TOWN OF PARADISE
RESOLUTION NO. 2024-11

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF PARADISE ADOPTING AN AMENDMENT TO THE SAFETY ELEMENT OF THE 1994 PARADISE GENERAL PLAN AND FINDING THE AMENDMENT WITHIN THE SCOPE OF THE CERTIFIED NEGATIVE DECLARATION PREPARED FOR THE TOWN OF PARADISE HOUSING AND SAFETY ELEMENT UPDATES: TOWN OF PARADISE SAFETY ELEMENT 2024 UPDATE

WHEREAS, the Safety Element is one of the seven mandatory elements of the Town's General Plan that are required by State law; and

WHEREAS, the update of the Safety Element focuses on identifying public safety risks and creating a unique set of goals, policies, and implementation actions that address these risks; and

WHEREAS, Senate Bill (SB) 1035 requires jurisdictions to review their Safety Element at least every eight years and revise it as necessary to address climate change and resiliency strategies; and

WHEREAS, SB 99 requires jurisdictions to review their Safety Element concurrently with the update to the Town's Housing Element and revise it as necessary to identify residential developments in a hazard area identified in the Safety Element that do not have at least two emergency evacuation routes; and

WHEREAS, Assembly Bill (AB) 747 requires jurisdictions to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios; and

WHEREAS, the Town has prepared an update to the Safety Element pursuant to the requirements of SB 1035, SB 99, and AB 747; and

WHEREAS, the Town of Paradise Safety Element incorporates by reference the current Butte County Local Hazard Mitigation Plan, approved by the Federal Emergency Management Agency (FEMA) in 2019, as required by AB 2140 to increase opportunities for financial assistance under the California Disasters Assistance Act; and

WHEREAS, the update to the Safety Element was completed concurrently as part of the Housing Element for 2022-2030 and will be a stand-alone Safety Element upon adoption; and

WHEREAS, pursuant to Government Code section 65302(g)(8), the draft update of the Safety Element was made available for review to the California Geological Survey of the Department of Conversation (CGS) and the Office of Emergency Services as well as the State Board of Forestry and Fire Protection; and

WHEREAS, pursuant to California Public Utilities Code (PUC) Section 21676(b), the draft Safety Element was referred to the Butte County Airport Land Use Commission (BCALUC) for a determination of consistency with relevant airport/land use compatibility criteria in the comprehensive Airport Land Use Compatibility Plan for the environs of the Paradise Skypark Airport; and

WHEREAS, on September 20, 2023, the BCALUC determined the update to the Town of Paradise Safety Element to be consistent with the applicable airport/land use policies; and

WHEREAS, the Town is also required to conduct early coordination with participating State agencies, such as CAL FIRE, and receive a recommendation for the Safety Element from the Board of Forestry and Fire Protection due to the Town's location within a designated Very High Fire Hazard Severity Zone; and

WHEREAS, on January 23, 2024, the Board of Forestry and Fire Protection's Resource Protection Committee had no recommendations for further updates to the Safety Element; and

WHEREAS, an Initial Study and Negative Declaration were prepared to evaluate the environmental impacts of the Housing and Safety Element Updates pursuant to the California Environmental Quality Act (CEQA) and certified on June 14, 2022 through Paradise Town Council Resolution No. 2022-39 (State Clearinghouse No. 2022040351); and

WHEREAS, the Town of Paradise acting as lead agency has determined that there are no new significant environmental impacts or new information associated with the project and therefore finds the Safety Element Update within the scope of the previously adopted Negative Declaration; and

WHEREAS, the Safety Element was publicly made available on February 11, 2024, and no written comments were received from members of the public; and

WHEREAS, California Government Code Sections 65353 and 65354 require the Planning Commission to conduct a public hearing and notify the Town Council in writing of its recommendation; and

WHEREAS, the Paradise Planning Commission conducted a duly noticed public hearing on February 27, 2024 concerning the proposed amendment to the Safety Element text of the 1994 Paradise General Plan and, after conducting the public hearing, adopted Resolution No. 2024-01 recommending Town Council approval of the Draft Safety Element Update; and

WHEREAS, on February 28, 2024, a public hearing notice was published for the Town Council public hearing on March 12, 2024; and

WHEREAS, the Town Council has considered the analysis and recommendations of town staff; has considered the Safety Element, as revised in response to comments received from the California Department of Forestry and Fire Protection (CAL FIRE); and has considered comments made at a public hearing conducted by the Town Council; and on the basis thereof has determined pursuant to Government Code Section 65358 that a certain amendment to the 1994 Paradise General Plan that would update the Safety Element in order to attain compliance with current State safety element law is not only in the public interest but also would be internally consistent with the remainder of the Paradise General Plan.

NOW, THEREFORE, BE IT RESOLVED by the Paradise Town Council of the Town of Paradise as follows:

SECTION 1. The Town, as lead agency under CEQA, has certified the Town of Paradise Housing and Safety Elements Update Negative Declaration by adoption of Town Resolution No. 2022-39 on June 14, 2022. The Town as lead agency, has determined that the update of the Safety Element does not include substantive changes that would result in new or more impacts than those identified, analyzed, and adopted as part of the project and is within the scope of and consistent with the final Negative Declaration certified by Town Council through Resolution No. 2022-39. Therefore, the update of the Safety Element has been determined to be within the scope of and consistent with the certified Negative Declaration and therefore no addendum or supplement to the Negative Declaration is necessary; and

SECTION 2. The Town Council hereby adopts the amendment to the Safety Element of the 1994 Paradise General Plan known as Town of Paradise Safety Element 2024 Update in order to make the Paradise Safety Element consistent with current State safety element law, which amendment is set forth in Exhibit "A" attached hereto.

PASSED AND ADOPTED by the Town Council of the Town of Paradise this 12th day of March 2024, by the following vote:

AYES:	Greg Bolin, Steve Crowder, Steve "Woody" Culleton, Rose Tryon and Ronald Lassonde, Mayor
NOES:	None
ABSENT:	None
ABSTAIN:	None

Ronald Lassonde, Mayor

ATTEST: March 13, 2024

By: Dina Volenski
Dina Volenski, Town Clerk

APPROVED AS TO FORM:

By:
Scott E. Huber, Town Attorney

Town of Paradise

Safety Element

Prepared for:

Town of Paradise

Draft December 2023

URBAN PLANNING PARTNERS INC.

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INTRODUCTION

The Safety Element is the primary document for linking land use, conservation, and housing decisions to local safety planning. The goal of the element is to protect public health and safety by reducing potential short- and long-term unreasonable risk of death, injuries, property damage, and economic impacts resulting from the effects of natural and non-natural hazards. Natural hazards for the town of Paradise include fire hazards, seismic and other geologic hazards, flooding, drought, and hazardous materials. The Safety Element also includes sections on climate resiliency and disaster preparedness and recovery, which include evacuation routes and emergency services.

The impacts of climate change pose an increasing and growing challenge to the safety and well-being of the residents of Paradise. California will continue to experience effects of climate change in different ways, including increased likelihood of wildfires, heat waves, drought, flooding, severe weather, and sea-level rise. The Safety Element also addresses climate vulnerability and adaptation. The primary goals of the Safety Element are to protect the residents of Paradise from these hazards and to ensure that law enforcement and fire protection continue to meet the demands of new and existing land use development.

In November of 2018, Paradise and some surrounding areas in Butte County faced one of the most destructive wildfires in California history. This fire, known as the 2018 Camp Fire, resulted in the loss of 85 lives, nearly 19,000 structures, the burning of more than 150,000 acres over two weeks, and $9 billion in insurance claims. It took less than six hours for the Camp Fire to destroy over 90 percent of Paradise. Thousands were left without a home to return to and some were only fortunate enough to grab a few of their possessions before escaping. The fire was reported 100 percent contained 17 days after it began. Addressing short- and long-term risks associated with wildfires and other hazards is important to ensure the improved safety of the community and assist in rebuilding with additional resiliency as Paradise recovers from the Camp Fire.

The Safety Element is organized as described below.

- **Introduction** provides context and outlines the purpose of this document.
- **Planning Process and Outreach** summarizes stakeholder outreach conducted in development of the Safety Element.
- **Regulatory Framework** outlines the various regulatory bodies and documents that also govern safety issues and describes the Safety Element's relationship to these other policies and plans.
- **Community Profile** describes the geographic context of the town as well as information on population and development trends and existing circulation.
- **Hazard Profiles** are provided for each required hazard: fire, geologic and seismic hazards, flooding, hazardous materials, climate resilience/severe weather, and drought. This section also discusses the Town's efforts and existing programs related to disaster preparedness, response, and recovery.
- **Goals, Policies, and Programs** establishes new (and identifies ongoing) policies and implementation programs to continue to protect residents and property.

PLANNING PROCESS AND OUTREACH

In tandem with the Housing Element update, the Safety Element update involved community outreach through stakeholder interviews as well as a community meeting, which offered valuable feedback on safety and resiliency policies. The public community meeting was held on September 21, 2021 which utilized breakout rooms (see Figure 1) and a live poll to gather community feedback. The live poll was made available as an online survey to gather additional public feedback for one week following the meeting.

Figure 1: Public Community Meeting

Based on this meeting and survey, it was understood that community members strongly supported establishing greenbelts or parks on key parcels to serve as wildfire buffers around the periphery of town. Other supported policies included easements to allow the Town to perform vegetation management on private property, increasing resiliency standards for new construction, and programs to educate and facilitate property owners on hardening their homes. See Figure 2 for an excerpt of the survey results.

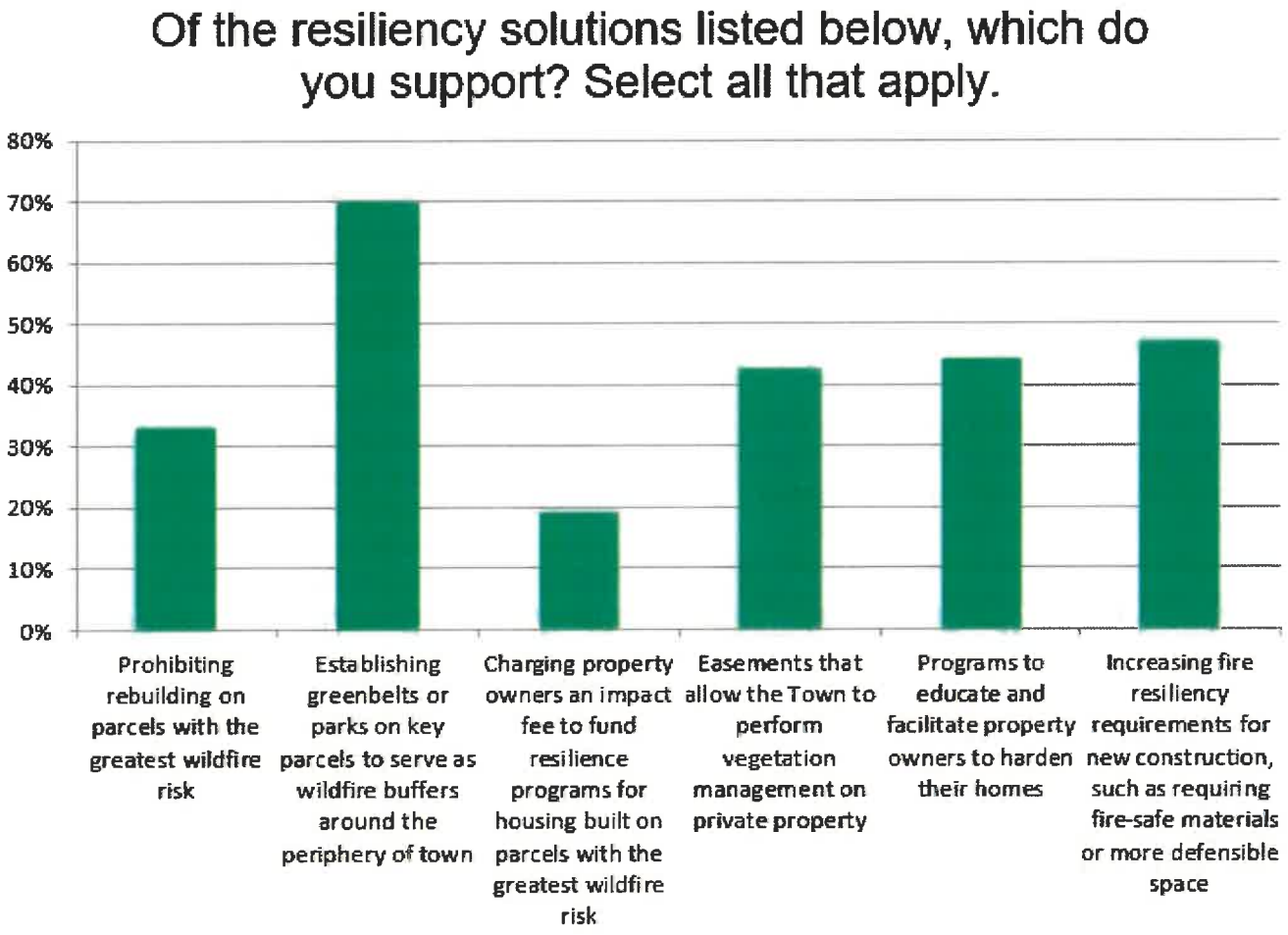
In addition, consistent with Government Code Section 65302(g)(8), the Town reached out to the California Geological Survey of the Department of Conservation and the Office of Emergency Services to request data sources and provide opportunity for consultation. No consultations were requested.

REGULATORY FRAMEWORK

This chapter describes the regulatory context of the Safety Element and its relationship to other local planning documents.

All counties and incorporated communities in California must prepare a General Plan, and one of the required elements (or chapters) of the General Plan is a Safety Element. This Safety Element meets these requirements, which are laid out in California law, particularly Section 65302(g) of the California Government Code. State law requires that the Safety Element address the following:

Figure 2: Excerpt of Survey Results



- Protect the community from risks associated with a **variety of hazards**, including seismic activity, landslides, flooding, and wildfire, as required by the California Government Code Section 65302(g)(1).
- Map and assess the risk associated with **flood hazards**, develop policies to minimize the flood risk to new development and essential public facilities, and establish effective working relationships among agencies with flood protection responsibilities, as required by California Government Code Section 65302(g)(2).
- Map and assess the risk associated with **wildfire hazards**, develop policies to reduce the wildfire risk to new land uses and essential facilities, ensure there is adequate road and water infrastructure to respond to wildfire emergencies, and establish cooperative relationships between wildfire protection agencies, as required by California Government Code Section 65302(g)(3).
- Assess the risks associated with **climate change** on local assets, populations, and resources. Note existing and planned development in at-risk areas and identify agencies responsible for providing public health and safety and environmental protection. Develop goals, policies, and objectives to reduce the risks associated with climate change impacts, including locating new public facilities outside of

high hazard areas, providing adequate infrastructure in at-risk areas, and supporting natural infrastructure for climate adaptation, as required by California Government Code Section 65302(g)(4).

- Identify "residential developments in any hazard area identified in the safety element that do not have at least two **emergency evacuation routes"** as required by California Government Code Section 65302(g)(5), added by SB 99 (2019).

RELATIONSHIP TO OTHER PLANS

This Safety Element is one of several plans that address public safety, disaster mitigation, wildfire protection, and other related topics. The Safety Element is consistent with these other plans, ensuring the Town and the surrounding region have a unified strategy to address public safety issues. The Safety Element's relationship to other local plans is detailed below.

Butte County Local Hazard Mitigation Plan (LHMP)

LHMPs are required by the Federal Disaster Mitigation Act of 2000 (Public Law 106-390). Having an approved LHMP is needed in order for a local jurisdiction to qualify for certain federal disaster assistance and hazard mitigation funding. LHMPs are required to be updated every five years.

The Butte County LHMP was developed in accordance with the Disaster Mitigation Act of 2000 (DMA 2000) and followed FEMA's Local Hazard Mitigation Plan guidance. The LHMP incorporates a process where hazards are identified and profiled, the people and facilities at risk are analyzed, and mitigation actions are developed to reduce or eliminate hazard risk. The implementation of these mitigation actions, which include both short and long-term strategies, involve planning, policy changes, programs, projects, and other activities.

The LHMP can be found at this location: https://www.buttecounty.net/808/Local-Hazard-Mitigation-Plan.

The Town of Paradise has participated in the LHMP multi-jurisdictional effort and has adopted each update of the LHMP. The LHMP was also developed, among other things, to ensure Butte County and participating jurisdictions' continued eligibility for certain federal disaster assistance, specifically the FEMA Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDM), and the Flood Mitigation Assistance Program (FMA).

The Safety Element is aligned with and draws heavily from the Butte County LHMP. The LHMP and Safety Element requirements are very similar in many respects, but not identical. The LHMP focuses on more specific mitigation actions while the Safety Element provides a higher-level view and more general safety-related policies across a broader array of topics. AB 2140 (2006) encourages (but does not require) a jurisdiction to incorporate the LHMP by reference into the Safety Element. Recent State legislation, SB 379 (2015) and SB 1035 (2018), have linked required updates of the Safety Element to the required updates of the LHMP and Housing Element.

The Town of Paradise has adopted and hereby incorporates by reference the most current Butte County LHMP as part of this Safety Element.

Butte County Community Wildfire Protection Plan

A Community Wildfire Protection Plan (CWPP) is a planning and funding prioritization tool authorized by the Federal Healthy Forests and Restoration Act of 2003 as an incentive for communities to engage in comprehensive forest and fire hazard planning and help define and prioritize local needs. CWPPs are updated every five years.

The Butte County CWPP was collaboratively developed through interested parties including Federal, State, City, Town, and County agencies within the Unit (the Unit includes Butte County and

some adjacent areas). The plan identifies and prioritizes pre-fire and post-fire management strategies and tactics meant to reduce the loss of values at risk within the Unit. It is intended to be used as a planning and assessment tool only. By placing the emphasis on what needs to be done long before a fire starts, the fire plan strives to reduce firefighting costs and property losses, increase firefighter safety, and enhance ecosystem health. The Butte County CWPP has been developed based upon the priority goals and objectives identified by the Butte County Fire Department and by local collaborators. The plan addresses the pre-fire strategies and tactics that will be implemented in cooperation with the fire agencies in Butte County, the Butte County Fire Safe Council, local community groups, and landowners.

The Butte CWPP can be found at this location: https://buttefiresafe.net/document-library/butte-county-community-wildfire-protection-plan-cwpp-2021-2025/.

The Butte CWPP also serves as the Butte Unit Fire Plan, further described below.

Butte Unit Fire Plan

California Department of Forestry and Fire Protection (CAL FIRE) operations are divided into 21 operational units. Each unit is required to have a Unit Fire Plan. Annual updates to the Unit Fire Plans are due June 1 of each year. Each unit plan addresses how each CAL FIRE Unit and Contract County is achieving the goals and objectives of the California Strategic Fire Plan. For the CAL FIRE Butte Unit, the Butte County CWPP also serves as the Butte Unit Fire Plan.

The Butte Unit Fire Plan can be found at this location: https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/fire-plan/#unit.

Long Term Community Recovery Plan

The Town of Paradise Long Term Community Recovery Plan (LTCRP) was created in 2019 by the community in direct response to the 2018 Camp Fire. The LTCRP includes an overview of the disaster, a detailed description of the community engagement process, the full recovery plan, and detailed recovery projects, both Town-led and partner-led. The LTCRP is centered around a consensus vision and goals generated by community members through outreach efforts. Projects proposed in the LTCRP include road evaluation and rehabilitation, a walkable downtown, reseeding the town, broadband services, public safety, and much more. In 2022, the LTCRP was updated to reflect new priorities and projects in the Town's recovery.

The LTCRP and any updates can be found at this location: https://www.townofparadise.com/recovery.

Town of Paradise Transportation Master Plan

Funded by a United States Economic Development Administration (EDA) grant, the Town of Paradise Transportation Master Plan (TMP) is a foundational document that guides the Town of Paradise's (Town) recovery through transportation initiatives and strategies consistent with the Town of Paradise LTCRP. The TMP is a critical step to both the Town's short-term recovery and vibrant long-term future. The TMP includes a comprehensive analysis of the Town's transportation daily needs, as well as recommend gap closures to strengthen future traffic evacuation demands. Additionally, the TMP considers how travel within the community can benefit from dedicated sidewalks and bikeways, and how transportation improvements can increase safety and support economic growth. The TMP will help to ensure safe, modern travel options, and efficient evacuation routes for the Town's residents, business owners, and visitors.

The TMP can be found at this location: https://www.townofparadise.com/pwe/page/transportation-recovery-efforts.

Town of Paradise – Other General Plan Elements

The Safety Element is one of the required elements of a general plan in California. State law requires that "the general plan and elements and parts thereof comprise an integrated, internally consistent, and compatible statement of policies." The Safety Element is being updated concurrently with the Housing Element. The Housing Element for 2022-2030 was adopted in 2022. The remainder of the Town of Paradise General Plan was adopted in 1994 and last amended in 2008. A comprehensive update of the remaining elements of the General Plan is proposed for 2023-2025.

Several Safety Element goals and policies are related to topics and policies in other general plan elements, including the Land Use, Circulation, Housing, and Open Space/Conservation/Energy Elements. Goals and policies most relevant to the Safety Element are listed below.

- LUP-2 The environmental and infrastructure constraints analysis system should be used to determine future zoning classifications, densities, and intensities of land use and to evaluate future development projects.
- LUG-8 Assure that law enforcement and fire protection services are enhanced sufficiently to meet the demands of new and existing land use development.
- LUP-14 Growth and land use development should be linked to the availability of public services and facilities, and to the degree of overall infrastructure and environmental constraints affecting property in the town.
- LUP-20 New land use development shall not cause the levels of police and fire protection to fall below the service levels established by this plan.
- LUG-10 Encourage infill development consistent with open space needs, neighborhood character and infrastructure capacity.
- LUG-13 Designate appropriate areas for high density residential use and for institutional and public uses in centralized and convenient locations.
- LUP-27 The town shall create a Central Commercial area generally bounded by Skyway, the Paradise Memorial Trailway, Elliott Road, and Pearson Road, evidencing the following: ready access from a variety of directions, visibility, established businesses, available developable land, and sufficient infrastructure planned or in place to support a more concentrated form of activity.
- LUP-82 Proposed development projects in the tertiary planning area shall acknowledge potential high wildland fire hazards, and include a comprehensive approach to regional fire protection, consistent with State and local fire protection laws and standards.
- OCEI-9 Establish open space, resource conservation, or low density rural residential zoning on sensitive (environmentally constrained) lands, such as areas of resource production, stream corridors and slopes greater than 30 percent.
- OCEI-25 Eliminate leaf burning after establishing a program for disposing of yard waste in an environmentally sensitive manner.
- CG-4 Provide adequate access, including access for emergency vehicles and evacuation, to all new parcels and to existing parcels when feasible.
- HG-2 Improve, rebuild, and preserve safe, decent housing and neighborhoods for all Paradise residents, including preparation for wildfire resiliency.

Paradise Household Hazardous Waste Element

In accordance with the requirements of State law, the Town of Paradise adopted a Household Hazardous Waste Element (HHWE) in 1992, which is

hereby incorporated by reference into this Safety Element.

Town of Paradise Emergency Operations Plan

The Town of Paradise Emergency Operations Plan (EOP) addresses the Town's planned response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies in or affecting the Town of Paradise. The plan does not apply to normal day-to-day emergencies or the established departmental procedures used to cope with such emergencies. Rather, this plan focuses on operational concepts and would be implemented relative to large-scale disasters that can pose major threats to life, property, and the environment requiring unusual emergency responses. The plan establishes the emergency management organization required to mitigate any significant emergency or disaster and identifies the roles and responsibilities required to protect the health and safety of Paradise residents and public and private property. The plan also establishes the operational concepts associated with a field response to emergencies, the Town of Paradise Emergency Operations Center (EOC) activities, and the recovery process.

The Emergency Operations Plan can be found at this location: https://www.townofparadise.com/community/page/emergency-operations-plan.

Paradise Skypark Airport Land Use Plan

The Paradise Skypark Airport is a privately owned and operated general aviation airport located south of the Town limits between Neal Road and Pentz Road. Land uses around airports are subject to the limitations established by the Airport Land Use Commission (ALUC) through the adoption of Airport Land Use Compatibility Plans.

The Butte County Airport Land Use Compatibility Plan adopted by the ALUC provides compatibility criteria for use by local jurisdictions in preparing land use plans and ordinances and review of proposed development. The Airport Influence Area extends up to approximately one mile into the Town of Paradise (approximately 1.8 miles from the north end of the runway). The Butte County Airport Land Use Compatibility Plan is hereby adopted by reference into this Safety Element.

The Butte County Airport Land Use Compatibility Plan can be found at this location: https://www.buttecounty.net/541/Airport-Land-Use-Commission-ALUC.

COMMUNITY PROFILE

Incorporated in 1979, the town of Paradise is located at the juncture of the western slopes of the Cascade and Sierra Nevada systems in north central Butte County. Topography and drainage patterns have had a major influence on development patterns in the area. This area is defined by steep canyons—to the east by the West Branch of the Feather River drainage, and to the northwest by the Butte Creek-Little Butte Creek drainage. The town of Paradise is accessible via Skyway, State Highway 191, Neal Road, and Pentz Road from the south. Skyway is the main entrance to town from the north. Paradise occupies an area identified as the Lower Ridge, which ranges from 2,200 feet in elevation in the north to 1,500 feet in elevation at the town's southern boundary. The area encompassing Paradise has a hot-summer Mediterranean climate.

Originally settled during the Gold Rush era, the Town of Paradise and surrounding area grew very slowly during the first half of this century. Paradise is predominately residential in character, and most of its dwelling units are single-family units. Multi-family units, at densities ranging from 8 to 12 units per acre, are found primarily in central Paradise, near commercial uses, and along major arterial streets. The Town's central business district consists of a narrow band of commercial uses along both sides of Skyway generally between Pearson Road and Elliott Road and stretching as far east as Black Olive Drive. The Town contains relatively little industrial

development. Agricultural uses, including vineyards, orchards, and grazing land, are located primarily in the southern third of the town.

The population of Paradise remained relatively constant, within a few hundred people, between 2000 and 2018. The Town was projected to reach a population of 29,547 by 2030, a growth rate of less than 1 percent per year, which is about half as much growth as was expected for the County. However, according to California Department of Finance estimates, the 2018 Camp Fire led to a population decrease from 26,581 as of January 1, 2018 to 4,474 as of January 1, 2019. Population has since increased to 9,142 as of January 1, 2023.

Historically, the highest percentage of jobs in Paradise and Butte County have been in Health & Education Services at 31 percent and 26 percent, respectively. Between 2002 and 2015, the number of jobs in Paradise increased by 17 percent, and then dropped again by 7 percent between 2015 and 2018. After the 2018 Camp Fire, many jobs, especially related to the hospital, were lost or moved elsewhere in the County due to the destruction caused by the fire.

Paradise's housing stock in 2015 was made up of 69 percent single-family detached homes, 16 percent mobile homes, and 9 percent multi-family homes with 2 to 4 units. The Camp Fire led to significant decreases in all housing stock, from 13,091 units in 2018 to 1,720 in 2019 to 4,365 in January 2023 according to the California Department of Finance. In 2023, the housing stock consisted of a 66 percent single-family detached or single-family attached homes, 15 percent multi-family homes with 2 to 4 units, 6 percent multi-family homes with five or more units, and 13 percent mobile homes.

Transportation within and around Paradise is predominately done by private vehicle. North to South circulation is provided by four main streets: Skyway, Neal Road, Clark Road, and Pentz Road. Circulation east to west is more constrained, as there is not one road that crosses the entire town's diameter. Larger east to west roads include Wagstaff Road, Bille Road, Elliott Road, and Pearson Road. The Town of Paradise uses a great number of private streets as local streets. Development patterns have resulted in narrow, substandard streets with deteriorated lanes, which affects access for fire and police protection. The Butte Regional Transit (B-Line) is the regional public transit system. B-Line routes 40 and 41 serve Paradise with service to Chico and Magalia.

As previously mentioned, the existing development in Paradise is primarily single-family homes, followed by small multi-family buildings (i.e., duplexes, triplexes, and fourplexes). Through the Regional Housing Needs Allocation process, the Town has been assigned 7,179 housing units for which it has to plan for the 2022-2030 planning period. The Housing Element envisions reaching this number with increased density along Skyway and Clark Road where a sewer system is planned in addition to the rebuilding of single-family homes lost to the Camp Fire.

HAZARD PROFILES

This section outlines the existing hazardous conditions and other public safety issues in Paradise. Consistent with State law, the hazard events discussed include those related to fires, geologic and seismic hazards, flooding, hazardous materials, climate change related severe weather (e.g., extreme heat, power shutoffs), and drought. This section also discusses emergency preparedness.

Each of the identified hazards includes a discussion of the existing conditions, past examples of the hazard in and around Paradise, and the regulatory setting and responsible agencies associated with the hazard.

FIRE HAZARDS

Given its combination of complex terrain, Mediterranean climate, and ample natural ignition sources from productive natural plant communities,

California is a very fire-prone area. In addition, utilities have frequently been the cause of wildfire, including in the case of the Camp Fire where a spark from an aging power line was determined to have started the blaze.

Existing Conditions

Wildland fire is an ongoing concern for the Town of Paradise, as exemplified by the Camp Fire in 2018. Generally, the fire season extends from early spring through late fall of each year during the hotter, dryer months. Fire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, accumulation of vegetation, and high winds. Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire suppression practices have affected the natural cycle of the ecosystem.

The topography of the town contributes to the fire hazards. Paradise is flanked by steep canyons to the northwest and east sides of the community and intermediary drainages to the south. At the southern end of Paradise, 1,600-foot elevation wildland fuels consist of light grass and brush with residential structures intermixed within the wildland fuels. The wildland fuels transition to heavy brush in the adjoining canyons and conifer forests through the majority of town to the northern extent at 2,300-foot elevation.

The climate in Butte County is Mediterranean which means summer conditions are warm, dry, and often accompanied by wind. The topography, fuel conditions, and Mediterranean climate combine to make the town of Paradise and surrounding areas of Butte County at high risk for wildfire. This coupled with the relatively moderate residential population of Paradise and the surrounding area present a unique wildland urban interface firefighting problem. The Town can best be described as a mix of relatively high-density wildland urban interface environment where structures on the northwest and eastern sides of town abruptly adjoin the wildland, and on the southern end of town, a moderate density wildland urban intermix where homes are intermixed with the wildland vegetation.

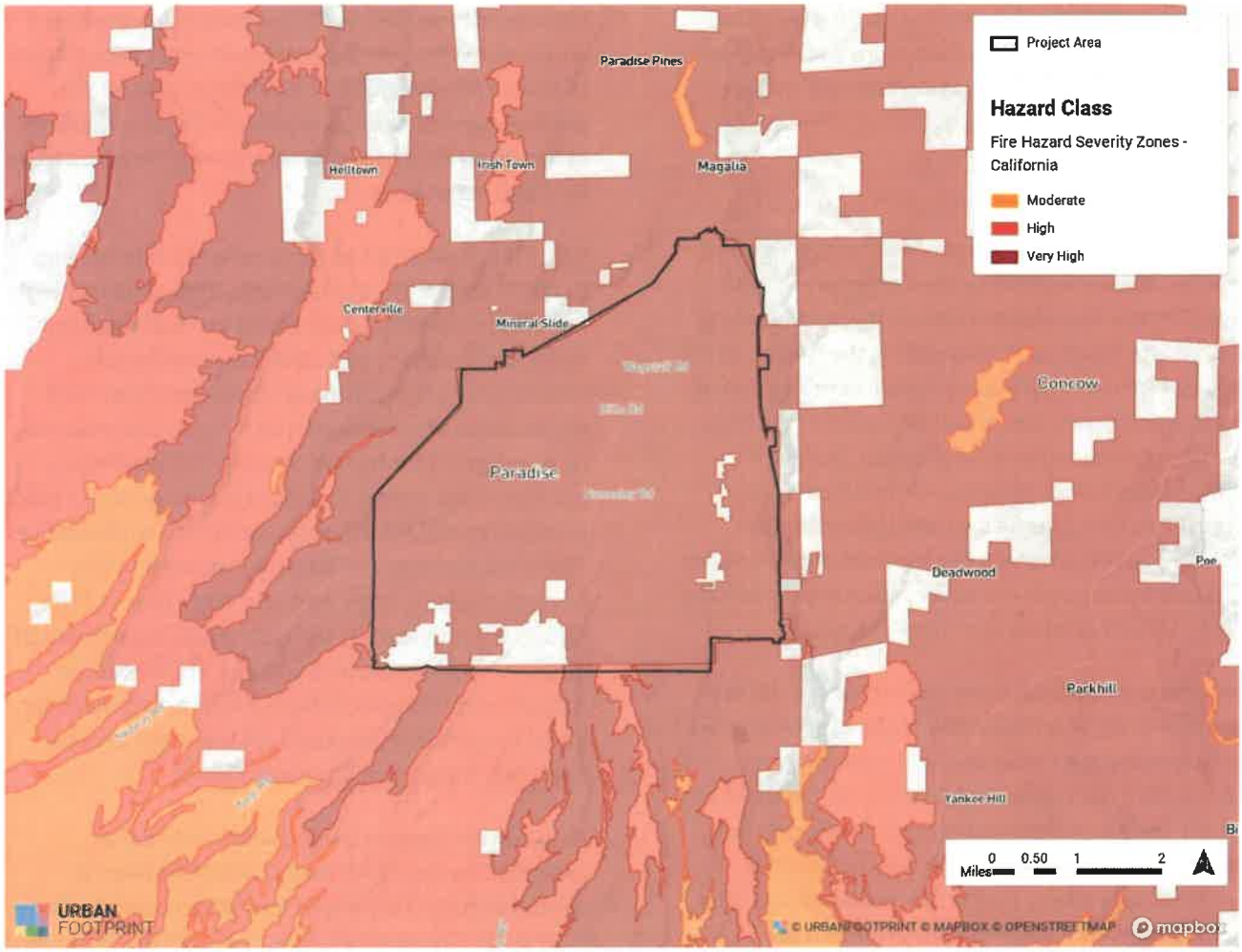
CAL FIRE is required by Government Code Section 51178 to map areas of moderate, high, and very high fire hazard severity zones based on "fuel loading, slope, fire weather, and other relevant factors including where winds have been identified...as a major cause of wildfire spread." These designations, referred to as Fire Hazard Severity Zones (FHSZ), mandate how people construct buildings and protect property to reduce risk associated with wildland fires. There are three zones, based on increasing fire hazard: medium, high, and very high. Maps of the FHSZs are provided by the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP). FRAP issues maps for Local Responsibility Areas (LRA) such as Paradise and State Responsibility Areas (SRA).

As shown in Figure 3 below, wildfire threat as identified by the FRAP maps within the town is almost entirely Very High Fire Hazard Severity Zone (VHFHSZ). Some areas along the southern boundary of the Town and along the Dry Creek west of Pentz Road are non-VHFHSZ.

Although a few areas are not designated VHFHSZ by the FRAP maps, the Town, by local ordinance, has designated the entire town in a VHFHSZ concurrently with the adoption of the California Building Standards Code. The Camp Fire showed that the whole town has extreme fire risk and based on professional opinion, the entire region known as the Ridge (e.g., Paradise, Concow, Magalia, Pulga) has extreme fire hazard severity potential.[1]

[1] Lunder, Zeke, Founder and Pyrogeographer, 2021. Personal communication with Deer Creek Resources, November 4.

Figure 3: Fire Hazard Severity Zones



Source: California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP), Fire Hazard Severity Zone Map for Paradise (https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-preparedness/fire-hazard-severity-zones/fire-hazard-severity-zone-maps/).

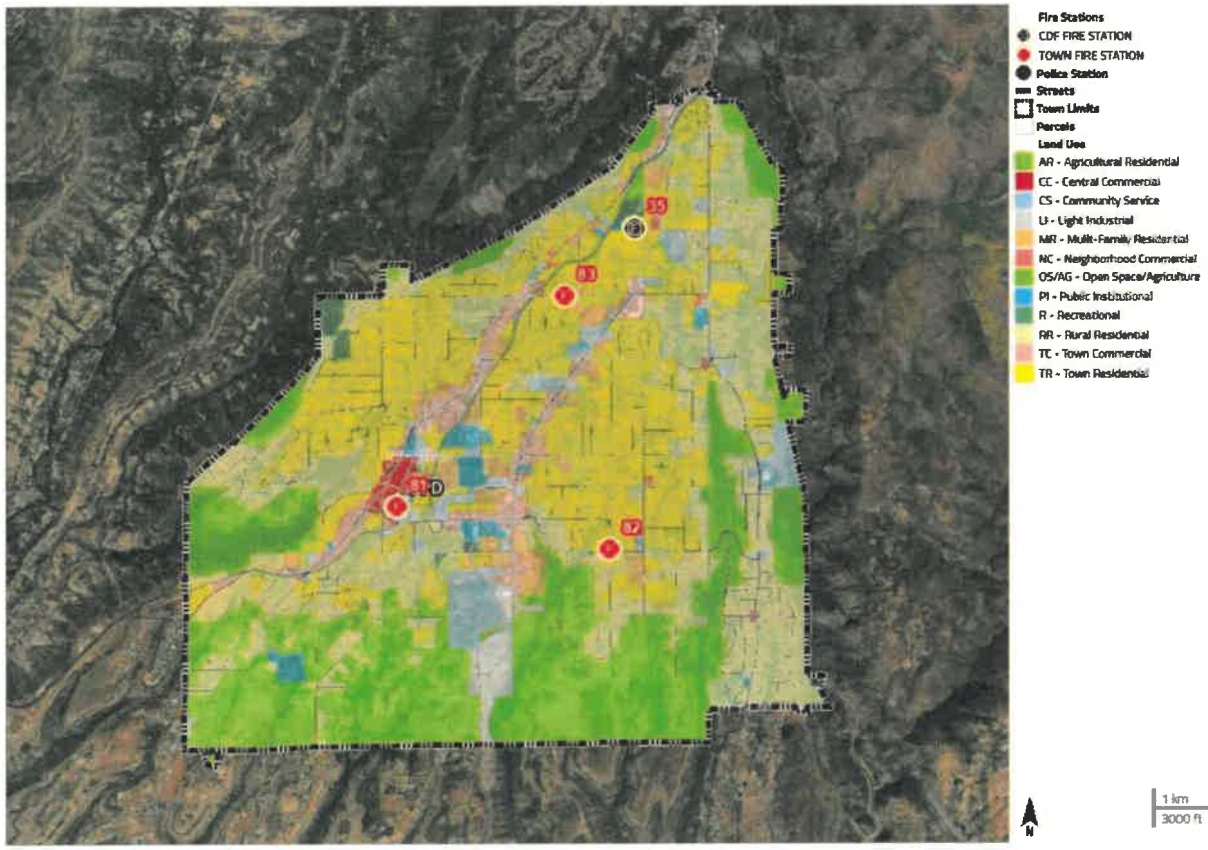
Critical facilities, such as Police and Fire Stations, as located along primary evacuation routes and are therefore in accessible locations. There are no areas of the Town lacking service. Figure 4 shows the General Plan Land Use designations, Police and Fire Stations.

The Town's interactive geographic information system (GIS) including zoning, land use and other information can be found here: https://www.townofparadisemapping.com/.

Fire Hazard Severity Zones Maps for both LRAs and SRAs can be found here: https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-preparedness/fire-hazard-severity-zones/fire-hazard-severity-zone-maps/.

Areas designated VHFHSZ are subject to more stringent requirements for buildings and property maintenance. California's wildland building codes (CBC Chapter 7A) apply to the design and construction of new buildings located in VHFHSZs in Local Responsibility Areas. Local ordinances may require ignition-resistant construction for remodel

Figure 4: General Plan Land Use and Critical Facilities



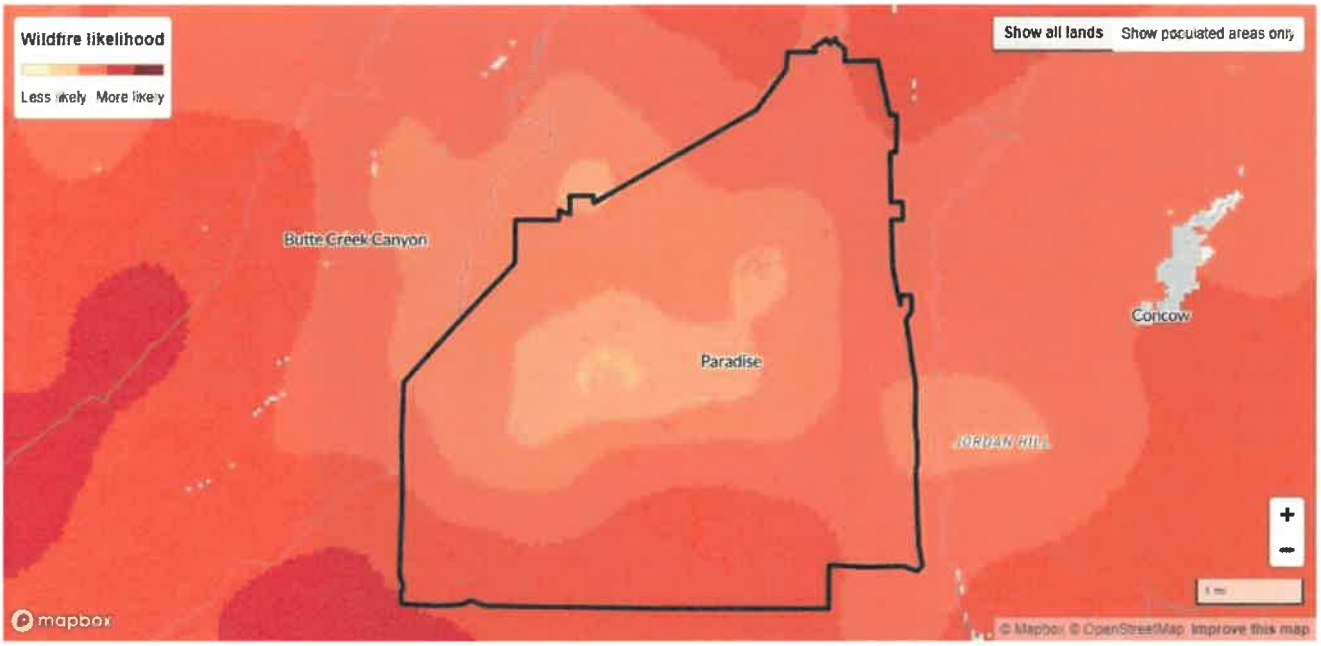
Source: Town of Paradise, 2023 (see: https://www.townofparadisemapping.com/).

projects. The Town considers any additions or remodels to be new construction and therefore subject to wildland building codes when 50 percent or more of the exterior weight bearing walls are removed or demolished. In addition, Government Code Section 51182 calls for defensible space clearance and other wildland fire safety practices for buildings. Owners are also required to make a natural hazard disclosure as part of a real estate transfer. Beginning July 1, 2021, California Assembly Bill 38 (AB 38, 2019) requires all homes in a High or VHFHSZ to be compliant following a Defensible Space Inspection.

Another resource to help understand wildfire risk is the *Wildfire Risk to Communities* maps provided by the USDA Forest Service. These maps are based on a variety of data, including vegetation and fuels from LANDFIRE, weather from the national Weather Service and community data from the U.S. Census Bureau. Figure 5 shows the Wildfire Hazard Potential for Paradise using these datasets. Compared to the CAL FIRE FHSZ maps, this map shows more areas of lower risk. Many of the lower-risk areas to the east around Concow were mapped as lower hazard because of the presence of the 2008 fire scar there. This assumption (recent burns will have lower severity fire) was not borne out by the Camp Fire. Fire experts recommend looking at potential future vegetation, not just existing conditions and for this reason, caution against considered areas on the Ridge as low fire risk.[2]

[2] Ibid.

Figure 5: Wildfire Likelihood



Source: U.S. Department of Agriculture Forest Service, Wildfire Risk to Communities, 2023.

Historical Data

The 2018 Camp Fire was the most destructive and deadliest fire in the State's history up to that point.[3] Fire was first reported around 6:30 a.m. on November 8 near Poe Dam and grew rapidly given extreme (up to almost 50 mph) winds, entering the Town of Paradise by 8:00 a.m. The Butte County Fire Department issued an evacuation order for the entire town, but many residents of Paradise were unable to evacuate before the fire arrived. Failures in the emergency alert system, including the loss of 17 cell towers, compounded the danger of the situation. Four at-risk areas in the town were not notified of evacuation orders due to human error and a technical error led to 94 percent of residents in some areas not being notified of emergency alerts.

In its first week, the fire burned tens of thousands of acres per day. The western half was contained once the fire reached highway and roadway arteries that formed barriers, but the eastern half continued to burn into a second week. Heavy rain fell starting on November 21 which helped contain the fire, and on November 25, CAL FIRE declared it 100 percent contained. The counts of structures damaged and destroyed in the Town of Paradise are provided in Table 1.

TABLE 1: TOWN OF PARADISE - STRUCTURES DAMAGED IN THE CAMP FIRE BY LEVEL OF DAMAGE

Damage Assessment	Damaged Structure Count	% of Total Structure Count
Destroyed (>50%)	14,352	86.9%
Major (25-50%)	18	0.1%
Minor (10-25%)	69	0.4%
Affected (1-9%)	449	2.7%
No Damage	1,633	9.9%
Town of Paradise Total	16,521	100%

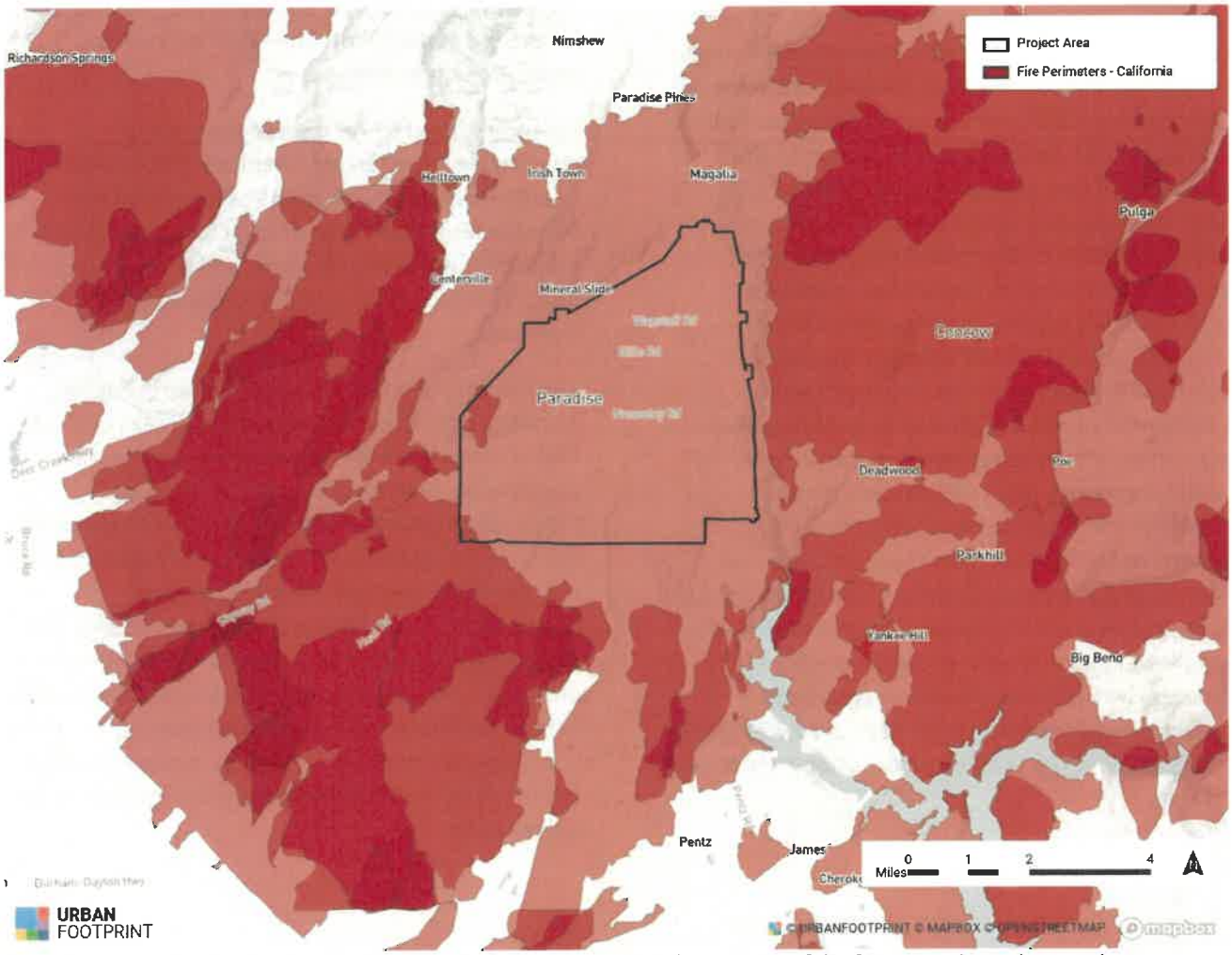
Source: CAL FIRE, Camp Incident Damage Inspection Report (DINS) November 26, 2018.

[3] Butte County Office of Emergency Management, Butte County Camp Fire Response County-Wide After Action Report, August 2020, p. 5.

In addition to the Camp Fire, there have been multiple wildfires over the years in and near the Town, as noted in the LHMP. More details including maps of previous fires are contained in the LHMP Volume 1. The previous fires in and near the Town of Paradise are shown in Figure 6 and summarized below.

- August 26, 2016 – Santos Incident. A small fire occurred off Highway 32 at Santos Ranch Road, south of Forest Ranch. Evacuation warnings were issued, but the fire was contained before evacuations became necessary.
- September 6, 2016 – Saddle Fire. On September 5, a fire was started off Pentz Road and Lime Saddle Road south of the Town of Paradise. Sparks from a malfunctioning exhaust started the blaze. Evacuation orders were issued for residents on both sides of Pentz Road from Lago Vista to Messilla Valley Road. Evacuation shelters were opened, as were animal shelters. The blaze consumed 850 acres before being contained, causing three injuries and destroying three structures.

Figure 6: Map of Historical Fires



Note: Darkness of red indicates overlap of multiple fires. Note that the severity of the fire is not shown here, only its perimeter.
Source: California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP), Map of Fire Perimeters, 2022.

- July 2, 2017 – De Sabla Incident. A small fire occurring in the vicinity of De Sabla Powerhouse Rd and Humbug Rd. The fire burned 14 acres.
- October 10, 2017 – Honey Fire. Active for 91 days, 150 acres burned.
- December 12, 2017 – Fire vicinity of Clark and Bille.
- September 24, 2018 – Nimshew Incident. A small fire occurred in the vicinity of Nimshew Road and Centerville Road. The fire burned 33 acres and was active for 102 days.
- November 8, 2018 – Camp Fire. Active for 229 days, 153,336 acres burned, 18,793 structures, 85 fatalities.

According to data from Urban Footprint, the Camp Fire had the most destruction, relatively speaking, on residential buildings built in 1911-1920 (95 percent of these structures were destroyed) and 1951-1961 (92 percent of structure destroyed). Newer construction tended to fare better. In 2008, Chapter 7A of the California Building Code was adopted, which requires certain fire resistance measures in fire hazard severity zones. Of the residential structures built between 2001-2010, 71 percent of structures were destroyed and 63 percent of residential structures built between 2011 and 2016 were destroyed, compared to an overall destruction rate of 86 percent for the residential building stock in general. However, research has found that the difference in survival percentage for homes built before and after adoption of Chapter 7A is not statistically significant. Instead, the following factors were strongest predictors of home survival: distance to nearest destroyed structure, number of structures destroyed within 100 meters, and pre-fire overstory tree canopy within 100 meters.[4]

Regulatory Setting/Responsible Agencies

Town of Paradise Fire Department / CAL FIRE)

The Town of Paradise and CAL FIRE provide fire protection services through a cooperative agreement. By contracting with CAL FIRE, the Town is able to staff two fire stations with three-person engine companies, and one station with a two-person engine company. In addition to the Town's resources, CAL FIRE maintains their own stations in Paradise and the neighboring community of Magalia. These resources are available to assist with the Town's fire protection efforts as necessary. The Town of Paradise employs two fire prevention inspectors, fire marshal, and administrative assistant for the fire department. The Town also utilizes citizen volunteer firefighters.

Paradise's fire chief (or his/her designee) is responsible for enforcing Chapter 8.58 Defensible Space and Hazardous Fuel Management of the Paradise Municipal Code. This includes inspecting properties, requesting records, and filing notices and public nuisance abatements in order to rectify violations.

The Direct Protection Area (DPA) map in Figure 7 identifies who responds when a fire breaks out. CAL FIRE is responsible for emergency response, fire suppression, and fire prevention in the State Responsibility Area (SRA). The Town of Paradise is bordered entirely by SRA, as shown in Figure 7. Maps maintained by the State illustrate Federal Responsibility Areas (FRA) in addition to SRAs. The SRA viewer illustrates who pays for firefighting on a given acre. For example, the State would respond to fires on the Bureau of Land Management (part of the U.S. Department of Interior) lands outside Paradise, but the Federal government pays for the costs of fire suppression

[4] Knapp, Erik et al, 2021. Housing Arrangement and Vegetation Factors Associated with Single-Family Home Survival in the 2018 Camp Fire, California. Available at https://fireecology.springeropen.com/articles/10.1186/s42408-021-00117-0, October 4.

Figure 7: CAL FIRE Direct Protection Areas

Source: California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP), Map of State Responsibility Areas, 2022

Town of Paradise Building Department

The Town of Paradise Building Department is responsible for ensuring that building code and local requirements for fire resilient structures are included in new and remodeled buildings. The Town of Paradise has adopted changes to the California Building Standards Code based on the town's climatic, geologic, and topographical conditions. The Town's local amendments include requirements for automatic fire sprinkler systems, ignition-resistant roofing materials, ignition-resistant outbuildings, and non-combustible gutters.

In 2022, the Town adopted requirements for new construction that are consistent with the Wildfire Prepared Home program for single-family homes developed by the Insurance Institute for Business and Home Safety (IBHS). These requirements address:

- Home Ignition Zone – The first 5 feet around the home is noncombustible.
- Accessory structures and outbuildings, including a minimum 10-foot separation.
- Enclosing decks or porches 4 feet or less above the ground.

- Non-combustible fencing within 5 feet of the home and eliminating back-to-back fencing.

The updated LTCRP calls for adoption of the Wildfire Prepared Home Multifamily and Wildfire Prepared Community standards when they are completed.

Retrofitting and maintenance of existing homes for fire safety are encouraged or required by a number of programs, including:

- Town of Paradise Defensible Space Requirements
- Wildfire preparedness programs of Paradise Ridge Fire Safe Council and Butte County Fire Safe Council

Butte County Safe Fire Council

The Butte County Fire Safe Council (BCFSC) formed in 1998 and is Butte County's largest ally in educating and assisting the public with wildfire preparedness.

The BCFSC is a non-profit community organization funded by grants and community donations. The organization operates in cooperation with local, State, and federal fire agencies throughout Butte County.

The BCFSC is the "parent" organization to several active local fire safe councils, including the Paradise Ridge Fire Safe Council, and nationally recognized FIREWISE Communities throughout the County. The BCFSC Board of Directors is comprised of representatives from the local councils and representatives of many public and private stakeholders throughout Butte County. The organization staff help implement projects, connect with community members, and leverage partnerships.

Peak Load Water Supplies

In order to have effective fire suppression capability, it is necessary to have an adequate and reliable supply of water. The Paradise Irrigation District (PID) provides water to most areas of the Town of Paradise. The PID obtains its surface water from the Little Butte Creek watershed and a single groundwater well. A few small areas near the edges of the Town limits are served by Del Oro Water Company.

The PID's distribution system suffered severe damage from the 2018 Camp Fire and related clean-up activities. The 2020 Urban Water Management Plan (UWMP) for the PID states that the PID will continue to rely on their existing water rights post Camp Fire as the quality and availability of these surface water supplies has remained unaltered. The UWMP states that as regrowth of the Town continues, PID is actively working toward the reconstruction and recovery of critical infrastructure as well as ways to increase the reliability and quantity of available supply for the future. PID continues to work on the rehabilitation of the water distribution system. Two major projects were completed in 2023, including the two new 1.5 million gallon tanks that replaced Reservoir B and a new waterline from the treatment plant to Reservoir A. The largest components of the recovery work include replacing the main pipelines, water meters, and service laterals which will take several years to complete.

The UWMP found that the supply and drought risk assessment do not anticipate a water deficit for a single-year or for a five-year consecutive drought in the near term or long term.

GEOLOGIC AND SEISMIC HAZARDS

Seismic and geologic hazards are caused when different part of the Earth's crust move. Seismic hazards refer to earthquakes whereas geologic hazards are related to unstable soils, minerals in the soil, or certain ground formations. Landslides and soil erosion are examples of geologic hazards.

Existing Conditions

The State of California has identified five areas of critical seismic concern including surface ruptures, ground shaking, ground failure, tsunamis, and seiches. Each of these is caused by earthquake activity thereby creating hazards for life and

property, which has the potential anywhere in California. Paradise is not at risk for tsunamis or seiches due to its inland location and the absence of nearby large bodies of water. Earthquakes can also cause liquefaction. Liquefaction is a process whereby soil is temporarily transformed to a fluid formed during intense and prolonged ground shaking.

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Seismologists have developed several magnitude scales, as discussed in Section 4.2.9 of the LHMP. The Richter Scale is used to quantify the magnitude or strength of the seismic energy released by an earthquake, expressed in whole numbers and decimals (e.g., 6.8). Another measure of earthquake severity is intensity. The Modified Mercalli Intensity (MMI) Scale is an expression of the amount of shaking at any given location on the ground surface, rated from I to XII. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

There are a number of faults within Butte County and a large number of relatively nearby faults that could be considered potentially active, based either on the fairly restrictive criteria developed by the California Geological Survey. These faults are detailed in the Butte County LHMP beginning on page 4-82 and shown in Figure 8 to include the following near the Town of Paradise:

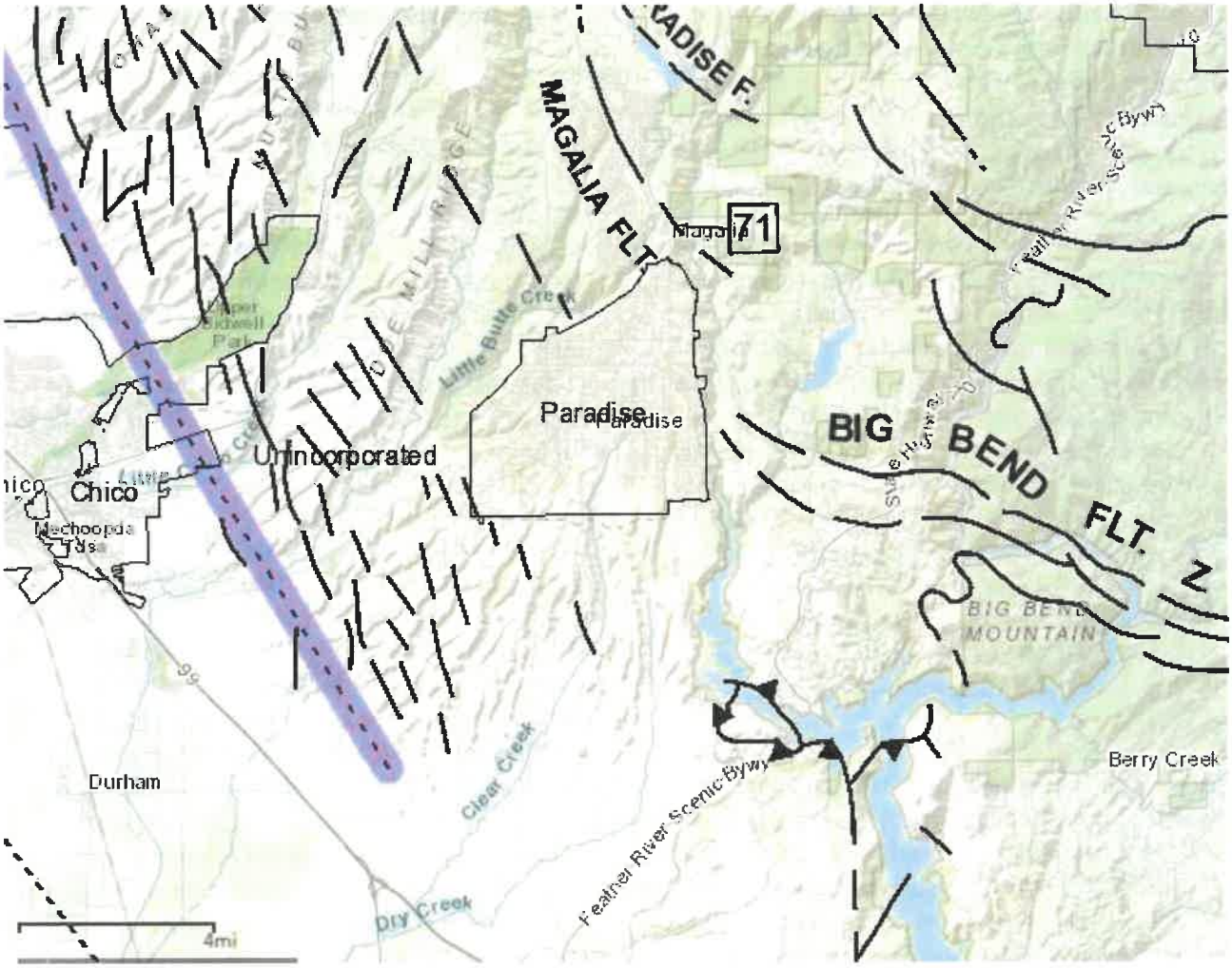
- **Magalia Fault.** The Magalia Fault is located near the northern end of the Foothill Fault System, a system of northwest trending east dipping normal fault formed along the margin of the Great Valley and the Sierra Nevada provinces. The DSD, based on Fault Activity Guidelines in 2001 reclassified the Magalia Fault as conditionally active. The Paradise Irrigation District commissioned a study by Holdrege & Kull, dated January 2007 to evaluate the Magalia Fault.
- **Foothills Shear Zone.** The Foothills shear zone extends into southern Butte County. A possible magnitude 7.0 earthquake in this zone would result in intensities as high as IX in Butte County.

Since earthquakes are regional events, the whole of the town is at risk to earthquake. However, Paradise and the surrounding area are relatively free from significant seismic and geologic hazards. There are no known or inferred active faults within the town. The only known active fault in Butte County is the Cleveland Hills fault, the site of the August 1975 Oroville earthquake. This earthquake had a Richter magnitude of 5.7. Due to the proximity of the Town to the nearby Cleveland Hills Fault, the Town can expect low to medium intensity shocks from time to time.

In 2016, the USGS and the California Geological Survey (CGS) released an update of the time-dependent version of the Uniform California Earthquake Rupture Forecast (UCERF III) model. The UCERF III results have helped to reduce the uncertainty in estimated 30-year probabilities of strong ground motions in California. The UCERF III map is shown in Figure 4-40 of the Butte County LHMP and indicates that Butte County has a low to moderate risk of earthquake occurrence, which coincides with the likelihood of future occurrence rating of occasional. This is consistent with Figure 9 below, which shows the expected relative intensity of ground shaking and damage in Paradise and its surroundings from anticipated future earthquakes. Shaking potential is calculated as the level of ground motion that has a 2 percent chance of being exceeded in 50 years.

Similar to earthquakes, the town is at risk of occasional landslides. The areas surrounding the town are where the topography most dramatically changes and are at greater risk to landslide. Figure E-9 and Table E-26 of the Butte County LHMP Paradise Annex show the geographical extent of land in landslide potential areas. The majority of the town is in the low to moderate susceptibility category.

Figure 8: Map of Faults



Source: California Department of Conservation, Fault Activity Map of California, 2010.

Historical Data

Historical data on earthquakes Magnitude 5.0 or greater within 90 miles of Butte County is contained in the Butte County LHMP base plan. The largest of these was the August 1, 1975 Oroville Earthquake at 5.7 Richter magnitude. Structural damage, consisting mainly of cracks in chimneys and walls, broken windows and plaster, and loosened light fixtures occurred at several schools, hospitals, and houses in the Oroville-Thermalito area. Many chimneys toppled or had to be taken down in Oroville and Palermo. Property damage was estimated at $2.5 million.

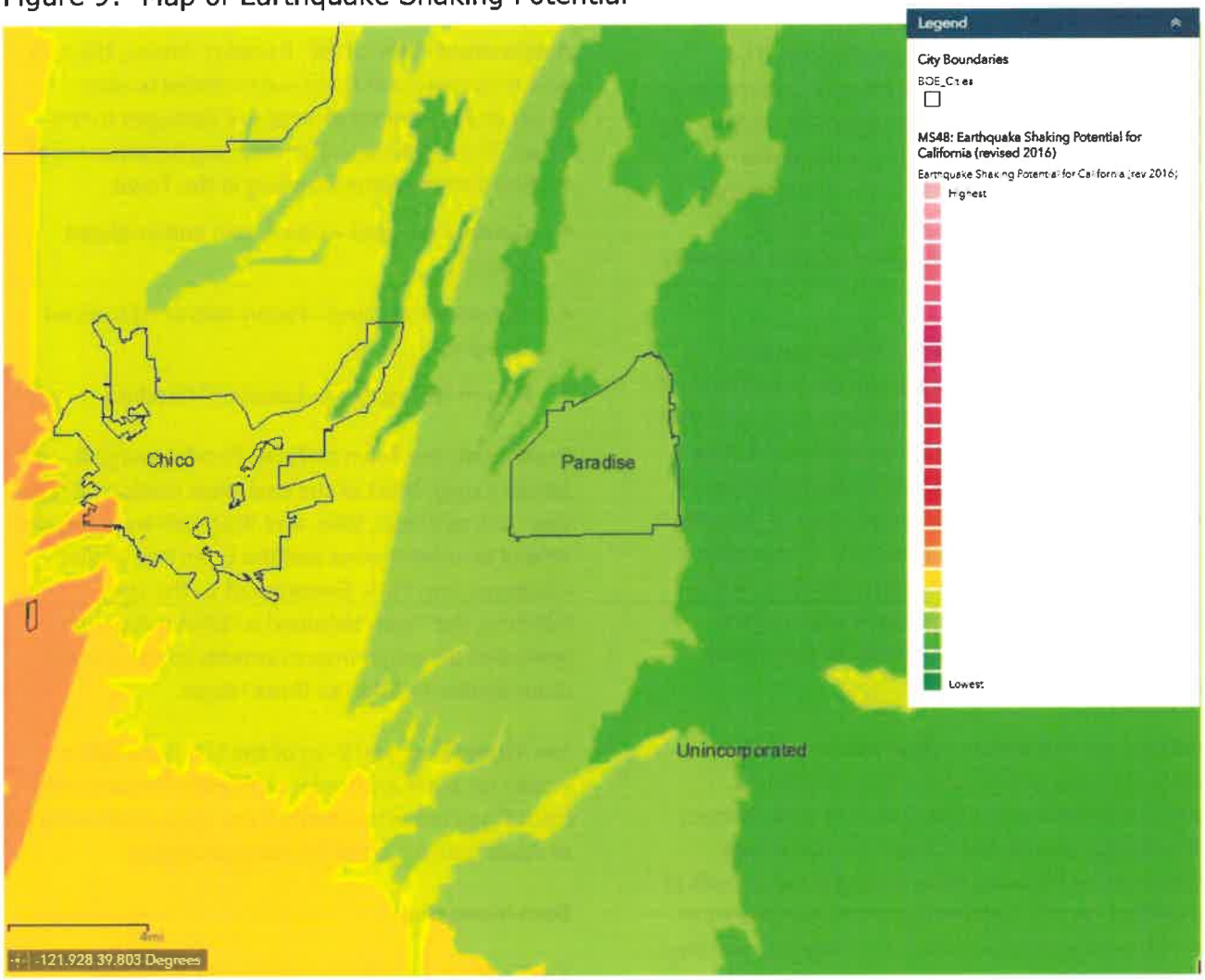
Paradise does not have any significant past occurrences of landslides or mudslides.

Regulatory Setting/Responsible Agencies

Uniform Building Code

The Uniform Building Code (UBC) identifies four seismic zones in the United States. The zones are numbered one through four, with Zone 4 representing the highest level of seismic hazard. The UBC establishes more stringent construction standards for areas within Zones 3 and 4. All of California lies within either Zone 3 or Zone 4. The town of Paradise is within Zone 3.

Figure 9: Map of Earthquake Shaking Potential



Source: California Department of Conservation, 2016.

Town of Paradise Building Department

The Building Department is responsible for ensuring the UBC is followed for new and renovated structures.

California Division of Safety of Dams (DSOD)

Also of concern during an earthquake event are the various dams located near the town of Paradise. The DSOD regulates dams to prevent failure, safeguard life, and protect property. The DSOD inspects each dam on an annual basis.

FLOODING

Floods are usually caused by large amounts of precipitation, either from a period of very intense precipitation or a long period of steady precipitation. In addition to storms, floods can also be caused by very rapid snow melting or from infrastructure failure, such as dam collapses or burst water storage tanks.

Existing Conditions

Paradise's location on a ridge makes it less susceptible to flooding and thus it does not have any

designated flood hazard areas as depicted on the Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Map (DFIRM). The entire Town of Paradise is located outside both the 1 percent and 0.2 percent annual chance flood zone as defined by FEMA. (See Figure E-7 in the Butte County LHMP Paradise Annex.) Any flooding that occurs is localized in nature, resulting from a temporary lack of capacity or blockage of a drainage basin.

According to the Butte County LHMP Paradise Annex, dam failure is unlikely in the town and limited in severity. See Table 4-72 of the Butte County LHMP for dam counts and inundation classifications. The Paradise Dam north of the town is considered an Extremely High Hazard dam for inundation, but the inundation area is completely outside of the town limits (see Figure 4-95 of the Butte County LHMP). Paradise Irrigation District's 2012 Water System Emergency Response plan includes an Emergency Action Plan for dam failure.

Although not mapped as a flood event by FEMA, there have been smaller, more frequent storm events, that have led to flooding of streets, homes, and buildings. During the Camp Fire, numerous culverts within Paradise were destroyed as a result of the wildfire. An On-System Culvert Replacement is one of the Infrastructure Recovery Projects identified by the Town. This project is in process. The Town Council adopted a Resolution on 1/11/2022 to award the contract to Escheman Construction. Replacement of damaged plastic culverts with reinforced concrete pipe culverts will decrease future possible damage to storm water infrastructure, improving safety along evacuation routes and effectively managing storm water runoff. A Storm Drain Master Plan was approved in June 2022 and will be used to prioritize replacements and improvements in coordination with transportation improvements to reduce the potential for localized flooding.

Historical Data

As discussed in the LHMP Paradise Annex, the only past occurrences of flood were related to storm water and had minor affects and damages to the Town. The LHMP lists the following occurrences of localized storm water flooding in the Town:

- October 20, 2017 – Heavy rain and localized flooding.
- December 15, 2016 –Heavy rain and localized flooding.
- November 19, 2015 –Localized flooding.

In addition, the Town suffered flood damage in January 1997. Most of the east/west roads that have dips such as Elliott, Bille, and Wagstaff were flooded as well as some homes and the Eden Roc Trailer Condominium Park. Subsequent to the 1997 flooding, the Town obtained a FEMA mitigation grant and did major improvements to the storm drain system to address these issues.

See Tables E-24 and E-25 of the LHMP Paradise Annex for State and Federal Disaster Declarations from Flood in Butte County from 1950-2018 and a list of roads with localized flooding problems.

Dam Inundation

The Town of Paradise is outside the potential inundation areas for both the Paradise Dam and the Magalia Dam, as shown on the maps approved by the California Department of Water Resources, Division of Safety of Dams.

Regulatory Setting/Responsible Agencies

Federal Emergency Management Agency (FEMA)

Using the results of flood insurance studies, FEMA prepares Flood Insurance Rate Maps (FIRMs) that depict flood risk. FEMA is responsible for maintaining the FIRMs as communities grow and as new or better scientific and technical data concerning flood risks becomes available.

California Division of Safety of Dams (DSOD)

The DSOD regulates dams to prevent failure, safeguard life, and protect property. The DSOD inspects each dam on an annual basis.

HAZARDOUS MATERIALS

Hazardous materials include toxic chemicals, flammable or corrosive materials, petroleum products, and unstable or dangerously reaction materials. Risks related to hazardous materials can arise when these materials are released through human error or broken equipment or indirectly via another emergency (e.g., a fire damages a hazardous material storage tank). Spilling or releasing large quantities of hazardous materials could result in a fire, explosion, or toxic cloud, as well as the contamination of water, people, or property. Health problems could be immediate, such as corrosive effects on skin and lungs, or gradual, such as the development of cancer from a carcinogen.

Existing Conditions

The LHMP assessed the potential for transportation-related hazardous materials releases from transportation corridors in the County. In the Town of Paradise, this included a 1-mile buffer on each side of Highway 191. The LHMP indicated four Essential Services Facilities (Fire, two Public Assembly Points, Emergency Animal Shelter) and one At Risk Population Facility (school) within this buffer area. The LHMP concludes that impacts from hazardous materials transportation incidents vary by location and severity, depending on the type of event and can be expected to continue to occur in the future.

Historical Data

One incident recorded by Butte County Environmental Health occurred on Clark Road, between McKale Road and Easy Street. The incident recorded on March 12, 1998, involved a transportation spill of 30-40 gallons of diesel. The incident was properly cleaned up under the oversight of Butte County Environmental Health and Regional Water Quality Control Board (RWQCB).

Regulatory Setting/Responsible Agencies

The Butte County Public Health Department is the Certified Unified Program Agency (CUPA) managing hazardous wastes in Butte County. The CUPA is certified by CalEPA to implement and enforce several State laws regarding hazardous waste. The CUPA program was created by SB 1082 (1993), eliminating the requirement for each County to have a Hazardous Waste Management Plan.

In accordance with the requirements of State law, the Town of Paradise adopted a Household Hazardous Waste Element (HHWE) in 1992, which is hereby incorporated by reference into this Safety Element.

CLIMATE RESILIENCY/SEVERE WEATHER

In accordance with the requirements of SB 379 (2015), codified at Government Code section 65302(g)(4), climate change adaptation and resilience must be addressed in the safety element of all general plans in California. This section provides advice to support a jurisdiction's compliance with the requirements of Government Code section 65302(g)(4), including use of the California Adaptation Planning Guide (Cal-Adapt).

Climate change refers to a change in the climate that can be identified by changes in the mean and/or variability of its properties and that persists for an extended period, typically decades or longer.[5] Climate change is already impacting the Town of Paradise and Butte County, contributing to the

[5] Intergovernmental Panel on Climate Change (IPCC), 2014. "Annex II: Glossary," eds. K.J. Mach, S. Planton, and C. von Stechow, in Climate Change 2014: Synthesis Report, eds. Core Writing Team, R.K. Pachauri, and L.A. Meyer (Geneva, Switzerland), pp. 117–130. Available at: https://www.ipcc.ch/report/ar5/syr/, accessed October 24, 2021.

intensity of wildfires, and is anticipated to cause more instances of severe weather in the future. This section will address the general impacts of climate change/severe weather and then provide additional discussion on each of the severe weather categories. This section draws substantially from the Butte County Climate Change Vulnerability Assessment and the Butte County LHMP.

The LHMP includes the summary of Cal-Adapt Climate Projections for the North Central Valley Region in Table 2.

TABLE 2:	BUTTE COUNTY – CAL-ADAPT CLIMATE PROJECTIONS
Temperature Change 1990-2100	January increase in average temperature of 4°F to 6°F and between 8°F and 12°F by 2100. July increase in average temperature of 6°F to 7°F in 2050 and 12°F to 15°F by 2100. (Modeled average temperatures; high emissions scenario)
Precipitation	Annual precipitation is projected to decline by approximately 1 to 2 inches by 2050 and 3 to 6 inches by 2100. (Community Climate System Model Version 3 (CCSM3) climate model; high carbon emissions scenario)
Heave Wave	Heat wave is defined as five days over 102°F to 105°F except in the mountainous areas to the east. Two to 3 more heat waves per year are expected by 2050 with 5 to 8 more by 2100.
Wildfire	By 2085, the north and eastern portions of the region will experience an increase in wildfire risk, more than four times current levels in some areas. (Geophysical Fluid Dynamics Laboratory (GFDL) climate model; high carbon emissions scenario).

Source: Cal-Adapt.

The Butte County Climate Change Vulnerability Assessment, July 2021 (BCCCVA) provides a qualitative analysis of how climate change may impact Butte County in the 21st Century and is hereby incorporated by reference. The BCCCVA is also found in Appendix A. The BCCCVA utilizes the process outlined in the Cal-Adapt model to complete Phases 1 and 2 of the Cal-Adapt recommended process to provide a vulnerability assessment, as illustrated in Figure 10. Each jurisdiction is then able to draw on this information to complete Phases 3 and 4 to define an adaptation framework and strategies and specify how these will be implemented and monitored.

Figure 10: Climate Change Vulnerability Assessment

Source: LHMP Base, p. 4-49.

Key Findings of BCCCVA

Out of the 71 populations and assets Butte County analyzed, 50 are highly vulnerable to at least one hazard condition. Wildfire is responsible for the highest vulnerability scores, followed by severe storms, severe wind, and extreme heat. The following list provides the key findings and critical vulnerabilities identified in the Climate Change Vulnerability Assessment:

- Populations and assets in the eastern portion of the county are most vulnerable to wildfires and populations in the western portion of the county are most vulnerable to severe storms.
- Outdoor workers and low-resourced ethnic minorities are the most vulnerable populations, and highly vulnerable to all climate change hazards.
- Electrical transmission infrastructure and energy delivery services are highly vulnerable to damage or Public Safety Power Shutoff (PSPS) events from extreme heat, severe wind, severe storms, and wildfire. Energy delivery services are a key supporting factor for everyday activities, economic drivers, and key services.
- Water and wastewater serving both the county and other areas of California can be disrupted

from drought, severe wind, severe storms, and wildfire.

- Major roads, highways, and single-access roads can become impassable due to severe wind, severe storms, and wildfire, isolating populations in remote areas of the county and disrupting services to those areas.
- Recreation infrastructure and recreation on regional, State, and federal land can be disrupted by all climate change hazards.
- Agriculture is the most vulnerable economic driver in Butte County.
- Conifer forests and open water ecosystems are the most vulnerable ecosystems.

Key Recommendations of the BCCCVA

The resilience of these populations and assets can increase through the implementation of adaptation measures. Adaptation is the adjustment to natural and human systems, in response to actual or expected changes in climate conditions to reduce the harmful effects of actual or expected changes.[6]

Potential adaptation measures that could reduce vulnerability in Butte County, and some of which are planned items in the LHMP, include:

- Promoting the creation of community support networks to check on persons without access to lifelines, seniors living alone, and persons with disabilities during dangerous conditions.
- Collaborating with PG&E and other utility providers to underground electricity transmission lines.
- Increasing funding through grants or private organizations for fuel reduction and vegetation management projects for both neighborhoods and infrastructure.
- Continuing to provide residential assistance programs to help homeowners create and maintain defensible space and fuels management on their properties.
- Conducting structural retrofits for at-risk bridges and ensuring that these retrofits include protections against flooding and landslides.
- Expanding the chipper program throughout the county to help private homeowners dispose of trees near structures, supplementing existing cost-sharing programs.
- Working with farming organizations and the University of California Cooperative Extension to promote the availability of crop varieties that are more resilient to climate change while meeting market demand for yield and quality, as options become available.
- Continuing to work with State and federal land management agencies to support fuel and pest management activities.
- In coordination with local, State, and federal plant and wildlife management agencies and organizations, monitoring shifts in habitats, and preserving habitats where habitat migration may be needed.
- Working with local, State, and federal plant and wildlife management agencies and organizations to protect vulnerable habitat and improve ecosystem connectivity.
- Coordinating with utility providers to conduct regular evaluations and retrofits of energy transmission and delivery infrastructure.
- Incentivizing water conservation measures by establishing indoor plumbing retrofit and turf replacement programs.
- Support the implementation of Groundwater Sustainability Plans that take into consideration of the increased severity of droughts and climate change.
- Identifying equitably located resilience hubs in each community in the County to provide

[6] Cal OES, 2020. California Adaptation Planning Guide. Available at https://www.caloes.ca.gov/HazardMitigationSite/Documents/CA-Adaptation-Planning-Guide-FINAL-June-2020-Accessible.pdf. June.

emergency assistance and information, cooling spaces on extreme heat days, and refuge for those who are unable to evacuate during hazardous conditions.

Extreme Heat

According to the Cal-Adapt tool, an extreme heat day is a day when the maximum/minimum temperature exceeds the 98th percentile of observed historical data from 1961–1990 between April and October. A heat wave is four or more consecutive days of extreme heat. By this calculation, eight consecutive extreme heat days would count as two heat waves.

Heat kills by taxing the human body beyond its abilities. In extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature. Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat. Conditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality. Consequently, people living in urban areas may be at greater risk from the effects of a prolonged heat wave than those living in rural areas. Also, asphalt and concrete store heat longer and gradually release heat at night, which can produce higher nighttime temperatures known as the urban heat island effect.

Existing Conditions

Heat is a regional phenomenon and affects the whole of the Town. Heat emergencies are often slower to develop, taking several days of continuous, oppressive heat before a significant or quantifiable impact is seen. Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations. Heat waves do not generally cause damage or elicit the immediate response of floods, fires, earthquakes, or other more "typical" disaster scenarios.

The National Weather Service (e) has in place a system to initiate alert procedures (advisories or warnings) when extreme heat is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. The NWS Heat Risk forecast provides a quick view of heat risk potential over the upcoming seven days. The heat risk is portrayed in a numeric (0-4) and color (green/yellow/orange/red/magenta) scale which is similar in approach to the Air Quality Index (AQI) or the ultraviolet (UV) Index. This can be seen in Section 4.2.2 of the Base Plan.

Health impacts are the primary concern with this hazard, though economic impacts are also an issue. Heat can exacerbate drought and can increase wildfire risk.

The elderly and individuals below the poverty level are the most vulnerable to extreme temperatures. Nursing homes and elder care facilities are especially vulnerable to extreme heat events if power outages occur and air conditioning is not available. In addition, individuals below the poverty level may be at increased risk to extreme heat if use of air conditioning is not affordable. This is especially true of homeless people and the transient population. Reliance on air conditioning causes a strain on the electrical energy in the Town. Occasionally peak demands outweigh supply and a condition known as brown-out occurs. This is an extremely dangerous situation for electrical equipment as it operates without the needed electricity causing damage to the systems. Periods of extended heat and dryness (droughts) can have major economic, agricultural, and water resources impacts. Extreme heat can also dry out vegetation, making it more receptive to wildfire ignitions.

Vulnerability to extreme heat will increase as the average age of the population in each city shifts. The residents of nursing homes and elder care facilities

are especially vulnerable to extreme temperature events. It is encouraged that such facilities have emergency plans or backup power to address power failure during times of extreme heat and in the event of a Public Safety Power Shutoff. Low-income residents and homeless populations are also vulnerable. Cooling centers for these populations should be utilized when necessary. However, many of the residents of the Town are accustomed to living with extreme heat and take precautions to guard against the threat of extreme heat. In addition, the shading provided by the numerous trees around town will be significantly different with the loss of an estimated 350,000 trees.

The Cal-Adapt tool looks at the 30-year average annual frequency of extreme heat days and uses four different Global Climate Models (all models were by California's Climate Action Team for performance in California) to project the number of heat waves lasting more than three days. Figure 11 shows the average across all four models. Paradise and the majority of Butte County are estimated to experience a high degree of heat waves in the future, an estimated annual average of 14 to 18 heat waves in 2070-2099, compared to an average of 1 per year in 1961-1990 and 5 per year in 2035-2064.

Historical Data

The LHMP Base Plan in Section 4.2.2 includes a list of past heat events, noting fourteen extreme heat events between 1993 and October 31, 2018.

Regulatory Setting/Responsible Agencies

Several general disaster preparedness efforts by the Town will also improve the ability of the Town to respond to extreme heat events, including enhanced public education (LHMP Action 2), improved Early Warning System (LHMP Action 3), and Public Works signs (LHMP Action 4).

Extreme Freeze and Winter Storms

According to the National Weather Service (NWS) and the Western Regional Climate Center (WRCC), extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening. Winter snowstorms can include heavy snow, ice, and blizzard conditions.

Existing Conditions

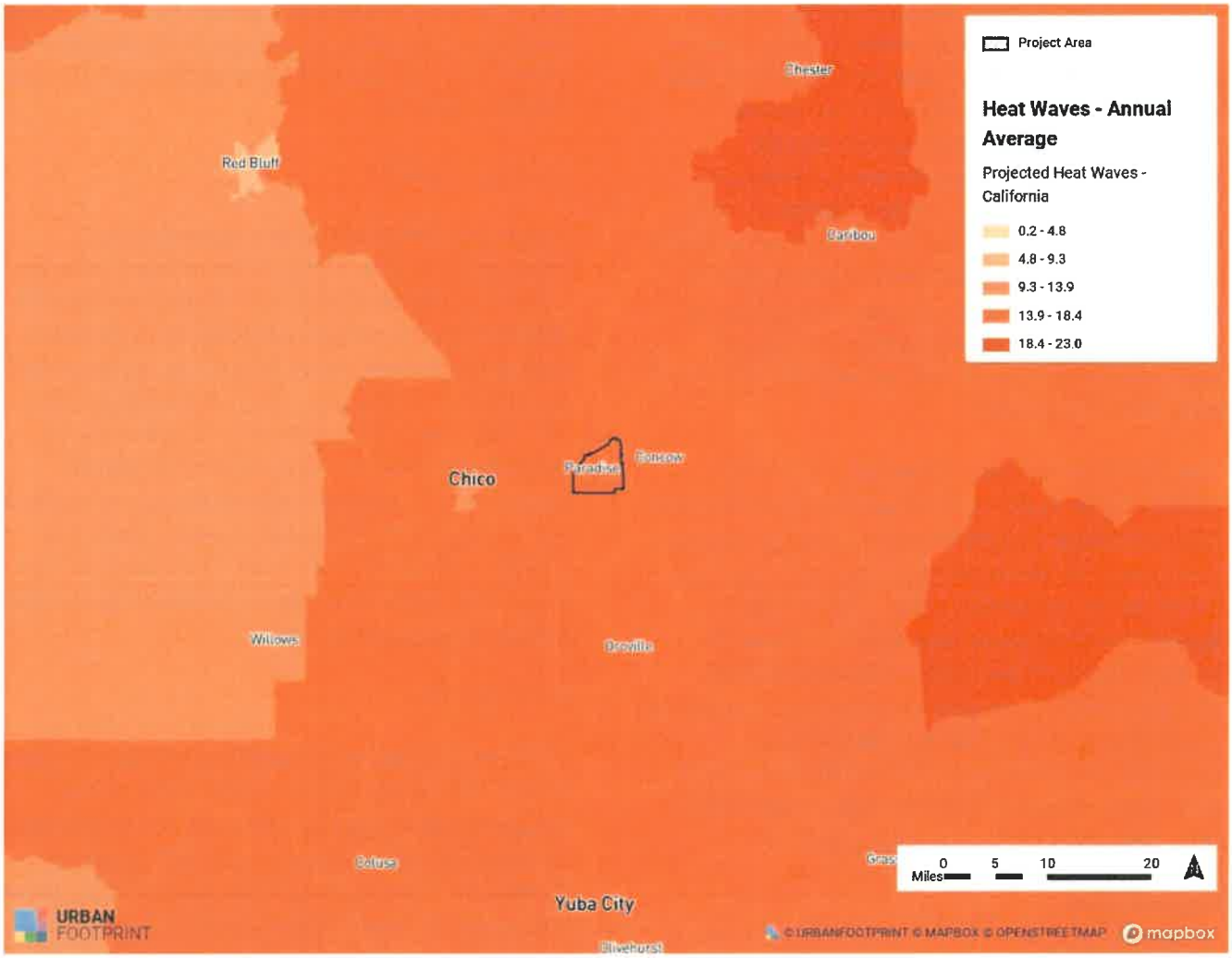
Freeze and winter storms are regional issues, meaning the entire town is at risk. While there is no scale (e.g., Richter, Enhanced Fujita) to measure the effects of freeze, temperature data from the WRCC indicates that there are 21.8 days that fall below 32°F in eastern Butte County, with no days falling below 0°F. Freeze has a slow onset and can generally be predicted in advance. Freeze events can last for hours (i.e., in a cold overnight) or for days to weeks at a time. Snowfall is measured in snow depths. It is rare for snow to fall in the town, and even rarer that snow accumulates in the town. Snowfall has an onset similar to freeze in the Town.

Historical Data

Between 1950 and 2019, Butte County had two State disaster declarations for freeze or winter storms. Severe weather data from the National Oceanic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information (NCEI), shows 139 freeze and winter storm events in Butte County between 1993 and 10/31/2018. The Town Planning Team for the LHMP noted that since freeze and winter storm is a regional phenomenon, events that affected the lower elevations of the County also affected the Town. Those past occurrences were shown in the Base Plan in Section 4.2.3.

A significant winter storm event occurred in February 1990 that did major damage to buildings including the collapse of the bowling alley, Long's Drugs, the Cannery grocery store, a tire shop, and also many homes damaged by snow and downed trees. The snowstorm immobilized the Town for ten days with power outages lasting over two weeks. After the 1990 storm, the Town changed the building snow load requirements above 1,800 feet elevation.

Figure 11: Projected Heat Waves – California and Historical Heat Health Events



Source: Cal-Adapt, 2022

In addition, the following freeze and winter storms since 2014 were noted in the LHMP:

- February 22, 2018 – Snowstorm/Winter Storm (road closures).
- February 23, 2017 – Freezing Temperatures.

The Town experiences temperatures below 32°F during the winter months. The temperature moves to the teens in rather extreme situations. Freeze normally does not impact structures but is a life safety issue. Secondary impacts of extreme cold can affect the supporting mechanisms or systems of a community's infrastructure. For example, when extreme cold is coupled with high winds or ice storms, power lines may be downed, resulting in an interruption in the transmission of that power shutting down electric furnaces, which may lead to frozen pipes in homes and businesses.

Occasionally, winter storms with snow and ice can affect the Town. Transportation networks, communications, and utilities infrastructure are the most vulnerable physical assets in the Town. The ability for the Town to continue to operate during periods of winter storm and freeze is paramount.

The elderly population in the planning area is most vulnerable to temperature extremes. The residents of nursing homes and elder care facilities are especially vulnerable to extreme temperature events. It is encouraged that such facilities have emergency plans or backup power to address power failure during times of extreme cold. Transient and homeless populations are also at risk to freeze.

Regulatory Setting/Responsible Agencies

Several general disaster preparedness efforts by the Town will also improve the ability of the Town to respond to extreme freeze and winter storm events, including enhanced public education (LHMP Action 2), improved Early Warning System (LHMP Action 3), Public Works signs (LHMP Action 4).

The Town's Building Department is responsible for enforcing building code requirements related to building snow loads and insulating pipes from freezing temperatures in new construction. Future development built to code should be able to withstand snow loads from severe winter storms. Pipes at risk of freezing should be mitigated be either burying or insulating them from freeze as new facilities are improved or added. Vulnerability to extreme cold will increase as the average age of the population in the County shifts. Greater numbers of future senior citizens will result from the large number of baby boomers in the planning area. The elderly are more at risk to the effects of freeze. However, many of the residents of the town are accustomed to living with freeze and take precautions to guard against the threat of freeze.

Extreme Rain and Storms

Storms in the Town of Paradise occur annually and are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado.

High winds can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. High winds, as defined by the NWS glossary, are sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration. These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events such as thunderstorms.

Existing Conditions

Heavy precipitation in the Town falls mainly in the fall, winter, and spring months. Location and Extent Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the Town. All portions of the Town are at risk to heavy rains. Most of the severe rains occur during the winter months. There is no scale by which heavy rains and severe storms are measured. Magnitude of storms is measured often in rainfall and damages. The speed of onset of heavy rains can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of severe storms in California, Butte County, and the Town is often short, ranging from minutes to hours. In some cases, rains can continue for days at a time.

The entire Town is subject to significant, non-tornadic (straight-line), winds. Each area of the Town is at risk to high winds. Magnitude of winds is measured often in speed and damages. These events are often part of a heavy rain and storm event, but can occur outside of storms. The speed of onset of winds can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of winds in California is often short, ranging from minutes to hours. The Beaufort scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. It can be seen in Section 4.2.5 of the Base Plan.

Historical Data

Information on precipitation extremes can be found in Section 4.2.4 of the Base LHMP. According to historical hazard data, severe weather is an annual occurrence in the Town of Paradise.

Damage and disaster declarations related to heavy rains and storms have occurred and will continue to occur in the future. Heavy rain and severe storms are the most frequent type of severe weather occurrences in the Town. Wind and lightning often accompany these storms and have caused damage in the past. Hail is rare in the Town. Actual damage associated with the primary effects of severe weather have been limited. It is the secondary hazards caused by weather, such as fire, that have had the greatest impact on the Town. Impacts to property, critical facilities (such as utilities), and life safety can be expected. The risk and vulnerability associated with these secondary hazards are discussed in the flood and localized flood sections of the LHMP Paradise Annex.

According to historical hazard data, high winds are an annual occurrence in the Town of Paradise. These high wind events are typically expected 7 to 8 times per year.

Regulatory Setting/Responsible Agencies

The Town Building Department is responsible for enforcing building code requirements developed to minimize damage from high winds in new development.

Several general disaster preparedness efforts by the Town will also improve the ability of the Town to respond to extreme rain and storm events, including enhanced public education (LHMP Action 2), improved Early Warning System (LHMP Action 3), Public Works signs (LHMP Action 4).

New critical facilities such as communications towers and others should be built to withstand hail damage, lightning, and thunderstorm winds. While deaths have occurred in the planning area in the past due to 2019 lightning, it is difficult to quantify future deaths and injuries due to lightning. Future losses to new development should be minimal.

Power Shutoffs

Public Safety Power Shutoffs (PSPS) are used to reduce the risk of power equipment inducing wildfires, as was found to be the cause of the Camp Fire. According to PG&E, factors considered include low humidity levels, high winds, and fuel conditions. Another potential cause of power shutoffs is a rotating outage (rolling blackout) caused by demands on the power grid. During heat waves, the California Independent System Operator (CAISO), the organization that runs the state's electric grid, can call for rotating outages when power demand threatens to exceed the capacity of the system.

Existing Conditions

PSPS events may be limited to specific areas or affect broad regions of the state. Power outages combined with high heat or extreme cold events can add to the risks to the public, especially for vulnerable populations such as low-income residents and the homeless. Power outages can also impact emergency communications and operations.

Historical Data

In 2019, PSPS events occurred in the County on June 8-9, August 23-25, and again on September 23-24.

Regulatory Setting/Responsible Agencies

The California Public Utilities Commission (CPUC) has adopted guidelines and rules that the power utilities must follow regarding PSPS events. PG&E must file reports with the CPUC for each PSPS event.

In 2019, PG&E completed significant upgrades to its Wildfire Safety Operations Center (WSOC) to assist in evaluating whether to enact a PSPS. PG&E provides a Medical Baseline Program to provide extra notifications during PSPS to Medical Baseline customers.

DROUGHT

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

Existing Conditions

As discussed in the LHMP Base Plan, drought and water shortage are regional phenomenon. The whole of the County, as well as the whole of the Town, is at risk. Drought has a slow speed of onset and a variable duration. Drought can last for a short period of time, which does not usually affect water shortages. Should a drought last for a long period of time, water shortage becomes a larger issue.

Historical Data

Since drought is a regional phenomenon, past occurrences of drought for Paradise are the same as those for the County. Those past occurrences can be found in Section 4.2.8 of the LHMP Base Plan.

Based on historical information, the occurrence of drought in California, including the Town of Paradise, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users.

The vulnerability of the Town of Paradise to drought is Town-wide, but impacts may vary and include reduction in water supply and an increase in dry fuels. The increased dry fuels result in an increased fire danger. Areas of Paradise are in the foothill interface and become more susceptible to wildfire as drought conditions increase. Residents of these areas are often times dependent upon ground water (water wells) for their water supply. As these water wells begin to fail during periods of drought, the ability of the residents to water landscaping decreases, and fire fuel loads increase.

Other qualitative impacts associated with drought in the planning area are those related to water intensive activities such as wildfire protection, municipal usage, commerce, tourism, and recreation.

Voluntary conservation measures are typically implemented during extended droughts. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. With more precipitation likely falling as rain instead of snow in the Sierra's, and warmer temperatures causing decreased snowfall to melt faster and earlier, water supply is likely to become more unreliable. In addition, drought and water shortage is predicted to become more common. This means less water available for use over the long run, and additional challenges for water supply reliability, especially during periods of extended drought. These and other impacts are thoroughly evaluated in the Paradise Irrigation District's 2020 Urban Water Management Plan, including a 2021 Water Shortage Contingency Plan.

Post Camp Fire, the Paradise Irrigation District is restoring potable water to standing homes, permitted homes, businesses, and Town buildings. While the process will take time, the District is working diligently to restore water to the community. The UWMP found that the supply and drought risk assessment do not anticipate a water deficit for a single-year or for a five-year consecutive drought in the near term or long term.

In addition, the Town's LTCRP has a project for the development of a wastewater system in the Town. As this Recovery project takes shape, a sewer system in the commercial areas would incentivize economic growth and reduce environmental impacts in the Town.

DISASTER PREPAREDNESS, RESPONSE, AND RECOVERY

Police

The Town strives to ensure a town-wide five-minute response time for police. The Paradise Police Department currently has 23 employees and 5 units: Administration, Patrol, Investigations, Communication/Records, and Animal Control. The Paradise Police Department is currently contracting 911 emergency and non-emergency dispatch services with the Butte County Sheriff's Office.

Patrol operations is the largest of the five units, with 11 authorized sworn patrol officers and 5 sergeants. Patrols provide 24/7 service every day of the year. Patrol personnel are the first responders to routine calls and crimes that are in progress. According to the Town of Paradise's police webpage, traffic safety is one of the most significant police issues in Paradise. The Police Department reports that there has been a reduction of injury collisions.

As previously mentioned, the Town of Paradise has an Emergency Operations Plan in place, in which all employees of the Paradise Police Department are subject to immediate recall. The Emergency Operations Plan also includes response from fire, medical and health, communication, and transportation services and facilities, to cope with problems around rescue, relief, evacuation, rehabilitation, and reconstruction in the event of a disaster.

Communications

As mentioned earlier, flaws in the Town's communications systems were exposed by the Camp Fire. There were failures in the emergency alert system, including the loss of 17 cell towers, and four at-risk areas in the town were not notified of evacuation orders due to human and technical errors.

Following the 2018 Camp Fire, the Town of Paradise has made improved communications a key priority, consistent with the LTCRP. The Town is utilizing funds from FEMA's Hazard Mitigation Grant Program to develop and implement an early warning system throughout the town. The system would immediately notify residents of hazardous events via sirens, text messages, voice messages, and more. 21 towers will be constructed across the Town as the basis of an audible system. 20 are operational as of October 2023.

The Town currently uses direct contact with residents by Town officials and mass media to notify residents of evacuation. AM radio, TV, and social media are all suggested sources for residents to stay informed and aware when an evacuation is ordered or warning issued.

The Town is also pursuing the installation of a fiber optic network that would be accessible to all residents and businesses in Paradise. A fiber optic network would improve access to the Internet and would provide a safer method of internet service distribution. The feasibility study for this project was completed in 2021. A funding request is part of the Town's federal advocacy platform.

Evacuation Planning

The topography and development history of the Town present problems in delivery of emergency services, including fire protection and evacuation. Hilly terrain with narrow, winding roads with little circulation, limited escape routes, and limited ingress and egress to access the Town limits rapid access and orderly evacuations. There are many miles of public streets and private roads, many of which were built years ago. Private roads may be substandard in design and access capability due to topography.

The Paradise Municipal Code sets a maximum cul-de-sac length of 1,800 lineal feet, measured as the distance between the cul-de-sac's terminus and its nearest intersection with a through street. For this Safety Element, areas are identified as having inadequate access if they are served exclusively by a cul-de-sac or dead-end road that exceeds this

standard (i.e., areas that do not have at least two emergency evacuation routes).

See Figure 12 for existing areas with inadequate emergency access/evacuation routes. These areas are predominantly located in the southern portion of the Town along South Libby Road and Edgewood Lane. With implementation of the TMP, described below, the areas with inadequate access/evacuation routes would be reduced, as shown in Figure 13.

Post-Camp Fire, one of the community's biggest concerns has been to improve emergency evacuation routes and evacuation planning. Consistent with the LTCRP, the Town of Paradise approved a TMP on May 10, 2022 that looks at emergency evacuation planning and local roadway safety with detailed information in Appendix D, Evacuation Technical Memorandum. The TMP evaluated the impact of permanent improvements and potential temporary modifications on emergency evacuation, focusing on an "all at once" event similar to the Camp Fire evacuation but applicable for a range of emergency scenarios.

The high-level town-wide evacuation analysis prepared for the TMP was completed for several different scenarios as shown in Table 3.

TABLE 3: OVERALL EVACUATION SCENARIOS ANALYSIS SUMMARY

Tested Scenario	Impact on Evacuation Time
Full Town of Paradise (Baseline Scenario)	N/A Baseline Scenario
Partial Evacuation of Paradise (North to South from Clark Road to Pentz Road)	Total evacuation time decreases by over 50%
Partial Evacuation of Paradise (North to South from Skyway to Clark Road)	Total evacuation time decreases by over 50%
Full Town of Paradise & Magalia	Total evacuation time decreases by 15% from Baseline Scenario
Staggered Full Town of Paradise & Magalia	Total evacuation time decreases by approximately 30% from full town of Paradise & Magalia scenario

Source: Transportation Master Plan, Appendix D, Evacuation Technical Memorandum, April 5, 2022, p. 10.

The TMP effort has included a high-level capacity analysis to determine major and secondary evacuation routes, potential areas of congestion (intersections or roadway segments), and opportunities for roadway extensions/connections on dead-end streets for additional routes and increased evacuation capacity. Figure 14 shows the primary, secondary, and potential future evacuation routes, as well as the number of travel lanes.

The TMP effort has developed a Roadway Improvement Plan, as shown in Figure 15, that identifies proposed improvements such as:

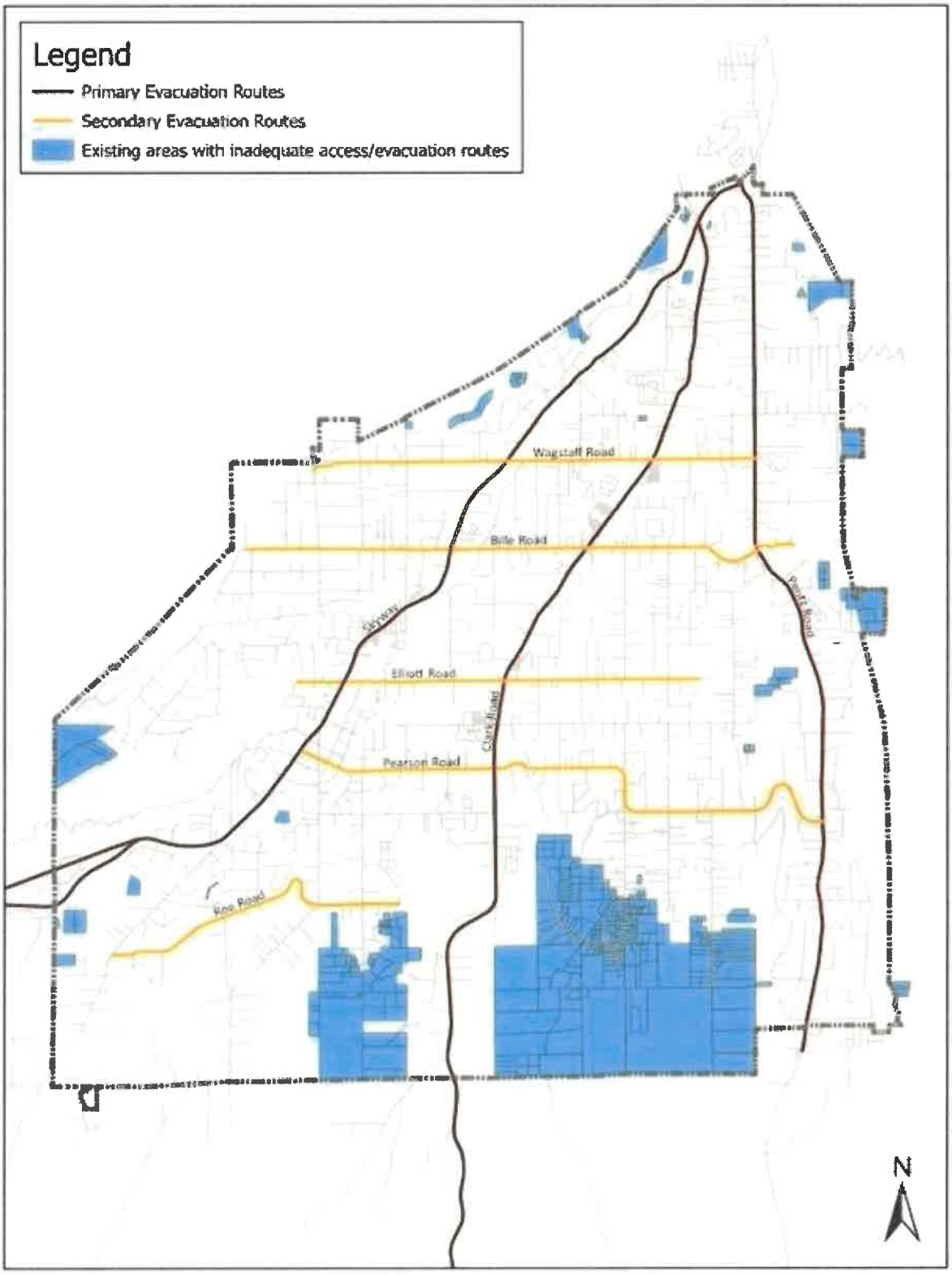
- Roadway widening, particularly downtown Skyway between Elliott Road and Pearson Road.
- Roadway widening plus a multiuse path that could be used by first responders during an evacuation on segments of Skyway, Neal Road, Clark Road, and Pentz Road.
- New roadway extensions including Roe Road, Elliott Road extension and others.
- Intersection improvements at select locations.

One identified project on Figure 15, "Skyway Capacity Improvements" including removal of the median and bulb outs on Skyway to facilitate flow during an evacuation, has been implemented. Another landscape median on Pearson Road is planned to be removed in 2024.

The TMP builds on the Camp Fire After-Action Report (AAR) and Corrective Action Plan (CAP) to develop the actions and recommendations in the TMP. The TMP includes recommendations for:

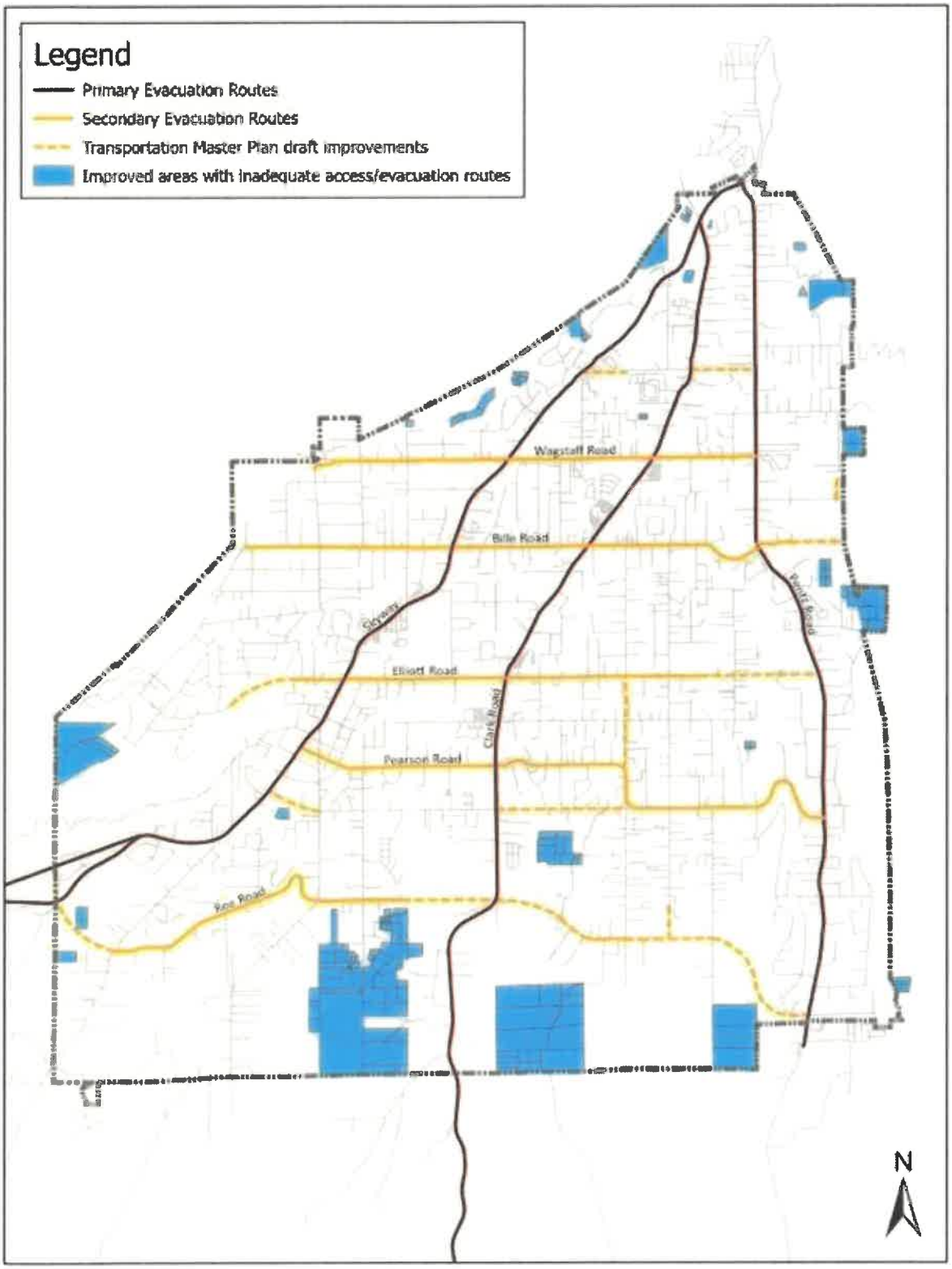
- Traffic control for evacuation.
- Facilitate multiagency collaboration.
- Non-roadway projects, such as signage, a traffic management center, and traffic signal interconnect.

Figure 12: Inadequate Emergency Access: Existing



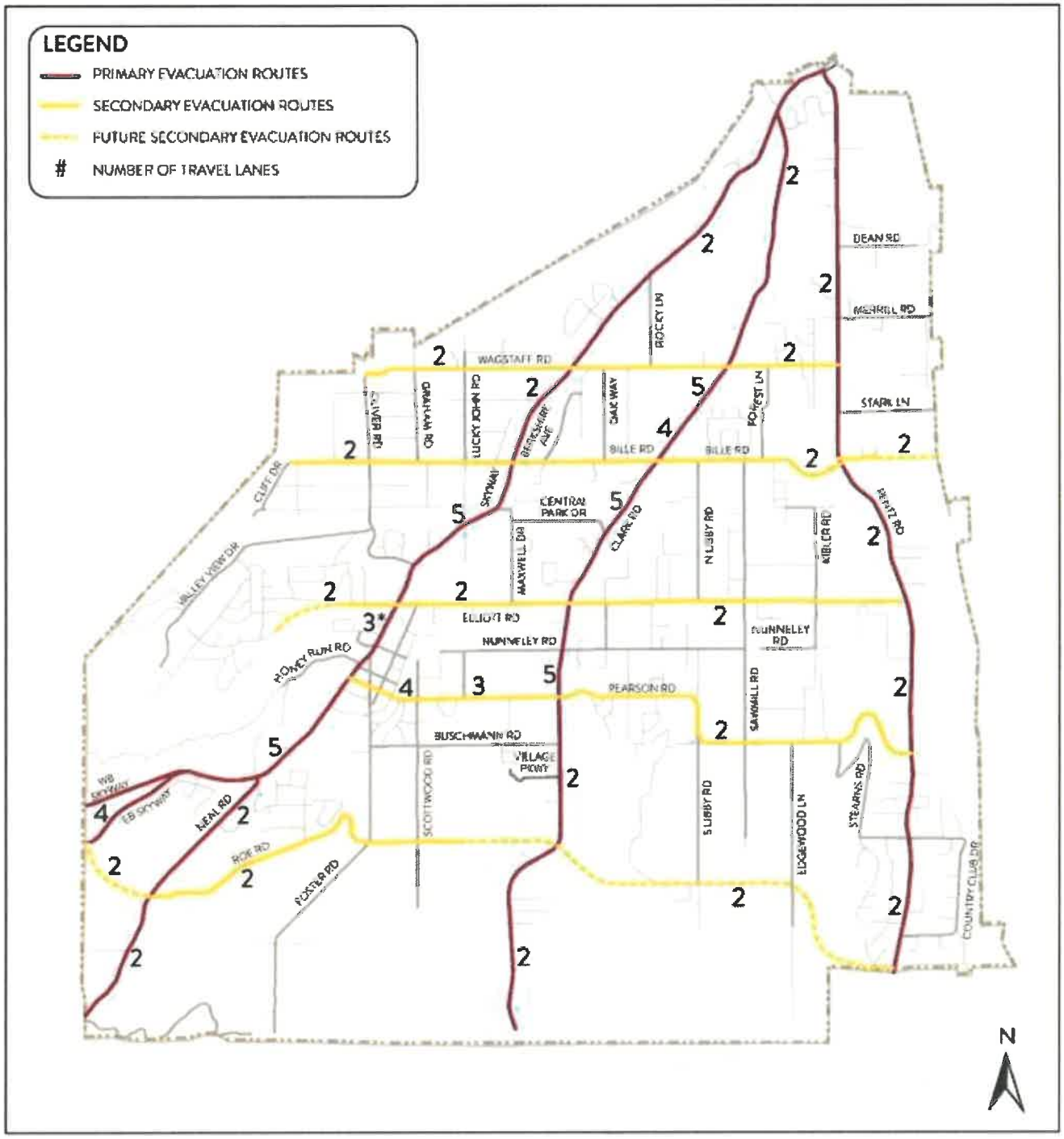
Source: Town of Paradise, 2022.

Figure 13: Inadequate Emergency Access: After Transportation Master Plan Improvements



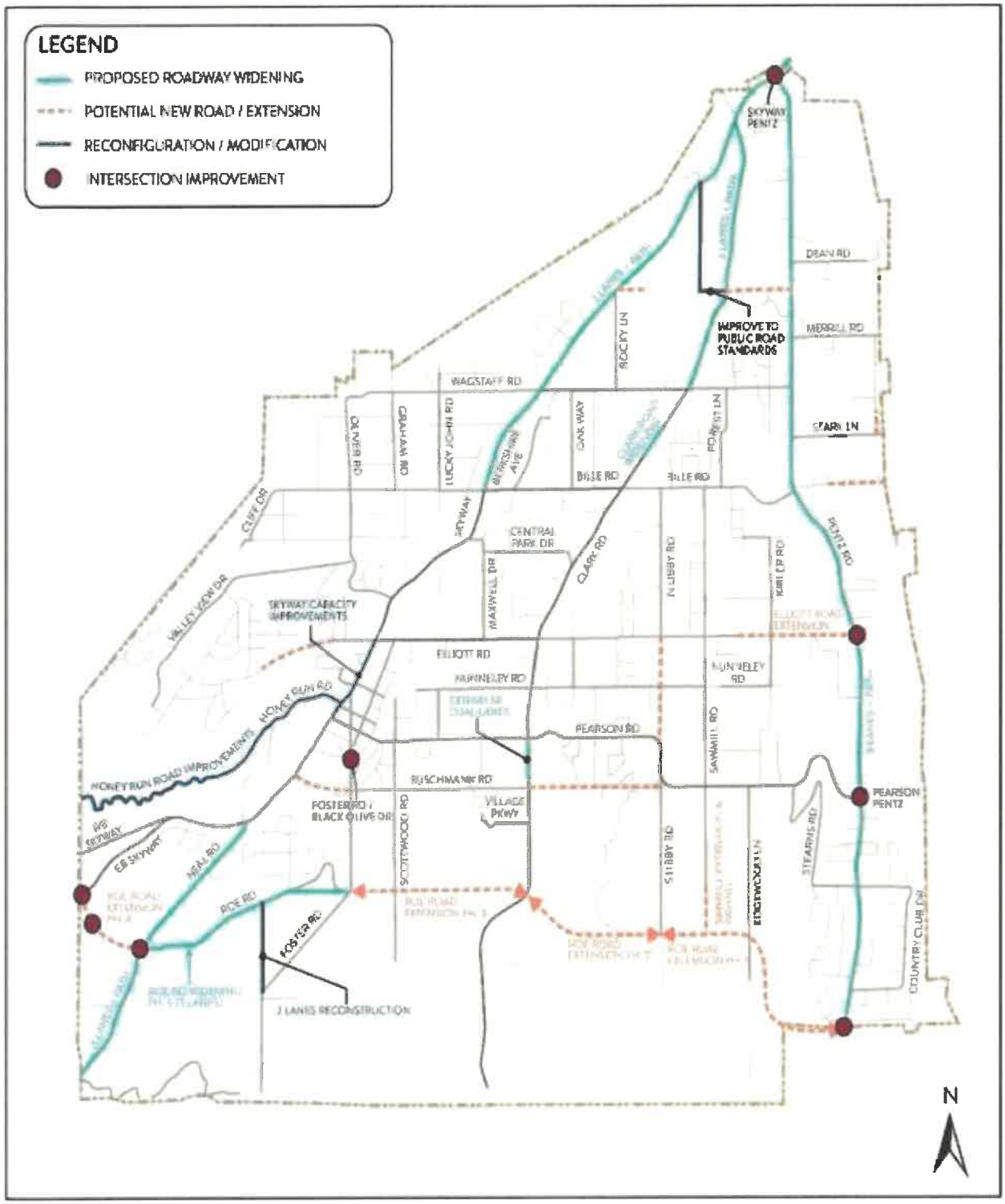
Source: Town of Paradise, 2022.

Figure 14: Evacuation Routes



Source: Town of Paradise, 2022.

Figure 15: Transportation Master Plan Roadway Improvement Plan



Source: Town of Paradise, 2022.

Proposed evacuation improvements have also been identified, including signal timing plans and multiagency coordination to address flow at key intersections outside the Town.

The TMP also provides a framework for identifying, evaluating, and prioritizing transportation safety improvements on local streets, as well as other roadway-related standards and policies.

Roadway Standards

Existing roadway requirements are contained in Sections 17.06.090 and Chapter 16.06 of the Paradise Municipal Code. Per Section 17.06.900, the Town does not allow any discretionary permit or project that seeks to increase the existing residential density on parcels that are on a cul-de-sac that exceeds 1,800 lineal feet. Chapter 16.06 requires all access easements or rights-of-way to be 50 feet in width, except for those which serve four or fewer lots. However, subdivision applicants may request widths of less than 50 feet for privately maintained roads (see Table 4). They must connect, via private roads if necessary, with a publicly-maintained street. The Town's maximum cul-de-sac length for new streets is 1,320 lineal feet.

TABLE 4: NEWLY CREATED ACCESS EASEMENT OR RIGHT-OF-WAY WIDTH REQUIREMENTS

Total Lots Served by Road or Street	Minimum Access Width Required (Feet)
5+	Public Street: 60 (Access width of 50 feet may be acceptable to Town engineer if underground utilities are installed) Private Street: 50*
4	40
3	30
2	25
1	20

* Unless special circumstances warrant a 60-foot access width, as determined by the Town engineer.
Source: Town of Paradise, 2021.

Concurrent with approval of the TMP, the Town adopted Roadway Design Guidelines that include Roadway Standard Drawings. This includes a minimum paved width of 14 feet for driveway access to single dwelling units and increased widths based on the roadway classification, as shown in Table 5.

TABLE 5: ROADWAY DESIGN GUIDELINES

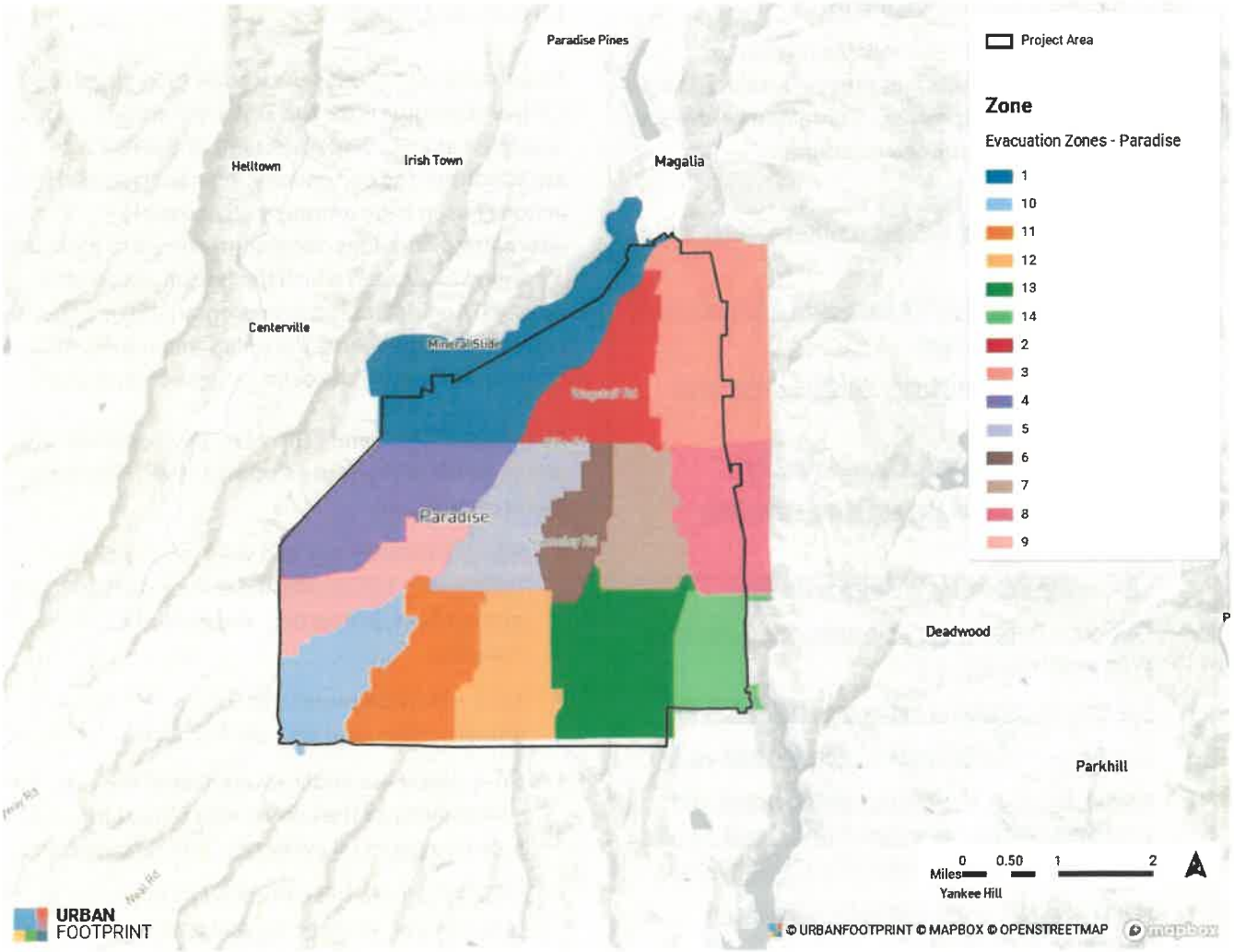
Roadway Type	Roadway Description	Minimum Surface Width (Feet)
A-1	Access for Single Family	14
A-2a	Private Interior Road	16
A-2b	Private Interior Road	18
A-3a, b	Private Interior Road, 5+ lots	20
B-1	Public Interior Road	24
B-2	Collector Residential	28
B-3	Multi-Family	40
B-4	Commercial	40
B-5	Local Road	32
B-6A, 6B	Collector	36
C-1	Arterial	60
C-1A	2-Lane Principal Arterial	40
C-1B	Minor Arterial without Sidewalk	40
C-2	Arterial-Divided Highway	28
C-2A	Principal Arterial 2-Lane	40
C-2B	Principal Arterial (Urban Diet)	46
C-3A	Principal Arterial No TWLTL	58
C-3B	Principal Arterial	72
C-3C	Principal Arterial with Multi-Use Trail	72

Source: Town of Paradise.

Evacuation Zones

The Town has 14 evacuation zones, shown in Figure 16. The Town has also identified Paradise Alliance Church and Paradise Auditorium as assembly points. The primary evacuation routes are Skyway, which provides access to Highway 99 and Chico; Neal Road; Clark Road, which provides access to Highway 70 and Oroville; and Pentz Road. Officials will determine which routes to use and to avoid given the specific circumstances of the emergency. Residents are encouraged to know several routes out of their neighborhood and their community.

Figure 16: Evacuation Zones



Source: Town of Paradise, 2022.

According to the BCFSC, evacuation notices can be provided directly to residents by law enforcement, volunteers in police service, or fire or other public safety personnel, or given indirectly through mass media (e.g., radio, TV) or social media. There is a notification service residents can subscribe to for cell phone and email evacuation notifications.

Resources Related to Implementation

The studies and resources available related to emergency preparedness and especially related to wildfires is constantly growing. Contained below is a short list of resources related to program implementation:

- Building a Wildfire-Resistant Home: Codes and Costs
- Butte County Camp Fire Response – County-wide Corrective Action Plan
- Butte County Community Wildfire Protection Plan (CWPP)
- Butte County Fire Safe Council website
- Butte County Local Hazard Mitigation Plan (LHMP)
- CAL FIRE – Ready for Wildfire website
- California Department of Insurance – Safer from Wildfires Program
- Community Planning Assistance for Wildfire
- Fire Adapted Communities Learning Network
- Knapp, Eric E et al: Housing arrangement and vegetation factors associated with single-family home survival in the 2018 Camp Fire, California
- Next10 Report – Rebuilding for a Resilient Recovery
- Paradise Forest Management Plan
- Paradise Grazing Plan
- Paradise Nature-Based Fire Resilience Project Report
- Town of Paradise Emergency Services Information website
- Town of Paradise Emergency Operations Plan
- Town of Paradise Transportation Master Plan
- ULI Report – Firebreak: Wildfire Resilience Strategies for Real Estate
- Wildfire Risk to Communities

GOALS, POLICIES, AND PROGRAMS

This chapter describes safety goals (SG), policies (SP), and programs for the Town of Paradise. A goal is defined as a general statement of the highest aspirations of the community. A policy is a course of action chosen from among many possible alternatives. It guides decision-making and provides a framework around which the housing programs operate. An implementation program (SI) is a specific action that implements the policy and moves the community toward the achievement of its goals.

The goals of this Safety Element are consistent with and build off of the Butte County LHMP. The Safety Element goals are:

- SG-1 – Minimize risk and vulnerability of the community to hazards and reduce damages and protect lives, properties, and public health in Paradise.
- SG-2 – Provide protection for critical facilities, infrastructure, and services from hazard impacts.
- SG-3 – Increase public awareness of the risk and vulnerability of the community to hazards and promote personal awareness and responsibility.
- SG-4 – Increase the community's ability to be prepared for, respond to, and recover from a disaster event.
- SG-5 – Reduce fire severity and intensity in Paradise and surrounding lands.
- SG-6 – Increase community resiliency to climate change's influence on disasters.
- SG-7 – Collaborate with the USDA Forest Service (USFS), Bureau of Land Management (BLM), California Department of Forestry and Fire Protection (CAL FIRE), and other fire protection agencies and stakeholders to mitigate the risk of wildfire.
- SG-8 – Collaborate with Butte County Fire Safe Council, Paradise Ridge Fire Safe Council, Paradise Recreation and Park District, and other

community groups and organizations to increase homeowner awareness of and participation in voluntary wildfire resiliency and climate change adaptation interventions.

- SG-9 – Utilize Paradise's experiences with wildfire to advocate for State and federal policies and regulations that assist in creating disaster resilient communities and facilitate post-disaster recovery.

For each implementation measure, the party responsible for implementation, funding source, timing of implementation, and quantified results (where appropriate) are identified.

SG-1 MINIMIZE RISK AND VULNERABILITY OF THE COMMUNITY TO HAZARDS AND REDUCE DAMAGES AND PROTECT LIVES, PROPERTIES, AND PUBLIC HEALTH IN PARADISE.

SP-1 The Town will consider extreme heat days in building and landscape design, including park design.

SP-2 The Town will stay informed on methods for home hardening and periodically review whether to include additional requirements as the town continues to recover and more science and information become available. The Town will evaluate home hardening and construction requirements annually and amend local buildings codes as warranted to take into account additional stressors on buildings including, but not limited to, building materials to reduce the impacts of high heat days, fire resistance in areas of increasing wildfire risk, and flood proofing for intermittent inundation.

SP-3 The Town will consider the costs of mandates and increased standards for climate change adaptation regulations and those standards and regulations on housing affordability. These standards and regulations may include home hardening, building materials standards, landscaping, and siting. Policies should balance the need for climate adaptation with the negative impact of decreasing housing affordability for vulnerable populations.

SP-4 The Town will ensure adaptation planning includes best available science, adequate mapping, and consideration of planning horizons. Best available, up-to-date scientific information about hazards shall be used in vulnerability assessments, permit applications that present hazard risks, and the preparation of technical reports and related findings. Map areas subject to existing and future hazards that present risks to life and property using multiple scenarios, including worst case scenario.

SP-5 The Town will encourage infill development near services and evacuation routes through regulatory levers such as reduced or waived permitting fees and zoning incentives. The proposed Sewer Service Area Overlay Zone will include considerations to incentivize development that has fewer GHG emissions relative to sprawl and to encourage building in safer parts of town.

SP-6 Because, by local designation, the entire Town is located in a Very High Fire Hazard Severity Zone (VHFHSZ), it is not feasible to avoid or minimize new residential development within VHFHSZs. The Town will improve the resiliency of residential development through enforcement of State requirements as well as local requirements for defensible space and fire resilient construction, consistent with the Fire Safe Regulations and Public Resources Code (PRC) 4290.

SP-7 The Town will limit and discourage construction of new development (including rebuild projects) in zones or overlay areas that have been identified or designated as key parcels for wildfire risk reduction.

SP-8 The Town will conduct an assessment that identifies housing units and neighborhoods in fire hazard severity zones that do not meet current fire safe building codes or road standards and develop retrofit programs that target highest risk areas including but not limited to programs to encourage lot consolidation, taking into consideration the increase in frequency and severity of wildfires.

SP-9 The Town will identify, map and establish land use designations and development standards that protect areas of significant habitat, biodiversity, carbon-sequestration, ecological integrity and those areas with high natural resilience to climate change to reduce loss of critical habitat, increase bio-diversity, mitigate climate change effects and protect ecological resources.

SP-10 The Town will continue to implement provisions of the California Fire Code for Very High Fire Hazard Severity zones.

SP-11 The Town will revise the Paradise Municipal Code to adopt development standards that meet or exceed Title 14, California Code of Regulations (CCR), Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commending with Section 1270) (SRA Fire Safe Regulations) and Title 14, CCR, Division 1.5, Chapter 7, Subchapter 3, Article 3 (commencing with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations), and PRC 4290. These standards will include but not limited to 30-foot setbacks for all buildings from all property lines or mitigation measures, designation and preservation of undeveloped and strategic ridgelines, and standards for emergency ingress and egress.

SP-12 New fire station(s) shall be located so that all areas within Town limits are within a five-minute emergency response time for 90 percent of all emergency incidents. New fire station locations should be within a 0.5-mile radius of the symbols indicated on the *Land Use Diagram*.

SP-13 The Town will endeavor to maintain an overall Insurance Services Office (ISO) rating[7] of three or better and an emergency fire response time within five minutes from 90 percent of all emergency incidents within the Town limits.

SP-14 The Town will strive to reduce the impact of pollutants on the well-being of Paradise citizens.

SP-15 The Town shall ensure that any new development or project for improvement of a structure located within potential floodways consider and account for special flood hazards by enforcing the Paradise Municipal Code standards for building in areas prone to flood hazards.

SP-16 Detrimental and toxic discharge into natural waterways shall not be permitted.

SP-17 Development projects should be designed to minimize soil erosion and shall be required to comply with all Town of Paradise-adopted soil erosion standards maintained by the Paradise Public Works Department.

SP-18 Butte County and its cities and towns, including Paradise, shall act to provide for the safe, effective management of hazardous wastes generated within the county. New off-site hazardous waste management facilities shall be primarily limited to a scale necessary to meet the hazardous waste management needs of this

[7] ISO Fire Suppression Rating Schedule (FSRS), evaluates four primary categories of fire suppression — fire department, emergency communications, water supply, and community risk reduction. The FSRS includes standards set by the National Fire Protection Association (NFPA).

county; larger facilities may be permitted in accordance with effective inter-jurisdictional agreements reached between Butte County and other jurisdictions or upon determination of the local governing body that the project meets local planning criteria and serves public needs.

SP-19 Butte County and its cities and towns, including Paradise, encourage multi-county and regional efforts to plan and implement alternatives to land disposal of untreated hazardous wastes and to limit the risks posed by the transportation of hazardous wastes around the state. Agreements for new facilities to provide the offsite capacity needed for hazardous waste treatment and residuals disposal should be reached among jurisdictions according to their fair share of the hazardous waste stream, each jurisdiction's environmental suitability for different types of facilities, their economic interests, and the economic viability of different types and sizes of facilities.

SP-20 Butte County and its cities and towns, including Paradise, shall ensure that onsite and offsite hazardous waste treatment facilities are subject to complete local review.

SP-21 Butte County and its cities and towns, including Paradise, should designate a system of preferred transportation routes for hazardous wastes within the county. Selection of preferred routes should be determined on the criteria of minimal risk of accident, and minimal exposure of the county's population to the consequences of any accidents. The designation of preferred routes need not imply any restrictions on other routes, nor any conflict with the California Highway Patrol's role in establishing transportation routes for hazardous materials.

SP-22 Butte County, and its cities and towns, including Paradise, shall require that all local land use decisions on siting specified hazardous waste management facilities are consistent with Butte County Public Health Department requirements and State law.

SI-1 INCREASE SHADE AND REDUCE HEAT IMPACTS

The Town will amend landscaping and development standards to ensure landscaping and building features such as awnings, canopies, arcades, and/or colonnades that can encroach in the public sidewalk area are used to create shade for pedestrians and reduce heat absorption.

The Town will develop design standards for parks to ensure that all park facilities, including recreational sports complexes, include a tree canopy, shade structures, and materials with low solar gain to improve usability on high heat days and reduce heat retention.

Responsible Party: Planning
Funding Source: General Fund
Implementation Schedule: Ongoing

SI-2 BALANCED AND EVOLVING NEEDS

Annually, the Town will review its building requirements against best practices for sustainability and fire resistance and construction costs. The Wildfire Prepared Home Program adopted in 2022 establishes standards for new fire resistant single-family home construction. Based on the Town's progress in recovery and the cost of requirements, the Town will identify whether requirements around building materials, construction methods, and/or energy systems should be made more stringent to achieve goals around minimized risk and reduced damage to property. Items to consider include building construction and operation practices that consume less energy and/or facilitate passive design; incorporating residential Electric Vehicle (EV) charging capabilities; facilitating decarbonization, such as converting from gas-powered to electric appliances; supporting back up energy systems; and requiring additional fire-resistant building materials

and practices such as ignition resistance improvements.

The Town will utilize incentives and aid whenever possible to offset the costs associated with increased resiliency. Potential incentives include rebates, reduced or waived fees, density bonuses, and/or a revolving loan or grant program to assist vulnerable populations, and owners of the properties that provide housing to these groups, with modifications to dwelling units. The Town will seek partnerships with non-profit organizations and funding mechanisms to assist property owners with climate adaptation and resiliency interventions, such as home hardening, expansion of defensible space, and energy improvements.

Responsible Party: Planning, Building, Recovery and Economic Development

Funding Source: General Fund

Implementation Schedule: Ongoing

SI-3 REMOVE RISK AND INCENTIVIZE INFILL

Utilizing the work of the Paradise Nature-Based Fire Resilience Project,[8] the Town will identify and map parcels to prioritize as Wildfire Risk Reduction Buffers (WRRBs). The Town will explore and implement at least one tool to disincentivize development on these parcels, such as a fire risk impact fee or an overlay zone that provides heightened development standards.

At the same time as development on the riskiest parcels is disincentivized, development in the town core will be encouraged. With the development of a sewer system, the Town will develop a zoning overlay for mixed-use and multi-family development in the Sewer Service Area (SSA) predominantly around Skyway and Clark. Increased densities up to 30 units/acre will be allowed in this area, which is better served by transit, flatter, and easier to evacuate. The Town will prepare a fact sheet on the sewer service overlay to send to active developers that will include a map of the SSA and a clear explanation of development standards within the overlay. The Town will explore other regulatory incentives to apply with or without the sewer, such as reduced permit fees, expedited processing, a special permitting desk, California Environmental Quality Act (CEQA) streamlining through a Specific Plan, and/or density bonus programs.

Responsible Party: Planning, Building, Recovery, and Economic Development

Funding Source: General Fund

Implementation Schedule: Ongoing

SI-4 DEVELOPMENT STANDARDS

Consistent with the Board of Forestry and Fire Protection (Board) State Minimum Fire Safe Regulations, the Town will notify the Board before revising local regulations and will utilize technical assistance for the Board as appropriate.

The Town will monitor the approval and codification of the State Minimum Fire Safe Regulations into the California Code of Regulations and will amend the Paradise Municipal Code to adopt development standards that meet or exceed Title 14, California Code of Regulations (CCR), Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commencing with Section 1270) (SRA Fire Safe Regulations) and Title 14, CCR, Division 1.5, Chapter 7, Subchapter 3, Article 3 (commending with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations), PRC 4290, and PRC 4291 consistent with the local designation of the entire Town as a VHFHSZ.

Through the development review process, the Town will also ensure that future development is designed and constructed to take maximum advantage of known fire and crime prevention siting, orientation, and building techniques. The Town will incorporate these measures as objective development standards.

Responsible Party: Fire

Funding Source: General Fund

[8] Conservation Biologist Institute in partnership with The Nature Conservancy and Paradise Recreation & Parks District, 2020. Paradise Nature-Based Fire Resilience Project, June.

Implementation Schedule: Objective design standards to be completed by December 2024.

SI-5 FIRE PROTECTION PLANS

New development projects in the Town shall prepare a Fire Protection Plan for adequate emergency water flow, emergency vehicle access, visible addressing and signage, evacuation routes, fuel management, defensible space, fire safe building construction, and wildfire preparedness.

Responsible Party: Planning and Fire

Funding Source: General Fund and EDA grant

Implementation Schedule: Adopt requirements for Fire Protection Plans by July 2024.

SI-6 STORMWATER MANAGEMENT

The Town will also assure that increased runoff resulting from additional coverage of surface area on developing properties does not adversely affect surrounding properties, roads, or stream courses. All development will be checked for compliance with the Master Storm Drain Study and Facilities Plan. Development will not be permitted if potential flooding and drainage impacts cannot be overcome by sound engineering practices.

The Town will require all development proposals on sites which contain slopes exceeding 20 percent and/or which border or include significant and sensitive stream courses or natural drainageways, to include programs for replanting and slope stabilization, erosion control plans, and to incorporate designs which minimize grading and cut-and-fill. Building on slopes in excess of 30 percent will not be permitted.

Responsible Party: Planning and Public Works

Funding Source: EDA Grant

Implementation Schedule: Ongoing

SI-7 HAZARDOUS WASTE

The current Paradise General Plan recommends the siting of community collection and transfer facilities in the industrial area of Paradise (see Figure 8-11, Hazardous Waste Management Plan). The Town has a Household Hazardous Waste (HHW) and recycling center which has been temporarily closed post-fire. The Town's goal is to reopen the HHW facility within 2-3 years. In the meantime, residents are directed to use the regional HHW facility in Chico.

The Town's development review process shall take into consideration the findings, recommendations, and requirements of the Certified Unified Program Agency (CUPA), State law, and the Town's Household Hazardous Waste Element.

The Town will work with Butte County to seek agreements with other counties in the region to site regionally scaled facilities designed to meet the needs of hazardous waste generators from several counties and to develop a program for ongoing hazardous waste data collection to increase accuracy and reliability of data estimates during subsequent plan updates. The Town will also work with Butte County to develop a countywide hazardous waste reduction program which will identify economically feasible waste reduction practices and incentives available to the following key target groups: large and small quantity industrial and commercial hazardous waste generators, agriculture, and individual households. In particular, the Town will work with Butte County to establish a program to manage waste oil produced by households and small quantity generators in Butte County.

The Town will work with Butte County to prepare countywide air quality control standards pertaining to siting of hazardous waste treatment facilities as necessary to protect the health and welfare of the residents of Butte County.

Responsible Party: Planning

Funding Source: General Fund

Implementation Schedule: Ongoing

SI-8 EMERGENCY RESPONSE

The Town will evaluate the need for and establish, as applicable, law enforcement and fire protection for new land use development sufficient to assure that adequate levels of protection are maintained. The

potential to levy fees on existing land uses will also be evaluated. The Town will consider the burden fees put on property owners and will balance construction feasibility with the need for emergency response.

Responsible Party: Planning and Economic Development
Funding Source: General Fund
Implementation Schedule: Ongoing

SG-2 PROVIDE PROTECTION FOR CRITICAL FACILITIES, INFRASTRUCTURE, AND SERVICES FROM HAZARD IMPACTS.

SP-23 The Town will seek funding sources to provide assistance in installing efficient air conditioning or cooling alternatives in existing structures to reduce peak electrical demands during high heat events to ensure reliability of the electrical grid (new homes will have efficient air conditioning as part of new construction).

SP-24 The Town will strive to harmonize the General Plan, the community's capital improvements plan and annual fiscal budget with climate action and/or adaptation policies.

SP-25 The Town will partner with community organizations to develop and maintain a community capacity inventory to facilitate drawing on the strengths of the community's individuals and organizations to work toward community goals, such as safety and resiliency. The inventory will identify the hard assets (e.g., educational institutions, community organizations) in and/or serving Paradise.

SP-26 The Town will maintain and implement the Town's Storm Drain Master Plan to provide safe and effective management of stormwater to reduce flooding.

SP-27 The Town will continue to implement infrastructure recovery projects to improve the safety and longevity of key infrastructure, including evacuation routes.

SP-28 The Town will require all new development to comply with the airport height restriction policy, airport safety area(s) policies, and land use guidelines for safety compatibility of the Paradise Skypark Airport as contained in the Butte County Airport Land Use Compatibility Plan.

SP-29 The Town will locate, when feasible, new essential public facilities along major evacuation routes, including hospitals and healthcare facilities, emergency shelters, fire stations, emergency command centers, and emergency communications facilities.

SI-9 ELECTRICAL GRID INTEGRITY

Design an incentive program, such as providing forgivable loans or a rebate program, to encourage alternatives to conventional air conditioning for retrofitting existing buildings constructed to older standards, such as high efficiency heat pumps, ceiling fans, air exchangers, increased insulation and low-solar-gain exterior materials to reduce peak electrical demands during high heat events to ensure reliability of the electrical grid. Cooling products that recirculate inside air and do not bring in outside air such as efficient heating, ventilation and air conditioning (HVAC) systems and heat pumps will be prioritized given the added air quality benefits of these methods when wildfire smoke may force residents to close their windows.

Responsible Party: Housing Division
Funding Source: TBD
Implementation Schedule: Ongoing

SI-10 IDENTIFY COMMUNITY ASSETS

The Town will engage non-profits and community-based organizations to develop and maintain a map or directory of community assets. The effort will require first defining the elements that should be included (such as critical facilities and community services), engaging non-governmental organizations (NGOs) and Town agencies to utilize current work, and then developing and sustaining standardized, transferrable procedures for collecting and managing

data. Partnerships with NGOs such as Code for America could yield an open-source, collaborative format for collecting and sharing this information.

Responsible Party: Planning

Funding Source: TBD

Implementation Schedule: Ongoing

SI-11 STRENGTHEN INFRASTRUCTURE

The Town will review standards for roadway widths, maximum cul-de-sac lengths, emergency access, and road and structural identification and amend as necessary to meet or exceed State Fire Safe Regulations.

Consistent with the Long Term Community Recovery Plan (LTCRP) and the ongoing Transportation Master Plan, the Town will continue to implement long-term recovery projects related to improving and protecting infrastructure, including the following:

- Replace damaged plastic culverts with reinforced concrete pipe culverts to improve the safety and long-term maintenance of evacuation routes.
- Remove and replace damaged hardscape, including concrete curb, gutter and sidewalk lighting, planters, and amenities.
- Repair damaged roadways and roadway signs along evacuation routes.
- Rehabilitate Neal Road, a key evacuation route, from Wayland Road to Skyway.
- Remove standing burnt trees on private lands that are hazardous to public safety.
- Repair off-system (i.e., local, public roads that are not part of the federal aid system) roadways along evacuation routes.
- Widen key evacuation routes (i.e., Upper Skyway from Bille Road to Pentz Road, Clark Road from Wagstaff Road to Skyway, Pentz Road from Skyway to Town limits, Neal Road from Skyway to Town limits) to include a center turn lane, widened shoulders, and a multi-use pathway to improve evacuation and increase evacuation capacity.
- Implement other circulation improvements in the Transportation Master Plan that will provide benefits for emergency preparedness, response, and evacuation.
- Develop a program to prioritize and facilitate correction of existing non-conforming development in terms of road standards and vegetative hazard.

The Town will include emergency vehicle access requirements in the Paradise Municipal Code subdivision and zoning ordinances, Town-adopted road standards, and Town-adopted current California Fire Codes. Through the development review process and in accordance with the Butte County Community Wildfire Protection Plan, adequate roads shall be required to be constructed and/or improved for emergency vehicle access.

The Town will maintain and continue to implement the updated Storm Drain Master Plan.

Responsible Party: Public Works Planning and Recovery

Funding Source: FHWA – Emergency Relief, FEMA – Hazard Mitigation Grant, FEMA – Public Assistance and some unsecured

Implementation Schedule: Ongoing

SI-12 AIRPORT

The Town will submit all zoning, subdivision, and General Plan amendment applications within the adopted airport area of influence to the Butte County Airport Land Use Commission for review and approval. In conjunction with the General Plan update, the Town will adopt zoning changes within the Skypark Airport's "C" Compatibility Zone to meet the standards of the Airport Land Use Compatibility Plan.

Responsible Party: Planning

Funding Source: General Fund

Implementation Schedule: Ongoing

SI-13 CRITICAL FACILITIES

In conjunction with the General Plan update, the Town will look at the current public-institutional (P-I) and community-service (C-S) land use designations

and, where feasible, ensure these designations are along or near major evacuation routes, recognizing it is not feasible to locate such facilities outside VHFHSZs because, by local designation, the entire Town is designated a VHFHSZ. Existing and new critical facilities will continue to provide visible street signs and adequate clearance for emergency response vehicles.

In conjunction with the Town's ongoing development of an early warning system, emergency communications facilities will be sited with consideration for future disasters.

Whenever feasible, critical facilities that serve the town will be placed outside of VHFHSZs. Within Town limits, the development of new critical facilities will be prohibited in WRRBs.

Responsible Party: Planning

Funding Source: General Fund

Implementation Schedule: Ongoing

SG-3 INCREASE PUBLIC AWARENESS OF THE RISK AND VULNERABILITY OF THE COMMUNITY TO HAZARDS AND PROMOTE PERSONAL AWARENESS AND RESPONSIBILITY.

SP-30 Incorporate links and references in system maps and incorporate interpretive signage at multi-use path trailheads providing education on climate change related health threats including heat-related illness and wildfire smoke and personal care steps.

SP-31 Require residential property managers and landlords to disclose hazard risk information to renters in a manner similar to that required when residential properties are sold.

SP-32 Continue to maintain and disseminate education and resources on wildfire risk and mitigation using a variety of methods and materials to reach at-risk or hard to reach populations.

SP-33 Conduct practice exercises to increase awareness of emergency operations for Town staff and members of the public.

SP-34 Conduct outreach and education around safe handling and disposal of household hazardous materials using a variety of methods and materials to reach at-risk or hard to reach populations.

SI-14 COMMUNITY AWARENESS

The Town to install signage along the Yellowstone Kelly Heritage Trailway, the planned Paradise Transit Center, and the planned multi-use pathways along main ingress and egress routes to remind residents of climate change related threats, including heat-related illness and wildfire smoke. The Town will work with local public health professionals to provide information on personal care steps to prevent heat-related illness and wildfire smoke in a brochure or placard that can be placed at trailheads and park entrances and on municipal bulletin boards.

Responsible Party: Public Works Department

Funding Source: TBD

Implementation Schedule: Ongoing

SI-15 PUBLIC EDUCATION

The Town will also amend the Town's Health and Safety Code (Title 8 of the Paradise Municipal Code) to require all residential property managers and landlords to disclose information in rental leases that identifies areas of unreasonable risks (pursuant to California Government Code 65302(g)(1)), including but not limited to California Department of Forestry and Fire Protection (CAL FIRE) fire hazard severity zone for the property and specifies whether the property is in an area prone to flood pursuant to Chapter 8.55 of the Municipal Code, in a high liquefaction susceptibility zone, or at risk of ground shaking.

Responsible Party: Planning

Funding Source: General Fund

Implementation Schedule: Ongoing

The Town will conduct Emergency Operations Center (EOC) training exercises throughout the life of the Safety Element, in addition to simulation exercises with the public.

The Town will initiate public education programs for household hazardous waste to increase public awareness of proper hazardous waste disposal. Working with Butte County and the franchised solid waste hauler, the Town will develop small quantity generator and residential hazardous waste educational programs. Such programs should provide information as to types of hazardous waste products, State and local requirements for disposal of hazardous wastes, available means for disposal of small quantities of hazardous wastes, and the risks associated with illegal disposal of hazardous wastes in septic systems, public wastewater treatment facilities and the municipal waste stream, and disposal to Land. Public information programs will also improve the level of general understanding about hazardous waste management and siting issues; educate Butte County residents as to particular hazardous waste issues of concern, such as the risk to groundwater and drinking water supplies; involve the public in hazardous waste management; and build a vehicle for incorporating public concerns into subsequent Safety Element updates.

The Town will educate residents regarding the dangers of seismic activity public outreach efforts and promotion of the findings contained within the adopted Butte County Local Hazard Mitigation Plan (LHMP), which hereby is incorporated by reference within the Paradise General Plan.

Public education efforts shall include outreach using a variety of methods and materials to reach at-risk or hard to reach populations.

Responsible Party: Planning

Funding Source: General Fund and TBD

Implementation Schedule: Ongoing

SI-16 PROMULGATE WILDFIRE MATERIALS

The Town will maintain its Emergency Services Information webpage and associated resources, including but not limited to the ember awareness checklist, disaster supplies kit checklist, evacuation routes map and plan, and defensible space brochures. The Town will periodically utilize its social media accounts to disseminate information on wildfire risk and reduction and will staff information tables or booths at community and/or neighborhood events (e.g., Paradise Chocolate Festival, Party in the Park, National Night Out) at least three times per year to pass out informational resources. In conjunction with Goal 8, the Town will continue to partner with the Butte County Fire Safe Council and other community organizations to lift up training sessions and share education resources. Working with community partners, the Town will explore the feasibility of holding an annual fire prevention and risk reduction day of awareness or workshop that could be held on the anniversary of the Camp Fire.

Responsible Party: Recovery and Fire Department

Funding Source: FHWA – Emergency Relief, FEMA – Hazard Mitigation Grant, FEMA – Public Assistance and some unsecured

Implementation Schedule: Ongoing

SG-4 INCREASE THE COMMUNITY'S ABILITY TO BE PREPARED FOR, RESPOND TO, AND RECOVER FROM A DISASTER EVENT.

SP-35 Implement the Emergency Operations Plan.

SP-36 Prioritize the needs of vulnerable and disadvantaged communities, including renters and low-income homeowners, during the emergency response and disaster recovery efforts.

SP-37 The Town shall develop policies and provide updates, as appropriate, that ensure recovery and redevelopment after a large fire reduces future vulnerabilities to fire hazard risks through site preparation, redevelopment layout design, fire-resistant landscape planning, and ignition resistant building design and materials.

SP-38 Provide adequate access, including emergency vehicle access and evacuation, to all new parcels and existing parcels in accordance with Title 14, California Code of Regulations (CCR), Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commending with Section 1270) (SRA Fire Safe Regulations) and Title 14, CCR, Division 1.5, Chapter 7, Subchapter 3, Article 3 (commencing with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations), and PRC 4290.where feasible and preferable in accordance with the town-adopted Butte County Community Wildfire Protection Plan.

SP-39 Continue to implement the Transportation Master Plan to improve circulation infrastructure used for evacuation and ensure it is appropriately sized for future populations and explore capital expenses for maintaining the system to ensure reliability in an emergency. Incorporate into appropriate plans the role of the active transportation options (such as walking paths, sidewalks, and bikeways) and local transit agency(s) in providing evacuation options based upon the duration and severity of events as well as different community needs, particularly those residents with access and functional needs.

SP-40 Continue to implement standards to prohibit or limit development on parcels without adequate emergency access.

SP-41 The Town will develop and provide a multi-layered, redundant communications system to be used for disaster preparedness education and emergency communications.

SP-42 The Town will work with community partners to run disaster event simulations twice per year for community members to be able to practice evacuation.

SP-43 The Town will designate an emergency aircraft landing area(s) within the Paradise primary and secondary planning areas.

SI-17 TOWN ACTION TO HELP VULNERABLE COMMUNITIES

The Town will support post-disaster funding for multi-family and affordable housing development, including manufactured housing. To the extent feasible within the Community Development Block Grant-Disaster Recovery (CDBG-DR) funding requirements, the Town will prioritize the replacement of affordable housing units that have been damaged or demolished, as well as the deployment of interim housing in vulnerable communities and the creation of new affordable housing.

Ensure that vulnerable populations and agencies and non-governmental organizations that work with these populations are represented in the development of any emergency response plan(s) and climate adaptation strategies.

Responsible Party: Housing and Planning

Funding Source: CDBG-R and General Fund

Implementation Schedule: Ongoing

SI-18 AFTER ACTION REPORTING

An after-action report shall be prepared following any declaration of a local emergency by the Town for which the governor proclaims a state of emergency, pursuant to the California Code of Regulations, Title 19, Section 2450 and Section 3.1 of the Town of Paradise Emergency Operations Plan. The after-action report will serve as a source for documenting the Town emergency response activities and identifying areas of concern and successes. It will also be utilized to develop a work plan for implementing improvements.

Responsible Party: Recovery and Planning

Funding Source: General Fund/TBD

Implementation Schedule: Ongoing

SI-19 DISASTER RESPONSE INFRASTRUCTURE

The Town will develop and maintain an early warning system that includes sirens, text messages, voice messages, and other alert best practices so that there are multiple layers of communication and built-in redundancy in case of disaster-driven failures. The warning system will be used at least twice per year for disaster simulations, which could occur on the anniversary of major past disasters like the Camp Fire. The simulations will help residents overcome behavioral obstacles related to evacuation as they become familiar with assigned evacuation routes and practice their own response plans.

Through its General Plan update process, the Town will designate an emergency aircraft landing area. This could be within Paradise's primary or secondary planning area.

The Town will continue to explore funding resources for improving and maintaining its evacuation system. The Town will continue to implement the evacuation route upgrades recommended in the Long-Term Community Recovery Plan and the Transportation Master Plan (TMP), and implementation will be according to the priority levels identified in the TMP. As mentioned under SG-3, the Town will continue to provide education around evacuation zones and routes and other disaster recovery educational resources.

The Town will continue to limit the densities of development on parcels that do not have adequate emergency access. At a minimum, the Town will not approve any discretionary permit or project that requests an increase of existing residential density on parcels that are served access by either an existing or resultant cul-de-sac exceeding a maximum length of 1,800 lineal feet. The Town will look to the TMP and Board of Forestry and Fire Protection for guidance on potentially developing more stringent access requirements. New development will be assessed on a project basis to ensure that new land uses will not cause emergency responses times to fall below acceptable levels. The Town will strive to maintain an overall fire insurance (ISO) rating of three or better, and an emergency fire response within five minutes for 90 percent of all emergency incidents within the Town Limits.

Responsible Party: Recovery and Public Works

Funding Source: HMGP

Implementation Schedule: Ongoing

SI-20 EARLY NOTICING FOR CONSTRAINED AREAS

The Town will establish a new evacuation zone for areas identified as having inadequate access/evacuation routes. Parcels within this new evacuation zone will be notified when the Town issues a warning or notice to any other evacuation zone, giving residents additional time to prepare.

Responsible Party: CAL FIRE and Planning

Funding Source: General Fund

Implementation Schedule: Ongoing

SG-5 REDUCE FIRE SEVERITY AND INTENSITY IN PARADISE AND SURROUNDING LANDS.

SP-44 Adopt an urban canopy ordinance that includes guidance and standards for new tree planting, proper tree pruning, and vegetation management to preserve the structural integrity of trees while ensuring fire resistance and fuels management. Recommendations for fire-resistant trees species (e.g., black oak) will be included.

SP-45 The Town will encourage the acquisition of high hazard parcels on the periphery of town (i.e., the Wildfire Risk Reduction Buffers identified by the Conservation Biology Institute) for open space or similar uses that serve as wildfire buffers. Explore zoning changes or other policy tools like the Bureau of Land Management's Area of Critical Environmental Concern planning process or the establishment of an impact fee to discourage or prohibit development in the most dangerous places.

SP-46 Support efforts to reduce health hazards from wildfire smoke, such as access to

respirators and air filtration systems, access to clean air refuge centers, and limits on outdoor activities.

SP-47 Support hazardous fuel reduction, defensible space clearing and forest fuel reduction in rural forested areas with high tree mortality and unnaturally high fuel loads to reduce the size and severity of catastrophic wildfires which reduces the release non-anthropogenic black carbon and methane.

SP-48 Continue to ensure that defensible space and hazardous fuel management requirements of Chapter 8.58 are enforced as expeditiously as possible. Maintain resident records as the Town continues to rebuild so that citations can be served more quickly.

SP-49 Work with community organizations to provide grants or volunteer assistance for vegetation management to help offset costs for low-income households. Assistance will prioritize seniors, persons with disabilities, and low-income residents. Consider contracting for or subsidizing a herd of goats or sheep in order to provide fuels management services to property owners at reduced rates. Grazing programs are most effective for fuels management in large areas and areas with steep or difficult terrain.

SI-21 WILDFIRE BUFFERS

Planning staff will meet with Paradise Parks and Recreation District staff, the Nature Conservancy, Conversation Biology Institute, and other stakeholders to identify the highest priority parcels for Wildfire Risk Reduction Buffers. The Paradise Nature-Based Fire Resilience Project Final Report will be used as a starting point for discussion.

The Town will work with potential funders and other partners to facilitate undeveloped, high-priority parcels being turned into parks or open space. If these parcels are not able to be acquired for open space use, the Town will explore establishing an impact fee for future development on these parcels that will go to fund fire prevention and resilience efforts, such as vegetation management programs and circulation upgrades for evacuation purposes. Development on these parcels would be subject to the most stringent fire and building codes.

Responsible Party: Recovery, Planning, and Recreation & Parks

Funding Source: TBD

Implementation Schedule: Ongoing

SI-22 VEGETATION MANAGEMENT

The Town will provide educational and financial resources to facilitate adequate fuels management. Assistance resources can include volunteer days in partnership with a local service organization, provision of goats or sheep to provide grazing services, and grants to help offset costs for low-income households. Assistance will prioritize seniors, persons with disabilities, and low-income residents. The Town will also continue to publicize local weed abatement businesses through the Town's online business directory: https://www.townofparadise.com/business-directory.

The Town of Paradise Public Works Department will continue to implement the annual roadside vegetation management program in a manner that is consistent with the California Department of Forestry and Fire Protection (CAL FIRE) Butte Unit Fire Plan and the Butte County Community Wildfire Protection Plan.

The Town will continue to enforce defensible space requirements and to publicize its system for code enforcement complaints related to hazardous fuel management. Based on community feedback, the Town will consider shortening the length of time that property owners have to become compliant with the Town's requirements from 30 calendar days to 20 calendar days and to look at opportunities to streamline the abatement process for properties that don't comply.

Responsible Party: Recovery, Public Works, Planning, Fire, and Recreation & Parks

Funding Source: TBD

Implementation Schedule: Ongoing

SI-23 STATE COMPLIANCE

The Town will enforce and comply with the provisions of Title 14, California Code of Regulations (CCR), Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commending with Section 1270) (SRA Fire Safe Regulations) and Title 14, CCR, Division 1.5, Chapter 7, Subchapter 3, Article 3 (commencing with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations), and PRC 4290.and Town-adopted California Fire Code, the Town will also require adequate clearance around structures.

Responsible Party: Recovery, Planning, and Fire

Funding Source: General Fund/Building Enterprise Fund/FEMA – Hazard Mitigation Grant

Implementation Schedule: Ongoing

SG-6 INCREASE COMMUNITY RESILIENCY TO CLIMATE CHANGE'S INFLUENCE ON DISASTERS.

SP-50 The Town will encourage or require native, low-water-use, drought-tolerant and fire-resistant plant species for use with open space and park development. The list will also be included in landscaping standards for private development to reduce reliance on potable and recycled water resources.

SP-51 The Town will develop a public outreach and engagement strategy to address impacts of climate change and its associated hazards, especially disproportionate impacts on vulnerable populations, that identifies all stakeholders, utilizes methods to engage the entire community, and includes education components in all planning and policy-making processes for climate change and adaptation.

SP-52 Educate and encourage property owners to consider site design and building features that can increase energy efficiency and improve the resiliency of structures.

SP-53 Complete a comprehensive General Plan update to align land uses and other Town policies with post-fire recommendations, community needs, and the threats of climate change.

SP-54 Work to provide safeguards so that infrastructure will be available to support residents during extreme weather and disasters.

SI-24 ENCOURAGING RESILIENCY

The Town will develop a guidance project checklist for building and site adaptation measures. The checklist, included with permit applications, will provide education to permit applicants on modifications to site plans and structures that can improve a project's resiliency to existing and potential future climate change hazards. The items on the checklist are not requirements but simply information on practices that could increase energy efficiency, reduce greenhouse gas emission, and increase resiliency. The checklist will include information on weatherizing techniques, solar panels, and wind energy.

In the public realm, consider using impact fees or other funding mechanism to develop battery charging stations for residents during power outages that can double as cooling stations during extreme heat days.

Responsible Party: Planning and Building

Funding Source: TBD

Implementation Schedule: Ongoing

SI-25 FUTURE PLANNING

The Town will continue its comprehensive General Plan update and will use the update process as an opportunity to continue to infuse resiliency into land use planning and local policy. Any General Plan updates will include robust community engagement processes that uses a combination of engagement methods (e.g., digital exercises, in-person meetings both large and small, phone-based engagement), culturally competent messaging, and engagement activities to target vulnerable populations that have historically been excluded from the planning process.

Targeted engagement activities could include focus groups with residents with protected characteristics, interviews with community-based organizations serving these populations, using stipends to remove barriers to participation, scheduling meetings at transit-served locations, and other equitable best practices.

Responsible Party: Planning
Funding Source: General Fund
Implementation Schedule: Ongoing

SG-7 COLLABORATE WITH THE USDA FOREST SERVICE (USFS), BUREAU OF LAND MANAGEMENT (BLM), CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION (CAL FIRE), AND OTHER FIRE PROTECTION AGENCIES AND STAKEHOLDERS TO MITIGATE THE RISK OF WILDFIRE AND OTHER HAZARDS.

SP-55 Adopt plans and support projects for forest management activities to restore California forest lands that have high tree mortality and unnaturally dense fuel loads to a fire resilient condition that will mitigate wildfire size and severity.

SP-56 The Town will continue to maintain adoption of a current California Fire Code amended to reflect the unique needs of Paradise and require compliance with its provisions. In addition, the Town shall require that, after a large fire event, a detailed and comprehensive evaluation of redevelopment of the affected area(s).

SP-57 The Town will harmonize and coordinate updates to hazard mitigation and safety planning. The Town will align and coordinate updates to the community's General Plan and Local Hazard Mitigation Plan to efficiently meet requirements and SB 379 (2015) and synchronize future updates of the Safety and Housing Element to ensure compliance with Senate Bill 1035 (2018) and consistency between policies, strategies, and implementation measures. Paradise will collaborate with Butte County jurisdictions and applicable, consider adoption of a multi-jurisdictional climate adaptation plan, climate action plans, capital improvements plans, transportation plans, or Local Hazard Mitigation plan(s) that can address cross jurisdictional issues or issues in which coordination and pooling of resources is a benefit.

SP-58 Designate an inter-departmental/inter-agency working group to coordinate the implementation and monitoring of the community's climate action and/or adaptation strategies.

SP-59 Designate a department, or staff position within an existing department, with responsibility for monitoring, reporting and progress towards implementation of the Safety Element.

SP-60 Support hazardous fuel reduction and forest fuel reduction in rural forested areas with unnaturally high fuel loads to reduce the size and severity of catastrophic wildfires. Ensure forest fuels reductions benefit the upper-watershed water quality, quantity, and timing.

SP-61 The Town will promote fire prevention by continuing to require brush removal and fuel load clearing in accordance with Title 14, California Code of Regulations (CCR), Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commending with Section 1270) (SRA Fire Safe Regulations) and Title 14, CCR, Division 1.5, Chapter 7, Subchapter 3, Article 3 (commencing with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations), and PRC 4290., the Butte County Local Hazard Mitigation Plan (LHMP), and the Butte County Community Wildfire Protection Plan as ongoing conditions of development approval and property maintenance.

SP-62 The Town will work with Del Oro Water Company and the Paradise Irrigation District to assure the adequacy and long-term maintenance of water supply, fire flow, and peak-load water supplies in accordance with Town-adopted current California Fire Codes.

SI-26 AGENCY COOPERATION

The Town will continue to coordinate with local, state, and federal agencies to update emergency, evacuation, and hazard mitigation plans, as necessary, to support inter-agency preparedness coordination, and establish and maintain mutual aid agreements where feasible.

The Town will continue to serve as a partner for fire protection agencies, including USDA Forest Service (USFS), Bureau of Land Management (BLM), California Department of Forestry and Fire Protection (CAL FIRE). The Town will distribute information on behalf of these organizations to Paradise residents as appropriate and will continue to publicize fire safe programs and resources from firefighting agencies.

In particular, the Town will continue to promote and support the vegetation clearance, defensible space activities, and fire prevention programs of the Fire Safe Councils, community organizations, and other local agencies such as the California Department of Transportation (Caltrans).

The Town will alert fire agencies of all evacuation drills in the event that fire fighters or agency representatives would like to participate. The Town will strive to establish emergency service training that meets or exceeds State or national standards, as provided by CAL FIRE. The Town will work with CAL FIRE to execute the trainings.

The Town will reduce wildland fuels through community fuel reduction, including lineal fuel breaks within and adjacent to the town and defensible space around homes through hazard abatement at the parcel level, particularly in reference to the Town of Paradise Defensible Space Ordinance the Butte County Local Hazard Mitigation Plan (LHMP), and the Town-adopted Butte County Community Wildfire Protection Plan. The Town will also endeavor to establish an assured funding means and cooperative partnership program(s) for ongoing maintenance of existing and proposed fuel breaks as well as private and public road clearances.

Through the development review and long-range planning processes, the Town will continue to coordinate and assure current and future water supply for fire suppression needs. The Town will establish standards for adequate fire flows for new land use development and expansion of existing development in accordance with the requirements of the Town-adopted California Fire Code.

Responsible Party: Planning and Fire
Funding Source: General Fund and TBD
Implementation Schedule: Ongoing

SI-27 COUNTY COLLABORATION

Maintain the Butte County Local Hazard Mitigation Plan (LHMP) and Butte County Community Wildfire Protection Plan. Share information and resources with other Butte County jurisdictions as the Town continues to recover.

The Town shall encourage Butte County to enforce standards conforming to the fire safety standards established by the Board of Forestry and Fire Protection for State Responsibility Areas within the Paradise secondary and tertiary planning areas, including the following:

- Road standards for fire equipment access. Common road standards for the Town's sphere of influence have been adopted by Butte County and the Town of Paradise.
- Standards for signs identifying streets, roads, and buildings, including standards for address identification.
- Minimum private water supply reserves for emergency fire use.

- Fuel breaks and greenbelts.
- Land use policies and safety standards that take into account the recurrent nature of wildland fires.
- Design standards establishing minimum road widths and clearances around structures.
- Emergency preparedness protocol and procedures.
- Maximum length of cul-de-sac roadways.

The Town will share its Operations Playbook (see SI-18) with other Butte County jurisdictions to promote collaboration and collective problem solving.

Responsible Party: Planning, Fire, and Public Works
Funding Source: General Fund and TBD
Implementation Schedule: Ongoing

SG-8 COLLABORATE WITH BUTTE COUNTY FIRE SAFE COUNCIL, PARADISE RIDGE FIRE SAFE COUNCIL, PARADISE RECREATION AND PARK DISTRICT, AND OTHER COMMUNITY GROUPS AND ORGANIZATIONS TO INCREASE HOMEOWNER AWARENESS OF AND PARTICIPATION IN VOLUNTARY WILDFIRE RESILIENCY AND CLIMATE CHANGE ADAPTATION INTERVENTIONS.

SP-63 Work with local fire officials to educate homeowners and landlords through social media and education programs on how to reduce fire risk to structures and landscaping as wildfire risk continues to increase due to climate change.

SP-64 Ensure coordination between emergency management personnel and local hospitals, urgent care medical providers, and area doctors to develop community-wide communications and response plans for high heat days exacerbated by climate change. These response plans should include alerts to medical professionals to ensure providers are equipped to handle increased patient load, allow local providers to check in or notify their vulnerable patients, and first responders are properly staffed and equipped to transport vulnerable patients to community heat shelters or medical facilities, if experiencing emergent conditions.

SP-65 Ensure all segments of the Paradise community, and especially vulnerable populations, are aware of and involved in adaptation planning. Utilize methods to engage the entire community and include education components in all planning and policy-making processes for climate change and adaptation.

SP-66 Work with community partners, local officials, and non-profit organizations to incorporate social media, traditional forms of outreach, and education programs into community plans, such as the Paradise Fuel Reduction Program, that seek to educate homeowners and landlords on how to reduce risks to structures, landscaping, and property.

SP-67 Work with community partners to implement recognition program(s) such as Firewise Community, Wildfire Prepared Home (see SI-2), and the California Department of Insurance Safer from Wildfires program to recognize new and existing properties that have implemented best practices for siting structures outside of the wildland-urban-interface, incorporated fuel reduction in landscaping, and incorporated building retrofitting and/or new construction standards to harden structures against fire.

SI-28 INCLUSIVE ENGAGEMENT AND EDUCATION

Seek opportunities to fund and partner with existing, successful community-based programs (e.g., community health programs, neighborhood associations and advocacy organizations, volunteer groups, and others) to connect community members to hazard and climate change risk information. An

example of such an expansion would be the promotion of voluntary retrofits to building owners in coordination with the public health sector Healthy Homes educational campaigns. The Town will encourage and promote neighborhood-based communication networks through which community members can post requests for assistance, availability of tools/supplies, local 'news' updates, helpful resources, etc. The Town will continue to post links to the Butte County Fire Safe Council and California Wildland Coordinating Group and its fire prevention website.

The Town and its partners will utilize best practices for inclusive engagement and education, including holding varying meeting times to accommodate different schedules, holding meetings in locations accessible to those without transportation, providing culturally relevant language, providing childcare, diversifying outreach through storytelling and active listening techniques, and ensure all materials are designed to communicate effectively to all groups.

Responsible Party: Planning
Funding Source: General Fund
Implementation Schedule: Ongoing

SI-29 ONGOING EDUCATION

The Town will continue to maintain and publicize information resources and workshop opportunities from the Butte County Fire Safe Council, including on the Town's Recovery Facebook page and other social media accounts. The Town will also continue to make fire safety resources available online, such as the ember awareness checklist, disaster supplies kit checklist, evacuation routes map and plan, and defensible space brochures.

The Town will approach local community partners about their interest in holding an annual fire prevention and risk reduction day of awareness or workshop that could be held during the NFPA National Fire Prevention Week. Should there be interest and feasibility, the Town will serve as a connector and play a role in support, with one of the Fire Safe Councils taking a more lead role.

Responsible Party: Planning and Fire
Funding Source: General Fund and TBD
Implementation Schedule: Ongoing

SG-9 UTILIZE PARADISE'S EXPERIENCES WITH WILDFIRE TO ADVOCATE FOR STATE AND FEDERAL POLICIES AND REGULATIONS THAT ASSIST IN CREATING DISASTER RESILIENT COMMUNITIES AND FACILITATE POST-DISASTER RECOVERY

SP-68 Advocate for new sources of State or federal financing for adaptation and resilience.

SP-69 Support the integration of disaster resilience and hazard mitigation planning into existing regional planning processes, including the Regional Housing Needs Assessments.

SP-70 Explore funding mechanisms for climate adaptation and fire resiliency, including but not limited to special districts, impact fees, a parcel tax, establishment of a regional adaptation authority, or enabling the Butte County Association of Governments to raise revenue.

SP-71 Engage with insurance companies in the area to identify ways to align insurance policies and incentive programs with wildfire mitigation priorities, such as allowing policyholders to lower their rates through home hardening and vegetation management or other risk reduction measures, or through programs such as those mentioned in SP-67. Offer grants or no-interest loans to low and moderate-income households to ensure the most vulnerable households are not left behind.

SP-72 Encourage local utilities to retain and enhance lifeline programs for life sustaining services such as water and electricity for vulnerable populations, especially due to hazards such as an increase in high heat ` and the potential for related power disruptions. Partner with utilities to provide education to program participants and property owners to

encourage retrofitting of appliances, lighting, plumbing fixtures and landscaping to reduce energy and water demand and backup power for life-dependent in-home medical equipment and devices.

SP-73 The Town will maintain and regularly update its 2021 Federal Advocacy Platform as recovery continues and more lessons are learned.

SI-30 REGIONAL COLLABORATION

The Town will work with Butte County and its cities to explore new sources of funding, such as establishing a regional adaptation authority or enabling the Butte County Association of Governments to raise revenues. The Town will continue to work with other jurisdictions on implementing and maintaining collaborative plans like the Butte County Local Hazard Mitigation Plan (LHMP) and Butte County Community Wildfire Protection Plan (CWPP). The Town will continue to participate in cross-jurisdictional planning processes, especially should a Butte County climate action or resiliency plan be instigated.

When feasible, Town staff who were/are integral to Camp Fire recovery and emergency operations should participate in professional development events, including speaking on panels or participating in roundtables, so that the Town can continue to learn best practices and share their experience with other jurisdictions. The Town will email its Operations Playbook (see SI-18) with all other Butte County jurisdictions to promote collaboration and collective problem solving. The Town should consider a press release and Q&A event for other jurisdictions and agencies with the release of the playbook to facilitate information-sharing.

Responsible Party: All departments, but especially Recovery
Funding Source: General Fund
Implementation Schedule: Ongoing

SI-31 ADVOCACY

The Town will maintain and implement its 2021 Federal Advocacy Platform. As the Town becomes aware of potential fundings resources and/or State legislation relevant to wildfire, the Town will share its experiences and continue to try to establish systems and policies that can help other communities recover from large wildfire events.

Town officials will reach out to local insurance providers to gauge interest in a partnership to reform property insurance. The intended reform would incentivize private fire mitigation actions with a program that allows policyholders to lower their rates through home hardening and vegetation. The Town will work with local, regional, and State level organizations and politicians to scale up the program should there be interest.

Responsible Party: Town Manager and Fire
Funding Source: General Fund/TBD
Implementation Schedule: Ongoing

BUTTE COUNTY CLIMATE CHANGE VULNERABILITY ASSESSMENT

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Acronyms/Abbreviations

Acronym/Abbreviation	Meaning
°F	degrees Fahrenheit
AB	Assembly Bill
APG	*California Adaptation Planning Guide*
BCAQMD	Butte County Air Quality Management District
CalOES	California Governor's Office of Emergency Services
CAL FIRE	California Department of Forestry and Fire Protection
CAP	Climate Action Plan
CEC	California Energy Commission
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
GSA	Groundwater Sustainability Agency
GSP	groundwater sustainability plan
IPCC	Intergovernmental Panel on Climate Change
LHMP	Local Hazard Mitigation Plan
OEM	Office of Emergency Management
PSPS	Public Safety Power Shutoff
RCP	Representative Concentration Pathway
SB	Senate Bill
SGMA	Sustainable Groundwater Management Act
WUI	wildland-urban interface

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Executive Summary

In 2015, Senate Bill (SB) 379 was signed into law, establishing California Government Code Section 65302(g)(4), which states that local governments need to address climate adaptation and resilience in General Plan Safety Elements upon the next revision of a local hazard mitigation plan, or before 2022. The first step in meeting this requirement is conducting a Climate Change Vulnerability Assessment to identify the risks that climate change poses to a local jurisdiction and the populations and assets at highest risk from climate change. California Government Code Section 65302(g)(4) requires the following information to be included in the Climate Change Vulnerability Assessment:

I. Information from the Internet-based Cal-Adapt tool.
II. Information from the most recent version of the California Adaptation Planning Guide.
III. Information from local agencies on the types of assets, resources, and populations that will be sensitive to various climate change exposures.
IV. Information from local agencies on their current ability to deal with the impacts of climate change.
V. Historical data on natural events and hazards, including locally prepared maps of areas subject to previous risk, areas that are vulnerable, and sites that have been repeatedly damaged.
VI. Existing and planned development in identified at-risk areas, including structures, roads, utilities, and essential public facilities.
VII. Federal, state, regional, and local agencies with responsibility for the protection of public health and safety and the environment, including special districts and local offices of emergency services.

Climate change is currently impacting Butte County, including contributing to major wildfires, and is projected to lead to more severe conditions in the future. Butte County Development Services staff saw an immediate need to meet SB 379 to ensure that the community could adapt and build resilience to the changing climate.

This Climate Change Vulnerability Assessment provides a qualitative analysis on how climate change may impact Butte County throughout the twenty-first century. Direct climate stressors in the county include an increase in average temperature and changes in annual precipitation patterns. Secondary climate stressors, or hazards, include agricultural pests and diseases, drought, extreme heat, human health hazards, severe wind, severe storms, and wildfire. **Appendix A** shows future climate projections for Butte County and **Appendix B** shows the full results of the Climate Change Vulnerability Assessment. **Appendix C** is a glossary identifying key terms used in the Climate Change Vulnerability Assessment.

Climate change hazards that create the highest vulnerabilities in Butte County include wildfire due to the heavily forested areas of eastern Butte County and limited access roads, followed by severe storms, severe wind, and extreme heat. The County's frontline populations, energy and water infrastructure, agricultural economic drivers, and conifer forest ecosystems are among the most vulnerable to climate change hazards. As part of the General Plan Update process, this Climate Change Vulnerability Assessment will directly inform the goals, policies, and actions of the Health and Safety Element of the General Plan to help create a more resilient Butte County.

1. Introduction

Climate change is a long-term change in the average meteorological conditions in an area. Currently, the global climate is changing due to an increase in greenhouse gas (GHG) emissions that trap heat near the Earth's surface. While some levels of these gases are necessary to maintain a comfortable temperature on Earth, an increased concentration of these gases from human activity traps additional heat, changing Earth's climate system in several ways. These effects can lead to an increase in frequency and intensity of climate change hazards, which, according to the *California Adaptation Planning Guide* (APG), have the potential to cause fatalities, injuries, property and infrastructure damage, interruption of business, and other types of harm or loss. These hazards can include agricultural pests and diseases, severe storms, wildfires, extreme heat, and drought conditions, among others. This Climate Change Vulnerability Assessment provides an overview of the primary and secondary climate stressors associated with climate change and identifies the hazards most likely to affect Butte County. The findings of the Climate Change Vulnerability Assessment will be used to develop climate adaptation strategies that address these vulnerabilities and inform the update to the Butte County General Plan Health and Safety Element, meeting California Government Code Section 65302(g) requirements, as amended by SB 379.

Other important updates to Section 65302(g) of the California Government Code related to Safety Elements, climate change, and resiliency and addressed in the Butte County General Plan Update include SB 1035 and SB 99. SB 1035 builds on previous legislation and requires local governments to review and update as needed their Safety Element during an update to their Housing Element or Local Hazard Mitigation Plan (LHMP) (or no less than every eight years). Any revisions should include updated information related to flood hazards, fire hazards, and climate adaptation and resilience. SB 99 established Section 65302(g)(5) of the California Government Code and requires jurisdictions to review and update the Safety Element to include information identifying residential developments in hazard areas that do not have at least two emergency evacuation routes. This vulnerability assessment, along with the update to the Safety Element, will help Butte County meet the state's requirements, in addition to increasing consistency with the LHMP.

1.1. Climate Change Vulnerability Assessment Method

The APG, developed by the California Governor's Office of Emergency Services (CalOES), helps communities throughout California plan for and adapt to the impacts of climate change. The APG includes a four-phase process, shown in **Figure 1**, which allows jurisdictions to assess specific climate vulnerabilities and provides strategies to reduce climate-related risks and prepare for current and future impacts of climate change.

Figure 1. California Adaptation Planning Guide Process

The first two phases in the APG (see **Figure 1**) result in a vulnerability assessment, which is an evaluation of climate change hazard impacts to populations and assets and the adaptive capacity of these populations and assets to prepare for, respond to, and recover from climate change hazards. The last two phases of the process use the information gathered in the vulnerability assessment to develop adaptation strategies and measures to help the community prepare for, respond to, and adapt to local climate change vulnerabilities, which is not included as part of this assessment. The second phase, Assess Vulnerability, is the focus of this report. This phase includes a four-step process: (1) characterizing the County's exposure to current and projected climate hazards; (2) identifying potential sensitivities and potential impacts to County populations and assets; (3) evaluating the current ability of the populations and assets to cope with climate impacts, also referred to as its adaptive capacity; and (4) identifying priority vulnerabilities based on systematic scoring. These steps are shown in **Figure 2**.

Figure 2. California Adaptation Planning Guide Vulnerability Assessment Method

Step 1: Identify Exposure. The goal of this step is to characterize the County's exposure to current and projected climate change hazards. Many projections of climate change hazards rely on multiple scenarios that reflect different levels of how global GHG emissions and atmospheric GHG concentrations may change over time. The Intergovernmental Panel on Climate Change (IPCC), an organization that represents the global scientific consensus about climate change, has identified four climate scenarios, also called Representative Concentration Pathways (RCPs), that can be used to project future conditions. RCPs are labeled with different numbers (e.g., RCP 2.6, RCP 6) that refer to the increase in the amount of energy that reaches each square meter of Earth's surface under that scenario. The four RCPs are:

- **RCP 2.6:** Under this scenario, global GHG emissions peak around 2020 and then decline quickly.
- **RCP 4.5:** Under this scenario, global GHG emissions peak around 2040 and then decline.
- **RCP 6:** Global emissions continue to rise until the middle of the century.
- **RCP 8.5:** Global emissions continue to increase at least until the end of the century.

The Cal-Adapt database, which provides California-specific climate change hazard projections, uses RCP 4.5 for a low emissions scenario and RCP 8.5 for a high emissions scenario. The Governor's Office of Planning and Research *Planning and Investing for a Resilient California* document and the APG recommend using RCP 8.5 for analyses considering impacts through 2050, as there are minimal differences between emission scenarios for the first half of the century. The APG also recommends using RCP 8.5 for late-century projections, for a more conservative and risk-adverse approach. The County used the RCP 8.5 GHG emission scenario results provided by the Cal-Adapt database and other resources for this assessment.

The first step of this Climate Change Vulnerability Assessment was to confirm which of the hazards are expected to take place at the local level in Butte County. The County identified seven climate change hazards for this assessment, listed here and discussed in more detail in Section 3.

1. Agricultural Pests and Diseases
2. Drought
3. Extreme Heat
4. Human Health Hazards
5. Severe Wind
6. Severe Storms
7. Wildfire

The climate change hazard data was derived from up-to-date information, including the Cal-Adapt database, the APG, the *California 4th Climate Change Assessment,* the California Geological Survey, the Federal Emergency Management Agency (FEMA), the California Department of Forestry and Fire Protection (CAL FIRE), and the Butte County 2019 LHMP.

Step 2. Identify Sensitivities and Potential Impacts. This step included evaluating past and potential future climate change impacts to community populations and assets. The County first identified a list of populations and assets to include in the assessment with the following five categories:

> **Sensitivity:** The level to which a species, natural system, or community, government, etc., would be affected by changing climate conditions.
>
> *Source: California Adaptation Planning Guide*

1. Populations: People that experience a heightened risk and increased sensitivity to climate change and have less capacity and fewer resources to adapt to or recover from climate impacts.
2. Infrastructure and Buildings: Structures that provide various services to Butte County community members and visitors.
3. Economic Drivers: Economic sectors and activities that make significant contributions to the Butte County economy.
4. Ecosystems and Natural Resources: Types of wild and natural lands within the County boundary.
5. Key Services: Important functions to community members provided by government agencies and private companies.

This list included 16 populations, 26 infrastructure and building types, 10 economic drivers, 7 ecosystems and natural resources, and 8 key services. Once this list was confirmed, the County looked at which hazards are likely to affect which populations and assets, because not all hazards would affect all populations or assets. For example, human health hazards are likely to impact most populations, but it would not physically affect parks and open space or school buildings. The outcome of this step was a matrix that identified whether a population or asset is likely to be exposed to a hazard. If a population or asset has the potential to be affected directly or indirectly by a hazard, a "yes" was indicated in the appropriate box. Direct impacts affect buildings and infrastructure, health or populations, or immediate operations of economic drivers or community services, and they can lead to indirect impacts on the broader system or community, including populations or asset types in a different category. For example, severe wind can *directly* damage electrical transmission lines causing power outages, which can *indirectly* impact persons with chronic illnesses who depend on the electricity for life support systems. Therefore, both electrical transmission lines and persons with chronic illnesses were marked as "yes" for being affected by severe wind and would be evaluated in the assessment.

> **Exposure:** The presence of people, infrastructure, natural systems, and economic, cultural, and social resources in areas that are subject to harm.
>
> **Impact:** The effects (especially the negative effects) of a hazard or other conditions associated with climate change.
>
> *Source: California Adaptation Planning Guide*

After the applicability review, the County evaluated potential impacts to the applicable populations and community assets. To identify how great the impacts of each relevant hazard are on the populations and community assets, the County considered a number of different questions that helped ensure the assessment broadly covered a range of potential harm. Examples of these questions include:

- Could the hazards cause injury or damage?
- Is there a risk of behavioral or mental harm, loss of economic activity, or other nonphysical effects?
- How many people or community assets could be harmed both directly and indirectly?
- How long would the impacts persist?

- Is there a substantial chance of death or widespread destruction?

Based on the results of the impact assessment, the County ranked each population and asset low, medium, or high for each relevant hazard. Impact is considered a negative quality, and therefore a higher impact score means that there is a higher potential for harm to a population or asset. A lower impact score means that there is a lower potential for harm to a population or asset. **Table 1** provides more detail about what each score means.

Table 1. Rubric for Impact Scoring

Impact Score	Meaning (People and Ecosystems)	Meaning (Buildings, Infrastructure, Services, and Economic Drivers)
Low Impact	Community members may not notice any change. If noticed, effect would be minor with only occasional disruptions.	Damage, interruption in service, or impacts on the local economy is small or intermittent enough to mostly go unnoticed. If noticed, effects are only minor.
Medium Impact	There is a marked impact to the community. Quality of life may decline. Impacts may be chronic, and at times substantial.	Damage, service interruptions, and other impacts are clearly evident. Impacts may be chronic and occasionally substantial.
High Impact	The well-being of the community declines significantly. The community's current lifestyle and behavior may no longer be possible. There is a severe risk of widespread injury or death to people, or of significant or total ecosystem loss.	Buildings, infrastructure, and services often or always cannot function as intended or needed to meet community demand. Large sections of the economy experience major hardships or are not feasible.

Step 3. Assess Adaptive Capacity. Adaptive capacity is the ability of populations and community assets to prepare for, respond to, and recover from the impacts of climate change. Each population and asset were evaluated for adaptive capacity by considering the following questions:

1. Are there existing programs, policies, or funding to provide assistance?
2. Are there barriers that limit response of recovery? Are these barriers, financial limitations, political challenges, lack of access to technology or other resources?
3. Do alternatives exist in or near Butte County that community members can use?

Adaptive Capacity: The "combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities."

Source: California Adaptation Planning Guide

Based on the results of the adaptive capacity assessment, the County ranked each population or asset as low, medium, or high adaptive capacity. Adaptive capacity is considered a positive attribute, so a higher adaptive capacity score will mean that a population or asset may be more adaptable to the hazard. A lower adaptive capacity score means that a population or asset may have a harder time adjusting to the changing conditions. **Table 2** provides more detail about what each score means.

Table 2. Rubric for Adaptive Capacity Scoring

Adaptive Capacity Score	Meaning
Low Adaptive Capacity	Adaptive solutions are available, but they are expensive, technologically difficult, and/or politically unpopular. Alternatives may not exist that can provide similar services. Some assets may not have feasible means to adapt.
Medium Adaptive Capacity	Some adaptation methods are available, but not always feasible. Adapting may create significant challenges for some sensitivities. Some alternatives exist within the jurisdiction area that can provide similar services.
High Adaptive Capacity	Adaptation solutions are feasible for most or all sensitivities. There may be occasional or small-scale challenges to implementing adaptation methods, but populations and assets can adapt with little or no effort. Many alternatives exist in the area that can provide similar services.

Step 4. Prioritize Vulnerability Scoring. The County used the impact and adaptive capacity scores for each population and asset for each relevant hazard to determine the vulnerability score. The vulnerability score reflects how susceptible a population or asset is to harm from a particular hazard. Vulnerability is assessed on a scale of low, medium, and high. Low vulnerability does not mean that the population or asset will be unaffected by climate change, but that the effects are likely to be less substantial. The matrix in **Table 3** shows how impact and adaptive capacity scores combine and translate into a vulnerability score. For example, extreme heat would create a high impact on energy delivery services by damaging electrical infrastructure and potentially exceeding the available electrical supply as mechanical failures, heat damage, and high demand for electricity from cooling equipment, can disrupt service. Adaptive capacity is low because many County residents need to use more electricity on extreme heat days to keep cool and because retrofitting electrical equipment can be expensive. Therefore, energy delivery services have a high vulnerability to extreme heat.

> **Vulnerability:** The degree to which natural, built, and human systems are susceptible "...to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt."
>
> *Source: California Adaptation Planning Guide*

Table 3. Vulnerability Scoring Matrix

	Low Impact	Medium Impact	High Impact
Low Adaptive Capacity	Medium	High	High
Medium Adaptive Capacity	Low	Medium	High
High Adaptive Capacity	Low	Low	Medium

1.2. Butte County Community Profile

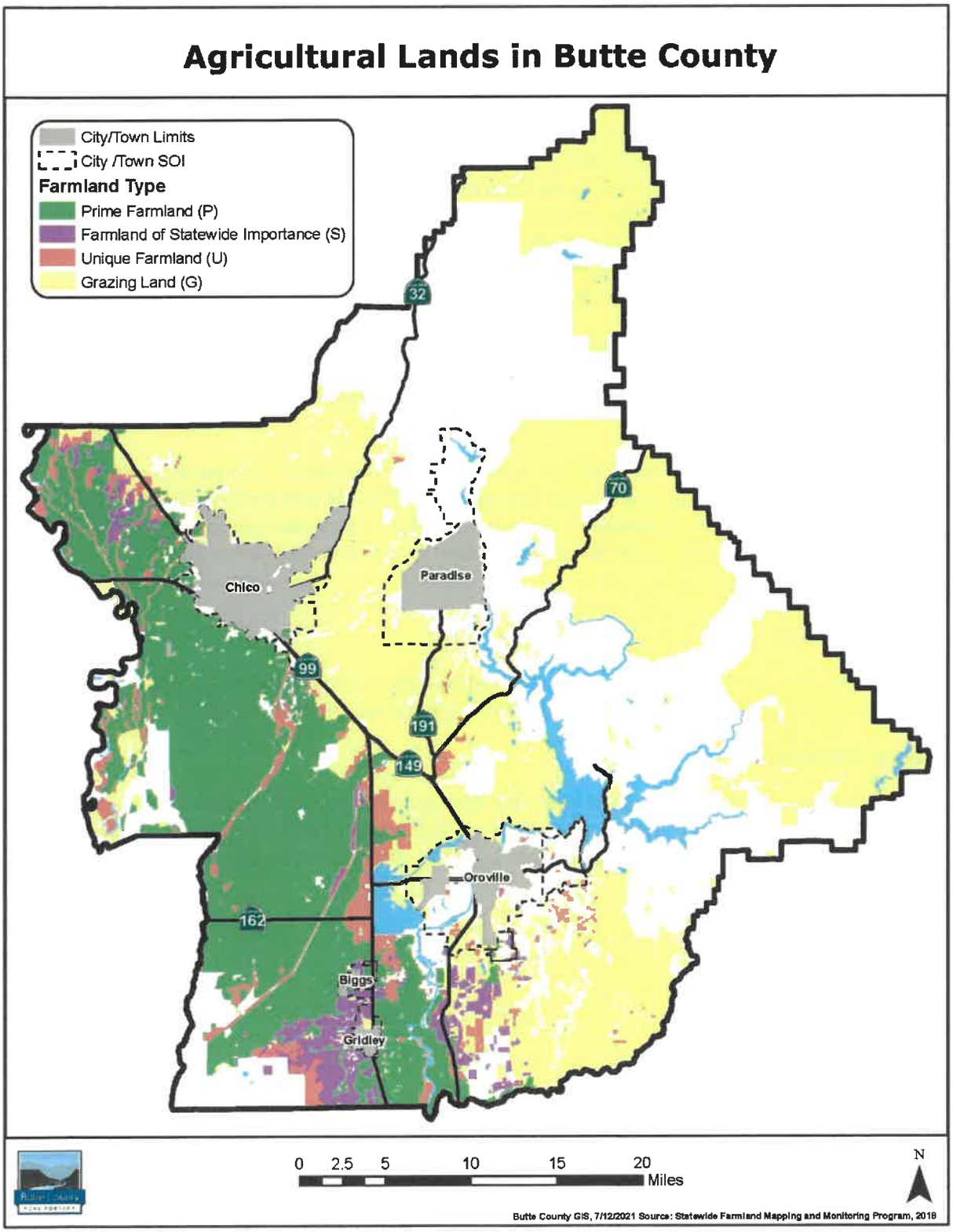
Located in Northern California, unincorporated Butte County has an area of approximately 1,680 square miles within the northeastern end of the Sacramento Valley extending east into the northern Sierra Nevada foothills. Butte County is a predominantly rural area; urban land makes up less than 5 percent of the total county area. Weather is generally temperate and warm, with hot, dry summers and cold, wet winters. The historic average minimum annual temperature is 44.6 degrees Fahrenheit (°F) and historic average maximum annual temperature is 71°F (Cal-Adapt 2018).

Homes and businesses are dispersed throughout the unincorporated county, resulting in transportation activity that is typical for a rural unincorporated county. Given the distribution of homes, businesses, and daily activities, driving in personal vehicles is common. Several unincorporated communities in eastern Butte County are located on single access and rural roadways.

Agriculture is a strong and growing sector of the Butte County economy and according to the 2019 *Butte County Crop & Livestock Report*, agriculture occupied about 425,000 acres of county land in 2019. Butte County's gross 2019 agricultural production totaled $688,369,916. Walnuts, almonds, and rice crops are the highest-value crop types grown in Butte County. Generally, agricultural activity has been shifting from field crops to higher-value nut crops that typically require less water and fertilizer. **Figure 3** shows agricultural lands within Butte County.

The primary crops grown in Butte County are rice, fruits, and nuts, with rice crops covering approximately 96,772 acres and fruit and nut orchards covering approximately 108,113 acres. Almonds (39,205 acres), walnuts (56,312 acres), and prunes (7,100 acres) are the primary orchard crops. Decreases in prune acreage and, to a lesser extent, other trees and vines (e.g., olives, peaches and nectarines, kiwis, pistachios, pears, and cherries) has been offset by increases in walnuts. Other agricultural activities include alfalfa crops (727 acres) and raising cattle (with pasture covering 207,000 acres). Acreages for grain and other crops have decreased substantially over time, while pasture and alfalfa acreage has increased. Approximately 16,000 head of cattle and sheep support the livestock industry, and 68,484,000 board feet of timber was harvested in 2019 (Butte County Department of Agriculture, Weights, and Measures 2019).

Figure 3. Agricultural Lands in Butte County



1.3. Water Resources

The following sections describe the water resources providing water to domestic and agricultural users locally, and to the rest of the state through Lake Oroville and the State Water Project.

1.3.1. Surface Water

Water districts, irrigators, private well owners, and municipal utilities in Butte County rely on snowmelt, originating in the Sierra Nevada, as well as precipitation as a key source of surface water. The Feather River, Big Chico Creek, Little Chico Creek, and many other creeks and streams provide municipal, agricultural, domestic, aquatic habitat, and recreational water uses for the County. The flow-regimes of these rivers and streams depend on spring and summer snowmelt originating from the Sierra Nevada runoff from precipitation as well as groundwater flows. The ability of snowpack to retain water and release it gradually is fundamental to water supply planning in the County and throughout the state.

Figure 4 shows the principal entry points to Butte County for surface water and the major channels, natural and modified, by which water flows through the county (Butte County Department of Water and Resources Conservation 2016). The principal waterways originating outside the County are:

- The Sacramento River
- The Feather River. The North, Middle, and South Forks originate outside Butte County and, together with the West Branch, supply water to Lake Oroville with a portion of flow routed through the Thermalito Forebay and Afterbay facilities to generate hydropower and deliver irrigation water supply, with the remaining water returning to the Feather River.
- Big Chico Creek
- Butte Creek
- Pine Creek

Runoff within the County also contributes to the flows in these waterways. These waterways represent the major streams, water supply, and drainage features in the county, including:

Natural Waterways

- The West Branch of the Feather River. The West Branch joins the forks originating outside the county and supplies water to Lake Oroville and then to Thermalito Forebay and Afterbay. Diversions are additionally made by the Pacific Gas and Electric Company (PG&E) to Butte Creek.
- Little Chico Creek
- Rock Creek
- Dry Creek
- Little Dry Creek
- Clear Creek
- Angel Slough
- Wyandotte Creek
- Honcut Creek

Supply Canals

- Western Main Canal
- Western Lateral 374
- Richvale Main Canal
- Sutter Butte Canal
- Minderman Canal
- Biggs-West Gridley Main Canal

Flood Control Channels

- Cherokee Canal
- Lindo Channel (Sandy Gulch)
- Sycamore Bypass Channel

Water is distributed from Thermalito Afterbay to canals serving multiple users, including Western Canal Water District and the Joint Districts. The Joint Districts include Richvale Irrigation District, Biggs-West Gridley Water District, Butte Water District, and Sutter Extension Water District.

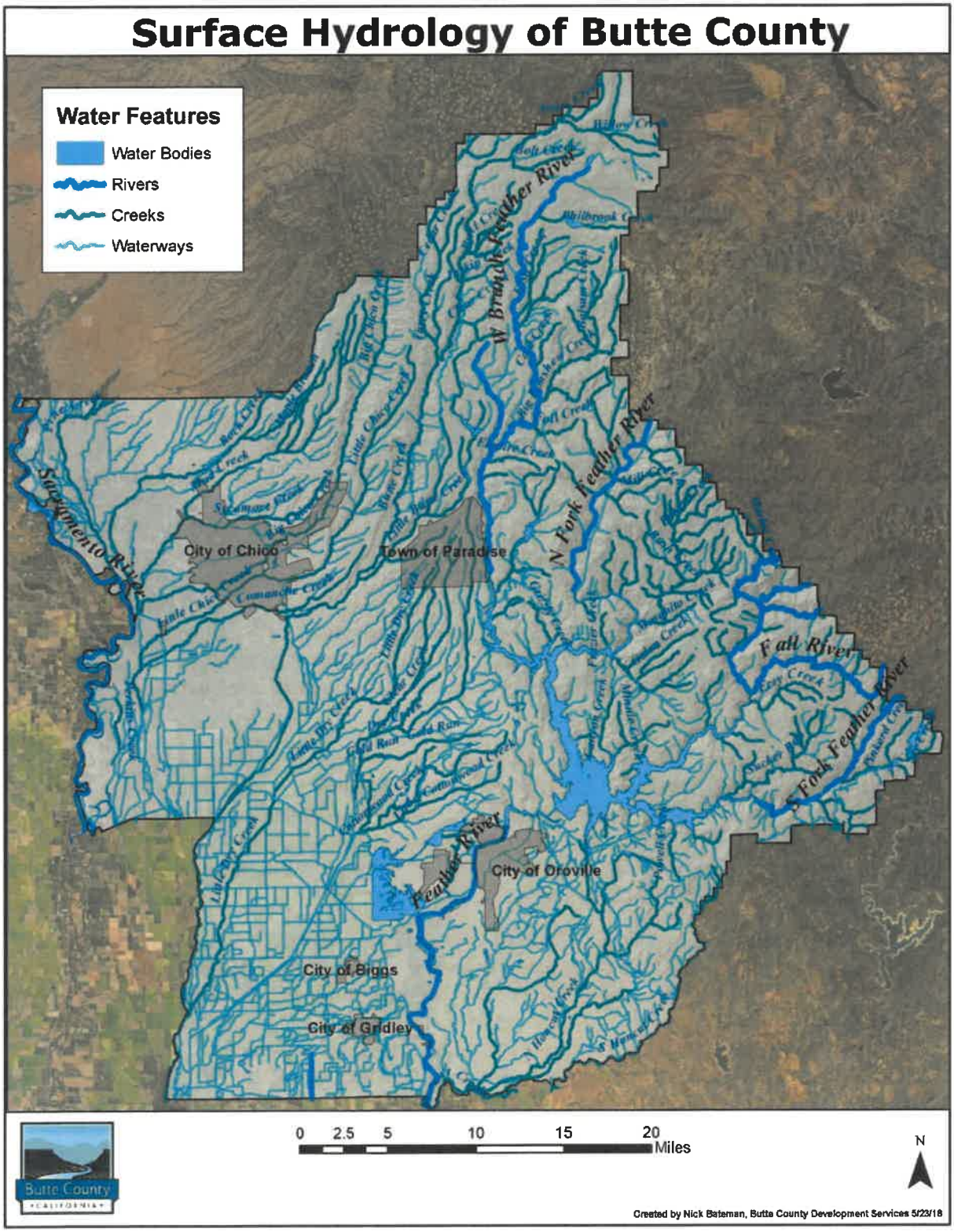
Water from the west branch of the Feather River is diverted to the Toadtown Canal for power generation by PG&E, where it also provides cold water for fish. The Butte Canal carries Toadtown Canal and Butte Creek water to the De Sabla power plant forebay. Hydropower is also generated at several other locations. Operations at these sites affect the timing of water releases. At Lake Oroville, Thermalito, Toadtown, and De Sabla Centerville, water for power generation is transferred from the Feather River watershed to the Butte Creek watershed (Butte County Department of Water and Resources Conservation 2016).

Average monthly flows for the Sacramento River are highest between January and March, reflecting runoff from precipitation on the valley floor, planned reservoir releases, and reservoir spillage in some years. Flows are sustained through July or August and even into November, as water is released from storage in Lake Shasta. In contrast, unimpaired flows from the Feather River, Butte Creek, and Big Chico Creek are highest between approximately February and May, as a result of runoff from snowmelt. These flows decrease greatly between May and July once the snow has melted. If the snowpack melts earlier, it could affect Feather River, Sacramento River, Butte Creek, Big Chico Creek, and other local creeks and streams that support the spring and winter Chinook salmon runs.

Local agencies in Butte County have entered into several contracts with the Department of Water Resources to retain their water rights which they held prior to the construction of Oroville Dam. Water rights settlement agreements were executed with the Joint Water District Boards (555,000 acre-feet) and Western Canal Water District (295,000 acre-feet) to settle protests over the construction of State Water Project facilities in Oroville. Under these agreements, the California Department of Water Resources provides the districts with water supply from Lake Oroville in exchange for the districts' individual water rights (Butte County Department of Water and Resources Conservation 2016). The delivery of water under these agreements may be curtailed if inflows into Lake Oroville do not meet specific targets by April 1st of each year. Under these circumstances, the Department of Water Resource could curtail water deliveries by no more than 50% in any one year and no more than 100% over a seven-year period.

Climate change may increase the variability between wet and dry months and the county will likely experience drought-like conditions, reducing overall water supply (Butte County Department of Water and Resources Conservation 2016). Climate change projections in the draft Butte Subbasin Groundwater Sustainability Plan assumes an increase in the frequency of curtailments over the next twenty years. Groundwater Sustainability Plans are being prepared pursuant to the Sustainable Groundwater Management Act and are described in the Groundwater Section.

Figure 4: Surface Water Hydrology in Butte County



1.3.2. Groundwater

Groundwater is directly linked to surface water in the county and snowmelt in the Sierra Nevada; therefore, increased average temperatures and changes in the timing and amounts of precipitation in the form of rain and snow could affect local aquifer recharge for groundwater supplies (DWR 2019). Butte County overlays a portion of the Sacramento Valley Groundwater Basin and is made up of three subbasins: Vina Subbasin, Butte Subbasin, and the Wyandotte Creek Subbasin (see **Figure 5**). While there is no single source of groundwater recharge, according to the studies (e.g., Lower Tuscan Aquifer Study, Isotope Recharge Study) conducted by the Butte County Department of Water and Resource Conservation, different parts of the basin are recharged from one or more of the following sources:

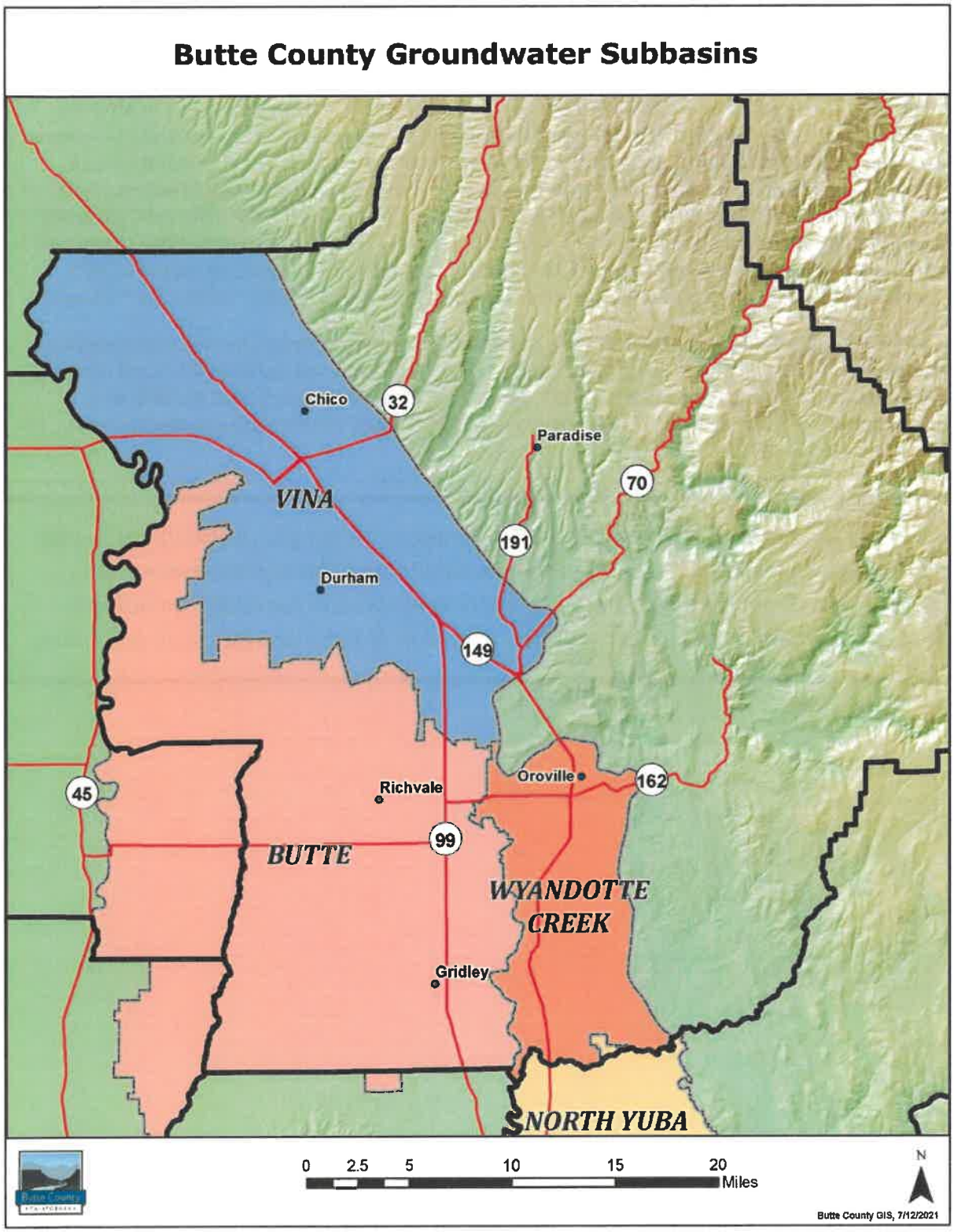
- Rainfall on the Lower Foothills
- Creeks
- Rivers
- Irrigation water
- Local rainfall on the Valley Floor

Butte County monitors groundwater conditions under the Groundwater Conservation Ordinance passed in 1996. The Ordinance requires that the County monitor groundwater levels, saltwater intrusion, and land subsidence quarterly. An annual groundwater status report is presented to the Butte County Board of Supervisors. Groundwater use typically increases during years characterized as dry and critical water years, or droughts. The most significant concern about increased groundwater use is the lowering of groundwater levels in the Vina and Wyandotte subbasins of the Sacramento Valley groundwater basin. Drought conditions exacerbate groundwater level declines due to reduced percolation (potential recharge) and increased groundwater pumping (Butte County Department of Water and Resources Conservation 2018). Under the Sustainable Groundwater Management Act, the groundwater sustainability plans for the three subbasins in Butte County will implement projects and actions to ensure that groundwater conditions will operate within a sustainable yield to avoid undesirable results for groundwater users.

The primary climate variable affecting water conditions in the county is inter-annual differences in precipitation and snowfall. Variability from year-to-year impacts both the availability of surface water to meet demands and the amount of pumping required to meet crop irrigation requirements. In the future, temperatures are likely to increase as a result of climate change, resulting in less snowpack in the Feather River watershed as well as earlier runoff. These changes will make existing surface water supplies less reliable, increasing the need to rely on groundwater to meet demands.

Butte County is currently addressing groundwater conservation through the Sustainable Groundwater Management Act (SGMA), which went into effect in January 2015. One of the key principles of SGMA is that each groundwater basin has unique characteristics and challenges; therefore, groundwater is best managed at the local level, and local agencies should have the tools they need to sustainably manage their resources (Butte County Department of Water and Resources Conservation 2016). To avoid state intervention, groundwater sustainability agencies were formed before June 2017 and these agencies are currently implementing groundwater sustainability plans (GSPs) that will bring the basin into sustainability in the next 20 years. The components of GSPs are subject to regulations adopted by the California Department of Water Resources. A water budget with potential use of a groundwater model is a required component of a GSP. GSPs establish the sustainable yield of the basin and identify regulatory and non-regulatory actions that will be taken to achieve sustainability by 2042.

Figure 5. Butte County Groundwater Subbasins



1.4. Cal-Adapt and Climate Change Projections

As directed by the APG, data needed to prepare the vulnerability assessment is available through several sources, with Cal-Adapt being one of the main sources. Cal-Adapt is a Web-based climate change scenario planning tool developed by the California Energy Commission (CEC) and the University of California, Berkeley, Geospatial Innovation Facility. The data available on this website offers a view of how climate change will likely affect Butte County at the local level. Climate projections included in this Climate Change Vulnerability Assessment include an average of four models representing Warm/Drier (HadGEM2-ES), Cooler/Wetter (CNRM-CM5), Average (CanESM2), and Complement (MIROC5) models. Cal-Adapt provides projections using two RCPs, RCP 4.5 and RCP 8.5, which project different possible future GHG emission scenarios. This Climate Change Vulnerability Assessment uses the recommended RCP 8.5 scenario in the APG, which represents a business-as-usual, sometimes called a "worst-case," scenario.

For the purposes of this assessment, climate change effects are characterized for two milestone years: midcentury (2050) and end of the century (2090). This data was downloaded from Cal-Adapt using the Butte County boundary. Projections for 2050 include an average of the years 2040 to 2060, and projections for 2090 include an average of the years 2070 to 2099. Historic data includes an average of the years 1961 to 1990.

Over the long term, these climate change impacts create the potential for a wide variety of consequences, including human health and safety risks, economic disruptions, diminished water supply, shifts in ecosystem function and habitat qualities, as well as difficulties with the provision of basic services such as utilities.

2. Populations and Assets

Populations and assets are the people, infrastructure, services, and economic drivers in Butte County that can be affected by climate change. The Climate Change Vulnerability Assessment looks at how each population and community asset has been and will continue to be affected by each of the climate change hazards discussed in Section 3. The APG provides a general list of populations and assets, which Butte County refined and used to develop five distinct asset categories: (1) populations, (2) buildings and infrastructure, (3) economic drivers, (4) ecosystems and natural resources, and (5) key services. The following sections describe the populations and assets included in each of the five categories.

2.1. Populations

The Climate Change Vulnerability Assessment evaluated 19 populations that may be disproportionately harmed by climate change hazards. These populations have financial, age, mobility, health, or other characteristics that make them more vulnerable to hazardous events. Butte County gathered data for many populations listed from the 2021 *Settings and Trends Report*, the California Native American Heritage Commission, the Healthy Places Index, and the 2019 Point-in-Time Count for Butte County. The following populations were included in the Climate Change Vulnerability Assessment:

- Children
- Cost-burdened households
- Households in poverty
- Immigrant communities
- Linguistically isolated persons
- Low-income households
- Low-resourced ethnic minorities
- Overcrowded households
- Outdoor workers
- Persons experiencing homelessness
- Indigenous peoples and tribal nations
- Persons living in mobile homes
- Communities on single access roads
- Persons with disabilities and/or chronic illnesses
- Persons without access to lifelines
- Renters
- Seniors
- Seniors living alone
- Students

2.2. Buildings and Infrastructure

The Climate Change Vulnerability Assessment assessed the vulnerability of 26 different types of buildings and infrastructure in the County. These infrastructure categories help daily activities, economic drivers, community services, and emergency response events. Several of these assets support the transportation network, energy delivery, water and wastewater services, and recreation and tourism activities. The infrastructure section of the Climate Change Vulnerability Assessment focuses on the physical effects of climate change hazards on infrastructure itself instead of the services or economic activity they provide. The County derived information on buildings and infrastructure from local, state, and federal agencies. The following building and infrastructure assets were included in the Climate Change Vulnerability Assessment:

- Airports
- Bridges and tunnels
- Communication facilities
- Community centers and libraries
- Dams

- Electrical transmission infrastructure (substations and power lines)
- Emergency operation buildings
- Evacuation and cooling centers
- Flood control infrastructure (levees, dikes, etc.)
- Government administrative facilities
- Hazardous materials sites
- Hiking and biking trails
- Homes and residential structures
- Hospitals and medical facilities
- Major roads and highways
- Natural gas pipelines
- Parks and open space
- Power plants
- Public safety buildings
- Railways
- Schools
- Single access, rural, and minor roads
- Solid waste facilities and landfills
- Transit facilities
- Water and wastewater infrastructure
- Waterway infrastructure

2.3. Economic Drivers

The Climate Change Vulnerability Assessment evaluated the vulnerability of 10 distinct economic drivers in Butte County. These economic assets include three separate agricultural-based sectors, major employment industries, and recreation and tourism on regional, state, and federal lands. The County obtained information on economic drivers from the 2019 *Butte County Crop Report* and the 2019 to 2020 *Butte County Comprehensive Annual Financial Report*. The following economic driver assets were included in the Climate Change Vulnerability Assessment:

- Agriculture
- Construction
- Education
- Healthcare
- Livestock
- Manufacturing
- Regional recreation and tourism
- Rice-growing areas
- State and federal land recreation and tourism
- Timber production

2.4. Ecosystems and Natural Resources

There are eight primary ecosystems in Butte County, although many can be subdivided into specific habitats. The Climate Change Vulnerability Assessment analyzes these seven ecosystems. The ecosystems and natural resources section of the vulnerability assessment focuses on the how the plants and wildlife in ecosystems are likely to be affected by climate change hazards and the current ability of these systems to adapt to changing conditions. The primary resource for this analysis is the 2021 *Settings and Trends Report*, Biological Resources chapter. The following ecosystems and natural resources were included in the Climate Change Vulnerability Assessment:

- Conifer forest
- Oak woodland
- Riparian woodland
- Chaparral
- Annual grassland
- Open water: reservoirs, ponds, drainages
- Wetlands
- Pacific Flyway

2.5. Key Services

The Climate Change Vulnerability Assessment assessed the vulnerability of eight different types of services in the county. These key service categories provide essential goods, utilities, and services to residents and visitors in the county. These services are provided by public and private agencies, as well as volunteer organizations. The key services section of the vulnerability assessment focuses on the actions and services provided in these categories instead of the physical buildings and infrastructure that support the services. The following key services were included in the Climate Change Vulnerability Assessment:

- Communication services
- Emergency medical response
- Energy delivery
- Vital goods delivery
- Government administration
- Public safety response
- Public transit access
- Water and wastewater

3. Hazards of Concern

The first step in the vulnerability assessment is to identify the climate change hazards projected for Butte County. Based on the Cal-Adapt projections and information obtained from the APG; the *California Fourth Climate Change Assessment*; the 2019 Butte County LHMP; and the 2021 *Setting and Trends Report*, "Hazards and Safety" chapter, direct climate stressors to Butte County include changes in air temperature and annual precipitation. Secondary climate stressors, also known as climate change hazards, include agriculture and forestry pests and diseases, drought, extreme heat, human health hazards, severe wind, severe storms, and wildfire. The Climate Change Vulnerability Assessment focuses on the climate change hazards, as shown in **Table 4**, as these will directly affect populations and assets within the County. The following sections describe the primary climate stressors and secondary climate change hazards likely to occur within Butte County.

Table 4. Primary and Secondary Climate Stressors in Butte County

Primary Climate Stressors	Secondary Climate Stressors
Increase in air temperature	Agriculture and forestry pests and diseases
	Extreme heat
	Human health hazards
	Wildfire
Changes in precipitation patterns	Drought
	Severe wind
	Severe storms (flooding and landslides)
	Wildfire

3.1. Primary Climate Stressors

3.1.1. Increase in Air Temperatures

Annual average air temperatures in Butte County are projected to rise substantially during the next century, compared to historic levels, as global temperatures continue to rise (Houlton 2018). This is measured through annual average minimum and maximum temperatures. Butte County's historical (1961 to 1990) average maximum temperature is 71°F (Cal-Adapt 2018). Butte County's average annual maximum temperature is projected increase to 76.4°F by 2050 and 80.1°F by 2090 (Cal-Adapt 2018).

Butte County's annual average minimum temperature is also projected to increase throughout the century. Historically, average annual minimum temperature was 44.6°F (Cal-Adapt 2018). The annual average minimum temperature is projected to increase to 49.5°F by 2050 and to 53.3°F by 2090 (Cal-Adapt 2018).

The increase in annual average temperatures is expected to create or worsen hazards throughout the County, such as agriculture and forestry pests and diseases, extreme heat, human health hazards, and wildfire. Increasing temperatures will increase evapotranspiration rates in plants, increasing the water demand for crops in the County. These secondary hazards are discussed in more detail in Section 3.2.

3.1.2. Changes in Precipitation Patterns

Global climate change will affect physical processes and conditions beyond average temperatures. For example, historic precipitation patterns could be altered. Rainfall and the winter snowpack in the Sierra Nevada range provides significant surface water flows and groundwater recharge as water drains through the County. While Cal-Adapt projections show minimal changes in total annual precipitation in California, even slight changes could have a dramatic effect on California's ecosystems, which are conditioned to historic precipitation levels (CalOES 2020). It is anticipated that climate change would lead to an increase in the frequency and intensity of storms, meaning more precipitation may fall in fewer storms throughout the year. This may also result in more frequent and prolonged periods of drought (Bedsworth et al. 2018).

According to Cal-Adapt, historical annual average precipitation was approximately 52.3 inches throughout Butte County. Precipitation is expected to vary over the course of the century, with an annual average of 47.2 inches by 2050 and an annual average of 50.8 inches by 2099 (Cal-Adapt 2018).

Changes in precipitation can directly and indirectly cause or worsen hazards in the County, such as drought, severe wind, severe storms, and wildfire. These secondary hazards are discussed in more detail in Section 3.2.

3.2. Secondary Climate Hazards

3.2.1. Agriculture and Forestry Pests and Diseases

According to the *2019 Butte County Crop Report*, agricultural production and timber harvesting had total gross production of over $688 million in 2019, with walnuts being the largest grossing crop. Agricultural and forestry pests and diseases can affect crop plants, forests, and livestock throughout Butte County. This hazard is measured by the occurrence of pests and diseases, which is likely to increase as higher temperatures allow for insects to reproduce more rapidly.

These pests and diseases, such as fruit flies (*Drosophila melanogaster*), Japanese beetles (*Popillia japonica)*, gypsy moth (*Lymantria dispar dispar*), glassy-winged sharpshooter (*Homalodisca vitripennis)*, Asian citrus psyllid (*Diaphorina citri*), European grapevine moths (*Lobesia botrana*), fir engraver beetle (*Scolytus ventralis*), white-fir sawfly (*Neodiprion*), fall webworm (*Hyphantria cunea*), black stain root disease, and heterobasidion root disease, can cause plants and animals to grow more slowly, damage them so that their products are less appealing and harder to sell, or even kill them (California Climate and Agricultural Network 2019). Many pests and organisms that carry diseases are most active during warmer months, so the threat of infection or infestation can be higher during this time of year. Temperatures are expected to get warmer earlier in the year and remain warmer until later in the year due to climate change, creating a wider activity window for pests and diseases.

3.2.2. Drought

A drought occurs when conditions are drier than normal for a long period of time, making less water available for people, agricultural uses, and ecosystems. Droughts are a regular occurrence in California and are measured by the timing and length of drought. However, in the past 50 years, there have been four major statewide droughts, plus smaller regional droughts (CalOES 2018). Due to changes in precipitation patterns discussed in Section 3.1.2, droughts will likely last longer and occur more frequently due to more variability in precipitation extremes. Baseflow in rivers and creeks is projected to decline significantly. Historic annual average baseflow in rivers and creeks in Butte County was 12.2 inches, which is projected to decrease to an annual average of 8.1 inches during a mid-century drought and an annual average of 7.4 inches during a late-century drought.

Changes in weather patterns resulting from increases in global average temperature could result in a decrease in the total amount of precipitation falling as snow, leading to a loss in snowpack. Projections show an overall reduction of snowpack in the Sierra Nevada (Cal-Adapt 2018). Based on historical data and climate projections, State studies indicate that the Sierra Nevada snowpack will decrease by more than a third from its historic average by 2050 and decrease 50 percent to 66 percent or more by 2100 (DWR 2008; Bedsworth et al. 2018 2013).

The historic average snow water equivalent, a common measurement of snowpack, for Butte County was 1.9 inches (Cal-Adapt 2018). By 2050, the average annual snow water equivalence is projected to be 0.5 inches and by 2100 the average annual snow water equivalence is projected to be 0.1 inches (Cal-Adapt 2018).

3.2.3. Extreme Heat

Extreme heat occurs when temperatures rise significantly above normal levels and is measured by the number of extreme heat events per year and heat wave duration. "Extreme heat" is a relative term—temperatures of 100°F are normal in locations like Palm Springs, but almost unprecedented in Truckee. An extreme heat day in Butte County is where temperatures reach at least 100.1°F (Cal-Adapt 2018). Although temperatures are typically lower at higher elevations in the county, it is still dangerous when temperatures are higher than usual for people and assets that are not accustomed to them and may not have the resources to cope with the warmer temperatures.

Butte County historically experiences an average of five extreme heat days a year. Climate change is already increasing the number of extreme heat days in Butte County substantially. Butte County is projected to experience an average of 29 extreme heat days per year by 2050 and 59 extreme heat days per year by 2090 (Cal-Adapt 2018).

High temperatures can also occur during the night, as temperatures may not cool off and provide relief from the heat. A warm night in Butte County is when temperatures exceed 64.8°F (Cal-Adapt 2018). Historically, Butte County experienced 4 warm nights per year, which is projected to increase to 33 warm nights per year by 2050 and 76 warm nights per year by 2090 (Cal-Adapt 2018).

When extreme temperatures are experienced over a period of four or more days, the State's Cal-Adapt database defines these as heat waves.

Climate change is already increasing the number of extreme heat days in Butte County substantially. Butte County experienced an average of 11 extreme heat days per year from 2010 to 2016, including 26 extreme heat days in 2015.

3.2.4. Human Health Hazards

Human health hazards are bacteria, viruses, parasites, and other organisms that can cause diseases and illness in people. Some of these diseases may only cause a mild inconvenience, but others are potentially life threatening. Examples include hantavirus pulmonary syndrome, Lyme disease, West Nile virus, and influenza, which can be debilitating or fatal for some of the population. These diseases are carried by animals such as mice and rats, ticks, and mosquitos, which are usually seen as pests even if they do not cause infections.

Similar to agriculture and forestry pests and diseases, changes in temperature and precipitation can increase the rates of infections because many of the animals that carry diseases are more active during warmer weather. Warmer temperatures earlier in the spring and later in the winter can cause these animals to be active for longer periods, increasing the time for the disease to be transmitted. Warmer temperatures and higher levels of rainfall lead to increased populations of animals such as mosquitos, rodents, and ticks, creating a greater risk of diseases carried by these animals.

3.2.5. Severe Wind

Severe wind in Butte County is defined as sustained wind speeds exceeding 40 miles per hour and lasting for one hour or longer, or winds of 58 miles per hour for any duration (Butte County 2019). These winds can occur seasonally or as part of a severe weather event, such as a thunderstorm. The entire county has historically been subject to severe winds, from high winds in the mountain areas of the County to tornadoes in the valley portion of the county. Severe wind or tornado events occur approximately every 3.3 years according to historic records (Butte County 2019). The climate science surrounding wind is less certain; however, the intensity of individual thunderstorm events is likely to increase throughout the century, which may bring stronger thunderstorm winds (Butte County 2019). Severe wind can damage or destroy buildings, knock over trees, damage power lines and electrical equipment, and exacerbate wildfire conditions, as seen during Butte County's 2018 Camp Fire (see Section 3.2.7).

3.2.6. Severe Storms

Climate change is projected to alter the frequency, intensity, and duration of severe storm events, with sustained periods of heavy precipitation and increased rainfall. Precipitation patterns may have more intense characteristics, such as a high volume of rain falling over a shorter period of time. These storms may produce higher volumes of runoff and contribute to an increased risk of flooding. These projected changes could lead to increased flood magnitude and flooding frequency (Bedsworth et al. 2018). Several factors determine the severity of floods, including rainfall intensity, duration, and localized drainage characteristics. Flash floods occur when a large amount of rain falls over a brief period of time. Currently, the county experiences localized flooding in several areas.

When the Sacramento River and Feather River reach their peak capacity, Big Chico Creek and the other tributaries that flow into these river systems cannot discharge at a normal rate. These conditions can cause tributaries to overflow and flood.

The precipitation that will fall may have more intense characteristics, such as high volume of rain falling over a shorter period of time and stronger, more destructive wind patterns.

Butte County is susceptible to various types of flood events: riverine, flash, and localized stormwater flooding (Butte County 2019). Butte County includes numerous watersheds as well as several watersheds that drain into Butte County from surrounding counties. The County has assessed its flooding hazards as part of the Butte County LHMP. According to the LHMP, the following are the principal areas subject to flooding in Butte County:

- Butte Creek
- Little Chico Creek
- Little Chico Creek Diversion
- Mud Creek
- Ruddy Creek and Ruddy Creek Tributary
- Sycamore Creek
- Wyman Ravine and Tributaries
- Comanche Creek

In addition to these streams, flooding in Rock Creek and Keefer Slough, located north of Chico, regularly occurs. These floods inundate State Route 99, State Route 32, and several county roadways, as well as impact extensive residential and agricultural areas in and around the North Chico area and the unincorporated community of Nord. The Dry Creek-Cherokee Canal poses a flood risk to the Richvale area, including rice research grounds and rice storage and chemical storage facilities (Butte County 2010).

Factors that directly affect the amount of flood runoff include precipitation quantity, intensity and distribution, the amount of soil moisture, seasonal variations in vegetation, snow depth in headwater regimes, and impermeability of developed surfaces, development patterns, building and infrastructure material choices, and project designs. The placement and integrity of existing levees, as well as reservoir operation for flood control, are also important factors. Intense storms may overwhelm local waterways, as well as threaten the integrity of flood-control structures (Butte County 2019).

Heavy rainfall can also cause landslides in the mountain areas of the county. Hillsides commonly absorb water, which increases instability of the slope, leading to increased slope failure. Steep slopes made up of loose or fractured material are more likely to slide. In some cases, the hillsides can become so saturated that slope failures can result in a mudslide (a mixture of soil and water moving downslope). Landslides and mudslides can move fast enough to damage or destroy buildings or other structures in their path, block roads or railways, and injure or kill people caught in them.

Butte County is also susceptible to localized stormwater flooding, where stormwater runoff exceeds the rate of drainage. Stormwater flooding occurs during periods of severe weather and unusually high amounts of rainfall, and where stormwater infrastructure is physically impaired or inadequate. This kind of flooding event typically occurs in urbanized areas with expanses of impervious surfaces.

During a large flooding event, some areas of the County may be vulnerable to levee and dam failure. Dam and levee failure-related flooding would vary in the planning area depending on which structure fails and the nature and extent of the failure and associated flooding. This flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, agricultural industry, and the local and regional economies (Butte County 2019).

Butte County is home to Lake Oroville, which releases water into the Feather River before joining with the Sacramento River. Eventually, the water flows into the Sacramento-San Joaquin Delta where the State Water Project's California Aqueduct diverts freshwater to the San Joaquin Valley for irrigation as well as contributing it to municipal and industrial water supplies in Southern California. Lake Oroville is a critical component of supplying water locally and throughout the state.

In February 2017, a record high rainfall event took place in Butte County. An infrastructure failure caused significant damage to Oroville Dam's main spillway, which led to reduced releases and resulted in Lake Oroville reaching its maximum capacity. The emergency spillway was activated for the first time since its construction. Due to the potential infrastructure failure of the emergency spillway, 188,000 people in the region were evacuated. Southern Butte County experienced flooding during this event, temporarily displacing many families. Most of this flooding was a result of infrastructure failure rather than the dam's inability to hold that much water. Climate change is expected to cause more frequent, extreme rainfall events such as the one that occurred in February 2017. If an event like this happened again, southern Butte County residents could be at risk of flooding.

Severe storms can also include severe winter weather, hail, and lightning. Severe winter weather includes blizzards, ice storms, and extreme cold. Blizzards and ice storms can damage buildings and other structures, knock over electricity lines and trees, and block roadways. Ice can form on roadways and paths, creating slippery conditions that make it difficult or even hazardous to get around, especially for visitors who may not be used to icy conditions. Very cold temperatures create a health risk for people who are exposed to them, including the possibility of trench foot, frostbite, or hypothermia. Hail can damage buildings and plants (and in extreme cases injure people), and lightning can spark fires, injure people, or cause fatalities.

3.2.7. Wildfire

Rising temperatures combined with changes in precipitation patterns and reduced vegetation moisture content can lead to a secondary climate impact: an increase in the frequency and intensity of wildfires. Changes in precipitation patterns and increased temperatures associated with climate change alter the distribution and character of natural vegetation and associated moisture content of plants and soils (CNRA 2012b:11). Increased temperatures increase the rate of evapotranspiration in plants, resulting in a greater presence of dry fuels in forests and creating a higher potential for wildfires (CNRA 2012b).

In addition to property damage and loss of life, increased wildfire activity across the western United States in recent decades has contributed to widespread forest mortality, carbon emissions, periods of degraded air quality, and substantial fire suppression expenditures. Although numerous factors aided the recent rise in fire activity, observed warming and drying have significantly increased fire-season fuel aridity, fostering a more favorable fire environment across forested systems. On October 11, 2016, the Proceedings of the National Academy of Sciences reported that climate change has contributed to over half of the documented increases in fuel aridity since the 1970s and doubled the cumulative forest fire area since 1984. This analysis suggests that climate change will continue to contribute to the potential for western U.S. forest fire activity where fuels are abundant. A description of the devastating 2018 Camp Fire and 2020 North Complex Fire can be found in the "Hazards and Safety" chapter of the 2021 *Butte County Setting and Trends Report*.

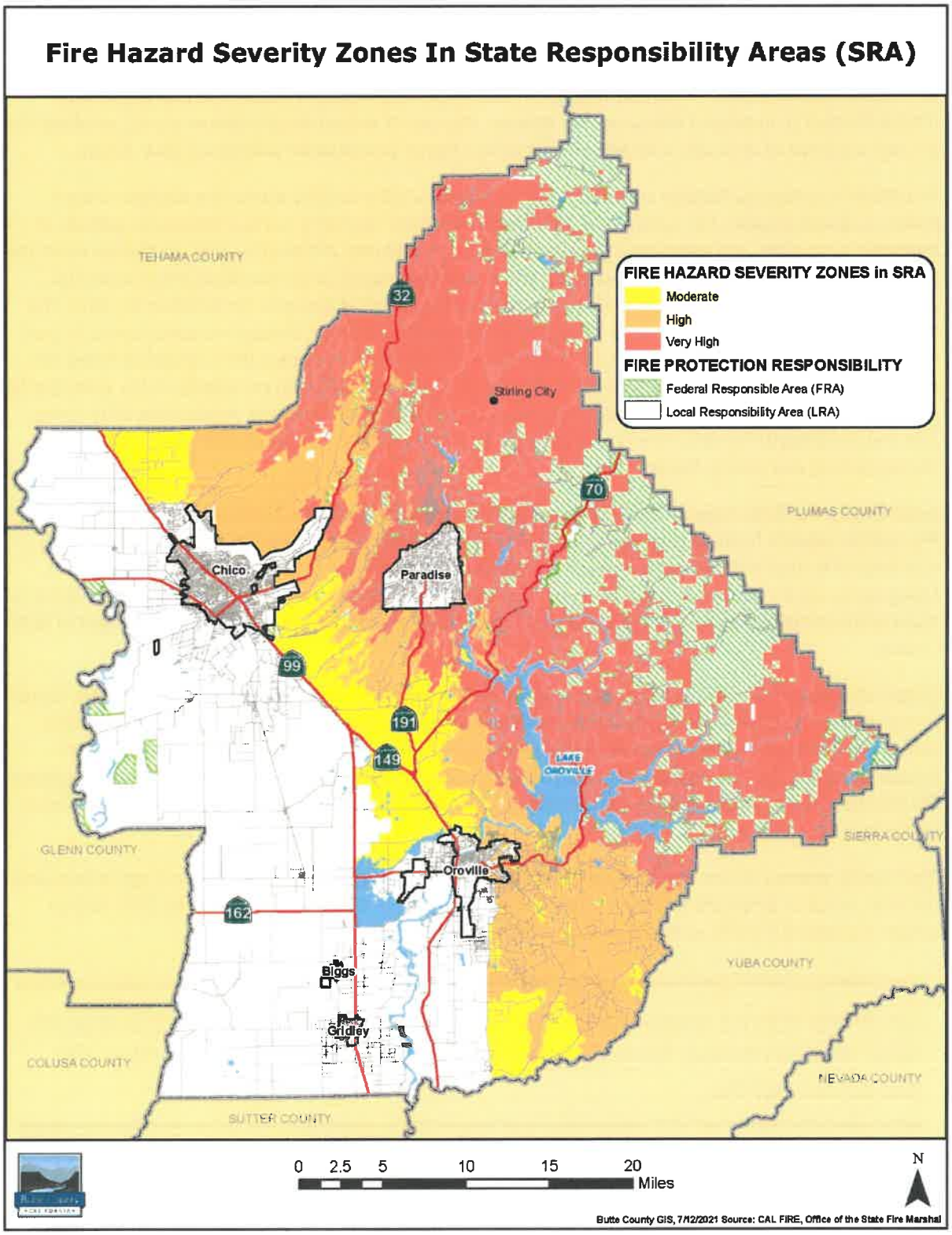
According to the Butte County 2019 LHMP, wildfire is an ongoing concern for the County. Generally, the fire season extends from early spring to late fall. With climate change, Butte County's fire season may now extend further into the winter months. Wildfire conditions arise from a combination of weather, topography, wind patterns, accumulation of vegetation, and low-moisture content in the air. Wildland fire hazards (open space, rangeland, chaparral, and forested areas) exist in approximately 70 percent of Butte County.

Urban wildfires often occur in areas where development has expanded into rural areas. Currently, many homes within the county are located in the wildland-urban interface (WUI), which is characterized by zones of transition between wildland and developed areas and often includes heavy fuel loads that increase wildfire risk. See **Figure 6** for a look at Butte County's Fire Severity Zones. Areas in eastern Butte County that appear empty but are surrounded by Very High Fire Hazard Severity Zones are mostly areas under federal jurisdiction.

The historic yearly average of area burned in Butte County was approximately 5,306 average annual acres per year, which is projected to increase to an annual average of 8,961 acres per year by 2050 and an annual average of 13,939 acres per year by 2099 (Cal-Adapt 2018).

Generally, the fire season for Butte County extends from early spring to late fall. With climate change, Butte County's fire season may now extend further into the winter months.

Figure 6. Butte County Fire Hazard Severity Zones



4. Potential Impacts

Climate change hazards at the local and regional scale carry some uncertainty. Therefore, the Climate Change Vulnerability Assessment included a qualitative analysis that describes the potential impacts based on the hazards discussed in Chapter 3 (CNRA 2012a). This assessment provides a high-level overview of potential impacts that could occur as a result of identified climate change hazards. Further evaluation and research would be needed to identify vulnerabilities to specific properties, structures, or services. The following sections describe the general impacts of hazards on populations and assets within Butte County, which was used to conduct vulnerability scoring. The results of the vulnerability scoring are provided in Appendix B.

4.1. Agriculture and Forestry Pests and Diseases

Agriculture and forestry pests and diseases can affect all population and asset sectors in Butte County. These pests and diseases can cause plants and animals to grow more slowly, damage them so that their products are less appealing and harder to sell, or even kill them. Though there are treatment options for several agriculture and forestry diseases, some have no cure. The forests face particular harm from insects and other pests, diseases caused by bacterial or viruses, fungal infections, and other conditions that can affect the health of forest trees and plants. Specific pests and diseases include sudden oak death, fir engraver, white-fir sawfly, fall webworm, black stain root disease, and heterobasidion root disease (California Forest Pest Council 2019). Pest or disease infections can cause trees and other plants to grow more slowly, damage them so they are less able to function in an ecosystem, or kill them outright, which can impact the timber production industry. Forest and wilderness managers can cure or treat some pests or diseases or control their spread. However, in some cases, there is nothing that can be done.

In places where forests are a scenic and recreation attraction—and an important contributor to local quality of life—such as the conifer forests, forestry pests and diseases can cause significant economic harm. Dead trees or tree limbs may fall, especially during high winds and severe storms, and can damage or destroy buildings and structures, electrical transmission lines, homes, and other property. Falling trees or tree limbs may block roadways and cause injuries or even fatalities to community members and visitors. Blocked roadways can isolate communities located in the remote regions of the County. Dead trees and other plants can also create more fuel for wildfires.

In the agricultural sector, pests and diseases can affect the quality and viability of crops and livestock, which could become chronic as conditions continue to warm. Outdoor workers, immigrant communities, and low-resourced ethnic minorities could face economic hardship if they rely on this industry for work. It may be difficult for these populations to find alternative work if agricultural production declines.

4.2. Drought

More persistent drought conditions coupled with reduced flows of freshwater and increased water demands will likely affect the quantity and quality of water supplies. When flows decrease, water temperature increases, leading to harmful bacteria and algal blooms in open water and wetland ecosystems. Butte County experienced harmful algae blooms in the summer of 2017; people and animals were advised to stay out of waters in Table Mountain Ecological Reserve due to toxic blue algal blooms in the water.

As mentioned previously, climate change will likely result in more periods of drought. Less precipitation and snowpack in the headwater region means Butte County may face a decrease in surface water availability. A reduction in surface water availability can result in an increased dependence on groundwater supplies. It is generally understood that groundwater use goes up when surface water flows are curtailed (Butte County Department of Water and Resources Conservation 2016). Many of California's groundwater basins are already in overdraft conditions, with groundwater use exceeding the rate of recharge.

Those who rely on agricultural wells may face challenges in meeting water demands of crops and livestock as groundwater levels decline. The cost of meeting crop water demands will increase due to the need to extend groundwater pumps deeper or install new wells. The economic impact to agriculture is likely to harm both the agricultural operations and the outdoor workers employed by these operations (Butte County Public Health Department 2017). Those who have domestic wells may see their wells go dry, unless they drill further into the aquifer. Drilling can be expensive and may not be possible for those with financial burdens or limited resources. Households dependent on community water supplies could experience price hikes during drought conditions, and those without financial means may be unable to afford water prices. Drought could also cause statewide water supply issues, as the State Water Project relies on water from the Sacramento River and Feather River watersheds. Shallow domestic wells may not be able to reach lower groundwater levels during drought conditions and the State Water Resources Control Board may curtail surface water rights, negatively impacting Butte County agriculture.

Increases or decreases in precipitation could have an effect on ecosystems in the Butte County area. If plant life is decimated, there may be numerous consequences that can lead to a steeper loss of biodiversity. Moisture can impact both host plants and pathogens in many ways. Some pathogens, such as apple scab, late blight, and several vegetable root pathogens, are more likely to infect plants with increased moisture content. Other pathogens, like the powdery mildew species, tend to thrive under conditions with lower (but not low) moisture. Drought conditions are also expected to lead to an increased frequency of tree pathogens due to indirect effects on host physiology. This can lead to tree mortality, which can devastate the timber production industry. Harm to ecosystems and natural resources can also affect regional recreation and tourism, as fewer individuals may be interested in traveling to the area for regional, state, and federal land recreation and tourism if water levels drop too low or the scenic appearance of the county has changed.

More persistent drought conditions, coupled with reduced flows of freshwater and increased water demands, will likely lead to increased water temperature in streams, lakes, and reservoirs. Higher water temperatures tend to lead to lower levels of dissolved oxygen in the water, resulting in more stress on fish, insects, crustaceans, and other aquatic animals that rely on it. This can also affect the patterns and availability of suitable ecosystems for migratory birds along the Pacific Flyway. Butte Creek, Big Chico Creek, Feather River, and the Sacramento River support Chinook salmon and are used for winter and spring-runs. They also support many other federally and state protected fish and wildlife species. Changes in water temperature will eventually cause waterways to be unable to support various life stages of protected fish in these areas. Many streams and rivers have already become unviable for salmon to spawn in, such as parts of Big Chico Creek in Upper Bidwell Park. Under the new climate scenarios, salmon and many other aquatic species may not be able to use these channels located in Butte County to thrive. Some ecosystems, such as wetlands, may shift to other ecosystems that require less water, such as grasslands and chaparral (Kershner 2014).

4.3. Extreme Heat

The projected rise in temperature will have severe impacts on human health. Cases of heat-related illnesses, such as nausea, dizziness, stroke, dehydration, and heat exhaustion, will likely rise, especially for those who do not have access to air conditioning, cool spaces, or shelter. Children, outdoor workers, financially burdened households, persons experiencing homelessness, and those who cannot easily regulate their body temperature face the greatest health impacts (OPR TAG 2018). Higher temperatures will also mean greater instances of record high minimum temperatures. When there is not a significant drop in temperature overnight (at least 20°F), the human body continues to behave in distress—high blood pressure, elevated heart rate—overtaxing the body. With longer heat waves, Butte County medical centers are likely to see an increase in patients admitted for care related to prolonged heat exposure. According to the Climate Change and Health Profile Report for Butte County, from 2005-2010 there was an annual average of 41 heat-related emergency room visits. This number is projected to increase and may become a concern for Butte County medical centers with the increase of heat-related illnesses (Maizlish Neil et al. 2017).

Disadvantaged communities in Butte County are likely to face greater challenges in dealing with extreme heat than others. People in low-income areas, some of which are communities of color; people with existing health issues, such as chronic diseases and mental health conditions; young children and the elderly; people experiencing homelessness; outdoor workers, including farmworkers; immigrants; some tribal nations; and socially or linguistically isolated people will likely be most affected by extreme heat. Many of these individuals may not have access to or be able to afford their own air conditioning. Low-income populations may live in older buildings with poor insulation and ventilation, leading to higher indoor air temperatures on warm days. These populations often live in communities where residents are less likely to have air conditioning to cool homes or shade from trees in their neighborhoods, more likely to have one or more chronic medical conditions, and less likely to own cars that can provide mobility to avoid deleterious climate effects.

As of 2019, there are 891 unsheltered persons experiencing homelessness in Butte County (Butte County CoC 2019). Homeless populations are especially vulnerable to heat-related illnesses in periods of excessively high heat, as refuge from high temperatures may not be accessible even if homeless shelters are available. The majority of agriculture laborers in Butte County work in orchards and rice fields. The harvest of walnuts and almonds takes place in late summer and early autumn when the highest annual temperatures occur. Cal-Adapt estimates that an annual average of 29 extreme heat days will occur in Butte County by 2050. These days will likely occur during the harvest season, exposing farm workers to extreme temperatures and intense sun. Farmworkers in row crop fields will be the most exposed and vulnerable because they work under the open sun, with no shade. Farmworkers in the orchards and rice fields have slightly lower exposure because most harvesting is done with machinery, and the workers are provided some shade by the orchard trees or within a tractor and harvesting machinery. Health risks such as heat stroke and dehydration may occur and could potentially lead to disability.

Increases in temperature can have a severe impact on Butte County's biological resources and ecological functions. Water temperature will generally increase in streams, lakes, and reservoirs as air temperature rises. This tends to lead to lower levels of dissolved oxygen in the water, resulting in more stress on the fish, insects, crustaceans, and other aquatic animals that rely on oxygen in open water and wetland ecosystems. An increase in temperature will decrease food availability, resulting in loss of habitat for many species, including migratory birds along the Pacific Flyway. In conifer forests, extreme heat can lead to heat stress, making them more susceptible to harm from forestry pests and diseases. It is also projected that scrublands or grasslands will expand into conifer forests under drier future scenarios

(Lenihan et al. 2003, 2008). See **Figure 7** and **Figure 8** for a map of projected temperature increases in relation to critical habitats.

CalFlora, a website that hosts information on wild California plants, lists about 35 species that are rare, native, or edaphically inclined to serpentine soils in Butte County. Many of these plants will be outcompeted by invasive species and are prone to disease. Virus vectors such as aphids, soil-borne fungi, and "weeds" (non-native invasive plants), can quickly spread the disease to heat-stressed natives. Plants that cannot disperse fast enough or those with longer life cycles, such as perennials and trees, might fail to survive under these new stressful conditions. There are about 153 invasive plant species in Butte County alone (CalFlora 2017). Invasive species often flourish where native species struggle. Faster development of non-perennial crops results in a shorter life cycle resulting in smaller plants, shorter reproductive duration, and lower yield potential. Temperature extremes that occur at critical times during development can significantly impact plant productivity.

Plant and wildlife distributions may also be affected by changes in temperature, competition from colonizing species, regional hydrology, and other climate-related effects. These shifts could also increase the ability of disease vectors (organisms that transmit diseases, such as mosquitoes) to survive or thrive in areas that were previously uninhabitable (City of Oroville 2015).

Extreme heat events can also harm agricultural crops and livestock, which could have economic impacts on farms and consumers. The majority of Butte County's commodities are walnut, almond, and prune orchards as well as rice farms. According to the 2016 *Water Inventory Analysis*, the county contains around 425,000 acres of plant crops. Out of these plant crops, around 108,113 acres produce nuts and around 96,772 acres produce rice. These two types of farming practices make up almost half of the designated agricultural lands.

Butte County agriculture productivity is vulnerable to increases in average temperature. Nut trees, such as walnuts, require chilling hours during winter. "Chilling hours" can be defined as the cumulative number of hours below 45°F (Tapan B. Pathak et al. 2018). Almonds require between 400 and 700 chilling hours while walnuts range from 400 to 1,500 chilling hours each winter (Tapan B. Pathak et Al. 2018). Increases in average temperatures will directly reduce the number of chilling hours experienced by fruit and nut crops. Fewer chilling hours has the potential to reduce yields and therefore profits. Changes in growing season conditions could cause variations in crop quality and yield.

The increase in summer temperatures will also impact livestock and dairy production negatively, as well as their supply of forage crops. When dairy cows become overheated or stressed, their milk production decreases.

Changes in growing season conditions could cause variations in crop quality and yield. Plant and wildlife distributions may also be affected by changes in temperature, competition from colonizing species, regional hydrology, and other climate-related effects.

Figure 7. Map of Predicted Annual Temperature Average in 2050 under the RCP 8.5 Scenario in Relation to Critical Habitats in Butte County

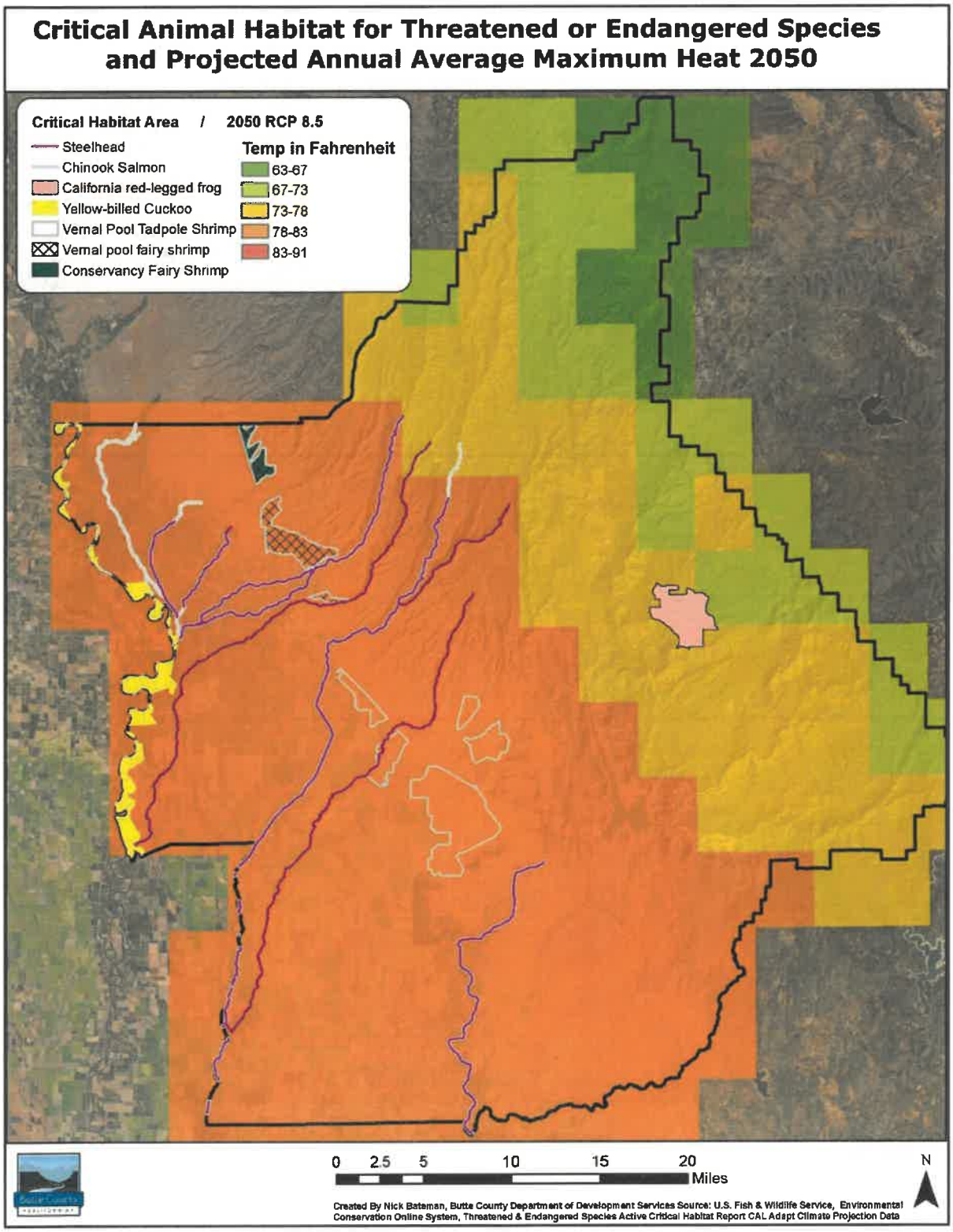
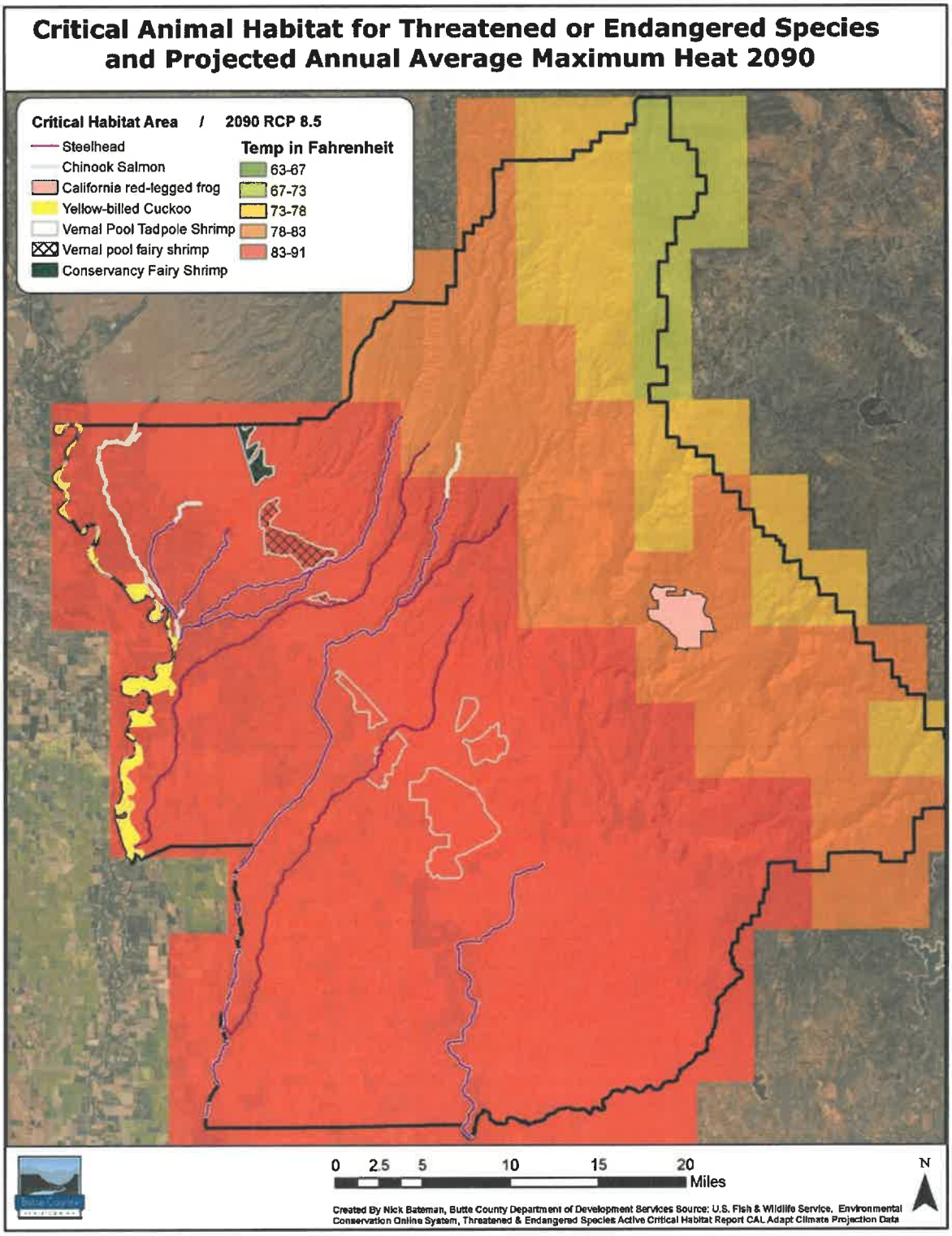


Figure 8. Map of Predicted Annual Temperature Average in 2090 Under the RCP 8.5 Scenario in Relation to Critical Habitats in Butte County



Extreme heat is also projected to impact infrastructure and utility services within Butte County. Infrastructure, such as roads, railroads, and bridges may bend and buckle in extreme heat conditions. Roads exposed to continued heat spells can experience cracks and pavement rutting, causing dangerous conditions for all transportation modes. Bridges experience expansion and contraction as temperature changes throughout the day. This impacts the way that bridge expansion joints function and absorbs movement over time. Butte County has railroad lines running through many small communities. The rail line's power system may experience thermal expansion, which can cause loss of tension, which can lead to reduced speeds that will impact public safety and mobility by increasing the need for road maintenance and road closures (Maizlish Neil et Al. 2017).

Utility services will also be impacted. High temperatures decrease power transmission line efficiency while summer air conditioning use increases electricity demand. This can lead to more power outages and blackouts and high winds could cause Public Safety Power Shutoffs. This could put public health and safety at risk with limited ways to stay cool during these times.

Utility services are likely to be impacted. High temperatures decrease the efficiency of power transmission lines while summer air conditioning use increases electricity demand. This can lead to more power outages and blackouts, leading to public health and safety risks if there are limited ways to stay cool during extreme heat events (Maizlish Neil et al. 2017). Limited or no access to air conditioning during heat events can be fatal for persons with chronic illnesses and seniors.

Quality of life could be affected by heat-related power outages. Loss of electricity reduces the ability to cool inside areas, which could affect people's ability to seek refuge from the heat. Food service and grocery stores could see economic losses from food spoilage due to loss of refrigeration caused by power outages. The ability to communicate via the Internet, cell towers, and landline could also be affected. Internet outages due to high heat can have a negative impact on local businesses who rely on internet to run business systems and communication.

Butte County is well known for its variety of outdoor activities. Spring and summer months are often filled with people hiking, swimming, and attending outdoor community events such as farmers' markets. As an increase in extreme heat events occurs, outdoor recreation will become less desirable. Visitors participating in recreation activities could be doing physically demanding hiking, biking, or other recreation activities, increasing the potential for heat-related illness. Reduced outdoor activity has the potential to affect revenue for businesses in the outdoor recreation industry on regional, state, and federal lands. Increases in temperature and extreme heat days could also affect quality of life, as getting outside and exercising is no longer an option. This could also lead to negative health impacts, such as obesity, weight gain, and anxiety.

4.4. Human Health Hazards

Human health hazards primarily affect populations within Butte County; however, they can have indirect impacts on economic drivers and key services. Some human health hazards can cause a mild inconvenience, while others are potentially life threatening. Examples include hantavirus pulmonary syndrome, Lyme disease, West Nile virus, and influenza, which can be debilitating or fatal for some

people. Other hazards that affect human health include extreme heat (discussed in Section 4.3), poor air quality, and smoke created from wildfires in the region, which can cause additional risks or exacerbate existing cardiovascular and respiratory illnesses. Populations at highest risk for human health hazards are those that spend a disproportionate amount of time outside, such as children, outdoor workers, and persons experiencing homelessness; those with chronic illnesses or weakened immune systems; persons in overcrowded households that spread illnesses more easily; and financially burdened households that may not be able to seek medical attention. Pandemic-scale human health hazards can also harm several economic sectors within the county, as well as emergency medical response services.

4.5. Severe Wind

Severe wind can harm all population and asset sectors in Butte County. Severe wind can damage homes and essential infrastructure that can isolate households or communities. High-velocity winds increase the risk of sparking from electrical power lines. In recent years, this has caused PG&E to conduct Public Safety Power Shutoff (PSPS) events. This can affect those who rely on electricity to power life-support devices or refrigerate medicine and food, in addition to affecting communication services throughout the county. The uncertainty of PSPS events during severe wind can trigger stress and anxiety for residents and business owners. Severe wind can also cause trees and other debris to fly through the air, which can damage homes, other buildings, and infrastructure. Older buildings and infrastructure would likely be most affected by this, and those with financial burdens may be unable to repair structures and other infrastructure. If a roadway is blocked by downed trees or debris, communities on single-access roads could become isolated from the rest of the county.

Agriculture is the economic driver most likely to be affected by severe winds, as these winds can flatten crops and severely damage the agricultural economy (Motha 2011). Other economic activities may also be hindered, as high winds can create dangerous conditions for construction and visitors for recreation and tourism may be deterred from traveling to Butte County during severe wind events.

Ecosystems can also be harmed by severe winds, as diseases such as sudden oak death can spread more easily through high-velocity winds (Kershner 2014).

4.6. Severe Storms

Climate change will not only lead to an increase in frequency and intensity of storms, meaning more water in the form of rain and flash flood, but it is also predicted we will see more prolonged periods of drought, which can lead to water shortages and decreases in groundwater levels. This dichotomy makes analyzing the impacts of precipitation difficult because not only will Butte County see more rainfall at times but also drought conditions.

Severe storms will most adversely affect populations living in 100-, 200-, and 500-year floodplains in western Butte County (FEMA 2021). All County residents living in flood zones may be adversely affected if a flood event occurs; however, flooding-related impacts will likely disproportionately affect populations with financial burdens, those who spend a disproportionate amount of time outdoors, those who live in less-resilient structures, and persons with limited mobility. Households in poverty and low-income

households may suffer higher mortality rates and their homes may sustain greater damage due to the housing stock and location. Furthermore, low-income households may not be able to afford structural upgrades or flood insurance to mitigate the effects of flooding associated with dam failure or levee collapse (Burton and Cutter **2008**). Financially burdened households or those with limited mobility may also lack transportation and other resources to respond to or evacuate during a flood event.

Race, income, ethnicity, and immigration status are also drivers of flood-related impacts. These factors may impose cultural and language barriers that may affect pre-disaster mitigation and access to post-disaster resources for recovery. Those with limited mobility and chronic illnesses may not have the capacity to adequately respond to or evacuate during a flood event. Educational status also contributes to the social vulnerability of a population. Lower education typically coincides with poverty, overcrowding, unemployment, income inequality, and marginalization (California Justice Working Group 2017), which are all factors that may increase vulnerability to climate-related hazards.

Floodwaters from heavy rainfall can interact with sources of pollution and distribute hazardous pollutants locally and regionally. The resulting water contamination may lead to human health impacts as well as the degradation of ecosystems. Floodwater intrusion also has the potential to damage critical infrastructure, such as bridges, flood-control infrastructure, roadways, and cause mold and mildew to grow in homes and residential structures, which can affect indoor air quality. This may also lead to a large economic impact to the County and its residents as well as leave people displaced.

Localized flooding already poses a threat to Butte County roadways, especially near the Sacramento and Feather Rivers. Heavy rainfall will likely exacerbate this issue, blocking access to commuters, affecting road infrastructure, home infrastructure, and could lead to school closures. Flooding events may disrupt communications, energy transmission, public services, and transportation systems by damaging infrastructure. Flood events can cause considerable property damage as well as structural damage, through erosion and an increased risk of mudslides. Increased flooding could lead to degradation of flood-control infrastructure, such as dikes and levees. During high-flow events, bridges over waterways are particularly vulnerable to damage and blockage due to high-velocity water and debris. Bridge collapses pose a risk to human life and can cause damage to property and structures. Collapsed bridges may also disrupt transportation routes.

The relatively minimal reported damages and loss of life attributed to flooding over the past 25 years in Butte County indicates that the current land use management practices have proven effective. However, increasing development and population growth will require disciplined land use management practices to ensure that the urbanization of land protected by levees does not occur and is not allowed to exacerbate the effects of flooding in other areas (Butte County 2006).

Several issues cause drainage problems that lead to flooding in Butte County's watersheds. Ditches and stormwater systems are needed to convey stormwater away from developed areas; however, in some areas, the topography prevents surface water from draining quickly to a ditch, stream, or storm drain. Typically, stormwater systems are designed to handle storm runoff for events smaller than the 100-year event, such as a 10-year event. Older stormwater systems were typically designed to convey the 10-year storm or less and may become inadequate as additional watershed development and associated runoff increases. Stormwater systems, ditches, and other waterways can be blocked by debris, resulting in ponding, which may flood adjacent areas. Many roads in the FEMA-designated floodplains have experienced flood damage in the past. The Butte County Storm Drainage criteria have not been updated to account for existing, excess flows and future conditions (Butte County 2006).

In addition to flooding, severe storms can cause landslides, which can block roadways, damage or destroy utility infrastructure, wash out hiking and biking trails, and harm the railway system. This can leave those living in communities on single-access roadways with few options for evacuating. Those with limited mobility may be unable to evacuate prior to a landslide event, further isolating them from the rest of the county. Landslides can also disrupt several key services that rely on the roadways and utility infrastructure, such as communication and energy delivery services, delivery of vital goods, and public transit access. Debris flows can also occur in wildfire burn scars, damaging structures, infrastructure, and economic sectors.

4.7. Wildfire

Increased temperatures, changes in precipitation patterns, and reduced moisture content in vegetation during dry years are expected to increase the severity of wildland fire within and beyond the boundaries of the county. As higher temperatures begin to last for longer periods of time, dead fuels of a wider diameter (e.g., twigs and sticks) will also become drier and contribute to increased wildfire intensity in the county. These conditions are predicted to lead to an increase in the total area burned by grassland fire, especially in the foothill areas in the eastern portion of the county, of which, a section is designated a moderate Fire Hazard Severity Zone by CAL FIRE. Climate change is also expected to subject forests to increased stress due to drought, disease, invasive species, and insect pests. These stressors are likely to make these forests more vulnerable to catastrophic fire, as seen in the 2018 Camp Fire and 2020 North Complex Fire (Westerling 2007). An increased rate and intensity of wildfire in the coniferous forests of the Sierra Nevada could adversely impact the populations, functions, and structures within the county.

Increased wildfire activity may occur on the WUIs around Butte County from drier conditions and development encroaching on wildland areas. The WUI is defined as the areas where community development has expanded into the foothills and mountainous areas prone to wildfire. The WUI describes those communities that are mixed in with grass, brush, and timbered covered lands (wildland). These are areas where wildland fire once burned only vegetation but now burns homes as well. The Town of Paradise and community of Magalia and Paradise Pines are examples of high-density housing meeting wildland in Butte County. Development can also occur in the wildland-urban intermix, which are rural, low-density areas where homes are intermixed in wildland areas. In Butte County, the communities of Cohasset, Forest Ranch, Concow, Yankee Hill, Berry Creek, and Forbestown are considered urban-wildland intermix areas. WUI communities are difficult to defend because they sprawl over large geographical areas with wildland fuels throughout. These attributes make emergency access, structure protection, and fire control difficult as fires are relatively difficult to stop. Human development of wildland areas has made it much more difficult to protect life and property during a wildland fire. This home construction creates a new fuel load, which shifts firefighting operations from wildland to structural. **Figure 9** and **Figure 10** show rural communities in CAL FIRE-designated Fire Hazard Severity Zones and communities within the WUI. A full description of the impacts from the 2018 Camp Fire and 2020 North Complex Fire is provided in the Hazards and Safety chapter of the 2021 *Butte County Setting and Trends Report*.

Figure 9. Rural Communities Living in Wildfire Severity Zones

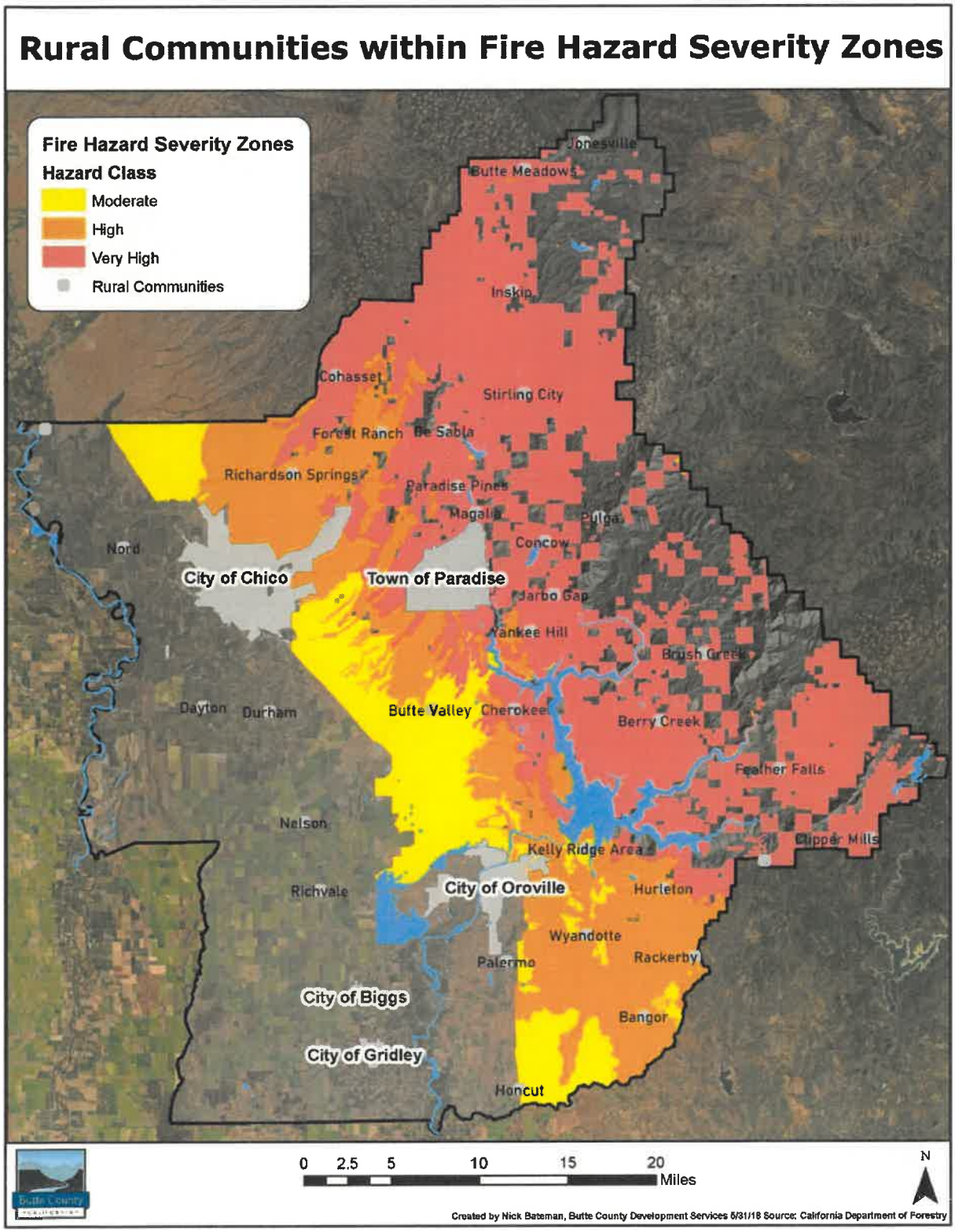
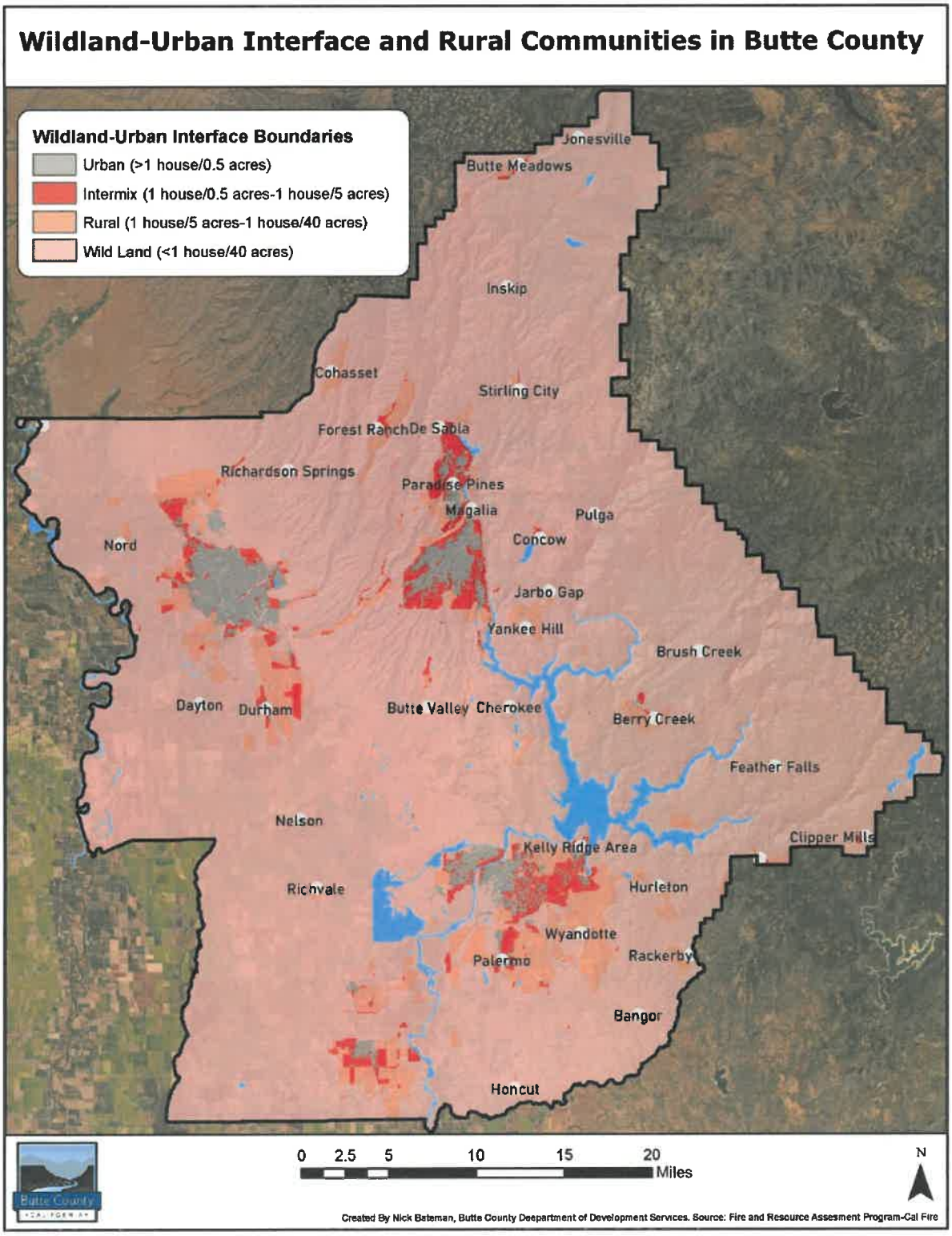


Figure 10. Wildland-Urban Interface Areas in Butte County



In addition to an increased threat to human safety, the increased frequency of wildfire may result in the release of harmful air pollutants into the atmosphere, which can affect the respiratory health of residents across a broad geographical scope. Particulate matter (including $PM_{2.5}$, which is soot and smoke), carbon monoxide, nitrogen oxides, and other pollutants are emitted during the burning of vegetation and can cause acute and chronic cardiovascular and respiratory illness, especially in vulnerable populations, such as the elderly, children, agricultural and outdoor workers, and those suffering from pre-existing cardiovascular or respiratory conditions.

Butte County is filled with many creeks, streams, lakes, reservoirs, etc. With more frequent and intense wildfires, there is a high probability that sedimentation within fish-bearing waters will increase. Nutrients and temperatures within the water will change and woody debris will become more prominent in the environment. Ultimately, this will negatively affect the overall health of the water and the fisheries themselves. This could affect the recreation and tourism industries that rely on healthy rivers and water sources. Loss of species such as deer and salmon from wildfires can impact Butte County's fishing and hunting industry, which can, in turn, have negative impacts on conservation efforts and funding.

The risk of wildfire may threaten deer migration and habitats. Herds may be temporarily forced out of their migration patterns and most likely move north to adjust for loss in habitat and food. This could cause deer to move into developed or populated areas. Traits that commonly make a species vulnerable to climate change include limited dispersal abilities, slow reproductive rates, specialized habitat and dietary requirements, restricted distribution and rarity, and narrow physiological tolerances, while potentially vulnerable habitats include montane habitats, savannahs, and grasslands. Migratory bird patterns along the Pacific Flyway can also be disrupted by smoke and ash that fill the sky during wildfires.

Wildfire can cause direct and indirect damage to electrical infrastructure. Direct exposure to fire can sever transmission lines, and heat and smoke can affect transmission capacity. Furthermore, because of historical forest management trends over the past century, increased temperatures, and more frequent drought, California wildfires are characteristically hotter and more intense as compared to naturally occurring fire regimes.

Forest health in Butte County and the economic vitality that these forests provide are likely to decrease because of wildfire. Forestry is over a $16 million-a-year economic sector in Butte County (Butte County Sustainable Forestry Brochure). Without the combination of ample rainfall, long growing seasons, and deep soils, forests in Butte County will be unable to maintain the productivity for our current and future needs. High-intensity fires may also affect the ability of Butte County's forests and other natural lands to sequester carbon, as tree growth potentially becomes less productive and trees are burnt more regularly. Carbon sequestration is an emerging source of economic activity for forested areas in California and increases in wildfire may threaten this nascent industry.

5. Adaptive Capacity

The California APG defines adaptive capacity as the ability of a population, asset, or community to prepare for, respond to, and recover from climate change hazards based on current resources, tools, funding, policies, and programs. Review of the County's existing local policies, plans, programs, resources, or institutions provides a good snapshot of the County's ability to adapt to climate change and reduce vulnerability. Based on this information, adaptive capacity for a specific population or asset rated high, medium, or low, as discussed in the Section 1.1.

A description of adaptive capacity of Butte County's populations and assets is provided in the following sections, based on identified hazard where possible. It is important to note that this review of local climate adaptation-related work offers an initial, high-level perspective on the issue and is not all-inclusive nor site-specific analysis. As more specific facilities, structures, and areas are identified in the future, additional review of adaptive capacity would be valuable.

On a planning level, the County addresses current and future impacts related to existing natural hazards, as evidenced by the County's LHMP, most recently updated in December 2019. The 2019 LHMP identifies current hazard risks and mitigation strategies for climate change, flooding, levee failure, drought/water shortage, severe weather, and wildfires (Butte County 2019).

Furthermore, the County's Climate Action Plan (CAP), adopted in 2014, contains policies aimed at reducing local contributions to global climate change and encourages sustainable building practices, efficient use of resources (i.e., water, land, and energy), and ecological stewardship. The County's CAP also addresses climate adaptation and resiliency. Chapter 5 of the CAP lays out several actions that should be taken to adapt to the changing climate. Example actions include establishing cooling centers during heat waves, promoting energy efficiency and renewable energy to reduce peak-load demand, and developing low-impact development standards to reduce stormwater runoff and increase groundwater demand. The County is currently preparing updates to the CAP and General Plan. These updates will include updates to adaptation goals, policies, and strategies that will be informed by this vulnerability assessment.

The Butte County Office of Emergency Management (OEM) website contains a variety of resources for disaster preparedness. Evacuation plans and routes, standards for defensible spaces, disaster supplies kit checklists, heatwave precautions, drought assistance, and flood after fire information are some of the resources provided by Butte County OEM.

Disaster recovery efforts require extreme measures and commitment to the development of healthy, organized responses to chaotic situations. Every region has a unique need. If a jurisdiction is not in sync with current regulation it may not only miss opportunities for state and federal funding but leave that jurisdiction more vulnerable to the threats of climate change-induced natural disasters. The County is conducting this assessment to find where its vulnerabilities lie and to be able to address them by incorporating adaptation strategies and emergency plans into the General Plan.

5.1. Agriculture and Forestry Pests and Diseases

Butte County's agriculture and timber production industries, persons who rely on these industries, and ecosystems surrounding these economic sectors will likely be harmed by an increase in agriculture and forestry pests and diseases. Pesticides can help crops and pastures resists pests and diseases; however, if pests and diseases quickly evolve, this may not be feasible for all crops. Agricultural owners and operators can work with the University of California Cooperative Extension to conduct more research on solutions to pests and diseases, or crop types that can more easily resist pest and diseases with less water and higher temperatures.

The timber production industry relies heavily on a healthy conifer forest ecosystem, which under normal conditions can resist pests and diseases. However, due to high temperatures and increased drought, the adaptive capacity of this ecosystem plummets and the forests have virtually no ability to resist pests and diseases, such as bark beetles. The timber industry may see additional challenges, as new market opportunities may shrink if forest resources are not available. Other tree ecosystems that can typically recover from pests and diseases, oak woodlands, and chaparral, may not be able to manage diseases such as sudden oak death (Kershner 2014). Other ecosystems may shift to other ecosystems that may be better suited for future conditions and disturbance regimes, such as grasslands (Kershner 2014). If forested ecosystems cannot recover, state and federal land recreation may decrease, as people may be deterred from traveling to the county.

The populations that rely on the agriculture and timber industries, such as immigrant populations and outdoor workers, may be able to transfer industries through educational opportunities. The Oroville Adult Education Program offers several programs for those living in or near the Cities of Chico and Oroville. However, due to potential fears of accessing government benefits and educational institutions, immigrant communities, low-resourced ethnic minorities, and outdoor workers may not seek these educational opportunities (Roos 2018).

The buildings and infrastructure damaged or blocked by diseases or dead trees can be repaired or retrofitted to prevent damage. Trees on single-access roadways can also be removed. However, these repairs, removals, and retrofits may take a considerable amount of time, and the facilities may not be useable until cleared and repaired. Mitigation action 46 of the Butte County LHMP may assist with this, as it is focused on hazard tree removal around infrastructure, specifically power lines; however, this project will require extensive funding to complete (Butte County 2019). Additional mitigation actions that may assist with agricultural pests and diseases include a marine and aquatic invasive species survey and surveillance project, foreign animal diseases rapid response quarantine program, and a Broom eradication project (Butte County 2019).

5.2. Drought

Butte County's Department of Water and Resource Conservation implements programs to protect Butte County's water resources. The priorities of the department come from the 2005 *Butte County Integrated Water Resource Plan*, some of which include: Administering Water Resource Management Programs, Groundwater Management Plan, Drought Management Plan, Coordination Regional Watershed Management Plan, and more.

The department also leads Butte County's involvement to implement the SGMA. SGMA went into effect in January 2016 and is California's new comprehensive statewide groundwater management law designed to provide for local management of groundwater resources. Butte County is a member agency in the Vina Groundwater Sustainability Agency and the Wyandotte Creek GSA. Butte County is a GSA fora

portion of the Butte subbasin. The GSAs are currently working on developing groundwater sustainability plans (GSP) for each subbasin. The GSPs must be adopted by 2022. The GSPs will ensure that groundwater extraction operates within the sustainable yield, accounting for future drought conditions, wet years, climate change, and future growth. The GSPs will provide a buffer against drought and contribute to reliable water supplies. However, SGMA recognized that drought conditions may result in impacts that cannot be avoided provided that the basin returns to its sustainable yield after the drought. California depends on groundwater for a major portion of its annual water supply, and sustainable groundwater management is essential to a reliable and resilient water system.

Butte County and other GSAs have been working with stakeholders to evaluate the feasibility of artificially recharging the groundwater in the Vina subbasin to ensure groundwater sustainability by 2042. One option would be to use the City of Chico's treated wastewater that now is discharged into the Sacramento River as a potential direct or indirect source of groundwater recharge. Other options under consideration are to promote recharging of winter flood water from streams and creeks, and water conservation.

General Plan 2030 contains policies and actions designed to promote groundwater recharge and minimize impervious land cover. Policy W-P3.3 protects groundwater recharge and groundwater quality in new development projects. Action W-A3.1 directs the County to seek funding for and conduct comprehensive, countywide mapping of water resources and groundwater recharge areas, and Action W-A3.2 directs the County to develop standards to preserve groundwater recharge and protect groundwater quality (Butte County 2010).

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in the planning area are those related to water-intensive activities, such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Those who are financially burdened or may rely on water-dependent economic activities may not be able to prepare for or recover from water price hikes or disruptions to economic drivers. Voluntary conservation measures are a normal and ongoing part of system operations and are actively implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding and erosion (Butte County 2019).

Butte County has several programs in place to conserve domestic water supply. Butte County citizens can engage in rebate programs provided by Cal-Water and other water purveyors and PG&E to improve the water efficiency of home appliances and replace water-demanding landscapes. Further, PACE financing programs can also help homeowners finance upgrades to their homes and landscapes to improve water efficiency along with energy efficiency. Implementation of these efforts can help to lower Butte County's overall domestic water usage, thereby helping ensure that Butte County residents continue to have a reliable source of potable water in the face of future dry years.

The primary water source within the county is surface water (55 percent), followed by groundwater (31 percent), and surface water reuse (14 percent). The majority of the surface water supply used by Butte County residents and businesses originates in the Feather River watershed, accumulates in Lake Oroville, and is primarily used for agriculture locally (Butte County Department of Water and Resource Conservation 2005). During drought years, county residents may face water shortages from dry wells. Residents served by water purveyors may face strict restrictions on water supply and permitted uses.

Agriculture operations relying on surface water may experience water shortages that can impact crop production during drought years.

Butte County also has a Drought Preparedness Plan, which established a Drought Task Force, drought monitoring, and drought response and mitigation to ensure that water supply limitation are addressed during drought conditions. Adaptive capacity will also be improved once SGMA begins to implement groundwater recharge throughout the county. Capturing stormwater and early snowmelt and getting that water back into the water table will ensure Butte County residents will have adequate water during droughts and help to mitigate any subsidence that could occur. Butte County may want to look into the development of drought response rules in advance of a drought.

5.3. Extreme Heat

The Butte County Public Health Department provides Butte County community members with information on how to stay safe during periods of extreme heat through press releases and their webpage. However, linguistically isolated persons and those without access to internet may not be aware or able to look for these notifications.

Butte County participates in several Property Assessed Clean Energy (PACE) financing programs. PACE programs help homeowners finance home energy and water-efficiency upgrades and save money on energy and water bills through special financing options. By enabling homeowners to retrofit their homes and install upgrades, this program increases insulation and air conditioning in homes, while reducing energy costs associated with extreme heat events and heat waves. It should be noted that PACE programs are only available to homeowners and cannot be used by renters or occupants of multifamily housing.

Urban greening and urban forestry in the county are supported by numerous organizations and agencies. Urban forestry involves the planting of trees to mitigate these impacts. Trees provide shade for homes, roadways, parking lots, and provide relief during periods of extreme heat. Further, ground-level ozone produced from excessive heat can be filtered by certain tree species, which improves local air quality (California Natural Resources Agency 2018). Tree canopy cover also reduces energy demand.

As discussed previously in Section 4.3, the populations most likely to be endangered by extreme heat events are those who spend a disproportionate amount of time outdoors, such as outdoor workers, children, and persons experiencing homelessness; seniors; persons with chronic illnesses; indigenous and tribal nations; linguistically isolated persons; and households in poverty and low-income households. Several cooling centers are available throughout the county for these individuals to seek relief from the heat. Persons in low-resourced ethnic minority communities or immigrant communities may not seek cooling centers or know about them because of immigration status or language barriers. For those with limited mobility or chronic illnesses, Butte Regional Transit does offer Dial-A-Ride and paratransit services, which seniors and other populations can use to seek relief from the heat.

Transportation infrastructure (e.g., roads, bridges, sidewalks) can also be damaged by extreme heat events. Damage from extreme heat conditions would place additional strain on already limited financial resources for maintenance and repair of county and state roads. Existing efforts to maintain and enhance the urban forest canopy may provide some increase in shading on local roads throughout the county, mitigating portions of transportation-related surfaces (e.g., asphalt) from excessive sun exposure. However, planting of shade trees alone may not be enough to fully mitigate potential damage from increased temperatures and extreme heat. Some roadways and rail lines may be managed by multiple agencies, which requires coordination that can extend the timeline for repairs and retrofits.

Other infrastructure that can be damaged by extreme heat includes electrical transmission lines. These transmission lines can be turned off during extreme heat events to reduce damage, and renewable energy, such as solar panels and wind turbines, can be installed to reduce electricity demands during the warmest part of the day. However, retrofits are expensive and may not be feasible for all structures. Turning off electricity lines can also be detrimental to critical facilities, residents who rely on electricity for life-support devices and refrigeration of medicines, and businesses in Butte County.

Butte County's agriculture sector will likely be highly affected by extreme heat. Agriculture owners and operators can work with the University of California Cooperative Extension and the Agriculture Commissioner's Office to conduct more research on crop types that can more easily resist damage from extreme heat days and warmer nights. By conducting this research, Butte County will increase its adaptive capacity for the increase of temperature on agriculture functions. Some industries, such as outdoor recreation and timber harvesting, may be less able to prepare for and recover from extreme heat, as visitors may be less likely to travel to the area during extreme heat days to participate in outdoor recreation and forests that support timber harvesting may be more susceptible to wildfires due to higher temperatures.

5.4. Human Health Hazards

As stated previously, households with financial burdens, overcrowded households, and populations that spend a disproportionate amount of time outdoors are most susceptible to human health hazards, in addition to the economic drivers they support and services they require. These populations may not be able to isolate if they have a contagious illness and may not have health insurance or financial means to seek medical attention. Persons working outdoors, persons experiencing homelessness, and others can wear protective clothing or bug spray to reduce exposure to vector-borne illnesses, but this may not be effective in all cases. Households with financial burdens may also not be able to take time off work to recover or seek medical attention, therefore worsening health outcomes.

Butte County does have a Mosquito and Vector Control District that can help mitigate the exposure to vector-borne illnesses, by removing ponding water and pests from specific areas. For those with limited mobility who need to seek medical attention, Butte Regional Transit offers paratransit and Dial-A-Ride services that can transport individuals to medical appointments. Even with these adaptive capacity measures, emergency medical response services may be overwhelmed by a human health hazard event. Strengthening medical supply chains and preparing emergency contingency plans for if and when human health hazards increase may take time and require extensive coordination.

5.5. Severe Wind

Butte County's adaptive capacity to severe wind events is similar to extreme heat and severe storms. For those whose homes may be impacted by severe wind, the County has low-cost PACE programs that homeowners can participate in to retrofit their homes to be more protected from severe wind events. Some populations may not feel safe participating in these programs because of immigration status or racial profiling towards low-resourced ethnic minorities (Roos 2018). For those who do not have permanent shelter during severe wind events, several homeless shelters are available throughout the county that can provide safety for these individuals or families.

Some populations, such as communities on single-access roads, persons with disabilities, and seniors, may become isolated during and after severe wind events. Communities on single-access roads can clear fallen trees and debris after a wind event, but this may take hours or days depending on the severity and remoteness of the community. Persons with disabilities and seniors may not be able to travel to find

shelter during extreme wind events. Butte Regional Transit's paratransit and Dial-A-Line services can help these individuals seek treatment following a severe wind event.

Severe wind may also cause PG&E to conduct PSPS events, which can harm both populations and economic drivers. The Butte County Disability Action Center does provide disaster preparedness and training programs and portable battery programs that may be able to assist persons with chronic illnesses and/or disabilities in the event of power loss. For energy delivery, electrical transmission lines can be undergrounded to reduce PSPS events; however, this can be expensive and may be difficult to do for larger transmission lines. Communication services may also be limited if the power is shut off, and there are few redundancies in communication infrastructure in the county, especially in remote mountain areas. Other infrastructure can be retrofitted to resist damage from severe wind or have trees trimmed to reduce damage from other debris carried by severe winds.

Some assets, such as crops flattened by high winds and oak woodlands decimated by sudden oak death, may be unable to recover from an increase in severe winds.

5.6. Severe Storms

Butte County Office of Emergency Management coordinates the overall countywide response to large-scale incidents and severe storm-related disasters through their Emergency Operations Center, which provides information and resources for agencies to coordinate disaster response efforts.

The County's website also provides information on flood evacuation plans for flood zones in southern Butte County that contains strategies to ensure evacuations are handled smoothly. For those with limited mobility or lack of access to transportation, Butte County has a Special Needs Awareness Program, established after the 2008 BTU lightning complex fire, which may be able to assist these individuals or families in evacuations during severe storm events.

General Plan 2030 includes policies that protect people and property from flooding that may be caused by severe storms. Health and Safety Element Policies HS-P2.4 and HS-P2.5 protect people and property from flood risks within the 100-year flood hazard zone and ensure that development within this area will not impede or redirect flood flows, and Policies HS-P3.1 through HS-P3.4 work to prevent and reduce flooding. In addition, Policy HS-P2.1 supports the efforts of regional, state, and federal agencies to improve flood management facilities along the Sacramento River, and Policy HS-P2.2 supports the efforts of private landowners and public agencies to maintain existing flood-management facilities (Butte County 2010).

There are a number of levees in Butte County that provide various levels of protection for the citizens and property in the county from flooding hazards. However, the levee system is maintained by independent local levee and reclamation districts and overseen by the U.S. Army Corps of Engineers, California Department of Water Resources, and the Bureau of Reclamation, and would require extensive coordination to raise or extend levees. Many of these are aging and may need repair and maintenance to adequately control flood flows. There are also dams that serve as water storage features in the county and surrounding areas (Butte County 2010). However, in February 2017, an atmospheric river dropped heavy rainfall on the Feather River watershed, filling Oroville Dam more quickly than water could be released. Emergency evacuations occurred throughout Oroville and the communities south of the dam as the emergency spillway crumbled under the weight of the water being released from the dam.

Butte County contains areas currently designated as 100-year flood zones, and the General Plan 2030 land use map allows occupied development within these flood hazard areas. However, General Plan 2030 includes policies designed to prevent flooding of occupied developments. Specifically, Health and Safety Element Policy HS-P2.4 prohibits development on lands within the 100-year flood zone, as identified on the most current available maps from FEMA, unless the applicant meets criteria that FEMA has set out demonstrating development will not cause a danger to life or property (Butte County 2010).

The Urban Level of Flood Protection Criteria was developed in response to the requirements from the Central Valley Flood Protection Act of 2008, enacted by SB 5. Urban level of flood protection means the level of protection necessary to withstand a 200-year flood in any given year. The criteria were developed by the Department of Water Resources as a systematic approach to assist affected cities and counties within the Sacramento-San Joaquin Valley in making findings related to an urban level of flood protection before approving certain land-use decisions. In response to the passage of SB 5, Butte County adopted the Flood Hazard Prevention Ordinance. This ordinance requires the Department of Development Services to review all applications for new construction or subdivisions in flood hazard areas and requires that the lowest floor of any new construction or substantial improvement in FEMA-designated Flood Zones be elevated by 1 foot or more above the regulatory flood elevation. In addition, applicants must show that development within the floodplain will not raise the existing flood level in a manner that adversely affects any neighboring property.

Residents living in areas at high risk for inundation from levee or dam failure have limited adaptive capacity to deal with flooding. Structural improvements to modify or elevate homes and other structures, as well as the purchase of flood insurance, can reduce the financial burden of recovering from flooding; however, these options are not universally acquirable. The County does participate in PACE financing programs, which can help populations with financial burdens increase the resiliency of their homes to severe storms and flooding.

Severe storms can also cause landslides in mountain areas of the county. Slope stabilization and increasing the capacity of drainage systems can help protect transportation, communication, and electrical infrastructure from damage by landslides. However, this can be difficult in remote areas of the county. Services such as energy delivery, vital good delivery, communication services, public transit access, and other utility services may be disrupted until infrastructure repairs can occur. Landslides may also affect timber harvesting, but they are required to have Timber Harvesting Plans to avoid harvesting trees in landslide-prone areas.

5.7. Wildfire

Butte County Office of Emergency Management coordinates the overall countywide response to large-scale incidents and disasters through their Emergency Operations Center, which provides information and resources for agencies to coordinate disaster response efforts.

There are wildfire evacuation plans for each town and city in the county on the Office of Emergency Management's website that contain strategies to ensure evacuations are handled smoothly and residents know where evacuation meeting points are located. However, those without internet access or linguistically isolated people may have difficulty receiving and acting on evacuation notices and emergency alerts. For those with limited mobility or lack of access to transportation, Butte County has a Special Needs Awareness Program, established after the 2008 BTU Lightning Complex Fire, which may be able to assist these individuals or families in evacuations during wildfires.

Butte County has adopted the 2019 California Fire Code, which includes provisions to help prevent the accumulation of combustible vegetation or rubbish that can be found to create fire hazards and potentially impact the health, safety, and general welfare of the public. Provisions include ensuring that defensible spaces, which are adjacent to each side of a building or structure, are cleared of all brush, flammable vegetation, or combustible growth (Butte County 2010). Damage to infrastructure development in Butte County must comply with the 2019 California Fire Code, which includes standards to reduce the safety risks associated with fire. This includes the incorporation of 100 feet of defensible space, which limits the proximity of combustible vegetation to new structures. However, those with limited mobility, chronic illnesses, or lack of financial resources may be unable maintain defensible space around their homes, especially in heavily forested areas.

The 2019 LHMP provides several wildfire hazard mitigation strategies to increase adaptive capacity of county residents and infrastructure to wildfire. These include wildfire fuels reduction and maintenance on the Upper Ridge, Concow/Yankee Hill, Berry Creek, Butte Meadows, Cohasset, Forest Ranch, Feather Falls, and Forbestown. Other hazard-reduction strategies include eave vent replacement and education projects, fire-wise communities and education programs, chipper programs, residents assistance defensible space programs, hazardous tree removal, fuel load management through the Department of Water Resources, and the creation of refuge areas. Policy HS-P11.4 in the Butte County General Plan requires that new development meet current State regulations for adequate emergency water flow, emergency vehicle access, signage, evacuation routes, fuel management, defensible space, fire-safe building construction, and wildfire preparedness, which would help to reduce the wildfire impacts on new development. Furthermore, Action HS-A11.1 directs the County to complete roadside fuel reduction projects to reduce wildfire risk, increase visibility, and maintain safe evacuation routes, which would help to reduce wildfire hazards (Butte County 2010).

In addition, Health and Safety Goal HS-12 and its associated policies and actions seek to protect people and property from wildland and urban fires. Specifically, Policy HS-P12.1 maintains regulations regarding vegetation clearance around structures, and Policy HS-P12.3 requires the use of fire-resistant landscaping and fuel breaks in residential areas. In addition, Policy HSP12.2 requires fuel breaks along the edge of developing areas in High and Very High Fire Hazard Severity Zones, and Policy HS-P12.4 requires all developments in WUI areas in High or Very High Fire Hazard Severity Zones to provide, at a minimum, small-scale water systems for fire protection (Butte County 2010).

The County's Wildfire Mitigation Action Plan aims to reduce damage and prevent injury from wildfire through wildfire mitigations, including a fuel-reduction program, a weed-abatement program, construction codes requiring the use of fire-resistant building materials in new construction, and improvements to the water supply and hydrant system. Additionally, the Butte County Community Wildfire Protection Plan (CWPP) of 2015 will help mitigate impacts associated with wildfire in developed areas through evaluation and assessment of proposed structures, implementation of mitigation measures associated with construction and education programs for private landowners and public agencies. Additional projects completed, in progress, or proposed in the CWPP include fuel reduction, evacuation signage, education programs, defensible space assistance, prescribed burns, defensible space inspections, and general fire planning.

The Butte County Fire Safe Council provides the portions of Butte County within its jurisdiction with a plan to combat the effects of wildland fire. The Butte County Fire Safe Council serves to protect both people and structures from fire-related damage and provides useful strategies to create an environment that is not conducive to ignition and spreading. Specific programs include a chipper program, residents

assistance program, fire-safe home visits, wildfire education, and forest health and fuels reduction projects.

Butte County Air Quality Management District (BCAQMD) takes actions to reduce exposure to harmful pollutants related to wildfire (e.g., particulate matter) by implementing no-burn days during periods of poor air quality. BCAQMD also provides resources to educate the public on the status of air quality on a daily basis, provides alerts on poor air quality days, and provides educational material on the health effects of air pollution. Due to the heavily forested areas of the county and several communities living on single-access roads, the adaptive capacity of several populations and assets is still relatively low for wildfires. As seen in the 2018 Camp Fire and 2020 North Complex Fire, when several of these programs were already in place, people had difficulties evacuating, lost homes and businesses, and suffered economic loss due to these fires.

6. Conclusion

The impacts and adaptive capacity described create several key vulnerabilities within Butte County. The following sections describe the key findings of the Climate Change Vulnerability Assessment and provide recommended actions to increase adaptive capacity and reduce vulnerabilities to populations and assets throughout the county.

6.1. Key Findings

Out of the 71 populations and assets Butte County analyzed, 50 are highly vulnerable to at least one hazard condition. Wildfire is responsible for the highest vulnerability scores, followed by severe storms, severe wind, and extreme heat. The following list provides the key findings and critical vulnerabilities identified in the Climate Change Vulnerability Assessment:

- Populations and assets in the eastern portion of the county are most vulnerable to wildfires and populations in the western portion of the county are most vulnerable to severe storms.
- Outdoor workers and low-resourced ethnic minorities are the most vulnerable populations, and highly vulnerable to all climate change hazards.
- Electrical transmission infrastructure and energy delivery services are highly vulnerable to damage or PSPS events from extreme heat, severe wind, severe storms, and wildfire. Energy delivery services are a key supporting factor for everyday activities, economic drivers, and key services.
- Water and wastewater serving both the county and other areas of California can be disrupted from drought, severe wind, severe storms, and wildfire.
- Major roads, highways, and single-access roads can become impassable due to severe wind, severe storms, and wildfire, isolating populations in remote areas of the county and disrupting services to those areas.
- Recreation infrastructure and recreation on regional, state, and federal land can be disrupted by all climate change hazards.
- Agriculture is the most vulnerable economic driver in Butte County.
- Conifer forests and open water ecosystems are the most vulnerable ecosystems.

6.2. Recommendations

The resilience of these populations and assets can increase through the implementation of adaptation measures. Adaptation is the adjustment to natural and human systems, in response to actual or expected changes in climate conditions to reduce the harmful effects of actual or expected changes (Cal OES 2020).

Potential adaptation measures that could reduce vulnerability in Butte County, and some of which are planned items in the 2019 LHMP, include:

- Promoting the creation of community support networks to check on persons without access to lifelines, seniors living alone, and persons with disabilities during dangerous conditions.
- Collaborating with PG&E and other utility providers to underground electricity transmission lines.
- Increasing funding through grants or private organizations for fuel reduction and vegetation management projects for both neighborhoods and infrastructure.
- Continuing to provide residential assistance programs to help homeowners create and maintain defensible space and fuels management on their properties.
- Conducting structural retrofits for at-risk bridges and ensuring that these retrofits include protections against flooding and landslides.
- Expanding the chipper program throughout the county to help private homeowners dispose of trees near structures, supplementing existing cost-sharing programs.
- Working with farming organizations and the University of California Cooperative Extension to promote the availability of crop varieties that are more resilient to climate change while meeting market demand for yield and quality, as options become available.
- Continuing to work with state and federal land management agencies to support fuel and pest management activities.
- In coordination with local, state, and federal plant and wildlife management agencies and organizations, monitoring shifts in habitats, and preserving habitats where habitat migration may be needed.
- Working with local, state, and federal plant and wildlife management agencies and organizations to protect vulnerable habitat and improve ecosystem connectivity.
- Coordinating with utility providers to conduct regular evaluations and retrofits of energy transmission and delivery infrastructure.
- Incentivizing water conservation measures by establishing indoor plumbing retrofit and turf replacement programs.
- Support the implementation of Groundwater Sustainability Plans that take into consideration of the increased severity of droughts and climate change.
- Identifying equitably located resilience hubs in each community in the County to provide emergency assistance and information, cooling spaces on extreme heat days, and refuge for those who are unable to evacuate during hazardous conditions.

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Appendix A: Countywide Climate Change Projections

Climate Change Stressor	Historical Average 1961-1990	2050 – High Emission (RCP 8.5) 2040-2060	2090 – High Emission (RCP 8.5) 2070-2099
Maximum Average Annual Temperature	71.0°F	76.4° F	80.1°F
Minimum Average Annual Temperature	44.6°F	49.5°F	53.3°F
Annual Average Extreme Heat Days Threshold: 100.1°F	5 days	29 days	59 days
Annual Average Warm Nights Threshold: 64.8°F	4 nights	33 nights	76 nights
Annual Average Precipitation	52.3 inches	47.2 inches	50.8 inches
Annual Average Snowpack Level	1.9 inches	0.5 inches	.01 inches
Annual Average Wildfire Size	5,306 average annual acres per year	8,961 average annual acres per year	13,939 average annual acres per year
Source: California Energy Commission. 2018. "Climate Tools". https://cal-adapt.org/tools/.			

Appendix B: Climate Change Vulnerability Assessment Results Matrix

The Climate Change Vulnerability Assessment Results Matrix shows the detailed results of the vulnerability assessment, which are summarized in in Chapter 4 and Chapter 5 above. The vulnerability assessment evaluates how the populations and assets (people, buildings and structures, resources, etc.) in the unincorporated areas of Butte County are vulnerable to different types of emergencies and hazardous conditions that may be created or made worse because of climate change. The assessment follows the recommended process in the updated *California Adaptation Planning Guide*, as described in Section 1.1, above, which is the State of California's guidance for how local communities should conduct climate adaptation planning efforts, including vulnerability assessments. The vulnerability assessment relies on local, regional, and statewide datasets and studies to support the assessment.

The hazards, populations, and assets were first put into an applicability matrix to determine which hazards would affect which populations and assets. For example, bridge and tunnel infrastructure would likely be affected by wildfire but is not likely to be affected by human health hazards. For each relevant hazard and population or asset pairing, the team assessed the **Impact** from the applicable hazard(s), and the County's **adaptive capacity** to the hazard. Impact refers to how substantial the effects of the hazard are on the population or asset, from a score of low (low impact) to high (severe impact). Adaptive capacity refers to the population's or asset's ability to resist and recover from damage given current programs and resources, from a score of low (low adaptive capacity) to high (high adaptive capacity).

The combination of the impact (IM) and adaptive capacity (AC) score determines the population's or asset's vulnerability to that hazard. A low impact and high adaptive capacity score lead to low vulnerability, while a high impact and low adaptive capacity score leads to a high vulnerability score. The vulnerability scores are:

- Low: Minimal to low vulnerability
- Medium: Moderate vulnerability
- High: High to severe vulnerability

Populations and Assets	Agriculture and Forestry Pests and Diseases	Drought	Extreme Heat	Human Health Hazards	Severe Wind	Severe Storms	Wildfire
Populations							
Children	-	-	High	Medium	Medium	High	High
Cost-burdened households	-	Low	Medium	Medium	Low	Medium	Medium
Households in poverty	-	High	High	High	High	High	High
Immigrant communities	High	Medium	High	High	High	High	High
Linguistically isolated persons	-	-	Medium	Medium	Medium	Medium	High
Low-income households	-	Low	Medium	Medium	Medium	Medium	High
Low-resourced ethnic minorities	High	High	High	High	High	High	High
Overcrowded households	-	-	Medium	High	Low	Medium	Medium
Outdoor workers	High	High	High	High	High	High	High
Persons experiencing homelessness	-	-	High	High	High	High	High
Indigenous peoples and tribal nations	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Persons living in mobile homes	-	-	High	Low	High	High	High
Communities on single access roads	Medium	-	Low	Low	High	High	High
Persons with disabilities and/or chronic illnesses	-	-	High	High	High	Medium	High
Persons without access to lifelines	-	-	Medium	Medium	Medium	Medium	Medium
Renters	-	-	Low	Low	Low	Medium	Medium
Seniors	-	-	High	High	Medium	High	High
Seniors living alone	-	-	High	High	High	High	High
Students	-	-	Low	Low	Low	Low	Low

Populations and Assets	Agriculture and Forestry Pests and Diseases	Drought	Extreme Heat	Human Health Hazards	Severe Wind	Severe Storms	Wildfire
Buildings and Infrastructure							
Airports	-	-	Low	-	Low	Low	Low
Bridges and tunnels	-	-	-	-	High	High	Medium
Communication facilities	-	-	Medium	-	High	Medium	Medium
Community centers and libraries	-	-	Medium	-	Medium	Medium	Medium
Dams	-	-	-	-	-	High	Low
Electrical transmission infrastructure (substations and power lines)	Low	-	High	-	High	High	High
Emergency operation buildings	-	-	Low	-	Low	Low	-
Evacuation and cooling centers	-	-	Medium	-	Medium	Medium	High
Flood control infrastructure (levees, dikes, etc.)	-	-	-	-	-	High	-
Government administrative facilities	-	-	Medium	-	Low	Low	-
Hazardous materials sites	-	-	-	-	-	Medium	Medium
Hiking and biking trails	Low	Low	-	-	Low	High	High
Homes and residential structures	High	-	Medium	-	High	High	High
Hospitals and medical facilities	-	-	Low	-	Low	Low	Low
Major roads and highways	Medium	-	Medium	-	-	High	High
Natural gas pipelines	-	-	-	-	-	Medium	Medium
Parks and open space	Low	Low	Medium	-	Low	Low	Medium
Power plants	-	-	Low	-	Medium	High	Medium
Public safety buildings	-	-	Low	-	Low	Medium	High

Populations and Assets	Agriculture and Forestry Pests and Diseases	Drought	Extreme Heat	Human Health Hazards	Severe Wind	Severe Storms	Wildfire
Railways	Low	-	High	-	-	High	High
Schools	-	-	Medium	-	Medium	Medium	High
Single access, rural, and minor roads	High	-	Medium	-	High	High	High
Solid waste facilities and landfills	-	-	-	-	Low	Low	Medium
Transit facilities	-	-	-	-	High	Medium	Low
Water and wastewater infrastructure	-	Low	-	-	-	Medium	High
Waterway infrastructure	-	Medium	-	-	-	Low	Low
Economic Drivers							
Agriculture	High	High	High	High	High	High	High
Construction	-	-	Medium	Medium	Medium	Medium	Medium
Education	-	-	-	Medium	Low	Low	Low
Healthcare	-	-	Low	Medium	Low	Low	Medium
Livestock	Medium	High	High	Low	Medium	Medium	High
Manufacturing	-	-	-	Low	Low	Low	Low
Regional recreation & tourism	Low	High	Medium	Medium	Medium	Medium	High
Rice-growing areas	Medium	High	Medium	High	Medium	High	Low
State and federal land recreation and tourism	High	High	High	Medium	Medium	Medium	High
Timber production	High	High	High	Medium	Low	High	Medium

Populations and Assets	Agriculture and Forestry Pests and Diseases	Drought	Extreme Heat	Human Health Hazards	Severe Wind	Severe Storms	Wildfire
Ecosystems and Natural Resources							
Conifer forest	High	High	High	-	Low	Low	High
Oak woodland	High	Low	Low	-	High	Low	Low
Riparian woodland	Medium	Medium	Medium	-	Medium	Medium	Medium
Chaparral	High	Medium	Low	-	Medium	Low	High
Annual grassland	Low	Medium	Low	-	Low	Low	Medium
Open water: reservoirs, ponds, drainages	Low	High	High	-	Low	High	High
Wetlands	Low	High	High	-	Low	Medium	Medium
Pacific Flyway	Low	High	High	-	Medium	Low	High
Key Services							
Communication services	Medium	-	Medium	-	High	High	Medium
Emergency medical response	Low	-	Medium	High	Low	Medium	Medium
Energy delivery	High	Low	High	-	High	High	High
Vital goods delivery	Medium	-	Low	Low	Low	High	Medium
Government administration	-	-	Low	Low	Low	Low	Low
Public safety response	Low	-	Low	Medium	Medium	Medium	High
Public transit access	Medium	-	High	Low	High	High	Medium
Water and wastewater	-	High	Medium	-	Low	High	High

Appendix C: Glossary

The Climate Change Vulnerability Assessment uses some terms specific to adaptation planning. The following identifies and defines key terms that will be used throughout the vulnerability assessment. For a more comprehensive list of terms commonly used in adaptation planning, consult the California Adaptation Planning Guide (https://www.caloes.ca.gov/climate).

List of Terms[i]

Adaptation: Making changes in response to current or future conditions (such as the increased frequency and intensity of climate-related hazards), usually to reduce harm and to take advantage of new opportunities.[ii, iii]

Adaptive Capacity: The "combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities."[iv]

Climate Change: A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

Community Asset: A valued feature of a community that may be harmed by climate change. Community assets may include buildings, infrastructure, community services, ecosystems, and economic drivers. See also *"Populations and Assets."*

Disadvantaged Communities: Areas disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation, or with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.[v,vi]

Drought: When conditions are drier than normal for a long period of time, making less water available for people, agricultural uses, and ecosystems.

Economic Driver: Economic assets in Butte County, including three agricultural-based sectors, major employment industries, and recreation and tourism on regional, state, and federal lands.

Exposure: The presence of people, infrastructure, natural systems, and economic, cultural, and social resources in areas that are subject to harm.[vii]

Extreme Event: When a weather or climate variable exceeds the upper or lower thresholds of its observed range.[viii, ix]

Extreme Heat: When temperatures rise significantly above normal levels and is measured by the number of extreme heat events per year and heat wave duration. An extreme heat day in Butte County is where temperatures reach at least 100.1°F.

Frontline Population: Those disproportionately affected by climate change. See *"Vulnerable Populations."*

Hazard: An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss.[x]

Hazard Mitigation: Sustained action taken to reduce or eliminate the long-term risk to human life and property through actions that reduce hazard, exposure, and vulnerability.[xi]

Impact: The effects (especially the negative effects) of a hazard or other conditions associated with climate change.

Populations and Assets: Populations and assets are the people, infrastructure, services, and economic drivers in Butte County that can be affected by climate change.

Resilience: The capacity of any entity—an individual, a community, an organization, or a natural system—to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience. Community resilience is the ability of communities to withstand, recover, and to learn from past disasters to strengthen future response and recovery efforts.

Risk: The potential for damage or loss created by the interaction of hazards with assets such as buildings, infrastructure, or natural and cultural resources.

Sensitivity: The level to which a species, natural system, or community, government, etc., would be affected by changing climate conditions.[xii]

Susceptibility: A person or population's potential for vulnerability due to demographic, socioeconomic, and geolocation characteristics.

Vulnerability: Climate vulnerability describes the degree to which natural, built, and human systems are susceptible "...to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt."[xiii]

Vulnerability Assessment: An analysis of how a changing climate may harm a community and which elements—people, buildings and structures, resources, and other assets—are most vulnerable to its effects based on an assessment of exposure, sensitivity, the potential impact(s), and the community's adaptive capacity.

Vulnerable Populations: Vulnerable populations include, but are not limited to, elderly, children, agricultural and outdoor workers, and those suffering from pre-existing cardiovascular or respiratory conditions.[xiv, xv]

8. Endnotes

[i] California Governor's Office of Emergency Services, "California Adaptation Planning Guide", 2020.
[ii] Louise Bedsworth, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja, "Statewide Summary Report," in *California's Fourth Climate Change Assessment*, publication number: SUMCCCA4-2018-013, 2018.
[iii] California Natural Resource Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy*, 2018, http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf.
[iv] Intergovernmental Panel on Climate Change, "Annex II: Glossary," ed. K. J. Mach, S. Planton, and C. von Stechow, in *Climate Change 2014: Synthesis Report*, ed. Core Writing Team, R. K. Pachauri, and L. A. Meyer (Geneva, Switzerland: IPCC, 2014), p. 117–130, https://www.ipcc.ch/report/ar5/syr/.
[v] California Natural Resource Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy*, 2018, p. 231.
[vi] California Health and Safety Code, Division 26, Part 2, Chapter 4.1, "Greenhouse Gas Reduction Fund Investment Plan and Communities Revitalization Act," Section 39711.
[vii] Louise Bedsworth, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja, "Statewide Summary Report," in *California's Fourth Climate Change Assessment*, publication number: SUMCCCA4-2018-013, 2018.
[viii] California Natural Resource Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy*, 2018, p. 231.
[ix] International Panel on Climate Change, "Glossary of Terms," in Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, special report of Working Groups I and II of the IPCC, ed. C. B. Field et al. (Cambridge, UK, and New York: Cambridge University Press, 2012), p. 555–564, https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf.
[x] California Governor's Office of Emergency Services, *California State Hazard Mitigation Plan*, 2018, https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/state-hazard-mitigation-plan.
[xi] California Governor's Office of Emergency Services, *California State Hazard Mitigation Plan*, 2018.
[xii] California Natural Resource Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy*, 2018, p. 231.
[xiii] Neil Adger, "Vulnerability," *Global Environmental Change* 16 (2006): 268–281, https://www.geos.ed.ac.uk/~nabo/meetings/glthec/materials/simpson/GEC_sdarticle2.pdf.
[xiv] California Natural Resource Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy*, 2018, p. 231, http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf.
[xv] California Health and Safety Code, Division 112, Part 1, Chapter 1, "Organization of the State Department of Public Health," Section 131019.5.