HOUSING ELEMENT &
TARGETED GENERAL PLAN ELEMENT UPDATES

City of Lodi
Safety Element

Adopted | December 4, 2024
Council Resolution No. 2024-203

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Acknowledgements

City of Lodi

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Council Resolution No. 2024-203 | Adopted December 4, 2024

Safety Element

City of Lodi

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8.1 Introduction

The Safety Element identifies the natural and manmade hazards that exist within the city. It seeks to mitigate their potential impacts, through both preventative and response measures, to ensure the continued health and safety of Lodi community members. This Element addresses flooding and drainage; potentially hazardous materials and operations; seismic and geologic hazards; fire hazards; emergency management, and climate change. Potential health hazards related to air quality are addressed in Chapter 7: Conservation. Storm drain infrastructure related to flooding and drainage is discussed in Chapter 3: Growth Management and Infrastructure.

Federal Programs and Regulations

Environmental Protection Agency

The United States Environmental Protection Agency (U.S. EPA) enforces the Federal Toxic Substances Control Act (1976) and the Resource Conservation and Recovery Act of 1976 (RCRA), which regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA was amended in 1984 by the Hazardous and Solid Waste Act (HSWA), which affirmed and extended the "cradle to grave" system of regulating hazardous wastes (controlling hazardous waste from the time it is generated until its ultimate disposal). The use of certain techniques for the disposal of some hazardous wastes was specifically prohibited by the HSWA.

The 1980 Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund, provides broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

United States Department of Transportation

Transportation of chemicals and hazardous materials are governed by the United States Department of Transportation (DOT), which stipulates the types of containers, labeling, and other restrictions to be used in the movement of such material on interstate highways.

Federal Emergency Management Agency

The primary mission of the Federal Emergency Management Agency (FEMA) is to reduce the loss of life and property and to protect the nation from all hazards, including natural disasters, acts of terrorism, and other manmade disasters, by leading and supporting a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.

Disaster Mitigation Act

The Disaster Mitigation Act of 2000 requires a state mitigation plan as a condition of disaster assistance, adding incentives for increased coordination and integration of mitigation activities at the state level.

State Regulations

California Department of Conservation

Cities and counties are required to consult with the California Geological Survey of the Department of Conservation prior to revising its safety element. Safety Elements should include historical data on landslides and mudslides and identify areas that are landslide-prone using, landslide features maps, seismic hazard zone maps, and geology maps produced by Department of Conservation.

California Environmental Protection Agency

The management of hazardous materials and waste within California is under the jurisdiction of the California Environmental Protection Agency (Cal EPA). Cal EPA is responsible for developing, implementing, and enforcing the state's environmental protection laws that ensure clean air, clean water, clean soil, safe pesticides and waste recycling and reduction. Within Cal EPA are various departments, three of which are described as follows:

Office of Environmental Health Hazard Assessment

The California Office of Environmental Health Hazard Assessment oversees implementation of the Safe Drinking Water and Toxic Enforcement Act of 1986 (commonly known as Proposition 65), which aims to protect California citizens and the state's drinking water sources from chemicals known to cause cancer, birth defects, or other reproductive harm and to inform citizens about exposures to such chemicals.

California Department of Toxic Substances Control

The California Department of Toxic Substances Control (DTSC) implements the California Code of Regulations Title 22, Division 4.5, which provides standards for the management of hazardous waste. The DTSC has the authority to delegate enforcement of the state's hazardous waste regulations to local jurisdictions.

California Department of Transportation

The California Department of Transportation (Caltrans) manages more than 50,000 miles of California's highway and freeway lanes, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports and works with local agencies. Caltrans is also the first responder for hazardous material spills and releases that occur on those highway and freeway lanes and inter-city rail services.

California Division of Safety of Dams

The California Department of Water Resources, Division of Safety of Dams supervises the construction, enlargement, alteration, repair, maintenance, operation, and removal of dams and reservoirs for the protection of life and property. Included in this authority is the approval of dam inundation maps to identify potential flood prone areas that may be critically impacted during a dam failure or emergency incident. Approved inundation maps are used to support emergency action plans that dam owners are required to prepare pursuant to Water Code Section 6161.

California Office of Emergency Services

The California Office of Emergency Services (Cal OES) is responsible for assuring the state's readiness to respond to and recover from all hazards, emergencies, and disasters. Cal OES assists local governments in developing their own emergency preparedness and response plans, in accordance with the Standardized Emergency Management System and the State Emergency Plan, for earthquakes, floods, fires, hazardous material incidents, nuclear power plant emergencies, dam breaks, and acts of terrorism. Cal OES also administers the State of California Multi-Hazard Mitigation Plan (SHMP), which presents goals, strategies, and actions for reducing future disaster losses throughout the state. The SHMP is a federal requirement under the Disaster Mitigation Act of 2000 in order for the state to receive federal funds for disaster assistance.

Safe School Plan (California Education Code Sections 32280 et seq.)

This statute requires public schools to prepare a school safety plan that identifies strategies and programs that will ensure a high level of school safety related to child abuse reporting; disaster procedures; on-campus violence; discrimination and harassment; safe ingress and egress to and from school; safe and orderly environment conducive to learning; and school discipline.

Relationship to State Law

Government Code Section 65302(g) requires each California city and county to include within its general plan a safety element that addresses the protection of the community from any unreasonable risks associated with the effects of seismic and other geologically induced hazards, flooding, and fires. The safety element is required to include mapping of known seismic and other geological hazards. Where applicable, it must also address evacuation routes, peak load water supply requirements, minimum road widths, and clearances around structures.

Government Code Section 65302(g) (as amended by SB 379 (2015)) requires cities and counties to include climate adaptation and resiliency strategies. The City of Lodi prepared a Climate Change Vulnerability Assessment (CCVA), Appendix C which assesses how the community and natural and built assets in Lodi are vulnerable to climate change. The Public Safety Element of the General Plan includes adaptation implementation measures consistent with this legislation.

Government Code Section 65302(5) (as amended by SB 99 (2019)) requires a local government to identify residential developments in hazard areas that do not have at least two emergency evacuation routes. A residential emergency evacuation route analysis was conducted as part of this Public Safety Element update and includes the identification of residential neighborhoods that do not have two evacuation routes, included in Appendix B.

Government Code Section 65302.15 (introduced by AB 747 (2019)) requires all cities and counties to identify evacuation routes and evacuation locations in the safety elements of their general plans. The bill requires evaluation of evacuation route capacity (e.g., the amount of traffic a roadway can handle in an emergency), safety, and viability (e.g., ability to function during an emergency scenario) under a range of emergency scenarios, as well as the identification of evacuation locations. Consistent with AB 747, a residential emergency evacuation route analysis was conducted and evacuation routes identified under a range of emergency scenarios included in Appendix B.

Government Code Section 65302(g) (as amended by SB 1035 (2018)) requires a jurisdiction's safety element to be revised to identify new information on fire hazards, flood hazards, and climate adaptation and resiliency strategies applicable to the City and County that was not available during the previous revision of the safety element.

Government Code Section 65302.6 (AB 2140 (2006)) allows local jurisdictions to be eligible for consideration for state funding to cover the local match of public assistance costs for recovery activities after hazard events. Jurisdictions must incorporate their local hazard mitigation plan into their safety element update to be eligible. The City of Lodi is participating in the Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP) for the County of San Joaquin planning area, which is currently in development in accordance with the Disaster Mitigation Act of 2000 (DMA 2000) and will follow FEMA's Local Hazard Mitigation Plan guidance. The LHMP will incorporate a process where hazards are identified and profiled, the people and facilities at risk are analyzed, and mitigation actions are developed to reduce or eliminate hazard risk. The implementation of these mitigation actions, which will include both short and long-term strategies, involve planning, policy changes, programs, projects, and other activities (https://www.sjgov.org/department/oes/local-hazard-mitigation-planning).

8.2 Flooding And Drainage

Flood Zones

Figure 8-1 shows areas within the 100-year floodplain zones. The map uses Flood Insurance Rate Map (FIRM) 100-year floodplain data produced by Federal Emergency Management Agency (FEMA). The FIRM is the only official mapping for the purposes of National Flood Insurance Program (NFIP) regulations and coverage areas. Additional flood risk data, including 200-year flood data shown in Figure 8-2, described below, is not approved by FEMA for use in relation to the NFIP.

Based on revised flood risk evaluations prepared by FEMA for the City of Lodi and San Joaquin County, effective October 19, 2009, flood hazards are a constraint to development only in two areas of the city: the area immediately adjacent to the Mokelumne River along the city's northern boundary, and the area around the White Slough Water Pollution Control Facility, the City's wastewater treatment facility, in the southwest corner of the Planning Area.

As shown on Figure 8-1, these areas are subject to a 1 percent annual (100-year) flood. Flooding depths in this area are generally greater than three feet. No new development is planned within either of these areas.

Most of the city and the Planning Area lie within areas designated Zone X (500) that are subject to the 0.2 percent annual (500-year) flood zone or that lie within the 100-year flood zone, but with flooding depths less than one foot. This suggests that these areas have a low susceptibility to major flooding, but would be inundated during a 500-year flood event. The remaining portions of the city and Planning Area are classified as Zone X, meaning that they lie outside the 500-year flood zone.

200-Year Floodplain

Figure 8-2 shows areas within the 200-year floodplain which are subject to urban level of flood protection requirements with flood depths of 3-feet or greater. This map identifies areas where higher standards of development and flood protection may be required before issuance of building permits.

Figure 8-2 was developed using data provided by DWR, supplemented by a floodplain study ***Mokelumne River Hydraulic Analyses: Summary of Methodology & Results, December 19, 2018*** prepared by the firm of Kjeldsen, Sinnock Neudeck, Inc. (KSN). This report provides the technical basis for mapping the extents of the 200-year floodplain within the City of Lodi.

The primary source of potential flooding for Lodi is the Mokelumne River which flows along the city's northern border. The 200-year floodplain resulting from the Mokelumne River within the city was modeled based on several data sources, including a review of the Mokelumne River watershed and a review of existing flood data.

The Mokelumne River is formed by the confluence of the North Fork Mokelumne River and the Middle Fork Mokelumne River in the western slopes of the Sierra Nevada. It flows from this confluence along the Amador and Calaveras County Line down through Pardee and Camanche Reservoirs past Lockeford and Lodi until its eventual discharge into the San Joaquin River near Bouldin Island. The watershed is generally divided into two sub-watersheds: the Upper Mokelumne River and the Lower Mokelumne River with Pardee and Camanche Reservoirs between the two sub-watersheds. The Upper Mokelumne River is primarily federally managed wilderness with some commercial timber land and protected watershed areas managed by the East Bay Municipal Utility District (EBMUD). The Lower Mokelumne River is part of the rich agricultural region of the Central Valley with grapes being the major crop grown in the watershed.

The anticipated 200-year flood event in Lodi is caused by the Mokelumne River rising out of its banks and inundating a wide, flat developed area. Various scenarios were modeled using a combined one-dimensional/two-dimensional hydraulic model. Due to the nature of the flooding anticipated in the Lodi area, the HEC-RAS v.5.0.5 was selected as hydraulic model for the flooding analysis.

Lodi has reliable historical data along four points of the Mokelumne River from past floods in 1955, 1986, 1997, and 2017. This data was combined with East Bay Municipal Utility District's hydrologic and stream flow data along the Mokelumne River to calibrate the model for this analysis.

Due to the significantly higher elevations in the high-water mark elevations observed during the 1955 flood event as compared to the three other events, the 1955 flood event was selected as the primary flood to which the hydraulic model was calibrated.

Based upon the analysis described above, and as described in greater detail within the KSN report, areas subject to flooding greater than three feet in depth within the city were mapped as presented in Figure 8-2. Consistent with the requirements of Senate Bill 5 (SB 5), no construction may occur within the delineated 200-year flood plan unless the City finds and determines that urban level of flood protection requirements have been satisfied.

Dam Inundation

Large quantities of water stored in reservoirs along the Mokelumne, Calaveras, and Stanislaus River systems pose a potential threat to inhabitants of the Planning Area. Flooding could occur as a result of releases from reservoirs upstream of the Planning Area. Partial or complete failure of a dam along any of these rivers, especially the Mokelumne River, could cause inundation in the Planning Area. Dams that pose a direct threat to the Planning Area include Camanche, Camanche South and North Dikes, Salt Spring, Lower Bear, New Woodbridge, Bear River, and Pardee Dam. The majority of the Planning Area would be inundated in the event of a failure of any of these dams, except for the New Woodbridge and Pardee Dams, whose failure would just flood the Planning Area north of Kettleman Lane and scattered portions of the city. Dam inundation maps can be found in Figure 8-3 through Figure 8-8.

Figure 8-1 100-YEAR AND 500-YEAR FEMA FLOOD ZONES

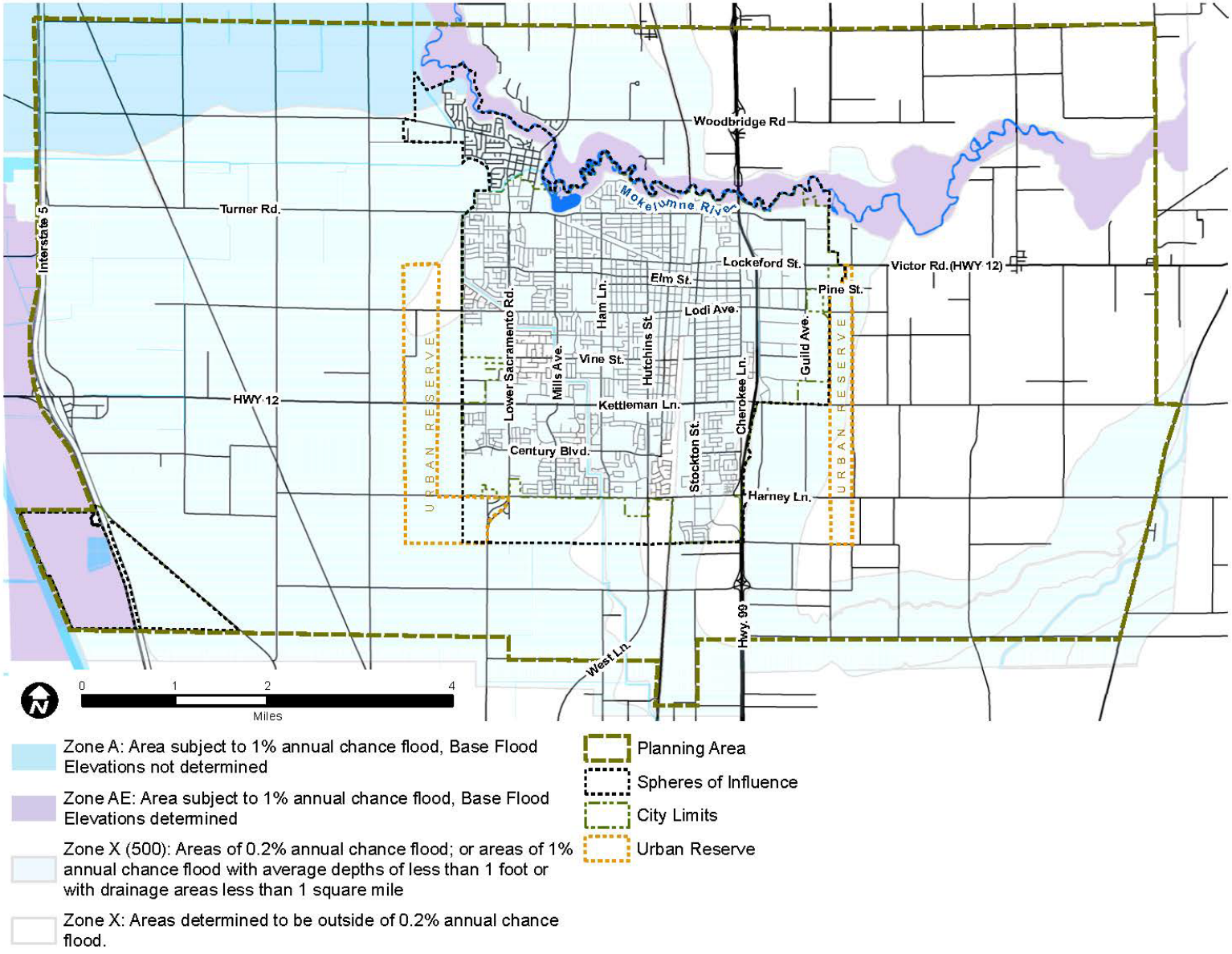


Figure 8-2 200-YEAR FLOOD ZONES Based on Mokelumne River Hydraulic Analyses: Summary of Methodology and Results, 2018

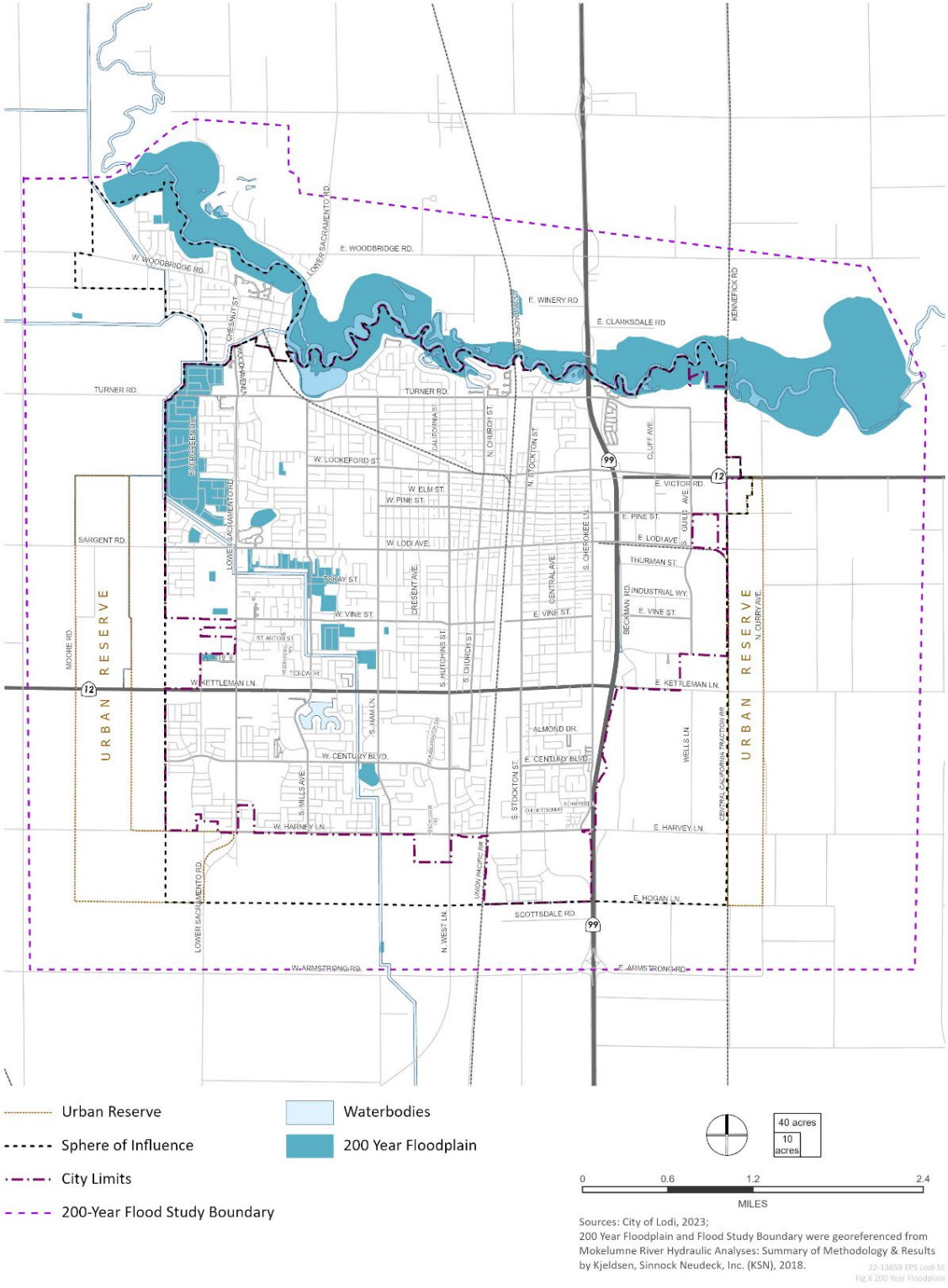


Figure 8-3 SALT SPRINGS DAM UNUNDATION ZONE

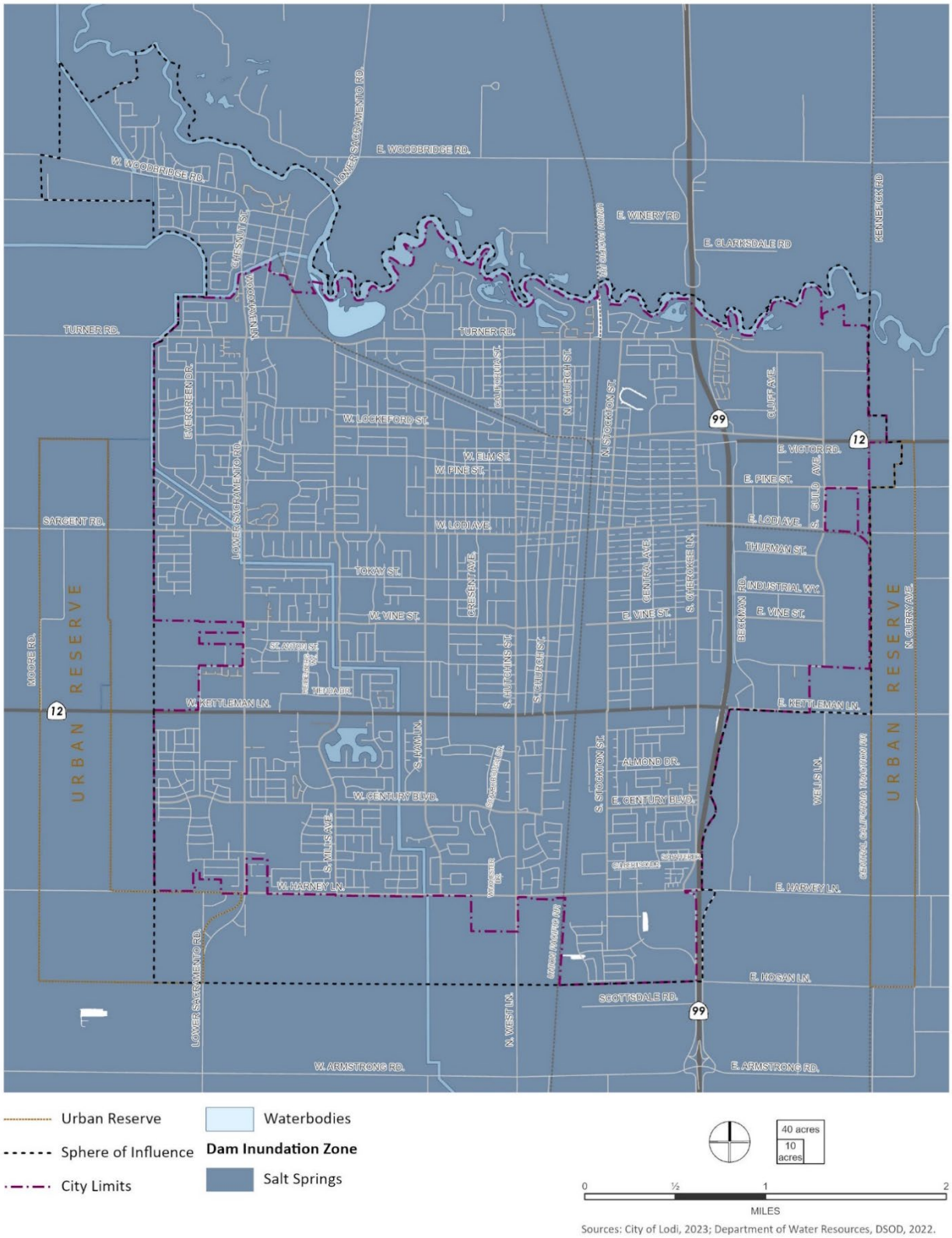


Figure 8-4 CAMANCHE DAM UNUNDATION ZONE

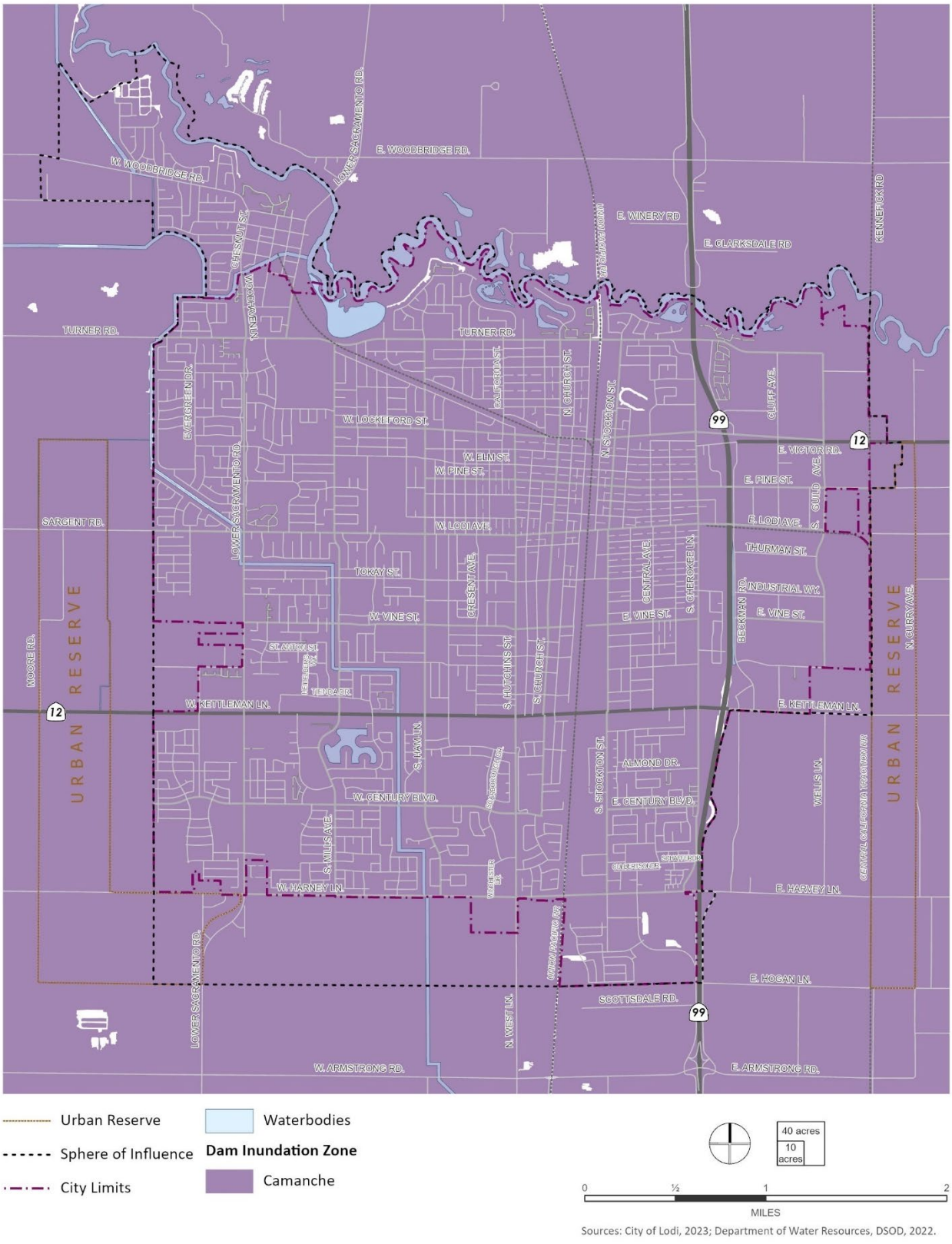


Figure 8-5 LOWER BEAR RIVER DAM UNUNDATION ZONE

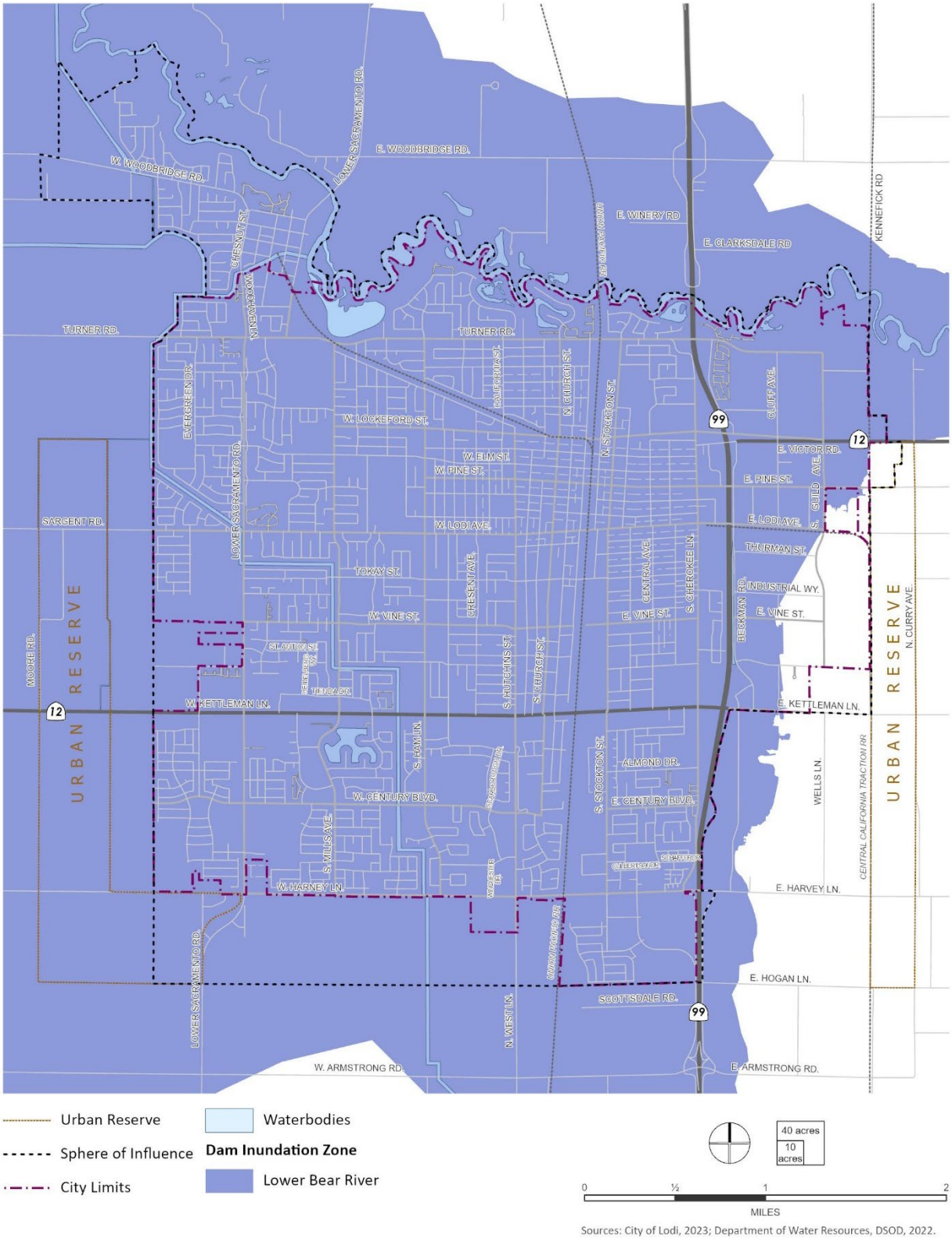


Figure 8-6 NEW WOODBRIDGE DAM UNUNDATION ZONE

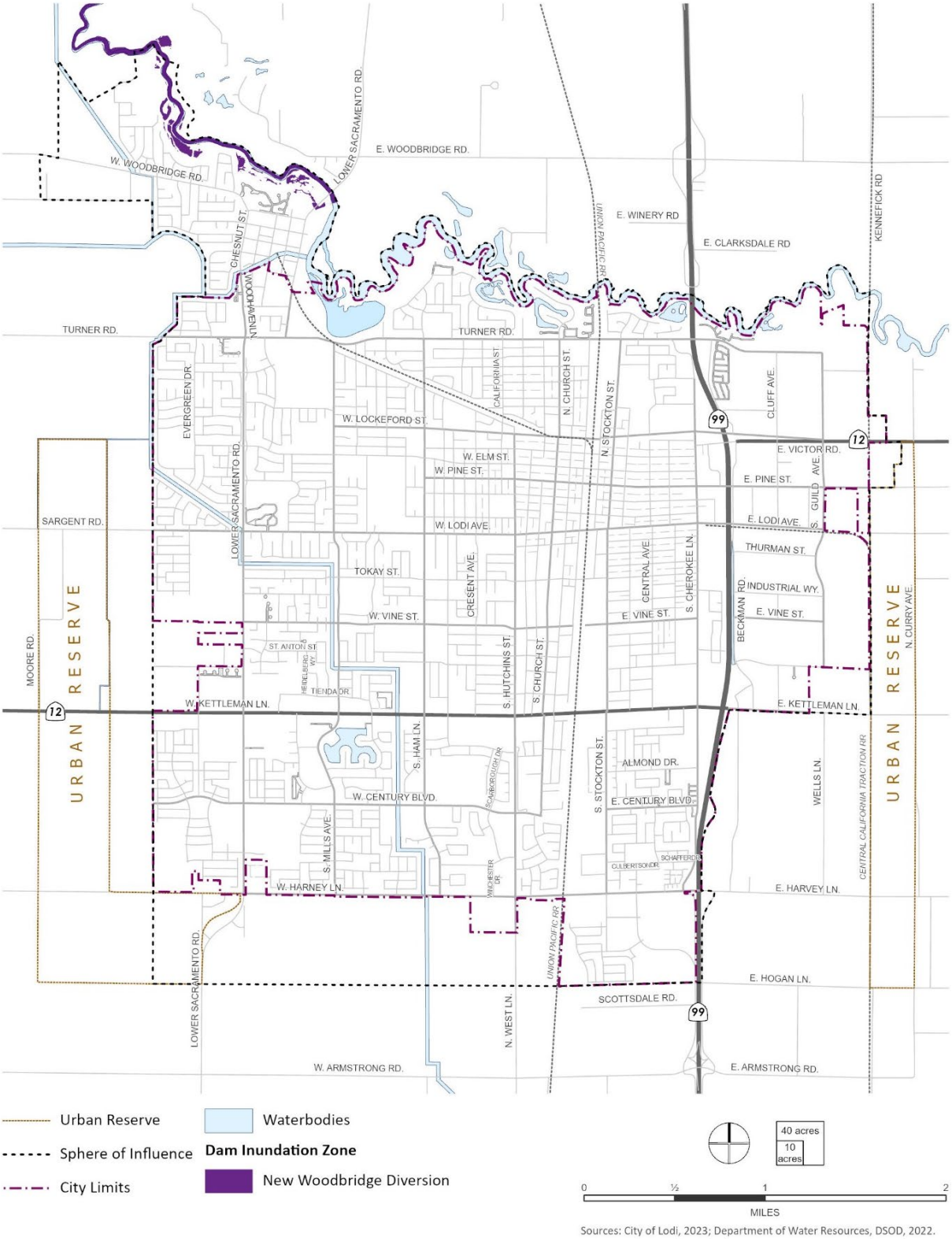


Figure 8-7 PARDEE DAM UNUNDATION ZONE

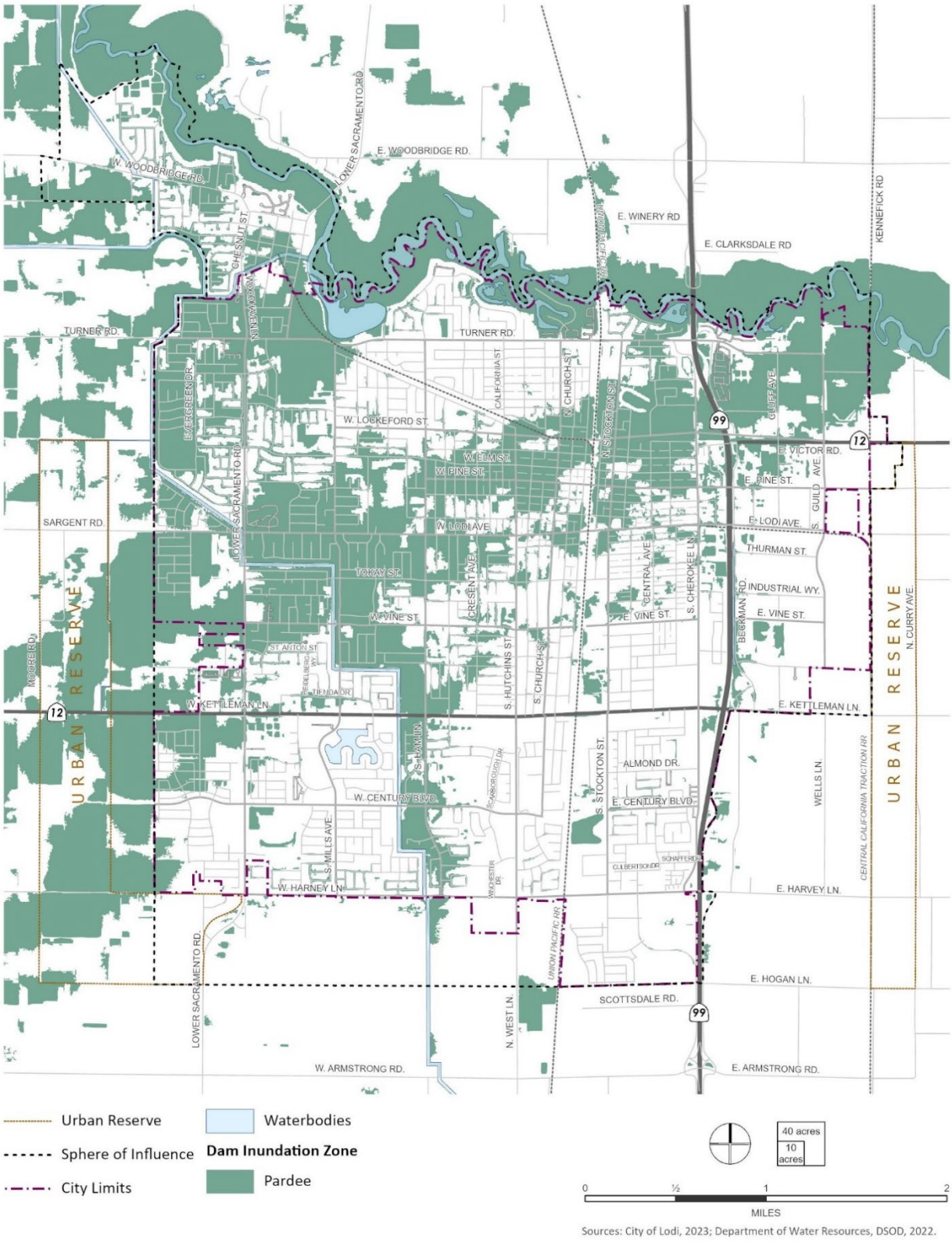
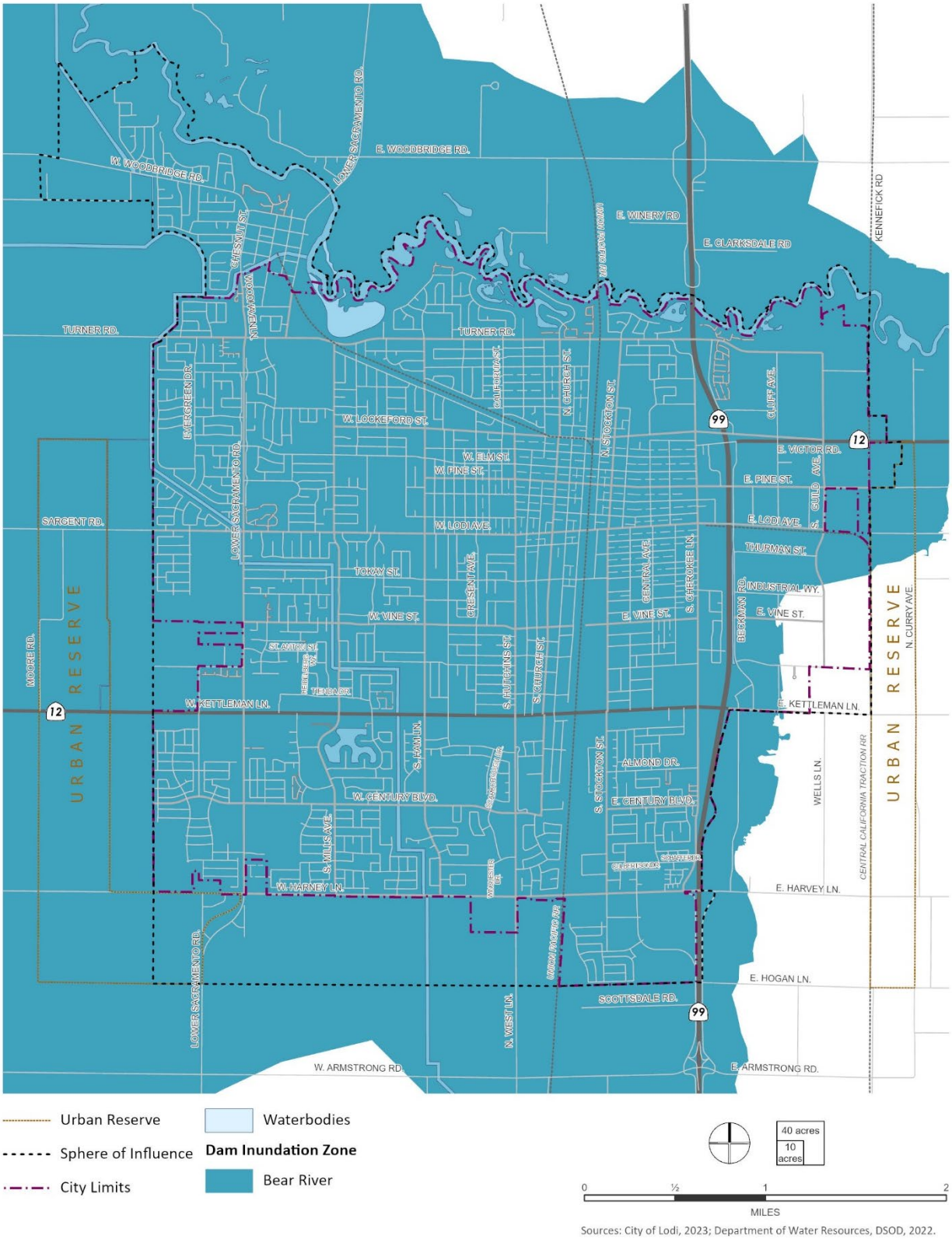


Figure 8-8 BEAR RIVER DAM UNUNDATION ZONE



Flood Protection

Berms along the Mokelumne River were privately built and vary in height. Upstream of SR-99, the adjacent agricultural lands are protected against floods up to the 50-year currents by low discontinuous berms. Berm overtopping here from larger flood events (e.g., the 100-year flood) would not, however, cause inundation in the Planning Area. Berms west of SR-99 are higher and provide protection from flows slightly greater than the 100-year event. Should a major storm event cause berms to be over topped or if a berm or dam fails, flooding would occur. Flooding can also occur when runoff exceeds the capacity of local systems and cannot drain adequately. As long as berms are not over-topped and maintain their structural integrity, flooding is considered to be very unlikely.

San Joaquin County has prepared a Dam Failure Plan that identifies hazards to the county from dams and reservoirs. The Dam Failure Plan also identifies actions that will be taken to respond to flood-related emergencies in the event that flooding occurs. These actions would include implementation of the Standardized Emergency Management System and the County's Multi-Hazard Emergency Plan (see Section 8.5: Emergency Management for details).[1]

Although major flooding is not anticipated, as existing agricultural and open space lands are converted to urban uses, there will be an increase in stormwater runoff from additional impervious surfaces. To minimize those impacts, General Plan policies seek to manage stormwater runoff, through the permitting process, good stormwater management practices (e.g. porous materials, cisterns, bioswales, etc.), and the construction of open spaces and drainage basins (see Chapter 6: Parks, Recreation, and Open Space).

Agencies Responsible for Flood Protection

Federal Emergency Management Agency

FEMA is a federal agency whose mission is to reduce the loss of life and property from natural and human-made disasters through a comprehensive, risk-based emergency management system. One of the agency's responsibilities is to maintain flood zone maps.

California Department of Water Resources

DWR implements the California Water Code, regulates activities in California's floodways, encourages preventive flood control maintenance, and operates some flood control projects.

Central Valley Flood Protection Board and Plan

The Central Valley Flood Protection Board updated and adopted the Central Valley Flood Protection Plan (CVFPP) in 2022 and continues to oversee the plan's implementation. The 2022 CVFPP provides a blueprint for improving flood risk management in the Central Valley and reduce the risk of flooding for about 1.3 million people in California and $240 billion in infrastructure, homes, and businesses with a goal of providing 200-year flood protection to urban areas.

8.3 Potentially Hazardous Materials and Operations

This section focuses on human-made hazards associated with the exposure to hazardous materials, as well as fire, transportation, and utility corridor hazards. Hazardous wastes generated by both residents and businesses within the Planning Area contribute to environmental and human health hazards that have become an increasing public concern. However, proper waste management and disposal practices can minimize public concern over toxicity and the contamination of soils, water, and the air.

Hazardous Materials

As of May 2009, the State Water Resources Control Board reported an inventory of Leaking Underground Storage Tanks (LUST) and other (non-fuel) cleanup sites. The majority of the LUST sites have been remediated, with only nine sites listed as still "open" for remediation, monitoring, or assessment. These sites are described in Appendix C and shown in Figure 8-9.

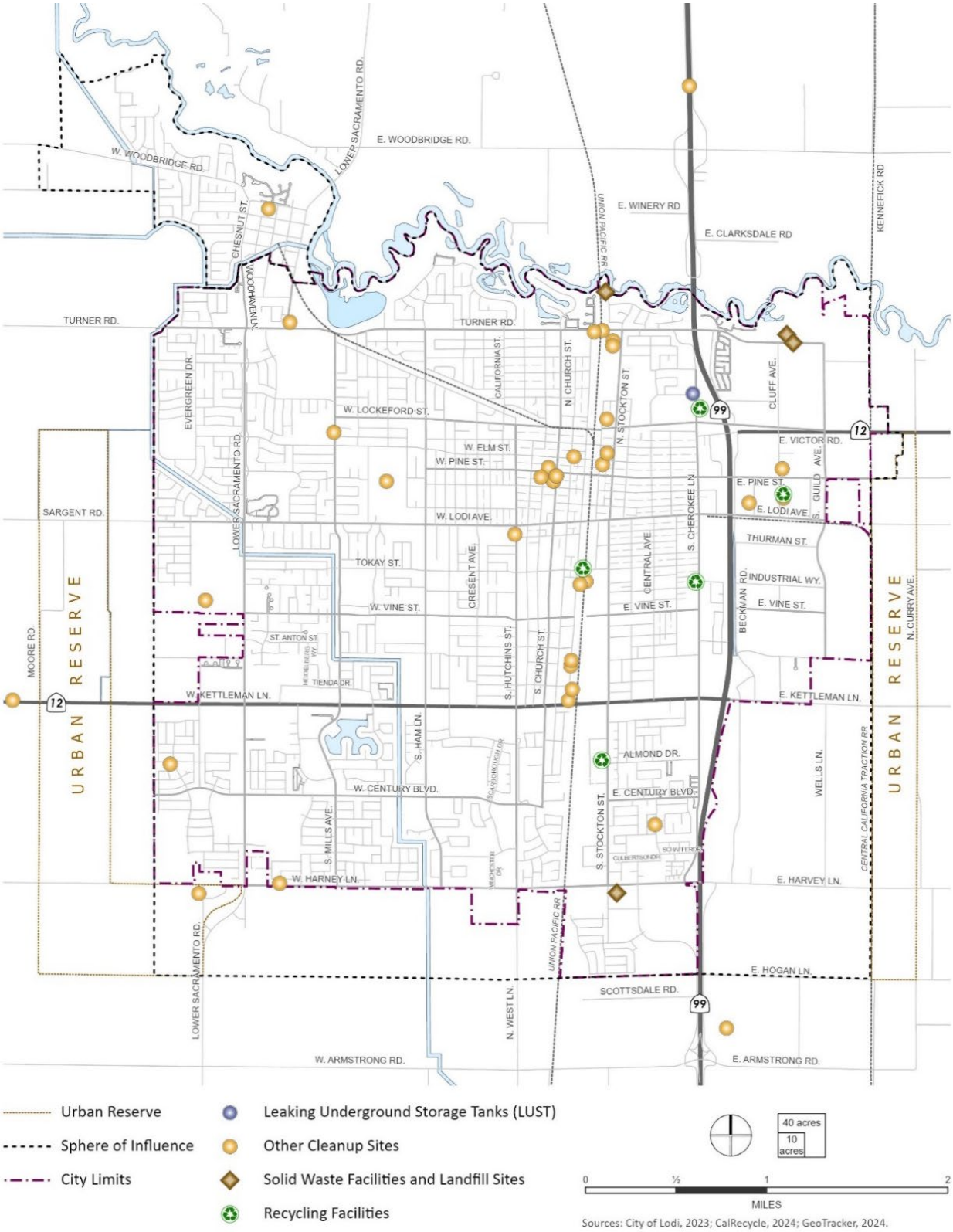
The California Integrated Waste Management Board (CIWMB) is responsible for managing California's solid waste stream. The CIWMB works in partnership with local government, industry, and the public to reduce waste disposal and ensure environmentally safe landfills are maintained. Table 8-1 and Figure 8-9 describe solid waste, recycling, and landfills facilities (including closed facilities).

The City of Lodi implements a Storm Water Management Program in compliance with the National Pollutant Discharge Elimination System (NPDES) Phase II General Permit addressing waste discharge requirements for storm water discharges for small municipal separate storm systems. Common stormwater pollutants, sources, and possible impacts to the Mokelumne River (Comanche Dam to Delta) and the Delta (Central and Eastern Areas) have been identified in storm water and their sources as a result of human-made hazards. Implementation of the program requires the City to develop and implement permit requirements, including Illicit Discharge Detection and Elimination and Construction Site Runoff Control measures.

Table 8-1 SOLID WASTE AND/OR RECYCLING FACILITIES AND LANDFILL SITES IN THE PLANNING AREA

SITE	ADDRESS
Solid Waste and Landfill	
Lodi City Landfill	North of Awani Dr. and Mokelumne River Dr.
Central Valley Waste Services	1333 E. Turner Rd.
Sanitary City Disposal Site	1333 E. Turner Rd.
Valley Landscaping	1320 East Harney Ln.
Recycling Centers	
Diaz Recycling	548 S. Sacramento St.
Go Green Recycling	1803 S. Stockton St
M & R Recycling LLC	741 S. Cherokee Ln
P & R Recycling	324 N. Cherokee Ln
Tokay Recycling Center	60 S. Cluff Ave.

Figure 8-9 POTENTIAL HAZARDOUS MATERIALS SITES



Potentially Hazardous Operations

Airports and Airstrips

Airport-related hazards are generally associated with aircraft accidents, particularly during takeoffs and landings. Airport operation hazards include incompatible land uses, power transmission lines, wildlife hazards (e.g., bird strikes), and tall structures (e.g. traffic control towers). (Note that noise impacts are discussed in Chapter 9: Noise.)

Existing public use airports within or adjacent to the Planning Area include:

- Kingdon Airpark: seven miles southwest of downtown Lodi;
- Lodi Airpark: five miles southwest of downtown Lodi, near the intersection of Armstrong and Lower Sacramento roads (inside the Planning Area); and
- Ten private airstrips within or adjacent to the Planning Area.

The 2009 San Joaquin County Airport Land Use Plan provides information on existing and future operations, potential hazards, and land use compatibility. According to the Plan, Kingdon Airpark is planning to extend its runway to permit more flights and aircraft types (i.e. from solely accommodating single-engine planes to allowing business jets and turboprop aircraft). No future improvements are anticipated at the Lodi Airpark. Given the distance of these airports from the city's boundaries, the airports do not present substantial hazards to people or property in Lodi.

The Plan's land use compatibility matrix and compatibility zone map is shown in Figure 8-10. The southeast portion of Lodi, south of Century Boulevard, lies with in Zone 8: Airport Influence Area, which does not have any land use restrictions. A portion of the Urban Reserve General Plan area, along the north side of Hogan Lane, lies within Zone 7: Traffic Pattern. This classification prohibits outdoor stadiums and non-residential uses with densities greater than 450 persons per acre, and requires at least 10 percent open space.

Railroads

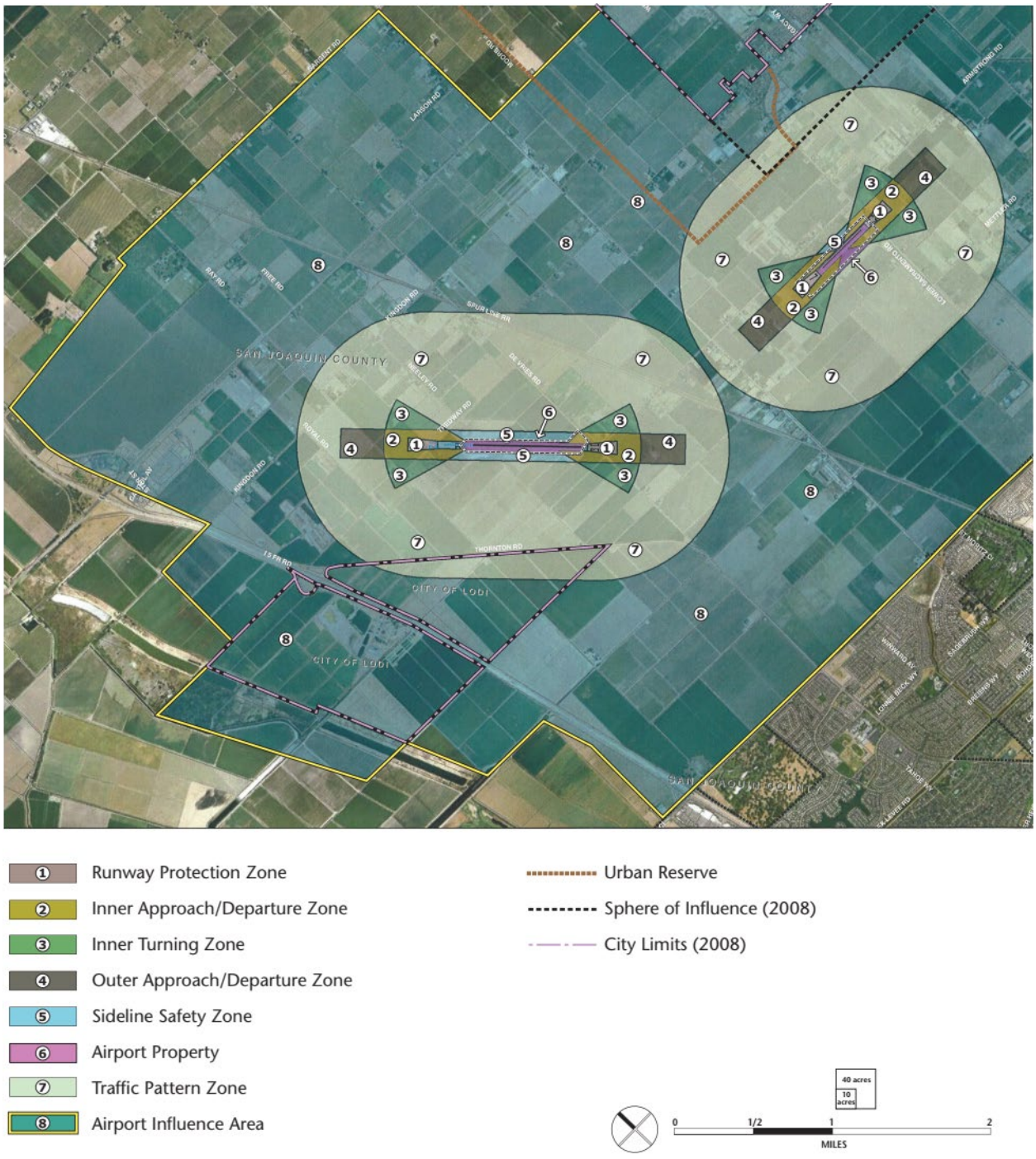
Potential hazards associated with railroads include collisions and train derailment. Either of these incidents can lead to human injury or death as well as causing various environmental impacts. The Federal Railroad Administration regulates railroad safety and provides oversight to the use of railroads.

Lodi is served by two national rail lines, Union Pacific Railroad and the Burlington Northern Santa Fe. The city is also served by a local railroad, Central California Traction, which runs contiguous to industrial areas. Daily passenger service via Amtrak is available from Lodi to San Francisco, Los Angeles, Sacramento and points between. A more detailed discussion of railroad operations and infrastructure may be found in Chapter 5: Transportation.

Utility Corridors

One of the primary causes of disruption to underground natural gas pipelines, which are present in the Planning Area, is external force damage that occurs during excavation activities. Such damage can create pipeline leaks or ruptures and lead to hazardous health and safety conditions. However, a national program is in place to prevent accidental pipeline damage caused by excavation. For areas adjacent to an underground utility pipeline, the U.S. Department of

Figure 8-10 AIRPORT COMPATIBILITY ZONES



Source: San Joaquin Council of Governments

Transportation Office of Pipeline Safety requires that individuals contact the state "One-Call" center prior to beginning excavation. Advanced planning, effective use of these one-call systems, accurate locating and marking of underground facilities, and the use of safe-digging practices can all be effective in reducing underground facility damage and potentially hazardous conditions.

8.4 Seismic And Geologic Hazards

In general, geologic and seismic hazards do not pose a substantial risk to development in Lodi or to overall public safety. The Central Valley is filled with a thick sequence of sediments eroded from the Sierra Nevada range to the east. The most recent deposits in the region are floodplain deposits, consisting of clay, silt, and some sand.

Seismicity

The Planning Area is located 65 miles east of the Bay Area and lies within Seismic Risk Zone 3. Earthquakes in Seismic Risk Zone 3 pose a lesser risk than those experienced in Zone 4 (such as the San Francisco Bay Area). The Planning Area may be affected by regionally occurring earthquakes; however, impacts resulting from such an event are not likely to be severe. Figure 8-11 identifies active and potentially active faults in and around the Planning Area.

Regional Faults

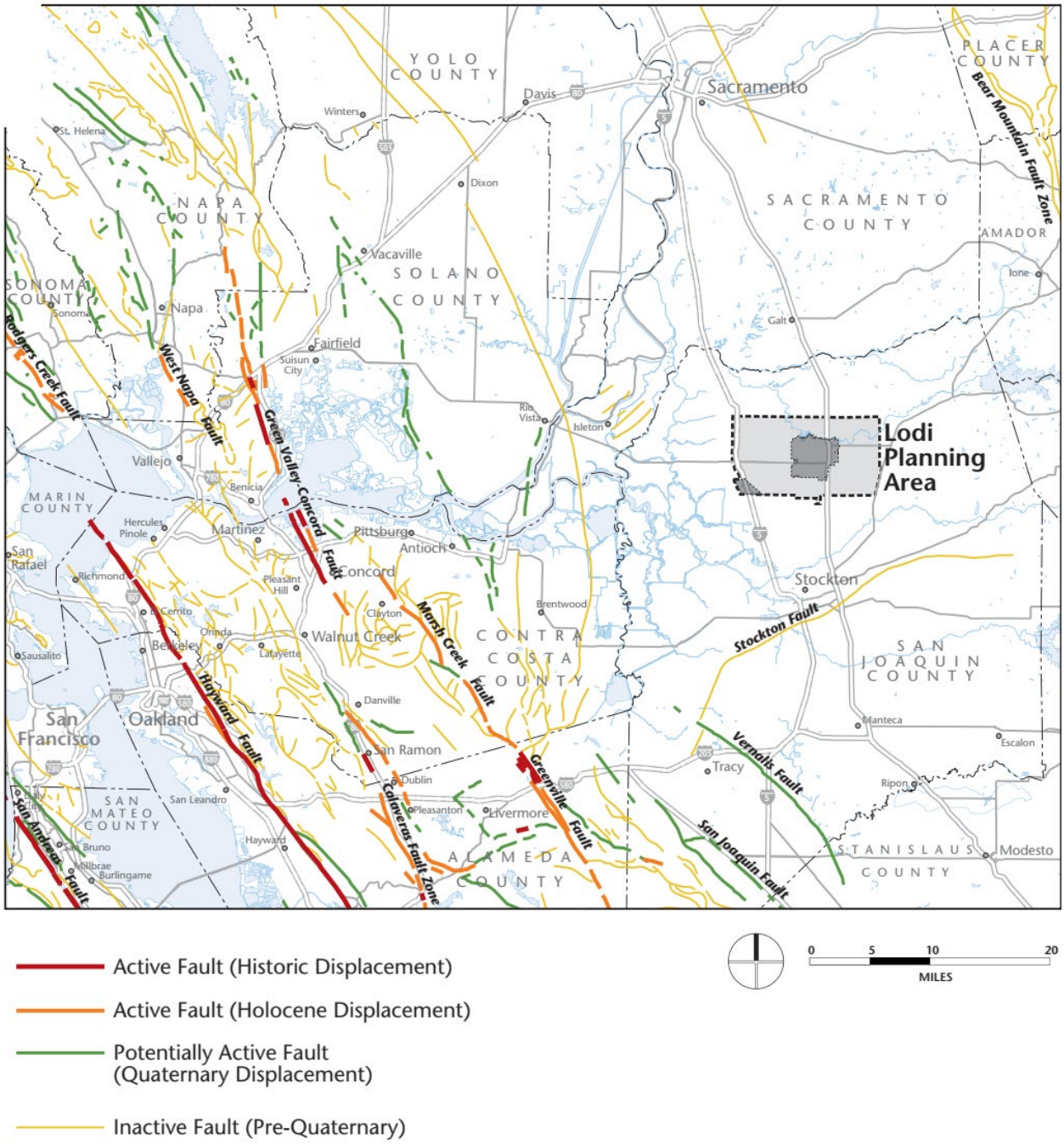
Lodi's nearest active fault is the Greenville Fault, located approximately 34 miles south of the Planning Area.[2] The Maximum Moment magnitude of the maximum probable earthquake on the Greenville Fault is estimated to be 6.9.[3] Other faults close to the Planning Area exhibiting historic displacement (activity within the last 200 years) are the Concord-Green Valley and Hayward Faults located approximately 45 miles west-northwest and 56 miles west of the Planning Area, respectively. Portions of the Calaveras Fault zone also have been rated as being active within the last 200 years; those portions are located approximately 46 miles southwest of the site. The nearest Quaternary fault (2 million years ago to present) to the Planning Area showing evidence of activity within the past 1.6 million years is the San Joaquin Fault located approximately 24 miles southwest of the Planning Area.[4] The nearest mapped fault trace, the Stockton Fault, is not considered an active fault.

Seismic Structural Safety

The greatest geologic hazard in Lodi is the structural danger posed by ground shaking from earthquakes originating outside of the area. During a high intensity event, some damage could occur to well-made structures and chimneys; some towers could fall; and poorly constructed or weak structures could be heavily damaged. The susceptibility of a structure to damage from ground shaking is related to the underlying foundation material. A foundation of rock or very firm material can intensify short-period motions, which affect low-rise buildings more than tall, flexible ones. A deep layer of saturated alluvium can cushion low-rise buildings, but it can also accentuate the motion in tall buildings. Other potentially dangerous conditions include, but are not limited to: building architectural features that are not firmly anchored, such as parapets and cornices; roadways, including column and pile bents and abutments for bridges and overcrossings; and above-ground storage tanks and their mounting devices.

The risk of surface fault rupture is considered low due to the substantial distance from the active Hayward and Calaveras Fault zones and the type of ground shaking expected from those faults.

Figure 8-11 REGIONAL FAULTS



The California Geologic Survey (CGS) prepared mapping that defines hazard levels associated with ground shaking, Earthquake Shaking Potential for California, 2016, and designates Lodi and surrounding lands as having low potential for earthquake-induced ground shaking.

Other Geologic Hazards

Additional geologic hazards that may exist within the Planning Area include soil erosion and settlement. The Planning Area is primarily flat and thus the risk of unstable soils or landslides is considered relatively low.

Soil Erosion

Soil erosion is the process whereby soil materials are worn away and transported to another area either by wind or water. Rates of erosion can vary depending on the soil material and structure, placement, and the general level of human activity. Soil containing high amounts of sand or silt can be easily eroded while clayey soils are less susceptible. The Tokay soils present in the Planning Area have a moderate potential for wind erosion. The Tujunga soils, found in more limited quantities in the Planning Area, have a severe potential for wind erosion if vegetative covering is removed.

Expansive Soils

Expansive soils are largely comprised of clay, which expand in volume when water is absorbed and shrink when dried. Structural damage may result over a long period of time, usually resulting from inadequate soil and foundation engineering or the placement of structures directly on expansive soils. Several of the soil types located within the Planning Area are comprised of potentially expansive materials. However, the majority of the Planning Area either has not been measured for soil shrink-swell or has a low potential for soil shrink-swell.

Settlement

Settlement is the consolidation of the underlying soil when a load, such as that of a building or new fill material, is placed upon it. When soil tends to settle at different rates and by varying amounts depending on the load weight, it is referred to as differential settlement. Settlement commonly occurs as a result of building construction or other large projects that require soil stockpiles. Areas of the Planning Area that contain fill material may be susceptible to settlement. If the fill materials are unconsolidated they have the potential to respond more adversely to additional load weights as compared to adjacent native soils.

Slope Instability/Liquefaction

Due to the relatively level terrain in and around the City of Lodi, potential for hazards associated with slope instability and/or landslides is very low. A review of CGS records (https:maps.consewrvation.ca.gov/cgs/informationwarehouse/) determined that CGS has not yet evaluated risks associated with slope instability or liquefaction in the vicinity of the City of Lodi.

8.5 Fire Hazards

Both urban and wildland fire hazards exist in the Lodi Planning Area, creating the potential for injury, loss of life, and property damage. In the event of a fire, the Fire Department relies on sufficient water supply and pressure. The City's design standard for water transmission facilities is to provide 4,000 gallons per minute of flow at a minimum 45 pounds per square inch of pressure in pipes 8 inches and larger.

Urban Fire Hazards

Urban fires primarily involve the uncontrolled burning of residential, commercial, and/or industrial structures due to human activities. Factors that exacerbate urban structural fires include substandard building construction, highly flammable materials, delayed response times, and inadequate fire protection services.

Wildland Fire Hazards

The Planning Area is not characterized by substantial areas of wildlands. The topography of the area is relatively homogenous and steep slopes that could contribute to wildland fires are not common. Lodi is in a local responsibility area, meaning the Lodi Fire Department is responsible for responding to fires and fire prevention. Data provided by the California Department of Conservation Fire and Resource Assessment Program indicates that

less than one percent of the Planning Area has “Moderate” fire hazard potential. The remaining areas are classified as urban or non-wildland. No portions of the Planning Area are classified as having a “High” or “Very High” risk.

8.6 Climate Change

As noted in the 2023 San Joaquin County LHMP, climate change is virtually certain to continue without immediate and effective global action. According to NASA, 2023 was the hottest year on record, and the 10 most recent years are the warmest years on record. Without significant global action to reduce greenhouse gas emissions, the Intergovernmental Panel on Climate Change (IPCC) concludes in its Sixth Assessment Synthesis Report (2023) that average global temperature increases are likely to exceed 1.5 C by the end of the 21st century, with consequences for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges.

In Lodi, climate conditions and associated natural hazards are expected to change in the following ways:

- **Extreme Heat:** Extreme heat days occur when the maximum temperature is above 101.7°F. The annual number of extreme heat days is projected to increase by as much as 36 days by 2100.
- **Drought:** Climate change will increase the likelihood that low-precipitation years will coincide with above-average temperature years. Over the past two decades, Lodi has experienced more frequent and longer contiguous droughts and this pattern is expected to continue and intensify through the end of the century with the average annual maximum length of dry spell being projected to increase by 19 days.
- **Air Quality:** Historic poor air quality events coincide with regional wildfire events, periods of time without wind, extreme heat events, and extended droughts. Poor air quality exposure is a common hazard in Lodi and can be caused by smog, dust, wildfire smoke, and fewer natural filtrations. Climate change may lead to a decline in air quality regionally and in Lodi due to extended droughts, more frequent regional wildfires, increased ambient temperatures, and sporadic natural filtrations of fog and wind.
- **Flooding:** While FEMA’s flood risk evaluation identified low risk of flooding in Lodi, flood risk may increase in the future due to climate change. FEMA’s flood maps do not evaluate projected flood risk and instead rely on historical data, including river flow, storm tide, and rainfall to show a community’s current flood risk. Increases in precipitation extremes caused by climate change may cause low-lying areas and exposed property throughout the city to experience more frequent flooding with the biggest risk associated with the Mokelumne river and failures of the surrounding dams. The frequency of atmospheric river events may also contribute to flood risks in the region with some locations experiencing a 25-30 percent increase of precipitation for the wettest annual day. In addition, extreme precipitation and faster snowmelt may erode dams, jeopardizing dam stability and increasing the risk of dam failure.

With regard to other hazards associated with climate change, Lodi faces relatively lower threats. The hazards of wildland fires impacting Lodi and its residents are reduced by the overall compact form of the urban community and the cultivated agricultural lands surrounding the city. The steep topography and wooded slopes that have contributed to severe fire events in other parts of the state are not present in and around Lodi. Similarly, the local topography is gently rolling and not subject to landslides or land failure resulting from severe storm events. Reduced water supply resulting from prolonged droughts has the potential to impact Lodi. Water supply and service is discussed in Chapter 3 – Growth Management and Infrastructure, of this General Plan

While all people in a community will experience the negative effects of climate change, some may be more affected than others. For example, older adults and young children are at higher risk for experiencing a heat related illness during an extreme heat event. Several factors influence sensitivity to climate hazards including an individual’s health, age, and ability, experience of structural inequality, inequities in access to health care, economic opportunity, education and other resources, and inequities found in basic needs and exposure to environmental

stressors (Cal OES 2020). These higher-risk populations should be prioritized when considering climate impacts, adopting climate resilience policies, and planning adaptation projects. Often individuals have multiple characteristics that make them sensitive to climate hazards. Population characteristics are grouped as described below based on similar types of exposure and commonalities.

- Individuals with High Outdoor Exposure, including outdoor workers, people experiencing homelessness, and visitors face disproportionate direct exposure to climate hazards, causing them to be extremely vulnerable to the effects of climate change.
- Under-resourced Individuals often do not have access or the ability to afford resources needed to prepare for, cope with, and recover from climate change impacts. Individuals who are unemployed or are low-income often face financial barriers when preparing for and recovering from climate change hazards. Individuals in these groups often live in homes that are less protected against climate hazards.
- Individuals Facing Societal Barriers also face additional impacts of climate change. Non-white individuals are more likely to live in high hazard risk areas and less likely to be homeowners, which leaves them vulnerable to climate hazards.
- Individuals with Chronic Health Conditions or Health Related Sensitivities are socially and physiologically vulnerable to climate change impacts and hazards. Older adults and individuals with disabilities may have limited or reduced mobility, mental function, or communication abilities, making it difficult to evacuate during or prepare for a climate hazard event. They may also have medical needs for electricity which may be impacted during a public safety power shutoff or climate hazard event.

Natural and recreational resources, buildings and facilities, and infrastructure and critical services are also vulnerable to the effects of climate change and were evaluated in detail in the Climate Change Vulnerability Assessment:

- Natural resources are highly vulnerable to extreme heat, drought, wildfire, and flooding. Vulnerability for natural resources includes the risk of habitat conversions and damage, mortality, and scarcity of resources for plants and wildlife.
- Buildings and Infrastructure are more vulnerable to climate change when they are not designed, operated, and/or maintained to function effectively under more extreme weather conditions. This asset group is sensitive to climate change as the impacts of hazards can affect the ability to provide services and resources; and the infrastructure in place may not be adequately prepared to sustain increasing and compounding hazards. Climate impacts can increase the costs of keeping critical elements functioning at necessary levels.

Local actions can help to mitigate the additional risks associated with climate change and increase community resilience. Cities that plan now will have the best options for adapting to climate change. Lodi adopted a Climate Action Plan in 2014 to reduce greenhouse gas emissions and build local resilience to climate hazards.

8.7 8.6 Emergency Management

Public Safety Departments

The Lodi Police and Fire departments manage public safety in Lodi, with the Fire Department leading emergency preparedness and planning.

The Fire Department provides a wide range of emergency and non-emergency services, including fire suppression, emergency medical services, hazardous materials response, technical rescue, fire prevention, public education, and related safety services. The Emergency Operations Center, located at the Police department building, serves

as the center of the City's emergency operations. City operations remain in compliance with the National Incident Management System, a comprehensive national approach to incident management, applicable to federal, state, and local governments and the Standardized Emergency Management System, which provides a strategy and framework to address multi-agency and multi-jurisdictional emergencies in California.

As of 2020, the Fire Department had 57 personnel, including 51 firefighters, company officers, or battalion chiefs. The City has an Insurance Services Office (ISO) rating of Class 3. A Class 3 ISO rating indicates that the Fire Department is strategically placed throughout the city, and has adequate personnel, equipment, and expertise to serve the current population. In 2006, the most recent year of data availability, the department met the self-imposed National Fire Protection Association's response time criteria of 6 minutes for 90 percent of all calls.

The Police Department's basic responsibility is to protect and serve the public and property within Lodi, through crime prevention, investigation, and other services. As of 2020, the Police Department had 109 full-time employees and 120 volunteers, with 77 sworn officers.

Emergency Planning

San Joaquin County updated its Local Hazard Mitigation Plan in 2023. This document addresses County lands and is not a Multi-Jurisdictional Hazard Mitigation Plan. San Joaquin County has also prepared an Emergency Operations Plan that addresses major hazards such as severe weather, flood and dam failure, drought and water shortage and electrical system de-energization. These plans identify measures to reduce the impacts of natural and manmade hazards and to facilitate the recovery and repair of structures if damage should occur from hazardous events.

Evacuation Routes and Safety Standards

The City of Lodi benefits from numerous points of access that range from State Highways (Highway 99 and Kettleman Lane/Highway 12) to minor roadways that extend into San Joaquin County lands that surround the city. Numerous roads extend to the north, south, east and west, providing multiple routes of exit in each direction from the city in the event of an emergency or catastrophic event.

The City provides street standards for all street types, thus ensuring appropriate standards for emergency access and evacuation. For example, the standards specify roadway widths of 30 feet (curb-to-curb) for minor residential streets and 52 feet for major collector streets.

Single-access Evacuation Analysis

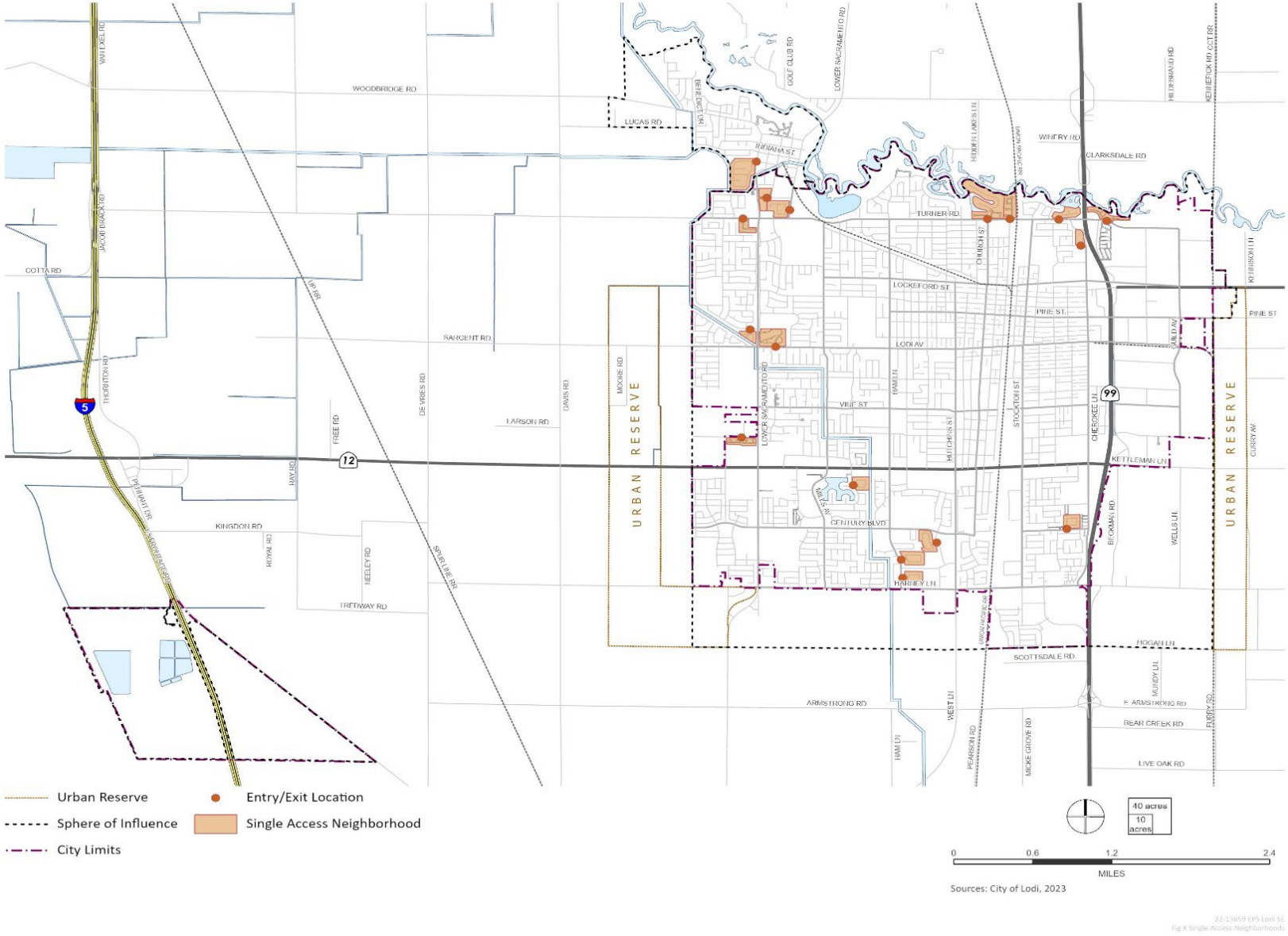
Single access points of entry and exit were identified (see Figure 8-12) in compliance with Government Code Section 65302(as amended by SB 99), and consistent with OPR's 2023 technical advisory document on Evacuation Planning. OPR's guidance clarifies that cities and counties must identify residential developments with less than two evacuation routes located in any hazard zone considered by the Safety Element. This analysis took a conservative approach and assessed all Lodi residential developments for single access entry and exit points, as most of the city is in at least one hazard risk zone.

For this analysis, a neighborhood is defined as 30 or more dwelling units located in a residential general plan land use designation that only have a single route to access a collector or arterial road based on California Fire Code Appendix D107.11. As shown in Figure 8-12, there are 17 neighborhoods in the city that have a single entry or exit point. Just over half of the neighborhoods are located in the northern portion of the city, predominately along the Mokelumne River, with the other half of the neighborhoods distributed throughout the city.

In the case of an evacuation event, these single entry/exit neighborhoods would likely use north/southbound State Route (SR) 99 and/or SR 12 to evacuate, depending on the location of the

evacuation area. Some neighborhoods could also use alternative evacuation routes, such as Lower

Figure 8-12 SINGLE ACCESS NEIGHBOORHOODS



Sacramento Road and Century Boulevard, depending on the severity of traffic congestion or the location of the evacuation area. Single access points, particularly in or near flood hazard zones, can make emergency evacuations problematic during an emergency.

Emergency Evacuation Capacity Analysis

Evacuation capacity, safety, and viability were analyzed in compliance with the AB 747 amendment to Section 65302.15 of the Government Code. The results of this analysis can be found in Appendix B. The Emergency Evacuation Capacity Analysis provides evacuation scenarios and identifies the evacuation routes that would be accessed in an emergency according to the evacuation scenarios. These evacuation routes are identified in Table 8-2 and include a citywide network of arterial and collector roadways that can be utilized in unique combinations to provide effective transportation evacuation during a range of emergency scenarios. Dependent on the type and location of the emergency, evacuation locations include commercial parking lots at Lowes and Walmart in the southwest part of the city, and southwest points outside of the city.

Table 8-2 EVACUATION SCENARIOS AND ROUTES SUMMARY

EVACUATION SCENARIO	EVACUATION ROUTES
Lodi Lake Park Wildfire	West Woodbridge Road, Lower Sacramento Road, Mills Avenue, Lockeford Street, and Church Street towards commercial parking lots at Lowes and Walmart in the southwest part of the city.
Salt Springs Dam Failure	Turner Road, Lodi Avenue, Vine Street, Kettleman Lane (SR 12), and Harney Lane towards southwestern points outside of the city and inundation zone.
Hazardous Waste Spill (train derailment) with Fire and Toxic Smoke	Turner Road, Ham Lane, Tokay Street, Church Street, Stockton Street, Cherokee Lane, SR 99, Guild Avenue, and Kettleman Lane towards commercial parking lots at Lowes and Walmart in the southwest part of the city.

All evacuation scenarios included in the analysis could result in traffic congestion that extends beyond the evacuation zones identified in each scenario. In the event of an emergency triggering an evacuation, the City will need to implement traffic management strategies to allow for efficient evacuation. To avoid challenges with communication during an evacuation, the City should improve training, procedures, and public education to pre-emptively strengthen communication between the City, agencies, and the public. The City should also consider prioritizing vulnerable populations in an evacuation event, including areas with a larger percentage of elderly, disabled, and institutionalized people and households without a vehicle.

8.8 Goals and Policies

Guiding Policies

S-G1 Ensure a high level of public health and safety.

S-G2 Prevent loss of lives, injury, illness, and property damage due to flooding, hazardous materials, seismic and geological hazards, and fire.

S-G3 Protect the public from disasters and provide guidance and response in the event a disaster or emergency.

S-G4 Minimize vulnerability of infrastructure and water supply and distribution systems.

S-G5 Adequately prepare for climate change-related hazards, including but not limited to extreme heat, extended drought, more frequent and severe flooding, extreme weather, and air quality declines.

S-G6 Resource the community's vulnerable populations to increase their ability to prepare for and recover from climate change impacts.

Implementing Policies

Flooding and Drainage

S-P1 Continue to participate in the National Flood Insurance Program and ensure that local regulations are in full compliance with standards adopted by FEMA.

S-P2 Cooperate with appropriate local, State, and federal agencies to address local and regional flood issues and dam failure hazards. Comply with all requirements of the California Department of Water Resources' Division of Safety of Dams and California Office of Emergency Services to ensure dam safety and adequate flood incident preparedness and response.

S-P3 Require adequate natural floodway design to assure flood control in areas where stream channels have been modified and to foster stream enhancement, improved water quality, recreational opportunities, and groundwater recharge.

S-P4 Cooperate with and encourage reclamation districts to institute a berm maintenance program to reduce berm failures and shall coordinate with appropriate State, federal, and local flood control agencies in planning efforts to ensure the continued protection of local and regional flood control systems.

S-P5 Continue to ensure, through the development review process, that future developments do not increase peak storm flows and do not cause flooding of downstream facilities and properties. Additionally, the City shall ensure that storm drainage facilities are constructed to serve new development adequate to storm runoff generated by a 100-year storm.

S-P6 Prohibit new development, except for public uses incidental to open space development, within Zone A (100-year flood zone) of the most current FEMA floodplain map (see Figure 8-1 for the most current map).

S-P7 The City will update data on the 200-year floodplain through an annual review. This updated information will be made available and referenced during the development review process for areas within the base case 200-year flood map, as shown in Figure 8-2.

S-P8 The City will not: approve any discretionary permit or other discretionary entitlement; approve any ministerial permit that would result in the construction of a new residence; approve a tentative map, or a parcel map for which a tentative map was not required; or enter into a development agreement for any project located in the 200-year floodplain unless it meets one or more of the flood protection findings established under Section 15.60.130.D of the Lodi Municipal Code.

S-P9 Site critical emergency response facilities—such as hospitals, fire stations, police offices, substations, emergency operations centers and other emergency service facilities and utilities outside of the 200-year floodplain to minimize exposure to flooding and other hazards.

S-P10 Update Zoning Ordinance and development review process as needed to reduce peak-hour stormwater flow and increase groundwater recharge. These may include provisions for:

- Constructing parking areas and parking islands without curbs and gutters, to allow stormwater sheet flow into vegetated areas.
- Grading that lengthens flow paths and increases runoff travel time to reduce the peak flow rate.

- Installing cisterns or sub-surface retention facilities to capture rainwater for use in irrigation and non-potable uses.

S-P11 Update City street design standards to allow for expanded stormwater management techniques. These may include:

- Canopy trees to absorb rainwater, slow water flow, and address extreme heat.
- Directing runoff into or across vegetated areas to help filter runoff and encourage groundwater recharge.
- Disconnecting impervious areas from the storm drain network and maintain natural drainage divides to keep flow paths dispersed.
- Providing naturally vegetated areas in close proximity to parking areas, buildings, and other impervious expanses to slow runoff, filter out pollutants, and facilitate infiltration.
- Directing stormwater into vegetated areas or into water collection devices.
- Using devices such as bioretention cells, vegetated swales, infiltration trenches and dry wells to increase storage volume and facilitate infiltration.
- Diverting water away from storm drains using correctional drainage techniques.

S-P12 Provide language-accessible materials to vulnerable populations on flood hazard exposure and available resources to protect against flooding impacts. Identify and improve access to flood mitigation related services for vulnerable populations including evacuation-based transportation resources, home retrofits, and technical and financial resources to combat cascading impacts associated with flooding on household income and personal health.

S-P13 Monitor and research the potential impacts of climate change and flooding on local habitat and wildlife.

S-P14 Collaborate with other local, regional, state, and federal entities to monitor climate impacts to dam facilities and promote watershed restoration and enhancement of natural ecosystems to create regional resilience.

Hazardous Materials and Operations

S-P15 Continue to maintain, implement, and enforce the requirements of the City's National Pollutant Discharge Elimination System Phase II Municipal Separate Storm Sewer System General Permit.

S-P16 Require that all fuel and chemical storage tanks are appropriately constructed; include spill containment areas to prevent seismic damage, leakage, fire and explosion; and are structurally or spatially separated from sensitive land uses, such as residential neighborhoods, schools, hospitals and places of public assembly.

S-P17 Ensure compatibility between hazardous material users and surrounding land use through the development review process. Separate hazardous waste facilities from incompatible uses including, but not limited to, schools, daycares, hospitals, public gathering areas, and high-density residential housing through development standards and the review process.

S-P18 Consider the potential for the production, use, storage, and transport of hazardous materials in approving new development. Provide for reasonable controls on such hazardous materials. Ensure that the proponents of applicable new development projects address hazardous materials concerns through the preparation of Phase I or Phase II hazardous materials studies, as necessary, for each identified site as part of the design phase for each project. Require projects to implement federal or State cleanup standards outlined in the studies during construction.

S-P19 Regulate the production, use, storage, and transport of hazardous materials to protect the health of Lodi residents. Cooperate with the County and Lodi Fire Department in the identification of hazardous material users, development of an inspection process, and implementation of the City's Hazardous Waste Management and Hazardous Materials Area plans. Require, as appropriate, a hazardous materials inventory for project sites, including an assessment of materials and operations for any development applications, as a component of the development environmental review process or business license review/building permit review.

S-P20 Work with waste disposal service provider(s)to educate the public as to the types of household hazardous wastes and the proper methods of disposal and shall continue to provide opportunities for residents to conveniently dispose of household hazardous waste.

S-P21 Continue to follow the County Comprehensive Airport Land Use Plan for guidelines on land use compatibility near airports, land use restrictions, and to ensure public safety.

S-P22 Support grade-separated railroad crossings, where feasible, and other appropriate measures adjacent to railroad tracks to ensure the safety of the community.

S-P23 Continue to mark underground utilities and abide by federal safe-digging practices during construction.

Seismic and Geologic Hazards

S-P24 Ensure that all public facilities, such as buildings, water tanks, underground utilities, and berms, are structurally sound and able to withstand seismic activity.

S-P25 For buildings identified as seismically unsafe, prohibit a change in use to a higher occupancy or more intensive use until an engineering evaluation of the structure has been conducted and structural deficiencies corrected consistent with City building codes.

S-P26 Require soils reports for new projects and use the information to determine appropriate permitting requirements, if deemed necessary.

S-P27 Require that geotechnical investigations be prepared for all proposed critical structures(such as police stations, fire stations, emergency equipment, storage buildings, water towers, wastewater lift stations, electrical substations, fuel storage facilities, large public assembly buildings, designated emergency shelters, and buildings three or more stories high) before construction or approval of building permits, if deemed necessary. The investigation shall include estimation of the maximum credible earthquake, maximum ground acceleration, duration, and the potential for ground failure because of liquefaction or differential settling.

S-P28 Require new development to include grading and erosion control plans prepared by a qualified engineer or land surveyor.

Fire Hazards

S-P29 Maintain a vegetation management program to ensure clearing of dry brush areas. Conduct management activities in a manner consistent with all applicable environmental regulations.

S-P30 Participate in mutual aid agreements and regional efforts to mitigate and adapt to future fire risks.

Emergency Management and Evacuation

Policies related to police and fire facilities are addressed in Chapter 3: Growth Management and Infrastructure.

S-P31 Coordinate with local, State, and Federal agencies to establish, maintain, and test a coordinated emergency response system that addresses a variety of hazardous and threatening situations.

Conduct periodic emergency response exercises to test the effectiveness of City emergency response procedures. Develop and implement public information programs concerning disaster response and emergency preparedness and develop mutual aid agreements and communication links with surrounding communities for assistance during times of emergency.

S-P32 Maintain and periodically update the City's Emergency Preparedness Plan, including review of County and State emergency response procedures that must be coordinated with City procedures.

S-P33 Ensure that major access and evacuation corridors are available and unobstructed in case of major emergency or disaster. Continue to identify appropriate road standards, including minimum road widths and turnouts to provide adequate emergency access and evacuation routes.

S-P34 Collaborate with San Joaquin County and other jurisdictions in the development and implementation of the San Joaquin County Multi-Jurisdictional Hazard Mitigation Plan and subsequent plan updates to plan for and reduce hazard risk.

S-P35 Ensure that the Lodi Fire Department has complete access to all locations in the city, including gated residential communities.

S-P36 In coordination with the Lodi Fire Department and Lodi Police Department, conduct regular evacuation trainings with single-access community homeowner associations and residents.

S-P37 Proactively engage with residential neighborhoods with single routes of entry and exit to conduct emergency preparedness trainings and appropriate home retrofits.

S-P 38 Collaborate with Caltrans and California Highway Patrol (CHP) to reverse one or more lanes of SR 12 to accommodate an increased flow of traffic in one direction. Apply the same strategy to City-owned major roadways.

S-P39 Redirect all lanes of a designated evacuation route to accommodate rapid evacuation from a city or region.

S-P40 Temporarily close inbound travel lanes on selected unlimited access arterials (such as parkways and boulevards) to allow outbound traffic to utilize these lanes during evacuation.

S-P41 Collaborate with Caltrans and/or CHP to close inbound lanes on highways used for evacuation routes to prevent drivers on these routes from entering the city while evacuation is underway.

S-P42 Minimize left-turn movements along evacuation routes and on roads leading to evacuation routes.

S-P43 Use variable message board equipment and targeted installation of permanent dynamic message signs on evacuation routes to improve communication and reduce public confusion.

S-P44 Collaborate with towing services to consider how to stage tow trucks at key bottleneck locations along evacuation routes to help detect and clear minor crashes and maintain traffic flow.

S-P45 Increase the green time and/or progression band for through movements leading out of an evacuation zone.

S-P46 Install signal battery backups in case signal operations need to be maintained during a power outage. Consider using channeling devices, static signs, and coning strategies to manage intersection flow during power outage if the signals lack power.

S-P47 Collaborate with bus system operators to develop transportation solutions such as the use of a bus system for evacuating individuals with special needs (such as those with mobility limitations).

S-P48 Establish traffic control points (i.e., locations along designated evacuation routes with emergency management personnel) to maintain a greater degree of evacuation management. These locations

could enhance the efficiency of an evacuation, reduce public confusion, and allow increased operational flexibility during an evacuation.S-P49 Strengthen and maintain communication among coordinating emergency event agencies. This could be achieved through systems such as the Public Information Emergency System and Emergency Satellite Communications.

S-P50 Implement a traffic control center to coordinate all evacuation activities. This center would have up to the minute reports on traffic patterns and can communicate directly with the broadcast media to let drivers know about roadway congestion and conditions and direct them to alternate routes.

S-P51 Install counters and/or CCTV cameras to assess traffic flow, volume of vehicles evacuating, and monitor incidents.

S-P52 Develop communication plan to provide information regarding primary and secondary evacuation routes and incidents to the public.

S-P53 Understand if there are areas in the city with a greater percentage of senior adults, disabled people, mobility impaired, visually impaired, people with medical conditions, and people without vehicles with of objective of identifying areas that should be prioritized by first responders during an evacuation.

S-P54 Develop system to ensure hearing impaired receive evacuation warnings.

S-P55 Provide special assistance to mobility impaired, visually impaired, people with medical conditions, and people without vehicles such as paratransit.

S-P56 Translated materials should be prepared to support communication to non-English speaking populations including during evacuation.

Extreme Heat, Air Quality, and Drought

Additional policies related to air quality are addressed in Chapter 7: Conservation.

S-P57 Protect vulnerable natural and recreational habitats and parks impacted by extreme heat through expansion of large contiguous greenspaces wherever possible for greater cooling magnitude and extent. Increase use of drought tolerant and native plants in landscaping.

S-P58 Identify opportunities and update the City's Landscape Manual to increase urban tree canopy and maintenance projects in coordination with existing efforts.

S-P59 Coordinate with San Joaquin County Public Health Services and local community organizations to establish extreme heat, drought, and air quality monitoring systems and develop accessible community education resources to prepare community members for increases in extreme heat events and ambient air pollution.

S-P60 Seek grant funding to pilot a project to install a cool roof on a city facility or cool pavement as part of a roadway project to showcase benefits to community members and local builders.

S-P61 Encourage weatherization retrofits of private properties and retrofit all critical facilities with adequate cooling and air filtration in conjunction with the Lodi Climate Action Plan.

S-P62 To improve energy resilience within Lodi and provide backup power for the community, engage in infrastructure development and retrofits including but not limited to activities that seek to:

- Harden vulnerable overhead lines against high winds and potentially regional wildfires;
- Protect energy infrastructure and increase redundancy of energy storage and distribution systems in surrounding regional hazard zones from wildfire;
- Invest in sustainable power sources to provide redundancy and continued services for critical facilities during periods of high demand during extreme heat events; and

- Explore the feasibility of installing microgrids, battery storage, or other local energy storage options.

Climate Change Governance Capacity

S-P63 Partner with community-based organizations to engage the community on hazard preparedness and climate change education.

S-P64 Broaden the functions of Lodi's Cooling Centers to address a greater variety of needs by facilitating health, food, medical, and emergency services during climate hazards such as extreme heat events, flooding, drought, and poor air quality events.

S-P65 Seek funding to plan and implement microgrids, cool roofs, augmented cooling centers, and other similar technology in areas with vulnerable populations through leveraging of the Lodi Climate Action Plan for grant funding.

S-P66 Distribute language and differently abled accessible information on the direct effects of climate change to the entire community. Include guidance on steps the community can take to minimize their vulnerability to adverse situations caused by floods, drought, extreme heat, and poor air quality days. Strengthen the preparedness and adaptability of vulnerable populations by resourcing the community to better adapt given identified gaps in access.

S-P67 Enhance the ability of both newly constructed and existing critical structures and infrastructure to operate effectively with increased exposure to more frequent climate-related risks including floods, extreme heat, drought, and air quality.

S-P68 Develop a checklist for adaptation-based design features and assessment of needed retrofits for critical facilities based on the outlined climate hazard exposures presented in the Lodi Climate Change Vulnerability Assessment.

8.9 Appendices

Appendix A –Adaptive Capacity

Appendix A

Adaptive Capacity

Adaptive Capacity

Adaptive capacity is the ability to adjust to the consequences of climate change. This section summarizes the ways in which the City currently manages for the negative impacts of climate change. Types of adaptive capacity include adjustments in behavior, resources, and technologies. Lodi has actively taken steps to increase the county's adaptive capacity. Existing policies, plans, programs, and institutions that increase the county's resilience to climate change impacts are organized by climate hazard and listed in Table 1, Table 2, and Table 3.

Extreme Heat and Wildfire

Table 1 lists programs, plans, and policies that help communities become more resilient to an increase in extreme heat and wildfire.

Table 1 Program, Plans, and Policies to Manage Impacts of Extreme Heat and Wildfire

Existing and Planned Programs, Plans, and Policies	Objectives
Lodi Cooling Centers (City of Lodi 2023)	Lodi hosts cooling centers (City of Lodi Library Saturdays through Thursdays and LOEL Center Fridays) for community members to seek shelter during extreme heat events. Cooling centers open when temperatures are forecast at 106°F and above.
Lodi Unified School District Heat Illness Prevention Program (Lodi Unified School District 2017)	The Heat Illness Prevention Plan overviews procedures and responsibilities to mitigate heat impacts to employees of the Lodi Unified School District. Topics covered include provisions of water, access to shade, identifying and controlling risk factors for heat illnesses, communication, emergency medical services, and training.
Pacific Gas & Electric (PG&E) Medical Baseline Program (PG&E 2021)	PG&E provides eligible customers with a medical need for electricity (for oxygen, dialysis, etc.) with extra notifications (i.e., calls, texts, or doorbell rings) in advance of a public safety power shutoff. Public safety power shutoffs may occur during an extreme heat event
Pacific Gas & Electric (PG&E) Self-Generation Incentive Program (PG&E 2020)	The PG&E Self-Generation Incentive Program pays for all costs associated with procuring battery storage for eligible customers. Medical Baseline Program customers qualify for full benefits of the Self-Generation Incentive Program.
Pacific Gas & Electric (PG&E) Automated System (PG&E 2022)	PG&E regularly communicates with customers in the county during power outages and notifies customers when power will be restored. PG&E provides translation assistance to non-English speaking individuals and the option to update language preference for PSPS alerts.
Pacific Gas & Electric (PG&E) Community Wildfire Safety Program (PG&E 2022)	PG&E's Community Wildfire Safety Program provides customer support during public safety power shutoffs, implements vegetation management strategies, conducts system resilience improvements, and deploys innovative technologies that reduce wildfire risk. The program provides specific support for non-English speaking individuals, individuals with disabilities, low-income individuals, the older adults, and those with chronic illnesses or health conditions.
Lodi Electric Utility Wildfire Mitigation Plan (2021)	Lodi Electric Utility's (LEU) Wildfire Mitigation Plan describes the mitigation activities the utility is taking to reduce risk of power-line ignited wildfires. The Plan describes LEU's efforts around weather monitoring, wildfire-mitigating design and construction, vegetation management, system maintenance and inspections, de-energization, and community outreach and public awareness.

Riverine and Stormwater Flooding and Droughts

Table 2 lists programs, plans, and policies that help increase the community's resilience to droughts and riverine and stormwater flooding.

Table 2 Programs, Plans, and Policies to Manage Riverine and Stormwater Flooding and Droughts

Existing and Planned Programs, Plans, and Policies	Objectives
Lodi Urban Water Management Plan (City of Lodi 2021)	The Urban Water Management Plan details water supply sources, historical, and projected water use, and potential future water supplies during normal, single-dry, and multiple-dry years. The Plan describes climate change impacts on water supplies, specifically relating to groundwater levels and snowmelt. Proposed demand management strategies center around metering, water conservation public education and outreach programs, asset management, and wholesale supplier assistance programs.
Lodi Water Shortage Contingency Plan (City of Lodi 2021)	The Water Shortage Contingency Plan was developed to increase the resilience and reliability of Lodi's water supplies to constraints on water resources and drought impacts. The Plan overviews water supply sources, past, current, and projected demand, previous and project water shortage conditions, potential water shortage responses, and communication protocols regarding water shortages. The Plan includes information on the impacts of climate change snowmelt and Lodi's water supplies.
Lodi Storm Drain Master Plan (City of Lodi 2012)	The Storm Drainage Master Plan outlines design criteria, level of service standards, service demands, alternative facilities plans, and presents recommended plans for providing storm drainage service to the community. The Plan does not include considerations around the impacts of climate change on storm drainage needs.
Lodi Water Master Plan (City of Lodi 2012)	The Water Master Plan outlines level of service, present design criteria, present and project service demands, alternative facilities plans, and water service recommendations for Lodi. The Plan does not describe the impacts of climate change on future water service demands and planning.
Lodi Storm Water Management Plan City of Lodi 2012)	The Storm Water Management Plan describes best practices and goals on storm water management, runoff control, and public education and outreach. The Plan describes storm water detention basin operated by the City to control runoff for event to a 100-year storm. The Plan does not describe best practices of considerations on managing storm water impacts from climate change hazards.
Eastern San Joaquin Groundwater Subbasin Groundwater Sustainability Plan (Eastern San Joaquin Groundwater Authority 2022)	The Groundwater Sustainability Plan (GSP) for the Eastern San Joaquin Groundwater Subbasin details strategies to increase groundwater recharge capacity and drought resilience. The GSP establishes a standard for sustainable groundwater management and use and determines strategies for ensuring that groundwater supplies reach this standard by 2042. The GSP includes projected conditions scenarios under potential climate change conditions, considering changes to precipitation, stream flows, and evapotranspiration. of the Sustainable groundwater management strategies identified center around water-use efficiency, alternate water sources, recycled water expansion, and stormwater capture and recharge.

Existing and Planned Programs, Plans, and Policies	Objectives
San Joaquin County Flood and Dam Failure Hazard Annex (San Joaquin 2019)	The Annex provides information and guidance for emergency management organization requiring to mitigate risk from localized flooding, slow-rise flooding, levee failure, and dam failure. The Annex outlines emergency operational procedures, communication protocols, roles and responsibilities, and training and exercises. The Annex does not specify responsibilities or protocols for Lodi.
Lodi Public Works Department Short Term Plan for Atmospheric Rivers (City of Lodi N.d.)	The Lodi Public Work Department Short Term Plan for Atmospheric Rivers outlines specific protocols and actions that the City completes to prepares for, weathers, and recovers from flooding from atmospheric river events. The Plan is an internal document that primarily aims to mitigate flood risk to low-lying and stormwater prone areas of the community.
Community Rating System (FEMA 2023)	The Federal Emergency Management Agency's (FEMA) Community Rating System is a voluntary program within the National Flood Insurance Program (NFIP) that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions.

Multiple Climate Hazards

Table 3 lists programs, plans, and policies that help increase the community's resilience to multiple climate hazards including hazards outlined previously and in conjunction with others.

Table 3 Programs, Plans, and Policies to Manage Multiple Climate Hazard Impacts

Existing and Planned Programs, Plans, and Policies	Objectives
City of Lodi General Plan Safety Element	Lodi's General Plan is a blueprint for meeting the community's long term vision for the future. The General Plan includes several elements (or sections) that topics. The Safety Element cover different addresses natural and man-made hazards that may result in personal injury, loss of life, property damage, or environmental damage. Hazards addressed include flooding, dam inundation, hazardous materials, seismic hazards, urban fire, wildfire, and erosion. The Element does not include information or policies addressing impacts of climate change.
City of Lodi Alert Center (City of Lodi 2023)	Lodi's Alert Center provides residents who subscribe, with alerts for emergency updates.
California' Fourth Climate Change Assessment San Joaquin Valley Region Report (Fernandez-Bou et al. 2022)	Produced as part of California's Fourth Climate Change Assessment, the San Joaquin Valley Region Report describes climate projects, hazards, impacts, and adaptations species specific to California's San Joaquin Valley. The Assessment outlines the impacts of climate change on water resources, infrastructure, ecosystems, agriculture, economy, employment, and sensitive community members in the San Joaquin Valley.
Draft San Joaquin Local Hazard Mitigation Plan (San Joaquin County 2023)	The Plan assesses hazards within the County and identifies mitigation strategies that reduce or eliminate long-term risks to people and property from those hazards. Climate hazards planned for include drought, flood, landslide, severe weather (e.g., extreme heat), wildfire. The Plan includes a climate vulnerability assessment with temperature and precipitation climate projections Cal Adapt, regional impacts, and information past occurrences. The Plan describes sensitive populations including the elderly, those who work and play outdoor, and those experiencing homelessness as well as sensitive species and ecosystems. The LHMP does not include specific information for Lodi. Beginning in 2024, the LHMP will be upgraded to a Multi-Jurisdictional Plan, with increased participation from communities and cities in the County.
San Joaquin County Emergency Operations Plan (San Joaquin County 2022)	The Plan provides guidance on all phases of an all-hazards emergency management process including preparedness, response, recovery, and mitigation. It outlines the systems and roles of responsible entities, alert and warning systems, public information communications, mutual aid agreements, threat and hazard identification and risk assessment, and preparedness training and exercises. The Plan included information on the relationship between drought and flooding hazards and climate change. The Plan outlines specific protocols and needs for sensitive populations including elderly, children, individuals with disabilities, and individuals with limited English proficiency.

Existing and Planned Programs, Plans, and Policies	Objectives
Pacific Gas & Electric (PG&E) Climate Change Vulnerability Assessment and Resilience Strategies (Pacific Gas & Electric 2016)	The Climate Change Vulnerability Assessment and Resilience Strategies Report evaluates how key climate hazards (i.e., flooding, severe storms, sea level rise, subsidence, drought, wildfires, and extreme temperatures) have the potential to impact PG&E's assets and services, including disadvantaged communities' reliance on the delivery of continuous power, PG&E outlines its approach to engagement, emergency preparedness, and response planning. The Plan acknowledges the need to support disadvantaged communities and preferentially consider disadvantaged communities for grant funding.

Appendix B – Emergency Evacuation Analysis

Rincon Consultants, Inc.
180 North Ashwood Avenue
Ventura, California 93003
805-644-4455

January 11 2024
Project No: 22-13659

Cynthia Marsh
City Planner
Community Development Department
City of Lodi
Via email: cmarsh@lodi.gov

Subject: City of Lodi Emergency Evacuation Analysis

Dear Ms. Marsh:

This supplemental evacuation analysis was prepared in support of the Lodi General Plan Update. This study is intended to provide the City with a broad planning level assessment of the capacity of the transportation system during a citywide evacuation event. It identifies residential developments with a single entrance and exit road, and evaluates the potential consequences of large evacuation events on the roadway system under various hazard scenarios in keeping with the following two statutes:

- **Senate Bill 99** (SB 99) requires that the Safety Element of the General Plan identify any residential developments in any hazard area that does not have at least two evacuation routes. This is a requirement for all safety element updates included upon the revision of the housing element on or after January 1, 2020.
- **Assembly Bill 747** (AB 747) requires that the Safety Element be reviewed and updated to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. This will be a requirement for all safety elements or updates to a hazard mitigation plan completed after January of 2022.

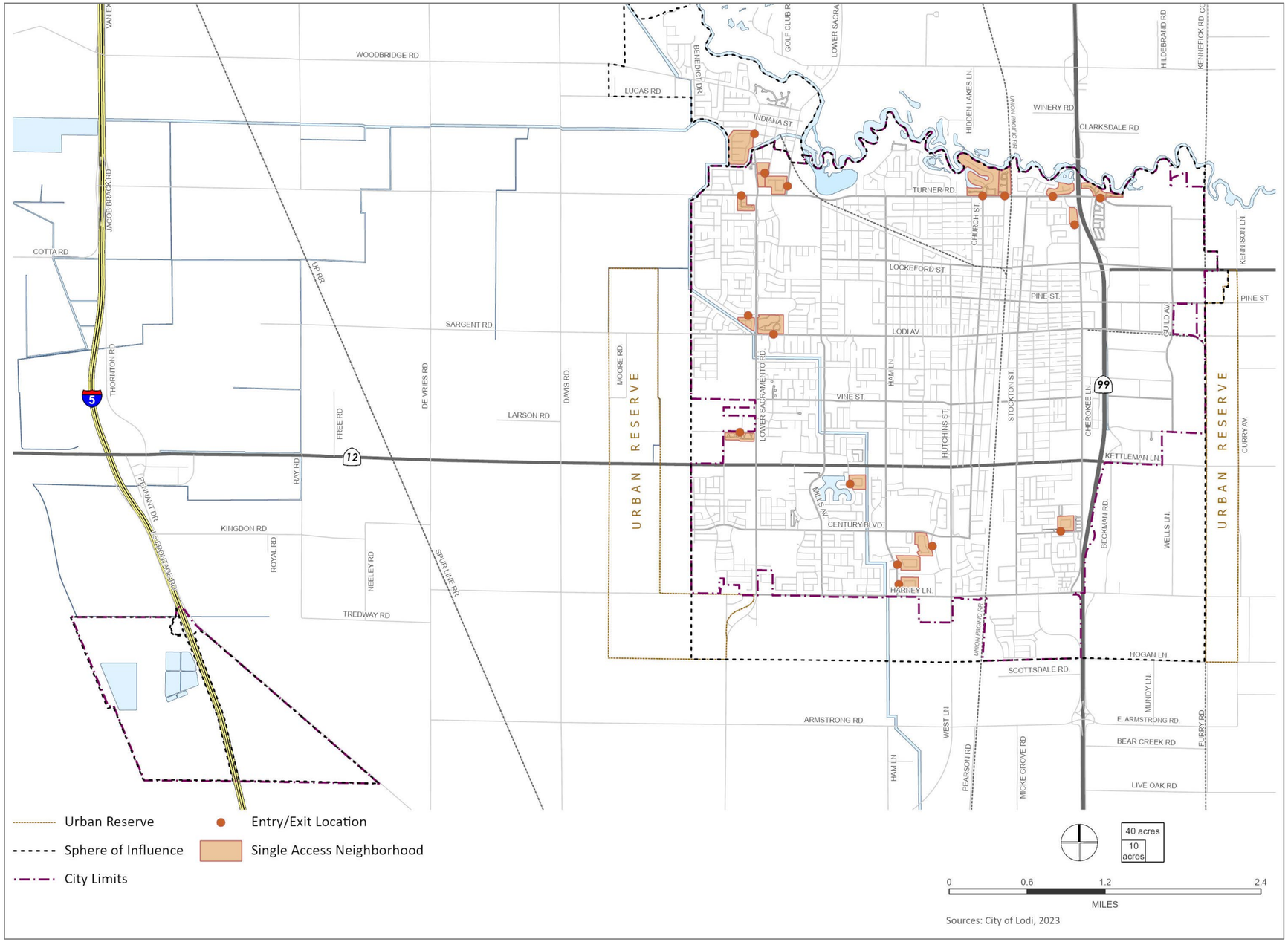
These scenarios are intended to model a potential range of different evacuation scenarios, but not all possible scenarios. Emergency evacuations can occur due to any number of events and at any location, beyond those specifically identified in this report. In addition, emergency movement is unpredictable, and the specific conditions of an emergency evacuation could result in evacuation behavior that diverges from the assumptions used in this analysis. This analysis serves only to represent informed estimates of likely potential evacuation scenario footprints and capacity constraints based on available data and does not guarantee that evacuations will follow modeling that is used for analysis purposes. Emergency evacuation assessment is an emerging field and the legislative requirement does not specify a standard methodology to follow. The methodology used in this evaluation is based upon best practices and the professional experience and knowledge of Rincon staff. Rincon is not responsible for any damage to life or property that might occur based on the results of the evacuation analyses herein, and any accompanying recommendations.

SB 99 Analysis – Single Entrance/Exit Neighborhoods

Per SB 99, the Safety Element of the General Plan is required to identify residential neighborhoods in any hazard area that does not have at least two evacuation routes. For this analysis, a neighborhood is defined as 30 or more dwelling units located in a residential general plan land use designation that only have a single route to access a collector or arterial road based on California Fire Code Appendix D107.1[1]. As shown in Figure 1, there are 17 neighborhoods in the city that have a single entry or exit point. Just over half of the neighborhoods are located in the northern portion of the city, predominately along the Mokelumne River, with the other half of the neighborhoods distributed throughout the city. In the case of an evacuation event, these single entry/exit neighborhoods would likely use north/southbound State Route (SR) 99 and/or SR 12 to evacuate, depending on the location of the evacuation area. Some neighborhoods could also use alternative evacuation routes, such as Lower Sacramento Road and Century Boulevard, depending on the severity of traffic congestion or the location of the evacuation area.

[1] 2019 California Fire Code, Title 24, Part 9 with July 2021 Supplement. Accessed at: https://codes.iccsafe.org/content/CFC2019P4/appendix-d-fire-apparatus-access-roads

Figure 1 Single Entry/Exit Neighborhoods



AB 747 Analysis – Evacuation Scenarios

In accordance with AB 747, the following analysis and results outline the potential outcomes of a variety of hazard events requiring emergency evacuation.

Evacuation Scenarios

In accordance with AB 747, a range of potential hazard scenarios are presented in this evacuation analysis. Hazard scenarios were selected in consultation with City staff and are based on a review of past hazard assessments, and by considering the potential likelihood, magnitude, and spatial extent of various hazards.

Scenario 1: Wildfire at Lodi Lake Park

- A wildfire originates in the Lodi Lake Park which triggers an evacuation within a half-mile buffer.
- Roadway closures: east/west lanes on Turner Road.
- Timing: Thursday in September.
- Evacuation Points: commercial parking lots at Lowes and Walmart in southwest part of town.

Scenario 2: Salt Springs Dam Failure

- The Salt Spring dam fails, resulting in city-wide flooding.
- Evacuation of the city would be gradual, beginning in the northeast corner progressing to the southwest corner with a 5-hour buffer before water reaches the city limits. Evacuations would mirror how the water enters the city, beginning in the northeast working towards the southwest.
- Roadway closures: SR 99 northbound and southbound.
- Timing: Thursday in June.
- Evacuation Points: southwest points outside of the city.

Scenario 3: Hazardous Materials Spill and Fire from Train Derailment at East Elm Street

- A large spill scenario involving hydrogen sulfide triggering a fire with prevailing wind out of the west.
- Roadway closures: Elm Street, SR 99, and neighboring cross streets without overpasses including Lockeford Street, Victor Road, Pine Street and Lodi Avenue.
- Timing: Thursday in August.
- Evacuation Points: commercial parking lots at Lowes and Walmart in southwest part of town.

Methodology

This section describes the methods, tools and data sources utilized to establish the transportation network, the approach to distributing the Lodi population within the city, average roadway capacity, and evacuation modeling.

Transportation Network

The transportation network was created by enhancing the city's roadway layer with ESRI's StreetMap Premium[2], which includes detailed basemap data and a network dataset for routing, both of which were used in the evacuation analyses. StreetMap Premium is a comprehensive dataset that provides

[2] ArcGIS StreetMap Premium. Accessed at: https://www.esri.com/en-us/arcgis/products/arcgis-streetmap-premium/overview

enriched network data based on commercial street reference data from leading global and local street data suppliers: HERE and GeoTechnologies, Inc. This dataset is well-suited for emergency evacuation analysis because it includes a comprehensive network of roads, baseline traffic data, and is regularly updated to ensure that it remains accurate and current. Further, the network data models the movements of automobiles by obeying one-way roads, speed limits, avoiding illegal turns, and other rules specific to automobiles, and finds solutions that optimize travel time.

Population Modeling

The population of Lodi was modeled using ESRI's Enrich Layer Tool. The Enrich Layer Tool appends demographic and landscape variables to any input polygon feature class for further analysis, modeling, and reporting. The input polygon layer used for Lodi were US census tracts within the city. The Enrich Layer Tool is then used to add daytime population data to the city census tracts. Daytime population data was from ESRI's daytime population data estimates, which are generated using a mix of inputs from ESRI's U.S. Updated Demographics, the decennial census, the American Community Survey (ACS), and business data from Data Axle, a full-service data provider. ESRI's daytime population is an estimate of the population that includes residents and workers in the city on weekdays during standard workday hours, between 9:00 a.m. and 5:00 p.m. Daytime population was used to best represent the number of individuals in the city at the time of an evacuation scenario.

After the values of daytime population were assigned to the census tracts, the city's building footprints[3] were used to concentrate the daytime population into places where the population would typically be present. This was done by randomly distributing total daytime population values to be within building footprints within each census tract. The daytime population points that intersect the evacuation area represent the individuals that are evacuating, and where they start their evacuation from. These points serve as evacuation origin points.

Evacuation Modeling

Evacuation routes and traffic volumes during an emergency evacuation event were modeled using ArcGIS's Closest Facility tool included in the Network Analyst extension. The Closest Facility tool enables finding the closest facility (e.g., hospital, fire station, or gas station) to a given location or set of locations. The Closest Facility tool can also be customized to include other factors that affect travel time, such as speed limits and road closures. For this evacuation analysis, the "facilities" analyzed will be points of safety and designated evacuation locations both inside and outside of Lodi city boundaries depending on the scenario. The facilities were identified in the section above titled Evacuation Scenarios. The location of facilities outside of city limits were assumed to be located on roads along evacuation routes, including SR 99, SR 12, and Kettleman Lane. After distributing the daytime population throughout the city, the evacuation model was run to simulate the level of traffic volumes on roads and major highways during each hazard scenario assuming simultaneous departure of all populations from the evacuation area to the nearest designated evacuation locations within the transportation network.

To depict the level of traffic volumes associated with each evacuation scenario, average daily traffic (ADT) was assigned to highways, arterial streets, and local roads within the city. ADT values for the highways, arterial streets, and some local roads were provided by the City. For local roads where ADT was not provided, an ADT value was assigned based on the average ADT value of all local roads provided by City staff. For this analysis, road capacity was estimated using road classifications and the

[3] The City of Lodi's building footprint data was sourced from Federal Emergency Management Agency (FEMA) data, which displays footprints for all structures (buildings) greater than 450 square feet in the United States and its territories. Accessed at: https://fema.maps.arcgis.com/home/item.html?id=0ec8512ad21e4bb987d7e848d14e7e24#overview

number of lanes traveling in the direction of the evacuation. Grade separated highways (SR 99) were assumed to have a traffic flow of 2,200 vehicles per lane per hour, arterial roads were assumed to have an ideal traffic flow of 1,900 vehicles per lane per hour, and collector and local roads were assumed to have an ideal traffic flow of 950 vehicles per lane per hour. On average, peak hour traffic ranges between 7-12 percent of ADT, according to the US Department of Transportation (DOT) Federal Highway Administration[4]. For this analysis, a lower-range value of about 8 percent of ADT was used to get the baseline volume of traffic on the roads, based on the suburban nature of the City. For the baseline scenario, baseline traffic volume is compared to the road capacity to get the baseline volume to capacity (V/C) ratio. For the evacuation scenarios, the number of evacuation routes that traveled along a particular road—moving from the evacuation origin to the nearest evacuation point outside the City Limits—will be added to the baseline volume of traffic already assumed to be traveling on the roads and compared to the road capacity to get the evacuation V/C ratios. V/C ratios less than 0.9 depict uncongested traffic, V/C ratios between 0.9 and 1 depict moderately congested traffic, and V/C ratios greater than 1 depict heavily congested traffic, or over-capacity traffic.

Assumptions and Limitations

The results of this analysis are intended to show roads that could experience increased traffic volumes during an emergency evacuation event. The model assumes that the daytime population within the evacuation area is going to exit the hazard area at the nearest evacuation point during typical traffic conditions. It is assumed that the locations of the exit points for each scenario change depending on the original direction of the hazard.

Evacuation Assessment Results

Baseline

The baseline scenario evaluates typical traffic volumes in the city during peak, weekday traffic hours (e.g., Thursday at 5 P.M.), assuming around 8 percent of ADT . After being compared to the road capacity, the resulting V/C ratio is used as the basis of comparison against each modeled evacuation scenario. As shown in Figure 2, all roads and highways exhibit no traffic congestion, or a V/C ratio under 0.9. All expected evacuation routes/locations along SR 99, SR 12, Kettleman Lane, and Lowes/Walmart parking lots are available to individuals for evacuation.

Scenario 1: Lodi Lake Park Wildfire

This scenario assumes a wildfire originating in Lodi Lake Park, with a half-mile evacuation zone surrounding Lodi Lake Park. Due to the extent of the evacuation zone, east- and westbound lanes on Turner Road are not viable. Figure 3 shows the extent of the proposed wildfire evacuation area and expected increased traffic volumes resulting from simultaneous departure throughout various points from the evacuation area. It is assumed that all evacuees will be travelling towards commercial parking lots at Lowes and Walmart (designated evacuation destination) in the southwest part of the city. A small segment of Lower Sacramento Road is expected to exhibit a V/C between 0.9 and 1, or moderately congested traffic, as individuals proceed into the designated evacuation destination. The largest traffic volumes, where traffic levels are expected to have a V/C greater than 1, or heavily congested traffic, occur along West Woodbridge Road, Davis Road, and portions of Mills Avenue, Lockeford Street, and Lower Sacramento Road. The largest occurrence of heavily congested traffic is

[4]US DOT Federal Highway Administration. Traffic Data Computation Method Pocket Guide. Accessed at: https://www.fhwa.dot.gov/policyinformation/pubs/pl18027_traffic_data_pocket_guide.pdf

Figure 2 Baseline Traffic Conditions

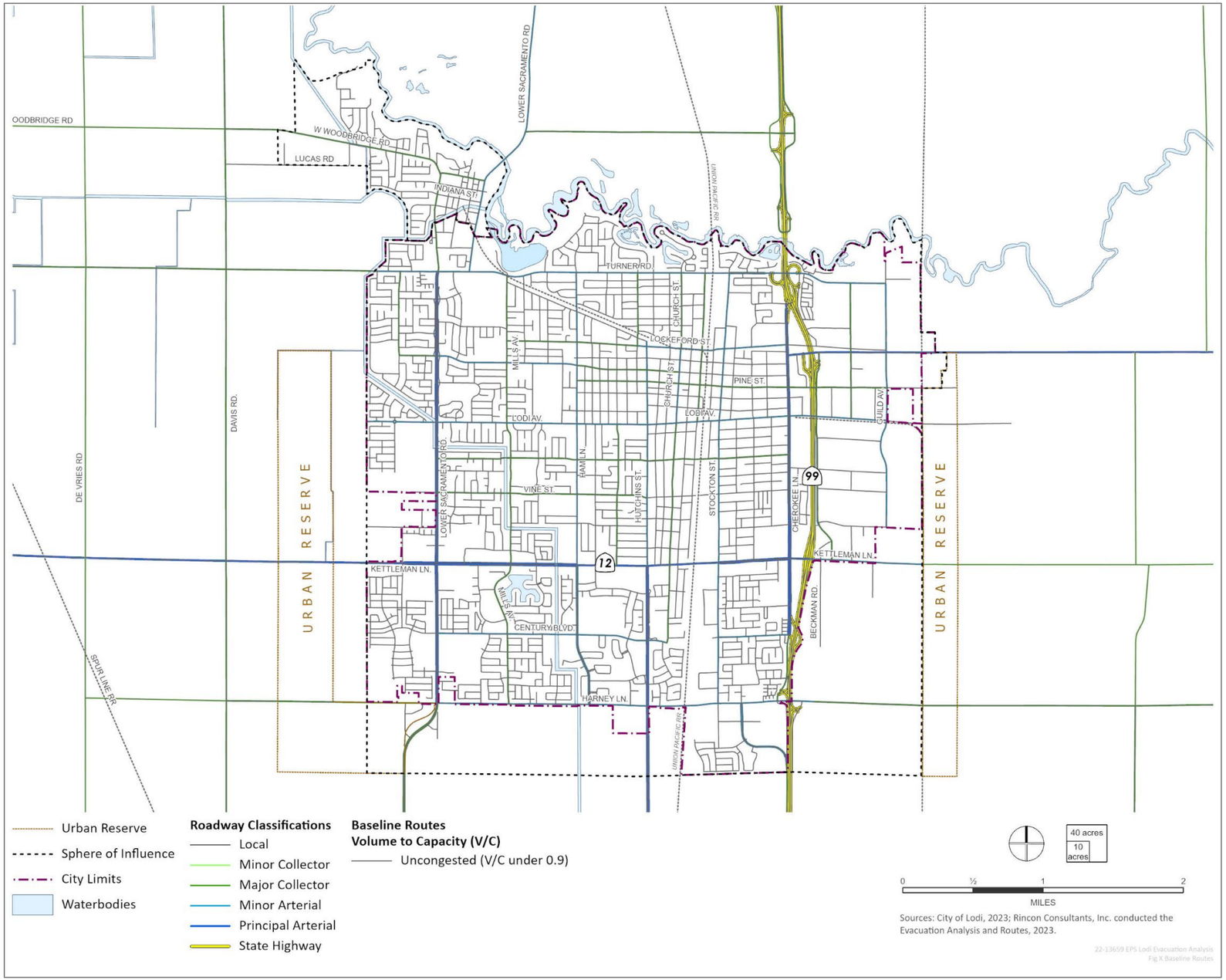
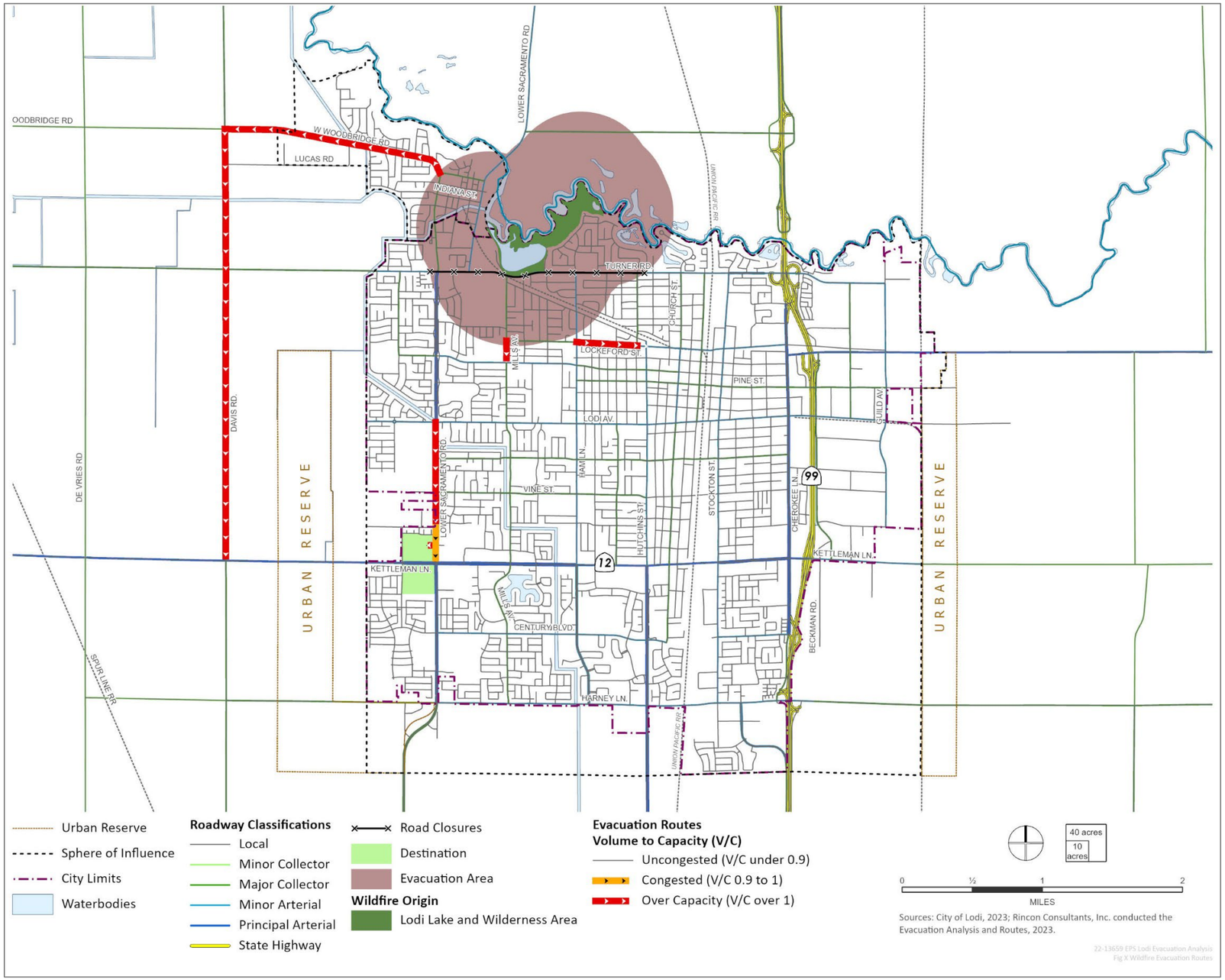


Figure 3 Lodi Lake Park Wildfire Evacuation Results



expected along West Woodbridge Road and Davis Road, as individuals directly east of the evacuation zone have limited evacuation routes due to southern road closures (Turner Road).

Due to this, evacuation responders could consider activating evacuation traffic management along these roadways and contra-flow lane reversal on westbound West Woodbridge Road and southbound Davis Road to allow both lanes to be used for evacuation, if necessary. In addition to these two roads, other areas to consider monitoring in this scenario include vicinities directly alongside the evacuation zone, along Mills Avenue and Lockeford Street, as immediate, heavy traffic congestion are expected in these areas as individuals vacate southbound and eastbound toward the designated evacuation destination. Similarly, Lower Sacramento Road could be monitored as heavy traffic congestion is expected as individuals vacating directly south of the evacuation area use this main road to access the designated evacuation destination.

Scenario 2: Salt Springs Dam Failure

This scenario assumes a city-wide flooding event due to failure of the Salt Springs Dam. This scenario assumes that exiting the city to the north or south using SR 99 are not viable as a result of the modeled flooding trajectory. Figure 4 shows the extent of the proposed flooding evacuation area and expected increased traffic congestion resulting from simultaneous departure throughout various points from the evacuation area. The largest traffic volumes, where traffic levels are expected to have a V/C greater than 1, or heavily congested traffic, occur along westbound Turner Road, Lodi Avenue, Vine Street, Kettleman Lane (SR 12), and Harney Lanell as evacuees converge onto SR 12 towards the evacuation destination point. Similarly, as evacuees proceed towards the evacuation destination point, major roadways expected to exhibit traffic levels with a V/C greater than 1 include a small segment of Cluff Avenue in the most northeastern portion of the City, and small segments of Stockton Street and Rocky Lane in the most southeastern portion of the City. Other collector and arterial roads expected to exhibit heavily congested traffic volumes include southbound Davis Road as evacuees move from Turner Road and Lodi Avenue towards SR 12, and northbound Lower Sacramento Road as evacuees move from Harney Lane towards SR 12.

The critical areas to maintain in this scenario would include all major roadways—Turner Road, Lodi Avenue, and Harney Lane—used to reach SR 12, and Kettleman Lane (SR 12) itself as this is expected to be the most direct route towards the evacuation destination area. Other collector and arterial roads, especially those located in the northeastern portion of the city, should also be monitored as flooding in this scenario is expected to begin in northeast areas of the city and progress towards the southeast. Similar to the previous scenario, evacuation responders could consider activating evacuation traffic management at these collector and arterial roads, and contra-flow lane reversal on SR 12 to allow both lanes to be used for westbound evacuation if necessary.

Scenario 3: Hazardous Waste Spill and Fire from Train Derailment

This scenario assumes a hazardous waste spill (hydrogen sulfide) and subsequent fire from a train derailment occurring on East Elm Street. In addition, this scenario assumes a prevailing wind out of the west resulting in toxic smoke and degraded air quality in areas east of the disaster site. As a result, Elm Street, SR 99, and neighboring cross streets without overpasses including Lockeford Street, Victor Road, Pine Street, and Lodi Avenue are not viable and therefore closed in this scenario. Figure 5 shows the extent of the evacuation area and expected increased traffic congestion resulting from simultaneous departure throughout various points from the evacuation area. The largest traffic volumes, where traffic levels are expected to have a V/C greater than 1, occur along Cluff Avenue, Turner Road, and Guild Avenue in northeastern parts of the city; Auto Center Drive, Kettleman Lane (SR 12), and Cherokee Lane adjacent to SR 99; and Ham Lane, Tokay Street, Church Street, Stockton

Figure 4 Salt Springs Dam Failure Evacuation Results

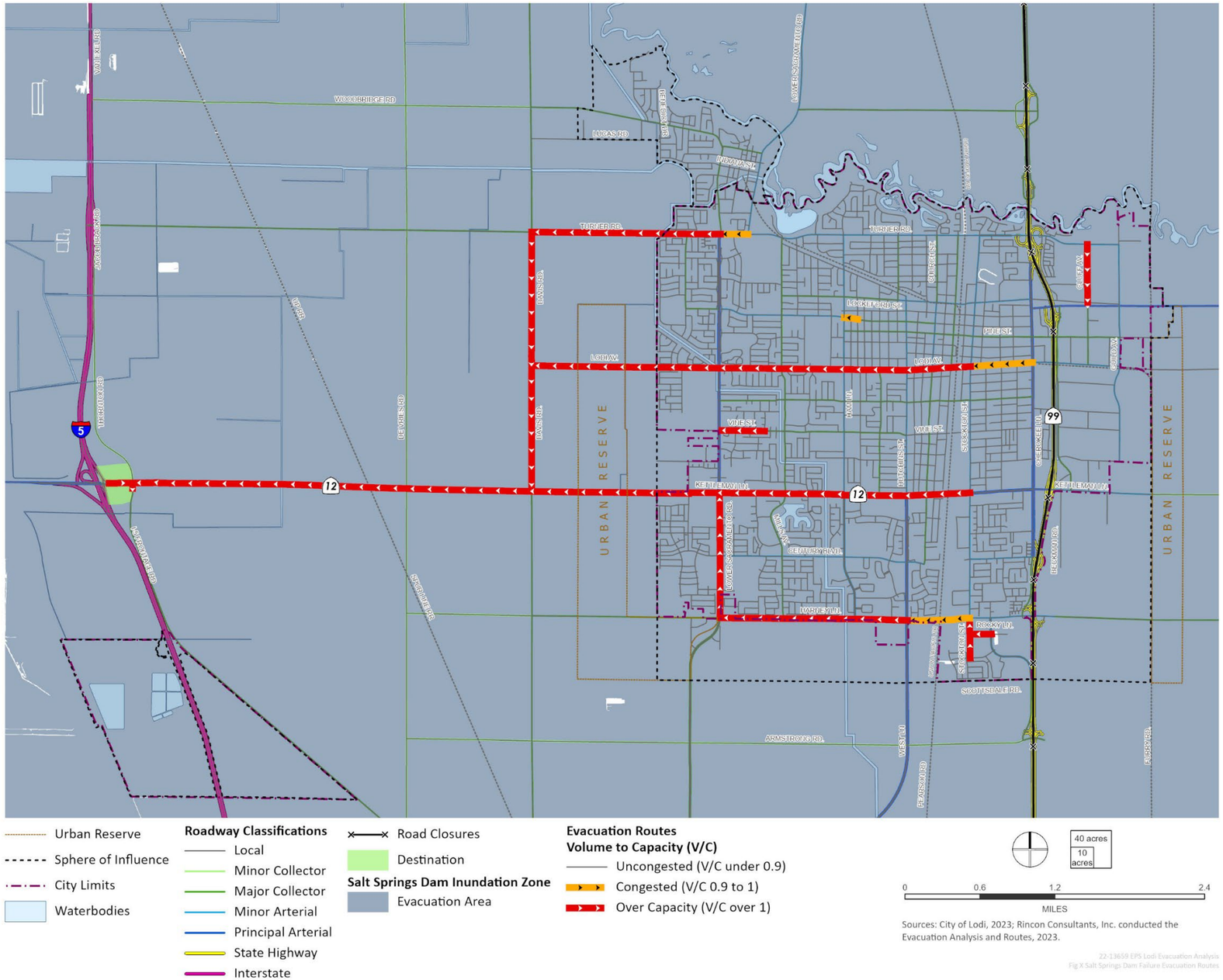
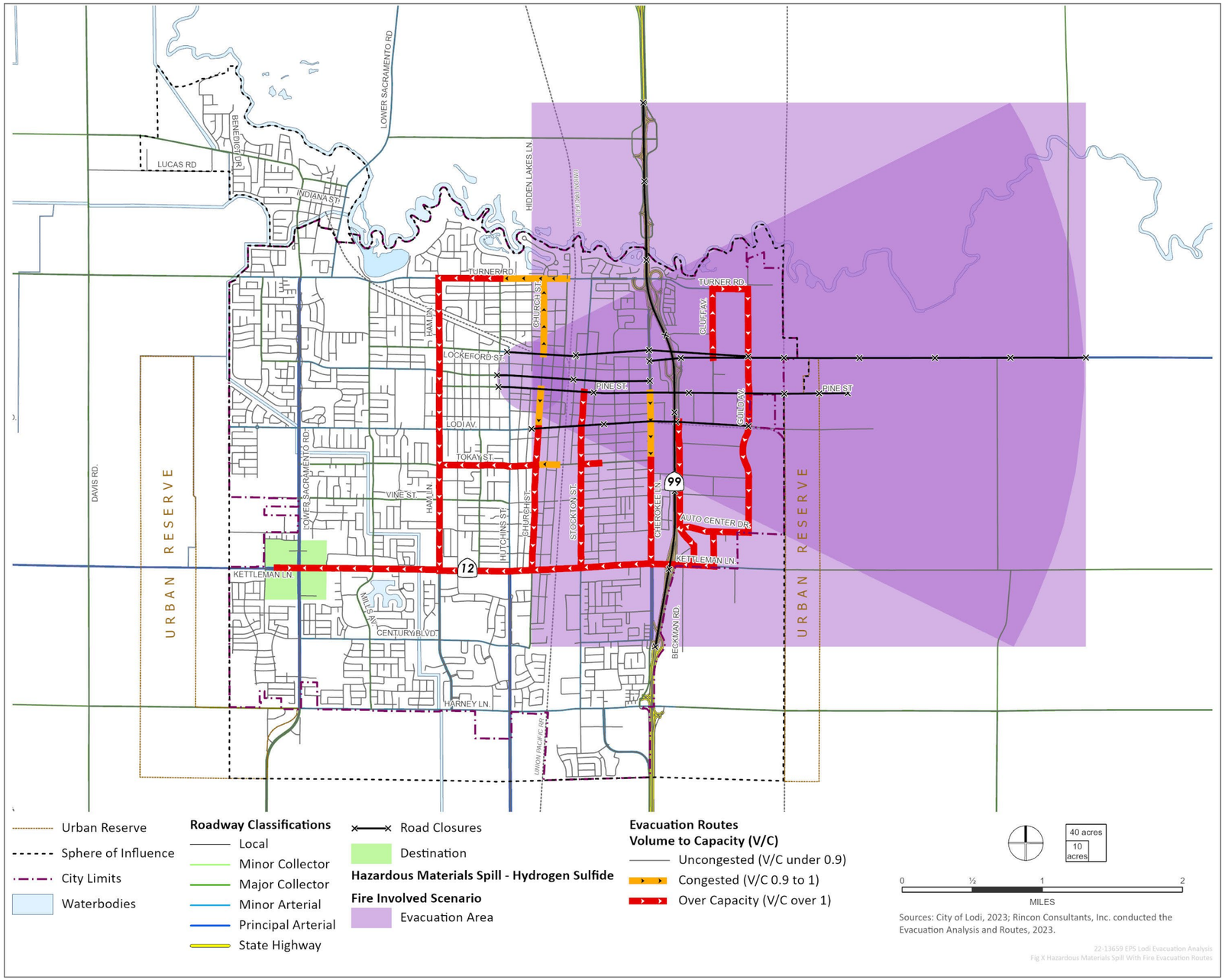


Figure 5 Hazardous Waste Spill with Fire Evacuation Results



Street, and SR 12 in areas west and south of the initial disaster area. Due to road closures on Lockeford, Elm, and Pine Street, evacuees vacating from areas northeast of the disaster are expected to proceed towards the evacuation destination area using eastbound Turner Road and southbound Guild Avenue to access the major evacuation roadway SR 12. Similarly, due to road closures, all traffic directly south of the initial disaster area is expected to travel southbound only on arterial and collector roads that allow access to SR 12.

The critical areas to maintain in this scenario would include all possible entry points surrounding the initial train derailment site, and the previously listed roadways with heavily congested traffic, especially areas northeast of the evacuation area as evacuees here will be the farthest away from the evacuation destination point and are expected to travel using alternative routes due to road closures. Like the previous scenarios, evacuation responders could consider activating evacuation traffic management on the heavily congested roadways and contra-flow lane reversal on heavily affected arterial roads (Church Street, Stockton Steet, and Cherokee Lane) south of the Pine Street road closure, if necessary, to aid in swift movement towards the major evacuation route SR 12.

Evacuation Strategies

The following lists evacuation strategies that city may consider to improve future evacuation events.

Single-Access Residential Neighborhoods

- Ensure that the Lodi Fire Department has complete access to all locations in the city, including gated residential communities.
- In coordination with the Lodi Fire Department and Lodi Police Department, conduct regular evacuation trainings with single-access community homeowner associations and residents.
- Proactively engage with residential neighborhoods with single routes of entry and exit to conduct emergency preparedness trainings and appropriate home retrofits.

Traffic Management

- Collaborate with Caltrans and California Highway Patrol (CHP) to reverse one or more lanes of SR 12 to accommodate an increased flow of traffic in one direction. Apply the same strategy to City-owned major roadways.
- Redirect all lanes of a designated evacuation route to accommodate rapid evacuation from a city or region.
- Temporarily close inbound travel lanes on selected unlimited access arterials (such as parkways and boulevards) to allow outbound traffic to utilize these lanes during evacuation.
- Collaborate with Caltrans and/or CHP to close inbound lanes on highways used for evacuation routes to prevent drivers on these routes from entering the city while evacuation is underway.
- Minimize left-turn movements along evacuation routes and on roads leading to evacuation routes.
- Use variable message board equipment and targeted installation of permanent dynamic message signs on evacuation routes to improve communication and reduce public confusion.
- Collaborate with towing services to consider how to stage tow trucks at key bottleneck locations along evacuation routes to help detect and clear minor crashes and maintain traffic flow.
- Increase the green time and/or progression band for through movements leading out of an evacuation zone.

- Install signal battery backups in case signal operations need to be maintained during a power outage. Consider using channeling devices, static signs, and coning strategies to manage intersection flow during power outage if the signals lack power.
- Collaborate with bus system operators to develop transportation solutions such as the use of a bus system for evacuating individuals with special needs (such as those with mobility limitations).
- Establish traffic control points (i.e., locations along designated evacuation routes with emergency management personnel) to maintain a greater degree of evacuation management. These locations could enhance the efficiency of an evacuation, reduce public confusion, and allow increased operational flexibility during an evacuation.

Communications

- Strengthen and maintain communication among coordinating emergency event agencies. This could be achieved through systems such as the Public Information Emergency System and Emergency Satellite Communications.
- Implement a traffic control center to coordinate all evacuation activities. This center would have up to the minute reports on traffic patterns and can communicate directly with the broadcast media to let drivers know about roadway congestion and conditions and direct them to alternate routes.
- Install counters and/or CCTV cameras to assess traffic flow, volume of vehicles evacuating, and monitor incidents.
- Develop communication plan to provide information regarding primary and secondary evacuation routes and incidents to the public.

Vulnerable Populations

- Understand if there are areas in the city with a greater percentage of senior adults, disabled people, mobility impaired, visually impaired, people with medical conditions, and people without vehicles with of objective of identifying areas that should be prioritized by first responders during an evacuation.
- Develop system to ensure hearing impaired receive evacuation warnings.
- Provide special assistance to mobility impaired, visually impaired, people with medical conditions, and people without vehicles such as paratransit.
- Translated materials should be prepared to support communication to non-English speaking populations including during evacuation.

Conclusion

Lodi's transportation network allows for evacuation in all directions during a disaster, if necessary. However, due to the population density, an evacuation event could still put a burden on the transportation network. In compliance with SB 99, we have identified 17 residential neighborhoods that have a single entry or exit point throughout the city. The analysis prepared in keeping with AB 747 shows that, major roadways and evacuation routes could become affected thus prompting emergency traffic management and the use of alternative evacuation routes during emergency events. While the Lodi Lake Park wildfire and hazardous waste spill scenarios are expected to remain fairly localized, resulting road closures could result in traffic congestion that extends beyond the evacuation zones. The Salt Springs Dam failure would result in citywide inundation and could trigger heavy traffic congestion across the entire city. Implementing traffic management strategies will aid in efficient and

expeditious flow of evacuation traffic, which is the most critical and challenging element in a successful evacuation. Communication during an evacuation event is found to be an extreme challenge due to the coordination between agencies responsible for communication. Improved training, procedures, platforms, and public education are all strategies that can occur pre-emptively to improve communication among entities involved in the management of response, and communication between the City and the general public. Vulnerability of residents should be considered in determining which areas may need to be prioritized by first responders during an evacuation. Areas within the city with a greater percentage of elderly people, disabled people, households that do not own vehicles (i.e., transit dependent populations), and institutionalized populations require a greater amount of support during an evacuation. Other vulnerable groups should be evaluated relative to evacuation route vulnerability.

It is recommended that the results of these analyses be considered to frame supportive policies for the Safety Element Update. These policies can be used to identify potential evacuation capacity and resiliency improvements throughout the city.

Appendix C – Climate Change Vulnerability Assessment

City of Lodi

Climate Change Vulnerability Assessment

December 2023

Prepared by
Rincon Consultants, Inc.

Table of Contents

Tables

Figures

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1 Introduction

1.1 Land Acknowledgement

We acknowledge that we inhabit the territorial traditional land of the Miwok Peoples, past and present, and honor with gratitude the land itself and the people who have stewarded it throughout the generations. This land acknowledgement calls us to commit to continuing to learn how to be better stewards of the land we inhabit.

1.2 Background on Climate Change

This report evaluates how climate change is projected to impact vulnerable community members, natural resources, agriculture, buildings, community facilities and infrastructure in Lodi. Government Code §65302, as amended by Senate Bill (SB) 379, requires cities and counties across California to prepare a Climate Change Vulnerability Assessment that informs updates to the Safety Element of the General Plan. Understanding Lodi's vulnerabilities to climate change provides a foundation to develop required climate adaptation goals, policies, and implementation programs for the Safety Element.

Causes of Climate Change

Climate change is caused by the addition of excess greenhouse gases (GHGs) to the atmosphere, which traps heat near the earth's surface raising global average temperatures in what is referred to as the greenhouse effect. This increase in average temperatures across the globe affects sea level rise, precipitation patterns, the severity of wildfires, the prevalence of extreme heat events, water supply, and ocean temperatures and chemistry (NASA 2022). According to the Intergovernmental Panel on Climate Change (IPCC), GHGs are now higher than they have been in the past 400,000 years, raising carbon dioxide levels from 280 parts per million to 410 parts per million in the last 150 years (IPCC, 2021). The dramatic increase in GHG's is attributed to human activities beginning with the industrial revolution in the 1800s, which represented a shift from an agrarian and handicraft-based economy to one dominated by industry and machine manufacturing (NASA 2022).

1.3 Glossary

Several words and phrases are used throughout the report to illustrate climate vulnerabilities within Lodi.

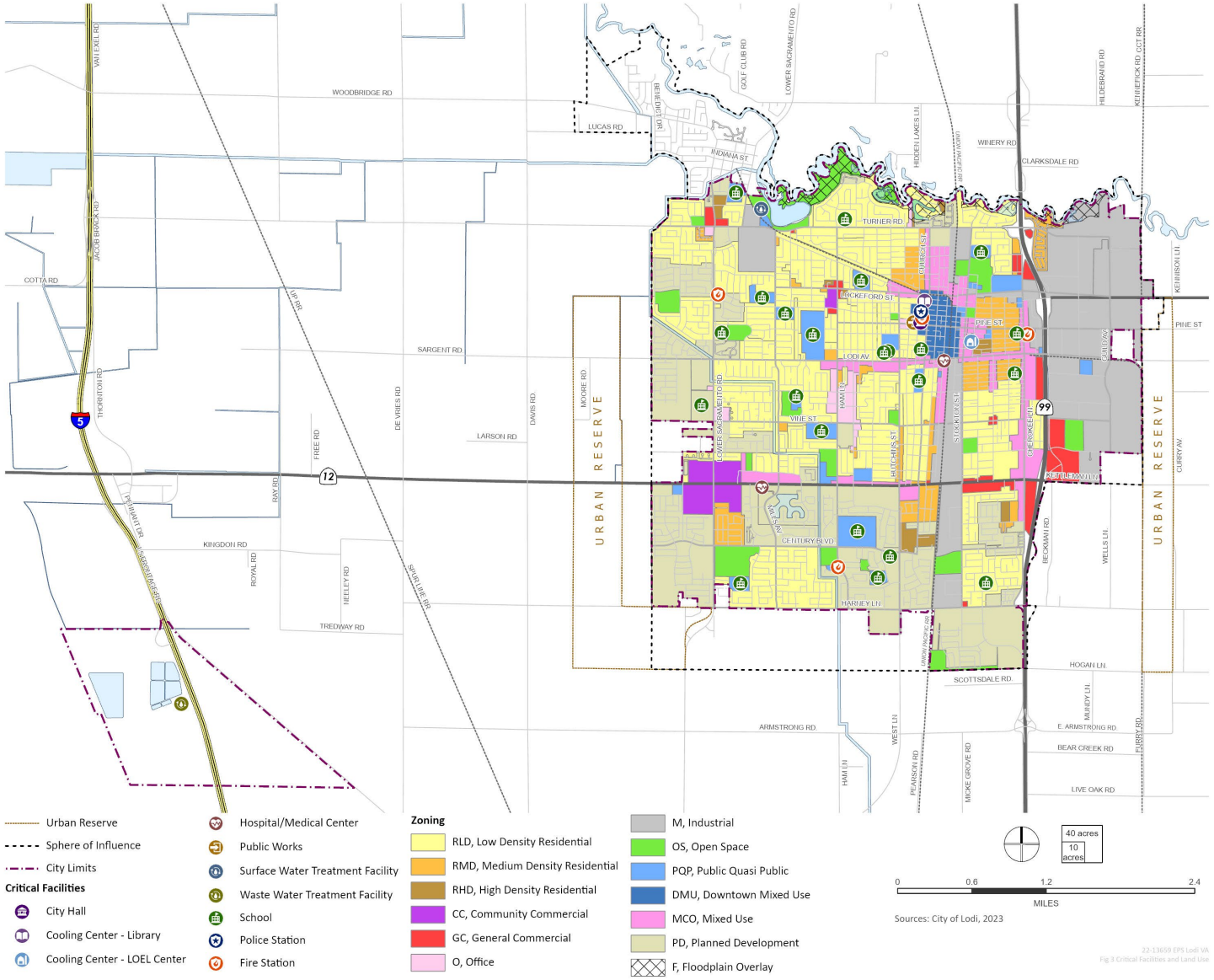
- **Adaptation.** The process of adjustment to actual or expected climate and its effects, either to minimize harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate (IPCC, 2012).
- **Adaptive Capacity.** The ability for a community to cope with and adjust to the impacts of climate change (Cal OES 2020).
- **Asset.** Reference to a resource, structure, facility, or service that is relied upon by a community.
- **Cascading Impact.** Climate hazard caused impacts that compromise infrastructure or disrupt critical services (i.e., power supply or water conveyance) broadening the scope of impact past a singular subject to reliant subsystems and populations (Collins et al. 2019).
- **Climate Driver.** A change in the climate which acts as the main source of change for subsequent climate hazards. Climate drivers relevant to the City and discussed in this report are temperature and precipitation.
- **Climate Hazard**. A dangerous or potentially dangerous condition created by the effects of the local climate (Cal OES 2020). Climate hazards of concern for Lodi are extreme heat, drought, air quality, and flooding.
- **Compounding Risk.** When two or more extreme events or average events occur simultaneously and increase the scope of impact or severity of the event; an additional risk brought about by increased frequency of events from climate change (Seneviratne et al. 2012).
- **Impact.** Effects on natural and human systems including effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate hazards and the vulnerabilities of the system or asset effected (IPCC 2012).
- **Mitigation.** An act or sustained actions to reduce, eliminate, or avoid negative impacts or effects (Cal OES 2020).
- **Resilience.** The capacity of an entity (an individual a community, an organization, or a natural system) to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience (Cal OES 2020)
- **Sensitivities**. The degree to which a species, natural system, community, asset, or other associated system would be affected by changing climate conditions (Cal OES 2020).
- **Vulnerable Populations.** Populations that experience heightened risk and increase sensitivity to climate change and have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts (Cal OES 2020).
- **Vulnerability.** The propensity or predisposition to be adversely affected (IPCC 2012).

1.4 Lodi Snapshot

Lodi is a compact community with a population of approximately 67,021 people bordering the Mokelumne River on the edge of the Sacramento Delta. Lodi covers 79.4 square miles in the greater San Joaquin Valley region between Stockton which is six miles to the south and Sacramento which is 35 miles to the north. SR-99 and the Union Pacific Railroad traverse the city in a north-south direction, as shown in Figure 1. Surrounded by agricultural lands, primarily vineyards, the city is a center for wine production. Critical facilities and General Plan land use designations for the city are displayed in Figure 1. Lodi's predominant land use is Residential at 50 percent followed by Public, Industrial and Commercial land uses ranging from 9 percent-13 percent. Critical facilities are structures and institutions necessary for a community's response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery. Critical facilities are identified and include the following:

- City Hall
- Library/Cooling Center
- Lodi Elderly (LOEL) Center/Cooling Center
- Hospital/Medical Center
- Public Works
- Surface Water Treatment Facility
- School
- Police Station
- Fire Station
- Wastewater Treatment Facility

Figure 1 Lodi Critical Facilities and General Plan Land Use Designations



2 Methodology

2.1 Vulnerability Assessment Methodology

California Adaptation Planning Guide Phases

The City of Lodi Climate Change Vulnerability Assessment follows the vulnerability assessment process recommended by the California Governor's Office of Emergency Services, as documented in the 2020 California Adaptation Planning Guide (Cal APG). The adaptation planning process outlined by the Cal APG consists of four phases, illustrated in Figure 2 below, with Phase 2 focused on the vulnerability assessment process (Cal OES 2020). The City of Lodi Climate Change Vulnerability Assessment is prepared consistent with Phase 2 of the Cal APG and is composed of the following sections outlined in Figure 3.

Figure 2 California Adaptation Planning Guide Phases

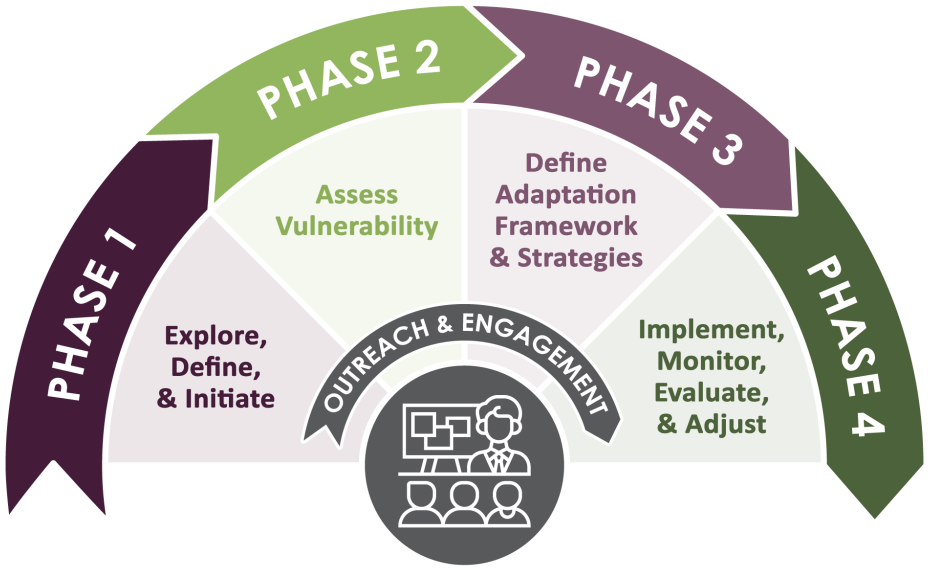
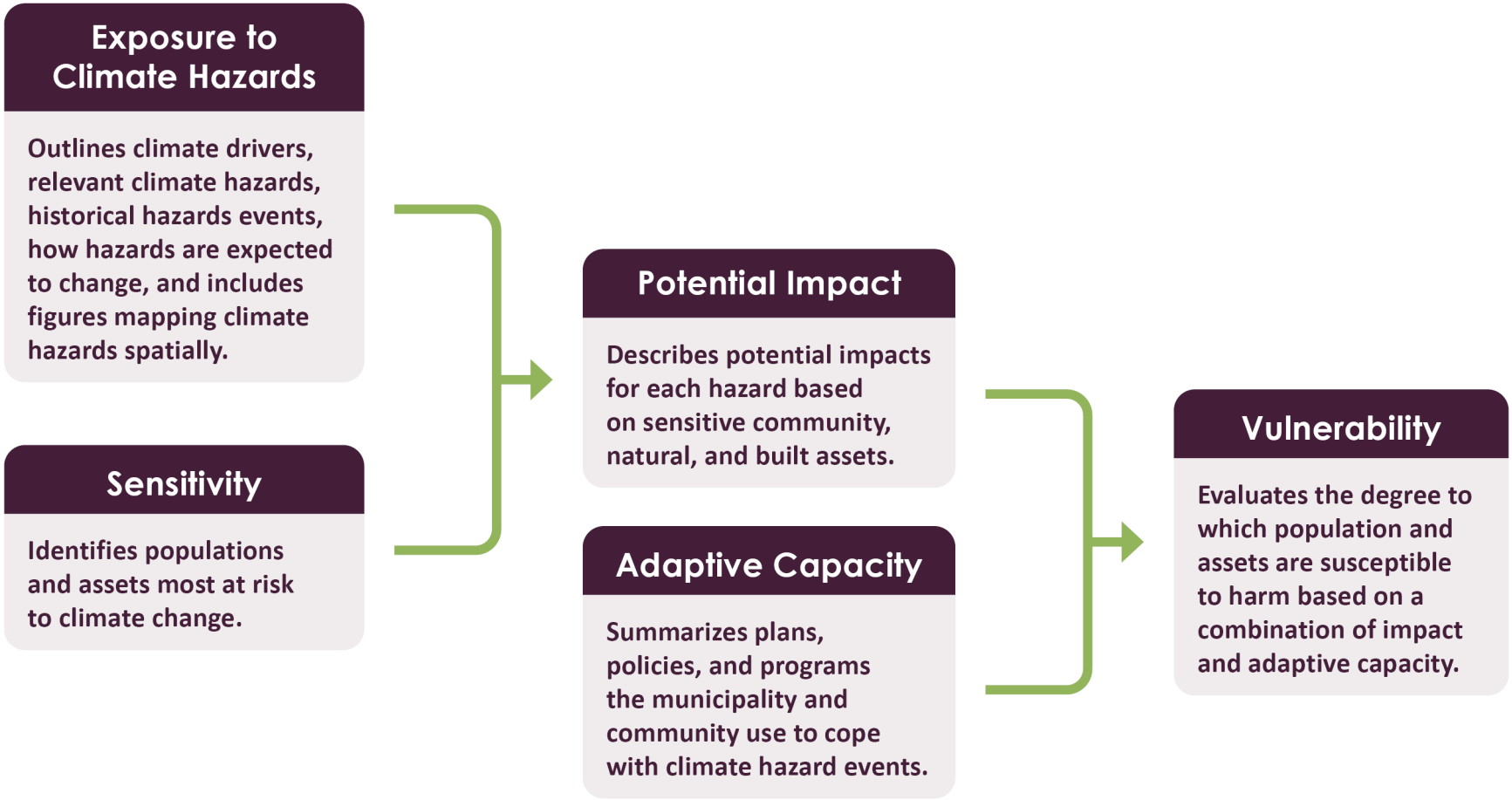


Figure 3 Climate Vulnerabilty Assessment Workflow



Key Data Sources

The following data sources and tools, many of which are recommended within the Cal APG, were used in preparation of this report.

- **Cal-Adapt 2.0** is an online tool that presents historic and modeled projections based on 10 different global climate models. The tool was developed and is maintained by the University of California, Berkeley Geospatial Innovation Facility with funding and oversight by the California Energy Commission (CEC). This tool was used to present projection data related to minimum and maximum temperature, precipitation, extreme heat, warm nights, drought, and wildfire (CEC 2021).
- **California's Fourth Climate Change Assessment** was developed by the CEC and other State of California coordinating agencies to present up-to-date climate science, projections and potential impacts associated with climate change. The CEC and coordinating agencies developed nine regional reports to provide regional-scale climate information to support local planning and action. The San Joaquin Valley Region Summary Report (2021) presents an overview of climate science, regional projections, specific strategies to adapt to climate impacts, and key research gaps needed to spur additional progress on safeguarding the San Joaquin Valley from climate change. The San Joaquin Valley Region Summary Report was used to understand regional changes that may affect the City of Lodi both directly and indirectly (Fernandez-Bou et al. 2021).
- **San Joaquin County Hazard Mitigation Plan** presents information on existing processes and plans in place that address San Joaquin County's ability to prepare for climate change impacts and informed the adaptive capacity discussion of this report. The Hazard Mitigation Plan (2023) was also used to identify recent historical events.
- **U.S. Census, 2021 American Community Survey** presents demographic data by census tract. U.S. Census data was used to identify the City of Lodi's population and household statistics that correspond with vulnerable population groups.
- **The Center for Disease Control's (CDC) PLACES Health Data (2021)** presents health demographic data by census tract. CDC PLACES Health Data was used to identify the Lodi population health statistics that correspond with vulnerable population groups.
- **The California Heat Assessment Tool (CHAT)** was developed with funding from the California Natural Resources Agency as part of the state's Fourth Climate Change Assessment. Collaboratively created by Four Twenty-Seven, Argos Analytics, Habitat Seven, and the Public Health Institute, this tool serves local and state health practitioners. Its aim is to enhance understanding of the various dimensions of vulnerability to heat due to climate changes. Additionally, it pinpoints actionable areas to mitigate the potential public health impacts of extreme heat in the future.
- **The Tree Equity Score** gauges the effectiveness of tree benefits in reaching communities facing economic challenges, people of color, and those disproportionately affected by extreme heat and other environmental risks. This nationwide score serves as a representation of unequal tree access. It is computed at the local level, specifically within neighborhoods (Census block groups). Ranging from 0 to 100, a lower score fewer trees. A score of 100 signifies adequate tree coverage in the neighborhood. The Tree Equity Score encompasses every urban Census block group across the United States.

Data Limitations

The limitations of this report and analysis stem from gaps in data availability and completeness of data methods. Census data can miss portions of the population (e.g., homeless populations, undocumented immigrants), which results in general demographic information not fully identifying the extent of populations vulnerable to climate change (Cantwell 2021). Federal Emergency Management Agency (FEMA) 100-year and 500-year flood plains do not account for climate change projections; zones are instead based on historical information. Extrapolating air quality hazard exposure data in the context of climate change is difficult and the estimates of exposure to these hazards are likely to be underestimated (Fernandez-Bou et al. 2021).

The data presented in Cal-Adapt tools are projections, or estimates, of future climate conditions. The limitation in these projections is that the long-term behavior of the atmosphere is expressed in averages – for example, average annual temperature, average monthly rainfall, or average water equivalent of mountain snowpack at a given time of year. The averages discussed often downplay the extremes by which daily weather events occur and when presented as an average, only show moderate changes within the climate. What is often lost in averages is that the frequency of extremes, like atmospheric rivers, may increase while low-moderate intensity weather events decrease through the end of the century. In instances of modeled precipitation projections, it maintains an average similar to historic levels which does not account for anticipated fluctuations in extremes (CEC 2021).

Vulnerability Scoring Methodology

Vulnerability scoring is a valuable step in the climate vulnerability assessment process because it identifies which assets and populations face the highest threat to climate hazards. This can aid in the prioritization of adaptation actions. The vulnerability score is a combination of the impact and adaptive capacity score. The impact and adaptive capacity scores are developed using a qualitative methodology outlined in the Cal APG, as shown in the scoring rubric in Table 1. Impact and adaptive capacity scores are identified for each asset and population for each climate hazard. The vulnerability score is prepared by combining the impact score and the adaptive capacity score as demonstrated in Table 2. The range of potential impacts spans 1 through 5 with 1 being low, 2-3 being medium, and 4-5 being high vulnerability.

The impact and adaptive capacity scores are combined to form the vulnerability score based on the approach presented in Table 2, which is consistent with methodology from Cal APG.

Table 1 Impact and Adaptive Capacity Scoring Rubric

Score	Impact	Adaptive Capacity
Low	Impact is unlikely based on projected exposure; would result in minor consequences to public health, safety, and/or other metrics of concern.	The population or asset lacks capacity to manage changes; major changes would be required.
Medium	Impact is somewhat likely based on projected exposure; would result in some consequences to public health, safety, and/or other metrics of concern.	The population or asset has some capacity to manage climate impact; some changes would be required.
High	Impact is highly likely based on projected exposure; consequences to public health, safety, and/or other metrics of concern.	The population or asset has high capacity to manage climate impact; minimal to no changes are required.

Source: Cal OES 2020

Table 2 Vulnerability Score Matrix

Potential Impacts	**High**	3	4	5
	Medium	2	3	4
	Low	1	2	3
		High	**Medium**	**Low**
		Adaptive Capacity		

Source: Cal OES 2020

3 Climate Hazard

Climate change is a global phenomenon that can impact local health, natural resources, parks, infrastructure, emergency response, and many other aspects of society. Projected changes to the climate are dependent on location. The Cal-Adapt tool provides climate data from global scale models that have been localized (downscaled) to 3.7 mile by 3.7-mile grids (CEC 2021). The data in Cal-Adapt specific to Lodi is combined with information from the California Fourth Climate Change Assessment San Joaquin Valley regional report to describe projected future changes for specific types of hazards. Projections throughout this section are presented consistent with the Governor's Office of Planning and Research (OPR) using Representative Concentration Pathway (RCP) 8.5 as a conservative approach to assessing and adapting to climate change (CEC 2021). RCP 8.5 is a high greenhouse gas emissions scenario in which global emissions continue to rise through the end of the 21st century. Projections are forecasted to mid-century (2035-2064) and end-of-century (2070-2099) as 30-year averages and are compared to a modeled historical baseline (1961-1990) (CEC 2021).

This section presents information on temperature and precipitation, which are characterized as climate drivers. The Hazards section provides information on projected changes to extreme heat, drought, air quality, and flooding resulting from changes to climate drivers.

3.1 Climate Drivers

In Lodi, the climate drivers of concern include Temperature and Precipitation.

Temperature

Lodi has an average baseline maximum temperature of 74.0°F and an average baseline minimum temperature of 46.4°F (CEC 2021). The average maximum and minimum temperatures are expected to increase, which will shift the temperature range up to 4.8°F by mid-century projections and 8.2°F (RCP 8.5) through the end of the century (CEC 2021). Temperature increases influence extreme heat and warm nights, drought, and air quality (discussed under Hazards below).

Precipitation

Increased intensity of precipitation events is expected for the greater San Joaquin Valley region, including Lodi, through the end of the century. It is projected that more precipitation will occur during extreme storms with wet extremes occurring more often and with greater intensity (Fernandez-Bou et al. 2021). The projections show that there will be more dry periods punctuated by increased precipitation intensities of the largest storms or wet periods, with a 20 percent decrease in precipitation on average (Fernandez-Bou et al. 2021). Precipitation changes are expected to affect the occurrence of hazards events including drought, flooding, and air quality. The San Joaquin Valley region is expected to experience 13 percent more precipitation during extreme events, a 4-10 percent increase in very dry years, and a 34-57 percent increase in very wet years by the end of the century (Fernandez-Bou et al. 2021).

Lodi precipitation projections under RCP 8.5 demonstrate a 0.06-inch mid-century increase and a 0.14-inch end century increase in annual precipitation totals (CEC 2021). However, as already observed in recent decades, precipitation changes are largely experienced as more extreme variability with intensely wet years followed by extreme droughts (Fernandez-Bou et al. 2021). This translates into longer dry seasons with less precipitation on average

that may lead to increased groundwater pumping from the City's 28 groundwater wells to compensate for the diminished surface water supplies (UWMP 2020). Groundwater pumping is one of the City's primary sources of potable water sourced from the Eastern San Joaquin Subbasin and surface water supplies from the Mokelumne River purchased from Woodbridge Irrigation District (UWMP 2020). Reduced snowpack from warmer precipitation can lead to less retainable surface water and overall reduced availability

3.2 Hazards

Changes in temperature and precipitation are expected to influence the frequency, duration, and magnitude of the following climate hazards:

Extreme Heat

Drought

Air Quality

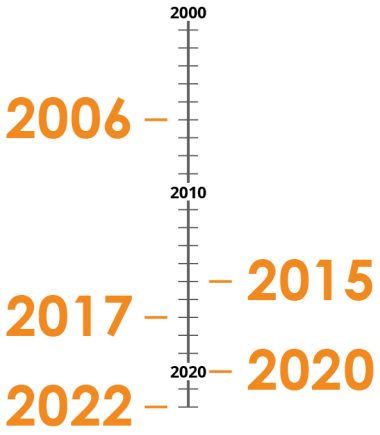
Flooding

EXTREME HEAT

Past

Extreme heat events across the state have presented historic challenges for all communities.

Extreme Heat Events in Lodi

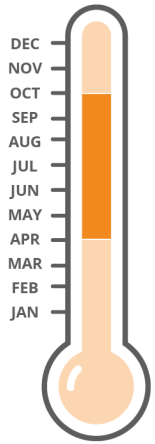


Present

Extreme heat events are presently defined as days in which the temperature exceeds the 98th percentile of 101.2°F. Current extreme heat days occur between the months of April to October while the 30-year baseline average is 4 days annually.

Extreme Heat Months

(Baseline Years)

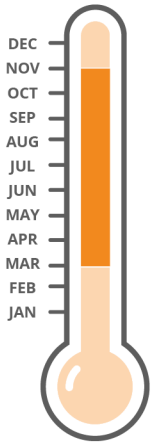


Future

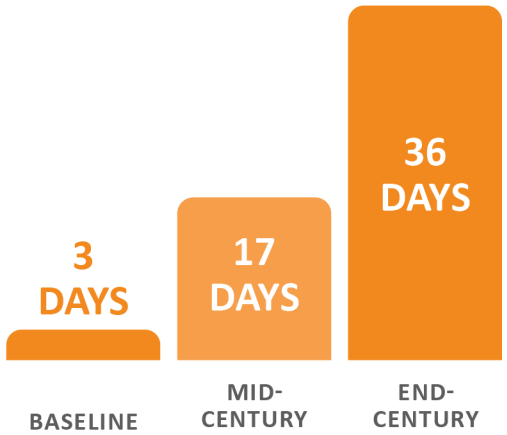
Extreme heat is expected to affect all of Lodi, with greatest impacts to sensitive population groups. Days above the present 98th percentile are projected to increase 36 days, an 11-fold increase, by the end of the century and occur during a wider range of months from March to November.

Extreme Heat Months

(End-century Years)



Projected Annual Average of Extreme Heat Days



Impacts on the Built and Natural Environment

- Cracked Pavement
- Grid Overload
- Vegetative Stress
- Strained Emergency Services

Impacts on Vulnerable Populations

- Dehydration
- Heat Stroke
- Health-related Mortality
- Income Loss
- Heart Disease
- Respiratory Illness
- Mental and Behavioral Health

Extreme Heat Compounding Effects

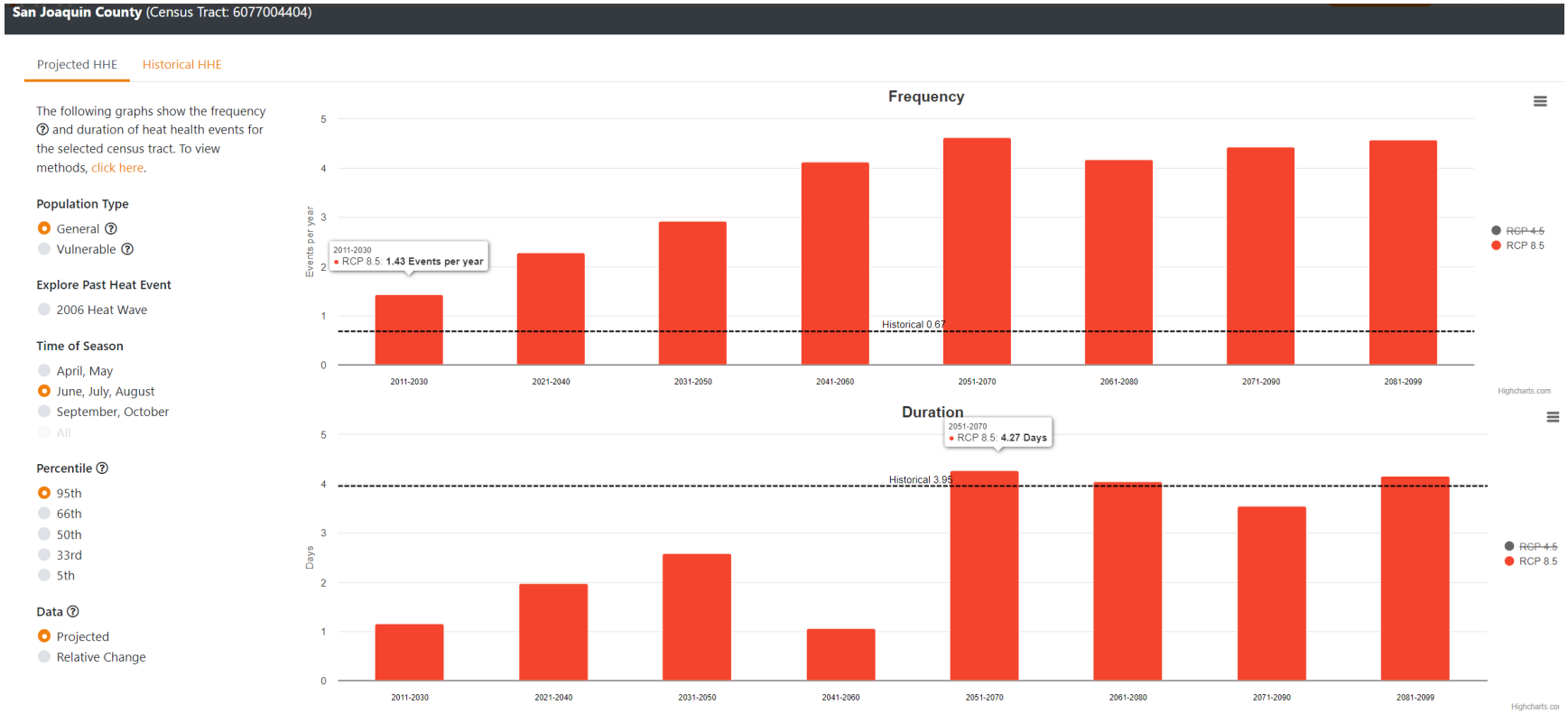
Extreme heat events attributed to increasing temperatures are made worse through compounding built and natural environment factors. The following subsections outline the built and natural environment contributors to extreme heat.

URBAN HEAT ISLAND

Urban Heat Island (UHI) is a term that refers to developed areas that are hotter than the surrounding landscape primarily due to the use of building materials and surfaces that absorb and re-radiate heat (like roofs and pavements), as well as a lack of vegetation, particularly trees. The UHI effect causes people in cities to have higher heat exposure than residents in less densely developed areas. Within urban landscapes, neighborhoods with more impermeable and dark colored surfaces, and fewer trees, parks, and water features, have greater heat exposure and heat related risk than urban communities with more green space and reflective surfaces. These differences in development patterns typically correspond with income and demographic disparities across the urban environment UHI will likely compound the impact and risk of extreme heat days and higher average temperatures resulting from climate change. In some locations, the effect could be twice as strong as the impact of global warming (Huang et al. 2019).

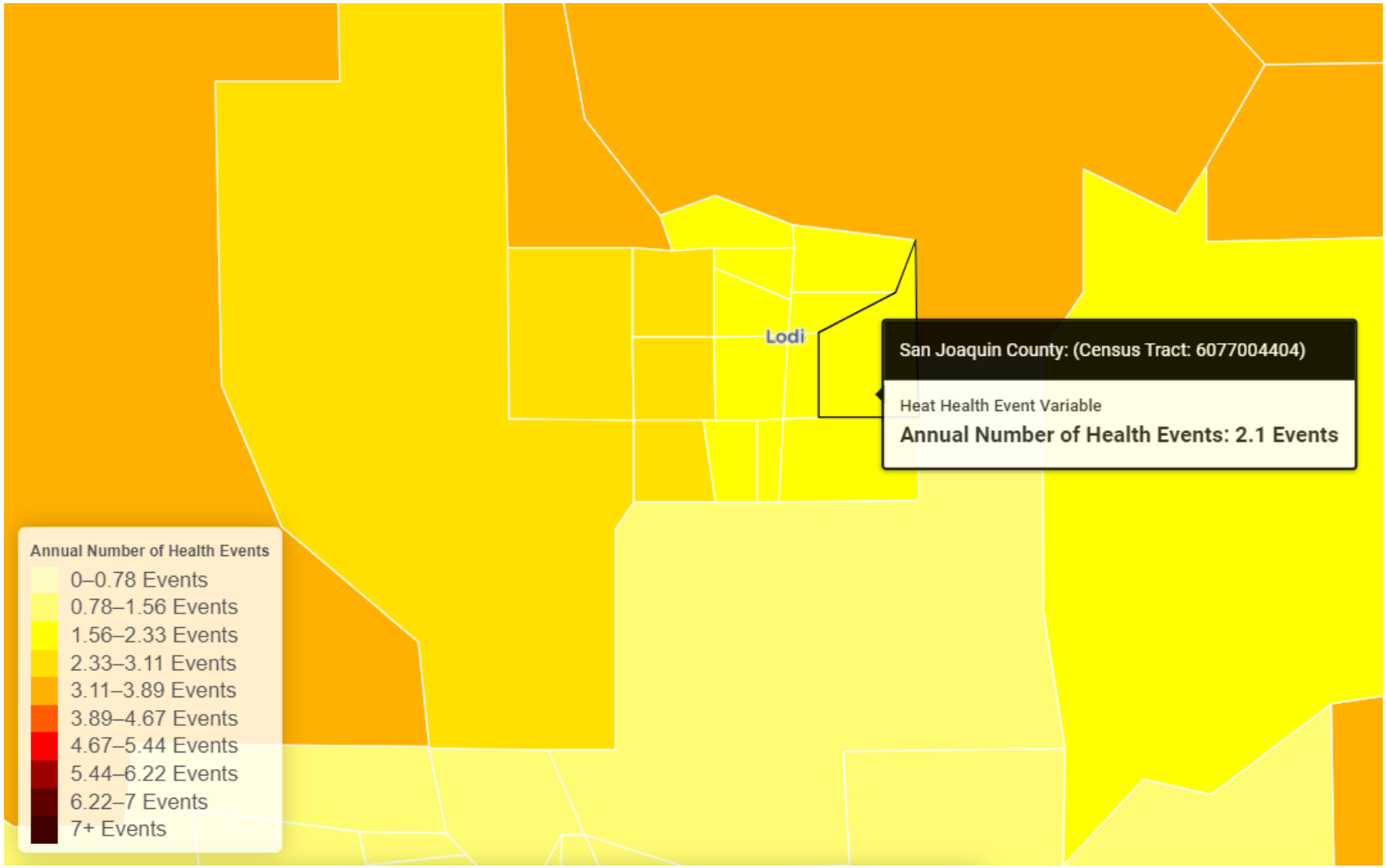
According to the California Heat Assessment Tool (CHAT), under RCP 8.5, Lodi is expected to experience more frequent and longer duration extreme heat health events (HHE), with almost a 700 percent increase in HHE projected frequencies when comparing the historical average of 0.67 HHE annually to the 2081-2099 projection of 4.58 HHE annually (see Figure 4). The census tract selected within Lodi to be representative of multiple land use types is shown below in Figure 5 and corresponds to a disadvantaged community (discussed in more detail in Section 4.1). The highest concentrations of Lodi community members most susceptible to UHI correspond to disadvantaged community census tracts which are in the downtown area and mixed use residential areas (see Figure 9).

Figure 4 Projected Heat Health Events for Higher-risk Populations in a Selected Census Tract in Lodi



Source: California Heat Assessment Tool

Figure 5 Projected Heat Health Events for Higher-risk Populations in a Selected Census Tract in Lodi



Source: California Heat Assessment Tool

EXISTING TREE CANOPY

The number and distribution of trees in cities in the United States, often reflects differences in race and income across city landscapes. While the amount of paved and impermeable surfaces and lack of water features and green spaces can increase the impact of temperature increases from climate change, adding more green spaces and especially trees, can have the opposite effect. Trees provide a number of critical services to cities and residents including shade, improved air quality, increased rain interception and reduced stormwater runoff, and, in great enough numbers, the ability to cool ambient temperatures and reduce the impact of climate change and extreme heat on public health.

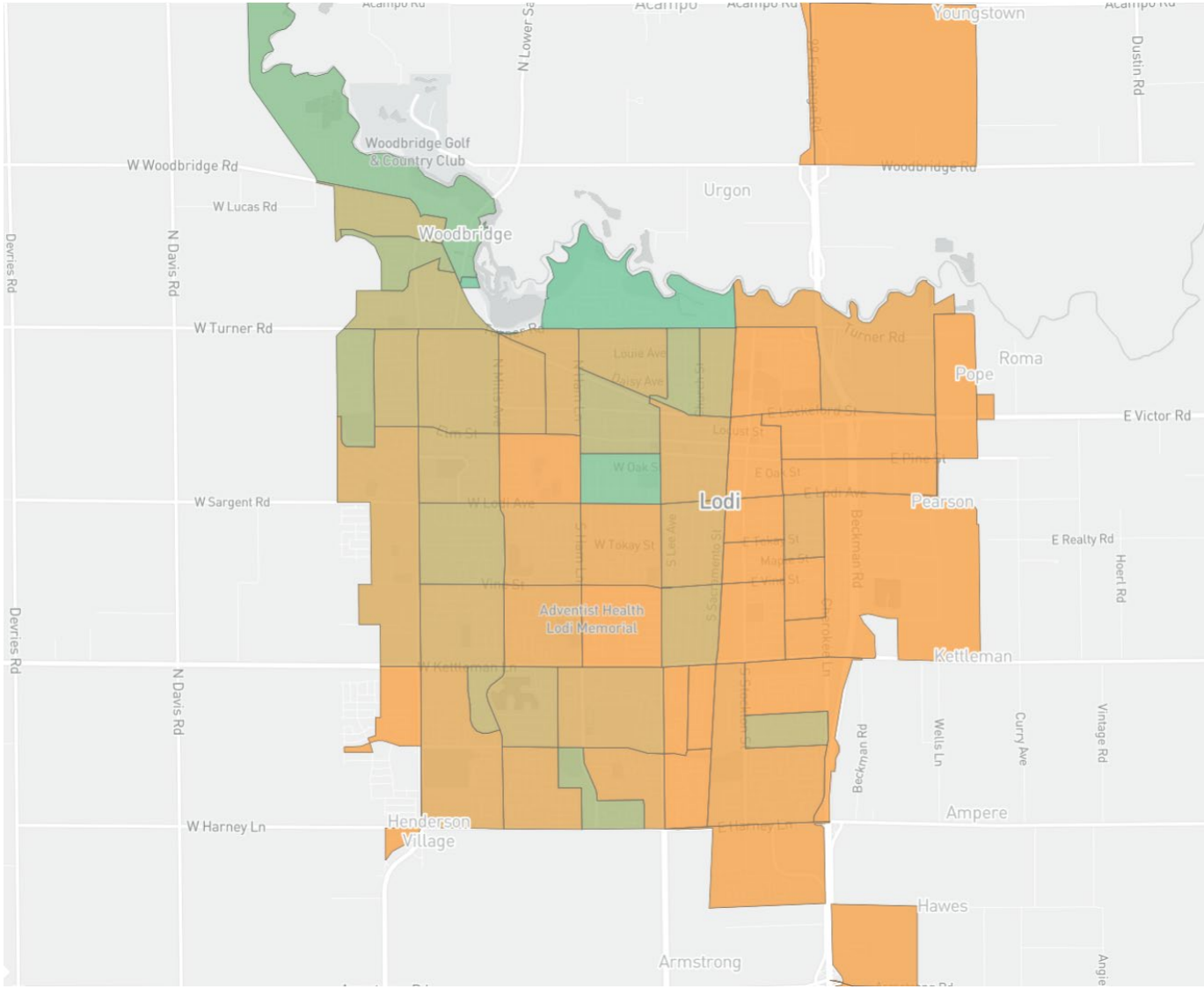
Treeequityscore.org analyzes a range of neighborhood characteristics including the existing tree canopy, population density, income, employment, surface temperature, racial demographics, age distributions, and health metrics to create a single tree equity score between 0 and 100. A score of 100 would indicate that a neighborhood has achieved tree equity.

Of the 51 census block groups included in the Tree Equity Score Municipality Report for Lodi, 24 have a tree equity score below 75. It is estimated that 24,144 trees would need to be planted to get all census blocks to a tree equity score of at least 75. This would increase the total tree canopy of Lodi by 4 percent and result in numerous other benefits including those listed below. The estimated annual service benefits from increasing Lodi's tree canopy by 4.0 percent includes:

- 577,090 tons of sequestered Carbon
- 5.8 million gallons of stormwater runoff avoided
- 7.2 tons of Ozone reduced
- 4,137 pounds of particulate matter pollution reduced (PM 10 and PM2.5)
- 3,369 pounds of other pollutants reduced

The spatial distribution of Tree Equity by census block groups in Lodi can be found below in Figure 6; the gradient indicates dark orange as a 0 and dark green as 100. Much of the City's low tree equity scores can be found across the entire city as identified in Figure 9.

Figure 6 Municipality Tree Equity Score Map for Lodi



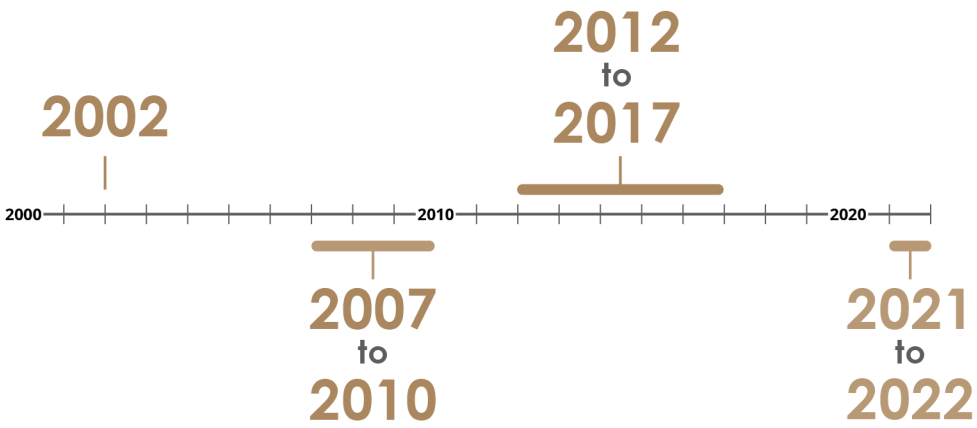
Source: Tree Equity Score Municipality Report for Lodi.

DROUGHT

Past

Over the past two decades, the City of Lodi has experienced more frequent and longer contiguous droughts.

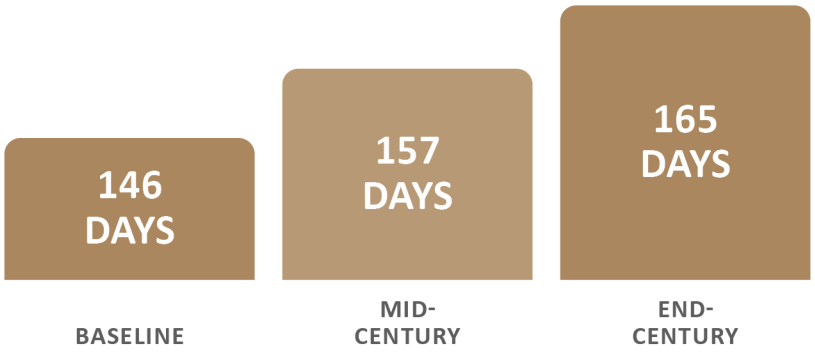
Extreme Drought Events



Present and Future

Lodi is expected to experience increased drought conditions through the end of the century. There is increased likelihood that low precipitation years will coincide with above-average temperature years. The average annual maximum length of dry spell is projected to increase 19 days by the end of the century.

Projected Annual Average Dry Spell Duration



Impacts on the Built and Natural Environment

- Vegetative Stress
- Water Scarcity
- Habitat Loss
- Strained Water System

Impacts on Vulnerable Populations

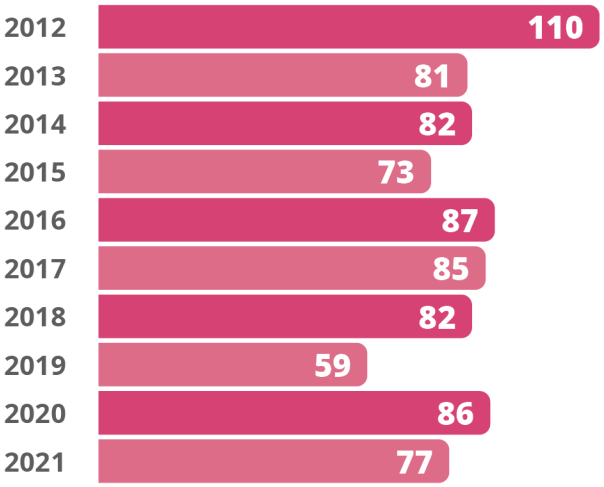
- Food Security
- Air Quality Declines
- Mental and Behavioral Health
- Respiratory Illness
- Income Loss

AIR QUALITY

Past

Historic poor air quality events coincide with regional wildfire events, periods of time without wind, extreme heat events, and extended droughts. Data over the last decade indicates increased days where ozone levels are above the national standard of 0.070 ppm during drought years within the San Joaquin Valley Air Basin.

Days Above Standard Ozone Levels



Present

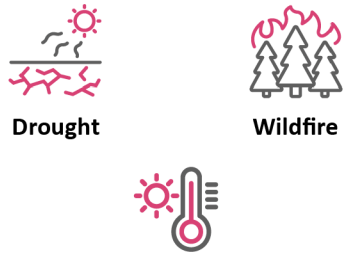
Poor air quality exposure in Lodi is commonly a hazard within the area. The San Joaquin Valley Region including Lodi experiences the second most polluted air in the United States. This poor air quality is a product of the surrounding mountains and inversion layer's geographic and atmospheric influence confining industrial and transit-based pollutants to the air basin. Common types of air quality issues for Lodi include smog and seasonal wildfire smoke.

Types of Air Quality Hazards

Future

Climate Change may lead to a decline in air quality regionally as well as throughout Lodi. Air Quality is expected to worsen in Lodi due to extended droughts, more frequent regional wildfires, increased ambient temperatures, and loss of sporadic natural filtrations of fog and wind.

Hazards Affecting Air Quality



Impacts on the Built and Natural Environment

Impacts on Vulnerable Populations

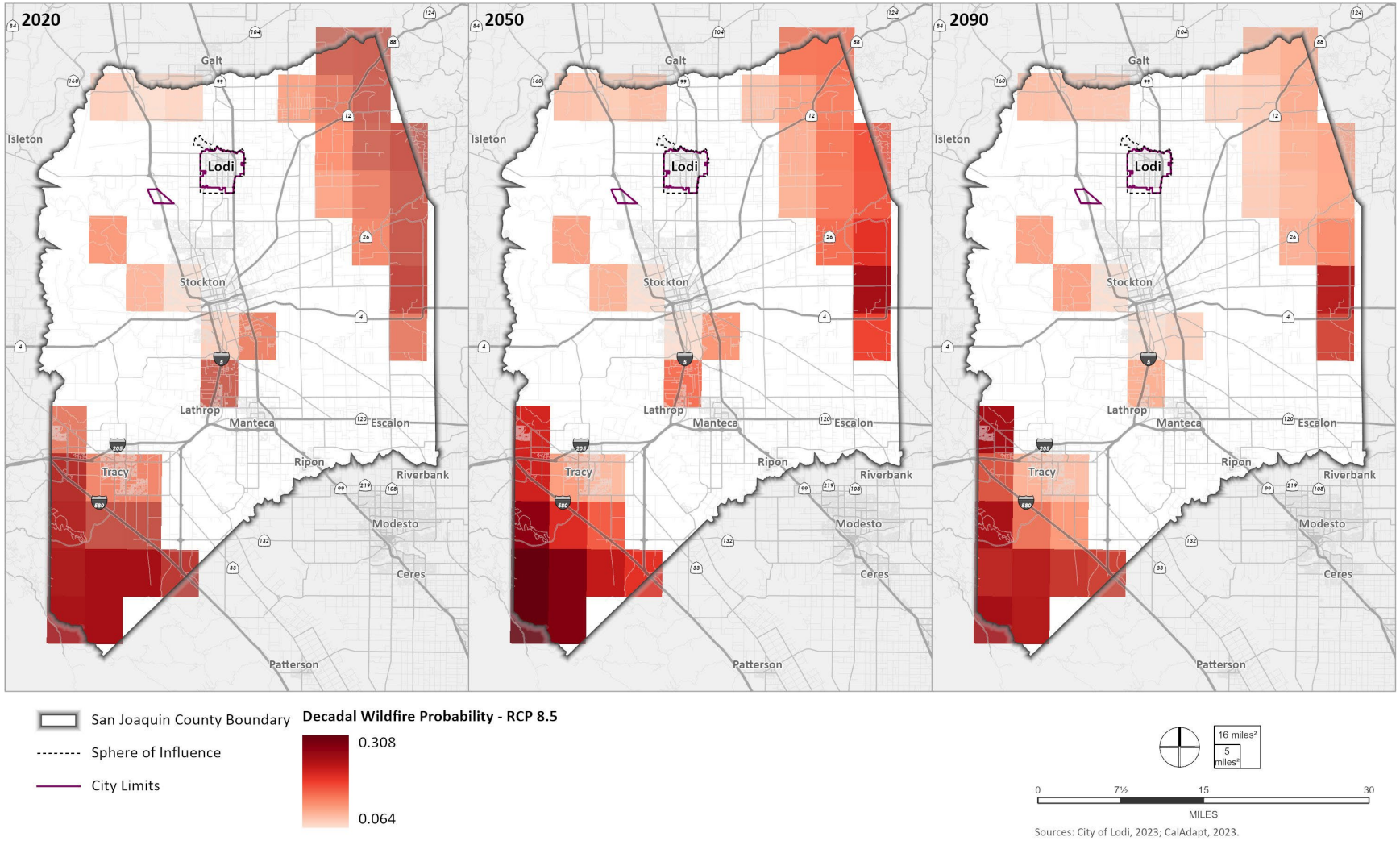
Poor air quality is associated with increased health impacts, most frequently from inhalation of pollutants. Higher temperatures are conducive to air pollution formation, and rising temperatures could therefore result in worsened air quality. Worsening air quality due to climate change can create respiratory issues for sensitive populations and impact indoor environments that do not have adequate air filtration systems. There are several types of air quality decline sources found below:

- **Dust.** Increased temperature leads to dry, dusty conditions also associated with drought (Hall et al. 2018). Increases in dust conditions increases exposure to particulate matter, including PM_{10} (particulates less than 10 microns in diameter). PM_{10} can cause increased respiratory disease, lung damage, cancer, premature death, reduced visibility, surface soiling. These adverse health effects have been reported primarily in infants, children, and older adults with preexisting heart or lung diseases (CARB 2022).
- **Smog.** Increases in ambient temperature can lead to higher rates of smog also referred to as ozone. Groups most sensitive to O_3 include children, the elderly, people with respiratory disorders, and people who exercise strenuously outdoors (USEPA 2021). Depending on the level of exposure, ozone can cause coughing and a sore or scratch throat; make it more difficult to breathe deeply and vigorously and cause pain when taking a deep breath; inflame and damage the airways; make the lungs more susceptible to infection; and aggravate lung diseases such as asthma, emphysema, and chronic bronchitis. Ground-level ozone specifically will be experienced at higher rates leading to raised cardiovascular and respiratory morbidity and mortality rates (CDPH 2014). Ground-level ozone has also been shown to have particularly disproportionate adverse impacts on populations experiencing homelessness and lower median income (PNAS 2021). Lodi will experience increases in ozone concentrations in parallel to temperature increases.
- **Fewer Natural Filtrations.** Precipitation variability and long periods of dry spells lead to less reliable air quality for the entire region. Moisture in the air can filter pollutants and provide for overall improved conditions. Urban vegetation can directly affect air quality. Trees remove gaseous air pollution. Large healthy trees remove more pollution than younger, smaller trees (USDA Forest Service, 2002). Rising temperatures could increase mortality for large healthy trees which would reduce the ability for urban vegetation to reduce air pollutants, therefore increasing pollutant exposure to sensitive populations. Additionally, the decline in Tule Fog projected for the San Joaquin Valley may exacerbate air quality concerns with a decrease in natural filtrations (Fernandez-Bou et al. 2021)
- **Wildfire Smoke.** Temperature, severe wildfire conditions, and the area burned by wildfires have all increased throughout the state and are expected to continue to increase. Higher temperatures accompanied by an increase in the incidence and extent of large wildfires will lead to increased wildfire smoke and associated toxins and air pollution (Hall et al. 2018). Wildfire smoke is comprised of a mixture of gaseous pollutants, hazardous air pollutants, water vapor, and particle pollution (fine airborne particulate matter – $PM_{2.5}$) with particle pollution being the main component and the principal threat to public health (USEPA 2021). Smoke from wildfires is known to contain a large abundance of $PM_{2.5}$ and are estimated to contribute to approximately 18 percent of the total $PM_{2.5}$ atmospheric emissions in the US (Liu et al. 2016). On days where $PM_{2.5}$ exceeds regulatory standards an average of 71.3 percent of the total $PM_{2.5}$ emissions are attributable to wildfires (Liu 2016). Short-term exposures to $PM_{2.5}$ (up to 24-hours duration) has been associated with premature mortality, increased hospital

admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. These adverse health effects have been reported primarily in infants, children, and older adults with preexisting heart or lung diseases (CARB 2022).

Lodi may experience air quality declines resulting from increased temperature and drought frequency as well as decreased presence of air filtrations like Tule Fog (Fernandez-Bou et al. 2021).Wildfire smoke may augment air quality concerns through the end of the century. The decadal probability of wildfire across San Joaquin County shown below in Figure 7 is expected to increase through 2050 and decrease by 2100 however, statewide, and broader regional wildfire probabilities are expected to increase through 2100 causing increased smoke.

Figure 7 Change in Decadal Wildfire Probability in San Joaquin County



FLOODING

Past

Lodi is at risk from riverine flooding from the Mokelumne River. There have been several flooding events within Lodi typically during the winter months with significant events as recent as October 2021, December 2022, and January 2023.

Regional Historic Flooding has Occurred in Response to:

- Local Geology
- Built Environment
- Geography

Present

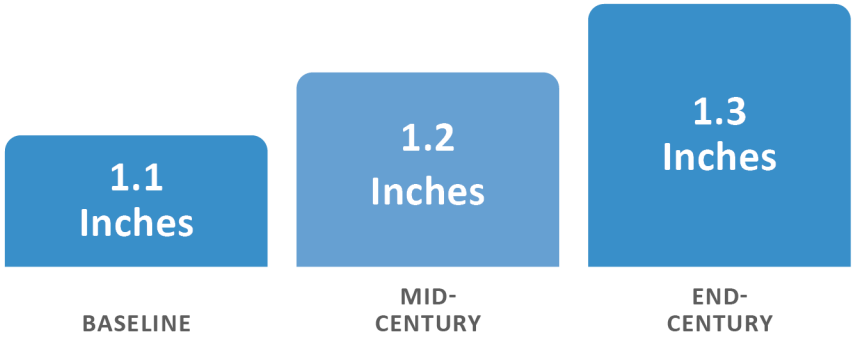
The biggest risk of flooding within the city is associated with the Mokelumne river and failures of the surrounding dams. The entirety of Lodi is located in multiple dam inundation zones and could be inundated should Salt Spring, Camanche, or Lower Bear dams fail. New Woodbridge dam failure will result in flooding in small areas along the Mokelumne River. Almost all of Lodi is presently located in a five hundred year floodplain while areas along the Mokelumne River are located in a one hundred year floodplain.

Future

Climate change may increase the extent and frequency of riverine flooding in Lodi due to increases in precipitation extremes. Storm water systems as well as dams may be overwhelmed from extreme precipitation events should the storm event exceed the capacity of storm water infrastructure.

The frequency of atmospheric river events may increase in the future with some locations experiencing 25-30% increases in the wettest annual day. Per the San Joaquin County MJHMP, the County is highly likely to face repeated flood incidents in the future. Dams may erode from extreme precipitation as well as faster snowmelt jeopardizing dam stability and increasing the risk of catastrophic dam failure.

Maximum One Day Precipitation



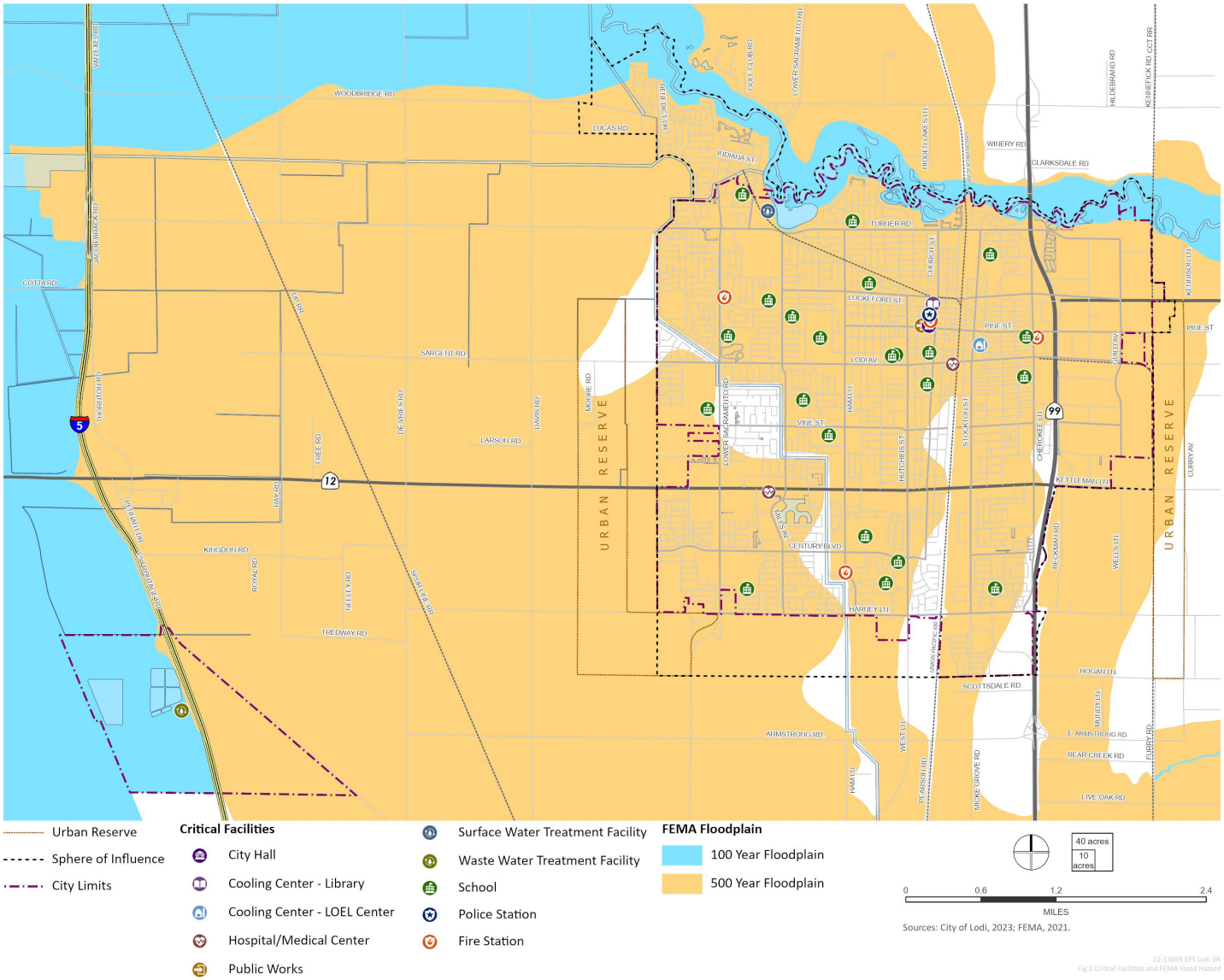
Impacts on the Built and Natural Environment

- Strained Emergency Services
- Stressed Water Drainages
- Property Damage
- Habitat Loss
- Hazardous Materials Leaks

Impacts on Vulnerable Populations

- Public Health and Safety Risks
- Water-borne Disease
- Mental and Behavioral Health
- Income Loss

Figure 8 One-Hundred and Five-Hundred Year Floodplains in Lodi



4 Sensitivity

Populations and assets are affected by climate change depending on their susceptibility to climate hazards. This section identifies Lodi's sensitivities across populations and assets. Asset categories are listed below:

- Sensitive Populations
- Parks and Natural Resources
- Buildings and Infrastructure
- Critical Services

Potential impacts from the climate hazards of concern on vulnerable populations and assets are presented in the Vulnerability Analysis section.

4.1 Vulnerable Populations

While all people in a community will experience climate change, some may be more affected than others. For example, older adults and young children may be more at-risk of heat illness during an extreme heat event. Several factors can influence sensitivity to climate hazards including an individual's health, age,

Relationship to Environmental Justice

Low-income communities along with communities of color are often disproportionately burdened with pollution and its associated health risks. In 2016, the State of California signed Senate Bill 1000 (SB 1000) into law, aiming to address inequitable distribution of pollution and its associated health risks specifically in low-income communities and communities of color. SB 1000 amended Government Code Section 63502, requiring both cities and counties to incorporate Environmental Justice (EJ) policies and programs into their general plan if two or more elements are being updated and/or revised concurrently and if the jurisdiction identifies any disadvantaged communities present within the jurisdiction's planning area boundaries.

The City has undergone a process of identifying disadvantaged communities, which involves social mapping tools such as CalEnviroScreen 4.0 provided by the California Environmental Protection Agency (Cal EPA). Disadvantaged communities are identified below in Figure 9. This process also involves the characterization of the major challenges that Lodi's disadvantaged communities face, such as adverse air quality or water quality caused by industrial activities. In many cases, climate hazards exacerbate pollution burdened communities. These disadvantaged communities are identified as higher risk and therefore vulnerable to the adverse effects of climate change. Through the policy development process, the City may develop strategies and programs to address issues that adversely affect disadvantaged communities.

and ability, inequitable access to health care, economic opportunity, education and other resources, and inequitable exposure to environmental stressors (Cal OES 2020). Vulnerable populations experience heightened risk to climate change and have fewer resources to adapt and recover from climate change impacts. Lodi has several vulnerable populations that will be disproportionately impacted by climate change that are grouped per the categories below and listed in Table 3. Vulnerable populations were grouped based on potential exposure to climate hazards, access to resources to prepare, cope with, or recover from climate hazards, whether individuals face societal disadvantages, or if individuals have heath conditions or health sensitivities that leave them sensitive to climate hazards. Often individuals have characteristics that make them sensitive in a variety of ways; however, for the purpose of this assessment, they were grouped based on the sensitivity that increases their risk to climate change the most. Compounding sensitivities are further explained for each vulnerable population in Section 5.1.

- **Individuals with high outdoor exposure**. People experiencing homelessness and outdoor workers.
- **Under-resourced individuals.** Low income, renters, and households without access to a vehicle.
- **Individuals facing societal barriers.** Communities of color, undocumented immigrants, Native Americans, and linguistically isolated individuals.
- **Individuals with chronic health conditions or health related sensitivities.** Older adults, young children, and people who are differently abled.

Disadvantaged communities identified pursuant to Senate Bill 1000 includes community members that have characteristics that also make them vulnerable to climate hazards. Often, disadvantaged populations have the same systemic barriers vulnerable populations face. For these reasons, the disadvantaged census tracts identified for the City's updated Environmental Justice Element are mapped as areas with higher numbers of populations vulnerable to climate change (see Figure 9).

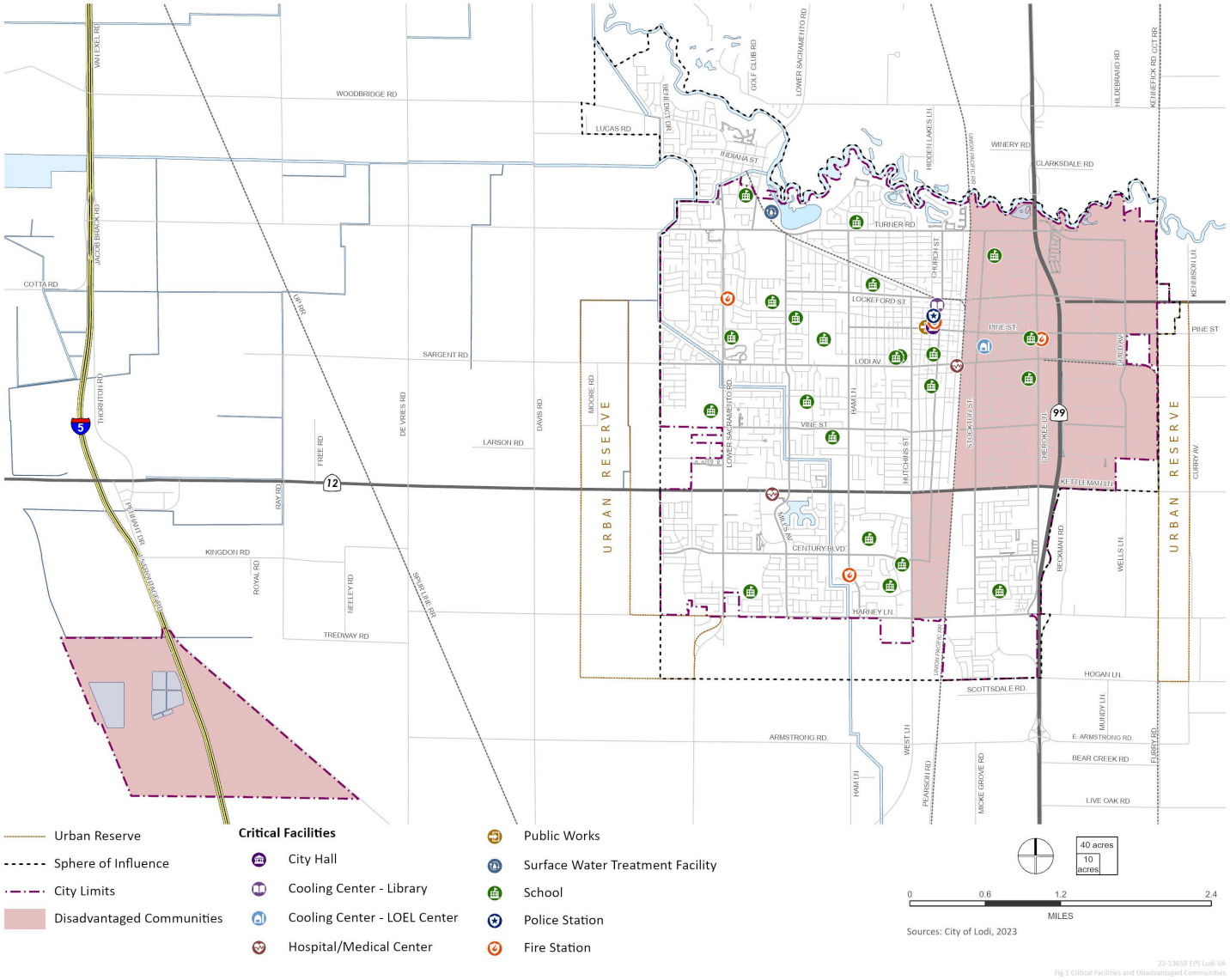
Table 3 Sensitive Population Types in Lodi

Population	Population Description	Lodi Percentage of Population or Households	San Joaquin County Percentage of Population or Households
People experiencing homelessness	Individuals who currently lack fixed, regular, and adequate housing	0.3%	0.3%
Low-income	Households below 80 percent of area median income	38.7%	35.6%
People who are undocumented[1]	Individuals residing in the United States without legal documentation	Not available	6.3%
Older adults	Individuals 65 years or older	13.5%	13.5 %
Young children	Individuals 5 years and younger	7.1 %	6.4 %
People of Color	Individuals that do not identify as white	56.4%	63.3 %
Native Americans	Individuals who identify as American Native and Alaskan Native	1.3%	0.9 %
Outdoor workers	Individuals who are employed, 16 and older, and work outdoors	11.5%	12%
Renters	Housing units that are renter occupied	46.7%	38.7%
Non-English speakers	Households with individuals who are non or limited English-speaking	14.6%	16.7%
Individuals without a bachelor's degree	Percent of people over age 25 without a bachelor's education or higher.	80.8%	81.2%
Individuals with Asthma	Individuals diagnosed with asthma	9.9%	9.6%
Individuals with Cardiovascular Disease	Individuals diagnosed with cardiovascular disease	6.6%	5.9%
Households without a computer	Households without access to a computer	5.8%	3.9%
Households without broadband internet	Households without access to broadband internet	9.9%	9%
Individuals with a disability	Individuals with access and functional needs (physical and mental)	12.1%	12.3%
Isolated Individuals	Households without access to a vehicle	7.2%	4.3%
Individuals in overcrowded households	Household with more than one person per room	7.5%	7.4%
Households experiencing housing burden	Households where over 50 percent of gross household income is spent on housing costs	34.8%	35.2%

Source: The percentages used in this table were acquired from the California Healthy Places Index 3.0 and U.S. Census, 2015-2019 American Community Survey (ACS). Lodi's people experiencing homelessness population was identified based on the San Joaquin 2022 Point-in-Time count.

[1] People who are undocumented percentage includes data for incorporated San Joaquin County and is sourced from the California Immigrant Data Portal.

Figure 9 Lodi Critical Facilities and Disadvantaged Communites



4.2 Parks and Natural Resources

Parks and natural resources within Lodi as detailed in the Parks, Recreation, and Open Space Element of the General Plan include 226 acres of parks, open spaces, and street trees making up the urban forest. These various resources contribute to community resilience in the city. The City currently provides 3.6 acres of parkland space for every 1,000 residents, which is 1.4 acres less than the statewide standard of five acres per 1,000 residents. These resources are distributed throughout the city and face various levels of exposure to climate hazards.

Primary vulnerabilities for parks and natural resources are typically associated with extreme heat and drought related stressors, with impacts such as species mortality and loss of habitat. Compounding climate hazards stresses natural ecosystems past their ability to absorb individual climate hazards, which can cause wildlife to shift towards more favorable habitats, such as parks and open spaces where people recreate (USDA 2020). Parks and recreation areas used by both wildlife and community members may also experience climate hazard stressors creating competing needs for safe habitats for wildlife as well as impacting the ability for community members to recreate.

4.3 Buildings and Infrastructure

Climate change is expected to amplify extreme weather and climate hazards in Lodi. A jurisdiction's vulnerability increases when buildings and facilities are not designed, operated, and/or maintained to function effectively under more extreme weather conditions or can be damaged by more extreme weather conditions. The following City facilities and infrastructure components could be sensitive to climate change: City buildings, educational facilities, hospitals, residential, industrial, and commercial development, roadways and transportation facilities, airfields, communication facilities, fire stations, and police stations. Lodi has multiple sources of water with the City's water distribution system including:

- Twenty-seven existing groundwater wells with a total pumping capacity of 35,200 gallons per minute (gpm).
- A network of water pipes, which includes about 225 miles of pipe ranging in diameter from two to 14 inches.
- Two storage tanks, including a 100,000-gallon elevated tank and a one-million-gallon ground level tank with booster pumping station (Lodi 2010).

This asset category is also used to explain cascading impacts of climate hazards as they affect the ability of the community to receive emergency and essential services. Infrastructure dependencies are explored further in the Vulnerability Analysis section.

The sensitivities presented in this asset category are critical to the city's health, quality of life, safety, security, and economy. Lodi depends on well-functioning roadways, water supplies, and utility infrastructure systems. Climate impacts can increase the costs of keeping critical elements functioning at necessary levels (Cornwall et.al, 2014). Figure 1 displays the locations of critical facilities, buildings, services, and infrastructure across the city.

Within Lodi, there is a variety of infrastructure and critical services that are vulnerable to climate change. Assets within this category include water services, wastewater, storm drainage and flood protection, solid and hazardous waste and recycling, fire services,

emergency services, medical services, utilities and major utility corridors, public transportation, roadways, and active transportation routes. This asset group is sensitive to climate change as the impacts of hazards can affect the ability to provide services and resources; and the infrastructure in place may not be adequately prepared to sustain increasing and compounding hazards.

5 Vulnerability Analysis

Vulnerability is the likelihood of a certain asset or population group to be affected by climate change impacts. In this assessment, it is based on the combination of potential impacts and adaptive capacity. The results of the analysis detail how climate change may impact vulnerable community members, parks and natural resources, buildings and infrastructure, and critical services in Lodi, for which adaptation policies and programs will be developed and implemented to increase community resilience.

The following section outlines the impacts each climate hazard has on populations and assets identified in the Sensitivity section. A detailed summary of the City's adaptive capacity can be found in Appendix A. An impact score and an adaptive capacity score is identified for each asset by climate hazard, along with an overall vulnerability score consistent with the scoring methodology provided in Methodology.

5.1 Vulnerable Populations

Overview

As climate change impacts occur, virtually all populations in a community will be affected; however, some individuals are more sensitive and therefore will be disproportionally impacted depending on the climate hazard and type and magnitude of sensitivity.

As identified in Figure 9, the areas of Lodi with the greatest concentration of disadvantaged communities are areas to the east of the train tracks as well as the census tract to the west of the train tracks south of State Route 12. The census tract containing the White Slough Water Pollution Control Facility is also identified as a disadvantaged community. All disadvantaged census tracts are exposed to potential floods associated with dam failure, extreme heat events, and worsening air quality due to temperature increases or regional wildfire smoke. The census tract associated with the wastewater treatment plant is partially exposed to 1% annual flood events. Extended drought conditions will impact all disadvantaged census tracts should utility rates increase due to limited availability or water conservation methods be put into place.

Individuals with High Outdoor Exposure

- Outdoor workers
- People experiencing homelessness.
- Visitors

Potential Impacts for Individuals with High Outdoor Exposure

Outdoor workers and people experiencing homelessness face high exposure to potential climate hazards. A significant portion of Lodi's local economy is associated with viniculture and agriculture. (Lodi 2010). The significant number of outdoor workers in these sectors face high risk to climate hazards both directly from exposure to hazards and indirectly due to loss of crop yield or interrupted work days due to hazard events affecting their economic livelihood.

Lodi has an estimated 208 people experiencing homelessness in 2022 (Lodi 2022). People experiencing homelessness often suffer from high rates of respiratory conditions, mental illness and other chronic health conditions and therefore are more sensitive to climate hazards (CDPH 2020).

Lodi is also a popular tourist destination with many people visiting the wineries. Visitors are at risk because they may not receive warning during emergency events and are more likely to be unsure of how or where to receive help. Visitor deterrence, which could occur during and following climate hazards, would have a notable negative impact on the local economy (Gamble et al. 2016).

Extreme Heat

Outdoor workers, people experiencing homelessness, and visitors are at risk of health impacts from extreme heat. Outdoor workers are often subject to strenuous work conditions and are vulnerable during extreme heat events. People experiencing homelessness and displaced individuals are exposed to the health-related impacts associated with extreme heat because they have limited access to shelter and air conditioning. The primary health impacts to these populations are heat-related illnesses, such as heat stress, heat stroke, and dehydration, which can be life-threatening (CDPH 2020). Visitors are particularly at risk during extreme heat events because they may not receive local heat warning communications and are less likely to know where to seek refuge.

Drought

Unless there are major water shortages in the City, individuals with high outdoor exposure are most likely not at disproportionate risk to drought.

Air Quality

Outdoor workers and people experiencing homelessness are disproportionally impacted by poor air quality because they are outdoors and are directly exposed to air pollutants for longer periods of time and during hotter parts of the day when levels of ground-level pollutants such as Ozone are higher (CDPH 2017). Outdoor workers and people experiencing homelessness may experience exacerbation or development of respiratory diseases and conditions, such as asthma and chronic obstructive pulmonary disease (COPD), and respiratory infections, which in some cases may be life-threatening (Ramin & Svoboda 2009).

Flooding

Outdoor workers may be exposed to hazardous work conditions during flooding events and therefore are vulnerable to health impacts (CDPH 2020). People experiencing homelessness are disproportionately at risk to health impacts during flood events because they often live in flood hazard areas and do not have access to transportation to evacuate inundated areas. They may also have their personal belongings destroyed or damaged during a flood event (Ramin & Svoboda 2009). Impacts of flooding are likely to result in minimal impact to visitors as trails and parks are often closed to visitors from elevated riverine water levels (Gamble et. al 2016).

Under-resourced Individuals

- Low-income
- Households without a computer
- Households without a broadband internet
- Renters
- Individuals without a bachelor's degree
- Single female heads of household
- Individuals in overcrowded housing
- Households experiencing housing burden.

Under-resourced individuals have fewer resources with which to prepare for, cope with, and recover from climate change impacts. Individuals who are unemployed or are low-income often face financial barriers when preparing for and recovering from climate change hazards. Individuals in these groups often live in homes that are less protected against climate hazards. Under-resourced individuals often lack the financial resources to evacuate from a climate hazard and/or find an affordable place to evacuate to.

Low-income individuals may not be able to take time off work to address health concerns either caused by or exacerbated by climate hazards.

Per the US Department of Housing and Urban Development, the Lodi community experiences vulnerabilities with geographic disparities. The eastern side of the city experiences lower resources and higher rates of segregation and poverty. Additionally, the census tracts to the east of the city report higher rates of overcrowded housing.

Single female heads of households, as defined by the U.S. Census as female householders with children under 18-years-old and no spouse/partner present, often face high levels of work-life conflict and financial hardship, which can make preparing for, coping with, and recovering from climate hazards difficult. They are also more likely to serve as the primary caretaker of children which can make evacuating during a hazard scenario difficult (Flanagan et al. 2011). Additionally, women's wages tend to be lower than their male counterparts. According to U.S. Census Bureau data, in 2020, women earned 84 percent of what men earned (Pew Research Center 2021).

Individuals with educational attainment of less than four years of high school usually have lower earning potential than those with a four-year school degree. These individuals are more likely to work in outdoor and/or labor-intensive environments (CDPH 2017). Individuals with four-year highs school degrees are half as likely to be unemployed than those who only have a high school degree (Association of Public and Land-Grant Universities N.d). Individuals in this group are less likely to have access to transportation, healthcare, and other basic needs.

Households without a computer or broadband internet may be less likely to receive emergency alerts or governmental guidance before or during a climate hazard event, making them particularly vulnerable in evacuation scenarios. Individuals without health insurance are more likely to have undiagnosed pre-existing health conditions which may make them more vulnerable to health impacts from climate hazards (Gamble et al. 2016).

Individuals who rent housing have limited ability to weatherize their homes for hazard events. Mobile homes households also often do not have adequately weatherized homes. They also may not have temperature control in their housing units and generally experience a higher water and energy utilities cost burden than homeowners (Cooley et al. 2012).

Households experiencing housing burden spend a significant amount of their annual gross income (50 percent or greater) on the costs of housing. Individuals with overcrowded housing are more likely to face health and safety concerns. U.S. Census defines an overcrowded unit as one occupied by 1.01 persons or more persons per room. Individuals in these groups are more likely to face financial barriers when preparing for and recovering from climate hazards (CA Department of Housing and Community Development 2022).

Potential Impacts for Under-resourced Individuals

Extreme Heat and Warm Nights

Under-resourced individuals may not be able to pay for adequate air conditioning or fans, increasing their exposure to extreme heat. Isolated individuals don't have access to a vehicle to travel to cooling centers or move to temporary shelters during an extreme heat event (Cooley et al. 2012). Under-resourced individuals are less likely to receive alerts without broadband and computer access or medical care for illnesses triggered or exacerbated by extreme heat. Households without a computer or broadband internet may not receive heat advisory warnings or governmental guidance, causing them to experience health impacts from extreme heat exposure (CDPH 2017). Households experiencing housing burden may face greater health impacts from extreme heat events. Renters and low-income households may have less control of their living environment because they lack resources to weatherize their homes.

Drought

During periods of prolonged drought, under-resourced individuals are more likely to experience the cost burden associated with increased water rates (Feinstein et al. 2017). These individuals may struggle to access clean and affordable drinking water which may cause financial strain (Gamble et al. 2016). Droughts often trigger cascading economic impacts through the agricultural sector, decreasing job availability and leaving low-income individuals particularly vulnerable to financial hardships (Howitt et al. 2015). Single-female heads of household are vulnerable to increased water rates as the primary source of income earning a proportionally lower income than dual parent or single male heads of households.

Air Quality

Under-resourced individuals may be disproportionally impacted by poor air quality because they are more likely to live in housing without high quality insulation and lacking sufficient air filtration, and they may not be able to afford supplemental air filtration equipment (Gamble & Balbuls 2016). Individuals in these groups may experience the development or exacerbation of respiratory illnesses and are less likely to receive medical treatment (CDPH 2017).

Flooding

Under-resourced individuals may experience injuries or death from high velocity flooding and are less likely to receive medical treatment (CDPH 2017). Individuals in these groups may experience cost burdens if their belongings and homes are damaged from floodwater inundation. Individuals without access to a vehicle are vulnerable during flooding because they may not have access to transportation to evacuate. Households without a computer or internet may not receive communications and emergency alerts to safely evacuate from hazard areas (CDPH 2020). Renters have limited control over home improvements that may protect against flood damage. Individuals living in mobile homes may also face disproportionate risk if their homes are not adequately hardened and weatherized. Subsequently, they may experience economic and health impacts and a greater loss of belongings than homeowners (Gamble et al. 2016).

Individuals Facing Societal Barriers

- People of Color
- Linguistically isolated
- Undocumented immigrants
- Native Americans

Individuals facing societal barriers are those that are directly impacted by the social and economic challenges that are ubiquitous in society. These challenges create educational, resource, economic, and health disparities that leave people of color extremely vulnerable to climate change impacts (Baird 2008). People of color are more likely to live in high-hazard risk areas and less likely to be homeowners, which leaves them vulnerable to climate hazards. In the city, many of these individuals face compounding risks associated with linguistical isolated and income barriers. Undocumented immigrants often lack access to medical services, quality housing, and basic needs. Because these individuals are not citizens, they lack access to social and economic services that would allow them to prepare for, respond to, and cope with climate hazards. Individuals who are linguistically isolated have no or limited English-speaking ability. If evacuation and/or advisory notices, hazard preparedness material, or governmental guidance is not provided in non-English versions, these individuals may not be able to prepare for, cope with, or recover from a climate hazard (Gamble et al. 2016).

Lodi is located on the ancestral lands of the Miwok tribe. The city has a rich human history that continues to this day. Not all city residents who identify as Native American have ties to tribal communities within Lodi. Most Native Americans experience some degree of the implications of colonial violence, cultural erasure, and social marginalization, and as a result, they are more likely to be under-resourced and low-income (Lynn et al. 2011). In 2020, one in three American Indians across the United States were living in poverty (Northwestern Institute for Policy Research 2020). American Indians have lower health status and life expectancies compared to other populations due to a variety of factors including inadequate education, disproportionate poverty, cultural differences, and discrimination in the delivery or accessibility of health services. American Indians are also less likely to have health insurance, which may limit their ability to seek medical care for injuries or illnesses caused or exacerbated by climate change impacts (Indian Health Services 2019). American Indians are more likely to live in high-hazard risk areas and less likely to be homeowners, which leaves them vulnerable to climate impacts (Gamble et al. 2016). Within the vulnerability analysis, potential impacts to Native American populations are discussed in the context of people of color.

The close relationship some tribal communities have with their surrounding ecosystems and natural resources leaves these populations particularly at risk to climate change impacts because the natural systems their livelihoods may be dependent on are rapidly changing (Baird 2008). Climate change impacts can disrupt traditional ways of life for some tribal communities by threatening the health of local plants, animals, and ecosystems that play a critical role in the maintenance of their cultural traditions, and climate hazards may damage or destroy a tribal community's cultural resources and sacred land (Karuk Tribe Department of Natural Resources 2016).

Potential Impacts for Individuals Facing Societal Barriers

Extreme Heat and Warm Nights

People of color and undocumented immigrants are more likely to live in housing with insufficient protection from extreme heat events and limited or no affordable air conditioning. Linguistically isolated individuals may not to be able to read heat advisory warnings or governmental guidance, potentially causing them to experience greater exposure to extreme heat (Gamble et al. 2016). The primary health impacts to these populations are heat-related illnesses, such as heat stress, heat stroke, and dehydration, which can be life-threatening (CDPH 2020). Undocumented immigrants may not have access to medical services to treat heat-related illnesses. Tribal elders may have limited or reduced mobility, making it difficult for them to seek medical treatment or refuge from extreme heat (California Department of Public Health 2020).

Drought

Unless there are major water shortages in the city, individuals facing societal barriers are not expected to experience direct impact due to drought. However, individuals facing societal barriers may have less access to engaging directly in decision-making processes related to water rate structure changes and may experience the cost burden associated with increased water rates.

Air Quality

People of color and undocumented immigrants are vulnerable to health impacts associated with poor air quality because their housing may lack sufficient air filtration and they may not be able to afford supplemental air filtration equipment (CDPH 2020). Undocumented immigrants are less likely to receive medical treatment for health impacts from poor air quality exposure (Mendez et al. 2020). Linguistically isolated individuals may not be able to read air quality advisory warnings or governmental guidance that are in English, potentially causing them to experience greater exposure to extreme heat (CDPH 2017).

Flooding

People of color and undocumented immigrants are more likely to live in flood hazard areas and in housing with insufficient protection against flooding. Linguistically isolated individuals may not be able to read flood warning or governmental guidance, potentially causing them to experience greater exposure to flooding. Individuals in these groups may face systematic and/or cultural barriers when seeking to access resources needed to safely evacuate hazard areas (Gamble et al. 2016). Individuals in these groups may experience injuries or death from high velocity flooding (CDPH 2017). Undocumented immigrants may not have access to medical services to treat injuries (Mendez et al. 2020).

Individuals with Chronic Health Conditions or Health Related Sensitivities

- Seniors
- Young children
- Individuals with disabilities
- Individuals with asthma
- Individuals with cardiovascular disease
- Military veterans

Individuals with chronic health conditions or health related sensitivities are socially and physiologically vulnerable to climate change impacts and hazards. Seniors and individuals with disabilities

may have limited or reduced mobility, mental function, or communication abilities, making it difficult to evacuate during or prepare for a climate hazard event. They may also have medical needs for electricity which may be impacted during a public safety power shutoff or climate hazard event. Individuals in these groups are more likely to have pre-existing medical conditions or chronic illnesses that may exacerbate the risk of illnesses and medical problems from climate hazards. Individuals with asthma and individuals with cardiovascular disease are more likely to experience health impacts from climate hazards because of pre-existing conditions or diseases. Seniors often face challenges regulating their temperature due to medications or underlying conditions related to age. Young children are socially and physiologically vulnerable to climate hazards. They often have limited understandings of climate hazards and insufficient resources to independently prepare for and safely respond during a climate hazard event. Young children are reliant on their caregivers to ensure their health, safety, and wellbeing. Young children also have vulnerable physical characteristics because they have not fully physiologically developed and are therefore more vulnerable to health effects of climate change impacts (Kenney et al. 2014). Military veterans may have been exposed to a variety of environmental, physical, and chemical stressors during military service which may have caused physiological or psychological health conditions, illnesses, or disabilities that make them particularly vulnerable to climate hazards (Olenick et at. 2015).

Potential Impacts for Individuals with Chronic Health Conditions or Health Related Sensitives

Extreme Heat and Warm Nights

Individuals with chronic health conditions or health related sensitivities are particularly at risk to heat related illnesses during extreme heat events. Individuals with disabilities, seniors, and children may have difficulty affording or accessing air conditioning or traveling to cooling centers during extreme heat events. Extreme heat events can also trigger power outages which are particularly dangerous for individuals who are electricity-dependent, either for their mobility, communication, or medical devices. Extreme heat conditions can exacerbate asthma, cardiovascular disease, certain disabilities, and other respiratory and cardiovascular conditions, potentially causing heat-related illnesses such as heat stress, heat stroke and dehydration, which can be life threatening (CDPH 2020). Young children and seniors are especially at risk of dehydration as their bodies are not able to regulate as well (Kenny et al. 2014). Dehydration may exacerbate underlying health conditions and illnesses.

Drought

Unless there are major water shortages in the city, or the household is entirely reliant on well water, individuals with chronic health conditions or health related sensitivities are not expected to be at disproportionate risk to drought.

Air Quality

Individuals with chronic health conditions or health related sensitivities are at risk of developing or experiencing exacerbated health impacts from poor air quality. Children are especially predisposed to health impacts from poor air quality because their respiratory system has not fully developed yet (CDPH 2020). Older adults are vulnerable to health impacts from poor air quality because they are more likely to have underlying respiratory and/or cardiovascular conditions. Individuals with cardiovascular disease, individuals with asthma, and individuals with

COPD may experience severe health impacts if exposed to poor air quality (USEPA 2022).

Flooding

Seniors and young children are particularly at risk to injury and/or death from high velocity flooding (CDPH 2017). Riverine and stormwater flooding may also limit access to transportation systems, healthcare centers, and emergency response to those that are injured or in need or consistent medical care, such as those with chronic health conditions or illnesses. Young children, older adults, individuals with disabilities, and individuals with chronic health conditions or illnesses may not be able to safely evacuate floodwater hazard areas.

Adaptive Capacity

There are existing plans, policies, and programs in place to help sensitive populations mitigate and adapt to multiple climate hazards.

- **PG&E Medical Baseline Program:** provides eligible customers with a medical need for electricity (for oxygen, dialysis, etc.) with extra notifications (i.e., calls, texts, or door-bell rings) in advance of a public safety power shutoff. Public safety power shutoffs may occur during an extreme heat event (PG&E 2021).
- **PG&E Self-Generation Incentive Program:** pays for all costs associated with procuring battery storage for eligible customers. Medical Baseline Program customers qualify for full benefits of the program (PG&E 2020).
- **Lodi Cooling Centers:** provides cooling centers for city residents during periods of extreme heat and/or poor air quality (Lodi 2023).
- **Lodi Electric Utility Wildfire Mitigation Plan:** Lodi Electric Utility's (LEU) Wildfire Mitigation Plan describes the mitigation activities the utility is taking to reduce risk of power-line ignited wildfires. The Plan describes LEU's efforts around weather monitoring, wildfire-mitigating design and construction, vegetation management, system maintenance and inspections, de-energization, and community outreach and public awareness. (Lodi 2022).
- **Lodi Unified School District Heat Illness Prevention Program:** The Heat Illness Prevention Plan overviews procedures and responsibilities to mitigate heat impacts to students and employees of the Lodi Unified School District. Topics covered include provisions of water, access to shade, identifying and controlling risk factors for heat illnesses, communication, emergency medical services, and training (Lodi Unified School District 2017).
- **Community Rating System:** The Federal Emergency Management Agency's (FEMA) Community Rating System is a voluntary program within the National Flood Insurance Program (NFIP) that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions (FEMA 2023).
- **Lodi Urban Water Management Plan:** The Urban Water Management Plan details water supply sources, historical, and projected water use, and potential future water supplies during normal, single-dry, and multiple-dry years. The Plan describes climate change impacts on water supplies, specifically relating to groundwater levels and snowmelt. Proposed demand management strategies center around metering, water conservation public education and outreach programs, asset

management, and wholesale supplier assistance programs (City of Lodi 2021)

- **City of Lodi Alert Center:** Lodi's Alert Center provides residents who subscribe with alerts for emergency updates (City of Lodi 2023).
- **Pacific Gas & Electric (PG&E) Climate Change Vulnerability Assessment and Resilience Strategies:** The Climate Change Vulnerability Assessment and Resilience Strategies Report evaluates how key climate hazards (i.e., flooding, severe storms, sea level rise, subsidence, drought, wildfires, and extreme temperatures) have the potential to impact PG&E's assets and services, including disadvantaged communities' reliance on the delivery of continuous power, PG&E outlines its approach to engagement, emergency preparedness, and response planning. The Plan acknowledges the need to support disadvantaged communities and preferentially consider disadvantaged communities for grant funding (Pacific Gas & Electric 2016).

Vulnerability Score – Sensitive Populations

Climate Hazard	Impact Score	Adaptive Capacity Score	Vulnerability Score
Extreme Heat	High	Medium	**4-High**
Drought	Low	Medium	**3-Medium**
Air Quality	High	Low	**4-High**
Flooding	High	Medium	**4-High**

5.2 Parks and Natural Resources

Primary vulnerabilities for parks and natural resources are associated with extreme heat and drought related stresses and direct species mortality and loss of habitat. Compounding climate hazards can stress natural ecosystems past their ability to absorb individual climate hazards, which can cause wildlife to shift towards more favorable habitats, such as parks and open spaces where people recreate (USDA 2020). Parks and recreation areas may also experience climate hazard stressors creating competing needs for safe habitats for wildlife. The urban forest can be impacted by climate hazards decreasing the viability of urban green spaces.

Potential Impacts

Extreme Heat and Warm Nights

The impacts from extreme heat and warm nights are similar to impacts experienced by vulnerable populations. Wildlife under these conditions face impacts of heat stress and heat related illness as well as disrupted reproductive cycles, and compounding risks associated with early and extended seasonal temperature increases (Backlund 2008). Because it is seasonally warmer earlier in the year species can emerge early with no food source and potentially face a delayed cold front which increases mortality rates. (Dale, 1997, Hamerlynck 1995, Maclean 2011). Plants are more likely to experience heat stress and drying and species' habitat ranges may shift. Some pests can proliferate more easily with warmer temperatures (Hamerlynck 1995), and some plants and animals ill-suited to the new warmer conditions may suffer increased mortality rates (Fernandez-Bou et al. 2021). Parks and natural resources are highly exposed to extreme heat and warm nights. As described Climate Hazard,, Lodi may experience significant increases in temperature and subsequently extreme heat events. Both mid- and end- of century projections depict dramatic increases in extreme heat days (CEC 2021).

Drought

Drought would likely increase irrigation requirements to adequately maintain landscaping, park facilities, and street trees. However, water use restrictions would potentially prevent asset managers from meeting this increased watering demand, resulting in water-stressed vegetation, increased vegetation mortality, and potentially reducing the quality of and benefits provided by recreational resources such as open spaces and parks and the urban forest.

Drought will disrupt habitats and wildlife abilities to survive from dehydration and reliable food sources. Extended or variable drought conditions affect the amount and duration water is available in ephemeral and permanent waters sources, impacting plants and wildlife dependent on those aquatic resources. Changes in the Mokelumne River's flow rate and potential changes in water temperature may impact river-dependent wildlife and natural resources like flora and fauna.

Air Quality

The direct effects of air quality declines on natural resources and parks relate to plant and wildlife health as increased levels of air pollutants cause stress and mortality. Impacts from air quality can further impact natural resources since air quality declines correspond with other hazards, such as extreme heat, compounding risks. The degradation of plant and wildlife

health could impact the quality of recreational resources such as open spaces and parks. Impacts from air quality can also make outdoor recreational resources dangerous or unhealthy for sensitive groups identified in the Vulnerable Populations section of this analysis.

Flooding

The Mokelumne River and the several dams surrounding Lodi are the main potential sources of flooding that could be exacerbated by changing climate conditions. Along with identified FEMA flood zones in Figure 8 primarily concentrated along the Mokelumne River, there is some direct exposure and expected impacts to parks and natural resources from riverine and stormwater flooding. Flooding impacts are mainly caused by associated erosion and the detrimental effects flooding can have on water quality, especially to aquatic and fish species dependent on water quality for survival (Talbot 2018). Riverine and stormwater flooding will mostly affect sensitive species of plants and wildlife that are not upland based along the River. Other impacts include damage from inundation within storm flooded areas such as habitats, parks, and lands around the river and waterbodies in the city.

Adaptive Capacity

There are existing plans, policies, and programs in place to help alleviate climate impacts on parks and natural resources particularly surrounding wildfire and drought. Many of the existing plans, policies, and programs in place are collaborative efforts at the local level, and it should be noted that many local entities may not have the staff or resources to fully implement strategies.

- **Community Rating System:** The Federal Emergency Management Agency's (FEMA) Community Rating System is a voluntary program within the National Flood Insurance Program (NFIP) that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions (FEMA 2023).
- **San Joaquin County Emergency Operations Plan:** The Plan provides guidance on all phases of an all-hazards emergency management process including preparedness, response, recovery, and mitigation. It outlines the systems and roles of responsible entities, alert and warning systems, public information communications, mutual aid agreements, threat and hazard identification and risk assessment, and preparedness training and exercises. The Plan included information on the relationship between drought and flooding hazards and climate change (San Joaquin County 2022).
- **Lodi Storm Water Management Plan:** The Storm Water Management Plan describes best practices and goals on storm water management, runoff control, and public education and outreach. The Plan describes storm water detention basin operated by the City to control runoff for event to a 100-year storm. The Plan does not describe best practices of considerations on managing storm water impacts from climate change hazards (City of Lodi 2012).
- **Lodi Storm Drain Master Plan:** The Storm Drainage Master Plan outlines design criteria, level of service standards, service demands, alternative facilities plans, and presents recommended plans for providing storm drainage service to the community. The Plan does not include considerations around the impacts of climate change on storm drainage needs (City of Lodi 2012).

Vulnerability Score – Parks and Natural Resources

Climate Hazard	Impact Score	Adaptive Capacity Score	Vulnerability Score
Extreme Heat	High	Low	**High-5**
Drought	Medium	Low	**High-4**
Air Quality	High	Low	**High-5**
Flooding	High	Medium	**High-4**

5.3 Buildings and Infrastructure

Overview

Within Lodi, there is a complex network of facilities and infrastructure vulnerable to climate change. Assets within this category are considered critical facilities and service line infrastructure and include:

- City Hall
- Library/Cooling Center
- Lodi Elderly (LOEL) Center/Cooling Center
- Hospital/Medical Center
- Public Works
- Surface Water Treatment Facility
- School
- Police Station
- Fire Station
- Storm Drainage and Flood Protection
- Solid and Hazardous Waste and Recycling
- Utilities and Major Utility Corridors
- Public Transportation
- Roadways
- Transportation Routes
- Wastewater Treatment Facility

Vulnerabilities to this asset category primarily concern physical exposure and damages related to Climate Hazards affecting operations of critical services.

Potential Impacts

Extreme Heat and Warm Nights

Extreme heat could impact occupants of buildings and facilities that are not adequately weatherized for increased temperatures. Additionally, as temperatures increase, roadways, transportation routes, and railroads are vulnerable to damages through sustained heat such as buckled railroad ties and cracked surfaces (Fernandez-Bou et al. 2021). Additional impacts from extreme heat are associated with increased emergency service calls which could strain health and medical services. Electrical infrastructure could be overwhelmed by demand and result in blackouts or energy providers could conduct power safety shutoffs to avoid impacts to electrical facilities. Power outages have significant cascading impacts on communication networks, water conveyance, and vulnerable populations. The ability for emergency services to fully function during a power outage is unlikely which can place additional strain on services during extreme heat events (Lodi 2010).

Drought

Drought will have minimal impact on the physical structures of buildings and facilities across Lodi. However, drought can impact water reliability and water infrastructure. All emergency services depend on water, particularly firefighters who require adequate water supply for fire suppression. Water providers within the region generally may encounter increased difficulty as drought impacts general service reliability.

Critical facilities are expected to maintain operations during projected droughts while water service providers are expected to encounter obstacles with supply. Drought impacts can create service strain for emergency and medical services. Cracked pavements from drought compounded with extreme heat affect roadways and transportation routes. Wells are expected to be severely depleted in drought conditions through overuse.

Air Quality

The impact of reduced air quality will have a similar effect as extreme heat for buildings and facilities. The ability to filter air will greatly affect the reliant subsystems, services, and populations reliant on buildings and facilities. The direct impact on structures is low.

Higher incidence of unsafe air quality generated by increased smog, dust and pollutants can create general strain on critical services through increased rates of hospitalization and emergency and medical services (CDPH 2020

Flooding

Impervious surfaces can impede the absorption of water and augment flooding in areas of Lodi. The entire city is located within multiple dam inundation zones anticipated to be affected by climate change with a risk of emergency failure brought on by successive atmospheric rivers and prolonged periods of rainfall and flooding exceeding design requirements (San Joaquin County LHMP 2023). There is risk of damage from increased extreme precipitation events including erosion, washouts, dam infrastructure erosion, and sinkholes. Storm drainage and flood protection services for the City may be impacted by these events and potential areas of impact can be found in Figure 8. Storm drainage and flood protection services for the City may be impacted by these events, and flooded roadways may be temporarily impassable, disrupt or delay provision of emergency services, or increase risk to road users. As shown in Figure 8, all City critical facilities are located in the 500-year flood plain while none are located in the 100-year floodplain.

Adaptive Capacity

Several plans and programs are in place to adapt Lodi Buildings and Infrastructure including utility and emergency services reliability. Most capacity can be found around hazards of extreme heat and flooding.

- **Lodi Electric Utility Wildfire Mitigation Plan:** Lodi Electric Utility's (LEU) Wildfire Mitigation Plan describes the mitigation activities the utility is taking to reduce risk of power-line ignited wildfires. The Plan describes LEU's efforts around weather monitoring, wildfire-mitigating design and construction, vegetation management, system maintenance and inspections, de-energization, and community outreach and public awareness. (Lodi 2022).
- **Lodi Public Works Department Short Term Plan for Atmospheric Rivers:** The Lodi Public Work Department Short Term Plan for Atmospheric Rivers outlines specific protocols and actions that the City completes to prepares for, weathers, and recovers from flooding from atmospheric river events. The Plan is an internal document that primarily aims to mitigate flood risk to low-lying and stormwater prone areas of the community (City of Lodi N.d.).
- **Community Rating System:** The Federal Emergency Management Agency's (FEMA) Community Rating System is a voluntary program within the National Flood Insurance Program (NFIP) that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance

premiums are discounted to reflect the reduced flood risk resulting from community actions (FEMA 2023).

- **San Joaquin County Emergency Operations Plan:** The Plan provides guidance on all phases of an all-hazards emergency management process including preparedness, response, recovery, and mitigation. It outlines the systems and roles of responsible entities, alert and warning systems, public information communications, mutual aid agreements, threat and hazard identification and risk assessment, and preparedness training and exercises. The Plan included information on the relationship between drought and flooding hazards and climate change. The Plan outlines specific protocols and needs for sensitive populations including elderly, children, individuals with disabilities, and individuals with limited English proficiency (San Joaquin County 2022).
- **Lodi Storm Water Management Plan:** The Storm Water Management Plan describes best practices and goals on storm water management, runoff control, and public education and outreach. The Plan describes storm water detention basin operated by the City to control runoff for event to a 100-year storm. The Plan does not describe best practices of considerations on managing storm water impacts from climate change hazards (City of Lodi 2012).
- **Lodi Storm Drain Master Plan:** The Storm Drainage Master Plan outlines design criteria, level of service standards, service demands, alternative facilities plans, and presents recommended plans for providing storm drainage service to the community. The Plan does not include considerations around the impacts of climate change on storm drainage needs (City of Lodi 2012).
- **Lodi Urban Water Management Plan:** The Urban Water Management Plan details water supply sources, historical, and projected water use, and potential future water supplies during normal, single-dry, and multiple-dry years. The Plan describes climate change impacts on water supplies, specifically relating to groundwater levels and snowmelt. Proposed demand management strategies center around metering, water conservation public education and outreach programs, asset management, and wholesale supplier assistance programs (City of Lodi 2021)

Vulnerability Score – Buildings and Infrastructure

Climate Hazard	Impact Score	Adaptive Capacity Score	Vulnerability Score
Extreme Heat	High	Low	**High-4**
Drought	High	Medium	**High-4**
Air Quality	Medium	Low	**High-4**
Flooding	High	Medium	**High-4**

6 Conclusion

This report evaluates how climate change may impact vulnerable community members, natural resources, managed resources, critical facilities, buildings, services, and infrastructure in Lodi. The report provides a prioritized list of vulnerable population groups and assets for which adaptation policies and programs should be developed and implemented to increase community resilience.

A complete list of the population groups and asset categories with high-vulnerability scores is provided below along with the following summary points.

- All vulnerable population groups identified are highly vulnerable to extreme heat, air quality, and flooding. Vulnerable populations may experience increased difficulty related to accessibility of resources and disproportionate impacts from climate hazards.
- Parks and Natural resources are highly vulnerable to extreme heat, drought, air quality, and flooding. Vulnerability for natural resources is focused on habitat conversions and damage, mortality, and scarcity of resources for plants and wildlife.
- Buildings and infrastructure are highly vulnerable to all hazards. There are many critical facilities, including fire stations and emergency shelters in the city's flood hazard zones. Infrastructure and dependent populations experience additional cascading impacts around power outages from downed utility lines, power safety shut offs and grid overload. All forms of power outages can affect how services are able to perform their needed functions during a hazard.

Climate Hazard	Impact Score	Adaptive Capacity Score	Vulnerability Score
Vulnerable Populations			
Extreme Heat	High	Medium	**4-High**
Air Quality	High	Low	**4-High**
Flooding	High	Medium	**4-High**
Parks and Natural Resources			
Extreme Heat	High	Low	**High-5**
Drought	Medium	Low	**High-4**
Air Quality	High	Low	**High-5**
Flooding	High	Medium	**High-4**
Buildings and Infrastructure			
Extreme Heat	High	Low	**High-4**
Drought	High	Medium	**High-4**
Air Quality	Medium	Low	**High-4**
Flooding	High	Medium	**High-4**

This assessment establishes a foundation for identifying adaptation policies and programs that can increase resilience in the city. The Lodi Safety Element will include policies and programs to increase the resilience of the population groups and asset categories with the highest vulnerability to climate change.

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Dale, Virginia H. First published: 01 August 1997.Photosynthetic and stomatal responses to high temperature and light in two oaks at the western limit of their range ERIK HAMERLYNCK1,2 and ALAN K. KNAPP1 1 Division of Biology, Kansas State University, Ackert Hall, Manhattan, KS 66506-4901, USA 2 Present address: Department of Biological Sciences, University of Nevada Las Vegas, 4505 Maryland Parkway, Box 454004, Las Vegas, NV 89154-4004, USA Received May 25, 1995

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