County of El Dorado Climate Vulnerability Assessment

May 2023

Public Review Draft

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Executive Summary

Purpose of the Climate Vulnerability Assessment

In the past decade, El Dorado County (County) has experienced increased temperatures, prolonged drought and extreme levels of precipitation and severe heavy snow events, widespread flooding, landslides, and larger and more severe wildfires. Each hazard event has impacted the communities in the County differently through direct impacts to property and infrastructure and people's well-being to indirect impacts associated with public service disruptions, power outages, school closures, economic hardship due to unemployment, loss of natural resources. These climate-related hazard events are projected to become more frequent and more severe by mid-century and the end-of-the-century. The County's Climate Vulnerability Assessment (CVA) addresses how people, property, critical infrastructure, and key economic and natural assets are vulnerable to climate change. Through a common understanding of climate change and its effects on natural hazards, the County, its stakeholders, and the community can work towards how to adapt to these changing climate stressors.

Assets in the County that are highly vulnerable to climate change are based on a combination of those assets with more exposure and higher sensitivity to climate hazards and an overall lower adaptive capacity or ability to manage and recovery from exposure impacts. The CVA builds on climate change science research and publications from publicly available tools, like Cal-Adapt and California's Fourth Climate Change Assessment to local assessments to evaluate vulnerability. Through this research and the local data, climate stressors to the County's more sensitive assets, like people with increased susceptibility due to factors such as age, income levels, education, language barriers, and underlying health conditions are examined and summarized through collaborative planning process and detailed vulnerability assessment.

Organization of the Climate Vulnerability Assessment

The County's Planning and Building Department developed the CVA in coordination with a Safety Element Advisory Committee (SEAC), a wide range of stakeholders, and the community. It consists of an introduction on the purpose of a CVA, a profile of the County, the methodology followed to develop the CVA (identify exposure, analyze sensitivity and impacts, evaluate adaptive capacity, and complete vulnerability scores), and a summary of the planning process. The CVA itself is organized into four key sections:

Exposure Identification. This section examines potential changes in the frequency and severity of climate-related hazards, such as increased temperatures, precipitation variability, drought, flooding, and wildfires.

Asset Inventory. The asset inventory looks at climate risk across the County to identify specific populations and infrastructure types that are more vulnerable to climate-related hazards. These are the groups of people, places, and key infrastructure assets that are likely to experience greater exposure to climate stressors. The inventory included an analysis of 20 sensitive population groups who are likely to experience disproportionate impacts from climate change.

- Children (under 14)
- Cost-burdened households
- Ethnic minorities
- High-pollution burdened communities
- Households in mobile homes
- Households in poverty
- Isolated and rural communities
- Low-income households
- Outdoor workers
- Overcrowded households
- Persons with disabilities and access and functional needs
- Persons with limited English proficiency (linguistically isolated)
- Persons with limited accessibility (no access to transportation)
- Persons experiencing homelessness
- Persons living in single-access roads (limited roads for evacuation)
- Renters

- People with chronic health conditions
- Unemployed persons
- Seniors
- Seniors living alone

The CVA also evaluated vulnerabilities for the following key assets:

- 88,437 improved parcels and
- 1,274 critical facility and infrastructure lifelines.

Natural and cultural resources and economic drivers and other key services in the County are assessed qualitatively but evaluated specific resource categories and economic sectors.

Vulnerability Assessment. The vulnerability assessment focuses on climate equity by explaining how climate change will impact sensitive populations, property, critical facilities and infrastructure, economic sectors, and natural resource assets. This means the assessment emphasizes understanding how climate change and a lack of adaptation capacity may impact certain groups of people and certain systems differently. Through this assessment, direct impacts associated with climate-related hazards are discussed and what types of indirect impacts may occur associated with cascading hazards given the interconnectedness of our communities and the infrastructure systems.

The vulnerability assessment relies on both quantitative and qualitative methods. It highlights the vulnerable census tracts, critical facilities, and property in the County using spatial geographic information systems (GIS) tools and modelling with anecdotal stories, experiences and feedback from technical committee participants shared during work sessions, stakeholder group workshops, and public meetings.

Adaptive Capacity Assessment. The adaptive capacity assessment looks at the ability for communities in the County to manage and recover from exposure to climate-related hazards. Adaptive capacity consists of many different plans and programs from building code policies to social services for socially vulnerable populations. While adaptive capacity is a key component of the climate vulnerability process, on its own, it does not fully reduce climate-related hazards. Therefore, this section focuses on information already in place at the County-level to help communities adapt to climate change and ensure our infrastructure is more resilient to withstand the increasing stressors associated with climate-related weather events. The concept of adaptive capacity and resilience is integrated throughout the CVA to inform the Safety Element update.

Key Findings

Climate stressors are conditions or trends related to climate variability, such as precipitation variability or warming temperatures that can exacerbate natural hazards. **Table ES-1** summarizes the 14 climate stressors and the key findings on the effects of the climate stressors in the County. The effects associated with cascading impacts that can link together and multiply hazards is also summarized.

Table ES-1 Primary Climate Stressors

Hazard	Key Findings
Increased Temperatures	• Historically, the highest 30-year annual average maximum temperature in the County was 66.9 °F and the projected 30-year annual average maximum temperature could reach 72.1 °F by 2050 and 83.5 °F by 2100. • The number of extreme heat days (>92.4 °F) is projected to rise by 26 days by 2050 and 54 days by 2100. • The number of warm nights (>60.4 °F) is projected to rise by 23 days by 2050 and 53 days by 2100. • The greatest increases in temperature will occur along the West Slope of the

Hazard	Key Findings
	County and will jeopardize the health of sensitive populations with existing respiratory conditions. • Critical facilities and infrastructure will be vulnerable to increasing temperatures, particularly the energy grid during heat waves when there is an increased demand associated with cooling loads.
Precipitation Variability	• Precipitation trends are expected to swing toward extreme values from both directions (drought and deluge). • Maximum 1-day precipitation could hit 5.5 inches by mid-century. • Maximum length of dry spell could reach more than 130 days in the West Slope by the end of the century. • Precipitation will change over time with an overall concentration of events over a shorter period that will increase the likelihood of flooding.
Reduced Snowpack	• The Sierra Nevada snowpack is critical for water supply and acts as a natural reservoir. • Increasing temperatures cause earlier snowmelt, accelerates the start of the wildfire season, and results in negative impacts on water-dependent sectors and natural resources. • Snowpack is predicted to decrease throughout the century and rising temperatures will raise the snow line – the average lowest elevation at which snow falls. • Changes in snowpack can affect agriculture, winter recreation, and tourism in some areas, as well as hydropower production.
Increased Wildfire Variability	• The annual average area burned is expected to increase by the end of the century. • The number of days where KDBI values exceed 600 (days with extreme wildfire susceptibility) is expected to increase by 51 days by the end of the century. • Projected changes include large increases in the area burned by wildfire and increased frequency of large fires. • The 2020 fire season broke records, as five of the State's six largest wildfires burned at the same time throughout California, destroying homes, forcing people to evacuate, and exposing millions of people to poor air quality. In 2021, the County was impacted by the Caldor Fire and in 2022, the Mosquito Fire.

Table ES-2 summarizes the key finding of secondary climate stressors in the County.

Table ES-2 Secondary Climate Stressors

Hazard	Key Findings
Agricultural and Forest Disease and Tree Mortality	• Agricultural pests thrive in warm weather. • Tree mortality rates between 1983 and 2004 nearly doubled while the water deficit increased. • Bark beetle infestations, like the one witnessed during the 2012-2016 drought, will become more frequent. • Increased stress on plants from warmer weather and drier soil increases plant susceptibility to disease and mortality. • As of December 2022, total tree mortality increased across California's

Hazard	Key Findings
	forested areas and in the County, approximately 78,000 acres were impacted by tree mortality with an estimated 1,400,000 dead trees. • Declining forest health can result in environmental, social, and economic impacts, such as increased wildfire risk from more dead and dry fuel accumulation and the loss of critical wildlife habitat, threats to public safety and infrastructure from falling trees, and lost revenue from tourism and recreation as facilities are closed.
Avalanche	• Since 1950, there have been 18 avalanches that resulted in 9 deaths and 12 injuries in the County. • During the 2022-2023 season, there were five avalanche incidents in El Dorado County; none resulted in deaths or injuries. • As winters become shorter, the potential for weak snow accumulations at the bottom of the snowpack increases, increasing the likelihood of an avalanche. • More extreme precipitation events that deposit large amounts of snow in a short period may also increase the potential for recurrent large avalanches.
Drought and Water Supply Changes	• The primary source of water in the County is snowpack runoff, which is projected to decrease by 85% by the end of the century. • Some of the most severe droughts coincided with years of abnormally low snowpack accumulation during the winter months, particularly in combination with record warm years like those in 2014 and 2015. This led to one of the most severe droughts in California and the County from 2012 to 2016. • The County lacks a robust storage of groundwater resources. • Seasonal redistribution of runoff results in more runoff earlier in the season, and at increased magnitudes, resulting in an increased frequency of flooding.
Extreme Heat	• Heat ranks among the deadliest of all climate-related hazards; the County is expected to experience more frequent, more intense, and longer heat waves by mid-century. • Heat waves lead to illness and death, particularly among the elderly, the young, and other vulnerable populations. • Extreme heat damages crops and kills livestock.
Flooding	• Flooding is one of the most serious climate-related hazards, and extreme precipitation due to atmospheric river events often results in localized rain on snow flooding across the County. • Current infrastructure is not designed to capture the increased runoff associated with climate change. • Loss of snowpack will lead to increased winter flows and flooding, and reductions in warm season flows. • Snow water runoff to reservoirs is expected to occur earlier in the season and at an increased magnitude that will likely result in flooding.
Human Health Hazards	• Climate change is likely to contribute to the next pandemic through the emergence of new pathogens like viruses. • Warmer temperatures in the spring and later into the fall months will enable animals to be more active for a longer period, which increases the

Hazard	Key Findings
	time a disease can be transmitted. • Bacteria, viruses, parasites, and other organisms that cause disease and illness are also more likely to persist in a warmer climate.
High Wind	• High winds can cause significant property, infrastructure, and crop damage related to downed trees, damaged power lines, and agricultural loss. • High winds can threaten public safety and have adverse economic impacts from business closures and power losses associated with Public Safety Power Shutoffs (PSPS). • High wind events that are combined with other natural hazards, such as hail, can disrupt daily activities, cause damage to buildings and structures, and increase the potential for other hazards.
Landslides and Debris Flow	• Historical and potential debris flow areas include Highway 50 east of Pollock Pines and State Route 49 north of Cool. • Precipitation and wildfire events and a loss of vegetation caused by climate change can lead to more flooding and runoff events, resulting in more landslide events. • Slope instability and debris flow hazards are found in eastern portion of the County.
Severe Weather: Thunderstorms, Heavy Rain, Lightning, and Hail	• Actual risk to the County is dependent on the nature and location of any given hazard event. • The most significant secondary hazards associated with severe local storms are flash floods, falling and downed trees, landslides, and downed power lines.
Severe Weather: Winter Storms and Heavy Snow	• Annual average maximum temperature for the County is expected to increase by 5.4 °F to 8.9 °F by the end-of-century, resulting in less precipitation falling in the form of ice or snow, but increased precipitation falling in the form of rain. • Increased temperatures and altered precipitation patterns are likely to lead to an increase in rain-on-snow flooding. • The rapidly melting snow combined with heavy rainfall can overwhelm both natural and manmade drainage systems, causing overflow, localized flooding, and property destruction. • If the snow load exceeds the weight the building was designed to withstand, the roof or the entire structure can fail. Increased snow loads are exacerbated by higher moisture content in the snow that increases the weight of the snow on structures.
Cascading Impacts	• The increasing interdependence of systems of modern life, on both a local and global scale, can cause a chain of impacts beyond the scope of the original event. • Subsequent impacts have the capacity to cause more destruction than the original hazard event. • Cascading impacts occurred in the County following the 2021 Caldor Fire; extreme heat, a lack of precipitation, and dry fuels in the Eldorado National Forest resulted in a fire that became one of the largest in State history, which resulted in structure losses, road closures, downed trees, and lost revenue.

Table ES-3 summarizes the key findings of the vulnerability assessment on property, critical facilities, and sensitive populations, natural and cultural resources, and economic services in the County.

Table ES-3 Key Vulnerability Assessment Findings

Assessment	Findings
Property	• A total of 2,042 parcels, worth over $485 million, along with 4,415 people, are located within the 1% annual chance floodplains. • A total of 83 parcels, worth over $15.7 million, along with 206 people, are located within the 0.2% annual chance floodplains.
	• 57,430 parcels are exposed to landslide hazard areas, worth almost $20 billion of property improvements. • 133,652 people are in landslide-prone areas, but direct impacts to people are expected to be minimal as it is unlikely that landslides will occur without warning.
	• Almost $22 billion worth of property and approximately 64,892 parcels are exposed to wildfire risk countywide. Most of these buildings are in high to very high wildfire threat areas. • Residential parcels constitute most of the number of parcels and the projected losses. • 150,955 people reside in areas that have moderate, high, and very high fire threat; this means that 78% of the County is comprised of areas that have some level of wildfire threat.
Sensitive Populations	• Of the 20 sensitive populations assessed, 18 had high or severe vulnerability (V4 or V5) for one climate-related hazard. • People are generally the most vulnerable to extreme heat, human health hazards, wildfire, and severe weather. • The most vulnerable sensitive populations are low-income households, seniors, children, and outdoor workers. • Sensitive populations are concentrated in 16 of the 42 census tracts in the County with the highest proportions located in Pollock Pines, Grizzly Flats, Omo Ranch, Diamond Springs, Kyburz, north and south of Placerville, and within the Al Tahoe, Bijou, and Stateline neighborhoods in South Lake Tahoe.
Critical Facilities	• The most vulnerable critical facilities and infrastructure in the County are water and electrical infrastructure, such as water treatment and storage facilities, water conveyance systems, electrical infrastructure, sewer lifts, and telecommunication facilities. • The County's transportation infrastructure, particularly State highways and County roads are particularly vulnerable to flood, landslide, and wildfire hazards.
	• There is only one essential business within the 1% annual chance floodplains and no essential businesses in the 0.2% annual chance floodplains.
	• There are 39 essential services exposed to potential landslide hazards.

Assessment	Findings
	• No essential business facilities are in any wildfire threat zones; however, 35 essential services are located in areas that have some level of wildfire threat.
	• Based on wildfire hazard risk by modeled flame length within 100 feet of critical facilities in the County, 11 of the 258 essential services facilities are exposed to high flame length hazards, 108 of the 698 infrastructure at risk facilities are exposed to high flame length hazards, and 10 of the 315 population at risk facilities are exposed to high flame length hazards.
	• Most critical facilities in the County that have a moderate or high hazard (flame lengths greater than 4 feet) are located on federal and private non-industrial lands.
Natural and Cultural Resources	• Water resources are vulnerable to increased temperatures and precipitation variability if changes alter the ecosystem and the native plant composition.
	• Extreme heat can result in harmful algal blooms in public parks and open spaces that could in turn impact public health.
	• Vegetation communities are vulnerable to extreme heat, drought, pest infestations like bark beetle, and wildfire and often replaced by new communities following hazards events, like wildfires.
	• State and County parks and open space facilities and campgrounds can be damaged and inundated by flooding, which would be exacerbated by more intense storms, further impacting regional recreation opportunities in the County.
	• Entire historic towns and districts can be lost during catastrophic events like wildfires.
	• The Shingle Springs Band of Miwok Indians and the Washoe Tribe of Nevada and California traditional practices and social systems involved seasonal movements around the County for hunting and gathering. Climate change may affect these Tribe's cultural heritage, in addition to culturally and historically significant buildings, resources, places, practices, properties, districts, and other non-tangible values.
Economic Services	• Drought impacts can be extensive on the economy depending on the circumstances during and after a severe drought event. • If water resources are limited, effects would be more severe for industries that rely on large amounts of water like the agriculture sector
	• The construction industry is dependent on raw materials and skilled labor, making them vulnerable to hazards that may affect the availability of lumber or the workers who turn the raw materials into products.
	• Government employment is dependent upon revenue from taxes, and a climate-hazard that decreases tourism, forces people to relocate, or causes a work shortage, will affect the ability of the government to continue normal operations.
	• Leisure and hospitality businesses will be affected by climate-related

Assessment	Findings
	hazards because people will not be able to easily access establishments, whether it is a result of road washout or pandemic protocols.
	• Tourism opportunities like whitewater rafting, are dependent on specific environmental conditions and easily interrupted by climate-hazards like poor air quality caused by nearby wildfires; these conditions may dissuade tourists from doing outdoor recreational activities.

Of the 14 climate stressors evaluated in the CVA, agricultural pests and disease and tree mortality, drought, extreme heat, flooding, severe winter weather, and wildfires resulted in the highest vulnerabilities. The County also has existing adaptive capacity in place to address these hazards, including forestry health programs; water management and drought contingency plans; flood ordinances; and proposed, ongoing, and completed fuels reduction projects; and vegetation and defensible space ordinances. The Safety Element update process will provide the County an opportunity to move forward with the revised and new set of goals and policies focused on adaptation to address these issues and enhance the County's resilience to climate change.

Table ES-3 summarizes the key findings of the County's adaptive capacity assessment.

Table ES-4 Key Adaptive Capacity Assessment Findings

Assessment	Findings
Community Resilience Score	• The County is rated as "relatively high" based on FEMA's National Risk Index (NRI) Community Resilience rating. This means that the County have a relatively high ability to prepare for anticipated natural hazards, changing climate conditions, and ability to withstand and recover rapidly from disruptions when compared to the rest of the United States.
Plans and Programs	• The County has a number of regulatory plans and programs in place based on existing planning and land use management tools used to protect public health and safety. These include, but are not limited to the General Plan, Zoning Ordinance, Floodplain Ordinance, other ordinances (e.g., Vegetation Management and Defensible Space Ordinance), Building Code, Local Emergency Operation Plan (EOP), and Local Hazard Mitigation Plan (LHMP).
Administrative and Technical Capacity	• Administrative and technical capacity is defined as the level of County personnel in place and working on activities related to public health and safety; disaster prevention, response, and recovery emergency preparedness; and long-range planning. The County has numerous personnel resources that support adaptive capacity, including planning, engineering, emergency managers, and building official staff. The are also 12 fire districts in the County and 10 that have active Community Wildfire Protection Plans (CWPPs).
Fiscal Capacity	• There are numerous federal fiscal capacity tools, resources, and grants opportunities the County could use to help fund climate adaptation, hazard mitigation, and flood management activities. There are also a

Assessment	Findings
	range of state grant opportunities available.
Outreach and Organizational Capacity	• The County has various organizational and collaborative partnership opportunities that enhance education, outreach, and engagement related to climate change, wildfire safety, and neighborhood planning. These include the Neighborhood Radio Watch Groups, Fire Safe Councils, and Firewise USA® programs.
	• The Sierra Business Council (SBC) partnered with the Sierra Institute for Community and Environment and conducted workshops in 2021 to rate community capacity. Based on the SBC's CVA, the County has a Climate Hazard Risk Score of 6.48/10 and found that communities on the western side of the County had higher capacity scores compared to the eastern side of the County, but overall, the County has a medium capacity score of 3 out of 5 in responding to climate stressors. The American River Canyon, Cedar Grove, Grizzly Flats/Omo, Mosquito/Swansboro, Pollock, Volcanoville/Quinette, and Outingdale/Somerset communities ranked as more vulnerable to climate change given lower capacity scores.
	• The key takeaways from over 900 public survey responses received on the CVA included the fact that respondents were most interested in climate adaptation strategies focused on wildfire protection.
	• The public survey showed that the community relies on the County to implement community-scale adaptation strategies and projects related to fuels reduction, evacuation planning, and snow removal and road maintenance.
	• The public survey input also shows that there are limited opportunities and financial incentives for homeowners, renters, and individual households to make improvements to their homes and to adapt at an individual scale besides mandatory defensible space maintenance and basic emergency planning.

1. Introduction

The County has prepared this CVA to support the unincorporated County community in preparing for, responding to, and recovering from hazard events intensified by climate change. The CVA provides a framework for understanding climate change science and modelling forecasts and for the consideration of incorporating adaptation and resilience goals and policies to include in the County's General Plan Noise, Public Health, and Safety Element (Safety Element). The CVA sets this framework by identifying climate stressors and the County's population and asset vulnerabilities that face the greatest risk and assessing areas for building adaptive capacity to ensure the community can withstand these vulnerabilities in the future. The County has prepared the CVA in accordance with California Government Code Section 65302(g)(4), which mandate that the County's Safety Element addresses climate change vulnerabilities and assesses a range of climate adaptation and resilience goals and projects. The CVA also presents the regulatory framework and methods used to prepare the vulnerability assessment, the climate-related hazards affecting the County's population and assets, a summary of key findings, and policy considerations for the Safety Element update that will build resiliency through the unincorporated County.

A. Climate Change Primer – What is Climate Change?

Climate change refers to a long-term change in average meteorological conditions due to natural internal processes and persistent increases in greenhouse gas (GHG) emissions that trap heat near the Earth's surface and change the composition of the atmosphere. These changes are attributed directly and indirectly to human activity, in addition to natural climate variability observed over comparable time periods. Climate change is attributable to human activities in how it alters the atmospheric composition, whereas climate variability is attributable to natural causes (UNFCCC 2018).

Sensitive Populations

Sensitive populations, also called socially vulnerable populations or frontline communities, are groups of people who experience heightened risk and increased sensitivity to climate change, and who have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts.
These disproportionate effects are caused and exacerbated factors including:

- Inequalities in access to support such as economic opportunity, social capital, or social services.
- Political and economic exclusion based on institutionalized bias.
- Physical barriers including age, health, and infrastructure connectivity.
- These groups may include but are not limited to the young and elderly, those with mobility challenges, individuals with limited English proficiency, immigrants and refugees, LGBTQ individuals, women, minorities, people of color, or combinations of these groups.

- CA Office of Planning and Research

According to the 2020 California Adaptation Planning Guide (APG), climate change is already impacting California and will continue to affect the State for the foreseeable future. The average temperature in most areas of California is already 1°F higher than historical levels, and some areas have seen average increases of over 2°F (Bedsworth et al 2018). The observed changes in the warming of the climate system since the 1950s are unprecedented (IPCC 2014). The primary effects of climate change include increased temperatures, reduced snowpack, increased wildfire severity, and altered precipitation patterns. Impacts from these primary climate stressors will also result in more frequent and longer droughts, more frequent extreme heat days with higher temperatures, increased flooding earlier in spring with a decrease in water supply as the year progresses, more frequent and extreme severe weather events, an increase in the total acres burned annually, increases in both agricultural and forestry disease, an increased risk of avalanche, which will decrease as more snow falls as rain, and increases in landslides and debris flow due to increases in wildfire and changes in precipitation patterns (Bedsworth et al 2018).

B. What is a Climate Vulnerability Assessment?

A CVA identifies the risks that climate change poses to the County and the geographic areas at risk from climate change impacts, based on the guidance found within Senate Bill (SB) 379 and other relevant vulnerability assessment tools and guides. A CVA is an emerging tool that can be used as an initial step in the climate adaptation planning process. The CVA will identify how the County is vulnerable to primary and secondary climate stressors that are the most likely to affect the County's sensitive populations, property, and community assets. The CVA will also help inform the development of new and revised goals and policies in the Safety Element that respond to these climate changes and focus on climate adaptation consistent with California Government Code §65302(g)(4).

Climate adaptation is the process of making changes in response to current or future conditions, usually to reduce harm or take advantage of new opportunities. In summary, a CVA identifies how climate change may affect the County by analyzing potential impacts and adaptive capacity to determine the vulnerability of populations, natural resources, and community assets.

C. Purpose of the Climate Vulnerability Assessment

The County has prepared this CVA as an important step in improving resiliency in the region by analyzing how climate change may affect people, property, important community assets, and critical facilities. The CVA emphasizes equity by examining impacts to sensitive populations, as well as the lifelines and infrastructure necessary for ensuring the continuity of essential services during and after a major hazard event.

Based on the results of the vulnerability assessment, a set of adaptation strategies can be developed to support the County's Safety

Element update. These strategies outline how the County will address the potential for harm identified in the CVA, given the community's resources, goals, values, needs, and regional context.

The CVA will play a role in determining the priorities for public health preparedness, response planning, and investments in various aspects of community planning and infrastructure protection. It will shape priorities for upgrading buildings, protecting critical facilities, making changes to zoning and building codes, and utilizing regulatory tools.

D. Regulatory Framework

The County Safety Element update will include new and expanded goals, policies, and implementation programs covering wildfire and flood risk, climate-related hazards, and evacuation planning based on the results of the CVA, updates to the County's Emergency Operations Plan (EOP), and findings from the Greater Placerville Emergency Preparedness and Evacuation Plan. The Safety Element update will address several revisions to the California Government Code Section 65302 based on State legislation summarized in **Table 1-1**.

Table 1-1 State Legislative Requirements for a General Plan Safety Element

Legislative Bill	Legislative Requirements
AB 2140	Links Local Hazard Mitigation Plans (LHMPs) and Safety Elements by encouraging the adoption of LHMPs into Safety Elements in return for an increased cost share of State disaster assistance funding (2006).
SB 379	Requires inclusion of a CVA and integration of adaptation strategies in the Safety Element and encourages climate change discussion in LHMP. Assessment must be complete by January 1, 2017, or after the adoption of the LHMP. These requirements are included in Government Code Section 65302(g)(4) (2015).
SB 1241	Requires Safety Element to address wildfire risks in State Responsibility Areas (SRAs) and very high Fire Hazard Severity Zones (FHSZs) pursuant to Government Code Section 65302(g)(3), develop policies to mitigate wildfire risk, and includes review by the State Board of Forestry and Fire Protection (2012).
SB 1000	Requires inclusion of environmental justice and equity goals and policies in the Safety Element – "Climate Equity". Identification of Disadvantaged Communities (DACs) and policies to reduce health risks, promote engagement, and address needs pursuant to Government Code Section 65302.10 (2016).
SB 1035	Addresses climate adaptation strategies in Safety Element and an update of climate data at least every 8 years (2018).
AB 747 **SB 99**	AB 747 requires Safety Element update to identify evacuation routes and evaluate their capacity, safety, and viability under a range of emergency scenarios. Requirements are included in Government Code Section 65302.15 related to land use (2019). SB 99 requires Safety Element to identify residential developments in hazard areas that do not have at least two emergency evacuation routes (2019).

AB 2140 – Plan Integration (2006)

Assembly Bill (AB) 2140 ties the related legislation together by linking LHMPs and General Plan Safety Elements and encouraging the adoption of LHMPs into General Plan Safety Elements. The California Disaster Assistance Act (CDAA) limits the state share for any eligible project to no more than 75 percent of total state-eligible costs. However, if a local agency has adopted an LHMP following the federal Disaster Mitigation Act of 2000 as part of the General Plan Safety Element, the CDAA may then provide for a state share of local costs that exceed 75 percent of total state-eligible costs.

SB 1241 – Fire Hazard Safety (2012)

SB 1241 mandates Safety Elements to be revised upon the next update of the Housing Element to address wildfire risk by mapping wildfire risk in SRAs and very high FHSZs. The revision must include information about wildfire hazards and develop goals, objectives, policies, and feasible implementation programs to mitigate wildfire risk and protect the community from the unreasonable risk of wildfire pursuant to Government Code Sections 65302(g)(3), 65302.5, and 66474.02.

SB 379 – Climate Change Adaptation (2015)

SB 379 requires General Plan Safety Elements to be reviewed and updated to include climate adaptation and resiliency strategies. The review and update must consist of the following components:

- Inclusion of CVA that identifies the risks climate change poses to the local jurisdiction and the geographic areas at risk from climate change;
- A set of adaptation and resilience goals, objectives, and policies based on the information specified in the vulnerability assessment; and
- Feasible implementation measures designed to carry out the goals, objectives, and policies identified in the adaptation objectives. This will support the State's overall adaptation strategy, "Safeguarding California," by ensuring counties and cities are providing for the safety of their communities and planning for adaptation to climate change impacts.

Key Terms

Resiliency is the ability of a community to withstand, recover, and learn from past disasters and to strengthen future response and recovery efforts.

Adaptation is the process of making changes in response to current and future conditions to reduce harm and take advantage of new opportunities.

SB 1000 (2016)

SB 1000 requires the inclusion of environmental justice and equity goals and policies in the Safety Element if there are DACs identified in the County. Tools used to identify DACs in California include the California Department of Water Resources (DWR) DAC Mapping Tool and the California Office of Environmental Health Hazard Assessment (OEHHA) CalEnviroScreen 4.0 Mapping Tool. The DWR defines a DAC as a community with an annual median household income (MHI) that is less than 80% of the State-wide annual MHI. Those census tracts with an annual MHI that is less than 60% of the State-wide annual MHI are considered "Severely Disadvantaged Communities." The CalEnviroScreen 4.0 scores are calculated by two groups of indicators, pollution burden and population characteristics, which account for sensitive populations and socioeconomic factors.

At a national scale, the Centers for Disease Control and Prevention (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) developed a Social Vulnerability Index (SoVI) to portray communities' capacities to prepare for and respond to natural and man-made disasters. This Social Vulnerability Index (SVI) index combines the following four main themes of vulnerability: socioeconomic status, household composition and disability, minority status and language, and housing and transportation characteristics. This tool has been used to identify socially vulnerable and sensitive populations more broadly in communities.

Similarly, the Federal Emergency Management Agency (FEMA) developed the National Risk Index (NRI), into which it incorporated the University of South Carolina's SVI, to address social vulnerability. The NRI dataset and online tool illustrates communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners, by considering the likelihood and consequences of natural hazards with social factors and resilience capabilities. NRI SVI scores and ratings represent the relative level of a community's social vulnerability compared to other communities at the same geographic level.

The 2022 Sierra Nevada Regional Climate Vulnerability Assessment (Regional CVA) was also used as a

reference to understand DACs in the Sierra Nevada. The Regional CVA states that more than half of the people that live within the Sierra Nevada region, which includes most of the County, are underserved or disadvantaged. Groups most vulnerable to climate impacts have been historically marginalized, underserved, and underrepresented. These groups include people of color, California Native American tribes, individuals in poverty, and the disabled community. Socially vulnerable communities assessed in the Regional CVA were identified based on communities with lower adaptive capacity. Taken together, these federal, state, and regional resources will be used to inform the development of environmental justice and equity goals and policies related to public health and safety for inclusion in the Safety Element update.

AB 747/SB 99 – Evacuation Route Planning (2019)

AB 747 requires Safety Elements to identify evacuation routes and evaluate their capacity, safety, and viability under a range of emergency scenarios. SB 99 requires that upon the next revision of the Housing Element on or after January 1, 2020, the Safety Element must identify residential developments in any hazard area that do not have at least two emergency evacuation routes.

E. Organization of the CVA

The sections that comprise the County's CVA include:

Executive Summary – This section includes the executive summary of the CVA.

Introduction – This section explains the purpose of the CVA, which topics are addressed in the assessment, and the key state regulatory requirements driving the need to address climate change and develop a set of adaptation strategies.

Methodology – This section describes how the vulnerability assessment was developed based on the California APG, which local governments can follow to identify and reduce climate change hazards. This consists of a four-step process, including identifying exposure, analyzing sensitivity and potential impacts, evaluating adaptive capacity, and conducting vulnerability scoring. The best publicly available science and data from global, national, state, and local sources used to support impact and vulnerability conclusions is also briefly summarized.

County of El Dorado Profile – This section profiles the geography, population trends, demographics, and economic conditions of the County.

Planning Process and Outreach and Engagement – This section describes the planning process, the SEAC members, stakeholder groups, and the planning sessions, workshops, and meetings held as part of the planning process. It also documents the outreach and engagement efforts.

Exposure Identification – This section covers the climate stressors within the region and the four climate scenarios that reflect different levels of global GHG emissions and atmospheric GHG concentrations. The section describes four primary climate stressors, multiple secondary climate stressors, and the cascading effects that may happen in the County.

County Population and Assets – This section identifies and describes the population and assets categories evaluated in the CVA. These assets are focused on socially vulnerable communities, followed by property, critical facilities and infrastructure, environmental resources, and economic drivers. Data limitations are also summarized.

Vulnerability Assessment – The Vulnerability Assessment covers all climate-related hazards and considers impacts on the following assets: sensitive populations, property, critical facilities and infrastructure, environment, economic conditions, and the continuity of operations and continued delivery of services. The quantitative and spatial analysis methods are described, in addition to the qualitative analysis used to address asset impacts not easily understood using data and mapping resources.

Evaluation of Adaptation Capacity – Based on the findings from the Vulnerability Assessment, this section will summarize the County's adaptive capacity based on existing plans, programs, tools, projects, and partnerships in place that are related to climate adaptation, hazard mitigation, and emergency preparedness, response, and recovery. This section will also summarize key takeaways from the bi-lingual

public survey circulated for the CVA.

Key Findings & Vulnerability Scores – This section will provide a detailed analysis of the assets and sensitive populations at most risk from climate-related hazards.

Acronyms and Abbreviations – This section defines acronyms and abbreviations used in the document.

Acknowledgements – This section highlights key contributors that supported the development of the CVA.

References – This section lists the sources cited in the CVA.

2. Methodology

A. Adaptation Planning Guide Methodology

The California APG provides guidance to support communities in addressing consequences of climate change by establishing a planning framework that governments can follow for adaptation and resiliency planning projects. The APG is designed to be flexible and guide communities in adaptation planning in a way that best suits their needs, whether it is taking a preliminary broader look at adaptation issues or conducting a detailed formal planning process. As illustrated in **Figure 2-1**, the APG presents a step-by-step, four-phase process that communities may use to plan for climate change.

Figure 2-1 California APG Planning Process

Climate adaptation planning allows communities to identify ways that they might be harmed by future climate conditions, including those unique to their communities, and to prepare for these conditions before they happen. Climate adaptation planning can be conducted on its own or integrated with other planning efforts across programs, departments, and sectors to develop a comprehensive and connected adaptation system. Climate adaptation activities can also have several benefits, such as increased public health and safety, reduced GHG emissions, greater economic stability, reduced cost savings of healthcare and infrastructure, increased resiliency of housing, improved air and water quality, and better stormwater management. The desired outcome is a locally focused, easy-to-follow process that summarizes vulnerabilities in a community as well as strategies and implementation actions that can be integrated into general plans, LHMPs, and other planning efforts.

The four phases of the adaptation planning process the County followed to develop the CVA are summarized below.

Phase 1: Explore, Define, and Initiate: This phase includes scoping the process for the development of the CVA, such as identifying the potential climate change effects and important physical, social, and natural assets in the unincorporated County. It identifies key stakeholders in government and throughout the community. The four steps in Phase 1 are described below.

Step 1.1 Confirm Motivation and Scope of the Process and Outcome

Preliminary steps conducted as part of this process included defining the motivation behind the development of the CVA. The County is conducting this assessment to comply with State legislative requirements related to climate change adaptation; respond to recent natural disaster events and ongoing climate-related stressors, such as wildfires, severe winter storms, drought, and flooding; and to address community concerns. Initial steps also involve defining the desired outcomes of the process, which is the comprehensive update of the General Plan Safety Element.

California Government Code Section 65302(g)(4) allows for any plan or document containing information on climate vulnerabilities and a set of adaptation strategies to meet the state's requirements. The general plan, climate action and adaptation plans, or LHMP are the most used planning mechanisms to ensure that climate adaptation is addressed in an integrated way.

Adaptation involves improving the community in the face of climate change and adjusting in response to new information and opportunities. Resiliency refers to being prepared for current and future hazard conditions in a way that allows communities to recover more quickly and rebuild in a way that accounts for a changing climate. In other words, the County will continue to work toward resiliency through holistic approaches that account for future needs, so that all members of the community are able to prepare for a recovery from climate impacts. The County can also accomplish this by ensuring the community is connected to a system of assets that can withstand climate stressors.

As part of this effort, the County participated in early visioning exercises during work sessions and workshops, using polling questions to help draft a vision statement shared with stakeholders and members of the public throughout the planning process for ongoing input and feedback. Additional steps during the scoping process set the geographic planning area, which is coterminous with the County's jurisdictional boundaries. The County also set the timeframe for the planning process, which occurred over a two-year period that relied on staff commitment, stakeholder engagement, and state agency review.

The timeframe for the Safety Element update also consists of an approximate 30- to 50-year timeframe that incorporates climate projections used to inform policies through mid-century (2050) and to the end-of-the-century (2100).

Step 1.2 Assemble Project Teams and Resources

The County assembled three main project teams, which included a combination of staff, subject-matter experts, and community representatives, to encourage community involvement: the internal County team, SEAC, and a stakeholder group.

California has developed an integrated set of policies and tools to support communities like El Dorado County in addressing the consequence of climate change:

- California Adaptation Planning Guide
- Safeguarding California Plan: California's Climate Adaptation Strategy
- California's Climate Change Assessment
- Cal-Adapt
- State of California General Plan Guidelines
- Adaptation Clearinghouse
- FEMA Local Mitigation Planning Handbook
- State Hazard Mitigation Plan

Internal County Team: This team consists of Planning and Building Department staff, who provide technical resources, along with an in-depth understanding of long-range planning, climate adaptation, and environmental compliance.

SEAC: The SEAC consists of subject-matter experts in wildfire risk, drought planning, transportation and evacuation planning, environmental health, and forestry management from an array of different County departments, outside agencies, and districts. County participants represent the El Dorado County Chief Administrative Office, Office of Wildfire Preparedness and Resilience, El Dorado County Transportation Commission (EDCTC), Department of Transportation, Sheriff's Office, El Dorado County Emergency Medical Services, and El Dorado Emergency Preparedness and Response. State participants represent the California Department of Forestry and Fire Protection (CAL FIRE). Other participants represent El Dorado County Water Agency (EDWA), U.S. Forest Service, El Dorado County Fire Prevention Officer's Association (FPOA), and 10 local fire protection districts.

Stakeholder Group: The County invited a diverse set of stakeholders to participate in the process based on an inclusive and multi-disciplinary stakeholder mapping process. The stakeholder groups included over 140 agencies and organizations, with a focus on organizations that represent sensitive and vulnerable populations, such as populations dependent on medical care/devices, elderly and seniors, low-income persons, persons experiencing homelessness, persons in designated DACs, persons with access and functional needs, and visitors and seasonal residents.

Federal agencies included but were not limited to the National Oceanic and Atmospheric Administration (NOAA), Bureau of Reclamation, and FEMA Region IX.

State agencies included but were not limited to the California Geological Survey (CGS), CAL FIRE, California Department of Transportation (Caltrans), Office of Planning and Research (OPR), California Office of Emergency Services (Cal OES), and California State Parks.

Regional and local agencies and organizations included the Sacramento Area Council of Governments (SACOG), Tahoe Regional Planning Agency (TRPA), Tahoe Transportation District, several Resource Conservation Districts (RCDs), neighboring counties, and the cities of Placerville and South Lake Tahoe.

Academic institutions like Folsom Lake College and Lake Tahoe Community College were included, as well as the local school districts. Public utility providers, such as Pacific Gas & Electric (PG&E), El Dorado Irrigation District (EID), and Liberty Utilities were invited. The Shingle Springs Band of Miwok Indians and the Washoe Tribe of Nevada and California were invited. Numerous non-profit organizations (NGOs) and community-based organizations (CBOs), such as Firewise USA communities, environmental organizations, climate collaboratives, faith-based groups, and hospital affiliations were also invited and participated in the planning process. Focused discussion and interview-based meetings were held with the TRPA, Tahoe RCD, and SBC.

Resources: Adaptation planning also depends on four key resources: time, technical capability, financial capability, administrative resources, and subject-matter knowledge from experts and specialists. The County used a simple matrix worksheet tailored from the Adaptation Capability Advancement Toolkit (Adapt-CA) to identify its capacity for adaptation planning to help assess its leadership and organizational culture, staffing and technical capability, stakeholder and engagement partnerships, and operations and institutional processes. The matrix worksheet measured capacity based on a four-point scale of levels from initiation (lowest level of capacity) to optimization (highest level of capacity).

Numerous tools and resources were used throughout the planning process, from the scientific datasets available through Cal-Adapt on future climate conditions to resiliency strategies and implementation considerations provided through the California Adaptation Clearinghouse. The County team worked with the regional climate collaborative, such as the Sierra Climate Adaptation and Mitigation Partnership (Sierra CAMP) (part of the SBC) and reviewed neighboring jurisdictions' vulnerability assessments to avoid the duplication of efforts and to maximize resources on existing regional efforts (Regional CVA). Primary tools and resources included Cal-Adapt, California's Fourth Climate Change Assessment, Adaptation Clearinghouse, the California State Hazard Mitigation Plan (SHMP), the U.S. Resilience Toolkit, Regional Resilience Toolkit, and Guide to Equitable Community-Driven Climate Preparedness Planning.

What is a Critical Asset?

A critical asset is any feature of a community that is not a person or a group of people. Critical assets include key buildings and infrastructure systems in the built environment and the natural environment. They are the most fundamental services in a community. Like community lifelines, they enable the continuous operational of critical government and business functions that are essential to human health and safety or economic security.

- U.S. Climate Resilience Toolkit, FEMA

Step 1.3 Identify Climate Effects and Community Elements

This step includes identifying a list of potential climate change stressors and effects and selecting populations and assets in the community that will be affected more severely than others to evaluate in the CVA. While the vulnerability assessment is completed in Phase 2, this step involves developing a preliminary list of primary climate stressors, and climate change effects beyond the primary consequences, such as human health hazards, agriculture and forestry pests, and other compounded hazards. Primary climate stressors that are highlighted based on input from the first SEAC work session included increased precipitation and variability, increased temperatures, reduced snowpack, and wildfire risk. Secondary climate stressors included avalanche, agriculture and forestry disease, drought and water supply challenges, extreme heat, flooding, landslides, public health hazards, high winds, and severe weather.

Climate change does not affect all parts of a community the same. Sensitive populations and critical facilities and assets can be affected more severely than others. The County selected segments of the population consisting of sensitive communities more susceptible to climate change hazards. This was done to ensure the County developed adaptation policies that addressed specific vulnerabilities, those at most risk and the critical assets most needed during and after a disaster event. As part of this process, the County developed a list of sensitive populations and critical facilities in the early stages of the planning process.

Critical assets were assigned to four categories: essential services (fire stations, emergency evacuation shelters, etc.), populations at risk (medical health facility, adult residential care facility, childcare facility, schools), infrastructure at risk (communication facilities, transportation infrastructure, water treatment plants, electrical transmission lines), or essential business (fuel stations, grocery stores, recreational facilities, large employers). This organization structure is consistent with the County's Focus Area Pre-Fire Planning efforts. Each critical asset was also organized according to FEMA's Community Lifelines to align with future updates to the County's LHMP.

Step 1.4 Prepare an Equitable Outreach and Engagement Approach

The County developed an Outreach Strategy early in the planning process. Public involvement should at a minimum provide an opportunity for the public to comment on a plan during the drafting stages and prior to plan approval. Public involvement and engagement included inviting the public to provide input throughout the planning process and ensuring there was adequate time to respond to the planning document and incorporate feedback. The County's Outreach Strategy was developed based on public involvement requirements for LHMPs, guidance from the U.S. Environmental Protection Agency (EPA) Regional Resilience Toolkit that is applicable to adaptation planning, and principles of outreach and engagement focused on inclusivity and the "whole community."

Phase 2: Assess Vulnerability: This phase includes analysis of potential impacts and adaptive capacity to determine the vulnerability for populations, natural resources, and community assets. The vulnerability assessment identifies exposure and how climate change could affect the community. The County assessed sensitivities by building on sensitive populations and assets, focusing on the climate impacts of greatest concern, reviewing documents, and completing worksheets to understand adaptive capacity. The five steps in Phase 2 are described below.

Step 2.1 Exposure

The first step is to characterize the community's exposure to current and projected climate hazards. The County confirmed hazards based on those addressed in the Public Health, Safety, and Noise Element and the natural hazards addressed in the County's LHMP risk assessment. These two lists were later expanded based on input from the SEAC, stakeholder groups, and public survey input. Climate-related hazards addressed in the Public Health, Safety, and Noise Element include fire safety, flood hazards, and air quality. Geologic and seismic hazards are not known to be linked to climate change; human-caused hazards addressed in the existing Safety Element were not included in the CVA. Instead, additional hazards considered for inclusion as a hazard topic in the Safety Element update include avalanche, agriculture and forestry pests (tree mortality), climate change, drought, extreme heat, landslides, public health hazards, and severe weather. Other key topics covered and discussed during SEAC work sessions related to climate adaptation planning were post-disaster recovery, evacuation planning, and energy shortages and resiliency.

Step 2.1B: Describe historical hazards

Historical hazards in the community are briefly described to provide context for assessing project climate-related changes. While historical extreme heat, drought, flooding, and wildfire events are listed, emphasis is put on the most recent of these events based on input and stories from stakeholders and the public. A detailed list of historical hazards is referenced in the LHMP.

Step 2.1C: Describe how climate hazards and other climate change effects are projected to change

The CVA describes two GHG emissions scenarios that reflect different projections for how global emissions and atmospheric GHG concentrations may change over time but selects a high emissions scenario (Representative Concentration Pathway [RCP] 8.5) for each primary climate stressor. The Governor's OPR recommends that agencies use RCP 8.5 for analyses considering impacts through 2050 because there are minimal differences between emissions scenarios during the first half of the century. The County's CVA also uses Cal-Adapt's default settings that provides outputs for subsets of 10 and 4 global climate models (GCMs) and integrates projections for mid-century (2040-2060) and through the end-of-century (2070-2090).

Step 2.1D: Map hazards and other climate change–related effects

The County mapped most climate-related hazards based on available GIS data sources and climate hazard projections for temperature increases, precipitation variability, hydrologic change, and wildfire risk from Cal-Adapt's downloadable data. These climate-related hazards layers were then overlaid with community population data and assets.

Step 2.2 Sensitivities & Potential Impacts

Prior to evaluating the sensitivity and potential impacts to future climate impacts, a final list of top indicators for sensitive populations was developed based on County and SEAC input.

Step 2.2A: Confirm community populations and assets

The County's list of critical facilities was organized and validated by the County's GIS team to confirm the accuracy of the location of the critical facility and to limit the scope to critical community assets. During the validation of the critical facility database, the County and consultant team redefined certain building and infrastructure assets, limited hazardous material facilities to Tier II facilities (facilities with hazardous chemicals present according to 40 Code of Federal Regulations (CFR) Part 370), focused only on linear transportation infrastructure, and expanded the list of community resources related to mental health, well-being, recovery, and shelter facilities. The asset location sources were based on a combination of Homeland Infrastructure Foundation-Level Data (HIFLD) Open Data, State, and County data sources. The scope of the critical facilities database is large, and the organization of the dataset was aligned with the County's asset categories and for most facilities, with the FEMA Community Lifeline categories, to focus on mitigation by sectors in later planning phases.

Step 2.2B. Identify climate impacts to community populations and assets to determine which are sensitive to climate change effects

Examining historical climate impacts is useful for establishing context and better understanding present-day vulnerability. The County considered both historical and projected impacts by collecting information on past impacts and augmenting this with future projection information from Cal-Adapt. This step involved desktop research on historical climate change effects (e.g., historical wildfire impacts) and potential future climate impacts.

Step 2.2C: Identify potential climate impacts of greatest concern

Through an iterative process and ongoing discussions with County staff, SEAC participants, stakeholder group, and the public, it was determined that the climate-related hazards that pose the greatest risk to the County include drought, extreme heat, flooding, severe winter storms, and wildfire.

Step 2.3 Adaptive Capacity

Adaptive capacity is the ability to moderate the potential damages or take advantage of the opportunities from climate change. Communities have adaptive capacity in the form of policies, plans, programs, or institutions. Understanding this adaptive capacity entails identifying existing resources and assessing the community's ability to cope with potential climate impacts.

Step.3A: Review documents to collect information on adaptive capacity

The County reviewed relevant information on government policies, plans, and programs to enhance adaptive capacity. This included local plans, like the LHMP, General Plan, and Area and Specific Plans. regional and sector-based plans were reviewed, such as Urban Water Management Plans (UWMPs), Emergency Operation Plans (EOPs), Fire Management Plans, and Community Wildfire Protection

Plans (CWPPs). Local ordinances and programs were reviewed, such as the County Building Code, Zoning Code, Fire Code and Floodplain Ordinance. Federal, state, and regional plans and grant programs were also reviewed such as the FEMA Hazard Mitigation Assistance (HMA) grant programs, CAL FIRE California Fire Plans, and TRPA Regional Plan.

Step 2.3B: Interview local agencies on their current ability to enhance adaptive capacity

As part of the CVA, Adaptive Capacity worksheets were distributed to County departments and partner agencies and organizations on the SEAC to better understand their adaptive capacity and to elicit information on existing and planned efforts to manage current and future climate impacts. The stakeholder group was also asked about adaptive capacity during its workshop. In addition, the County team integrated key findings from workshop input gathered on the public's perception of adaptive capacity during the development of the Regional CVA.

Step 2.4 Vulnerability Scoring

The County team completed a systematic scoring exercise to identify priority climate vulnerabilities, which are summarized in a table showing key vulnerabilities and the overall vulnerability score for each climate stressor. The vulnerability scores are qualitative, based on the combination of potential impact and adaptive capacity and a process that encouraged the SEAC and stakeholder groups to provide input.

Step 2.4A: Summarize vulnerability

Vulnerability is summarized based on the status of specific population and community assets and the consequences to public safety, human health, and continuity of public services due to exposure to climate change effects. This summary considers the County's ability to manage the impacts (adaptive capacity).

Step 2.4B: Score vulnerability

A rubric was used to score potential impact and adaptive capacity based on three scoring levels. The scoring process was based on an iterative process that considers County staff determination, GIS analysis, SEAC and stakeholder group feedback, and general input and opinions from the public.

Step 2.5 Outreach and Engagement

The County informed and engaged with community members throughout the vulnerability assessment phase to confirm climate stressors, identify sensitive populations and community assets, and improve understanding of community capacity. Outreach during this phase involved bi-weekly team coordination calls with the core County team and consultant staff, focused stakeholder interviews and meetings with government and organization groups (e.g., EDCTC, TRPA, TRCD, SBC, CAL FIRE, etc.). The public survey was open during this phase for a three-month period to gather public input, and the County publicized the survey through ongoing press releases, newspaper notices, and social media postings on the CVA process and Safety Element update. Community engagement during this phase was designed to help refine the assessment and ensure it accurately reflected on-the-ground conditions for both the West Slope of the County and the Tahoe Basin.

Phases 3 and 4 are associated with the development of an adaptation framework, strategies, and implementation programs and will be the focus of the Safety Element update.

B. Background Reports and Modelling Sources

The RCP 4.5 and RCP 8.5 climate change scenarios available on the Cal-Adapt web platform are best suited for California projections as they have been downscaled to the California State level. The GCMs are meant to simulate conditions across the globe. The models break out the surface of the

Earth into grid cells, which are used to forecast conditions in each grid cell. While these global models are good indicators for projecting global conditions, the scale is too large to model the climate differences across local areas in California. As a result, these models have been "downscaled" to more granular grid cells to display projections on a county level.

The Cal-Adapt web platform and California Fourth Climate Change Assessment was developed and updated through collaboration between the California Governor's OPR, California Natural Resources Agency (CNRA), California Energy Commission (CEC), and University of California, Berkeley, and provides the foundation of climate change science and modelling for the State. The State has also developed a comprehensive list of reports and tools that local jurisdictions can use to assess climate change hazards and prepare for these hazards. The key background reports, models, and tools used and referenced in the CVA include:

- Cal-Adapt Web Platform (cal-adapt.org)
- California Climate Adaptation Strategy (2021)
- California's Wildfire and Forest Resilience Action Plan (2021)
- California's Extreme Heat Action Plan (2022)
- California Adaptation Planning Guide (2020)
- Tahoe Climate Adaptation Prime (2021)
- California 4th Climate Change Assessment (2018)
- Defining Vulnerable Community in the Context of Climate Adaptation (2018)
- Planning and Investing for a Resilient California (2017)
- California Building Resilience Against Climate Effects (2018)
- Sierra Nevada Regional Climate Vulnerability Assessment (2022)

Several of these tools were reviewed as reference guides, used to inform the planning process, while others were reviewed to integrate state and local information related to climate-related hazards into the summaries on the primary and secondary climate stressors, and the potential climate vulnerabilities to socially vulnerable populations, critical assets and infrastructure, and natural resources. Additional County-specific scientific studies and plans included the EDWA's Water Resources Development and Management Plan (2019) and the Bureau of Reclamation American River Basin Study findings on increasing temperatures and changing precipitation through the 21st century.

C. Data Limitations

The climate change projections and data used to profile and describe several of the secondary climate stressors have data limitations. The CVA includes projections for the years 2035-2065 and 2070-2099 to identify how climate change hazards are likely to affect the County by the mid-century and end-of-century. The CVA focuses on the mid-century and end-of-century projections to understand how soon sensitive populations and critical assets will experience climate-related hazard impacts. However, historical climate conditions and future climate conditions were not available for all the secondary hazards addressed in the CVA. These historical and future condition scenarios were only available for air temperature, precipitation, extreme heat, severe weather, snowpack, and wildfire. Additional data limitations are due to the lack of spatial GIS datasets. For these secondary climate stressors, the CVA references and supplements the discussion with information from the California Fourth Climate Change Assessment and the NOAA National Centers for Environmental Information State Climate Summaries (Bedsworth et al 2018, Frankson et al 2022).

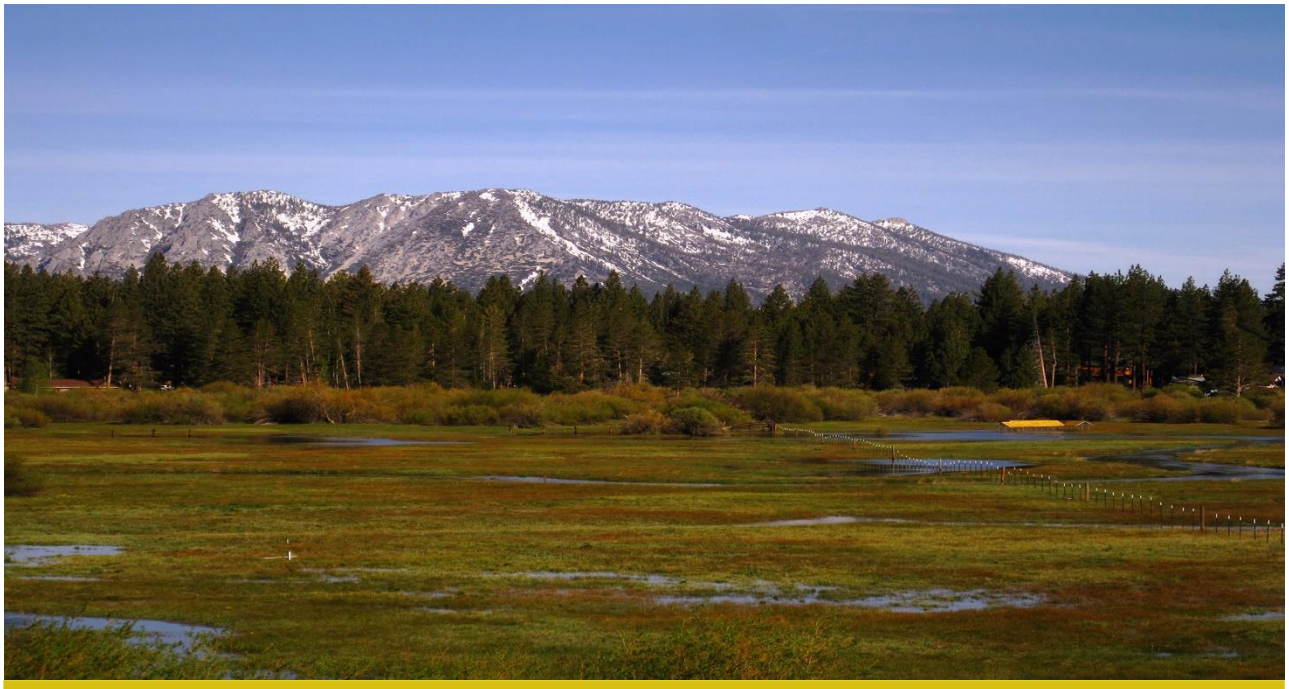
Two ways suggested by the APG to address uncertainty are the "low/no regrets" principle," and a "triggers approach." The "low/no regrets" principle asks if the project would still be beneficial to a community if the expected environmental impacts do not occur. For example, flood mitigation could be addressed by conserving open land in a floodplain, which would still benefit the community if increased flooding did not occur as precipitously as expected. A flood control structure in the same scenario, however, may cause habitat disruption with no additional benefit.

The "triggers approach" considers future scenarios under which an adaptation strategy might fail. A stormwater management system, for example, may fail if increased deluge overwhelms the capacity of the system. This would then set a "trigger" point, which would indicate the need for a modified or new strategy. The goal would be to develop a mitigation strategy that was robust enough to adapt to future conditions, or that may be modified without significant cost, although future conditions may still require a complete policy shift.

What is Uncertainty?

Uncertainty in climate adaptation planning comes from three sources.

- First, because climate change is largely driven by the amount of GHGs in the atmosphere, the extent of warming will largely depend upon the success of GHGs limiting policies.
- Second, while climate models are constantly evolving and improving, the impacts of any given amount of GHGs on human and natural systems are ultimately unknown.
- The final source of uncertainty is introduced by uncertainty about innovations, changing technology, economic conditions, population, human behavior, and other factors.



View from the Upper Truckee Marsh looking west towards the Sierra Nevada.

Photo Credit: The Tahoe Resource Conservation District

3. County of El Dorado Profile

A. Geographic Setting

The County spans the eastern part of the Central Valley of California and increases in elevation from urban Western El Dorado across the Sierra Nevada crest to high-alpine City of South Lake Tahoe and the Nevada state line. The County comprises 1,708 square miles of land and 78 square miles of water. The County is generally divided into two geographically distinct areas, the Western Slope – El Dorado Hills to Strawberry – and the Tahoe Basin – Strawberry to South Lake Tahoe. The Western Slope includes the rolling foothills and agricultural lands in the lower elevations near Sacramento County, and the Tahoe Basin contains the mountainous terrain over the Sierra Nevada crest to Lake Tahoe.

B. Population

The County comprises two incorporated cities and 13 census designated places; in 2022, the County had a population of approximately 193,211 people. Of the two cities, the City of South Lake Tahoe is the most populous with an estimated 21,414 residents in 2022. However, most county residents live outside the incorporated areas, and this percentage continues to increase. In 2000, 78.7% of the County's residents lived outside the incorporated areas, compared to 82.4% in 2010, and 83.4% in 2022. **Table 3-1** below shows the distribution of the population of the County during each of the last three decennial Census counts.

Table 3-1 El Dorado County Population

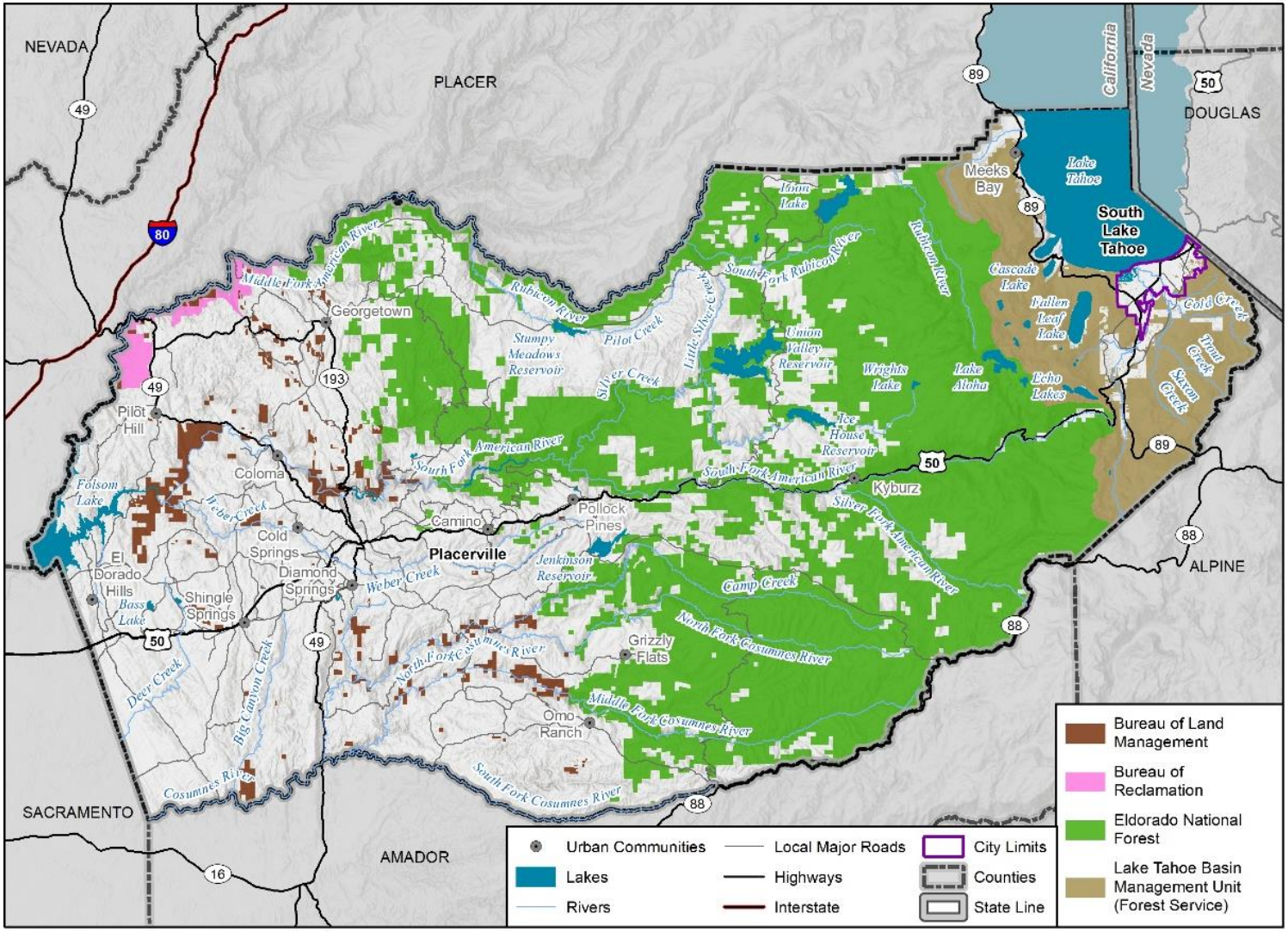
	Total Population		
	2000	2010	2020
South Lake Tahoe	23,639	21,403	21,330
Placerville	9,724	10,389	10,747
Unincorporated County	122,936	149,266	159,108
County Total	156,299	181,058	191,185

Source: U.S. Census Bureau Decennial Census

C. Land Ownership

Large expanses of the County are public land. The Eldorado National Forest comprises approximately 43% of the County's total acreage, primarily on the Western Slope. A large portion of the Tahoe Basin consists of federally owned land that is part of the U.S. Forest Service, Lake Tahoe Basin Management Unit (LTBMU). **Figure 3-1** shows the extent of federal land ownership in the County. Additional land is owned by the State of California, including the California Department of Fish and Wildlife, California State Parks, California State Lands Commission, and the California Tahoe Conservancy. The large amount of preserved and open spaces provides the County with an abundance of adaptive capacity for floodplain management, drought and water supply projects, and forestry and vegetation and fuels reduction opportunities. These opportunities also come with challenges, as federal and state land managers must collaborate with private landowners and developers.

Figure 3-1 El Dorado County Federal Land Ownership



D. Climate

The climate varies throughout the County, primarily based on elevation, which ranges from 700 feet above sea level to more than 10,800 feet, in the peaks of the Sierra Nevada. Summers are long and dry throughout the County, although temperatures are relatively hot in the lower elevations and relatively cool in the higher elevations. Winters in the lower elevations are short, and precipitation is primarily in the form of rain. In higher elevations, winters vary from short and mild with moderate snowfall to moderately severe with frequent snowfall. Most of the precipitation throughout the County occurs between October and April. Table 3-2 shows the differences in climate between the Western Slope and the Tahoe Basin.

Table 3-2 El Dorado County Temperature and Precipitation Summary

	The Tahoe Basin (Station No. 048762, South Lake Tahoe)	**The West Slope** (Station No. 046962, Placerville)
Period of record	1968-2016	1955-2012
Winter Average Minimum Temperature	16.7°F	38.4°F
Winter Mean Temperature	29.3°F	46.4°F
Summer Average Maximum Temperature	76.6°F	87.8°F
Summer Mean Temperature	58.2°F	74.8°F
Average Annual Number of Days >90°F	1.5	57.1
Average Annual Number of Days <32°F	198.1	27.3
Mean Total Precipitation (in.)	16.27	38.76
Mean Snow Depth (in.)	2	0
Maximum Temperature	99°F on July 22, 1988	109°F on July 14, 1972
Minimum Temperature	-29°F on December 9, 1972	11 °F on February 5, 1989

Source: Western Regional Climate Center (WRCC)
Winter is defined as December, January, February; Summer is defined as June, July, August

E. Transportation System

The County's transportation system includes a regional roadway system, public transportation systems, a non-motorized transportation system, and an aviation system. The primary transportation corridor in the County is the U.S. Highway 50, which provides connections from Sacramento County to the State of Nevada and serves all the County's major population centers, including El Dorado Hills, Cameron Park, Diamond Springs, and Camino, as well as the two incorporated cities. The regional roadway system includes an additional four State Routes (SR) (SRs 49, 89, 153, and 193) and a network of local public and private roads.

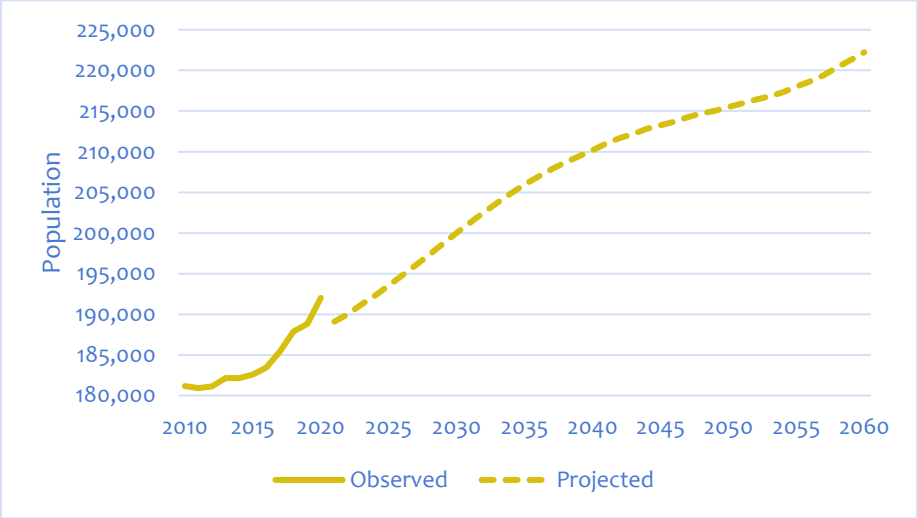
Public transportation in the West Slope is provided by the El Dorado County Transit Authority, and public transportation in the Tahoe Basin is provided by Tahoe Transportation District. Additional public transit options in the unincorporated County includes Amtrak, two taxi services in the West Slope and seven services in the Tahoe Basin, and carpools/vanpools provided by the State of California.

While regional bikeways and trails do exist in the County, due to the low-density development pattern and lack of investment in bicycle and pedestrian infrastructure, non-motorized forms of transportation are used mainly for recreation and not as a mode of transit. Additionally, four general aviation airports used by the public and government are located within the County's boundaries, including the Placerville Airport, Lake Tahoe Airport, Cameron Park Airport, and Georgetown Airport.

F. Population and Projected Growth

According to the Department of Finance (DOF) the 2020 population of the County was 193,098 (DOF 2022). The DOF projects the total population will increase by 7% to 207,496 by 2030 (DOF 2020). While total households in the County are also projected to increase from 191,428 in 2020 to 205,592 in 2030, people per household is projected to slightly decrease from 2.54 in 2020 to 2.42 persons per household in 2030 (DOF, 2020). These projections are shown in **Figure 3-2.**

Figure 3-2 El Dorado County Projected Population



Source: DOF

G. Development Trends

The Sphere of Influence (SOI) for each incorporated jurisdiction consist of areas that each city plans to grow into and are slated for potential development. Identifying the potential climate hazards in each area can help to mitigate the impacts before development occurs in these areas. Due to growth management regulations, most residential development is limited within the city limits of each jurisdiction. Neighborhoods and certain residences in the County recently impacted by wildfire are also being rebuilt.

H. Demographics

Select demographic and social characteristics for the County from the 2016-2020 American Community Survey (ACS) and the California DOF are shown in **Table 3-3**. Additional information on social vulnerability demographic indicators is provided in Section 6.B.

Table 3-3 El Dorado County Select Demographic and Social Characteristics

Characteristic	Percent
Gender/Age	
Male	49.8%
Female	50.2%
Median age (years)	46.3
Under 5 years	4.5%
Under 18 years	19.9%
65 years and over	21.2%
Race/Ethnicity	
White	77.2%

Characteristic	Percent
Asian	4.7%
Black or African American	0.8%
American Indian/Alaska Native	0.5%
Hispanic or Latino (of any race)	13.0%
Native Hawaiian and Other Pacific Islander	0.2%
Some other race	0.2%
Two or more races	3.5%
Education*	
% High school graduate or higher	94.0%
% with Bachelor's Degree or Higher	35.2%
Social Vulnerability	
% with Disability	13.1%
% Language other than English spoken at home**	11.7%
% Speak English less than "Very Well"**	3.5%
% of households with a computer	94.0%
% of households with an Internet subscription	88.1%
% of households with no vehicle available	4.3%
* Population 25 years and over ** Population 5 and over	

Source: U.S. Census Bureau, 2020 ACS 5-Year Estimates

The following sections examine and analyze the demographics used to collect and assess the County's sensitive populations based on several social vulnerability indicators.

U.S. Census ACS

Socially vulnerable populations identified by using the U.S. Census Bureau data were broadly classified into the following categories: demographics, employment and education, or connectivity. As defined in the introduction, socially vulnerable populations, referred to as sensitive populations in the CVA, are groups of people who experience heightened risk and increased sensitivity to climate change, and who have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts. These disproportionate effects are caused by factors including inequalities in access to support such as economic opportunity, social capital, or social services; political and economic exclusion based on institutionalized bias; and physical barriers such as age, health, and infrastructure connectivity. **Table 3-4** summarizes the metrics (indicators) for these three categories and the percentage of the population in the County represented by these characteristics that define the socially vulnerable populations. These indicators were also identified and reviewed during the SEAC work sessions. The U.S. Census Bureau ACS is the source for 15 of the 20 indicators for sensitive populations.

Table 3-4 Socially Vulnerable Populations Identified by SEAC

Characteristic	Metric	Value
Demographics	Percent of population equal or under the age of 14	16.6%
	Percent of households where householders (65+) live alone	0.34%
	Number of unhoused individuals in 2019*	613
	Percent of housing units that are mobile homes	5.4%

Characteristic	Metric	Value
	Percent of population with disability	13.1%
Employment & Education	Unemployment Rate	4.7%
	Percent of population 25 years and over without high school degree or equivalent	6.0%
	Percent of people whose income in the past 12 months is below the poverty level	8.5%
	Percent of population that speak English less than "very well"	3.5%
	Number of outdoor workers**	5,308
Connectivity	Percent of population in Unincorporated County	83.4%
	Percent of households with no vehicles available	4.1%
	Percent of households with no internet subscription	7.5%
	Percent of occupied households with no telephone service available	1.2%
	Percent of population without health insurance coverage	4.3%

Source: US Census Bureau 2020 ACS 5-Year Estimates
* = 2019 Applied Survey Research Point-in-Time Count
** = data from ACS 2010

The young and the old, the unhoused, those with disabilities, and those who reside in mobile homes may have more difficulty preparing for, or evacuating from, dangerous situations and may become stranded. These groups may be more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. The unemployed, those without a high school degree, those living below the poverty line, and those who are not proficient in English are less likely to have the tools necessary to prepare for a climate-related hazard. Additionally, those who work outdoors in the agricultural industry or in recreational tourism are the most likely to be exposed to climate related hazards. Populations who reside in the rural, unincorporated County, and those without access to vehicles, internet, or telephones are more difficult to reach in an emergency event and may not have access to the most recent safety information. Finally, those without health insurance are more vulnerable to the lasting effects of a climate-related hazard.

Table 3-5 lists the census tracts with the highest concentrations of sensitive populations in the unincorporated County based on ACS data. Some of the census tracts overlap with the cities of Placerville and South Lake Tahoe because the census tracts do not align with city limits. If a census tract overlaps with a city, data from both the unincorporated County and within the city limits were included.

Table 3-5 Census Tracts with the Highest Concentration of Socially Vulnerable Communities from the ACS

Census Tract	Percentage	Population Indicators
6017031800	28.2%	% of population that are children
6017031700	27.4%	
6017031700	22.1%	% of population without a high school diploma
6017031100	19.1%	
6017031302	21.3%	% of population with a disability
6017031504	21%	% of population over 65
6017031600	21.8%	% of population that speak

Census Tract	Percentage	Population Indicators
6017030200	17.4%	English less than "very well"

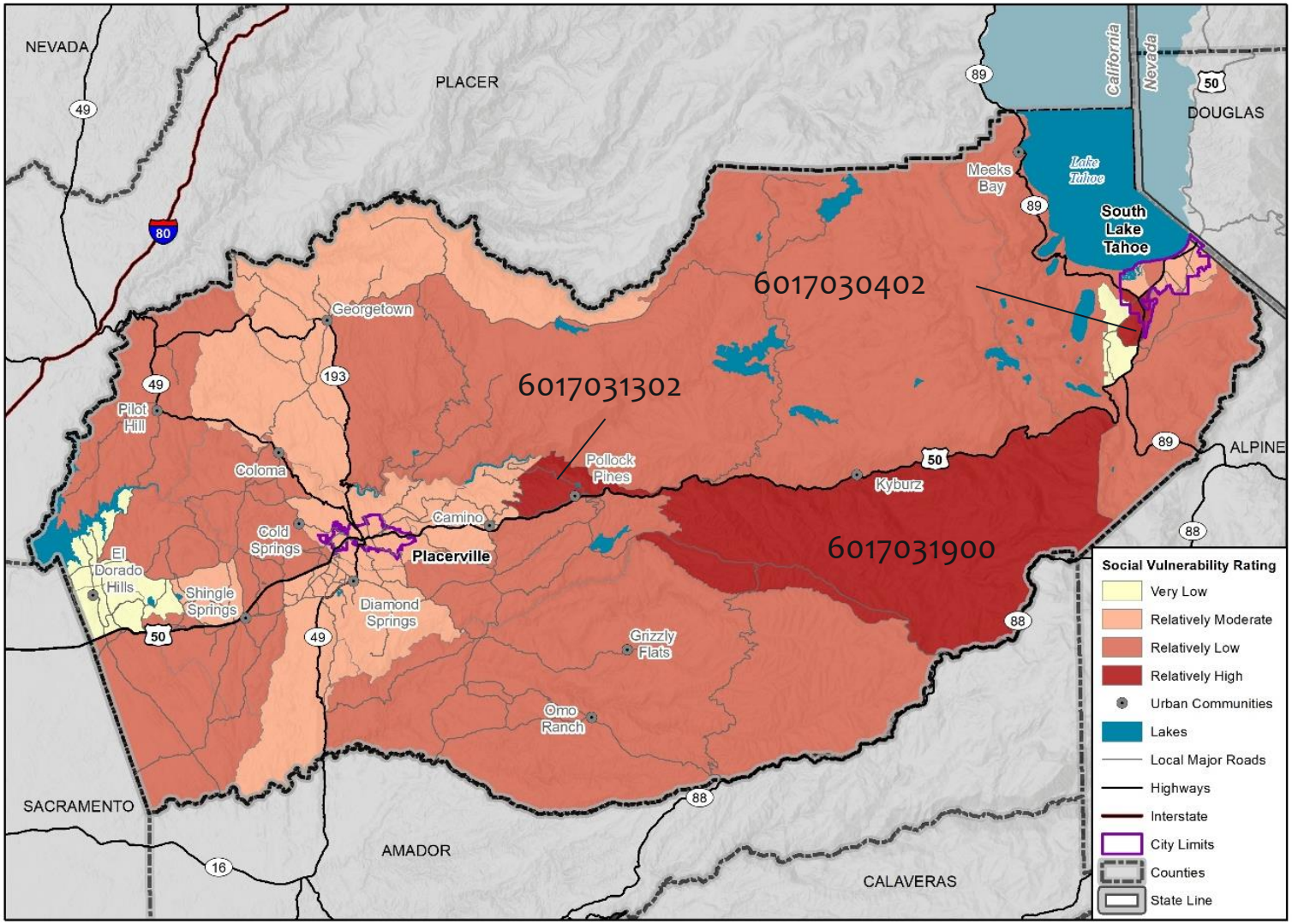
Source: U.S. Census ACS

FEMA NRI

FEMA NRI SoVI rating utilizes 29 socioeconomic variables deemed to contribute to a community's ability to prepare for, respond to, and recover from hazards. The data for these socioeconomic variables are pulled from the ACS and are similarly organized into the broader categories used in the ACS: wealth, race and social status, age, ethnicity and lack of health insurance, special needs populations, service sector employment, race, and gender.

Figure 3-3 below shows the FEMA SoVI rating for the County by census tract level. Census tracts with a high social vulnerability rating are more likely to be adversely affected during a hazard event and less likely to recover as quickly as other communities.

Figure 3-3 El Dorado County Census Tract FEMA SoVI Rating



The census tracts that are shown to have a relatively high social vulnerability rating are further discussed in **Table 3-6** below.

California Healthy Places Index

The California Healthy Places Index (HPI), developed by the Public Health Alliance of Southern California and visualized by Axis Maps, is a tool to explore the community conditions that impact life expectancy. The HPI helps prioritize public and private investments, resources, and programs in communities where they are needed most.

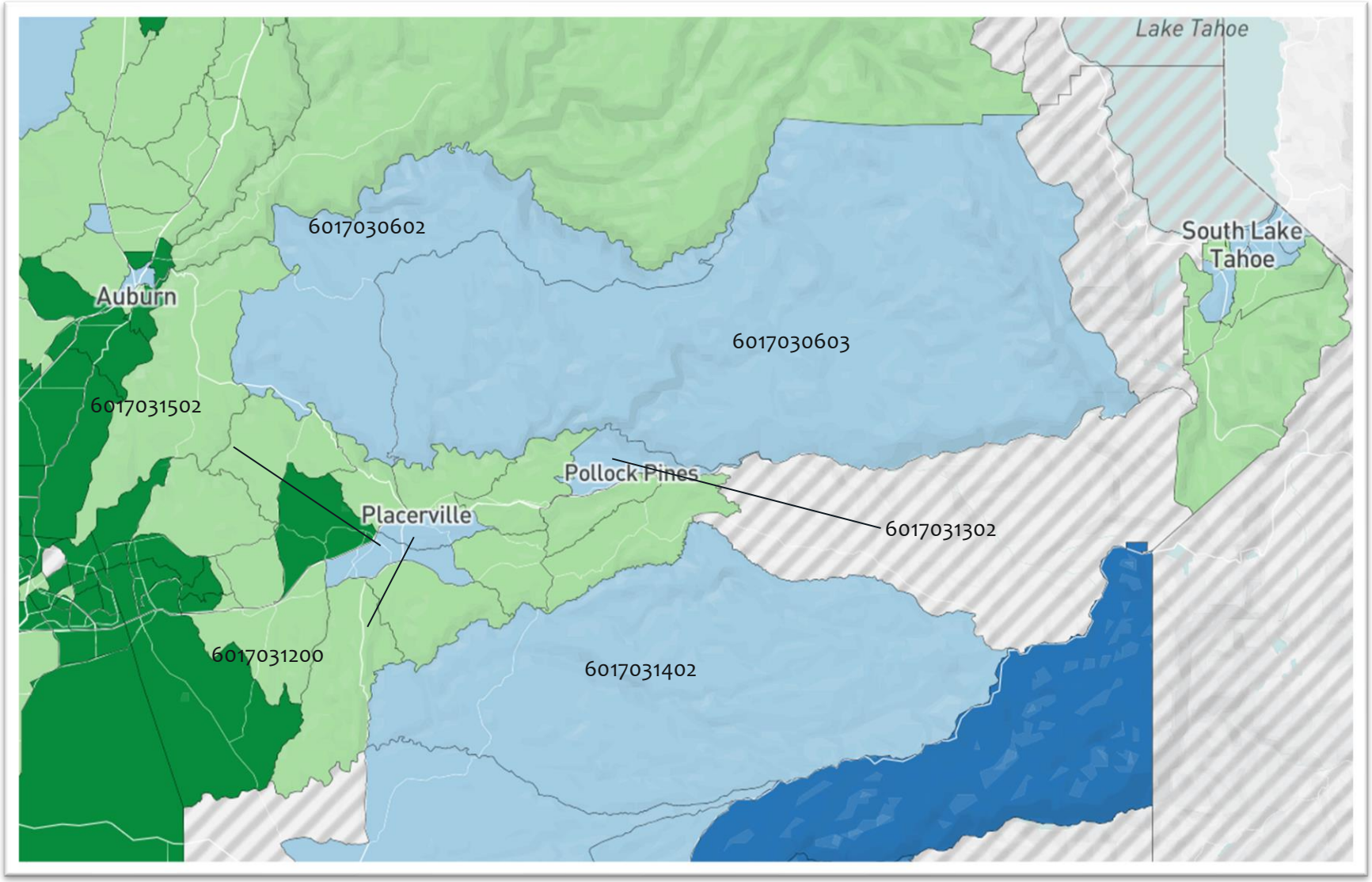
The HPI combines 25 community characteristics, including access to healthcare, housing, education, and more, into a single indexed HPI score. These community characteristics include aspects such as economic, education, social (2020 census response rate, voting), transportation, neighborhood (park access, retail density, tree canopy), housing, and clean environment. The healthier a community, the higher the HPI score. The HPI applies a positive frame focusing on assets a community has that they can build on, rather than what is lacking.

Figure 3-4 below shows the HPI results for the County also by census tract. The blue census tracts are less healthy when compared to other California tracts. The light green and green census tracts are healthier than other California tracts. The census tracts that are shown to be less healthy are further discussed in **Table 3-6**.

CalEnviroScreen

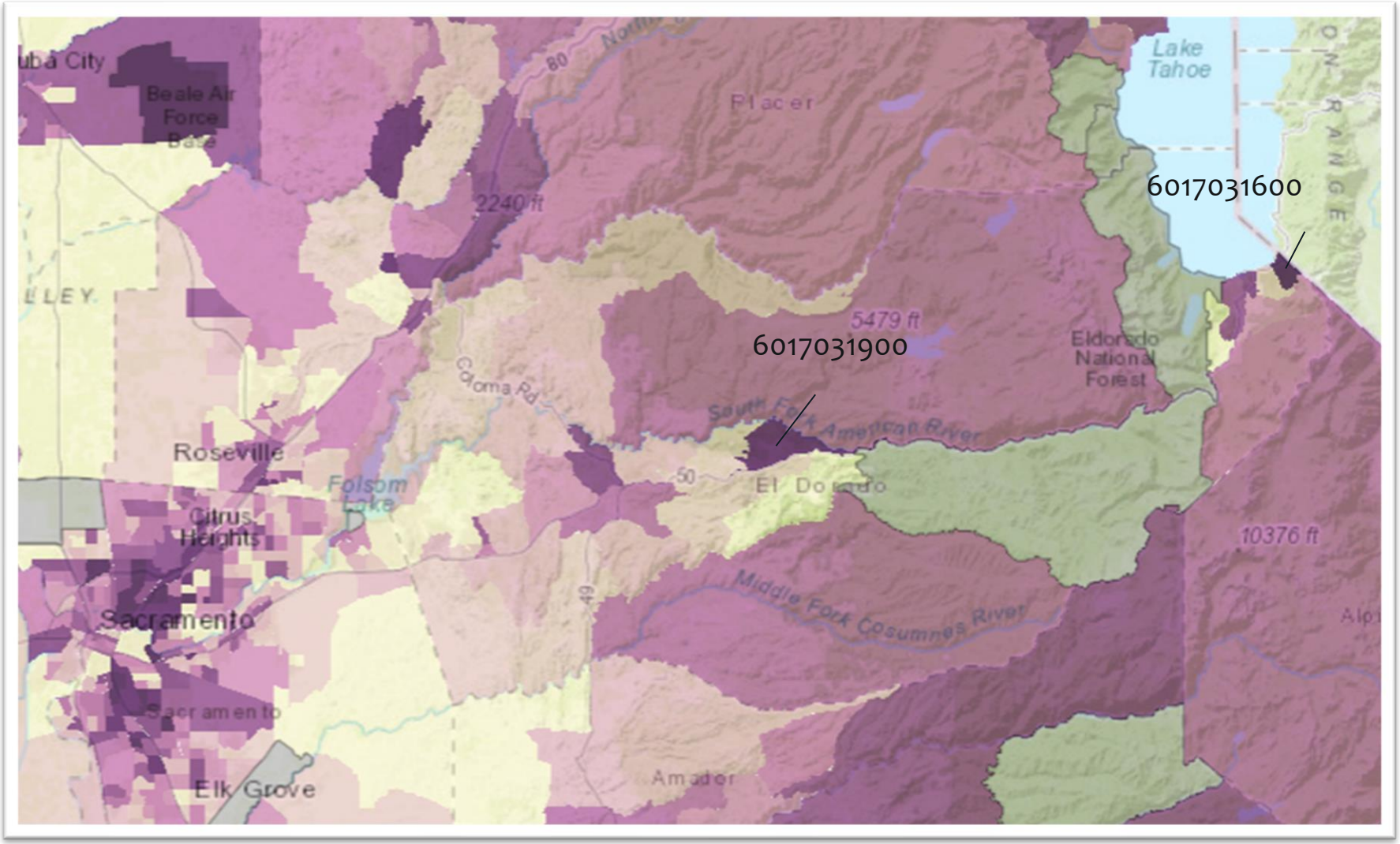
The California OEHHA CalEnviroScreen tool is available to show census tracts that have a higher percentage of housing-burdened low-income households. Housing-burdened low-income households are households that are both low-income (making lower than 80% of the Housing and Urban Development Area Median Family Income) and severely burdened by housing costs (paying higher than 50% of income to housing costs). These households spend a larger proportion of their income on housing and may suffer from housing-inducted poverty. These households are also more likely to be adversely affected during a hazard event and less likely to recover as quickly as other communities. As shown in **Figure** 3-5, census tracts that are dark purple have a higher percentage of housing-burdened low-income households.

Figure 3-4 El Dorado County HPI Ratings



Source: California HPI; www.healthyplacesindex.org

Figure 3-5 CalEnviroScreen Housing-Burdened Low-income Households



Source: CalEnviroScreen

Table 3-6 below lists the census tracts that are shown to have a higher social vulnerability based on three sources: FEMA NRI, California HPI, and CalEnviroScreen.

Table 3-6 Census Tracts with High Concentration of Socially Vulnerable Communities from FEMA NRI, California HPI, and CalEnviroScreen

Source	Census Tract
FEMA NRI	6017031900
	6017031302
	6017030402
California HPI	6017030602
	6017030603
	6017031402
	6017031200
	6017031502
	6017030402
	6017030200
	6017031600
CalEnviroScreen 4.0*	6017031302
	6017031600
	6017031000
	6017030402
	6017030603
	6017031402

Sources: FEMA NRI SoVI, CDC ATSDR SVI, OEHHA CalEnviroScreen 4.0, DWR DAC Mapping Tool, and California HPI
* The percentage of such households in these tracts is higher than at least 50% of the other tracts in the State.

Furthermore, census tracts that appeared at least twice in Table 3-5 and Table 3-6 are shown in Table 3-7 as the census tracts that have the highest concentration of sensitive populations and social vulnerability. Table 3-7 also shows further details on these census tracts together with their related primary indicators and relevant sources.

Table 3-7 Census Tracts with the Highest Concentration of Sensitive Populations and Social Vulnerability

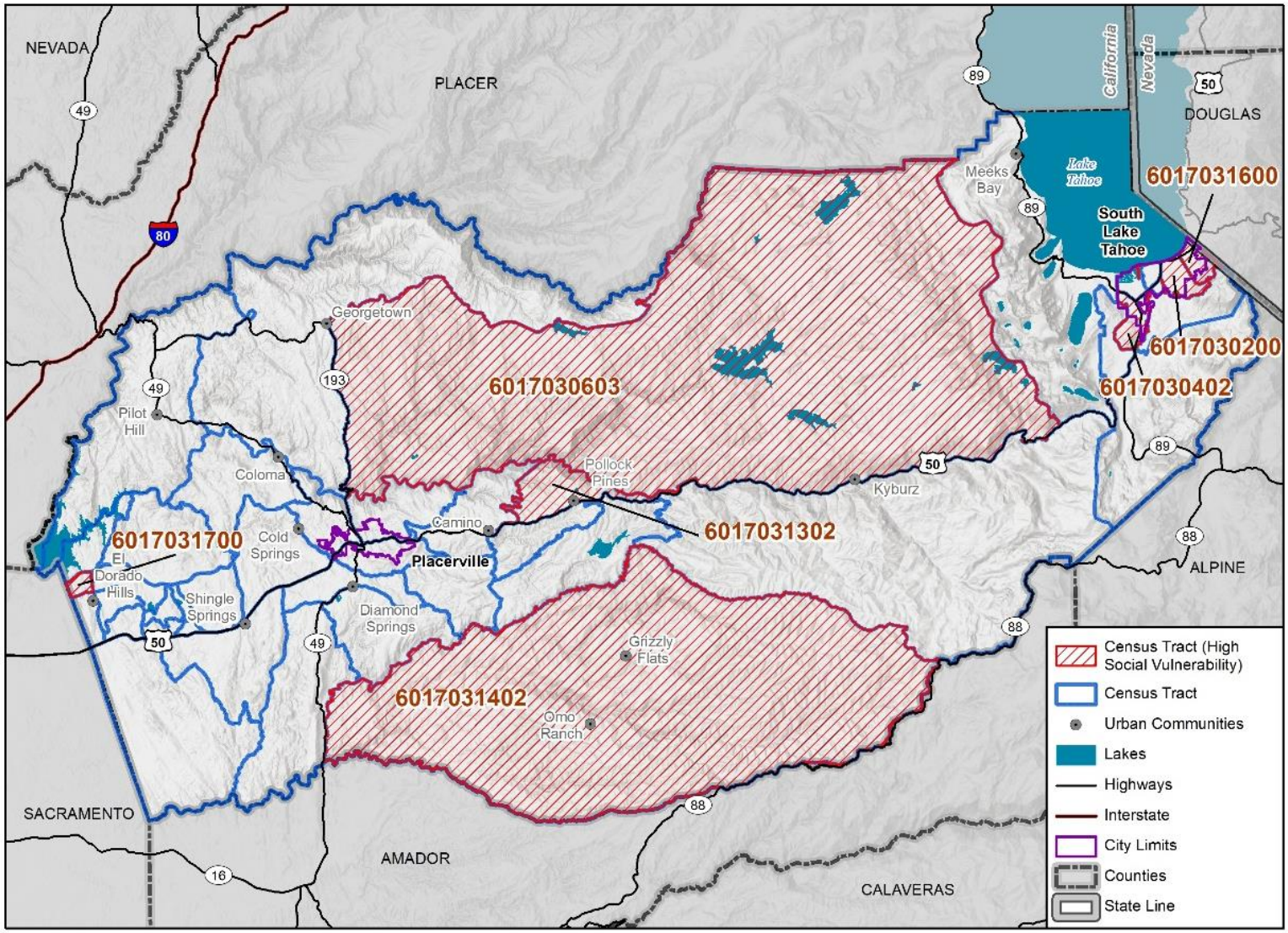
Census Tract	Primary Indicators	Source
6017031600	• Housing-Burdened Low-income Households • Persons with Limited English Proficiency	• ACS • California HPI • FEMA NRI
6017030402	• Housing-Burdened Low-income Households	• California HPI • FEMA NRI
6017031402	• Low-Income Households • Cost-burdened Households	• California HPI • CalEnviroScreen
6017031302	• Low-Income Households • Persons with Disabilities and	• California HPI • FEMA NRI

Census Tract	Primary Indicators	Source
	Access and Functional Needs	• CalEnviroScreen
6017030603	• Low-Income Households	• California HPI • CalEnviroScreen
6017030200	• Low-Income Households • Cost-burdened Households • Persons with Limited English Proficiency	• ACS • California HPI
6017031700	• Percent of population that are children • Percent of population without a high school diploma	• ACS

Sources: US Census Bureau ACS, FEMA NRI SoVI, OEHHA EnviroScreen, WSP Analysis 2022
NOTES: FEMA's NRI SoVI is a location-specific assessment of social vulnerability that utilizes 29 socioeconomic variables that contribute to a community's reduced ability to prepare for, respond to, and recover from hazards, therefore not every specific indicator is listed.

Figure 3-6 shows where these census tracts are located within the County.

Figure 3-6 El Dorado County Census Tracts with the Highest Concentration of Sensitive Populations and Social Vulnerability



It should be noted that during the development of the CVA, additional federal climate and economic justice tools have become available that were not part of the GIS analysis used to define sensitive populations in the County. The Climate and Economic Justice Screening Tool is one such tool that identifies census tracts that are overburdened and underserved and highlighted as being disadvantaged. This tool identifies Census Tract 06017030602, which has a population of 7,911 residents spread across the rural communities of Greenwood, Buckeye, Spanish Flat, Lotus, Coloma, and Kelsey (CEQ 2023). Ten percent of the population in this census tract is Hispanic or Latino, the area has a high expected economic loss related to agriculture each year, a higher-than-normal loss to building values resulting from natural hazards each year, and the community spends more money and time on transportation (CEQ 2023). Many of these burdens are also associated with a higher risk to wildfire.

I. Economy

According to the California Employment Development Department, the County's economy is heavily dependent on recreation and tourism. Eldorado National Forest, which takes up a significant portion of the County's land, is one of the most heavily used wilderness areas in the nation. The Sierra Nevada, the south fork of the American River, and Lake Tahoe are also some of the County's natural attractions.

As mentioned on the County's "Elevate to El Dorado" website, the County is part of the six-county Sacramento Region, one of the fastest-growing regions in California. The County enjoys an economy as diverse as its landscape. A recent county-wide analysis concluded that major employment sectors with room for growth include Health & Social Services, Accommodation & Food Services, Retail Trade, Construction, Administration & Waste Services, Finance & Industry, Manufacturing, and Arts, Entertainment & Recreation. Estimates of select economic characteristics for the County are shown in **Table 3-8**.

Table 3-8 El Dorado County Economic Characteristics, 2016-2020

Characteristic	Percent
Families below Poverty Level (%)	5.6%
All People below Poverty Level (%)	8.5%
Median Family Income	$ 105,391
Median Household Income	$ 83,710
Per Capita Income	$ 44,651
Population in Labor Force	57.3%
Population Employed*	54.5%
Unemployment Rate**	2.7%

Source: U.S. Census Bureau, California DOF, 2016-2020 ACS 5-Year Estimates
*Excludes armed forces.
**Does not reflect unemployment numbers due to COVID-19 Pandemic

The most common industries within a five-mile radius of the County are educational services and health care (a combined average of 18 percent of workers). Professional, scientific, and management services and arts; entertainment; recreation; and accommodation and food services are two other major industries. **Table 3-9** and **Table 3-10** below show the labor force breakdown by occupations and industry based on estimates from the 2016-2020 5-Year ACS.

Table 3-9 El Dorado County Employment by Industry, 2016-2020

Occupation	# Employed	% Employed
Agriculture, forestry, fishing and hunting, and mining	1,178	1.4%
Construction	7,290	8.5%
Manufacturing	5,582	6.5%
Wholesale trade	1,661	1.9%
Retail trade	8,153	9.5%
Transportation and warehousing, and utilities	3,326	3.9%
Information	1,431	1.7%
Finance and insurance, and real estate and rental and leasing	6,477	7.5%
Professional, scientific, and management, and administrative and waste management services	11,467	13.3%
Educational services, and health care and social assistance	17,778	20.7%
Arts, entertainment, and recreation, and accommodation and food services	11,301	13.2%
Other services, except public administration	3,918	4.6%
Public administration	6,337	7.4%
Total	**85,899**	**100.0%**

Source: U.S. Census Bureau, California DOF, 2016-2020 ACS, 5-Year Estimates
*Excludes armed forces

Table 3-10 El Dorado County Employment by Occupation, 2016-2020

Occupation	# Employed	% Employed
Management, business, science, and arts occupations	41,612	46.5%
Service occupations	15,303	17.1%
Sales and office occupations	18,703	20.9%
Natural resources, construction, and maintenance occupations	7,607	8.5%
Production, transportation, and material moving occupations	6,264	7.0%
Total	**89,489**	**100%**

Source: U.S. Census Bureau, California DOF, 2016-2020 ACS, 5-Year estimates
*Excludes armed forces

J. Housing Characteristics

In the United States, individual households are expected to use private resources for climate adaptation to some extent. This means that households living in poverty are automatically disadvantaged when preparing for hazards. Additionally, low-income populations typically occupy more inadequately built and improperly maintained housing. Mobile or modular homes, for example, are more susceptible to damage in floods and less equipped to protect against extreme heat than other types of housing. Mobile homes represent 5.3% of the total housing stock in the County (US Census ACS 2020).

Table 3-11 shows select housing characteristics from the ACS 5-Year Estimates for 2020 for the County.

Table 3-11 El Dorado County Select Housing Characteristics, 2016-2020

Housing Characteristic	Estimate	Percentage
Total Housing Units	91,569	100%
Units Occupied	73,078	79.8%
Vacant	18,491	20.2%
Owner Occupied	55,193	75.5%
Renter Occupied	17,885	24.5%
1-unit detached	72,846	79.6%
1-unit attached	2,416	2.6%
2 units	1,669	1.8%
3 or 4 units	3,166	3.5%
5-9 units	2,101	2.3%
10-19 units	1,585	1.7%
20 or more units	2,768	3.0%
Mobile Home	4,861	5.3%
Boat, RV, van etc.	157	0.2%

Source: U.S. Census Bureau, California DOF, 2016-2020 ACS 5-Year Estimates

K. Natural and Recreation Resources

Nearly half of the County (about 460,000 acres) consists of the Eldorado National Forest. The Forest supplies and regulates water from upper watersheds and meadows, providing over 527 billion gallons per year to downstream systems – enough to provide California's population with drinking water for more than 45 years. It is estimated that over 898,000 people visit the Eldorado National Forest annually to engage in recreation such as camping, hiking, and fishing and hunting. These visitors contribute an estimated $116.3 million to the local economy. Timber harvesting also occurs in the forest to prevent fires and provide for the sustainable production of timber and biomass.

A significant portion of Lake Tahoe resides in the County. Lake Tahoe is the largest freshwater lake in California and is well-known for its clear waters, pristine beaches, and abundance of outdoor recreation activities. In addition to being the second deepest lake in the United States, it is the sixth largest by volume, trailing only the five Great Lakes. It contains enough water, about 39 trillion gallons, to cover an area the size of California to a depth of 14.5 inches. While the estimated number of annual visitors varies, the Tahoe Transportation District estimates that 24 million people visit Lake Tahoe annually (TMPO 2017).

The Folsom Lake State Recreation Area spans about 19,500 acres and encompasses two reservoirs, Folsom Lake and Lake Natoma. The reservoirs were created by the Bureau of Reclamation as part of the Central Valley Project, a system of dams, canals, and aqueducts designed to move water throughout the Central Valley. In addition, the dams provide flood protection, drinking water, hydroelectric power, and recreation opportunities such as camping, aquatic sports, and equestrian, hiking, and biking trails.

Three RCDs operate in the County: the Tahoe RCD, Georgetown Divide RCD, and the El Dorado RCD. RCDs are special districts in the State of California, which aim to develop innovative conservation solutions. They are composed of leaders appointed or elected locally, who live in their respective districts and are well-versed in local issues. RCDs are a link between federal, state, and local programs, who engage in conservation through education and programs on public and private lands.

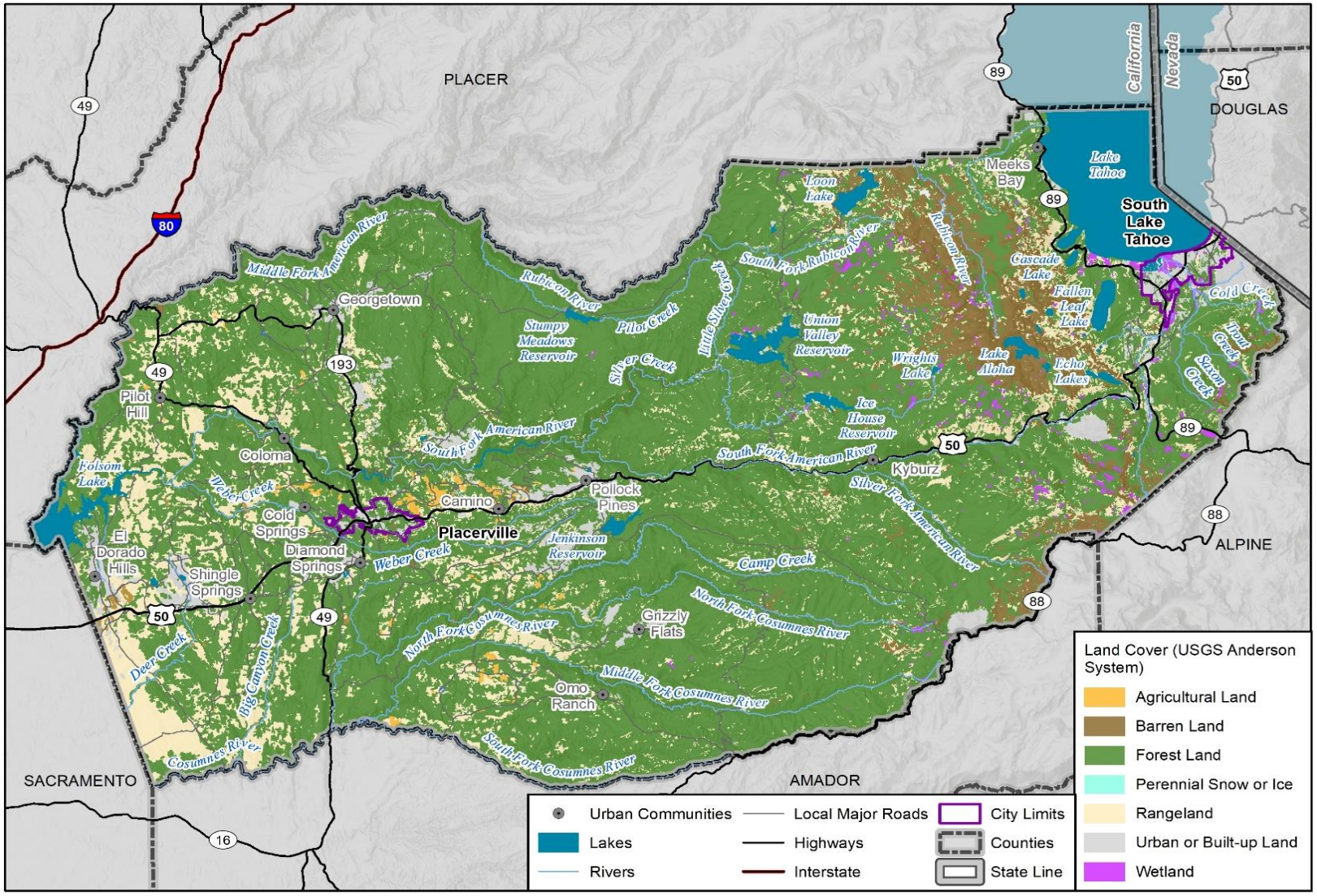
The Tahoe RCD spans approximately 236 square miles on the California side of the Tahoe Basin. Through education, restoration, monitoring, and management, the Tahoe RCD addresses water quality, wildlife

habitat, fire defensible space, sustainable recreation, water conservation, and community enhancement in the Tahoe Basin area.

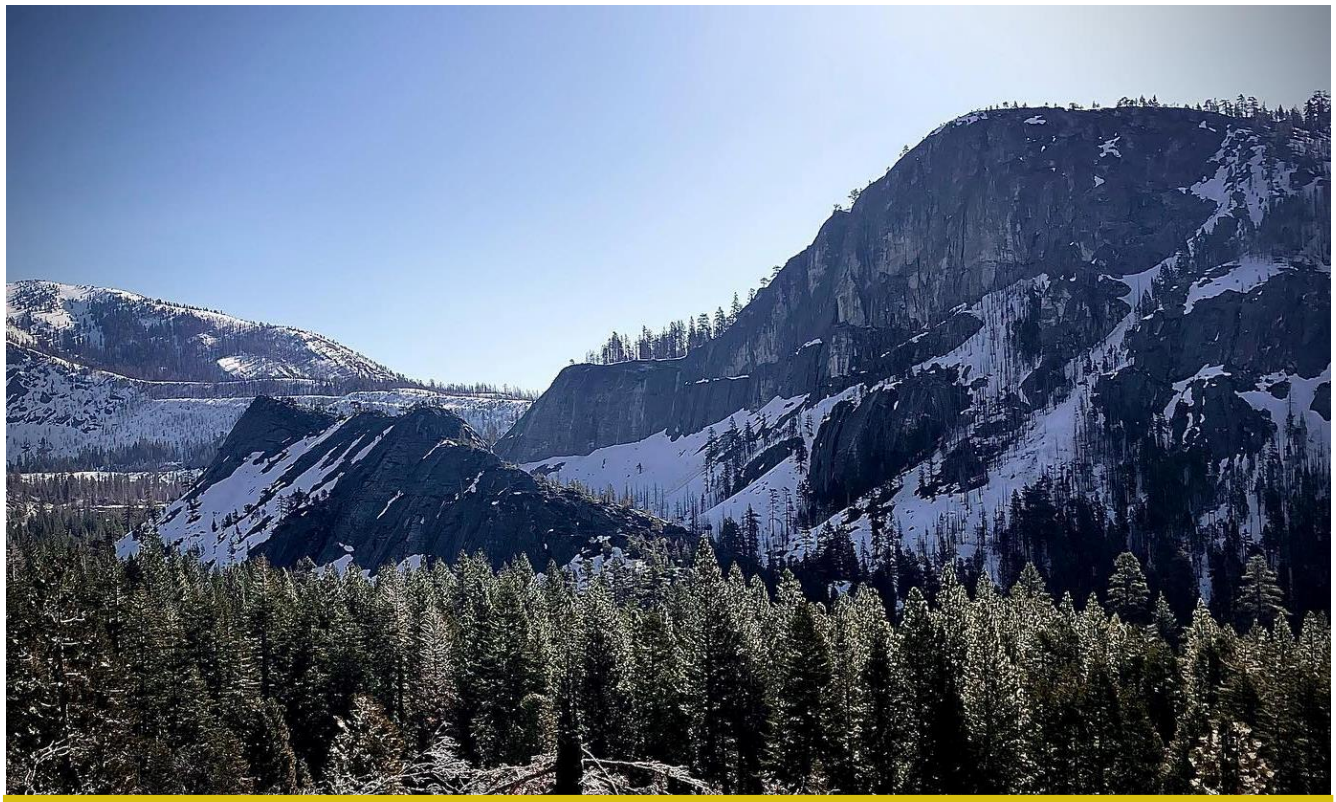
The Georgetown Divide RCD spans the northern portion of the County, abutting the Tahoe RCD on the eastern side of the Tahoe RCD and covering almost 540 square miles. The El Dorado County RCD covers the rest of the County, approximately 340 square miles, from the Georgetown Divide RCD to the southern end of the County, and from the eastern county line to the Tahoe RCD boundary. The joint mission of the Georgetown Divide and El Dorado RCDs is to enhance the quality of life in the County through effective natural resource management.

Other natural and recreation resources in the County include the American River, Marshall Gold Discovery State Historic Park, and Sly Park Reservoir. The diverse terrain hosts several habitat types – aquatic, wetland, riparian, oak woodland, grassland, shrublands, and mixed conifer forests. **Figure 3-7** below illustrates the diverse land cover across the County.

Figure 3-7 El Dorado County Land Coverage



Map compiled 1/2023;
Intended for planning purposes only.
Data Source: El Dorado County, USDA, USFS



View of Lovers Leap in looking east following the 2022-2023 winter season. The Lover's Leap area near the unincorporated community of Strawberry on the South Fork American River and along U.S. Highway 50 provides a gateway to recreational activities in the County, including rock climbing, fishing, hiking, and skiing. The area became a popular resort in the 1850s and a stop along the Central Overland Pony Express. It is also home to the Historic Strawberry Lodge.

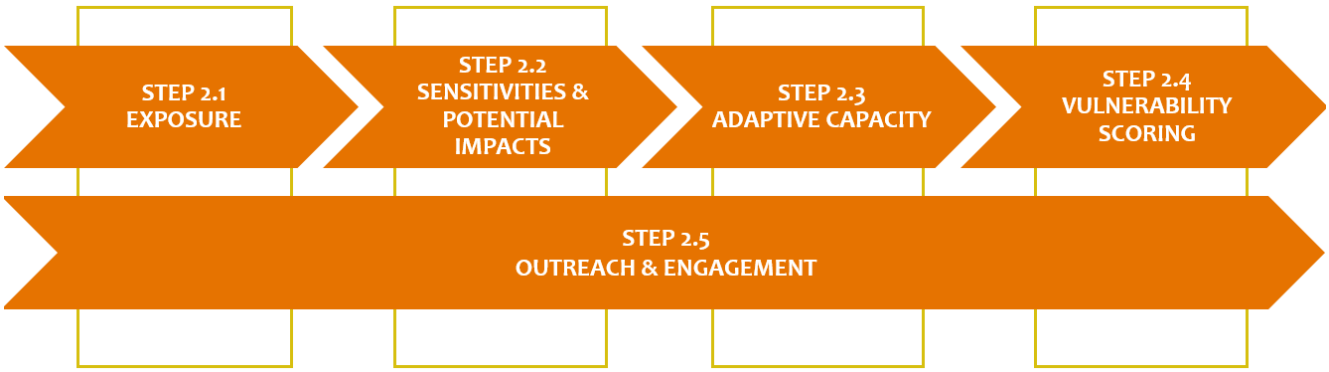
Photo Credit: Lovers Leap Guides, April 2023

4. Planning Process and Outreach and Engagement

A. Planning Process Method

This CVA follows the Phase 2, "Assess Vulnerability" planning process provided in the APG. The steps involved in Phase 2 are shown in **Figure 4-1**.

Figure 4-1 Steps in Phase 2 of the APG Planning Process



Source: APG 2020

Exposure Identification

Exposure is the presence of people, property, buildings, critical infrastructure, natural and cultural resources, or economic drivers in areas that may be subject to hazards. The goal of exposure identification is to recognize a community's exposure to current and projected climate-related hazards, defined as events or physical conditions that have the potential to cause harm to people or loss of property.

To gain a broad understanding of exposure in the County, historic hazards and hazard events were assessed, the ways in which climate hazards are projected to change were examined, and hazards and other climate change effects were mapped. The CVA includes climate-related hazard data from best available public sources of downscaled climate projections. Statistical downscaling is a technique by which large-scale global climate models are translated into small spatial scales (see Section 2 Methodology). In addition, the SEAC was consulted for input on past hazard exposures in the County.

Climate-related hazards profiled in the CVA include:

- Agriculture and Forestry Disease and Tree Mortality
- Avalanche
- Drought and Water Supply
- Extreme Heat
- Flooding
- Human-health Hazards
- High Wind
- Landslide and Debris Flows
- Severe Weather: Thunderstorms, Heavy Rain, Lightning, and Hail
- Severe Weather: Winter Storms and Heavy Snow
- Wildfire

Many of these hazards have the capacity to become "cascading" or "compounding" hazards. A cascading hazard is one that can lead to another, causing a cascading chain of events. **Figure 4-2** below shows an example of a cascading climate-related hazard.

Figure 4-2 Example of a Cascading Hazard

Analyze Sensitivity and Potential Impacts

Sensitivity is defined as the level to which changing climate conditions affect a community, critical facilities, wildlife, or natural systems. Potential impacts are the effects of probable climate-related hazards, or the combination of exposure and sensitivity. As each population and critical facility asset in the County is likely to experience a different sensitivity to potential impacts, the CVA includes an assessment of the sensitivities and potential impacts from each priority climate-related hazard on each socially vulnerable population and critical facility asset.

Analyzing sensitivity in the County necessitated the development of two datasets: one of the County's sensitive populations, and one of the County's key critical facilities and infrastructure (such as buildings, essential services, and essential businesses). The sensitivity of each dataset was evaluated both quantitatively and qualitatively. The quantitative process involved spatial overlay analysis using GIS to determine the number of people that would be impacted by climate-related hazards, as well as the critical facility and infrastructure assets directly impacted by certain hazards.

The qualitative process addressed questions to assess the sensitivity and potential impacts of climate-related hazards, such as:

- What types of direct impacts may occur?
- Are the impacts likely to result in physical injury, damage, or loss? If not, are indirect effects likely to result in economic loss, non-physical impacts, or mental or well-being impairment?
- How quickly will the impacts happen and how long will they last?
- Is there a significant chance of substantial destruction?

Based on the results of the qualitative and quantitative assessments, each climate related hazard was assigned a low, medium, or high impact score. A higher impact score means that there is a higher potential for harm to the asset, while a lower impact score means that there is a lower potential for harm. **Table 4-1** provides a rubric from the APG to aid in the determination of scores. These scores are then used to determine potential climate impacts of greatest concern.

Table 4-1 Impact Scoring Matrix

Impact Score	Definition for Population Assets	Definition for Critical Facilities and Infrastructure Assets
Low Impact	Change is not noticeable. If there is a noticeable effect, it is minor and consists of temporary disruptions.	Slight damage, temporary disruption in service, impacts on the economy is minor or intermittent enough that it is unnoticed, and overall effects are minor.
Medium Impact	Change is noticeable. Well-being and quality of life may decline. Impacts may also be ongoing and substantial.	Moderate damage, considerable service disruptions, impacts on the economy that are significant, and overall effects are modest.
High Impact	Change is readily apparent. Well-being and quality of life decline significantly.	Substantial damage to buildings, severe and long service disruptions due to critical assets

Impact Score	Definition for Population Assets	Definition for Critical Facilities and Infrastructure Assets
	Impacts are severe due to widespread injury and death to people.	that cannot function, impacts on the economy that result in major loss and hardship, and overall effects are significant.

Source: California APG; Modified by WSP

Assess Adaptive Capacity

Adaptive capacity is the ability to moderate the potential damage and impacts from climate-related hazards by taking advantage of opportunities and resources such as policies, plans, programs, or institutions. Examples of adaptive capacity include retrofitting buildings to diminish the effects of extreme heat or translating emergency response plans into multiple languages. This step focuses on the County's existing adaptive capability to cope with impacts. Phase 3 focused on the expansion of adaptive capacity and mitigation through new adaptation actions.

A thorough review of documents provided by federal, state, regional, and local agencies, as well as NGOs and CBOs, was conducted to assess the adaptive capabilities present in the County. The review of these documents focused on existing and planned climate adaptation strategies, the extent to which these strategies are expected to manage current and future climate impacts, as well as opportunities to build on and strengthen these strategies. SEAC work sessions and stakeholder workshops further supported this assessment through project-specific efforts and local knowledge about smaller communities. As mentioned in Section 1, the County used a matrix worksheet to identify its capacity for adaptation planning. The goal of this worksheet and the stakeholder workshop was to elicit further information on existing policies and programs, their effectiveness, and potential barriers that may prevent vulnerable populations from reaping the benefits of these policies and programs. The County also integrated information from the SBC's Regional CVA.

Based on the adaptive capacity assessment and SEAC and stakeholder input, each socially vulnerable population, critical facility, and infrastructure asset was assigned an adaptive capacity score of low, medium, or high. Adaptive capacity is a positive outcome, so a higher adaptive capacity score means a sensitive population or critical facility asset may be more adaptable to the climate-related hazard. A lower adaptive capacity score means a population or asset may need more resources to adjust to changing climate conditions. **Table 4-2** shows the Adaptive Capacity Scoring Matrix.

Table 4-2 Adaptive Capacity Scoring

Adaptive Capacity Score	Definition of Adaptive Capacity
High Adaptive Capacity	Adaptation capacities and opportunities are feasible for most populations and assets. There may be occasional challenges to implementing new adaptation strategies due to technical, capacity, or funding challenges, but populations and assets generally adapt with little to no effort. Many alternatives and redundancy options also exist that can provide similar services.
Medium Adaptive Capacity	Some adaptation capacities and opportunities are available for populations and assets but are not always feasible. There may be significant challenges to implementing new adaptation strategies due to substantial technical, capacity, or funding limitations, making it difficult for populations and assets to adapt. Some alternatives and redundancy options exist to provide similar services.
Low Adaptive Capacity	Adaptive capacities are available, but they are not accessible or feasible because of significant technical needs, lack of staff capacity, funding and cost constraints, technological limitations, and/or other resource barriers, such as lack of political

Adaptive Capacity Score	Definition of Adaptive Capacity
	support from decision-making bodies or the community. Few alternatives or redundancy options exist, or assets may not have feasible methods to adapt.

Source: California APG; Modified by WSP

Vulnerability Scoring

Vulnerability is defined as the exposure of sensitive people, property, and critical facility assets to climate change impacts, and is determined by differences in exposure, sensitivity, and adaptive capacity. Vulnerability scoring is a quantitative process to identify priority hazard vulnerabilities. The overall vulnerability score reflects how susceptible the sensitive population or critical facility asset is to harm from a particular hazard.

An overall vulnerability score was determined based on the combination of the impact scoring and adaptive capacity scoring for each sensitive population and asset for each relevant climate-related hazard in the County. Initial scoring was completed by the core County team; and impact, adaptive capacity, and vulnerability scores were adjusted in response to County, SEAC, and stakeholder input. This resulted in an iterative process to ensure the SEAC, stakeholder, and public input was thoughtfully integrated into the CVA, and to ensure the CVA accurately reflects the conditions in the County.

Table 4-3 shows how the combined impact and adaptive capacity scores translate into a vulnerability score of 1 to 5 (1 – Minimal Vulnerability, 2 – Low Vulnerability, 3 – Moderate Vulnerability, 4 – High Vulnerability, and 5 – Severe Vulnerability).

Table 4-3 Vulnerability Score Matrix

	Low Impact	Medium Impact	High Impact
Low Adaptive Capacity	V3	V4	V5
Medium Adaptive Capacity	V2	V3	V4
High Adaptive Capacity	V1	V2	V3

Source: California APG; Modified by WSP

These scores help the County determine which vulnerabilities are the most pressing and those that should be prioritized for adaptation strategies.

Outreach and Community Engagement

Community outreach was a key component of the CVA planning process. Community members provide valuable on-the-ground information and personal experience with both the County and the climate vulnerabilities it faces. Community members can best identify priority climate vulnerabilities and practical capacities. Soliciting input from all segments of the population ensures that the resulting CVA and Safety Element is inclusive and representative of the needs of every resident. Outreach opportunities included SEAC work sessions, focused stakeholder interview and meetings, stakeholder workshops, public workshops, and a bilingual public survey.

The following is a summary of formal stakeholder and community outreach events.

- **Core County Team Meetings** – The project team held ongoing bi-weekly meetings throughout the planning process from March 2022 through February 2023 to review and provide feedback on the CVA and discuss ongoing and parallel planning efforts, like the Greater Placerville Wildfire Emergency Evacuation and Preparedness Plan.
- **SEAC Work Sessions** – The SEAC served as a liaison to the Core County planning team throughout

the CVA and Safety Element update process. They encouraged public participation by sharing outreach strategies provided by WSP to their departments and agencies, and by coordinating stakeholder workshops, as well as by sharing community stories to encourage dialogue between the internal teams and the public. The four SEAC Work Sessions were instrumental in reviewing and evaluating the data that informed the CVA and Safety Element update.

- **Stakeholder Interviews** – The core County team coordinated five stakeholder interviews and meetings from November 2022 through February 2023 as part of the impact assessment and adaptive capacity evaluation process. Stakeholder groups included the County's Office of Wildfire Preparedness and Resiliency, the EDCTC, TRPA, Tahoe RCD, and SBC. The purpose of the interviews and meetings was to develop a better understanding about related planning efforts, County expertise related to the CVA, and opportunities to enhance engagement based on previous or parallel planning efforts. Each stakeholder group provided information on the specific planning efforts and the assets they manage that relate to the CVA.
- **Stakeholder Workshop** – One virtual stakeholder workshop was held with relevant federal, state, and local stakeholders. Stakeholders were consulted to clarify decision-making needs, to balance adaptation measures with County economic development goals, and to determine trade-offs. These meetings focused on the next steps, effective execution of monitoring strategies, relevant climate thresholds, and incremental steps of implementation.
- **Public Workshops** – One virtual public workshop was held to inform the public about the planning process and solicit input from residents who may not otherwise be involved. The workshop covered background on climate adaptation planning, the CVA results, and the purpose and components of the CVA and Safety Element update. A second public workshop is planned once the Public Review CVA is ready for circulation.

Tallac Historic Site at South Lake Tahoe
Photo Credit: Chris Mansker

5. Exposure Identification

A. Identification of Key Hazards and Climate Stressors

Climate stressors are conditions that exacerbate climate-related hazards, such as changes in frequency or severity of extreme weather events due to natural climate variability (i.e., episodes of El Nino and La Nina) as well as through human-caused climate change. They fall into two categories: primary climate stressors and secondary climate stressors. Concentrations of heat trapping GHGs are increasing in the Earth's atmosphere, causing average temperatures at the Earth's surface to increase and continue rising; these changes in air temperature, precipitation variability, reduced snowpack, and wildfire risk are primary climate stressors in the County that are expected to become more frequent and severe. These primary climate stressors can also lead to secondary climate stressors or climate-related hazards that can cause death and injuries to sensitive populations, property damage, infrastructure impacts, business interruptions, and damage to the environment.

Sensitive populations and assets in the County are also subject to non-climate stressors. Non-climate stressors include occurrences such as changes in land cover (for instance, when natural vegetation is cleared and replaced with roads and buildings), construction projects that disrupt natural water drainage or common traffic patterns, and population growth (U.S. Resilience Toolkit 2022). These are generally conditions unrelated to climate that can exacerbate climate-related hazards.

B. Climate Scenarios

The profiles for the primary and secondary climate stressors are based on current public information from the Cal-Adapt database, APG, and California's Fourth Climate Change Assessment. State climate information from the NOAA NCEI is also summarized. Climate change projections rely on multiple climate scenarios that reflect different levels of global GHG emissions and atmospheric GHG concentrations. The Intergovernmental Panel on Climate Change (IPCC) uses RCPs or climate scenarios. RCPs are labelled with numbers that refer to the increase in the amount of energy that reaches each square meter of Earth's surface under the respective scenario. While there are now updated climate scenarios referenced in the IPCC's Sixth Assessment Report, these updated projections are not yet available at a local scale within the Cal-Adapt tool. The two RCPs available used in the Cal-Adapt tool and discussed in the Fourth Climate Change Assessment are:

- RCP 4.5 –global GHG emissions peak around 2040 and then decline, and
- RCP 8.5 – global emissions continue to rise until the end-of-century.

The Cal-Adapt tool provides California-specific climate changes projections and uses RCP 4.5 for a low emissions scenario and RCP 8.5 for a high emissions scenario. OPR's "Planning and Investing for a Resilient California" and APG recommend using RCP 8.5 for analyses that consider impacts through 2050, because there are minimal differences between the emission scenarios for the first half of the century. It also recommends using RCP 8.5 for end-of -century projections for a more conservative and risk-adverse approach (OPR 2020, APG 2020). As a result, all maps, graphs, and model summaries are based on the RCP 8.5 GHG emission scenario. Future modeled conditions in the County area are also based on an average of multiple climate models: averages of the CanESM2 (average), CNRM-CS5 (cooler/wetter), HadGEM2-ES (warm/drier), and the MIROC5 (complement) models. For those climate stressors where spatial data is available, maps of the primary and secondary climate stressors and projected changes for the years 2050 (2035-2064), and 2100 (2070-2099) are included.

The following sections describe four primary climate stressors: increased temperatures, precipitation variability, reduced snowpack, and wildfire severity. Nine secondary climate stressors are described, including the cascading effects. Each climate stressor summary profiles the hazard and summarizes the projected trends and change, and where possible, characterizes the general trend differences between the West Slope and the Tahoe Basin portions of the County.

C. Primary Climate Stressors

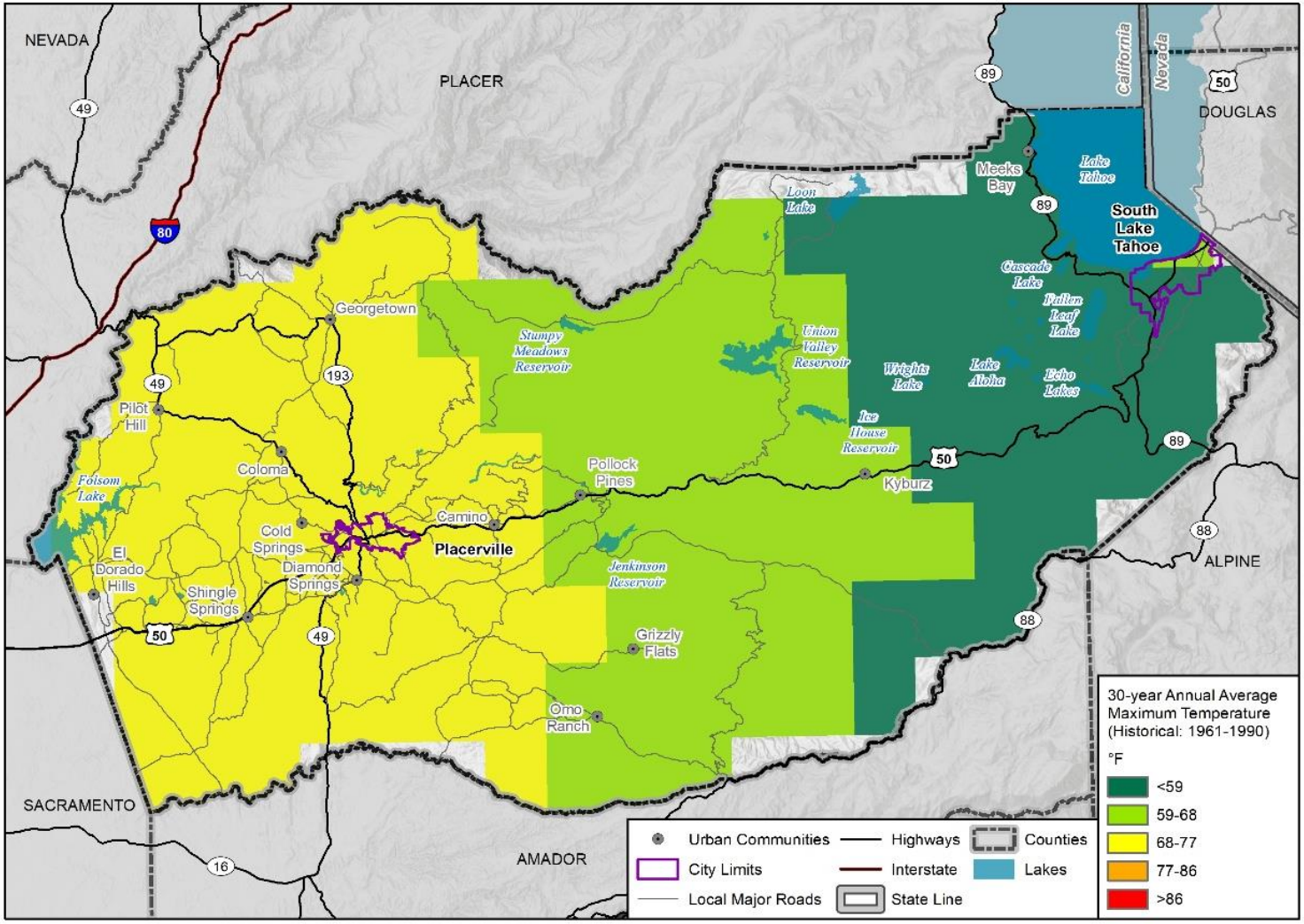
Increased Temperatures

Temperatures in California have risen almost 3° Fahrenheit since the beginning of the 20th century and the six warmest years on record have all occurred since 2014 (NOAA NCEI 2023). Increases in air temperature will rise in the County during the next century when compared to the historical annual average temperatures. These increased temperatures can lead to more intense extreme heat events, which can cause illness and death, especially in sensitive populations.

Annual average maximum temperature, an average of all the hottest daily temperatures in a year, is used to measure temperature trends and projections in the County. Other climate metrics related to temperature include the number of extreme heat days and warm nights per year, defined as temperature exceeding the 98th percentile value of historical temperatures for a given location (Cal-Adapt, 2023). The County had a historical annual average maximum temperature of 63.4 °F in 2005. The year 2005 is selected because the observed temperatures within Cal-Adapt are currently compiled through mid-2005. Any data beyond 2005 are projections generated based on climate models and therefore, are not the actual observed data. This also applies to the other primary climate stressors discussed in this section where data from the year 2005 are referenced. **Figure 5-1** illustrates the historical 30-year annual average maximum temperatures in the County from 1961 to 1990.

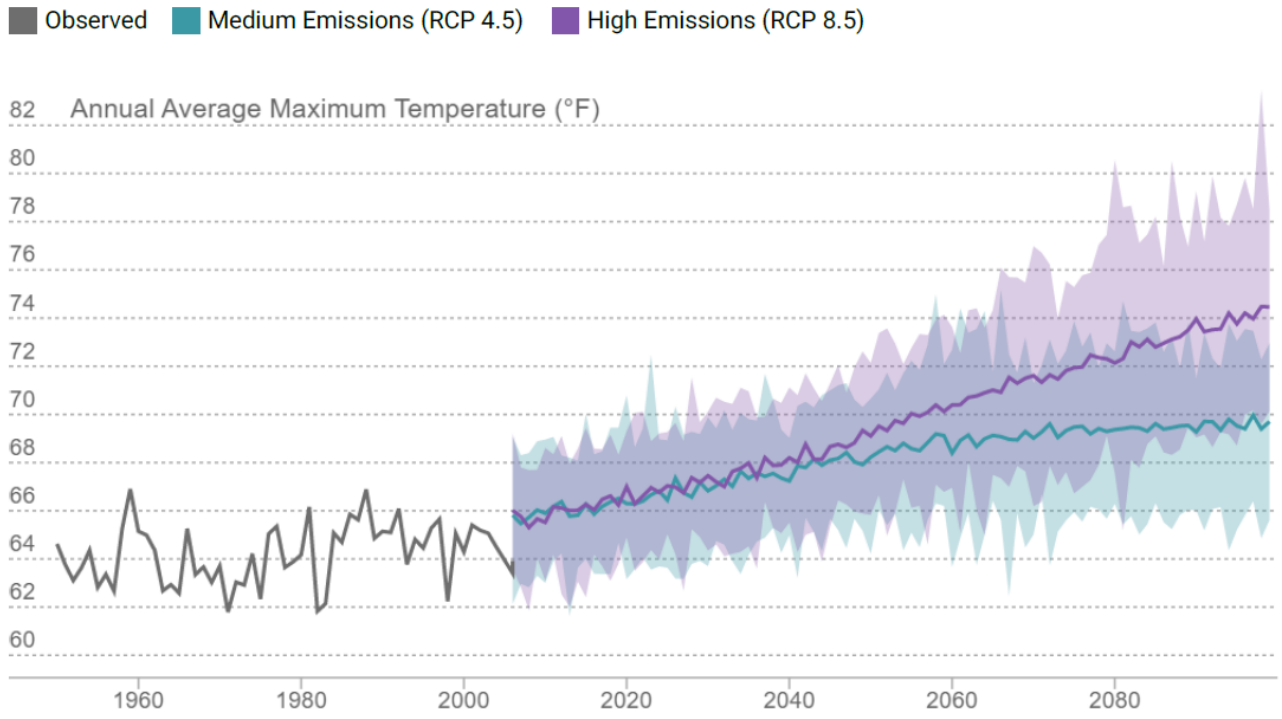
Figure 5-1

Figure 5-1 30-Year Annual Average Maximum Temperature: Historical (1961-1990)



Projections for annual average maximum temperature in the County show a substantial rise during the next century as global temperatures rise. As shown in **Figure 5-2** and based on data from Cal-Adapt, under the RCP 8.5 scenario, the annual average maximum temperature will rise by 5.2 °F by mid-century and 8.9 °F by end-of-century. The observed temperatures within Cal-Adapt are currently compiled through mid-2005.

Figure 5-2 Annual Average Maximum Temperature in El Dorado County



Source: Cal-Adapt 2022

Figure 5-3 and
Figure 5-4 below illustrate the 30-year annual average maximum temperatures under the RCP 8.5 scenario for the predicted mid-century and end-of-century in the County. As shown in **Figure 5-3**, maximum temperatures are likely to increase gradually by mid-century. The highest temperature increases are projected to occur more rapidly towards the end-of-century, particularly in the southwestern portion of the County, with maximum temperatures likely to increase to 86°F, as shown in
Figure 5-4.

Furthermore, the County is divided into two geographical areas to depict differences in future predicted annual average maximum temperature: the West Slope, which is predominantly below an elevation of 4,000 feet above mean sea level (msl) and includes the community of Camino, the City of Placerville, and all land west of the crest of the Sierra Nevada; and the Tahoe Basin, which is generally above 4,000 feet above msl, receives snowfall, and includes the City of South Lake Tahoe and all of the County east of Echo Summit and south of the community of Tahoma and north of Hope Valley. As shown in **Figure 5-3** and
Figure 5-4, both the western and eastern County are predicted to have increased 30-year annual average maximum temperatures by mid-century and end-of-century, while **Table 5-1** demonstrates the details on the temperature increase based on **Figure 5-3** and
Figure 5-4. Note that the Countywide data in **Table 5-1** is based on **Figure 5-2**.

The increase in average maximum temperature will result in an increase in agricultural pests and disease, human health hazards, and increased wildfire severity. The Extreme Heat section addresses these secondary hazards.

Figure 5-3 30-Year Annual Average Maximum Temperature: Mid-Century (2035-2064)

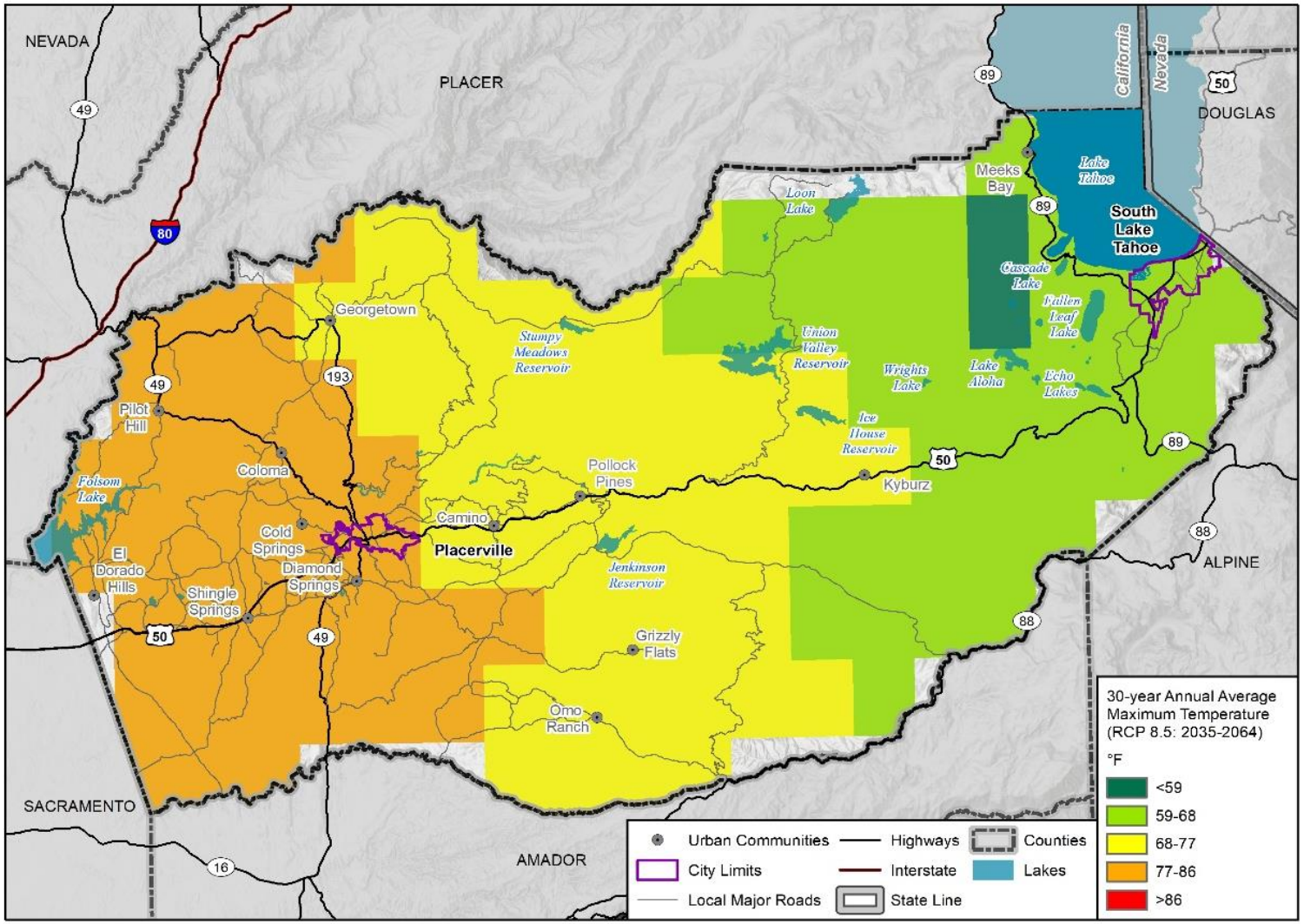


Figure 5-4 30-Year Annual Average Maximum Temperature: End-of-century (2070-2099)

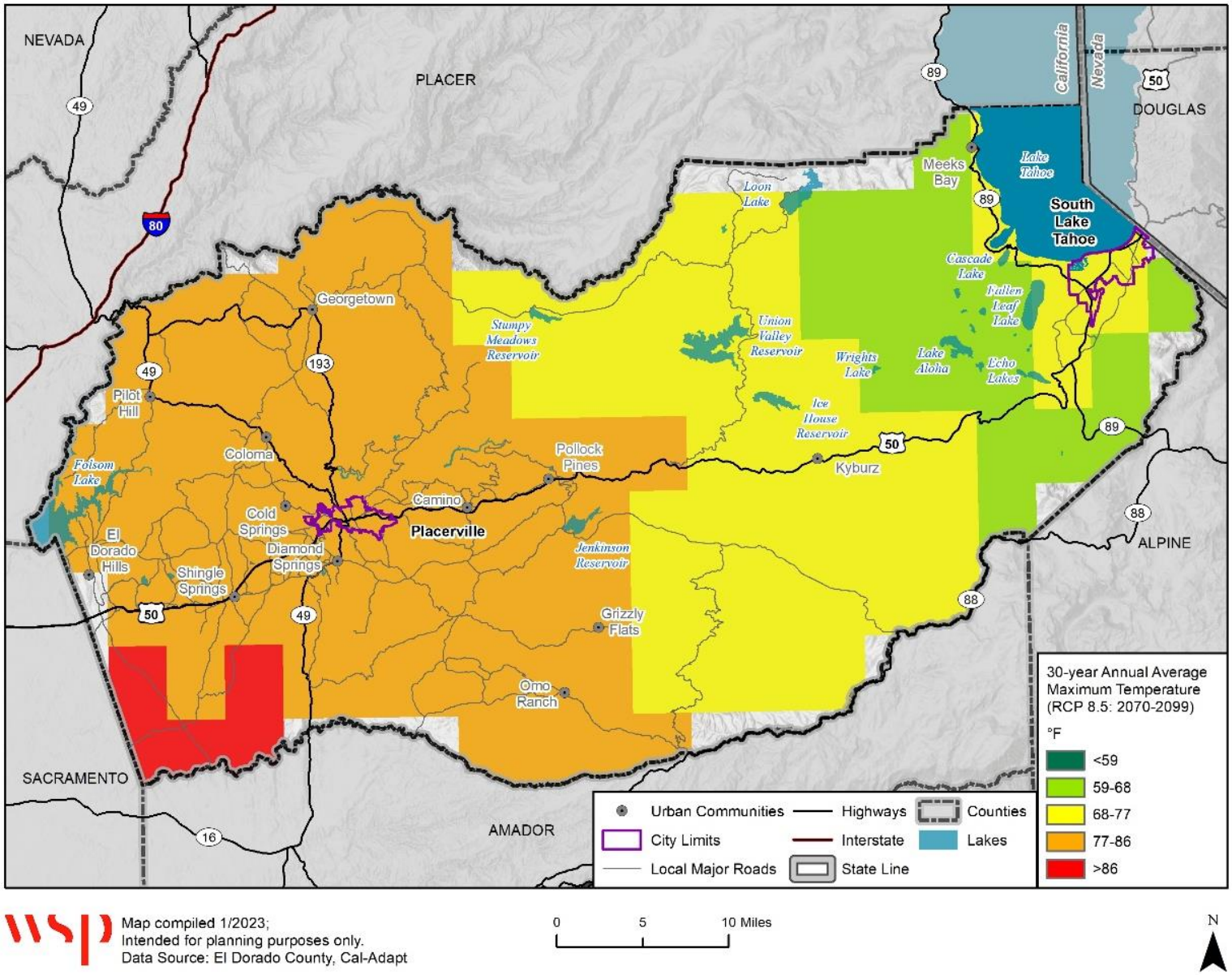


Table 5-1 Historical and Projected 30-year Annual Average Maximum Temperatures (°F) under RCP 8.5 Scenario

Geography	Historical	Mid-Century	End-of-Century
West Slope	59-68°F	68-86°F	77-88°F
Tahoe Basin	51-68°F	51-77°F	59-86°F
Countywide	64°F	69.7°F	73.5°F

Source: Cal-Adapt 2022

Precipitation Variability

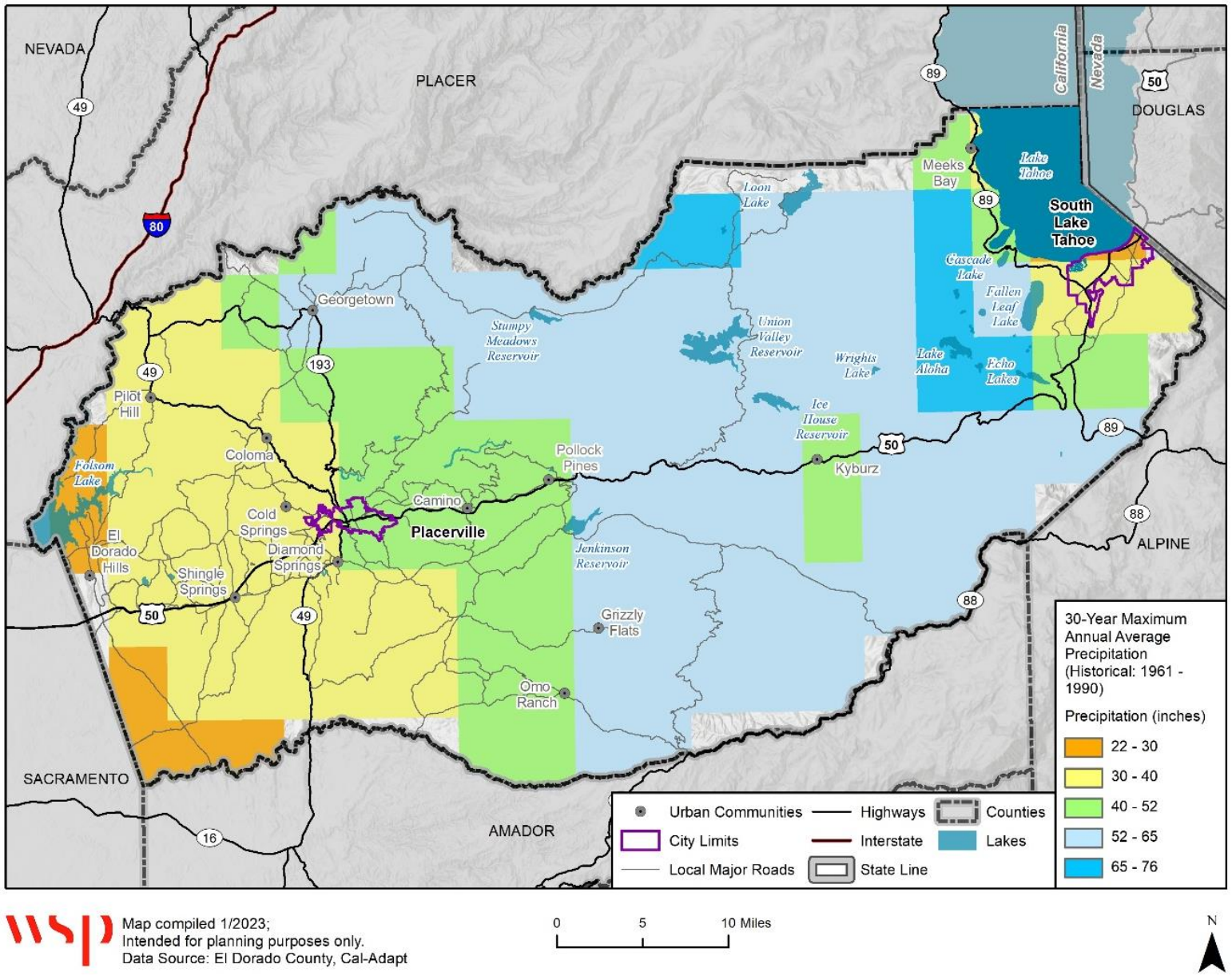
Annual precipitation shows wide variability but has been below average since 2000 for California and this variability is expected to continue to be highly variable from year to year (NOAA NCEI 2023). Extreme precipitation often results in damaging flooding and atmospheric rivers, a weather phenomenon in which a narrow band of moist air is transported from tropical latitudes of the Pacific Ocean to the West Coast, can causing torrential rainfall (NOAA NCEI 2023). From December 1996 to January 1997, heavy rains and snow fell in northern California with particularly large amounts of precipitation in The County. The large amounts of rainfall and warm temperatures caused tremendous snowmelt and Lake Tahoe reached its highest level since 1917 (NOAA NCEI 2023).

Annual precipitation, maximum one day precipitation, and maximum length of dry spell are metrics used by Cal-Adapt to measure precipitation trends and projections in California. According to Cal-Adapt, the historical average precipitation, also known as the total precipitation projected for a year, for the County is 43.3 inches (Cal-Adapt 2022). Projections show a small increase in precipitation to 44.9 inches by mid-century, and 45.0 inches by the end-of-century. While the total annual precipitation in the County is not expected to change significantly, fluctuations in seasonal variation of precipitation due to climate change are already being observed. Increasing temperatures have resulted in a diminished snowpack that melts earlier in the year. This in turn results in diminished water availability during the warm growing season, which can cause an abundance of secondary climate impacts including food and water scarcity, as well as increased tree mortality due to pests and wildfire susceptibility. Additionally, as more precipitation is falling as rain instead of snow, precipitation is being delivered in more intense storms and within a shorter wet season, which can cause flash flooding and subsequent landslide and debris flow events.

Figure 5-5 below illustrates the historical 30-year maximum annual average precipitation in the County from 1961 to 1990.

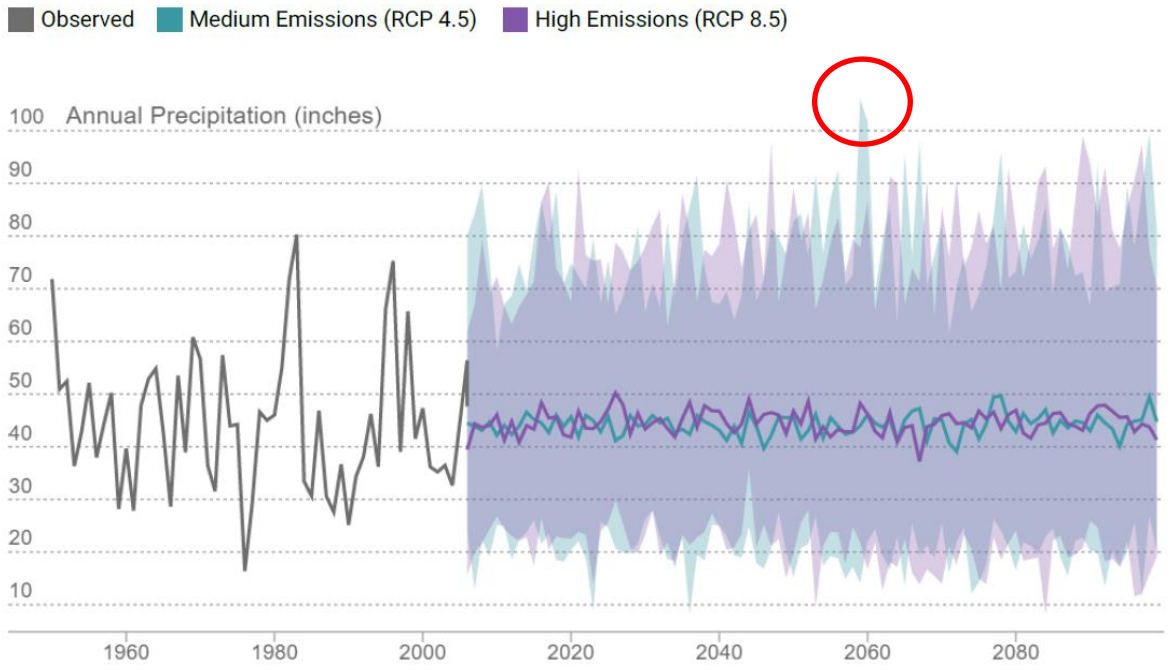
While the total annual precipitation in the County is not expected to change significantly, fluctuations in seasonal variation of precipitation due to climate change are already being observed. Increasing temperatures have resulted in a diminished snowpack that melts earlier in the year. This in turn results in diminished water availability during the warm growing season, which can cause an abundance of secondary climate impacts including food and water scarcity, as well as increased tree mortality due to pests and wildfire susceptibility. Additionally, as more precipitation is falling as rain instead of snow, precipitation is being delivered in more intense storms and within a shorter wet season, which can cause flash flooding and subsequent landslide and debris flow events.

Figure 5-5 El Dorado County 30-Year Maximum Annual Average Precipitation: Historical (1961 – 1990)



As shown in **Figure 5-6**, there will be subtle annual precipitation fluctuations in the County throughout the 21st century. The shaded area in the graph, however, shows that there will be increased variability in future annual precipitation, with both high and low values becoming more extreme. Historically, according to Cal-Adapt, the County's 30-year annual average precipitation based on all climate models has ranged from 41.5 to 48.6 inches. Under the RCP 8.5 scenario, the County's 30-year annual average precipitation based on all climate models could range between 32.6 and 59.8 inches by the end-of-century (Cal-Adapt 2022). Furthermore, the peak high value circled in red in **Figure 5-6** around the year 2060 shows that the annual precipitation during that year could exceed 100 inches.

Figure 5-6 Projected Annual Precipitation in El Dorado County



Source: Cal-Adapt 2022

Like the methodology used above to discuss regional differences in annual average maximum temperature, the County is divided into two geographical areas to depict differences in projected annual precipitation. The Tahoe Basin and the West Slope share similar future trends in annual precipitation changes. As shown in **Table 5-2**, both regions are predicted to have increased annual precipitation by mid-century and end-of-century. The increase in precipitation, however, is not very significant. An example of an annual precipitation increase would be from 52 to 65 inches per year to 65 to 76 inches per year. In other words, the County will experience greater future variability in annual precipitation, instead of an overall annual precipitation change. Also, because the County will experience a slight increase in precipitation through the end-of-century, this may change the seasonality of precipitation and water resource related events, such as the timing of spring snowmelt in any given year. As further discussed in the California4th Climate Change Assessment Sierra Nevada Region report, there could be more dry days punctuated by increased precipitation intensities when precipitation occurs, contributing to the overall increase in annual variability.

Table 5-2 Historical and Projected Annual Average Precipitation under the RCP 8.5 Scenario

Geography	Summary
West Slope	This region is predicted to generally receive more annual precipitation by mid-century. For example, places that historically received a maximum 22 – 30 inches of annual precipitation, will receive 30 – 40 inches of annual precipitation by mid-century, but may receive similar amounts of annual precipitation by the end-of-century.
Tahoe Basin	This region is predicted to generally receive more annual precipitation by mid-century. For example, places in this region that historically received 65 – 76 inches of annual precipitation, may receive a maximum of 76 – 95 inches of annual precipitation by mid-century, and may receive similar amounts of annual precipitation by the end-of-century. However, there are a few areas that historically received a maximum 52 – 65 inches of annual precipitation, which will receive 65 – 76 inches of annual precipitation by mid-century and will receive further increased precipitation: 76 – 95 inches of annual precipitation by the end-of-century.

Source: Cal-Adapt 2022

Figure 5-7 and **Figure 5-8** below illustrate the predicted mid-century and end-of-century 30-year maximum annual average precipitation under the RCP 8.5 scenario for the County. Both figures show the increased precipitation variability modeled for the County throughout the century.

Figure 5-7 El Dorado County 30-Year Maximum Annual Average Precipitation: Mid-Century (2035-2064)

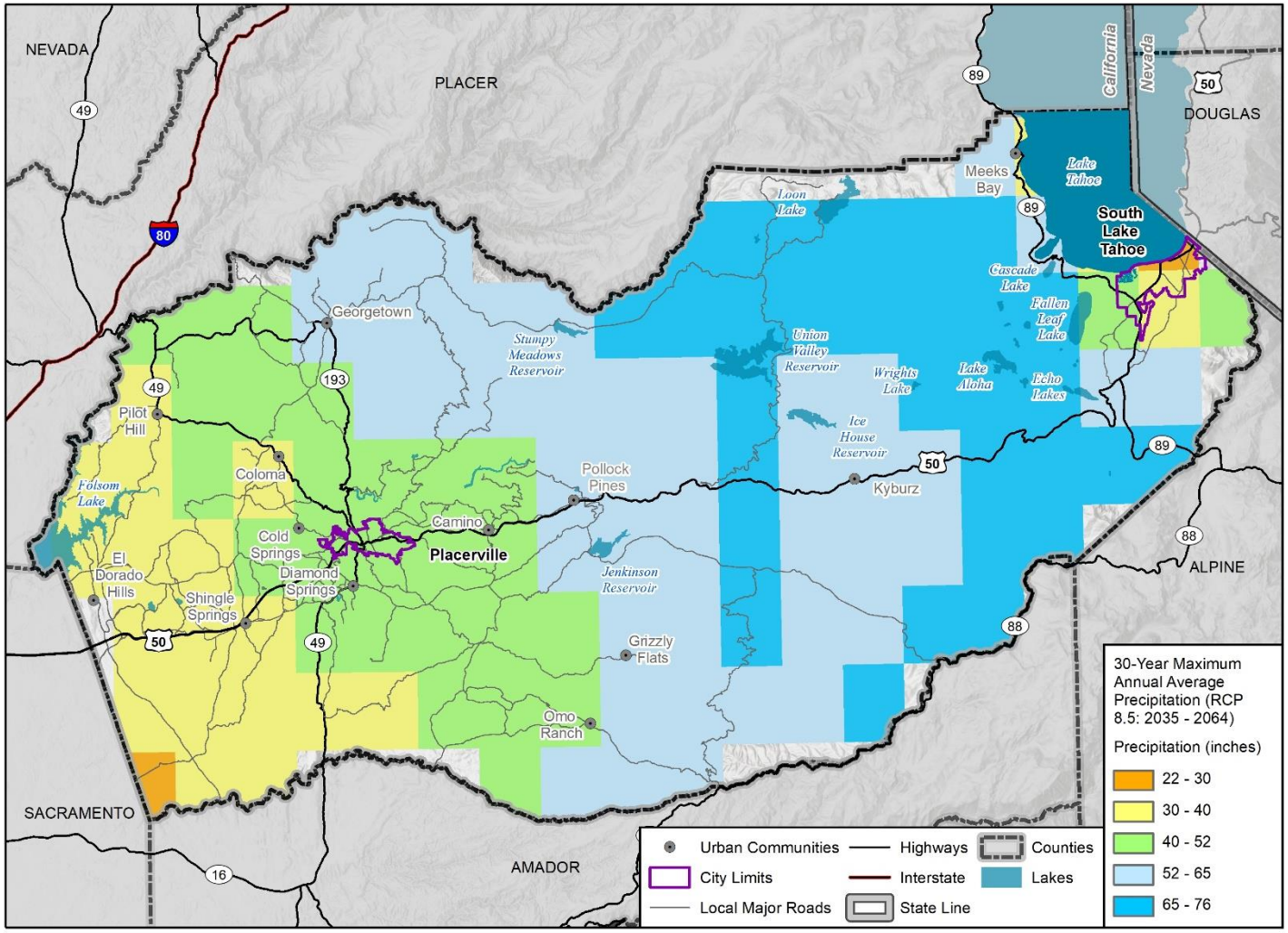
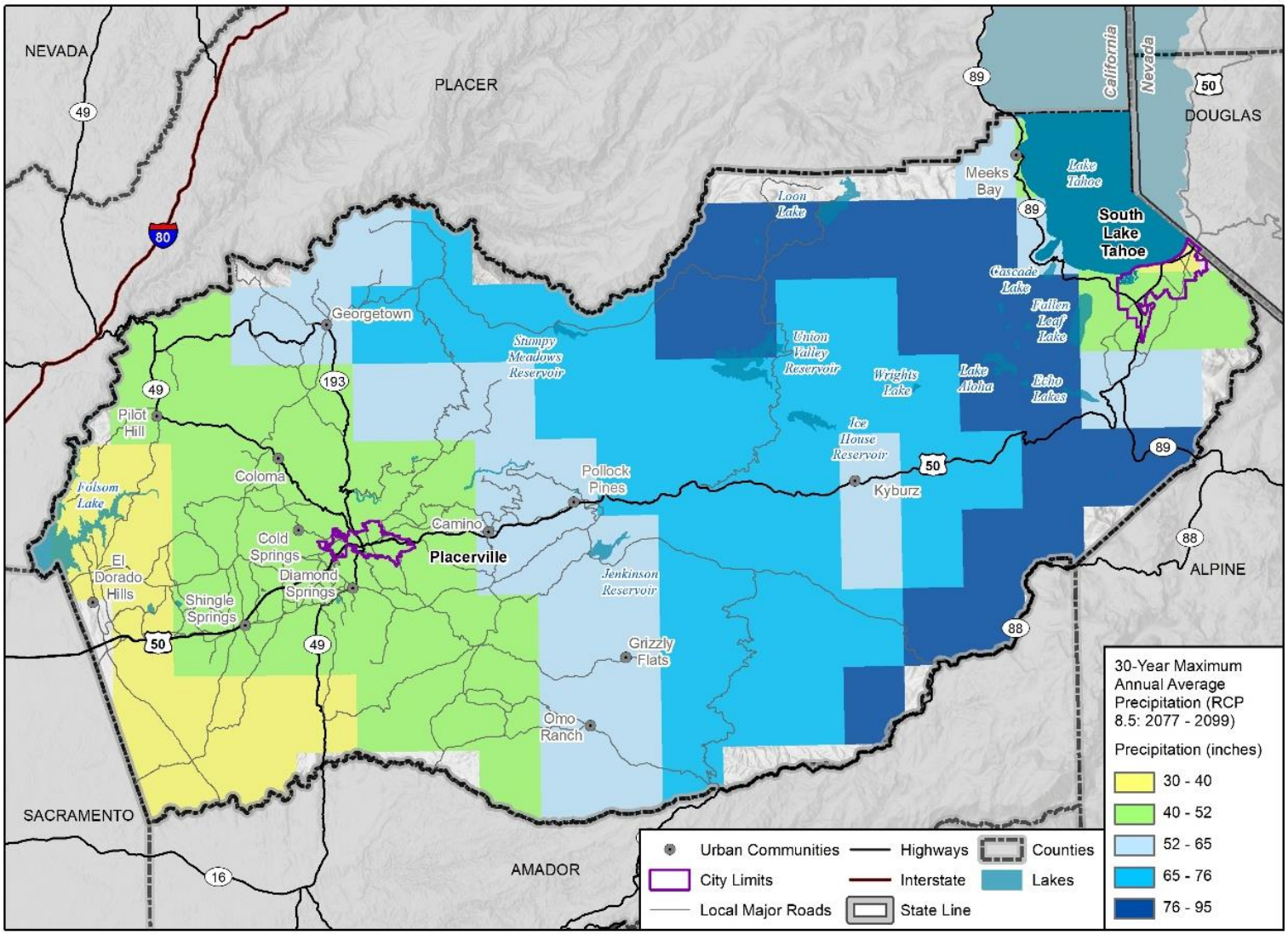
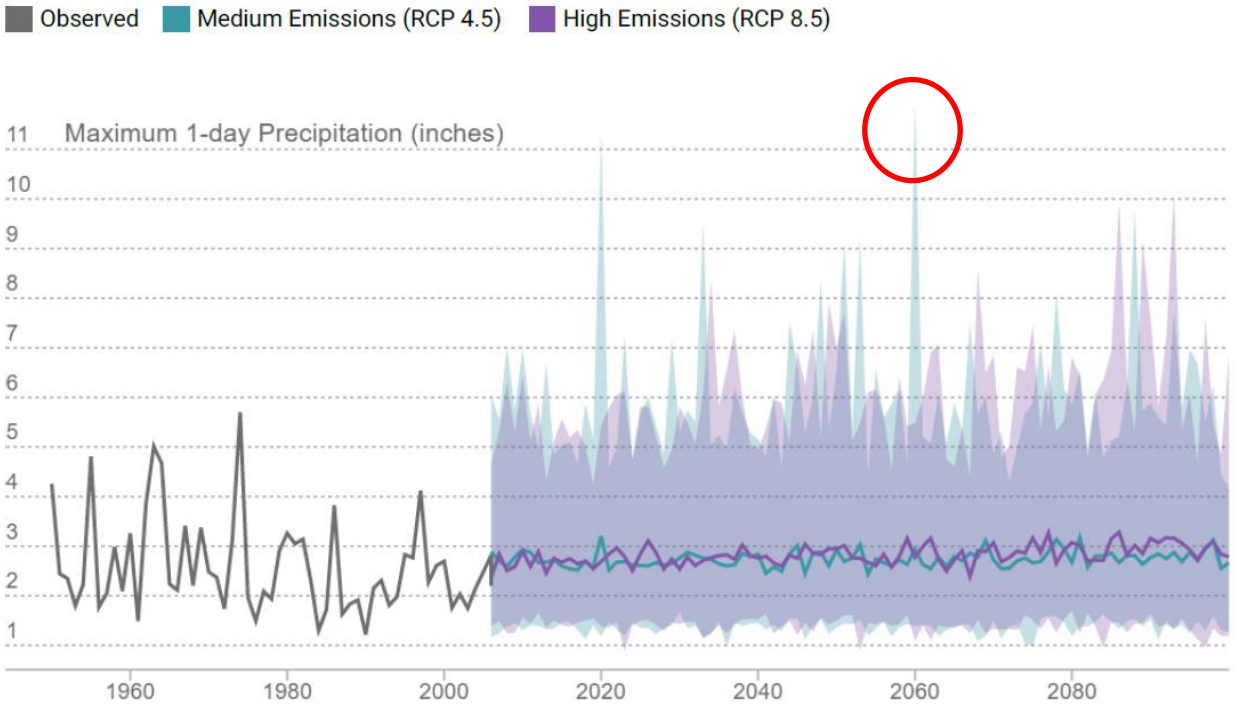


Figure 5-8 El Dorado County 30-Year Maximum Annual Average Precipitation: End-of-Century (2070-2099)



Maximum 1-day precipitation, or the greatest amount of rain or snow over a 24-hour period for a given year, is another metric used to illustrate precipitation variability in the County. As shown in **Figure 5-9**, the projected maximum 1-day precipitation in the County will not change significantly throughout the 21st century. Instead, there will be a slight overall increase but with peak values that are predicted to be more extreme. The peak high value circled in red shows that the maximum 1-day precipitation could exceed 11 inches around the year 2060. Note that this spike is for the RCP 4.5 medium emissions scenario around mid-century, further explaining the minimal differences between the emission scenarios through the first half of the century.

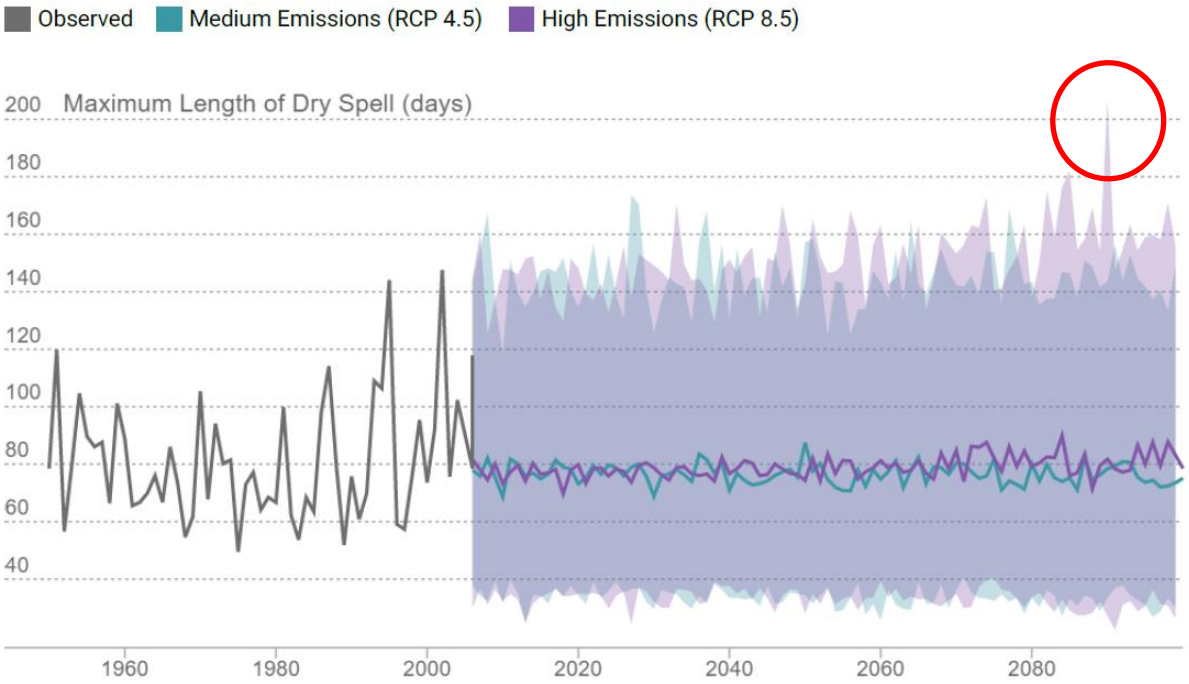
Figure 5-9 Projected Maximum 1-day Precipitation in El Dorado County



Source: Cal-Adapt 2022

The maximum length of dry spell is defined as the number of consecutive days with precipitation that is < 1 millimeter (mm). As shown in **Figure 5-10**, the projected maximum length of dry spell in the County will not change significantly throughout the 21st century, although there is expected to be increased variability in the future maximum lengths of dry spells, with both high and low values becoming more extreme. According to the Cal-Adapt tool, the historical maximum length of dry spell in the County ranges from 61 to 87 days (Cal-Adapt 2022). Under the RCP 8.5 scenario, the mid-century maximum length of dry spell is projected to be between 61 and 99 days, while the end-of-century maximum length is projected to be between 46 and 114 days. The peak value circled in red in **Figure 5-10** shows that the maximum length of dry spell could exceed 200 days by the end-of-century.

Figure 5-10 Projected Maximum Length of Dry Spell in El Dorado County



Source: Cal-Adapt 2022

As shown in **Figure 5-11**, no area in the County had a historical annual average maximum length of dry spell that exceeded 130 days. However, as shown in

Figure 5-13, areas of the West Slope near El Dorado Hills and Shingle Springs are predicted to have their maximum length of dry spell exceed 130 days towards the end-of-century.

Figure 5-11 El Dorado County 30-Year Annual Average Maximum Length of Dry Spell: Historical (1961-1990)

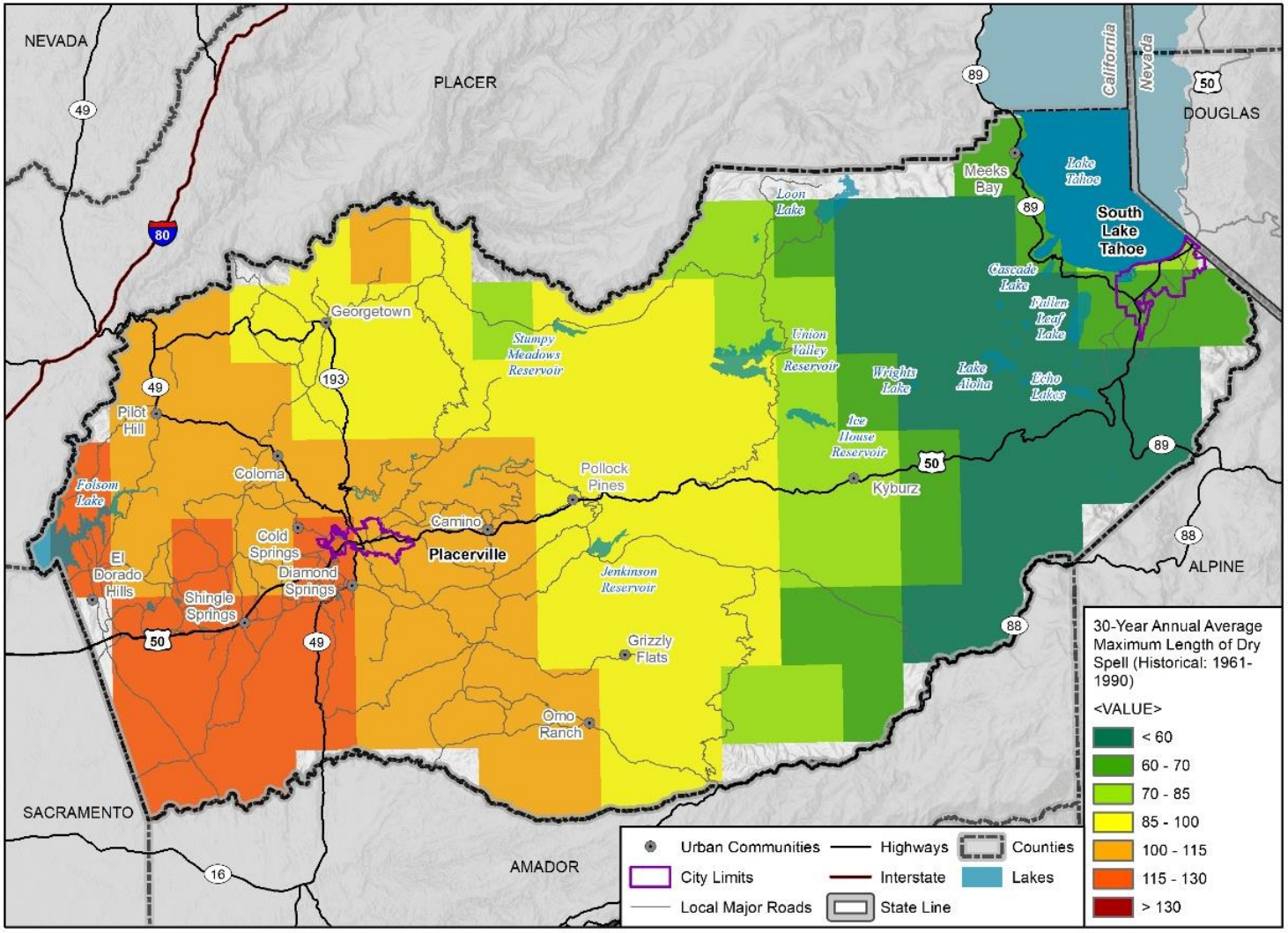


Figure 5-12 El Dorado County 30-Year Annual Average Maximum Length of Dry Spell: Mid-of-Century (2035-2064)

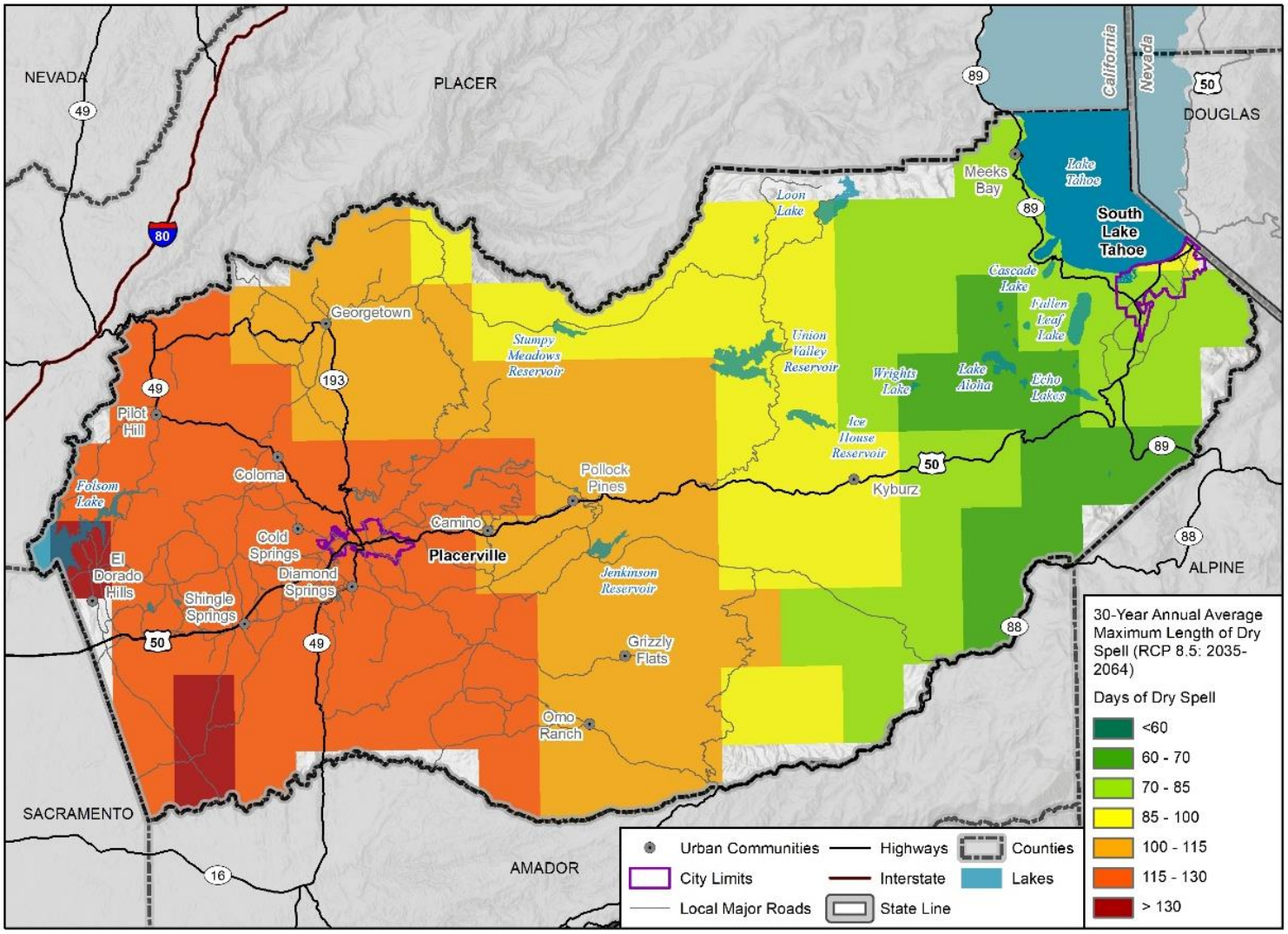
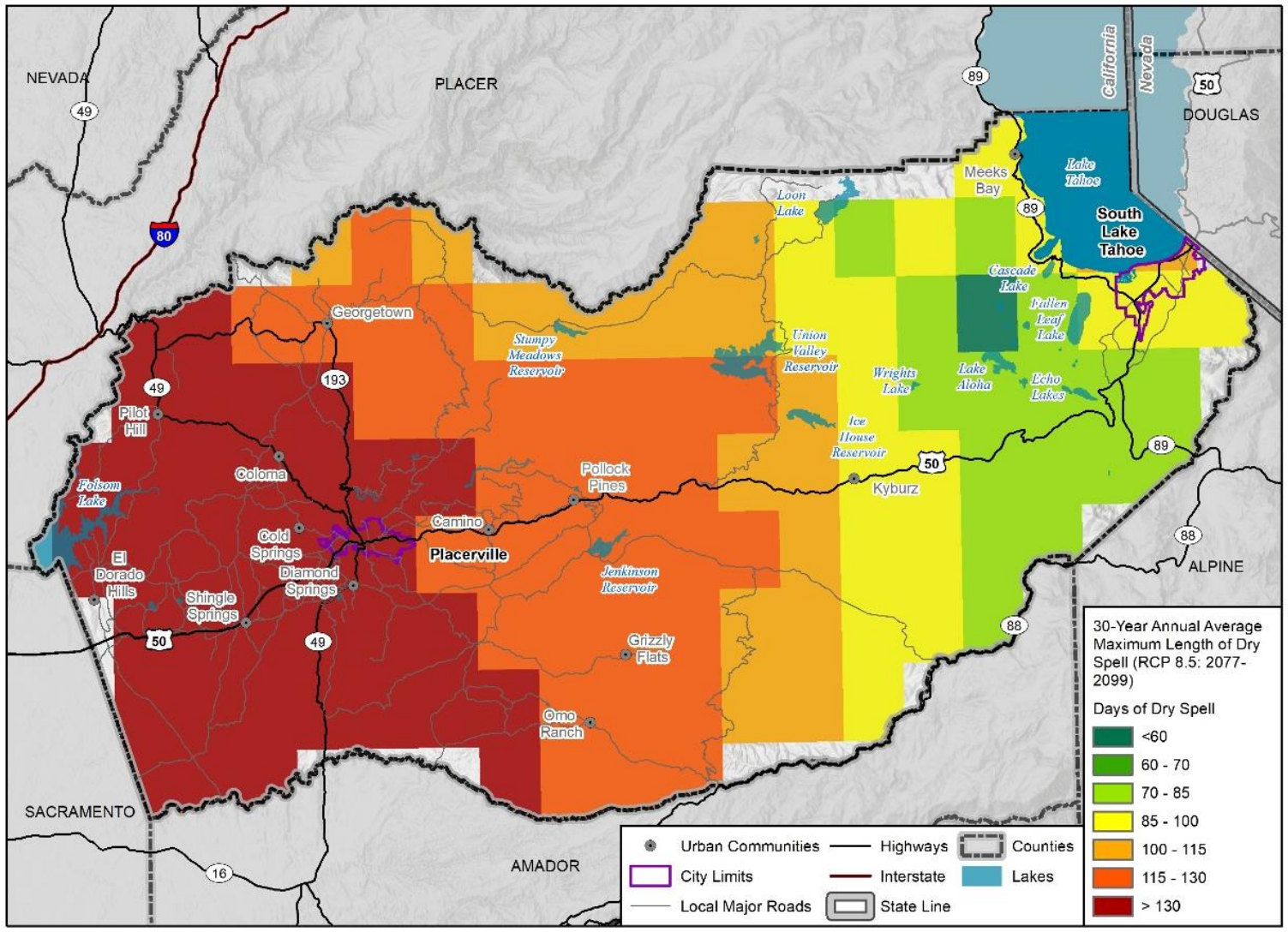


Figure 5-13 El Dorado County 30-Year Annual Average Maximum Length of Dry Spell: End-of-Century (2070-2099)



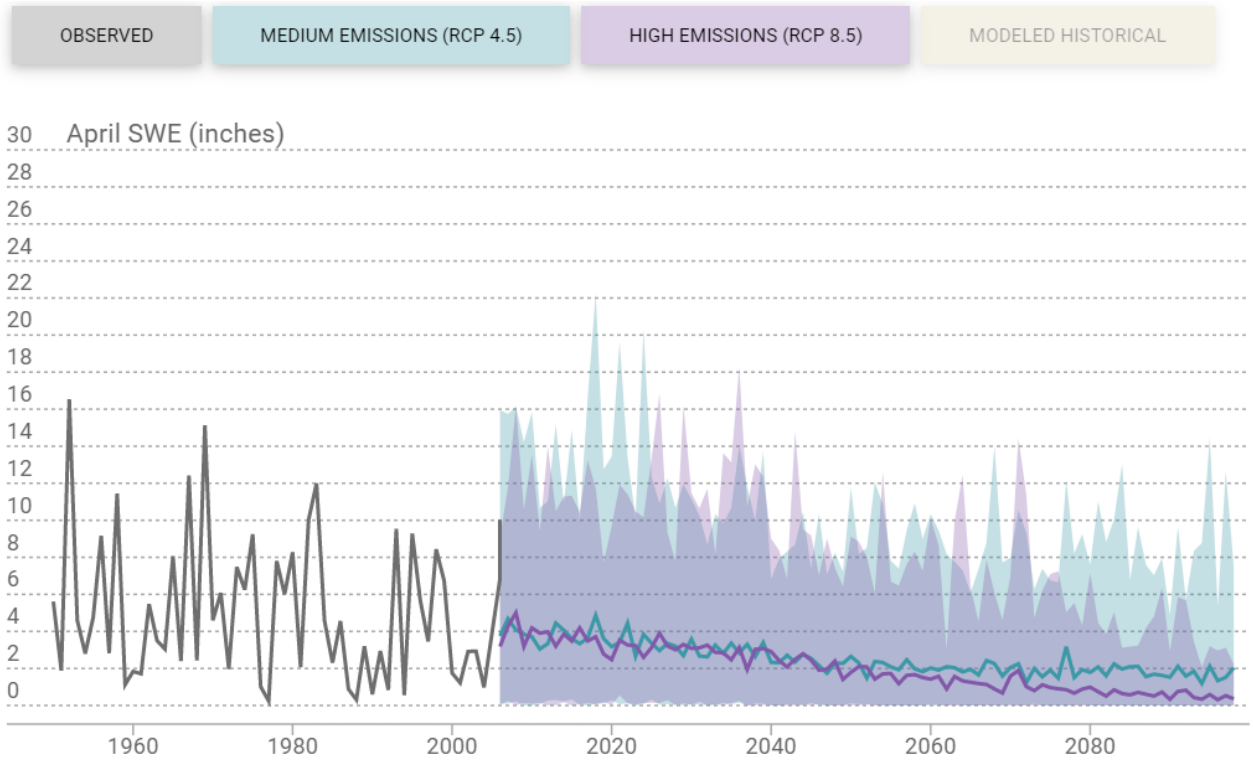
In summary, the County's precipitation extremes (both deluge and drought) are expected to increase markedly as a result of climate change, which can directly and indirectly worsen other climate-related hazards. High precipitation delivered in the form of intense storms, and within a shorter wet season, may cause flash flooding and subsequent landslide and debris flow events. Extremely low precipitation would result in long periods of drought or extreme drought situations, which can then lead to water supply shortages and increased wildfire risk.

Reduced Snowpack

Snowpack is the accumulated snow that defines the dramatic peaks of the Sierra Nevada. In a warming climate, less precipitation is expected to fall as snow, leading to a reduced snowpack and a higher snow line (the elevation above which rainfall gives way to snowfall) over time. The snowpack plays a key role in the water cycle in western North America, storing water in the winter when the snow falls and releasing it as runoff in spring and summer when the snow melts. Millions of people in the West depend on the melting of mountain snowpack for hydropower, irrigation, and drinking water. In most western river basins, snowpack is a larger component of water storage than human-constructed reservoirs.

Snow Water Equivalent (SWE) is a measurement used to determine trends in snowpack. It is equal to the amount of water contained within the snowpack if it were to melt. SWE is often measured in April to determine changes in precipitation, although measurements may be taken throughout the year to gauge variability in seasonality. Spring snowpack at Donner Summit reached record-low levels in 2014, which were exceeded in 2015 by a SWE value of only 5% of average; however, as of March 2023 these levels are now above average (NRCS NWCC n.d.). Historically, the April SWE in the County has ranged from 4.1 to 6.6 inches (Cal-Adapt 2022). **Figure 5-14** shows how the County's SWE is projected to gradually drop throughout the century, resulting in an estimated SWE of 0.1 to 3.1 inches by the end-of-century.

Figure 5-14 El Dorado County Projected SWE in April



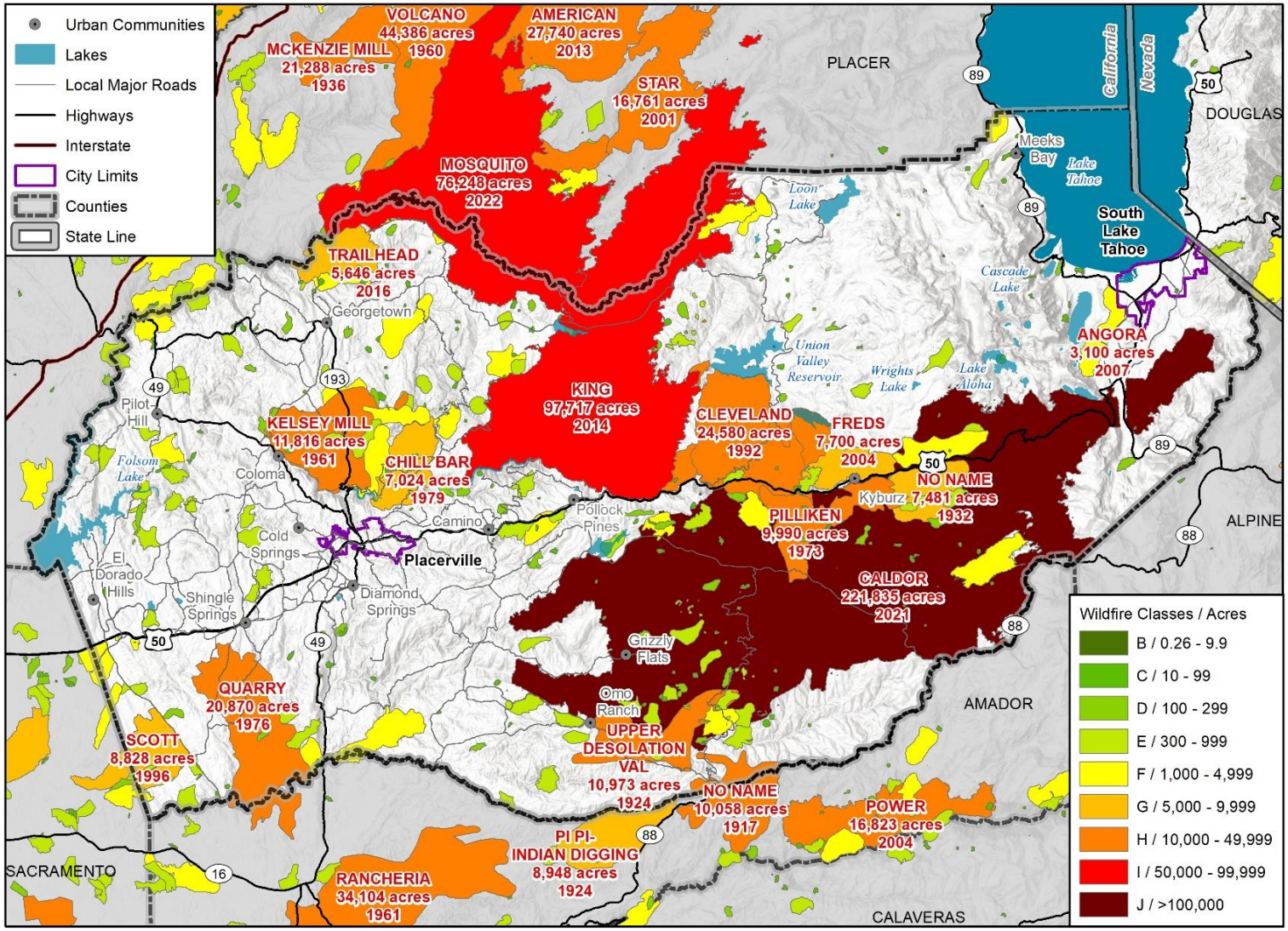
Source: Cal-Adapt 2022

Increased Wildfire Severity

Wildfire is a complex and regular occurrence within the County's landscape. It is a significant concern throughout California as the frequency, intensity, and size of wildfires has increased over the last 25 years throughout the State. The frequency, severity, and impacts of wildfire are influenced by climate change and many other factors, including development patterns, temperature increases, wind patterns, precipitation change, and pest infestations, making it difficult to project exactly where and how fires will burn. Instead, climate models estimate the likely risk of wildfire. Historically, wildfires have started from lightning, but more and more wildfires are now human-caused and ignited by equipment malfunctions, vehicles, electrical infrastructure, and arson. Many areas within the County landscape are prone to wildfires. Winter snowmelt and rain in the lower elevations support vegetation growth, and then the summer dry season and drought periods dry out the vegetation, thereby increasing the potential for ignition and wildfire risk during the summer and fall months when temperatures are the highest and there are high wind days that can quickly spread the fires. **Figure 5-15** below shows the fire history in the County from 1911 to 2022.

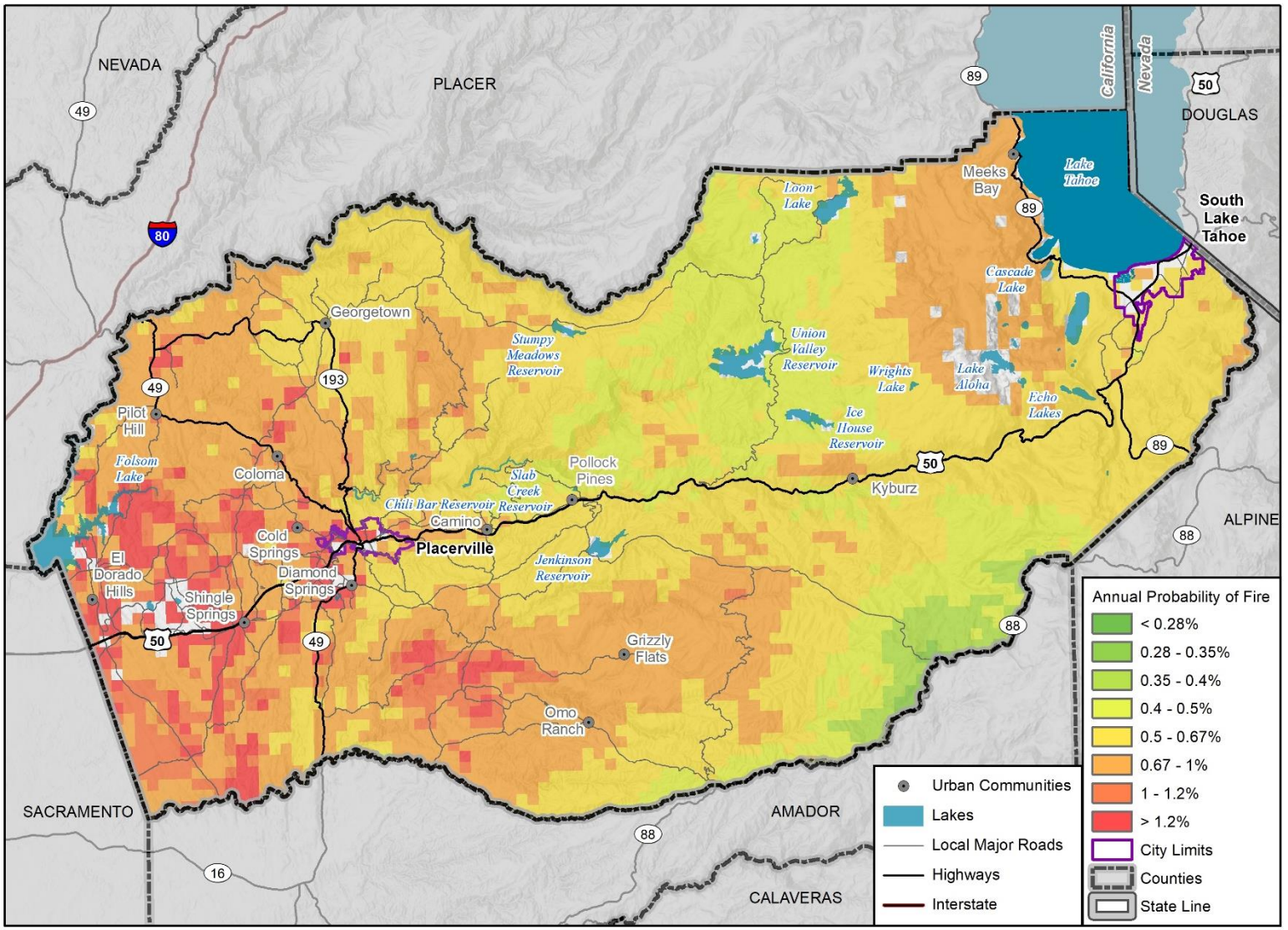
Figure 5-16 shows the annual burn probability in the County.

Figure 5-15 El Dorado County Fire History: 1911 to 2022



Map compiled 2/2023;
Intended for planning purposes only.
Data Source: El Dorado County, CALFIRE, USDA FS, USDI BLM and FWS, NPS, NIFS

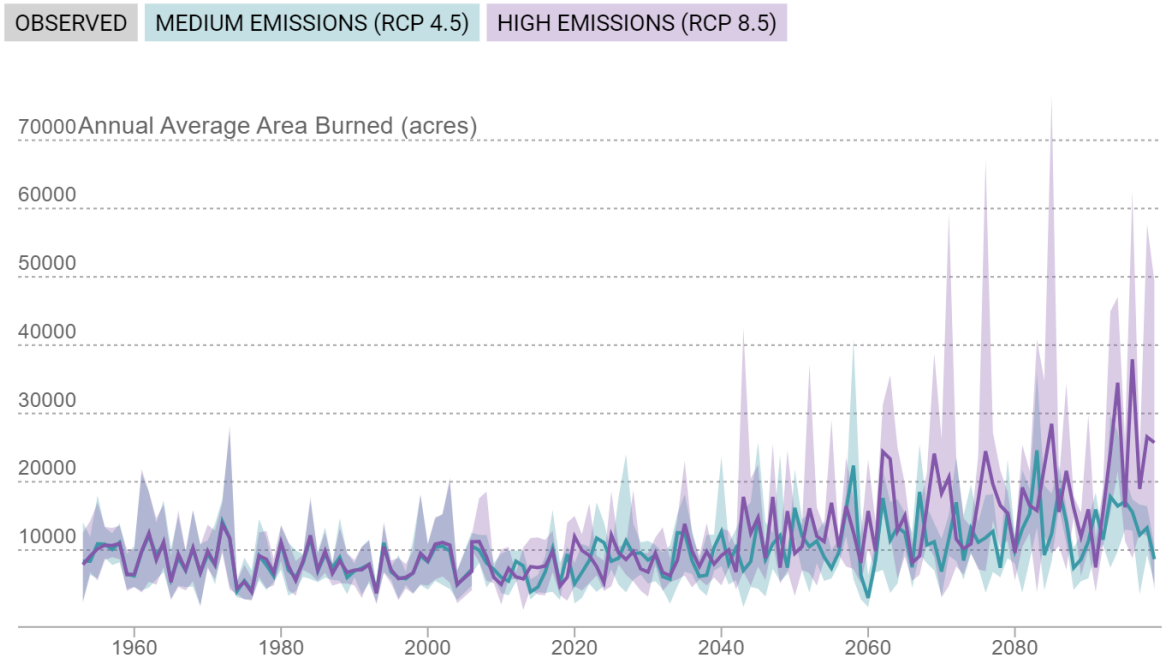
Figure 5-16 El Dorado County Annual Probability of Fire: 2021 – 2050



The frequency, severity, and impacts of wildfire are influenced by climate change, but also many other factors, including development patterns, temperature increases, wind patterns, precipitation variability, and pest infestations. It is therefore difficult to project where and how wildfires will burn (Cal-Adapt 2022). Therefore, climate models estimate increased risk of wildfire.

Wildfire risk is measured by the annual average area burned and by the Keetch-Byram Drought Index (KBDI). The annual average area burned is the projected area at risk of burning each year and can show at a high level if wildfire activity is likely to increase. The projections are robust for the Sierra Nevada region compared to other parts of California, based on detailed model inputs. **Figure 5-17** shows that the annual average area burned for the County is projected to increase throughout the 21st century. Historically, the County has had around 8,350 acres at risk of burning annually (Cal-Adapt 2022). According to the Cal-Adapt tool, the 30-year average annual area at risk of burning under the RCP 8.5 climate scenario, or the average of RCP 8.5 climate projections shown on the graph below between the years of 2070 and 2099, is expected to more than double to around 18,850 acres annually.

Figure 5-17 El Dorado County Projected Annual Average Area Burned



Source: Cal-Adapt 2022

Future wildfire acres burned per 10,000 acres were assessed using data obtained through Cal-Adapt (Westerling 2018; UC Merced 2018) under RCP 8.5. Over the period of 2005-2099, the area burned is modeled to increase throughout the entire county, with most of increase in the foothills and mid-elevation areas from Coloma and Placerville to Coloma. **Figure 5-21** shows the modeled annual acres burned in the County per 10,000 acres for the year 2005. As shown in the graph above, the average annual acres burned in 2005 was under 10,000 acres. In
Figure 5-19 and
Figure 5-20, the modeled annual acres burned in the County gradually increases through mid-century and the end-of-the-century, or over the next two 30-year time periods from 2035-2065 and 2070-2099, respectively (Cal-Adapt 2022). Under the RCP 8.5 scenario and based on the 30-year averages, which represents the average of the most likely outcome over a 30-year period, by mid-century the average annual acres burned is projected to increase to 12,658 acres and by the end-of-the-century to 18,843 acres (Cal-Adapt 2022).

Figure 5-18 El Dorado County Modeled Annual Acres Burned per 10,000 Acres (2005)

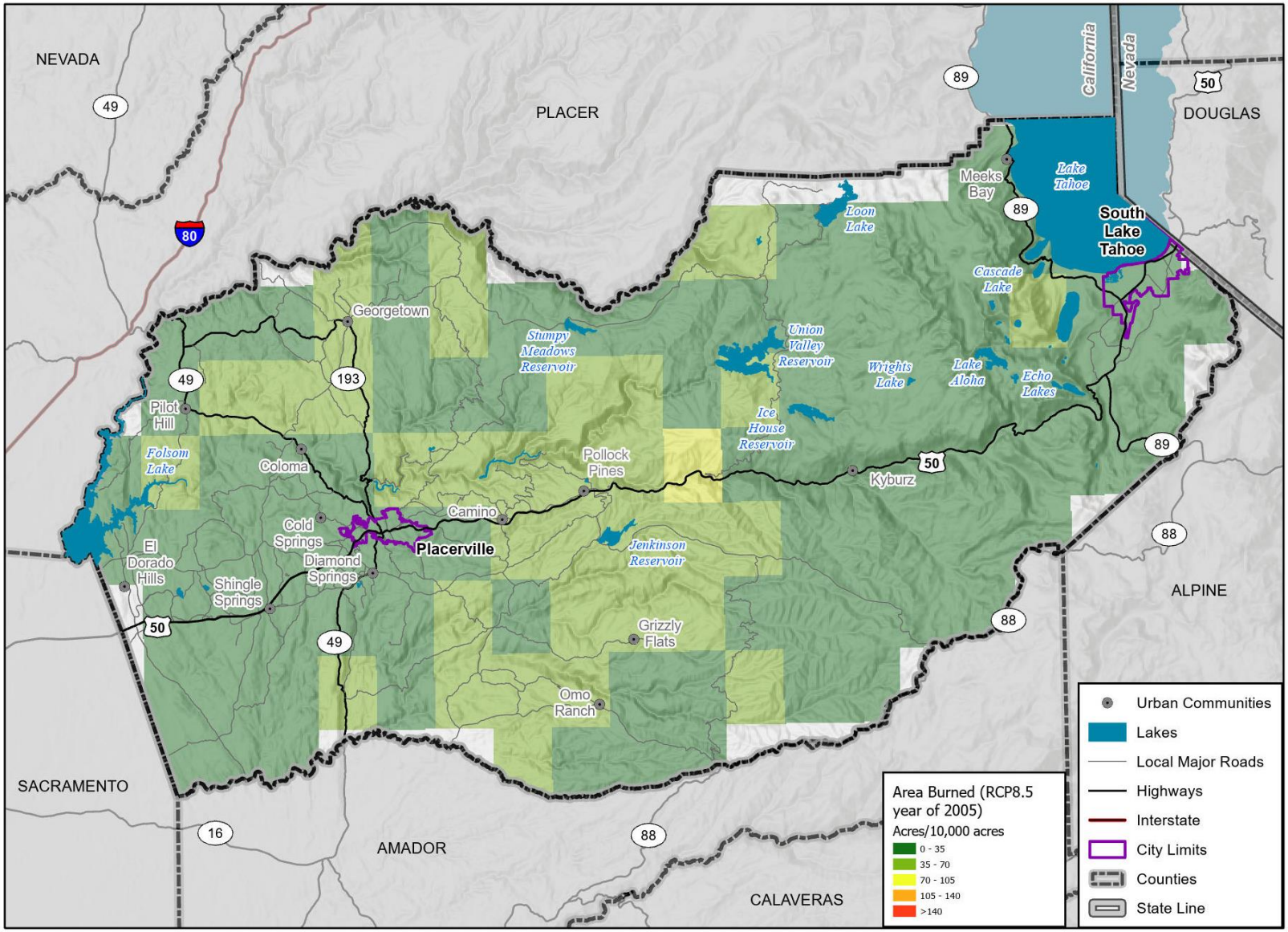


Figure 5-19 El Dorado County Modeled Annual Acres Burned per 10,000 Acres (2050)

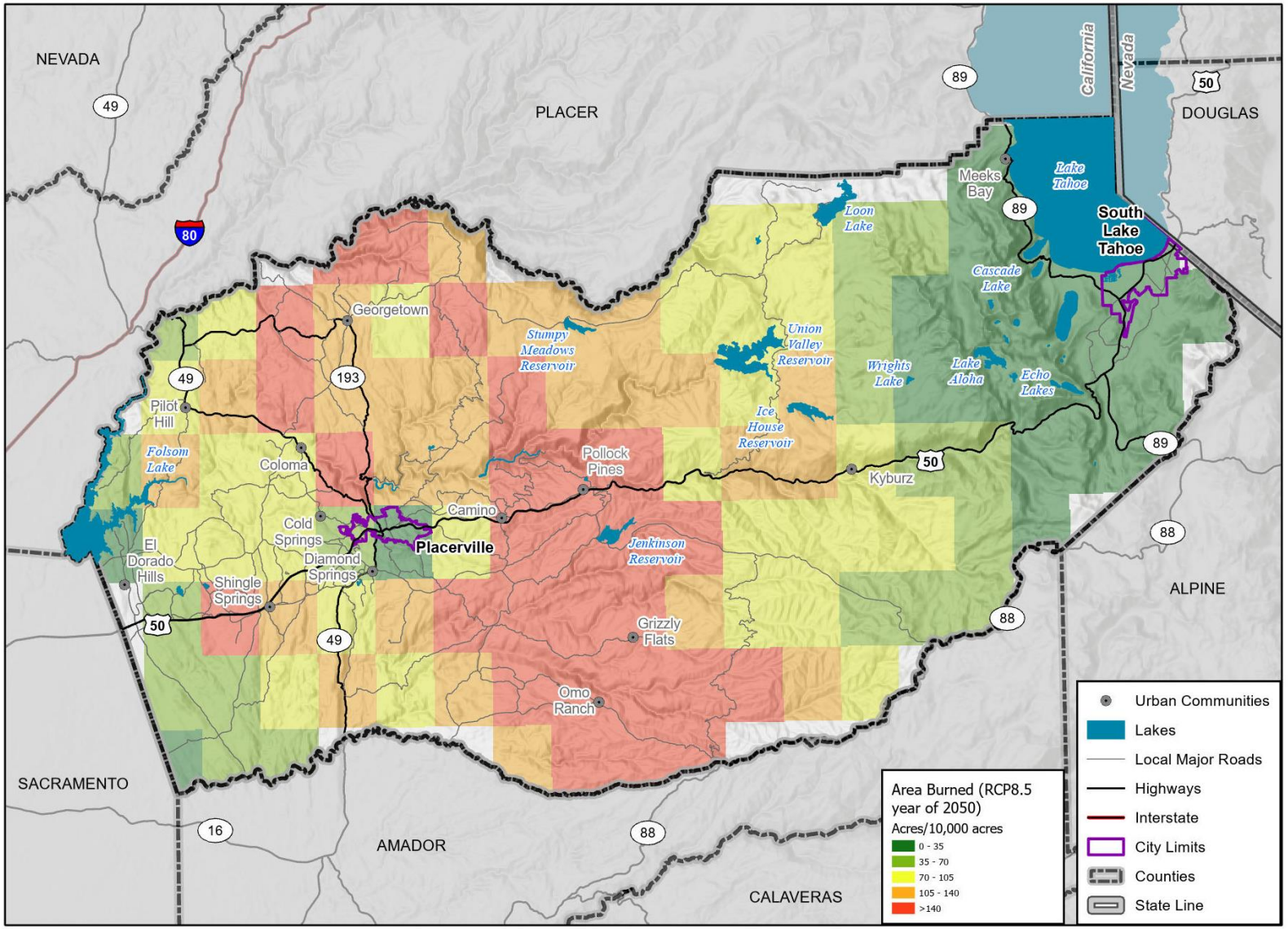
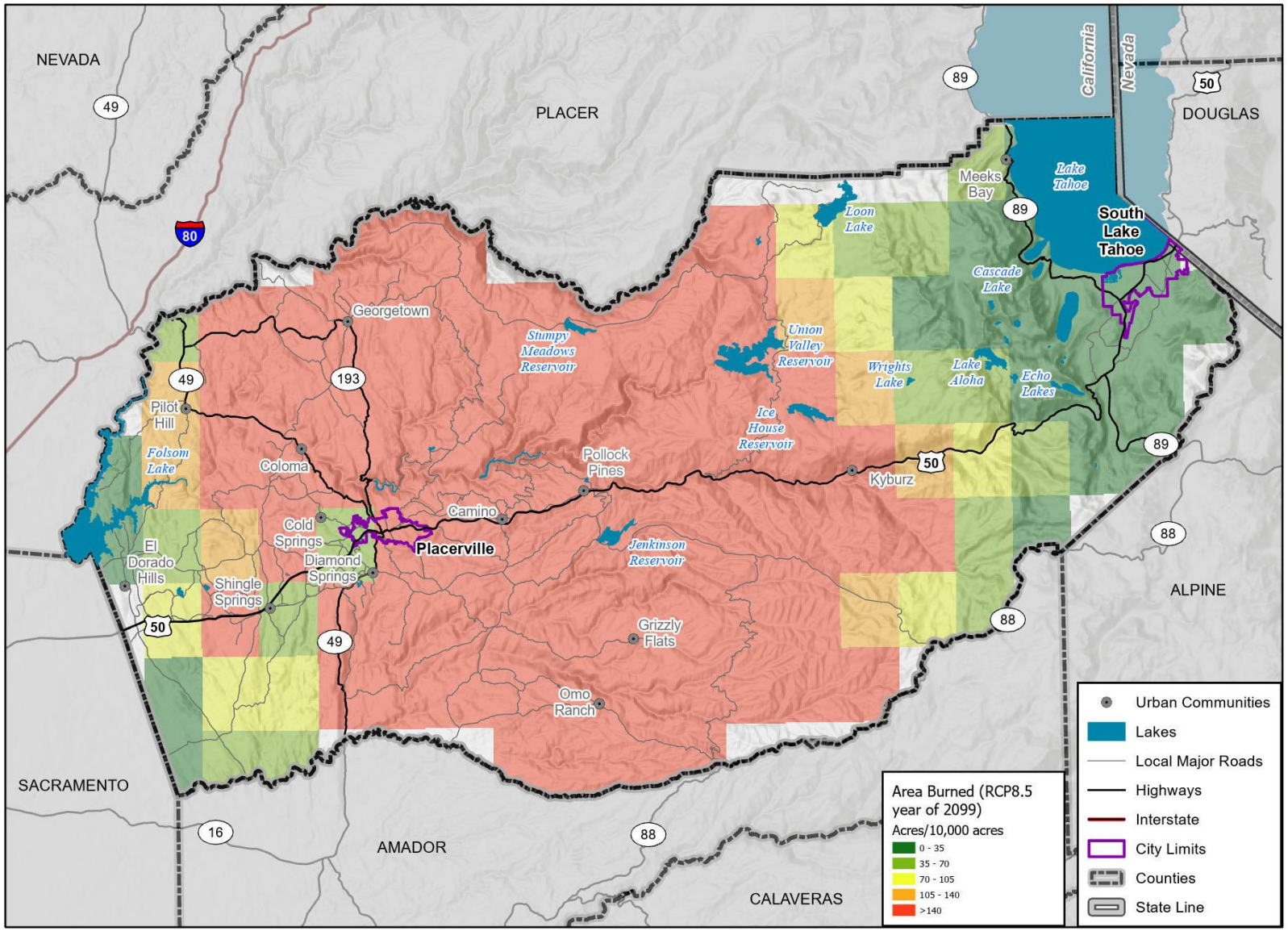


Figure 5-20 El Dorado County Modeled Annual Acres Burned per 10,000 Acres (2099)



The KBDI is a measure of the amount of precipitation required to return soil to full moisture capacity. A KBDI of zero indicates a total lack of moisture deficiency, while 800 represents drought conditions deep within soil layers. KBDI is cumulative, meaning values will increase on dry and warm days and decrease during rainy periods. It is a simplified proxy for favorability of occurrence and spread of wildfire but is not itself a predictor of fire. KBDI values are briefly explained in **Table 5-3**.

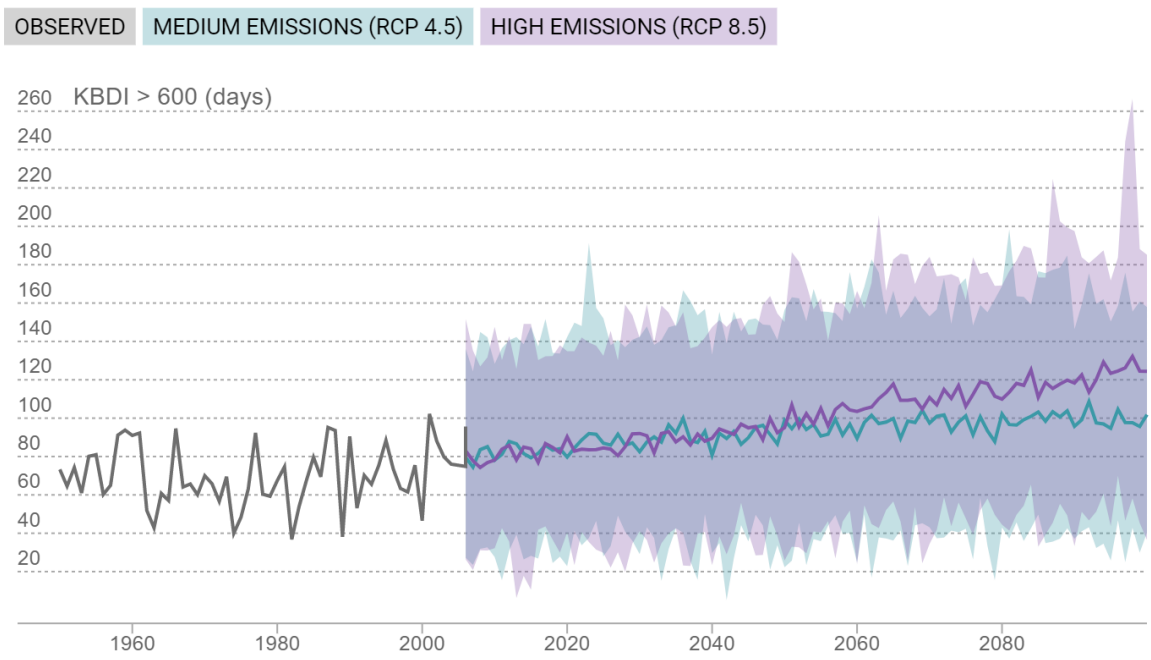
Table 5-3 KDBI Values and Descriptions

Index Range	Description
0-200	Soil Moisture and fuel moisture are high, low wildfire risk.
200-400	Soil and fuels start to dry, average wildfire risk.
400-600	Onset of drought with moderate to serious wildfire risk.
600-800	Severe drought, extreme wildfire risk and increased wildfire occurrence.

Source: Cal-Adapt 2022

Figure 5-21 below shows the number of days in the County where KBDI is greater than 600. These are days when severe drought conditions and wildfire risk are present. Cal-Adapt projections show that the number of days in a year where KBDI is greater than 600 in the County will nearly double under the RCP 8.5 scenario by the end-of-century, from 67 days to 118 days.

Figure 5-21 Projected Number of Days where KBDI > 600 in El Dorado County



Source: Cal-Adapt 2022

Figure 5-22 illustrates the historical annual number of days when KBDI exceeds 600 in the County. The annual number of days when KBDI exceeds 600 varied geographically but was less than 116 days throughout the County (Cal-Adapt 2022).

Figure 5-23 and

Figure 5-23 below show the projected mid-century and end-of-century annual number of days when KBDI exceeds 600 under the RCP 8.5 scenario for the County. As is the case in the historical model, KBDI values are highly dependent on location in both the mid-century and end-of-century models. The end-of-century KDBI values for the Tahoe Basin remain largely the same, although variations too subtle for the model to predict may occur. The KBDI values for the West Slope, however, are expected to increase rapidly throughout the 21st Century.

Figure 5-22 El Dorado County Annual Number of Days when KBDI > 600: Historical (2005)

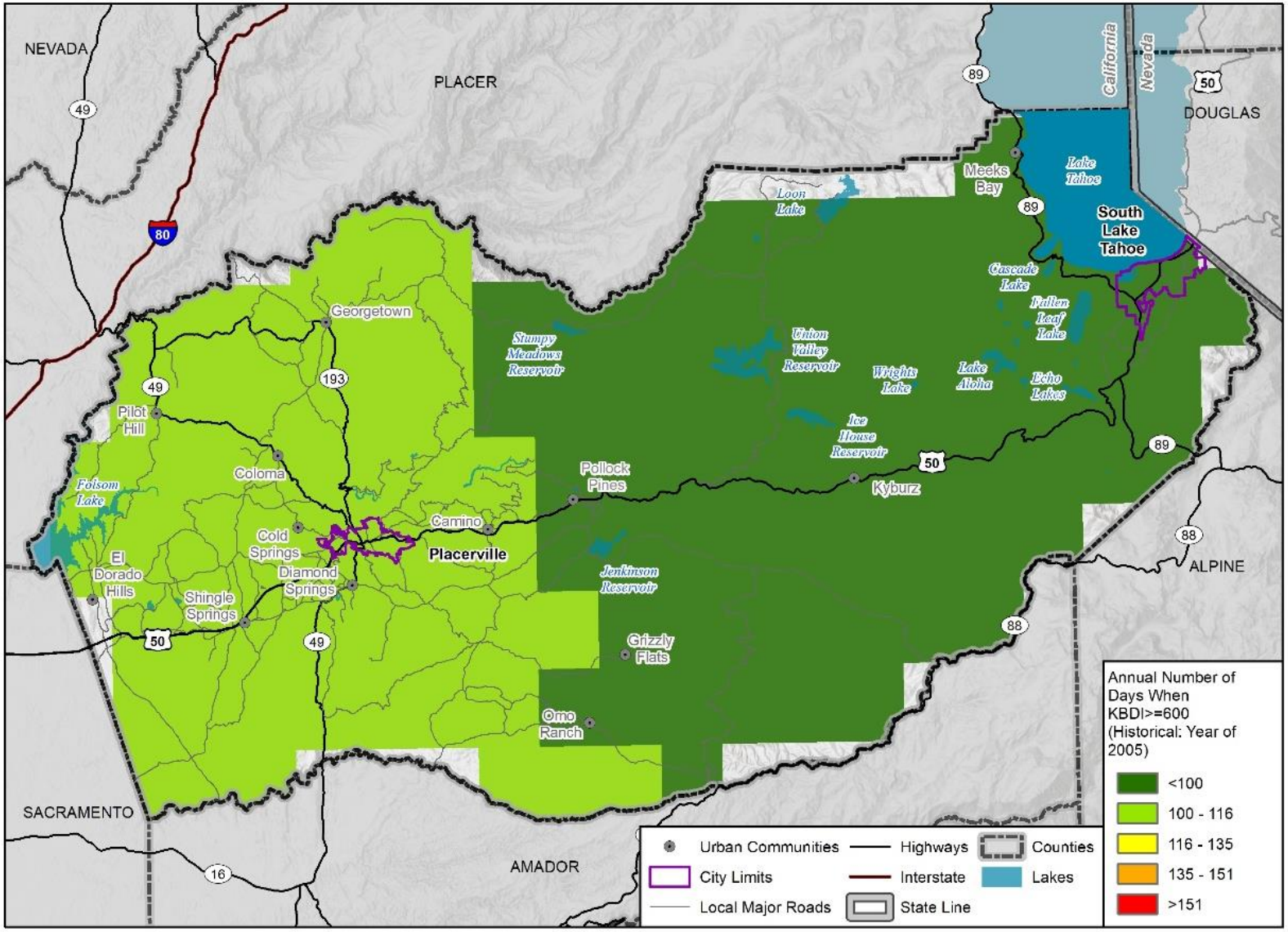


Figure 5-23 El Dorado County Annual Number of Days when KBDI > 600: Mid-Century (2050)

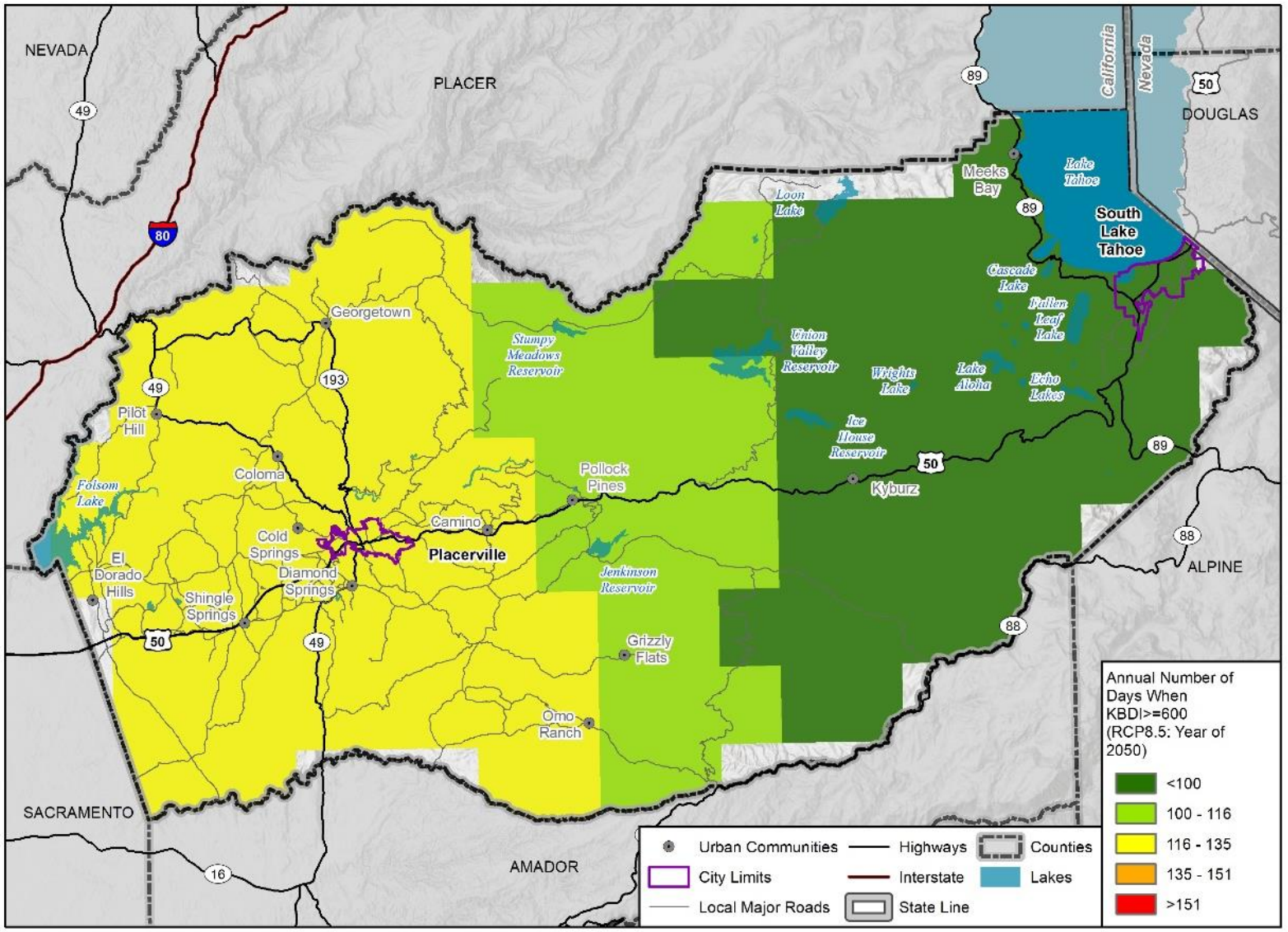
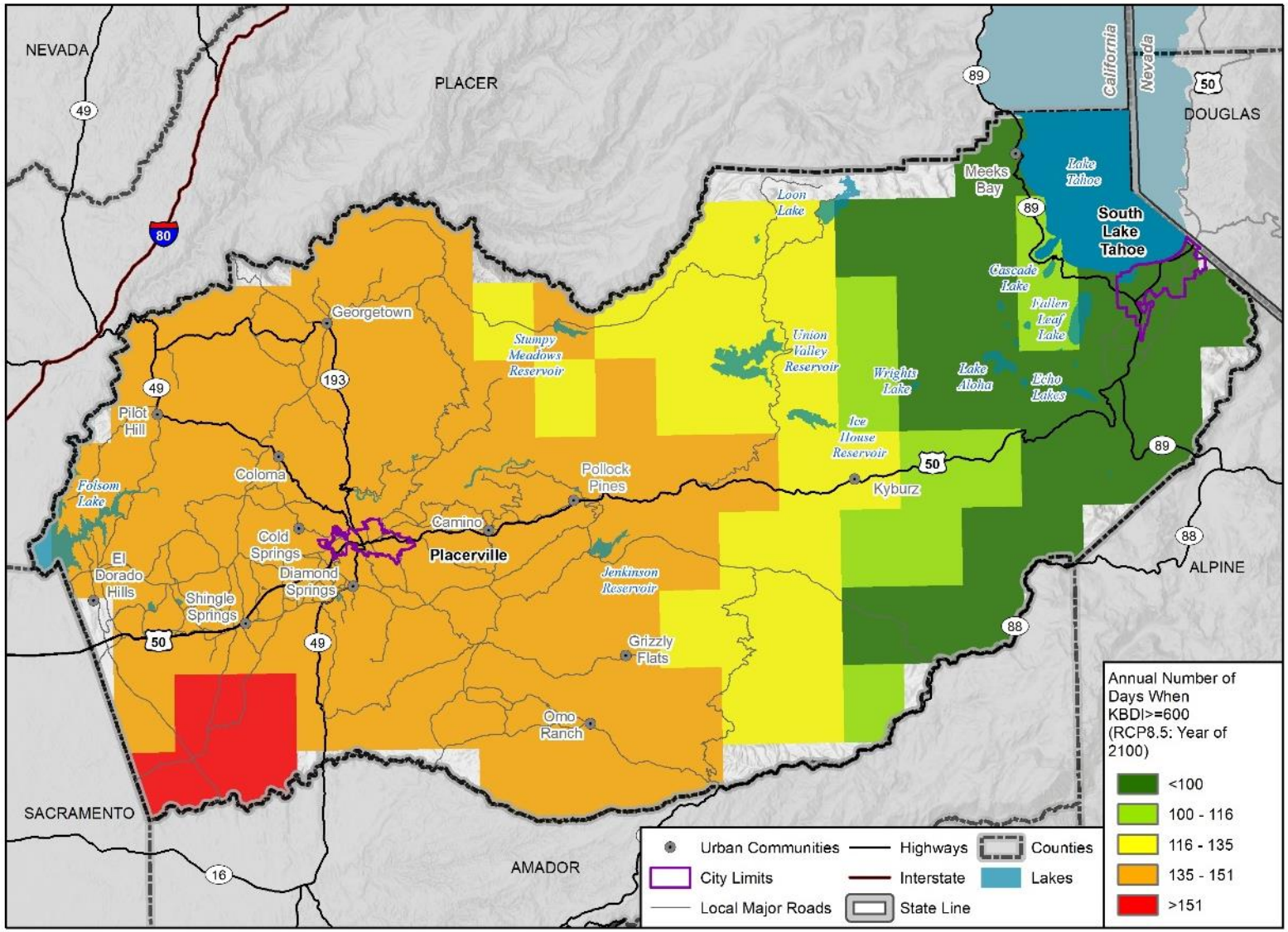


Figure 5-24 El Dorado County Annual Number of Days when KBDI > 600: End-of-Century (2100)



Federal, State, and local governments, as well as the citizens of the County, pay a price to mitigate the risk of wildfire. Fuels reductions programs are an ongoing effort, and grants and incentives are provided to those who can afford to reinforce their property against future fires. However, the risk of wildfire cannot be eliminated completely, and additional recovery and rebuilding costs remain after wildfire events.

In addition to the direct costs resulting from human injury and property destruction, secondary effects have the potential to continue impacting the community for years. Wildfires release gaseous pollutants, such as carbon monoxide and hazardous air pollutants, such as particulate matter (i.e., polycyclic aromatic hydrocarbons composed of acids, molds, metals, or soot), into the air where they can drift long distances, affecting millions of people (Borgschulte et al 2022). These small particles easily slip into homes, where they are inhaled, causing negative cardiovascular and respiratory conditions. These effects are felt most acutely by first responders and sensitive populations, such as children and seniors.

D. Secondary Climate Stressors

Secondary climate stressors are the result of complex interactions between primary climate stressors, and primary climate stressors can contribute to the development of secondary climate stressors when other external variables are considered. This section profiles 10 secondary climate-related stressors relevant to the County, including metrics used to measure current trends and climate change projections.

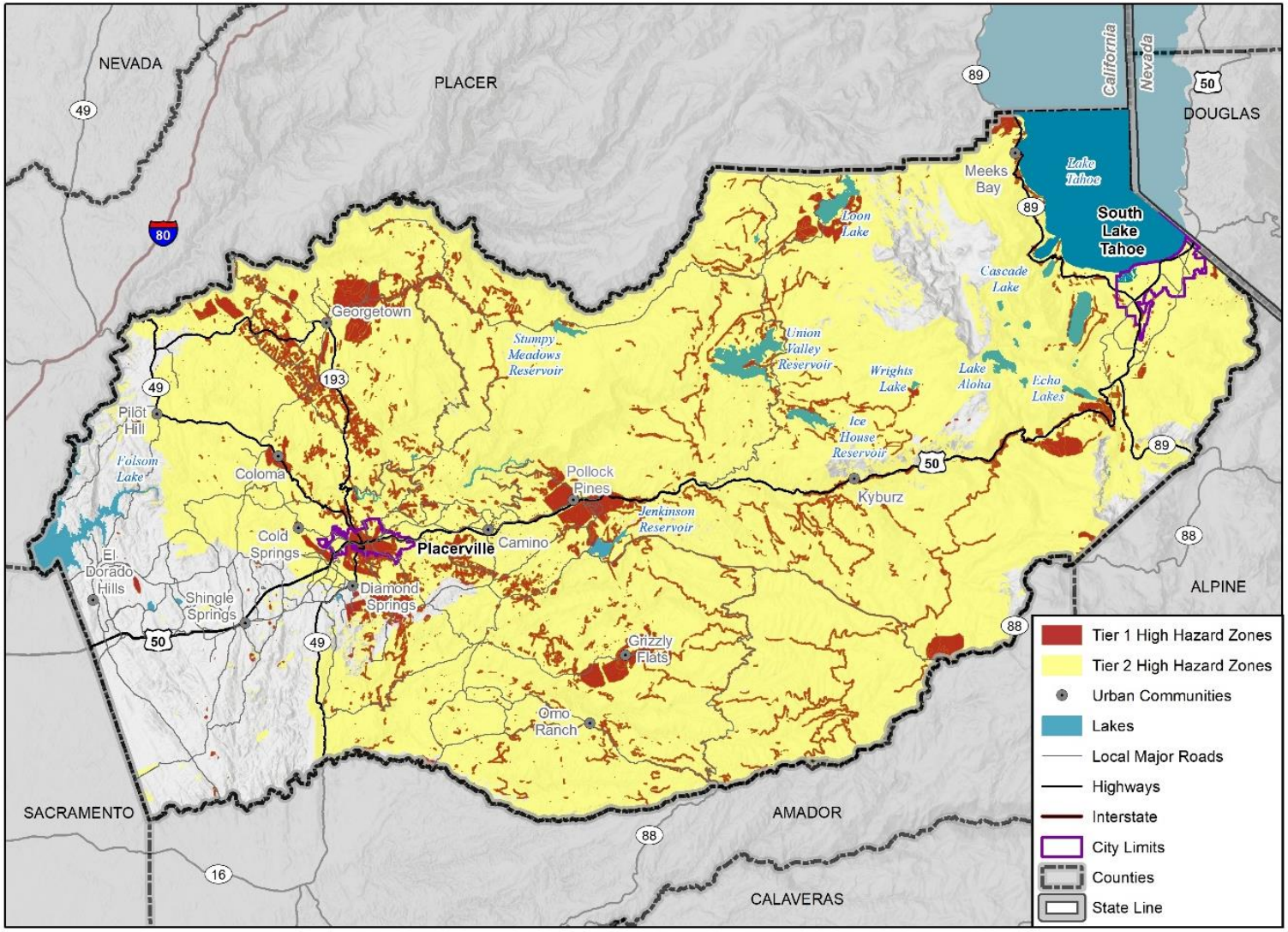
Agriculture and Forestry Disease and Tree Mortality

The County is particularly vulnerable to the threat posed by agricultural and forestry disease, and tree mortality. According to the 2020 County of El Dorado Crop Report, agriculture, livestock, and timber harvest products had a gross crop value of $72.2 million, with apples and apple products representing the leading crop with a value of $22 million. It is estimated that the total impact of agriculture to the County equaled $730 million in 2020. The County is also in the heart of one of the most diversified recreational areas in California, with approximately one million acres of National Forest land; Desolation Wilderness is a popular wilderness area (63,960 acres) in Eldorado National Forest that consists of chapparal, conifer, fir, and high-alpine sub-alpine forests. Additionally, the promotion and expansion of agriculture, recreation, and tourism and their related businesses is a key goal in the County's 2021 Strategic Plan. Each of these industries would be heavily impacted by outbreaks of agricultural and forestry disease like bark beetle infestations and related tree mortality.

Many species of bark beetles are native to the Sierra Nevada. Historically, they have been a part of a healthy ecosystem, feeding on small numbers of damaged trees (Sierra Nevada Conservancy 2017). However, the recurring and intensifying droughts in California have weakened trees, making them more susceptible to infestation. The population of bark beetles has therefore dramatically increased. When populations of bark beetles are high, even healthy trees are not able to fend off infestation. In addition to direct damage done to trees, bark beetles can also be carriers of fungi and disease that may further impair trees. In 2016, a severe bark beetle infestation, which was intensified by persistent drought, caused a massive increase in tree mortality, prompting the County Board of Supervisors to declare a state of emergency. As of 2017, drought-related mortality has killed almost 110 million trees in the Sierra Nevada region (Sierra Nevada Conservancy 2017). Also, as of December 2022, total tree mortality increased across California's forested areas, and in the County, approximately 78,000 acres were impacted with tree mortality with an estimated 1,400,000 dead trees (USFS 2022).

As shown in
Figure 5-25 **25**, most of the County falls under the Tree Mortality Related Tier 2 High Hazard Zones. Tier 2 High Hazard Zones are areas that have significant tree mortality and significant community and natural resource assets. Tier 1 High Hazard Zones are also scattered throughout the County. These are areas where tree mortality directly coincides with critical infrastructure.

Figure 5-25 El Dorado County Tree Mortality Related High Hazard Zones



As temperatures rise, pest and disease incidents are likely to get worse as many pests are most active in warm weather. Currently, the average annual minimum temperature in the County is 38.7°F. Based on modeling from the Cal-Adapt Tool, using the RCP 8.5 scenario, this temperature could be as high as 49.9°F by the end-of-century. Additionally, the County currently experiences about four "warm nights" (see Increased Temperatures) per year. Using the same modeling scenario, that number is expected to increase to up to 53 days per year by the end-of-century. These rising temperatures will increase the extent of pest habitat and the duration of the year during which bark beetles can thrive. This shift toward an increased warm season and a more accommodating environment for disease and infestations will alter the cropping patterns of agricultural plants. Crops such as walnuts, which require a long, cool winter, may no longer be viable in the County. Increased stress on plants from warmer weather, infestations, and disease will likely reduce agricultural yield.

Changes in water supply are likely to affect agricultural resiliency. While the overall average precipitation level in the County is not expected to change dramatically, the distribution of precipitation will change. Currently, the average length of dry spells in the County is 72 days (Cal-Adapt 2022). Using the RCP 8.5 scenario, the maximum length of dry spell is expected to increase to up to 114 days. Plants that have been weakened by drought are more susceptible to disease and infestations.

Diseased trees also pose a threat to infrastructure resiliency. Deteriorated trees or limbs can fall and damage homes and other facilities, including electrical infrastructure. The 2021 Dixie Fire, which destroyed over 1,300 structures, was started when a tree fell on an electrical line (CAL FIRE 2022a). While wildfire is a regular occurrence in California, rising temperatures and damaged trees threaten to increase the severity of future catastrophic fires. Fires that may have previously burned a small area can be fueled by weakened vegetation and result in much more destructive fires

Tree mortality in the Sierra Nevada in 2015 was the worst in recorded history. The U.S. Forest Service estimated 129 million trees in California died after four years of extreme drought. Results from a 2022 U.S. Forest Service surveys and field observations suggest additional tree mortality is evident in dying coniferous trees (USFS 2022). Increased tree mortality is an indicator for other climate-related hazards, as dead trees provide fuels for wildfires and elevated rates of mortality change vegetation type and characteristics and composition of the forest.

Source: California Tahoe Conservancy

Avalanche

State Highway 50 along Echo Pass closed in April 2019 after an avalanche occurred and caused a collision.

Photo Credit: El Dorado County Sheriff's Office 2019

An avalanche is a fall, release, or slide of a mass of snow in a sufficient enough amount to cause damage to infrastructure or to threaten the safety of people. Avalanches are possible when weak layers of snow within the cumulative seasonal snowpack fail to support the weight of the snow above and collapse. The result causes the overlying snow to break free and flow downhill. There are two destructive elements at work within an avalanche. Primarily, the actual impact of the displaced snow and ice is a concern. Embedded within the snow, debris such as broken-off trees, branches, and rocks are just as dangerous as the snow itself. Secondly, the avalanche wind, caused by air pushed ahead of the moving mass of snow, can cause additional damage. The effects of an avalanche are confined to the areas within and around the avalanche path.

Avalanches can be triggered by human activity or environmental factors, such as wind loading, precipitation, or warm weather, and they are usually isolated occurrences that happen in the backcountry. The terrain most susceptible to avalanches is typically in sheltered regions of mountains where snow is most prone to accumulate, and along steep slope angles ranging from 30 to 45 degrees. The most sheltered aspects in the Sierra Nevada, where snow can most greatly accumulate, are upon north and northeast-facing slopes.

The Sierra Avalanche Center (SAC) keeps records of snow conditions, avalanche observations, and other avalanche related incidents, recorded from a variety of professional sources, mountain guides, and the public. The SAC designated an Avalanche Zone in 2018 that encompasses the eastern portion of the County, including the entire City of South Lake Tahoe. Since 1950, there have been 18 avalanches that resulted in nine deaths and 12 injuries in the County, according to NOAA's National Centers for Environmental Information. Recently, there have been additional avalanches that resulted in injuries during the 2022-2023 winter season and a particularly high number of incidents in March 2023.

The likelihood and nature of future avalanches in the County may be affected by climate change. As winters become shorter, the potential for weak snow accumulations at the bottom of the snowpack increases. As snow piles on top of the weak layer, and temperatures remain warm, the upper, moisture-laden layers become vulnerable to sliding. More extreme precipitation events that deposit large amounts of snow in a short period may also increase the potential for recurrent large avalanches. Research suggests that with ongoing climate change, the characteristics of avalanches may change, affecting the rates of avalanche burial and survival (Strapazzon et al 2021). With a wetter and warmer snow climate, the consequences of burial may become more severe. Higher snow densities in avalanche debris may interfere with the respiration of completely buried victims, and blunt trauma and secondary injuries may become more frequent as snow cover becomes thinner (Strapazzon et al. 2021).

Drought and Water Supply Challenges

Drought is a complex phenomenon that occurs when a region experiences drier than normal conditions for an extended period. A drought can result from a variety of environmental events, including decreased precipitation, decreased snowpack or a shift in snowpack run-off, or because of water sources being depleted faster than they can recharge. According to DWR, a singular dry year will not constitute a drought in California due to its extensive water supply infrastructure.

Drought can be defined based on its causes or effects:

- Meteorological drought is usually defined by a period of below-average water supply.
- Agricultural drought occurs when there is an inadequate water supply to meet the needs of the State's crops and other agricultural operations such as livestock.
- Hydrological drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured by streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- Socioeconomic drought occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

In 2016, Governor Jerry Brown declared the severe 2012-2016 drought a state of emergency. The official declaration was lifted in 2017, and the need for municipalities and water agencies to reinforce water supplies and enhance long term resiliency to drought was made clear. The County faces difficulties conserving water supplies, as some of its residents are supplied by disparate public water purveyors or small private water companies, and some rely primarily on surface water or in some cases, groundwater with no alternative water supplies during dry years. While some of the West Slope water purveyors have drought plans, numerous water purveyors experience hardships, because they do not have secure water supplies. For example, during the 2012-2016 drought, residents in rural areas obtained water supplies from EID's bulk water stations (EDWA 2019).

The water supply, water quality, and public safety issues also vary from the West Slope to the Tahoe Basin. The West Slope lacks a consistent groundwater supply, making it vulnerable due to its reliance on surface water; there are also more than 100 small water public water systems susceptible to drought (EDWA 2019). Demand projections and climate hydrology also suggest a significant water supply-demand imbalance during drought conditions based on existing facilities and operations (EDWA 2019). The water infrastructure on the West Slope also includes historic unlined ditches and wooden flumes that are susceptible to wildfire and landslide impacts exacerbated by climate change. The TRPA Regional Plan in the Tahoe Basin has set strict growth and land use restrictions to reduce the risk of water supply and demand imbalances (TRPA 2012). The Tahoe Basin is less susceptible to drought given the community relies on both surface water and groundwater; however, there are small water systems that are vulnerable to the effects of drought in the event of a temporary loss of water supply. Long-term groundwater availability is also less of a concern because runoff and snowmelt are adequate for recharge (EDWA 2019). However, the increased frequency of wildfires can degrade long-term water quality.

Snowpack is currently the primary source of water in the County. Snowpack has historically melted throughout the year, providing a reliable source of water. As temperatures increase, precipitation that would have accumulated as snowpack is now falling as rain instead of snow. The decreased snowpack will melt sooner, shifting the seasonal distribution of precipitation, resulting in less water availability during late summer to early fall, often the warmest part of the year. For example, the runoff midpoint (when 50 percent of the total annual runoff has occurred) may shift from March to between 30 to 35 days earlier by mid-century and the end-of-century projections (EDWA 2019). Currently, the average SWE is about 5.2 inches for the County in April. Based on the RCP 8.5 scenario, that number could be as low as 0.8 inches by the end-of-century. Increased temperatures lead to increased water demand. Warmer temperatures also cause water to evaporate quicker, resulting in more demand for outdoor water use. Vegetation that is dehydrated is more susceptible to pest infestation and lends itself to becoming a wildfire risk.

The Caldor Wildfire burned through EID's Flume 4, 5, 6, and 30 in August 2021. Reconstruction of these flumes began in September 2021 and are now complete.

Photo Credit: EID 2022

Wildfire poses an especially devastating threat to the County, given that in some locations, the EDWA and EID still employ wooden flumes to deliver water across steep and hard-to-access terrain along Highway 50 (EDWA 2019). These are liable to be destroyed directly by fire, or by the secondary effects of fire, such as erosion and landslides. Damage incurred to these flumes would impede the ability to reliably deliver water for human, agricultural, or ecosystem purposes, and would increase the risk of flooding and water pollution. Several of these flumes were damaged during the Caldor Fire in August 2021. These flumes were reconstructed and repaired as emergency projects in May 2022, and water again flows through the EID's water delivery system.

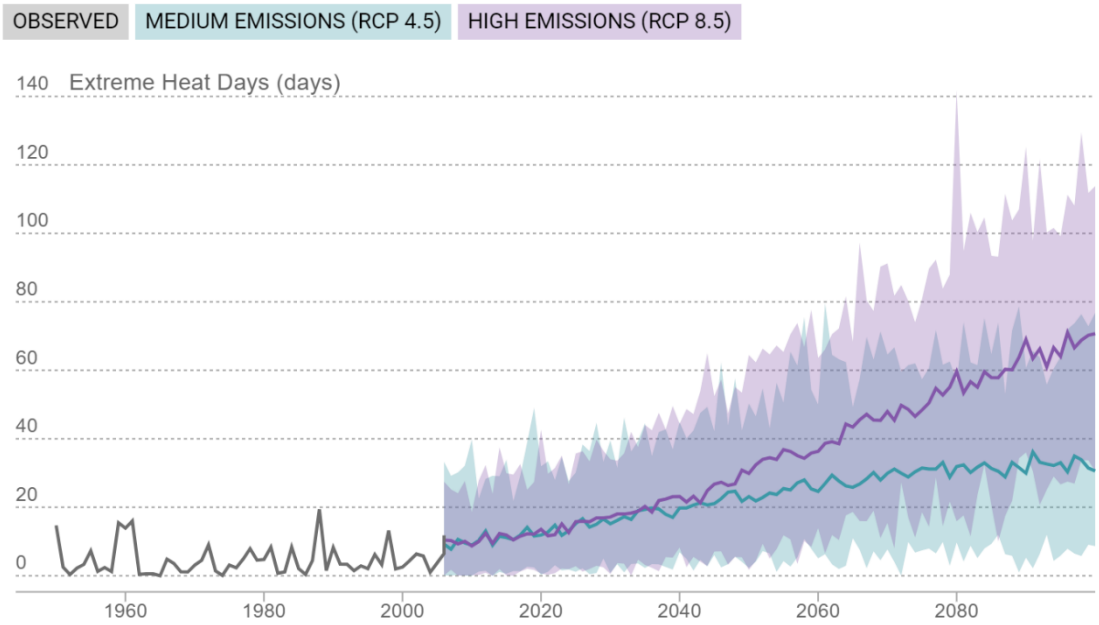
Extreme Heat

Summers in the County tend to be hot, arid, and mostly clear, and winters are cold, wet, and partly cloudy. On average, the summer season lasts for 3.3 months, from June to September, with an average daily high temperature above 86°F. The hottest month of the year is July with an average high of 93°F and low of 63°F. The winter season lasts for three months, from November to February, with an average daily high temperature below 61°F. The coldest month is December, with an average low of 39.6°F and high of 54°F.

Extreme heat hazards are measured by the number of extreme heat days or events per year and the duration of a heat wave event. Extreme heat days are defined as days when the maximum temperature exceeds the 98th percentile values of the historic daily maximum temperatures of a given location from 1961 – 1990, between April and October (Cal-Adapt 2022). Extreme heat is also defined by FEMA as temperatures that are over 10 degrees or more above the average high temperature for the region and last for several weeks. In other words, heat waves are periods of abnormally hot weather lasting days to weeks. In the County, an extreme heat day is defined as a day when the maximum temperature exceeds 92.4 °F (Cal-Adapt 2022).

Figure 5-26 shows how the number of extreme heat days in the County is projected to increase towards the end-of-century.

Figure 5-26 Forecasted Number of Extreme Heat Days in El Dorado County



Source: Cal-Adapt 2022

Figure 5-27 shows the historical number of extreme heat days per year for the County, which is fewer than 20 days, and **Figure 5-28** and **Figure 5-29** show the predicted mid-century and end-of-century number of extreme heat days per year under the RCP 8.5 scenario for the County. While the historic number of extreme heat days was four, the County is predicted to have between 20 and 35 extreme heat days by the year 2050, and most of the County is predicted to have more than 65 extreme heat days by 2100 (Cal-Adapt 2022).

Figure 5-27 El Dorado County Average Number of Extreme Heat Days: Historical (2005)

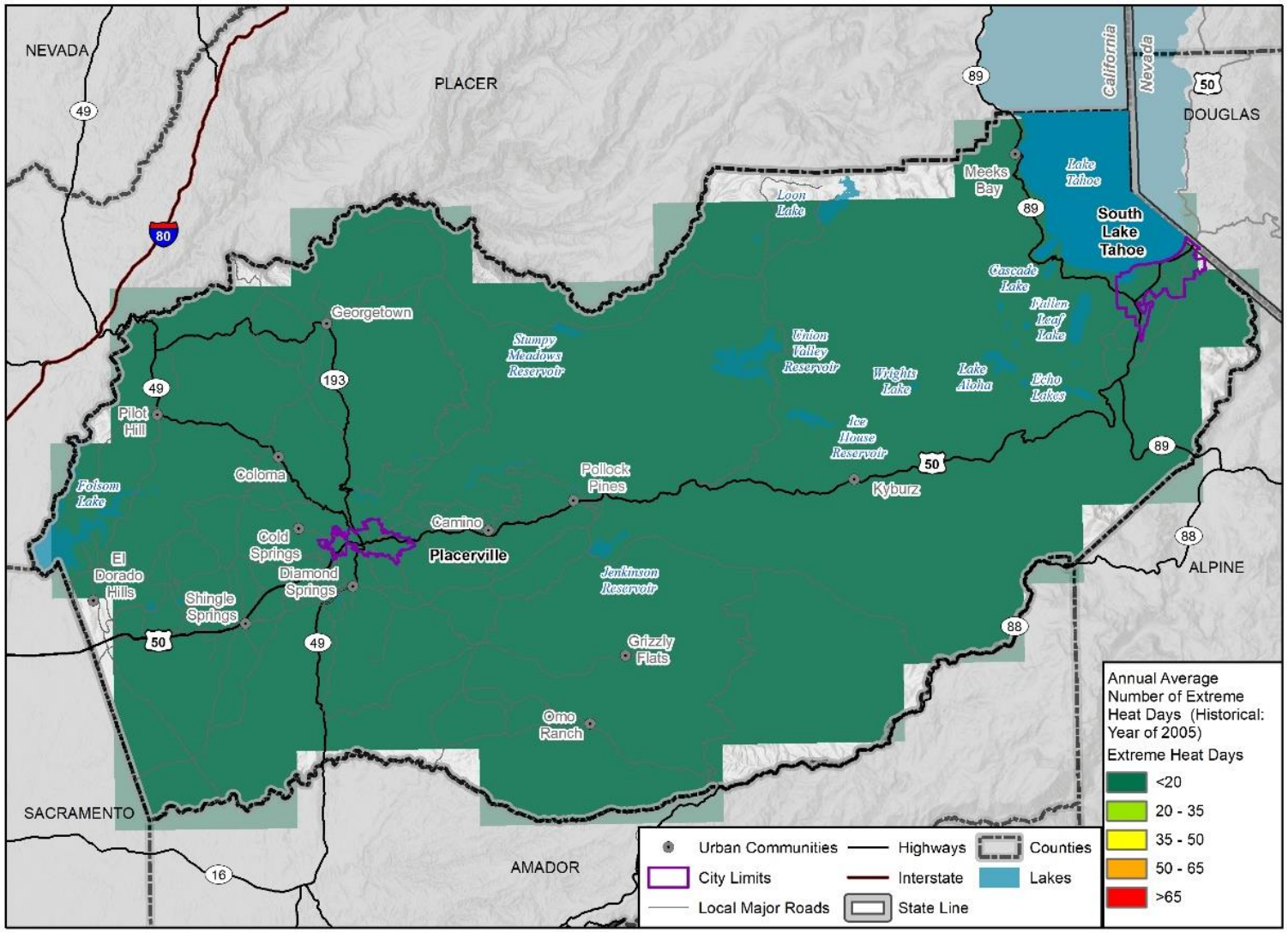


Figure 5-28 El Dorado County Average Number of Extreme Heat Days: Mid-Century (2050)

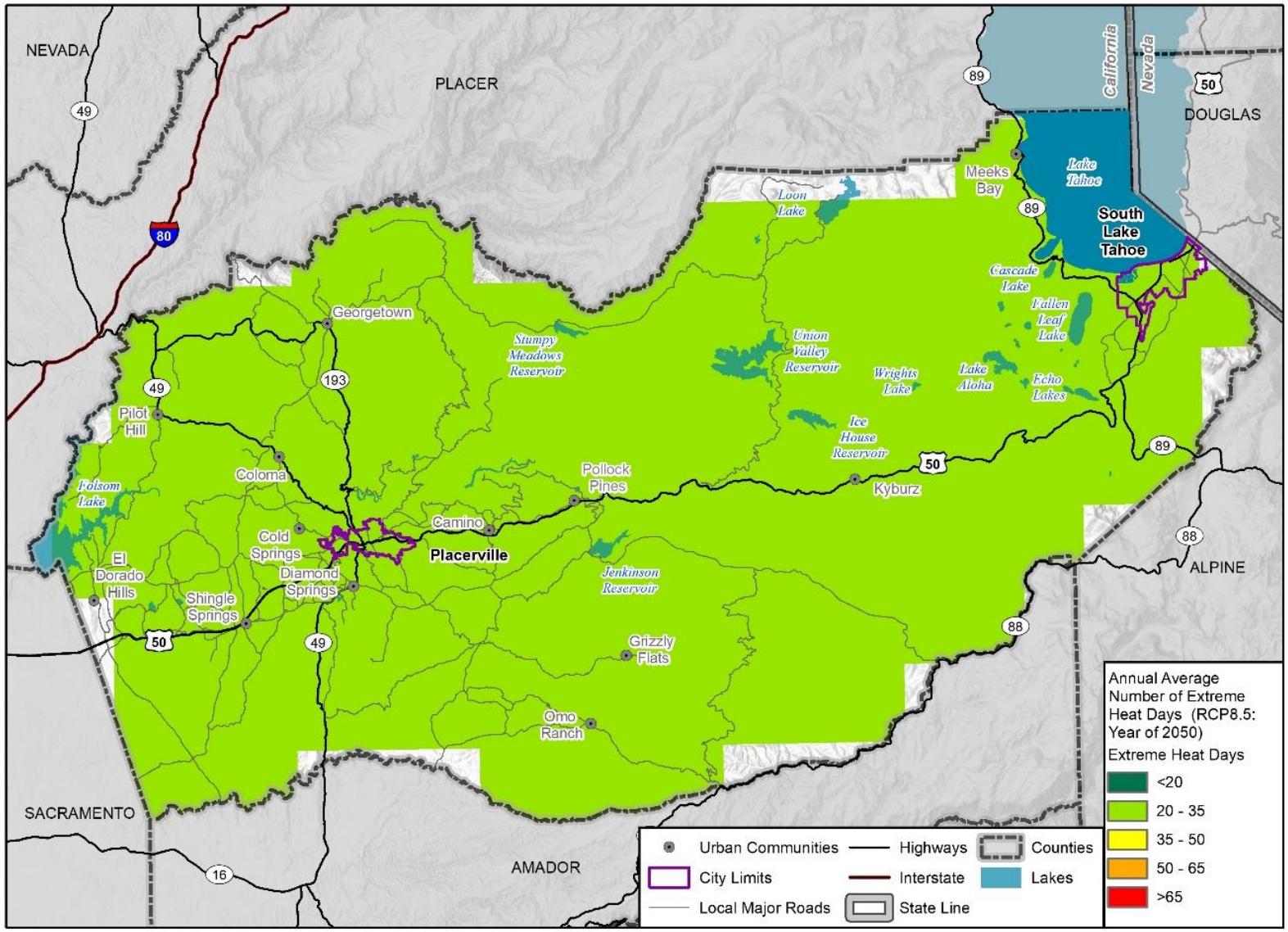
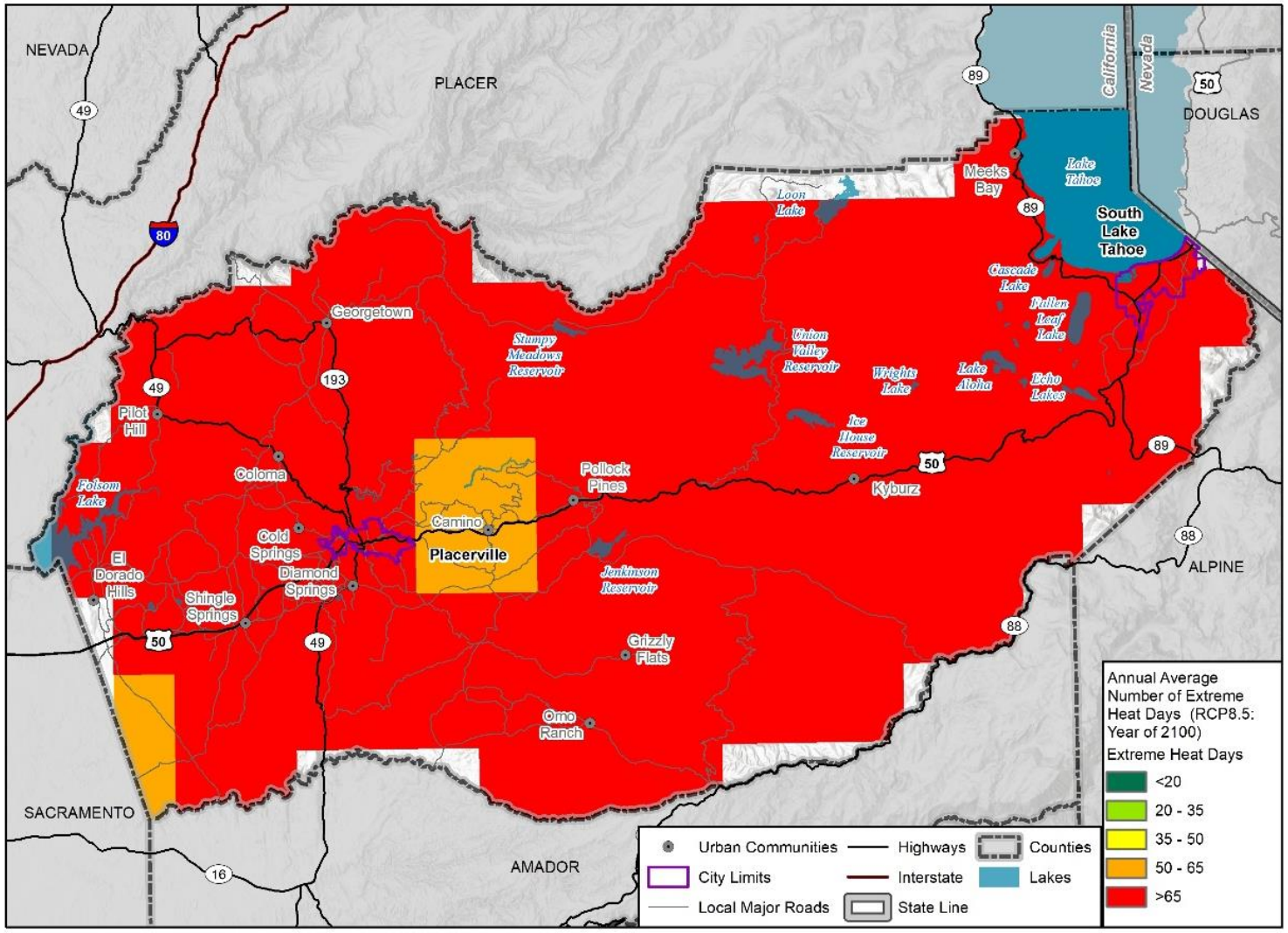
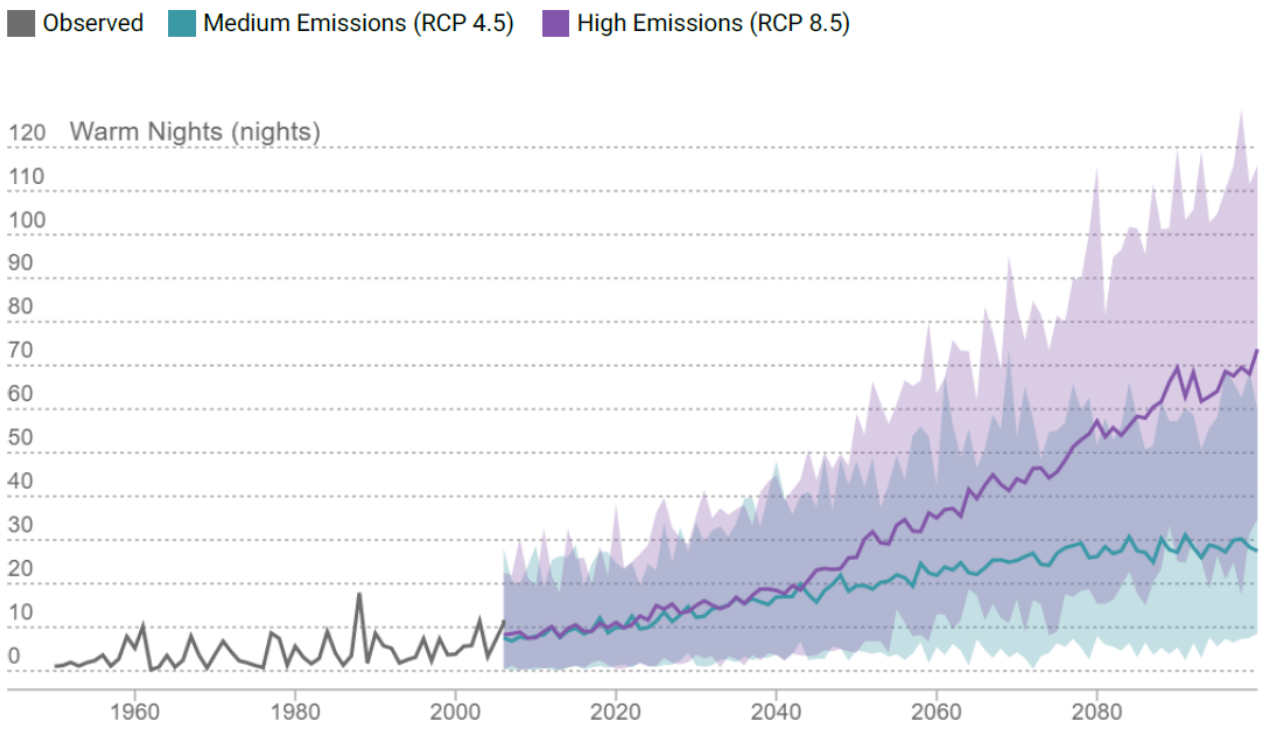


Figure 5-29 El Dorado County Average Number of Extreme Heat Days: End-of-Century (2100)



While climate change is making days hotter, it is also making nights warmer. This trend deprives people's bodies and minds the opportunity to cool off, which is detrimental for overall human health (Dahl 2022). The number of warm nights is the number of nights where the maximum temperature exceeds the 98th percentile values of the historic nightly maximum temperatures in each location from 1961 – 1990, between April and October. In the County, the threshold temperature for warm nights is 60.4 °F and is determined to be four nights annually (Cal-Adapt 2022). That number is projected to rise by a 30-year average of 23 nights by mid-century and a 30-year average of 53 nights by the end-of-century, as shown as an average of the values correlated with the years between 2035-2064 and 2070-2099 respectively, in **Figure 5-30.**

Figure 5-30 Projected Number of Warm Nights in El Dorado County



Source: Cal-Adapt 2022

The County's overall temperature, number of extreme heat days, and number of warm nights are projected to rise throughout the 21st century. These increases will result in drier soils, increased drought conditions, greater tree mortality, increased risk of public health hazards, and increased wildfire risk. As the climate changes in California, one of the most serious threats to the public health of Californians will stem primarily from the higher frequency of extreme conditions, especially longer, more frequent, intense heat waves. Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades.

Heat may kill by taxing the human body beyond its abilities, usually from heat stroke and related conditions. Heat waves are also associated with increased hospital admissions for cardiovascular, kidney, and respiratory disorders. In a typical year, about 175 Americans die from summer heat. The daily maximum average temperature, an indicator of extreme temperature shifts, is expected to rise 4.4°F – 5.8°F by 2050 and 5.6°F – 8.8°F by 2100, further exacerbating the frequency and duration of these events (CNRA 2022).

Heat-health events, which are public health impacts caused by heat waves, are also projected to worsen. According to the National Weather Service (NWS), among natural hazards, only the cold effects of winter take a greater toll, surpassing that of lightning, hurricanes, tornadoes, floods, or earthquakes. As a comparison, in the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died. The

2018 California State Hazard Mitigation Plan notes that the 2006 heat wave led to 650 deaths in a 13-day period (Cal OES 2018) and in the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined (California Climate Adaptation Strategy 2018).

According to the State's Extreme Heat Action Plan, extreme heat ranks amongst the deadliest of all climate change-driven hazards in California (CNRA 2022). Prolonged exposure to excessive heat can lead to other impacts, such as damaging crops, injuring or killing livestock, and increasing the risk of wildfires. Power outages may also occur as heavy demands for air conditioning strain the power grid. In summary, extreme heat events can have severe impacts on public health and safety, economic prosperity, natural systems, and communities and lead to disproportionate consequences on vulnerable populations.

Flooding

Floods occur when infrastructure does not have adequate capacity to manage water levels, resulting in normally dry areas that inundated with water. While floods are usually caused by increased precipitation, they can also be caused by dam or levee failure. The risk of flood by infrastructure damage is increasing as current infrastructure in the United States is aging and, in many cases, has reached or exceeded its expected lifespan.

The County has a diverse geography with varying amounts of precipitation. Rainfall averages range from 30 inches a year at the western end of the county, to 70 inches a year at the Crystal Basin. Historical annual precipitation in the American River Basin, which is the upper watershed within the West Slope, has fluctuated between 50 to 200 percent of average (EDWA 2019). Snowfall averages span from 20 inches per year at an elevation of 3,500 ft., to 250 inches in the areas immediately surrounding the Crystal Basin at the Sierra Nevada crest.

The County is prone to four types of flooding:

- General rain floods are likely to occur in the County from November to May. They are characterized by prolonged, heavy rainfall and a large volume of runoff with high peaks and moderate durations.
- Cloudburst storms are likely to occur from early fall to late spring. They can last up to three hours and are characterized by high peak flows, equal to or greater than the peak flow of general rainstorms, short duration of flood flow, and small volume of runoff.
- Snowmelt floods are prone to occur in the Upper Truckee River Basin between May and June. They last longer and consist of larger volumes than general rain floods, although they do not have the high peak flows typically seen with those floods.
- Thunderstorm flooding may occur from late spring to early fall and usually lasts about 15 to 20 minutes. Although they may produce three inches or more of precipitation, their short duration and small extent make their runoff relatively small.

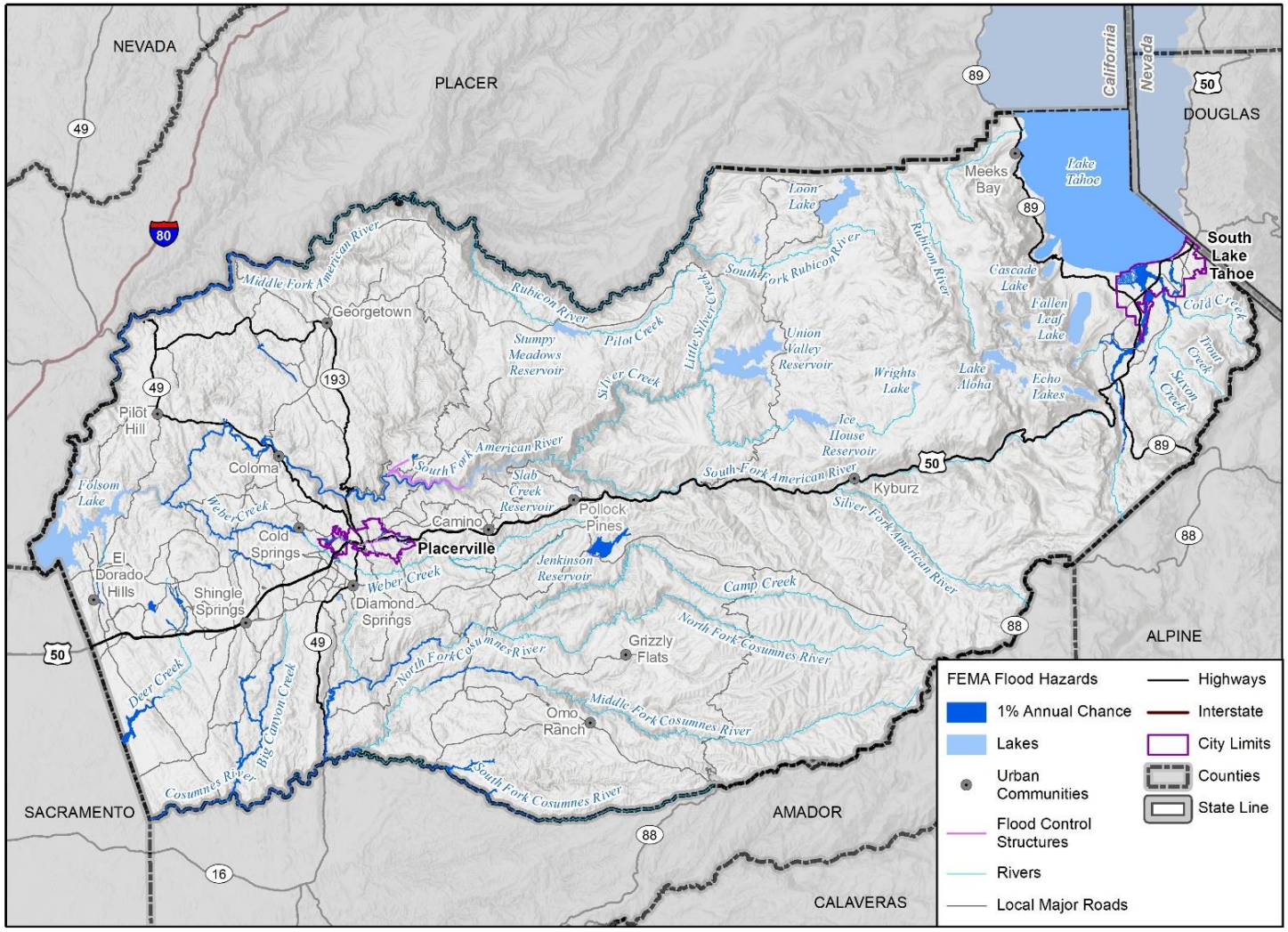
While climate change is not expected to drastically alter the overall amount of precipitation received by the County, warming temperatures are expected to shift precipitation patterns, resulting in both more droughts and flooding events. Precipitation that had previously fallen as snow is expected to increasingly fall as rain, triggering increased runoff during winter months and decreased snowmelt water supply during warmer months. Secondary effects of this cycle are likely to result in increased flooding. Soil that has been dried out and hardened by drought is less adept at absorbing water, resulting in a greater volume of runoff. Vegetation, which may have slowed water flow, will likely be weakened or killed by drought. Damaged vegetation also becomes fuel for wildland fire, which in turn dries out soil, hardening it and making the area more prone to flooding. The combination of West Slope hydrology, soils and topography may cause areas to experience frequent and localized flooding. Drainage problems and flooding have occurred in low-lying areas around Cameron Park, and areas where culverts are undersized or blocked with debris can intensify flooding (EDWA 2019). The Tahoe Basin experiences flooding because of rain-on-snow events, particularly when severe storms start warm with rain and later, snow. For example, residential neighborhoods and

roads that are routinely plowed for snow removal still experience flooding during rain events when runoff pools because it cannot infiltrate through the snow or the densely packed surfaces. Much of this flooding has also occurred in neighborhoods near the floodplain (e.g., Truckee River).

Current water infrastructure was designed to manage historic levels of runoff. As such, it is not able to capture the increased levels of runoff expected with climate change or to offer adequate protection against intensified flooding. Much flood related damage in the County is associated with transportation. Road washout is common, and damages and closures prevent the flow of people, supplies, and emergency services throughout the County. During a flood, water can move swiftly and powerfully enough to remove buildings from their foundations. Slow-moving or still flood water can leach asbestos from buildings and soak structures in untreated sewage and mold. Floodwaters can pick up residues of gasoline, mercury, and other contaminants and carry them into waterways.

A flood vulnerability assessment was performed for the County. The County's parcel layer and associated assessor's building improvement valuation data were provided by the County and were used as the basis for the inventory. The County's effective FEMA Digital Flood Insurance Rate Map (DFIRM) dated April 3, 2012, was used as the hazard layer. A DFIRM is FEMA's flood risk data that depicts the 1% annual chance (100-year) and the 0.2% annual chance (500-year) flood events. This data is incorporated into the National Flood Hazard Layer (NFHL).
Figure 5-31 summarizes the flood zones in the County. As shown, the floodplains closely follow the major rivers and tributaries on the West Slope; Truckee River, Cold Creek, and Trout Creek in the Tahoe Basin; and the area around Lake Tahoe. The 0.2% annual chance floodplains, however, are not shown on the map because they are not very visible at the current map scale. Reports of localized flooding in the County are localized and often related to capacity and conveyance issues on the West Slope and rain on snow flooding in the Tahoe Basin.

Figure 5-31 El Dorado County 1% Annual Chance Floodplains



Map compiled 1/2023;
Intended for planning purposes only.
Data Source: El Dorado County,
FEMA NFHL 4/3/2012
*0.2% Annual chance floodplains are not shown due to not being able to show up at the current map scale.

Human Health Hazards: Pandemic/Epidemic

The scale of a human health hazard is described by the prevalence of a disease within a community, or the geographic extent of its transmission.

- An endemic is defined as something natural to, or characteristic of, a particular place, population, or climate.
- An outbreak results when there is a higher number of cases than expected in an area over a certain time.
- An epidemic is like an outbreak, but with a larger number of cases, or a larger geographic extent, or a combination of the two.
- A pandemic can be defined as a public health emergency that spans several countries or continents, usually affecting many people.

While many diseases are spread through ingestion or insects, airborne diseases and those spread through physical contact pose higher risks to the community as they are difficult to control. Diseases such as influenza, pertussis, tuberculosis, and meningitis are all spread through these methods and pose a threat to communities. Health agencies closely monitor for diseases with the potential to cause an epidemic and seek to develop and promote immunizations.

Pandemics are most often caused by new subtypes of viruses or bacteria to which humans have little or no natural immunity. A pandemic disease may easily spread person-to-person, causing serious illness. Even when there is a strong healthcare system in place, disease outbreaks can strain and overwhelm community resources. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines. An especially severe pandemic could lead to high levels of illness, death, social disruption, and economic loss.

Due to the process utilized to prepare vaccines, it is impossible to have vaccines prepared in advance to combat pandemics. Additionally, for novel viruses, identification of symptoms, mode of transmission, and testing/identification may require development, causing significant delays in response actions. A portion of the human and financial cost of a pandemic is related to the lag time to prepare a vaccine to prevent the future spread of the novel virus. In some cases, current vaccines may have limited efficacy against novel strains.

Since March 2020, the County, the nation, and the world have been dealing with the COVID-19 pandemic. The COVID-19 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission. While most people have mild symptoms, some people develop acute respiratory distress syndrome, with roughly one in five requiring hospitalizations. A key challenge in containing the spread has been the fact that it can be transmitted by asymptomatic people.

According to the County of El Dorado Health and Human Services, as of January 3, 2023, there have been 33,865 positive cases of COVID-19 in the County since the beginning of the pandemic. Of those cases, a confirmed 236 cases have resulted in death. The County's vulnerable populations – young children, the elderly, under-resourced households, and those with underlying health conditions – are likely to be hardest hit during any pandemic or disease outbreak.

Changes in temperature and precipitation variability can increase the potential for human health hazards because animals are more likely to carry diseases during warmer weather. Warmer temperatures in the spring and later into the fall months will enable animals to be more active for a longer period, which increases the time a disease can be transmitted. Bacteria, viruses, parasites, and other organisms that cause disease and illness are also more likely to persist in a warmer climate.

High Wind

The National Weather Service defines high wind events as events during which sustained wind speeds of 40 miles per hour (mph) or greater last for 1 hour or longer, or winds of 58 mph or greater last for any duration. Strong winds are directly caused by large differences in atmospheric pressure from a storm and the surrounding environment. Winds can be further enhanced in localized areas on the leeward side of mountain ranges in what is called a downslope windstorm. Wind gusts in these situations can exceed 80 mph, reaching nearly 100 mph in the most extreme cases.

Thunderstorms, which were rated a hazard of high concern in the County's 2018 LHMP, can cause high wind events called downbursts and microbursts. Downbursts may reach speeds of 125 mph while microbursts are more concentrated and can reach up to 150 mph. Typically, both last five to seven minutes. Winter storms in the Sierra Nevada also produce periods of high wind. Winds of 40-60 miles mph typically precede the snow portion of winter storms; however, during the 2022-2023 winter storms wind gusts along the Sierra Nevada crest were reported between 60-80 mph, although maximum wind gusts measured at the Central Sierra Snow Lab on Donner Summit between November 2002 and November 2022 (latest date of publicly available data) ranged from 35 to 59 mph (WRCC 2022b)

High winds can cause significant property, infrastructure, and crop damage related to downed trees, damaged power lines, and agricultural loss. High winds can also threaten public safety and have adverse economic impacts from business closures and power losses associated with both intentional and unintentional PSPS. High wind events that are combined with other natural hazards, such as hail, can disrupt daily activities, cause damage to buildings and structures, and increase the potential for other hazards. High wind events combined with snow can cause highway closures due to low visibility and induce avalanches. Additionally, flying debris from high wind events can result in injuries and deaths.

High wind events are not uncommon in the County. According to the National Centers for Environmental Information database, since 1950, there have been 173 reports of high winds that led to $13.58 million in property loss, and $48,000 in crop loss. Additionally, one death and three injuries have been reported. 173 reports of high winds equate to 2.5 high wind events every year, making it highly likely that a high wind event will happen in the County in any given year.

California's Fourth Climate Assessment indicated that extreme fire weather, particularly in the form of hot and dry winds, can strongly influence shrub-land fire regimes. Strong winds have been associated with severe forest fires in California, meaning that climate change impacts on wind patterns may also affect forest health and wildfire susceptibility. Winds have the critical effect of drying out the air as the air descends after passing over mountain peaks. When the ultradry air overlays parched vegetation, tinderbox conditions develop, which facilitate extreme fire growth.

According to CalFire, climate change is considered a key driver of California's flare-up fire activities in the past decade (CALFIRE 2021). Changes in Santa Ana and Diablo winds, which led to some of the most devastating wildfires in California, were assessed as evidence that climate change is worsening their effects. At this time, these changing factors are not well understood and are currently incorporated into state and regional research and risk analysis.

Landslides and Debris Flows

A landslide may be defined as the downward sliding of a relatively dry mass of earth and rock, or as a "slope failure," which may include landsides, mudflows, post-fire debris flows, and rockfalls. Gravity is the primary factor involved in landslides and the constant in any equation trying to quantify the stability of a slope face. Slope angle, slope material, and the amount of water present also affect slope stability when combined with gravity. Other factors that can affect the stability of a slope to a lesser degree are vegetation and climate.

Landslides are categorized into groups by movement and type of material that is involved. The types of movement are falls, slides, and flows. The amount of water is usually the defining component when classifying a movement. In "falls," very little water is present. In "flows," there is a substantial amount of water involved. The type of material involved can be soil, rock, or debris. These groups help identify rockfalls, earthflows, or debris slides. A rockfall is dry and fast while a debris slide is wet and slow.

While a mudslide is defined as a mass of water and fine-grained earth that flows, if more than half of the solids in the mass are larger than sand grains (rocks, stones, boulders), the event is called a debris flow. Two types of debris flows are common in the County, those related to shallow landslides and those that occur post-wildfire. A debris flow associated with a shallow landslide may occur where soil liquefies and runs downhill. These tend to occur following periods of heavy rainfall when soil is saturated. Post-wildfire debris flows occur when rain follows the destruction of vegetation that serves to stabilize soil from erosion. Without the stabilizing vegetation, runoff increases and picks up debris as it moves downslope. Heavy rains on the denuded landscape can lead to rapid development of destructive mudflows. Slope failures are likely to become more frequent as more precipitation falls during fewer storms, particularly as higher temperatures, droughts, and wildfires impact the vegetation that holds soil in place, making it unable to absorb water and decreasing the stability of the slope.

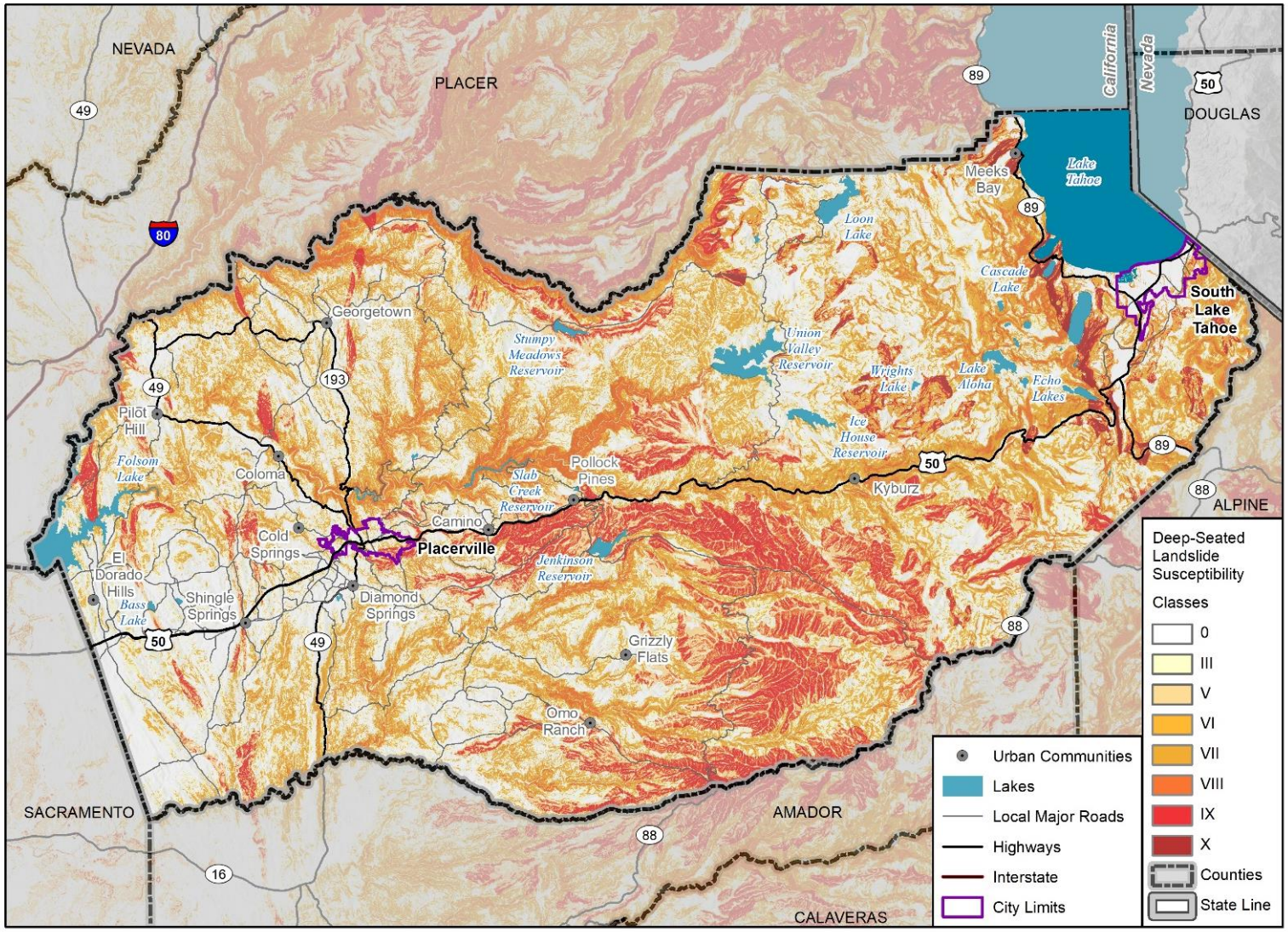
Two debris flows have occurred outside the County, but in neighboring counties. A large debris flow occurred near Topaz Lake in Douglas County, Nevada along a portion of U.S. 395 in May 2018; over 200 people in Topaz Lake Lodge needed to shelter in place on the second floor after mud inundated the first floor. A mudslide also occurred along State Route 89 north of Markleeville in Alpine County in August 2022 following the July 2021 Tamarack Fire; the mud and debris flowed into the road during a severe rainstorm after flowing through the hillsides in the areas affected by the recent wildfire.

Landslides are a natural process and are unavoidable in the long term, due to the patient nature of gravity and the gradual weathering of the earth's surface. Landslides commonly result in disruptions in public services and emergency response, blocked transportation routes, diverted water flow in creeks and drainage ways, and contamination of water supplies. According to the United States Geological Survey (USGS), they cause more than $1 billion dollars in damage annually in the U.S., in addition to 25 and 50 deaths (USGS, n.d.).

There are areas in the County that are particularly prone to debris flows. Slope instability and debris flow hazards are generally found in areas of the eastern portion of the County, as seen in active and inactive landslide deposits. Historical and potential debris flow areas also include Highway 50 east of Pollock Pines and State Route 49 north of Cool. There have also been rock falls and other slope failures along Highway 50 at Echo Summit.

As shown in **Figure 5-32**, the entire County is exposed to landslide hazards with different levels of susceptibility. The southern part of the County has contiguous areas that show high susceptibility to landslide hazards. Several areas in the eastern County near Lake Tahoe show high to extremely high susceptibility. Areas along the northern boundary of the County show medium to high susceptibility. Moreover, a few scattered areas in the western County also show high landslide susceptibility.

Figure 5-32 Deep-Seated Landslide Susceptibility In El Dorado County

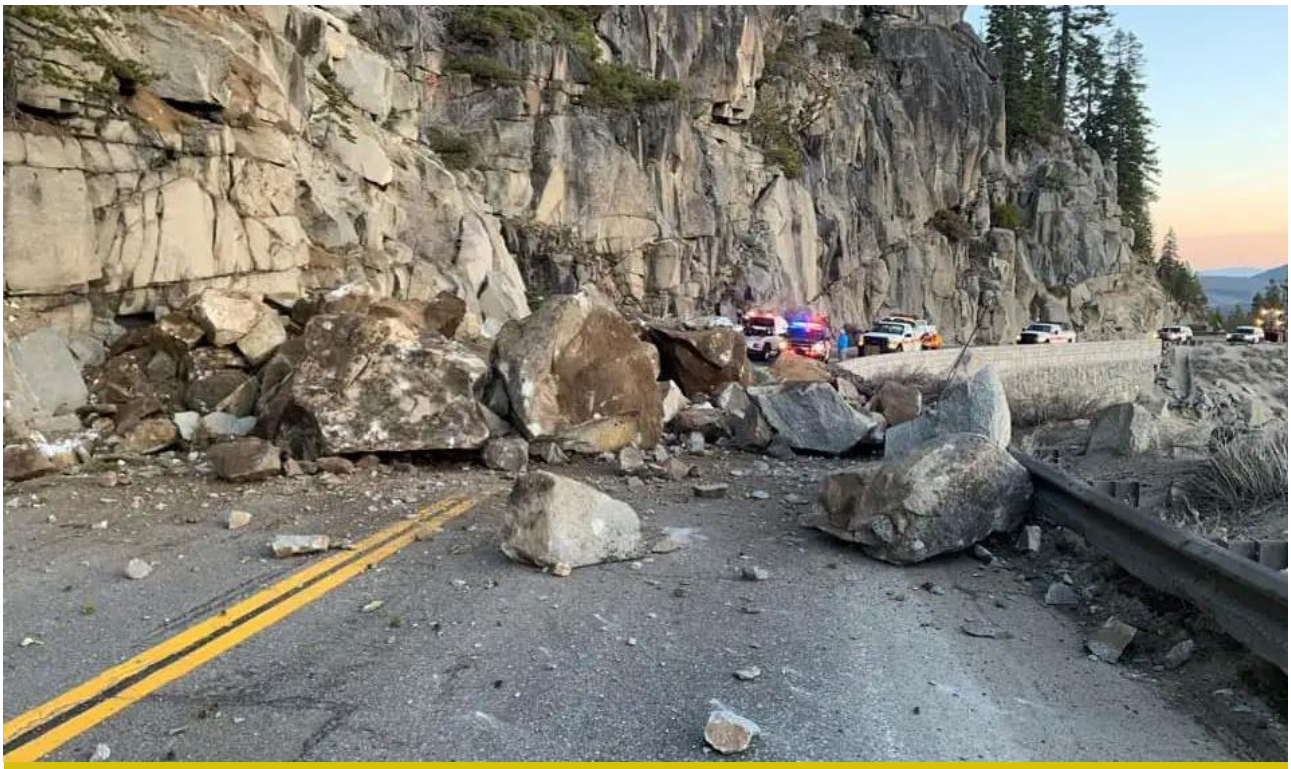


Map compiled 1/2023;
Intended for planning purposes only.
Data Source: El Dorado County, Department of Conservation, California Geological Survey

0 5 10 Miles

N

According to FEMA, there have been seven federal landslides and mudflow disaster declarations associated with severe winter storms, severe storms, and flooding in the County since 1953 (1995 (twice), 1997, 2006 (twice), 2017 and 2019). The California Department of Conservation's Geological Survey keeps a database of reported California Landslides. The County is expected to continue to experience extreme precipitation events and face increased wildfire severity in the future. Variances in precipitation may result in more high-intensity events, including flash flooding and dry-mantle flooding, which may increase landslide frequency. As climate change affects the length of the wildfire season, a higher frequency of large fires may occur in late fall, when conditions remain dry, followed immediately by intense rains early in the winter, increasing the likelihood of landslide and debris flow events.



State Highway 50 along Echo Pass closed in April 2019 after a rockslide occurred and caused a collision.

Photo Credit: El Dorado County Sheriff's Office

Severe Weather: Thunderstorms, Heavy Rain, Lightning, and Hail

Severe weather includes thunderstorms, heavy rain, lightning, and hail. Thunderstorms are formed from a combination of moisture, rapidly rising warm air, and a force capable of lifting air, such as warm and cold fronts or a mountain. Thunderstorms may occur alone, in clusters, or in lines. As a result, several thunderstorms can affect one location in a few hours. A thunderstorm can produce lightning, thunder, and rainfall and may also lead to the formation of tornadoes, hail, downbursts, and microbursts of wind. Electricity can be interrupted by lightning strikes, and property damage can occur if hailstones reach a large diameter. Severe weather is measured by the number of events per year, which is likely to increase because of climate change.

During the summer, climatic factors combine to promote the development of thunderstorms. As heated air from lower elevations rises and rapidly cools, intense thunderstorm cells can develop in high elevation landscapes. These thunderstorms often generate hailstones as large as golf balls. Severe thunderstorms also introduce lightning hazard events.

Hail forms on condensation nuclei such as dust or ice crystals, when supercooled water freezes on contact. In clouds containing large numbers of supercooled water droplets, these ice nuclei grow quickly. Once a hailstone becomes too heavy to be supported by the storm's updraft it falls out of the cloud. Hailstones usually range from the size of a pea to the size of a golf ball. The NWS in Reno issues Severe Thunderstorm Warnings for thunderstorms capable of producing large hail (above 1-inch diameter) and/or high winds (above 58 mph).

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four strokes per flash. The length and duration of each lightning stroke vary but typically average about 30 microseconds. As mentioned above, thunderstorms can form downbursts and microbursts of wind. Downbursts may reach speeds of 125 mph while microbursts are more concentrated and can reach up to 150 mph. Typically, both last five to seven minutes.

Additionally, winter storms produce periods of high winds in the Sierra Nevada. Winds of 40-60 mph that typically precede the snow portion of a winter storm are the most common, starting from late fall through spring. Strong winds are the direct result of large differences in atmospheric pressure from the storm itself and the surrounding environment. Winds can be further enhanced in localized areas on the leeward side of mountain ranges in what is called a downslope windstorm. Wind gusts in these situations can exceed 80 mph, reaching nearly 100 mph in the most extreme cases.

Over 70 years of recordkeeping, 20 hail events and 173 high winds events have occurred in the County, which is the equivalent of one hail event every 3.5 years and 2.5 high wind events every year (NOAA NCEI 2022). Actual risk to the County is dependent on the nature and location of any given hazard event. The most significant secondary hazards associated with severe local storms are flash floods, falling and downed trees, landslides, and downed power lines.

Violent summer thunderstorms can result in localized dry-mantle flash-flooding events that threaten life and property. Landslides occur when heavy and prolonged rains cause soil on slopes to become oversaturated and ultimately fail. Landslides can block roads and affect transportation infrastructure. Lighting strikes can also spark wildfires, while high winds may exacerbate wildfires. High winds in the winter can turn a small amount of snow into a complete white-out and create drifts in roadways. Debris carried by high winds can also result in injury or damage to property.

Severe Weather: Winter Storms and Heavy Snow

Winter snowstorms often originate as systems of low pressure from the Gulf of Alaska that move into the western United States. As the moist air masses push across the Sierra Nevada and Great Basin mountains, the air masses cool and the water condenses as snow. Some winter storms are accompanied by strong winds, creating blizzard conditions, severe drifting, and dangerous wind chills. In some instances, freezing rain may occur when very cold inland arctic air becomes trapped under warm moist air.

Winter storms can produce periods of widespread high winds. These winds of 40-60 mph typically precede the snow portion of a winter storm by a day or so and are most common from late fall through spring. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibility to only a few feet in areas where there are no trees or buildings. Heavy snow can cause avalanches in areas along steep terrain.

Heavy snow can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees, power lines, electrical wires, and communication towers that result in long-term power outages; many of these impacts were evident during the recent snowstorm events in December 2021 and in December 2022 through January 2023. Communications and power may be disrupted for days until the damage can be repaired. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost.

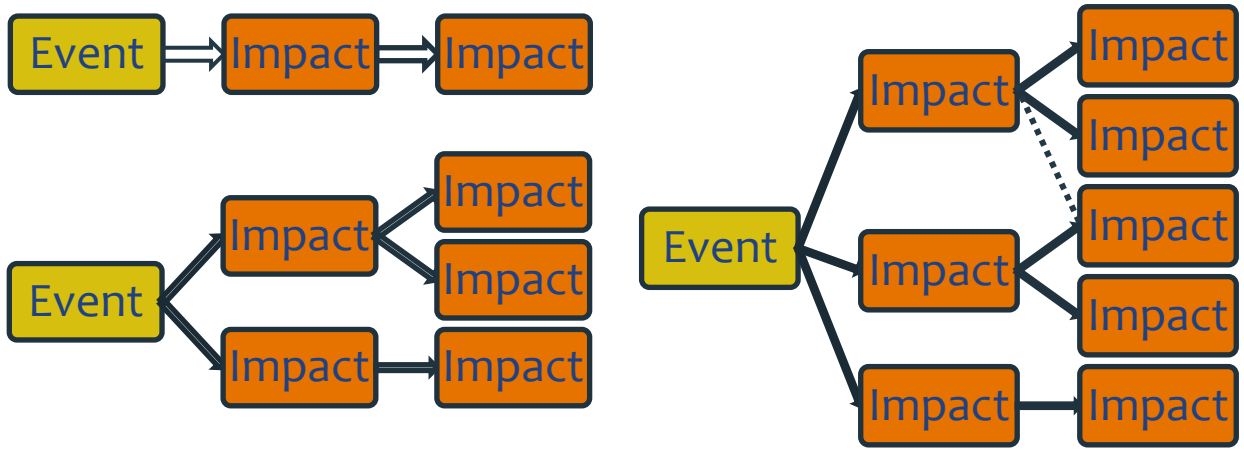
Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. The cost of snow removal, damage repair, and business losses can have a tremendous impact on the County. The County has experienced 25 state emergency declarations from 1950 to 2017 (FEMA 2022). Of the 25, 18 were associated with severe winter storms, heavy rains, or flooding, and one was for a severe freeze event (FEMA 2022). Given this historical data, it is highly likely that both winter storms and heavy snow events will occur in the future.

According to the Cal-Adapt tool, the annual average maximum temperature for the County is expected to increase by 5.4 °F to 8.9 °F by the end-of-century. The annual average minimum temperature is expected to rise by the same values. This will result in less precipitation falling in the form of ice or snow, but increased precipitation falling in the form of rain. This is likely to lead to an increase in rain-on-snow flooding, an event which occurs when heavy snow precedes warm rain, resulting in mass snowmelt and rain runoff. The rapidly melting snow combined with heavy rainfall can overwhelm both natural and manmade drainage systems, causing overflow, localized flooding, and property destruction.

Cascading Impacts

Hazard events rarely happen in isolation. The increasing interdependence of systems of modern life, on both a local and global scale, can cause a chain of impacts beyond the scope of the original event. Intense rainfall can trigger landslides that dam rivers and cause catastrophic flooding. Flooding could then wash out evacuation routes and down electrical systems. Without electricity, all forms of mass communication become inoperable, cutting people off from crucial information when they need it most. Such chains of events are referred to as "cascading impacts," or "cascading disasters," and these subsequent impacts have the capacity to cause more destruction than the original hazard event. **Figure 5-33** illustrates examples of cascading impacts.

Figure 5-33 Examples of Cascading Impact Structures



Source: Adapted from Pescaroli and Alexander, 2019

Natural Examples

The water-year 2021 was the second driest on California record. Extreme heat, lack of snowfall, and lack of rain parched the overgrown and thick vegetation in the Eldorado National Forest and the Sierra Nevada. Vegetation weakened by the environmental conditions withered or were left susceptible to further damage from pests and disease. A small fire that started just south of Grizzly Flats on August 14, 2021, became the Caldor Fire, the 16th largest fire to date in California that expanded across three counties and burned over 221,000 acres (CAL FIRE 2022b). Damages to structures and properties are obvious impacts, though cascading effects on the economic sectors include road closures due to direct damages, downed trees, or

other hazards, lower revenue to the County based on reduced tourism and visitation, and excessive costs of firefighting and relocating people or natural and manmade resources. Table 5-4 lists examples of cascading hazard impacts in the County by climate stressor.

Table 5-4 Cascading Hazard Impacts in the County of El Dorado

Secondary Climate Stressor	Cascading Hazard Impacts
Agricultural Pests and Disease	• Weakens trees and agricultural crops • Causes more susceptibility to extreme heat, prolonged drought, and wildfire
Avalanche	• Results in loss of vegetation that stabilize the slopes and greater likelihood of surface water runoff during spring and summer months
Drought and Water Supply	• Dries out vegetation, which increases natural fuel for wildfire • Degrades water quality
Extreme Heat	• Increases evaporation and evapotranspiration rates, which dries out vegetation, increasing wildfire risk • Makes crops and livestock more susceptible to agricultural pests and disease • Results in cardiovascular and respiratory disease in sensitive populations • Places higher demand on electricity-generating equipment, which increases the potential for intentional or unintentional planned power outages (PSPS events) in the summer months
Flooding	• Increases in intense precipitation can trigger cascading flood hazards along waterways causing impacts to neighborhoods and loss of crops • Impacts sensitive populations with lower-income households being displaced from their homes
High Wind	• Spread wildfires and increase their intensity • Results in PSPS events to reduce the risk of wildfires caused by energized powerlines
Human Health Hazards	• Impacts the economy if people are unable to perform their jobs
Landslide and Debris Flows	• Alters waterways or drainage areas and basins, which can lead to flood risk in new locations
Severe Weather	• Causes flooding • Ignites wildfires • Spreads wildfires and increase their severity
Wildfire	• Burns vegetation and forests in mountains areas and rolling hillsides, and the lack of vegetation destabilizes the slopes and contributes to landslides or post-fire debris flows and flooding

Source: WSP Analysis 2023

Energy Shortages

Energy shortage hazards can include energy disruptions related to electricity, renewable energy, natural gas, and gasoline and diesel fuels. Based on the energy types, electrical power outages, both planned and unscheduled disruptions, can result in cascading hazards related to traffic, economic losses, other utility

disruptions, and public health hazards. There are few areas of modern life that are not impacted by electrical failure. Tap water, sewage plants, cellphone and internet infrastructure, are all dependent on electricity. A major hazard event that damages infrastructure and electrical systems will present compounding problems as a lack of electricity will impede restoration efforts. Electricity-dependent individuals will be at elevated risk until electricity is returned.

Energy shortages, specifically PSPS, are unpredictable but recurrent experiences in the County. Each of these events can result in a range of cascading impacts on local businesses and the continuity of operations in the County. Businesses can no longer use cash registers or process payment transactions. Gasoline pumps no longer operate, limiting accessibility for travelers and visitors. Restaurants may close because kitchen appliances and other equipment, such as lighting, cannot work without power. Hotels may also have limited accommodations due to lack of heating supplies, lighting, and other needs. These impacts indirectly lead to economic losses in the commerce, tourism, and recreation industries in the County.

Post Wildfire Recovery

Wildfires create short, long, and cumulative impacts to ecosystems, communities, and individuals. Recent studies have summarized some of these impacts (Western Forest Leadership Coalition 2022). Beyond the dollar cost of large wildfires, local county and community support organizations can be overwhelmed by the wildfire recovery process. Preparing for a major wildfire may include the need to review existing county policies and procedures which may impede post wildfire recovery. These include current building permit procedures, accessory dwelling unit laws, temporary residence (trailer) locations, and rules governing inhabiting burned properties after post wildfire debris removal is completed but before and during home rebuilding. In addition, having a plan to address large numbers of persons becoming homeless in a short period is critical. This includes sheltering and caring for the post-wildfire physical, emotional, and mental health issues for at-risk populations, seniors, and children. Finally post-wildfire vegetation recovery strategies that facilitate long term resiliency, particularly in the Wildland Urban Interface, are key for long term sustained recovery.

In August 2021, the Caldor Fire burned through the Sierra at Tahoe Resort in the County and destroyed and damaged approximately 1,600 acres of the 2,000-acre ski resort. Lift towers, haul ropes, terrain parks, snowcats, a maintenance building, and other infrastructure were destroyed. Beginning in 2022 agencies, organization, and volunteer partners came together to begin the process of restoring the forests and ski facilities and during the first phase, over 14,000 fire damaged trees were removed. The resort re-opened for the 2022/2023 season after being closed due to the damage sustained by the Caldor Fire.

Photo Credit: Sierra at Tahoe; Brian Walker 2022.

6. County Population and Assets

The County's key assets were organized into five categories: property, populations, critical facilities and lifelines, natural and cultural resources, and economic drivers. These five categories generally align with the four focus categories the County uses to organizes critical facilities: essential service, population at risk, infrastructure at risk, and essential business.

The property dataset consists of 2022 County Assessor data. Sensitive population data came from a variety of federal and state datasets, primarily the U.S. Census ACS. The critical facility database was developed with the County's GIS team and involved an internal validation process to refine the types of facilities included and to confirm the accuracy of the locations of the point data. Natural and cultural resource data was illustrated spatially in maps but did not include a quantitative dataset or analysis. Similarly, the data on economic drivers was summarized based on a qualitative understanding of essential businesses and economic impacts that could occur because of climate-related hazards. In total, the CVA evaluated vulnerabilities for the following key assets:

- 88,437 improved parcels,
- 20 sensitive population indicators, and
- 1,274 critical facility and infrastructure lifelines.

Natural and cultural resources and economic drivers and other key services in the County are assessed qualitatively but included specific resource categories and economic sectors.

A. Property

Building value assessments in the CVA are based on data from the County's Assessor's Office. This data provided the baseline for an inventory of the total exposure of developed properties within the County and helps to ensure that the CVA reflects the vulnerability of existing development and changes in development patterns and potential future development vulnerability. It is important to note that depending on the nature and type of hazard event or disaster, it is generally the value of the infrastructure or improvements to the parcels (properties) that are of concern or at risk. Generally, the land itself is not a total loss, but may see a reduction in value. Thus, the parcel analysis excludes land value.

The 2022 El Dorado County Assessor data was used to inventory the total number and types of parcels with improvements, defined as parcels with an improvement value greater than zero in the County. Building content values are defined by FEMA as furniture, equipment, computers, and other supplies and non-structural components like lights and mechanical and electrical equipment that are not integral to a structure (FEMA 2022). These values were estimated based on methods and formulas developed by FEMA: a) Residential, including Multi-Family Residential and Mobile Home Park properties received content values worth 50% of the improved values; b) Commercial, Miscellaneous, Unassessed properties received content values worth 100% of the improved values; and c) Industrial properties received content values worth 150% of the improved values.[1] Adding up these content and original improved values yields the Total Value of Improved Parcels, which is an estimation of the total property exposure within the County. Since the CVA focuses on the vulnerability of the unincorporated County, the parcels within the cities of Placerville and South Lake Tahoe are excluded. **Table 6-1** summarizes the property inventory for the unincorporated County with detail by property type.

[1] The parcel-level analysis was conducted according to flood loss and earthquake loss estimation methodology developed by FEMA and summarized in the Hazus 5.1 Flood and Earthquake Model Technical Manuals. A companion document, the Hazus Inventory Technical Manual provides additional methodology and data descriptions.

Table 6-1 Total Unincorporated Area Exposure Summary by Property Type Jurisdiction

Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
Commercial	1,064	$632,111,386	$632,111,386	$1,264,222,772
Industrial	1,176	$717,611,990	$1,076,417,985	$1,794,029,975
Multi-Family Residential	546	$499,699,938	$249,849,969	$749,549,907
Mobile Home Park	48	$47,256,698	$23,628,349	$70,885,047
Miscellaneous	2,896	$175,478,813	$175,478,813	$350,957,626
Residential	80,986	$20,629,099,188	$10,314,549,594	$30,943,648,782
Unassessed	1,721	$19,195,651	$19,195,651	$38,391,302
Total	88,437	$22,720,453,664	$12,491,231,747	$35,211,685,411

Source: El Dorado County Assessor's Office, WSP Analysis

B. Sensitive Populations

Most of the demographic data on populations in the County comes from the U.S. Census Bureau's ACS. This data represents residents or households in the County, but in some cases, may not include all people living in the County. There are also data limitations given the population statistics only count certain population groups where credible data sources are available, and this may not account for undocumented persons in the County and other socially vulnerable groups.

Of the total population, the unincorporated areas of the County comprises several sensitive populations and communities that include people or households who experience heightened risk and increased sensitivity to climate change. These people or households may need additional resources to prepare for, respond to, cope with, adapt to, and recover from climate-related hazards. They may live in rural parts of the unincorporated County, have low-incomes or are "income restrained," be housing cost burdened (defined by the U.S. Housing and Urban Development as spending more than 30% of total income on housing), experience chronic health conditions, or live alone.

Sensitive populations may include groups based on age that are more vulnerable to climate-related hazards. They may also include groups with chronic health conditions, access and functional needs, and households in mobile homes, poverty, or located in rural and isolated areas. Many of these sensitive populations have characteristics that also fall into multiple indicator categories. The core County team evaluated each population group, indicator, and definition based on information from the U.S. Census Bureau, and other federal and state resources applicable to the County. The following 20 sensitive populations listed in alphabetical order by indicator were identified by the SEAC and are addressed in the CVA:

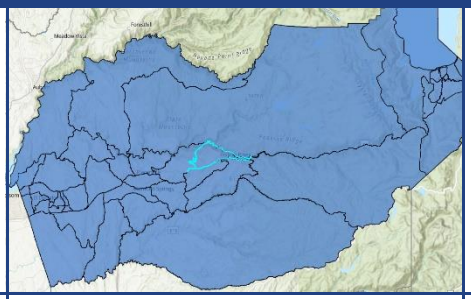
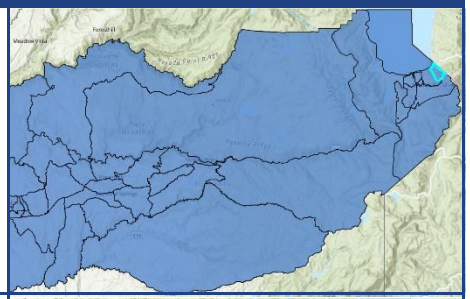
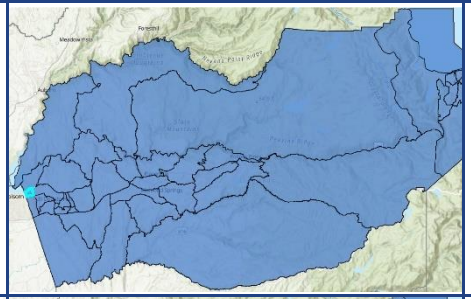
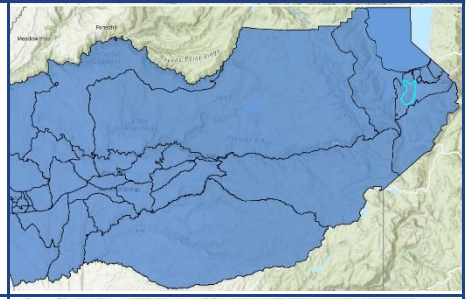
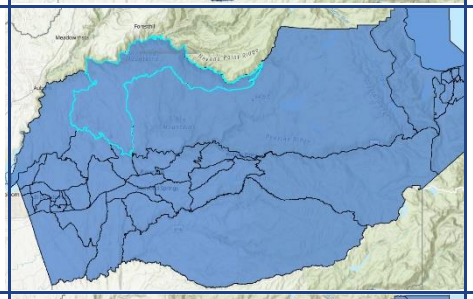
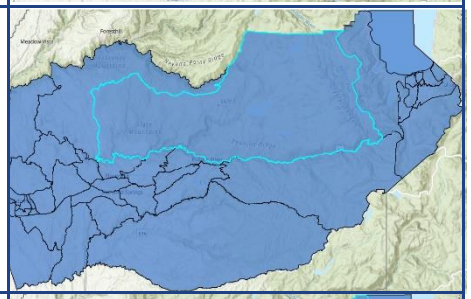
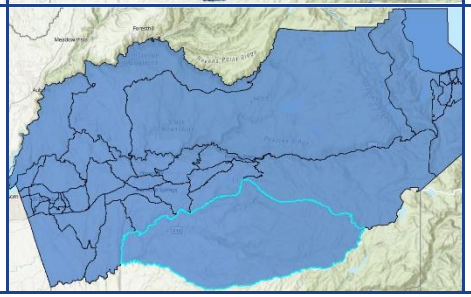
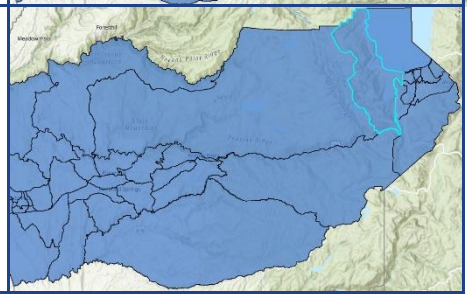
- Children (under 14)
- Cost-burdened households
- Ethnic minorities
- High-pollution burdened communities
- Households in mobile homes
- Households in poverty
- Persons with disabilities and access and functional needs
- Persons with limited English proficiency (linguistically isolated)
- Persons with limited accessibility (no access to transportation)

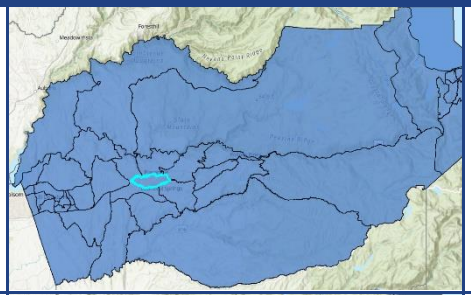
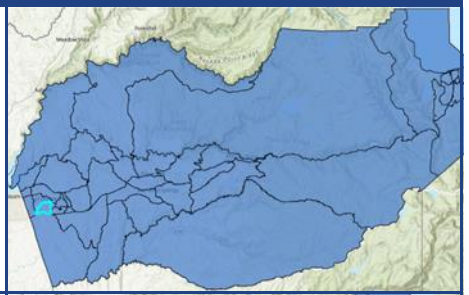
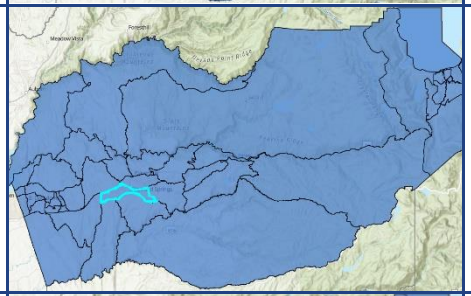
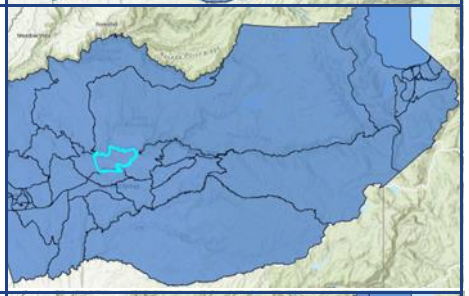
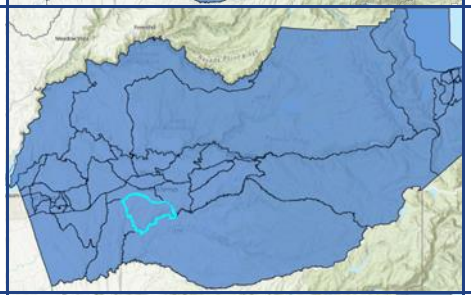
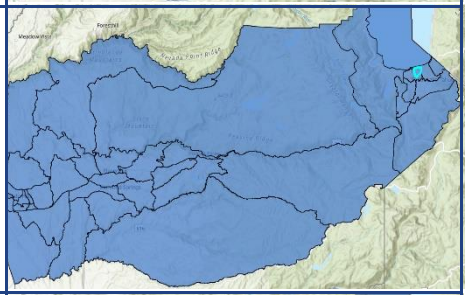
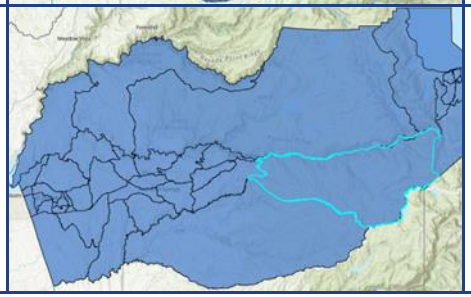
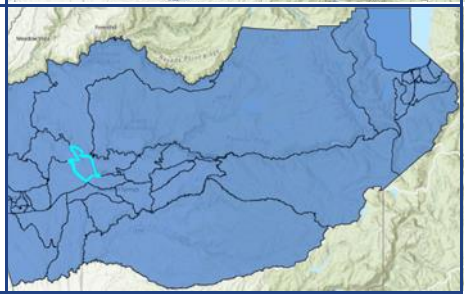
- Isolated and rural communities
- Low-income households
- Outdoor workers
- Overcrowded households
- People with chronic health conditions
- Unemployed persons
- Persons experiencing homelessness
- Persons living in single-access roads (limited roads for evacuation)
- Renters
- Seniors
- Seniors living alone

Each indicator has been reviewed by the County and SEAC to determine what types of sensitive populations would experience non-climate stressors that would make them more vulnerable to climate-related hazards. The team reviewed U.S. Census data from the 5-Year ACS, the FEMA NRI SoVI Tool, the OEHHA CalEnviroScreen 4.0 mapping tool, and the California HPI to determine which sensitive populations exist in the County. Findings were also supplemented with data from the Climate and Economic Justice Screening Tool.

Table 6-2 shows 16 of the 42 census tracts in the County with the highest concentrations of sensitive populations and social vulnerability in both the incorporated and unincorporated County. These are census tracts defined as socially vulnerable based on their occurrence in both the U.S. Census Bureau ACS and other sources and tools (described in the next section). Some of the census tracts overlap with incorporated areas like the cities of Placerville and South Lake Tahoe and were therefore included here given the high number of disadvantaged and socially vulnerable communities in these areas.

Table 6-2 Vulnerable Census Tracts in El Dorado County

Census Tract Number and Location Description	Census Tract on Map	Census Tract Number and Location Description	Census Tract on Map
6017031302 West of Pollock Pines		6017031600 Northeastern part of South Lake Tahoe but extends north and south beyond the City Limits	
6017031700 **Near El Dorado Hills**		6017030402 Southern part of South Lake Tahoe, extends west beyond the City Limits	
6017030602 North County		6017030603 Significant portion of the Northern County	
6017031402 Southern County, includes both Grizzly Flats and Omo Ranch		6017030200 South Lake Tahoe, extends east and west beyond the City Limits	

Census Tract Number and Location Description	Census Tract on Map	Census Tract Number and Location Description	Census Tract on Map
6017031200 Southern portion of Placerville, extends beyond the City Limits		6017031800 Near El Dorado Hills	
6017031502 South of Placerville and north of Diamond Springs		6017031100 North part of Placerville	
6017031504 South and Southeast of Diamond Springs		6017030302 South Lake Tahoe	
6017031900 South of Kyburz		6017031000 Western Placerville, extends north and northwest beyond the City Limits	

Sources: US Census ACS 2020, WSP Analysis

C. Critical Facilities

A detailed critical facilities and community lifeline database that includes 1,274 facilities was developed in GIS based on a combination of County-provided data, HIFLD, and local and jurisdiction-specific input. The County's GIS Department was then able to review and validate the critical facility data, edit descriptive attributes, address information, and add new critical facilities. The critical facilities database was organized by County asset categories (focus areas) and by FEMA Community Lifeline (where appropriate). For the purposes of the CVA, a critical facility is defined as a building structure, infrastructure, or system that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. The County organizes critical facilities into four categories (focus areas): essential service, population at risk, infrastructure at risk, and essential business, as shown in Table 6-3.

Table 6-3 County of El Dorado Facility Type Categories

Facility Type	Essential Service	Population at Risk	Infrastructure at Risk	Essential Business
Fire Station	X			
Police Station	X			
Emergency Evacuation Shelter*	X			
Government Facilities	X			
General Acute Care Hospital	X			
Medical Health Facility		X		
Adult Residential Care Facility		X		
Child Care Facility		X		
Adult Care Facility		X		
Public Elementary School		X		
Private Elementary School		X		
Public Middle School		X		
Private Middle School		X		
Public High School		X		
Private High School		X		
College / University		X		
Vulnerable Population Centers**		X		
Water Treatment Plant			X	
Water Storage Facility			X	
Water Conveyance System			X	
Electrical Transmission Lines			X	
Electrical Substation			X	
Sewer Lift Station			X	

Facility Type	Essential Service	Population at Risk	Infrastructure at Risk	Essential Business
Telecommunications Facilities			X	
Corporation Yard	X			
Vehicle Fuel Stations				X
Grocery Stores				X
Recreational Facilities				X
Large Employers				X

Source: County of El Dorado 2022
* Includes General Population, Access/Functional Needs Shelters and Animal Shelters
** Includes Disadvantaged, Disabled and Low-Income Census Areas

FEMA sorts critical facilities into seven lifeline categories as shown in **Figure 6-1**. These lifeline categories standardize the classification of critical facilities and infrastructure that provide indispensable service, operation, or function to a community. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security. These categorizations are particularly useful as they:

- Enable effort consolidations between government and other organizations (e.g., infrastructure owners and operators);
- Enable integration of preparedness efforts among plans, easier identification of unmet critical facility needs;
- Refine sources and products to enhance awareness, capability gaps, and progress towards stabilization;
- Enhance communication amongst critical entities, while enabling complex interdependencies between government assets; and
- Highlight lifeline related priority areas regarding general operations and response efforts.

Figure 6-1 Lifeline Categories

Source: FEMA 2020

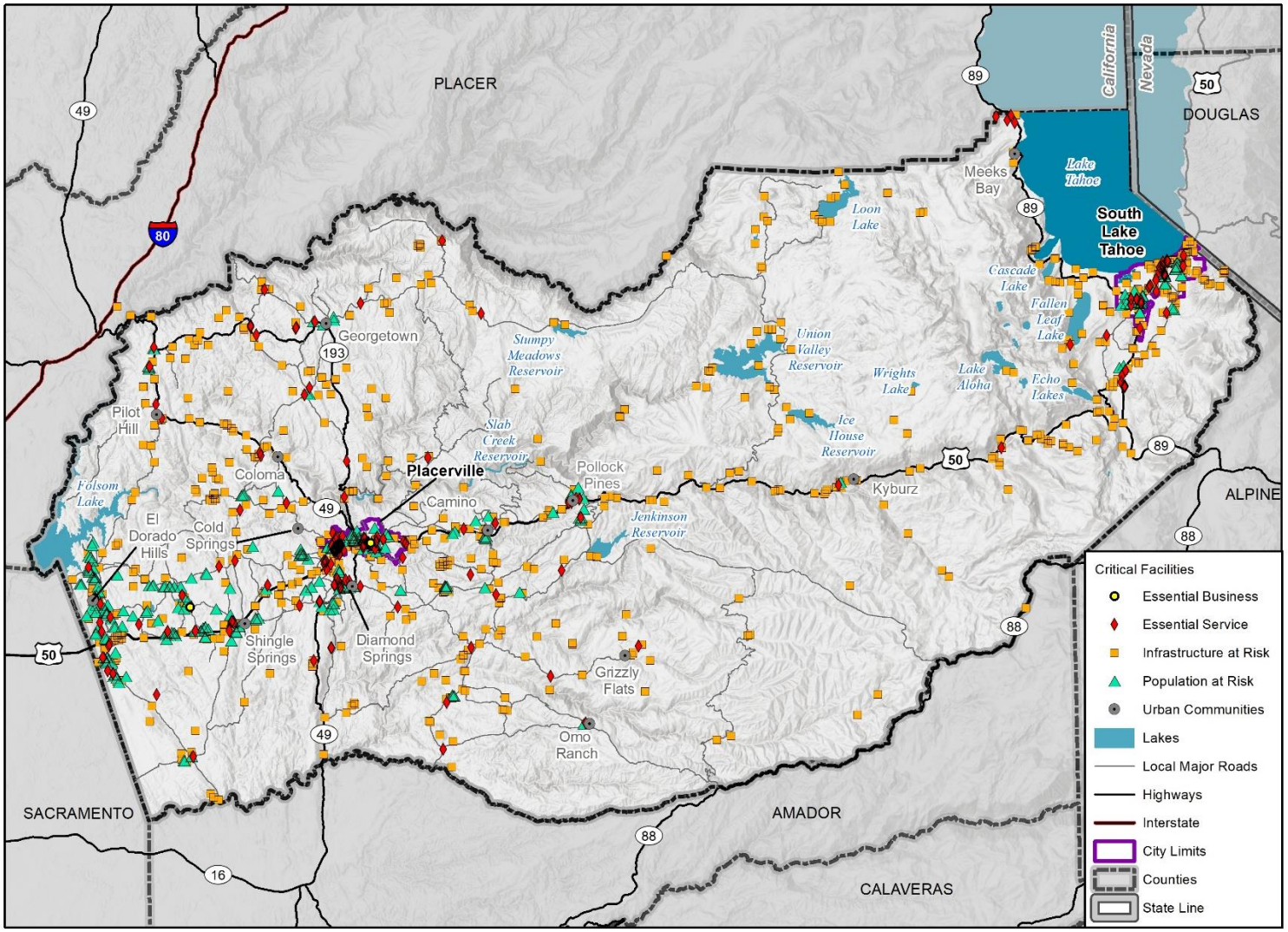
Table 6-4 shows a summary of the critical facilities inventory grouped by focus areas. **Figure 6-2** shows the locations of the critical facilities across the County.

Table 6-4 Summary of Critical Facilities by Focus Area

Jurisdiction	Essential Service	Population at Risk	Infrastructure at Risk	Essential Business	Total
City of Placerville	1	93	24	60	178
City of South Lake Tahoe	0	47	62	40	149
Unincorporated County	2	118	612	215	947
Total	3	258	698	315	1,274

Sources: HIFLD, National Inventory of Dams (NID), DWR, and the County

Figure 6-2 Critical Facilities in the County of El Dorado



Key facilities included key safety and security facilities and lifelines, specifically County fire and police stations and Emergency Operation Centers. Other essential food, water, and shelter services included community facilities like emergency shelters, water and wastewater treatment plans and related infrastructure, and regional parks. Health and medical facilities included hospitals, medical clinics, and health centers. Essential services related to energy included stationary and point data for electrical substations, electric vehicle charging stations, and power plants; linear electrical transmission and distribution line infrastructure was not included, nor were natural gas pipelines. Essential businesses like gas station locations were also not included, primarily to focus the assessment on specific facilities that served populations at risk and to facilitate adaptation strategy and mitigation project development. Transportation facilities included major airports, railways, and bridges, but did not include State and County highways and roads. Some of these linear facilities are also already being addressed by the power utilities, Caltrans, and the EDCTC. Finally, hazardous material facilities primarily include facilities that store, handle, or transport major hazardous materials, specifically those facilities that operate under a Risk Management Program (RMP) and Tier II facilities that must report the amount of hazardous chemicals used at the facility as defined by 29 CFR 1910.1201).

D. Natural and Cultural Resources

Natural and cultural resources generally include farms and vineyards; agricultural lands; federal, state, and local recreation lands; private timberlands; ski resorts; and large water infrastructure, like reservoirs used for recreation purposes.

Assessing the County's vulnerability to disaster also involves inventorying the natural, historical, and cultural assets of the area. This step is important for the following reasons.

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- In the event of a disaster, an accurate inventory of natural, historical, and cultural resources allows for more prudent care in the disaster's immediate aftermath when the potential for additional impacts is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards. For example, wetlands and riparian habitat help absorb and attenuate floodwaters and thus, support overall mitigation objectives.

Historical resources are buildings, structures, objects, places, and areas that are eligible for listing in the National Register of Historic Places (NRHP), the California Register of Historic Resources (CRHR), or the County's List of Historic Resources; have an association with important persons, events in history, or cultural heritage; or have distinctive design or construction method.

For purpose of federal actions, a qualified historic resource is defined as a property listed in or formally determined eligible for listing in the NRHP before a disaster occurs. The NRHP is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archaeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. The National Register is administered by the U.S. Department of the Interior, National Park Service. Local and state agencies may consider a broader definition of qualified historic properties in the review, evaluation, and treatment of properties damaged during a disaster.

The State of California Office of Historic Preservation can provide technical rehabilitation and preservation services for historic properties affected by a natural disaster. Depending on the hazard, protection could range from emergency preparedness, developing a fire safe zone around sites susceptible to wildfires, or

seismically strengthening or structurally reinforcing structures.

State and local registers of historic resources provide designated Historical Landmarks, Points of Historical Interest, and Historic Buildings. These resources include, but are not limited to:

- The California Register of Historical Resources,
- The California Historical Landmarks,
- The California Inventory of Historical Resources, and
- The California Points of Historical Interest.

Historical Landmarks designated on a federal or state level are listed in **Table 6-5**.

Table 6-5 El Dorado County Historical Resources

Register	Location	Property Name
National Historic Landmarks	Cedar Grove	Sportsman's Hall Overland Pony Express Route in California
	Clarksville	Mormon Tavern-Overland Pony Express Route in California
	Coloma	Marshall Monument
		Gold Discovery Site
		Coloma Road-Coloma
		Coloma Road-Rescue
	Diamond Springs	Diamond Springs
	El Dorado	El Dorado (Originally Mud Springs)
	El Dorado	El Dorado-Nevada House (Mud Springs) -Overland Pony Express Route in California
	3 miles NE of Folsom	Mormon Island
	4 miles NE of Folsom	Negro Hill
	0.1 miles NE of El Dorado-Sacramento County Line	Salmon Falls
	0.1 miles NE of El Dorado-Sacramento County Line	Condemned Bar
	Georgetown	Georgetown
	Gold Hill	Wakamatsu Tea And Silk Farm Colony
	Greenwood	Greenwood
	Kelsey	Marshall's Blacksmith Shop
	Kyburz	Mores (Riverton)-Overland Pony Express Route in California
		Websters (Sugar Loaf House)-Overland Pony Express Route in California
		Strawberry Valley House-Overland Pony Express Route in California
	Meyers	Hanks Station-Overland Pony Express Route in California
	Pilot Hill	Site of California's First Grange Hall
	Placerville	Hangman's Tree
		Studebakers Shop
		Old Dry Diggins-Old Hangtown-Placerville

Register	Location	Property Name
		Placerville-Overland Pony Express Route In California
		Methodist Episcopal Church
	Rescue	Pleasant Grove House Overland Pony Express Route In California
		Coloma Road-Rescue
	Shingle Springs	Shingle Springs
	South Lake Tahoe	Site of Echo Summit
National Park Service National Historic Landmarks	Coloma	Coloma

Sources: California Office of Historic Preservation, National Park Service National Historic Landmarks

Lists of designated historical resources change periodically, and they may not include those currently in the nomination process and not yet listed. Additionally, as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, if the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Cultural resources defined in California Environmental Quality Act (CEQA) Section 15064.5 include prehistoric and historic archaeological resources and historic-period resources (buildings, structures, area, place, or objects). Archaeological resources reflect past human activity extending from Native American prehistoric cultures through the early 20th century. Many cultural and historical resources in the County are vulnerable to several hazards due to location and the nature of their construction. Some of these risks include earthquakes, wildfires, or adverse weather.

E. Economic Services

The economic drivers consist of essential businesses in the County. These drivers are discussed qualitatively based on how they would be potentially impacted by climate-related hazards. Primary economic drivers in the County include the agricultural economy, forestry products, retail and hospitality industry, tourism, and recreation-based economy.

View of residential development in the El Dorado Hills community.

Photo credit: Stephen Leonardi

7. Vulnerability Assessment

A. Community Assets

As a starting point for analyzing the County's vulnerability to identified hazards, the SEAC used a variety of data to define a baseline against which all climate-related impacts could be compared. If a catastrophic disaster or ongoing climate shocks and stressors were to occur over time in the County, this section describes significant assets exposed or at risk in the planning area. Data used in this baseline assessment included:

- Total parcel assets at risk;
- Sensitive populations at risk;
- Critical facility inventory;
- Cultural and natural resources; and
- Economic services.

Several of these assets represent similar County vulnerabilities, specifically for sensitive and underserved people living and working in the County. For example, sensitive populations are assessed based on the location of census tracts in the County. Sensitive populations' homes and properties are also assessed as part of a parcel-level analysis. Similarly, critical facilities are assessed based on whether the buildings or infrastructure could be exposed to and damaged by climate-related hazards. Critical facilities are also assessed based on the services they provide. For example, a fire station would be directly impacted by a wildfire, and the emergency response and fire suppression services would also be disrupted.

These effects are described separated in the following section because climate change affects property, population, and critical facilities differently. These different types of effects may be evident during a wildfire that results in damaged water line infrastructure in a rural area. If there is a temporary disruption in water delivery systems, this would have a significant impact on a rural community, particularly if there are no redundant back-up water supplies. However, the temporary loss of water deliveries to a rural community would not directly impact the other critical facilities, as there would be no physical damage related to infrastructure like a water treatment plant.

B. Non-Climate Stressors

Non-climate stressors refer to conditions that are not related to climate change but can still have an impact on a community and make certain groups more vulnerable. These stressors can include factors such as poverty, limited access to transportation, language barriers, and other societal inequalities. Non-climate stressors can be problematic because they increase the vulnerability of already sensitive populations to climate-related hazards, which can further decrease their ability to prepare for, respond to, and recover from these hazards. For example, a low-income community with limited access to transportation may have a harder time evacuating before a wildfire or accessing emergency services in the aftermath of a flood.

In many cases, the same indicators used to define sensitive populations are also used to identify non-climate stressors. These indicators can include poverty, income level, educational level, burdened households, language barriers, age, persons with access and functional needs, disabilities, and health conditions. When these non-climate stressors are combined, they can further increase the sensitivity of a population and decrease their adaptive capacity to climate change. Non-climate stressors can include the following factors:

- Education attainment
- Language barrier
- Income status
- Housing affordability
- Limited community resources
- Unreliable electrical supply

- Lack of accessibility
- Disability
- Citizenship
- Access to healthcare and resources

In summary, the non-climate stressors can have the greatest impact on sensitive populations, as the factors define several of the same characteristics that make certain socially vulnerable and underrepresented populations more susceptible to climate-related hazards. These institutional and social factors create and contribute to many of these disparities and inequities, and climate change hazards will likely worsen these effects.

Critical facilities, such as buildings and infrastructure, face non-climate stressors due to the need for operation and maintenance upgrades, improvements, and rehabilitation beyond the expected lifespan of a facility. The absence of timely retrofits, repairs, and routine upgrades may be due to a lack of funding or financial capability. Without these timely upgrades and improvements, these buildings and infrastructure may experience greater climate change effects. This is problematic in rural areas of the County where there are limited community resources, and where water supplies lack alternatives if a water supply line is disrupted. Key services are also dependent on critical facilities. For example, water supply must be delivered through an underground water system, and electrical supply is delivered through the energy grid. Other services heavily dependent on infrastructure include services delivered by air, road, or water transportation.

Natural and cultural resources can also be affected by non-climate stressors related to development patterns that result in impacts to habitat, plant and wildlife, and water and air quality. These human-influenced impacts can in turn affect the ability of these natural resources to provide ecosystem services and the resiliency of natural resources to the effects of climate change.

The County's economic health depends on thriving industries (e.g., recreation; agriculture, orchards, and wineries; and tourism) and healthy residents and workers. Many of these services rely on access to healthy forests and land, clean water and air quality, and healthy people. Therefore, impacts to any of these resources or the neighborhoods where the County's employees and staff reside following a severe storm, flood, wildfire, or other event can severely impact the viability of community businesses and services.

C. Key Vulnerabilities by Asset Type

The CVA looked at the impacts and adaptive capacity of property, sensitive populations, critical facilities, natural and cultural resources, and economic assets in the County for the following climate-related hazards:

- Agriculture Pests and Disease
- Avalanche
- Drought and Water Supply
- Extreme Heat
- Flooding
- Public Health Hazards
- Landslide and Debris Flows
- Severe Weather
- Wildfire

Severe weather includes high wind; thunderstorms, heavy rain, lightning, and hail; and winter weather and heavy snow for purposes of the assessment.

Vulnerability scores summarized the combination of the impact and adaptive capacity to show the level of susceptibility of each asset to the exposure to the nine climate-related hazards based on the methodology outlined in the California APG. These scores were assigned on a scale of 1 to 5 and adjusted for the risk and onset of the exposure based on a combination of a quantitative and qualitative analysis. The quantitative analysis consisted of GIS analysis for flood, landslide and debris flow, and wildfire risk. The qualitative analysis consisted of a series of questions selected to assess the sensitivity and potential impacts of climate-related hazards (see Section 4). The scores reflect how susceptible the asset category is to the harm posed by climate change. Assets are grouped by property; 20 sensitive population indicators; and 4 critical facility category types. Vulnerability scores are assigned to 1,098 combinations of exposures and

sensitivities to climate change. Scores were not provided if the exposure was not considered a threat to the asset. Table 7-1 illustrates the five vulnerability scores:

Table 7-1 Vulnerability Scores

Score	Vulnerability Type
V1	Minimal Vulnerability
V2	Low Vulnerability
V3	Moderate Vulnerability
V4	High Vulnerability
V5	Severe Vulnerability

Source: APG 2021

A score of V4 or V5 is considered significant. Assets that score at least a V4 for one or more exposures are considered vulnerable. The summaries in the CVA focus only on scores of at least V4 or above. The vulnerability scores are organized for each asset category except property. The properties in the County were assessed using a parcel-level analysis, as described in the first section below.

Property

Flood Hazards

El Dorado County Assessor parcel data was used to estimate flood hazard impacts to parcels with improvement values greater than zero. This method assumes that improved parcels have a structure of some type. FEMA's NFHL flood zones were overlaid in GIS on the parcel boundaries to identify parcels that would likely be inundated during a 1% annual chance and 0.2% annual chance flood event. Building improvement values and counts for those parcels were then extracted from the parcel/assessor's data and summed for the unincorporated County. Results of the overlay analysis area are shown in Table 7-2 for the 1% annual chance flood and Table 7-3 for 0.2% annual chance flood.

Property type refers to the land use of the parcel and includes Commercial, Industrial, Multi-Family Residential, Mobile Home Park, Miscellaneous, Residential, and Unassessed. Contents values were estimated as a percentage of improved values based on their occupancy type, using FEMA/Hazus estimated content replacement values. This includes 100% of the improved value for commercial, miscellaneous, and unassessed parcels; 50% for multi-family residential, mobile homes parks and residential parcels; and 150% for industrial parcels. Building and contents values were then totalled to obtain total exposure. In addition, populations that are at risk of flood hazards are estimated by multiplying the average number of persons per household in the County (2.54) with the number of residential, multi-family residential and mobile home park parcels in floodplain areas. The populations at risk are also included in Table 7-2 and Table 7-3.

Table 7-2 1% Annual Chance Floodplain Exposure and Loss by Jurisdiction

Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Population
Commercial	18	$3,670,832	$3,670,832	$7,341,664	-
Industrial	10	$3,846,739	$5,770,109	$9,616,848	-
Multi-Family Residential	17	$9,823,139	$4,911,570	$14,734,709	43

Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Population
Mobile Home Park	2	$457,591	$228,796	$686,387	5
Miscellaneous	105	$12,147,941	$12,147,941	$24,295,882	-
Residential	1,719	$285,012,765	$142,506,383	$427,519,148	4,366
Unassessed	171	$444,378	$444,378	$888,756	-
Total	2,042	$315,403,385	$169,680,007	$485,083,392	4,415

Sources: County of El Dorado 2020; WSP Analysis 2022

Table 7-3 0.2% Annual Chance Floodplain Exposure and Loss by Jurisdiction

Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Population
Multi-Family Residential	2	$663,497	$331,749	$995,246	5
Miscellaneous	2	$-	$-	$-	
Residential	79	$9,821,254	$4,910,627	$14,731,881	201
Total	83	$10,484,751	$5,242,376	$15,727,127	206

Sources: County of El Dorado 2020; WSP Analysis 2022

It is important to note that there could be more than one structure or building on an improved parcel (i.e., a condo complex occupies one parcel but might have several structures). The flood loss assessment also does not account for business disruption, emergency services, environmental damages, or displacement costs; thus, actual losses could exceed the estimate shown. Conversely, this analysis does not differentiate parcels that may have been developed since the County adopted floodplain regulations, which would be mitigated to the 1% annual chance flood if developed in accordance with local floodplain regulations.

As shown, a total of 2,042 parcels, worth over $485 million, along with 4,415 people, are located within 1% annual chance floodplains. A total of 83 parcels, worth over $15.7 million, along with 206 people, are located within 0.2% annual chance floodplains. Also, of the 2,042 parcels in the floodplain, 1,719 are single-family residential structures. However, the number of residential parcels at risk to flooding represents just under 2% of the total parcels (88,437 parcels) assessed in the County.

Landslide

A GIS analysis of exposure to landslide hazard areas was performed. GIS was used to intersect the parcel boundaries with a deep-seated landslide susceptibility layer to obtain the number of parcels exposed to different classes of deep-seated landslide. The GIS analysis indicates that a total of 57,430 parcels are exposed, worth almost $20 billion of property improvements. **Table 7-4** summarizes landslide exposure by parcel property type. Only parcels with improvement values greater than zero were used in the analysis. This method assumes that improved parcels have a structure of some type. There is a high level of uncertainty as to the actual risk to these exposed parcels, thus a more specific loss estimation is not provided. A more detailed, site-specific analysis would be needed to assess actual risk within the identified

parcels. 133,652 people are in landslide-prone areas, but direct impacts to people are expected to be minimal as it is unlikely that landslides will occur without warning.

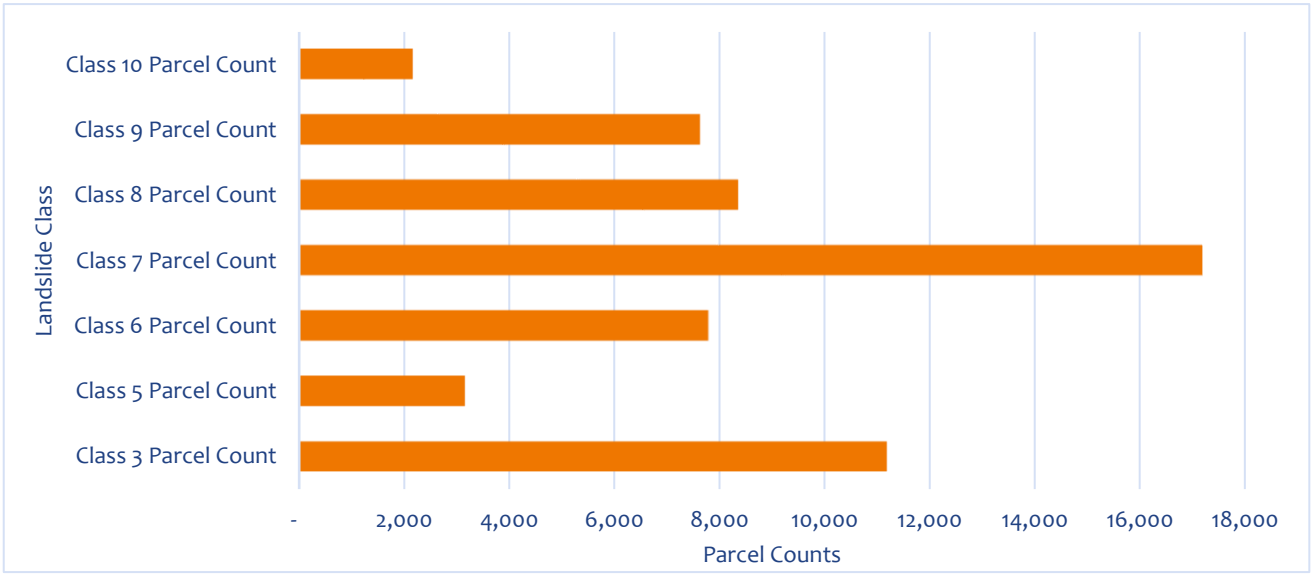
Table 7-4 Landslide Exposure by Parcel/Property Type

Property Type	Improved Parcel Count	Improved Value	Total Value	Population
Commercial	372	$205,752,901	$411,505,802	-
Industrial	326	$167,855,782	$419,639,455	-
Multi-Family Residential	250	$225,004,598	$337,506,897	635
Mobile Home Park	37	$32,175,343	$48,263,015	94
Miscellaneous	2,695	$146,394,103	$292,788,206	-
Residential	52,332	$12,222,627,237	$18,333,940,856	132,923
Unassessed	1,418	$6,308,948	$12,617,896	-
Total	57,430	$13,006,118,912	$19,856,262,126	133,652

Sources: County of El Dorado 2020; WSP Analysis 2022

Figure 7-1 below further breaks down the numbers of exposed parcels by landslide class. The higher the class the greater the susceptibility (see **Figure 5-32**). The classes are based on a combination of slope and rock strength and express the generalization that on very low slopes, landslide susceptibility is low even where there are weak rock and soil materials, and that landslide susceptibility increases with slope and weaker rock and soil materials (USGS 2011). Very high landslide susceptibility includes classes VIII, IX, and X (Classes 8 and above) and includes very steep slopes in hard rocks and moderate to very steep slopes in weak rocks (USGS 2011). As shown, the highest number of susceptible parcels fall under Class 7, with over 16,000 parcels with exposure to landslide that could be influenced by climate change.

Figure 7-1 Total Parcel County by Landslide Class



Sources: County of El Dorado 2020; WSP Analysis 2022

Wildfire

A wildfire threat assessment was performed for the County using the following GIS methodology. The Assessor's parcel layer was overlaid on the wildfire threat layer from CAL FIRE. For the purposes of this analysis, the wildfire hazard class that intersected each Assessor's parcel was assigned as the hazard class for the entire parcel. It was assumed that every parcel with an improved value greater than zero was developed in some way; thus, only improved parcels and their values were analyzed.

An analysis of the value of those parcels – the improvement value plus estimated value of building contents – quantifies the potential losses from wildfires by wildfire class. The results in **Table 7-5** show that almost $22 billion worth of property and approximately 64,892 parcels are exposed to wildfire risk countywide. Most of these buildings are in high to very high hazard areas. Residential parcels constitute most of the number of parcels and the projected losses. The total values shown also include both structure value and contents and can be used as an estimate of potential losses since wildfires typically result in a total loss.

Table 7-5 Wildfire Hazard Parcel Exposure Summary by Parcel Type and Fire Threat Class

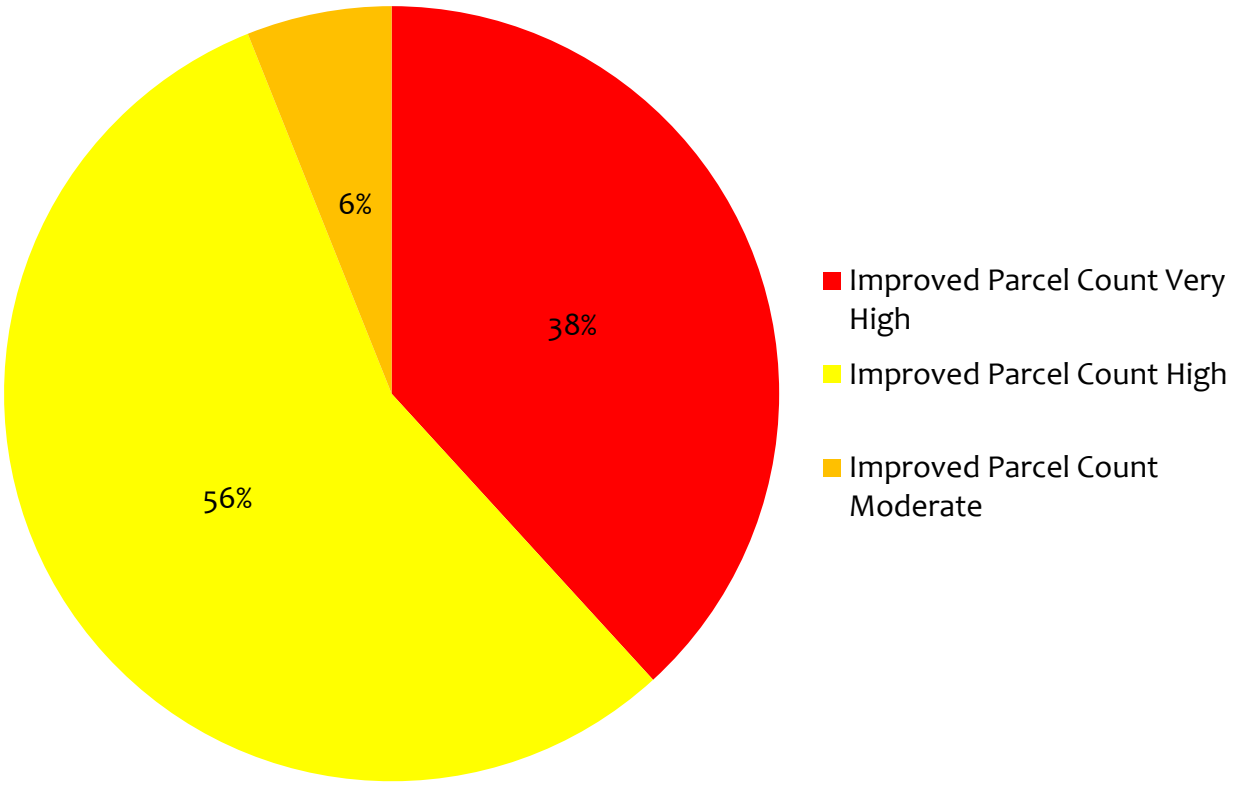
Parcel Type	Parcel Count Very High	Parcel Count High	Parcel Count Moderate	Total Parcel Count	Improved Value	Estimated Content Value	Total Value	Population
Commercial	150	362	39	551	$244,394,585	$244,394,585	$488,789,170	-
Industrial	135	357	72	564	$383,850,541	$575,775,812	$959,626,353	-
Multi-Family Residential	76	222	17	315	$290,356,434	$145,178,217	$435,534,651	800
Mobile Home Park	17	22	2	41	$40,808,824	$20,404,412	$61,213,236	104
Miscellaneous	1,537	1,239	54	2,830	$146,047,945	$146,047,945	$292,095,890	-
Residential	21,966	33,389	3,720	59,075	$12,990,899,399	$6,495,449,700	$19,486,349,099	150,051
Unassessed	917	576	23	1,516	$11,520,096	$11,520,096	$23,040,192	
Total	24,798	36,167	3,927	64,892	$14,107,877,824	$7,638,770,766	$21,746,648,590	150,955

Note: In addition to Very High, High and Moderate, CalFire offers the highest fire threat level as "Extreme". However, the County does not have parcels that are within Extreme Fire Threat Zones.

Sources: CAL FIRE, El Dorado County Assessor, WSP GIS analysis

Figure 7-2 shows the composition of improved parcels that are exposed to wildfire threats within the unincorporated County, categorized by fire threat zone. More than half of the parcels have a high wildfire threat. The rest of the parcels are mostly very high fire threat. Only a small portion of the total parcels are moderate fire threat.

Figure 7-2 Unincorporated County Parcels in Fire Threat Classes



Source: CAL FIRE, El Dorado County Assessor, WSP GIS analysis

In addition, as shown in **Table 7-5**, a total of 150,955 people reside in areas that have moderate, high, and very high fire threat. Based on the DOF 2020 population estimate (193,098) this means that 78% of the County comprises areas that have some level of wildfire threat.

Sensitive Populations

The most sensitive populations are those with limited mobility and resources, existing economic and financial disparties, and those who are directly exposed to climate-related hazards. Residing in rural and isolated areas of the County, limited accessibility to health, language barriers, and a lack of emergency, and support services makes it more difficult to prepare for, respond to, and recover from disasters and climate-related shocks and stresses. Of the 20 sensitive populations assessed, 18 had high or severe vulnerability (V4 or V5) for one climate-related hazard. People are generally the most vulnerable to extreme heat, human health hazards, wildfire, and severe weather. The most vulnerable sensitive populations are low-income households, seniors, children, and outdoor workers. People of color who lack resources are also vulnerable. These populations are concentrated in neighborhoods around the City of South Lake Tahoe (Al Tahoe and Stateline neighborhoods), Kyburz, Pollock Pines, Cedar Grove, Georgetown, and Coloma. **Table 7-6** summarizes the high and severe vulnerabilities and impacts in the County.

Table 7-6 Sensitive Populations with High to Severe Vulnerability to Climate-related Hazards

Population Indicator	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Limited Mobility and Communications	Children (under 14) Seniors Seniors Living Alone Persons with Disabilities and Access and Functional Needs Persons with Limited English Proficiency Persons with Limited Accessibility Persons Living on Single-Access Roads Isolated and rural communities	• Mobility challenges • Dependency on others for transportation • Lack of access to communication services • Financial instability	Persons with limited mobility will experience delays in receiving communications during hazard events and greater challenges during evacuations. These persons may be unable to prepare for emergencies from their homes during events. Children are often less aware about avoiding heat-related illnesses due to extreme heat without the support of an adult, and not all children may have access to air-conditioned spaces. Seniors are also more likely to be impacted the greatest by heat-related illnesses, as well as poor air quality due to wildfires. Seniors may also have existing health conditions that can worsen with certain climate-related hazards, like extreme heat. Like children, seniors may also have less awareness about extreme heat days, wildfires, and other hazards. Decreased access to transportation and physical disabilities also make it more difficult for seniors to take actions to evacuate. Persons living in areas with limited access and communications in combination with language barriers could become isolated if hazards result in road closures, preventing them from evacuating or receiving services. Further, disruptions can last days when public services are disrupted in these communities, and these persons have a lack of backup supplies.	• Drought and Water Supply • Extreme Heat • Flooding • Human Health Hazards • Landslide and Debris Flows • Severe Weather • Wildfire
Income	Cost-burdened Households Households in Poverty	• Lack of affordable housing • Financial instability • Lack of air	Households with income constraints are one of the most vulnerable populations in the County. All climate-related hazards pose threats to this population indicator as these households have limited financial resources. This makes it cost-	• Drought and Water Supply • Extreme Heat • Flooding

Population Indicator	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Constrained	Low-Income Households Unemployed Ethnic Minorities	• conditioning	prohibitive to retrofit their homes and purchase equipment or other supplies to resist climate-related hazards. These households are also less likely to be able to absorb the costs of recovery, repair, and rebuild activities.	• Human Health Hazards • Landslide and Debris Flows • Severe Weather • Wildfire
Poor Housing Conditions	Overcrowded Households Households in Mobile Homes Renters	• Lack of affordable housing • Poor housing • Constraints related to home ownership	Households in mobile homes also face increased vulnerabilities from flooding, severe weather, and wildfires. These homes lack structural integrity when compared to permanent homes, making them more susceptible to damage and loss. Households living in mobile homes typically have lower income levels. Because renters and sometimes, households in mobile homes, do not own the land their home sits on, they lack the incentive to invest in maintenance and in protective improvements to make their home more resilient to hazards. Overcrowded households may also include rental situations and generally unhealthy housing conditions that are not safe due to the number of people residing in them or due to mold, lack of air conditioning, or close living quarters.	• Extreme Heat • Flooding • Human Health Hazards • Severe Weather • Wildfire
Outdoor Exposure	High-pollution burdened communities People with Chronic Health Conditions Outdoor workers Persons experiencing Homelessness	• Lack of mobility • Lack of air conditioning • Lack of access to healthcare • Limited transportation	Pollution-burdened communities, outdoor workers, and people experiencing homelessness have longer exposure outside, making them more susceptible to illnesses associated with extreme heat and poor air quality due to wildfires. Agriculture and forestry pests and diseases can also be harmful to outdoor workers who depend on the agriculture or recreation industry for work. Persons experiencing homelessness can also lose belongings during climate-related hazards.	• Extreme Heat • Human Health Hazards • Severe Weather • Wildfire

Critical Facilities

The most vulnerable critical facilities and infrastructure in the County are water and electrical infrastructure, such as water treatment and storage facilities, water conveyance systems, electrical infrastructure, sewer lifts, and telecommunication facilities. These facilities also do not include the major transportation roads and transit infrastructure within the County, which have multiple uses beyond worker commute trips, such as the transport of major goods and services, bus routes, and evacuation routes. Water and wastewater infrastructure can also be impacted by flooding, severe weather, landslides and debris flows, and wildfires. Linear transportation facilities, such as highways, major local roads, and minor local roads compiled from the County GIS data portal were included in early critical facility databases but given the high number of linear road features (and hazardous material facilities), these were excluded for purposes of focusing the analysis. Most of these facilities also consisted of complex underground and aboveground infrastructure, and for many of the rural communities, there are no back-up alternatives to move water and wastewater to and from these neighborhoods.

The list of critical facilities included critical buildings and infrastructure in both the unincorporated County and the two incorporated cities, given that many key assets and community services were located within the two cities. Therefore, the critical facility analysis summarizes the facilities by jurisdiction whereas the parcel-level analysis only included the parcels within the unincorporated County. A GIS analysis of exposed critical facilities was conducted, like the parcel analysis. The master list of critical facilities and those with high or severe vulnerability to climate-related hazards is included in the Appendix.

Flood

FEMA's NFHL flood zones were overlaid in GIS with critical facility point data to identify critical facilities that would likely be inundated during a 1% annual chance and 0.2% annual chance flood event. The results of critical facilities throughout the County that are exposed to the various flood hazards are shown in **Table 7-7** and **Table 7-8** below and organized by the jurisdiction they are located in and the focus area they are classified in. There is only one essential business within the 1% annual chance flood event, and no essential businesses in the 0.2% annual chance flood event.

Table 7-7 Critical Facilities Within the 1% Annual Chance Flood Hazard by Focus Area and Jurisdiction

Jurisdiction	Essential Business	Essential Service	Infrastructure at Risk	Population at Risk	Grand Total
Placerville	0	5	8	3	16
South Lake Tahoe	0	0	1	0	1
Unincorporated area	1	0	31	0	32
Grand Total	**1**	**5**	**40**	**3**	**49**

Sources: HIFLD, NID, National Bridge Inventory (NBI), the County, NFHL Effective date 4/3/2012, FEMA; WSP GIS Analysis

Table 7-8 Critical Facilities Within the 0.2% Annual Chance Flood Hazard by Focus Area and Jurisdiction

Jurisdiction	Infrastructure at Risk	Population at Risk	Grand Total
Placerville	2	0	2
South Lake Tahoe	2	0	2
Unincorporated area	2	2	4
Grand Total	**6**	**2**	**8**

Sources: HIFLD, NID, NBI, DWR, El Dorado County, NFHL Effective date 4/3/2012, FEMA; WSP GIS Analysis

Landslide

A deep-seated landslide susceptibility layer was overlaid in GIS with critical facility point data to identify critical facilities that are exposed to potential landslide hazards. **Table 7-9** below summarizes the results of the critical facilities analysis, highlighting the exposure of critical facilities throughout the County to landslide hazards.

Table 7-9 Critical Facilities Exposed to Deep-seated Landslide Hazard by Landslide Class

Jurisdiction	Landslide Class	Essential Service	Infrastructure at Risk	Population at Risk	Grand Total
Placerville	3	17	4	8	29
	6	6	0	2	8
South Lake Tahoe	7	1	6	1	8
Unincorporated area	3	1	76	6	83
	5	9	41	13	63
	6	1	38	4	43
	7	4	45	0	49
	8	0	11	4	15
	9	0	15	0	15
	10	0	6	0	6
Grand Total	-	**39**	**242**	**38**	**319**

Sources: HIFLD, NID, NBI, Department of Conservation, CGS, the County, WSP GIS Analysis

Wildfire

Wildfire threat areas GIS layer was overlaid in GIS with critical facility point data to identify critical facilities that are exposed to various wildfire threat levels. **Table 7-10** through **Table 7-12** below summarize the results of the critical facilities analysis, highlighting the exposure of critical facilities throughout the County to various levels of wildfire threat. No essential business facilities are in any wildfire threat zones.

Table 7-10 Critical Facilities Within the Moderate Wildfire Threat by Jurisdiction and Focus Area

Jurisdiction	Essential Service	Infrastructure at Risk	Population at Risk	Grand Total
Placerville	0	0	1	1
South Lake Tahoe	0	1	1	2
Unincorporated area	3	79	5	87
Grand Total	**3**	**80**	**7**	**90**

Sources: HIFLD, NID, NBI, CAL FIRE, Fire and Resource Assessment Program (FRAP), the County, WSP GIS Analysis

Table 7-11 Critical Facilities Within the High Wildfire Threat by Jurisdiction and Focus Area

Jurisdiction	Essential Service	Infrastructure at Risk	Population at Risk	Grand Total
Placerville	0	4	1	5
South Lake Tahoe	5	21	14	40
Unincorporated area	22	223	18	263
Grand Total	**27**	**248**	**33**	**308**

Sources: HIFLD, NID, NBI, CAL FIRE, FRAP, the County, WSP GIS Analysis

Table 7-12 Critical Facilities Within the Very High Wildfire Threat by Jurisdiction and Focus Area

Jurisdiction	Essential Service	Infrastructure at Risk	Population at Risk	Grand Total
Unincorporated area	5	80	13	98
Grand Total	**5**	**80**	**13**	**98**

Sources: HIFLD, NID, NBI, CAL FIRE, FRAP, the County, WSP GIS Analysis

Wildfire Assessment for Critical Facilities

Spatial Informatics Group (SIG) completed an additional assessment of wildfire hazard impacts on critical facilities. The assessment is based on the average flame length in feet within 100 feet, 100 to 300 feet, and 300 to 1,000 feet buffers around each critical facility. 100 feet is the legal minimum distance for defensible space per California law (Public Resources Code [PCR] 4921). Beyond the 100 foot minimum, managing an additional 100 to 300 feet of fuels where hazard is high can provide additional protection for structures during a wildfire. A larger buffer (300 feet to 1,000 feet) was assessed to define the relative hazard of the extended areas surrounding the facility and allowing comparison with fire hazard in the immediate vicinity of the facility. These buffers can also represent different defensible space maintenance areas that may be suitable for the facilities based on surrounding flame length risk. Flame lengths were produced by Pyrologix (pyrologix.com) for the Pyregence Consortium (pyregence.org) in 2021 and is an update of the 2020 dataset developed by Pyrologix for the USFS Pacific Southwest Region.

Increased flame lengths increase the likelihood of torching events and crown fires and require increased suppression intensity. Flame length is influenced in part by fuel type, potential for crown fire, and weather conditions. Fuel type and crown fire potential, in turn, influence the rates at which fire lines can be constructed by different fire resources, including hand crews and mechanical equipment. Flame lengths above 4 feet will present serious control problems. They are too dangerous to be directly contained by hand crews (NWCG 2004). Flame lengths over 8 feet are generally not controllable by ground-based equipment or aerial retardant and present serious control problems, including torching, crowning, and spotting.

Based on the flame length information and the relationship between flame length and potential for success for suppression shown in **Table 7-13**, average flame lengths less than or equal to 4 feet, which can be attacked directly with hand tools are classified as low hazard. Average flame lengths greater than 4 feet to 8 feet, which are too large to attack directly, but can still be suppressed using heavy equipment, are classified as moderate hazard. Flame lengths greater than 8 feet are classified as high hazard as control efforts will probably be ineffective.

Table 7-13 Relationship between Flame Length and Potential for Success of Active Suppression

Fire Hazard Rating	Flame Length	Description
Low	Less than 4 feet	Fires can generally be attacked at the head or flanks by firefighters using hand tools. A hand line should hold the fire.
Moderate	4–8 feet	Fires are too intense for direct attack at the head with hand tools. A hand line cannot be relied on to hold the fire. Bulldozers, engines, and retardant drops can be effective.
High	8–11 feet	Fire may present serious control problems: torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Extreme	Greater than 11 feet	Crowing, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Source: NWCG 2004.

Most critical facilities in the County that have a moderate or high hazard (flame lengths greater than 4 feet) are located on private non-industrial lands based on a GIS overlay of the critical facilities and the land uses contained in the California Protected Areas Database. **Figure 7-3** through

Figure 7-9 show the wildfire hazard by average flame length for critical facilities located in seven geographic areas of the County.

Table 7-14 lists the wildfire hazard by modeled flame length within 100 feet of critical facilities in the County. As shown in this table, 11 of the 258 essential services facilities are exposed to high flame length hazards, 108 of the 698 infrastructure at risk facilities are exposed to high flame length hazards, and 10 of the 315 population at risk facilities are exposed to high flame length hazards. Of these 129 critical facilities at risk to high flame length hazards, 83 are located on private lands, 40 are located on federal lands, and the remaining are on State and local lands. In summary, the assessment shows that a substantial number of critical facilities at risk to high flame length hazards are located on federal and private lands. Enhanced coordination with federal agencies on defensible space maintenance and improved enforcement of the County's Hazardous Vegetation and Defensible Space Ordinance (Chapter 8.09 of Code of Ordinances) can minimize risks to these critical facilities.

Table 7-15 summarizes the critical facilities with high and severe vulnerability to climate-related hazards.

Figure 7-3 Wildfire Hazard for Critical Facilities in El Dorado County (Northwest – Inset 1)

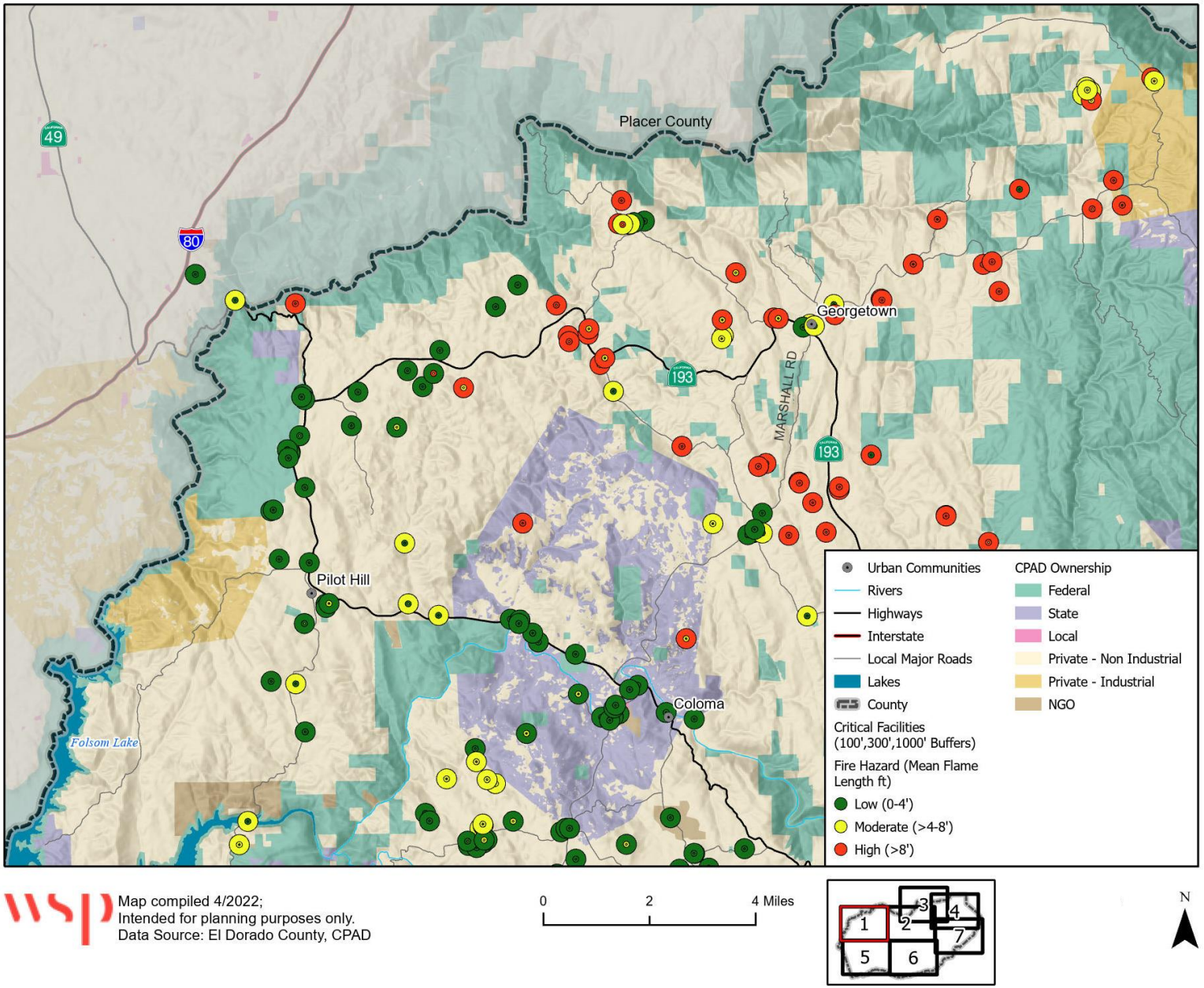


Figure 7-4 Wildfire Hazard for Critical Facilities in El Dorado County (North Central – Inset 2)

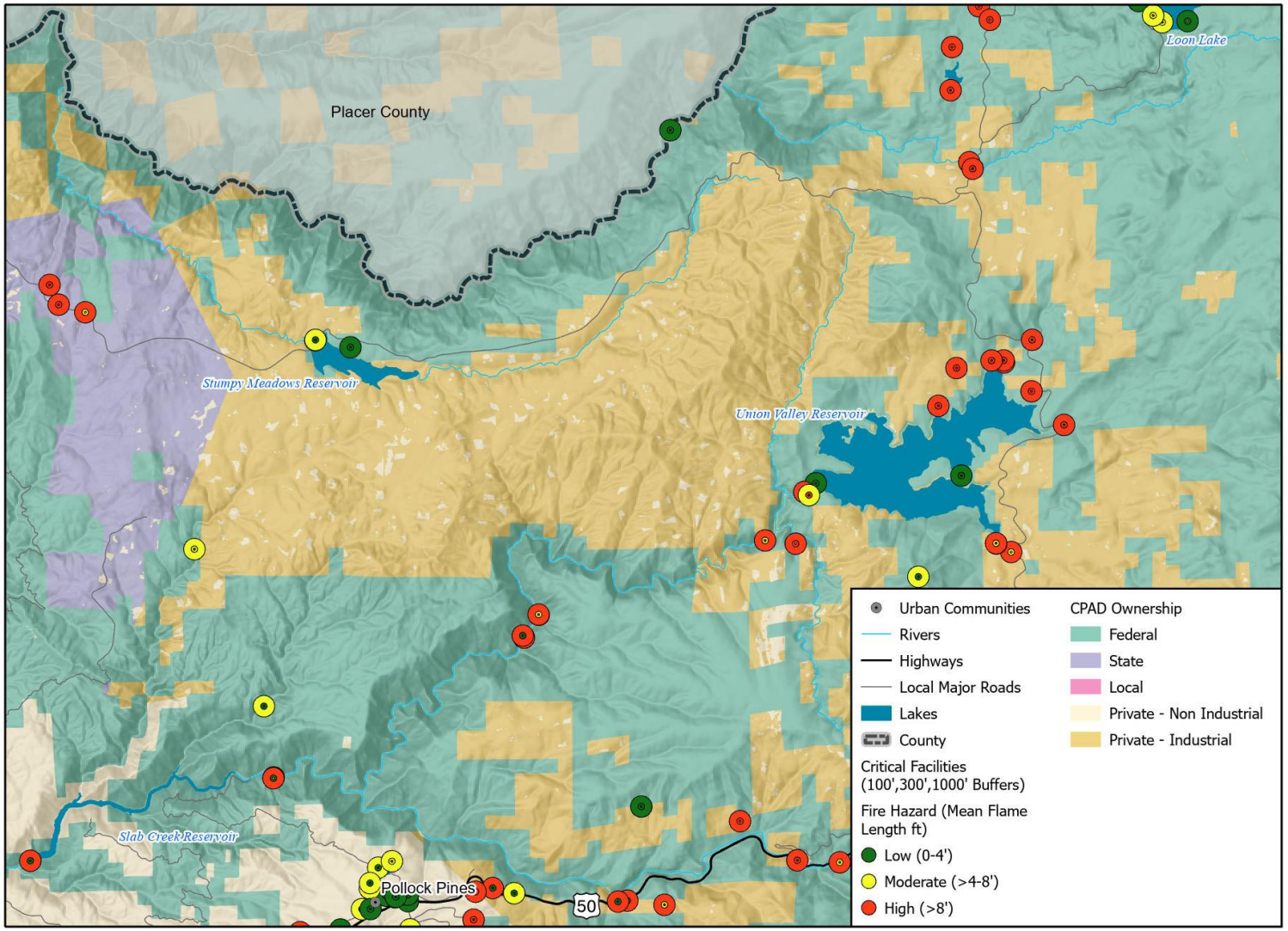


Figure 7-5 Wildfire Hazard for Critical Facilities in El Dorado County (North – Inset 3)

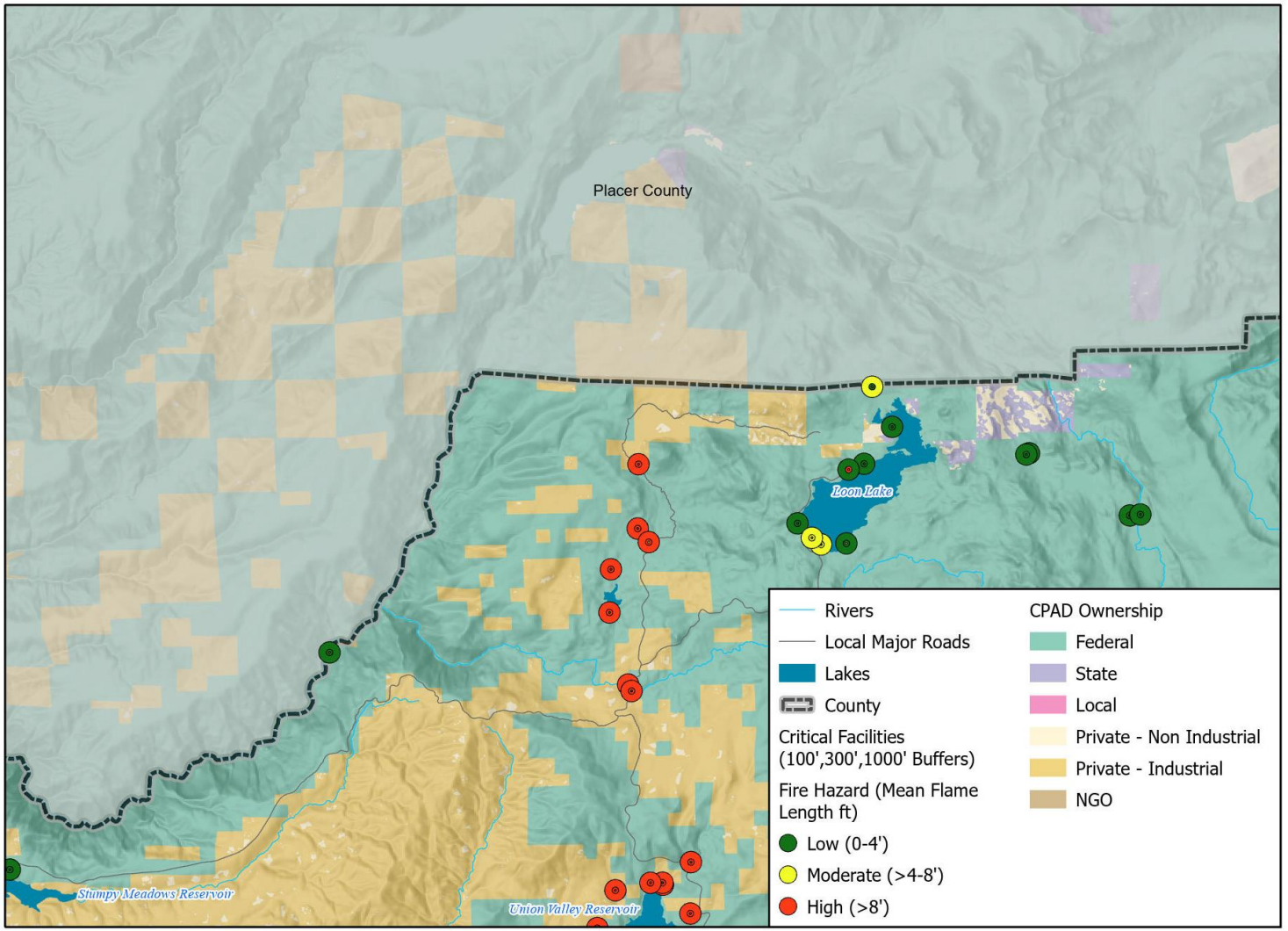


Figure 7-6 Wildfire Hazard for Critical Facilities in El Dorado County (Northeast – Inset 4)

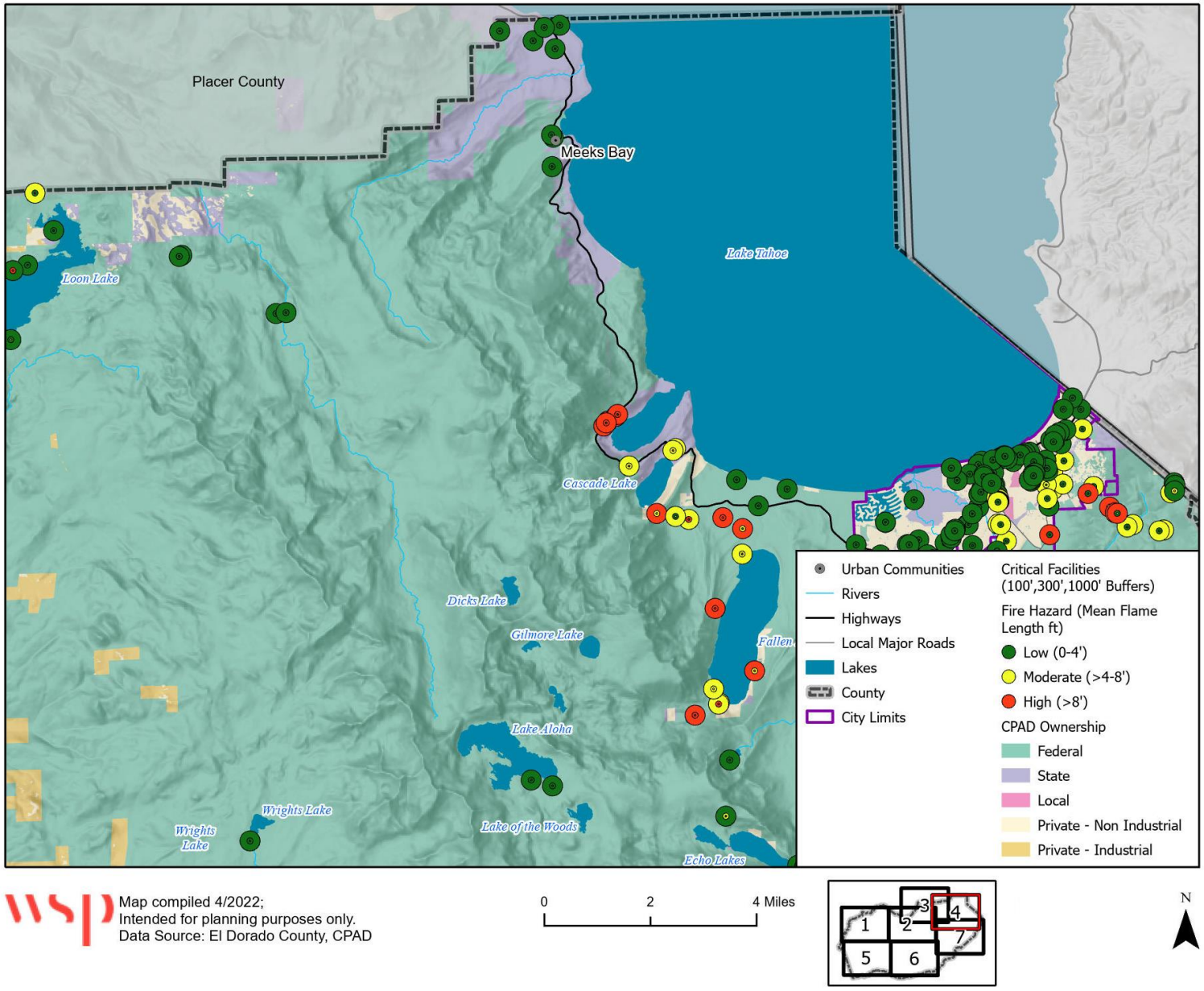


Figure 7-7 Wildfire Hazard for Critical Facilities in El Dorado County (West – Inset 5)

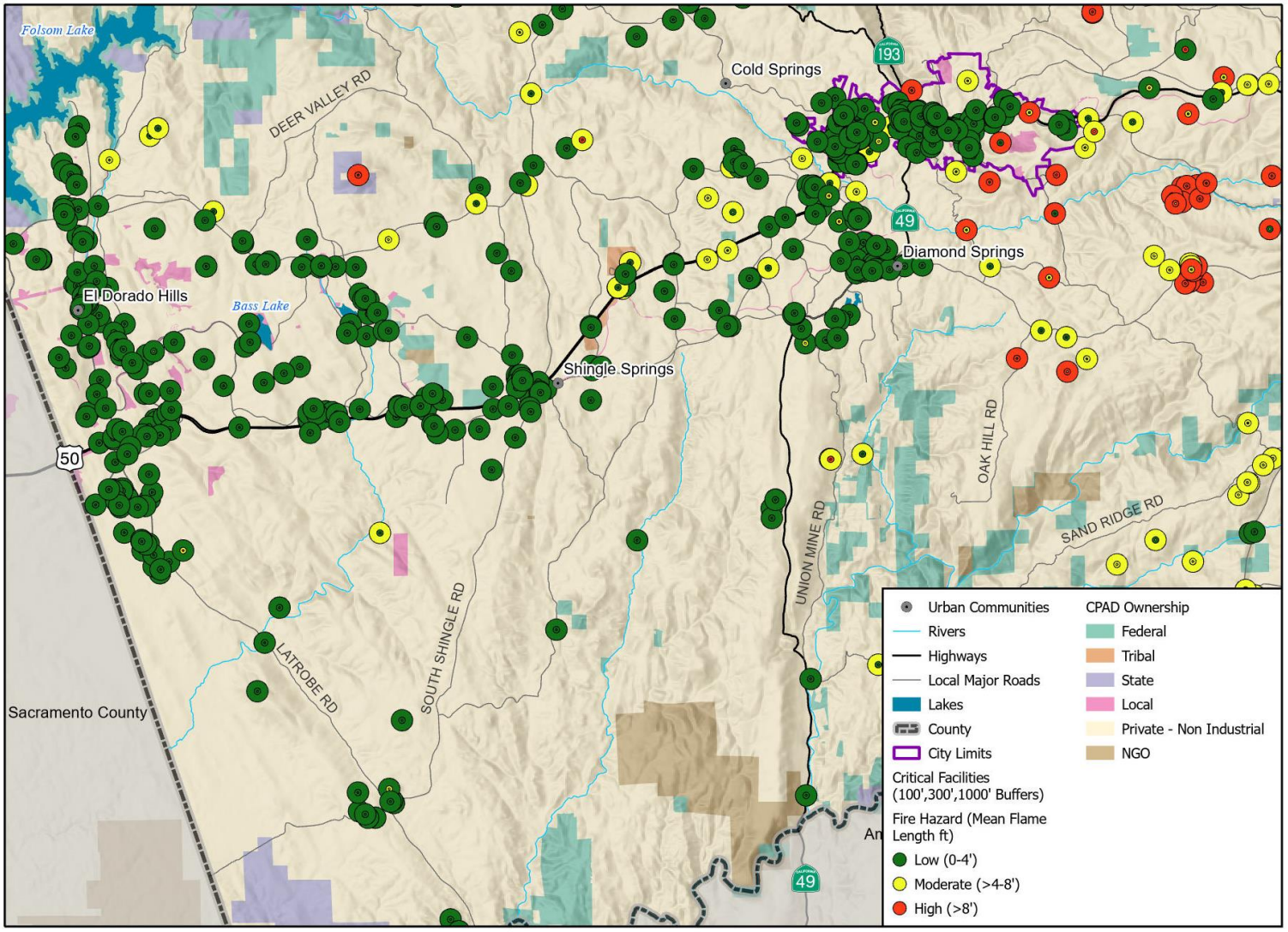
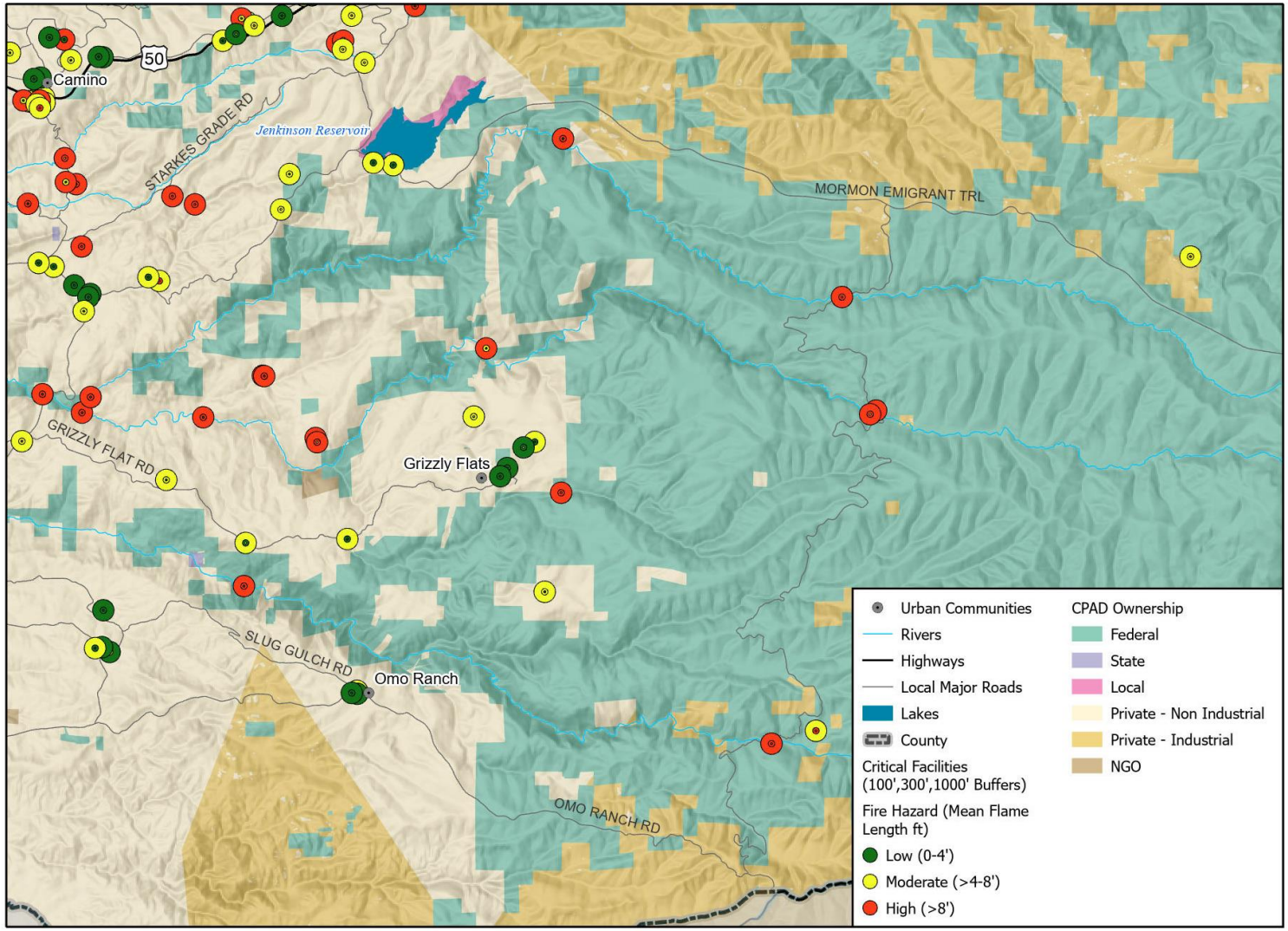


Figure 7-8 Wildfire Hazard for Critical Facilities in El Dorado County (South Central – Inset 6)



Map compiled 4/2022;
Intended for planning purposes only.
Data Source: El Dorado County, CPAD

0 2 4 Miles

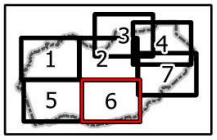


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Figure 7-9 Wildfire Hazard for Critical Facilities in El Dorado County (Southeast – Inset 7)

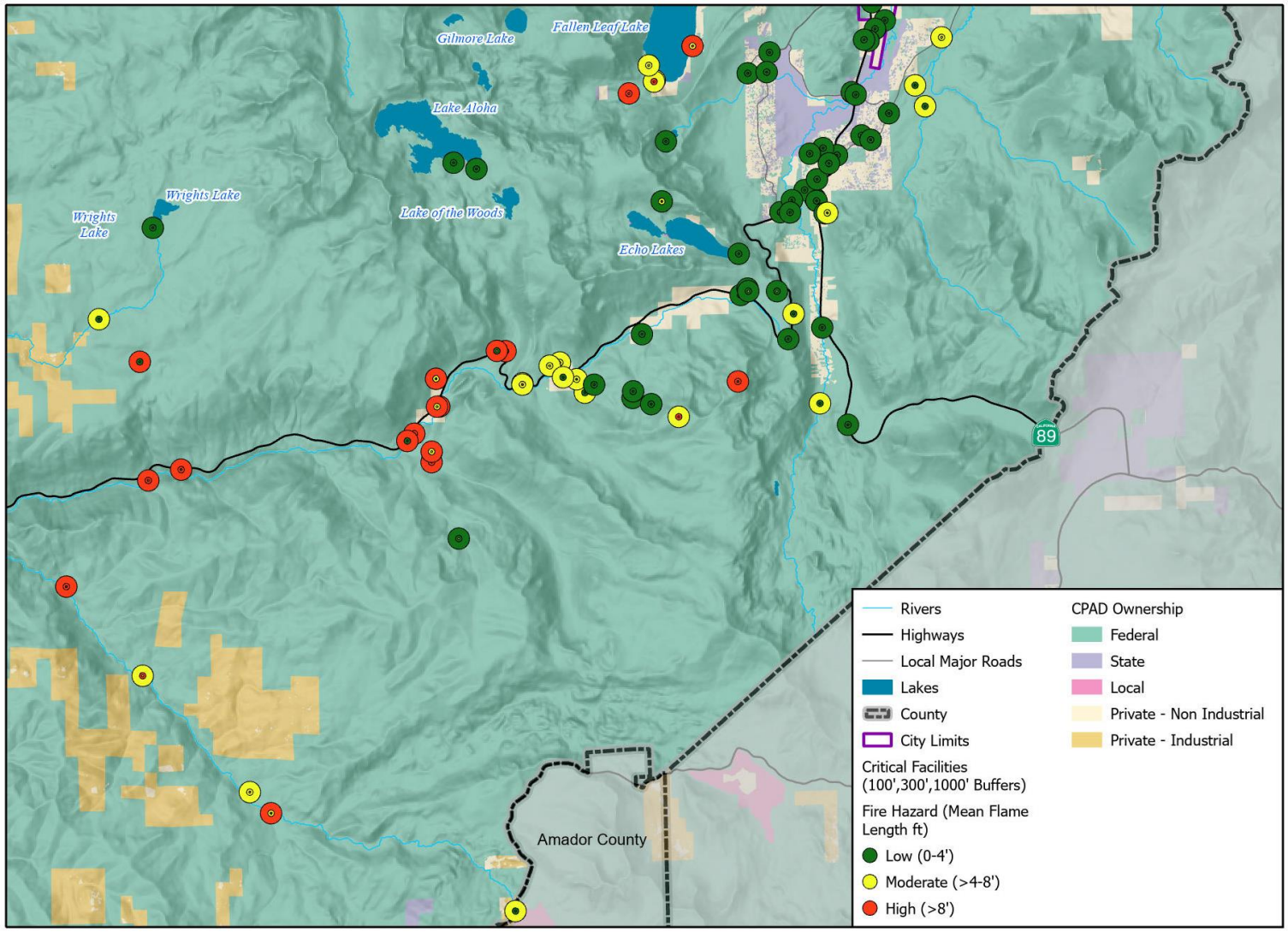


Table 7-14 Wildfire Hazard (within 100 feet) for Critical Facilities in El Dorado County

Critical Facility Type by Ownership	Fire Hazard (Flame Length in Ft)			
	Low Hazard (0'-4' FL)	Moderate Hazard (4'-8' FL)	High Hazard (>8' FL)	Total Facilities
Essential Business	**3**			**3**
Private – Non Industrial	3			3
Essential Service	**236**	**11**	**11**	**258**
Federal	1	1		2
Local	4			4
Private – Industrial	1		1	2
Private – Non Industrial	225	10	10	245
State	4			4
Tribal	1			1
Infrastructure at Risk	**492**	**98**	**108**	**698**
Federal	93	24	40	157
Local	9			9
NGO	1			1
Private – Industrial	15	4	7	26
Private – Non Industrial	360	69	56	485
State	14	1	5	20
Population at Risk	**288**	**17**	**10**	**315**
Local	2		1	3
Private – Non Industrial	284	17	9	310
State	1			1
Tribal	1			1
Grand Total	**1019**	**126**	**129**	**1,274**

Sources: El Dorado County 2022; WSP 2022; SIG GIS Analysis 2023

Table 7-15 Critical Facilities with High and Severe Vulnerability to Climate-related Hazards

Critical Facility Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Water and Wastewater	Dam Water Station Water System Wastewater Treatment Plant Water Treatment Plant Water & Power Authority	• Lack of funding for repairs and retrofits • Lack of feasible back-up alternatives • Relocation challenges • Engineering constraints	Water and wastewater infrastructure may receive the greatest impact in the County from climate-related hazards, particularly because of the aging infrastructure and systems that exist beyond their normal lifespan. The structures can be damaged from ground movement or inundation. Drought and flooding conditions can prevent dams and wastewater infrastructure from functioning properly, causing secondary impacts and contamination of the soil and water. *68% of small water systems are in at least moderate fire threat zones.	• Flooding • Human Health Hazards • Severe Weather • Wildfire
Electrical Infrastructure	Electrical substation Power Plant	• Lack of funding for repairs and retrofits • Lack of feasible back-up alternatives • Relocation challenges • Engineering constraints	Electrical transmission lines that run through areas with slope instability or landslide and avalanche potential can be damaged during such events. Alternatives, like solar power and other renewables are not readily available, and accessing remote locations for repairs and routine maintenance is difficult.	• Extreme Heat • Severe Weather • Wildfire

Critical Facility Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Communications	Telecommunication / Cellular Tower	• Lack of staffing and funding for timeline repairs and response related to disruptions • Few redundancies in the communication systems	Communication systems that are in hazard-prone areas in the County, particularly in rural areas, are most vulnerable if they are damaged during climate-related hazard events because it would take time to address and respond to the situation and repair the system. Severe winds and weather can also damage these facilities. Also, planned and unplanned PSPS can result in power outages that cause limited means of communication. *65% of the communication towers are in at least moderate wildfire threat zones.	• Severe Weather (Heavy Snow, Rain, Wind) • Wildfire
Transportation Infrastructure	Aviation Facility Amtrak Station Bridge Government Transportation Transit Station	• Limited financial and staffing resources for timing repairs • Need for alternative modes of transportation • Ongoing repairs needed due to aging roads in rural areas	Of the transportation infrastructure, roads are the most vulnerable given they are the most exposed to climate-related hazards like flooding, landslides, and wildfires. Severe weather also damages roads since these hazards can block or close a road, even if there is no physical damage to the road (e.g., potholes). Road closures that limit accessibility or isolate communities have the most severe safety risks. The remote and rural roads in the County are at the highest risk because access for repairs and maintenance is difficult and may be limited to only summer months. Other vulnerable infrastructure includes bridges vulnerable to flooding and severe weather. *65% of the bridges are in at least moderate wildfire threat zones.	• Extreme Heat • Flooding • Human Health Hazards • Severe Weather • Wildfire
Educational Facilities	School Colleges/University			• Extreme Heat

Critical Facility Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
	Child Care Provider/Service	• Lack of funds or bond measures to make retrofits and modernizations • Aging buildings	Educational facilities, like school buildings can be directly damaged by climate-change hazards, particularly flooding and wildfires. They may also be indirectly impacted by extreme heat and cold temperatures during severe weather. These facilities need routine modernizations associated with heating, cooling, ventilation, and thermal comfort amenities like operable windows to maintain healthy learning environments. For example, public health hazards may require buildings to have increased ventilation. *UCCE (UC Cooperative Extension) is in Class 6 deep-seated landslide hazard zone.	• Flooding • Human Health Hazards • Severe Weather • Wildfire
Public Safety Buildings	Fire Station Police Station Emergency Operations Center	• Limited financial and staffing resources for timing repairs, relocated facilities, and new facilities	Fire and police stations in the County could be damaged or lost during flooding and wildfire events. Indirect impacts may result in mold and smoke damage. Repairs and upgrades may cause facilities to be unavailable during emergencies. Medical facilities may also need to be routinely upgraded. *33% of police stations are in at least moderate wildfire threat zones.	• Extreme Heat • Flooding • Human Health Hazards • Severe Weather • Wildfire
Government Facilities	Community Resources (child support, library, museum, event center, etc.) Government Building/Department/Office (Superior) Court Jail Shelter	• Limited financial and staffing resources for timing repairs, relocated facilities, and new facilities	Government facilities in the County are highly and severely vulnerable to flooding, severe weather, and wildfire. Damage to these facilities results in indirect impacts to the community that rely on them for public services and important resources. Some of these facilities in the Tahoe Basin may also lack air conditioning, making them more vulnerable to extreme heat.	• Extreme Heat • Flooding • Severe Weather • Wildfire

Critical Facility Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
			*The law library of South Lake Tahoe is in high fire threat zone. *Pollock Pines Camino Community Center is in very high fire threat zone.	
Medical and Long-Term Healthcare Facilities	Clinic Community Nursing & Family Service Emergency Medical Service Health Support & Recovery & Prevention Service Hospital Senior Care Facility/Senior Community Service Veteran Service	• Limited financial and staffing resources for timing repairs, relocated facilities, and new facilities	Hospitals must be designed and constructed to specific building standards and should be able to withstand climate-related hazards. Medical clinics, emergency medical facilities, and long-term care facilities would be more vulnerable if not routinely upgraded. This category also covers other aspects of medical services required during a hazard event including survivor care, fatality management, public health, and the distribution of medical supplies making any one of these services also vulnerable. *Placerville's emergency medical services center is located within 1% annual chance floodplain. *Three senior care facilities are located within very high fire hazard zones.	• Extreme Heat • Flooding • Human Health Hazards • Severe Weather • Wildfire
	RMP/Tier II Facility			• Extreme Heat

Critical Facility Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Hazardous Material Facilities	Toxic Release Inventory Facility	• Lack of staffing and funding for timeline repairs and response related to disruptions • Few redundancies in the communication systems	There are facilities that store, handle, dispose, and transport hazardous materials in the County and former facilities that are being remediated. Existing facilities that use hazardous materials in hazard-prone area can have the highest vulnerability to climate-related hazards, especially if this means the hazardous materials at the facility itself are at risk. Flooding, landslides and debris flows, and wildfires would pose the most risk. While most of these facilities are highly regulated by the State and go through regular inspections and permitting processes to stay in operation, increased maintenance and repairs must be in place to minimize increased hazard potential. *67% of the RMP facilities are in at least moderate fire hazard zones.	• Flooding • Severe Weather • Wildfire

Sources: HIFLD, NID, NBI, El Dorado County, NFHL Effective date 4/3/2012, FEMA, Department of Conservation, CGS, CAL FIRE, FRAP, WSP GIS Analysis

Natural and Cultural Resources

Natural and cultural resources, such as waterways and bodies of water (reservoirs, lakes), aquatic habitat and wetlands, forests, protected areas, parks and open spaces, and historic buildings and sensitive cultural resources would experience varying impacts from climate-related hazards. Some hazard interactions like drought and extreme heat over time are likely to result in cascading hazards related to increased wildfire severity and susceptibility to landslides and debris flows. Ecosystems can also be disrupted by increased temperatures and changes in precipitation that reduce water resources, cause harmful algae blooms, change the conditions of dissolved oxygen and nutrients in waterways, and result in increased susceptibility to agricultural and forestry pests and disease.

All four natural resource types scored high or severely vulnerable to climate-related hazards. Agricultural pests and disease, drought, extreme heat, and wildfire would have the greatest impact on natural and cultural resources in the County. Water resources would face the greatest threat from climate hazards due to existing issues such as degraded air, soil, and water quality, as well as urban and rural development and timber harvesting. Forest resources would experience the second highest exposure to climate-related hazards. Cultural resources, including cultural heritages, traditional practices, sacred places, buildings, and other values would be equally impacted, meaning no single aspect of cultural resources is more or less vulnerable than the others, and are expected to experience similar levels of vulnerability and exposure to climate-related hazards.

Water Resources

With climate change and its effects on precipitation variability and snowpack levels, groundwater levels may drop and change the distribution of wetland and riparian vegetation and species. Wetlands and riparian ecosystems occur at the interface between uplands and lakes, rivers, and streams. While riparian habitats are limited across the County, they are ecologically important because they provide connections within the watershed and support a diversity of animal and plant species. While higher elevation groundwater-dependent ecosystems may be more resilient because snowpack will persist longer, lower elevation resources will experience more runoff, erosion, and declining groundwater levels. Groundwater levels and natural recharge typically can buffer the impacts of drought conditions, but more frequent and larger precipitation events over shorter periods of time will decrease the total amount of rainwater that infiltrates to groundwater. The encroachment of conifer species (i.e., lodgepole) into riparian areas due to the lack of wildfire, drought, and reduced snowpack levels also threatens the persistence of aspen groves. However, increased wildfires in forested areas, if not too frequent, can provide an opportunity for aspen to regenerate in the riparian areas (California Tahoe Conservancy 2020).

As primarily natural processes, landslides and debris flows can have varying impacts on water resources; however, debris flows have the potential to permanently alter the natural landscape, as was the case in Santa Barbara County following the Thomas Fire. Climate change studies indicate the likelihood that increasingly unpredictable flash flooding and uncertainty in storm occurrence will lead to a worsening in erosion and sedimentation conditions. However, natural areas within the floodplain often benefit from periodic flooding as a naturally recurring phenomenon, and these natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters.

Forest Resources

The County supports a high diversity of sensitive species and vegetation types. Historically, the County land managers have been working to restore the watersheds and forest communities by minimizing grazing in the Tahoe Basin and promoting forest regeneration on the West Slope. Today, urbanization is highly regulated, and natural and ecologically beneficial fire regimes are allowed to occur within the forest landscape. Climate change still has the potential to directly affect the characteristics of the forest primarily through increased temperatures and changes in precipitation patterns that will exacerbate soil water deficits during droughts that gradually shift the composition of the forest and the historical range of

species habitat (California Tahoe Conservancy 2020). Droughts and wildfires are also expected to be more frequent and severe, which will further alter the forest composition across the County. Tree mortality due to an increase in disease and insect outbreaks like bark beetle infestations will occur, and invasive non-native plants could also increase, spread, and out-compete native species. These changes can also alter atmospheric conditions that could influence the carbon storage capacity (carbon sequestration) of the forests in the County. Avalanches are a natural event, but they can also negatively affect forest resources, including trees located on steep slopes. A large avalanche can knock down many trees and kill the wildlife that lives in and under them. In spring, this loss of vegetation on the mountains may weaken the soil, causing landslides and mudflows. Taken together, climate-related hazards can result in numerous impacts. However, given the scale of forest resources, they also have the capacity to mitigate impacts and create refugia for sensitive species (California Tahoe Conservancy 2020).

Parks and Open Space

State and County parks and open spaces are prone to flooding, landslide, and wildfire risk. Developed parks along the South Fork of the American River can be damaged during high flood events, and all facilities are susceptible to wildfires. The undeveloped areas of the parks that burn during wildfire can also be lost, but direct impacts would be generally limited to temporary closures during repair and reconstruction. Various parklands in the County are also susceptible to landslides, and biking and hiking trails can be buried during these events. While facilities within park and open space areas, such as parking areas, trailheads, bathrooms, and picnic ramadas may contain irrigated landscaping for protection, these alternatives are limited in rural areas with no water supply connection. Also, the natural park and open space lands will eventually recover following flood, landslide, and wildfire events.

Cultural and Historic Resources

The County is home to several Tribal nations, including the Shingle Springs Band of Miwok Indians (Miwok Indians) and the Washoe Tribe of Nevada and California (Washoe Tribe). Traditionally, these Tribes' practices and social systems involved seasonal movements around the County, as both the Miwok Indians and Washoe Tribe travelled to and from summer camps in the high Sierra Nevada and Lake Tahoe region for hunting and gathering. Indigenous burning was also an important practice for the Tribes that is no longer a part of the fire regime. Climate change may affect these Tribe's cultural heritage, in addition to culturally and historically significant buildings, resources, places, practices, properties, districts, and other non-tangible values. Climate-related hazards like agricultural pests and disease, drought, extreme heat, and wildfire can all negatively affect the cultural heritages of the Tribes by directly reducing the diversity of plants, traditional foods, medicinal and artisanal plants, and other culturally important resources. Landslides and wildfires could also degrade and damage archaeological artifacts and sacred cultural sites. Historic buildings may be more vulnerable to wildfires due to their age. These buildings may also be less able to withstand significant heat levels both associated with fires but also extreme heat. The increase and severity of wildfires would also result in poor air quality that affects the health of Tribal communities and those with pre-existing health conditions.

In summary, drought, extreme heat, severe weather (wind), wildfire, and post-fire landslides and debris flow have the potential to result in the greatest impacts to natural resources through direct damage and indirectly, through the loss of valuable ecosystem services.

There are approximately four discrete natural and cultural resources within the County: water resources (rivers, streams, lakes, wetlands, riparian areas), forests (coniferous and oak woodland forests), parks and open space, and historic buildings and cultural resources. Of these four resource categories, all were highly or severely vulnerable (score of V4 or V5) for at least one hazard type. Water and forest resources are the most vulnerable to drought and wildfire. **Table 7-16** highlights the natural resources that are highly and severely vulnerable to climate-related hazards and summarizes the impacts.

Table 7-16 Natural Resources with High and Severe Vulnerability to Climate-related Hazards

Natural Resource Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Water Resources	Rivers, Creeks, Streams Lake and Reservoirs Aquatic Resources Wetlands and Wet Meadows Riparian Areas	• Urban encroachment • Existing habitat fragmentation • Poor water quality due to existing soil erosion and sedimentation and pollutant runoff	Water resources are vulnerable to increased temperatures and precipitation variability if changes alter the ecosystem and the native plant composition. Extreme heat can result in harmful algal blooms in public parks and open spaces that could in turn impact public health. Other hazards like wildfires and landslides can cause more pollutants and sedimentation in waterways, which will affect aquatic wildlife.	• Agricultural Pests and Disease • Extreme Heat • Flooding • Landslides and Debris Flows • Severe Weather • Wildfire
Forest Resources	Mixed Conifer Forests Oak Woodland Mixed Chaparral Shrublands Annual Grasslands	• Habitat fragmentation • Poor water and soil quality	The forests in the County range from grasslands, oak woodland, and chamise chaparral along the West Slope to lodgepole pine, white fir, and sierran mixed conifer forests along the Sierra Nevada crest and Tahoe Basin. These ecosystems and specific vegetation communities are vulnerable to extreme heat, drought, pest infestations like bark beetle and wildfire. These vegetation communities are also replaced by new communities following climate-related hazards (aspen forests replaced by lodgepole pine and oak woodlands replaced by shrublands or grasslands).	• Agricultural Pests and Disease • Extreme Heat • Flooding • Landslides and Debris Flows • Severe Weather • Wildfire
Parks and Open Space	State Parks and Recreation Areas County Parks and Open Space Fairgrounds	• Limited funding to maintain and upgrade recreational amenities in parks and open spaces • Lack of staffing capacity to	State and County parks and open space facilities and campgrounds can be directly damaged and inundated by flooding, which would be further exacerbated by climate change and more	

Natural Resource Category	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
	Campgrounds Greenways Bicycle Trails Hiking Trails Beaches	plan for and implement needed retrofits and upgrades • Feasibility challenges associated with relocation of trails and campgrounds	intense storms. This would disrupt and directly impact regional recreation opportunities in the County. While most of this flooding may occur on the West Slope along major waterways like the South Fork of the American River, flooding can also impact the open space, public lands, and waterways around Lake Tahoe. Biking and hiking routes can be impacted by severe weather that results in soil erosion. Beaches may also be impacted by drought and fluctuating water levels, evident along Lake Tahoe, that can result in harmful algal blooms and public health hazards related to warming temperatures and toxic algae.	• Agricultural Pests and Disease • Drought • Extreme Heat • Flooding • Landslides and Debris Flows • Public Health Hazards • Severe Weather • Wildfire
Cultural and Historic Resources	Historic Buildings Historic Districts Cultural Resources	• Lack of funding • Limited cultural protections • Aging buildings	Cultural and historic resources can also be damaged by climate-related hazards; entire historic towns and districts can also be lost during catastrophic events like wildfires. Direct losses to historic buildings result in the greatest impact and these can occur from landslides and wildfires. Cultural resources are also directly impacted during flood events, landslides, and wildfires; however, some of these resources are within areas that are commonly inundated during flooding.	• Agricultural Pests and Disease • Drought • Extreme Heat • Flooding • Landslides and Debris Flows • Public Health Hazards • Severe Weather • Wildfire

Sources: County of El Dorado natural resource categories are adapted from the General Plan 2004; WSP Analysis 2022.

Economic Services

Drought impacts on the economy can be extensive depending on the circumstances during and after a severe drought event. If water resources are limited, effects would be more severe for industries that rely on large amounts of water like the agriculture sector, and any prolonged drought would intensify these impacts. Sectors critical to the economy such as commerce, distribution, agriculture, related environmental resources, municipal and industrial water supply, key city assets, energy generation, and even socioeconomic aspects can be affected by climate-related hazards due to lack of or reduced quality of water resources. **Table 7-17** highlights the economic services that are highly and severely vulnerable to climate-related hazards and summarizes the impacts.

Table 7-17 Economic Services with High and Severe Vulnerability to Climate-related Hazards

Economic Sectors	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Agriculture	Apiary Grazing/Pastures Livestock Nursery Orchards Timber Products Vineyards	• Fluctuations in demand for products • Pesticide overuse and related plant mortality	The effects of most climate-related hazards will be felt acutely by the agricultural industry. Lack of water or decreased quality of water will be experienced by all sectors. An especially virulent pest or disease could wipe out an entire harvest. Extreme heat exacerbates drought conditions and damages young or sensitive plants. While some agriculture is protected from the elements, most products are tended to outdoors and are therefore vulnerable to any extreme or dangerous weather condition.	• Agricultural Pests and Disease • Drought and Water Supply • Extreme Heat • Flooding • Landslides and Debris Flows • Severe Weather • Wildfire
Construction	Building Materials Non-residential Building Outdoor Recreation Development Power and Communication Systems Residential Building Road Development and Maintenance Water and Sewer Systems	• Fluctuations in demand for products • Limited staffing resources for timing repairs, relocated facilities, and new facilities • Supply shortages • Aging infrastructure	The construction industry is heavily dependent on raw materials and skilled labor. This makes it vulnerable to hazards that may affect the availability of construction materials, such as lumber, or the supply of workers, who turn the raw materials into products; therefore, climate change may exacerbate public health hazards. The outputs of the construction industry are also threatened by climate-related hazards, such as flooding, debris flow, and severe weather, especially before a product is finished.	• Agricultural Pests and Disease • Drought • Extreme Heat • Flooding • Landslides and Debris Flows • Public Health Hazards • Severe Weather • Wildfire
Government Employment	City Government General Offices County Government General Offices Police and Fire Protection Transportation Program Regulation	• Limited financial and staffing resources	Government employment is heavily dependent upon revenue from taxes. Any climate-hazard that decreases tourism, forces people to relocate temporarily or permanently, or causes a work shortage or economic downturn, is going to have a profound effect on the ability of the government to continue normal operations. This likely will result in downstream effects on other economic activities.	• Agriculture and Forestry Disease and Tree Mortality • Avalanche • Drought and Water Supply • Human-health Hazards • Wildfire

Economic Sectors	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
Information Technology	Computer Programming Services Publishing, Production, and Broadcasting	• Fluctuations in availability of raw materials • Fluctuations in demand of products • Automation of tasks	Any climate-hazard that affects the transport or connectivity of people, or the electric grid, will affect the information technology sector. Extreme heat conditions can also affect the efficacy of some technology.	• Extreme Heat • Human-health Hazards
Leisure and Hospitality	Bars Casinos Hotels/Motels Resorts Restaurants	• Limited staffing resources • Inflation • Aging infrastructure	Climate-related hazards will primarily affect leisure and hospitality when they physically prevent people from accessing establishments, whether it is a result of road washout or pandemic protocols. If climate hazards decrease the availability of raw inputs and contribute to increased prices of non-essential goods and services, this industry will experience the impacts indirectly, which include decreased demand for luxury goods.	• Avalanche • Drought and Water Supply • Flooding • Human-health Hazards • Landslide and Debris Flows • Severe Weather • Wildfire
Manufacturing	Aviation Accessory Products Commercial Printing Computer Parts Microwave and Millimeter Wave Products Sign Manufacturing	• Fluctuations in availability of raw materials • Fluctuations in demand of products	The manufacturing industry is heavily dependent on raw materials and skilled labor. This makes it vulnerable to hazards that may affect the availability of raw materials or the supply of workers, who turn the raw materials into products. Any climate related hazard that interferes with the transportation of people or goods, or that may affect the electrical grid, could affect manufacturing.	• Drought and Water Supply • Extreme Heat • Human-health Hazards • High Wind • Wildfire
Professional and Business Services	Consulting Services Education Services Financial Sector Hospitals	• Fluctuations in availability of raw materials • Fluctuations in demand of products • Limited financial and staffing resources for timing repairs,	Many climate-related hazards have the capacity to interfere with professional and business services. As the industry is highly reliant on human capital, any hazard that interferes with the mobility or connectivity of a population, will affect the professional and business services industry.	• Extreme Heat • Human-health Hazards • High Wind • Landslide and Debris Flows • Severe Weather:

Economic Sectors	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
	Insurance Research Services	relocated facilities, and new facilities		Heavy Rain, Thunderstorms, Heavy Snow, Lightning/Hail • Wildfire
Retail and Trade	Bakeries and Food Manufacturing Car Dealerships Gas Stations Grocery Stores Home Centers	• Fluctuations in availability of raw materials • Fluctuations in demand of products • Limited staffing resources	Climate-related hazards primarily affect retail and trade by preventing consumers from accessing services, such as grocery centers or home improvement stores. However, retail and trade can also be affected through the damage of raw materials or forced closure of brick-and-mortar stores due to damage from a climate hazard.	• Agricultural Pests and Disease • Drought • Extreme Heat • Flooding • Landslides and Debris Flows • Public Health Hazards • Severe Weather • Wildfire
Tourism	Farms Whitewater Rafting Wine Tasting Rooms Fishing Marinas Ski Resorts	• Limited staffing resources • Inflation • Over extraction • Fluctuations in demand for products • Poor water quality	Many of the tourism opportunities in the County are dependent on specific environmental conditions, and therefore are easily interrupted by climate-hazards. For example, whitewater rafting represents an important source of economic revenue and jobs in the Coloma area of the County and peak day river use in summer months can exceed 3,000 people with over 105,000 total boaters on the South Fork of the American River being recorded in some years (El Dorado County 2017). Climate conditions, such as poor air quality caused by nearby wildfires, may dissuade tourists from partaking in outdoor activities. Climate hazards also may physically prevent customers from accessing businesses or impede the ability of businesses to remain open.	• Agricultural Pests and Disease • Extreme Heat • Flooding • Landslides and Debris Flows • Severe Weather • Wildfire
Transportation and Warehouse	General Freight Trucking	• Fluctuations in demand for products	Any climate-related hazard that affects road conditions, from snow that causes decreased visibility to debris flow	• Avalanche • Extreme Heat

Economic Sectors	Type	Non-Climate Stressors	Impact Description	Climate-Related Hazards
	Household and Office Goods Moving Long-distance trucking Transit Systems Employment	• Limited financial and staffing resources for timing repairs	that destroys entire expanses of roads, will affect the transportation industry. Climate hazards, such as extreme heat, severe weather, or public health restrictions, are likely to affect transit system operations by decreasing transit use.	• Flooding • Human-health Hazards • High Wind • Landslide and Debris Flows • Severe Weather • Wildfire

Sources: U.S. Census Tract ACS Economic Sector Categories; WSP Analysis 2023.

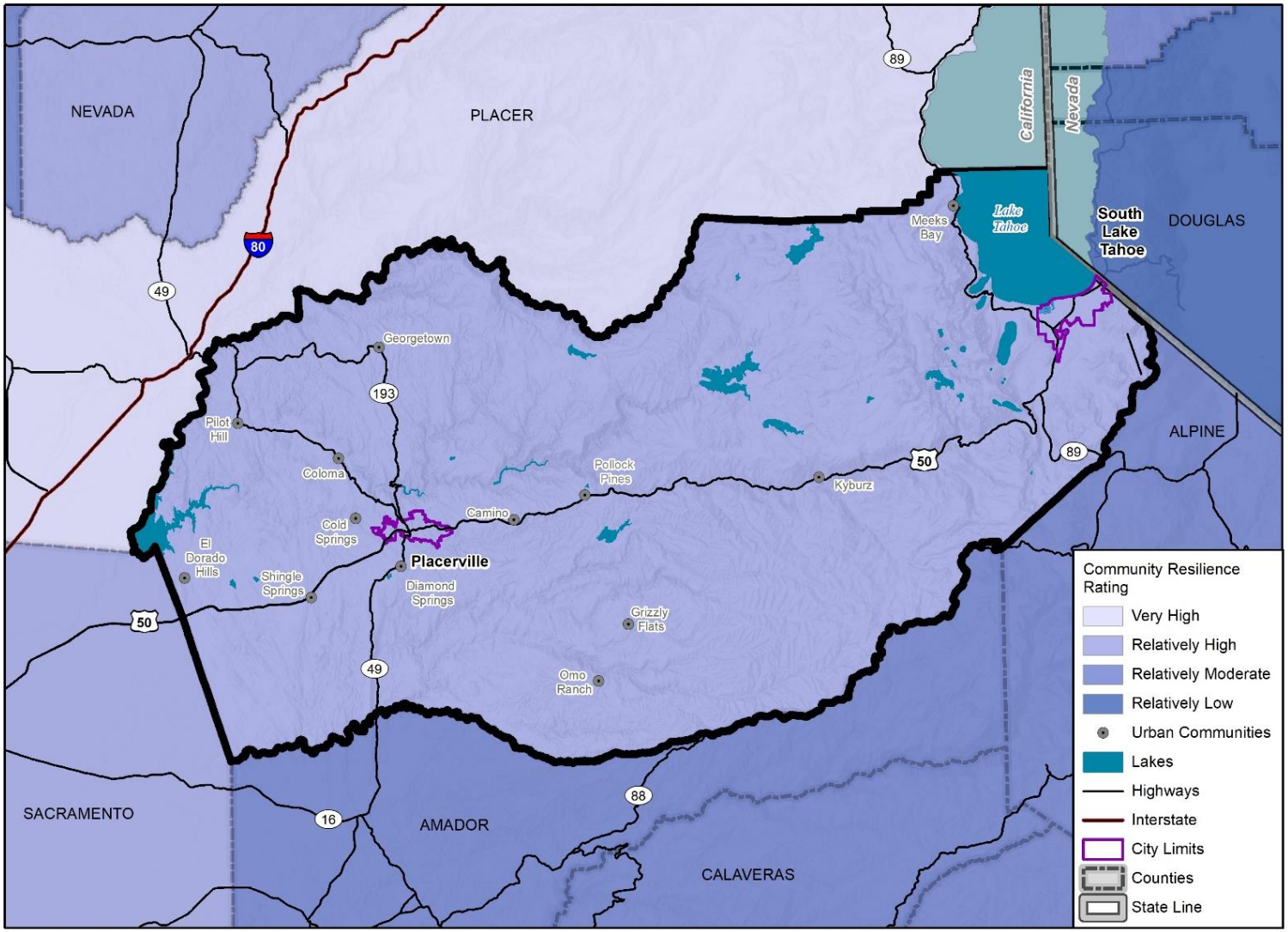
8. Adaptative Capacity

Adaptive capacity is the ability of a community to respond to, recover from, and adapt to climate-related hazards using existing programs and plans, tools, resources, and funding opportunities. It reflects the existing strengths of the County in meeting climate challenges and recognizes the resilience of the community in learning how to respond to and recover from recent hazard events associated with severe weather, flooding, and wildfires. In other words, it describes the ability and resources available to the County to implement changes that will make people and assets better prepared for a changing climate.

By understanding existing capabilities, the County can determine how these programs and tools influence the level of risk the communities face due to climate-related hazards. However, measuring adaptive capacity is a challenge, because it is particular to each community within the County and is not assessed the same way sensitivity and exposure to climate stressors is estimated, based on numerical and spatial GIS data available to quantify impacts. There is no set standard to measure the capacity of a community, which makes it difficult to compare capacity among communities. National tools, like FEMA's NRI, provide useful comparisons by using adaptive capacity scores based on plans and programs in place, the presence of planning department staff and floodplain administrators, and other community-based resources. The NRI uses a top-down approach and indices based on recommendations from the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) Baseline Resilience Indicators for Communities (HVRI BRIC) index (FEMA 2022). The HVRI BRIC dataset includes a set of 49 indicators that represent 6 types of resilience: social, economic, community capital, institutional capacity, housing/infrastructure, and environmental. It uses a local scale within a nationwide scope, and the national dataset serves as a baseline for measuring relative resilience (FEMA 2022).

Figure 8-1 shows the community resilience rating for the County based on FEMA's NRI. The County is rated as "relatively high", meaning that the communities in the County have a relatively high ability to prepare for anticipated natural hazards, changing climate conditions, and ability to withstand and recover rapidly from disruptions when compared to the rest of the United States (FEMA 2023). This community resilience ranking ranges from very low, relatively low, relatively moderate, to relatively high and very high (FEMA 2023). Moreover, in addition to the ranking, NRI also generates a community resilience score for counties nationwide. El Dorado County has a score of 67.60, meaning that only 33% of United States counties have a higher/stronger community resilience than El Dorado County. Meanwhile, when compared to other California counites this means that the County score (54.08) is near the national and state averages, but still behind approximately 27.6% of the counties in California. For example, according to FEMA's NRI, El Dorado's Community Resilience score is ranked "relatively moderate" The scoring ranges from The County's score (54.80) ranks slightly above the California average (52.85) meaning that only 27.6% of the counties in California have a higher Community Resilience score but the County has a score similar to the national average (54.59), meaning that 56.9% of the counties in the rest of the country have a higher score (FEMA 2023).

Figure 8-1 FEMA NRI Community Resilience Rating for El Dorado County



Source: FEMA NRI 2023.

By inventorying the County resources and national tools, the adaptive capacity assessment provides useful information because it shows a snapshot in time on how the County is currently coping with stressors and sets a baseline upon which to measure the effectiveness of future interventions to increase a community's overall resilience to climate change.

The purpose of the adaptive capacity assessment is to understand how ready the County is to respond and adjust to climate change based on input provided by the core County team, SEAC, stakeholder group, and community members. The adaptive capacity assessment for the County was examined based on existing federal, state, regional, and local policies and programs that help the communities in the County adapt to climate-related hazards. The policies and programs were organized by scale, starting with existing local plans and programs at the County-level administrative and technical level, existing programs at the State-level, and the federal funding opportunities available to the County, local communities, homeowners, and businesses.

Plans and programs consist of local plans, policies, programs, zoning ordinances, building and design standards, and key federal and state grant funds. The adaptive capacity assessment was also based on the public survey input and how the public perceives they are coping with climate change hazards; this input is important because it reflects a sample of individual and households in the County and their experiences adapting to climate change.

Public input from the survey, work sessions and workshops, and key feedback from the SBC's CVA process is also summarized to help inform policy development for climate adaptation in the County's General Plan Safety Element update. Drawing on existing plans and tools available to the public, the County can gain insight on the strategies people are currently using to cope with climate hazards, policies and programs' degree of effectiveness and how to prioritize investments. Taken together, the plans and public input provide direction on which policies should be implemented based on the most vulnerable communities and assets. Also, the combination of the adaptive capacity assessment with the County's climate vulnerability assessment results in the County's "net vulnerability" to climate-related hazards.

The adaptive capacity assessment is organized into four sections: plans and program capacity, administrative and technical capacity, fiscal capacity, and outreach and partnership capacity, which includes the feedback from the public survey.

A. Plans and Programs Capacity

The regulatory plans and programs incorporate existing planning and land use management and regulatory tools to protect public health and safety. **Table 8-1** outlines the plans and programs in place in the County.

Table 8-1 Regulatory Plans and Programs

Regulatory Tool	Active in County	Summary of Tool
General plan	Yes	Adopted July 19, 2004; Amended December 10, 2019
Zoning ordinance	Yes	Adopted August 14, 2018; Amended August 23, 2022
Subdivision ordinance	Yes	Amended February 10, 2009
Growth management ordinance	Yes	Development is guided by the Lake Tahoe Regional Plan and the County's General Plan. While not referenced as a growth management ordinance, development is controlled by established growth caps that regulate development over time through development rights.
Floodplain ordinance	Yes	Addressed in Chapter 130.32 of County code
Other special purpose ordinance (storm water, steep slope, wildfire)	Yes	Chapter 8.09 Vegetation Management and Defensible Space specifies the process to remove hazardous vegetation and combustible materials situated in the unincorporated areas of

Regulatory Tool	Active in County	Summary of Tool
		the County to reduce the potential for fire and to promote the safety and welfare of the community.
Building code	Yes	Adopted 2010 edition of California Building Standards Code, Chapter 110.16
Fire department ISO rating	Not Available	An ISO score reflects how prepared a community and area is for fires. While it mainly focuses on the local fire departments and water supply, there are other factors that contribute to an area's score. A fire department with a strong score may result in lower insurance premiums.
Erosion or sediment control	Yes	Addressed in Chapter 110.14 of County Code
Storm water management program	Yes	Storm Water Management Plan adopted 2004.
Site plan review requirements	Yes	Revised January 2004
Capital improvements plan	Yes	Adopted 2022
Economic development plan	No	A strategic plan developed to promote economic growth and development; aims to increase employment opportunities, improve the standard of living, and enhance the competitiveness of the region.
Local EOP	Yes	Adopted August 2022
Other special plans	Yes	The 2022 Strategic Plan lays out the County's roadmap to goals and objectives, and strategies to achieve economic development, good governance, healthy communities, infrastructure, and public safety.
Flood insurance study	Yes	Effective April 2012
Elevation certificates	No	Per County Code, elevation certificates are only required when unable to determine if project is in a flood zone.
Climate Action / Adaptation Plan	No	A practical tool to address the challenges posed by climate change; outlines strategies, policies, and actions to mitigate the causes of climate change while adapting to its impacts.
LHMP	Yes	Adopted 2018
Evacuation Plan	No	Ensures the safe and efficient evacuation of people during an emergency event or disaster; outlines specific procedures, protocols, and resources to be used during an evacuation, including transportation, sheltering, and communication.
Sustainability Plan	No	Outlines strategies, policies, and actions to promote sustainable development; may include specific targets and goals for reducing environmental impacts, improving social equity, and promoting economic prosperity in a way that balances the needs of the present with those of the future.
Community Health Plans & Assessments	No	Outlines goals, strategies, and actions to promote the health and well-being of community members; typically includes specific goals for improving community health outcomes, reducing health disparities, and enhancing access to health services.

Regulatory Tool	Active in County	Summary of Tool
Transportation Plan/Sustainable Communities Strategy	No	The West Slope is covered by SACOG's 2020 MTP/SCS and the Tahoe Basin is covered by the RTP/SCS developed by TMPO and TRPA.
Drought Contingency Plans	Yes	The El Dorado County Water Agency has developed an Upper American River Basin Regional Drought Contingency Plan

Sources: El Dorado County 2023, WSP Analysis 2023.

Local Plans and Programs

El Dorado County General Plan (2004)

The General Plan is the fundamental policy document of the County. It provides the guiding framework for the management and use of the County's physical, economic, and environmental resources. It also provides the basis for land use, design, open space conservation, existing housing and the provision of new housing, the provisions of supporting infrastructure and public services, the protection of environmental resources, and the protection of the residents and property from natural and human-caused hazards.

The General Plan outlines the goals, policies, and priorities for land use, growth, and development in the County. As an important component of the General Plan, the Safety Element identifies and addresses potential hazards, such as natural disasters, public health emergencies, and other threats to public safety.

Local Hazard Mitigation Plan (2018)

The LHMP provides a comprehensive analysis of natural and human-caused hazards in the County and focuses on the development of a range of mitigation projects. The LHMP maintains the County's eligibility for federal and state hazard mitigation assistance (HMA) grant funding. The LHMP complements the goals and policies in the Safety Element, and multiple sections of the Safety Element incorporate the LHMP through incorporation by reference, pursuant to California Government Code Section 65302(g).

Emergency Operations Plan (2023)

The Emergency Operations Plan establishes a structured and collaborative approach, from the initial response of on-site units to the functions of the Emergency Operations Center to the recovery phase. Its aim is to identify ways to address the needs of all members of the community throughout all stages of the emergency response process.

West Slope Community Wildfire Protection Plan

The El Dorado County Fire Safe Council recently developed a comprehensive CWPP for the West Slope of the County. This plan will rely on the outcomes of a large-scale community risk evaluation and prioritization approach, with a focus on creating practical fuel management zones that align with the current treatment network. The treatment initiatives will be designed to safeguard the community while considering the expected expenses and will offer a standardized format to help communities with financing and grant applications.

Tahoe Basin Community Wildfire Protection Plan

Tahoe RCD is leading an effort to update the Lake Tahoe CWPP. The current CWPP is an all-inclusive planning document that has assisted Tahoe collaborators in identifying crucial actions to mitigate wildfire hazards. The plan outlines tactics to minimize dangerous fuels, reinforce homes and enhance defensible spaces, as well as to prepare Tahoe communities for wildfire events. As the TFFT partners finalized the CWPP in 2015, it is necessary to refresh the plan's content, which includes incorporating knowledge acquired from the Caldor Fire.

El Dorado County Regional Transportation Plan 2020-2040
The RTP is designed to be a guide for the systematic development of a balanced, comprehensive, multi-modal transportation system. This system includes but is not limited to highways, streets and interregional roadways, public transit, aviation, freight/goods movement, active transportation (bikeways and pedestrian facilities), transportation systems management, and intelligent transportation systems. The RTP is action-oriented and pragmatic, considering both the short-term (up to 10 years) and long-term (10 to 20 year) periods.

Vegetation Ordinance
The County has a diverse and complex landscape, including mountains, forests, and other brush, or grass-covered wildlands, which have the potential to fuel a catastrophic fire event. The purpose of the ordinance is to provide for the removal of hazardous vegetation and combustible materials situated in the unincorporated areas of the County to reduce the potential for fire and to promote the safety and welfare of the community.

Integrated Natural Resource Plan
The Integrated Natural Resources Management Plan (INRMP) identifies important habitat in the County and establishes a program for effective habitat management. The goal of the INRMP is to mitigate impacts (direct, indirect, and cumulative) on biological resources that result from land use decisions associated with implementing the 2004 General Plan, to the extent that is economically, technically, and practically feasible. The INRMP also serves to fulfil project-level CEQA requirements for cumulative impacts from habitat loss and fragmentation.

El Dorado County Water Agency Water Resources Development and Management Plan
To achieve the County's General Plan vision, the WRDMP links the identified water resource-related challenges with the EDCWA's implementation programs through an assortment of resource management strategies. These strategies provide strategic directives that can mitigate the identified challenges through the collective and coordinated efforts of all responsible parties. The plan establishes key actions, specifies the primary responsible agency, and clarifies the Agency's corresponding roles in leading, facilitating, or supporting each activity in line with its authority.

El Dorado Irrigation District Urban Water Management Plan
The Urban Water Management Plan (UWMP) integrates local and regional land use planning, regional water supply, infrastructure, and demand management projects, as well as accounting for statewide challenges that may manifest through climate change and evolving regulations. Thoughtful urban water management planning provides an opportunity for the supplier to integrate supplies and demands in a balanced and methodical planning platform that addresses short-term and long-term planning conditions. In brief, the UWMP gathers, characterizes, and synthesizes water related information from numerous sources into a plan with local, regional, and statewide practical utility.

State and Regional Plans and Programs

2018 Safeguarding California
The California Climate Adaptation Strategy, also known as "Safeguarding California," is a comprehensive plan developed by the State to address the impacts of climate change on the State's economy, public health, natural resources, and infrastructure. The strategy includes measures to reduce greenhouse gas emissions and adapt to the effects of climate change that are already occurring, such as sea-level rise, more frequent and intense wildfires, and changes in precipitation patterns. It identifies best practices for varying regions and sectors, and provides resources, tools, guidance documents, and funding opportunities.

State Hazard Mitigation Plan

The California SHMP establishes statewide goals and objectives for hazard mitigation and provides guidance on mitigation strategies and access to resources. This information can be synthesized and used to guide local mitigation actions. The State recently released their Draft SHMP in March 2023.

California Wildfire and Forest Resilience Action Plan

The California Wildfire and Forest Resilience Action Plan is a comprehensive strategy developed by the State to address the increasing threat of wildfires in the State. The plan includes a wide range of measures beneficial to the County, including increasing investments in forest management, implementing measures to reduce the risk of catastrophic wildfires, and expanding the use of prescribed fire.

Tahoe Regional Planning Agency (TRPA) Regional Plan

The Regional Plan sets forth measures to achieve specific benchmarks that will revive Lake Tahoe's condition while also considering the economic and social well-being of the community. To accomplish this, the Regional Plan makes use of collaborations between private and public entities and offers incentives to property owners who undertake initiatives to preserve the lake. Additionally, the Regional Plan encourages sustainable renovation of older structures into compact, mixed-use town centers that allow residents and tourists to access work, home, and nature without relying on personal vehicles.

California Tahoe Conservancy Integrated Vulnerability Assessment of Climate Change in the Lake Tahoe Basin

The California Tahoe Conservancy created an Integrated Vulnerability Assessment of Climate Change in the Lake Tahoe Basin in 2020. The Integrated Vulnerability Assessment of Climate Change in the Lake Tahoe Basin provides residents, visitors, businesses, and public agencies with state-of-the-art information on how patterns of temperature and precipitation will change, and how these patterns will affect the things people care about. The common scenarios and analyses provided will help public agencies and stakeholder organizations anticipate climate change implications, and better design and maintain their future projects that improve the quality of life, land, and waters in Tahoe.

Bureau of Reclamation American River Basin Study

The Basin Study developed data, tools, analyses, and climate change adaptation strategies for the American River Basin. Strategies were examined to integrate and better coordinate local and federal water management practices to improve regional water supply reliability while enhancing Reclamation’s flexibility in operating Folsom Reservoir to meet flow and water quality standards.

Fire Adapted 50 Project

The objective of this project is to return forests and wildlands along the Highway 50 corridor to a more natural, fire resilient condition. The strategic fuel management project aims to help contain wildfires and facilitate long-term stewardship through practices such as continued mechanical and hand treatment and prescribed fire.

South County Fuels Reduction Project

The El Dorado County Fire Safe Council will receive more than $3.3 million to reduce fire fuels along roads and remove trees destroyed by bark beetles. The treatment zone encompasses 845 acres, where 4,813 residences within the vicinity of the project are expected to benefit. Communities within the project area include Diamond Springs, Omo Ranch, and Outingdale.

Additional Plans and Regulations

- 2021 California Climate Action Plan for Transportation Infrastructure
- Fire Management Plans
- Fire Code
- CAL FIRE California Fire Plans

Additional County Area and Specific Plans

- Meyers Area Plan
- Carson Creek Specific Plan
- Promontory Specific Plan
- Valley View Specific Plan
- El Dorado Hills Specific Plan
- Town Center West Development Plan
- Town Center East Development Plan
- Bass Lake Hills Specific Plan
- North West El Dorado Hills Specific Plan

Related Local Agency Plans

- El Dorado Irrigation District Plans
- Lake Tahoe Community College Plans and Programs
- South Tahoe Public Utility District UWMP
- South Tahoe Public Utility District LHMP

B. Administrative and Technical Capacity

Administrative and technical capacity is defined as the level of County personnel in place and working on activities related to public health and safety; disaster prevention, response, and recovery emergency preparedness; and long-range planning. **Figure 8-2** outlines the administrative and technical positions, tools, and services in place in the County.

Table 8-2 Administrative and Technical Personnel Resources

Personnel Resources	Yes/No	Department
Planner/engineer with knowledge of land development/land management practices	Yes	Planning and Building Department
Engineer/professional trained in construction practices related to buildings and/or infrastructure	Yes	Planning and Building Department
Planner/engineer/scientist with an understanding of natural hazards	Yes	Planning and Building Department
Personnel skilled in GIS	Yes	County Surveyor's Office
Full-time building official	Yes	Planning and Building Department
Floodplain manager	Yes	Building Services Department, Deputy Director of Building/Building Official
Emergency manager	Yes	Sherriff's Office
Grant writer	No	
Other personnel	Yes	Environmental Management Department
GIS Data Resources (Hazard areas, critical facilities, land use, building footprints, etc.)	Yes	County Surveyor's Office

Personnel Resources	Yes/No	Department
Warning Systems/Services (Reverse 9-11, cable override, outdoor warning signals)	No	

Sources: El Dorado County 2023, WSP Analysis 2023.

Air Quality Management District

The County Air Quality Management District (AQMD) works to improve air quality and quality of life for El Dorado County residents. The AQMD's primary goal is to ensure that the air in the County meets state and federal standards for clean air.

Animal Services

The agency works to promote responsible pet ownership and to ensure that domestic animals are properly cared for and protected. The agency provides support and assistance to animals during disasters and emergencies, including evacuation and sheltering services.

Area Agency on Aging

The Area Agency on Aging (AAA) is responsible for the administration of programs for County residents 60 years of age and older. The AAA services include aid weatherizing and fire-protecting homes, as well as transit services and information and assistance services.

Building Services

The Building Services agency is responsible for ensuring that buildings in the County are constructed and maintained in a safe and code-compliant manner. They conduct permits and inspections so ensure that buildings meet hazard mitigation requirements and work closely with local fire departments to ensure that buildings are constructed and maintained in a manner that reduces the risk of fire and promotes fire safety.

Chief Administrative Office

The CAO's primary role is to provide strategic leadership and management support to the County's Board of Supervisors and its departments. The CAO plays a central role in the County's emergency management efforts through its emergency preparedness and response program, which works to provide information to residents and coordinate resources to respond to crises and disasters.

Department of Agriculture

The County Department of Agriculture oversees ranch marketing and winery ordinances, industrial hemp, agricultural water stewardship and water quality management, as well was invasive weed information.

Department of Transportation

The County Department of Transportation (DOT) is responsible for managing and maintaining the County's transportation infrastructure, including roads, bridges, and public transit. The DOT roles include infrastructure planning and design, alternative transportation options, and emergency response facilitation.

Environmental Health

The Environmental Health Department is responsible for protecting public health and the environment in the County. The department plays an important role in climate adaption efforts through public education and outreach, ensuring water quality and supply, and providing proper channels to dispose of toxic waste.

Environmental Management

The mission of the Environmental Management Department is to protect, preserve, and enhance the public health, safety, and environment through a balanced program of environmental monitoring and

enforcement, innovative leadership, community education, customer service, and emergency response. The department is responsible for hazardous materials waste management and emergency plans.

Housing, Community, and Economic Development

The El Dorado County Housing, Community, and Economic Development Department is responsible for promoting affordable housing, economic development, and community revitalization in the County. The department provides grants and other funding opportunities to community organizations to support a range of activities, including infrastructure improvements, economic development projects, and community revitalization efforts. The division also provides technical assistance to help organizations plan and implement community development projects.

Long-Range Planning

The Long-Range Planning Department is tasked with ensuring that development in the County is consistent with the County's General Plan and zoning ordinances, and that it meets the needs of the community while also protecting the County's natural resources. The department conducts environmental reviews to ensure they meet CEQA requirements, and develops and implements land use plans such as the General Plan,

Office of Wildfire Preparedness and Resilience

The Office of Wildfire Preparedness and Resilience was established to facilitate the planning and implementation of wildfire mitigation activities across jurisdictions and land ownership in the County, and to support the creation and maintenance of fire-adapted communities through a countywide wildfire protection strategy. This effort is in response to the ever-increasing frequency and intensity of wildfires in California, which have resulted in the destruction of thousands of homes and hundreds of thousands of acres every year.

The County Wildfire Preparedness and Resilience Advisory Committee comprises the Chief Administrative Office, El Dorado County Fire Safe Council, CAL FIRE – Amador El Dorado Unit, USFS – El Dorado National Forest, El Dorado County Fire Chiefs Association, El Dorado County Fire Prevention Officers Association and the El Dorado and Georgetown Divide Resource Conservation Districts. Its purpose is to incorporate the interests and leverage the resources of stakeholders to create a fire-adapted and resilient County guided by a comprehensive wildfire prevention and preparedness strategy.

Parks, Trails, and River Mangement

The Parks, Trails, and River Management Department oversees recreation resources in the County. The department implements both the County and South Lake Tahoe Parks and Trails Master Plans, as well as the 2018 River Management Plan.

Public Health Division

The Public Health Division promotes the health and safety of individuals, communities, and animals in El Dorado County. The division works to protect public health by monitoring and regulating the County's food and water supply, air quality, and hazardous waste, and works to prepare for and respond to public health emergencies, such as disease outbreaks or natural disasters.

Sheriff's Office

The El County Sheriff's Office of Emergency Services (OES) is the emergency management agency for the County. Working in partnership with cities, fire departments, and law enforcement agencies, the office delivers countywide emergency services. Among its responsibilities are overseeing the County's response to both natural and human-caused disasters, delegating emergency duties to County departments, and supervising the County's emergency operations center. In addition, the OES disseminates current emergency-related information to the public through the County's website

Tahoe Planning and Stormwater Department

The Tahoe Planning & Stormwater Management division is responsible for planning and managing development in the Tahoe Basin area of the County, which is subject to unique environmental regulations due to its proximity to Lake Tahoe. It conducts environmental reviews, issues permits, and provides public outreach and education. It is also responsible for the Stormwater Management Program and West Slope development and redevelopment standards.

Vector Control

The Environmental Management Environmental Control District provides quality Vector Control services and protect the public health and safety with minimal impact to the environment over 195 square miles from the crest of the Sierra Nevada mountain range near Echo Summit to the shore of Lake Tahoe in both the City of South Lake Tahoe and the unincorporated area of El Dorado County

County Fire Protection Districts

There are several fire protection districts in the County. Some, but not all, have participated in creating a Community Wildfire Protection Plan (CWPP). Participation in a CWPP makes a district more prepared to prevent and respond to wildfires and can help to secure access to wildfire prevention and preparedness grants. **Table 8-3** lists the 12 fire districts in the County and shows whether they participated in the development of and are covered by a CWPP.

Table 8-3 County Fire Protection Districts and Community Wildfire Protection Plans

Fire Protection District	CWPP (Yes/No)	CWPP Name
Cameron Park Fire Department	No	
Diamond Springs/El Dorado Fire Protection District	Yes	Diamond Springs/El Dorado Fire Protection District CWPP
El Dorado County Fire District	Yes	El Dorado County Fire District Wildfire Protection Plan Auburn Lake Trails Property Owners Association CWPP Goldbug Park CWPP Logton CWPP
El Dorado Hills Fire Department	Partial	Lakehills/Southpointe CWPP
Garden Valley Fire Protection District	No	
Georgetown Fire Protection District	Yes	Georgetown Fire Protection District CWPP
Lake Valley Fire Protection District	Yes	Lake Tahoe CWPP
Latrobe Fire Protection District	No	
Meeks Bay Fire Protection District	Yes	Lake Tahoe CWPP
Mosquito Fire Protection District	No	
Pioneer Fire Protection District	Partial	Grizzly Flats CWPP
Rescue Fire Protection District	Partial	Gold Hill Estates CWPP

Sources: El Dorado County 2023, WSP Analysis 2023.

C. Fiscal Capacity

Table 8-4 identifies federal fiscal capacity tools, resources, and grant opportunities the County could potentially use to help fund climate adaptation, hazard mitigation, and floodplain management activities.

Table 8-4 Summary of Federal Grants related to Climate Adaptation

Federal Grants	Eligible Applicants	Summary of Grant
Building Resilient Infrastructure and Communities (BRIC)	State agencies, federally recognized tribes, local governments/communities	BRIC funds may be used for capability and capacity-building activities, mitigation projects, and management projects. Projects must reduce or eliminate risk and damage from future natural hazards.
Hazard Mitigation Grant Program (HMGP)	State agencies, federally recognized tribes, local governments/communities, private non-profit organizations	HMGP funding is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster.
EPA Green Infrastructure	State, tribal and local governments, regional councils, Water utilities	The EPA Green Infrastructure Grant Program provides funding to support the implementation of green infrastructure projects that can help communities manage stormwater and reduce combined sewer overflows, which can pollute waterways and cause flooding.
Pre-Disaster Mitigation (PDM) Program	State agencies, federally recognized tribes, local governments/communities	PDM is designed to assist implementation of a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters.
Flood Mitigation Assistance (FMA) Program	State agencies, federally recognized tribes, local governments/communities	FMA funding is available through the National Flood Insurance Fund (NFIF) for flood hazard mitigation projects as well as plan development and is appropriated by Congress.
Fire Management Assistance Grant (FMAG) Program	State agencies, local governments, and tribal governments	Under the FMAG Program, FEMA provides grants for equipment, supplies, and personnel costs for the mitigation, management, and control of any fire on public or private forest land or grassland

Federal Grants	Eligible Applicants	Summary of Grant
		that threatens such destruction as would constitute a major disaster.
Community Development Block Grant (CDBG) Mitigation program	State agencies, local governments, non-profit organizations	The CDBG Mitigation program provides resources to assist communities in reducing the risks and impacts of natural disasters. The program is intended to help communities build resilience and mitigate future risks by supporting a variety of activities, including infrastructure projects, public facilities improvements, and community planning.
Assistance to Firefighters Grant (AFG)	Fire departments, non-affiliated EMS organizations, state fire training academies, non-federal airport and/or port authority fire or EMS organizations	The AFG Program provides financial assistance to provide critically needed resources that equip and train emergency personnel to recognized standards, enhance operational efficiencies, foster interoperability, and support community resilience.

Sources: El Dorado County 2023, WSP Analysis 2023.

Table 8-5 identifies state fiscal capacity tools, resources, and grant opportunities the County could potentially use to help fund climate adaptation, hazard mitigation, and floodplain management activities.

Table 8-5 Summary of State Grants

State Grants	Eligible Applicants	Summary of Grant
DWR Water Resource Grants	Water districts	The California DWR offers various grant programs to support water resource management in California. These grants are aimed at improving water supply reliability, protecting the environment, and enhancing the resilience of California's water systems.
Prepare California	Tribal Governments, local governments/ communities/ special districts, private non-profit organizations	The Prepare California Initiative is aimed at reducing long-term risks from natural disasters, such as flooding, earthquakes, wildfires, landslides, extreme heat, and drought by investing in local capacity building and mitigation projects designed to protect communities. This program is designed to unlock federal matching funds for community mitigation projects and is intended for communities that are the most socially vulnerable and at the highest risk for future natural hazard events.
California Wildfire	Local governments (including	CWMP is a state-funded grant program

State Grants	Eligible Applicants	Summary of Grant
Mitigation Program (CWMP)	cities, counties, and special districts), resource conservation districts, fire protection districts and fire departments	designed to reduce the risk of wildfire in California. The program provides funding for projects that improve forest health, reduce fuel loads, and increase the resiliency of communities to wildfires.
Adaptation Planning Grant Program (APGP)	Local public entities, California Native American Tribes, community-based organizations, and non-profits	The APGP helps fill local, regional, and tribal planning needs, provide communities the resources to identify climate resilience priorities, and support the development of a pipeline of climate resilient infrastructure projects across the state.
Regional Resilience Planning and Implementation Grant Program (RRGP)	Local public entities, California Native American tribes, community-based organizations	The RRGP will fund projects that advance climate resilience and respond to the greatest climate risks in their regions through three major activities: capacity building, planning (including identifying climate resilience priorities), and project implementation.
Water Recycling Funding Program (WRFP)	Local agencies and other stakeholders	WRFP provides funding for construction loans and grants, and planning grants.
Forest Health Grants	Local, state, and federal agencies, universities, special districts, Native American tribes, private forest landowners, and non-profit organizations	CAL FIRE's Forest Health Program funds active restoration and reforestation activities aimed at providing for more resilient and sustained forests to ensure the future existence of forests in California while also mitigating climate change, protecting communities from fire risk, strengthening rural economies, and improving California's water and air.
Environmental Enhancement and Mitigation Grant Program	Local, state, and federal governmental agencies	The California Natural Resources Agency EEM Program offers grants for projects to mitigate the environmental impacts caused by new or modified public transportation facilities.
Regional Forest and Fire Capacity Program (RFFC)	California Department of Conservation	The RFFC Program supports regional leadership to build local and regional capacity, and to develop, prioritize, and implement strategies and projects that create fire-adapted communities and landscapes by improving ecosystem health, community wildfire preparedness, and fire resilience.
Small Community	Public agencies, public utilities,	The Program aims to implement needed

State Grants	Eligible Applicants	Summary of Grant
Drought Relief Program	special districts, colleges and universities, mutual water companies, non-profit organizations, federally or locally recognized tribes	resiliency measures and infrastructure improvements for small water suppliers and rural communities. The Program will support projects and programs that provide immediate and near-term water supply reliability benefits and improve small communities' drought and water shortage resiliency and preparedness.
Drinking Water State Revolving Fund (DWSRF)	Non-profits, public agencies, tribal governments	DWSRFs fund a wide range of drinking water infrastructure projects. Six categories of projects are eligible to receive DWSRF assistance: treatment, transmission and distribution, source, storage, consolidation, and creation of new systems.
Sierra Nevada Conservancy (SNC) Wildfire Recovery and Forest Resilience Program	Public agencies, non-profit organizations, federally or locally recognized tribe	The Program prioritizes planning and implementation of forest health projects that promote wildfire and forest resilience and support the goals of California's Wildfire and Forest Resilience Action Plan and the SNC Watershed Improvement Program.
Regional Climate Collaboratives Resources	California Tribes, CBOs, foundations, joint-powers agreements, non-profits, small businesses, local governments	The program funds Collaboratives to conduct place-based capacity building activities, within a three-year grant term, that support under-resourced communities in accessing funding and resources to plan and implement climate mitigation, adaptation, and resiliency projects.
Transformative Climate Communities (TCC) Program	CBOs, local governments, non-profits, philanthropic organizations and foundations, faith-based organizations, coalitions or associations of non-profits, community development finance institutions, community development corporations, joint powers authorities, California Native Tribes	The TCC Program funds community-led development and infrastructure projects that achieve major environmental, health, and economic benefits in California's most DACs. TCC empowers the communities most impacted by pollution to choose the strategies and projects best suited to achieve their community vision and enact transformational change with data-driven milestones and measurable outcomes.

Sources: El Dorado County 2023, WSP Analysis 2023.

Table 8-6 identifies additional grant opportunities the County could potentially use to help fund climate adaptation, fuel reduction and vegetation management, and air quality improvement projects.

Table 8-6 Summary of Additional Grants

Additional Grants	Eligible Applicants	Summary of Grant
Air Quality Management District (AQMD) Grant/Incentive Programs	Citizens, private and public entities	The County AQMD offers a large variety of grants to aid in the improvement of air quality and quality of life for County residents.
The El Dorado County Fire Safe Council (EDCFSC) Defensible Space Assistance Program	Senior, veterans, and those with low incomes in the western slope of the County.	ECFSC has been awarded funding to help those who are both financially and physically unable to develop defensible space around their homes to improve fire suppression efforts and improve likelihood of surviving a fire.

Sources: El Dorado County 2023, WSP Analysis 2023.

D. Organizational and Outreach Capacity

Table 8-7 summarizes other organizational and collaborative partnership opportunities in the County that enhance education, outreach, and engagement related to climate change, wildfire safety, and neighborhood planning.

Table 8-7 Organizational and Outreach Capacity Summary

Organization	Available in County	Description
Neighborhood Radio Watch	Yes	Neighborhood Radio Watch Groups are informal groups made up of residents. Their mission is to stay connected through the use of radios, establish a radio communications system to educate residents on security and safety, and to provide back-up communication when traditional communication methods fail or are not available.
Fire Safe Council	Yes	Fire Safe Councils are grassroots, community-led organizations that mobilize residents to protect their homes, communities, and environments from catastrophic wildfire. Fire Safe Councils educate homeowners about community wildfire preparedness activities while working with local fire officials to design and implement projects that increase the wildfire survivability of their communities.
FAIR Plan	Yes	The FAIR Plan is a syndicated fire insurance pool that comprises all insurers licensed to conduct property/casualty business in California. The FAIR Plan provides basic fire insurance for high-risk properties when this coverage is not available from a traditional carrier.
Firewise	Yes	Firewise USA® program teaches people how to adapt to living with wildfire and encourages neighbors to work together and take ongoing action to prevent losses.

Sources: El Dorado County 2023, WSP Analysis 2023.

Sierra Business Council

The Sierra Business Council (SBC) is a non-profit that assists communities throughout the Sierra Nevada in planning for climate change by reducing greenhouse gas emissions and adapting to changes already impacting the region. In 2021, the SBC conducted a CVA for rural communities throughout the Sierra Nevada to prepare for climate change by examining social, economic, and environmental vulnerabilities

specific to the region and by providing climate planning technical assistance.

The primary intent of the report was to provide an understanding of climate risks within the Sierra Nevada Conservancy region (not including Lake Tahoe Basin), and to technically assist with implementation of SB 379, as many communities in the region do not have a hazard mitigation plan or an updated safety element as required by SB 379. The CVA provides specific indicators and hazards at the jurisdictional level, and explains how Sierra ecosystems, economies, and communities will be impacted by those hazards. The assessment can be used to inform hazard mitigation plans and safety elements for counties within the SNC region.

The SBC partnered with the Sierra Institute for Community and Environment to conduct workshops to rate community capacity based on five capitals: physical, human, social, cultural, and financial. Risk profiles were developed for each of the 22 counties within the SNC region, using climate and population data at the county level. The Potential Impact and Adaptive Capacity Scoring Rubric was used to determine impact and capacity scores for climate hazards facing different populations in the Sierra. Capacity scores can vary greatly even among neighboring communities within the same county. The County met with the SBC during the development of their CVA to leverage information in the SBC's CVA and specifically, the input gathered during a series of public workshops held in 2021.

The County has a Climate Hazard Risk Score of 6.48/10. Tourism could be significantly affected by increased extreme heat and reduced snowpack. Drought and heat-related illnesses could also lead to public health threats. Additionally, 45% of the population lacks high-speed internet access, which could hinder communication during emergencies such as floods, fires, or extreme heat. Communities on the western side of the County tend to have higher capacity scores compared to the eastern side of the County, but overall, the County has a medium capacity score of 3 out of 5 in responding to climate stressors.

Table 8-8 outlines the capacity scores for the communities in the County. As shown, the American River Canyon, Cedar Grove, Grizzly Flats/Omo, Mosquito/Swansboro, Pollock, Volcanoville/Quinette, and Outingdale/Somerset were ranked as more vulnerable to climate change given their lower capacity scores.

Table 8-8 SBC Community Capacity Scores for El Dorado County

Community	Overall Capacity Score
American River Canyon	1
Auburn Lake Trails	4
Camino	4.5
Cedar Grove	2
Cameron Park	4
Coloma/Lotus	4
Cool/Pilot Hill	3
Diamond Springs	3.5
El Dorado Hills	5
El Dorado/Nashville	2.5
Fair Play	3.5
Georgetown	3
Gold Hill	3

Community	Overall Capacity Score
Garden Valley/Greenwood	3.5
Grizzly Flats/Omo	2
Kelsey	3
Latrobe	2.5
Mosquito/Swansboro	1.5
Newton/Sly Park	3
Placerville	4
Pleasant Valley	4
Pollock	2
Rescue	3.5
Shingle Springs	3.5
Volcanoville/Quinette	2
Outingdale/Somerset	1.5

Source: SBC 2022.

El Dorado Community Foundation

The El Dorado Community Foundation's goal is to improve the community for present and future generations by supporting non-profits in their efforts to improve public health, safety, and welfare. One of the ways the foundation accomplishes its goal is through the Endow El Dorado grant cycle, which provides large capacity-building grants to organizations to support their growth. The foundation is prepared to respond to community needs as a partner, convener, and funder, without directing the community but instead supporting its direction.

The South Fork of the American River (SOFAR)

SOFAR Cohesive Strategy project aims to promote a healthy, productive forest ecosystem across all lands and to create a fire-resilient ecosystem that supports viable populations of all native species, sustainable fisheries, functioning and restored watersheds and water quality, protected cultural resources, and diverse recreational opportunities.

Tahoe Central Sierra Initiative (TCSI)

The TCSI is the first pilot project under the Watershed Improvement Program (WIP) and aims to restore the resilience of 2.4 million acres of Sierra Nevada forests and watersheds. It focuses on developing and demonstrating innovative planning, investment, and management tools across all lands.

Better Together Caldor Recovery

The mission of Better Together is to assist in identifying the unmet needs of those affected by the Caldor Fire and work toward disaster recovery, and to coordinate access to resources that would provide relief. The Better Together Caldor Fire Relief Long Term Recovery Group is a community-led collaboration of non-profit, faith-based, local, county, state, and national organizations that works to share information and resources that can help address the needs of individuals, families and children in the County, California, all of whom have been affected by the Caldor Fire disaster.

E. Opportunities for Adaptive Capacity Building

Based on the adaptive capabilities assessment, the County has several existing mechanisms that already help to mitigate hazards. In addition to these existing capabilities, the County has opportunities to expand or improve on these policies and programs to further protect the community. These adaptation opportunities are organized into short-term and long-term strategies. Short-term future adaptation strategies are opportunities the County could consider promoting and implementing in the next 1 to 3 years, such as evacuation planning efforts, defensible space maintenance, and home hardening incentives. Long-term adaptation strategies are opportunities the County could consider in the future like increasing public education, discouraging future development in flood-prone areas, and expanding vegetation management programs. These longer-term strategies often contain benefits that require initial investment and time to grow. For example, tree planting in public spaces and parks may be less desired than cooling centers on the West Slope when considered with a short-term lens, because it takes time for trees to mature and provide adequate shade. However, these trees will provide a whole host of benefits to the community when they mature. Below is a summary of additional short-term and long-term adaptation strategies.

Short-Term Adaptation

- Energy efficient appliances
- HVAC upgrades
- Home hardening
- More shelters
- Defensible space
- Better utilization of material generated from fuels reduction – biomass, saw logs
- Prescribed fire projects
- Generators for critical facilities

Long-Term Adaptation

- Tree planting
- Shade structures
- Roof/snow load inspections
- Cooling centers
- Wildfire fuels treatment projects (i.e. mechanical, prescribed burning, thinning, etc.)
- Electrical power grid resiliency programs
- Forest health and watershed protection projects
- Evacuation route development
- Water efficiency and conservation
- Ordinance enhancements
- Energy independence initiatives/ energy efficiency upgrades
- Critical facilities protection

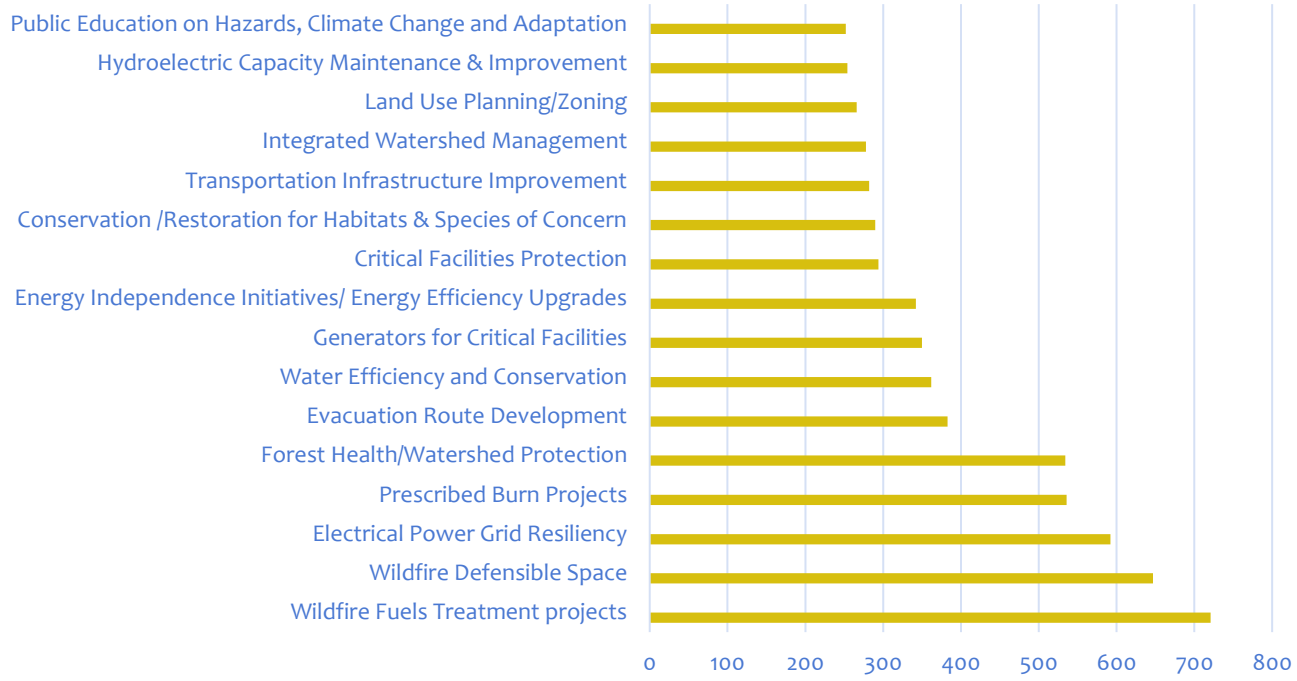
Barriers

- Cost of retrofits
- Regulatory approvals
- Homeowners vs. renters (who can do what based on lease, ownership, etc.)
- Utility options (electric vs. community-scale options)
- Education not available

F. Public Survey Results and Recommendations

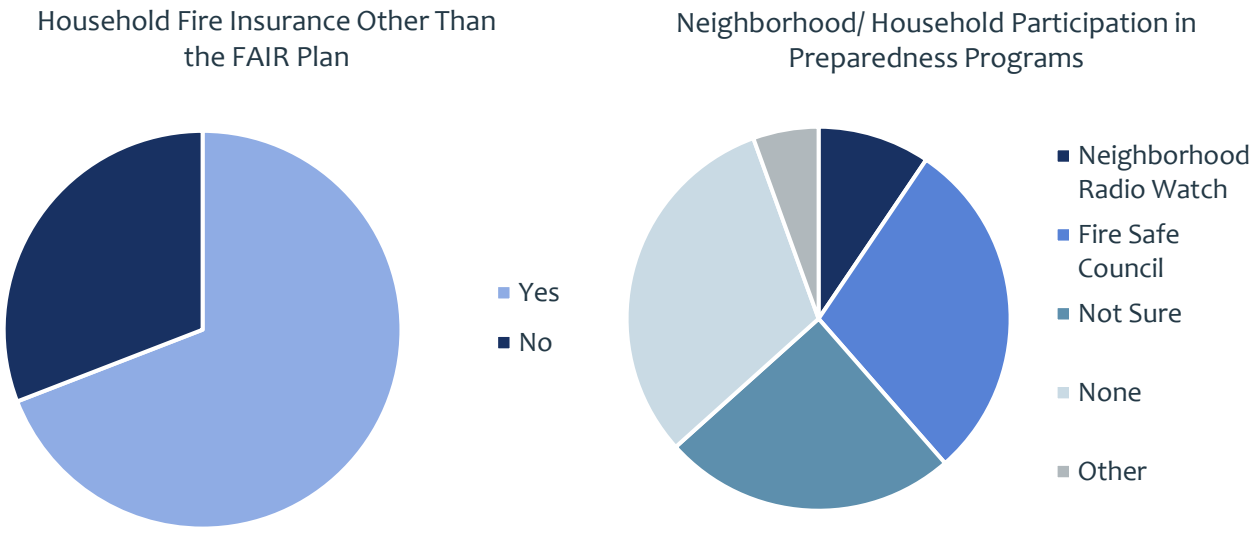
The key takeaways from over 900 public survey responses received on the CVA included the fact that respondents were most interested in climate adaptation strategies focused on wildfire protection. **Figure 8-2** and **Figure 8-3** summarize the public survey input.

Figure 8-2 Top Adaptation Strategies from the Public Survey



Sources: County CVA Public Survey 2023

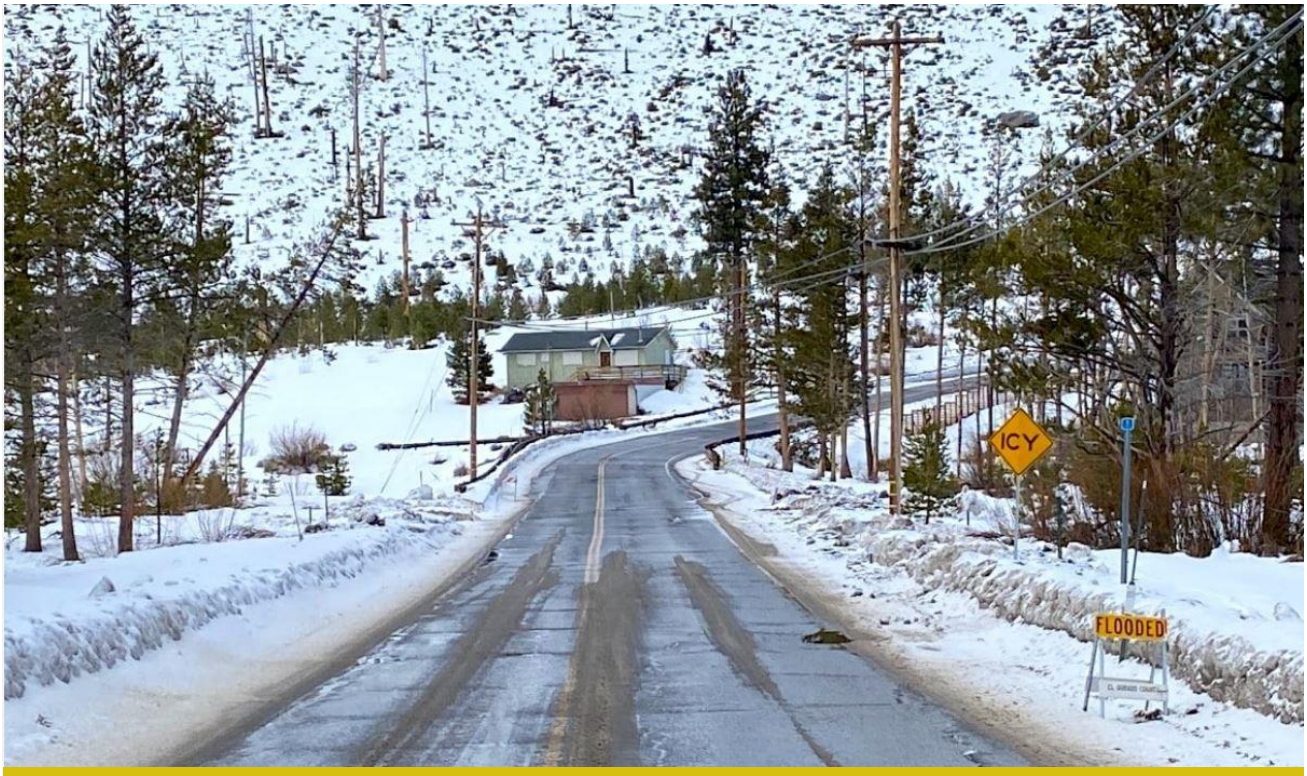
Figure 8-3 Current Public Participation in Adaptation Measures



Sources: County CVA Public Survey 2023

In summary, the key takeaways from the survey show that the community relies on the County to implement community-scale adaptation strategies and projects related to fuels reduction, evacuation

planning, and snow removal and road maintenance. The survey input also shows that there are limited opportunities and financial incentives for homeowners, renters, and individual households to make improvements to their homes and to adapt at an individual scale besides mandatory defensible space maintenance and basic emergency planning. Local training through FireWise and Fire Adapted Communities programs and individual grants to homeowners and renters currently provide incentives for retrofitting existing neighborhoods based on the number of residents participating in these programs. Scaling up these individual and community incentives should be considered as policies and programs in the Safety Element update.



Localized flooding associated with numerous rain on snow events occurred during the 2022-2023 winter season in the County. These events involved multiple warm and wet multi-day storms with heavy snow at high elevations and rain at lower elevations.

Photo Credit: Tahoe Daily Tribune, Bill Rozak 2023.

9. Key Findings and Vulnerability Scores

The CVA process helps County staff, the SEAC, stakeholder groups, elected and appointed officials, and members of the public understand the vulnerabilities of key community assets exposed to climate change. As part of this assessment, the County and SEAC developed the vulnerability scores to identify populations and assets in the County that have a high and severe vulnerability to climate-related hazards. This scoring tool serves to support the County and its socially vulnerable populations by informing future planning efforts associated with the health, safety, and well-being of the County. The results of the vulnerability scores highlight the sensitive populations, critical facilities, natural resources, and economic services that are highly and severely vulnerable to climate-related hazards.

Table 9-1 shows the 20 sensitive populations that are highly or severely vulnerable to each climate-related hazard. These sensitive populations are based on the indicators that were found to best represent the socially vulnerable communities in the County based on the various sources referenced in Section 4. Of the 180 combinations of sensitive populations and climate-related hazards, 47 were highly or severely vulnerable (score of V4 or V5).

The 1,274 critical facilities were categorized into 42 categories based on the critical facility database categories. Among these 42 categories, 22 are highly or severely vulnerable (score of V4 or V5) for at least one hazard type. Water and wastewater and electrical transmission infrastructure was the most vulnerable to flooding, landslides, and wildfire hazards, followed by communication, transportation, and education facilities and infrastructure. **Table 9-2** shows the critical facility categories that are highly or severely vulnerable to each climate-related hazard. The vulnerabilities scores for the critical facilites is also based on a combination of the quantitative GIS analysis, the wildfire assessment for critical facilities, and the qualitative assessment. Of the 279 combinations of the critical facilities and climate-related hazards, 30 were highly or severely vulnerable.

Table 9-3 shows the natural resource categories that are highly or severely vulnerable to each climate related hazard. The vulnerability scores for natural resources were based on a qualitative assessment. Of the 189 combinations of natural resource types, 45 were highly or severely vulnerable.

Table 9-4 shows the economic service sectors that are highly or severely vulnerable to each climate related hazard. The vulnerability scores for economic service categories were based on a qualitative assessment. Of the 450 combinations of economic service sectors, 51 were highly or severely vulnerable.

Vulnerability scores were not completed for private and commercial properties in the County.

Table 9-1 Vulnerability Scores for Sensitive Populations to Climate-Related Hazards

Population Indicator	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flow	Severe Weather	Wildfire
Children (under 14)	V1	--	V1	V5	V2	V3		V4	V4
Cost-burdened households	V2	--	V2	V4	V3	V3	V2	V4	V5
Ethnic minorities	V2	--	V1	V1	V2	V2	--	V2	V2
High-pollution burdened households	V2	--	V2	V2	V2	V5	--	V3	V3
Households in mobile homes	V1	--	V2	V4	V4	V3	V2	V4	V5
Households in poverty	V2	--	V2	V4	V3	V3	V2	V4	V5
Isolated and rural communities	V1	V2	V5	V4	V3	V3	V2	V3	V5
Low-income households	V2	--	V2	V4	V3	V3	V2	V4	V5
Outdoor workers	V2	--	V2	V5	V2	V4	V2	V2	V4
Overcrowded households	V2	--	V2	V4	V2	V3	--	V3	V3
People with chronic health conditions	V2	--	V2	V2	V2	V5	--	V3	V3
Unemployed persons	V2	--	V2	V4	V3	V3	V2	V4	V5
Persons with disabilities and access and functional needs	V1	--	V2	V3	V2	V3	V1	V5	V5
Persons with limited English proficiency	V2	--	V2	V3	V2	V3	--	V4	V4
Persons with limited accessibility	V1	--	V2	V4	V3	V3	--	V5	V5
Persons experiencing homelessness	V1	--	V3	V5	V3	V3	--	V5	V5
Persons living in single-access roads	V1	--	V2	V2	V3	V3	--	V3	V5
Renters	V1	--	V2	V3	V2	V2	--	V3	V3
Seniors	V1	--	V2	V5	V3	V5	--	V5	V5
Seniors living alone	V1	--	V2	V5	V3	V5	--	V5	V5

Sources: California APG 2020; WSP Analysis 2022.

NOTES: * Blank cells with dashes indicate that the climate-related hazard is not applicable to the sensitive population indicator. Vulnerability Scores based on methodology summarized in the California APG and based on a combination of quantitative GIS analysis completed by WSP and qualitative analysis completed by the County team.

Table 9-2 Vulnerability Scores for Critical Facilities and Infrastructure Highly and Severely Vulnerable to Climate-Related Hazards

Critical Facility Type	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Water infrastructure	V1	V2	V3	V2	V1	V1	V3	V4	V5
Wastewater treatment system	V1	V2	V3	V2	V1	V1	V1	V4	V2
Dam	--	V1	--	--	V2	--	V4	V3	V4
Substation	--	V1	--	V2	V2	--	V3	V3	V2
Power plant	--	V1	V2	V4	V2	--	V3	V4	V2
Communication tower	--	V1	--	--	V1	--	V3	V4	V4
Amtrak station & transit station	--	V1	--	--	V3	--	V1	V3	V1
Aviation facility	--	V1	--	--	V1	--	V1	V1	V2
Bridge	--	V2	--	--	V1	--	V3	V4	V4
Government transportation	--	V1	--	--	V1	--	V1	V3	V2
Marina*	--	--	V4	--	V4	--	--	V3	V1
Child care provider/service		--		V4	V1	V4	V2	V4	V3
School	--	--	--	V4	V1	V4	V2	V4	V3
College/university	--	--	--	V4	V1	V4	V3	V4	V1
Emergency operations center	--	--	--	--	V1	--	V1	V1	V1
Fire station	--	V1	V1	--	V1	--	V2	V2	V3
Police station	--	V1	--	--	V1	--	V1	V2	V1
Community resource	--	--	--	V4	V1	V2	V2	V2	V3
Government facility	--	--	--	V3	V1	V2	V3	V2	V1
Jail		--		V1	V1	V2	V1	V2	V1
Shelter	--	--	--	V4	V1	V2	V2	V2	V3
Court (including Superior Court)	--	--	--	V1	V1	V2	V2	V2	V1
Clinic	--	--	--	V1	V1	V3	V1	V1	V1

Critical Facility Type	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Community nursing & family service	--	--	--	V1	V1	V3	V2	V1	V2
Emergency medical service	--	--	--	V1	V4	V3	V4	V1	V1
Health support & recovery & prevention service	--	--	--	V1	V2	V3	V3	V1	V3
Hospital	--	V1	--	V1	V1	V3	V1	V1	V1
Senior care facility/senior community service	--	--	--	V1	V2	V3	V3	V1	V4
Veteran service	--	--	--	V1	V1	V1	V1	V1	V1
RMP/tier II facility	--	--	--	V1	V1	--	V4	V2	V4
Toxic release inventory facility	--	--	--	V1	V1	--	V1	V2	V4

Sources: HIFLD, NID, NBI, El Dorado County, NFHL Effective date 4/3/2012, FEMA, Department of Conservation, CGS, CAL FIRE, FRAP, WSP GIS Analysis
NOTES: *Refers to Tahoe Keys Marina.

Table 9-3 Vulnerability Scores for Natural Resources Highly and Severely Vulnerable to Climate-Related Hazards

Natural Resource Types	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Rivers, creeks, streams	V1	V1	V4	V4	V1	--	V3	V2	V5
Lake and reservoirs	V1	V1	V4	V4	V1	--	V3	V2	V5
Aquatic resources	V1	V1	V4	V4	V2	--	V4	V2	V5
Wetlands and wet meadows	V1	V1	V4	V4	V2	--	V4	V2	V5
Riparian areas	V1	V1	V4	V4	V2	--	V4	V2	V5
Mixed conifer forests	V1	V1	V4	V4	V2	--	V4	V3	V5
Oak woodland	V1	V1	V4	V4	V2	--	V4	V2	V5
Mixed chaparral	V1	V1	V4	V4	V2	--	V4	V2	V5
Shrublands	V1	V1	V4	V4	V2	--	V4	V2	V5
Annual grasslands	V1	V1	V4	V4	V2	--	V4	V2	V5
State parks and recreation areas	--	--	V1	V1	V3	--	V2	V2	V4

Natural Resource Types	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
County parks and open space	--	--	V2	V1	V3	--	V2	V2	V4
Fairgrounds	--	--	V2	V1	V3	--	V2	V1	V3
Campgrounds	--	--	V2	V1	V3	--	V2	V1	V4
Greenways	--	--	V1	V1	V2	--	V1	V1	V3
Bicycle trails	--	--	V1	V1	V2	--	V1	V1	V3
Hiking trails	--	V4	V1	V1	V2	--	V1	V1	V3
Beaches	--	--	V4	V1	V3	--	V1	V1	V2
Historic buildings	--	--	V1	V2	V2	--	V2	V3	V4
Historic districts	--	--	V1	V2	V2	--	V2	V3	V4
Cultural resources	--	--	V2	V2	V2	--	V2	V2	V2

Sources: El Dorado County, WSP GIS Analysis
NOTES: Includes marinas on Natomas Lake and Lake Tahoe.

Table 9-4 Vulnerability Scores for Economic Sectors Highly and Severely Vulnerable to Climate-Related Hazards

Economic Services	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Apiary	V4	--	V5	V4	V1	--	V1	V2	V4
Grazing/pastures	V2	--	V5	V5	V1	--	V1	V1	V4
Livestock	V2	--	V4	V4	V2	--	V2	V2	V4
Nursery	V5	--	V4	V3	V1	--	V2	V1	V5
Orchards	V5	--	V4	V3	V1	--	V2	V1	V5
Timber products	V5	V1	V5	V4	V1	--	V3	V1	V5
Vineyards	V5	--	V5	V4	V1	--	V2	V3	V5
Wineries	V5	--	V5	V4	V2	V4	V4	V2	V5
Building materials	V3	--	V2	V1	--	V3	--	--	V3
Non-residential building	--	--	--	V2	--	V3	--	V3	V4
Outdoor recreation development	--	V2	--	V3	V1	V3	V1	V2	V4
Power and communication systems	--	V2	--	V3	V1	V3	--	V5	V5

Economic Services	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Residential building	--	--	--	V2	V1	V3	--	V3	V4
Road development and maintenance	--	--	--	V2	V1	V3	--	V3	V4
Water and sewer systems	--	--	--	V1	V1	V3	--	V1	V4
Government offices	--	--	--	V1	V1	V3	--	V3	V3
Police and fire protection	--	--	--	--	V1	V3	--	V4	V4
Transportation program regulation	--	--	--	V1	V1	V3	--	V3	V3
Computer programming services	--	--	--	--	--	V3	--	--	--
Publishing, production, and broadcasting	--	--	--	--	--	V3	--	--	--
Bars	--	--	--	--	--	V5	--	V3	V3
Casinos	--	--	--	--	--	V5	--	V3	V3
Hotels/motels	--	--	--	--	--	V4	--	V3	V3
Resorts	--	--	--	--	--	V4	--	V3	V3
Restaurants	--	--	--	--	--	V4	--	V3	V3
Ski resorts	--	V2	--	--	--	V3	--	V3	V5
Aviation accessory products	--	--	--	--	--	V3	--	--	--
Commercial printing	--	--	--	--	--	V3	--	--	--
Computer parts	--	--	--	--	--	V3	--	--	--
Microwave and millimeter wave products	--	--	--	--	--	V3	--	--	--
Sign manufacturing	--	--	--	--	--	V3	--	--	--
Consulting services	--	--	--	--	--	V3	--	--	--
Education services	--	--	--	--	--	V4	--	--	--
Financial sector	--	--	--	--	--	V3	--	--	--
Hospitals	--	--	--	--	--	V5	--	--	--
Insurance	--	--	--	--	--	V3	--	--	--
Research services	--	--	--	--	--	V3	--	--	--
Bakeries and food manufacturing	--	--	--	--	--	V4	--	--	--

Economic Services	Agriculture Pests and Disease	Avalanche	Drought	Extreme Heat	Flooding	Public Health Hazards	Landslide and Debris Flows	Severe Weather	Wildfire
Car dealerships	--	--	--	--	--	V3	--	--	--
Gas stations	--	--	--	--	--	V2	--	--	--
Grocery stores	--	--	--	--	--	V4	--	--	--
Home centers	--	--	--	--	--	V3	--	--	--
Farms	V3	--	V3	V1	--	V4	--	V1	--
Fishing	--	--	V1	V1	--	V1	--	--	--
Trucking and Transport	--	--	--	--	--	V2	--	V1	--

Sources: El Dorado County, WSP GIS Analysis

10. Acronyms and Abbreviations

AAA - Area Agency on Aging

AB – Assembly Bill

ACS – American Community Survey

ADU – Accessory dwelling unit

APG – The California Adaptation Planning Guide

AQMD – Air Quality Management District

ATSDR – Agency for Toxic Substances and Disease Registry

CAL FIRE – California Department of Forestry and Fire Protection

Cal OES – California Office of Emergency Services

Caltrans – California Department of Transportation

CBO – Community-based organization

CDC – Centers for Disease Control and Prevention

CDDA – The California Disaster Assistance Act

CEC – California Energy Commission

CEQA – California Environmental Quality Act

CFR – Code of Federal Regulations

CGS – California Geological Survey

CRHR – California Register of Historic Resources

CRNA – California Natural Resources Agency

CVA – Climate vulnerability assessment

DACs – Disadvantaged communities

DFIRM – Digital Flood Insurance Rate Map

DOF – Department of Finance

DOT – Department of Transportation

DWR – Department of Water Resources

EDCTC – El Dorado County Transportation Commission

EDWA – El Dorado County Water Agency

EID – El Dorado Irrigation District

EOC – Emergency Operation Centers

EOP – Emergency operations plan

FEMA – Federal Emergency Management Agency

FHSZs – Fire Hazard Severity Zones

FPOA – Fire Prevention Officer's Association

FRAP – Fire and Resource Assessment Program

GHG – Greenhouse gas

HIFLD – Homeland Infrastructure Foundation-Level Data

HMA – Hazard Mitigation Assistance

HPI – Healthy Places Index

HVRI – Hazards and Vulnerability Research Institute

HVRI BRIC – Hazards and Vulnerability Research Institute Baseline Resilience Indicators for Communities

INRMP – Integrated Natural Resources Management Plan

IPCC – International Panel on Climate Change

ISO – Insurance Services Office

KDBI – Keetch-Byram Drought Index

LHMP – Local hazard mitigation plan

LTBMU – Lake Tahoe Basin Management Unit

MHI – Median household income

Miwok Indians – The Shingle Springs Band of Miwok Indians

mm – Millimeter

mph – Miles per hour

msl – Mean sea level

MTP/SCS – Metropolitan Transportation Plan/Sustainable Communities Strategy

NBI – National Bridge Inventory

NEPA – National Environmental Policy Act

NFHL – The National Flood Hazard Layer

NGO – Non-profit organization

NID – National Inventory of Dams

NOAA – National Oceanic and Atmospheric Administration

NRHP – National Register of Historic Places

NRI – National Risk Index

NWS – The National Weather Service

OEHHA – California Office of Environmental Health Hazard Assessment

OPR – Office of Planning and Research

PG&E – Pacific Gas & Electric

PRC – Public Resources Code

PSPS – Public Safety Power Shutoff

RCD – Resource Conservation District

RCP – Representative Concentration Pathway

RMP – Risk Management Program

RTP/SCS – Regional Transportation Plan/Sustainable Communities Strategy

SAC – The Sierra Avalanche Center

SACOG – The Sacramento Area Council of Governments

Safety Element – General Plan Noise, Public Health, and Safety Element

SB – Senate Bill

SBC – Sierra Business Council

SEAC – Safety Element Advisory Committee

SHMP – State Hazard Mitigation Plan

Sierra CAMP – Sierra Climate Adaptation and Mitigation Partnership

SIG – Spatial Informatics Group

SOI – Sphere of Influence

SoVI – Social Vulnerability Index

SR – State Route

SRAs – State Responsibility Areas

SVI – Social Vulnerability Index

SWE – Snow water equivalent

TFFT – Tahoe Fire & Fuels Team

TRPA – Tahoe Regional Planning Agency Tahoe Transportation District

UCCE – University of California Cooperative Extension

UNFCCC – The United Nations Framework Convention on Climate Change

USGS – United States Geological SurveyUWMP –Urban Water Management Plan

Washoe Tribe – The Washoe Tribe of Nevada and California

WRCC – Western Regional Climate Center

WRDMP – Water Resources Development and Management Plan

WUI – Wildland urban interface

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12. References

Applied Survey Research (ASR). (2019). *2019 El Dorado County homeless point-in-time count & survey.* El Dorado County. https://static1.squarespace.com/static/59d77cb46f4ca3f9b42e222a/t/5f22df2d00b2cb6d552adce4/1596120879832/2019+El+Dorado+Homeless+Point-in-Time+Count+%26+Survey.pdf

Bedsworth, Louise, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja. (2018). *Statewide summary report. California's fourth climate change assessment*. California Governor's Office of Planning and Research, Scripps Institution of Oceanography, California Energy Commission, California Public Utilities Commission. https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf

Borgschulte, M., Molitor, D., & Zou, E. (2022). Air pollution and the labor market: Evidence from wildfire smoke (No. w29952). *National Bureau of Economic Research*. https://doi.org/10.1162/rest_a_01243

The Bureau of Land Mangement. (2022) *GIS data*. U.S. Department of the Interior. Retrieved 2022, from https://www.blm.gov/services/geospatial/GISData

The Bureau of Reclamation. (2022) *American River basin study: Interior region 10 – California-Great basin*. U.S. Department of the Interior. https://www.usbr.gov/watersmart/bsp/docs/arbs/ARBS-Study.pdf

CAL FIRE. (2022a). *CAL FIRE news release: CAL FIRE investigators determine cause of the Dixie Fire*. California Department of Forestry and Fire Protection. https://www.fire.ca.gov/media/edwez51p/dixie_fire_release.pdf

CAL FIRE. (2022b). Statistics. Top 20 Largest California Wildfires. Retrieved 2023, from https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/our-impact/fire-statistics/featured-items/top20_acres.pdf?rev=be2a6ff85932475e99d70fa9458dca79&hash=A355A978818640DFACE7993C432ABF81

Cal-Adapt. (2018). Cal-Adapt. University of California at Berkeley's Geospatial Innovation Facility under contract with the California Energy Commission. Retrieved 2022, from https://cal-adapt.org/

Climate Change and Health E–uity - CalBRACE Project. (2018). *California building resilience against climate effects (CalBRACE) project: Preparing for climate change in Calif–rnia - A public health approach*. California Department of Public Health. Retrieved 2022, from https://www.cdph.ca.gov/Programs/OHE/Pages/calbrace.aspx

California Department of Finance (DOF). (2022). *Population Estimates for Cities, Countites, and the State – January 1, 2021 and 2022.* May 2022. The State of California. Retreived March 2023, from https://dof.ca.gov/forecasting/demographics/estimates-e1/

California Department of Finance (DOF). (2020). *Projections.* The State of California. https://dof.ca.gov/forecasting/Demographics/projections/

California Department of Water Resources (DWR). (n.d.) *DAC mapping tool.* State of California. Retrieved 2022, from https://gis.water.ca.gov/app/dacs/

California Department of Water Resources (DWR). (n.d.) *Drought.* State of California. Retrieved 2022, from https://water.ca.gov/drought

California Employment Department. (2022). *Labor market profiles.* Retrieved 2022, from https://edd.ca.gov/en/jobs/

California Geological Survey. (2018). *Deep-Seated landslide susceptibility (MS58).* California Department of

Conservation. https://maps.conservation.ca.gov/cgs/

California Natural Resources Agency (CRNA). (2022). *Protection Californians from extreme heat: A state action plan to build community resilience*. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Climate-Resilience/2022-Final-Extreme-Heat-Action-Plan.pdf

California Office of Emergency Services (Cal OES). (2018). *Califronia state hazard mitigation plan.* Govenor's office of emergency services. https://www.caloes.ca.gov/wp-content/uploads/002-2018-SHMP_FINAL_ENTIRE-PLAN.pdf

California Office of Environmental Health Hazard Assessment. (2021). *CalEnviroScreen 4.0*. California Environmental Protection Agency. Retrieved 2022, from https://oehha.ca.gov/calenviroscreen

California Office of Historic Preservation. (n.d.) *California historical landmarks by county.* California State Parks. Retrieved January 2023, from https://ohp.parks.ca.gov/?page_id=21387

California Tahoe Conservancy. (2021). Tahoe Climate adaptation primer. The State of California, California Natural Resources Agency. https://tahoe.ca.gov/wp-content/uploads/sites/257/2021/06/Tahoe-Climate-Adaptation-Primer.pdf

California Tahoe Conservancy. (2020). Integrated Vulnerability Assessment of Climate Change in the Lake Tahoe Basin. California Natural Resources Agency. Retrieved in 2022. Available at: https://tahoe.ca.gov/wp-content/uploads/sites/257/2020/04/Integrated-Vulnerability-Assessment-of-Climate-Change-in-the-Lake-Tahoe-Basin_2020.pdf

Centers for Disease Control and Prevention (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) Geospatial Research, Analysis, and Services Program. (2020). *CDC/ASTDR social vulnerability index (SVI).* U.S. Department of Health and Human Services. Retrieved 2022, from https://www.atsdr.cdc.gov/placeandhealth/svi/

Coloma – Lotus Fire Safe Council. (2016). *Community wildfire protection plan for the Coloma – Lotus fire safe council area of El Dorado County, California*. Prepared for the El Dorado County Fire Safe Council, Diamond Springs, California. https://www.edcfiresafe.org/about-the-council/satellite-councils/lotus-coloma-fsc/community-wildfire-protection-plan/

Council on Environmental Quality (CEQ). (2022). Climate and Economic Justice Screening Tool. (Version 1.0 of the Tool was released on November 22, 2022). Office of the President of the United States, Executive Office. Retreived March 2023, from https://screeningtool.geoplatform.gov/en/

Cowan, J., & Knoll, C. (2023). *In Montecito, the million-dollar views still come with mudslide risks.* The New York Times. Retrieved January 25, 2023, from https://www.nytimes.com/2023/01/17/us/montecito-mudslide-2018-california-storms.html

Dahl, K. (2022). *With climate change, nights are warming faster than days. why?* The Equation. Retrieved December 2022, from https://blog.ucsusa.org/kristy-dahl/with-climate-change-nights-are-warming-faster-than-days-why/

Department of Homeland Security. (2021). *Homeland infrastructure foundation-level data (HIFLD) open data.* Geospatial Management Office. Retrieved 2022, from https://hifld-geoplatform.opendata.arcgis.com/

Dettinger, Michael, Holly Alpert, John Battles, Jonathan Kusel, Hugh Saford, Dorian Fougeres, Clarke Knight, Lauren Miller, Sarah Sawyer. (2018). Sierra Nevada summary report. California's Fourth Climate Change Assessment. https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-

SUM-CCCA4-2018-004_SierraNevada_ADA.pdf

El Dorado and Apline Counties. (2020). 2020 El Dorado / Alpine County agriculture crop & livestock report. The California Department of Agriculture. https://www.edcgov.us/Government/CAO/StrategicPlan https://www.edcgov.us/Government/ag/pages/annual_crop_report.aspx

El Dorado County Assesors Office. (n.d.) *Assessor.* El Dorado County. https://www.edcgov.us/Government/Assessor

El Dorado County Chief Administrative Office. (2022). *2022 Board approved strategic plan*. County of El Dorado. https://www.edcgov.us/Government/CAO/StrategicPlan

El Dorado County Health and Human Services. (2023) C*oronavirus 2019 (COVID-19) cases for El Dorado County*. El Dorado County. Retrieved January 3, 2023, from https://edcgov.us/Government/hhsa/covid-19-cases

El Dorado County Planning Department. (2004). 2004 El Dorado County general plan: A plan for managed growth and open roads; A plan for quality neighborhoods and traffic relief (General Plan). https://www.edcgov.us/Government/planning/pages/adopted_general_plan.aspx

El Dorado County Praks Division. 2017. *El Dorado County River Management Plan: 2017 Annual Report.* River Management Program. River Use 1997-2017. Retrieved March 2023, from https://www.edcgov.us/Government/River/Documents/2017%20El%20Dorado%20County%20River%20Management%20Plan%202017%20Annual%20Report%20final%20draft.pdf

El Dorado County Sheriff. (2018). *El Dorado County local hazard mitigation plan (LHMP).* https://www.edcgov.us/Government/sheriff/Documents/ElDoradoCounty_LHMP.pdf

El Dorado Water Agency (EDWA). (2019) *Water resources development and management plan.* https://www.edwateragency.org/Shared%20Documents/2019_WRDMP_Final.pdf

Elevate to El Dorado. (n.d.) Strategic advanages. El Dorado County. Retrieved 2022 from https://www.elevatetoeldorado.com/strategic-advantages

FEMA. (2022). Hazus Flood Technical Manual. Hazus 5.1. July 202. Retrieved in February 2023 from https://www.fema.gov/sites/default/files/documents/fema_hazus-flood-model-technical-manual-5-1.pdf.

FEMA. (2012). *National flood hazard layer: NFHL_06017C*. Department of Homeland Security. https://msc.fema.gov/portal/home

FEMA. (2018). *Glossary of Related Terms*. Emergency Management Institute. Retrieved January 30, 2023, from https://training.fema.gov/emiweb/is/icsresource/assets/glossary%20of%20related%20terms.pdf

FEMA (n.d.) *Disaster declarations for states and counties.* Department of Homeland Security. Retrieved 2022, from Disaster Declarations for States and Counties | FEMA.gov

Fire and Resource Assessment Program (FRAP). (2022). *GIS data*. California Department of Forestry and Fire Protection (CAL FIRE). https://frap.fire.ca.gov/mapping/gis-data/

Frankson, R., L.E. Stevens, K.E. Kunkel, S.M. Champion, D.R. Easterling, W. Sweet, and M. Anderson, 2022: California State Climate Summary 2022. NOAA Technical Report NESDIS 150-CA. NOAA/NESDIS, Silver Spring, MD, 6 pp.

California Department of Forestry and Fire Protection (CAL FIRE). 2021. The Governor's Forest Management Task Force. (2021). California's wildfire and forest resilience action plan. California Department of Water Resources, Public Affairs Office, Creative Services Branch.

https://www.fire.ca.gov/media/ps4p2vck/californiawildfireandforestresilienceactionplan.pdf

GreenInfo Network. (2022). *California protected areas database (CPAD)*. Retrieved 2022, from https://data.cnra.ca.gov/dataset/california-protected-areas-database

The Integrated Climate Adaptation and Resiliency Program (ICARP). (2018). Defining vulnerable communities in the context of climate adaptation. Governor's Office of Planning and Research. https://opr.ca.gov/docs/20180723-Vulnerable_Communities.pdf

Intergovernmental Panel on Climate Change (IIPC) Fifth Assessment Report (AR5) . (2014). *Climate change 2014: Synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change.* Core Writing Team, R. K. Pachauri, and L. A. Meyer. Retrieved December 2022, https://www.ipcc.ch/report/ar5/syr/

Tahoe Metropolitan Transportation Organization (TMPO). (2017). Linking Tahoe: Lake Tahoe Basin Transit Master Plan. (2017). Retrieved January 2023, from https://www.tahoetransportation.org/wp-content/uploads/2020/09/2017-June-6_Tahoe_TMP_adopted.pdf

National Centers for Environmental Information. (2022). *Storm events database.* National Oceanic and Atmospheric association. Retrieved August 2022, from https://www.ncdc.noaa.gov/stormevents/

National Historic Landmarks. (n.d.). *List of NHLs by state. National Parks Service*. Retrieved January 2023, from https://www.nps.gov/subjects/nationalhistoriclandmarks/list-of-nhls-by-state.htm

National Park Service. (nd). GIS program. Department of the Interior. Retrieved 2022, from https://www.nps.gov/orgs/1581/index.htm

National Risk Index. (n.d.) *Social vulnerability (SoVI)*. Department of Homeland Security. Retrived 2022, from https://hazards.fema.gov/nri/social-vulnerability

National Weather Service. (n.d.). Heat safety tips and resources. NOAA's National Weather Service. Retrieved 2022, from https://www.weather.gov/safety/heat

NRCS NWCC, n.d.: Snowpack: Snow Water Equivalent (SWE) and Snow Depth [Donner Summit, CA]. Natural Resources Conservation Service, National Water and Climate Center, Portland Oregon. https://www.nrcs.usda.gov/wps/portal/wcc/home/snowClimateMonitoring/snowpack/

Pescaroli, G., & Alexander, D. (2019). What are cascading disasters?. *UCL Open Environment*, 2019(1). . https://dx.doi.org/10.14324/111.444/ucloe.000003

Public Health Alliance of Southern California (2022). *California healthy places index (HPI)*. Retrieved 2022, from https://healthyplacesindex.org

Pyregence 2022. Pyrologix Fire Hazard and Risk Data Created for Pyregence. https://pyregence.org/

Sierra Climate Adaptation and Mitigation Partnership (Sierra CAMP). (2022). Sierra Nevada regional climate vulnerability assessment (Regional CVA). Sierra Business Council. https://www.sierrabusiness.org/archives/vulnerability-assessment/

Sierra Nevada Conservancy. (2017). *The state of the Sierra Nevada's forests: From bad to worse.* https://sierranevada.ca.gov/wp-content/uploads/sites/326/2019/12/SOS-v2-a11y.pdf

Strapazzon, G., Schweizer, J., Chiambretti, I., Brodmann Maeder, M., Brugger, H., & Zafren, K. (2021). Effects of climate change on avalanche accidents and survival. *Frontiers in physiology*, 12, 639433. https://doi.org/10.3389/fphys.2021.639433

Tahoe Regional Planning Agency (TRPA). (2012) *Threshold standards and regional plan.* *https://www.trpa.gov/wp-content/uploads/Adopted-Regional-Plan.pdf*

The Technical Advisory Group (TAG). (2018). *Planning and investing for a resilient California: A guidebook for state agencies.* Govenor's Office of Planning and Research. https://opr.ca.gov/docs/20180313-Building_a_Resilient_CA.pdf

Thomas, N., Mukhtyar, S., Galey, B., and Kelly, M. (2018). Cal-Adapt: Linking Climate Science with Energy Sector Resilience and Practitioner Need. Report prepared for California's Fourth Climate Change Assessment. California Governor's Office of Planning and Research, California Natural Resources Agency, and California Energy Commission. https://www.energy.ca.gov/sites/default/files/2019-11/Projections_CCCA4-CEC-2018-015_ADA.pdf

U.C. Merced wildfire area burned annual mean business as usual scenario CanESM2 RCP 8.5, 2005 , 2050, 2099 https://cal-adapt.org/data/download/

U.S. Census Bureau. (2021). *2016-2020 American community survey 5-year estimates*. https://data.census.gov/table

U.S. Census Bureau (2021). *Decennial census*. Retrieved 2022, from https://data.census.gov/table

U.S. Climate Resilience Toolkit. (n.d.). *Glossary*. NOAA's Climate Program Office. Retrieved January 30, 2023, from https://toolkit.climate.gov/content/glossary

U.S. Forest Service (USFS). 2022. *Aerial Detection Survey: 2022 Summary Report.* Accessed in February 2023, from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1088611.pdf

U.S. Federal Government, 2014: U.S. Climate Resilience Toolkit. [Online] http://toolkit.climate.gov. Accessed January 2023.

U.S. Fish and Wildlife Service. (nd). *All geospatial data*. Department of the Interior. Retrieved 2022, from https://gis-fws.opendata.arcgis.com/

UNFCC (United Nations Framework Convention on Climate Change). (2019). *UN climate change annual report 2018.* https://unfccc.int/sites/default/files/resource/UN-Climate-Change-Annual-Report-2018.pdf

USA Federal Lands. (2022). *DOD military installations ranges and training areas layer*. USA Department of Defense Lands. Retrieved 2022, from https://www.arcgis.com/home/item.html?id=6b911a60a5a4465a85fd5c42668bf907

USGS (United States Geological Survey). (2021). *Data Spotlight: Downscaled Climate Projections to Inform Climate Research in the South-Central U.S. Region*. Climate Adapatation Science Centers. Retrieved December 2022, from https://www.usgs.gov/news/data-spotlight-downscaled-climate-projections-inform-climate-research-south-central-us-region

USGS (United States Geological Survey) Gap Analysis Project (GAP). (2020) *Protected areas database of the United States (PAD-US) 2.1.* U.S. Geological Survey data release, https://doi.org/10.5066/P92QM3NT

USGS (United States Geological Survey). (2011). Susceptibility to Deep-Seated Landslides in California. Retrieved February 2023, from https://www.conservation.ca.gov/cgs/Documents/Publications/Map-Sheets/MS_058.pdf

USGS (United States Geological Survey). (n.d.). *Landslides 101.* Natural Landslides Hazards Program. Retrieved 2022, from https://www.usgs.gov/programs/landslide-hazards/landslides-101

Westerling, A. L. (2018). Wildfire simulations for California's Fourth Climate Change Assessment: Projecting changes in extreme wildfire events with a warming climate. California's Fourth Climate Change

Assessment, California Energy Commission. Publication Number: CCCA4-CEC-2018-014. https://www.energy.ca.gov/sites/default/files/2019-11/Projections_CCCA4-CEC-2018-014_ADA.pdf

Western Regional Climate Center. (2022a). *Station metadata*. Desert Research Institute and National Centers for Environmental Information. Retrieved December 2022, from https://wrcc.dri.edu/

Western Regional Climate Center. (2022b). *Station Maximum Wind Gust Data.* Sierra Snow Lab California. Station Wind Rose Maximum Wind Gusts from November 1, 2002 through November 1, 2022. Retrieved March 2023, from https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?cacssl