SEISMIC AND PUBLIC SAFETY ELEMENT

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I. INTRODUCTION

PURPOSE, SCOPE, AND CONTENT

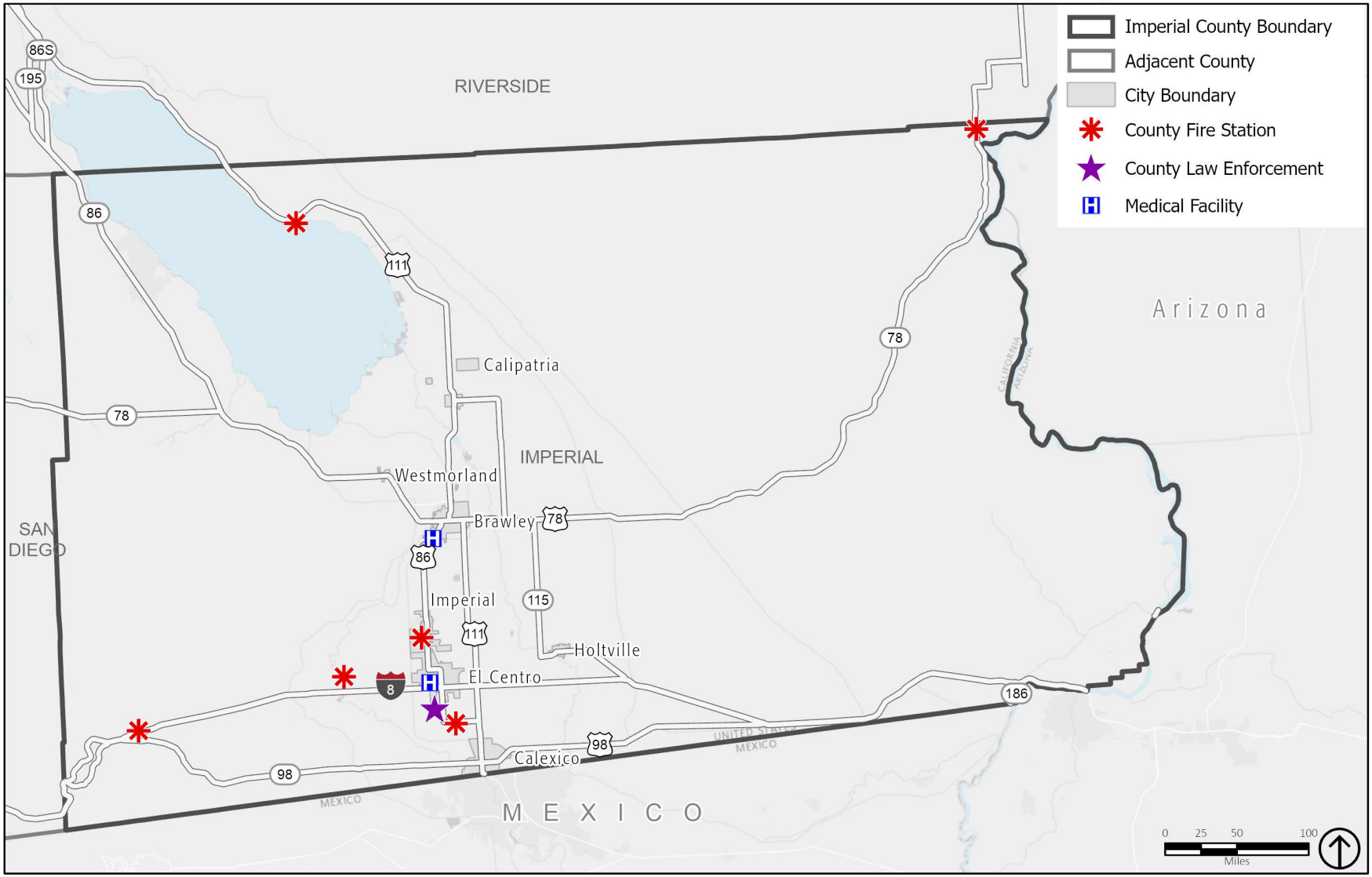
The Seismic and Public Safety Element is a state-mandated General Plan element that must identify potential natural and human-created hazards that could affect Imperial County (County) residents, businesses, and services. The purpose of the Seismic and Public Safety Element is to establish a framework that anticipates these hazards and prepares the community to mitigate exposure to these hazards. Imperial County's jurisdictional are shown in Figure 1.

The Seismic and Public Safety Element conveys the County's goals, policies, and actions to minimize hazards to safety and welfare in Imperial County. Upon adoption, this Seismic and Public Safety Element will replace the 1997 Seismic and Public Safety Element. This element identifies the natural and human-caused hazards that affect existing and future development and provides guidelines for protecting residents, employees, visitors, and other community members from injury and death. It describes present and expected future conditions and sets policies and standards for improved public safety. The Seismic and Public Safety Element also seeks to minimize physical harm to the buildings and infrastructure in Imperial County to reduce damage to local and regional economic systems, community services, and ecosystems.

Some degree of risk is inevitable because the potential for many disasters cannot be completely eliminated and the ability to predict such disasters is limited. The goal of the Seismic and Public Safety Element is to reduce the risk of injury, death, property loss, and other hardships to acceptable levels. The Seismic and Public Safety Element serves the following functions:

- Develops a framework by which safety considerations are introduced into the land use planning process.
- Facilitates the identification and mitigation of hazards for new development, thus strengthening existing codes, project review, and permitting processes.
- Presents policies and implementation programs directed at identifying and reducing hazards in existing development.
- Strengthens earthquake, flood, inundation, and wildland fire preparedness planning and post-disaster reconstruction policies.
- Identifies how hazards are likely to increase in frequency and intensity in the future and provides policies to increase community resilience.

FIGURE 1 – JURISDICTIONAL BOUNDARIES



Source: ESRI, 2018.

Regulatory Framework

Under state law, all counties and incorporated communities in California must prepare a General Plan, which addresses several topics, one of which is public health and safety. The Seismic and Public Safety Element addresses this topic in accordance with state requirements, which are laid out in California law, particularly in Section 65302(g) of the California Government Code. State law requires that the Seismic and Public Safety Element address the following:

- Protect the community from risks associated with a variety of hazards, including seismic activity, landslides, flooding, and wildfire, as required by California Government Code Section 65302(g)(1).
- Map and assess the risk associated with flood hazards, develop policies to minimize the flood risk to new development and essential public facilities, and establish effective working relationships among agencies with flood protection responsibilities, as required by California Government Code Section 65302(g)(2).
- Map and assess the risk associated with wildfire hazards, develop policies to reduce the wildfire risk to new land uses and essential facilities, ensure there is adequate road and water infrastructure to respond to wildfire emergencies, and establish cooperative relationships between wildfire protection agencies, as required by California Government Code Section 65302(g)(3).
- Assess the risks associated with climate change on local assets, populations, and resources. Note existing and planned development in at-risk areas and identify agencies responsible for providing public health and safety and environmental protection. Develop goals, policies, and objectives to reduce the risks associated with climate change impacts, including locating new public facilities outside of at-risk areas, providing adequate infrastructure in at-risk areas, and supporting natural infrastructure for climate adaptation, as required by California Government Code Section 65302(g)(4).
- Identify residential developments in any hazard area identified that do not have at least two emergency evacuation routes, as required by California Government Code Section 65302(g)(5).

Relationship to Other Documents

The Imperial County Seismic and Public Safety Element does not exist in a vacuum but is instead one of several plans that address public safety and related topics. The Seismic and Public Safety Element is part of a comprehensive effort to address the impacts of hazards in Imperial County and must be consistent with these other plans to minimize conflicts between documents and ensure that the County has a unified strategy to address public safety issues. The Seismic and Public Safety Element incorporates information, technical analyses, and policies from these other documents where appropriate to help support this consistency.

Other General Plan Elements

The Seismic and Public Safety Element is one of several elements of the Imperial County General Plan. Other social, economic, political, and aesthetic factors must be considered and balanced with safety needs. Rather than compete with the policies of related elements, the Seismic and Public Safety Element provides policy direction and designs safety improvements that complement the intent and policies of other General Plan elements. Crucial relationships exist between the Seismic and Public Safety Element and the other General Plan elements. How land uses are determined in areas prone to natural hazards, what regulations limit development in these areas, and how hazards are mitigated for existing development, are all issues that tie the elements together. For instance, Land Use Element policies must consider the potential for various hazards identified in the Seismic and Public Safety Element and must be consistent with the policies to address those hazards. The Conservation and Open Space Element is also closely tied to the Seismic and Public Safety Element. Floodplains, for example, are not only hazard areas, but often serve as sensitive habitat for threatened or endangered species or provide recreation or passive open space opportunities for residents and visitors. As such, flood and inundation policies balance the need to protect public health and safety with the need to protect habitat and open space. Seismic and Public Safety Element policies, especially those concerning evacuation routes and critical facilities, must also be consistent with those of the Circulation and Scenic Highways Element. The County's Circulation Plan routes are considered the backbone routes for evacuation purposes. Policies and information in this Seismic and Public Safety Element should not conflict with those in other elements.

Imperial County Multi-Jurisdictional Hazard Mitigation Plan

The Multi-Jurisdictional Local Hazard Mitigation Plan (MHMP) for Imperial County was developed in accordance with the Disaster Mitigation Act of 2000 and followed the Federal Emergency Management Agency's (FEMA) Local Hazard Mitigation Plan guidance. Imperial County's MHMP is a plan to identify and profile hazard conditions, analyze risk to people and facilities, and develop mitigation actions to reduce or eliminate hazard risks in the incorporated and unincorporated areas of Imperial County. The MHMP and the Seismic and Public Safety Element address similar issues, but the Seismic and Public Safety Element provides a higher-level framework and set of policies, and the MHMP focuses on more specific mitigation actions. The implementation of these mitigation actions, which include both short- and long-term strategies, involve planning, policy changes, programs, projects, and other activities. The Seismic and Public Safety Element also includes policies related to emergency response, recovery, and preparation activities. The most recent version of Imperial County's MHMP can be found online at https://firedept.imperialcounty.org/wp-content/uploads/2019/10/ICMHMP.pdf.

Climate Change Vulnerability

Changes to the global climate system are expected to affect future occurrences of natural hazards in and around Imperial County. Many hazards are projected to become more frequent and more intense in coming years and decades, and in some cases, these trends have already begun. According to California's *Fourth Climate Change Assessment,*[1,2] Imperial County can expect the following changes to climate-related hazard events:

- Warmer temperatures are projected to cause an increase in extreme heat events. Because extreme heat is relative to the area, this means that extreme heat events may occur anywhere in Imperial County. The number of extreme heat days, defined in Imperial County as a day when the high temperature is at least 111.2 degrees Fahrenheit (°F), is expected to rise from a historical annual average of 4 to 36 by the middle of the century (2035 to 2064), and to 67 by the end of the century (2070 to 2099), depending on the severity of climate change and the specific location. In addition to the increases in extreme heat events, Imperial County is expected to see an increase in the average daily high temperatures. Extreme heat poses a significant human health risk, especially to senior citizens, outdoor workers, and persons who do not have access to adequate cooling, including people experiencing homelessness. Some buildings and infrastructure systems may be damaged by very high temperatures, constraining their ability to meet community needs.
- Rainfall rates are currently low (approximately 3.4 inches per year) and highly variable from year to year. High variability between climate model predictions of future rainfall rates makes projections of future water availability highly uncertain. However, rainfall variability is projected to increase over the coming decades, with extreme dry and extreme wet events both becoming more common. Climate change is expected to increase the frequency and severity of droughts that cause soil to dry out and condense. When precipitation does return, more water runs off the surface rather than being absorbed into the ground, which can lead to floods. As a result, floods are expected to occur more often in Imperial County, and climate change may expand the parts of the county that are considered flood-prone.
- Climate change can increase the rates of infection for various diseases because many of the animals that carry diseases are more active during warmer weather. There are several diseases that are linked to climate change and can be harmful to the health of Imperial County community members, such as hantavirus pulmonary syndrome, Lyme disease, West Nile fever, and influenza. Many of these diseases are carried by animals, such as mice and rats, ticks, and mosquitos, which are

[1] Bedsworth, Louise, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja. (California Governor's Office of Planning and Research, Scripps Institution of Oceanography, California Energy Commission, California Public Utilities Commission). 2018. *Statewide Summary Report. California's Fourth Climate Change Assessment.* Publication number: SUMCCCA4-2018-013.

[2] Hopkins, Francesca (University of California, Riverside). 2018. *Inland Deserts Summary Report*. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-008.

usually seen as pests even if they do not cause infections. Warmer temperatures earlier in the spring and later in the winter can cause these animals to be active for longer periods, increasing the time that these diseases can be transmitted.

- Climate change can impact the morphology, lifecycle, and behavior of agricultural and forestry pests, including insects and weeds. Higher temperatures will likely allow some insects to mature faster, decreasing the time between subsequent generations and enabling insects to spend more time flying around fields, reproducing, and feeding on crops. Additionally, climate change, by changing atmospheric levels of carbon dioxide (CO_2), is projected to alter weed morphology such that some major weeds may become less sensitive to herbicide treatments. Changes in weed and insect morphology, lifecycle, and behavior may trigger increased reliance on pesticides, which in turn can harm sensitive aquatic habitats. Increased pesticide application, coupled with extreme rainfall events that can efficiently flush agricultural cultures into rivers and streams, means that climate change can lead to high levels of chemical exposure among aquatic species.
- Climate change is expected to negatively impact local and regional air quality through increased dust and fire. More severe and frequent drought and high temperature conditions could increase dust production from desert regions. While Imperial County itself is not at especially high wildfire risk, increasing regional fire frequency can create recurring air quality degradation events leading to respiratory health effects. Increased air emissions from an expanded playa of the Salton Sea may also add to these air quality problems. Health impacts associated with air pollution are typically most severe for young children, senior citizens, and those already suffering from respiratory or cardiovascular disease. Outdoor workers, individuals experiencing homelessness, and others who may experience particularly high levels of air pollution exposure are also vulnerable.
- Severe weather events, such as strong storms and high winds, may become more frequent and intense due to climate change. Climate change is expected to cause an increase in intense rainfall, which is usually associated with strong storm systems. Heavy rainfall may also contribute to an increased risk of landslides in the hills around Imperial County. In Imperial County, most severe weather is linked to high winds. The types of dangers posed by severe weather vary widely and include injuries or deaths, damage to buildings and structures, fallen trees, roads blocked by debris, and fires sparked by lightning.

Vulnerability Assessment

Under California law, the Seismic and Public Safety Element is required to include a vulnerability assessment that examines how people, buildings, infrastructure, and other key community assets may be affected by climate change. The County conducted a Climate Change Vulnerability Assessment in summer and fall of 2021 to analyze Imperial County's susceptibility to climate-related hazards. The County's vulnerability assessment, prepared in accordance with the most recent available guidance in the California Adaptation Planning Guide, assesses how nine different climate-related hazards (agricultural and forestry pests,

air quality, drought, extreme heat, flooding, human health hazards, landslides, severe weather, and wildfire) may affect 81 different population groups and community assets. Each population or asset received a score of V1 (minimal vulnerability) to V5 (severe vulnerability) for each climate-related hazard. The Climate Change Vulnerability Assessment indicates that Imperial County's populations and assets are most vulnerable to extreme heat, drought, and poor air quality. The most vulnerable communities include households in poverty, immigrants and refugees, incarcerated and formerly incarcerated individuals, outdoor workers, people with chronic illnesses, and seniors living alone.

Countywide, energy delivery is vulnerable to multiple hazards, including severe weather, such as high winds that can trigger public safety power shutoff (PSPS) events, extreme heat that reduces the capacity and strains the system, and wildfires that damage the system, ultimately disrupting energy service. These conditions can damage communication infrastructure, decreasing network capacity. There may be a higher demand for communication services during severe weather, potentially putting stress on the network and increasing the risk of service interruptions. Furthermore, energy delivery services, specifically electricity delivery, is subject to harm during extreme heat events. Extreme heat can lead to power outages by causing mechanical failure of grid equipment, heat damage to power lines, and by creating a high demand for electricity to power air conditioners, all of which place stress on the network. This is likely to lead to greater service disruptions.

Interruptions in energy service can create vulnerabilities for Imperial County community members. A loss of electricity can cause a loss of refrigeration for food and medical supplies, limit cooking, cause loss of cooling (particularly dangerous during extreme heat events), lighting, and limited or no access to the Internet or other information systems. Many businesses are forced to close during a power outage, causing economic hardships and depriving community members of important services, such as grocery stores, gas stations, and banks/ATMs. Power outages may also be harmful to people who depend on electrically powered medical devices.

Climate change could affect the transportation network and associated economic activity within Imperial County via strain on transportation infrastructure, impacts of travel behavior, and impacts on goods movement and supply chain business continuity. Transportation infrastructure such as roadways, bridge supports, railways, and airports are all potentially at increased risk due to severe storms, flash floods, higher temperatures, landslides, and increased wildfire risk. When parts of the transportation infrastructure network fail, typical travel routes for both passenger travel and goods movement may be affected. Disruption in transportation of goods can affect the economic vitality of the region and the livelihood of many businesses.

Agriculture is a major economic driver within Imperial County. Already at the high temperature limit for agriculture globally, climate change will bring additional heat stress to field crops, livestock, and the health of farm workers. Agriculture in the region is almost completely dependent on irrigation, and demand will likely increase with rising evapotranspiration rates under warmer climate conditions. Potential climate-driven reductions to Colorado River flow and competing water needs in other regions pose

another threat to agriculture. Temperature changes may also exacerbate insect, weed, and other pest problems for humans, animals, and crops due to the potential for increased insect, pathogen, and weed growth at higher temperatures.

A major geographic feature of the region is the Salton Sea, which is maintained by inflows from agricultural runoff. The Salton Sea serves as a tourist attraction, rest stop for millions of migratory birds along the Pacific Flyway, and a year-round habitat for several endangered and sensitive species, including the desert pupfish (*Cyprinodon macularius*), Yuma clapper rail (*Rallus longirostris yumanensis*), and burrowing owl (*Athene cunicularia*). The sea's water quality has been in steady decline since its formation due to the accumulation of salts and pollutants, hastened by declines in water transfers to the sea. Reductions in agricultural runoff to the Salton Sea pose a hazard for public and ecological health as well as the region's economy. As the sea shrinks, the increasingly exposed playa is likely to become a major source of dust, polluting the air of the region. The County already suffers from high rates of childhood asthma and cardiovascular disease thought to be linked to dust emissions from the sea, making increased playa dust emissions of particular concern in terms of human health. Climate change will exacerbate water supply and quality issues that hamper efforts to restore the sea, and will place additional stress of environmental quality, habitat, and public health challenges related to the shrinking sea.

The Seismic and Public Safety Element includes goals, policies, and implementation programs to increase community resilience and help lower vulnerability to populations and assets, particularly for those that received a score of V4 or V5 (high or severe vulnerability) in the Vulnerability Assessment. A full list of the Vulnerability Assessment results can be found in Appendix A.

Seismic and Public Safety Element Organization

This element outlines the existing and likely future hazardous conditions and other public safety issues in Imperial County, including:

- Seismic and geologic hazards
- Flood hazards
- Fire hazards (urban and wildland)
- Hazardous waste and materials
- Lifelines and Critical Facilities
- Disaster preparedness, response, and recovery
- Drought
- Extreme heat
- Severe weather

This element provides details pertaining to probable locations of each hazard or issue likely to occur (per availability of data), past notable events in Imperial County, agencies responsible for providing protection from hazards, and other background information required by the State of California Government Code Section 65302(g)(4). Goals and policies are identified following the discussion of each hazard, and implementation strategies that support one or more of the Seismic and Public Safety Element policies are in the General Plan Implementation Strategies.

II. EXISTING CONDITIONS

SEISMIC AND GEOLOGIC HAZARDS

Seismic and geologic hazards are caused by the movement of different parts of the Earth's crust or surface. Seismic hazards include earthquakes and secondary hazards caused by seismic activity. Geologic hazards are other hazards involving land movements that are not linked to seismic activity and are capable of inflicting harm to people or property.

Seismic Hazards

Earthquakes

Seismic activity occurs along boundaries in the Earth's crust, called faults. Pressure along the faults build over time and is ultimately released, resulting in ground shaking that we refer to as an earthquake. Earthquakes can also trigger other hazards, including surface rupture (cracks in ground surface), liquefaction (causing loose soil to lose its strength and liquefy), landslides, and subsidence (sinking of the ground surface). Earthquakes and other seismic hazards often damage or destroy property and public infrastructure, and falling objects or structures pose a risk of injury or death.

While Imperial County is at risk from many natural and human-caused hazards, the event with the greatest potential for loss of life or property and economic damage is an earthquake. This is true for most of Southern California, since damaging earthquakes affect widespread areas and trigger many secondary effects that can overwhelm the ability of local jurisdictions to respond. In Imperial County, earthquake-triggered effects include ground shaking, fault rupture, landslides, liquefaction, subsidence, and seiches. Earthquakes can also cause human-caused hazards, such as urban fires, dam failures, and toxic chemical releases.

California rests on the boundary between the North American Plate and the Pacific Plate. The San Andreas Fault system is located where the northwesterly drifting Pacific Plate grinds along and is subducted by the southwesterly drifting North American Plate. The portion of the state of California located to the west of the fault system is part of the Pacific Plate and moves northwest compared to the rest of California and North America.

The Imperial Valley is a broad, flat, alluvial area that lies partly below sea level, cut off from the Gulf of California to the south by the Colorado River Delta. The Imperial Valley, located in the Salton Trough, is one of the most tectonically active regions in the United States. The Salton Trough is an active tectonic pull-apart basin that lies within Imperial, Riverside, and San Diego Counties. The eastern boundary of the Salton Trough is formed by branches of the San Andreas Fault and the western boundary is formed by the San Jacinto-Coyote Creek and the Elsinore-Laguna Salada Faults. Consequently, the Salton Trough is subject to potentially destructive and devastating earthquakes. The Salton Trough is also referred to as a sedimentary basin; sources of the sediment are the mountainous areas that surround the trough and the Colorado River. The deep, sediment-filled geologic structure of the trough makes the area particularly susceptible to severe earthquake damage.

Figure 2 shows regional fault lines in Imperial County.

In the event of a major earthquake in the region, critical damage may occur to public and private buildings, homes, and structures, including those that provide emergency services, such as hospitals, fire stations, schools, emergency shelters, as well as essential services and infrastructure, such as roads and utility lines for water, gas, telephone, sewer, and storm drainage. Access and continuity of services may be interrupted and services could be offline for extended periods.

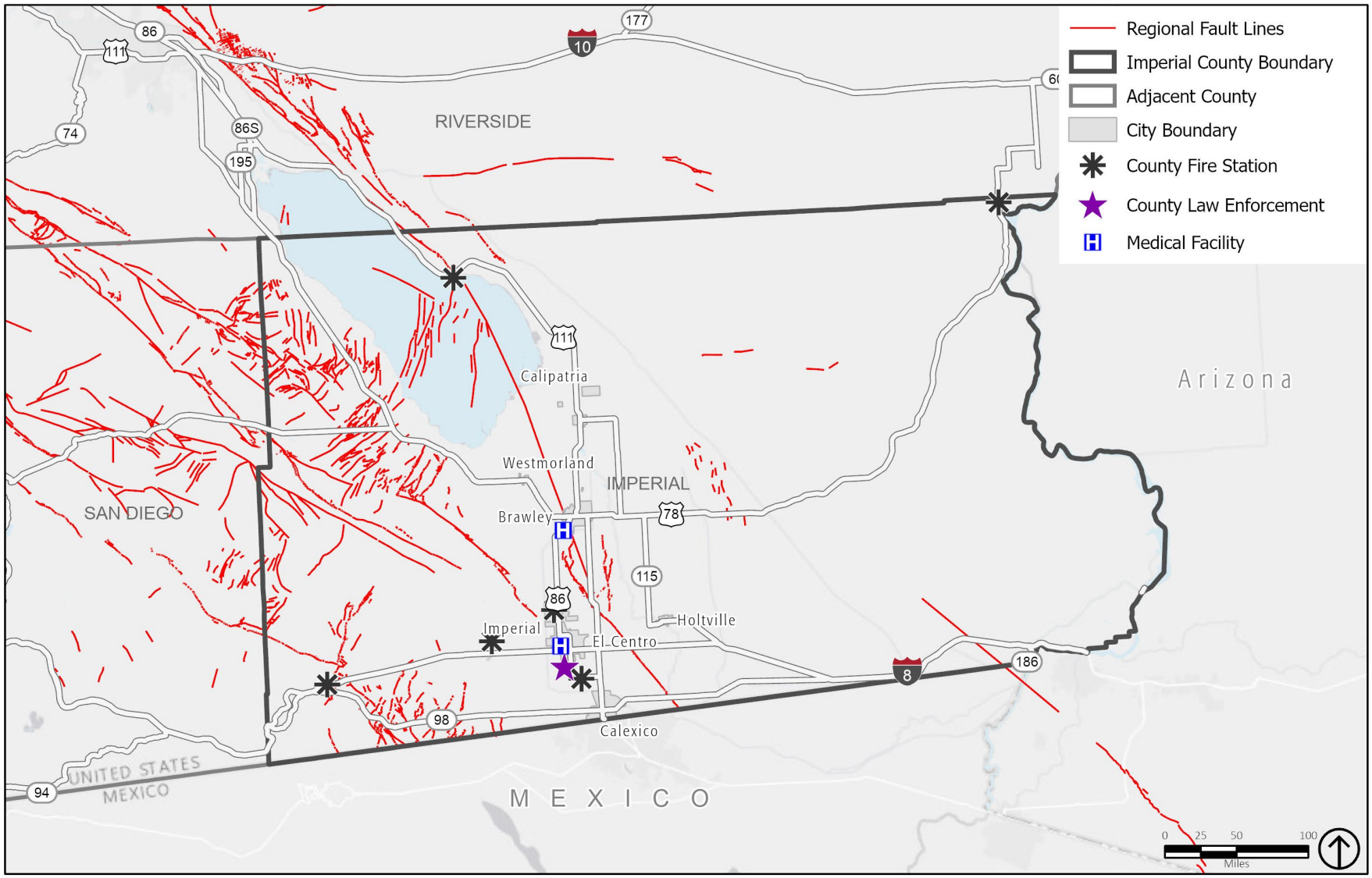
There have been more small to moderate earthquakes in the Imperial Valley area than along any other section of the San Andreas Fault system. Over the last 100 years, the Imperial Valley area experienced 11 earthquakes of magnitude 6.0 or greater with the strongest earthquake being a magnitude of 7.2 in 2010.

It is difficult to predict the severity of property damage and number of casualties that could result from an earthquake. The severity of casualties and property damage depend on the intensity of the earthquake, location of the epicenter to populated areas, and the time of day of the occurrence. The analysis of past earthquakes provides some useful information regarding the potential consequences of future severe earthquakes. Appendix B provides a summary of earthquakes that have impacted the county between 1852 and 2012.

The most recent major earthquake affecting Imperial County occurred on August 26, 2012, in Brawley. The event included a series of strong earthquakes with three of them measuring magnitude 4.6 or higher in the Brawley Seismic Zone south of the Salton Sea. The Brawley Seismic Zone, between the northern end of the Imperial Fault and the southern end of the San Andreas Fault, is a tectonically active area with numerous earthquake swarms occurring over the last several decades. The energetic earthquake swarm started with earthquake activity on a northeast-striking fault zone approximately 12.5 miles south of the young volcanic center known as Salton Buttes.

A field visit on August 27, 2012, found no evidence of surface rupture nor evidence of liquefaction. Some light cosmetic damage was found on some older buildings in downtown Brawley.

FIGURE 2 - REGIONAL FAULT LINES



Source: USGS, 2017.

The 7.2-magnitude earthquake on April 4, 2010, caused extensive damage to the Imperial County Administration Center and its equipment, when the suspended ceiling system collapsed. Had the building been occupied at the time of the earthquake, there is a high likelihood that injuries and/or deaths would have occurred. The Cities of Brawley, Imperial, El Centro, and Calexico have experienced damage from the movements of major faults in the San Jacinto Fault zone, which includes the Imperial and Superstition Hills Faults.

A moderate to severe incident with intense ground shaking in the populated areas of Imperial County could reasonably be expected to cause numerous casualties, extensive property damage, fires, road closures, as well as disruptions to the rail systems, communication systems (particularly telephone systems), the County's extensive canal system, and utilities. In addition, damaged sewer systems, waste treatment facilities, and the possible contamination of the county's potable water supply could pose health hazards.

In 1940, an earthquake along the Imperial Fault registered with a magnitude of 7.1 on the Richter scale. The epicenter was east of El Centro. The ground was ruptured for 40 miles from Volcano Lake in Baja California, Mexico, to a point near the City of Imperial. Seven deaths occurred and property loss was in excess of $5 million. Eighty percent of the buildings in Imperial were destroyed; 50 percent of Brawley's structures were damaged. Indirect damage to crops was substantial due to the subsequent disruption of drainage and the occurrence of flooding. Horizontal displacement across the completed but unfilled International Canal was 14 feet, 10 inches, and the U.S.-Mexico boundary was permanently changed. The Alamo Canal in Baja California, Mexico, was also offset, and a local flood resulted from water spilling out of the broken channel.

Liquefaction

Liquefaction occurs primarily in saturated, loose, fine- to medium-grained soils in areas where the groundwater table is within approximately 50 feet of the surface. Shaking causes the soils to lose strength and behave as liquid. Excess water pressure is vented upward through fissures and soil cracks and can result in a water-soil slurry flowing onto the ground surface. Liquefaction-related effects include loss of bearing strength, ground oscillations, lateral spreading, and flow failures or slumping. Site-specific geotechnical studies are the only practical and reliable way of determining the specific liquefaction potential of a site; however, a determination of general risk potential can be provided based on soil type and depth of groundwater. The geologically young, unconsolidated sediments of the Salton Trough are subject to failure during earthquakes, especially throughout the irrigated portion of the valley where the soil is generally saturated. Liquefaction and related loss of foundation support is a common hazard. The representation of areas having a liquefaction potential is only intended as notification to seek further site-specific information and analysis of this potential hazard as part of future site development. It should not be solely relied upon, without site-specific information and analysis, for design or decision-making purposes.

Geologic Hazards

Geologic hazards, such as landslides and erosion, depend on the geologic composition of the area. Landslides and rock falls may occur in sloped areas, especially areas with steep slopes, and usually in areas of loose and fragmented soil. Landslides, rockfalls, and debris flows occur continuously on all slopes; some processes act very slowly, while others occur very suddenly, often with disastrous results. They often occur as a consequence of seismic activity or heavy rainfall, either of which may cause slopes to lose structural integrity and slide. There are predictable relationships between local geology and landslides, rockfalls, and debris flows. Slope stability is dependent on many factors and interrelationships, including rock type, pore water pressure, slope steepness, and natural or human-made undercutting.

Landslides

A landslide refers to slowly to very rapidly descending rock or debris caused by the pull of gravity. A very rapid landslide could result in casualties and devastating property damage, while a slow landslide could result in the nuisance of having a fence slowly pulled apart.

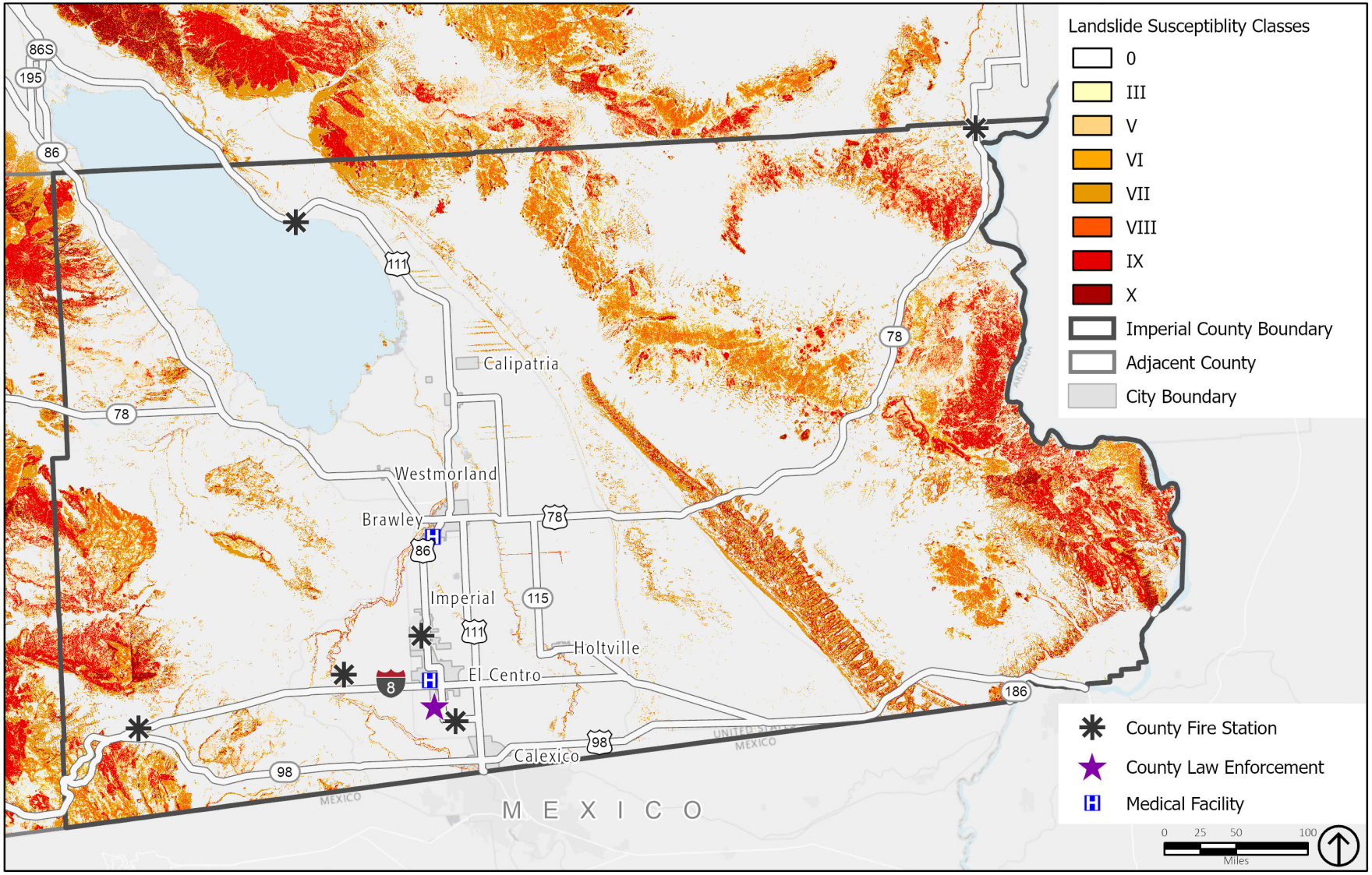
The process of grading can accelerate landslide activity. Slope and material failure often results from failing to use precautionary measures to stabilize slopes or cutting into the failure plane of an existing landslide. In California, landslides are a common problem in hillside or mountain areas and particularly in developed hillside areas that required grading.

Landslide risk in Imperial County is low to moderate along the western edge of the county parallel to the Coast Range Mountains. Additional areas in the county subject to landslide risk include the irrigated valley between the East Highline and Westside Main canals and bluffs adjacent to the All-American Canal, Coachella Canal, New River, Alamo River, and the Colorado River. Susceptible landslide areas adjacent to these water courses are defined as:

1. A distance of 50 feet outside of the shaded flood zone areas delineated on FEMA maps for the New River and Alamo River; and
2. A distance of one-half the canal bank height beyond the toe of the slope for all of the levee and canal banks.

Figure 3 shows the landslide risk in and around Imperial County.

FIGURE 3 - LANDSLIDE SUSCEPTIBILITY



Source: CGS, 2018.

Subsidence

Subsidence refers to the sudden sinking or gradual downward settling and compaction of soil and other surface material with little or no horizontal motion. It may be caused by a variety of human and natural activities, including earthquakes, water saturation, and groundwater pumping. Subsidence occurs when large amounts of groundwater have been excessively withdrawn from an aquifer. In addition, differential displacement and fissures occur at or near the valley margin and along faults. In Imperial County, the worst damage to structures as a result of regional subsidence may be expected at the valley margins.

Subsidence from earthquakes and other activities, including geothermal resources development, can disrupt drainage systems and cause localized flooding. Agricultural operations within the county depend on gravity-fed irrigation, drainage, and tiling systems. These systems use existing land contours and have little tolerance for change. Areas away from the irrigated fields, canals, and drains may be less sensitive to land surface elevation change.

It should also be noted that Imperial Valley experiences a continuous natural subsidence toward the Salton Sea. Natural subsidence has occurred within the Salton Trough, averaging nearly two inches per year at the center of the Salton Sea and decreasing to zero near the Mexican border. The Imperial Valley is generally uniform; however, local depressions have formed, such as the Mesquite Sink along Highway 86 between the City of Imperial and the City of Brawley. Earthquakes have caused abrupt elevation changes in excess of one foot across fault lines.

Erosion

Erosion is the geological process in which earthen materials are worn away and transported by natural forces, such as water or wind, causing the soil to deteriorate. Eroded topsoil can be transported into streams and other waterways. Water erosion is the removal of soil by water and transportation of the eroded materials away from the point of removal. The severity of water erosion is influenced by slope, soil type, soil water storage capacity, nature of the underlying rock, vegetation cover, and rainfall intensity and period. The effect of soil erosion on water quality becomes significant, particularly as soil surface runoff. Highly erosive soils can damage roads, bridges, buildings, and other structures.

Wind erosion is soil movement initiated as a result of wind forces exerted against the surface of the ground. Dust particles in the air create major health problems, such as respiratory discomfort and the spread of pathogens that cause eye infections and skin disorders. In some cases, wind erosion reduces highway and air traffic visibility. Dust storms can cause additional problems, such as damage to buildings, fences, roads, crops, trees, and shrubs by abrasive blowing soil.

The areas in Imperial County that are most susceptible to erosion include the Algodones Sand Dunes, as well as the Chocolate, Picacho, Cargo Muchacho, and Coast Range Mountains. Other areas within Imperial County are generally flat and experience lower rates of erosion.

Potential Changes to Geologic and Seismic Risk in Future Years

Likelihood of Future Occurrence

Seismic Risk

Earthquakes are likely to continue to occur on an occasional basis and are likely to be small to moderate. They may cause no substantive damage and may not even be felt by most people. Major earthquakes are rare, but a possibility in the region, as shown in Appendix B. Imperial County experiences hundreds of minor quakes each month from the myriad of faults in the area. Large earthquakes from faults such as the San Andreas Fault may cause significant damage to homes, infrastructure, businesses, and communities in the county. Based on historical data and the location of Imperial County relative to active and potentially active faults, the Uniform California Earthquake Rupture Forecast projects that southern California has a 93-percent chance of a significantly damaging earthquake (magnitude 6.7 or higher) by 2044.

If serious shaking does occur, newer construction is in general more earthquake resistant than older construction because of improved building codes. Older manufactured housing is very susceptible to damage because their foundation systems are rarely braced for earthquake motions. Earthquake losses would vary across Imperial County depending on the source and magnitude of the event. Since Imperial County is subject to frequent seismic events, ground shaking, soil liquefaction, and rock and mudslides also pose a risk. In Imperial County, the potential for liquefaction is greatest in and around the Imperial Valley (Salton Trough) where geologically young, unconsolidated sediments occur. These areas are subject to failure during earthquakes, especially throughout the irrigated portion of the valley where the soil is generally saturated.

Geologic Risk

Minor landslides have occurred in the past, probably over the last several hundred years, evidenced by both past deposits exposed in erosion gullies and recent landslide events. Imperial County has a history of landslides during seasons of high precipitation. With significant rainfall, additional failures are likely in the identified landslide hazard areas, minor landslides will likely continue to impact the area when heavy precipitation occurs, as they have in the past. Since the county is generally flat, landslides are not considered a major concern. However, bluff failure and mudslides may occur along slopes and embankments of the rivers and canals.

Imperial Valley is also susceptible to subsidence. Given than natural subsidence has occurred within the Salton Trough, it is highly likely that the valley area will experience continued subsidence near the Salton Sea. Imperial County is especially vulnerable to wind erosion as a result of high winds throughout the region. The most significant wind erosion is likely to occur in areas with light-textured soils, such as agricultural areas and sand dunes (i.e., Algodones Sand Dunes).

Climate Change and Geologic and Seismic Hazards

While climate change is unlikely to increase earthquake frequency or strength, the threats from seismic and geologic hazards are expected to continue. Climate change may result in precipitation extremes (i.e., wetter rainfall periods and drier dry periods). While total average annual rainfall may not change significantly, rainfall may be concentrated in fewer, more intense precipitation events. Heavy rainfall could cause an increase in the number of landslides or make landslides larger than normal. Increased wildfire frequency can destabilize hillsides due to loss of vegetation and change in soil composition, which can contribute to greater runoff and erosion.

A generally drier climate in the future will increase the chance of drought, wildfires, and areas susceptible to erosion. The combination of these conditions with the occasional extreme downpour is likely to cause more mudslides and landslides. Impacts from these conditions would compound landslide potential for the most susceptible locations. However, the county is generally flat and landslide potential is limited and therefore not a major concern. Climate change is expected to increase the severity and frequency of severe weather events. Consequently, wind erosion resulting from strong winds will likely have the most significant effect on agricultural areas and sand dunes where light-textured soils are most susceptible.

FLOOD HAZARDS

Flooding is considered the rising and overflowing of a body of water onto normally dry land. Flooding is a natural hazard present in Imperial County due to the county's geography, geology, and climate. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide, causing substantial damage to structures, landscapes, and utilities, as well as life-safety issues. Flooding can be extremely dangerous, and even six inches of moving water can knock a person over given a strong current. Floodwaters can transport large objects downstream, which can damage or remove stationary structures, such as dam spillways. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utility lines and interrupt services. Standing water can cause damage to roads, foundations, and electrical circuits, as well as provide habitat for vectors that carry illnesses, such as mosquitos. Flood hazards include natural floodplains, seiches, and dam failure.

Agencies responsible for flood control in Imperial County include the United States Bureau of Reclamation (USBR), United States Army Corps of Engineers (USACE), FEMA, the Federal Insurance Administration (FIA), and the California Department of Water Resources (DWR).

- USBR oversees the Lower Basin states (i.e., Arizona, California, Nevada) in managing, developing, and protecting water and related resources, such as dams, powerplants, canals, and other water conveyance infrastructure. Both the Imperial Diversion and the All-American Canal are part of the Boulder Canyon Project for the Lower Basin. The operations of Imperial Irrigation District’s River Division Office at

Imperial Dam, as well as system-wide water distribution, all fall under the direction of the USBR.

- The USACE identifies the need for and constructs major flood-control facilities. It also develops flood and dam inundation maps and reports.
- FEMA manages the National Flood Insurance Program (NFIP), providing insurance to the public in communities that participate in the program. FEMA is the main federal government agency contact during natural disasters and publishes the Flood Insurance Rate Maps (FIRM), which identify the extent of flood potential in flood-prone communities based on a 100-year flood (or base flood) event.
- The FIA is the primary agency that delineates potential flood hazard areas and floodways through the FIRMs and the Flood Boundary and Floodway Map. Flood insurance is required of all homeowners who have federally subsidized loans.
- DWR is responsible for managing and protecting California's water. DWR works with other agencies to protect, restore, and enhance the natural and human environments. DWR also works to prevent and respond to floods, droughts, and catastrophic events that would threaten public safety, water resources and management systems, the environment, and property.

Natural Floodplains

Although the county is located in a desert with very low precipitation, it is sometimes subject to heavy rains and subsequent flooding. The entire county is subject to various degrees of flooding in the form of flash floods or slow floods caused by heavy precipitation. Flash flooding is a common problem, especially in the desert areas of the county. Flash flooding is typically associated with short duration, high-intensity precipitation events, such as those that may occur during summer thunderstorms. Such flooding occurs when sudden downpours over the mountains and/or desert tend to create instantaneous peak flows that roughly follow empty stream beds and mountain washes.

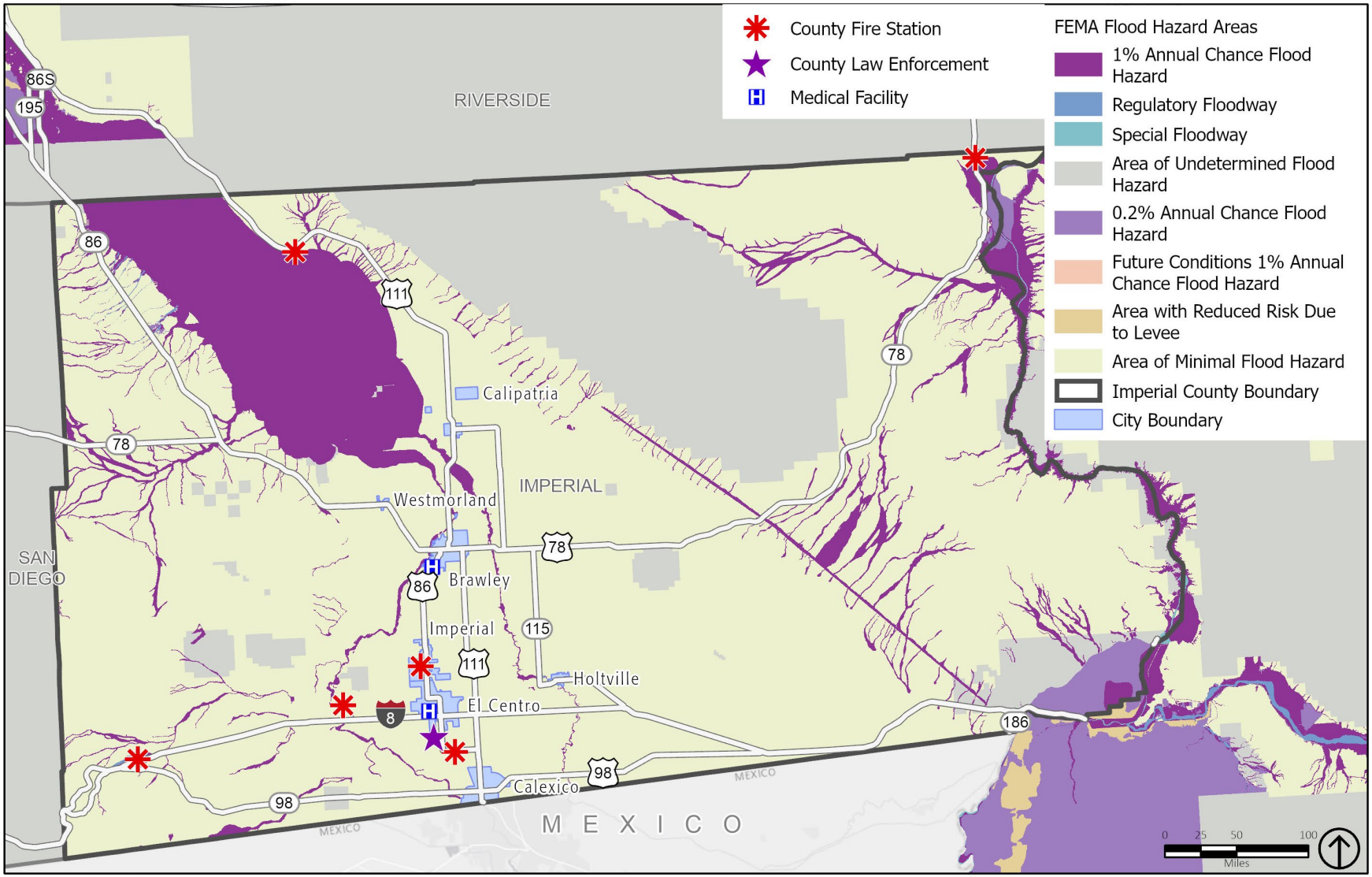
Flooding can occur either in floodplains or floodways. Floodplains are generally adjacent to rivers and other bodies of water, and in low-lying areas near a water source. Floodways are defined by discernible drainage channels and are more hazardous than other flood zones due to the anticipated velocities of the flood waters and expected damage to life and property. Such designations occur along Myer Creek (through Ocotillo) and within the levees along the Colorado River. Areas at an elevated risk of flooding are generally divided into 100- and 500-year flood zones. A 100-year flood zone has a 1-percent chance of experiencing a major flood in any given year, a 200-year flood zone has a 0.5-percent chance of flooding in any given year, a 500-year flood zone has a 0.2-percent chance of flooding in any given year. Figure 4 shows the 100- and 500-year flood zones in Imperial County.

The communities of Bombay Beach and Ocotillo are the most likely to experience significant flooding in the county. In El Centro, the Gillett/Cannon Roads area experiences significant flooding due to its low elevation. Bombay Beach is in a low-lying pocket created

by the Salton Sea on the west and the Chocolate Mountains on the east, which contributes to its risk of significant flooding.

Floodplain management is the key component to effective flood control within Imperial County. FIA delineates areas of special flood hazards, risk premium zones, and floodways through official maps, including the FIRM, Flood Boundary, and Floodway Map. These maps form the basis for Imperial County's Flood Ordinance, which is intended to be applied to those areas subject to periodic flooding.

FIGURE 4 - FLOOD HAZARD ZONES



Source: FEMA, 2020.

Seiches

A seiche is a standing wave oscillating in a body of water. Seiches are typically caused when strong winds and rapid changes in atmospheric pressure push water from one end of a body of water to the other. When the wind stops, the water rebounds to the other side of the enclosed area. The water then continues to oscillate back and forth for hours or even days. In a similar fashion, earthquakes, tsunamis, or severe storm fronts may also cause seiches.

The most likely location for a significant seiche to occur is the Salton Sea. While there have been several seismic events since the formation of the Salton Sea, no significant seiches have occurred to date. However, a seiche could occur in the Salton Sea under appropriate seismic conditions. The Salton Sea is near the San Andreas and San Jacinto Faults and could be subject to a seiche generated by a seismic event.

Dam Failure

Dam failure also poses a risk to Imperial County. Floods from dam failure are a notable secondary effect of earthquakes, landslides, and heavy precipitation events. Often, in earthquake country, the most economical (and sometimes only) dam site is in a high-risk seismic zone. The geological forces generating faults often produce the topographic features desirable for dams. Earth fill dams are more susceptible to seismic-induced failure than concrete or other structural dams.

Flooding due to dam failure is a hazard that could significantly impact eastern Imperial County. There are three major dams in Imperial County, including Imperial, Laguna, and Senator Wash, located on the Colorado River; several large, earth fill impoundment reservoirs in irrigated areas; hundreds of miles of above ground level earth levee canals; and hundreds of check dams, drops, and gates. Failure of these dams is generally considered a very unlikely event, although such events are not unprecedented.

Figure 5 shows areas in the county that would be affected by inundation of these dams. Hazard analysis suggests that dam failure would likely occur if both a heavy precipitation event occurred simultaneously with significant seismic activity within the vicinity of a dam. Flooding through Mexico would most probably be confined to the already designated flood areas. The Colorado River is not a known seismically active zone and to date, there have been no reported cases of earthquake damage to the dams along the river. Within the irrigated area, there have been several instances of levee failure from earthquakes and resultant flooding. However, flood hazards are a low concern due to the comparatively small volumes of water involved, low head, variety of options to check or divert flows in the canals, and the ubiquitous drainage network. Nevertheless, dam failure hazards do exist, and even minor flooding could be an incremental contribution to the other disruptions an earthquake might cause.

Dam inundation flooding is usually associated with intense rainfall or prolonged flood conditions. A dam failure is an uncontrolled release of water from a reservoir through a dam as a result of structural failures or deficiencies in the dam. Dam failures can range from fairly minor to catastrophic and can potentially harm human life and property downstream from the failure. In addition, ecosystems and habitats are destroyed as a result of waters flooding them. Although dam failures are very rare, these events are not unprecedented. Additionally, the older that dams get, the more potential exists for catastrophic dam failures. There are four major causes of dam failures, which include the following:

- **Overtopping:** These failures occur as a result of poor spillway design, leading to a reservoir filling too high with water, especially in times of heavy rainfall. Other causes of this type of failure include settling of the crest of the dam or spillway blockage.
- **Foundation defects:** These failures occur as a result of settling in the foundation of the dam, instability of slopes surrounding the dam, uplift pressures, and seepage around the foundation. All of these failures result in structural instability and potential dam failure.
- **Piping and seepage failures:** These failures occur as a result of internal erosion caused by seepage and erosion along hydraulic structures such as the spillways. Erosion as a result of animal burrows and cracks in the dam structure contribute to these failures as well.
- **Conduit and valve failure:** These failures occur as a result of problems with valves and conduits.

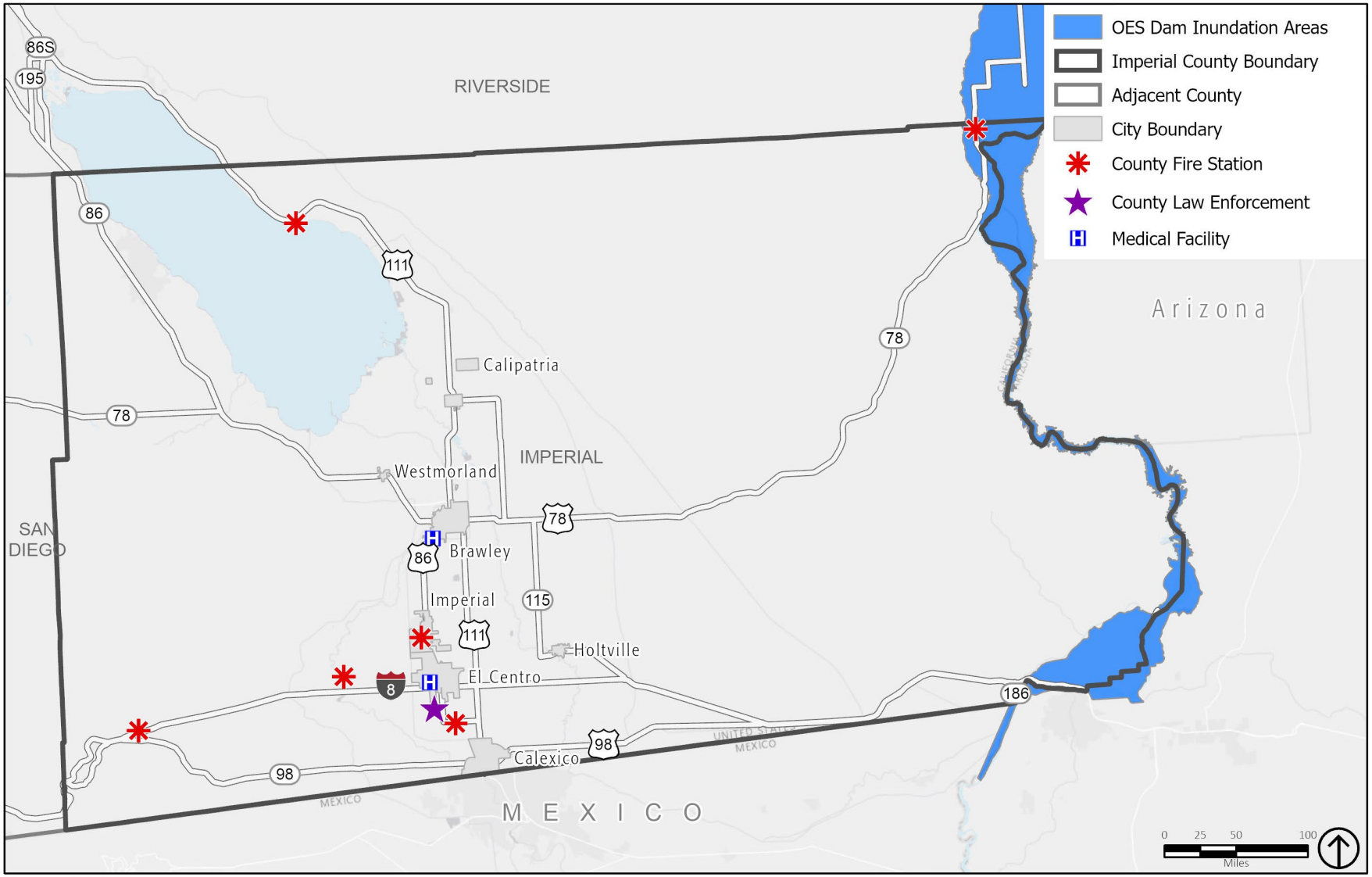
Other dam failures arise as a result of miscellaneous causes, such as earthquakes, landslides, or extreme storms. Other causes include equipment malfunction, structural damage, and sabotage.

Dams are constructed with safety features known as “spillways” that allow water to overtop the dam if the reservoir fills too quickly. Spillway overflow events, often referred to as “design failures,” result in increased discharges downstream and increased flooding potential. In a dam failure scenario, the greatest threat to life and property typically occurs in those areas immediately below the dam since flood depths and discharges generally decrease as the flood wave moves downstream. The primary danger associated with dam failure is the high-velocity flooding downstream of the dam and limited warning times for evacuation.

The Federal Energy Regulatory Commission, as required by federal law, has reviewed and approved comprehensive emergency action plans (EAPs) for each of these dams. The EAP minimizes the threat to public safety and the response time to an impending or actual sudden release of water from project dams. The EAP is also designed to provide emergency notification when flood water releases may present the potential for major flooding.

As mandated by the National Dam Inspection Act, the USACE has the authority and responsibility for conducting inspections of all dams. The purpose of these inspections is to check the structural integrity of the dam and associated appurtenant structures, ensuring protection of human life and property. Periodic inspections disclose conditions that might disrupt operation or dam safety. Furthermore, the California Water Code entrusts dam safety regulatory power to DWR's Division of Safety of Dams (DSOD), which provides oversight to the maintenance of 1,200 dams in the state. DSOD ensures safety through dam inspection on an annual basis. Periodically, DSOD reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California.

FIGURE 5 – DAM INUNDATION ZONES



Source: Cal OES

Potential Changes to Flood Risk in Future Years

Likelihood of Future Occurrence

The entire county is subject to various degrees of flooding in the form of flash floods or slow floods caused by heavy precipitation. Historically, Imperial County has been subject to previous flooding events primarily during the winter and spring months when river systems swell with heavy rainfall runoff. However, flash flooding may occur as a result of summer thunderstorms. These flash flood events are more likely to occur in the desert areas of the county.

Normally, stormwater is kept within defined limits by a variety of storm drainage and flood-control measures. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage. Flooding has occurred both within the 100- and 500-year floodplains and in other localized areas. As land uses and climate conditions shift and as improvements are made to flood-control channels, the size of these flood zones is likely to change.

Climate Change and Flooding

Floods are among the most damaging natural hazards in Imperial County, and climate change is expected to make flood events more severe. Although climate change may only increase precipitation slightly, scientists expect that it will cause more frequent and extreme precipitation events. This means that more years are likely to see particularly intense storm systems that drop enough precipitation over a short enough period to cause flooding. Consequently, floods are expected to occur more often in Imperial County, and climate change may expand the parts of the county that are considered flood prone.

Indirect effects of climate change may also increase flooding in Imperial County. Climate change is expected to increase the frequency and severity of droughts that cause soil to dry out and become hard. Therefore, when precipitation does occur, more water runs off the ground surface rather than being absorbed into the ground, which can increase flooding. Wildfires, which are expected to become more frequent because of climate change, cause a similar effect by baking the surface of the ground into a harder and more impenetrable layer. Trees and other vegetation help slow water down, which allows the water to be absorbed into the soil and prevents it from becoming runoff. Therefore, changes to soil properties resulting from climate change may also increase flood risk.

While the risk and associated short- and long-term impacts of climate change are uncertain, experts in this field tend to agree that among the most significant impacts include those resulting from increased temperatures and changes in precipitation patterns, which increase frequency and magnitude of severe storms that cause flooding. Increases in damaging flood events will cause greater property damage, public health and safety concerns, displacement of communities, and loss of life. Displacement of residents can

include both temporary and long-term displacement, increase in insurance rates, or restriction of insurance coverage in vulnerable areas.

FIRE HAZARDS

Fire hazards can come in the form of both wildfires and urban fires. California is recognized as one of the most fire-prone and consequently fire-adapted landscapes in the world. The combination of complex terrain, Mediterranean climate, and productive natural plant communities, along with ample natural ignition sources, has created ideal wildfire conditions. Wildfire is an ongoing concern for communities in Imperial County. Generally, the fire season extends from early spring through late fall of each year during the hotter, dryer months. Fire conditions arise from a combination of high temperatures, low-moisture content in the air and plant matter, an accumulation of vegetation, and high winds.

Three types of fires are of concern to Imperial County: (1) wildfires, (2) wildland-urban interface fires, and (3) urban fires.

Wildfires

Wildfires occur on mountains, hillsides, and grasslands. Vegetation, wind, temperature, humidity, and slope are all factors that affect how these fires spread. In Imperial County, native plant communities, such as woodland and scrub habitats provide fuel that allows fire to spread easily across large tracts of land. These plant species are capable of regeneration after a fire, making periodic wildfires a natural part of the ecology of these areas. However, high-intensity wildfires can limit plant community regeneration by scorching roots and seed banks.

Wildfire threat within the county ranges from moderate to very high. A significant portion of the county is undeveloped and consists of rugged topography with some flammable brush vegetation. Although wildfire potential is generally low throughout the county, wildfire potential does exist in a small area west of Ocotillo adjacent to San Diego County. This region is considered a High and Very High Fire Hazard Severity Zone. However, this area is a low concern since it is isolated and not near any residences. All other areas of the county are within a moderate fire hazard severity zone due to flammable brush and other vegetation. Figure 6 shows the fire hazard severity zones in Imperial County.

Fire potential for Imperial County is typically greatest in the months of August, September, and October, when dry vegetation coexists with hot, dry Santa Ana winds. However, in Imperial County, fires with conflagration potential can occur at any time of the year. Seasonal drought conditions exacerbate fire hazards.

Wildfire Smoke

While Imperial County itself is not at especially high wildfire risk, increasing regional fire frequency can create recurring air quality degradation events leading to respiratory health effects. Wildfire smoke consists of a mix of gases and fine particulate matter from burning vegetation and materials. The pollutant of most concern from wildfire smoke is fine

particulate matter ($PM_{2.5}$). $PM_{2.5}$ from wildfire smoke is damaging to human health because of its ability to deeply penetrate lung tissue and affect the heart and circulatory system. Although wildfire smoke presents a health risk to everyone, some populations may experience more severe acute and chronic symptoms from exposure to wildfire smoke, such as children, older adults, people with chronic respiratory or cardiovascular disease, or people experiencing low socioeconomic status.

Wildland-Urban Interface Fires

The wildland-urban interface is an area where buildings and infrastructure (e.g., cell towers, schools, water supply facilities) mix with areas of flammable wildland vegetation. This interface is sometimes divided into the defense zone (areas in close proximity to communities, usually about a quarter-mile thick) and threat zones (an approximately one-and-a-quarter-mile buffer around the defense zone). Hundreds of homes now border major forests and brush areas. With thousands of people living near and visiting wildland areas, the probability of human-caused fires is growing.

In the wildland-urban interface, efforts to prevent ignitions and limit wildfire losses hinge on hardening structures and creating defensible space through a multi-faceted approach, which includes engineering, enforcement, education, emergency response, and economic incentive. Different strategies in the defense and threat zones of the wildland-urban interface help to limit the spread of fire and reduce the risk to people and property.

Figure 7 identifies the wildland-urban interface.

Structural Fires

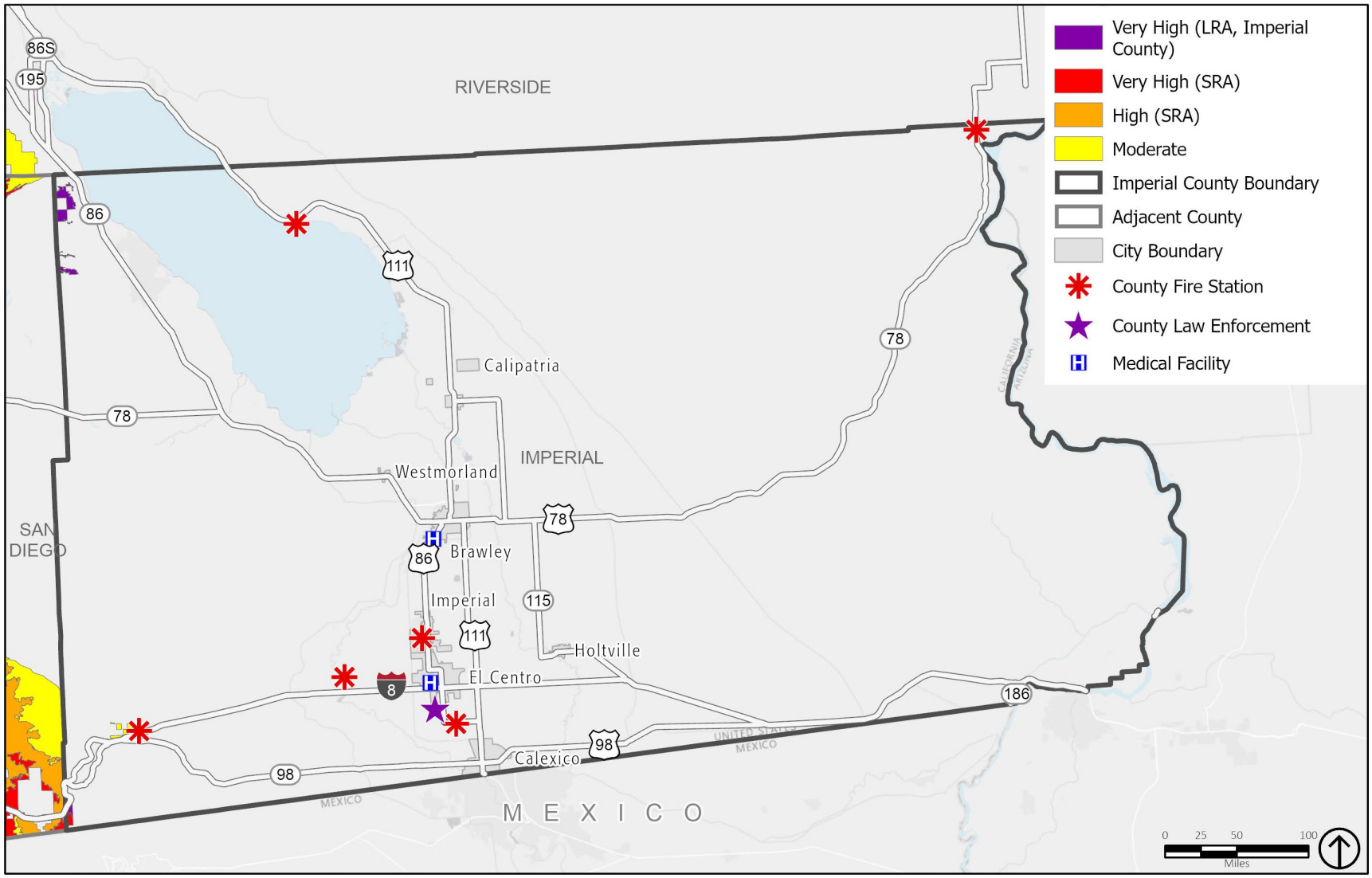
Urban fires occur in built-up environments, destroying buildings and other human-made structures. These disasters are often due to faulty wiring or mechanical equipment, combustible construction materials, or the absence of fire alarms and sprinkler systems. Structural fires are largely from human accidents, although deliberate fires (arson) may be a cause of some events. Older buildings that lack modern fire safety features may face greater risk of damage from fires. To minimize fire damage and loss, the County's Fire Code, based on the California Fire Code, sets standards for building and construction. It requires the provision of adequate water supply for firefighting, fire-retardant construction, and minimum street widths, among other things. Fire prevention awareness programs and fire drills are conducted to train residents to respond quickly and correctly to reduce injury and losses during fires.

Fire Responsibility Areas

In Imperial County, different organizations have some responsibility for wildfire protection in different areas. These responsibility areas are codified under state law into three categories: local responsibility areas (LRAs), state responsibility areas (SRAs), and federal responsibility areas (FRAs).

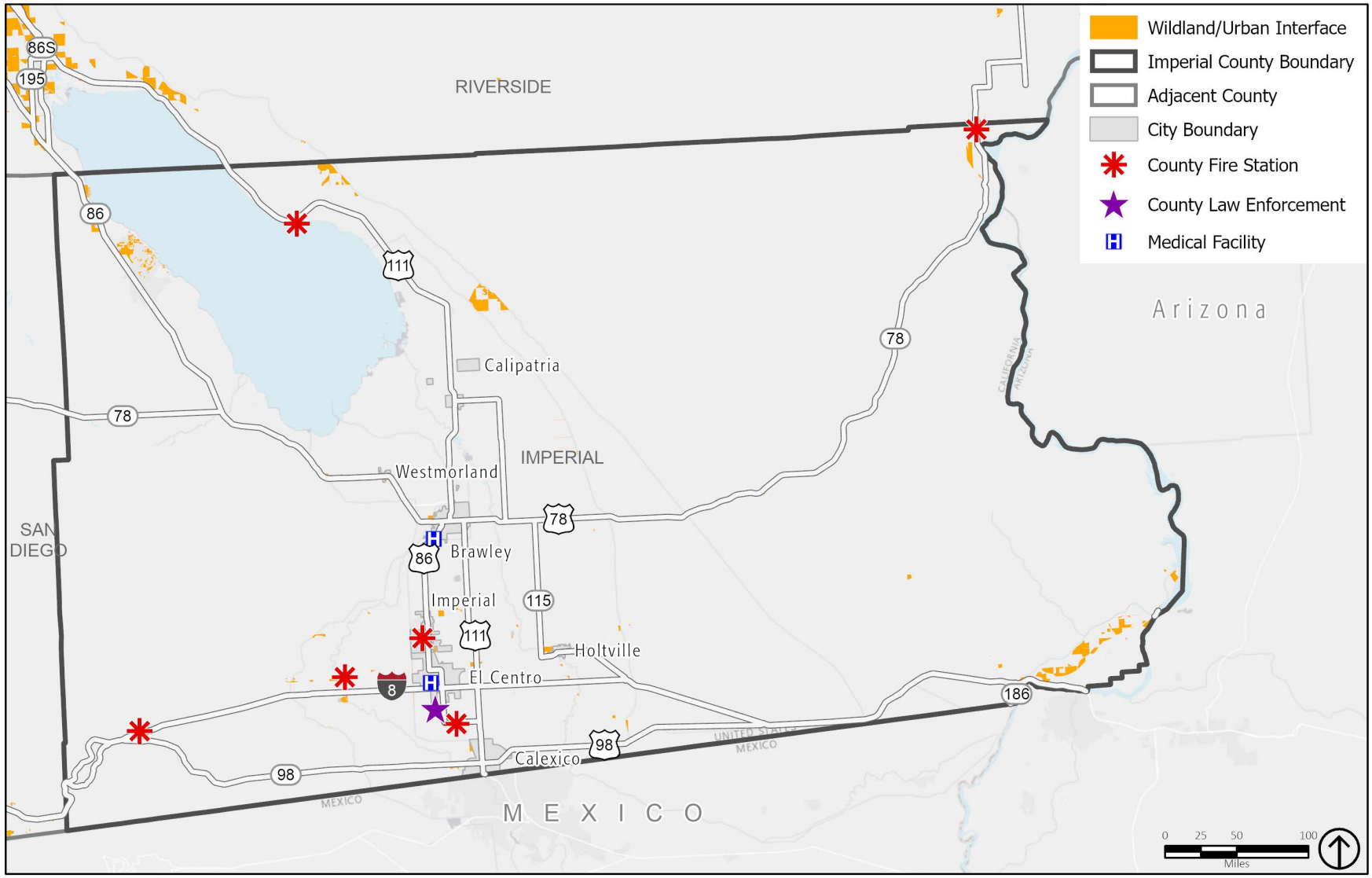
- LRAs are areas protected by local agencies, including city and county fire departments, local fire protection districts, and the California Department of Forestry and Fire Protection (CAL FIRE) when under contract to local governments. Approximately half of the land in western Imperial County is an LRA and small areas of land throughout eastern Imperial County is an LRA.
- SRAs are areas where CAL FIRE has responsibility for wildfire protection. SRAs are generally unincorporated areas that are not federally owned, are undeveloped, and are covered by wildland vegetation or rangeland. A small portion of the county west of Ocotillo consists of SRAs.
- FRAs are areas that are managed by a federal agency, including the U.S. Forest Service, the U.S. Fish and Wildlife Service, the Bureau of Land Management, and U.S. Department of Defense. A majority of land in the county is federally owned and consists of FRAs.

FIGURE 6 - FIRE HAZARD SEVERITY ZONES



Source: CalFIRE, 2020.

FIGURE 7 – WILDLAND-URBAN INTERFACE



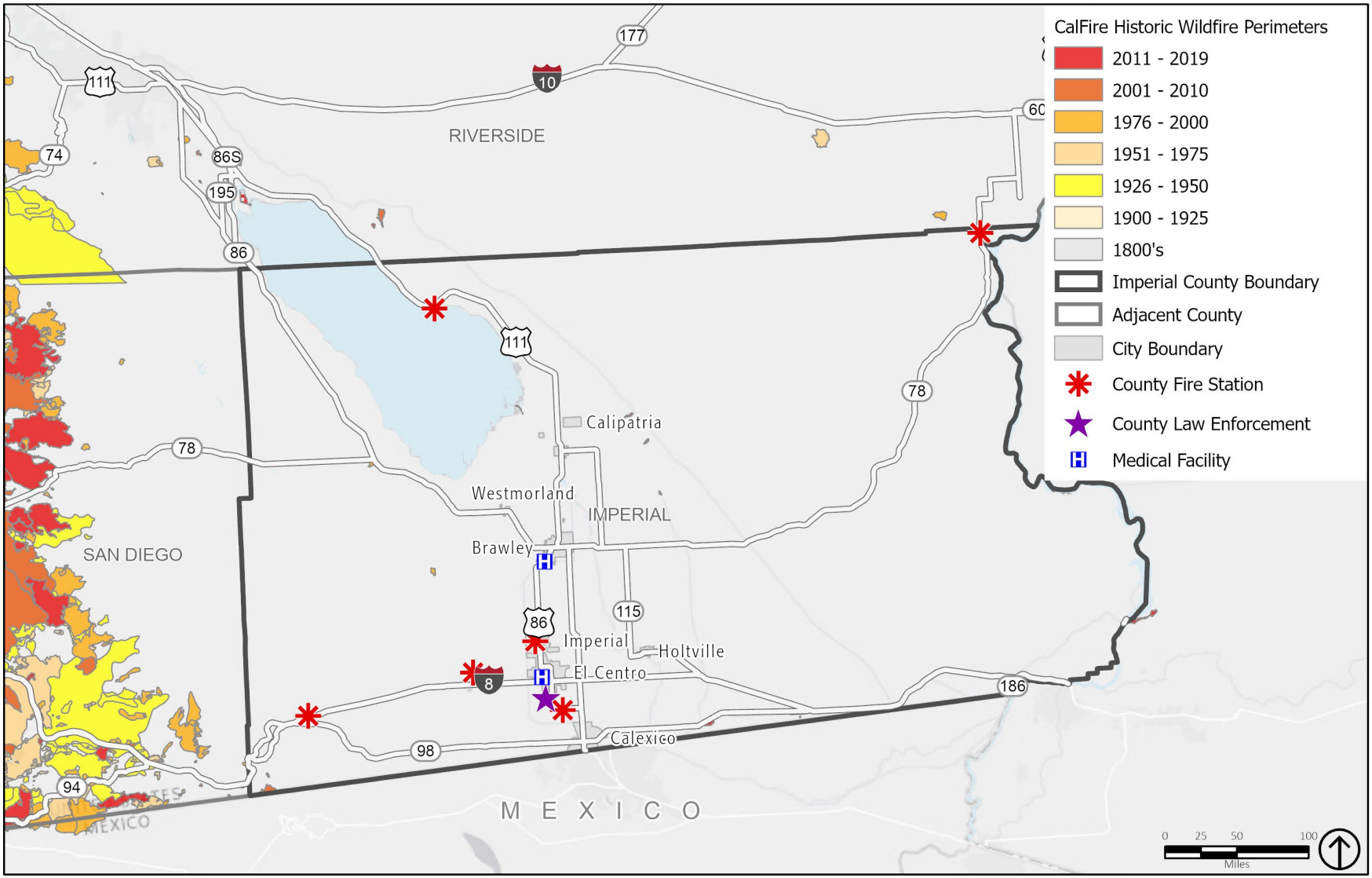
Past Occurrences

Table 1 contains a list of historical fires that have occurred around the county, dating back to 1978. Figure 8 shows the areas burned by historic wildfires in and around Imperial County. Figure 9 shows the projections of wildfire increase in the future with the average annual acres burned.

TABLE 1 FIRES IN IMPERIAL COUNTY, 1978-2020

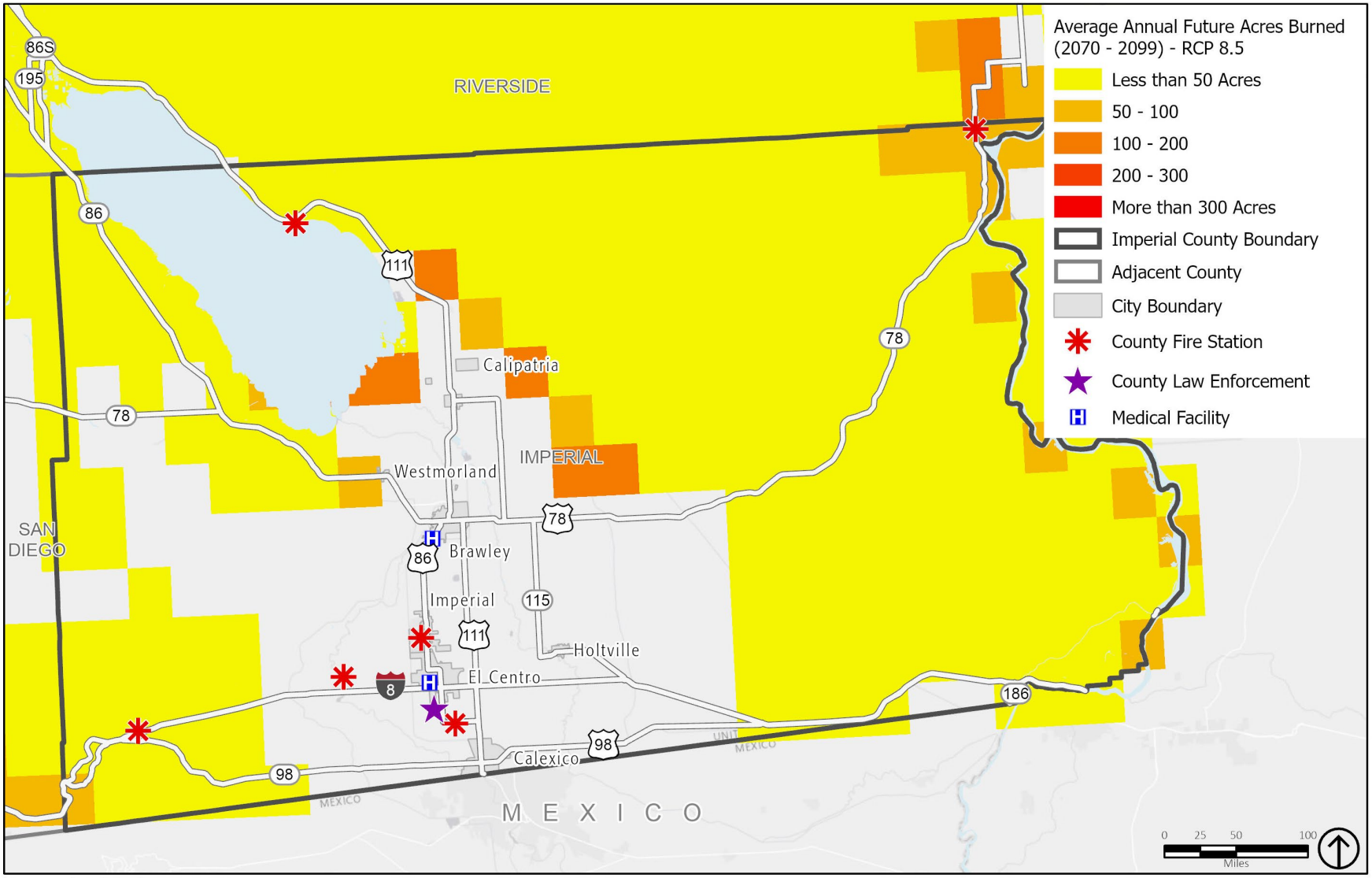
Fire Name	Date		Acres Burned	Vegetation Type	Cause
	Start	End			
Elliot Fire	7/6/2020	7/12/2020	103	Brush	Undetermined
Myer Fire	6/11/2020	6/13/2020	13	Brush	Equipment Use
Highline Fire	3/25/2017	3/31/2017	67	Brush	Undetermined
Highline Fire	3/31/2013	4/2/2013	261	Brush	Lightning
Highline Fire	5/31/2012	5/31/2012	142	Brush	Debris
Alamo Fire	8/19/2011	8/20/2011	35	Brush	Undetermined
Border 12 Fire	6/20/2011	6/21/2011	36	Brush	Undetermined
Laguna Fire	5/17/2011	5/22/2011	731	Brush	Human
Midway Fire	4/16/2009	N/A	112	Brush	Equipment Use
Mountain Fire	6/22/2008	6/22/2008	53	Brush	Lightning
Montgomery Fire	4/6/2008	4/6/2008	290	Brush	Campfire
Inkopah Fire	6/4/2007	6/7/2017	699	Brush	Campfire
Assist #101 Fire	7/3/1987	N/A	280	Brush	Undetermined
R&N Farms Fire	6/4/1978	N/A	171	Brush	Undetermined
Nees Fire	5/21/1978	N/A	228	Brush	Undetermined
Sources: California Fire Perimeters 1878 – 2020: Fire and Resource Assessment Program					

FIGURE 8 – HISTORIC WILDFIRES



Source: CalFIRE, 2019.

FIGURE 9 – PROJECTIONS OF WILDFIRE INCREASE



Source: Cal Adapt

Fire Protection

Fire protection in Imperial County is provided by the Imperial County Fire Department and CAL FIRE. Imperial County contracts with CAL FIRE to provide fire protection and rescue services in the unincorporated areas of the county. The Imperial County Fire Department and CAL FIRE participate in a Cooperative Fire Response Agreement, where fire agencies have agreed to automatically support each other on incidents using the closest available resource.

The Imperial County Fire Department consists of nine stations and six contracting agencies. The stations are located in the communities of Heber, Seeley, Ocotillo, Palo Verde, Niland, Winterhaven, Salton City, and the City of Imperial. The department contracts with Brawley, Calipatria, Holtville, and Westmorland. Each of the county fire stations is staffed with a captain, firefighter, and reserve firefighter with the only exceptions being the Ocotillo Station is staffed with one senior firefighter and one reserve firefighter and the Palo Verde station that is staffed with two reserve firefighters. Every station has a Type I engine as its primary apparatus. The City of Imperial and Heber stations also house a ladder truck along with the Type I engine. The Seeley and Heber stations also house Type III engines. The Imperial County Fire Department provides fire protection, emergency medical services, and disaster preparedness and response.

CAL FIRE has a legal responsibility to provide fire protection on all SRA lands, which are defined based on land ownership, population density, and property use. In the event of a fire, assistance from various fire departments within the county would be required.

Fire Safety

The most significant regulatory codes from the standpoint of fire safety are fire prevention and building codes. The County implements the Uniform Building Code and the California Fire Code. These uniform codes are intended to serve only as minimum standards. Therefore, it is important that these minimum fire safety standards be strictly enforced by fire and building agencies in the unincorporated County.

The Imperial County Codified Zoning Ordinance also contains provisions which act to reduce fire hazards. The Zoning Ordinance is a tool that helps prevent the construction of incompatible or hazardous structures. For example, the ordinance separates industrial, commercial, and residential uses and provides for the isolation of land uses that may create excessive fire exposure to other properties. It also limits the height and bulk of buildings, specifies setbacks and distances between buildings.

The Imperial County Subdivision Ordinance is also used to reduce the risk of fire by securing, as a condition of subdivision of land, water systems of adequate size and pressure for firefighting, and adequate roadway widths for emergency service vehicle access, including maneuverability of fire trucks. As part of the review process, the Imperial County Planning Department seeks recommendations from fire and water districts wherever the proposed subdivision is located.

The County of Imperial Fire Prevention and Explosives Ordinance, Section 53101-53300, contains provisions for the purpose of prescribing regulations governing conditions hazardous to life and property from fire or explosion. The Imperial County Fire Prevention Program encompasses a public information and education component that promotes public awareness of the significance of Fire and Safety prevention measures. This program enables the public to be better prepared when an emergency fire situation occurs. The purpose of the Imperial County Fire Prevention Program is to assist in preventing injuries, deaths, business interruption, and property damages resulting from fires and other emergencies.

The Fire Prevention Bureau is active in public education efforts throughout the year. The Bureau currently enforces the 2019 California Fire, Building, Electrical, County Ordinances, as amended by the County of Imperial Municipal Code, in addition to National Fire Protection Association standards; Title 19, of the California Public Safety Code; and the California Health and Safety Code. The Fire Prevention Bureau conducts an annual fire inspection program, which is intended to help protect the business owners, employees, and patrons from fire hazards.

Potential Changes to Fire Risk in Future Years

Likelihood of Future Occurrence

The wildfire season in Imperial County typically lasts from August through October. Extreme weather conditions during periods of low humidity, low fuel moisture, and high winds also contribute to the severity of any potential wildfires. Fires occurring during these times typically burn hot and fast and are difficult to control unless initial suppression occurs immediately. However, the potential for a wildfire in the county is very low due to the presence of agriculture and its desert environment.

Fire hazards exist at two different sites in the county, which are located at the fuel storage farms south of the City of Imperial and east of Niland. In the event of a fire, assistance from various fire departments within the county would be required. The threat of fire spreading and causing major problems to other areas of the county are minimal because of the isolated locations of the fuel storage farms.

Climate Change and Fire

Changing climate conditions are expected to increase the wildfire risk in and around Imperial County. Warmer temperatures are also expected to increase the number of pest outbreaks, such as the shot hole borer, creating more dead trees and increasing the fuel load. Warmer temperatures are also expected to occur later in the year, extending the wildfire season, which is likely to begin earlier in the year and extend later than it has historically. Wildfires occurring later or earlier in the year are more likely to occur during Santa Ana wind events, which can cause wildfires to move more quickly and increase the likelihood of burning in the wildland-urban interface areas.

HAZARDOUS WASTE AND MATERIALS

Hazardous materials are materials that pose a significant risk to public safety and environmental health. These include toxic chemicals, flammable or corrosive materials, petroleum products, and unstable or dangerously reactive materials. They can be released through human error, malfunctioning or broken equipment, or as an indirect consequence of other emergencies (e.g., if a flood damages a hazardous material storage tank). Hazardous materials can also be released accidentally during transportation, as a consequence of vehicle accidents.

A release or spill of bulk hazardous materials could result in fire, explosion, toxic cloud, or direct contamination of water, people, and property. The effects may involve a local site or many square miles. Health problems may be immediate, such as corrosive effects on skin and lungs, or gradual, such as the development of cancer from a carcinogen. Damage to property could range from immediate destruction by explosion to permanent contamination by a persistent hazardous material.

The majority of hazardous materials in the county are being transported by truck on Interstate (I-) 8, and State Route (SR-) 78, SR-86, SR-98, and SR-111. The most vulnerable areas along these routes are considered the on-/off-ramps and interchanges. Pipeline systems also carry hazardous materials, and under some conditions these pipelines can rupture and cause a release of hazardous materials. Liquid petroleum products are delivered to and are transported through the county via the 20-inch Santa Fe Pacific Pipeline. This line is generally located within the Southern Pacific Railroad right-of-way. The right-of-way follows the northwest to southeast trend of Imperial Valley and subsequently parallels the major faults. It passes near the east side of the Salton Sea and serves the storage facility at Niland.

These freeways are areas of concern, as are Union Pacific Railroad tracks that run roughly parallel to I-8, SR-86, and SR-111. In addition to highway traffic, other hazardous materials are transported through the county on the Southern Pacific Railroad. Since 1970, approximately 76 railway and roadway hazardous materials incidents have occurred in Imperial County.

Several state agencies monitor hazardous materials/waste facilities. Potential and known contamination sites are monitored and documented by the Department of Health Services (DHS) and the Regional Water Quality Control Board (RWQCB). A review of the leaking underground storage tank list produced by the RWQCB, and the Hazardous Waste and Substances Sites List produced by the Office of Planning and Research indicates hazardous waste sites throughout the county.

If an imminent public health threat is posed by an outside factor, the County will support local regulating agencies in notifying the public. The transport of hazardous materials/wastes and explosives through the county is regulated by the California Department of Transportation (Caltrans). I-8, SR-78, SR-86, SR-98, and SR-111 are open to vehicles carrying hazardous materials/wastes. Transporters of hazardous wastes are required to be certified by Caltrans and manifests are required to track the hazardous waste during transport. The danger of hazardous materials/waste spills during transport does exist and can potentially increase as transportation of these materials increases on freeways and railways. The Imperial County Sheriff's Department, Imperial County Fire Department, CAL FIRE, Imperial County Emergency Management Department, and Imperial County Public Health Department are responsible for hazardous materials accidents at all locations within the county.

Following is a summary of the largest concentrations of hazardous materials and sources of potential massive leaks or spills in the county:

- **Santa Fe Pacific Pipeline Tank Farm**. The Santa Fe Pacific Pipeline Tank Farm is at Aten Road and the Southern Pacific Railroad junction in the southeast quadrant of the City of Imperial. This facility is a component of the Santa Fe Pacific Pipeline network that delivers gasoline, diesel, and jet fuel to Southern California and Arizona. The tank farm contains 16 storage tanks, in varying sizes, with a total storage capacity of approximately 10 million gallons.
- **Naval Air Facility (El Centro)**. The Naval Air Facility (El Centro) is serviced by a four-inch fuel line directly from the Santa Fe Pacific Pipeline Tank Farm. Safety devices include manual and automatic shutoff valves, as well as pressure regulators. The facility also stores one million gallons of fuel, which is predominantly jet fuel, in underground tanks. Munitions storage is limited to aircraft and small arms training ammunition.
- **ST Services**. ST Services is south of the Santa Fe Pacific Pipeline Tank Farm and has the capacity to store 70,000 gallons of fuel.
- **Brea Agricultural Service**. Brea Agricultural Service is at 89 East Main Street in the City of Heber and serves as a chemical and fertilizer storage facility.
- **United Agriculture Products**. United Agriculture Products is at 2415 Clark Street in the City of Imperial. This facility handles hazardous wastes, chemicals, insecticides, and pesticides.
- **Puregro Company**. The Puregro Company is at 10th Street and River Drive in the City of Brawley. This facility handles chemicals and fertilizers.
- **Rockwood Chemical Company**. Rockwood Chemical Company is at 47 West Rutherford Road in Brawley. This facility handles chemicals and fertilizers.
- **Helena Chemical Products**. Helena Chemical Products is at 101 East Carey Road in the City of Brawley. This facility handles chemicals, fertilizers, insecticides, and pesticides.

- **Wilbur Ellis Company**. The Wilbur Ellis Company is at 45 West Danenberg Road in the community of Heber. This facility handles chemicals, fertilizers, insecticides, and pesticides.
- **Pipelines**. There are 89.92 miles of pipeline in Imperial County that transport hazardous material. Pipe sizes vary in size from 12 to 20 inches and the average size is 12 inches. Pipelines are adjacent to the Southern Pacific railroad tracks from the Arizona border at Yuma to the Niland tank farm, north to the Riverside County Line, and south to the Imperial tank farm. The pipeline system has section fuel-control valves.

Pursuant to Section 25500 et seq. of the California Health and Safety Code, the County Environmental Health Services Department is designated as the administering agency responsible for maintaining a list of handlers/vendors of toxics within the county. In addition, they are required to maintain, for each handler/vendor, an inventory and business plan. This information is also available to the County Fire Marshal and city fire departments. The Imperial County Emergency Plan lists the 10 largest concentrations of toxics in the county, which include: (1) Naval Air Facility El Centro; (2) Santa Fe Pacific Pipeline Tank Farm; (3) ST Services; (4) 89.92 miles of fuel pipelines; (5) Brea Agricultural Service; (6) United Agriculture Products; (7) Puregro Company: (8) Rockwood Chemical Company; (9) Helena Chemical Products; and (10) Wilbur Ellis Company.

The release of hazardous material into the environment could cause a multitude of problems. The release of explosive and highly flammable materials can cause fatalities and injuries, require large-scale evacuations, and destroy property worth millions of dollars. Toxic chemicals in gaseous form have caused injuries and fatalities among emergency response teams and passerby. Serious health problems have occurred where toxins have entered either surface or groundwater supplies. Releases of hazardous chemicals have been especially damaging when they have occurred in highly populated areas, or along heavily traveled transportation routes. The decree of threat posed to life and property is dependent on the type, location, and concentration of the material released, in addition to prevailing weather conditions such as precipitation, wind speed, and wind direction. Appendix C contains a summary of hazardous material storage sites, handlers, and vendors.

Potential and known contamination sites are monitored and documented by the RWQCB and the Department of Toxic Substances and Controls (DTSC). The RWQCB and the DTSC EnviroStor maintains a database with a list of all hazardous waste facilities and sites with known or suspected contamination issues in the county. Additionally, the State Water Resources Control Board maintains a data management system known as GeoTracker, which contains records for sites that require cleanup, such as Leaking Underground Storage Tank (LUST) sites, Department of Defense Sites, and Cleanup Program Sites. GeoTracker also contains records for various unregulated projects as well as permitted facilities.

The Laidlaw Environmental Services hazardous waste facility west of Westmorland is unique in the sense that a major wash traverses the site. Substantial engineering design was used to minimize flooding, and channel maintenance requirements have been implemented. While the facility does pose a potential risk, the continued monitoring and stringent design standards imposed on the facility have minimized the probability of a serious failure. Special reports on design requirements and risk concerns are on file at the Planning Department.

A second type of facility that is more predominant and more difficult to assess are the chemical handling and storage facilities and include distributors, transporters, and crop-dusting firms. These firms are not permitted to store the various hazardous chemicals in open areas, or in buildings not adequately protected from flood conditions. During severe flooding, the potential for these chemicals to be mixed with the floodwater can pose a potentially serious health concern.

Potential Changes to Hazardous Materials in Future Years

Likelihood of Future Occurrence

A hazardous material accident could occur in Imperial County due to the agricultural economy, proliferation of fuel tanks and transmission facilities, intricate canal system, and the confluence of major surface arteries and rail systems. Although a hazardous material accident can occur almost anywhere, certain regions are more vulnerable. The potential for an accident increases in regions near roadways or railways that are frequently used for transporting hazardous material as well as those with agricultural or industrial facilities that use, store, handle, or dispose of hazardous material.

Given that 76 hazardous materials incidents have happened in transport through the county in the past 50 years, it is likely a hazardous materials incident will occur in Imperial County every year. However, according to Caltrans, most incidents are related to releases of fluids from the transporting vehicles themselves and not the cargo, thus the likelihood of a significant hazardous materials release within the county is more limited and difficult to predict.

Climate Change and Hazardous Materials

Climate change is unlikely to affect hazardous materials transportation incidents. However, increases in the frequency and intensity of hazards, such as floods, landslides, and severe storms, may create a greater risk of hazardous materials releases during these events.

Lifelines and Critical Facilities

The disruption of lifelines and critical facilities can endanger the safety of the public. Lifelines refer to networks of services that extend over a wide area and are vital to the public welfare. Lifelines typically involve supply sources, transmission lines, storage facilities, and distribution systems. Damage to any one of these key elements might cause

loss of service to large areas or the entire service area. Lifelines can be classified into five categories: Energy, Water Transportation, Communication, Emergency Facilities, and Community Facilities. These categories circumscribe the lifelines indicated in Table 2.

TABLE 2 SUMMARY OF LIFELINES

	Energy	Water	Transpor-tation	Communi-cations	Emergency Facilities	Community Facilities
Type of Lifelines	Electricity Liquid Fuel Gas	Potable water Sewage Solid Waste	Highway Railway Airport Harbor	Telephone Telegraph Radio Television Mail Press	Fire stations Sheriff stations Emergency operations center Hospitals	Community centers Libraries Schools

Energy. Electricity is provided to the vast majority of Imperial County and the Coachella Valley area of Riverside County by the Imperial Irrigation District (IID). The transmission and distribution systems are moderately resistant to earthquakes. When parallel overhead power lines have too much slack or sag unevenly, they may come in contact with one another during an earthquake. The resulting arcing could cause conductors to burn and fall to the ground. If overhead powerlines are too taut, they could snap and fall to the ground from earthquake shaking. Overhead powerlines can also be broken by objects jostled from earthquake shaking, (e.g., trees, antennas). The entire electrical distribution system is protected by relays designed to prevent current overload. Seismic vibrations themselves can cause the relays to "trip" and cut off power. Such an abrupt power disruption could cause current overloads in other parts of the system. As a result, other relays could trip and cut off more power. Although the risk of serious damage to the distribution system is low, the risk of partial or total loss of power is fairly high.

The IID's generating facilities and sources of power are varied and dispersed across the County. The probability is low for all of the facilities being disrupted simultaneously. The main generating facilities are El Centro (180 megawatts), Brawley (18 megawatts), Rockwood (50 megawatts), and Coachella (80 megawatts). Hydroelectric facilities along the All-American Canal have a maximum capacity of 45 megawatts. All of these facilities are located in seismically active zones. The facilities are also located within 15 miles of each other with the exception of the Coachella plant and the hydroelectric facilities. The probability of all of the plants being disrupted during a seismic event is considered low. A break in the All-American Canal could also reduce electricity generation.

Liquid petroleum products are delivered to and are transported through the county via the 20-inch Santa Fe Pacific Pipeline. This line is generally within the Southern Pacific Railroad right-of-way. The right-of-way follows the northwest to southeast trend of Imperial Valley and subsequently parallels the major faults. It passes near the east side of the Salton Sea and serves the storage facility at Niland. Southeast of Ogilby, the line turns east and travels to Yuma. A six-inch branch line distributes gas to the storage facility south of Imperial and a four-inch line serves the Naval Air Facility near Seeley. The maintenance staff for the line anticipates no special problems from earthquakes or fault movement and are unaware of such a situation occurring in California in past years. A major break would take one to two days to repair.

The petroleum storage facilities in Niland and Imperial are vulnerable to earthquakes. Storage capacity at Niland is 77,500 barrels and at Imperial is 289,000 barrels. Storage tanks, however, are never full at one time but are normally filled 50 percent. The 1979 earthquake resulted in the rupture of one tank and a gasoline leak of 100 gallon per minute at the Imperial facility. The potential for a major disaster does exist. The probability of loss of all liquid petroleum in the County is low. Emergency service via tanker is readily available if required during an emergency situation.

Natural gas is delivered by the Southern California Gas Company via twin 10-inch lines that generally run south through the County in Range 14 East. These lines serve Niland, Calipatria, Brawley, Imperial, El Centro, Heber, and Calexico and branch lines serve Holtville, Westmorland, Seeley, Naval Air Facility, and Plaster City. Rural residents are served by laterals from the branch lines. The lateral lines typically do not exceed a quarter-mile in length.

The gas lines are less resilient to seismic stress than the liquid lines and the entire natural gas system is vulnerable to disruption. The lines were damaged from the 1979 earthquake. The north to south line was damaged in the area it crossed the fault. The line suffered compressive stress and a fitting buckled and resulted in a major leak. The leak was repaired without shutting down the line. The line to Holtville was stretched where it crossed the fault. The line did not break and was repaired without shutting down the line.

The natural gas network is much more extensive than the liquid petroleum system. Leaks are more insidious. The risk of an explosion or fire is greater. The most serious potential hazards are at the customer service connections. Gas connections to hot water heaters are notably vulnerable to seismic shaking.

The biggest potential problem would result from damage that required shutting the natural gas delivery system down. A major rupture of the 10-inch line would be difficult to repair. Once pressure was lost and air entered the system, a total shut down would be required. Service personnel would have to visit the customer connections at each twice. The initial visit would be required to ensure that the gas was turned off. The second visit would be required to turn the gas back on, bleed the air, and assist in relighting fixtures. This would be a massive job that would take weeks. The main purpose of the twin lines is to avoid this type of disaster.

Water and Sewer. About 70 percent of the population is provided potable water for domestic purposes from municipal water systems, which are primarily served by the IID. Rural residents obtain potable water from truck delivery companies, such as the AAA Company, or from individual wells. IID operates 1,700 miles of canals; and the Coachella Irrigation District operates 83 miles of canals that traverse the County. The entire system is vulnerable to disruption by earthquakes. Approximately half of the system could generate flooding from a break. IID has adopted the Disaster Readiness Standard Operating Procedure to respond to earthquakes and other emergencies.

Several communities in the county are provided sewer service by municipal districts. Earthquakes can rupture lines and affect lift station operations. These problems are not considered serious. Unless the seismic event totally disables the treatment plant, sewage can be transported using alternative means such as portable pumps and lines. In the event of a complete plant failure, temporary evaporation ponds could be utilized for the interim repair period.

Transportation. The county is well served by a variety of transportation routes that are unlikely to be so extensively damaged by a natural disaster as to endanger the public safety due to disruption of lifelines. I-8 to San Diego County is the most critical because it goes through mountainous terrain. No other convenient surface route to the metropolitan San Diego area exists. The Southern Pacific Railroad line along the east side of the Salton Sea is also endangered by its proximity to the San Andreas Fault. Severe damage to either of these facilities is likely to significantly impact local and interstate commerce, but not substantially threaten public safety.

Communications. The telephone system in the county is the most elaborate communication network in the country. The equipment and facilities can withstand earthquakes up to 8.0 magnitude on the Richter scale. An Emergency Preparedness Plan has been developed by the telephone company. The telephone network is designed to service 60 percent of the customers requesting dial tone.

The telephone system was not damaged by the 1979 earthquake but was overloaded with attempted phone calls within minutes of the earthquake and remained essentially inoperative for up to 18 hours in parts of the county. There is a high probability that the telephone system would be significantly dysfunctional following a major earthquake. Due to problems with the telephone system immediately after the 1979 earthquake, the IID installed its own in-house telephone system that uses a microwave system. The microwave towers have been designed to withstand the most severe earthquake.

Critical Facilities. This refers to site specific facilities that serve to maintain the health, safety, and general welfare of the public. Critical facilities can serve the public under normal circumstances (e.g., hospitals, fire stations, water reservoirs, and power plants) or under emergency circumstances (e.g., emergency operating centers, armories, or disaster supply warehouses). The *Imperial County Emergency Plan* provides specific details on functional, organizational, and operational concepts and procedures for the provision of critical services during an emergency. This includes overall management of emergency

operations, fire and rescue, law enforcement and traffic control, medical, public health, coroner, care and shelter, evacuation movement, construction and engineering, and resources and support operations.

DISASTER PREPAREDNESS, RESPONSE, AND RECOVERY

Imperial County Emergency Services establishes the responsibilities of the various Imperial County agencies in times of a disaster. Disaster preparedness and response planning include identifying short-term actions to reduce the scope of an emergency and managing necessary resources in the event of a disaster. After any disaster, particularly an earthquake, short-term disaster recovery requires many operations that are less urgent than fire suppression or medical attention but are equally important.

Emergency Preparedness

Emergency preparedness activities in Imperial County are conducted through the Imperial County Office of Emergency Services (OES). OES provides emergency management services for the county and Operational Area, which includes its seven cities, towns, and special districts. OES coordinates emergency operations activities among all the various local jurisdictions and develops written guidelines for emergency preparedness, response, recovery, and mitigation to natural, human-made disasters, and technological disasters. OES is mandated by the California Emergency Services Act (Chapter 7, Division 1, Title 2 of the California Government Code) to serve as the liaison between the state and local government political subdivisions comprising Imperial County.

The Imperial County Fire Department and CAL FIRE are prepared to handle most everyday emergencies, such as all types of fire, medical, or hazardous situations. However, during a disaster, the number and scope of incidents may exceed the fire department's and CAL FIRE's ability to provide effective emergency services. For this reason, the Imperial County Public Health Department provides the public with access to a community emergency response team (CERT) training program. The CERT Program provides for community and employee self-sufficiency to meet the general public's urgent life-saving and sustenance needs until emergency personnel arrive. The CERT Program educates people about disaster preparedness and trains them in basic response skills, such as fire safety, light search and rescue, and disaster medical operations. CERT members assist their fellow citizens and coworkers in their community or workplace following a disaster. CERT members take an active role in their community by preparing for a disaster, thus reducing their own impact risk.

Imperial County uses alert systems such as the Emergency Alert Systems (EAS) and the Emergency Digital Information System (EDIS).

The EAS is a national public warning system commonly used by state and local authorities to deliver important emergency information, such as weather and AMBER alerts, to affected communities. EAS participants – radio and television broadcasters, cable systems, satellite radio and television providers, and wireline video providers. FEMA, the Federal Communications System, and the National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS) work collaboratively to maintain the EAS

and Wireless Emergency Alerts, which are the two main components of the national public warning system and enable authorities at all levels of government to send urgent emergency information to the public. The EDIS is a wireless based emergency and disaster information service operated by the State of California Governor's Office of Emergency Services and is an enhancement to the EAS. These systems are available in multiple languages.

Disaster Preparedness

In recent years, Imperial County has expanded its emergency preparedness planning. The County is required under state law to prepare and maintain a Standardized Emergency Management System (SEMS) Multi-hazard Functional Plan. The California Governor's Office of Emergency Services has extensive guidelines outlining the requirements of the Imperial County SEMS.

Evacuation Needs

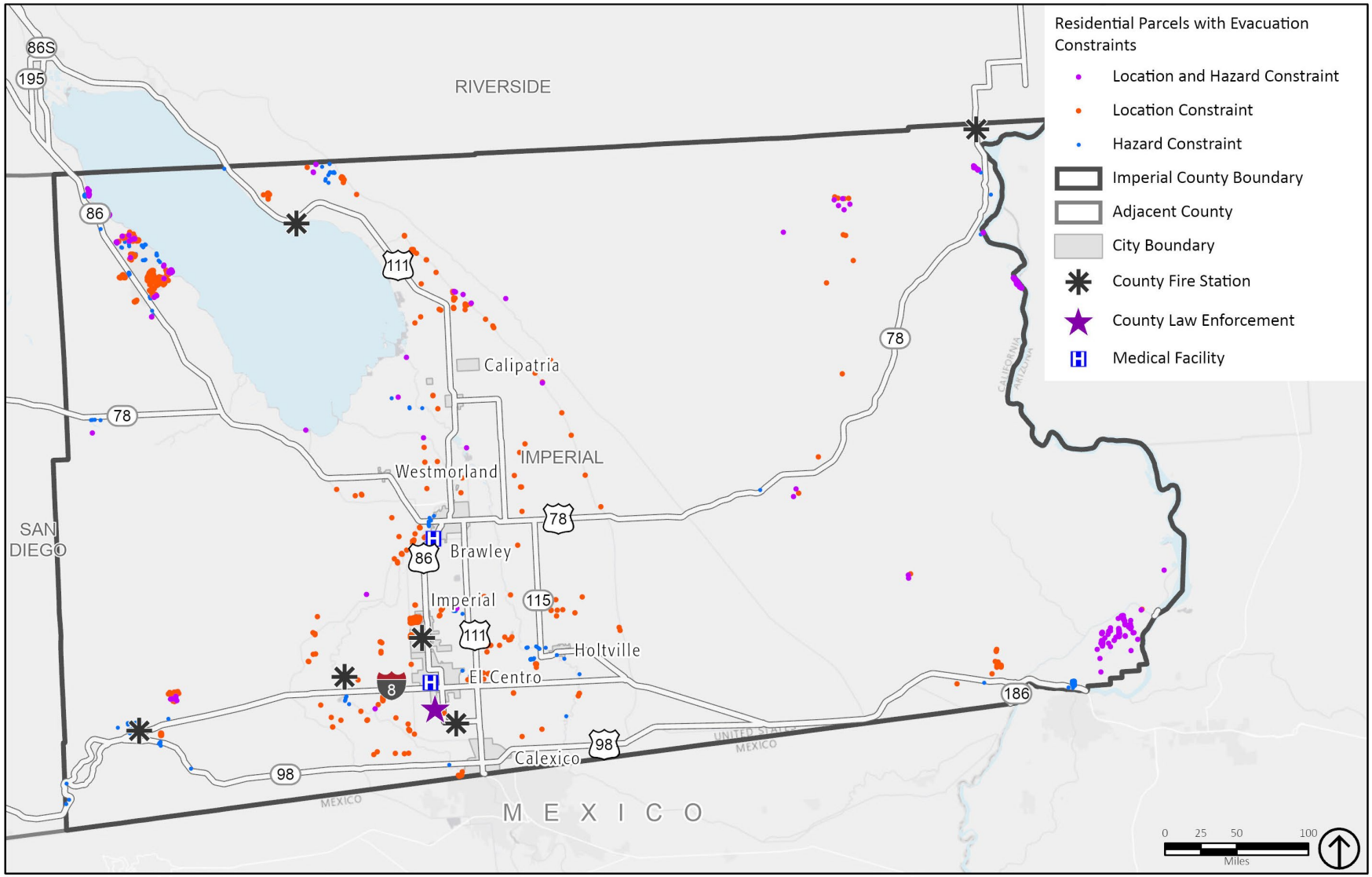
Some natural disasters or other public safety events may require evacuation of parts of Imperial County. In some instances, these evacuations may be limited to a particular neighborhood or street. In other instances, entire communities may need to evacuate. To allow for a safe and effective evacuation, all community members should be able to easily access an evacuation route that allows them to safely travel out of the evacuation zone. If there is limited access to evacuation routes or if these routes cannot accommodate evacuation traffic, evacuation efforts may be severely hampered by slow traffic and collisions, which can put community members at risk. Evacuation constraints can also slow down the public safety response by hindering access by emergency responders.

Figure 10 shows residential areas with only one access point, which face a higher risk of evacuation constraints. These include areas located on dead-end routes, are at least half a mile from a major roadway, or cannot be reached by at least two roads.

Mutual Aid Agreements

Additional emergency management and response services for jurisdictions throughout the county are provided through a mutual-aid agreement with the Imperial County Fire Department and CAL FIRE. The Imperial County Fire Department and CAL FIRE provide a variety of public safety services, including fire protection, medical aid, rescue, hazardous materials response, and educational safety programs.

FIGURE 10 – RESIDENTIAL PARCELS WITH EVACUATION CONSTRAINTS



Source: PlaceWorks, 2021

ADDITIONAL CLIMATE-RELATED HAZARDS

Drought

A drought is a long period when precipitation levels are well below normal. Imperial County chronically experiences drought cycles. Drought makes less water available for people, businesses, agricultural activities, and natural systems. Less snow falling in mountainous areas causes water levels in lakes and reservoirs to drop, which can affect recreation activities. Local ecosystems that are not well adapted to drought conditions can be more easily harmed by it. During drought events, the flow of water in creeks and streams is reduced, creating more slow-moving or standing water. This can concentrate sediment and toxins in the low water levels, causing harm to plants and animals. Many fish species also prefer specific streamflow speeds, especially for spawning and egg incubation, and changes to stream velocity as a result of drought conditions can affect reproduction. Droughts can also indirectly lead to more wildfires, and the stress caused by water shortages can weaken plants, making them more susceptible to pests and diseases.

The U.S. Drought Monitor recognizes a five-point scale for drought events: D0 (abnormally dry), D1 (moderate drought), D2 (severe drought), D3 (extreme drought), and D4 (exceptional drought). According to the U.S. Drought Monitor, the most intensive drought conditions in recent years occurred during most of 2007, when all of Imperial County was classified as being in “extreme” drought. As of summer 2021, Imperial County, was classified as being in “moderate” drought.

Potential Changes to Drought in Future Years

Likelihood of Future Occurrence

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

Based on historical information, the occurrence of drought in California, including Imperial County, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users. The vulnerability of Imperial County to drought is countywide, but impacts may vary and include reduction in water supply, agricultural losses, and an increase in dry fuels.

Most of the imported water comes from the Colorado River. Reduced winter precipitation levels and warmer temperatures have greatly decreased the size of the Colorado River Basin snowpack (the volume of accumulated snow), which in turn makes less freshwater

available for communities throughout California who rely on this water. Continued decline in the Colorado River Basin snowpack volume is expected, which may lead to lower volumes of available imported water.

Climate Change and Drought

Although droughts are a regular feature of California's climate, scientists expect that climate change will lead to more frequent and more intense droughts statewide. Overall, precipitation levels are expected to stay similar, and may even increase in some places. However, the state's current data say that there will be more years with extreme levels of precipitation, both high and low, as a result of climate change. This is expected to cause more frequent and intense droughts compared to historical norms. Higher air temperatures are expected to increase evaporation, causing more water loss from lakes and reservoirs, exacerbating drought conditions.

Extreme Heat

While there is no universal definition of extreme heat, California guidance documents define extreme heat as temperatures that are hotter than 98 percent of the historical high temperatures for the area, as measured between April and October of 1961 to 1990. Days that reach this level (an average of 112.5-degrees Fahrenheit (°F) across all of Imperial County, although this threshold varies by location) are called extreme heat days. An event with five extreme heat days in a row is called a heat wave. Extreme heat is any period of time when the temperatures are well above the usual level. This level is relative to the area, which means that extreme heat events may occur anywhere in Imperial County, even though temperatures to the east of North Algodones Dunes Wilderness will almost always be the hottest.

Health impacts are the primary concern with this hazard, though economic impacts can also occur. The Centers for Disease Control and Prevention (CDC) recognizes extreme heat as a substantial public health concern. Historically, NOAA data indicates that about 175 Americans succumb to the demands of summer heat, although this number has increased in recent years. From 2004 to 2018, studies by the U.S. Department of Health and Human Services indicate that there is an average of 702 deaths annually that are directly or indirectly linked to extreme heat.

Extreme heat events are dangerous because people exposed to extreme heat can suffer a number of heat-related illnesses, including heat cramps, heat exhaustion, and (most severely) heat stroke. Elderly persons, small children, persons with chronic illnesses, and those on certain medications are particularly susceptible to reactions from extreme heat. The elderly and individuals below the poverty level are the most vulnerable to extreme heat. Nursing homes and elder care facilities are especially vulnerable to extreme heat events if power outages occur, and air conditioning is not available. In addition, individuals below the poverty level may be at increased risk to extreme heat if use of air conditioning is not affordable and indoor air temperature reach unhealthy levels. Areas with lower extreme

heat thresholds are not necessarily at lower risk, as persons and community assets used to cooler temperatures may be less prepared for extreme heat events.

Very high temperatures can harm plants and animals that are not well adapted to them. This includes wild ecosystems as well as farm crops and livestock. Extreme heat can increase the temperature of water in lakes, streams, creeks, and other water bodies, especially during drought events when water levels are lower. In some cases, water temperatures may exceed comfortable levels for a number of plants and animals, causing ecological harm. Extreme heat is expected to have a severe effect on agriculture. Excessive heat and prolonged dry or drought conditions can impact agriculture by creating worker safety issues for farmworkers, severely damaging crops, and reducing availability of water and food supply for livestock. Outdoor workers are much more exposed to the elements than most people, so they are more susceptible to extreme heat conditions and the potential illnesses associated with very high temperatures. Additionally, excessive heat can cause high levels of mortality among livestock as well as damage to crops.

Indirectly, extreme heat puts more stress on power lines, causing them to run less efficiently. The heat also causes more demand for electricity (usually to run air conditioning units), and in combination with the stress on the power lines, may lead to brownouts and blackouts.

Potential Changes to Extreme Heat in Future Years

Likelihood of Future Occurrence

Extreme heat tends to occur on an annual basis in Imperial County and is likely to continue occurring annually. Due to Imperial County's desert environment, extremely high temperatures will continue to be a more common occurrence than cold temperatures.

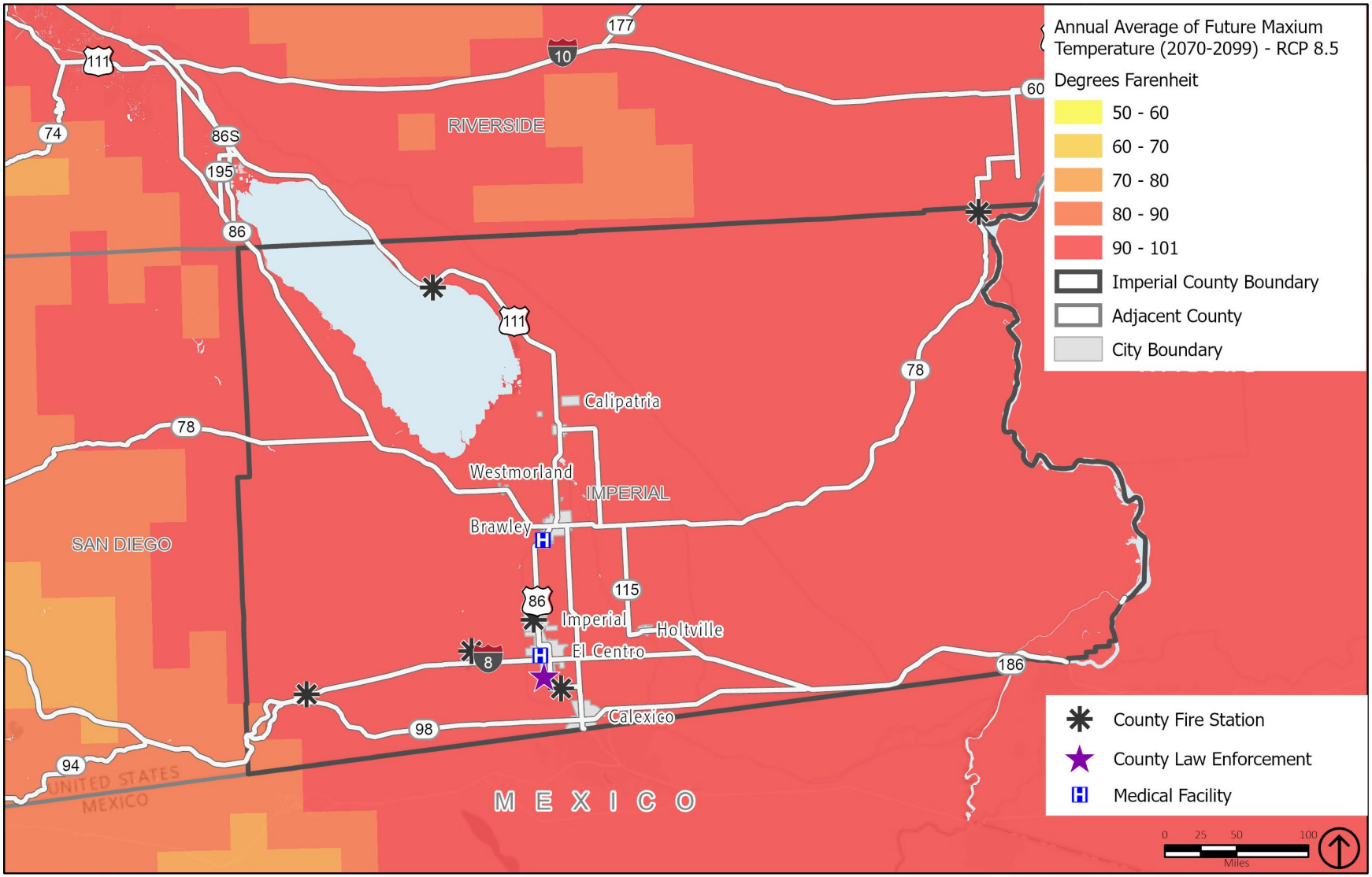
Climate Change and Extreme Heat

The warmer temperatures brought on by climate change are likely to cause an increase in extreme heat events in different regions of Imperial County. Depending on the location and emissions levels, the state Cal-Adapt database indicates the number of extreme heat days is expected to rise from a historical annual average of 4 to 36 by the middle of the century (2035 to 2064), and to 67 by the end of the century (2070 to 2099), depending on the severity of climate change and the specific location. Cooler areas may see about as many extreme heat days as warmer areas. Figure 11 shows the projections of temperature increase in the future with the average annual maximum temperature.

Overall, Imperial County is expected to see an increase in the average daily high temperatures. Although the temperature increases may appear modest, the projected high temperatures are substantially greater than historical norms. These increases also make it more likely that an above-average high temperature will cross the extreme heat threshold. As temperatures increase, Imperial County residents will face increased risk of death from

dehydration, heat stroke, heat exhaustion, heart attack, stroke, and respiratory distress caused by extreme heat. Climate change can also indirectly create a greater risk of agriculture pests and diseases. Many crop plants, trees, and livestock may be harmed and consequently weakened by extreme heat and warmer temperatures. The weaker plants and animals may not be able to fend off infestations or infections as well as a stronger plant or animal, causing pests and diseases to affect more of the population. These pests and diseases can cause plants and animals to grow slower, damage crops so their products are less appealing and harder to sell, or even kill them.

FIGURE 11 – PROJECTIONS OF TEMPERATURE INCREASE



Source: Cal Adapt

Severe Weather

Severe weather is generally any destructive weather event, but usually occurs in Imperial County as localized storms that bring heavy rain, hail, lightning, and strong winds. Severe weather is usually caused by intense storm systems, although types of strong winds can occur without a storm. The types of dangers posed by severe weather vary widely and may include injuries or deaths, damage to buildings and structures, fallen trees, roads and railways blocked by debris, and fires sparked by lightning. Severe weather often produces high winds and lightning that can damage structures and cause power outages. Lightning from these storms can ignite forest and structure fires that can cause damage to buildings and endanger people. Objects can also be struck directly, which may result in an explosion, burn, or total destruction.

Imperial County is especially vulnerable to windstorms and thunderstorms in the spring (primarily in March) and the late summer. Power lines are susceptible to collapse from windstorms and thunderstorms, putting the electrical delivery infrastructure at high risk. While tornados have been relatively rare in Imperial County, they do occur and can be quite destructive. In Imperial County, most severe weather is linked to high winds. High winds, often accompanying severe storms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss.

Santa Ana winds have caused large amounts of damage and increased the fire damage level dramatically. Santa Ana winds are generally defined as warm, dry winds that blow from the east or northeast (offshore). These winds occur below the passes and canyons of the coastal ranges of Southern California. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon. The complex topography of Southern California, combined with various atmospheric conditions, creates numerous scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Nevada and west of the Rocky Mountains, including most of Nevada and Utah). Santa Ana winds commonly occur between October and February with December having the highest frequency of events. Summer events are rare. Wind speeds are typically north to east at 40 miles per hour (mph) through and below passes and canyons with gusts to 58 mph. Stronger Santa Ana winds can have gusts greater than 69 mph over widespread areas and, in rare instances, gusts greater than 115 mph in specific areas. Frequently, the strongest winds in the basin occur during the night and morning hours due to the absence of a sea breeze.

All wind events, including Santa Ana winds, pose several different types of threats. By themselves, the winds pose a threat to the health of people and structures in the county. Dust and plant pollen blown by the wind can create breathing problems. The winds can blow roofs off buildings and cause tree limbs to fall on structures. High winds also increase the threat of wildfires. Winds may dry out brush and forest areas, increasing the fuel load in fire-prone areas. Winds may spark wildfires by knocking down power lines or causing them

to arc. If fires do start, high winds can push flames quickly into new areas, contributing to rapid spread of wildfires and making them harder to control.

Potential Changes to Severe Weather in Future Year

Likelihood of Future Occurrence

According to historical hazard data, severe weather is an annual occurrence in Imperial County. Thunderstorms, heavy winds, heavy rainfall, dust storms, and tornados have all caused damage to Imperial County in the past and will occur in the future. Moreover, disaster declarations related to severe weather have occurred and will continue to occur in the future.

Heavy rain and thunderstorms are the most frequent type of severe weather occurrences in the county. Wind and lightning often accompany these storms and have caused damage in the past. However, actual damage associated with the primary effects of severe weather have been limited. It is the secondary hazards caused by weather, such as floods, fire, and agricultural losses that have had the greatest impact on the county.

Climate Change and Severe Weather

Climate change is expected to cause an increase in intense rainfall, which is usually associated with strong storm systems. This means that Imperial County could see more intense storms in the coming years and decades, possibly causing an increase in the frequency of severe weather events and any associated hazards. Such an increase may not affect all forms of severe weather and may not always be apparent. However, severe wind and dust storms are likely to increase in severity and frequency throughout the county.

While average annual rainfall may increase or decrease slightly, climate change is expected to cause an increase in the number of years with intense levels of precipitation. Heavy rainfall can increase the frequency and severity of other hazards, including flooding and landslides. Some already-rare forms of severe weather, such as tornados, are not expected to increase in a noticeable way.

Appendix A: Vulnerability Assessment Results

The following table shows the results of the Vulnerability Assessment prepared for Imperial County, in accordance with the requirements of Senate Bill 379. For each population or asset that may be vulnerable to each climate-related hazard, the population or asset is scored on a scale of zero to five:

0: Not vulnerable

V1: Minimal vulnerability

V2: Low vulnerability

V3: Moderate vulnerability

V4: High vulnerability

V5: Severe vulnerability

The vulnerability scores reflect both the severity of climate-related impacts and the ability of populations and assets to resist and recover from these effects. Refer to the “Climate Change Vulnerability” and “Vulnerability Assessment” sections of the Seismic and Public Safety Element for additional details on the Vulnerability Assessment method.

POPULATIONS AND ASSETS	Agricultural and Forestry Pests	Air Quality	Drought	Extreme Heat	Flood	Human Health Hazards	Landslides	Severe Weather	Wildfire
POPULATIONS									
Children	-	V4	-	V4	V3	V3	V3	V3	V4
Cost-burdened households	-	V3	V3	V3	V3	V3	V2	V3	V3
Households in poverty	-	V4	V4	V4	V5	V5	V3	V5	V4
Immigrants and refugees	-	V5	V3	V4	V4	V4	V3	V4	V4
Incarcerated and formerly incarcerated individuals	-	V4	V4	V5	V3	V5	V3	V4	V5
Linguistically isolated populations	-	V4	V3	V3	V3	V3	V2	V3	**V3**
Low-income households	-	V3	V3	V4	V4	V3	V2	V3	V3
Outdoor workers	V5	V5	V4	V5	V4	V5	V3	V5	V5
Persons experiencing homelessness	V5	V5	V4	V5	V5	V5	V3	V5	V5
People living in mobile homes	-	V3	V4	V4	V5	V3	V2	V3	V3
Persons in overcrowded households	-	V3	-	V3	-	V4	V2	V3	V3
Persons with chronic illnesses	-	V4	-	V5	V4	V4	V2	V4	V4
Persons with disabilities	-	V3	-	V4	V2	V3	V2	V3	V3
Households that lack internet access	-	V3	-	V3	V4	V3	V3	V3	V4
Households that lack a private vehicle	-	V3	-	V2	V4	V3	V3	V3	V3

POPULATIONS AND ASSETS	Agricultural and Forestry Pests	Air Quality	Drought	Extreme Heat	Flood	Human Health Hazards	Landslides	Severe Weather	Wildfire
Households that lack access to municipal treated water	-	-	V5	V3	V3	V2	V2	V3	-
Renters	-	V3	V3	V2	V2	V2	V2	V3	V3
Seniors	-	V4	-	V4	V3	V4	V2	V3	V3
Seniors living alone	-	V5	-	V4	V4	V5	V3	V4	V4
Tribal communities	-	V3	V5	V4	V3	V3	V5	V3	V3
Winter residents ("snowbirds")	-	V1	-	V2	-	V3	-	V3	V2
Airport	-	-	-	V3	V3	-	V2	V3	-
Biking and hiking trails	-	-	-	V1	-	-	V2	V2	V3
Bridges	-	-	-	V3	V4	-	-	V3	-
Canals	-	-	-	-	V3	-	V3	V3	-
Communication facilities	-	-	-	V3	-	-	V1	V3	V3
Dams/Reservoirs	-	-	-	-	V2	-	-	V1	-
Electrical substations and transmission lines	-	-	-	V4	V4	-	V3	V4	V3
Electric vehicle charging stations	-	-	-	V3	V2	-	-	V1	-
Evacuation routes	-	-	-	V4	V4	-	V3	V4	V3
Flood-control infrastructure	-	-	-	-	V3	-	V2	V2	-
Hazardous materials sites	-	-	-	-	V3	-	V3	-	-

POPULATIONS AND ASSETS	Agricultural and Forestry Pests	Air Quality	Drought	Extreme Heat	Flood	Human Health Hazards	Landslides	Severe Weather	Wildfire
Major roads and highways	-	-	-	V4	V5	-	V3	V3	V2
Natural gas pipelines	-	-	-	-	V2	-	V5	-	-
Parks and open space	V4	-	V3	V2	V3	-	V4	V3	V3
Power plant	-	-	-	V3	V4	-	-	V4	V2
Railways	-	-	-	V4	V4	-	V2	V3	-
Single-access roads	-	-	-	V3	V4	-	V5	V4	V3
Solid waste facilities and closed landfills	-	-	-	-	V3	-	V3	V2	-
Transit stops	-	-	-	V3	V3	-	V1	V4	-
Water and wastewater infrastructure	V4	-	V2	V2	V4	-	V4	V3	-
Commercial centers	-	-	-	V1	V3	-	V2	V3	V3
Community centers and libraries	-	-	-	V2	V3	-	V2	V1	V3
Emergency shelters/cooling centers	-	-	-	V3	V3	-	V3	V3	V4
Government buildings	-	-	-	V1	V3	-	V2	V1	V1
Homes and residential structures	-	-	-	V3	V4	-	V3	V4	V2
Medical and care facilities	-	-	-	V3	V3	-	V3	V3	V3
Public safety buildings	-	-	-	V1	V2	-	V3	V2	V2
Schools	-	-	-	V3	V3	-	V3	V3	V1

POPULATIONS AND ASSETS	Agricultural and Forestry Pests	Air Quality	Drought	Extreme Heat	Flood	Human Health Hazards	Landslides	Severe Weather	Wildfire
Agricultural land	V4	V4	V5	V5	V4	V3	V3	V3	V3
Historic and cultural resources	V2	V3	V3	V3	V4	V3	V4	V4	V3
Industrial/manufacturing centers	-	-	V2	V3	V3	V3	V2	V3	V3
International ports of entry	-	-	-	V2	V2	V4	-	V2	-
Livestock and grazing lands	V4	V4	V5	V4	V3	V3	-	V3	V4
Local businesses	-	V3	V2	V3	V3	V4	V2	V3	V3
Major employers	V3	-	V4	V2	V2	V4	-	V2	V2
Mining operations	-	-	V3	V3	V4	V3	V3	V2	V3
Military bases	-	-	V3	V2	V3	V3	V2	V2	V2
Outdoor recreation	-	-	-	-	-	-	V3	-	-
State and national protected lands	V3	V4	V4	V5	V3	V2	V4	V1	-
Water recreation sites	V3	V3	V5	V5	V4	V3	V3	V2	V4
Algodones Dunes	-	-	V1	V1	V4	-	V2	V2	V3
Aquatic habitat	-	-	V5	V3	V3	-	V2	V3	V4
Bird habitats	V3	V3	V5	-	V3	-	V3	V3	V3
Mineral resources	-	-	-	-	-	-	-	-	-
Ocotillo-Coyote Wells Sole Source Aquifer	-	-	-	-	-	-	-	-	-

POPULATIONS AND ASSETS	Agricultural and Forestry Pests	Air Quality	Drought	Extreme Heat	Flood	Human Health Hazards	Landslides	Severe Weather	Wildfire
Riparian forest and woodland	V4	-	V4	V4	V3	-	V3	V2	V3
Sensitive habitats and conservation areas	V3	V3	V3	V3	V3	-	V3	V3	V3
Sonoran Desert scrub	V2	-	V3	V1	V3	-	V3	V2	V3
Wetlands	V3	-	V4	V5	V2	-	V3	V3	V4
Woodland	V4	-	V4	V4	V1	-	V3	V3	V3
Communication services	-	-	-	V3	V3	-	V4	V4	V3
Emergency medical response	-	V3	V2	V2	V2	V4	V2	V2	V4
Energy delivery	-	V1	V3	V5	V3	-	V4	V5	V4
Food-providing agencies and organizations	V3	V3	V3	V3	V3	V3	V3	V2	V3
Freight and shipping	-	-	-	V3	V3	V3	V3	V3	V3
Government administration and community services	-	V2	-	V1	V1	V1	V1	V2	V2
Public safety response	-	V2	V3	V2	V3	V3	V3	V3	V3
Public transit access	-	V3	-	V4	V4	V2	V3	V4	V4
Solid waste removal	-	V3	-	V3	V3	V2	V3	V3	V4
Water and wastewater	-	-	V4	V3	V5	-	V4	V2	V3

III. GOALS AND POLICIES

A. PREFACE

The Seismic and Public Safety Element of the General Plan is to be consulted in the implementation of development policies and land uses in Imperial County. This chapter of the Seismic and Public Safety Element presents Imperial County's goals and policies relative to all land use decisions within the unincorporated areas of the county.

The goals and policies, combined with the implementation programs in Chapter IV, are the statements that shall provide direction for private development as well as government actions and programs. Imperial County's goals and policies are intended to serve as long-term principles and policy statements representing ideals that have been determined by the citizens as being desirable and deserving of community time and resources to achieve. These goals and policies are important guidelines for public safety decision making. However, it is recognized that other social, economic, environmental, and legal considerations are involved in land use decisions and that these goals and policies, and those of the other General Plan elements, should be used as guidelines rather than doctrines.

B. GOALS AND POLICIES

Land Use Planning and Public Safety

Goal 1: Integrate public health and resilience into land use planning.

Policy 1.1 Incorporate data on areas with geological and seismic hazards into the land use review process and future development processes. As development is proposed, developers shall be required to provide information related to these hazards.

Policy 1.2 Incorporate Federal Emergency Management Agency (FEMA)-required updates to Section 91600 of the Imperial County Code of Ordinances.

Policy 1.3 Regulate development adjacent to or near all mineral deposits and geothermal operations.

Policy 1.4 Require seismic risks be avoided, when feasible, and mitigation measures, commensurate with risks, be taken to reduce injury, loss of life, destruction of property, and disruption of service.

Policy 1.5 Collaborate with local, state, and federal agencies and the private sector to minimize risk of disruption to critical facilities and lifelines.

Policy 1.6 Ensure natural hazards are considered when siting critical facilities, as well as the extent to which the range, frequency, and intensity of environmental hazards may change due to climate change, as applicable.

Policy 1.7 Reduce fire hazards through fire safe design and the siting of new developments and critical facilities outside of very high fire hazard severity zones.

Policy 1.8 Encourage the reclamation and management of lands where mining, irrigation, landfills, solid waste, hazardous materials/waste storage or disposal, and natural soil erosion has occurred, so as to pose no danger to public health and safety.

Policy 1.9 Work with the Imperial Irrigation District and agriculture water users to underground open canals adjacent to and within urban areas to prevent accidental drownings, without placing unreasonable cost burden on agricultural water users.

Policy 1.10 Restrict residential development on unsuitable lands, recognizing that prohibition or restriction of residential uses are in the public interest, health, and safety.

Seismic and Geologic Hazards

Goal 2: Avoid loss of life, injury, and property damage from seismic and geologic hazards

Policy 2.1 Ensure that no structure for human occupancy, other than one-story wood-frame structures, shall be permitted within 50 feet of an active fault trace, as designated on maps compiled by the State Geologist under the Alquist-Priolo Geologist Hazards Zone Act.

Policy 2.2 Require new development in areas prone to geologic hazards (e.g., landslides, slope instability) to be adequately protected against these hazards. Any development in hillside areas shall prepare drainage plans to direct runoff and drainage away from potentially unstable slopes. New developments shall incorporate hillside design techniques and features to mitigate and support slope stability.

Policy 2.3 Require that geological and geotechnical investigations for new development proposals in areas with potential earthquake-induced liquefaction, landslides, or settlement. To the extent feasible, the County will limit intensive developments and land uses along rivers and waterways where it is likely that erosion could cause property damage or threaten life during high-precipitation events.

Policy 2.4 Encourage building retrofits that improve resiliency to geologic and seismic hazards.

Policy 2.5 Participate in local and regional emergency preparedness planning efforts with public and quasi-public agencies (e.g., the Imperial County Sheriff's Office, the Imperial County Fire Department, Caltrans District 11) to ensure the continued functionality of major utility services and roadways in the event of a major earthquake.

Policy 2.6 Implement development restrictions and seismic study requirements around active faults pursuant to the Alquist-Priolo Act to ensure that potential impacts of seismic hazards are mitigated.

Policy 2.7 Require suppliers of all existing utilities that cross active faults to file with the County an operation plan describing the probable effects of failures at the fault and the various emergency facilities and procedures that exist to ensure that failure does not threaten public safety.

Policy 2.8 Maintain an inventory of unreinforced masonry structures in compliance with California's Unreinforced Masonry Law.

Policy 2.9 Promote the development of groundwater recharge basins outside of areas with increased potential for liquefaction resulting from an earthquake.

Policy 2.10 Require that grading activities preserve natural features, including vegetation, terrain, watercourses, and similar resources, wherever feasible.

Policy 2.11 Reduce the risk of damage due to subsidence resulting from extraction of groundwater and geothermal resources by appropriate regulation.

Flood Hazards

Goal 3: Minimize the risk of life and injury, damage to property, and economic and social dislocations resulting from flooding and inundation hazards.

Policy 3.1 Require all projects in the county to address and mitigate adverse impacts to the carrying capacity of local and regional storm drains.

Policy 3.2 Update stormwater infrastructure design requirements as needed to maintain consistency with federal, state, and local regulatory requirements, prioritizing vulnerable communities.

Policy 3.3 Ensure that new development projects and retrofits to existing large-scale projects incorporate design strategies and features to reduce the area of

impervious surfaces and flood risks with natural drainage, as well as groundwater replenishment.

Policy 3.4 Require all new development for human occupancy within the 100-year floodplain to be adequately flood-proofed.

Policy 3.5 Prohibit development along rivers and waterways that would reduce stream capacity, increase erosion, or cause deterioration of the channel.

Policy 3.6 Promote flood-control measures that maintain natural conditions within Imperial County's regulatory floodplain of rivers and streams.

Policy 3.7 Continue to assess the flood risk within Imperial County, identify areas of poor drainage, and install new or upgraded existing drainage facilities and infrastructure at risk. Use natural or green infrastructure to the extent possible.

Policy 3.8 Collect and maintain data from the Federal Emergency Management Agency (FEMA) and Department of Water Resources (DWR) regarding potential flood hazards within the county and ensure that information is made publicly available to community members to serve as an educational resource.

Policy 3.9 Discourage development within the 100-year floodplain. Where not feasible or existing development is within the 100-year flood zone, require development to be consistent with Federal Emergency Management Agency (FEMA) floodplain regulations to minimize risks associated with flood hazards, including requiring structures for human occupancy and roadways to be constructed above the projected profile of a 100-year flood event.

Policy 3.10 Coordinate with the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, the Resource Conservation District, the Federal Emergency Management Agency, the California Department of Water Resources, and the Imperial Irrigation District, in defining existing and potential flood-problem areas.

Policy 3.11 Continue to assess the dam inundation risk within the county and upgrade facilities and infrastructure at risk.

Fire Hazards

Goal 4: Avoid the loss of life, injury, and minimize property damage from urban and wildland fires.

Policy 4.1 Enforce fire-safe development codes to use as standards and regulations for fire protection in accordance with the California Building Code, the California Fire Code, California Public Resources Code, and the County Municipal

Code for building and landscaping, and the Imperial County Fire Department regulations for new development in State Responsibility Areas or Very High Fire Hazard Severity Zones that meet or exceed the statewide minimums in the State Responsibility Area Fire Safe Regulations.

Policy 4.2 Require proposed development in High or Very High Fire Hazard Severity Zones to be located where fire and emergency services are available or will be constructed as part of the proposed development activities.

Policy 4.3 Prior to approval of new developments proposed in areas of very high, high, or moderate fire hazard, as designated on maps maintained by CAL FIRE, applicants shall demonstrate compliance with fire safety regulations and local regulations for defensible space, ignition-resistant construction materials, property maintenance to reduce fuels, natural hazards disclosure requirements, emergency access and multiple access points, ease of evacuation, availability of water for fire suppression, and other relevant building and development standards.

Policy 4.4 For existing non-conforming development, the County shall work with property owners to improve or mitigate access, water supply and fire flow, signing, and vegetation clearance to meet current state and/or locally adopted fire safety standards.

Policy 4.5 Following a large and/or destructive fire in Imperial County or the region, the County shall reassess standards and other requirements for new development and redevelopment and revise these requirements to ensure a high level of community resilience to fire events.

Policy 4.6 Require project-specific fire-prevention plans and fuel modification around homes and subdivisions in areas of High or Very High Fire Hazard Severity Zones.

Policy 4.7 Coordinate with local water providers to ensure the long-term sustainability of water supplies to meet current and anticipated future firefighting needs. Identify areas lacking adequate water service for firefighting, including capacity for peak load under a reasonable worst-case wildland fire scenario determined by Imperial County Fire Department.

Policy 4.8 Require that conceptual landscaping plans for development in High or Very Fire Hazard Severity Zones identified by CAL FIRE and shown in Figure 6 be reviewed by the Planning and Development Department and Imperial County Fire Department prior to the issuance of development permits. The conceptual landscaping plan of the proposed development shall, at a minimum, include:

1. Site plan, planting plan, planting palette, and irrigation plan to reduce the risk of fire hazards with consideration to site conditions, including slope, structures, and adjacencies.

2. Defensible space maintenance plan.

3. Provision of multiple points of ingress and egress to improve evacuation and emergency response access and adequate water infrastructure for water supply, fire flow, and fire equipment access.

Policy 4.9 Require continued long-term operation and maintenance of fuel breaks, brush management, controlled burning, revegetation, and roads by Imperial County and private landowners.

Policy 4.10 Coordinate with the Imperial County Fire Department to ensure that the Department has appropriate municipal staffing to address development pressure and adequately respond to long-range fire safety planning.

Policy 4.11 Coordinate with Imperial County Fire Protection District to implement a long-term fire protection training program and continue public education efforts to inform the community of wildland and urban fire hazards, evacuation routes, and ways to minimize damage caused by fires such as through defensible space. The County shall identify and map at-risk populations within the community and prioritize public outreach, as well as fire education and training among these populations.

Policy 4.12 Support measures that help firefighting crews and emergency response teams respond to fire hazards or work under low-visibility conditions, such as high-visibility street and building address signage.

Policy 4.13 Implement a coordination program with fire protection and emergency service providers to reassess fire hazards after wildfire events and adjust fire prevention and suppression needs, including needs for new or revised development and reconstruction standards.

Policy 4.14 Continue to work cooperatively with CAL FIRE to strengthen fire-fighting capabilities and successfully respond to multiple fires.

Policy 4.15 Adopt and maintain an evacuation route network and ensure emergency evacuation routes are clearly identified with adequate signage throughout the county. The County will also develop a blueprint for managing evacuation plans, including allocation of buses, designation, and protection of disaster routes to maximize capacity and redundancy, and creation of traffic-control contingencies. The County will work to ensure that evacuation transportation services are available for those with limited mobility or lacking access to a personal vehicle.

Policy 4.16 Require all new development projects with land classified as Very High Fire Hazard Severity Zones (VHFHSZs; Section 51177 of the California Government Code) or within areas defined as a wildland-urban interface, to prepare a long-term comprehensive fuel reduction and management program, including provisions for multiple points of ingress and egress to improve evacuation and emergency response access and adequate water infrastructure for water supply and fire flow, and fire equipment access.

Policy 4.17 Identify existing public and private roadways in fire hazard areas not in compliance with contemporary fire-safe standards, including road standards, vegetation clearance, and other requirements of Sections 1273 and 1274 of the California Code of Regulations to the extent resources are available. Work at retrofitting County-owned roadways as needed to meet current standards and require private property owners to do the same, to the extent feasible and given the absence of other site constraints.

Hazardous Wastes and Materials

Goal 5: Protect the public from exposure to hazardous wastes and materials.

Policy 5.1 Collaborate with private industry to find alternative routes for the transporting of hazardous materials/waste that do not go near or through residential areas and critical facilities.

Policy 5.2 Collaborate with the California Department of Toxic Substances and Controls and the State Water Board to minimize the potential for hazardous materials and waste spills.

Policy 5.3 Discourage incompatible development, such as schools and residential uses, adjacent to sites and facilities used for the production, storage, disposal, and transport of hazardous materials and waste.

Policy 5.4 Continue to implement and update ordinances, policies, and guidelines that assure the safety of county ground and surface waters from toxic or hazardous materials and wastes.

Policy 5.5 Collaborate with local jurisdictions and other appropriate agencies to facilitate the safe and immediate cleanup of all hazardous waste sites and to provide safe facilities for disposal, in accordance with applicable federal, state, and local regulations.

Policy 5.6 Encourage businesses to use practices and technologies that will reduce the generation of hazardous waste.

Policy 5.7 In conjunction with the Imperial County Fire Department, review and monitor potentially hazardous materials associated with industrial uses.

Policy 5.8 Require that any business that handles or stores hazardous materials prepare a plan for emergency response to a release or threatened release of a hazardous material, including providing updated information to emergency responders on the type and quantity of hazardous materials kept on-site.

Policy 5.9 Identify sites that are inappropriate for hazardous material storage, maintenance, use, and disposal facilities due to potential impacts on adjacent land uses and the surrounding natural environment. Prohibit the siting of new or expanded hazardous material facilities on such sites.

Policy 5.10 Ensure that the use and disposal of hazardous materials in the county complies with local, state, and federal safety standards.

Policy 5.11 Require commercial businesses, utilities, and industrial facilities that handle hazardous materials to install automatic fire and hazardous materials detection, reporting, and shut-off devices, and install an alternative communication system in the event power is out or telephone service is saturated following an earthquake.

Policy 5.12 Encourage use of on-site green infrastructure to protect and enhance community water quality with landscape features (e.g., berms, grasslands, plantings) that either contain released hazardous materials or process and/or absorb pollutants from infiltrating the soil or watershed.

Disaster Preparedness, Response, and Recovery

Goal 6: Prepare for and respond to natural and human-caused disasters to deliver vital services in the event of emergency to avoid the loss of life and minimize impacts to health and property.

Policy 6.1 Update emergency preparedness and evacuation plans, such as the Imperial County Emergency Operations Plan, Multi-Jurisdiction Hazard Mitigation Plan, and Hazardous Materials Area Plan, to include updated science, identified hazards, and new emergency response methods.

Policy 6.2 Advise and, where appropriate, require all new developments to help eliminate impediments to evacuation within existing community plan areas, where limited ingress/egress conditions could impede evacuation events.

Policy 6.3 All development proposals are required to identify evacuation routes at the Community Plan level and identify and facilitate the establishment of new routes

needed to ensure effective evacuation. Evacuation routes should be incorporated into existing Community Wildfire Protection Plans when applicable.

Policy 6.4 Reduce risk and damage from seismic hazards by updating appropriate regulations, such as that found in Title 9 of the County Code of Ordinances.

Policy 6.5 Maintain up-to-date mapping of inundation from dam failure and/or water releases.

Policy 6.6 Support and assist in informing the public and other agencies of the hazards and risks of earthquakes and of techniques to employ to reduce those hazards.

Policy 6.7 Maintain and use geologic and seismic information as provided by the United States Geological Survey and California Geological Survey.

Policy 6.8 As appropriate, require rehabilitation of buildings that pose a public hazard from inadequate structural design.

Policy 6.9 Avoid and minimize death, injuries, property damage, and economic and social dislocation resulting from natural hazards through appropriate planning and emergency measures.

Policy 6.10 Continually strengthen the Imperial County Emergency Operations Plan and Multi-Jurisdictional Hazard Mitigation Plan (as approved by the Federal Emergency Management Agency) and maintain mutual-aid agreements with federal, state, local agencies, and the private sector to assist in:

a) Clearance of debris in the event of widespread slope failures, collapsed buildings or structures, or other circumstances that could result in blocking emergency access or regress

b) Heavy search and rescue

c) Fire suppression

d) Hazardous materials response

e) Temporary shelter

f) Geologic and engineering needs

g) Traffic and crowd control

h) Building inspection

Policy 6.11 Promote public and quasi-public education programs to enhance public safety and support the safety awareness efforts of the Office of Emergency Services and other agencies through public information and educational activities.

Policy 6.12 Coordinate with the Imperial County Fire Department, Imperial County Sheriff's Office, and other appropriate agencies for the provision of adequate equipment and personnel, as well as expanded levels of service as necessary.

Policy 6.13 Coordinate with Imperial County Office of Emergency Services and the National Weather Service to provide alerts about potential, developing, and ongoing emergency situations through extensive early-warning and notification systems that convey information to all residents, in multiple languages and formats to ensure it is widely accessible.

Policy 6.14 Ensure residents that speak languages other than English have access to communication, educational materials, and assistance in evacuation, short-term, and long-term recovery activities.

Policy 6.15 As feasible, install solar energy and battery backup systems at critical public and private facilities to ensure continuation of services if the power grid is disrupted.

Policy 6.16 Regularly review and clarify emergency evacuation plans identified in the County's Emergency Operations Plan for dam failure, inundation, fire, and hazardous materials releases. The County shall also continue to maintain, periodically update, and test the effectiveness of the Emergency Operations Plan.

Policy 6.17 Monitor the effectiveness of public safety, preparedness, and hazard mitigation policies under changing climate conditions to continue to protect the community as local and regional conditions change.

Policy 6.18 Identify critical facilities in hazard-prone areas and work to relocate or harden these facilities to reduce risk of damage and loss of service.

Policy 6.19 Ensure that all public services, municipal operations, and critical facilities can continue operating during and after a hazard or emergency event to meet community needs to the greatest extent possible.

Policy 6.20 Adopt inundation alert and readiness levels corresponding with official forecasts by the California Office of Emergency Services, regarding earthquake prediction and potential for dam failure.

Policy 6.21 Promote strengthening of planned and existing utilities and lifelines, the retrofit and rehabilitation of existing weak structures, and the relocation of critical facilities within hazard-prone areas.

Policy 6.22 Prohibit development of critical facilities in dam failure inundation areas unless no feasible alternative exists and apply hazardous materials safety guidelines within such zones.

Policy 6.23 Establish a network of equitably located resilience centers throughout Imperial County and ensure that resilience centers are situated outside of areas at risk from hazard impacts to the extent possible, offer refuge from extreme heat and extreme weather events, and are equipped with renewable energy generation and backup power supplies. Such facilities should be in easily accessible locations and be available to all community members, as needed.

Policy 6.24 Conduct public outreach and education efforts to inform people in Imperial County of the hazard risks, vulnerabilities, and threats in the community, and what steps community members should take to reduce their risks and provide all materials and information in both English and Spanish by default, as well as any other languages, as requested.

Climate-Related Hazards

Goal 7: A resilient County able to adapt to and mitigate impacts from climate-related hazards.

Policy 7.1 Collaborate with local governments and special districts in Imperial County as well as with Inland Southern California Climate Collaborative to develop and implement regional climate change adaptation and resilience initiatives.

Policy 7.2 Use the reported data and findings of applicable local, regional, or state documents or plans pertaining to climate change and climate-related hazards that could impact Imperial County, including the California Climate Change Assessment, the California Adaptation Planning Guide, and the Safeguarding California plan.

Policy 7.3 Prepare for a reduced, long-term water supply resulting from more frequent and severe drought events, including working with regional water providers to implement extensive water conservation measures and ensure sustainable water supplies.

Policy 7.4 Renovate existing County-owned assets and design future facilities to incorporate renewable energy generation systems, battery storage systems, and energy-efficient design and features, as feasible.

Policy 7.5 Coordinate with water agencies and irrigation districts to explore ways to improve and increase storage capacity and generation efficiency.

Policy 7.6 Coordinate with local governments and regional transit providers to increase shading and heat-mitigating materials on pedestrian walkways and transit stops.

Policy 7.7 Ensure that unhoused persons or groups in Imperial County have access to temporary and/or emergency housing, food, and other essential living materials to keep them safe during anticipated hazard events.

Policy 7.8 Encourage new developments and existing property owners to incorporate sustainable, energy-efficient, and environmentally regenerative features into their facilities, landscapes, and structures to reduce energy demands and improve on-site resilience. Support financing efforts to increase community access to these features.

Policy 7.9 Promote and expand the use of drought-tolerant green infrastructure, including street trees and landscaped areas, as part of cooling strategies in public and private spaces.

Policy 7.10 Use natural resources and infrastructure to absorb the impacts of climate change and associated natural hazards, as feasible.

Policy 7.11 Ensure that workers in outdoor industries have the training and resources to be adequately protected from environmental hazards, including extreme heat, poor air quality, and diseases.

IV. IMPLEMENTATION PROGRAMS

A. PROGRAMS

TABLE 3 IMPLEMENTATION PROGRAMS

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
S-1	Continue to implement the County's most currently adopted Building Codes to ensure that development is constructed in a structurally and seismically safe manner. To the extent feasible, conduct periodic seismic safety inspections to ensure compliance with adopted codes.	2.2	Planning & Development Services Department	Ongoing	General Fund / Fines
S-2	Review and provide feedback of geotechnical studies submitted by developers or applicants working in areas of the county prone to earthquake and seismic hazards.	2.3	Planning & Development Services Department	Ongoing	General Fund
S-3	The County will update and maintain standards designed to avoid geologic hazards, mitigate for soils-related constraints, reduce impacts to hydrological and drainage conditions, and minimize erosion resulting from site grading and preparation, construction, and ongoing operations. Projects will be conditioned to include measures to avoid geologic- and soils-related impacts, as necessary.	2.3	Public Works Department	Ongoing	Project Applicant Funding
S-4	Communicate with the Imperial Irrigation District to ensure the seismic safety of all existing and proposed water storage tanks and pipe connections.	2.5	Planning & Development Services Department	Annually	General Fund
S-5	Maintain a reference collection of maps and other materials illustrating the location of seismic hazards occurring within the county boundaries.	2.6	Planning & Development Services Department	Ongoing	General Fund
S-6	The County shall update the Zoning Ordinance as necessary to comply with state requirements for flood control.	3.2 3.3 3.4 3.6	Planning & Development Services Department	Ongoing	General Fund

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
S-7	Update development and building standards, if necessary, to remain consistent with state and federal standards for floodplains, levee design criteria, and urban development in areas subject to flooding during General Plan buildout.	3.5	Planning & Development Services Department	Ongoing	General Fund
S-8	The County shall annually provide flood-protection safety information via social media and posting on the County's website to educate citizens about safety during flood conditions, including the dangers of driving on flooded roads.	3.7	Planning & Development Services Department	Ongoing	General Fund / Grant Programs
S-9	The County shall conduct regular cleaning and maintenance of storm drains along key roadways, especially in advance of the rainy season. The County shall address potential ponding and the need for storm drain improvements on major roadways.	3.7	Public Works Department	Ongoing	General Fund
S-10	Continue to disseminate information on flooding, flood control on private property, floodplains, and flood preparedness to the public on the County's website.	3.8	Planning & Development Services Department	Ongoing	General Fund
S-11	Communicate with the Federal Emergency Management Agency regarding Flood Insurance Rate Maps to keep these documents updated on a regular basis.	3.8 3.10	Planning & Development Services Department	Ongoing	General Fund
S-12	Periodically review county, state, and federal flood-control best practices and incorporate appropriate standards into the Municipal Code.	3.9	Planning & Development Services Department	Ongoing	General Fund
S-13	Consult with the Imperial Irrigation District as well as upstream and downstream jurisdictions regarding regional approaches for the planning, construction, operation, and maintenance of drainage and flood-control facilities. Include these entities in the referral of project applications, as	3.10	Planning & Development Services Department / Public Works Department / Engineering Department	Ongoing	General Fund

	Implementation Program	Applicable Policy	Responsible Department	Time Frame	Funding Source
	appropriate.				
S-14	Review all applicant submittals to ensure that wildfire risk has been mitigated to the lowest extent for development proposals located in fire-prone areas by ensuring the proximity of fire crews and firefighting facilities, County approval of any required landscaping plans, appropriate and minimum evacuation capacity, and planning for fuel reduction. Recommend either alternative siting if development proposal is located in a fire hazard severity zone or appropriate design features to reduce fire risks.	4.2	Planning & Development Services Department	Ongoing	General Fund
S-15	Review all applicant submittals to ensure that wildfire risk has been mitigated to the lowest extent for development proposals in fire-prone areas by ensuring the proximity of fire crews and firefighting facilities, County approval of any required landscaping plans, appropriate and minimum evacuation capacity, and planning for fuel reduction. Recommend either alternative siting if development proposal is located in a fire hazard severity zone or appropriate design features to reduce fire risks.	4.4 4.8	Planning & Development Services Department	Ongoing	General Fund
S-16	When reviewing long-term comprehensive fuel-reduction and management programs for discretionary projects, the County shall require these plans to include a risk analysis; fire response capabilities discussion; fire safety requirements, including defensible space, infrastructure, and	4.4	Planning & Development Services Department	Ongoing	General Fund

	Implementation Program	Applicable Policy	Responsible Department	Time Frame	Funding Source
	building ignition resistance; mitigation measures and design considerations for non-conforming fuel modification; wildfire education; and maintenance and limitations. Fire hazard reduction measures shall be incorporated into the design of development projects in fire hazard areas and incorporated into the covenants, conditions, and restrictions (CC&Rs), as appropriate.				
S-17	Develop a fire risk-reduction assessment to use for new development in High, Very High Fire Hazard Severity Zones, or wildland-urban interface areas. The assessment should include identifying existing fire hazards on properties, describing the proposed projects, developing thresholds, and establishing guidance (e.g., fuel modification, fire breaks, etc.) to mitigate wildfire risks to these new developments.	4.6	Planning & Development Services Department	2021	General Fund
S-18	Encourage and identify opportunities to incentivize owners of existing properties and new development projects, to adopt the defensible space landscaping zones as defined by CAL FIRE. When needed, clear excess dried vegetation across the county in areas identified by the Imperial County Fire Department.	4.8	Fire Department / CAL FIRE / Planning & Development Services Department / Public Works Department	Ongoing	General Fund / Developer Cost / Bureau of Reclamation Drought Resiliency Grants
S-19	The County shall periodically evaluate fire protection services in the county to determine if fire protection resources are being effectively and efficiently used.	4.10	Planning & Development Services Department / CAL FIRE	Ongoing	General Fund
S-20	The County shall work with CAL FIRE and the Imperial County Fire Department to maximize the use of resources to develop functional and/or operational consolidations and standardization of services and to maximize the efficient use of fire-protection resources.	4.10	Planning & Development Services Department / CAL FIRE	Ongoing	General Fund

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
S-21	The County shall work with the Imperial Irrigation District to maintain adequate water supply and identify areas lacking adequate water service for firefighting, including capacity for peak load under a reasonable County-case wildland fire scenario, to be determined by CAL FIRE. The County shall identify areas lacking adequate water service, where future development may occur.	4.14	Planning & Development Services Department / Fire Department / CAL FIRE	Ongoing	General Fund
S-22	Make information available to local businesses for incentives to reduce the generation of hazardous waste. Program components can include rebates for recycling; apply for grant funding through CalRecycle.	5.6	Planning & Development Services Department	Ongoing	General Fund
S-23	Stay up to date on hazardous materials associated with industrial and commercial uses by communicating with county, state, and federal agencies.	5.7	Planning & Development Services Department	Ongoing	General Fund
S-24	Designate the Imperial County Fire Department as the keeper of a database of all properties in the county engaging with hazardous materials and include such information as their address, their owner's contact information, and a list of all the hazardous materials on site.	5.9	Fire Department	Ongoing	General Fund
S-25	Require that construction activities cease if ground or water contamination is discovered during construction until the contamination is reported and the extent of the contamination, as well as necessary actions for remediation, have been identified to the satisfaction of the appropriate agency. Require that remediation activities be completed to the satisfaction of the appropriate responsible agency (i.e., Imperial County Public Health Department, Colorado River Regional Water	5.10	Fire Department	Entitlement process and through routine inspection	General Fund

	Implementation Program	Applicable Policy	Responsible Department	Time Frame	Funding Source
	Quality Control Board, Department of Toxic Substances Control, or the County of Imperial, depending on the type of contamination).				
S-26	The County shall develop and maintain agreements with other local, state, and federal agencies to ensure coordinated disaster response.	6.10 6.17	Fire Department / Sheriff's Office / Planning & Development Services Department	Ongoing	General Fund
S-27	The County shall continue to update the Multi-Jurisdictional Hazard Mitigation Plan when it expires to ensure that the County maintains eligibility for pre-disaster mitigation funding.	6.10	Planning & Development Services Department	Ongoing	General Fund
S-28	Encourage the Imperial County Fire Department to conduct periodic inspection of commercial, industrial, institutional, and multifamily buildings to ensure fire code compliance and to educate building and development managers on fire safety issues.	6.11	Planning & Development Services Department	Ongoing	General Fund
S-29	Coordinate with the Imperial County Sheriff's Department and Imperial County Fire Department to provide input on goals and standards for desired emergency personnel performance.	6.12	Planning & Development Services Department	Ongoing	General Fund
S-30	Work with the Imperial County Sheriff's Department, Imperial County Fire Department, and the Office of Emergency Services to create an educational program to enhance awareness of public safety. Components of the program could include a brochure, a workshop, a booth at community events, and additional information posted to the County's website. Topics can include earthquakes, urban and wildfires, severe weather conditions, hazardous materials, and flooding.	6.12	Planning & Development Services Department	Ongoing	General Fund

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
S-31	Continue to develop resources and materials that effectively communicate with non-English speakers in emergency and evacuation situations.	6.13 6.14	Planning & Development Services Department	Ongoing	General Fund
S-32	The County shall support hiring multi-lingual staff and offer language training to existing staff to improve communication and assistance with non-English-speaking residents.	6.14	Planning & Development Services Department	Ongoing	General Fund
S-33	Work with water utilities, including Imperial Irrigation District, to ensure continuity of water provision during flooding and other hazards through improved electricity reliability.	6.15 6.17	Planning & Development Services Department / Office of Emergency Services	Ongoing	General Fund
S-34	Establish backup power and water resources in case of power outages and emergencies at resilience hubs.	6.15	Planning & Development Services Department / Office of Emergency Services	Ongoing	General Fund
S-35	The County shall adopt and implement current emergency management principles and practices in all aspects of its emergency operations plan.	6.16	Planning & Development Services Department	Ongoing	General Fund
S-36	Update the County's maintenance regimes and practices for its infrastructure and other assets to account for increased climate risks.	6.17	Planning & Development Services Department	Ongoing	General Fund
S-37	Pursue grant funding to harden existing County facilities in identified hazard-prone areas as well as funding to finance the operation of redundant communications systems.	6.18 6.19	Planning & Development Services Department	Ongoing	General Fund
S-38	The County shall work with local medical providers to ensure that medical facilities are prepared to meet any increased demand from hazardous events.	6.19	Planning & Development Services Department / Public Works Department	By 2020	General Fund

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
S-39	The County shall work with local schools and community centers to create resilience hubs that can serve as gathering places during emergencies and interruptions in services, and contain access to water, electricity, and other necessary services.	6.23	Planning & Development Services Department / Public Works Department / Office of Emergency Services	Ongoing	General Fund
S-40	Join the Inland Southern California Climate Collaborative to effectively address and build regional resilience to climate-related hazards that pose a threat to the county.	7.1	Planning & Development Services Department	By 2022	General Fund
S-41	The County shall integrate the results and adaptive policies of the Climate Change Vulnerability Assessment into other County planning documents where feasible, including this General Plan Safety Element, the Local Hazard Mitigation Plan, Zoning Ordinance, building code, and other applicable codes.	7.2	Planning & Development Services Department	By 2022	General Fund
S-42	The County shall annually review the climate adaptation and resiliency strategies and shall update them as needed to ensure compliance with state laws and community needs.	7.3	Planning & Development Services Department	Annually	General Fund
S-43	Mandate drought-responsive design features and measures such as retrofitting all existing County-owned buildings with water-efficient fixtures (e.g., faucets, toilets, sprinklers) as well as prohibiting landscape irrigation during the middle of the day.	7.4 7.5	Public Works Department	By 2025	Development Impact Fees
S-44	Where feasible, the County shall encourage the use of existing natural features and ecosystem processes, or the restoration of, when considering alternatives and adaptation projects through the conservation, preservation, or sustainable management of open space. This includes, but is	7.9	Planning & Development Services Department	Ongoing	General Fund/Development Fees

Implementation Program		Applicable Policy	Responsible Department	Time Frame	Funding Source
	not limited to, the conservation, preservation, or sustainable management of any form of aquatic or terrestrial vegetated open space, such as parks, rain gardens, and urban tree canopies. It also includes systems and practices that use or mimic natural processes, such as permeable pavements, bioswales, and other engineered systems, such as levees that are combined with restored natural systems, to provide clean water, conserve ecosystem values and functions, and provide a wide array of benefits to people and wildlife.				

Appendix B: Seismic Safety Technical Report

INTRODUCTION

In terms of seismic activities, Imperial County is similar to most regions bordering the Pacific Ocean and is an area of high seismic activity. Consequently, most of the seismic activity is in the Salton Trough (Imperial Valley) and subject to potentially destructive and devastating earthquakes. Imperial Valley in this instance, encompasses the central area commonly known as the "irrigated" area.

Earthquakes are the result of an abrupt release of energy stored in the earth. This energy is generated from the forces which cause the continents to change their relative position on the earth's surface. This process is known as "plate tectonics."

The earth's outer shell is composed of several relatively rigid plates which move slowly over the comparatively fluid molten layer below. The boundaries between plates are where the more active geologic processes take place. Earthquakes are an incidental product of these processes.

California rests on the boundary between the North American Plate and the Pacific Plate. The San Andreas Fault system is located where the northwesterly drifting Pacific Plate grinds along and is subducted by the southwesterly drifting North American Plate. Baja, and California west of the fault system, are part of the Pacific Plate and move northwest compared to the rest of California and North America. The relative motion is two inches per year, but the plates do not slide easily past each other as they do over the molten layer below. They stick until the strain exceeds the elastic capacity of the rock which then fractures and allows the sudden movement which is an earthquake.

When sudden movement ruptures the earth's surface, it causes vibrations called seismic waves. Complex methods and equipment have been developed to measure earthquakes. Magnitude is a measurement of the energy released. Intensity is a measurement of the damage done. Earthquake prediction methods have been developed, but at this time it is not possible to tell when or where a quake will occur with certainty.

Effect of Earthquakes

The principal seismic hazards in Imperial County are (1) ground shaking including differential ground settlement, soil liquefaction, rock and mudslides, ground lurching, and avalanches; (2) ground displacement along the fault; (3) floods from dam and levee failure, and seiches; (4) fires; and (5) the various adverse results of disruption of essential facilities and systems – water, sewer, gas, electricity, transportation, and communication and notably in Imperial Valley, the irrigation and drainage system.[3]

[3] Robert Iacopi, *Earthquake Country*, (California:Menlo Park, Lane Books, 1976):58-60.

Ground shaking is by far the most important hazard. In accordance with the Alquist - Priolo Special Studies Zone Act (Chapter 7.5, Division 2, Public Resources Code, State of California, effective May 4, 1975) the Office of State Geologist delineated Special Study Zones which encompass potentially and recently active traces of four major faults (i.e., San Andreas, Calaveras, Hayward and San Jacinto). These Special Study Zone Maps depicting active fault traces are available for public review at the Imperial County Planning Department and the Imperial County Public Works Department. The Alquist - Priolo Special Study Zone Act is enforced by the County to assure that homes, offices, hospitals, public buildings, and other structures for human occupancy which are built on or near active faults, or if built within special study areas, are designed and constructed in compliance with the County of Imperial Codified Ordinance.

An earthquake is the release of force built up by plate stress and triggered by some action; therefore, an earthquake is the triggering event to permit the force of gravity to operate. Rockslides, mudslides, avalanches, slope slumping, and ground settlement illustrate this. Water saturated, sandy and fine-grained soils subjected to vibrations may lose their shear strength, take on a liquid character, and fail to support structures (liquefaction). Buildings may sink into the soil; lighter structures may be buoyed up.

Seiches are earthquake generated waves in small bodies of water. Although there are no records of seiches in the Salton Sea, the following account from the Owens Valley quake of 1872 is instructive: "A huge wave developed in Owen Lake... the water (was) drawn away from the shore and standing in a perpendicular wall... But the return was fairly gentle so only 200 feet of new ground was covered by the waves.[4]"

Floods from dam failure are a notable secondary effect of earthquakes. Often, in earthquake country, the most economical (and sometimes only) dam site is in a high-risk seismic zone. The geological forces generating faults often produce the topographic features desirable for dams. Earthfill dams are obviously more susceptible to seismic induced failure than concrete or other structural dams.

In Imperial County, there are three major dams – Imperial, Laguna, and Senator Wash, located on the Colorado River; and in the irrigated area, several large, earthfill impoundment reservoirs; hundreds of miles of above ground level earth levee canals, and hundreds of check dams, drops and gates. The Colorado River is not a known seismically active zone and, to date, there have been no reported cases of earthquake damage to the dams there. Within the irrigated area, there have been several instances of levee failure from earthquakes and resultant flooding. Because of the comparatively small volumes of water involved, low head, variety of options to check or divert flows in the canals, and the ubiquitous drainage network, the flooding hazard is not great. Nevertheless, some hazard does exist, and even minor flooding could be an incremental contribution to the other disruptions an earthquake might cause.

[4] Matthews H. William, *Geology Made Simple*, (New York:Doubleday & Company, Inc., 1982):78.

Effects on Structures

Five main factors effect building damage from earthquakes are:

1. The strength of earthquake waves. For record purposes, accelerations over 0.1g are considered "strong shaking" although this level generally does not produce significant damage. Imperial County's two largest quakes; 1940 and 1979, produced .22g vertical, .36g horizontal, and .38g vertical, .40g horizontal, respectively, as measured at El Centro.[5]

2. The frequency of the waves. Ordinary structures respond mainly to shaking at frequencies higher than 1 Hz (1 cycle per second). These occur out to a maximum of about 20 miles from the epicenter. However, large structures such as large bridges, and/or high-rise buildings respond to frequencies as long as 10 Hz. These may be significant as much as 60 miles away.

3. The duration of the shaking. It is the cumulative effect of the shaking – not the single pulse – that affects structures and causes their collapse. Each shake can weaken part of the structure. Subsequent oscillations further weaken the structure especially if magnified by the resonance of the natural frequency of the structure with the frequency of the waves.

   Relating strength and duration, it is the repeatable high ground acceleration (RHGA) as opposed to the peak ground acceleration that is the main criterion in designing structures to be safe from ground shaking impacts. In this respect, aftershocks also play an important role. They frequently produce substantial damage to buildings weakened by the main shock sequence. The Kern County quake of July 21, 1952, had a magnitude of 7.3. However, most of the actual damage occurred a month later when an ordinarily mild 5.8 aftershock brought down the already weakened buildings.

4. The geologic foundation. Engineers and insurance companies often consider this the most important factor in building damage. Fill and "made" land, especially when saturated, transmits much greater intensity of motion than solid rock even when both are subjected to the same seismic waves. The greater stress on the structure, as well as the possibility of liquefaction, differential settlement, or slope failure, make a poor geological foundation and create a double jeopardy in earthquakes.

5. The building design. Where subjected to the effects of a major event, an "earthquake proof" building may, at least with current technology be impossible to design. Architects and engineers know how to design earthquake resistant structures.

[5] The World Book Encyclopedia, 1988 Edition, *Flash Flood*, (Chicago:World Book Inc., 1987 F Volume 7): 237.

Buildings traditionally are designed first to resist the force of gravity. The traditional building techniques and materials are very good for this: post and beam, bricks, concrete. The loads are very easy to calculate and to design for; "dead load" representing the weight of the building itself, and the "live load" representing the contents of the building, wind, people, furniture, goods, etc. All of these are static and dynamic forces acting in the vertical plane. Often, in older buildings the main force holding the building together is the force of gravity itself – the upper parts pressing down on the lower parts.

When an earthquake occurs, it introduces vertical and horizontal dynamic forces. Newer buildings generally have reasonably large margins of safety designed into them to withstand the constant pull of gravity. Therefore, they generally withstand vertical seismic accelerations reasonably well. However, horizontal accelerations and sudden rapid vertical acceleration are what cause the major damage.

During an earthquake, buildings usually fail at the location where their various parts are joined together. Weakened structural sections are then affected by gravity which then may cause them to collapse. Most buildings usually "pancake" and seldom fall or roll over. Because there are so many factors that affect the structural integrity of a building, it is possible to have two identical buildings exhibit substantially different results in an earthquake.

The second consideration in traditional building safety design is against fire (also a major secondary effect from earthquakes). Here too, the most resistant materials are stone, bricks, concrete, etc. As buildings became larger, and safer in their resistance to gravity and fire, and to weathering and wind, they become more massive and have greater inertia. Like the damaging seismic forces, wind is dynamic and acts horizontally. Most of the wind resisting design techniques also resist earthquakes. However, whereas the inertia of massive buildings works positively to help resist horizontal wind forces, it can be detrimental in withstanding horizontal earthquake accelerations.

Rigid Strength buildings tend to hold together well with little or no damage from quakes up to the point at which some part fails and then the whole building may come apart. To design rigid strength to withstand the greatest expected quakes may require bulk and costs that would prevent the building from ever being built in the first place. There are numerous architectural designs that have been implemented across the world to minimize earthquake damage, such as massive shock absorbers, counterbalance weights, floating support systems, etc. Unfortunately most of these solutions are only practical in very large and expensive structures.

The alternative to rigid strength is flexibility. Wood (i.e., in small buildings), and especially steel, permits construction that will bend and deform, and allow the energy of the earth movements to pass through the building rather than try to resist and absorb the energy. Flexibility permits the construction of buildings which are lighter, freer in design, much less costly, and which still won't completely fail under very large quakes. Wood has both tensile and compressive strength. It is usually readily available, is easy to work and assemble, and is thus both a popular and a good earthquake resistant building material. Its notable failing

is at the joints. Where bolts and screws, in addition to nails are combined with steel straps and "strong ties," and plywood is used for shear walls and horizontal diaphragms, quite excellent "flexible strength" can be built into wooden structures up to three stories high. Larger than this, the weight of the structure begins to exceed the "cost effective strength" of the lower floor wooden supports. Since flexible designs do permit various parts of a structure to move in relation to its other parts, damage such as cracked tile and plaster, shattered windows, and broken pipes, may occur from moderate quakes.

Because earthquakes involve dynamic oscillations, building design can also influence its reaction to a quake in ways not expected solely based on strength to accommodate applied force. All things, including buildings, have a natural frequency at which they oscillate. If this natural frequency matches that of the passing seismic waves, the building oscillations may build up to a much greater amplitude than would otherwise occur.

Buildings with irregular layouts or abrupt changes in structural materials have been shown to suffer more earthquake damage than other buildings with the same strength. Particularly vulnerable are buildings with mixed rigidity and flexibility. A classic example is the house in which a wall opening has been enlarged to install bigger windows. That wall now is weaker, but also more flexible than its opposite wall counterpart. In a quake, most of the load previously carried by both walls, will be absorbed by the stronger, stiffer wall, and it may fail while the weaker, more flexible wall, remains intact.[6]

An aspect of building design is building orientation. In Imperial County, faults all trend northwest to southeast and fault movement is mostly strike slip. The waves from an earthquake can be expected to be stronger in the northwest/southeast direction. Wise residents in earthquake country are known to take such basic precautions as anchoring furniture, water heaters, and breakables such as china cabinets, to diminish hazards. Architects and engineers can apply this knowledge of predominant seismic wave orientation to building and site design.

The foregoing discussion on building design is not meant to suggest design alternatives, as much as to illustrate the necessity to think in terms of tradeoffs and cost versus risk. While we cannot prevent earthquakes, we can build resistant characteristics into structures and avoid building those which are particularly susceptible to the effects of earthquakes.

Seiches

A seiche is a to and from vibration of a body of water in its own natural tempo like the slopping of water in a jolted basin. Once started, the water body will continue to oscillate independently with its own proper period. Seismic sea waves are only one of the many causes of seiches which often occur also in lakes and ponds.[7]

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6 Office of Emergency Services Imperial County, *Imperial County Emergency Plan*, (June 1988): Appendix 1-3, 57.

7 Federal Emergency Agency, Flood Insurance Study Imperial County, California Unincorporated Areas, (September 15, 1983):4.

While there have been several seismic events since the formation of the Salton Sea, to date seiches have not occurred to any significant recorded magnitude. There is, however, no guarantee that under specific circumstances one could not occur.

Although the San Andreas Fault is known to be quite active in the Salton – Imperial Basin, it is difficult to define and almost impossible to trace.[8] In addition to the San Andreas fault, the San Jacinto Fault lies west of the Salton Basin and, on the east side of the Salton Sea, another fault trace is recognizable near Durmid, where sandstone and shale beds on the southwest side of the fault have been opened and contorted near the fault.[9]

Nevertheless, it is reasonable to believe that the close proximity of these faults to the Salton Basin implies that the Salton – Imperial Basin could be subjected to an occurrence of significant seismic ground shaking in the future, thus, possibly inducing a seiche.

SEISMIC HISTORY IN IMPERIAL VALLEY

Reliable accounting of earthquakes began around the turn of the century when Imperial County became inhabited. What evidence exists, suggests that earlier seismic activity was similar to recent activity. Generally only events of intensity V or greater are included here.

The following accounts, (through 1970), are taken largely from *An Earthquake History of the United States* by the U.S. Department of Commerce. The accounts for after 1970 are compiled from a variety of sources, all listed in the reference section.

1853 November. Based on reported effects in distant towns, a large earthquake is believed to have occurred in the northern Salton Trough, probably in the Imperial Valley. A magnitude of 6.5 is estimated for this event.

1853 December. Fort Yuma. Many shocks. Possibly of destructive force.

1868 May. Los Palmas, east and north of Salton Sea. One source states that a long fissure opened in the earth. (If this is true, the intensity was IX, perhaps X).

1871 (Month Unknown). Imperial Valley. Halfway between Los Palmas and Yuma, the shock rolled men over who were sleeping on the ground.

1877 June 11. Imperial County. Violent vibrations preceded volcanic eruption in the mountains near Flowing Well Station, about 60 miles northeast of Yuma.

1892 February 23. Northern Baja California. The intensity of this shock probably reached X near the epicenter, which was apparently in the uninhabited region of northern Baja

[8] Federal Emergency Agency, Flood Insurance Study Imperial County, California Unincorporated Areas, (September 15, 1983):4.

[9] Federal Emergency Agency, Flood Insurance Study Imperial County, California Unincorporated Areas, (September 15, 1983):4.

California. It was felt strongly along the Pacific coast of Baja California, as far as San Quentin, Mexico, and as far north as Visalia, California. At Carrizo, all adobe buildings were destroyed; at Jamul, walls of stone kilns cracked. At Campo, there were 155 shocks in 12 hours. After shocks were numerous for several days.

1903 January 23. Baja California. A strong earthquake, centering in the uninhabited region south of Imperial Valley, was felt throughout southern California, southern Nevada, and western Arizona. A similar shock under present conditions in the Imperial Valley would cause damage. Recorded by distant seismographs. Magnitude 7+.

1906 March 3. Southern California. Felt widely in southern California. Origin south of border. Recorded by distant seismographs, which indicates moderately destructive power.

1906 April 18. Brawley, Imperial Valley. Chimneys fell. Banks of New River caved in; water tanks destroyed at Cocopah in Baja California. The published information is very limited, but H. O. Wood, on the basis of verbal information, reported this to be a very severe shock. Magnitude 6+. It came just hours after the great San Francisco quake and most probably was related.

1915 June 22. El Centro, Calexico, and Mexicali. Two destructive shocks, nearly 1 hour apart. Heavy damage (about $900,000) in southern Imperial Valley was caused as much by poor quality buildings as by the intensity of shock. In El Centro, well-constructed buildings merely suffered cracks. At Mexicali, Mexico, people returned to buildings after the first shock; six were killed and many were injured by the second earthquake. Though a few cracks were formed in the alluvium, the irrigation ditches and works were damaged very little. The unstable banks of the New and Alamo Rivers slid down in many places. Several farmers observed that after the shocks, one-third more water was required for irrigation because of the cracks in the soil. Despite the rather high local intensity, the total energy was moderate. Magnitude 6 1/4 for both shocks.

1915 November 20. Baja California. A shock, revealed by seismograms to have been considerably greater than that of June 22, occurred in the Volcano Lake region south of the Mexican boundary. In the Imperial Valley, the highest intensity was at Calexico; at Volcano Lake, levees and damp ground were cracked. Magnitude 7.1.

1917 May 27. Imperial Valley. Seems to have been most severe in open country. Walls were reported cracked at Brawley.

1918 April 30. Calexico, Plate glass broke. Felt over an area of about 100-mile radius.

1919 September 29. Baja California. Levees slumped and many longitudinal cracks were formed in the Volcano Lake region south of Imperial Valley. Reported intensity distribution suggests that more than one shock occurred. A few fore shocks and numerous aftershocks.

1919 October 1. Baja California. A shock similar in location and energy to that of September 29.

1921 September 8. South of Imperial Valley. Duration at Calexico 30 seconds, then a second shock of same duration. Felt over a large area; probably of destructive intensity in the epicenter area.

1923 November 5. Calexico. The epicenter was probably near Calexico where a hotel shifted several inches on its foundation and other buildings sustained minor damage. Intensity was about the same at El Centro.

1923 November 7. Baja California. Intensity VII at Calexico. Damage caused by the shock of November 5 was increased, and one fire resulted. A stronger shock than that of November 5. Epicenter appears to have been in Baja California, south of Calexico.

1925 April 15. Calexico. Plaster was shaken from walls; inhabitants fled to the streets. Again, the epicenter probably was a short distance south of the border.

1926 April 19. Baja California. Volcano Lake region. Light at Calexico, duration 20 seconds. Seismograms indicate energy sufficient to be destructive over a small area. Felt as far as San Diego.

1927 January 1. Imperial Valley, near Mexican border. Two heavy shocks about an hour apart began a long earthquake series, though none of the latter exceeded VI in intensity. In Calexico and Mexicali many buildings were damaged, water mains broke, and some fires ignited. Between 15 and 20 persons were injured. At Heber, El Centro, and Imperial, slight damage was reported. At Heber, telephone service was interrupted. Magnitude 5 3/4 and 5 1/2, respectively. The aftershock of February 12, 00:59, was farther north and was felt as strongly at Brawley as the main shocks. Hundreds of aftershocks occurred.

1930 February 25. Imperial Valley. At Westmorland, walls cracked, chimneys toppled and inferior buildings were damaged. Mud craterlets were found a few miles east of Westmorland. Several fore shocks and many aftershocks. Magnitude 5.0.

1930 March 1. Imperial Valley. This shock was of smaller magnitude than that of February 25. At Brawley, brick buildings were damaged, chimneys were thrown down, and plate glass shattered. Structural damage included falling of cornice sand walls, severe cracks in walls, and displacement of roofs. Well-constructed buildings sustained little damage. Magnitude 4.5.

1934 December 30 and 31. South of Calexico. Two separate main events, the first, magnitude 6.5 and the second 7.1. It is difficult to determine which event caused what damage. Railroad bridges were damaged and tracks twisted. Surface cracks appeared. Water sprouted in dry riverbeds. Adobe houses were wrecked and a large water tower was thrown down. Irrigation ditches were damaged, roads buckled and communication systems

disrupted. It was felt strongly in Tijuana. Chimneys and walls were thrown down at Calipatria. Intensities XI and X in Baja, VI and VII in Imperial Valley.

1940 May 18. Imperial Valley. Sixty thousand square miles affected in the United States (including Arizona and Nevada) and an unknown area in Mexico. The epicenter was located southeast of El Centro, but there was surface slipping with surface rupture over a known distance of 40 miles. The existence of the Imperial Fault was revealed for the first time. The horizontal displacement reached 19 feet near the border. Vertical displacements up to 4 feet were observed. There was damage at all towns in the Imperial Valley and canals were damaged with serious interruption to water service.

The Alamo Canal was opened by the displacement causing a local flood south of the border.

At Imperial, the city water tanks collapsed and 80 percent of the buildings were damaged. At the more heavily populated town of Brawley, there was greater total damage but less percentage of loss. Possibly 40 percent of the buildings were damaged, but the percentage was higher in business buildings.

At Holtville, the city's water tank collapsed, but the damage was not great. Damage at Calexico and at Mexicali, Mexico was not as extensive as might have been expected. The principal loss in Mexicali was fire set by a short circuit.

Indirect loss of crops was considerable; direct earthquake loss in the United States was 6 million dollars. Nine lives were loss. Magnitude 7.1, intensity X.

Again, the rest of the decade was relatively quiet. There were eight quakes of magnitude 5 or greater in the area. Six of these came in 1942, with five of these on October 21-22. A landslide damaged the SD&AE railroad bridge in Carrizo Gorge and some cracked plaster was reported throughout the Imperial Valley. A 5.4 event centered south of Borrego, January 8, 1946, caused no damage.

1950 July 29. Imperial Valley. Strongest of the series of shocks centering near Calipatria on July 27, 28 and 29. Fifty thousand dollars in damage resulted, chiefly from merchandise being thrown from the shelves in the Calipatria, Westmorland, and Niland areas. In Calipatria, concrete standpipes broke, and a small railroad bridge shifted six to eight inches. There was considerable plaster damage. In the outskirts, sand boils appeared, and irrigation ditch banks sloughed. In Westmorland, reinforced concrete walls of the post office building cracked and window broke at the City Hall and at the Food Center Building. Also felt at Parker and Yuma, Arizona. Magnitude 5.4. A 4.7 aftershock on August 1 caused sand boils and ground fissures around the North End Dam.

1951 January 23. Near Calipatria, cracked Westside Main canal. Magnitude 5.6, intensity VII.

1953 June 13-13. Brawley-Westmorland area. Landslides at Tamarack Road and the New River. Windows broken and plaster cracked. First event and aftershock of 5.5, intensity VII.

1954 November 12. A 6.3 event in Baja was strongly felt in the Imperial Valley.

1955 December 16. Brawley area, magnitude 5.4, intensity VII.

1957 April 25. South end of Salton Sea slight damage in El Centro, Brawley and Westmorland, magnitude 5.2, intensity VII.

1958 November 30. Main shock of a series caused minor damage at Calexico and Seeley. Magnitude 5.8, intensity VII.

1963 June 11. A 5.8 event in Baja was felt widely in Imperial Valley.

1965 June 15. A 4.5 main event in a series. Slight damage to buildings, broken windows, and "residents alarmed" in Brawley and Westmorland.

The history of seismic events is also a history of improvements in recording earthquakes and in understanding of seismic phenomena. Two events at this time are notable more for what they revealed about earthquakes than for damage that occurred.

1966 March 4. Imperial. Magnitude 3.6. This quake caused virtually no damage but did cause surface rupture and horizontal displacement. It is the smallest known earthquake to do so. (Some authorities question these effects.)

1968 April 9. South of Ocotillo Wells. The main shock of a series was felt over a large area of California, Arizona, and Nevada. Minor ground cracking and displacement occurred on the Coyote Creek Fault, and Highway 78 was cracked and adjacent to Ocotillo Wells. Ground cracking, minor building damage, and power disruption occurred in some areas of Imperial Valley. A 200-foot long, 2-inch-wide crack occurred in a road 6 miles west of Imperial. Minor damage was also sustained at Calexico, El Centro, Los Angeles, San Diego, and Yuma Arizona. Magnitude 6.5. Intensity VII. Later an aftershock of magnitude 5.2 was widely felt. The significant feature of this earthquake was the triggering of minor ground ruptures on neighboring Superstition Hills Fault, Imperial Fault, and the Banning Mission Creek portion of the San Andreas Fault. A 4.7 aftershock at Calexico knocked down plaster. A 4.4 event, listed as an aftershock, occurred at Salton City on May 22.

1969 May 19. A 4.5 quake near Borrego Springs was felt in San Diego, Riverside, and Imperial Counties. There was no damage.

1971 September 30. Superstition Hills area, magnitude 5.1. No known effects.

1975 January 23-25. Eight events from 4.0 to 4.8 in the Brawley are. The smallest, on January 23 was assigned the highest intensity VII, but there was no significant damage recorded.

1975 June 20. Two events at Mexicali of 4.1 and 4.2.

1976 November 4. Eight events from 4.0 to 4.9 in the Calipatria area with no recorded significant effect.

1977 October 20 to November 14. Eight events from 4.0 to 4.3 southeast of El Centro, but with no recorded damage or effects.

Seismic activity from 1940 to 1979 was characterized by "earthquake swarms" with little or no damage. These were in addition to and sometimes associated with the individual events and series of events listed above. They occurred in 1950, 1955, 1966, 1973, 1975 and 1976. For example, eighty-two separate tremors were reported felt in Brawley between December 16 and 20, 1955. The 1975 Brawley swarm was studied in detail by C.E. Johnson and revealed complex interaction between the Brawley and Imperial Faults. These swarms were composed of dozens, and sometimes hundreds, of events in the range of 2.0 to 4.0.

Seismic monitoring arrays installed by Chevron and Union Geothermal Companies, to assist in their exploration of the geothermal reservoirs and to determine what effects their operations might cause, have sensitivities of 1.0 Richter magnitude. They frequently reveal hundreds of events daily. There is no easy way to tell if these "swarms" and "micro-seismicity" (events less than 2.0 Richter magnitude) are normal to the Valley and not recorded in earlier years or are a change in the normal pattern.

1979 October 15. The earthquake occurred at 4:16 p.m. (PDT). The epicenter was on the Imperial Fault approximately 12 miles south of the Mexican border and 12 miles east of Mexicali. It was widely felt throughout Southern California and was assigned a magnitude of 6.6 ML (Richter). Two aftershocks of 5.0 or greater occurred by 9:00 p.m.

Approximately 100 persons were reported injured; two were hospitalized. The six story County Services Building, the largest building ever built in Imperial County, suffered the most notable damage resulting in its subsequent demolition and total loss. It was occupied by 400 persons at the time of the quake. None were seriously injured. Commercial damage was widespread, particularly in the older sections of Imperial, Calexico, Brawley, El Centro, and Mexicali. Sixty percent of the commercial buildings in Imperial were subsequently condemned. Windows and bottle goods were the major loss. One hundred and three mobile home units in El Centro were knocked from their piers. Throughout the quake area two homes were destroyed and 1,565 damaged. Broken windows, cracked plaster, and collapsed brick chimneys were typical.

One 30,000-gallon gasoline tank (among 18 at the Santa Fe Pacific Tank Farm at Aten and Clark Roads) were ruptured and began leaking 100 gallons per minute. It was controlled by the next morning. All roads within one mile were closed and ten families in the area were evacuated.

There were 15 ruptures of water mains in El Centro and a temporary loss of ninety percent of the firefighting capability. The Southern Pacific Railroad tracks were offset nine inches where they cross the Imperial Fault. Traffic was halted for 30 hours. Interstate 8, Routes 98 and 80 were damaged where they crossed the fault. The New River Bridge west of Brawley suffered serious damage by an aftershock about midnight. The west end of Runway 26 at the Naval Air Facility settled. The runway was closed 62 days for repairs. Sewage treatment plants in El Centro, Brawley, and Imperial were seriously disrupted. Clarifiers at all three were knocked out, pumps at Imperial were misaligned and subsequently burned out, and miscellaneous other damage occurred. All exceeded their holding capacity and dumped raw sewage into the drainage system. Normal service was not restored for from 2 to 6 months. Estimates of sewer main ruptures have never been summarized.

The All-American Canal suffered major slumping to its embankments on both sides for an eight mile stretch in the vicinity of the Imperial Fault. There were extensive slope failures in many of the other canals. The IID immediately reduced flow to about fifteen percent and later shut the entire irrigation system down for several days for inspection and repairs. Although media accounts, and the staff report stated the system never was completely shut down. There was extensive drainage tile damage in fields crossed by the fault.

Electrical power was out in parts of the Valley for 3 to 4 hours. Several key emergency generators failed to function - one for the County fire station and control tower at the Imperial Airport and another at a local hospital. All hospitals remained otherwise functional with only minor damage. Students were not in class at the time of the quake. Schools remained closed the following day to assess damage. It was all non-structural – estimated at $345,000, "County-wide". Telephone and telegraph facilities were undamaged but became inoperative due to overload of attempted calls for up to 18 hours in certain areas. This seriously interfered with emergency analysis and response. Local radio and television (including designated Emergency Broadcast Station) were off the air for about an hour. Total loss was estimated at $30,000,000.

1981 April 27. Westmorland. Magnitude 5.6 Intensity VII. There was more damage to Westmorland than resulted from the October 1979 quake. Several commercial buildings and 16 homes were substantially damaged. The water tower, and the water and sewage treatment plants received $500,000 damage. A quarter mile of the concrete lined Vail Canal was broken up. An eight-inch crack opened in Lack Road. There were no injuries, nor significant damage reported elsewhere in the valley.

The swarm of thirty quakes (seven between 3.0 and 4.1) occurred over a 12-hour period three days before the main quake. More than three dozen quakes (over 3.0) occurred in the 24 hours afterwards.

This quake apparently ruptured underground gasoline storage tanks, which was revealed months later with fumes and seepage into surface waters.

1985 May 8. An earthquake measuring 5.2 on the Richter Scale, rocked a large uninhabited area of the Mexican desert 65 miles southwest of Calexico, but there were no reports of damage or injuries, authorities said.

The quake was followed by a series of aftershocks, including one that registered 4.3 on the Richter Scale, according to a spokesman for the California Institute of Technology at Pasadena.

1986 July 8. A quake struck 12 miles northwest of Palm Springs measuring 5.9 on the Richter Scale of ground motion. It did an estimated $5.75 million damage and injured 40 people. Numerous aftershocks, some measuring as high as 4.0 on the Richter scale, have jostled the area since then.

1986 July 13. A 5.3 earthquake epicentered 28 miles southwest of Oceanside in the Pacific Ocean. The quake was felt as far away as Yuma, AZ, 160 miles east of San Diego, but caused no reported damage or injuries in Imperial Valley.

1987 February 6. A strong earthquake shattered windows and disrupted power in Mexicali and briefly interrupted phone service in the Imperial Valley but there were no reported injuries, authorities said. The trembler registered 5.6 on the Richter Scale and was centered 19 miles southeast of Mexicali according to a spokesman of Caltech in Pasadena.

The quake was felt as far east as Yuma, about 60 miles from the epicenter and as far west as San Diego.

1987 November 23-24. Two strong earthquakes, which registered 6.0 and 6.3 on the Richter Scale, caused widespread damage, but few injuries were reported. The Calexico area was apparently the hardest hit by the trembler, which was centered near Westmorland.

Two bridges, on Forrester Road over the New River and on Worthington Road over the New River were damaged according to the County Public Works Department. The California Highway Patrol also reported that Keystone Road between Forrester and Highway 86 is closed because of bridge damage.

1988 January 25. A large earthquake struck Baja California, Mexico, shaking some Californians awake but triggering no immediate damage reports either north or south of the border, officials said.

The quake registered 5.3 on the Richter Scale was centered in a sparsely populated area about 45 miles east of the resort city of Ensenada according to a spokesman of the California Institute of Technology in Pasadena. The U.S. Geological Survey in Golden, Colorado, measured the quake at 5.0. There were no reports of damage in Imperial County.

2005 September 2. This earthquake registered 5.1 on the Richter Scale and was part of a swarm of temblors that have hit the same region in Imperial County for four days. The earthquake shook buildings as far away as San Diego. It was centered about one mile east-southeast of Obsidian Butte – 16 miles north of El Centro and 100 miles east of San Diego. The tremor was part of what seismologists are calling the Obsidian Butte Earthquake Swarm of August-September 2005.

2009 December 30. A magnitude 5.8 earthquake struck southeast of Mexicali, Mexico, about 35 km south of the US-Mexico border, at 10:48 a.m. Pacific time (PST); it was widely felt in Mexico, southern California, and southwest Arizona.

2010 April 4. El Mayor-Cucapah Earthquake (also known as the Easter Sunday Earthquake). A magnitude 7.2 occurred and there have been 758 events at least M3.0 or larger. More than one million people were exposed to shaking equal to or exceeding VI intensity. This is strong shaking with light damage to resistant structures (reinforced concrete, wood-framed homes, etc.), and moderate damage or greater to vulnerable buildings (non-reinforced masonry, brick, cinderblock without reinforcement, etc.).

2012 August 26. The swarm began on Saturday evening with six events of M<2.0, and activity picked up at 8:30 am with three M2.5 events in a few minutes. As of 12:00 pm on 8/28/2012, CISN recorded more than 550 events. The largest two are M5.3 at 12:31 pm and a M5.5 at 1:57 pm. There have been eight events ranging between M4.0 and M5.0, and a total of 57 events M 3.0 or larger have occurred. A field visit on 8/27/12 found no evidence of surface rupture nor evidence of liquefaction. Some light cosmetic damage was found on some older buildings in downtown Brawley.

Appendix C: Storage Sites, Handlers, And Vendors Of Hazardous Materials And Waste

This report contains a summary of the largest concentrations of hazardous material and the obvious sources of massive leaks or spills in the County of Imperial. Space requirements of this document preclude the listing of every potential source of hazardous material and waste. This type of detailed information may be obtained by contacting the County of Imperial Department of Health Services.

1. Santa Fe Pacific Pipeline Tank Farm

The Santa Fe Pacific Pipeline Tank Farm is located at Aten Road and the Southern Pacific Railroad junction in the southeast quadrant of the City of Imperial. This facility is a component of the Santa Fe Pacific Pipeline network that delivers gasoline, diesel, and jet fuel to Southern California and Arizona. The tank farm contains 16 storage tanks, in varying sizes, with a total storage capacity of approximately ten million gallons.

2. Naval Air Facility (El Centro)

The Naval Air Facility (El Centro) is serviced by a four-inch fuel line directly from the Santa Fe Pacific Pipeline Tank Farm. Safety devices include manual and automatic shutoff valves, as well as pressure regulators. The facility also stores one million gallons of fuel, which is predominantly jet fuel, in underground tanks. Munitions storage is limited to aircraft and small arms training ammunition.

3. ST Services

ST Services is located south of the Santa Fe Pacific Pipeline Tank Farm and has the capacity to store 70,000 gallons of fuel.

4. Brea Agricultural Service

Brea Agricultural Service is located at 89 East Main Street in the City of Heber and serves as a chemical and fertilizer storage facility.

5. United Agriculture Products

United Agriculture Products is located at 2415 Clark Street in the City of Imperial. This facility handles hazardous wastes, chemicals, insecticides, and pesticides.

6. Puregro Company

The Puregro Company is located at 10th Street and River Drive in the City of Brawley. This facility handles chemicals and fertilizers.

7. ROCKWOOD CHEMICAL COMPANY

Rockwood Chemical Company is located at 47 West Rutherford Road in Brawley. This facility handles chemical and fertilizers.

8. HELENA CHEMICAL PRODUCTS

Helena Chemical Products is located at 101 East Carey Road in the City of Brawley. This facility handles chemicals, fertilizers, insecticides, and pesticides.

9. WILBUR ELLIS COMPANY

The Wilbur Ellis Company is located at 45 West Danenberg Road in the community of Heber. This facility handles chemicals, fertilizers, insecticides, and pesticides.

10. PIPELINES

There are 89.92 miles of pipeline in Imperial County that transport hazardous material. Pipe sizes vary in size from 12 to 20 inches and the average size is 12 inches. Pipelines are located adjacent to the Southern Pacific tracks from the Arizona border at Yuma to the Niland tank farm, north to the Riverside County Line, and south to the Imperial tank farm. The pipeline system has section fuel control valves.

Source: 1988 Imperial County Emergency Plan