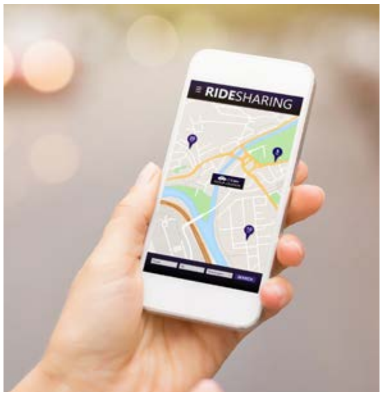
FEBRUARY 2021

CITY OF ELK GROVE

COMMUNITY MOBILITY RESILIENCE PLAN



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City of ELK GROVE

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A diverse group of community members including the City of Elk Grove staff, key stakeholders, and citizens provided knowledge, assistance, and insight through the development process for the Community Mobility Resilience Plan. Thank you to all those who contributed to the process. A special thanks to the community organizations and agencies that participate in the set of working groups that were established as part of the planning process. See below for a full list of participating organizations and agencies.

Participating Working Group Organizations and Agencies

- California Department of Water Resources
- California Department of Transportation
- City of Elk Grove Economic Development Department
- City of Elk Grove Police Department
- City of Elk Grove Public Works Department
- Elk Grove Chamber of Commerce
- Office of Assemblymember Jim Cooper (9th District)
- Sacramento Area Council of Governments
- Sacramento County Public Health Department
- Sacramento Metropolitan Air Quality Management District
- Sacramento Municipal Utility District
- Sacramento Regional County Sanitation District (Regional San)
- Sacramento Tree Foundation
- Sheldon Community Association
- Stone Lakes National Wildlife Refuge

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COMMUNITY MOBILITY RESILIENCE PLAN

BRIEFING BOOKLET

OVERVIEW OF COMMUNITY MOBILITY RESILIENCE PLAN

The Community Mobility Resilience Plan (Plan) is the City of Elk Grove's (City's) primary climate adaptation planning document. The Plan has been developed both to identify how the City's existing natural hazards will be affected by climate change through the 21st century and to provide a comprehensive set of strategies to mitigate and adapt to these impacts. The Plan focuses on three core areas related to climate change. Two of these focus areas are climate-related hazards: changes in annual temperatures and extreme heat events, and changes in precipitation and flooding. The third focus area is how the global and statewide trends in transportation to reduce greenhouse gas (GHG) emissions (e.g., reduce fuel consumption, vehicle miles traveled (VMT), and single-occupancy vehicle use; increase biking, walking, and public transit use) will affect the City's fiscal health, specifically regarding gas tax and vehicle-related sales tax revenue for the City.

WHY PLAN FOR RESILIENCE?

"Resilience" refers to the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and thrive in the face of chronic stresses and acute shocks (APA 2017). Climate change is already exacerbating hazards that affect the City, causing increased wildfire smoke impacts; more frequent severe storms, as experienced in winter 2016/2017; and, most recently, more frequent and more extreme heat wave events, as seen in summer 2020. These impacts are anticipated to become more frequent and more severe throughout the 21st century, even if global GHG emissions are drastically reduced by midcentury. As a result, climate resilience planning is increasingly important to ensure that the City and its residents are fully prepared for projected impacts and can still prosper in a changing climate.

RESILIENCE PLANNING PROCESS

The Plan was developed using guidance from the *California Adaptation Planning Guide* (Cal OES and CNRA 2012); the *California Adaptation Planning Guide 2.0* (Cal OES 2020); and the Federal Highway Administration's *Vulnerability Assessment and Adaptation Framework*, which provides guidance on assessing the climate vulnerabilities of transportation systems (FHWA 2017). As part of Plan development, the City conducted a series of four outreach activities to gain input on the Plan from community residents and stakeholders: (1) a preliminary public workshop in February 2020 at District56 to introduce the planning process and the vulnerability assessments, (2) an online survey to gain input on a preliminary set of resilience strategies, (3) a set of stakeholder meetings to gain feedback on the draft Plan, and (4) development of an online StoryMap to provide an interactive website for residents to read about key highlights of the Plan and engage in Plan implementation.

FISCAL IMPACTS IN THE FUTURE

The City is home to a large auto mall (i.e., Elk Grove Auto Mall) that attracts customers from around the Sacramento region. Because of the regional draw of the auto mall, vehicle-related sales activity is a major contributor to the City budget in the form of sales taxes. In 2018, 38 percent of the City's general fund revenue was sales tax revenue, and 42 percent of the sales tax revenue came from vehicle-related sales activities. This overreliance on vehicle-related sales tax revenue creates vulnerabilities for City revenue because transportation behavior is projected to change in the future.

Over approximately the last 5 years, there has been a decline in traditional vehicle ownership, and new technologies, including electric vehicles (EVs), ride-hailing applications like Lyft and Uber, autonomous vehicles (AVs), and micromobility (e.g., bike/car-sharing services), have spurred change in how people live and get around in their communities. The current COVID-19 pandemic has forced communities to shelter in place and forced many larger employers to implement work-from-home policies, further affecting vehicle-related sales tax revenue for the City. As a result of the stay-at-home orders in spring 2020, the Sacramento region experienced an approximately 70% decrease in VMT from March through May (SACOG 2020). Although the reductions in VMT are likely temporary and VMT likely will increase to close to pre-pandemic levels, more permanent shifts in telework policies for employers in the region may have long-term impacts on VMT and, in part, vehicle-related sales tax revenue for the City.

The loss in fuel sales related to the COVID-19 pandemic also has resulted in economic impacts on the City. Compared to the fiscal year (FY) 2019-20 final budget, the actual revenues received for FY 2019-20 from gas taxes decreased by $867,421 because of the decline in fuel consumption related to VMT reductions during the COVID-19 pandemic (City of Elk Grove 2020). Although the fiscal impacts are attributable to the COVID-19 pandemic and therefore do not represent a permanent reduction in gas tax revenue, these data illustrate the type of fiscal impacts that are projected to occur in the future because of anticipated permanent changes in transportation behavior.

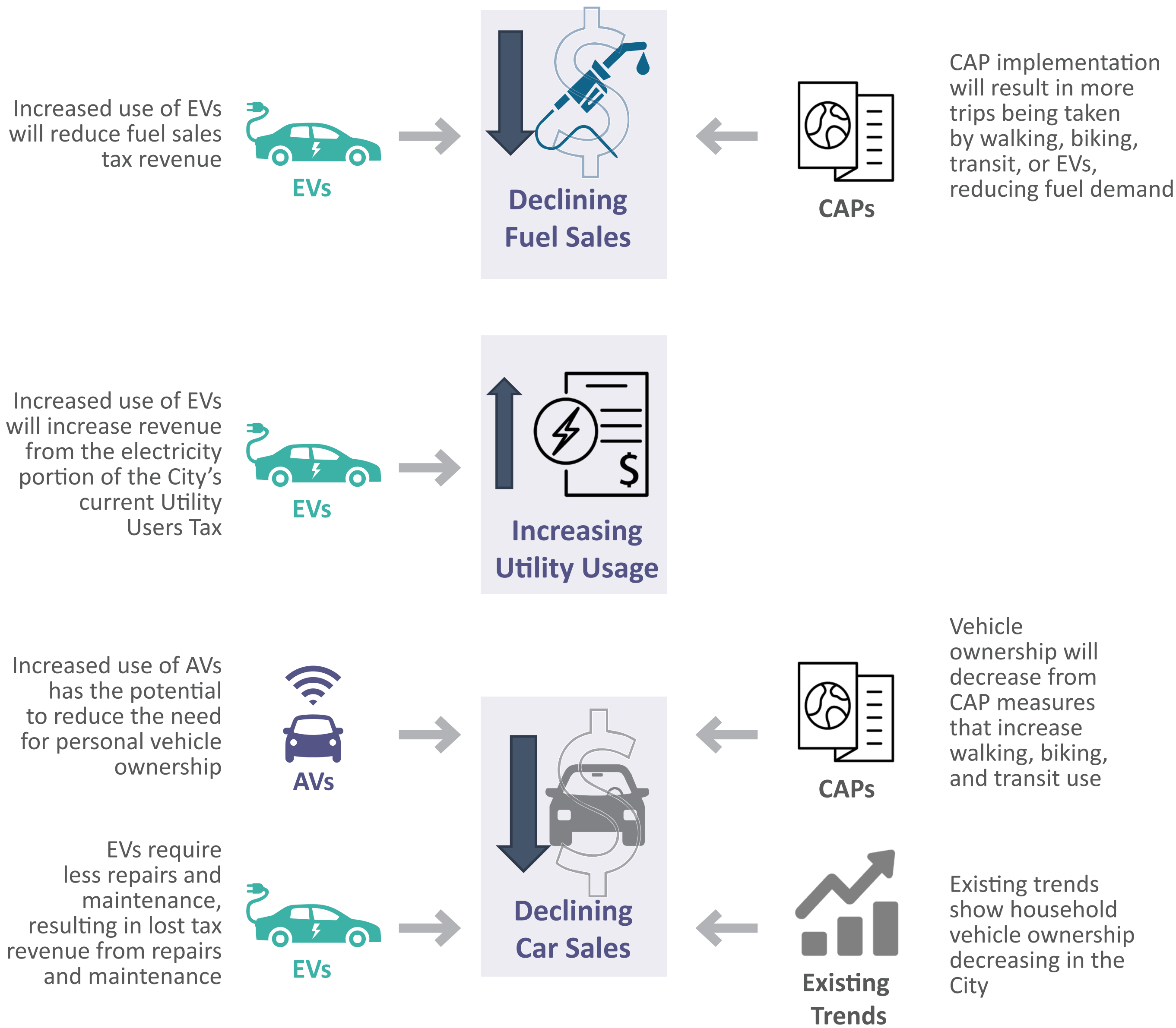
As part of Plan development, scenario modeling was conducted to determine how these recent trends in transportation behavior may affect the City's vehicle-related revenue sources through 2050. Three main revenue streams for the City are likely to be affected by the adoption of EVs and AVs: sales tax, gas tax, and utility users tax. Below are several key findings from the modeling results, which can be seen in detail in the Plan.

KEY FISCAL IMPACTS AND FINDINGS

- EV and AV adoption is anticipated to decrease sales and gas tax revenue but increase utility users tax revenue because electricity use for EVs will increase.
- Population growth, vehicle ownership projections, EV adoption, and AV adoption will affect the projected taxable spending on vehicle purchase and maintenance, which affects sales tax.
- Overall, vehicle-related sales tax revenue for the City is expected to either plateau or reduce slightly over the next 30 years. As the City's population continues to grow, vehicle-related tax revenue per household will decrease from approximately $220 in 2019 to between $150 and $70 by 2050.
- The local and state gas tax represents 30 percent of the operation and maintenance budget for the City's Public Works Department. By 2050, gas tax revenue is projected to be 50–70 percent below current levels, resulting in a sizeable deficit in funding for road maintenance in Elk Grove.

WHAT'S DOWN THE ROAD?

Revenue



Costs

Population growth and potential increases in VMT will result in additional costs for roadway repairs and maintenance

Population growth will result in increased demand for city services

FISCAL RESILIENCE STRATEGIES

The Plan also includes a set of strategies to provide a comprehensive framework for the City to address and mitigate the short- and long-term impacts of changing transportation behavior in the future. Because there are multiple sales tax revenue sources projected to be affected in the future, the strategies are designed to provide a diversified approach to generating new sources of revenue for the City. Together, these strategies provide a framework that, if implemented together, will help the City become more fiscally resilient to both anticipated and unforeseen changes in the future.

A FORWARD-LOOKING TRANSPORTATION SYSTEM

- Reduce Parking Requirements to Match Reduced Vehicle Ownership
- Identify New Revenue Sources Related to Increased EV Ownership
- Advocate for a Statewide Vehicle Miles Traveled Tax and Prepare for Local Impacts

A RESILIENT AND DIVERSIFIED TAX BASE

- Implement General Plan Chapter 5, “Economy and the Region”
- Explore New Tax Offset Policy

EXTREME HEAT IMPACTS IN THE FUTURE

Climate change is already affecting the City's annual average temperature and high temperatures. New record daily high temperatures were set at the Sacramento Executive Airport, the weather station nearest to the City, in August (112°F) and September (109°F) 2020 (NOAA 2020). The previous record for August (110°F) was set in 1996, and the previous record for September (108°F) was set in 1950 (Sacramento County 2017). Heat impacts such as those experienced in summer 2020 are going to become more frequent and more severe as the impacts of climate change increase, affecting the City's transportation system, vulnerable populations, and community functions.

As shown in Table ES-1, between 2020 and 2050, the City is projected to experience a significant increase in the number of extreme heat days and extreme heat events. These increases in extreme heat are anticipated to affect various components of the City, which are highlighted below.

Table ES-1: Changes in Annual Extreme Heat Days and Heat Wave Events (Historic to 2099) – High-Emissions Scenario

EXTREME HEAT INDICATOR	EXTREME HEAT DAYS AND HEAT WAVE EVENTS			
	HISTORIC (1961–1990)	NEAR TERM (2020–2050)	MIDTERM (2040–2070)	LONG TERM (2070–2099)
Number of annual extreme heat days (daily max temp of 103.1°F)	4 DAYS	15 DAYS	24 DAYS	40 DAYS
Annual heat wave event frequency (4+ consecutive days above 103.1°F)	0.2 HEAT WAVE EVENTS	1.6 HEAT WAVE EVENTS	3.1 HEAT WAVE EVENTS	5.8 HEAT WAVE EVENTS
Average heat wave duration (days)	2 DAYS	5.3 DAYS	7 DAYS	11.1 DAYS

Notes: extreme heat day = day with a daily maximum temperature of 103.1°F; heat wave event = 4 consecutive days above 103.1°F.
Source: CEC 2019a

KEY HEAT IMPACTS AND FINDINGS

- During periods of extreme heat, rail lines can expand and come out of alignment. This loss of alignment, termed “buckling,“ can cause serious safety issues, including train derailment. As the number of extreme heat days increases, the City will experience increased risk from rail buckling on days when the daily temperature is 111°F or above.
- An increase in the number of days with a maximum temperature over 100°F will place increased stress on buses and their air conditioning systems, as well as result in potential declines in bus ridership because of discomfort.
- Extreme heat will cause roadway rutting, affecting pavement performance, particularly on high-volume roadways in the City, such as Laguna Boulevard and Elk Grove Boulevard.
- Specific populations in the City are particularly vulnerable to heat and extreme heat events. For example, residents over the age of 65, children under 5 years old, unhoused residents and residents with cardiovascular diseases or asthma are at greater risk from the heat (CDPH 2017). By 2035, the City is projected to experience six heat health events per year for vulnerable populations in the City, resulting in increased emergency room visits and increased demand on emergency services during these events.
- Although the City is not at risk from the direct impacts of wildfires, the City’s location in the Sacramento Valley makes it susceptible to impacts of smoke from wildfires in the coastal mountain ranges of northern California. Increased annual average temperatures and the subsequent increase in the frequency and severity of wildfires in northern California are anticipated to result in impacts from wildfire smoke on the City’s population and on vulnerable populations in particular (OPR et al. 2018).

Certain land use patterns in the City are contributing to the urban heat island (UHI) effect under existing conditions. Impacts from increases in annual average temperatures and in the frequency and severity of extreme heat events will be exacerbated by the UHI effect and may disproportionately affect populations in the City that are near UHI hot spots. Populations near commercial and industrial land uses, as well as other large impervious surfaces, are at a higher risk from the impacts of the UHI effect, including increased energy demand for cooling, potential decreases in air quality, and increased minimum temperatures during nighttime hours.

FLOODING IMPACTS IN THE FUTURE

Because of changes in climate, shifts in precipitation patterns in northern California are anticipated to directly affect the Sacramento Valley region and affect adjacent regional watersheds, also affecting the Sacramento Valley (OPR et al. 2018). Projected shifts include increases in the intensity of large storm events, which could compromise the performance of the Sacramento Valley and Central Valley flood management systems (Pierce et al. 2018). Because of California's location next to the Pacific Ocean, the state is exposed to the atmospheric river (AR) phenomenon, a narrow corridor of concentrated moisture in the atmosphere. The presence of the AR contributes to the frequency of "wet years" in the state, when there is an above-average number of AR storms and above-average annual precipitation. The most severe flooding impacts are caused by persistent storm sequences on subseasonal timescales (i.e., short time periods, typically 2 weeks to 3 months), which bring a significant fraction of annual average precipitation over a brief period. These storm events are similar to the Great Flood events of 1861–1862, which caused widespread damage throughout northern California (Swain et al. 2016). It is estimated that a storm similar in magnitude to the Great Flood events is more likely than not to occur at least once between 2018 and 2060 (Swain et al. 2018). A storm of this size would likely compromise large portions of the flood control systems in the Sacramento and the Central Valleys (Swain et al. 2018). Table ES-2 summarizes the anticipated increase in the 2-, 10-, and 100-year storm events for the four watersheds that intersect with the City through 2099 under a high-emissions scenario.

Table ES-2: Storm Event Changes in Elk Grove Watersheds through 2099 under a High-Emissions Scenario

WATERSHEDS	CHANGE IN 24-HOUR RAINFALL PERIOD (INCHES) FOR 2-, 10-, AND 100-YEAR STORM EVENTS					
	MIDCENTURY (2035–2064)			LATE CENTURY (2070–2099)		
	2-YEAR	10-YEAR	100-YEAR	2-YEAR	10-YEAR	100-YEAR
Morrison Creek	+6%	-5%	-16%	+20%	+22%	+26%
Snodgrass Slough	-2%	+3%	-9%	+28%	+27%	+26%
Upper Cosumnes River	-2%	+6%	+23%	+8%	+17%	+40%
Deer Creek	-3%	-3%	-1%	+11%	+12%	+15%

Note: The midcentury and late century periods have been preset as approximately 30-year average periods in the Cal-Adapt tool. The increase between these two periods is anticipated to be gradual.
Source: CEC 2019b

KEY FLOODING IMPACTS AND FINDINGS

- Future emissions scenarios in which the City's watersheds will experience increases in the intensity of storm events are more likely to have an impact on the City's stormwater management and related systems. Increases in the 2- and 10-year storm events during these periods will likely contribute only to localized flooding impacts with increases in the 100-year storm event leading to more widespread impacts when these events do occur. Key sensitive flood areas in the City under existing conditions will be at increased risks of flooding, particularly for localized flooding impacts.

- Increases in the precipitation and the intensity of storm events in the larger region will increase the City's risk to impacts from larger flood events. The Laguna West-Lakeside and Stonelake neighborhoods, given their location near the Sacramento River and geographic context, are at increased risk of impacts from larger storm events, particularly if the events involve levee breaches along the Sacramento River.

- Key populations in the City that are at increased vulnerability to flooding hazards (e.g., elderly, residents with disabilities, residents with limited mobility options) are at higher levels of risk from the impacts of flooding, as well as, in some cases, the ability to recover from flooding events.

- Most relevant local and regional agencies either have begun to take action or have completed actions to increase their resilience to the impacts of climate change. There are a number of opportunities for collaboration with regional partners and stakeholders to develop and help implement resilience strategies for the City.

- Because the severity of flood impacts is dependent on a number of factors outside the City's control, namely global emission trends, it is important that the City remain engaged with the latest information on the projected impacts of climate change, which will likely change in the future. The analysis provides a baseline of impacts projected to occur that the City can use to develop resilience strategies.

CLIMATE RESILIENCE STRATEGIES

The Plan includes a comprehensive set of strategies that the City can implement to increase the community's resilience to the impacts of climate change. The impacts of climate change on the City are anticipated to exacerbate existing hazards (e.g., flooding, heat waves) and potentially present new and unforeseen challenges for the City and its residents. As a result, the resilience strategies are organized into categories that focus on particular assets or systems in the City and include specific strategies targeted at addressing individual hazard-related issues. The categories are organized to include strategies that mitigate multiple climate-related impacts (e.g., extreme heat, flooding) on that particular asset or system, as well as provide best practices for addressing related unforeseen issues.

A RESILIENT ROADWAY NETWORK AND STORMWATER MANAGEMENT SYSTEM

STRATEGIES FOR HEAT-RELATED IMPACTS

- Upgrade Pavement Design Standards for Extreme Heat
- Assess the Roadway Network's Vulnerability to Long-Term Drought
- Increase Resilience and Redundancy in the City's Truck Routes
- Plan for Alternative Construction Schedules to Avoid Disruptions from Extreme Heat

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

- Create a Climate-Smart Stormwater Management System
- Prevent Roadway Degradation and Increase Local Flood Monitoring
- Support a Coordinated Regional Climate-Smart Flood Management System
- Upgrade the City's Laguna West Levee System to mitigate climate-related flood impacts
- Support Updates to the Regional Flood Warning System

A RESILIENT TRANSPORTATION SYSTEM

STRATEGIES FOR HEAT-RELATED IMPACTS

- Increase the Resilience of the City's Public Transit System
- Establish a Resilient Pedestrian and Bicycle Infrastructure Network
- Increase the Resilience of City Traffic Operations from Extreme Heat

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

- Support a Resilient Rail Network
- Ensure Robust Communication during Flood Events
- Increase the Resilience of City Traffic Operations to Flood Events

A RESILIENT BUILT ENVIRONMENT

STRATEGIES FOR HEAT-RELATED IMPACTS

- Implement a Cool Pavement Road Map for the City
- Implement a Comprehensive and Climate-Smart Green Infrastructure Strategy
- Support a Climate-Smart Building Code
- Support Climate-Smart Parks and Recreation Areas

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

- Create a Comprehensive Climate-Smart Green Infrastructure Plan and Prioritize Sustainable Flood Management That Includes Ecosystem Benefits
- Require Climate-Smart Flood Protection for New Development
- Explore Options for Climate-Smart Permeable Pavements

A CLIMATE-READY COMMUNITY

STRATEGIES FOR HEAT-RELATED IMPACTS

- Protect Vulnerable Populations from Heat-Related Climate Impacts
- Implement Training and Education for Heat-Related Impacts
- Develop a Network of Cool Zones for Heat Wave Events
- Support a Climate-Smart Electricity Grid
- Support Climate-Smart Emergency Services
- Develop a Community-Led Wildfire Smoke Strategy

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

- Develop Neighborhood Readiness Plans and Promote Flood Preparedness Education
- Support Climate-Smart Capital Improvement Projects

SOCIAL AND ECONOMIC RESILIENCE

STRATEGIES FOR HEAT-RELATED IMPACTS AND LARGE STORM EVENTS

- Support Incentives to Shift Energy Demand and Offset Costs for Low-Income Residents
- Support Post-Disaster Recovery Efforts
- Implement and Maintain a Climate-Specific Infrastructure Fund

INTRODUCTION 1

OVERVIEW OF COMMUNITY MOBILITY RESILIENCE PLAN

The Community Mobility Resilience Plan (Plan) is the City of Elk Grove's (City's) primary climate adaptation planning document. The Plan is intended to provide background on the City's current physical hazards (e.g., flooding), projections on how these hazards will be affected by climate change, and a wide-ranging set of strategies to mitigate and adapt to these impacts. The Plan focuses on the City's transportation system and how this key component to the City's daily functions will be affected by climate change. The Plan includes three core areas related to climate change. Two of these core areas are climate-related hazards: (1) changes in annual temperatures and extreme heat events; and (2) changes in precipitation and flooding. The third core area (3) investigates how the global and statewide trends in transportation to reduce greenhouse gas (GHG) emissions (e.g., reduce fuel consumption, vehicle miles traveled [VMT], and single-occupancy vehicle use; increase biking, walking, and public transit use) will affect the City's fiscal health, specifically regarding gas tax and vehicle-related sales tax revenue for the City. Given the specific fiscal issues covered in the third core area, this content is included as a separate, stand-alone document but remains part of the overall Plan. In anticipation of these impacts, the Plan includes an extensive list of strategies that the City can implement to help mitigate the projected fiscal shortfalls from these changes in the mobility landscape, focusing on innovative strategies that are designed to work along with the changing mobility landscape.

Elk Grove Park

PLAN FRAMEWORK

Provided below is the organization of the document and a summary of each chapter in the Plan.

Community Mobility Resilience Plan Briefing Booklet (Executive Summary)

This chapter provides a summary of the Plan, including key findings on the projected climate-related impacts and a summary of the proposed strategies to adapt to these impacts. The chapter follows the general format of the Plan itself and was developed to serve as a stand-alone document to be used for public outreach and to inform decision-makers. This section covers all three core areas.

Introduction – (Chapter 1)

This chapter provides an overview of the Plan framework and a summary of the overall planning process conducted for Plan development.

Mobility and Fiscal Resilience Strategy – (Chapter 2)

This chapter of the Plan serves as a stand-alone strategy document. It focuses on how changes in transportation behavior, emerging transportation technologies (i.e., electric vehicles and autonomous vehicles), and the State's efforts to reduce GHG emissions from the transportation sector (e.g., reduce fuel consumption, VMT, and single-occupancy-vehicle use while promoting zero-emission vehicles) will affect the City's fiscal health, specifically regarding vehicle-related sales tax and gas tax revenue for the City. This chapter focuses on examining potential losses in vehicle-related sales tax and gas tax revenue for the City and provides strategies for the City to adapt to these changes and become more fiscally resilient.

Climate Change Strategy – (Chapter 3)

This chapter includes a discussion of the projected impacts of climate change on the City, as well as a set of strategies to mitigate these impacts. It is organized into the following sections:

- **Climate Change and Elk Grove Today (Section 3.1) –** This section serves as the introduction to the portion of the Plan focused on the impacts of climate change and provides an overview of existing climate-related vulnerabilities in the community, focusing on the two impact areas discussed above. This section also includes an overview of climate change science, the adaptation regulatory framework in California, and why this Plan is important for achieving State and local goals regarding climate adaptation.

- **Climate Impacts on Elk Grove in the Future (Section 3.2) –** This section includes a summary of the climate-related changes anticipated to occur in the City over three time periods over the 21st century: near term (2020–2050), midterm (2040–2070), and long term (2070–2099). This section also includes a discussion of the potential impacts from these changes both on the physical assets in the City and on Elk Grove residents and businesses, particularly the populations most vulnerable to the impacts of climate change.

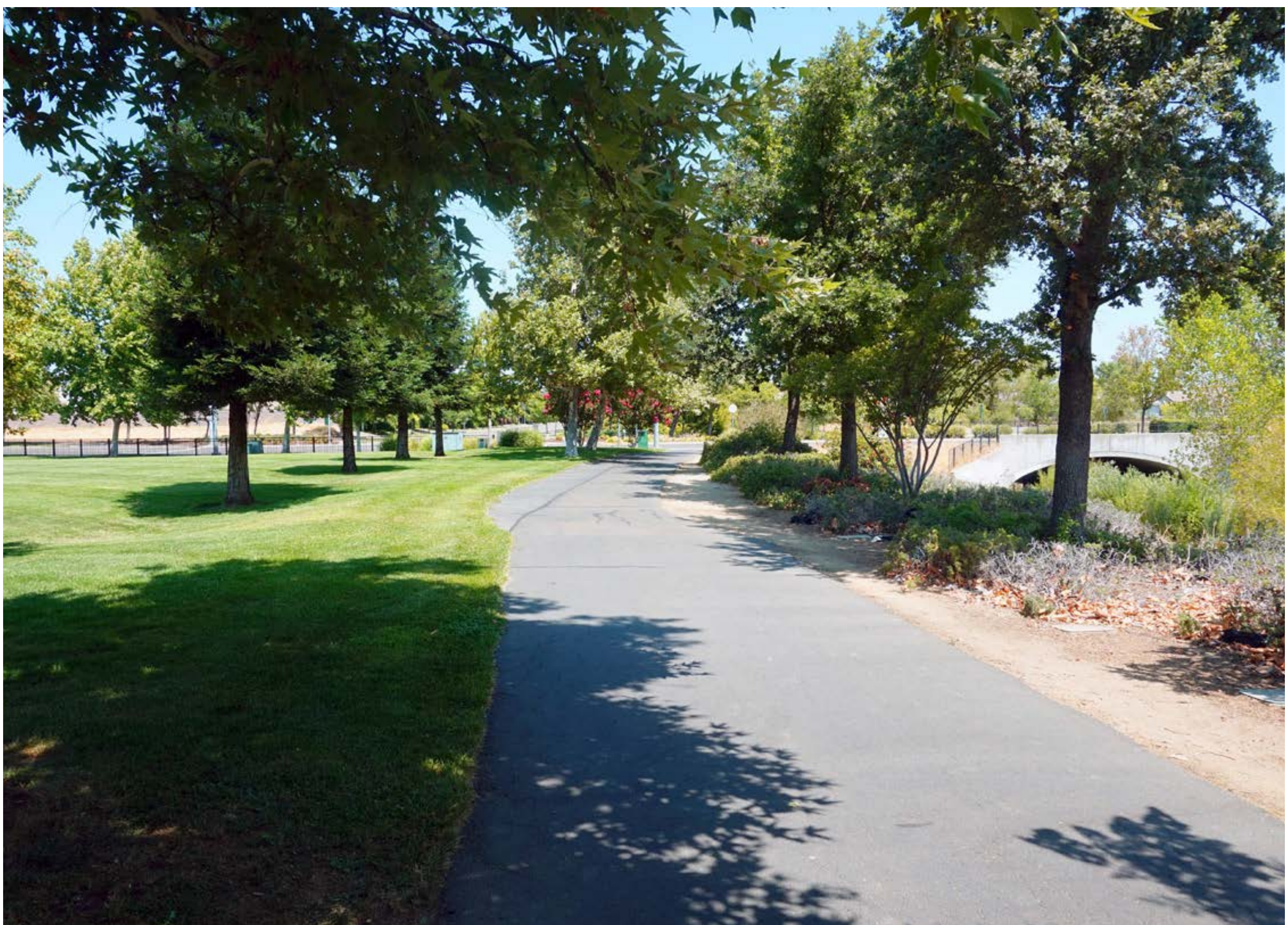
- **Climate Resilience Strategy Matrix (Section 3.3) –** This section includes a comprehensive set of resilience strategy categories and individual strategies intended to help the City mitigate the impacts of climate-related hazards and become more resilient to these changes and a more unpredictable future.

- **Implementation Framework (Section 3.4) –** This section includes a framework for funding and implementing the strategies identified in the previous sections of Chapter 3, including best practices on how these strategies should be integrated into existing City policies and operations while remaining consistent with State adaptation planning guidance. The section is intended to be the implementation tool for the Community Mobility Resilience Task Force, composed of residents, stakeholders, and climate adaptation experts, which will help implement the Plan.

1.1 WHAT IS RESILIENCE?

Resilience planning is increasingly important as the impacts of climate change intensify. "Resilience" refers to the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and thrive in the face of chronic stresses and acute shocks (APA 2017). As has been demonstrated by the recent (2018–2020) catastrophic wildfire seasons, the more frequent severe storms, the prolonged drought periods, and the longer and hotter summer seasons, the effects of climate change are already occurring in California. Planning for how to mitigate and adapt to these impacts is important to ensure that the City is able to respond and continue to prosper. In recent years, the State has increased efforts to support and provide regulatory guidance for local governments as they continue to prepare for the impacts of climate change.

"RESILIENCE" REFERS TO THE CAPACITY OF INDIVIDUALS, COMMUNITIES, INSTITUTIONS, BUSINESSES, AND SYSTEMS TO SURVIVE, ADAPT, AND THRIVE IN THE FACE OF CHRONIC STRESSES AND ACUTE SHOCKS (APA 2017).

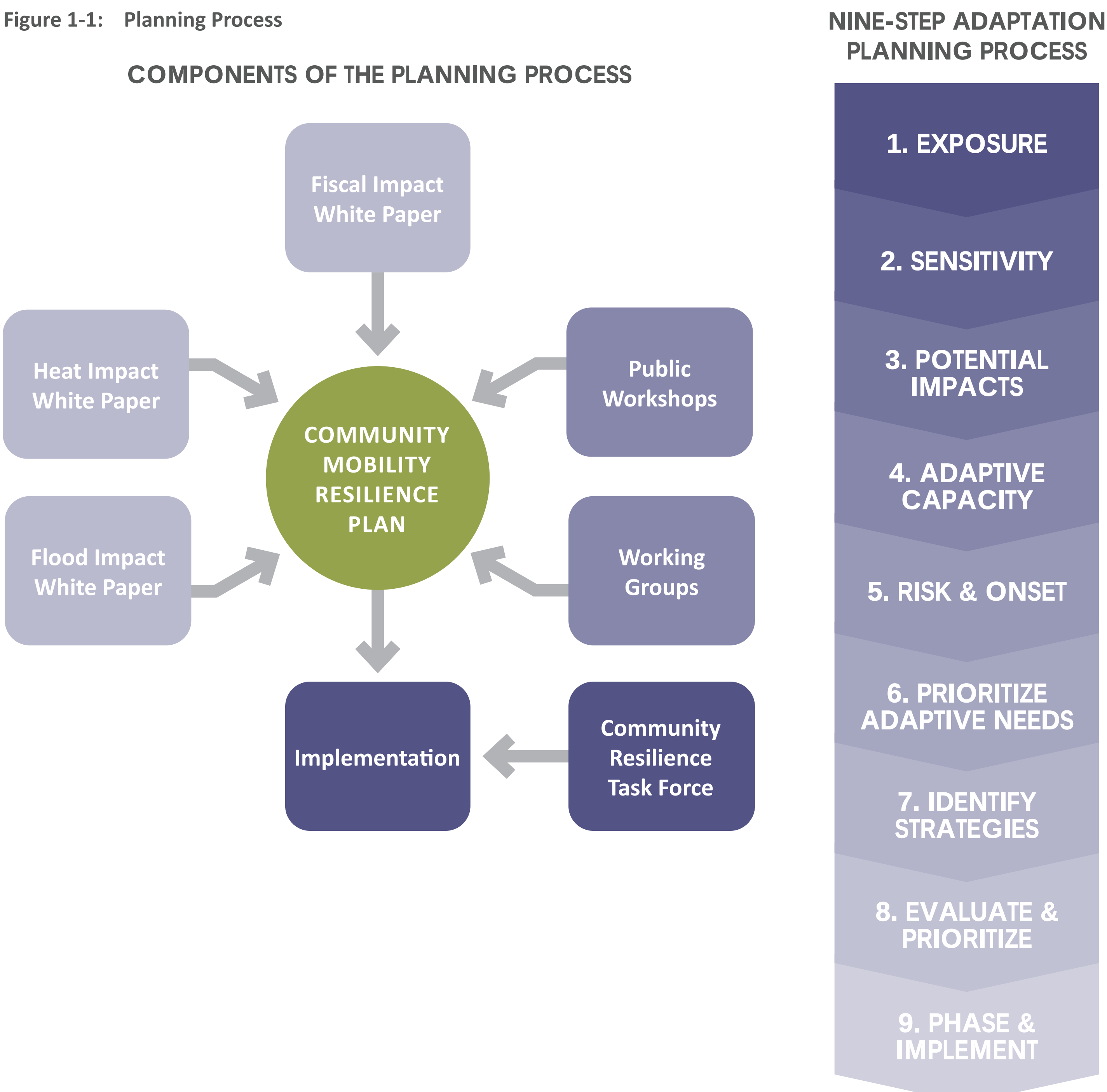


Elk Grove's extensive trails and water

1.2 ADAPTATION PLANNING PROCESS

Development of the Plan was conducted using guidance from the original *California Adaptation Planning Guide* (Cal OES and CNRA 2012); the 2020 update to the *California Adaptation Planning Guide* (Cal OES 2020); and the Federal Highway Administration's *Vulnerability Assessment and Adaptation Framework,* which provides guidance on assessing the climate vulnerabilities of the transportation system (FHWA 2017). The Plan was developed using the nine-step adaptation planning process included in the *California Adaptation Planning Guide* for developing a vulnerability assessment and adaption strategies. The components of the Plan development process and the nine-step planning process are illustrated in Figure 1-1.

Figure 1-1: Planning Process



As shown in Figure 1-1, the nine-step adaptation planning process is organized into two main components. The first five steps make up the vulnerability assessment, which involves (Step 1) describing the climate change effects that a community will experience, (Step 2) summarizing a jurisdiction's current sensitivities, (Step 3) making projections about how certain climate variables (e.g., extreme heat) will change over time because of climate change, (Step 4) describing the community's current ability to adapt to these changes, and (Step 5) identifying what the risk level and timeframe is for each of the anticipated impacts (i.e., when, over a given timeframe, the impact will occur). The culmination of these five steps for this Plan resulted in a set of three white papers focused on the three core areas of the Plan, discussed above. The white papers were published in February 2020 and can be found on the City's website[1].

The last four steps of the nine-step process focus on developing an adaptation strategy, including (Step 6) prioritizing adaptive needs based on the vulnerability assessment, (Step 7) researching and identifying appropriate strategies, (Step 8) evaluating when various strategies should be implemented, and (Step 9) determining how the strategies can be effectively funded and implemented. For a detailed discussion of this process, see the *California Adaptation Planning Guide* (Cal OES and CNRA 2012).

As noted above, in August 2020, the Governor's Office of Emergency Services released an updated version of this guidance document. The development of this Plan began before the release of the 2020 update; therefore, primarily uses guidance from the original *California Adaptation Planning Guide* (Cal OES and CNRA 2012). However, the two primary stages of the adaptation planning process (i.e., the vulnerability assessment and strategy development) are included in the 2020 update. New guidance included in the 2020 update, including guidance specific to community outreach and environmental justice, was integrated into the plan wherever possible.

1.2.1 COMMUNITY OUTREACH AND TECHNICAL WORKING GROUPS

As part of the development plan, the City conducted a series of four outreach activities to gain input on the plan from community residents and stakeholders. Outreach activities included: (1) a preliminary public workshop in February 2020 at District56 to introduce the planning process and the vulnerability passements, (2) an online survey to gain input on a preliminary set of resilience strategies, (3) a set of stakeholder meetings to gain feedback on the draft plan, and (4) the development of an online StoryMap to provide an interactive website for residents to read about key highlights of the plan and engage in plan implementation. The City also established three working groups focused on the three core areas in the Plan discussed above. The workings groups were comprised of City staff, technical experts, representatives from regional and local agencies, and community members and met at key periods in the planning process to provide input on the overall planning process and plan development.

COMMUNITY OUTREACH ACTIVITIES

- **Two public workshops**
- **Three White Papers**
- **Three Technical Working Groups**
- **Online Strategy Survey**
- **Online Interactive StoryMap Website**

1 http://www.elkgrovecity.org/mobilityresilience

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MOBILITY AND FISCAL RESILIENCE STRATEGY 2

STRATEGY OVERVIEW

This Mobility and Fiscal Resilience Strategy has been developed by the City as part of the larger planning process for the Plan. The Plan addresses three core areas related to climate change. Two of these core areas are climate-related hazards: (1) changes in annual temperatures and extreme heat events and (2) changes in precipitation and flooding. The third core area relates to how the State's efforts to reduce greenhouse gas (GHG) emissions (e.g., reduce fuel consumption, vehicle miles traveled [VMT], and single-occupancy-vehicle use) will affect the City's fiscal health, specifically regarding vehicle-related sales tax and gas tax revenue for the City. This chapter focuses on the third portion of the Plan and specifically addresses potential losses in vehicle-related sales tax and gas tax revenue. In preparation for the development of this Plan, a Mobility and Fiscal Resilience white paper was developed and provides an in-depth analysis of this portion of the Plan. The white paper can be found on the City's website[1].

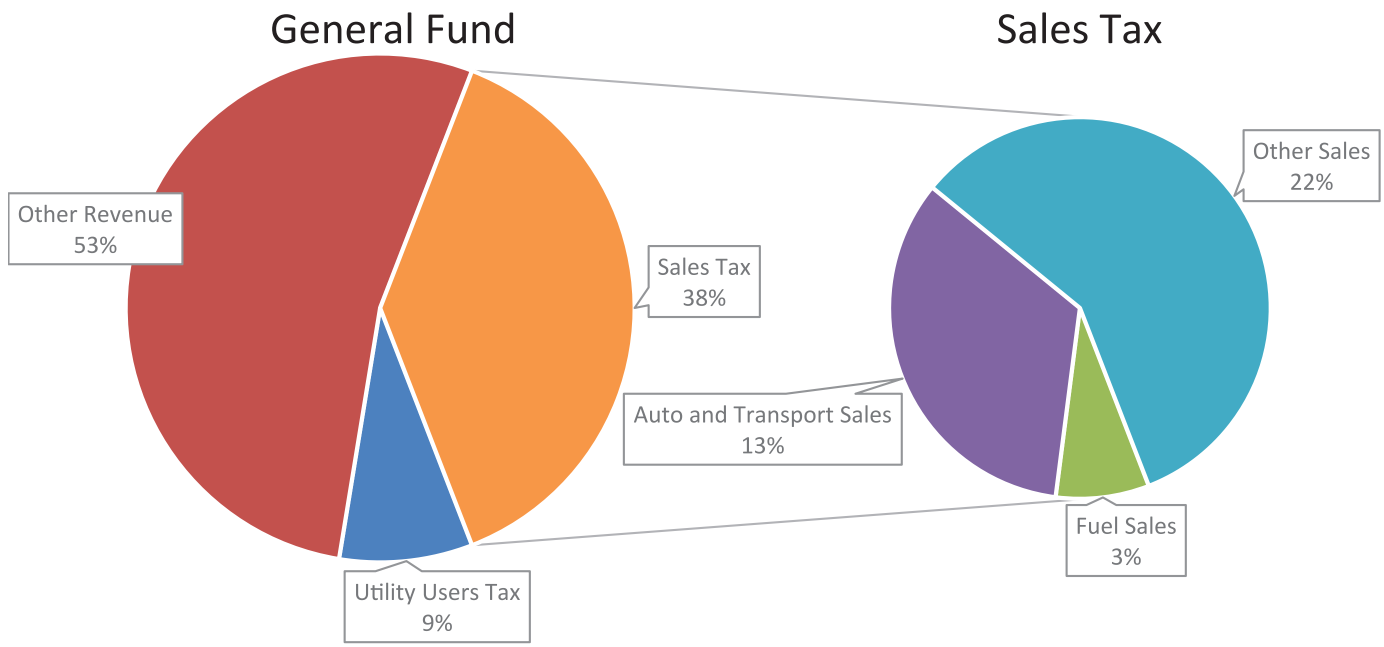
The United States is undergoing a dramatic change in the mobility landscape. Transportation systems in cities have long been designed around single-occupancy-vehicle use by residents and visitors. However, over the last 5 years there has been a decline in traditional vehicle ownership, and new technologies, including electric vehicles (EVs), ride-hailing applications, autonomous vehicles (AVs), and micromobility (e.g., bike/car sharing services), have spurred change in how people live and travel within their communities. This section provides an overview of the City's existing revenue sources that are likely to be affected by these changes.

The City is home to a large auto mall (Elk Grove Auto Mall) that attracts customers from around the Sacramento region. Because of the regional draw of the auto mall, and the fact that the 2019 average new vehicle sales price was approximately $40,000 (Kelley Blue Book 2019), vehicle-related sales activity is a major contributor to the City budget in the form of sales taxes. As shown in Figure 2-1, in 2018, 38 percent of the City's general fund revenue was from sales tax revenue, with 16 percent of the City's total general fund revenue coming from vehicle-related sales activities. (For comparison, 15 percent of the City of Sacramento's general fund revenue came from all general[2] sales tax revenue, including tax revenue from auto sales and all other retail transactions, in the same year.) Vehicle-related sales tax includes revenue from the sale and repair of new and used vehicles in the City, as well as sales tax on fuel purchased in the City. In addition to sales tax on fuel sales, the State imposes an excise tax on fuel sales known as the gas tax, which is collected at the State level and then distributed to municipalities based on their population and road network size, with a small portion of the State's gas tax revenue returning to the City. However, changes in transportation behavior statewide, as discussed, above could affect the amount of gas tax revenue returned to the City.

1 https://www.elkgrovecity.org/city_hall/departments_divisions/city_manager/strategic_planning_and_innovation/community_mobility_resilience_project

2 Sacramento levies an additional sales tax beyond the Statewide base rate of 1 percent for municipal revenue, which is not counted in the 15-percent figure quoted above. For more information, see the City of Sacramento budget: http://www.cityofsacramento.org/-/media/Corporate/Files/Finance/Budget/FY20-Approved_Final.pdf?la=en.

Figure 2-1: Elk Grove General Fund and Sales Tax Revenue Sources in 2018



Source: City of Elk Grove 2019a

SALES TAX

Three main revenue streams for the City are likely to be affected by changes in travel behavior and vehicle ownership trends in the future: sales tax (both general sales tax and restricted Measure A[3] sales tax), gas tax, and utility users tax. Sales tax is the largest of those revenue sources, generating $27 million in revenue for the City in 2018, $11 million of which came from vehicle-related sources.

Sales taxes (both local sales tax and the regional Measure A sales tax) support two main parts of the City's budget: the general fund and the operations and maintenance (O&M) budget for the City Public Works Department (PW). The general fund is the core of the City's budget and is used for expenses such as the cost of emergency services, general administration, and other needs that do not have a dedicated revenue stream (City of Elk Grove 2019a). The PW O&M budget does not receive any general sales tax revenue but receives Measure A revenue, a regional sales tax dedicated specifically for road maintenance and some road-related capital expenditures. The O&M budget is dedicated primarily to keeping roads and other fixed infrastructure, including stormwater drainage systems, in working condition.

GAS TAX

In addition to sales tax on fuel sales, the State imposes an excise tax on fuel sales known as the gas tax. The gas tax is a flat per-gallon fee imposed on gasoline sales, which is adjusted for inflation each year. California's adoption of Senate Bill (SB) 1 in 2017 increased the gas tax and introduced an annual increase to match inflation. This analysis incorporates the new, higher gas tax rate imposed by SB 1[4]. Currently, the total gas tax collected by the State is $0.473 per gallon (California Department of Tax and Fee Administration n.d.). The gas tax is collected at the

3 Measure A is a one-half-percent sales tax in Sacramento County, originally approved by voters in 1988 and renewed by voters in 2004. Measure A funds are reserved for transportation expenses, and although they are controlled by the county transportation authority, some funds are distributed to cities, including Elk Grove. Elk Grove uses its Measure A revenue to fund a significant portion of its road maintenance budget. For more information, see the Sacramento Transportation Authority website: http://www.sacta.org/p_measurea.html.

4 SB 1 raised the gas tax and annual vehicle registration fees, which all go to the State government initially. In addition to the pass-through that comes to the City discussed above, the revenues also fund grant programs, which may mean additional money to the City. However, because grant programs are competitive and unpredictable, they are not included in the model described above. Grants are currently awarded out of a flat annual appropriation that is unlikely to fluctuate with changes in SB 1 revenue. For more information, see https://catc.ca.gov/programs/sb1/local-streets-roads-program.

State level and then distributed to municipalities based on their population and road network size[5]. In 2018, the City received approximately $4 million in State gas tax revenue (City of Elk Grove 2018).

UTILITY USERS TAX

The Elk Grove utility users tax is a 2.25-percent[6] tax on most common household utilities, such as telephone, electricity, gas, sewer, and video services. Revenue from this tax goes into the general fund, currently making up 9 percent of total general fund revenues[7]. EVs consume a significant amount of electricity; therefore, an increase in EV ownership will cause an increase in electricity consumption and a resulting increase in utility users tax revenue.

VMT AND FISCAL IMPACTS OF COVID-19

Starting in March 2020, as a result of the COVID-19 pandemic, Sacramento County has issued a series of stay at home orders to prevent the spread in the County (Sacramento County 2020) and has forced many industries in the region to institute work-from-home policies for their employees. As a result of the stay at home orders in spring of 2020, the Sacramento region experienced an approximately 70-percent decrease in VMT from March through May (SACOG 2020). While the reductions in VMT are likely temporary and will return close to pre-pandemic levels, more permanent shifts to telework policies for employers in the region may have long term impacts on VMT and, in part, vehicle-related sales tax revenue for the City. Many of the estimates regarding reductions in VMT in the future may be experienced sooner than expected and place increased importance on the consideration of the fiscal resilience strategies included in the Plan.

In addition to reductions in VMT in the Sacramento region and the City, the COVID-19 pandemic has resulted in economic impacts on the City from a loss in fuel sales. Compared to the fiscal year (FY) 2019-20 final budget, the actual revenues received for FY 2019-20 from gas taxes decreased by $867,421 due to a decline in fuel consumption attributable to VMT reductions as a result of the COVID-19 pandemic (City of Elk Grove 2020a). As stated above, while the fiscal impacts are likely due to the COVID-19 pandemic and therefore do not represent a permanent reduction in gas tax revenue, these data illustrate the type of fiscal impacts that are projected to occur in the future due to anticipated permanent changes in transportation behavior.

2.1 TRANSPORTATION IN THE FUTURE

It is projected, based on recent trends in transportation behavior in California and globally, as well as the State's efforts to reduce VMT and associated GHG emissions, that vehicle-related revenue sources for the City will continue to decline. This section discusses what changes are likely to occur in the future and what impact these changes may have on transportation behavior and, as a result, revenue for the City. By understanding these trends, the City can better prepare for these changes and reduce anticipated fiscal impacts on the community. For the full details of the financial modeling regarding fiscal impacts on the City, see the Mobility and Fiscal Resilience Strategy White Paper developed for this Plan[8].

2.1.1 HOUSEHOLDS AND VEHICLE OWNERSHIP

The Housing Element in the City's General Plan identifies a projected growth rate of 1.3[9] percent per year (City of Elk Grove 2019b). If growth occurs at that rate, the City will have 78,710 total households in 2050, up from 51,350 in 2017 (U.S. Census Bureau 2017). However, the historical household growth rate in the City between 2005 and 2017 is 2.5 percent per year. If growth occurs at this higher rate, the City could have as many as 115,763 households in 2050, more than double the current number. By 2050, the number of households with no vehicles is projected to

5 The model assumes that trends in Elk Grove gas sales will mimic Statewide gas sale trends and that Elk Grove's share of the State population and road network size will remain roughly the same over time or change proportionately to each other.

6 The tax rate on prepaid wireless services is 1.5 percent. For more information, see http://www.uutinfo.org/uutinfo_city_info/elk_grove/uutinfo_elk_grove.htm.

7 Note that this 9-percent figure includes utility users tax revenue from all utilities, not just electricity.

8 https://www.elkgrovecity.org/UserFiles/Servers/Server_109585/File/Departments/SPI/Resilience/Elk%20Grove%20Mobility%20and%20Fiscal%20Resilience%20White%20Paper%20-%20Public%20Draft.pdf.

9 The annual percentage change is retrieved from Table 3 on page 12-56 of Elk Grove General Plan published in 2019.

grow from 2 percent of households in 2005 (U.S. Census Bureau 2005) to 8 percent in 2050. Over the same period, meanwhile, the number of households with two vehicles is projected to decrease from 48 percent in 2005 to 26 percent in 2050.

2.1.2 ELECTRIC VEHICLE ADOPTION

In January 2018, then-Governor Jerry Brown unveiled a goal to increase the number of EVs on California roads to 1.5 million by 2025 and 5 million by 2030 (Rogers 2018). At the time of the announcement, EVs represented approximately 2 percent of the total fleet, or 350,000 vehicles, and about 7 percent of all new vehicle sales in the State. This represented a 1,000-percent increase in sales from 2011, when EVs made up one-half of 1 percent of all vehicle sales in California. Furthermore, in 2019, the California Air Resources Board began a study to identify strategies to significantly reduce transportation-related fossil fuel demand and emissions in the State, including transitioning to zero-emission vehicles, as part of the State's goal to achieve carbon neutrality by 2045 (California Environmental Protection Agency 2019). Furthering this initiative, in September 2020, Governor Gavin Newsom signed Executive Order N-79-20, setting the goal that by 2035, 100 percent of the new passenger cars and trucks sold in California will be zero-emission vehicles (Office of Governor Gavin Newsom 2020).

These stated goals demonstrate that State-level regulation in California is likely to be favorable to EVs going forward and that is in line with projections that show EV sales reaching 100 percent of new vehicle sales in the State by 2050. Using historical estimates from the California New Car Dealers Association on EV purchases and Statewide projections from the industry publication *EV Adoption*, EVs' share of new car purchases in the City is forecast to grow from 5.3 percent in 2017 to 30 percent in 2025, falling just short of Sacramento's goals (EV Adoption 2019). Based on the above trends and projections, the modeling projections for the Plan assume all new vehicle purchases in the City are expected to be EVs by 2050, along with 75–80 percent of all cars on the road. The latest State initiative to transition to all zero-emission vehicles by 2035 will accelerate the timeframe for the modeling projections, but the projections remain consistent with the legislative goals discussed above.

2.1.3 AUTONOMOUS VEHICLE ADOPTION

Fully[10] autonomous vehicles are still in development, and their future is uncertain. However, a great deal of study has been conducted on what effect they will have on modern mobility systems. Broadly speaking, there are two main effects AVs could have: an increase in VMT and a decrease in vehicle ownership. The increase in VMT comes from the fact that driving will become less onerous. The ability to watch TV, nap, or work remotely while driving would reduce the disincentive to drive, particularly long distances. The decrease in vehicle ownership would result from the distinct possibility that after cars reach full autonomy, Transportation Network Companies (TNCs), like Uber and Lyft, would be able to run autonomous fleets cheaply. The availability of cheap TNC rides would mean that for some households, it would make financial sense to forgo car ownership in favor of ridesharing.

The Elk Grove Autonomous/Connected Vehicles Readiness Plan (ACVRP) (City of Elk Grove 2019c) outlines two scenarios of AV adoption. By the year 2040, the ACVRP's aggressive estimate predicts that 60 percent of the vehicle fleet will be considered automated. The ACVRP's conservative estimate reduces the predicted rate of automation to 20 percent. Although AV adoption is forecast to increase VMT and decrease vehicle ownership, these impacts are sensitive to regulations and incentives that will be defined as this market matures. To manage this complexity, the Plan makes assumptions around AVs in a manner that reflects an upper and lower bound of impacts. For the outward bound of impacts, the Plan assumes that AVs will increase VMT by 31 percent and decrease vehicle ownership by 9.5 percent.

10 The literature on autonomous vehicles describes a phasing-in of autonomy over five different levels, from sensors that beep and even brake when you are too close to the car in front of you, to self-parking abilities and a cruise control that can follow curves in a lane, to full autonomy. For the purposes of this document, only full autonomy is considered. For more information on levels of autonomy, see the National Highway Traffic Safety Administration's website: https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety.

2.1.4 VEHICLE FLEET

Even though the average number of vehicles per household is decreasing slightly, household growth is projected to outpace this decrease, meaning the City's vehicle fleet is expected to increase through 2050. Historical sales data from the California New Car Dealers Association, combined with projections from *EV Adoption*, were used to project the percentage of new vehicle purchases that are anticipated to be EVs. EVs last longer than internal combustion engine vehicles and require less repair and maintenance over the lifetime of the vehicle (Kljaic 2018). The average EV is expected to last roughly 60 percent longer than an internal combustion engine vehicle (Clarke 2018). The modeled estimates for the Plan separate the turnover of EVs from internal combustion engine vehicles.

Elk Grove Automall

2.1.5 VEHICLE MILES TRAVELED

VMT is used to determine gasoline and electricity consumption, which affects sales tax, gas tax, and utility users tax revenue. The environmental impact report (EIR) developed for the City's recent General Plan update includes a baseline for current Citywide annual VMT, as well as projections for future increases in VMT. Importantly, the EIR notes that although VMT is projected to increase as the City grows, per capita VMT is projected to decrease because of increased efficiency for future land use development. Some scenarios included in the projections for the Plan include a higher VMT based on induced VMT associated with AV adoption, and other scenarios use a lower VMT based on VMT reduction strategies included in the City's Climate Action Plan (CAP). All VMT projections; however, are based on the initial VMT projection from the City's General Plan.


EV charging stations in Elk Grove

2.2 MOBILITY SCENARIOS

Forecasting the future is a complex process, and because of a lack of perfect knowledge about future conditions, uncertainty must be managed by assessing the key drivers of change under a range of scenarios. The following modeling estimations of the future scenarios were selected that represent the extreme ends (highs and lows) of two major factors (Table 2-1).

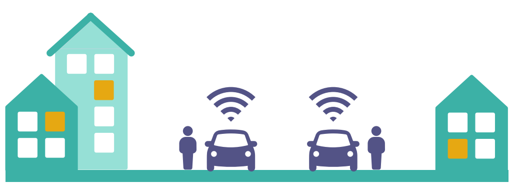
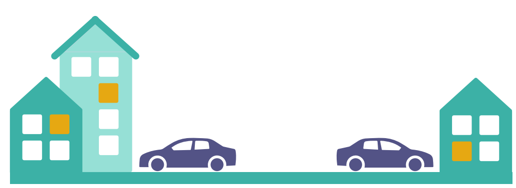
It should be noted that these scenarios are examined to understand the most extreme potential impacts of these conditions rather than considered balanced forecasts of the underlying conditions. For example, Scenario 1, Individual Autonomous TNCs, seeks to examine the full potential impact of AVs, which includes the potential for increased VMT. Increased VMT is a component of the scenario construction and is included to understand what broader economic conditions could result from large-scale AV adoption.

2.2.1 SCENARIO OVERVIEW

Each of the four scenarios examined is profiled here in relation to the other scenarios. Each scenario was constructed to consider changes in the City's key fiscal drivers and to represent an outer boundary of impact resulting from significant changes in each key driver with and without AVs.

Scenario 1, Individual Autonomous TNCs, and Scenario 2, Personal AV Ownership, represent "autonomous traffic": the idea that AVs will make driving so easy and undisruptive to the passenger that people will more frequently drive long distances, thereby increasing VMT significantly. Scenario 1, Individual Autonomous TNCs, and Scenario 3, Shared Autonomous TNCs, represent "mobility as a service": the idea that AVs will make ridesharing so cheap that a portion of households will no longer own cars and will instead use TNCs to get around. Scenario 4, Business as Usual, does not incorporate any anticipated impacts from AVs.

Table 2-1: Future AV Scenarios

		VEHICLE OWNERSHIP	
		DECREASE ⬇	NO EFFECTS FROM AVS
VMT	⬆ INCREASE	 **Scenario 1, Individual Automous TNCs:** VMT will increase, and vehicle ownership will decrease	 **Scenario 2, Personal AV Ownership:** VMT will increase, but vehicle ownership will not be affected by AVs
	NO EFFECT FROM AVS	 **Scenario 3, Shared Autonomus TNCs:** Vehicle ownership will decrease, but VMT will not be affected by AVs	 **Scenario 4, Business as Usual:** Neither vehicle ownershop nor VMT will be affected by AVs

Notes: AV = autonomous vehicle; TNC = Transportation Network Company; VMT = vehicle miles traveled.
Source: City of Elk Grove 2020b

Table 2-2 shows the estimated number of vehicles and VMT in the City by 2050 for each scenario.

Table 2-2: Vehicle and VMT Estimates by Scenario

SCENARIO	VEHICLES IN ELK GROVE	VEHICLE MILES TRAVELED IN ELK GROVE
Current estimate (2018)	110,000	4 million miles per day
Scenario 1, Individual Autonomous TNCs (2050)	140,000	12 million miles per day
Scenario 2, Personal AV Ownership (2050)	225,000	12 million miles per day
Scenario 3, Shared Autonomous TNCs (2050)	140,000	9 million miles per day
Scenario 4, Business as Usual (2050)	225,000	9 million miles per day

Notes: AV = autonomous vehicle; TNC = Transportation Network Company.
Source: City of Elk Grove 2020b

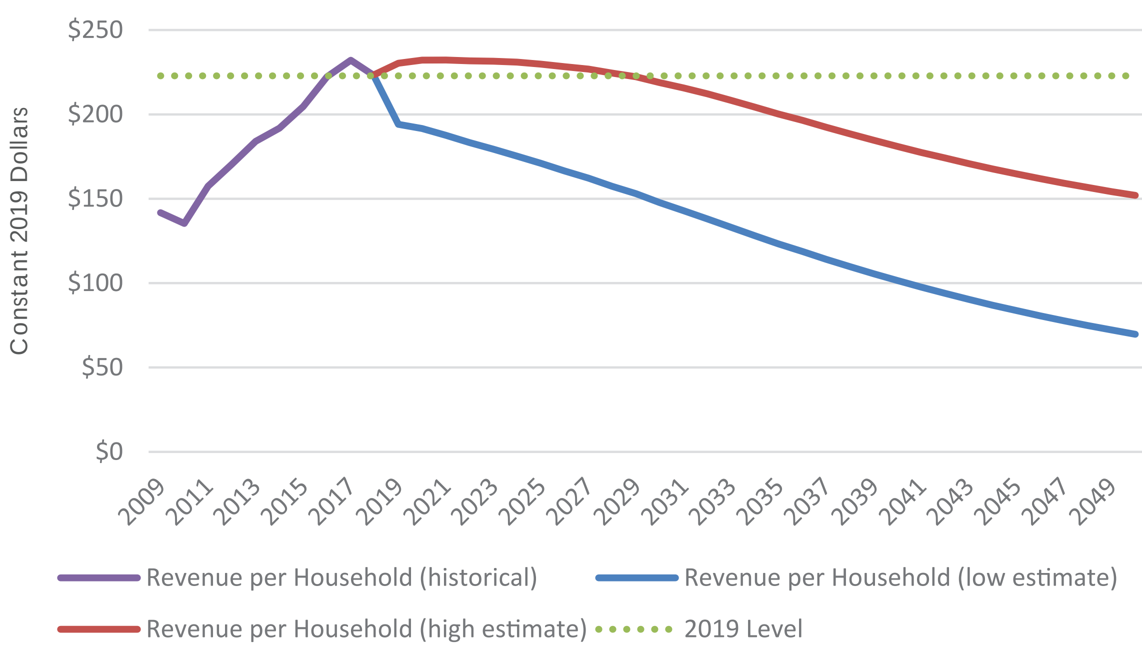
2.3 FISCAL IMPACTS

As discussed above, there are three main revenue streams for the City that are likely to be affected by the adoption of EVs and AVs: sales tax, gas tax, and utility users tax. EV and AV adoption will decrease sales and gas tax revenue but increase utility users tax revenue. Population growth, vehicle ownership projections, EV adoption, and AV adoption will affect the projected taxable spending on vehicle purchase and maintenance, which affects sales tax and Measure A revenue. The modeled VMT projections, which are affected by CAP measures and AV adoption, along with EV adoption, are anticipated to affect the amount of fuel and electricity purchased, which affects all three revenue sources.

2.3.1 SALES TAX IMPACTS

Overall, vehicle-related sales tax revenue for the City is expected to either plateau or reduce slightly over the next 30 years in every scenario examined. However, in Scenario 2, Personal AV Ownership, and Scenario 4, Business as Usual, plateauing revenue assumes rapid population growth, which means that although total revenue may not be decreasing, sales tax revenue per resident household, or per car on the road, will drop significantly. See Figure 2-2 for a visual depiction of the impact of population

Figure 2-2: Vehicle-Related Sales Tax Revenue in Elk Grove, per Household



Source: City of Elk Grove 2020b

growth on vehicle-related sales tax per household. Even at the upper edge (calculated using Scenario 2, Personal AV Ownership, combined with the low household estimate), revenue per household in 2050 is expected to be below 2011 levels. Projections regarding vehicle-related sales tax revenue were developed prior to March 2020 and, therefore, do not reflect the decrease in sales tax revenue as a result of the COVID pandemic.

2.3.2 GAS TAX IMPACTS

Figure 2-3 shows the projected gas tax revenue for the City through 2050. The trend is similar to the projected fuel sales tax revenue but reaches its peak sooner because it is a flat tax and would not be affected by projected increases in the cost of fuel. It is possible that the State will raise the gas tax beyond the inflation rate, but that possibility is outside the City's control.

The gas tax represents 30 percent of PW's O&M budget. By 2050, gas tax revenue is projected to be 50 percent (Scenario 1, Individual Autonomous TNCs) to 70 percent (Scenario 4, Business as Usual) below current levels.

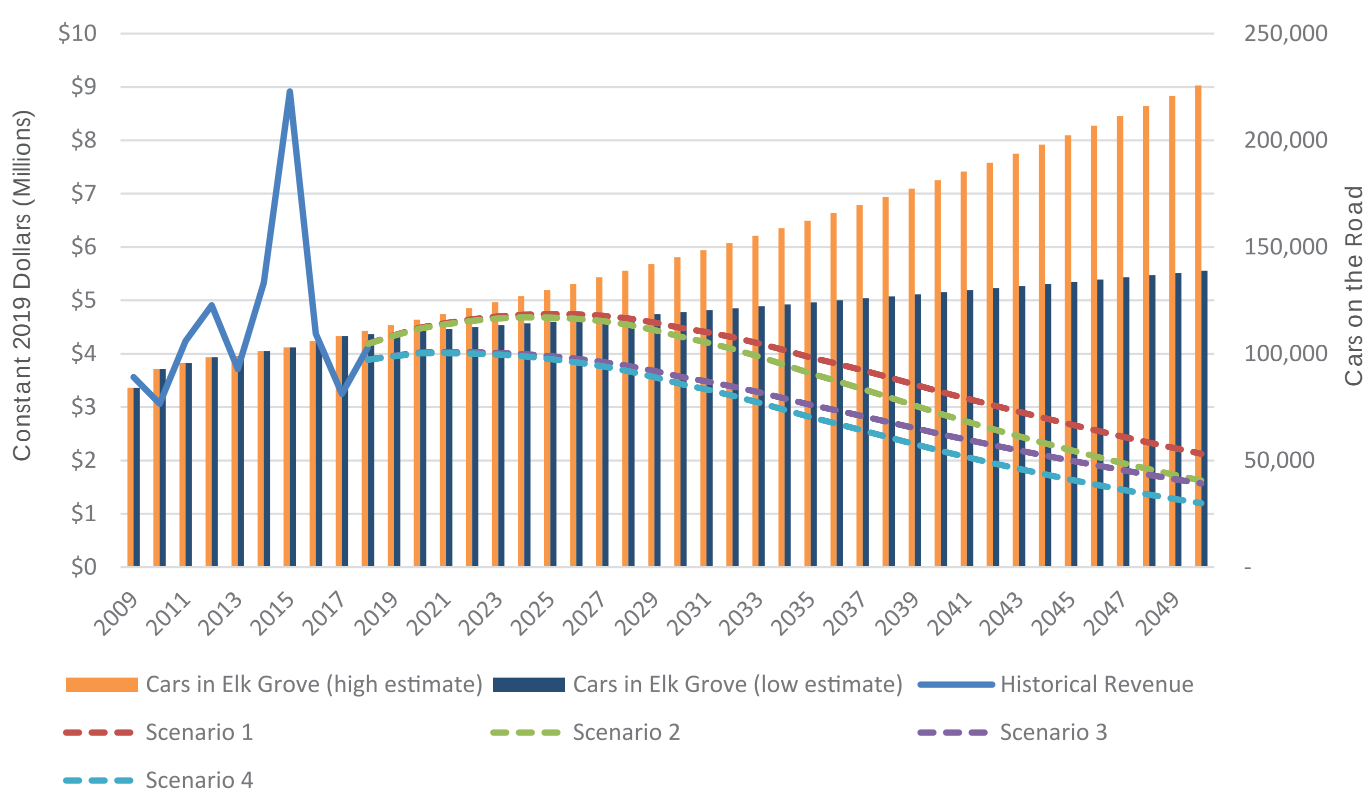
This will result in a sizeable deficit in funding for road maintenance in Elk Grove. Although EVs do not generate gas tax revenue, they drive on the roads like any other car, causing wear and tear, as well as congestion. The projected shortage of O&M funding will mean either a deterioration in road quality as PW loses funding or deterioration in other City services as the general fund is used to subsidize the losses in PW's budget. The existing utility users tax, discussed in the next section, will offset this effect to a certain extent, but it is not forecast to be enough to fully make up the loss in gas tax revenue.

2.3.3 UTILITY USERS TAX IMPACT

Electricity consumption will increase as EVs become more common and more households and visitors use electricity instead of gasoline to power their vehicles. However, it is unlikely that increases in utility users tax revenue from increased consumption will offset losses in sales tax and gas tax revenue.

The utility users tax is unlikely to fully replace revenues from the gas tax for two main reasons. First, using

Figure 2-3: Gas Tax Revenue in Elk Grove



Source: City of Elk Grove 2020b

electricity to power a vehicle is more energy efficient than using gasoline, and this efficiency is only going to increase as battery technology improves. A gallon of gasoline has the equivalent of 33.7 kilowatt-hours (kWh) of energy (DOE 2014). The average EV currently uses 30 kWh per 100 miles. This is the equivalent of 112 miles per gallon, much better mileage than the vast majority of internal combustion engine vehicles. Even when considering that electricity is more expensive to produce than gasoline per kWh, the per-mile cost of fueling an EV in Elk Grove is less than half the cost of fueling an internal combustion engine vehicle[11]. Second, since gasoline is used only for fueling on-road vehicles (with minor exceptions), the State can justify levying a per-gallon excise tax on gasoline sales and reserving that money entirely for transportation purposes. However, electricity is used for numerous purposes, many of which are not transportation-related, making it politically difficult to devote additional utility users tax to transportation-related expenses as with the gas tax. EV charging currently makes up less than 1 percent of utility users tax revenue and generates less than $1 per household per year. Figure 2-4 illustrates the increase in City revenue projected for all scenarios in the future. In 2050, EV charging is expected to generate $40–80 in utility users tax per household per year, a significant increase relative to current levels but still less than the decrease expected in vehicle sales tax revenue over the same time period, as discussed above.

11 The average pretax cost of a gallon of gas in California in 2019 was $2.92 (U.S. Energy Information Administration 2019). This fueled the average internal combustion engine vehicle on the road in Sacramento County for 27.1 miles (California Air Resources Board 2019). The average cost of electricity in Sacramento County in 2019 was $0.1469 per kWh (Sacramento Municipal Utility District 2019). To go 27.1 miles, the average EV uses 8.1 kWh of electricity, costing about $1.20 before taxes.

2.3.4 TOTAL FISCAL IMPACTS

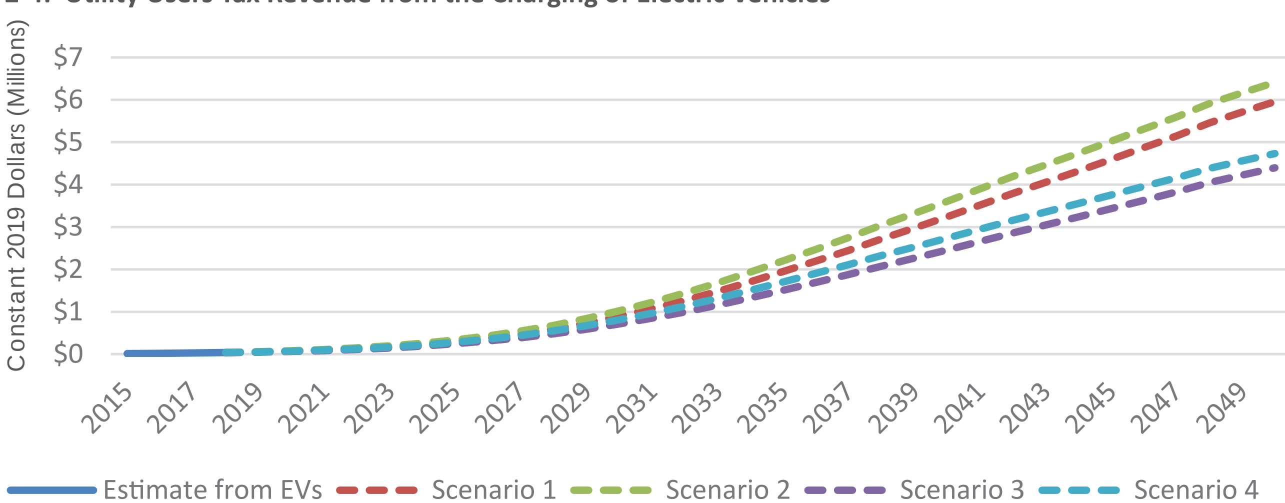
Figure 2-5 shows the total projected tax revenue from vehicle-related sources in the City through 2050. Scenario 2, Personal AV Ownership, and Scenario 4, Business as Usual, result in higher vehicle-related tax revenue generation, whereas Scenario 1, Individual Autonomous TNCs, and Scenario 3, Shared Autonomous TNCs, yield lower vehicle-related tax revenue generation.

Figure 2-6 shows the high and low estimates for revenue per household through 2050, combining the high revenue estimate with the low household estimate for the high end, to show the highest possible outcome, and doing the inverse for the low end.

FISCAL IMPACTS SUMMARY

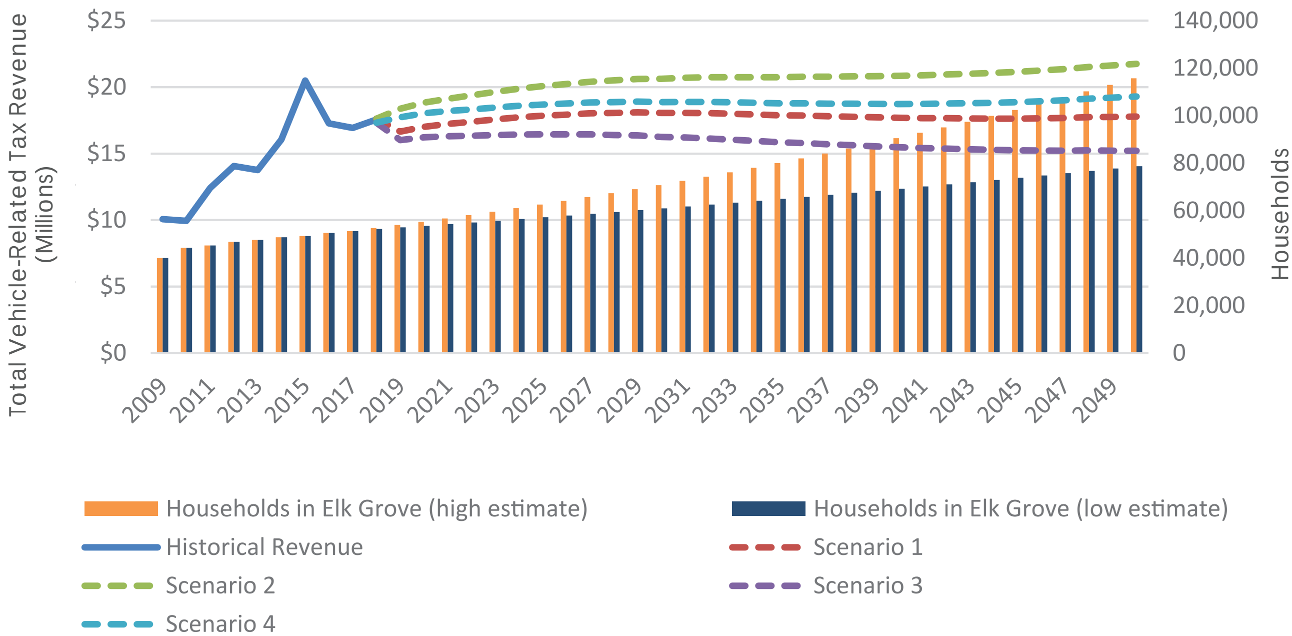
- As the City's population continues to grow over the next 30 years, vehicle-related sales tax revenue for the City is expected to either plateau or reduce slightly in every scenario examined.
- As shown in Figure 2-6, the plateau in vehicle-related sales tax revenue will result in a decrease in per household revenue available to spend on essential City services, such as maintaining and

Figure 2-4: Utility Users Tax Revenue from the Charging of Electric Vehicles



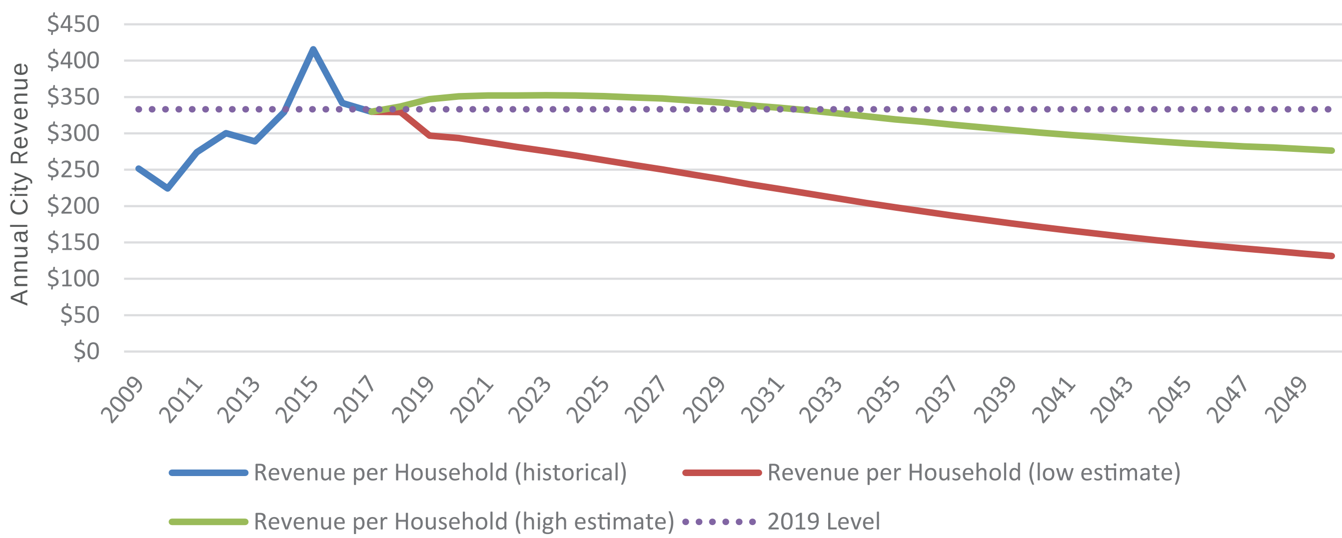
Source: City of Elk Grove 2020b

Figure 2-5: Total Vehicle-Related Tax Revenue in Elk Grove



Source: City of Elk Grove 2020b

Figure 2-6: Total City Revenue per Household



Source: City of Elk Grove 2020b

repairing roadways and social services (e.g., emergency services), unless this revenue is replaced by other sources.

- Similar to the projected decrease in fuel sales tax revenue, revenue generated through the State's gas tax is projected to reach its peak sooner since it is a flat tax and is not affected by projected increases in the cost of fuel. The State is exploring options for implementing a VMT tax that would replace the State gas tax to account for lost revenue as these changes in transportation, particularly the rate of adoption of EV technologies, increases.
- As EVs become more common, electricity consumption will increase as more households and visitors use electricity instead of gasoline to power their vehicles. However, it is unlikely that increases in utility users tax revenue from increased consumption will offset losses in fuel sales tax revenue.

2.4 FISCAL RESILIENCE STRATEGY FRAMEWORK

Addressing the anticipated loss in vehicle-related municipal revenue may take several forms, from traditional methods, such as new taxes or tax increases to more innovative and holistic strategies to develop a more intelligent and adaptable transportation system and a more resilient local economy that is less dependent on vehicle-related transactions. The set of strategies identified in this section provide a framework for the City to address and mitigate the short- and long-term impacts of changing transportation behavior in the future. [many don't]These strategies provide a framework that, if implemented together, could help the City become more fiscally resilient to both anticipated and unforeseen changes in the future.

DEVELOP A FORWARD-LOOKING TRANSPORTATION SYSTEM

As discussed in Section 2, changes in transportation behavior are anticipated to result in fiscal impacts from losses, specifically in vehicle-related tax revenue sources. As a result, the primary focus for the City should be on creating new sources of vehicle-related tax revenue that do not place an undue burden on other sectors of the City's economy These strategies are intended to help the City develop a forward-looking transportation system that can adapt to anticipated changes in transportation behavior in the City, as well as the larger Sacramento region.

A-1: REDUCE PARKING REQUIREMENTS TO MATCH REDUCED VEHICLE OWNERSHIP

As discussed in Section 2, household vehicle ownership rates are projected to decrease in the future. As the City continues to grow, the City's minimum parking requirements for new development will likely result in an overabundance of parking spaces based on historical vehicle ownership rates. By reducing or eliminating parking requirements for new development in appropriate locations (i.e., more dense, mixed-use areas in the City), the City can increase the total amount of land available for new residential or commercial square footage. This strategy, in turn, increases the potential to increase property tax revenue for the City for land that would otherwise be developed as a lower-value use (i.e., parking) (Victoria Transport Policy Institute 2020).

Implementation Items

- Implement Policy MOB-3-15 and Policy MOB-3-16 of the City's General Plan to reduce parking requirements and/or create parking maximums in appropriate areas of the City to promote walkable neighborhoods and districts and increase the potential for property tax revenue.
- Update the City's zoning code to allow for shared parking districts to reduce the total land required for parking in residential and nonresidential land uses. Identify areas in the City to promote or require park-once-and-walk districts to increase the total potential land available for building footprints.
- Use the City's Transportation Demand Management Guidelines and VMT Analysis Guidelines for new large nonresidential development to encourage nonvehicle commute modes for intracity trips, reducing vehicle reliance for City residents.

A-2: SUPPORT DEVELOPMENT OF EV INFRASTRUCTURE TO INCREASE EV OWNERSHIP

As EV ownership continues to increase in the future, electricity use will increase and, in turn, generate increased revenue through the City's utility users tax. However, as discussed in Section 2, this increase in utility users tax is not anticipated to fully offset losses in fuel sales tax revenue associated with declining VMT and vehicle ownership. As a result, the City should seek other opportunities to generate City revenue from increases in EV ownership as the State continues to promote EV ownership and to reduce GHG emissions.

Implementation Items

- Work with key stakeholders, including property owners, EV installation companies, and the Sacramento Municipal Utility District, to develop a strategy to promote EV charging stations at appropriate existing commercial developments. Identify business types that will benefit from the installation of EV charging stations (e.g., businesses with longer in-store dwell times, such as movie theaters, restaurants, and grocery stores).
- Provide technical assistance to new retail developments to establish a sustainable business model for including EV charging infrastructure as part of the development. Promote the benefits of hosting EV

infrastructure at retail developments, beyond revenue generated for equipment use, which could include increased revenue generation for the businesses, corporate branding, and customer and employee attraction.

- Use resources and information included in the publication Public EV Charging Business Models for Retail Site Hosts to inform this strategy (Atlas Public Policy 2020).
- Identify opportunity sites for regional EV charging station locations to capture pass-through traffic from Interstate 5 and State Route 99. Explore the feasibility of and plan for the long-term adaptative reuse of gas stations for EV charging stations as EV charging demand increases.

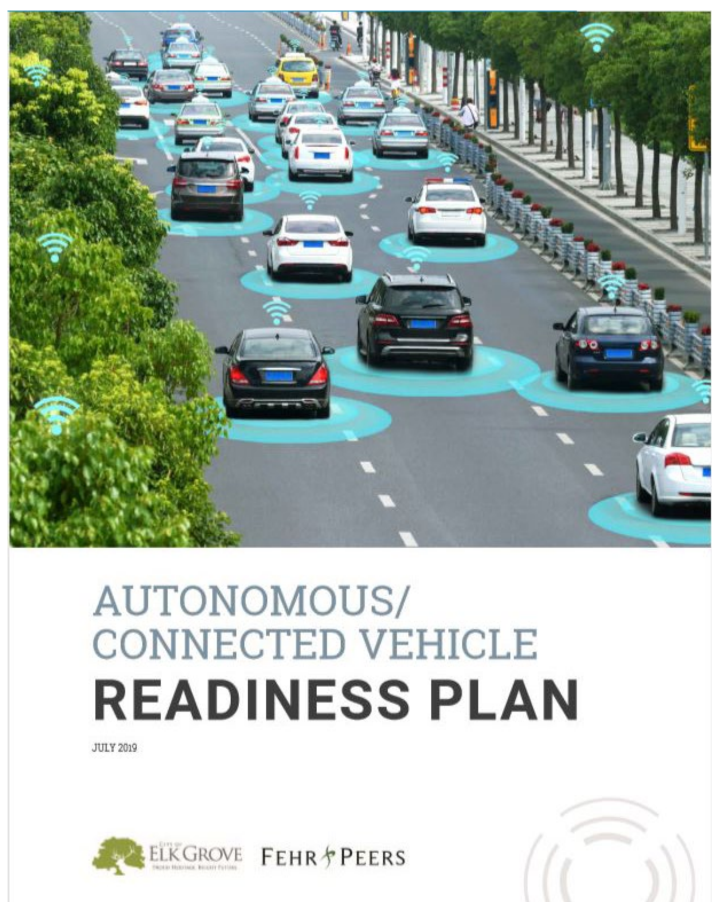
EV charging stations in Elk Grove

A-3: IMPLEMENT THE CITY'S AUTONOMOUS/ CONNECTED VEHICLES READINESS PLAN

Although the exact impacts of AV technology on the City's land use patterns are still uncertain, the eventual adoption of AV technologies is anticipated to affect the City. In 2019, the City adopted the ACVRP which helps to better understand these impacts and includes strategies to help the City prepare for the adoption of AV and connected vehicle technologies. Although preparing for these changes in transportation behavior may not fully mitigate impacts from lost vehicle-related tax revenue, it remains important for the City to adequately prepare for these changes and help mitigate potential negative impacts on the City. Alongside the strategies included here, the City should assess and implement the appropriate recommendations included in the ACVRP.

A-4: ADVOCATE FOR A STATEWIDE VEHICLE MILES TRAVELED TAX AND PREPARE FOR LOCAL IMPACTS

As EV ownership in the State increases, overall vehicle ownership decreases in the City, and VMT reductions continue, local sales tax revenue from gas sales, as well as revenue from the State's gas tax, will continue to decrease, causing revenue loss for essential services provided by the City and the State, such as road maintenance. In anticipation of this revenue loss, the State, led by the California State Transportation Agency, has begun to research and test feasible implementation of a road charge program that charges drivers based on how much they drive rather than a gas tax to generate tax revenue. If implemented, the program would be conducted Statewide, and the City would have little control over the collection and distribution of the revenue, similar to the State gas tax (CalSTA 2017). However, the City can advocate for the implementation of the program, participate in future road charge pilot programs, and plan for the transition from fossil fuel–based infrastructure to charging infrastructure.


AUTONOMOUS/
CONNECTED VEHICLE
READINESS PLAN
JULY 2019
ELK GROVE FEHR PEERS

Autonomous/Connected Vehicle Readiness Plan

Implementation Items

- Promote participation among the City and Elk Grove residents and businesses in future road charge pilot programs, communicating the benefits of the program to residents and elected officials.
- Work with the City's auto dealerships to participate in future road charge pilot programs serving to assist in the assessment and reporting of VMT data for residents participating in the program.
- Work with local elected officials and community organizations to lobby for the equitable implementation of a road charge program that offsets the City's revenue loss from a decrease in gas sales and that does not disproportionately affect residents with long commute lengths.

A RESILIENT AND DIVERSIFIED TAX BASE

As discussed in Section 1, the City currently is heavily dependent on vehicle-related tax revenue sources to fund essential City services, including infrastructure and road maintenance. As the City continues to grow and transportation behavior changes in the future, the City is projected to experience a loss of revenue from vehicle-related taxes, which will result in a decrease in per capita spending on City services for residents. In anticipation of these changes, the City can begin to shift its tax base away from an overreliance on vehicle-related sales tax toward a more diversified set of industries to generate revenue, particularly industries more resilient to changes in transportation behavior, as well as shocks to the economic system, such as a recession, natural hazards, and events similar to the current global COVID-19 pandemic.

B-1: IMPLEMENT GENERAL PLAN CHAPTER 5, "ECONOMY AND THE REGION"

Chapter 5 of the City's General Plan focuses specifically on creating a robust and diversified economy. The chapter has a set of goals and policies consistent with the objectives of creating a resilient and diversified tax base. The City should work to fully implement appropriate policies in the chapter as a foundation for shifting the City's tax base away from an overreliance on vehicle-related tax revenue to a more diversified tax base. Given the impacts on work-at-home policies for various industries caused by the COVID pandemic, the City should also evaluate appropriate planning and economic development strategies.

Implementation Items

- Implement Policies RC-1-1 through RC-1-5 in Chapter 5, "Economy and the Region," of the City's General Plan, focusing on establishing a new regional employment center in the City with a preference for industries in the digital economy.
- Prioritize City funding and resources to expand the City's broadband and fiberoptic cable network and similar public services to attract new large employers to the City focused on digital economy and related industries (e.g., "knowledge sector").
- Explore opportunities to work with large employers to establish or expand existing office space to accommodate pressure from the Bay Area real estate market.
- Focus future land use and planning decisions to ensure quality-of-life outcomes that will attract remote workers from industries shifting to permanent work-from-home policies (Dare County 2016). These could include:
  - highlighting local and regional outdoor destinations that provide a healthy work-life balance for potential new residents;
  - promoting land use and zoning strategies that encourage live-work residential uses, vertical and horizontal mixed uses, co-working spaces, and satellite offices for larger employers; and
  - reducing or eliminating regulatory and financial barriers for new home-based businesses.

B-2: DEVELOP AND IMPLEMENT VEHICLE-RELATED TAX REVENUE OFFSET POLICY

As the City continues to experience fiscal impacts from decreasing vehicle-related sales tax revenue, it is important to explore opportunities to offset this lost revenue that could include increased sales taxes from non-vehicle taxable sales, increased utility users tax, other forms of tax revenue beyond sales tax, or increasing existing tax rates. Diversifying the forms of tax revenue the City receives, outside of sales taxes, can help create a more resilient revenue base that is less volatile and less susceptible to impacts on the larger economy, such as economic recessions, during which households have less expendable income to spend in the community.

Implementation Items

- Explore and implement tax strategy to offset lost revenue from decreases in vehicle-related sales tax revenue. The strategy should explore the use of other forms of taxes and/or existing tax increases, outside of sales tax, to offset projected revenue loss. Because of anticipated changes in transportation behavior (e.g., decreases in vehicle ownership and VMT), vehicle-related business will become a smaller portion of the City's economy. Therefore, this strategy should explore tax options beyond those related to the transportation sector. Included below are several tax options to be included in the strategy:
  - **Sales tax increase**—This would include a tax on most purchases, both physical and digital, in the City of Elk Grove. Benefits to using this approach include that it is a proven method of revenue generation that includes a pre-existing system for collection. Potential drawbacks include an increased reliance on existing revenue sources and the potential to make Elk Grove shopping destinations less competitive, and it may disproportionately affect low-income residents.
  - **Parcel tax**—This is a form of property tax assessed based on certain established characteristics of a parcel rather than a rate based on the assessed value of the property. Parcel taxes are commonly accessed according to the number of acres or number of apartment units on the parcel, the square footage of the parcel, or the presence of single-family homes on the parcel. A parcel tax is considered a qualified special tax in California and requires a two-thirds (66.67 percent) supermajority vote for approval. Benefits to using this approach include that it is a proven method of revenue generation that includes a pre-existing system for collection. Potential drawbacks include an increased reliance on existing revenue sources, and it is a regressive tax.
  - **Utility users tax increase**—The Elk Grove Utility Users Tax is a 2.25-percent tax[12] on most common household utilities, such as telephone, electricity, gas, sewer, and video services. As discussed in Section 2.4.3, the anticipated increase in EV ownership in the City will help offset losses in sales tax from fuel purchases. An increase in the electricity portion of the utility users tax could offset the difference in losses from decreasing vehicle-related tax revenue. Benefits to using this approach include that it is a proven method of revenue generation that includes a pre-existing system for collection. Potential drawbacks include an increased reliance on existing revenue sources and the potential for tax increase to disincentivize EV adoption in the City.
- As part of the new tax policy, explore options to ensure that the tax increase does not have the effect of reducing spending in the City by diverting commercial sales to other areas in the region with lower sales tax rates or disproportionately affecting low-income households.
- To ensure the tax policy is specifically offsetting revenue loss from vehicle-related sources, develop an appropriate implementation timeline or establish a revenue-loss threshold at which point the new tax policy will be put into place.
- Implement a policy to analyze trends in the City's vehicle-related tax revenue on a bi-annual basis to monitor important changes in these revenue sources.
- Explore options to generate revenue from emerging business sectors that may not be taxed at the appropriate level commensurate with their use of City services and infrastructure. This could include a tax on transportation-related businesses that may not be paying their fair share of contributions to developing and maintaining the transportation network that they rely on (e.g., Uber, Lyft). It also could include a tax on food delivery services conducted through mobile applications (e.g., Grubhub, Postmates).

12 The tax rate on prepaid wireless services is 1.5 percent. For more information, see http://www.uutinfo.org/uutinfo_city_info/elk_grove/uutinfo_elk_grove.htm.

CLIMATE CHANGE STRATEGY 3

3.1 CLIMATE CHANGE AND ELK GROVE TODAY

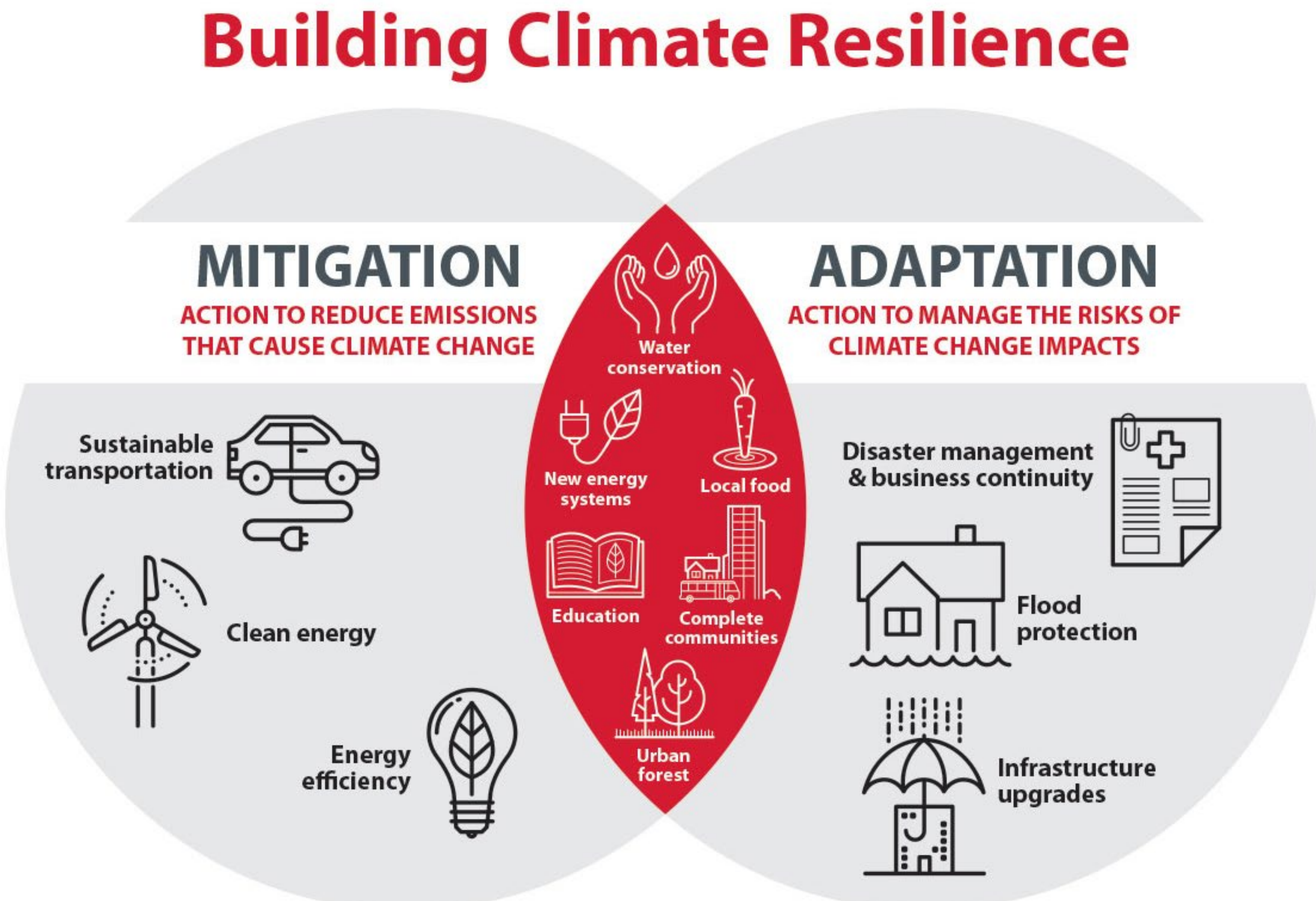
This section provides an overview of the steps the State has taken to address climate change, a summary of the State's regulatory framework regarding climate adaptation, and a snapshot of current climate-related hazards in Elk Grove today. This snapshot is intended to provide an assessment of the City's existing climate-related characteristics and hazards so as to better understand how the City is likely to be affected by climate change in the future.

CLIMATE CHANGE OVERVIEW

Climate change has been an important issue for the State for several decades. California has been a leader in addressing climate change through both government policy and private enterprise. Beginning in 2005, with the signing of Executive Order (EO) S-3-05 by Governor Schwarzenegger, which established long-term emissions reduction goals for the State by 2050, the State began to greatly increase its efforts to reduce GHG emissions. In 2015, with the signing of EO B-30-15 by Governor Brown, State agencies were directed to begin incorporating climate change impacts into the State's Five-Year Infrastructure Plan, as well as identify how climate change will affect California infrastructure and industry and what actions the State can take to reduce the risks posed by climate change. The impacts of climate change are being felt across the State, increasing the frequency and severity of existing natural hazards while introducing new and challenging issues for local communities and State agencies. As a result, understanding and preparing for the impacts of climate change is becoming an increasingly important part of local planning.

In 2019, the City completed an update to its General Plan (GP) and, as part of this process, updated the City's Climate Action Plan (CAP). As part of the GP update, a Climate Change Vulnerability Assessment was conducted to provide an overall assessment of the potential impacts of climate change on the City (See Chapter 12 of the GP). Chapter 8 of the GP, "Service, Health, and Safety," provides a comprehensive set of policies to address the impacts of climate change using information gathered in the vulnerability assessment. This Plan is intended to provide an in-depth analysis of potential climate-related impacts on the City and help support the previous work completed as part of the City's GP to prepare for the impacts of climate change. The CAP is intended to reduce GHG emissions from activities in the City. To comprehensively address climate change, it is necessary both to reduce GHG emissions and to adapt to impacts of climate change. However, as shown in Figure 3.1-1 , several strategies can be used to help achieve both goals.

Figure 3.1-1: Planning Framework for Building Climate Resilience



Source: City of Calgary n.d.

RESILIENCE REGULATORY FRAMEWORK

Included below is a list of regulations that have defined the regulatory framework for climate adaptation planning in the State.

- **EO S-13-08—**EO S-13-08, signed by Governor Arnold Schwarzenegger on November 14, 2008, required the California Natural Resources Agency (CNRA) to develop California's first Climate Adaptation Strategy in coordination with local, regional, State, and federal public and private entities.
- **Senate Bill (SB) 379, Climate Change Adaptation in General Plan Safety Elements—**SB 379 (Jackson, Chapter 608, Statutes of 2015) requires all cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans, codified at Government Code Section 65302(g)(4). The general plan safety element updates must include a climate change vulnerability assessment that identifies the risks that climate change poses to the local jurisdiction; a set of adaptation and resilience goals, policies, and objectives based on the results of the climate change vulnerability assessment; and feasible implementation measures, including feasible methods to avoid or minimize climate change.
- **SB 246, Integrated Climate Adaptation and Resiliency Program—**SB 246 (Wieckowski, Chapter 606, Statutes of 2015) establishes the Integrated Climate Adaptation and Resiliency Program, which is to be administered by the Governor's Office of Planning and Research. The program will coordinate regional and local adaptation planning efforts with statewide climate adaptation strategies.
- **Assembly Bill 1482, Climate Adaptation—**Assembly Bill 1482 requires CNRA to update the State's climate adaptation strategy every three years and use the State's climate adaptation strategy to maximize specified objectives, including promoting the use of the climate adaptation strategy to inform planning decisions and ensure that State investments consider climate change impacts, as well as promote the use of natural systems and natural infrastructure when developing physical infrastructure to address adaptation.
- **California Adaptation Planning Guide—**The Governor's Office of Emergency Services (Cal OES) and CNRA prepared and adopted the California Adaptation Planning Guide in July 2012. The purpose of the guide is to assist local and regional jurisdictions with proactively addressing the unavoidable consequences of climate change. In August 2020, Cal OES released the 2020 update of the guide.

ELK GROVE TODAY

This section provides an overview of existing conditions in Elk Grove with a focus on demographics, the built environment, and City operations that likely will be affected by climate change in the near and distant future. This discussion addresses existing climate and extreme heat and existing precipitation and flooding conditions.

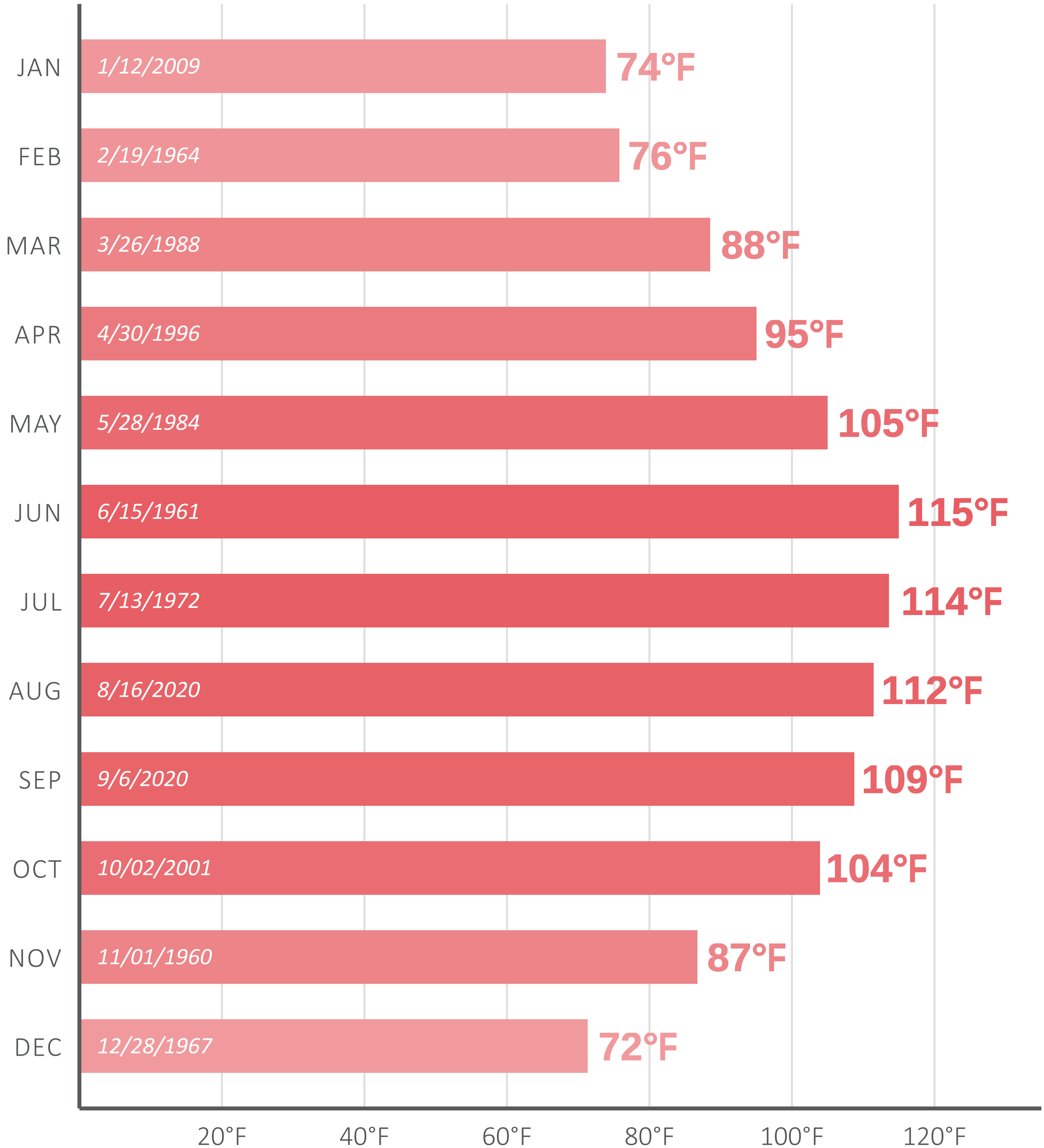
3.1.1 EXISTING CLIMATE AND EXTREME HEAT

The City has a Mediterranean climate with mild winters and dry summers. The average temperature throughout the year is 61 degrees Fahrenheit (°F), with the daily average ranging from 46°F in December and January to 76°F in July. Table 3.1-1 identifies the record high temperatures in the City for each month of the year. As noted in the City's Local Hazard Mitigation Plan (LHMP), the City operates cooling centers in various facilities during periods of extreme heat. Historically, cooling centers have been opened an average of five times per year but have had low attendance (Sacramento County 2017).

Climate change is already beginning to affect the City's annual average temperature and high temperatures. New record daily high temperatures were set for the weather station nearest to the City, at the Sacramento Executive Airport, for both August (112°F) and September (109°F) of 2020 (NOAA 2020). The previous record for August was set in 1996 (110°F) and for September was set in 1950 (108°F) (Sacramento County 2017).

Laguna Creek in the north east portion of the City

Figure 3.1-2: Historic Record High Temperatures in Elk Grove

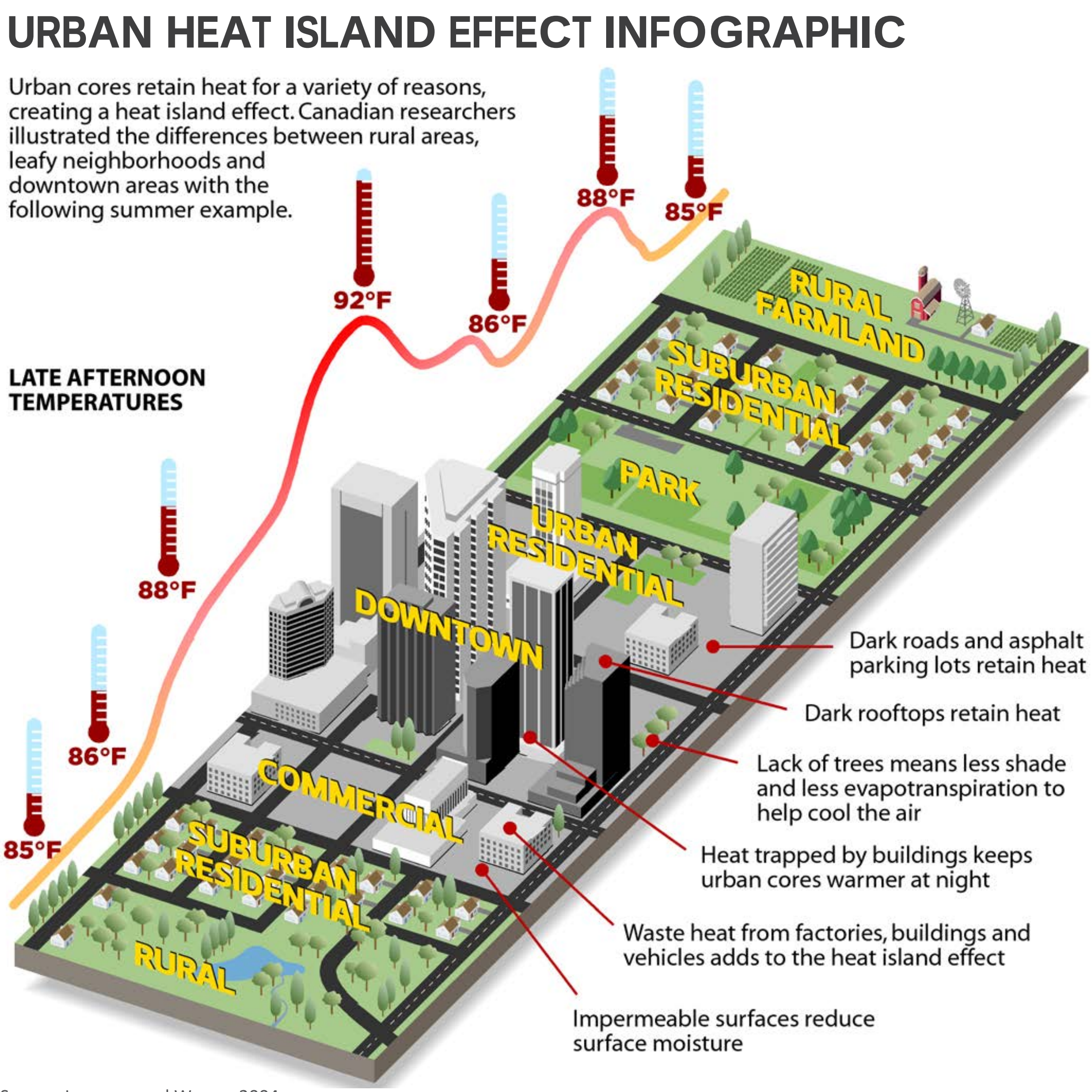


Note: Temperatures recorded at Western Regional Climate Center, Federal Aviation Administration Sacramento Executive Airport Station.
Source: Sacramento County 2017, NOAA 2020.

EXISTING HEAT SENSITIVITIES AND URBAN HEAT ISLAND EFFECT

Although the City's Mediterranean climate includes high temperatures during summer and fall months, the City's urban land use patterns can intensify periods of extreme heat through the "urban heat island" (UHI) effect. The UHI effect is generally understood as the phenomenon of urban areas being significantly warmer than surrounding rural areas because of human activity and land use patterns in the built environment. Several factors contribute to the effect, with the primary cause being changes in land surfaces (EPA 2008). The albedo of a surface is the measure of the surface's ability to reflect or absorb solar radiation, with darker surfaces having a lower albedo and absorbing more solar radiation. As urban areas develop over time, resulting in the development of more land surfaces with low albedos (e.g., asphalt pavement, dark building surfaces), more solar radiation is absorbed in these materials, causing increased ambient temperatures and warmer nighttime temperatures. Another factor contributing to the UHI effect is the loss of evapotranspiration in urban areas. Evapotranspiration,

Figure 3.1-3: Urban Heat Island Effect Infographic

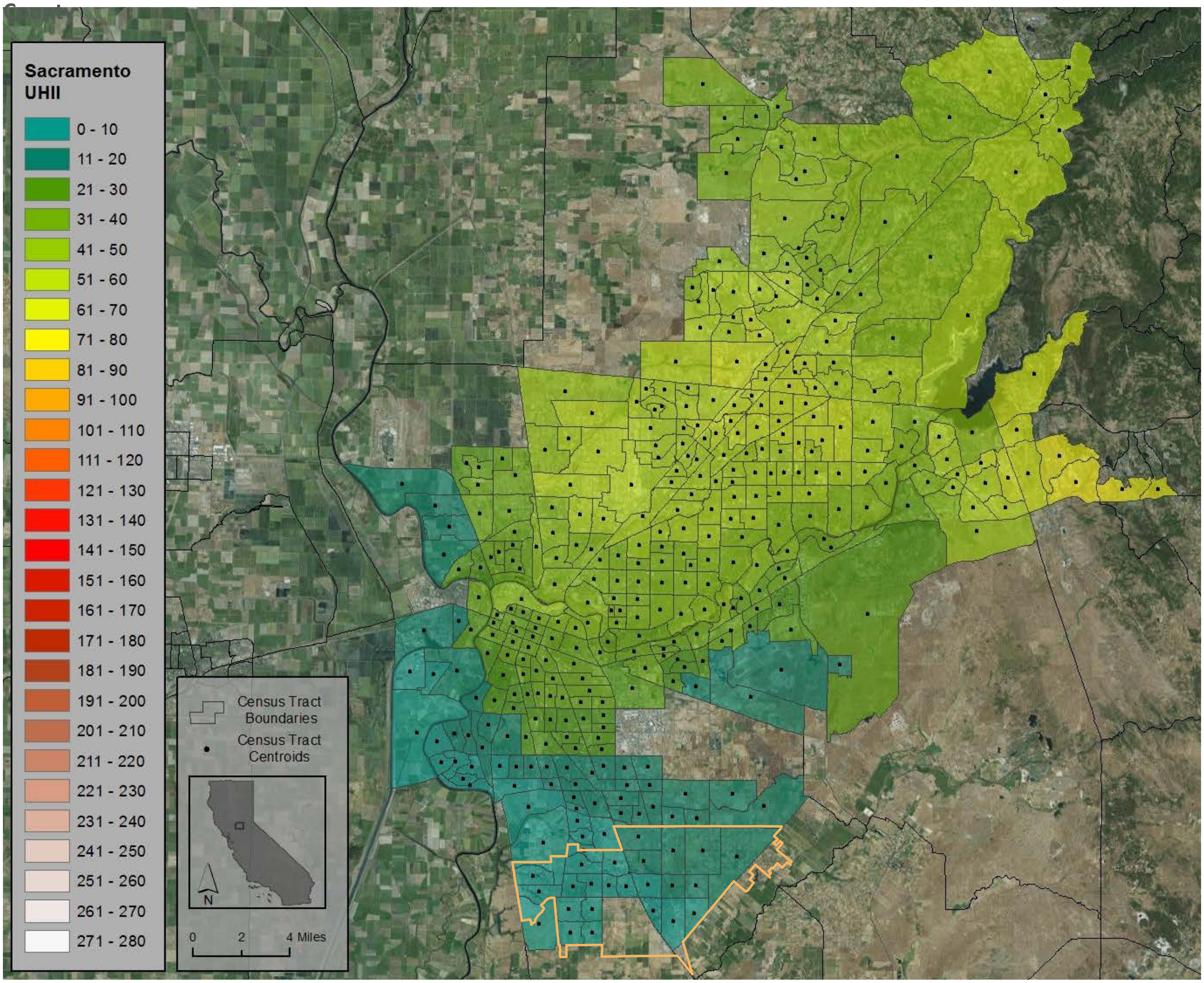


Source: Lemmen and Warren 2004

the movement of water to the air from sources such as the soil, plants, and bodies of water, reduces ambient air temperatures (EPA 2008). As cities grow and often reduce the extent of available vegetation that contributes to evapotranspiration, UHI effects are exacerbated. Additionally, waste heat from human activities involving machinery (e.g., vehicle traffic, use of air conditioning, industrial activity) can also contribute to the UHI effect, with excess heat absorbed by surrounding surfaces (Sailor 2011; Zhu et al. 2017).

The California Environmental Protection Agency has developed a UHI index (UHII) to assess the severity of the UHI effect in various urban areas throughout the State. The scores are based on the temperature difference over time between urban census tracts and nearby upwind rural reference points to demonstrate the relative difference in temperature caused by the urban environment (CalEPA 2019). Figure 3.1-2 shows the UHI effect for Sacramento County by census tract.

Figure 3.1-4: Urban Heat Island Index for Sacramento County



Source: CalEPA 2019

As shown in Figure 3.1-2, compared to other urban areas in Sacramento County, census tracts in the City are relatively low on the UHII. As discussed above, a number of factors contribute to the UHI effect. Factors that could be contributing to the City's relatively low UHII score include the presence of rural land uses surrounding the City; the City's relatively low density and a substantial amount of vegetation (e.g., lawns, trees); the presence of the Sacramento–San Joaquin Delta breeze; and the relatively low height of buildings, which allows winds to cool surfaces in the City (EPA 2008).

HEAT-SENSITIVE LAND USES

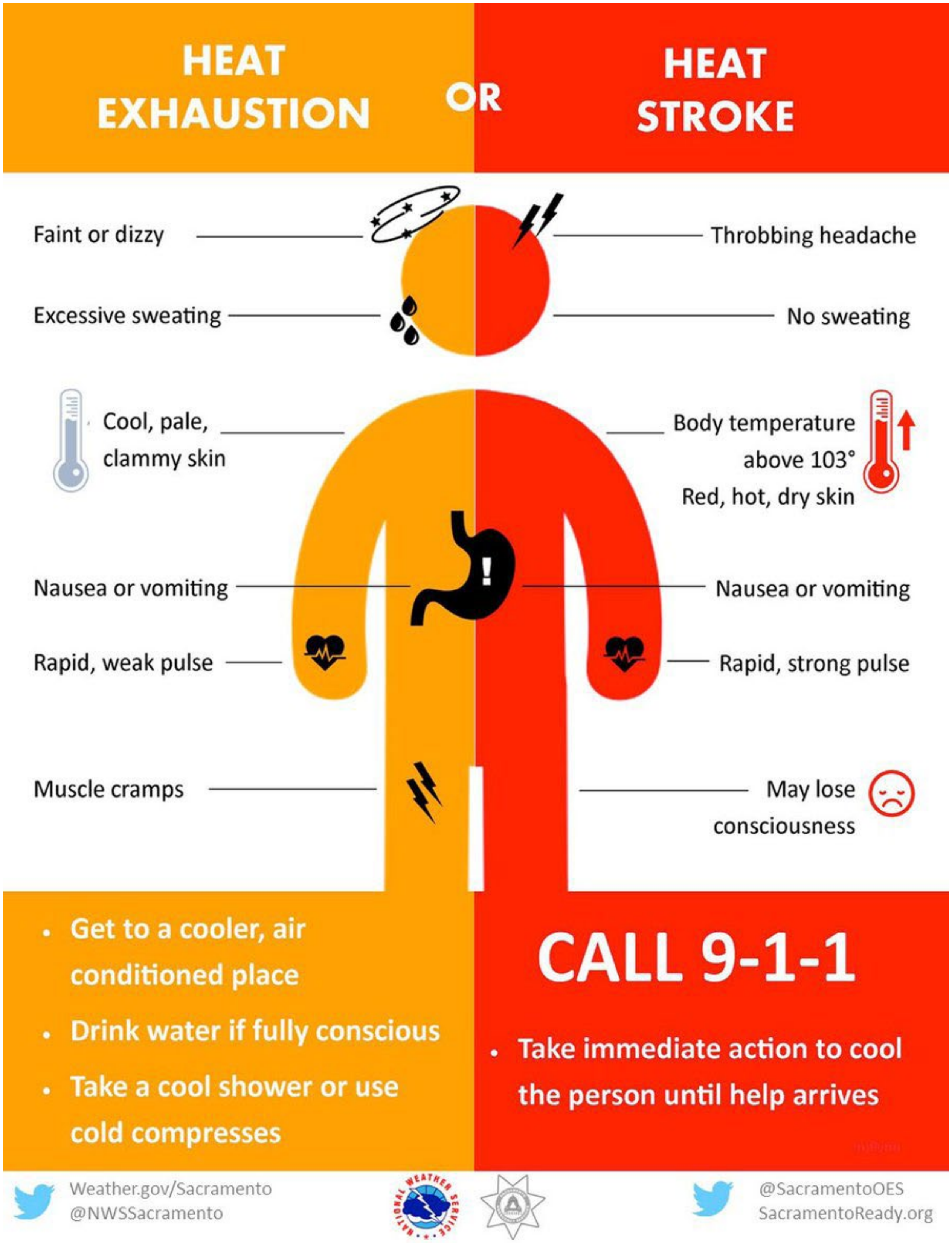
Land use patterns and the design of the built environment in urban areas play a large role in an area's exposure to the UHI effect (Stone and Rodgers 2001; Solecki et al. 2005). Urban land uses with large paved areas, low albedo, and less vegetation (e.g., commercial, industrial uses) tend to be subject to the UHI effect and have higher nearby ambient temperatures. Conversely, land uses with smaller percentages of paved surfaces and abundant vegetation (e.g., parks) tend to have lower average temperatures compared to other portions of urban areas (Rinner and Hussain 2011). Areas that have higher concentrations of commercial and industrial land uses clustered together can have increased ambient and surface temperatures, with temperatures increasing relative to the size of these areas (Rinner and Hussain 2011). Increased temperatures in areas with concentrations of commercial and industrial land uses can also result in secondary impacts, including increased cooling demand for buildings, pavement deterioration, decreased air quality, and reduced stormwater quality from above-average-temperature runoff entering natural waterways and nearby ecosystems (Rinner and Hussain 2011). Figure 3.1-3 illustrates how different types of land uses and communities are affected by the UHI effect.

VULNERABLE POPULATIONS

Certain populations in urban areas are particularly vulnerable to a variety of hazards, including extreme heat. Vulnerable populations include persons over the age of 65, infants and children, individuals with chronic health conditions (e.g., cardiovascular disease, asthma), low-income populations, athletes, and outdoor workers (CDC 2019). Increased temperatures have been reported to cause heatstroke, heat exhaustion, heat syncope, and heat cramps, with certain vulnerable populations at increased probability of experiencing these effects (Kovats and Hajat 2008). Figure 3.1-4, developed by the National Weather Service, illustrates some of the common symptoms of heat stroke and heat exhaustion. Extreme heat can also worsen air quality, quickening the production of ozone in areas with increased concentrations of ozone precursors (i.e., oxides of nitrogen [NOX] and reactive organic gases [ROG]) (Knowlton et al. 2004). This is of particular concern to the City because the Sacramento Valley Air Basin has high concentrations of NOX and ROG emissions and is currently in nonattainment status for California's ambient air quality standard for ozone (SMAQMD 2017).

Alongside populations with health sensitivities, residents with specific sociodemographic characteristics are at increased sensitivity to extreme heat events (CDC 2019). Research has found that low-income residents spend a larger proportion of their income on utilities, including electricity use for cooling, with these residents being disproportionally affected during extreme heat events (Voelkel et al. 2018). Additionally, research has found that low-income neighborhoods can often have less tree coverage and park space, further contributing to the disproportionate impact on low-income residents (Zhu and Zhang 2008). Unhoused individuals are also at increased risk from extreme heat events with, generally, less access to places to cool off and healthcare resources during these events. In addition, decreased access to transportation services can further increase exposure and health risks from extreme heat events for the unhoused community (Ramin and Svoboda 2009).

Figure 3.1-5: Potential Health Effects from Extreme Heat Events



Source: National Weather Service Sacramento 2020

3.1.2 EXISTING PRECIPITATION AND FLOODING CONDITIONS

EXISTING STORMWATER MANAGEMENT AND FLOOD CONTROL SYSTEM

The City maintains a traditional storm drainage and flood control system, much of it inherited from Sacramento County after the City's incorporation in 2000 and the annexation of Laguna West in 2004. The storm drainage collection and conveyance system consists of channels, creeks, ditches, pipes, streets, and detention basins throughout the City and has been designed to effectively control and drain stormwater runoff during normal rainfall events and larger storm events. The system consists of approximately 400 miles of underground pipes and 60 miles of natural and constructed channels draining within 13 watersheds in the City (City of Elk Grove 2019a).

In 2011, the City adopted a comprehensive Storm Drainage Master Plan (SDMP), which assessed the City's system and provided a variety of drainage concepts for upgrading the existing storm drainage and flood control collection system. The SDMP also included technical analysis of the performance of the stormwater management system in the City's 13 watersheds and provided specific recommendations for improvements that balance cost, safety, and ecosystem benefits. In 2019, the City prepared a minor update to the SDMP. The purpose of the update was to provide a summary of projects completed since 2011; provide details regarding remaining projects, including implementation costs and schedules (if available); and provide information regarding new regulatory requirements related to stormwater management and flood control.

Figure 3.1-5 identifies the five regions of the City included in the SDMP area, which will be used in the Plan's discussion of the impacts of climate change on the City and its transportation system in subsequent sections.

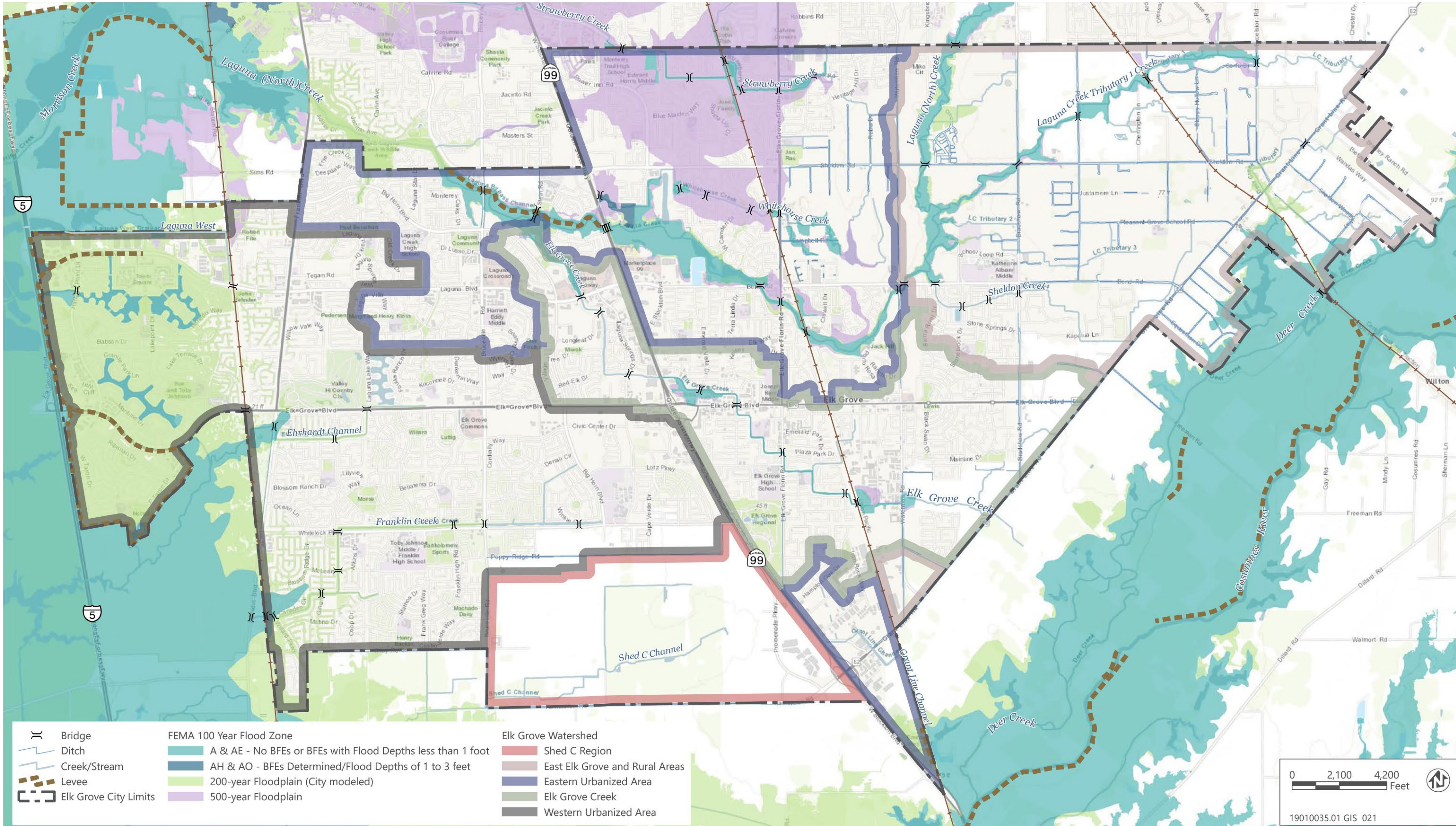
LOCALIZED ROADWAY FLOODING

Localized flooding occurs primarily during the winter and spring months in the City, with several areas of concern largely near waterways and creek systems that swell during heavy rainfall events, as noted in the City's LHMP (Sacramento County 2017). Additionally, the City experiences localized flooding along roadways in the City that is caused by either inadequate drainage structures in the City's more rural regions or blockages in the stormwater drainage system related to debris and leaf buildup. As noted in the City's LHMP and observed by City staff, during heavy rainfall events, major streets in the City experience localized flooding because inlets are blocked with leaves, resulting in standing water in one or more lanes in the roadway. Major streets of primary concern that are monitored during rain events are Big Horn Boulevard, Laguna Boulevard, Bruceville Road, Elk Grove Boulevard, and Franklin Boulevard.

LARGE FLOOD EVENTS

The City's LHMP, which was developed as an annex to the Sacramento County Local Hazard Mitigation Plan update in 2016, assesses current risk levels in the City for flood hazards, including large flooding events and flood-related hazards. As noted in the LHMP, the City has not experienced any large flooding events since incorporation, although smaller localized flooding events occur annually. As shown in Figure 3.1-5, portions of the City are located in the Federal Emergency Management Agency (FEMA) floodplains for the 100- and 500-year storm events. Figure 3.1-5 also identifies areas in the 200-year flood zone that were mapped as part of the City's GP update process and used to comply with SB 5, which requires cities in the Sacramento-San Joaquin Valley area to assess risk levels and provide increased flood protection for properties in the 200-year floodplain. The northern portion of the City is located in the Morrison Creek watershed, which includes Laguna Creek and several tributaries, including Elk Grove Creek, Sheldon Creek, and Whitehouse Creek. Areas surrounding portions of Laguna Creek, Elk Grove Creek, and Whitehouse Creek are located in the FEMA 100-year floodplain (identified in light and dark blue in Figure 3.1-5). Certain areas in the western portion of the City, specifically the Laguna West, Lakeside, and Stonelake neighborhoods,

Figure 3.1-6: Existing Flood Conditions in Elk Grove



Source: Data received and downloaded from City of Elk Grove in 2019

are protected from a 100-year flood event by the Laguna West levee system, which is located along the western, and portions of the northern and southern, boundaries of these neighborhoods.

The City's Department of Public Works is actively assessing the integrity and performance of the Laguna West levee system because of potential flooding from a 200-year storm event that could result in a failure of the Sacramento River levee near the western boundary of the City. In July 2019, the City released a staff report summarizing the results of the analysis being conducted regarding the performance of the City's levee system. The report states that the Laguna West levee system has been accredited by FEMA as meeting 100-year storm event standards and that the system provides properties in the Laguna West and Lakeside areas with significant flood protection. However, the system would need to be raised by an average of approximately 3.5 feet to comply with the 200-year flood protection standard. The cost to make these improvements to 4.5 miles of existing Laguna West levees would be approximately $12.2 million. An additional $3.0 million may be required to extend the height of the levees in some areas. There is also the potential for underseepage and stability issues in the levee system. The potential cost to address these issues and achieve 200-year flood protection would be an additional $7 million to $30 million. The City is currently performing additional geotechnical data collection and analysis on the levee system to better understand the existing condition of the levee system, to confirm that the levees adequately provide 100-year flood protection and to investigate potential underseepage issues (City of Elk Grove 2019b).

Laguna West Levee System near Don Nottoli Park

3.2 CLIMATE IMPACTS ON ELK GROVE IN THE FUTURE

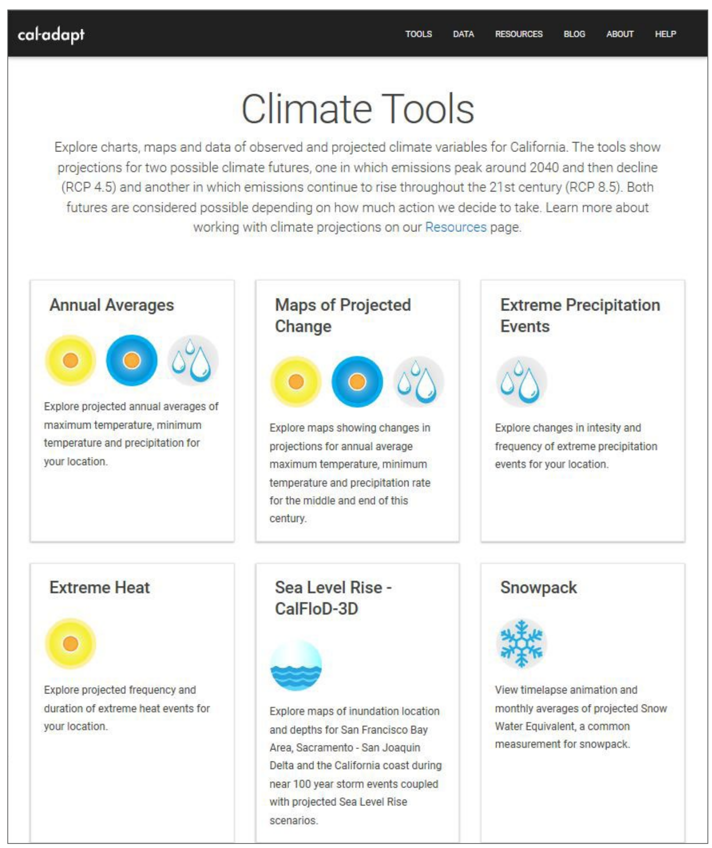
CHAPTER OVERVIEW

This chapter provides a summary of the projected changes in key climate variables (e.g., extreme heat events, annual precipitation) for three time periods over the 21st century. It discusses how these changes are anticipated to affect various aspects of the city (i.e., transportation system, vulnerable populations, community functions). To understand which impacts are expected to occur, a set of impact indicators were used to understand how changes in climate variables will, directly and indirectly, affect specific facilities, populations, and functions in the city (e.g., pavement deterioration). This chapter presents snapshots of what the city is predicted to experience by the years 2035 and 2055, as well as a discussion of impacts forecast to occur beyond 2055. It is a summary of the in-depth analysis conducted for a series of white papers developed in preparation for this Plan. For the full analysis, see the three white papers developed in preparation for this Plan on the City's website[1].

CLIMATE CHANGE PROJECTIONS

According to the work of the Intergovernmental Panel on Climate Change (IPCC) and research conducted by the State of California and partner agencies and organizations, climate change is already affecting and will continue to affect the physical environment throughout California, including the city of Elk Grove. To identify the local impacts of climate change in California, the California Energy Commission and the University of California, Berkeley, Geospatial Innovation Facility developed the scenario planning tool Cal-Adapt. The Cal-Adapt tool uses global climate simulation model data downscaled to a local and regional resolution to identify localized impacts from various climate metrics.

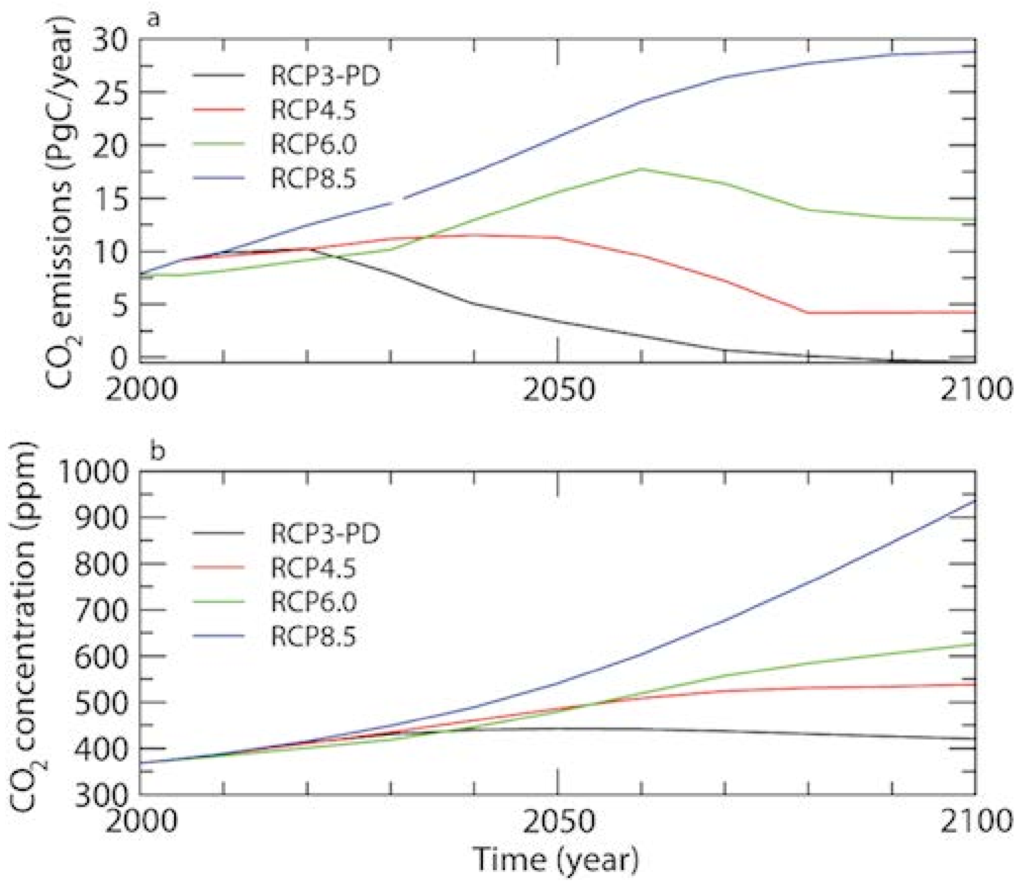
The effects of climate change over the next century will vary depending on global greenhouse gas (GHG) emissions trends. The Cal-Adapt tool includes global climate simulation model data from two emissions scenarios through the year 2099, known as Representative Concentration Pathways (RCPs), that were used in the *IPCC's Fifth Assessment Report* (IPCC 2014). The first RCP scenario used in the Cal-Adapt tool is the RCP 8.5 scenario (high-emissions scenario), which represents a business-as-usual future emissions scenario with global emissions peaking by 2100. The second RCP scenario used in Cal-Adapt is the RCP 4.5 scenario (low-emissions scenario), which is likely the best-case scenario for climate impacts with global GHG emissions peaking in 2040 and then declining through the rest of the century. These two emissions scenarios depend on global GHG emissions trends in the future and the efficacy of global GHG reduction strategies proposed by the international community. Figure 3.2-1 illustrates global annual emissions and global carbon dioxide concentrations under the two RCP scenarios used in Cal-Adapt, as well as other RCPs modeled by IPCC.



Cal-Adapt Tools

1 https://www.elkgrovecity.org/city_hall/departments_divisions/city_manager/strategic_planning_and_innovation/community_mobility_resilience_project

Figure 3.2-1: Representative Concentration Pathway Used in Global Climate Modeling



Notes: CO2= carbon dioxide; PgC = one billion metric tons of carbon; ppm = parts per million; RCP = Representative Concentration Pathway.
Source: Goosse et al. 2010

The State's Adaptation Planning Guide 2.0 (Cal OES 2020) and the Governor's Office of Planning and Research's guidance for State agencies (OPR 2018) provide direction on choosing appropriate RCP scenarios to be included in the analysis. For analysis of impacts beyond approximately 2050, the Adaptation Planning Guide 2.0 suggests using a conservative approach and using the high-emissions scenario, to assume a worst-case scenario for impacts, and notes that changes in climate variables before approximately 2050 are similar under both scenarios. Therefore, the analysis for this Plan looks at changes under the high-emissions scenario through approximately 2050 and analyzes changes under both the high- and the low-emissions scenarios beyond approximately 2050.

Three time periods throughout the 21st century have been chosen for this analysis based on guidance in the *California Adaptation Planning Guide* (Cal EMA and CNRA 2012). The three time periods are near term (2020–2050), midterm (2040–2070), and long term (2070–2099). For this chapter, the discussions of the near-term and midterm periods are framed as snapshots for the years 2035 and 2055, respectively, which are the midpoint years for these time periods. The discussion of changes during the long-term period are discussed more broadly as impacts likely to occur between 2070 and 2099. For changes to extreme precipitation events, the midcentury (2035–2064) and late century (2070–2099) are used. The time periods are established as 30-year time intervals to gather accurate data on average changes in the climate, which is typically measured over 30-year time periods or longer. This results in overlap among some time periods. Because of annual fluctuations in climate variables, climate data on shorter time periods may be less accurate and may not reflect long-term averages (NOAA 2018).

CLIMATE CHANGE IMPACT AND SENSITIVITY THRESHOLDS

To understand how changing climate will affect the city, it is important to understand the existing sensitivities in the city and establish thresholds that, when exceeded, indicate larger disruptions to the city. The Federal Highway Administration's (FHWA's) *Vulnerability Assessment and Adaptation Framework* (FHWA 2017) provides guidance for local jurisdictions on how to analyze climate change impacts on the transportation system. The document also provides resources to help analyze transportation asset sensitivity to key climate stressors and recommends climate stressor thresholds to use in determining when various assets may begin to fail or decrease in performance based on key climate variables. For these reasons, the *Vulnerability Assessment and Adaptation Framework* was used to guide the development of a set of climate stressor thresholds for the transportation system used in the impact analysis. In addition to transportation thresholds, a series of thresholds focused on vulnerable populations and community functions have been identified to better understand how changes in climate variables will affect other aspects of the city. For an in-depth discussion on how these thresholds were determined, see the three white papers developed in preparation for this Plan on the City's website[2].

2 https://www.elkgrovecity.org/city_hall/departments_divisions/city_manager/strategic_planning_and_innovation/community_mobility_resilience_project

3.2-1 ELK GROVE IN 2035

The city is already beginning to experience the effects of climate change, and these effects are projected to worsen in the future, even under a scenario in which global annual GHG emissions are reduced by as early as 2040. This section provides a snapshot of the changes projected to occur by 2035, but it describes the average changes expected to occur between 2020 and 2050.

CHANGES IN TEMPERATURE AND EXTREME HEAT EVENTS

Historically (1961–1990), the annual average temperature in the city has been 73.7°F. By 2035, the city's annual average temperature is projected to increase by 3.8 degrees to 77.5°F, approximately a 5-percent increase (CEC 2019a). Although this increase may seem minor, even a minor increase in annual average temperature is anticipated to have profound impacts on the ecosystem, as well as on increases in extreme heat events (OPR et al. 2018). As shown in Table 3.2-1, by 2035, the city is projected to experience a substantial increase in the number of annual extreme heat days[3] from 4 historically to approximately 15. The number of annual heat wave events[4] will increase from 0.2 historically[5] to 1.6 events. The average duration of heat wave events is projected to more than double, increasing from 2 days to 5.3 days under both scenarios (CEC 2019b).

As noted in the *Fourth Climate Change Assessment Sacramento Valley Report*, California's climate oscillates between extremely dry and extremely wet periods with annual precipitation varying widely from year to year. Climate change is anticipated to exacerbate these seasonal extremes with dry periods becoming dryer and wet periods becoming wetter (OPR et al. 2018:19). Current research suggests that extended drought periods ("mega-drought") could occur more often over the course of the century, placing increased stress on ecosystems and increasing the

3 Based on the parameters set in Cal-Adapt and for the purposes of this analysis, an extreme heat day is defined as a day between April and October with a maximum temperature of 103.1°F or above. This threshold was chosen because it is the 98th percentile of historic maximum temperature for days in the historic period (1961–1990), meaning 98 percent of all recorded temperatures in this period were below 103.1°F.
4 For the purposes of this analysis, a heat wave event is defined as a series of 4 or more days above 103.1°F.
5 In the historic period, the maximum duration of days above 103.1°F is 2 days, which does not qualify as a heat wave based on the heat wave threshold used.

2035

Table 3.2-1: Changes in Annual Extreme Heat Days and Heat Wave Events around 2035

EXTREME HEAT INDICATOR	EXTREME HEAT DAYS AND HEAT WAVE EVENTS – HIGH-EMISSIONS SCENARIO	
	HISTORIC (1961–1990)	NEAR TERM (2020–2050)
Number of annual extreme heat days (daily max temp of 103.1°F)	4 DAYS	15 DAYS
Annual heat wave event frequency (4+ consecutive days above 103.1°F)	0.2 HEAT WAVE EVENTS	1.6 HEAT WAVE EVENTS
Average heat wave duration (days)	2 DAYS	5.3 DAYS

Notes: extreme heat day = day with a daily maximum temperature of 103.1°F or above; heat wave event = 4 or more consecutive days above 103.1°F.
Source: CEC 2019b

risk of grassland fires in the Sacramento Valley (OPR et al. 2018). In addition, increases in the grassland fire and wildfire season are projected to be driven by an earlier spring season and less summer moisture (Westerling 2016).

HEAT-RELATED IMPACTS

As annual average temperatures increase, extreme heat days and prolonged extreme heat events will place increased stress on the city's built environment and increase the severity of impacts on city residents and normal community functions. Although heat-related impacts are expected to affect the city with increasing severity throughout the century, this section provides more detail and establishes a framework to understand the types of systems that will be affected by changes in temperature and extreme heat events while focusing on impacts expected to occur by 2035.

TRANSPORTATION SYSTEM IMPACTS

The physical components of the City's transportation system are designed to withstand extreme heat based on a historically stable climate. As annual average temperature and the severity and duration of extreme heat events increase, the city is likely to experience more rapid deterioration of transportation infrastructure, as well as more disruptions in transportation system functions. A summary of these impacts can be seen in Table 3.2-2.

Table 3.2-2: Summary of Potential Heat Impacts by Impact Area by around 2035

IMPACT AREA	IMPACT TYPE	THRESHOLD CRITERION	HISTORIC (1961–1990)	HIGH-EMISSIONS SCENARIO (2020–2050	THRESHOLD SOURCE
Transportation system impact	Roadways and pavement	7 consecutive days above 108°F	0	0	DOT 2014
	Rail buckling	Days per year where the temperature hits 111°F	0	1	OFCM 2002
	Bridges and bus operations	Days above 100°F	12	30	Zimmerman 1996; Cambridge Systematics 2015
Vulnerable population impacts	Heat wave events	4-day period above 103.1°F	0.2	1.6	CEC 2019b
	Heat wave duration	Consecutive days above 103.1°F	2	5.3	CEC 2019b
	HHEs	Range of potential HHEs per year	N/A	1.5 – 2.3	CEC 2018a
Community function impacts	Cooling Degree Days	Days above 65°F per year	40	55	CEC 2019b
	Heating Degree Days	Days below 65°F per year	86	69	CEC 2019b

Notes: NA = not available; HHE = Heat Health Event.
Source: See sources in the “Threshold Source” column of the table.

2035

Pavement Deterioration

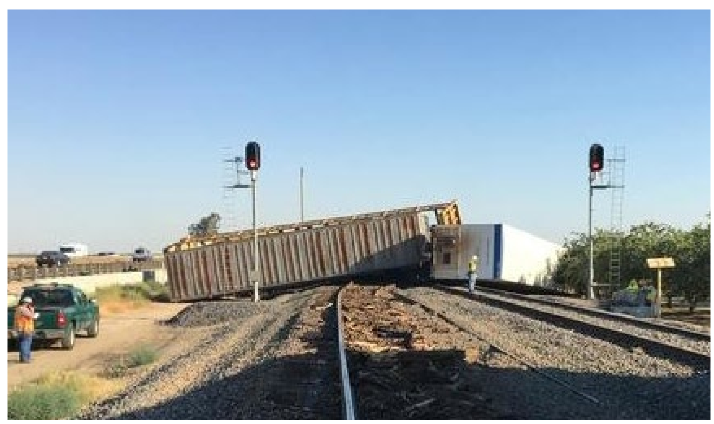
The effect of temperature on the performance and integrity of pavement depends on a variety of factors, including material type (asphalt versus concrete), the albedo of the material, details specific to the material mixing and placement, and soils and materials in the subbase of the roadway (Harvey et al. 2000). The performance of pavement also is dependent on the traffic volumes and types of vehicles using the roadway (Harvey et al. 2000). The City's Construction Specifications Manual (City of Elk Grove 2018), based on guidance from the California Department of Transportation, requires roadways built in the city to use asphalt binders that can withstand 7 consecutive days of pavement temperatures up to 64°C (147°F). Beyond this point, the heat can result in rutting along high-volume roadways and cause significant safety issues. Based on guidance in FHWA's *Vulnerability Assessment and Adaptation Framework* (FHWA 2017), this pavement temperature threshold can be translated into an ambient air temperature of 111°F. The urban heat island (UHI) effect can increase ambient temperatures between 1.8°F and 5.4°F in urban areas compared to surrounding rural areas. Therefore, the city could experience widespread impacts on pavement in the City during heat waves with 7 consecutive days with a maximum daily temperature of 108°F. By 2035, temperature increases and an increase in extreme heat events are not anticipated to have a large effect on the roadway conditions in the City. There will likely not be any extended periods (7 consecutive days) above 108°F during this period; therefore, there will not be widespread impacts from pavement deterioration in the city.

Extreme heat events can result in concrete roadway blowouts in which the pavement expands and can buckle or explode. Highway 50 in West Sacramento experienced blowouts from extreme heat in 2017 (shown above).

Source: CBS Sacramento 2017a

Rail Buckling

During periods of extreme heat, rail lines can expand and come out of alignment. This loss of alignment, termed "buckling," can cause serious safety issues, including train derailment. However, the risk of buckling is managed by designing the rail neutral temperature at 95–110°F, with tracks designed and fit into infrastructure that assumes that operations at those temperatures could occur (OFCM 2002; Transportation Research Board and National Research Council 2008). In 2017, a cargo train derailment of 19 Union Pacific Railroad (UPRR) cars occurred in the southern tip of Tulare County as a result of railway buckling caused by heat (Bakersfield Now 2017). The city could experience increased risk from rail buckling on days when the maximum daily temperature is 111°F or above. Two major rail lines run through the city: a UPRR line runs north-south through the eastern portion of the city, serving Amtrak passenger trains with an average of seven daily passenger train trips; another UPRR line runs north-south through the western portion of the city and currently is used for an average of three daily freight train trips. By 2035, the city will experience a slight increase in risk from railway buckling, with 1 day per year over 111°F.



Derailment from railway buckling occurred in Tulare County in 2017

Source: Bakersfield Now 2017

Bridges and Public Transportation Operations

Research has found that when daily maximum temperatures reach 100°F, air conditioning units in buses are placed under increased stress and risk of failure (Cambridge Systematics 2015). Although bridges are designed to expand during periods of extreme heat, projected increases in extreme heat events could go beyond design criteria, resulting in cracking and crushing of the roadway deck, as well as increased maintenance costs (Transportation Research Board and National Research Council 2008). Research also indicates that bridges are at increased risk from thermal expansion during periods above 100°F (Zimmerman 1996). As a result, increases in the number of days above 100°F will place increased strain on transit operations in the city, as well as increased risk of damage to bridges in the city.

By 2035, the number of annual days above 100°F will increase from 12 historically to 30. This change will place increased stress on buses and their air conditioning systems, as well as result in potential declines in bus ridership because of discomfort. Impacts on bus operations in the city have the potential to disproportionately affect low-income residents and individuals with disabilities who rely on public transit as their primary means of transportation. The city is served by its own transit system, e-Tran, which includes local transit service and commuter routes to the broader Sacramento region. There are seven local transit routes provided on weekdays and four routes on Saturdays. The increase in the number of days above 100°F also will cause a noticeable increase in risk from thermal expansion of bridges.

VULNERABLE POPULATION IMPACTS

Unlike impacts on the transportation system, heat-related impacts on the city's populations can vary widely and depend on several factors, including the sensitivity of specific populations to heat and extreme heat events. For example, residents over the age of 65, children under 5 years old, unhoused residents, and residents with cardiovascular diseases or asthma are at greater risk from the heat (CDPH 2017). The populations are at the highest risk during Heat Health Events (HHEs), as defined in the California Heat Assessment Tool (CHAT), which was used for this analysis. An HHE is defined as any event that results in adverse public health impacts, regardless of the absolute temperature. The CHAT includes a unique HHE threshold for locations throughout the state that is specific to the climate and the historical sensitivity of people in that area to past extreme heat events. Extreme heat can also worsen air quality, quickening the production of ozone in areas with increased concentrations of ozone precursors (i.e., oxides of nitrogen and reactive organic gases) (Knowlton et al. 2004). Additionally, people who work outdoors (e.g., agricultural workers, construction and utility workers) and homeless individuals are more likely to be exposed to the sun during extreme heat days, giving them greater vulnerability. Homeless populations often have higher rates of chronic disease because of extreme poverty, delays in seeking care, nonadherence to therapy, substance abuse, cognitive impairment, and other factors, placing them at increased risk during extreme heat events. Additionally, preexisting psychiatric illness can triple the risk of death for homeless populations during extreme heat events (Ramin and Svoboda 2009).

By 2035, the city is projected to experience 1.65 HHEs per year for the general city population, resulting in health-related impacts and increased emergency room visits during these events. Because vulnerable populations

Source: The Sacramento Bee 2020

Vulnerable populations including children, youth, and the unhoused are at increased risk during extreme heat events.

Source: Los Angeles Times 2017

(youth, elderly, and racial minorities as defined in the CHAT) have a lower heat sensitivity threshold during extreme heat events, these populations will experience 5.53 HHEs per year, resulting in health-related impacts and increased emergency room visits for these populations (CEC 2018a).

Although the city is not at risk from the direct impacts of wildfires, the city's location within the Sacramento Valley makes it susceptible to impacts of smoke from wildfires in the coastal mountain ranges of northern California. Community public health factors that can increase the impacts of wildfire smoke include the prevalence of asthma in children and adults; chronic obstructive pulmonary disease; hypertension; diabetes; obesity; percent of population 65 years of age and older; and indicators of socioeconomic status, including poverty, income, and unemployment. Exposure to wildfire smoke, particularly exposure to vulnerable populations, can result in worsening of respiratory symptoms, increased rates of cardiorespiratory emergency visits, hospitalizations, and even death (Rappold et al. 2017). Increased annual average temperatures and the subsequent increase in the frequency and severity of wildfires in northern California are anticipated to result in impacts from wildfire smoke on the city's population and vulnerable populations in particular (OPR et al. 2018).

COMMUNITY FUNCTION IMPACTS

Although increases in annual average temperatures and extreme heat events will have direct impacts on the City's transportation system and vulnerable populations, the impacts can result in secondary impacts on the city's normal community functions. Impacts are likely to include impacts on the City's traffic operations related to roadway deterioration, disruptions to the City's public transit system during heat wave events, and increased energy demand for cooling in home and businesses.

Data on the shifts in Cooling Degree Days (CDDs), which is a proxy for energy used to cool buildings, also are used as the community function indicator to understand potential economic impacts from increased energy demand for cooling. By 2035, the number of CDDs will increase from 40 to 55, a 37-percent increase over historic levels. This will likely result in a disproportionate burden on low-income residents who, in general, contribute a higher percentage of their monthly income to utilities, such as energy use for residential cooling (Calkins et al. 2016).

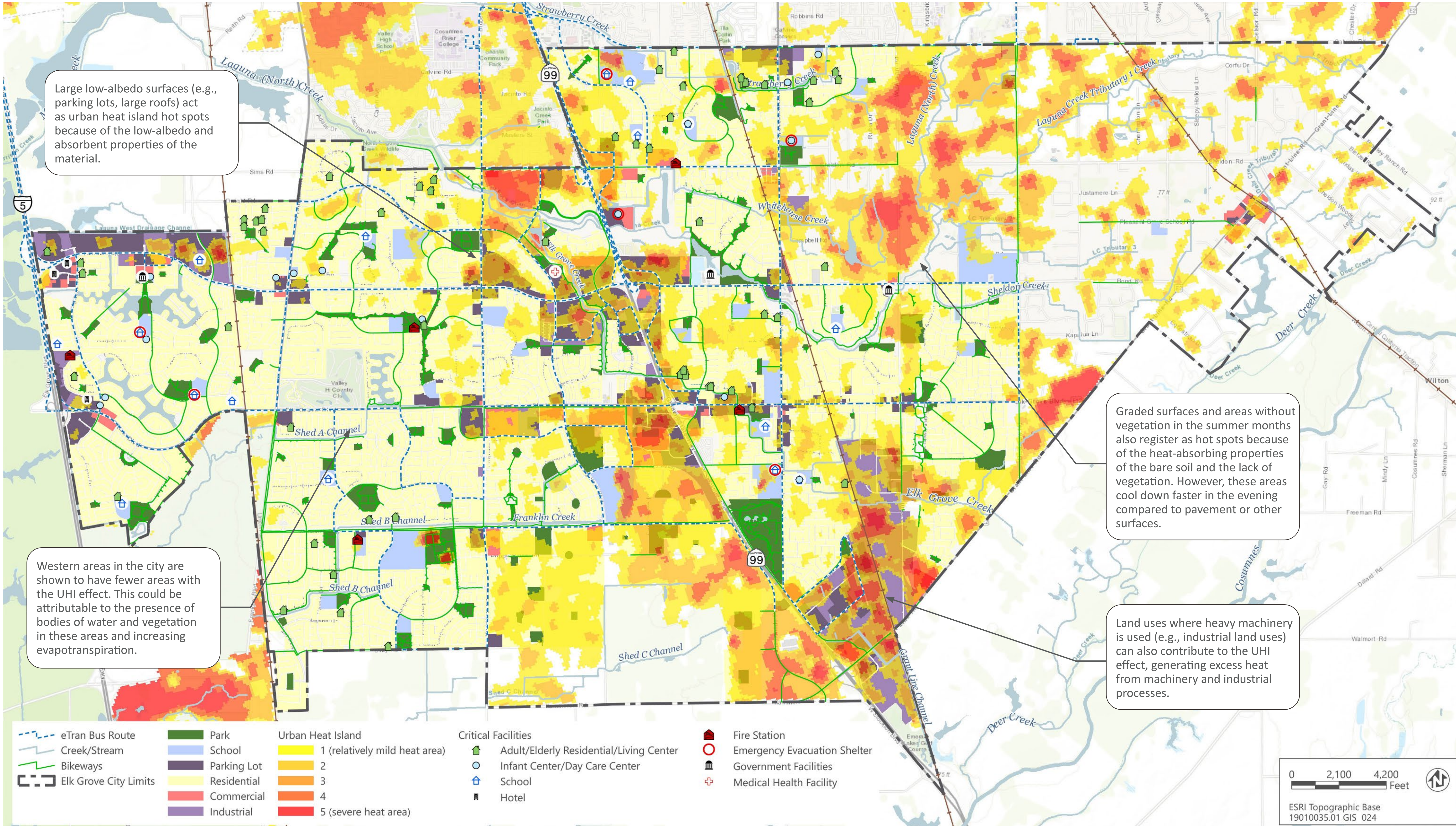
Increases in CDDs, particularly energy use demands for cooling during extreme heat events, can result in increased peak energy demand across larger regions and place increased stress on the electricity grid. In extreme cases, this can lead to blackouts or brownouts, when energy demand exceeds the power generation capacity of the grid (Auffhammer et al. 2017). Blackouts and brownouts can cause serious disruptions to the city's normal community functions, including impacts on business operations, disruptions to the City's traffic signal operations, and decreases in productivity and economic activity.

URBAN HEAT ISLAND

Although the projected impacts discussed above are anticipated to occur as a result of increases in annual average temperatures and extreme heat events, these impacts will likely be exacerbated to some degree by the UHI effect. As discussed in Chapter 1, several factors contribute to the UHI effect, including land use patterns; the presence of large paved areas (e.g., roads and parking lots); traffic from high-volume roadways (Zhu et al. 2017), impervious surfaces (e.g., roofs); and the presence of vegetation and trees, which contribute to evapotranspiration. All of these factors affect surface temperatures in urban areas. To show how the UHI effect may further exacerbate projected heat impacts on the city, including vulnerable populations, Figure 3.2-2 identifies land uses in the city, as well as the locations of critical facilities for vulnerable populations. Figure 3.2-2 also presents data from The Trust for Public Land, which has developed maps to identify hot spots in cities with above-average temperatures compared to the city as a whole. These maps were developed using Landsat (ground-level thermal sensor) data pertaining to surface temperatures measured in urban areas, including in Sacramento County. The data represent a snapshot of the summer months of 2018 and 2019 and highlight the UHI effect in the city.

As shown in Figure 3.2-2, areas in the city with an increased concentration of commercial and industrial land uses have above-average surface temperatures, particularly those land uses adjacent to State Route (SR)

Figure 3.2-2: Land Uses and Degree of Urban Heat Island Effect in Elk Grove



Source: Data received and downloaded from City of Elk Grove in 2019

99. The industrial area east of SR 99 shows the effect of clusters of land uses that contribute to the UHI effect and their potential effect on increased ambient air temperatures in surrounding land uses. Figure 3.2-2 also demonstrates the effect of large parking lots on the UHI effect, with parking lot land uses illustrated in purple. The large parking lots to the north and south of Laguna Boulevard between Bruceville Road and SR 99 illustrate this phenomenon well. Finally, Figure 3.2-2 illustrates the cooling effect that vegetation, green spaces, and parks can have in the city with park areas not experiencing above-average temperatures even when located next to other land uses that do have above-average temperatures.

CHANGES IN PRECIPITATION AND FLOODING

As discussed in the *Fourth Climate Change Assessment Sacramento Valley Report*, changes in precipitation patterns in northern California are anticipated to affect the Sacramento Valley region, as well as adjacent regional watersheds, which will affect the Sacramento Valley (OPR et al. 2018). Projected shifts include increases in the intensity of large storm events, which could compromise the performance of the Sacramento Valley and Central Valley flood management systems (Pierce et al. 2018).

REGIONAL CHANGES IN PRECIPITATION AND STORM EVENTS

Given the city's proximity to the Sacramento River (approximately 1 mile northwest of the city limits), precipitation changes in the regions affecting the Sacramento River and its tributaries also may affect the city. Major tributaries affecting the Sacramento River include the Feather River, Yuba River, Bear River, American River, and Cosumnes River, as well as portions of their tributaries. By 2035, it is projected there will be an approximately 8-percent increase in annual average precipitation affecting these waterways (CEC 2019a).

Based on California's location next to the Pacific Ocean, the state is exposed to the atmospheric river (AR) phenomenon, a narrow corridor of concentrated moisture in the atmosphere. California is subject to precipitation from an AR that transports water vapor from as far south as Hawaii to the state. The presence of the AR contributes to the frequency of "wet years" in the state, when there is an above-average number of AR storms and above-average annual precipitation. Although research indicates that the frequency of large storm events does increase in these wet years, the most severe flooding from ARs may not be in wet years (Swain et al. 2018). The most severe flooding impacts are caused by persistent storm sequences on subseasonal timescales (i.e., short time periods, typically 2 weeks to 3 months), which bring a significant fraction of annual average precipitation over a brief period. These are storm events similar to the Great Flood events of 1861–1862, which caused widespread damage throughout northern California (Swain et al. 2016). It is estimated that a storm similar in magnitude to the Great Flood events is more likely than not to occur at least once between 2018 and 2060 (Swain et al. 2018). A storm of this size would likely compromise large portions of the flood control systems in the Sacramento and the Central Valleys (Swain et al. 2018).

California's climate oscillates between extremely dry and extremely wet periods, with annual precipitation varying widely from year to year. Climate change is anticipated to exacerbate these seasonal extremes with dry periods becoming dryer and wet periods becoming wetter (OPR et al. 2018:19). As a result, the frequency and severity of large storm events also are anticipated to increase. These oscillations between extremely dry and extremely wet periods, which have occurred historically in the state, are anticipated to become more severe with rapid shifts from dry to wet periods known as "whiplash events" (Swain et al. 2016). As Swain et al. note in their research, the recent 2012–2016 drought followed by the 2016–2017 flood events throughout the state serves as a good example of the type of whiplash events that will occur more frequently over the next century. These types of events are estimated to increase by approximately 25 percent in northern California, with increases in frequency occurring largely after 2050 (Swain et al. 2016).

LOCAL CHANGES IN PRECIPITATION AND STORM EVENTS

Increases in average annual precipitation also are expected to occur at the local level. By 2035, precipitation in both the city and Sacramento County is projected to increase between 10 and 11 percent. However, as noted above, this increase in annual precipitation will largely be influenced by increases in rainfall during larger storm events.

PRECIPITATION- AND FLOOD-RELATED IMPACTS

As discussed above, by 2035, the city will experience increases in annual average precipitation at both the regional and the local levels. However, the majority of the increase in risk to the city will occur from large storm events at the regional level, similar to the Great Flood events of 1861–1862, which would likely compromise large portions of the flood control systems in the Sacramento and the Central Valleys (Swain et al. 2018). However, it is projected that impacts on the City's flood management and stormwater management (stormwater drainage system) will occur after 2055, when an increase in precipitation will place increased stress on these systems, leading to increased degradation or system failures. Therefore, the main discussion regarding precipitation and flooding impacts on the city is included in Section 2.4, "Elk Grove in 2055."

3.2-2 ELK GROVE IN 2055

The impacts of climate change that became more prevalent in the city by 2035 are projected to worsen by 2055, even under a scenario in which global annual GHG emissions are reduced by as early as 2040. This section provides a snapshot of the changes projected to occur by 2055, but it describes the average changes expected to occur between 2040 and 2070.

CHANGES IN TEMPERATURE AND EXTREME HEAT EVENTS

Historically (1961–1990), the annual average temperature in the city has been 73.7°F. By 2055, the city's annual average temperature is projected to increase by 5.6 degrees to 79.3°F, an approximately 8-percent increase. As noted above, small increases in annual average temperature are indicators of much larger impacts on the ecosystem, as well as increases in extreme heat events

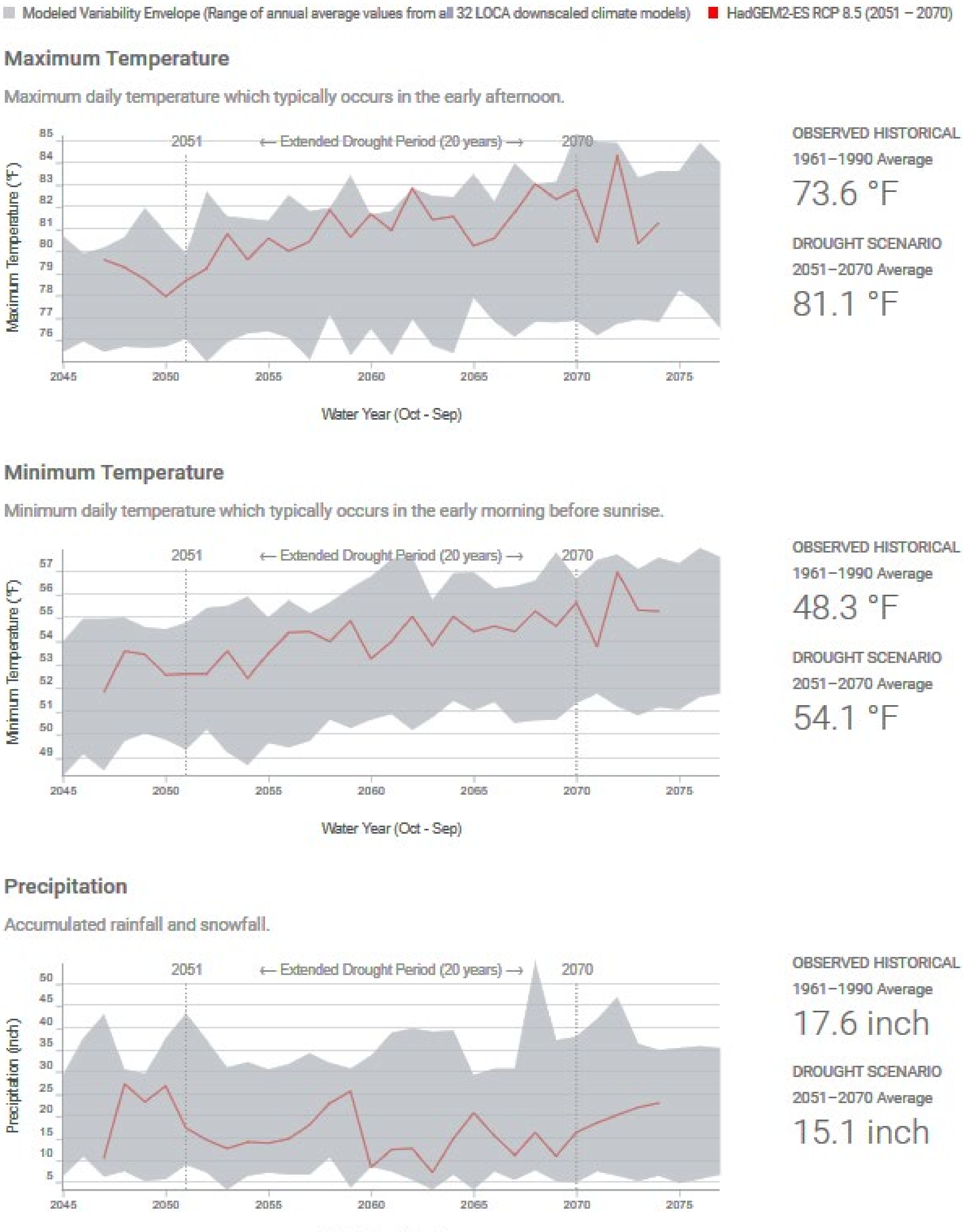
Table 3.2-3: Changes in Annual Extreme Heat Days by and Heat Wave Events around 2055

EXTREME HEAT INDICATOR	EXTREME HEAT DAYS AND HEAT WAVE EVENTS – HIGH-EMISSIONS SCENARIO	
	HISTORIC (1961–1990)	NEAR TERM (2040–2070)
Number of annual extreme heat days (daily max temp of 103.1°F)	4 DAYS	24 DAYS
Annual heat wave event frequency (4+ consecutive days above 103.1°F)	0.2 HEAT WAVE EVENTS	3.1 HEAT WAVE EVENTS
Average heat wave duration (days)	2 DAYS	7 DAYS

Notes: extreme heat day = day with a daily maximum temperature of 103.1°F or above; heat wave event = 4 or more consecutive days above 103.1°F.
Source: CEC 2019b

2055

Figure 3.2-3: Extended Drought Scenario for Elk Grove during the Later Part of 21st Century (2051–2070)



Source: CEC 2019d

(OPR et al. 2018). As shown in Table 3.2-3, by 2055, the city is projected to experience a 500-percent increase in the number of annual extreme heat days from 4 historically to approximately 24. The number of heat wave events will increase from 0.2 historically to 3.1 events per year. The average duration of heat wave events is also projected to increase substantially, increasing from 2 days to 7 days under both scenarios.

Current research suggests that extended drought periods ("mega-drought") could occur more often over the course of the century, particularly after 2055 (OPR et al. 2018). Figure 3.2-3 presents the annual average maximum and minimum temperatures, as well as annual average precipitation, over a 20-year drought period beginning in 2051. As illustrated in Figure 3.2-3, during this extended period, annual average maximum and minimum temperature increase while precipitation decreases with wide variations in annual precipitation from year to year.

HEAT-RELATED IMPACTS

Beginning in 2035, the number of extreme heat days and prolonged extreme heat events will increase, continuing to place stress on the city's built environment and increase the severity of impacts on city residents and normal community functions.

TRANSPORTATION SYSTEM IMPACTS

As annual average temperature and the severity and duration of extreme heat events continue to increase through 2055, the impacts that will begin to take effect by 2035 will increase substantially in extent and severity by 2055.

Pavement Deterioration

By 2055, temperature increases and an increase in extreme heat events are not anticipated to have a large effect on the roadway conditions in the city. There will likely not be any extended periods (7 consecutive days) above 108°F during this period; therefore, there will not be widespread impacts from pavement deterioration in the city.

RAIL BUCKLING

The risk to rail lines from extreme heat days will increase slightly, with only 2 days over 111°F. However, as noted in Section 2.3, because of the severity of potential harm that could occur during railway derailments, railway buckling will become a more serious issue in the future. Days over 111°F will become more prevalent and will occur with more consistency, increasing overall risk to the city and its residents from potential train derailments caused by railway buckling.

Public Transportation Operations and Bridges

By 2055, the impacts on bus operations and the risk from thermal expansion of bridges will continue to increase, with the number of days above 100°F increasing from 12 historically to 42 during this period. This change will also continue to place stress on buses and their air conditioning systems, as well as result in potential declines in bus ridership because of discomfort. As part of the California Air Resource Board's Innovative Clean Transit program, by 2055, public transit agencies are required to transition their transit fleets to zero-emission vehicles, including the option for electric buses. Similar to buses using internal combustion engines, electric buses and their air conditioning systems are placed under increased stress in extreme heat environments, causing potential issues including shorter-than-expected battery life and inadequate range (Engineering and Technology 2019). These issues may be experienced by the City's transit system by 2055. The increase in days over 100°F will also result in increased risk from thermal expansion of and potential damage to bridges, resulting in disruptions to traffic operations in the city.

VULNERABLE POPULATION IMPACTS

By 2055, the city is projected to experience 2.25 HHEs per year for the general city population, resulting in health-related impacts and increased emergency room visits during these events. Because vulnerable populations have a lower heat sensitivity threshold during extreme heat events, these populations will experience, as described for 2035, 6.03 HHEs per year, resulting in health-related impacts and increased emergency room visits for these populations. Impacts on unhoused individuals and outside workers will continue to increase, with the severity and frequency of extreme heat days and heat wave events projected to increase further by 2055.

2055

Table 3.2-4: Summary of Potential Heat Impacts by Impact Area by around 2055

IMPACT AREA	IMPACT TYPE	THRESHOLD CRITERION	HISTORIC (1961–1990)	HIGH-EMISSIONS SCENARIO (2040–2070)	THRESHOLD SOURCE
Transportation system impact	Roadways and pavement	7 consecutive days above 108°F	0	0	DOT 2014
	Rail buckling	Days per year where the temperature hits 111°F	0	2	OFCM 2002
	Bridges and bus operations	Days above 100°F	12	42	Zimmerman 1996; Cambridge Systematics 2015
Vulnerable population impacts	Heat wave events	4-day period above 103.1°F	0.2	3.1	CEC 2019b
	Heat wave duration	Consecutive days above 103.1°F	2	7	CEC 2019b
	HHEs	Range of potential HHEs per year	N/A	3.1 – 3.8	CEC 2018a
Community function impacts	Cooling Degree Days	Days above 65°F per year	40	74	CEC 2019b
	Heating Degree Days	Days below 65°F per year	86	60	CEC 2019b

Notes: NA = not available; HHE = Heat Health Event.
Source: See sources in "Threshold Source" column of table.

As discussed in Section 2.3, increased annual average temperatures and the subsequent increase in the frequency and severity of wildfires in northern California are anticipated to result in impacts from wildfire smoke on the city's population and vulnerable populations in particular (OPR et al. 2018).

COMMUNITY FUNCTION IMPACTS

By 2055, the number of CDDs will increase from 40 to 74, an 85-percent increase over historic levels. This is expected to disproportionately affect low-income residents who, in general, contribute a higher percentage of their monthly income to utilities, such as energy use for cooling (Calkins et al. 2016).

First discussed in Section 2.3, increased energy demand for cooling during extreme heat events will place increased stress on the electricity grid, increasing the risk of blackouts or brownouts, when energy demand exceeds the power generation capacity of the grid (Auffhammer et al. 2017). By 2055, these events will increasingly cause impacts on business operations, disruptions to the City's traffic signal operations, and decreases in productivity and economic activity.

Table 3.2-4 provides a summary of the heat-related impacts anticipated to occur by 2055.

CHANGES IN PRECIPITATION AND FLOODING

REGIONAL CHANGES IN PRECIPITATION AND STORM EVENTS

By 2055, it is projected that watersheds affecting the Sacramento River, including the Feather River, Yuba River, Bear River, American River, and Cosumnes River. as well as portions of their tributaries, will experience an approximately 9- to 11-percent increase in annual average precipitation affecting these watersheds. (CEC 2019a). However, although the Sacramento Valley and adjacent regions are anticipated to experience only moderate increases in annual precipitation, research indicates that the majority of the increase in annual rainfall at the regional and local levels is anticipated to occur during large storm events, which are projected to increase in size and frequency.

As noted in Section 2.3, the recent 2012–2016 drought followed by the 2016–2017 flood events throughout the state serves as a good example of the type of whiplash events that will occur more frequently over the next century. These types of flooding events are estimated to increase by approximately 25 percent in northern California, with increases in frequency occurring largely after 2055 (Swain et al. 2016).

SEA-LEVEL RISE AND FLOODING

Although the city is not located directly in the Sacramento–San Joaquin Delta (Delta), it is adjacent to the Delta region and could be affected by flood impacts from the system. When the Sacramento River reaches its peak capacity, the American River and other tributaries that flow into the Sacramento River cannot discharge at normal rates. These conditions result in "backflows," which can cause tributaries to overflow and flood local areas. The areas of the Sacramento River closest to the Delta are also affected by ocean tides. High tides that occur simultaneously with high river flows could increase the chances of flooding. Research conducted for California's *Fourth Climate Change Assessment Statewide Report* and the *Central Valley Flood Protection Plan* indicates that future changes in hydrologic patterns and sea-level rise will affect water levels in the Delta (CEC and CNRA 2018). This research includes hydrologic modeling to understand the effect both sea-level rise and the projected increase in the intensity of storm events will have on the Delta, particularly during large storm events. Research results indicate that sea-level rise will increase the base elevation of waterways in the Delta and, therefore, will have an impact on upstream waterways that feed into the Delta (e.g., Cosumnes River, Sacramento River). However, the research notes that sea-level rise has a larger effect on water surface elevation in locations closer to the center of the Delta, toward the San Francisco Bay. Further upstream to the riverine system, sea-level rise has a smaller effect on water surface elevation because the channel bottom's slope increases while the amplitude of the tide further up the Delta and away from the coast decreases. Notably, the research indicates that the water surface elevation in the San Joaquin River could increase as much as 7 feet for the 200-year return period flood event, which would overtop the levee near the City of Stockton (CEC and CNRA 2018).

LOCAL CHANGES IN PRECIPITATION AND STORM EVENTS

By 2055, annual average precipitation in both the city and Sacramento County is projected to remain relatively the same compared to 2035, with increases between 10 and 11 percent over historic levels. Although annual precipitation is anticipated to increase in the city over the coming decades, the majority of the increase in precipitation is likely to occur during extreme precipitation events (Swain et al. 2018). As a result, it is important to understand how these shifts in extreme precipitation events will affect the city and regional watersheds, which affect the stormwater drainage system and larger waterways in the city, although they begin outside the city boundaries. This analysis includes data on projected changes in annual precipitation and changes in the intensity, duration, and frequency (IDF) of extreme precipitation events that will affect the city, and it has the ability to identify changes at various geographic levels. Considering that impacts on the city from shifts in precipitation are affected by watersheds both within and outside the city boundaries, the analysis identifies precipitation changes at the larger, watershed level for four watersheds affecting the city. This analysis includes climate data from four watersheds that affect the City's stormwater drainage system and waterways in or near the city (Morrison Creek and Snodgrass Slough watersheds) and have importance to regional flooding impacts which may affect the City as well as the surrounding regions including the Sacramento River (Deer Creek and Upper Cosumnes River watersheds).

As shown in Figure 3.2-4, the Morrison Creek watershed affects northern and eastern portions of the city and includes tributaries to Laguna Creek, which runs east to west through the city and flows into Morrison Creek just north of the city limits. The Morrison Creek watershed also affects Elk Grove Creek, which flows into Laguna Creek near Lewis Stein Road. The Snodgrass Slough watershed affects the southern and eastern portions of the city and contributes to runoff in the Shed C Channel, Franklin Creek, and Ehrhardt Channel in the southern part of the city, as well as the detention basins in areas west of Bruceville Road. The Deer Creek and Upper Cosumnes River watersheds are located southeast of the city and affect regional flooding impacts from the Sacramento River.

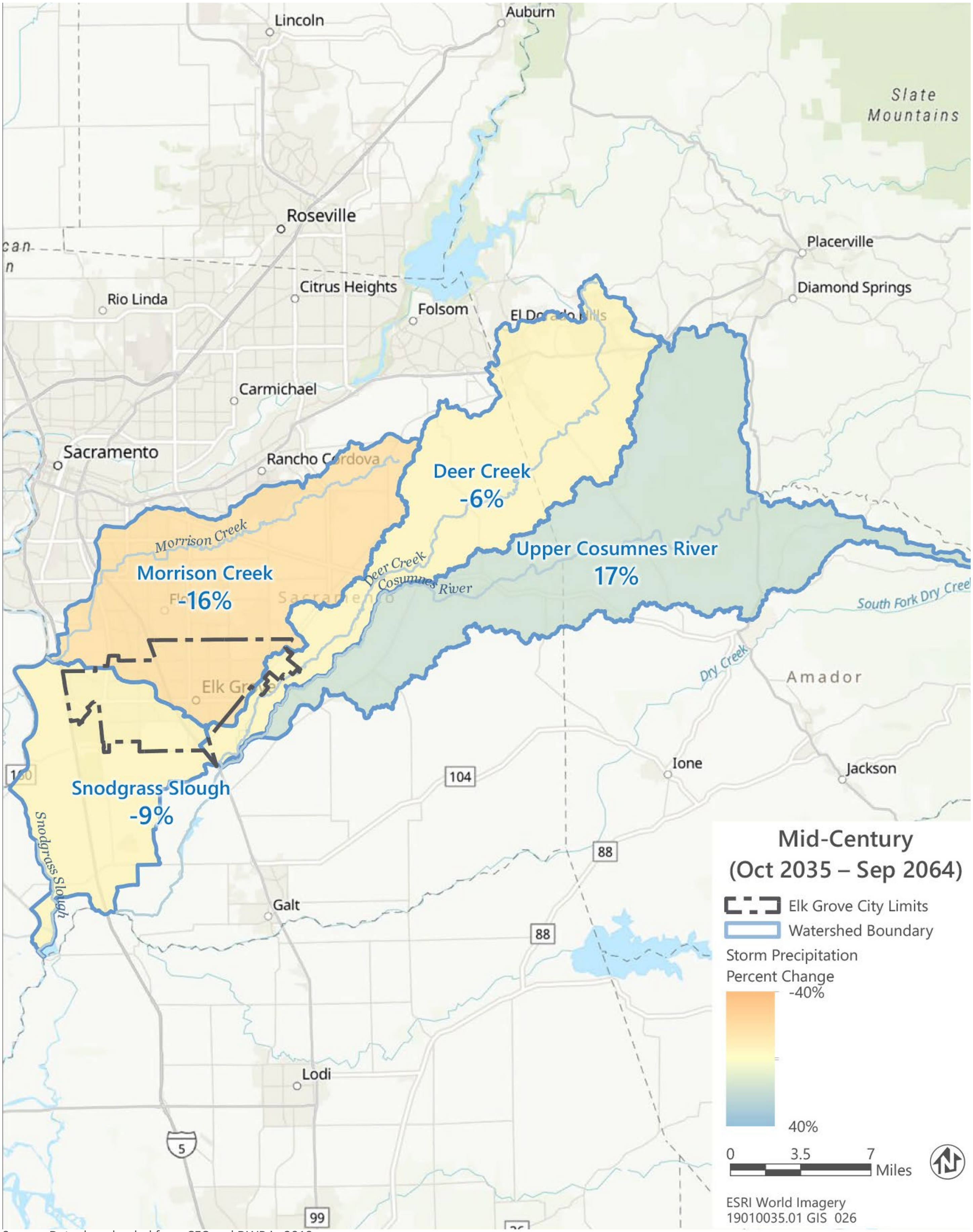
The characteristics of extreme precipitation events are what are most commonly used to model and design urban stormwater drainage systems to ensure these systems can withstand the rainfall and stormwater runoff that occurs during these events. This analysis looks at the 2-, 10-, and 100-year storm events for rainfall over a 24-hour period, which are used to design the City's stormwater drainage system and are included in the *Sacramento County Drainage Manual.*

Figure 3.2-4 illustrates the changes in rainfall during the 100-year storm event in the midcentury period. By around 2055, the Morrison Creek watershed is projected to experience a decrease in the rainfall during the 100- and 10-year storm event and a slight increase in the 2-year storm event under the high-emissions scenario. The Snodgrass Slough watershed is projected to experience a slight decrease in rainfall during the 100-year storm event and a noticeable increase in the 2- and 10-year storm event under the high-emissions scenario. The Deer Creek watershed will experience a slight decrease in rainfall during all size storm events under the high-emissions scenario. The largest change will occur in the Upper Cosumnes River watershed, which will experience a 17-percent increase in rainfall during the 100-year storm event under the high-emissions scenario.

Certain populations such as the elderly and those with limited mobility are more vulnerable to flooding impacts. Consumes Fire Department helps evacuate residents in the Point Pleasant neighborhood south of Elk Grove in the winter of 2018

Source: CBS Sacramento 2017

Figure 3.2-4: Changes in Rainfall during Extreme Precipitation Events in Watersheds Affecting Elk Grove – High-Emissions Scenario from 2035 through 2064



Source: Data downloaded from CEC and DWR in 2019

2055

In addition to changes in the total rainfall occurring during these events, by 2055, the four watersheds will experience an increase in the maximum duration during the 100-storm event, with a range between 17 and 24 percent depending on the watershed. The number of extreme precipitation events during the water year (October through September) is also projected to increase. By 2055, these four watersheds will experience an approximately 2.7- to 3.1-day increase in the total number of extreme precipitation events by the end of the century. The timing of when these extreme precipitation events will occur during the year is also anticipated to change, with these events occurring over a more condensed period in December through February with a decrease in events during October and November (CEC 2019c).

PRECIPITATION- AND FLOOD-RELATED IMPACTS

As discussed above, by 2055, the city will continue to experience increases in annual average precipitation and extreme precipitation events at both the regional and the local levels. This section establishes a framework of understanding of the types of systems that will be affected by changes in annual precipitation and extreme precipitation events while also discussing the impacts on these systems expected to occur by 2055.

STORMWATER MANAGEMENT AND DRAINAGE IMPACTS

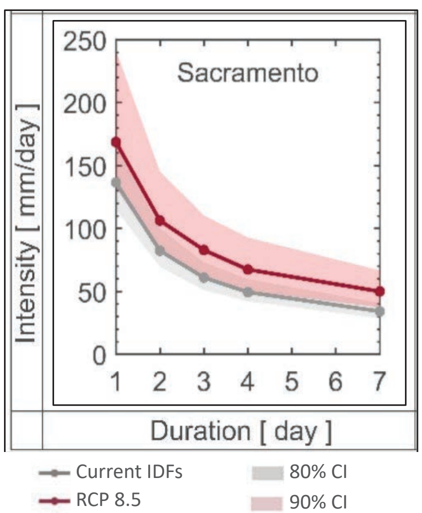
The City's stormwater drainage system is the primary mechanism in place to manage stormwater runoff during rainfall and storm events and protect properties from larger storm events (Sacramento County 2017). Increases in precipitation and the intensity of storm events will affect the performance of the City's stormwater management system and, as a result, affect the local transportation system and other key community components.

As discussed above, climate change is projected to shift precipitation patterns of storm events in watersheds affecting the city. Watersheds affecting stormwater infrastructure in the city will experience increases and decreases (ranging from 12 to 16 percent) in the intensity of 2-, 10-, and 100-year storm events by around 2055. These shifts are not anticipated to have a large impact on the performance of the City's stormwater drainage system, particularly because there will be decreases in the intensity of the 100-year storm events. However, the maximum duration and frequency of storm events are both anticipated to increase by 2055 under the high-emissions scenario, which will provide additional stress to the City's stormwater drainage system. In addition, the increased intensity and frequency of very large storm events (e.g., AR storms) are likely to compromise the performance of the City's stormwater drainage system.

The design of all bridges, culverts, and channels assume certain flow rates (e.g., cubic feet of water per second passing through a culvert) for different-size storm events and specific characteristics of stormwater runoff based on local variables (e.g., land uses, soil types). Increases in the intensity of future storms could increase the flow rate of water in creeks and channels in the city during these events and, depending on the size of the storm event, could exceed the design capacity of these components of the stormwater infrastructure. This could result in existing components of infrastructure being unable to manage future flows, leading to backups that cause localized flooding on roadways and properties adjacent to culverts and channels (McCurdy and Travis 2018). Because the City's stormwater drainage system is designed to manage large storm events, increases in the intensity of smaller events may not affect the system to the same degree. However, increases in the intensity of 100-year storm events will have much larger impacts on the City's stormwater drainage system.

Shifts in the IDF curve can also increase the risk that detention basins, which are designed to store and release runoff during heavy rainfall events, exceed their design capacity and cause localized flooding near detention basins (Elshorbagy et al. 2018). The design capacity of these detention basins will be exceeded because of the increased intensity of storm events under both the low- and the high-emissions scenarios, likely resulting in impacts on the surrounding area, particularly during large storm events. As noted in research conducted for California's Fourth Climate Change Assessment, increases in the IDF of extreme precipitation can adversely affect the integrity of infrastructure, particularly natural and engineered slopes (CEC 2018b). Figure 3.2-5 shows the expected shifts in the IDF curves for the Sacramento region by 2100 under the high-emissions scenario, including the confidence interval for both current and future IDF curves. As shown in Figure 3.2-5, the increases in the variability of the 90-percent confidence interval for the future IDF curve indicate that the uncertainty in the size of storm events will increase, making the task of designing new facilities for future storm intensities more difficult. The exact impacts on stormwater infrastructure from shifts in the IDF curve depend on the specific geographic context of the systems, as well as the magnitude of the anticipated shifts. However, the repeated occurrence of storm events that exceed the designed capacity of a stormwater system will likely affect the integrity and performance of the systems over their lifetime (CEC 2018b).

Figure 3.2-5: Changes in the Sacramento Region IDF Curve



Source: CEC 2018b

Twenty two train car derailment near the Cosumnes River south of Elk Grove in 2017

Source: The San Diego Union Tribune 2017

LEVEE IMPACTS

Increases in precipitation and particularly in the intensity and frequency of extreme precipitation events attributable to climate change will have impacts on the integrity of levee systems (Jasim et al. 2017). Shifts in the IDF curve, particularly during multiday events, can increase the risk of levee failure. A study that modeled the impacts of projected changes in IDF curves on the Elkhorn Levee in Sacramento County found that the probability of levee failure could increase between 3 and 12 percent during projected extreme precipitation events under the high-emissions scenario when compared to the baseline scenario. Levee systems, particularly systems not maintained through the federally protected levee system, are subject to other factors that can compromise their structural integrity, including land subsidence and climatic conditions, which will be exacerbated by climate change (Jasim et al. 2017). The combination of land subsidence and specific climatic conditions, including drought and severe flooding, can further threaten the structural integrity of these aging levees (Robinson and Vahedifard 2016). The city is protected by a number of levee systems, including the Laguna West system, levees along the Sacramento River near the city, and older levees that protect properties along the Cosumnes River and Deer Creek. Based on the research referenced above, these levee systems will be at increased risk of failure because of increasingly intense storm events, as well as increases in the frequency of these events.

3.2-3 ELK GROVE BEYOND 2055

This section focuses on changes in climate variables beyond 2055. Because the climate projections and associated impacts beyond 2055 depend largely on trends in global GHG emissions, this section provides a discussion of impacts under both the low-emissions and the high-emissions scenarios. The projected changes discussed represent the average changes expected to occur between 2070 and 2099.

CHANGES IN TEMPERATURE AND EXTREME HEAT EVENTS

By the end of the century (2070–2099), under the low-emissions scenario, the city's annual average temperature is projected to increase by 5.5 degrees over historic levels to 79.2°F, an approximately 8-percent increase. Over this same time period, under the high-emissions scenario, the city's annual average temperature is projected to increase by 8.4 degrees to 82.1°F, an approximately 11-percent increase over historic levels. As noted previously, small increases in annual average temperature are indicators of much larger changes in the ecosystem, as well as increases in extreme heat events (OPR et al. 2018).

Table 3.2-5: Changes in Annual Extreme Heat Days and Heat Wave Events from 2070–2099

EXTREME HEAT INDICATOR	EMISSIONS SCENARIO (2070-2099)	
	LOW EMISSIONS (RCP 4.5)	HIGH EMISSIONS (RCP 8.5)
Number of annual extreme heat days (daily max temp of 103.1°F)	23 DAYS	40 DAYS
Annual heat wave event frequency (4+ consecutive days above 103.1°F)	2.7 HEAT WAVE EVENTS	5.8 HEAT WAVE EVENTS
Average heat wave duration (days)	6.6 DAYS	11.1 DAYS

Notes: extreme heat day = day with a daily maximum temperature of 103.1°F or above; heat wave event = 4 or more consecutive days above 103.1°F.
Source: CEC 2019b

As shown in Table 3.2-5, by the end of the century (2070–2099), under the low-emissions scenario, the city is projected to experience an increase in the number of annual extreme heat days from 4 historically to approximately 23 (Table 3.2-5). Under the same scenario and time period, the city will experience an average of 2.7 heat wave events per year, with the average duration of these events increasing from 2 days, historically, to 6.6 days. By the end of the century (2070–2099), under the high-emissions scenario, the number of annual extreme heat days will increase to approximately 40 (Table 3.2-5). Under this scenario and time period, the city will experience an average of 5.8 heat wave events per year, with the average duration of these events increasing from 2 days, historically, to 11.1 days.

HEAT-RELATED IMPACTS

By the end of the century, the number of extreme heat days and extreme heat events will continue to increase, along with the frequency and duration of extreme heat events. These events will continue to place stress on the city's built environment and increase the severity of impacts on city residents and normal community functions.

TRANSPORTATION SYSTEM IMPACTS

As the city's annual average temperature and the severity and duration of extreme heat events continue to increase beyond 2055, the impacts that will begin to take effect by 2035 and continue through 2055 will, in large part, remain the same through the end of the century under the low-emissions scenario and will become increasingly severe under the high-emissions scenario.

Pavement Deterioration

By the end of the century (2070–2099), under the low-emissions scenario, temperature increases and increases in extreme heat events are not anticipated to have a large effect on the roadway conditions in the city, with impacts remaining similar to those experienced by 2055. There would likely not be any extended periods (7 consecutive days) above 108°F during this period; therefore, there would not be widespread impacts from pavement deterioration in the city. However, under the high-emissions scenario, there would be an average of 0.4 event per year with extended periods (7 consecutive days) above 108°F. These events will result in much larger impacts on the performance of pavements in the city. Extensive rutting could occur, particularly on high-volume roadways, including Elk Grove Boulevard and Laguna Boulevard, as well as on California Department of Transportation facilities (i.e., SR 99 and Interstate 5), if actions are not taken to increase the resilience of the roadway network to extreme heat events.

Rail Buckling

Between 2070 and 2099, under the low-emissions scenario, the risk to rail lines from extreme heat days will remain the same as described for 2055, with only 2 days per year with maximum temperatures over 111°F per year. However, during the same period under the high-emissions scenario, there will be approximately 7 days per year with maximum temperatures over 111°F per year and with at least 2 days per year over 115°F. As noted above, although the increase in the number of days with maximum temperatures over 111°F does not guarantee that rail buckling will occur, the overall likelihood of these events occurring will increase, increasing overall risk to the city and its residents from potential train derailments.

Public Transportation Operations and Bridges

By the end of the century (2070–2099), under the low-emissions scenario, the impacts on bus operations and the risk from thermal expansion of bridges will continue to increase, with the number of days above 100°F increasing from 12 historically to 41 during this period, similar to the impacts experienced by 2055. However, during the same period under the high-emissions scenario, the number of days above 100°F will increase from 12 historically to 62 per year. This increase will continue to place stress on buses and their air conditioning systems, as well as result in likely declines in transit ridership during these periods.

VULNERABLE POPULATION IMPACTS

Between 2070 and 2099, under the low-emissions scenario, the city is projected to experience 2.95 HHEs per year across the entire city population. During the same period under the high-emissions scenario, the city is projected to experience 4.3 HHEs per year. These impacts will be even more severe for vulnerable populations.

BEYOND 2055

Table 3.2-6: Summary of Potential Heat Impacts by Impact Area from 2070 through 2099

IMPACT AREA	IMPACT TYPE	THRESHOLD CRITERION	HISTORIC (1961–1990)	LOW-EMISSIONS SCENARIO (2070–2099)	HIGH-EMISSIONS SCENARIO (2070–2099)	THRESHOLD SOURCE
Transportation system impact	Roadways and pavement	7 consecutive days above 108°F	0	0	0.4	DOT 2014
	Rail buckling	Days per year where the temperature hits 111°F	0	2	7	OFCM 2002
	Bridges and bus operations	Days above 100°F	12	41	62	Zimmerman 1996; Cambridge Systematics 2015
Vulnerable population impacts	Heat wave events	4-day period above 103.1°F	0.2	2.7	5.8	CEC 2019b
	Heat wave duration	Consecutive days above 103.1°F	2	6.6	11.1	CEC 2019b
	HHEs	Range of potential HHEs per year	N/A	N/A	4.6 – 5.4	CEC 2018a
Community function impacts	Cooling Degree Days	Days above 65°F per year	40	74	79	CEC 2019b
	Heating Degree Days	Days below 65°F per year	86	60	45	CEC 2019b

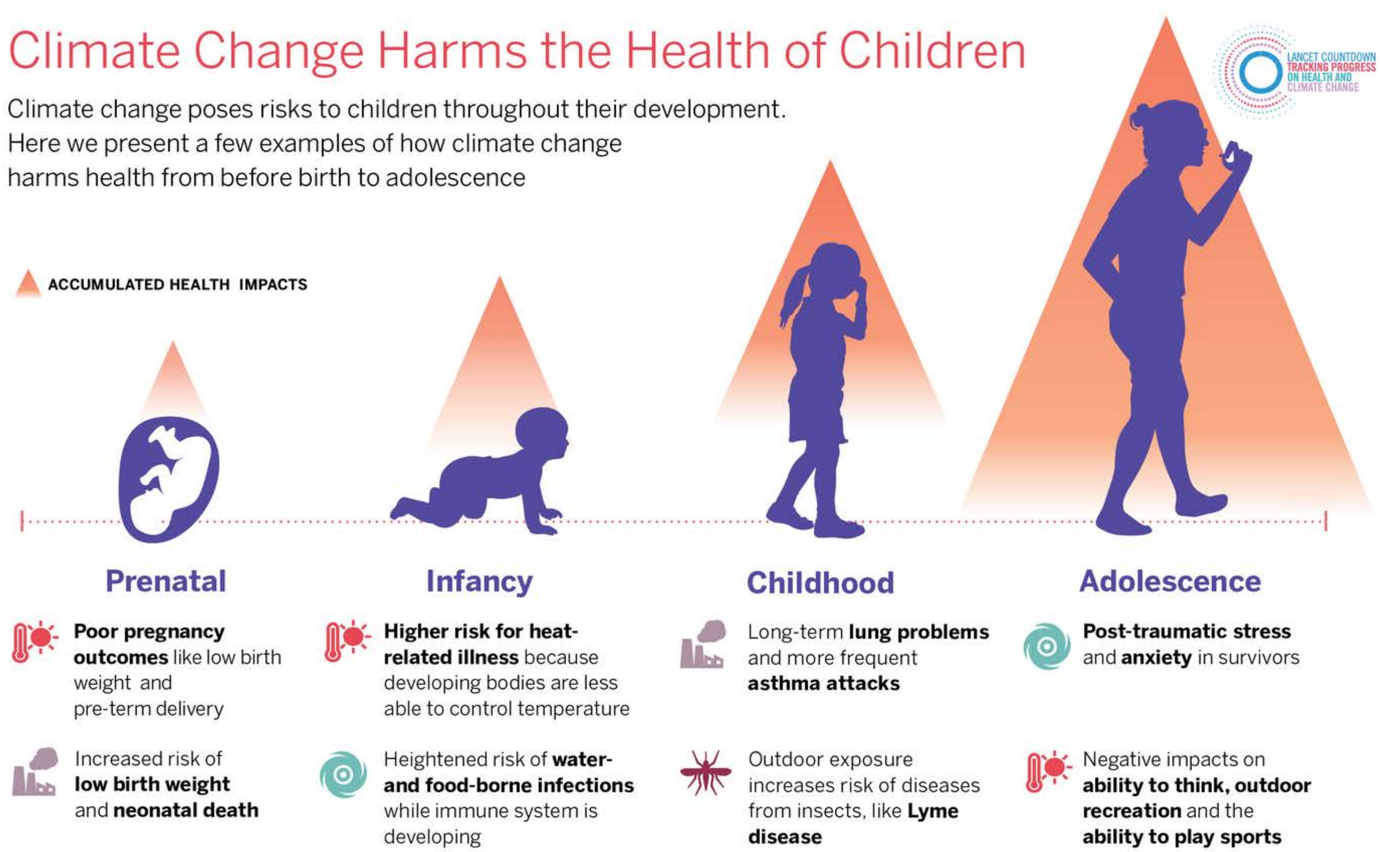
Notes: NA = not available; HHE = Heat Health Event.
Source: See sources in the "Threshold Source" column of the table.

Between 2070 and 2099, vulnerable populations will experience 6.73 HHEs per year under the low-emissions scenario and 7.73 HHEs per year under the high-emissions scenario. These events will result in increased emergency room visits and increased mortality rates for vulnerable populations during these events if the city and community do not take steps to mitigate these impacts. As noted above, by the end of the century (2070–2099), under the high-emissions scenario, an average of 5.8 heat wave events per year would occur, with the average duration of these events increasing from 2 days, historically, to 11.1 days. These events are likely to have disproportionately high impacts on vulnerable populations, including youth, the elderly, low-income populations, and the unhoused community, as discussed previously.

COMMUNITY FUNCTION IMPACTS

Between 2070 and 2099, under the low-emissions scenario, the number of CDDs will increase from 40, historically, to 74, similar to the increase experienced by 2055. During the same period under the high-emissions scenario, the number of CDDs will increase slightly to 79. These increases are expected to disproportionately affect low-income residents who, in general, contribute a higher percentage of their monthly income to utilities, such as energy use for cooling (Calkins et al. 2016). The increased energy demand for cooling during extreme heat events will place increased stress on the electricity grid, increasing the risk of blackouts or brownouts, causing impacts on business operations, disruptions to the City's traffic signal operations, and decreases in productivity and economic activity in the city.

Table 3.2-6 provides a summary of the heat-related impacts anticipated to occur between 2070 and 2099.



Source: Harvard University 2019

BEYOND 2055

CHANGES IN PRECIPITATION AND FLOODING

REGIONAL CHANGES IN PRECIPITATION AND STORM EVENTS

Between 2070 and 2099, under the low-emissions scenario, it is projected that watersheds affecting the Sacramento River will experience an approximately 9- to 10-percent increase in annual average precipitation over historic levels, similar to the increase experienced by 2055. During the same period under the high-emissions scenario, it is projected that these watersheds will experience an approximately 19- to 20- percent increase in annual average precipitation.

LOCAL CHANGES IN PRECIPITATION AND STORM EVENTS

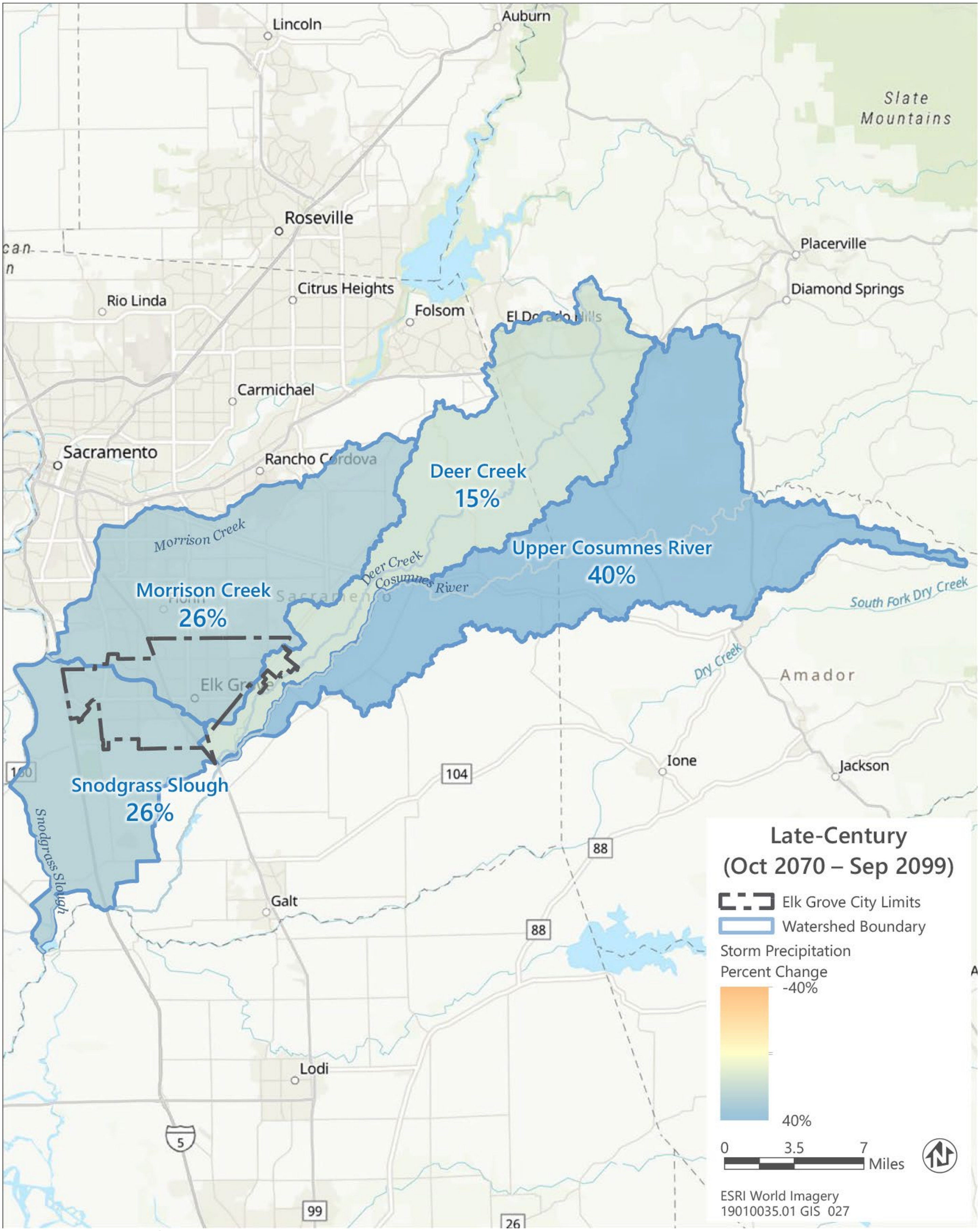
Between 2070 and 2099, under the low-emissions scenario, annual average precipitation in the city is projected to remain relatively the same compared to 2035, increasing 13 percent over historic levels. During the same period under the high-emissions scenario, the city is projected to experience a 24-percent increase in annual average precipitation over historic levels. As noted previously, the majority of the increase in annual rainfall at the regional and local level is anticipated to occur during large storm events, which are projected to increase in size and frequency (Swain et al. 2018). Table 3.2-7 includes the changes in the intensity of the 2-, 10-, and 100-year storm events between 2070 and 2099 for both a low-emissions and a high-emissions scenario. Figure 3.2-6 includes the location of each of the four watersheds affecting the City as well as their relative precipitation changes between 2070-2099 under the RCP 8.5 scenario.

Table 3.2-7: Changes in Intensity of Storm Events through 2099 under the Low- and High-Emissions Scenarios

WATERSHEDS	LATE CENTURY (2070–2099)					
	LOW-EMISSIONS (RCP 4.5) SCENARIO			HIGH-EMISSIONS (RCP 8.5) SCENARIO		
	2-YEAR	10-YEAR	100-YEAR	2-YEAR	10-YEAR	100-YEAR
Morrison Creek	+20%	+6%	+5%	+20%	+22%	+26%
Snodgrass Slough	+13%	+12%	+8%	+28%	+27%	+26%
Upper Cosumnes River	-3%	+2%	+17%	+8%	+17%	+40%
Deer Creek	-3%	-5%	-6%	+11%	+12%	+15%

Note: RCP = Representative Concentration Pathway.
Source: Impact areas identified by Ascent Environmental in 2019

Figure 3.2-6: Changes in Rainfall during Extreme Precipitation Events in Watersheds Affecting Elk Grove – High-Emissions Scenario from 2070 through 2099



Source: Data downloaded from CEC and DWR in 2019

BEYOND 2055

In addition to changes in the total rainfall occurring during these events, between 2070 and 2099 under the low-emissions scenario, all four watersheds will experience increases in the maximum duration of storm events, with a range between 22 and 24 percent depending on the watershed. During the same period under the high-emissions scenario, it is projected that the maximum duration of storm events will increase between 31 and 41 percent depending on the watershed. Between 2070 and 2099 under the low-emissions scenario, all four watersheds will experience an approximately 1-day increase in the total number of extreme precipitation events per year and a 3-day increase under the high-emissions scenario. The timing of when these extreme precipitation events will occur during the year is also anticipated to change, with these events occurring over a more condensed period in December through February with a decrease in events during October and November (CEC 2019d).

PRECIPITATION AND FLOOD-RELATED IMPACTS

Between 2070 and 2099, three out of the four watersheds affecting stormwater infrastructure in the city will experience increases in the IDF of the 100-year storm event under the low-emissions scenario, and all will experience a large increase in the 100-year storm under the high-emissions scenario. However, the range of increases will vary based on the emissions scenario and the watershed. These changes are anticipated to have substantial impacts on the City's stormwater drainage system (e.g., decreased performance, localized flooding for facilities not able to manage increased rainfall, degradation of the subbase foundations for roadways, bridge scour) and areas adjacent to the waterways in the city, including those located in or near a Federal Emergency Management Agency 100-year floodplain.

Because the City's stormwater drainage system is designed to manage large storm events based on historic data, increases in the intensity and duration of 100-year storm events will have large impacts on the City's stormwater drainage system. Although future development in the city is able to include stormwater infrastructure that is adequately sized for these increases, existing stormwater infrastructure in the city will likely be compromised during larger storm events.

KEY IMPACT AREAS

As shown in Figure 3.2-7, eight areas in the city have been identified as having particularly high flood risk as a result of climate change. These areas, in some cases, are located in areas of the city adjacent to vulnerable populations or critical facilities. The areas identified were assessed (i.e., low, mid, and high) based on the characteristics and magnitude of flood impacts anticipated to occur, as well as the sensitivity of surrounding land uses, facilities, and populations. The locations of the focus areas are listed in Table 3.2-7 and shown in Figure 3.2-7. Because the impact areas face varying levels of risk under the low- and high-emissions scenarios, the areas included in Table 3.2-7 are not ranked based on priority but rather illustrate the risk level of each area under both emissions scenarios between 2070 and 2099.

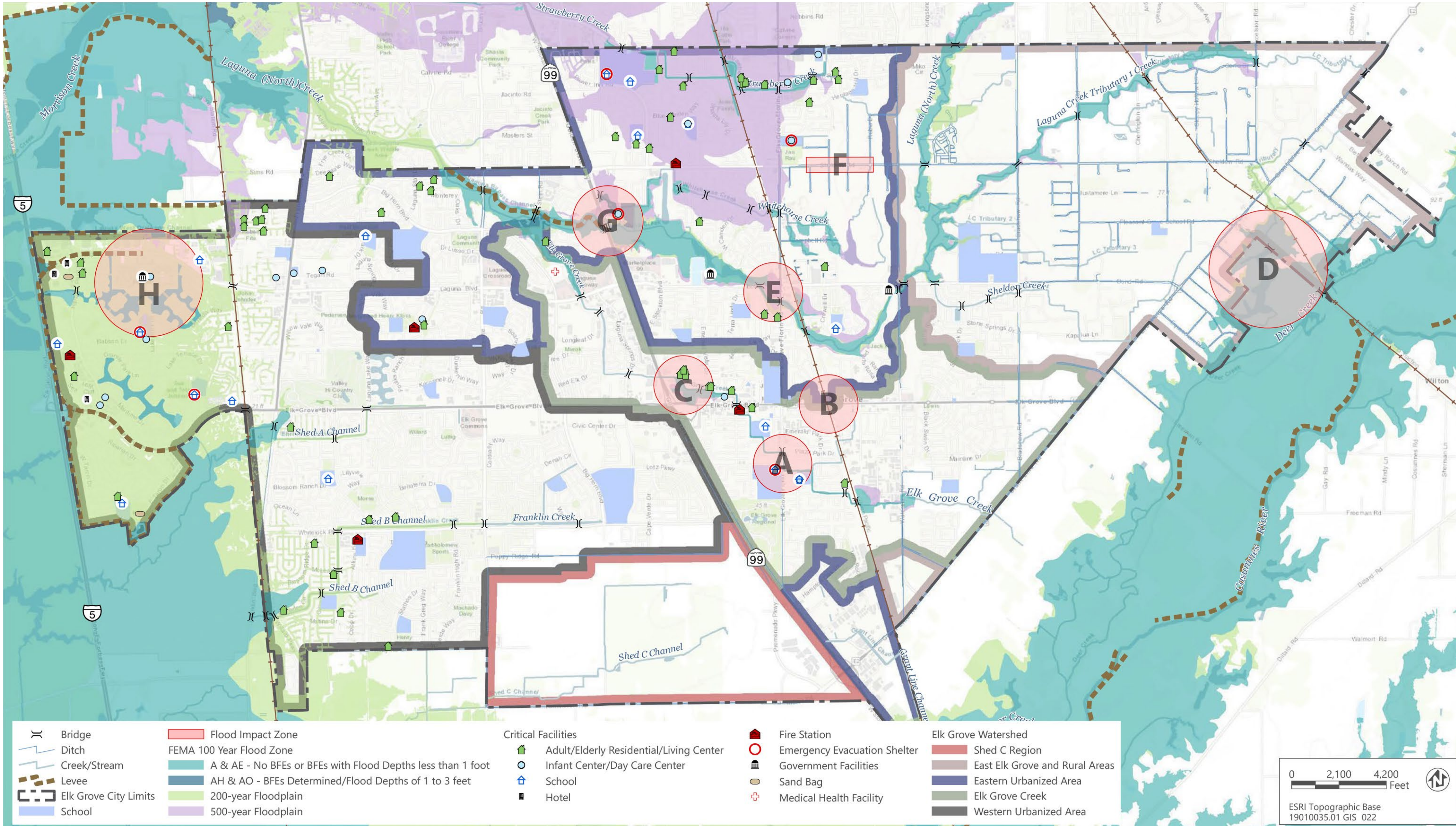
As part of the impact analysis conducted for this Plan, six indicator variables were identified that characterize various potential impacts on the City's drainage and transportation systems. The eight key locations identified were analyzed based on the presence of certain drainage and transportation assets and the extent these assets would be affected. The indicator variables included are the presence of a:

- **road** adjacent to or in the identified flood area,
- **railway** adjacent to or in the identified flood area,
- **road or rail bridge** adjacent to or in the identified flood area,
- **bus route** adjacent to or in the identified flood area,
- **bike lane** adjacent to or in the identified flood area, and
- **stormwater detention basin** adjacent to or in the identified flood area.

This analysis also identified vulnerable populations in the City, as well as key components of the City's normal functions, that may be at increased risk from flooding impacts in specific areas of the City. The following social and community function–related indicators were included in the overall scoring analysis:

- Social Vulnerabilities:
  - Senior populations (65 and older)
  - Youth populations (5 years and younger)
  - Households experiencing linguistic isolation

Figure 3.2-7: Flood and Precipitation Impacts in Elk Grove from Climate Change



Source: Data received and downloaded from City of Elk Grove in 2019

  - o Low-Income households
  - o Households without access to a vehicle
  - o Census tract scores from the CalEnviroScreen 3.0 tool
- Community Function Vulnerabilities:
  - o Average daily traffic on adjacent roadways
  - o Presence of electrical substation in or near the identified flood area
  - o Commercial or Industrial land use in or near the identified flood area
  - o Presence of government or other critical facility in or near the identified flood area

Table 3.2-8 provides a summary of the vulnerability of each area based on the number of specific populations and facilities in these impact areas that are at increased vulnerability from flooding impacts beginning in 2055 and are at increasing risk under the high-emissions scenario between 2070 and 2099. For a detailed discussion of the indicators used to identify and rank these key impact areas, see the flooding and precipitation white paper developed in preparation for this Plan on the City's website[6].

As shown in Table 3.2-8, most locations are at the midlevel of risk under the low-emissions scenario between 2070 and 2099. Under the high-emissions scenario, the risk to these areas grows significantly in all focus areas with the magnitude of the 100-year storm events increasing above historic levels. However, by this period, impacts on these areas will occur under both the low-emissions and the high-emissions scenarios, with impact severity remaining relatively the same between 2055 and the end of the century under the low-emissions scenario. This means that the impact projections for 2055 can serve as a baseline for the level of impacts anticipated to occur in the city by 2070 through 2099, regardless of future emissions trends. For a detailed discussion of the anticipated impacts on the four regions in the city and a discussion of the key focus areas included in each of these regions, see the flooding and precipitation white paper developed in preparation for this Plan on the City's website[7]. The regions can be seen in Figure 3.2-7. Figure 3.2-7 also includes Shed C region, which is included in the western urbanized region in Tables 3.2-8 and 3.2-9.

6 https://www.elkgrovecity.org/city_hall/departments_divisions/city_manager/strategic_planning_and_innovation/community_mobility_resilience_project

7 https://www.elkgrovecity.org/city_hall/departments_divisions/city_manager/strategic_planning_and_innovation/community_mobility_resilience_project

Table 3.2-8: Key Precipitation and Flooding Focus Areas from 2070 through 2099

ANALYSIS REGION	AREA #	FOCUS AREAS	PRIORITY RANKING	
			LOW-EMISSIONS SCENARIO	HIGH-EMISSIONS SCENARIO
Elk Grove Creek region	1	Valley Oak Lane at Elk Grove High School	Mid	High
	2	Old Town Elk Grove area	Mid	High
	3	East Stockton Boulevard at Emerald Vista Drive	Mid	High
East Elk Grove area/rural region	4	Sheldon area east of Grant Line Road	Mid	High
Eastern urbanized area	5	Laguna Creek at Bond Road and Elk Grove Florin Road	Mid	High
	6	Sheldon Road between Scenic Elk Court and St. Anthony Court	Low	High
	7	Laguna Creek at State Route 99 and surrounding area	Mid	High
Western urbanized area	8	Laguna West neighborhood and surrounding area	Mid	High

Note: Low, mid, and high rankings are based on the overall scores each impact area received as part of the impact analysis process.
Source: Flood impact zones areas identified by Ascent Environmental in 2019

Table 3.2-9: Precipitation and Flooding Focus Area Scoring Summary

ANALYSIS REGION	AREA #	FOCUS AREAS	FOCUS AREA SCORING CATEGORIES				
			STORMWATER AND TRANSPORTATION (6 INDICATORS)	SOCIAL VULNERABILITY (6 INDICATORS)	ECONOMIC VULNERABILITY (4 INDICATORS)	LAND USE	CRITICAL FACILITY
Elk Grove Creek region	1	Valley Oak Lane at Elk Grove High School	4/6	3/6	2/4	R	YES
	2	Old Town Elk Grove area	4/6	4/6	2/4	R, C	NO
	3	East Stockton Boulevard at Emerald Vista Drive	4/6	4/6	2/4	R, C	NO
East Elk Grove area/rural region	4	Sheldon area east of Grant Line Road	3/6	1/6	2/4	R, C	NO
Eastern urbanized area	5	Laguna Creek at Bond Road and Elk Grove Florin Road	6/6	2/6	3/4	R, C, I	NO
	6	Sheldon Road between Scenic Elk Court and St. Anthony Court	2/6	1/6	0/4	R	NO
	7	Laguna Creek at State Route 99 and surrounding area	4/6	4/6	2/4	R, C	YES
Western urbanized area	8	Laguna West neighborhood and surrounding area	5/6	1/6	2/4	R, C, I	NO

Notes: R = Residential; C = Commercial; I = Industrial.
Source: Focus areas identified by Ascent Environmental in 2019

3.3 CLIMATE RESILIENCE STRATEGY FRAMEWORK

SECTION OVERVIEW

This section includes the set of strategies the City will implement to increase the community's resilience in mitigating and responding to the impacts of climate change. The strategies included in this section are based on the extreme heat and precipitation and flooding white papers developed as part of the plan development process. The white papers include in-depth analysis of the projected changes in extreme heat and flooding throughout the 21st century as well as the anticipated impacts from these changes on the City's built environment, vulnerable populations, and community functions. The overall categories and individual strategies included in this section have been developed to respond to the anticipated impacts from climate change identified in the white paper findings.

ORGANIZATION OF THE RESILIENCE STRATEGY FRAMEWORK

The impacts of climate change on the City are anticipated to exacerbate existing hazards (e.g., flooding, heat waves) and present potential new and unforeseen challenges for the City and its residents. As a result, the resilience strategies are organized into categories that focus on particular assets or systems in the City and include specific strategies targeted at addressing individual hazard-related issues. The categories are organized to include strategies that mitigate multiple climate-related impacts (e.g., extreme heat, flooding) to that particular asset or system as well as providing tools for addressing related unforeseen issues. The individual strategies in each category highlight key information, including what impact is addressed by the strategy, what mechanism is being used to address the impact, how the strategy may be implemented, and the source document used to develop the strategy. The following information is presented for each strategy in the section:

RESILIENCE STRATEGY FRAMEWORK

- **Strategy Name and Number:** Provides the number of the strategy for reference purposes and lists the name of each strategy.
- **Strategy Details**: Details specifics for the strategy and highlights where there is a cross-over between the strategy and actions included in Chapter 10, "Implementation Strategy," of the City's General Plan (GP).
- **Adaptation Mechanism:** Describes the principle being used to increase the resilience and mitigate extreme heat or flooding impacts in the City.
- **Implementation Mechanism**: Describes how the strategy would be implemented. The mechanisms in this category are consistent with those included in the U.S. Environmental Protection Agency's Regional Resilience Toolkit (EPA 2019).
- **Responsible Department**: Identifies the City department likely responsible for implementing the strategy, as well as supporting departments and local or regional partners. Appropriate organizations are identified, although others not shown may also be included in the effort
- **Timeline**: Identifies the period when the strategy should be implemented with a total time frame between 2022 and 2035.
- **Source/Example**: Identifies the source document or plan that was used to develop the strategy and provides information about the effectiveness of the strategy and implementation details.

3.3.1 A RESILIENT ROADWAY NETWORK AND STORMWATER MANAGEMENT SYSTEM

A well-functioning and comprehensive roadway network is an essential system for any city to function and thrive. Increases in annual average temperatures and the intensity and frequency of heat wave events will place increased stress on transportation assets (e.g., roads, rails, bridges) and could result in the reduced performance or failure of the assets. Storm events exceeding storm levels for facilities designed to manage smaller storm events (2- and 10-year storm events), anticipated to occur largely after 2050, will result in increased localized flooding. Large storm events that exceed the design storm levels for flood management systems such as levees (100-year storms and above) will result in increased stress on these systems and potentially compromise the integrity of flood management assets. This set of strategies focuses on increasing the resilience of the City's roadway network (e.g., roads, bridges) and supporting systems (e.g., stormwater management system) to the future impacts of climate change. This set of strategies focuses on improvements to how the City's roadway network is designed, constructed, and maintained over time to account for projected climate impacts.

STRATEGIES FOR HEAT-RELATED IMPACTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.1-A	Upgrade Pavement Design Standards for Extreme Heat	• Research options and upgrade the City's Construction Specification Manual and Improvement Standards Manual to better adapt to increases in extreme heat days and heat wave events. For flexible pavements, explore upgrading heat-resistant asphalt mixes, including increasing the high-temperature asphalt binder grade. For rigid pavements (i.e., concrete), explore design options for roadways and bridges, including using shorter joint spacing, thicker slabs, less rigid support, and enhanced load transfer techniques.	Increased resilience of roadways to extreme heat	Plans, regulations, and policy development	Development Services, Public Works	2040–2050	Caltrans 2013; FHWA 2017; Willway et al. 2008
3.1-B	Assess the Roadway Network's Vulnerability to Long-Term Drought	• Assess vulnerabilities and potential impact to the City's transportation assets from a long-term drought scenario. • Focus the assessment on the City's most critical (e.g., high-volume roadways) transportation assets, including bridges, roadways, and levee's owned and maintained by the City	Increased awareness of vulnera-bilities	Evaluation	Public Works	2030–2040	Caltrans 2013; Markolf et al. 2019
3.1-C	Increase Resilience and Redundancy in the City's Truck Routes	• Prioritize upgrades to the City's existing truck routes, using the City's updated design standards, to mitigate roadway impacts from extreme heat days and heat wave events. • Explore options for designating alternative routes for freight and heavy trucks that are equally more robust than existing routes to use during heat wave events.	Increased resilience of roadways to extreme heat	Plans, regulations, and policy development	Development Services, Public Works	2050–2060	DOT 2013, 2015
3.1-D	Plan for Alternative Construction Schedules to Avoid Disruptions from Extreme Heat	• Assess how projected increases in temperature and extreme heat events will affect construction schedules for capital improvement projects in the City. Develop a strategy to adjust construction schedules to avoid impacts from extreme heat on the construction and design of roadway improvement projects as well as impacts on construction workers. Consider opportunities to shift construction projects to winter and spring months to avoid disruptions from heat wave events.	Increased resilience of the population to extreme heat	Plans, regulations, and policy development	Public Works	2020–2030	DOT 2015

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.1-E	Create a Climate-Smart Stormwater Management System	• Work with Sacramento County to conduct appropriate analysis and begin the process to update the intensity, duration, and frequency curves used in stormwater infrastructure standards used for managing localized runoff and smaller precipitation events. Incorporate updated modeling in standards for new development in the City, including capital improvement projects and the City's Storm Drainage Master Plan. • Develop a comprehensive list of existing stormwater and drainage facilities that are at increased risk from failure or loss of performance from increases in the intensity of storm events. • Explore opportunities to add redundancy to the City's existing stormwater and flood management systems (e.g., additional detention basins) to mitigate impacts from increased storm intensities as needed. • Explore and identify feasible strategies (e.g., riprap, hardening) to mitigate scour for bridges. Identify critical bridges (e.g., high-volume roadways) and prioritize improvements to these bridges to prevent scour and asset failure.	Increased stormwater infrastructure capacity	Plans, regulations, and policy development	Development Services, Public Works	2020–2030	Burrel et al. 2007; Transportation Research Board and National Research Council 2008; Caltrans 2013; Wang 2015; Peck et al. 201; Pregnolato et al. 2017; Hettiarachchi et al. 2018; Markolf et al. 2019, Nemry and Demirel 2012; Wright et al. 2012
3.1-F	Prevent Roadway Degradation and Increase Local Flood Monitoring	• Explore options and implement strategy to increase durability of materials and roadway subbase design to mitigate degradation impacts from future storm intensities. • Develop, regularly update, and publish a map of areas in the City prone to localized flooding that includes the latest observational data on localized flooding near creeks, waterways, roads, and other emerging flooding areas.	Increased resilience in roadways	Plans, regulations, and policy development; evaluation	Development Services, Public Works	2030–2040	Willway et al. 2008; Li et al. 2011; Caltrans 2013; City of Seattle 2017

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.1-G	Support a Coordinated Regional Climate-Smart Flood Management System	• Work with State and regional partners, including, but not limited to, the California Department of Water Resources, the Sacramento Area Flood Control Agency, and Sacramento County, to explore options and costs for conducting a hydraulic study of waterways in the City that incorporates future intensities of large regional storm events (i.e., 50-, 100-, 200-year storms) affecting regional waterways that could impact the City (e.g., Sacramento River, Cosumnes River).	Increased awareness of vulnerabilities	Evaluation	Development Services, Public Works, California Department of Water Resources, Sacramento Area Flood Control Agency, Sacramento County	2040–2050	Wright et al. 2012; Mauger and Lee 2014
3.1-H	Upgrade the City's Laguna West Levee System to mitigate climate-related flood impacts	• Continue to evaluate potential upgrades to the Laguna West levee system to increase the City's resilience to large-scale flooding events. This strategy aligns with Action 9.6, "Infrastructure to Reduce Flood Hazards," and Action 9.5, "Floodplain Data Update," in the GP Implementation Strategy.	Increased preparedness for large flood events		Public Works	2030–2040	City of Elk Grove 2019a
3.1-I	Support Updates to the Regional Flood Warning System	• Support updates to Sacramento County's early warning system from flood events and implement strategies to increase public awareness of the warning system.	Increased preparedness for large flood events	Education, outreach, and coordination	Sacramento County, Police Department, Public Works	2040–2050	Kundzewicz 2013


Elk Grove Creek and surrounding floodplain serves as both a flood management system and linear park for residents.


Laguna West Levee in Elk Grove at Don Nottoli Park"

3.3.2 A RESILIENT TRANSPORTATION SYSTEM

Increases in annual average temperatures and the intensity and frequency of heat wave events will place increased stress on various aspects of the transportation system (e.g., public transit system, bicycle network) and may decrease usability and comfort level for users during extreme heat events. Storm events exceeding historic storm levels for facilities designed to manage smaller storm events (2- and 10-year storm events), anticipated to occur largely after 2050, will result in increased localized flooding. Large storm events that exceed the design storm levels for flood management systems such as levees (100-year storms and above), also anticipated to occur after 2050, will result in increased stress on these systems and potentially compromise the integrity of flood management assets. This set of strategies focuses on ensuring that all components of the City's transportation system, including pedestrian and bicycle infrastructure, public transit and paratransit system, and railways, are prepared for impacts associated with projected increases in average temperatures, frequency of extreme heat events, localized flooding, and large storm events.

STRATEGIES FOR HEAT-RELATED IMPACTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.2-A	Increase the Resilience of the City's Public Transit System	• Work with Sacramento Regional Transit District to assess vulnerabilities to transportation operations of the e-Tran system. • Incorporate projections of future extreme heat impacts into the transition to electric buses and the purchase of new transit vehicles as part of the Innovative Clean Transit regulations.	Increased awareness of vulnerabilities and resilience of transit operations	Programmatic	City Manager's Office, Public Works, Sacramento Regional Transit District	2020–2030	Transportation Research Board and National Research Council 2008; Caltrans 2013
3.2-B	Establish a Resilient Pedestrian and Bicycle Infrastructure Network	• Incorporate projections of future extreme heat impacts into the design and development of pedestrian and bicycle infrastructure in the City. • Identify opportunities to upgrade existing bicycle and pedestrian infrastructure to mitigate future extreme heat impacts and ensure comfort for users (e.g., tree canopy, high-albedo surfaces).	Increased resilience of pedestrian and bicycle infrastructure	Plans, regulations, and policy development	Development Services, Public Works	2020–2030	Caltrans 2013; City of Seattle 2017
3.2-C	Increase the Resilience of City Traffic Operations from Extreme Heat	• Identify and prioritize updates to high-volume roadways and truck routes that will be affected by extreme heat events. Use information from Section 2.2.1 to inform strategy implementation. • Identify potential vulnerabilities to signal operations from extreme heat events, including issues presented during brownouts and blackouts from prolonged heat waves.	Increased resilience of traffic operations to extreme heat	Plans, regulations, and policy development	Public Works	2040–2050	Transportation Research Board and National Research Council 2008; Caltrans 2013

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.2-D	Support a Resilient Rail Network	• Work with Union Pacific to identify segments of railway particularly vulnerable to flooding impacts and potential subgrade erosion. Work with Union Pacific and the California Public Utilities Commission Railroad Operations and Safety Branch to assess risk level and upgrades needed to mitigate future storm intensities.	Increased awareness of vulnerabilities	Evaluation	Public Works, Union Pacific, California Public Utilities Commission	2040–2050	Caltrans 2013
3.2-E	Ensure Robust Communication During Flood Events	• Develop a City-specific flood warning website and notification system to notify residents about flood areas in the City to help residents avoid flooded areas and reduce impacts to traffic operations. This strategy aligns with GP Implementation Strategy Action 9.11, “Public Information on Preparedness and Services for Extreme Weather Events.”	Increased awareness of vulnerabilities	Education, outreach, and coordination	City Manager’s Office, Sacramento County Office of Emergency Services , Public Works	2030–2040	Sacramento County 2019
3.2-F	Increase the Resilience of City Traffic Operations from Flood Events	• Analyze the City’s traffic signal system to identify key points of sensitivity to flooding. Prioritize reducing risk of flooding impacts to key points of sensitivity for the City’s traffic signal system.	Increased awareness of vulnerabilities	Evaluation	Public Works	2040–2050	Caltrans 2013

Elk Grove Creek Trail


Bike Trails in east Elk Grove

3.3.3 A RESILIENT BUILT ENVIRONMENT

Increases in annual average temperatures and the intensity and frequency of heat wave events will increase the effects of the urban heat island (UHI) effect in the City, with effects amplified in commercial and industrial land uses and surrounding areas due to the presence of large paved areas (e.g., parking lots). Impacts on the City's stormwater and flood management systems could result in secondary impacts on specific transportation assets in the City, including increased degradation rates for specific facilities and decreased system performance. This set of strategies focuses on making upgrades to the City's built environment (e.g., roads, buildings, parks, landscaped spaces) to better mitigate the impacts of the UHI effect and heat wave events.

STRATEGIES FOR HEAT-RELATED IMPACTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.3-A	Implement Cool Pavement Road Map for the City	• Develop and implement a cool pavement "road map" to implement Policy ER-6-4 of the City's GP, which focuses on using cool pavements and higher-albedo impervious materials, as well as trees and foliage along rights-of-way. This strategy aligns with GP Implementation Strategy Action 13.2, "Public Works Standards."	Increased albedo of paved surfaces	Plans, regulations, and policy development	Development Services, Public Workst	2030–2040	ASLA 2018
3.3-B	Implement a Comprehensive and Climate-Smart Green Infrastructure Strategy	• Require larger land development projects to incorporate principles of green infrastructure (e.g., bioswales, permeable pavements, rain gardens, linear parks, green roofs), which help mitigate the UHI effect in the City. • Work with the Sacramento Tree Foundation to implement measure BE-9 (Increase Tree Planting) of the City's CAP, which focuses on increasing tree planting to sequester carbon. Ensure that implementation of the strategy considers projected increases in temperature and precipitation in the selection of tree varieties to be planted. This strategy aligns with GP Implementation Strategy Action 12.1, "Urban Forest." • Review and update Chapter 23.54, "Landscaping," of the City's Municipal Code and other design guidelines to incorporate strategies to mitigate future increases in temperature and extreme heat events and mitigate the UHI effect in new development.	Increased evapotrans-piration and reduced heat-absorb-ing surfaces	Plans, regulations, and policy development; programmatic	Development Services, Strategic Planning & Innovation, Sacramento Tree Foundation	Ongoing	ASLA 2018; City of Seattle 2017; EPA 2016; Stone et al. 2019; USDA 2019; Harlan and Ruddell 2011

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.3-C	Support a Climate-Smart Building Code	• As part of the implementation of the City's Climate Action Plan measure BE-5 (Building Stock: Phase in Zero Net Energy Standards in New Construction), incorporate projected increases in temperature and extreme heat events in building standards to mitigate impacts from the UHI effect on energy demand. • Explore cost-effective strategies to integrate green roofs into the City's building code with consideration of solar photovoltaic system requirements for new development. Incentivize new development projects to include green roofs and high-albedo roofs	Increased resilience of building to extreme heat	Plans, regulations, and policy development	Strategic Planning & Innovation, Development Services	2040–2050	Nahlik et al. 2016; ASLA 2018; City of Seattle 2017; EPA 2016
3.3-D	Support Climate-Smart Parks and Recreation Areas	• Work with Cosumnes Community Services District (CCSD) to develop a strategy to educate populations that frequently use parks and recreation areas (e.g., sports teams) about the public health effects of extreme heat. Ensure facilities are adequately prepared to help mitigate heat impacts. Prioritize upgrades to park facilities owned and operated by the City.	Increased resilience of population to extreme heat	Education, outreach, and coordination	City Manager's Office, Police Department, CCSD	2030–2040	ASLA 2018; USDA 2019

Urban tree canopies can help reduce surface temperatures, provide. shading, and sequester carbon, proving multiple benefits for the City."

Bioswales and other green infrastructure can help reduce localized flooding impacts, improve water quality, and mitigate the UHI effect.

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.3-E	Create a Comprehensive Climate-Smart Green Infrastructure Plan and Prioritize Sustainable Flood Management That Includes Ecosystem Benefits	• Develop a comprehensive plan and set targets to decrease stormwater runoff from existing residential and nonresidential land uses, as well as City facilities, through green infrastructure approaches (e.g., rain gardens, rainwater catchment barrels, green stormwater infrastructure, permeable parking lots, and pavement) to help offset impacts on the City's stormwater management system from climate change. This strategy aligns with GP Implementation Strategy Action 1.8, "Sustainable Stormwater Management Ordinance." • Prioritize sustainable flood risk management strategies that provide increased flood protection and ecosystem benefits (e.g., increased creek setbacks, increased open space, sponge City strategies, bioswales). This strategy aligns with GP Implementation Strategy Action 8.3 "Open Space Conservation and Management Plan."	Reduced stormwater runoff impacts on creeks and waterways during storm events	Programmatic; plans, regulations, and policy development	Development Services, Public Works, CCSD, Sacramento County	2030-2040	Green 2010; EPA 2016; ASLA 2018
3.3-F	Require Climate-Smart Flood Protection for New Development	• In coordination with future updates to the Central Valley Flood Protection Plan (per Senate Bill 5), continue to assess Urban Level of Protection for properties in the City and update the City's elevation and construction standards accordingly for new construction. As part of this process, identify list of priority critical facilities that are at increased risk from flooding based on hydraulic modeling that includes future storm intensities. Implement strategies to reduce risk for flooding in and near these facilities, including potential relocation of facilities.	Increased awareness of vulnerabilities	Plans, regulations, and policy development, Evaluation	Development Services, City Manager's Office	2030–2040	EPA 2016
3.3-G	Explore Options for Climate-Smart Permeable Pavements	• Assess feasibility of incorporating permeable pavements into aspects of the City's infrastructure to decrease stormwater runoff impacts during storm events. Conduct pilot project at a City facility to better understand opportunities, costs and benefits.	Increased stormwater infrastructure capacity	Capital improvement projects	Public Works	2020–2030	Selbig and Buer 2018

3.3.4 A CLIMATE-READY COMMUNITY

Impacts on the City's stormwater and flood management systems could result in secondary impacts on the vulnerable populations in the City and on critical community functions, including economic activity and emergency operations. Increases in annual average temperatures and the intensity and frequency of heat wave events will increase the risk to vulnerable populations. These strategies focus on ways the City and residents can better prepare for the projected increase in the frequency of extreme heat events, with a focus on ensuring vulnerable populations are protected during these events.

STRATEGIES FOR HEAT-RELATED IMPACTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.4-A	Protect Vulnerable Populations from Heat-Related Climate Impacts	• Identify areas in the City with increased concentrations of older residents and areas with increased density of elderly care facilities and senior homes. Work with community organizations and the County Health Department to provide additional resources and training to staff working with elderly populations on how to prevent health-related impacts form extreme heat. Use resources developed by the American Association of Retired Persons and work with the organization to educate elderly populations in the City about health impacts from extreme heat events and strategies to prevent these impacts. • Work with community organizations and schools to help mitigate the impacts of extreme heat and heat wave events on youth. Educate and train staff working with youth populations on how to prevent health-related impacts from extreme heat. • Review and update the City's Construction Specification Manual to bolster protections for construction workers working in the City. Provide educational material to construction workers and City staff who work outside about best practices to reduce health impacts from extreme heat.	Increased resilience of population to extreme heat	Programmatic	Community organizations, Development Services, Police Department, school district, Sacramento County Department of Health Services, Development Services	2020–2030	Voelkel et al. 2018; Moda and Minhas 2019; CalOES 2020; Mohnot et al. 2019
3.4-B	Implement Training and Education for Heat-Related Impacts	• Increase education and training opportunities for residents to prepare for extreme heat events, with a prioritization on vulnerable populations and on businesses and institutions that house and/or support vulnerable populations. This strategy aligns with GP Implementation Strategy Action 15.2, "Outreach Techniques for Minority and Disadvantaged Communities."	Increased resilience of population to extreme heat	Education, outreach, and coordination	City Manager's Office, Police Department, Sacramento County Department of Health Services	Ongoing	White-Newsome et al. 2014

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.4-C	Develop a Network of Cool Zones for Heat Wave Events	• Develop a strategy to work with local businesses that volunteer to serve as "cool zones" during extreme heat days and allow residents to cool off in air-conditioned spaces in these businesses (e.g., coffee shops, movie theater). Provide information about the location of these cool zones to City residents.	Increased resilience of population to extreme heat	Education, outreach, and coordination	City Manager's Office, Elk Grove Chamber of Commerce	2020–2030	San Diego County n.d.
3.4-D	Support a Climate-Smart Electricity Grid	• Work with the Sacramento Municipal Utility District (SMUD) to promote and help educate residents about SMUD's time-of-day energy rates and the cost benefits of reducing electricity use during peak demand periods. • Work to support further adaptation and resilience efforts initiated by SMUD that affect the City. This strategy aligns with Action 2.13, "Energy Efficiency in Housing," in the GP Implementation Strategy.	Increased resilience of electricity grid to extreme heat	Education, outreach, and coordination	City Manager's Office, SMUD	Ongoing	DOE 2016
3.4-E	Support Climate-Smart Emergency Services	• Develop or adapt an existing assessment program to ensure that emergency services in the City are adequately prepared for future impacts from extreme heat events. Assess internal emergency service operations (e.g., emergency service vehicles, facilities, staff) to identify sensitivities to extreme heat events.	Increased resilience of emergency services to extreme heat	Programmatic	City Manager's Office, Emergency Services, Police Department, CCSD	2030–2040	Paterson et al. 2014
3.4-F	Develop a Community-Led Wildfire Smoke Strategy	• Assess the City's capacity to respond to impacts from wildfire smoke on residents and increase the City's capacity to respond to these events, if needed. Work with community organizations to develop a strategy to ensure residents, particularly vulnerable populations, are educated and prepared to respond to wildfire smoke events.	Increased resilience of population to extreme heat	Education, outreach, and coordination	City Manager's Office, Sacramento County Department of Health Services	2020–2030	EPA 2016

STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.4-G	Develop Neighborhood Readiness Plans and Promote Flood Preparedness Education	• Work with community organizations to develop neighborhood readiness plans for areas of the City at increased risk of flooding. Identify priority (i.e., flood-prone) neighborhoods to serve as pilot plans for this strategy. • Work with Sacramento County Office of Emergency Services (OES), community organizations, and regional partners to develop neighborhood readiness plans. Use the planning process to increase flood preparedness education and training opportunities for City residents.	Increased social resilience, increased preparedness for large flood events	Education, outreach, and coordination	City Manager's Office, Development Services, Sacramento County OES	2020–2030, ongoing	Cal OES 2020
3.4-H	Support Climate-Smart Capital Improvement Projects	• Incorporate updated precipitation and storm intensity data into the City's capital improvements planning process, specifically projects in areas anticipated to be impacted by future flood events.	Increased stormwater infrastructure capacity	Education, outreach, and coordination	Public Works Development Services	Ongoing	City of Seattle 2017

State Route 99 bridge over Laguna Creek.

3.3.5 SOCIAL AND ECONOMIC RESILIENCE

These strategies focus on increasing the social and economic resiliency of residents and businesses during extreme heat events, which may have secondary economic impacts for the City (e.g., increased spending on cooling for homes and businesses, potential loss of productivity, decreased economic activity during heat waves). The strategies also include assisting with post-disaster recovery efforts and ensuring adequate funding is available to fund implementation of large infrastructure projects.

STRATEGIES FOR HEAT-RELATED IMPACTS AND LARGE STORM EVENTS

STRATEGY NUMBER	STRATEGY NAME	STRATEGY DETAILS	ADAPTATION MECHANISM	IMPLEMENTATION MECHANISM	RESPONSIBLE DEPARTMENT	TIMELINE	SOURCE/ EXAMPLE
3.5-A	Support Incentives to Shift Energy Demand and Offset Costs for Low-Income Residents	• Work with SMUD and regional partners to promote energy efficiency upgrades and behavior change that reduces energy demand for cooling and provide cost savings for low-income residents.	Increased resilience of population to extreme heat	Education, outreach, and coordination	City Manager's Office, SMUD	Ongoing	DOE 2016; Voelkel et al. 2018
3.5-B	Support Post-Disaster Recovery Efforts	• Explore opportunities to expand access to post-disaster recovery resources for residents and businesses (e.g., recovery funding, recovery services) and remove barriers for rebuilding in post-disaster situations. This strategy aligns with GP Implementation Strategy Action 9.3, "Post-Disaster Recovery Ordinance."	Increased economic resilience	Programmatic	City Manager's Office	2040–2050	Mohnot et al. 2019 2016
3.5-C	Implement and Maintain a Climate-Specific Infrastructure Fund	• Identify and prepare funding as part of the City's General Reserve fund for future repairs to damaged infrastructure that may be required due to increased stress from extreme heat, extreme storms, and other climate impacts. This strategy aligns with GP Implementation Strategy Action 9.12, "Climate-related Infrastructure Repair Reserve."	Increased economic resilience	Programmatic	Public Works, City Manager's Office, Financial Planning Division	2020–2030	City of Elk Grove 2019

3.4 IMPLEMENTATION FRAMEWORK

SECTION OVERVIEW

This section provides information on how the City can successfully implement the set of resilience strategies identified in Section 3.3. It describes how best to conduct community outreach and develop regional partnerships to ensure successful implementation of the strategies, and it presents cost estimates for the implementation of each strategy. Using these cost estimates, the City will be better able to anticipate expected costs, identify appropriate funding strategies to support implementation, and ultimately prioritize strategy implementation.

3.4.1 COMMUNITY OUTREACH, PARTNERSHIPS, AND EQUITABLE IMPLEMENTATION

Effective implementation of the strategies included in this Plan will require sustained collaboration with community partners and regional agencies, as well as collaboration between various City departments. Collaboration with partners during the strategy implementation process ensures that knowledge and resources will be shared and allows the City to implement strategies effectively. Many of the strategies in the Plan that focus on hazard preparedness require educating City residents on how to prepare their household and neighborhoods for climate-related hazards (e.g., flooding, heat wave events). By conducting community outreach and involving residents in the implementation process, the City will ensure that the community overall will be better prepared to respond to and adapt to changing circumstances, whether they are chronic stresses, such as climate change, or acute shocks, such as a pandemic. Community engagement during Plan implementation can also help create a committed group of community stakeholders who will help implement strategies and help create sustained commitment in the community for achieving successful Plan implementation (Cal OES 2020).

CLIMATE EQUITY IN PLAN IMPLEMENTATION

As the strategies included in the Plan begin to be implemented, it is vital that the City ensures that implementation is done in an equitable manner that gives careful consideration to historically disadvantaged communities and populations in the City, which made them more vulnerable to climate impacts. To help with equitable strategy implementation, there are several types of equity that should be used to guide this process and inform how successful implementation of the strategies is measured. Three types of equity that have been prioritized in the State's Adaptation Planning Guide (Cal OES 2020) are provided in Table 3.4-1.

Table 3.4-1: Types of Equity in Adaptation Planning

TYPE OF EQUITY	EQUITY METRICS
Procedural Equity	• Create processes that are transparent, fair, and inclusive in developing and implementing any program, plan, or policy. • Ensure that all people are treated openly and fairly. • Increase the civic engagement opportunities of communities that are disproportionately impacted by climate change.
Distributional Equity	• Fairly distribute resources, benefits, and burdens. • Prioritize resources for communities that experience the greatest inequities and most disproportionate impacts and have the greatest unmet needs.
Structural Equity	• Make a commitment to correct past harms and prevent future unintended consequences. • Address the underlying structural and institutional systems that are the root causes of social and racial inequities. • Include adaptation strategies to eliminate poverty, create workforce development, address racism, increase civic participation, protect housing availability, increase education, and provide healthcare.

To help ensure strategies are implemented in an equitable manner and prioritize the most vulnerable populations, the City should take the following steps:

- Identify key community organizations working with underserved and historically disadvantaged communities and invite them to join the Community Resilience Task Force.
- Use existing resources (listed below) that identify disadvantaged communities in the City and prioritize community outreach to these communities during implementation of relevant strategies.
    - California Department of Water Resources Disadvantaged Communities Mapping Tool
    - Public Health Alliance of Southern California's California Healthy Places Index
    - Environmental Protection Agency's Environmental Justice Screening Tool
    - Office of Environmental Health Hazard Assessment CalEnviroScreen 3.0
- Ensure community outreach and education opportunities focused on Plan implementation include multi-lingual options for both written materials and in-person engagement.
- Include demographic surveys as part of community outreach events to ensure that participants are representative of the demographic makeup (e.g., race, age, ethnicity) of the City's population as a whole.
- As strategies are implemented, ensure that the goal of the strategy aligns with community needs by providing opportunities for community organizations and other stakeholders to review strategy details before implementation.

COMMUNITY RESILIENCE TASK FORCE

As part of Plan implementation, the City will establish a Community Resilience Task Force (Task Force) to help increase the City's capacity and knowledge base for implementing the comprehensive set of strategies included in the Plan. Successful strategy implementation will require the expertise and experience of various parts of the community and the larger Sacramento region regarding, for example, the transportation system, the flood management system, and community preparedness. The Task Force will be comprised of technical experts, City residents, representatives from community organizations, members of the business community, City staff, and other relevant partners. As discussed above, as the Task Force membership is developed, the City should ensure there is representation from communities who are most vulnerable to the impacts of climate change and may not have historically been involved in the City's planning process. Taking this step will ensure that the most vulnerable populations are adequately prepared for climate impacts and prioritized during the implementation process. The primary responsibilities of the Task Force will be to (1) meet regularly to guide the successful implementation of the strategies, (2) assist the City by providing subject area expertise as various strategies are implemented, (3) help increase the City's capacity to implement strategies by encouraging collaboration with regional and State agencies and community partners, and (4) review and support grant applications for identified actions as appropriate to leverage additional funds for implementation.

COMMUNITY OUTREACH EVENTS AND PLAN WEBSITE

The City will need to host community outreach events to gather input on how best to implement the strategy and identify community priorities to help design strategy implementation. Many of the strategies in the Plan will require sustained community participation or comprehensive infrastructure updates, requiring significant City staff time and resources. By conducting sustained community outreach during implementation of the Plan, the City can gain support and buy-in from members of the community who will help advocate for and support implementation of these strategies.

As part of the Plan, the City is developing an interactive website that will provide a platform for residents to easily access the Plan and that will serve as a real-time tool to monitor and provide input on implementation of specific strategies. The website will also serve as a platform for community members to receive the most up-to-date information on ways to get involved in implementation of certain strategies, attend community events, and participate in other activities to support Plan implementation. The website will be updated regularly to report progress on implementation of specific Plan strategies.

3.4.2 STRATEGY COST ESTIMATES

This section presents approximate cost estimates to assist in implementing each of the resilience strategies identified in the Plan. The total cost estimate for each strategy is based on a set of costs required to effectively implement the strategy. These costs are provided in the series of tables presented below. The estimates presented in the tables do not consider the exact scale of the strategy and interventions, which are currently presented at a high level. In addition, the estimates presented here do not consider inflation, any potential for cost changes beyond inflation, or any future unforeseen fluctuations in cost (e.g., staff salaries, material costs). Some strategies have not been estimated because they are anticipated to be implemented alongside other strategies. Similarly, some strategies do not have cost estimates because it is assumed that they can be implemented as part of the City's existing capacity and operations. For full details on the assumptions used to develop the strategy cost estimates, see Appendix A.

In addition to identifying the strategy by number and name, the tables present the following information for each strategy:

- **Cost Magnitude—**Each resilience strategy is estimated on a cost order of magnitude scale. Estimates reflect one-time costs and a net present value estimate for ongoing costs. Estimated costs below $200,000 are "Low," estimates between $200,000 and $1,000,000 are "Medium," and estimates over $1,000,000 are "High."
- **Implementation Length—**This is an estimate of how much noncontiguous staff time will be needed to initiate implementation of the strategy. Because the implementation details for each strategy will need to be established by the City and are unknown at this time, the total time for the strategy to be fully implemented is not specified. As noted in the tables, some strategies will be ongoing.
- **Total Staff Cost—**This is an estimate of the total City staff cost, in terms of staff time, required to complete the strategy, presented in 2020 dollars. Staff costs are based on the estimated time (full time equivalent) it would take for one senior City staff member and entry level City staff member to implement the strategy.
- **Consultant Costs—**This is an estimate of the consultant costs that will be required to assist the City in implementing the strategy.
- **Material Costs—**This is an estimate of the material cost to implement specific strategies that will require upgrades to physical infrastructure or other aspects of the built environment in the City. The assumptions used to generate these material cost estimates are presented in Appendix A.
- **Ongoing Costs—**This is an estimate of the ongoing cost, in terms of staff time, that will be needed to implement the strategy.
- **Total Cost Estimate—**This is a total cost estimate for the strategy, which includes all relevant cost components, including ongoing costs for the strategy for those strategies that will require ongoing costs. Estimates have been rounded to the nearest thousand dollars.

A RESILIENT ROADWAY NETWORK AND STORMWATER MANAGEMENT SYSTEM

STRATEGY NUMBER	STRATEGY NAME	COST MAGNITUDE	IMPLEMENTATION LENGTH (NONCONTIGUOUS STAFF TIME IN YEARS)	TOTAL STAFF COST (2020 DOLLARS)	CONSULTANT COSTS	MATERIAL COSTS	ONGOING COSTS	TOTAL COST ESTIMATE (ROUNDED)
STRATEGIES FOR HEAT-RELATED IMPACTS								
3.1-A	Upgrade Pavement Design Standards for Extreme Heat	Medium	1	$62,000	$150,000	The cost of heat-resistant (rubberized asphalt) is typically 10–35 percent more than the cost of conventional asphalt.[1]	NA[2]	$212,000[3]
3.1-B	Assess the Roadway Network's Vulnerability to Long Drought	Low	1	$25,000	$150,000	NA	NA	$175,000
3.1-C	Increase Resilience and Redundancy in the City's Truck Routes	High	0.5	$31,000	$150,000	$13,187,000	NA	$13,218,000
3.1-D	Plan for Alternative Construction Schedules to Avoid Disruptions from Extreme Heat	Low	0.5	$13,000	$150,000	NA	NA[4]	$163,000
STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS								
3.1-E	Create a Climate-Smart Stormwater Management System	Medium	2.5	$160,000	$150,000	NA	NA	$310,000
3.1-F	Prevent Roadway Degradation and Increase Local Flood Monitoring	Medium	Ongoing	$20,000	NA	Improved subbase costs approximately $24,000 per mile[5]	$228,000	$228,000[6]
3.1-G	Support a Coordinated Regional Climate-Smart Flood Management System	Low	2	$60,000	NA	NA	NA	$60,000
3.1-H	Upgrade the City's Laguna West Levee System to Mitigate Climate-Related Flood Impacts	High	1	$125,000	NA	$22,200,000	NA	$22,325,000
3.1-I	Support Updates to the Regional Flood Warning System	Low	Incorporated into Strategy 3.1-G					

Note: NA = not applicable.
Source: Cost estimates developed by Ascent Environmental in 2020

1 The analysis of cost differential between asphalt containing crumb rubber and conventional asphalt was taken from a California State Transportation Agency cost analysis for 2014 (CalSTA 2016).
2 Maintenance costs are roughly comparable to those for conventional asphalt. (The California Department of Transportation estimates a maintenance cost savings of 3 percent for rubberized asphalt over conventional asphalt.) (CalSTA 2016).
3 The total does not include materials costs.
4 Maintenance costs for green paving materials are typically 70 percent lower than the maintenance for traditional paving materials. This estimate is based on the forthcoming Long Beach Mitigation and Adaptation Action Financial Analysis (City of Long Beach forthcoming).
5 This estimate comes from RS Means, construction cost–estimating software, with estimates specific to the Sacramento metropolitan area, and it assumes the use of union labor.
6 The total does not include material costs.

A RESILIENT TRANSPORTATION SYSTEM

STRATEGY NUMBER	STRATEGY NAME	COST MAGNITUDE	IMPLEMENTATION LENGTH (NONCONTIGUOUS STAFF TIME IN YEARS)	TOTAL STAFF COST (2020 DOLLARS)	CONSULTANT COSTS	MATERIAL COSTS	ONGOING COSTS	TOTAL COST ESTIMATE (ROUNDED)
STRATEGIES FOR HEAT-RELATED IMPACTS								
3.2-A	Increase the Resilience of the City's Public Transit System	High	Ongoing	$15,000	NA	NA	$1,707,000	$1,722,000
3.2-B	Establish a Resilient Pedestrian and Bicycle Infrastructure Network	High	0.5	$25,000	$150,000	$9,183,000	NA	$9,358,000
3.2-C	Increase the Resilience of City Traffic Operations to Extreme Heat	Low/ Medium	0.75	$41,000	$150,000	NA	NA	$191,000
STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS								
3.2-D	Support a Resilient Rail Network	Low	0.2	$5,000	NA	NA	NA	$5,000
3.2-E	Ensure Robust Communication during Flood Events	Low	1	$35,000	NA	NA	NA	$35,000
3.2-F	Increase the Resilience of City Traffic Operations to Flood Events	Low	0.5	$18,000	$150,000	NA	NA	$168,000

Note: NA = not applicable.
Source: Cost estimates developed by Ascent Environmental in 2020

A RESILIENT BUILT ENVIRONMENT

STRATEGY NUMBER	STRATEGY NAME	COST MAGNITUDE	IMPLEMENTATION LENGTH (NONCONTIGUOUS STAFF TIME IN YEARS)	TOTAL STAFF COST (2020 DOLLARS)	CONSULTANT COSTS	MATERIAL COSTS	ONGOING COSTS	TOTAL COST ESTIMATE (ROUNDED)
STRATEGIES FOR HEAT-RELATED IMPACTS								
3.3-A	Implement the Cool Pavement Road Map for the City	Implement as part of Strategy 3.1-A						
3.3-B	Implement a Comprehensive and Climate-Smart Green Infrastructure Strategy	High	Ongoing	$120,000	NA	$2,450,000	$4,825,000	$7,395,000
3.3-C	Support a Climate-Smart Building Code	Low	1	$60,000	NA	NA	NA	$60,000
3.3-D	Support Climate-Smart Parks and Recreation Areas	Low	0.5	$18,000	NA	NA	NA	$18,000
STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS								
3.3-E	Create a Comprehensive Climate-Smart Green Infrastructure Plan, and Prioritize Sustainable Flood Management That Includes Ecosystem Benefits	Implement as part of Strategy 3.1-E[7]						
3.3-F	Require Climate-Smart Flood Protection for New Development	Existing capacity						
3.3-G	Explore Options for Climate-Smart Permeable Pavements	Implement as part of Strategy 3.1-E						

Note: NA = not applicable.
Source: Cost estimates developed by Ascent Environmental in 2020

7 The cost of the tree canopy component is included in the cost estimate for Strategy 3.3-B.

A CLIMATE-READY COMMUNITY

STRATEGY NAME	STRATEGY NAME	COST MAGNITUDE	IMPLEMENTATION LENGTH (NONCONTIGUOUS STAFF TIME IN YEARS)	TOTAL STAFF COST (2020 DOLLARS)	CONSULTANT COSTS	MATERIAL COSTS	ONGOING COSTS	TOTAL COST ESTIMATE (ROUNDED)
STRATEGIES FOR HEAT-RELATED IMPACTS								
3.4-A	Protect Vulnerable Populations from Heat-Related Climate Impacts	Low	0.5	$5,000	NA	NA	NA	$5,000
3.4-B	Implement Training and Education for Heat-Related Impacts	Medium	Ongoing	$35,000[8]	NA	NA	$398,000	$398,000
3.4-C	Develop a Network of Cool Zones for Heat Wave Events	Low	1	$20,000	NA	NA	NA	$20,000
3.4-D	Support a Climate-Smart Electricity Grid	Low	1	$35,000	NA	NA	NA	$35,000
3.4-E	Support Climate-Smart Emergency Services	Incorporated as part of Strategy 3.4-B						
3.4-F	Develop a Community-Led Wildfire Smoke Strategy	Incorporated as part of Strategy 3.4-G						
STRATEGIES FOR LOCALIZED FLOODING AND LARGE STORM EVENTS								
3.4-G	Develop Neighborhood Readiness Plans, and Promote Flood Preparedness Education	Low	2	$140,026	NA	NA	NA	$140,000
3.4-H	Support Climate-Smart Capital Improvement Projects	Medium	Ongoing	$25,000[9]	NA	NA	$284,000	$284,000

Note: NA = not applicable.
Source: Cost estimates developed by Ascent Environmental in 2020

SOCIAL AND ECONOMIC RESILIENCE

STRATEGY NUMBER	STRATEGY NAME	COST MAGNITUDE	IMPLEMENTATION LENGTH (NONCONTIGUOUS STAFF TIME IN YEARS)	TOTAL STAFF COST (2020 DOLLARS)	CONSULTANT COSTS	MATERIAL COSTS	ONGOING COSTS	TOTAL COST ESTIMATE (ROUNDED)
STRATEGIES FOR HEAT-RELATED IMPACTS								
3.5-A	Support Incentives to Shift Energy Demand and Offset Costs for Low-Income Residents	Incorporated as part of Strategy 3.4-D						
3.5-B	Support Post-Disaster Recovery Efforts	Incorporated as part of Strategy 3.4-G						
3.5-C	Implement and Maintain a Climate-Specific Infrastructure Fund	Low	2	$80,000	NA	NA	NA	$80,000

Note: NA = not applicable.
Source: Cost estimates developed by Ascent Environmental in 2020

8 Staff costs represent an annual estimate for ongoing program administration (20-year time horizon) and do not include a one-time cost. They are included in the ongoing costs using a net present value estimate.
9 Staff costs represent an annual estimate for ongoing program administration (20-year time horizon) and do not include a one-time cost. They are included in the ongoing costs using a net present value estimate.

3.4.3 RESILIENCE STRATEGY FUNDING AND FINANCING

As shown in Section 3.4.3, successful implementation of the resilience strategies will require both City staff time and resources. In many cases, it also will require funding for consultants to assist with implementation, as well as material costs to complete physical upgrades to the City's infrastructure and the built environment. For other strategies, the City will be able to integrate strategies into existing operations and procedures, as well as into already planned projects. The funding required to implement the strategies will need to come from a variety of sources, including both external funding opportunities, such as grants, and the internal funding sources devoted to climate resilience, such as general fund revenue sources. The following discussion identifies available external funding opportunities and presents a summary of internal funding mechanisms that the City can use to implement the strategies.

EXTERNAL FUNDING OPPORTUNITIES

Federal, State, and local grants can help fill the gap for projects that cannot be funded from the City's general fund or local funding mechanisms.

Federal Emergency Management Agency: Hazard Mitigation Assistance Grants

The Federal Emergency Management Agency's (FEMA's) hazard mitigation assistance grants provide funding for eligible mitigation measures that reduce disaster losses. FEMA administers four hazard mitigation assistance grant programs relevant to the City:

- **Hazard Mitigation Grant Program**—Assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration
- **Flood Mitigation Assistance Program**—Provides funds for planning and projects to reduce or eliminate the risk of flood damage to buildings that are insured annually under the National Flood Insurance Program
- **Building Resilient Infrastructure & Communities**—Support for states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards
- **Pre-Disaster Mitigation Program**—Provides funds annually for hazard mitigation planning and projects

Sacramento Municipal Utility District: Low-Income Assistance

Sacramento Municipal Utility District's (SMUD's) Energy Assistance Program Rate (EAPR) provides discounts on monthly bills. Customers with the lowest household income, based on the federal poverty level (FPL), receive the largest discount. EAPR customers with a household income between 0 and 100 percent of the FPL receive the largest monthly discounts. EAPR customers with a household income between 100 and 200 percent of the FPL receive smaller discounts.

SMUD Rebates and Financing

SMUD offers a series of rebates for residents and businesses that are purchasing energy-efficient appliances for their home or business. Rebates are offered toward the purchase of LED lighting, induction cooktops, refrigerators, smart thermostats, heat pump water heaters, room air conditioners, and clothes washers and dryers. SMUD also offers to finance for whole-home energy efficiency upgrades, including heating and cooling system upgrades and sealing and insulation improvements. In addition, SMUD provides incentives for residential solar installations.

Community Resource Project: Low-Income Weatherization Program

Community Resource Project is the regional administrator for the Low-Income Weatherization Program in northern California. This program provides a variety of services intended to promote the use of safe and clean energy in homes in disadvantaged households in the Sacramento region. Home and appliance upgrades covered by the program include refrigerators, heaters and air conditioners, solar panels, water heaters, dishwashers, washing machines, new windows and glass repair, weatherization (e.g., sealing and insulation improvements), and attic and floor insulation.

National Oceanic and Atmospheric Administration: Environmental Literacy Grants

The goal of this funding opportunity is to improve the environmental literacy of K–12 students and the public so that they are knowledgeable of the ways in which their community can become more resilient to extreme weather and other environmental hazards and become involved in achieving that resilience. Projects are intended to build the collective environmental literacy necessary for communities to become more resilient to the extreme weather and other environmental hazards they face in the short and long term.

Arizona State University, a NOAA Environmental Literacy Program grantee, engages Phoenix, Arizona, residents in a public forum exploring how communities might adapt to extreme heat and drought

Source: NOAA n.d.

U.S. Department of Agriculture: Conservation Innovation Grants

The Conservation Innovation Grant program is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. These projects may be watershed based, regional, or statewide in scope.

CivicSpark Program

The CivicSpark Program supports sustainability-focused research, planning, and implementation projects throughout California by providing public agencies and other organizations with capacity-building support to implement sustainability projects or programs from CivicSpark Fellows. Fellows serve for 11 months and can work on variety of issues including social equity, climate resilience, water resource management, affordable housing, and mobility.

CivicSpark Water Fellows for 2017-2018

Source: Local Government Commission

California Climate Investments

California Climate Investments is a statewide initiative that directs funds from the State’s Cap-and-Trade Program to projects and programs that work to reduce greenhouse gas emissions in the state. These funds can support a variety of projects, including affordable housing, renewable energy, public transportation, environmental restoration, more sustainable agriculture, and recycling. Numerous State programs, including some discussed above, are funded through California Climate Investments; however, the State’s Cap-and-Trade Program continues to evolve and is updated by the State periodically to include new or modified programs.

LOCAL FUNDING AND FINANCING MECHANISMS

Given that cost estimates for the resilience strategies include multimillion-dollar investments, it is likely that financing mechanisms will need to be leveraged to pay for large upfront costs. Financing requires a source of repayment, commonly referred to as funding, to secure a large upfront payment that is then paid back over time with interest.

However, in California, regulatory hurdles that govern how revenue can be raised from taxes, assessments, and fees, combined with the need for a variety of public investments competing for the same dollars, make securing funding a larger challenge than securing financing. Making a compelling case that ensures broad-based public support by clearly articulating the cost of inaction (e.g., what will be lost without the investment in the context of progressive climate impacts) and the resulting co-benefits is an important component of securing funding for climate-related investments through mechanisms such as taxes, assessments, and fees, as well as successfully pursuing grants and other external funding opportunities.

After funding is secured, typical financing mechanisms used by local governments include municipal bonds and loans, although in recent years, additional types of bonds that include consideration of characteristics that may be relevant for climate-related investments, such as green bonds, are now offered. Selection of a financing mechanism should be based on the total cost of the financing and its suitability for funding the needed investment.


U.S. Army Corps of Engineers construct cutoff wall to reduce seepage and stability issues along the Sacramento River East Levee

Source: U.S. Army Corps of Engineers 2020

The mechanisms discussed below are a few of those commonly used to implement climate adaptation projects, which may have multiple sources of funding and/or financing. An assessment of which mechanisms would be used to pay for particular resilience strategies would be conducted as the City begins to implement the Plan.

Funding

TAXES

The cost of resilience strategies for large infrastructure projects can be offset through various tax mechanisms. For adaptation and resilience projects, a tax is generally a special tax that is implemented to pay for a specific project or program. Because of voter approval requirements, special taxes can be more difficult to develop without a clear understanding by the public of their purpose and the specific benefits they provide. Under California law, if a jurisdiction would like to adopt, increase, or extend a special tax, a two-thirds-majority approval is required. General taxes can pass with a simple majority. The following common types of taxes could be used to fund appropriate resilience strategies:

- **Ad valorem property tax**—This is a tax levied on property owners based on a property's value. It can be used only to finance voter-approved debt or finance bonds for infrastructure projects. The requirements for voter approval to raise property taxes depend on the type of infrastructure project being funded. In general, property tax increases for infrastructure bonds need approval by two-thirds of local voters.
- **Parcel taxes**—This is a form of property tax assessed based on certain established characteristics of a parcel rather than a rate based on the assessed value of the property. A parcel tax is considered a special tax and requires approval from two-thirds of all local voters.

- **Mello-Roos taxes**—A Mello-Roos district is a special district established by a local government to obtain additional public funding for specific projects or services, such as emergency services (e.g., fire departments, police) or public work projects (e.g., infrastructure improvements).

Financing

BONDS

A bond is a financing tool whereby money borrowed from investors is paid back with interest. Bonds are bought and sold on the bond market. Local governments can finance specific resilience projects by issuing bonds.

GREEN BONDS

For adaptation and resilience projects, green bonds can expand the potential investor pool by characterizing aspects of the investment that interest investors focusing on projects with defined environmental performance characteristics, but this approach could have higher administrative costs. Several green and climate bond certifications, such as the Climate Bond Standard and the Green Bond Principles, have been created to standardize the definition of the environmental characteristics of green bond projects.

LOANS

Loans are a financing tool whereby a party borrows money from a single source, such as a bank or the government, for a specific purpose. Loans can have fixed interest rates, as bonds do, but they often have variable interest rates, making them less attractive to cities that have budgets that fluctuate over time. Loan payback terms also tend to be shorter than bond payback terms. Commercial loans are available to local governments for resilience- and infrastructure-related projects in California from the Infrastructure State Revolving Fund, which provides financing to nonprofits and public agencies for infrastructure and economic development (excluding housing).

3.4.4 STRATEGY IMPLEMENTATION TIMELINE

The timing of when the resilience strategies should be implemented depends on when various climate impacts are projected to affect the City. The tables included in this section provide a decadal timeline for when heat- and flood-related strategies should be implemented by the City. These timelines have been developed based on the projections of when climate impacts are going to affect various aspects of the City (e.g., transportation system impacts, vulnerable population impacts, and community function impacts). The implementation timelines have also been designed to account for the time required for the strategy to be fully implemented and become effective in mitigating the climate impact. For example, for Strategy 3.3-B, “Implement a Comprehensive and Climate-Smart Green Infrastructure Strategy,” although heat wave impacts are not projected to increase before 2030, establishing a comprehensive urban tree canopy will take at least 10 years to be established and; therefore, the strategy should be implemented much sooner than 2030.

IMPLEMENTATION TIMELINE FOR HEAT-RELATED STRATEGIES

STRATEGY NUMBER	STRATEGY NAME	2020-2030	2030-2040	2040-2050	2050-2060
A RESILIENT ROADWAY NETWORK AND STORMWATER MANAGEMENT SYSTEM					
3.1-A	Upgrade Pavement Design Standards for Extreme Heat				
3.1-B	Assess the Roadway Network's Vulnerability to Long-Drought				
3.1-C	Increase Resilience and Redundancy in the City's Truck Routes				
3.1-D	Plan for Alternative Construction Schedules to Avoid Disruptions from Extreme Heat				
A RESILIENT TRANSPORTATION SYSTEM					
3.2-A	Increase the Resilience of the City's Public Transit System				
3.2-B	Establish a Resilient Pedestrian and Bicycle Infrastructure Network				
3.2-C	Increase the Resilience of City Traffic Operations from Extreme Heat				
A RESILIENT BUILT ENVIRONMENT					
3.3.A	Implement Cool Pavement Road Map for the City				
3.3-B	Implement a Comprehensive and Climate-Smart Green Infrastructure Strategy				
3.3-C	Support a Climate-Smart Building Code				
3.3-D	Support Climate-Smart Parks and Recreation Areas				
A CLIMATE-READY COMMUNITY					
3.4-A	Protect Vulnerable Populations from Heat-Related Climate Impacts				
3.4-B	Implement Training and Education for Heat-Related Impacts				
3.4-C	Develop a Network of Cool Zones for Heat Wave Events				
3.4-D	Support a Climate-Smart Electricity Grid				
3.4-E	Support Climate-Smart Emergency Services				
3.4-F	Develop a Community-Led Wildfire Smoke Strategy				
SOCIAL AND ECONOMIC RESILIENCE					
3.5-A	Support Incentives to Shift Energy Demand and Offset Costs for Low-Income Residents				

IMPLEMENTATION TIMELINE FOR FLOOD-RELATED STRATEGIES

STRATEGY NUMBER	STRATEGY NAME	2020-2030	2030-2040	2040-2050	2050-2060
A RESILIENT ROADWAY NETWORK AND STORMWATER MANAGEMENT SYSTEM					
3.1-E	Create a Climate-Smart Stormwater Management System				
3.1-F	Prevent Roadway Degradation and Increase Local Flood Monitoring				
3.1-G	Support a Coordinated Regional Climate-Smart Flood Management System				
3.1-H	Develop Flood Management Redundancies though Detention Basins				
3.1-I	Support Updates to the Regional Flood Warning System				
3.1-J	Mitigate Bridge Scour during Large Storm Events				
A RESILIENT TRANSPORTATION SYSTEM					
3.2-D	Support a Resilient Rail Network				
3.2-E	Ensure Robust Communication During Flood Events				
3.2-C	Support a Resilient Rail Network				
A RESILIENT BUILT ENVIRONMENT					
3.3.E	Create a Comprehensive Climate-Smart Green Infrastructure Plan and Prioritize Sustainable Flood Management That Includes Ecosystem Benefits				
3.3-F	Require Climate-Smart Flood Protection for New Development				
3.3-E	Create a Comprehensive Climate-Smart Green Infrastructure Plan and Prioritize Sustainable Flood Management That Includes Ecosystem Benefits				
A CLIMATE-READY COMMUNITY					
3.4-G	Develop Neighborhood Readiness Plans and Promote Flood Preparedness Education)				
3.4-H	Support Climate-Smart Capital Improvement Projects				
SOCIAL AND ECONOMIC RESILIENCE					
3.5-B	Support Post-Disaster Recovery Efforts				
3.5-C	Implement and Maintain a Climate-Specific Infrastructure Fund				

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ACRONYMS/ABBREVIATONS

AB	Assembly Bill
ACVRP	Autonomous/Connected Vehicles Readiness Plan
AV	autonomous vehicles
Cal OES	Governor’s Office of Emergency Services
CARB	California Air Resources Board
CAP	Climate Action Plan
CCSD	Cosumnes Community Services District
CEC	California Energy Commission
CDD	Cooling Degree Days
CHAT	California Heat Assessment Tool
City	City of Elk Grove
CNRA	California Natural Resource Agency
EIR	Environmental Impact Report
EO	Executive Order
EV	electric vehicles
FHWA	Federal Highway Administration’s
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
GP	City of Elk Grove General Plan
HHE	Heat Health Event
IPCC	Intergovernmental Panel on Climate Change
OES	Sacramento County Office of Emergency Services
O&M	operations and maintenance
OPR	Governor’s Office of Planning and Research
Plan	Community Mobility Resilience Plan
PW	Department of Public Works
RCP	Representative Concentration Pathway
SB	Senate Bill
SMUD	Sacramento Municipal Utility District
UHI	urban heat island
UPRR	Union Pacific Railroad
VMT	vehicle miles traveled

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APPENDIX A

APPENDIX A - RESILIENCE STRATEGY COST ESTIMATE METHODOLOGY

Caveats: These cost estimates are approximate, and do not represent precise calculations of exact costs, but rather order of magnitude estimates. These estimates are based on City staffing requirements, approximate anticipated consultant fees, and materials costs based on other California cities that have engaged in similar strategies. Consultant fees will vary depending on the exact scope of work and are presented as rough estimates. These estimates do not consider the exact scale of the strategy and interventions, as these are currently presented at a high-level, as are the existing conditions from which to baseline cost estimates. Additionally, the estimates presented here do not consider inflation, any potential for cost changes beyond inflation, or any future unforeseen fluctuations in cost (e.g. staff salaries, material costs). It should also be noted that no City staff were interviewed in producing these estimates. Ongoing costs are estimated by a net present value over a 20-year period, and the lifecycles of specific infrastructure types will vary.

Each resilience strategy is estimated on a cost order of magnitude scale below. Estimates include one-time costs and a net present value estimate for ongoing costs. Estimated costs are assessed on an order of magnitude, with estimates below $200,000 being Low, estimates between $200,000 and $1,000,000 being Medium, and estimates over $1,000,000 being High.

Cost Order of Magnitude Scale

Low	Less than $200,000
Medium	$200,000 to $1,000,000
High	Over $1,000,000

3.1-A: Technical standards update that requires consultant input. One-time cost is based on two City staff members working 25 percent of their time on the project for one year, as well as consultant input. No ongoing costs. **Cost order of magnitude: Low/Medium**

3.1-B: Infrastructure assessment project that requires consultant input. One-time cost includes one City staff member working 25 percent of their time for a year, as well as a consultant team to perform engineering inspections on City infrastructure. No ongoing costs. **Cost order of magnitude: Low/Medium**

3.1-C: Planning and capital improvement project that requires consultant input and coordination with the County. One-time cost includes two City staff members working 25 percent of their time for the half-year project duration, consultant input on designating alternative truck routes, as well as additional capital expenditures associated with green truck route upgrades (does not include the full cost of repaving, only the additional cost of paving with green infrastructure). No ongoing costs are included in the estimate, as one-time costs are clearly large enough to place this firmly in the high cost magnitude category. Note that green road infrastructure creates maintenance cost savings, which is not included in this analysis. Green road infrastructure maintenance can be up to 70 percent lower than traditional road maintenance costs (Long Beach Mitigation and Adaptation Action Financial Analysis). **Cost order of magnitude: High**

3.1-D: Desk research project that requires consultant input. One-time cost is based on one City staff member working 25 percent of their time for the half-year project duration, as well as a consultant to advise on how extreme heat events may affect planned capital improvements. No ongoing costs. **Cost order of magnitude: Low**

3.1-E: Coordinated stormwater infrastructure standards update involving City staff, county cooperation, and an outside consultant. One-time cost includes two City staff members working an average of 35 percent of their time for the two-year project duration, and consultants to model flooding stress projections on stormwater infrastructure. No ongoing costs. Note that infrastructure upgrade costs are not included in estimate and would place this more firmly within the medium cost magnitude. **Cost order of magnitude: Medium**

3.1-F: Ongoing planning project that can be fully covered by City staff. No one-time cost. Ongoing costs are based on one City staff member working 20 percent of their time for an estimated 20-year project duration. The cost of implementing new roadway materials is not included in this cost estimate. **Cost order of magnitude: Medium**

3.1-G: Coordinated regional strategy for flood management. One-time cost is based on one City staff member working 20 percent of their time for the two-year project duration. No ongoing costs are included in the estimate. Would require coordination with Sacramento County. **Cost order of magnitude: Low**

3.1-H: One-time cost is based on City estimate of capital improvement costs to the Laguna West Levee system. No ongoing costs are included in the estimate, as one-time costs are clearly large enough to place this firmly in the high cost magnitude category. Would require coordination with Sacramento County. **Cost order of magnitude: High**

3.1-I: Desk research project that can be fully covered by City staff. One-time cost is based on one City staff member working 25 percent of their time for the half-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.2-A: Planning project that requires coordination with Sacramento RTA. One-time cost is based on two City staff members working, on average, 25 percent of their time for one year. Ongoing maintenance costs are calculated based on increased electric bus operating costs due to extreme heat conditions for the Elk Grove E-Tran system. **Cost order of magnitude: High**

3.2-B: Planning project that requires consultant services, as well as bicycle and pedestrian infrastructure upgrades. One-time cost is based on two City staff members working 20 percent of their time for the half-year project duration, as well as additional capital expenditures associated with green bicycle and pedestrian route upgrades (does not include the full cost of paving, only the additional cost of paving with green infrastructure). No ongoing costs are included in the estimate, as one-time costs are clearly large enough to place this firmly in the high cost magnitude category. Note that green road infrastructure creates maintenance cost savings, which is not included in this analysis. Green road infrastructure maintenance can be up to 70 percent lower than traditional road maintenance costs (Long Beach Mitigation and Adaptation Action Financial Analysis). **Cost order of magnitude: High**

3.2-C: Planning project that requires consultant input. One-time cost includes two City staff members working an average of 22.5 percent of their time for the 9-month project duration, as well as a consultant team to analyze extreme heat effects on road infrastructure. No ongoing costs. **Cost order of magnitude: Low/Medium**

3.2-D: Desk research project that requires coordination with Union Pacific Railroad. One-time cost is based on two City staff members working 15 percent of their time on average for the 2.4-month project duration. No ongoing costs. **Cost order of magnitude: Low**

3.2-E: Website and flood-warning notification system creation, in coordination with the County. One-time cost is based on two City staff members working 15 of their percent time on average for the 1-year project duration. Ongoing costs are negligible. **Cost order of magnitude: Low**

3.2-F: Desk research project that requires consultant input. One-time cost is based on two City staff members working 15 percent of their time on average for the half-year project duration, as well as consultant input on flooding impacts to traffic signaling systems. No ongoing costs. **Cost order of magnitude: Low**

3.3-A: This strategy is included as part of the cost estimate for Strategy 3.1-A.

3.3-B: Largely a building code update that can be covered by City staff, and includes an expansion of the urban canopy. One-time costs are based on two City staff members working 35 percent of their time on average for the 1.5-year project duration, as well as the cost of planting new street trees. Ongoing costs are based on maintenance for the new trees associated with this strategy. **Cost order of magnitude: High**

3.3-C: Desk research project that can be fully covered by City staff. One-time cost is based on two City staff members working 25 percent of their time on average for the one-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.3-D: Education strategy that can be fully performed by City staff. One-time cost is based on two City staff members working 15 percent of their time on average for the half-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.3-E: This strategy is included as part of the cost estimate for Strategy 3.1-E.

3.3-F: It is assumed the City has the existing capacity to implement this strategy.

3.3-G: This strategy is included as part of the cost estimate for Strategy 3.1-E.

3.4-A: Public outreach strategy that requires coordination with the County. One-time cost is based on one City staff member working 10 percent of their time for the half-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.4-B: Ongoing public outreach campaign that requires coordination with the County. No one-time cost. Ongoing costs are based on two City staff members working 15 percent of their time on average for an estimated 20-year project duration. **Cost order of magnitude: Medium**

3.4-C: Public outreach campaign that requires coordination with the County. One-time cost is based on one City staff member working 20 percent of their time for the one-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.4-D: Public outreach campaign that requires coordination with the Municipal Utilities District. One-time cost is based on two City staff members working 15 percent of their time on average for the one-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.4-E: This strategy is included as part of the cost estimate for Strategy 3.4-B.

3.4-F: This strategy is included as part of the cost estimate for Strategy 3.1-G.

3.4-G: Planning and public outreach campaign that requires coordination with the County. One-time cost is based on two City staff members working 30 percent of their time on average for the two-year project duration. No ongoing costs. **Cost order of magnitude: Low**

3.4-H: Ongoing planning project that can be fully covered by City staff. No one-time cost. Ongoing costs are based on two City staff members working 10 percent of their time for an estimated 20-year project duration. **Cost order of magnitude: Medium**

3.5-A: This strategy is included as part of the cost estimate for Strategy 3.4-D.

3.5-B: This strategy is included as part of the cost estimate for Strategy 3.4-G.

3.5-C: Planning project that can be fully covered by City staff. One-time cost is based on two City staff members working 15 percent of their time on average for the two-year project duration. No ongoing costs. Does not include anticipated funding reserve contributions. **Cost order of magnitude: Low**

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