requirements. For example, 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.

The City of Irvine currently has 11 circuits that could be affected by future PSPS events. 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 future PSPS events is important for community resilience and adaptation.

The history of wildfires in Orange County and the presence of Very High FHSZs 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 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 vegetation 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. Moreover, increases in fuel supplies could cause wildfires to move faster or spread into more-developed areas, which could increase the threat to Irvine.

Figure 16. Fire Hazard Physical Threat in Irvine



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Source: City of Irvine 2020.

IRVINE 2045 GENERAL PLAN

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Figure 16

Fire Hazard Physical Threat in Irvine

DROUGHT

Existing Conditions

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 and snow are limited for an extended period. A drought may also occur when infrastructure connecting communities to long-distance water sources begin to fail. This can occur due to deferred maintenance or may be the result of a natural disaster. Given Irvine's location, any drought that is significant enough to reduce water supply to Southern California may have an impact on the City. The City's water supplies are provided by the Irvine Ranch Water District (IRWD), which has taken significant steps towards reducing water supply scarcity during a drought. Therefore, the City may not feel the effects of drought in the same way other cities in Southern California may experience drought.

Approximately 65 percent of the City's water is sourced from groundwater from OCWD. To supplement this water supply, IRWD also uses imported water from the Metropolitan Water District (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. However, given that most of Irvine's water comes from local groundwater sources, this type of event would have to be exceptional or prolonged for the City and its residents to feel the impact.

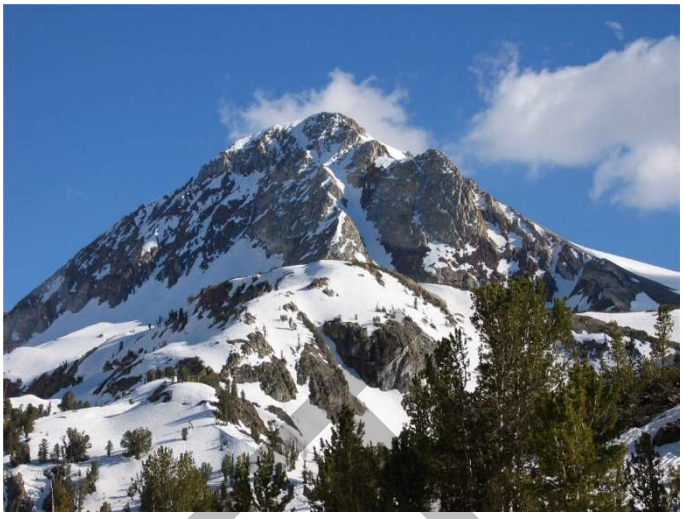
Availability of water resources is important to meet the City's water demand and to provide water for fighting fires. Peak load water supply requirements for the City are consistent with those required by IRWD, as shown in Table 3.

Areas of Concentration

Reduced water supply and availability due to drought is not anticipated to threaten any of the City's physical assets. It is possible that any water delivery infrastructure 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.

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.

An exceptional drought 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 die, which would alter the City's aesthetic appearance. For more specific information on tree health, please refer to the Tree Mortality discussion under Diseases and Pests. Any open spaces with extensive lawns may also start to die, turning brown in color, which could discourage residents from using these parks and open spaces.



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.

Climate change is anticipated to abate drought in certain situations but could also intensify and exacerbate it in other cases. For example, climate change-intensified weather patterns, like the El Niño (warm and wet) phase of the El Niño Southern Oscillation (ENSO), may bring more rain to Southern California and Irvine, which would abate drought conditions. In other years, climate change may prolong the La Niña (cold and dry) 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 City's 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 (refer to *Geologic Hazards* above).

SEVERE WEATHER

Severe weather includes extreme heat, extreme precipitation, and severe wind.

Existing Conditions

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:

- 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. The minimum threshold for an extreme heat day in Irvine is 93.2 degrees Fahrenheit (°F).
- Warm Nights: a day between April and October when the minimum temperature exceeds 98 percent of all historic minimum daytime temperatures observed between 1961 to 1990. The minimum threshold for a warm night in Irvine is 66.4°F.
- 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.

Source: City of Irvine, https://www.cityofirvine.org/community-development/hvac

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.

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.

EXTREME PRECIPITATION

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 (*refer to Flooding above*). In California, heavy rainfall events are often short, intense bursts of rain, but in some cases heavy rain can persist for multiple days.

SEVERE WIND

Wind is 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. 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. Irvine is often affected by Santa Ana winds blowing through the Santa Ana Mountain range.

When winds are fast enough, they can carry particulate matter and aggravate the respiratory health of those who have allergies. High winds 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. Additionally, Santa Ana winds are a leading cause of wildfires in California (refer to *Wildfire* above).

Areas of Concentration

EXTREME HEAT

Very high temperatures can cause roads to deform and buckle as concrete expands in the heat, especially in 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.

A heat event can be relatively harmless for those with a reliable means for staying hydrated and cool and 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. 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 PSPS events, during which extreme heat impacts may affect larger portions of the City and populations that wouldn't be viewed as vulnerable under normal circumstances. Extreme heat events occur in Irvine a few times each year. It is considered highly likely for extreme heat events to occur and to increase in the future.

The primary effect of climate change is warmer average temperatures. 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 in 2040 but could increase to as many as 86 if emissions continue to rise until 2100.

EXTREME PRECIPITATION

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.

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. Flash flooding during a heavy rain event 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.

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, the probability they will occur again in the future is highly likely and anticipated to increase in the future.

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 and less frequent. 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

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 PSPS activities. During high wind events, these shutoffs may impact structures that rely on electricity for normal operations.

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.

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.

It is anticipated that the atmospheric rivers that deliver storms to Southern California may intensify because 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. 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.

DISEASES AND PESTS

The discussion of diseases and pests includes epidemic/pandemic/vector-borne diseases, agricultural pests, and tree mortality. The discussion of diseases and pests includes epidemic/pandemic/vector-borne diseases, agricultural pests, and tree mortality.

Existing Conditions

A disease is a serious type of illness that affects an organism (e.g., trees, the human body) to the degree that normal activities can become more hampered, difficult, or even impaired.

Pests are organisms whose presence is generally considered a nuisance due to the public health and property damage they can cause. 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 utility infrastructure, trees, or other landscaped areas, either by directly consuming the plant material or spreading infectious diseases.

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

- Influenza (the flu)
- COVID-19
- West Nile Virus
- Zika Virus
- Mosquitoes, mice, rats, and small rodents

The Orange County Health Care Agency is the regional health jurisdiction providing preventative and responsive health care services for Orange County, including the City of Irvine.

AGRICULTURAL PESTS

In areas where agricultural production occurs, the presence of pests can impact the quality and quantity of products harvested. Orange County has over 19,000 acres of land under agricultural production. Within Irvine, approximately 1,323 acres of land are designated for agricultural use, which is scattered throughout the City. Agricultural pest damage is typically measured in the amount of crop loss caused by the pest.

TREE MORTALITY

The entirety of a city's trees is generally referred to as an urban forest. These trees may be publicly owned and maintained or privately owned. Urban forests represent important assets for a city as they provide shade, which helps keep the community cool during hot weather, as well as provide aesthetic beauty to a community. Trees are also 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. Like other living beings, trees are also subject to vector-borne diseases spread by pests.

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

- Asian Citrus Psyllid (ACP)
- Gold Spotted Oak Borer (GSOB)
- Invasive Shot Hole Borer (ISHB)

The City follows the UC Integrated Pest Management guidelines for shot hole boring pests.

Areas of Concentration

EPIDEMIC/PANDEMIC/VECTOR-BORNE DISEASE

To some degree, diseases affect everyone in Irvine, whether the impact is a mild inconvenience or more severe. Generally, 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 are especially threatened by the Zika virus since it may cause their infants to be born with microcephaly, which is shown to cause health problems for infants.

Since diseases only affect the human body, an epidemic, pandemic, or vector borne disease would not directly threaten physical assets in Irvine. However, 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 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.

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. In Irvine specifically, there are two large hospitals (i.e., Kaiser Permanente Orange County – Irvine Medical Center and Hoag Hospital) serving high populations of individuals with infectious diseases. In addition, large commercial and employment areas, like the Irvine Spectrum, Irvine Business Complex, and University of California (UC) Irvine, are highly trafficked by many 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. Any pools or other bodies of standing water in Irvine likely pose an increased risk of being bitten by a mosquito and infected by a mosquito-borne disease to anyone who regularly spends time near these locations.

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.

AGRICULTURAL PESTS

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 (ACP; which can infect citrus trees with a bacteria that causes a serious plant disease called Huang Long Bing [HLB]).

Source: California Department of Water Resources, https://water.ca.gov/Water-Basics/Agriculture

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, businesses, or critical facilities significantly.

It is anticipated that agricultural 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.

Agricultural pests may cause significant issues in conjunction with particular climate 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.

TREE MORTALITY

The City of Irvine Public Works Landscape Maintenance Division maintains over 76,000 trees across 1,700 acres of parks, greenbelts, and street landscapes in the City. Any tree has the potential to be infested by pests which could result in the tree's death. A serious outbreak of pests in Irvine could threaten the City's urban forest, leading to an episode of intense tree mortality throughout all areas of Irvine that are landscaped with trees. These areas include parks, landscaped parkways, and street medians, schools, as well as private homes or businesses.

Based on the City's current inventory of trees, the City estimates the value of their tree assets at approximately $181 million. Part of the tree inventory process is the identification of impacted trees that require monitoring and/or removal. 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.

Trees could also die because of other hazards or multiple hazards could combine to cause tree mortality. Additionally, 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.

Source: City of Irvine, https://www.cityofirvine.org/great-park/great-park-trails

Given the aesthetic beauty that healthy trees add to homes and businesses, Irvine residents who experience tree mortality on their property may be potentially threatened by decreased property values. 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.

Urban forestry has been demonstrated to increase mental health and reduce levels of depression and anxiety among residents. 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.

AIRPORT HAZARDS

Existing Conditions

An aircraft *accident* refers to an occurrence associated with the operation of an airborne vehicle, such as an airplane, helicopter, or airship, 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 aircraft *incident* is an occurrence – other than an accident– associated with the operation of an aircraft that affects or could affect the safety of operations. Accidents or incidents could be the result of human error, inclement weather, deferred maintenance, design flaw, equipment failure, or, in a worst-case scenario, a collision.

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 outlines airports near Irvine and includes their distance from Irvine's City Center:

- John Wayne Airport/Santa Ana 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, the 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 and number of flights is anticipated to be lower than other adjacent airports, such as the John Wayne Airport.

The John Wayne Airport, which borders the City of Irvine to the southwest, has experienced aircraft accidents and incidents in the past. According to the National Transportation Safety Board, there were 62 accidents and 6 incidents reported at John Wayne Airport over a 36-year period (between 1982 and 2018), or an average of 2 aircraft accidents/incidents per year. Over this period, less than 10 percent of individuals involved in an aircraft accident suffered an injury.

Areas of Concentration

The risk associated with aircraft incidents is similar to other parts of Orange County and Southern California. Any structures located within the Airport Environs Land Use Plan planning boundary for John Wayne Airport are at an elevated risk to aircraft incidents, predominantly associated with landing, take off, and approach activities. Beyond this planning boundary, the risk associated with aircraft incidents is limited to flyover activities above the City. These incidents have the potential to send the bodies of the aircraft or falling debris crashing down, which could damage any structures or physical assets lying below.

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. The intensity recommendations and development standards identified in the Airport Environs Land Use Plan for John Wayne Airport for developments within the planning boundary help to ensure the density of people and height of buildings within these areas is designed to reduce unnecessary exposure to these hazards. Nevertheless, given the potential for falling debris, all persons in Irvine may be threatened by an aircraft incident. If future events occur in Irvine, it is assumed that lower-income persons may not be able to recover as easily (e.g., afford repairing the damage to their homes, purchasing new automobiles to replace any destroyed, etc.).

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, resulting in partial or complete outages of utilities services to the sections of the City. 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. Areas of the City affected by the crash may be closed until authorities deem it safe for employees to return, resulting in loss of economic activity in the City.

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. Implementation of the Airport Environs Land Use Plan for John Wayne Airport can reduce aircraft hazards. This plan identifies the height restrictions and safety zones that require land use restrictions to minimize potential impacts associated with aircraft incidents. 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.

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.

Emergency Evacuation Route Analysis

A variety of hazard scenarios could require an evacuation in parts of Irvine. These emergency situations could be caused by either natural or human-made events, such as wildfires, floods, or earthquake. An Emergency Evacuation Route Analysis (Appendix B) was prepared to identify evacuation capacity and network connectivity in Irvine in addition to meeting the requirements associated with the following legislative updates:

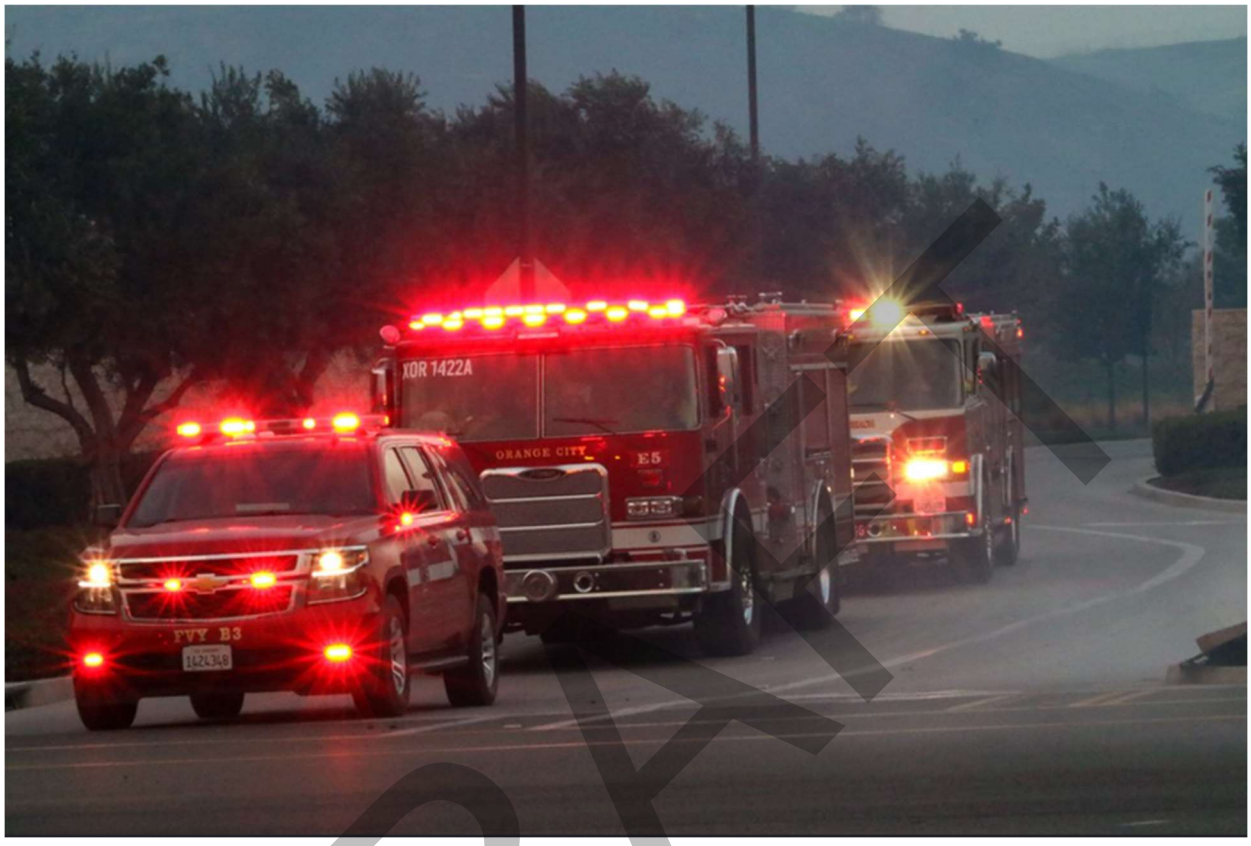
- **AB 747** (2019) requires the City to update the Safety Element of its General Plan to identify evacuation routes and assess the capacity, safety, and viability of those routes under a range of emergency scenarios.
- **SB 99** (2019) requires the City to identify residential developments in hazard areas that do not have at least two emergency evacuation routes (i.e., neighborhoods or households within a hazard area that have limited accessibility).
- **AB 1409** (2021) requires the City to identify evacuation locations.

The Emergency Evacuation Route Analysis supporting this Safety Element utilizes updated data from the City's interactive web map of evacuation management zones (EMZs) and evacuation routes, consistent with evacuation routes identified in the City's LHMP. Evacuation route viability is largely determined by the location of the hazard. Because Irvine is surrounded by Very High FHSZs to the south, northeast, east, and north/northwest, the City considered the following four wildfire scenarios:1) a fire originating in the south, (2) a fire originating in the northeast, (3) a fire originating in the east, and (4) a fire originating in the northwest). Evacuation route viability is also assessed for flood hazards due to the presence of flood zones and landslide susceptibility areas in Irvine. Residential parcels lacking at least two points of egress were also identified in the Emergency Evacuation Route Analysis to further identify potential vulnerabilities in Irvine. The results of the analysis indicate that residents closest to the southern, northern, and eastern extents of the City are most vulnerable given the distance and number of roads needed to traverse to access an outbound road (Appendix B):

- **Wildfire (originating in the area south of the City):** The residential parcels in the southern region of the City are the most vulnerable in the event of a wildfire from the south; however, these residents have more than two viable evacuation routes in this scenario.
- **Wildfire (originating in the area northeast of the City):** The residential parcels in the northern and eastern regions of the City are the most vulnerable in the event of a wildfire from the northeast; however, these residents have more than two viable evacuation routes in this scenario.
- **Wildfire (originating in the area east of the City):** The residential parcels in the northern and eastern regions of the City are the most vulnerable in the event of a wildfire from the east; however, these residents have more than two viable evacuation routes in this scenario.
- **Wildfire (originating in the area northwest of the City):** The residential parcels in the northern region of the City are the most vulnerable in the event of a wildfire from the northwest; however, these residents have more than two viable evacuation routes in this scenario.
- **Flood (extreme precipitation):** Under the flood hazard scenario, which conservatively assumes all roadways within a FEMA flood hazard zone are not viable, the residential parcels in the southern region of Irvine have only one viable evacuation route (Sunnyhill Road to Turtle Rock Drive) given that Shady Canyon Drive would be inundated to the west and east of Copper Creek (road).
- **Landslide:** The residential parcels in the northernmost, eastern, and southernmost extents of the City are the most vulnerable in the event of a landslide; however, these residents have more than two viable evacuation routes in this scenario.

Evacuation locations for Irvine residents would be dependent on the type and location of hazardous event affecting Irvine and would be determined by the City's Emergency Operations Center and first responders on site during emergency situations. For example, if a wildfire occurs northeast of Irvine, residents would be directed to evacuate to community centers and City buildings in the southern and western portions of Irvine, such as the City of Irvine Civic Center or to areas west of the City, such as Huntington Beach and Long Beach. Evacuation locations would consist of places in Irvine that residents are familiar with, such as parks, community centers, schools, libraries, City department buildings, or churches.

GOALS, OBJECTIVES, POLICIES, AND IMPLEMENTATION MEASURES



Certain natural conditions and human activities in Irvine create risks to individuals and properties within the community. Unreasonable risk from such hazards can be reduced or avoided through implementation of the Safety Element. In consideration of these efforts, the City has identified the following issues for consideration:

- How can the City reduce the risk to life and property associated with aircraft operations adjacent to the City?
- How can the City reduce the probability of fire, non-seismic geologic, flood, and air operation hazards?
- What actions can the City take to reduce the severity of hazards (i.e., reducing the loss of life and personal property) when natural disasters occur?

The Objectives and Policies within this Element reflect the community's intent to provide and foster a safe community for all its residents, that include:

- Protect and prepare the community for natural and human-caused hazards.
- Improve the community's resilience to seismic and geologic hazards by ensuring the integrity of the built environment.
- Anticipate the risks and mitigate the effects that flood hazards pose to the community.
- Safeguard the community from the threat of urban and wildfire hazards.
- Protect the community from the threat of drought and extreme heat.
- Protect the community from hazards related to diseases and pests.
- Protect and improve resilience of the community from the effects of climate change.

The objectives are overall statements of the City's goals and consist of broad statements of purpose and direction pertaining to the community's safety. The policies serve as guidelines for reducing the risk and vulnerability associated with natural and human activity hazards and directs and maximizes community emergency preparedness.

The City's LHMP includes hazard mitigation actions related to natural and human-caused, seismic, geologic, flood, and urban and wildfire hazards, as well as risks related to drought and extreme heat, diseases and pests, and climate change. These hazard mitigation actions meet the requirements of Government Code Section 65302.15 and are incorporated by reference into the Safety Element.

In addition, the Safety Element has formulated the following goals, objectives, policies, and actions to respond to these safety issues. The policies were developed to support the goals and are identified by lettering (e.g., Policy J-1[a]). The implementation actions were developed to support goals and policies and are identified numerically.

Goal 1: Protect and prepare the community for natural and human-caused hazards.

Objective S-1: Hazard Preparedness and Occurrence

Policies:

Policy (a): Expand participation in the Irvine Community Emergency Response Team (CERT) program for residents and businesses, including offering training in a variety of languages.

Policy (b): Coordinate with Caltrans and Orange County Transit Authority for inspection and maintenance of primary evacuation routes.

Policy (c): Coordinate with regional transit providers to identify alternative routes, stops, and modes of transit if normal infrastructure is damaged or closed as a result of extreme events.

Policy (d): Encourage collaboration with local and regional partners to support business resiliency through preparedness education, trainings, and resources.

Policy (e): Update the City's Local Hazard Mitigation Plan every five years, to ensure consistency and relevancy of hazards and issues within the City, and to maintain consistency with State and/or federal legislation.

Policy (f): Update the Irvine Power Outage Response Plan (annex to the Emergency Operations Plan) to identify back-up energy technologies that are more resilient to climate impacts and communications locations for critical facilities, critical infrastructure (e.g., traffic signals), sensitive uses, and community lifelines (including water, sewer, telecommunications).

Policy (g): Continuously update response procedures for first responder departments to properly address new hazard events as they emerge.

Policy (h): Encourage community members to sign-up for disaster alerts.

Policy (i): Identify opportunities to expand access to emergency and evacuation notices via multiple sources, including voice, text, siren, radio, and outdoor broadcasts.

Policy (j): Increase understanding of all energy storage technologies including critical features such as storage capacity, efficiency, duration of power, lifestyle impacts, and realistic function to provide long-term, reliable sources of power during grid outages.

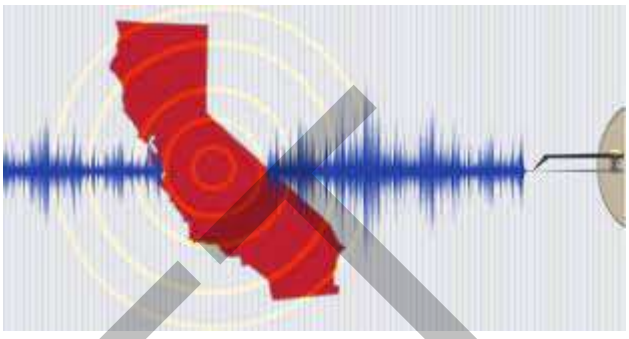
IMPLEMENTATION MEASURES:

- Develop and maintain detailed City department and agency-specific checklists and standard operation procedures (SOP) to support Irvine Emergency Operations Plan implementation.
- Identify and maintain at least one emergency power-generating station (with priority for solar and battery back-up power) 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.
- Conduct regular emergency preparedness drills and training exercises for City staff.
- Work with local school districts to ensure that school facilities can act as evacuation sites during major emergencies.
- Ensure that community evacuation plans include provisions for community members who do not have access to private vehicles or are otherwise unable to drive.
- Educate City staff, residents, and businesses regarding appropriate actions to safeguard life and property before, during, and immediately following emergencies.
- Ensure residents are notified through public service announcements or reverse 911 calls in advance of severe weather (e.g., extreme heat) events and natural disasters. 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.
- Continue to ensure that emergency management activities are conducted equitably and are responsive to the needs of all community members, primarily by communicating emergency plans in many different formats and in multiple languages. Ensure that information is accessible to persons with disabilities and functional needs.
- Educate all community members about evacuation protocols, maps, and procedures for emergency preparedness and evacuation.

Goal 2: Improve the community's resilience to seismic and geologic hazards by ensuring the integrity of the built environment.

Objective S-2: Seismic and Geologic Hazards

Policies



Policy (a): Coordinate with Irvine Ranch Water District and Orange County Water District on emergency water storage and distribution following a liquefaction or landslide event.

Policy (b): Coordinate groundwater management with Orange County Water District to avoid subsidence impacts in Irvine.

Policy (c): Promote the strengthening of planned utilities, the retrofit and rehabilitation of existing weak structures and lifeline utilities, and the relocation or strengthening of certain critical facilities to increase public safety and minimize potential damage from seismic and geologic hazards.

Policy (d): Encourage replanting bare or disturbed areas after landslides to reduce erosion.

IMPLEMENTATION MEASURES:

- For projects proposed in areas identified in a geologic hazard area (e.g., liquefaction zone), a geologic/geotechnical consultant shall establish either that unfavorable conditions do not exist in the specific area in question or that they can be mitigated through proper design and construction.
- Educate residents and the business community on how to prepare for, and recover from, a seismic or geologic event.

Goal 3: Anticipate the risks and mitigate the effects that flood hazards pose to the community.

Objective S-3: Flood Hazards

Policies

Policy (a): Work with Orange County Flood Control District to ensure flood control facilities are adequately provided and maintained.

Policy (b): Collaborate with partner agencies and municipalities to align green infrastructure projects (i.e., projects that allow for the filtration of stormwater where it falls) and develop regulations for watersheds across jurisdictions to reduce impervious hard surfaces.

Policy (c): Support efforts of other organizations and academic institutions to conduct studies of the impact combined riverine and coastal flooding, groundwater intrusion, and increased precipitation has on flood risk and vulnerability.

Policy (d): Support efforts of other organizations and academic institutions to inventory and map vegetation on hillsides with a specific focus on improving hillside stability in the case of extreme rainfall and seasonal erosion.

Policy (e): Develop or update a long-term plan to address current and future flood risk to critical facilities.

Policy (f): Continue to partner with Orange County Public Works to proactively disseminate information from the "H2OC Stormwater Program" to educate home and small business owners on regulations and highlight the role that engaged residents can play in assisting with community-based stormwater management.

Policy (g): Ensure resilience and long-term functionality of stormwater and sewer systems.

Policy (h): Encourage the use of climate-smart landscaped surfaces (e.g., permeable pavement, stormwater parks, green streets) in new and existing developments to reduce runoff, minimize flood hazards, and maintain existing drainage ways.

Policy (i): Continue to encourage the implementation of low-impact development (e.g., rain gardens and rainwater harvesting) to reduce flood risk, filter pollutants, and replenish groundwater over time.

Policy (j): Continue to promote the application of nature-based solutions (e.g., greenways, tree trenches) to improve resilience and preserve biodiversity.

Policy (k): Coordinate with other agencies to increase the public awareness of flooding, stormwater management, and drought management issues and techniques for residents to mitigate those challenges on their property.

IMPLEMENTATION MEASURES:

- Update City procedures to encourage climate-smart irrigation and implementation of Low Impact Development (LID) standards for new development to reduce the amount of stormwater runoff.
- Include improvement of drainage ways and flood control facilities in Irvine's Capital Improvements Program to lessen recurrent flood problems.
- Conduct frequent cleanings of storm drain intakes before and during the rainy season.
- Require that future transportation infrastructure projects consider current and future flood risk and align the projected lifespan of the project with best available science.
- Provide residents, businesses, and neighborhood organizations storm evacuation procedures and shelter-in-place guidelines to grow community resilience.
- Provide flood emergency supplies and resources; including, but not limited to, items such as water main repair parts, generators, pumps, sandbags, road clearing, medical, and communication.
- Provide sandbags for residents and businesses, including prefilled sandbags for individuals who may be unable to fill them on their own.
- When constructing new roadways medians, install storm water capture technologies, as feasible.
- When reviewing new development applications, require integration of green infrastructure techniques (i.e., projects that allow for filtration of stormwater where it falls) into site design, as feasible.

Goal 4: Safeguard the community from the threat of urban and wildfire hazards.

Objective S-4: Wildfire Hazards

Policies

Policy (a): Coordinate with regional partners to explore and deploy fire detection cameras as part of a wildfire monitoring network.

Policy (b): Coordinate with surrounding municipalities and Orange County to enhance evacuation and emergency management protocols, agreements, and processes.

Policy (c): Coordinate with City of Irvine and Orange County Fire Authority first responders to create a rapid response plan to secure hospital, nursing, and assisted living facilities, especially those located within fire hazard severity zones.

Policy (d): Work with the Irvine Ranch Water District to ensure the long-term integrity of water supplies for the City.

Policy (e): Continue to work with the Orange County Health Care Agency Department of Public Health and other applicable health care agencies to convey notifications to the public regarding recommendations for outdoor activities, cancelled sporting events, and other recommendations for public health and safety during periods of poor air quality.

Policy (f): Encourage public and private landowners to minimize the risk of wildfire moving from wildland areas to developed properties or from property-to-property by increasing structural hardening measures (e.g., fire-rated roofing and fire-resistant construction materials and techniques), maintaining and improving defensible space on site, and supporting vegetation management in adjacent undeveloped areas.

Policy (g): Encourage existing non-conforming development to update to contemporary fire safe standards (e.g., road standards, vegetative hazards).

Policy (h): Encourage removal of highly flammable vegetation with little to no biological value in Very High, High, and Moderate Fire Hazard Severity Zones and replant with fire-adapted specimens.

Policy (i): Promote the proper maintenance and separation of power lines and efficient response to fallen power lines in accordance with Title 14 CCR Division 1.5 Chapter 7 Article 4 (Fire Prevention Standards for Electric Utilities).

Policy (j): Encourage the use of underground power lines for replacement power lines, where feasible.

Policy (k): Ensure that all new development and redevelopment in the Very High Fire Hazard Severity Zone is developed in compliance with minimum structural fire protection standards in the adopted edition of the California Fire and Building Codes, applicable state or local fire safety and defensible space regulations or standards, and any applicable fire protection or risk reduction measures identified in locally adopted plans.

Policy (l): Ensure future neighborhoods are designed with adequate fire access and evacuation egress in the event of an emergency.

Policy (m): Avoid expanding new residential development, essential public facilities, and critical infrastructure in areas subject to extreme threat or high risk, such as Very High Fire Hazard Severity Zones, or areas classified by the California Department of Forestry and Fire Protection as having an Extreme Threat classification on Fire Threat Maps, unless all feasible risk reduction measures have been incorporated into project designs or conditions of approval. Example risk reduction measures include, but are not limited to, fuel modification zones or defensible space, structure hardening, enclosed foundations, and highly visible street signs and property addresses.

Policy (n): Ensure adequate water supply for fire suppression and ensure that the water supply is protected from wildfire impacts, including providing back-up power, with priority for solar and battery storage back-up supplies.

Policy (o): Ensure future neighborhoods are designed with sufficient water pressure to maintain fire flow.

Policy (p): Encourage the use of underground power lines for new developments.

Policy (q): Ensure that private development subject to the California Environmental Quality Act evaluate hazard impacts to ensure adequate evacuation in the event of an emergency, and if required, develop standards for the protection of the community.

Policy (r): Review development proposals and coordinate with regional transportation agencies to ensure that multiple evacuation routes are available under a range of scenarios and identify alternative routes that are accessible to people without life-supporting resources.

Policy (s): Coordinate with fire protection, emergency service, and water providers to reassess fire hazards and future availability of water supplies after wildfire events to adjust fire prevention and suppression needs, as necessary, for both short- and long-term fire prevention.

Policy (t): Coordinate evaluations for redevelopment of areas that have been burned after a large fire.

Policy (u): Continue the long-term maintenance of fire reduction projects; including but not limited to, a roadside fuel reduction plan, defensible space clearances (including fuel beaks) around structures, subdivisions, and other developments in the Very High Fire Hazard Severity Zone.

Policy (v): Maintain established response time standards for fire and life safety service.

Policy (w): Encourage the continued development, implementation, and public awareness of fire prevention programs.

IMPLEMENTATION MEASURES:

- Increase resilience of existing development in high-risk areas built prior to modern fire safety codes or wildfire hazard mitigation guidance.
- Support state legislation that would provide tax incentives to encourage the repair or demolition of structures that could be considered fire hazards.
- Provide ongoing maintenance of vegetation clearance on public and private roads.
- During the development review process, require vegetation management (including vegetation health) to change fire behavior, increase the success of fire suppression, support defensible space (including ember-resistant zones), incorporate ecological objectives, and consider other hazards, topography, and wildland-urban interface characteristics.
- Require that all signage, including home and street addressing, remain publicly visible.
- Continue to involve the Orange County Fire Authority in the review of development applications to minimize fire hazards. Consideration shall be given to adequate emergency access, driveway widths, turning radii, and fire hydrants.
- Continue to require fire prevention planning and defensible space in all new development within Very High Fire Hazard Severity Zones or wildland-urban interface.
- During the development review process, continue to require that all new development projects have an adequate water supply (e.g., sprinklers, fire hose terminals, and fire suppression systems) to meet the fire protection needs of future occupants.
- Review development proposals and coordinate with regional transportation agencies to ensure that multiple evacuation routes are available under a range of scenarios and identify alternative routes that are accessible to people without life-supporting resources.
- Use and refine hillside weed abatement program using goats or other livestock to reduce fuel loads in fire-prone areas, when feasible.
- 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.
- Following extended drought periods, coordinate with partners to clear dead vegetation in flood control facility footprints, railroad rights-of-way, parks, and open spaces, where feasible.
- Conduct regular emergency preparedness drills and training exercises for City staff.

- Expand participation in the Irvine Community Emergency Response Team (CERT) program for residents and businesses.
- Ensure that the distribution of fire hydrants and capacity of water lines is adequate through periodic review.
- Reinforce and regularly inspect fire retardant infrastructure such as sprinklers, fire hose terminals, and fire suppression systems in City facilities.
- Analyze and assess post-fire impacts to all inventoried cultural and historical resources within the Open Space.
- Expand the fire hazard prevention awareness campaign to residents in the High and Very High Fire Hazard Severity Zones, by providing information regarding defensible space and building retrofits.
- Work with local businesses and organizations to conduct regular workplace emergency preparedness drills.
- Work with Orange County Fire Authority on home and business preparedness assessments to assist residents and businesses in understanding and addressing their wildfire risk through methods, such as maintaining fire retardant landscaping and buffer zones in areas of high wildfire risk. Continue to support annual wildfire readiness campaign.
- Continue to educate the public on the importance of fire safety with information on topics including but not limited to defensible space, evacuation routes, and road clearance, with a focus on reaching at-risk, vulnerable populations.

Goal 5: Protect the community from the threat of drought and extreme heat.

Objective S-5: Drought and Extreme Heat

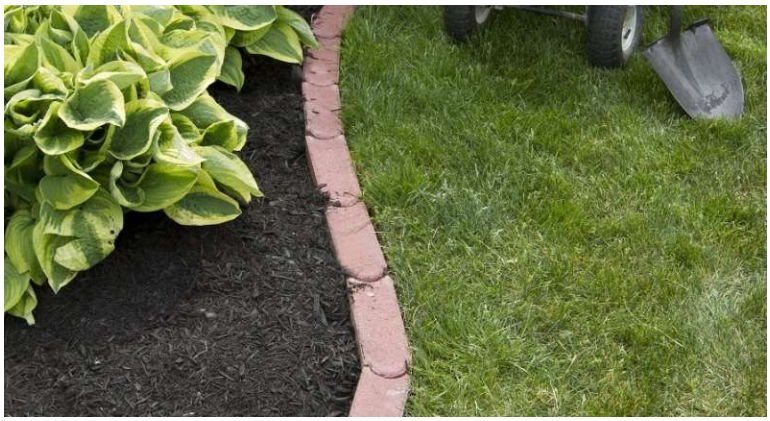
Policies:

Policy (a): Collaborate with federal, State, and local agencies and organizations to explore alternative water sources (e.g., desalinization) and improve capacity in consideration of increased demand and drought.

Policy (b): Continue to support Irvine Ranch Water District's recycled water program and explore opportunities to enhance water recycling.

Policy (c): Continue to support and participate in the development of a regional and local drought contingency plan.

Policy (d): 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.



Policy (e): Explore the feasibility of recycled water distribution for residential uses on all lot sizes.

Policy (f): Protect groundwater supply against contamination, degradation, or loss due to flooding.

Policy (g): Promote a system for rapidly detecting, reporting, and repairing water leaks in public facilities and the water conveyance system.

Policy (h): Promote nature-based methods and best management practices (BMPs) (e.g., bioswales, rain gardens, natural ground cover) through the City's stormwater program to promote groundwater infiltration and reduce the impacts of drought.

Policy (i): Support regional partners in education and outreach efforts focused on water conservation measures (e.g., water reuse, water use, and irrigation efficiency) for City residents.

Policy (j): Collaborate with State and regional agencies and organizations to share best practices for addressing heat impacts.

Policy (k): Explore mechanisms to improve the energy reliability of municipal facilities to withstand increased energy demands.

Policy (l): Ensure adequate power availability during peak demand (e.g., extreme heat events).

Policy (m): Ensure vulnerable community members and their caregivers (e.g., aging, elderly, ill) have information on how to detect signs and symptoms of and prevent heat-related illness.

Policy (n): Promote adequate protection for outdoor workers and people experiencing homelessness from extreme conditions.

IMPLEMENTATION MEASURES:

- Continue to implement the City of Irvine's Model Water Efficient Landscape Ordinance for private and public projects.
- Limit non-drought-tolerant landscaping to recreational fields and in instances where no feasible drought-tolerant alternatives exist.
- Require native, fire-resistant landscaping for public properties, parks, yards, and grounds.
- During the development review process, encourage the installation of dual plumbing and high-efficiency appliances, developing a program to repair leaks, landscaping with native and drought-tolerant plant species, and using recycled water to irrigate plants, to reduce indoor and outdoor potable water use in new and existing public and private developments.
- Explore programs to expand access to limited water resources for at-risk, vulnerable populations (e.g., people experiencing homelessness).
- Update the City's stormwater program to promote groundwater infiltration and reduce the impacts of drought by encouraging nature-based methods and best management practices (BMPs) (e.g., bioswales, rain gardens, natural ground cover) in City and private development projects.
- Provide information to the community on water efficiency and conservation efforts.
- Work with regional and local health agencies to evaluate extreme heat warning thresholds and protocols and incorporate enhanced extreme heat preparedness into local operations.
- Work with energy providers to assess grid vulnerabilities related to extreme heat-caused power outages and mitigation plans to address. This could take the form of microgrids and battery storage, renewable natural gas, or hydrogen fuel cell backup generators for critical buildings, sensitive uses, and sensitive populations.
- Provide working water refill stations at public facilities, parks, and bus shelters.
- Explore potential City-owned locations for cooling centers for use during extreme heat events. Cooling centers should be air-conditioned, accessible to all members of the public, compliant with the American

Disabilities Act, have access to restrooms and water, have available seating for all guests, be close to public transportation routes, and include battery storage back-up.

- Ensure cooling centers are resilient to climate hazard events (e.g., supply cooling centers with refrigerators for storing medicine, backup water supplies, and social services information in multiple languages).
- Provide incentives and/or programs for important service facilities to assess power needs, ensure adequate backup generation capacity (that considers climate projections during extreme heat days), and install off-grid distributed alternative energy systems with islanding capabilities. Priority should be given to solar and battery storage back-up.
- Continue expedited review of building permits for solar equipment and electric vehicle charging stations.
- Continue to monitor, assess, and repair City roadways and bridges that may be impacted by extreme heat and other extreme weather events.
- Update education and communication to encourage the conservation of energy during peak demand hours.
- Ensure vulnerable community members and their caregivers (e.g., aging, elderly, ill) have information on how to detect signs and symptoms of and prevent heat-related illness. Coordinate with the Community Services Department and public health organizations to encourage a public outreach campaign regarding medical assistance needed for heat-related illness.
- Coordinate with community-based organizations to ensure public awareness of available emergency shelters and cooling centers during climate events, such as extreme heat events, poor air quality, severe weather events, and other highly hazardous conditions.

Goal 6: Protect the community from hazards related to diseases and pests.

Objective S-6: Diseases and Pests

Policies:

Policy (a): 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 ensure community members have information about current public health trends or issues, free and low-cost healthcare options, treatments, and where to find local healthcare facilities.

Policy (b): Coordinate with the Orange County Mosquito and Vector Control District to ensure community members have information on best practices for mosquito-proofing homes and businesses and how to avoid mosquito bites.

IMPLEMENTATION MEASURES:

- Update education and communication and continue to work with residents, business owners, and utilities to remove dead, dying, and diseased trees weakened by disease/pests.

- Update education and communication on best practices for vector control.

Goal 7: Improve the community's resiliency to climate change-related hazards by incorporating the best available science into community planning.

Objective S-7: Climate Change Resiliency and Adaptation

Policies:

Policy (a): Coordinate with transportation agencies to identify local and regional transportation corridors that are at risk from climate change effects while using the best available science and resilient design features to improve resiliency to extreme climate events.

Policy (b): Encourage the consideration of climate projections and the impacts associated with them in City planning documents, policies, programs, and ordinances as they are reviewed or updated.

Policy (c): Encourage regional utility providers to enhance the preparedness, protection, and resilience of water, energy, and telecommunications infrastructure.

Policy (d): Encourage multimodal and local access upgrades to improve capacity and the resilience of the transportation network.

Policy (e): Continue to encourage public outreach campaigns for climate awareness to help community members understand potential risks, solutions, and opportunities to address climate impacts.

Policy (f): Continue coordination with important community assets (e.g., schools, and businesses) to ensure community members understand and plan for extreme weather events and emergencies.

Policy (g): Support climate adaptation and resilience-related community groups to increase their engagement in climate change adaptation-related activities.

IMPLEMENTATION MEASURES:

- Collaborate with local, regional, state, and federal partners to provide community-wide outreach to educate people on how to prepare for and recover from climate change effects.
- Integrate findings of climate vulnerability into emergency planning, including mitigation, preparedness, response, and recovery efforts.
- Investigate the use of monitoring and metrics that evaluate the efficacy of the climate change resilience actions identified in the Climate Vulnerability Assessment.
- Support community organizations as they identify gaps in vulnerable community resilience planning and provide outreach to vulnerable populations.
- Investigate financing and funding opportunities to fund short- and long-term climate adaptation projects. Continue to prepare the appropriate planning documents to leverage FEMA mitigation funding.
- Consider projects that reduce the exposure of persons experiencing homelessness to safety and health impacts from climate hazards.
- Develop plans and protocols to provide adequate access and function for people with disabilities.

RESOURCES:

- 2020 City of Irvine Local Hazard Mitigation Plan (certified December 17, 2020)
- City of Irvine Emergency Operations Plan (September 2022)

APPENDICES:

- Draft City of Irvine Climate Vulnerability Assessment and Adaptation Framework (February 2023)
- Draft Emergency Evacuation Route Analysis (March 2024)