Chapter 4 Risk Assessment

Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a community's potential risk to natural hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:

1. Identify Hazards;
2. Profile Hazard Events;
3. Inventory Assets; and
4. Estimate Losses.

Data collected through this process has been incorporated into the following sections of this chapter:

- **Section 4.1: Hazard Identification** identifies the hazards that threaten the Planning Area and describes why some hazards have been omitted from further consideration.
- **Section 4.2: Hazard Profiles** discusses the threat and impacts to the Planning Area and describes previous occurrences of hazard events and the likelihood of future occurrences.
- **Section 4.3: Vulnerability Assessment** assesses the Planning Areas' exposure to natural hazards; considering assets at risk, critical facilities, future development trends, and, where possible, estimates potential hazard losses.
- **Section 4.4: Capability Assessment** inventories existing local mitigation activities and policies, regulations, plans, and projects that pertain to mitigation and can affect net vulnerability.

This risk assessment covers the entire geographical extent of Butte County (i.e., the Butte County Planning Area). And as required by FEMA, this risk assessment for the Butte County Planning Area also includes an evaluation of how the hazards and risks vary across the Planning Area.

This LHMP Update involved a comprehensive review and update of each section of the 2014 risk assessment. Information from the 2014 LHMP was used in this Update where valid and applicable. As part of the risk assessment update, new data was used, where available, and new analyses were conducted. Where data from existing studies and reports was used, the source is referenced throughout this risk assessment. Refinements, changes, and new methodologies used in the development of this risk assessment update are summarized in Chapter 2 What's New and also detailed in this risk assessment portion of the Plan.

4.1 Hazard Identification

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

The Butte County Hazard Mitigation Planning Committee (HMPC) conducted a hazard identification study to determine the hazards that threaten the Planning Area. This section details the methodology and results of this effort.

Data Sources

The following data sources were used for this Hazard Identification portion of the plan:

- HMPC input
- National Climatic Data Center Storm Events Database
- 2011 Butte County Emergency Operations Plan
- 2014 Butte County Hazard Mitigation Plan
- 2018 State of California Hazard Mitigation Plan
- Butte County 2030 General Plan
- FEMA Disaster Declaration Database

4.1.1. Results and Methodology

Using existing hazards data and input gained through planning meetings, the HMPC agreed upon a list of hazards that could affect the Butte County Planning Area. Hazards data from the California Office of Emergency Services (Cal OES), FEMA, California Department of Water Resources, the National Oceanic and Atmospheric Administration (NOAA), and many other sources were examined to assess the significance of these hazards to the Planning Area.

The following hazards in Table 4-1, listed alphabetically, were identified and investigated for this LHMP Update. As a starting point, the 2018 California State Hazard Mitigation Plan was consulted to evaluate the applicability of new hazards of concern to the State to the Butte County Planning Area. Building upon this effort, hazards from the past plan were also identified, and comments explain how hazards were updated from the previous plan. All hazards from the 2014 plan were profiled in this LHMP Update. One new hazard, climate change, was added.

Table 4-1 Butte County Hazard Identification and Comparison from 2014 LHMP

2019 Hazards	2014 Hazards	Comment
Climate Change	–	New hazard.
Dam Failure	Dam Failure	Additional dams were reviewed and analysis was performed. Analysis was performed on both pre- and post-Camp Fire values.
Drought & Water shortage	Drought & Water shortage	Similar analysis was performed.
Earthquake and Liquefaction	Earthquakes	Updated Hazus analysis was performed.
Floods: 100/200/500 year	Floods: 100/200/500 year	Analysis was performed on both pre- and post-Camp Fire values.
Floods: Localized Stormwater	Floods: Localized Stormwater	Additional data was added based on data supplied by the County.
Hazardous Materials Transportation	Hazardous Materials Incidents: Transportation	Additional analysis was performed on population, values, and critical facilities at risk. Analysis was performed on both pre- and post-Camp Fire values.
Invasive Species: Aquatic	Marine Invasive Species	Similar analysis was performed.
Invasive Species: Pests/Plants	Invasive Species: Pests/Plants	Similar analysis was performed.
Landslide, Mudslide, and Debris Flow	Earth Movements: Landslide	Additional analysis was performed on population, values, and critical facilities at risk Analysis was performed on both pre- and post-Camp Fire values.
Levee Failure	Levee Failure	An updated levee inventory was conducted.
Severe Weather: Extreme Heat	Severe Weather: Extreme Heat	Similar analysis was performed.
Severe Weather: Freeze and Winter Storm	Severe Weather: Freeze and Winter Storm	Similar analysis was performed.
Severe Weather: Heavy Rain and Storms (Hail, Lightning)	Severe Weather: Heavy rain, hailstorm, lightning	Similar analysis was performed.
Severe Weather: Wind and Tornado	Severe Weather: Tornado Severe Weather: Windstorms	Similar analysis was performed.
Stream Bank Erosion	Earth Movements: Erosion	This hazard and analysis was limited to stream bank erosion.
Volcano	Volcanoes	Similar analysis was performed.
Wildfire	Wildfires	Additional analysis was performed on population, values, and critical facilities at risk Analysis was performed on both pre- and post-Camp Fire values.

Certain hazards were excluded from consideration for this Plan Update. They are shown in Table 4-2.

Table 4-2 Butte County – Excluded Hazards

Hazard Excluded	Why Excluded
Tsunami	The County is not on the coast.
Avalanches	The County does not have sufficient snowfall in populated areas to have avalanche as a hazard.
Air Pollution	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Coastal Flooding, Erosion, and Sea Level Rise	The County is not on the coast.
Energy Shortage and Energy Resilience	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Epidemic/Pandemic/Vector Borne Disease Hazards	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Natural Gas Pipeline Hazards	The County did not consider this a hazard due to the low number of gas pipelines traversing the County.
Oil Spills	The County did not consider this a hazard, as there are few pipelines or oil wells in the County.
Radiological Accidents	There are no areas in the County at risk to this hazard.
Cyber Threats	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Airline Crashes	There have been few past occurrences in the County of airplane crashes.
Civil Disturbance	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Well Stimulation and Hydraulic Fracking	This is not occurring in the County.

Table 4-3 was completed by the County and HMPC to identify, profile, and rate the significance of identified hazards. Only the more significant (or priority) hazards have a more detailed hazard profile and are analyzed further in Section 4.3 Vulnerability Assessment. Those hazards that occur infrequently or have little or no impact on the Planning Area were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, crop, and economic damage. The ability of a community to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the Planning Area, enabling the County to focus resources where they are most needed. Table 4-53 in Section 4.2.20 Natural Hazards Summary provides an overview and initial prioritization of these hazards. For each hazard profiled in Section 4.3, this initial prioritization included a determination as to whether the hazard is considered a priority hazard for the Butte County Planning Area for purposes of conducting a vulnerability assessment of the hazard. At the completion of the risk assessment, a second hazard prioritization was conducted to determine priority hazards for mitigation strategy planning.

Table 4-3 Butte County Hazard Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Limited	Medium	–
Dam Failure	Extensive	Occasional	Catastrophic	High	Medium
Drought & Water shortage	Extensive	Likely	Critical	Medium	High
Earthquake and Liquefaction	Extensive	Unlikely	Catastrophic	Medium	Low
Floods: 100/200/500 year	Significant	Likely	Critical	High	Medium
Floods: Localized Stormwater	Significant	Highly Likely	Limited	Medium	Medium
Hazardous Materials Transportation	Significant	Likely	Limited	Medium	Low
Invasive Species: Aquatic	Limited	Likely	Limited	Medium	Low
Invasive Species: Pests/Plants	Extensive	Highly Likely	Limited	Medium	Low
Landslide, Mudslide, and Debris Flow	Significant	Likely	Critical	Medium	Medium
Levee Failure	Significant	Occasional	Critical	High	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Limited	Medium	High
Severe Weather: Freeze and Winter Storm	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Heavy Rain and Storms (Hail, Lightning)	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Wind and Tornado	Extensive	Highly Likely/Likely	Critical	Medium	Low
Stream Bank Erosion	Significant	Highly Likely	Limited	Medium	Low
Volcano	Extensive	Unlikely	Negligible	Low	Low
Wildfire	Extensive	Highly Likely	Catastrophic	High	High

Geographic Extent
Limited: Less than 10% of Planning Area
Significant: 10-50% of Planning Area
Extensive: 50-100% of Planning Area

Likelihood of Future Occurrences
Highly Likely: Near 100% chance of occurrence in next year, or happens every year.
Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.
Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability
Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

4.1.2. Disaster Declaration History

One method the HMPC used to identify hazards was the researching of past events that triggered federal and/or state emergency or disaster declarations in the Butte County Planning Area. Federal and/or state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

A USDA declaration will result in the implementation of the Emergency Loan Program through the Farm Services Agency. This program enables eligible farmers and ranchers in the affected county as well as contiguous counties to apply for low interest loans. A USDA declaration will automatically follow a major disaster declaration for counties designated major disaster areas and those that are contiguous to declared counties, including those that are across state lines. As part of an agreement with the USDA, the SBA offers low interest loans for eligible businesses that suffer economic losses in declared and contiguous counties that have been declared by the USDA. These loans are referred to as Economic Injury Disaster Loans. These programs are discussed in Section 4.2.5.

Based on the disaster declaration history provided in Table 4-4, Butte County is among the many counties in California susceptible to disaster. Details on federal and state disaster declarations were obtained by the HMPC, FEMA, and Cal OES and compiled in chronological order in Table 4-4. A review of state declared disasters indicates that Butte County received 30 state declarations between 1950 and 2018. Of the 30 state declarations: 17 were associated with severe winter storms, heavy rains, or flooding; 2 were for drought; 1 was from economic disasters, 2 were for freeze and severe weather conditions; and 8 were for fire. A review of federal disasters shows 33 federal disaster declarations. Of these 33 federal declarations: 17 were associated with severe winter storms, heavy rains, or flooding; 10 for wildfire, 2 for freeze, 2 for drought, 1 from earthquake, and 1 was for hurricane (a nationwide declaration for Katrina evacuations). A summary of these events by disaster type is shown in Table 4-5.

Table 4-4 Butte County State and Federal Disaster Declarations, 1950-2019

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2019	California Severe Winter Storms, Flooding, Landslides, And Mudslides	Flood	Storms	DR-4434	–	5/17/2019

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2018	California Wildfires	Fire	Fire	DR-4407	–	11/12/2018
2018	California Wildfires	Fire	Fire	EM-3409	–	11/9/2018
2018	Camp Fire	Fire	Fire	FM-5278	–	11/8/2018
2017	California Wildfires	Fire	Fire	DR-4344	10/9/2017	10/10/2017
2017	Laporte Fire	Fire	Fire	FM-5218	–	10/9/2017
2017	Cascade Fire	Fire	Fire	FM-5216	–	10/09/2017
2017	Ponderosa Fire	Fire	Fire	FP 2017-10	9/1/2017	–
2017	Wall Fire	Fire	Fire	FM-5189	7/9/2017	7/9/2017
2017	California Severe Winter Storms, Flooding, Mudslides	Flood	Storms	DR-4308	3/7/2017	4/1/2017
2017	California Severe Winter Storms, Flooding, and Mudslides	Flood	Storms	DR-4301	–	2/14/2017
2017	California Potential Failure of the Emergency Spillway at Lake Oroville Dam	Flood	Storms	EM-3381	–	2/14/2017
2014	California Drought	Drought	Drought	GP 2014-13	1/17/2014	–
2008	–	Agricultural	Drought	S2708	–	9/16/2008
2008	–	Agricultural	Freezing Temperatures	S3109	–	6/30/2008
2008	Mid-year fires	Fire	Fire	EM-3287	6/28/2008	–
2008	Humboldt Fire	Fire	Fire	FM 2771	6/11/2008	–
2008	Ophir Fire	Fire	Fire	FM 2770	–	6/10/2008
2008	2008 January Storms	Flood	Storms	GP 2008-01	1/15/2008	–
2005/ 2006	2005/06 Winter Storms	Flood	Storms	DR-1628	–	2/3/2006
2005	Hurricane Katrina Evacuations	Economic	Hurricane	EM-3248 2005	–	9/13/2005
2004	Oregon Fire	Fire	Fire	FM-2545	–	8/11/2004

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2001	Energy Emergency	Economic	Greed	GP-2001	1/1/2001	–
1999	1999 August Fires	Fire	Fire	EM-3140	8/26/1999	9/1/1999
1998	1998 El Nino Floods	Flood	Storms	DR-1203	Proclaimed	2/19/1998
1997	1997 January Floods	Flood	Storms	DR-1155	1/2/97-1/31/97	1/4/1997
1995	1995 Severe Winter Storms	Flood	Storms	DR-1046	1/6/95-3/14/95	3/12/1995
1995	1995 Severe Winter Storms	Flood	Storms	DR-1044	1/6/95-3/14/95	1/13/1995
1990	1990 Freeze	Freeze	Freeze	DR-894	12/19/1990 - 1/18/1991	2/11/1991
1990	1990 Severe Storms	Flood	Storms	GP 989-06	2/22/1990	–
1987	1987 Wildland Fires	Fire	Fire	GP	9/10/87	–
1986	1986 Storms	Flood	Storms	DR-758	2/18-86-3/12/86	2/18/1986
1982	Winter Storms	Flood	Flood	DR-677	12/8/82-3/21/83	2/9/1983
1976	1976 Drought	Drought	–	EM-3023	2/9/76, 2/13,76, 2/24/76, 3/26/76, 7/6/76	1/20/1977
1975	Butte Earthquake	Earthquake	Earthquake	DC 75-03	–	8/1/1975
1973	1973 Freeze	Freeze	Freeze	-	2/28/1973	–
1970	1970 Northern California Flooding	Flood	Flood	DR-283	1/27/1970, 2/3/1970, 2/10/1970, 3/2/1970	2/16/1970
1969	1969 Storms	Flood	Storms	DR-253	1/23/69-3/12/69	1/26/1969
1964	1964 Late Winter Storms	Flood	Storms	DR-183	–	12/24/1964
1963	1963 Floods	Flood	Storms	–	2/14/1964	–
1962	1962 Floods and Rain	Flood	Storms	DR-138	10/17/62, 10/25/62, 10/30/62, & 11/4/62	10/24/1962

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1961	1961 Widespread Fires	Fire	Fire	–	9/18/1961	–
1958	1958 April Storms and Floods	Flood	Storms	DR-82	4/5/1958	4/4/1958
1958	1958 February Storms and Floods	Flood	Storms	CDO 58-03	2/26/1958	–
1955	1955 Floods	Flood	Flood	DR-47	12/22/1955	12/23/1955
1950	1950 Floods	Flood	Flood	OCD 50-01	11/21/1950	–

Source: Cal OES, FEMA

Table 4-5 Butte County – State and Federal Disaster Declarations Summary 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Drought	2	1976, 2008	2	1976, 2014
Earthquake	1	1975	0	
Economic	0		1	2001
Flood	17	1955, 1958, 1962, 1964, 1969, 1970, 1982, 1986, 1995 (twice), 1997, 1998, 2005, 2017 (three times), 2019	17	1950,1955, 1958 (twice), 1962, 1963, 1969, 1970, 1982, 1986, 1990, 1995 (twice), 1997, 1998, 2008, 2017
Freeze	2	1990, 2008	2	1973, 1990
Hurricane	1	2005	0	
Wildfire	10	1999, 2004, 2008, 2017 (four times), 2018 (three times)	8	1961, 1987, 1999, 2008 (twice), 2017 (three times)
Totals	**33**	–	**30**	**–**

Source: Cal OES, FEMA

Disasters since 2014

As detailed above, there have been 11 FEMA disaster declarations since the 2014. 7 were from wildfire, 3 from flooding, and 1 from potential dam failure. There were 5 state disaster declarations since 2014 – 1 for flood (2017), 3 for wildfire, and 1 for drought in 2014.

EOC Activations since 2014

Butte County OES provided a list of EOC activations due to hazard events since 2014. These are:

Table 4-6 Butte County EOC Activations

Year	Event	Declaration
2015	Drought	CDAA
	Swedes Fire in September	Local declaration
2017	January Storms	Federal Declaration
	Wall Fire (July)	FMAG
	Ponderosa Fire (August/September)	CDAA
	Cherokee/Laporte Fire (October)	Federal Declaration
2018	Camp Fire	Federal Declaration
2019	Public Safety Power Shutoff	–
	February Storms	Federal Declaration

Source: Butte County

4.2 Hazard Profiles

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The hazards identified in Section 4.1 Hazard Identification, are profiled individually in this section. These profiles set the stage for Section 4.3 Vulnerability Assessment, where the vulnerability is quantified for each of the priority hazards.

Each hazard is profiled in the following format:

- **Hazard/Problem Description**—This section gives a description of the hazard and associated issues followed by details on the hazard specific to the Butte County Planning Area. Where known, this includes information on the hazard location, extent, seasonal patterns, speed of onset/duration, and magnitude and/or any secondary effects.
- **Past Occurrences**—This section contains information on historical incidents, including impacts where known. The extent or location of the hazard within or near the Butte County Planning Area is also included here. Historical incident worksheets and other input from the HMPC were used to capture information on past occurrences.
- **Frequency/Likelihood of Future Occurrence**—The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. It was determined by dividing the number of events observed by the number of years on record and multiplying by 100. This gives the percent chance of the event happening in any given year (e.g., three droughts over a 30-year period equates to a 10 percent chance of experiencing a drought in any given year). The likelihood of future occurrences is categorized into one of the following classifications:
  - ✓ **Highly Likely**—Near 100 percent chance of occurrence in next year or happens every year
  - ✓ **Likely**—Between 10 and 100 percent chance of occurrence in next year or has a recurrence interval of 10 years or less
  - ✓ **Occasional**—Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years
  - ✓ **Unlikely**—Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.
- **Climate Change**—This section contains the effects of climate change (if applicable). The possible ramifications of climate change on the hazard are discussed.

Section 4.2.20 Natural Hazards Summary provides an initial assessment of the profiles and assigns a level of significance or priority to each hazard. Those hazards determined to be of high or medium significance were characterized as priority hazards that required further evaluation in Section 4.3 Vulnerability Assessment. Those hazards that occur infrequently or have little or no impact on the Planning Area were determined to be of low significance and are not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, crop, and economic damage. The ability of a community to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used by the HMPC to initially prioritize those hazards of greatest significance to the Planning Area, enabling the County to focus resources where they are most needed. At the completion of the risk assessment, a second hazard prioritization was conducted to determine priority hazards for mitigation strategy planning.

The following sections provide profiles of the natural hazards that the HMPC identified in Section 4.1 Hazard Identification. The severe weather hazards are discussed first because it is the secondary hazards generated or exacerbated by severe weather (e.g., flood and wildfire) that can result in the most significant losses. The other hazards follow alphabetically.

Data Sources

In general, information provided by planning team members is integrated into this section with information from other data sources. The data sources listed below formed the basis for this Hazard Profiles portion of the plan. Where data and information from these studies, plans, reports, and other data sources were used, the source is referenced as appropriate throughout this risk assessment.

- 2006 Butte County Flood Mitigation Plan
- 2018 California State Hazard Mitigation Plan
- Bureau of Land Management
- Butte County 2015 - 2020 Community Wildfire Protection Plan
- Butte County 2030 General Plan Conservation Element
- Butte County 2030 General Plan Land Use Element
- Butte County 2030 General Plan Safety Element
- Butte County 2030 General Plan Water Resources Element
- Butte County Climate Adaptation Plan
- Butte County Digital Flood Insurance Rate Map January 6, 2011 (updated with 8/30/2017 LOMRs)
- Butte County Flood Insurance Study January 6, 2011
- Butte County General Plan Environmental Impact Report
- Butte County GIS
- Butte County Recovers
- Butte County Rice Growers Association
- Cal DWR Best Available Maps
- CAL FIRE
- Cal OES
- Cal-Adapt
- California Climate Adaptation Strategy (CAS) – 2014
- California Department of Fish and Wildlife
- California Department of Water Resources
- California Department of Water Resources (Cal DWR) Division of Safety of Dams
- California Division of Mines and Geology
- California Geological Survey
- California Invasive Plant Council
- California Natural Resource Agency
- California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources.

- CalTrans Truck Network
- Chicowiki.org
- Climate Change and Health Profile Report – Butte County
- County Agricultural Commissioner's Annual Crop Reports
- Debris Deposition in the Cherokee Canal Flood Control Project
- DINS Damage Assessment
- Don Schloesser, USGS, Biological Resources Division
- FEMA
- FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes
- Flood Damage Survey Reports
- Independent Forensic Team Report – Oroville Dam Spillway Incident.
- IPCC Fifth Assessment Synthesis Report (2014)
- Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR.
- Multi-Hazard Identification and Risk Assessment, FEMA 1997
- National Drought Mitigation Center
- National Integrated Drought Information System
- National Oceanic and Atmospheric Administration's National Climatic Data Center
- National Park Service
- National Weather Service
- Natural Resource and Conservation Service
- NOAA Storm Prediction Center
- Pacific Gas and Electric Company
- Public Policy Institute of California
- Review of Interim Flood Control Survey Report on Sacramento River and Tributaries, Cherokee Canal and Butte Creek, 15 June 1948
- Science Magazine
- State of California Department of Conservation Farmland Mapping and Monitoring Program
- U.S. Department of Transportation
- U.S. Environmental Protection Agency
- U.S. Occupational Safety and Health Administration
- United States Geological Survey Open File Report 2015-3009
- US Army Corps of Engineers
- US Department of Agriculture
- US Department of Transportation Pipeline and Hazardous Materials Safety Administration's Office of Hazardous Materials Safety
- US Drought Monitor
- US Farm Service Agency
- US Fish and Wildlife Service
- US Geological Survey: Volcanic Ash: Effect & Mitigation Strategies
- USDA Forest Service Region 5
- USGS – A Sight "Fearfully Grans" – Eruptions of Lassen Peak California, 1914 to 1917
- USGS National Earthquake Information Center
- USGS Publication 2014-3120
- Vaisala National Lightning Detection Network
- Western Regional Climate Center

4.2.1. Severe Weather: General

Severe weather is generally any destructive weather event, but usually occurs throughout the Butte County Planning Area as localized storms that bring heavy rain and strong winds.

The National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) has been tracking severe weather since 1950. Their Storm Events Database contains data on the following: all weather events from 1993 to current (except from 6/1993-7/1993); and additional data from the Storm Prediction Center, which includes tornadoes (1950-1992), thunderstorm winds (1955-1992), and hail (1955-1992). This database contains 350 severe weather events that occurred in Butte County between January 1, 1950, and October 31, 2018. Table 4-7 summarizes these events.

*Table 4-7 NCDC Severe Weather Events for Butte County 1950-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Astronomical Low Tide**	1	0	0	0	0	$0	$0
Blizzard	1	0	0	0	0	$0	$0
Cold/Wind Chill	2	0	0	0	0	$2,400,000	$0
Debris Flow	2	0	0	0	0	$4,308,000	$0
Dense Fog	1	0	0	0	0	$0	$0
Drought	12	0	0	0	0	$0	$0
Excessive Heat	2	2	0	2	0	$0	$0
Flash Flood	6	0	0	0	0	$700,000	$0
Flood	25	0	0	0	0	$551,645,000	$0
Frost/Freeze	5	0	0	0	0	$0	$0
Hail	9	0	0	0	0	$0	$0
Heat	12	1	0	0	0	$0	$0
Heavy Rain	19	0	0	0	0	$6,000	$0
Heavy Snow	25	1	0	0	0	$0	$0
High Surf**	1	0	0	0	0	$0	$0
High Winds	34	3	0	2	0	$11,425,000	$30,000,000
Lightning	3	0	0	0	0	$135,000	$0
Strong Wind	2	0	1	0	0	$300,000	$0
Thunderstorm Wind	7	0	0	0	0	$1,020,000	$0
Tornado	16	0	0	6	0	$8,230,500	$50
Wildfire	19	0	5	7	89	$2,380,000	$0
Winter Storm	134	0	0	0	0	$150,000	$0
Winter Weather	12	0	0	0	0	$0	$0
Total	**350**	**7**	**6**	**17**	**89**	**$582,699,500**	**$30,000,050**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Butte County

The NCDC table above summarize severe weather events that occurred in Butte County. Only a few of the events actually resulted in state and federal disaster declarations. It is further interesting to note that different data sources capture different events during the same time period, and often display different information specific to the same events. While the HMPC recognizes these inconsistencies, they see the value this data provides in depicting the County's "big picture" hazard environment.

As previously mentioned, most all of Butte County's state and federal disaster declarations have been a result of severe weather. For this plan, severe weather is discussed in the following subsections:

- Extreme Heat
- Freeze and Winter Storm
- Heavy Rains and Storms
- High Winds and Tornadoes

4.2.2. Severe Weather: Extreme Heat

Hazard/Problem Description

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died. Extreme heat can also affect the agricultural industry.

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds a level at which the body can remove it, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise, and heat-related illness may develop. Elderly persons, small children, chronic invalids, those on certain medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions.

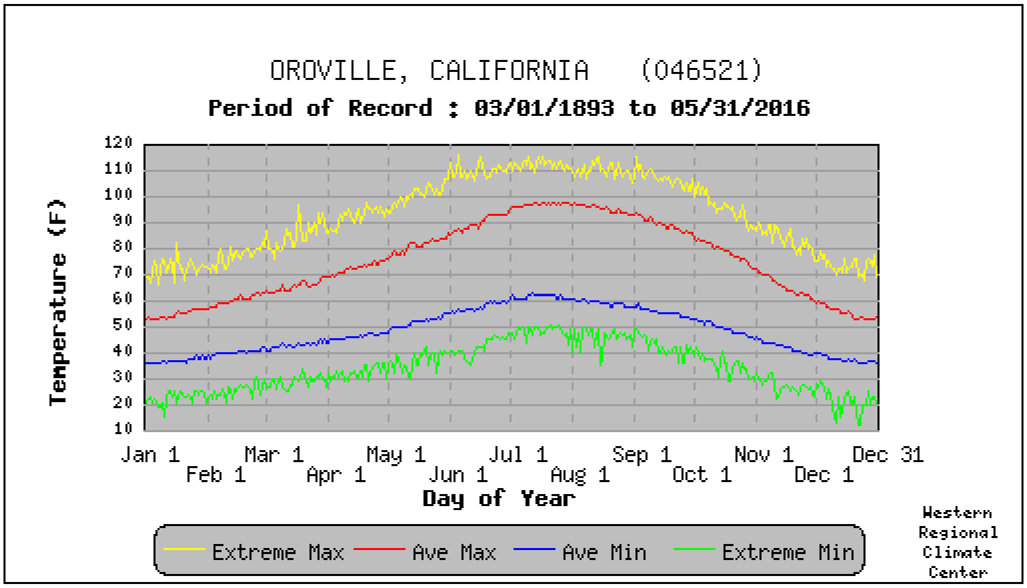
Location and Extent

Extreme heat events occur on a regional basis. Extreme heat can occur in any location of the County, though it is more prevalent in the lower elevations of the County. Extreme heat occurs throughout the Planning Area primarily during the summer months. The WRCC maintains data on weather normal and extremes in the western United States. Two weather stations were chosen for the County, with one in the Central Valley, and the other in the upper elevations of the County. WRCC data for the County is summarized below.

Western Butte County— Oroville Weather Station, Period of Record 1893 to 2016

According to the WRCC, in western Butte County, monthly average maximum temperatures in the warmest months (May through October) range from the upper-70s to the mid-90s. The highest recorded daily extreme was 115°F on both June 16, 1961 and July 15, 1972. In a typical year, maximum temperatures exceed 90°F on 93.3 days. Figure 4-1 shows the average daily high temperatures and extremes for the western County. Table 4-8 shows the record high temperatures by month for the western County.

Figure 4-1 Western Butte County — Daily Temperature Averages and Extremes



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Table 4-8 Western Butte County – Record High Temperatures

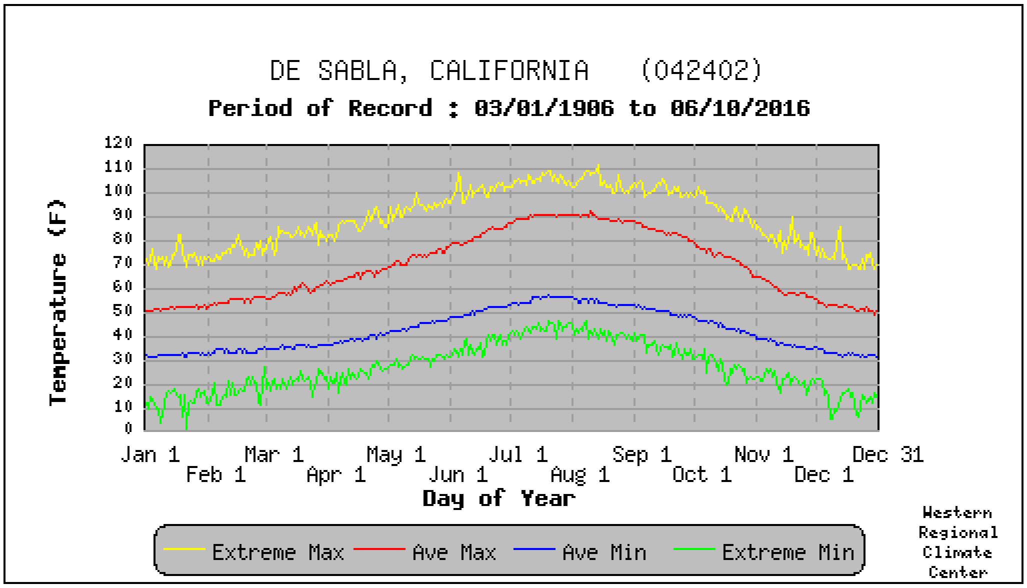
Month	Record High	Date	Month	Record High	Date
January	82°	1/16/2009	July	115°	7/15/1972
February	82°	2/28/1985	August	113°	8/1/1971
March	88°	3/28/1955	September	108°	9/11/1953
April	96°	4/27/2004	October	102°	10/2/2001
May	104°	5/31/2001	November	90°	11/2/1967
June	115°	6/16/1961	December	76°	12/27/1967

Source: Western Regional Climate Center

Eastern Butte County— De Sabla Weather Station, Period of Record 1906 to 2016

According to the WRCC, in eastern Butte County, monthly average maximum temperatures in the warmest months (May through October) range from the mid-70s to the low-90s. The highest recorded daily extreme was 112°F on August 14, 1933. In a typical year, maximum temperatures exceed 90°F on 51.2 days. Figure 4-2 shows the average daily high temperatures and extremes for the eastern County. Table 4-9 shows the record high temperatures by month for the eastern County.

Figure 4-2 Eastern Butte County — Daily Temperature Averages and Extremes



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Table 4-9 Eastern Butte County – Record High Temperatures

Month	Record High	Date	Month	Record High	Date
January	82°	1/17/1920	July	109°	7/20/1938
February	82°	2/16/1930	August	112°	8/14/1933
March	87°	3/26/1930	September	106°	9/15/1929
April	94°	4/25/1926	October	102°	10/3/1933
May	97°	5/30/1910	November	90°	11/19/1936
June	108°	6/05/1926	December	86°	12/13/1964

Source: Western Regional Climate Center

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. While heat waves are obviously less dramatic, they are potentially deadlier. According to the 2018 California State Hazard Mitigation Plan, the worst single heat wave event in California occurred in Southern California in 1955, when an eight-day heat wave resulted in 946 deaths.

The NWS 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 HeatRisk 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 UV Index. This can be seen in Table 4-10.

Table 4-10 National Weather Service HeatRisk Categories

Category	Level	Meaning
Green	0	No Elevated Risk
Yellow	1	Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration
Orange	2	Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration
Red	3	High Risk for much of the population, especially those who are heat sensitive and those without effective cooling and/or adequate hydration
Magenta	4	Very High Risk for entire population due to long duration heat, with little to no relief overnight

Source: National Weather Service

The NWS office in Sacramento can issue the following heat-related advisory as conditions warrant.

- **Heat Advisories** are issued during events where the HeatRisk is on the Orange/Red threshold (Orange will not always trigger an advisory)
- **Excessive Heat Watches/Warnings** are issued during events where the HeatRisk is in the Red/Magenta output

Past Occurrences

Disaster Declaration History

There have been no FEMA or Cal OES disasters related to extreme heat, as shown in Table 4-4.

NCDC Events

The NCDC data shows 14 extreme heat incidents for Butte County since 1993. Information for these events are shown in Table 4-11. Specific information by event are discussed below the table.

*Table 4-11 NCDC Extreme Heat Events in Butte County 1993 to 10/31/2018**

Event	Date	Deaths	Injuries	Property Damage	Crop Damage
Heat	7/11/1999	0	0	$0	$0
Heat	5/21/2000	0	0	$0	$0
Heat	6/13/2000	1	0	$0	$0
Heat	7/29/2000	0	0	$0	$0
Heat	9/18/2000	0	0	$0	$0
Heat	6/7/2013	0	0	$0	$0
Heat	6/28/2013	0	0	$0	$0
Heat	7/1/2013	0	0	$0	$0
Excessive Heat	6/17/2017	2	0	$0	$0
Heat	6/22/2018	0	0	$0	$0
Heat	7/15/2018	0	0	$0	$0

Event	Date	Deaths	Injuries	Property Damage	Crop Damage
Heat	7/15/2018	0	0	$0	$0
Excessive Heat	7/24/2018	0	0	$0	$0
Heat	7/24/2018	0	0	$0	$0
Total		**3**	**0**	**$0**	**$0**

Source: NCDC

*Deaths, injuries, and damages are for the entire event, and may not be exclusive to the County.

June 7, 2013 – 103-112 degrees on Saturday. Minimum temperatures were quite warm, approximately in the low 70s to mid-80s.

June 28, 2013 – High temperatures ranged from approximately 101 to 109 for the Central Sacramento Valley for 7 consecutive days. Minimum temperatures ranged between mid-60s to low 80s overnight. A max temperature record was broken for Marysville during this period.

July 1, 2013 – High temperatures ranged from approximately 101 to 109 for the Central Sacramento Valley for 7 consecutive days. Minimum temperatures ranged between mid-60s to low 80s overnight. A max temperature record was broken for Marysville during this period.

June 22, 2018 – The NWS Experimental HeatRisk reached High readings that prompted a heat warning for the central Sacramento Valley. PG&E activated their Emergency Operations Center in support of the June Heat Event.

July 15, 2018 – The NWS Experimental Heat Risk reached Moderate to High readings for several days prompting a Heat Advisory for the Central Sacramento Valley. The hottest day was the 18th, when the temperature reached 104 at Marysville. The NWS Experimental Heat Risk reached High readings for several days also prompting a Heat Advisory for the northeast foothills adjacent to Sacramento County.

July 24, 2018 – The NWS Experimental Heat Risk reached Moderate to High readings for several days prompting a Heat Advisory for northeast foothills of the northern Sacramento Valley. Highs were in the low 100s, lows were in the mid to upper 70s to lower 80s.

Hazard Mitigation Planning Committee Events

The County Agricultural Commissioner reported that from March 12-15, 2004, the prune crop was damaged by a period of high temperatures and low humidity during the blossoming period. Estimated losses to the prune crop were in excess of $11.7 million.

The HMPC noted that extreme heat is an annual event, but could recall no other events where heat caused damages.

Likelihood of Future Occurrence

Highly Likely—Temperature extremes are likely to continue to occur annually in the Butte County Planning Area. Temperatures at or above 90°F are common most summer days in the County.

Climate Change and Extreme Heat

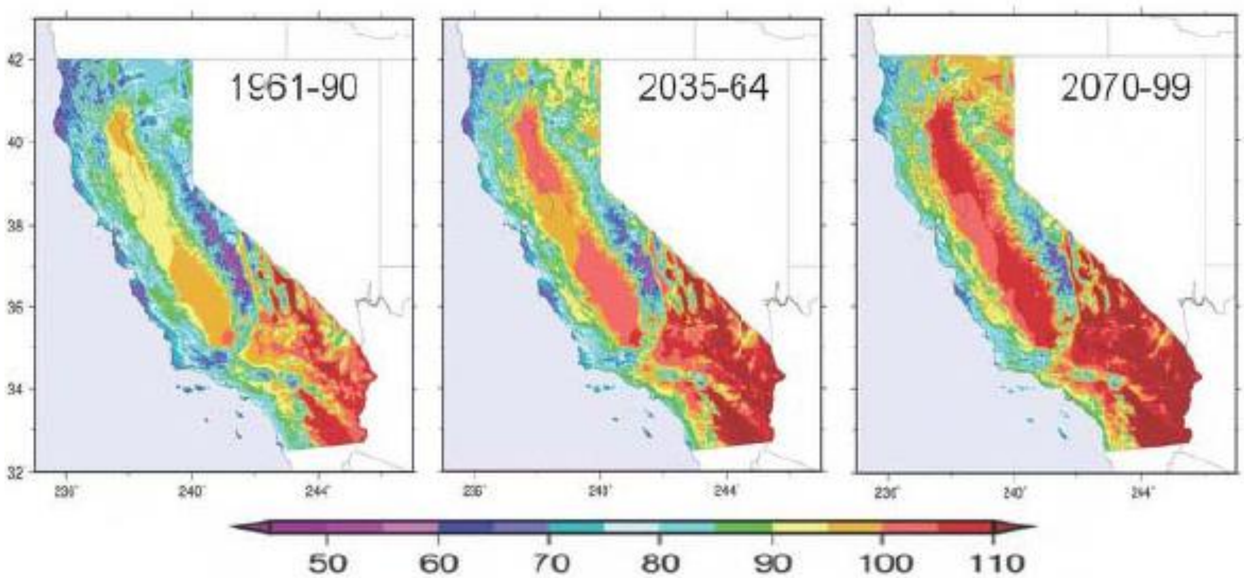
Climate change and its effect on flood near the City has been discussed by three sources:

- California Climate Adaptation Strategy (CAS) – 2014
- Climate Change and Health Profile Report – Butte County
- Cal-Adapt

Climate Adaptation Strategy

The 2014 California Climate Adaptation Strategy (CAS), citing a California Energy Commission study, states that "over the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined." This study shows that California is getting warmer, leading to an increased frequency, magnitude, and duration of heat waves. These factors may lead to increased mortality from excessive heat, as shown in Figure 4-3.

Figure 4-3 California Historical and Projected Temperature Increases – 1961 to 2099



Source: Dan Cayan; California Climate Adaptation Strategy

As temperatures increase, California and Butte County will face increased risk of death from dehydration, heat stroke, heat exhaustion, heart attack, stroke and respiratory distress caused by extreme heat. According to the CAS report and the 2018 State of California Hazard Mitigation Plan, by 2100, hotter temperatures are expected throughout the state, with projected increases of 3-5.5°F (under a lower emissions scenario) to 8-10.5°F (under a higher emissions scenario). These changes could lead to an increase in deaths related to extreme heat in Butte County.

Climate Change and Health Profile Report – Butte County

The CCHPR noted for Butte County that increased temperatures manifested as heat waves and sustained high heat days directly harm human health through heat-related illnesses (mild heat stress to fatal heat stroke) and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable. Increased heat also intensifies the photochemical reactions that produce smog and ground level ozone and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide enhance the growth of plants that produce pollen, which are associated with allergies. Increased temperatures add to the heat load of buildings in urban areas and exacerbate existing urban heat islands adding to the risk of high ambient temperatures.

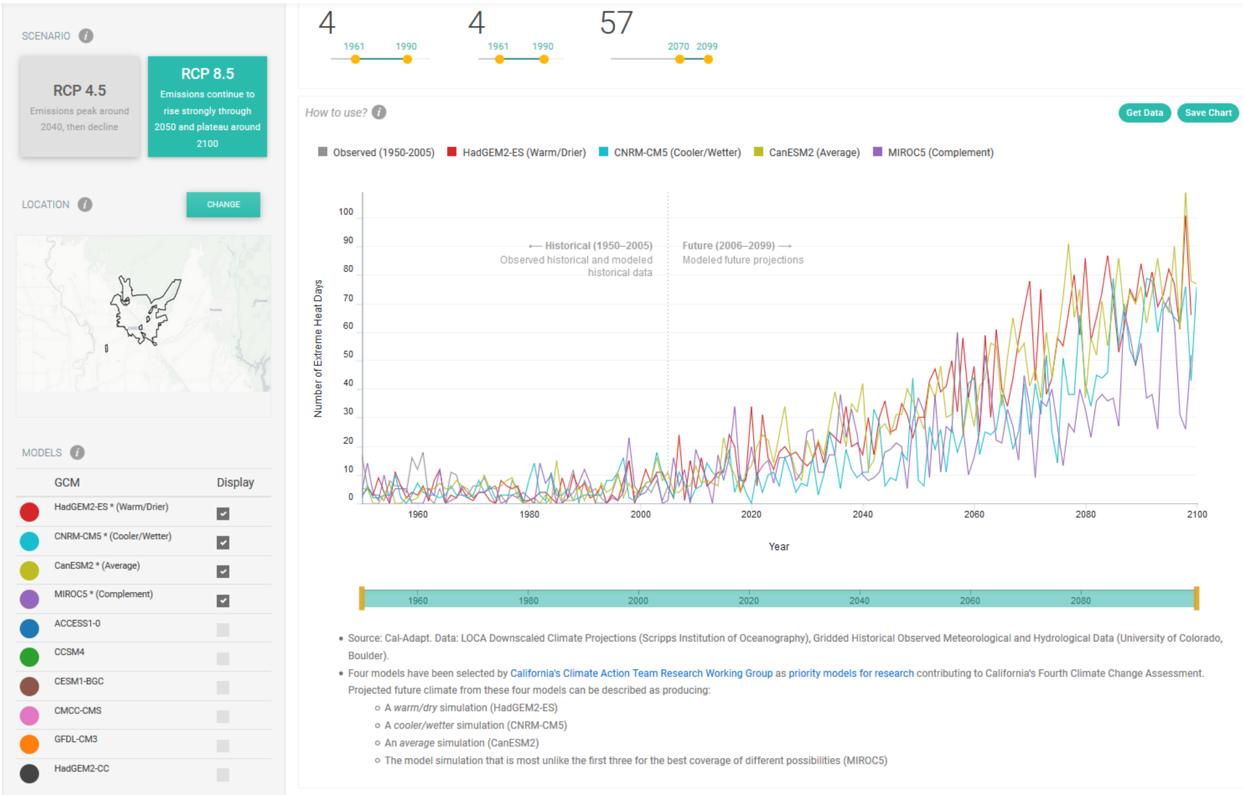
Cal-Adapt

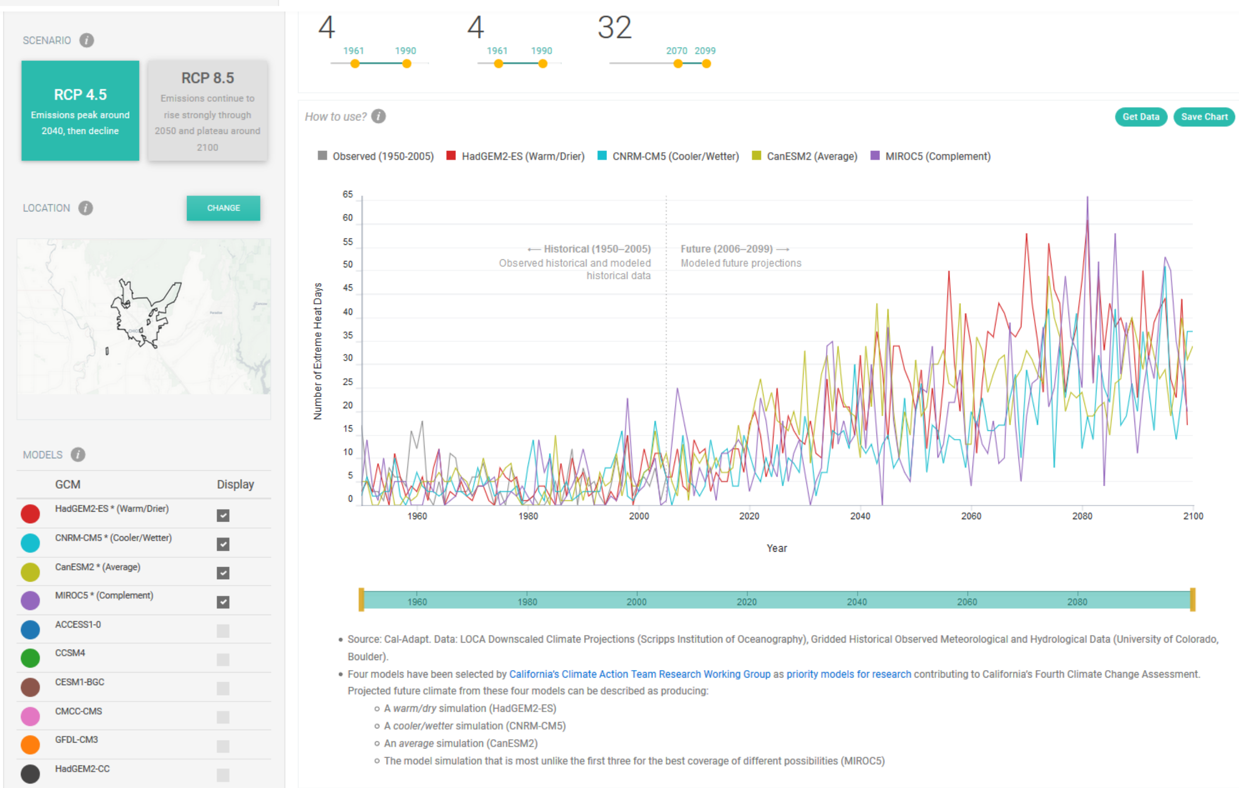
Cal Adapt also noted that overall temperatures are expected to rise substantially throughout this century. During the next few decades, scenarios project average temperature to rise between 1 and 2.3°F; however, the projected temperature increases begin to diverge at mid-century so that, by the end of the century, the temperature increases projected in the higher emissions scenario (Representative Concentration Pathways (RCP) 8.5) are approximately twice as high as those projected in the lower emissions scenario (RCP 4.5).

These projections also differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand. Future temperature estimates from Cal-Adapt for the Butte County Planning are shown in Figure 4-4. It shows the following:

- The upper chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 90.0°F. Data is shown for Butte County under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100.
- The lower chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 90.0 °F. Data is shown for Butte County under the RCP 4.5 scenario in which emissions peak around 2040, then decline.

Figure 4-4 Butte County – Future Temperature Estimates in Low and High Emission Scenarios





Source: Cal-Adapt – Number of Extreme Heat Days by Year

4.2.3. Severe Weather: Freeze and Winter Storm

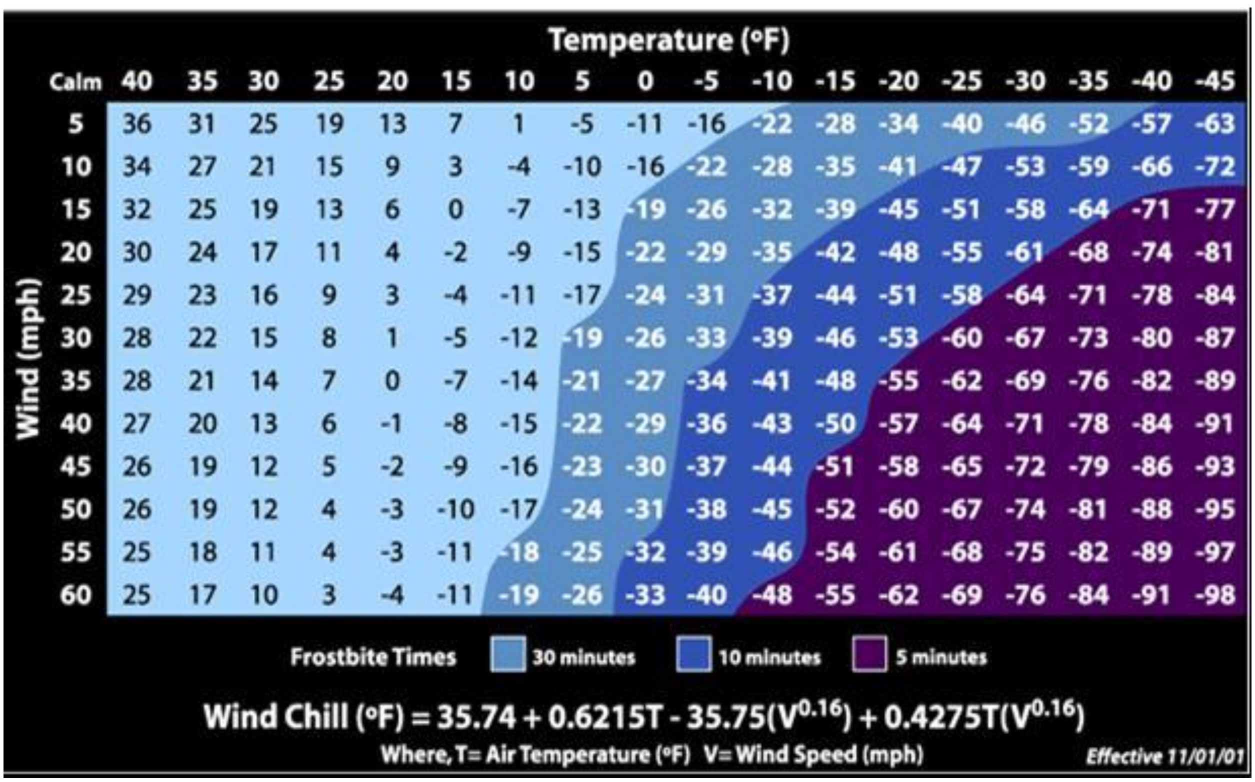
Hazard/Problem Description

Freeze

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. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Freezing temperatures can cause significant damage to the agricultural industry. The effects of freezing temperatures on agriculture in Butte County are discussed further in Section 4.2.5 Agricultural Hazards.

In 2001, the NWS implemented an updated Wind Chill Temperature index (shown in Figure 4-5), which is reproduced below. This index was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 4-5 Wind Chill Temperature Chart



Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill } (^\circ F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

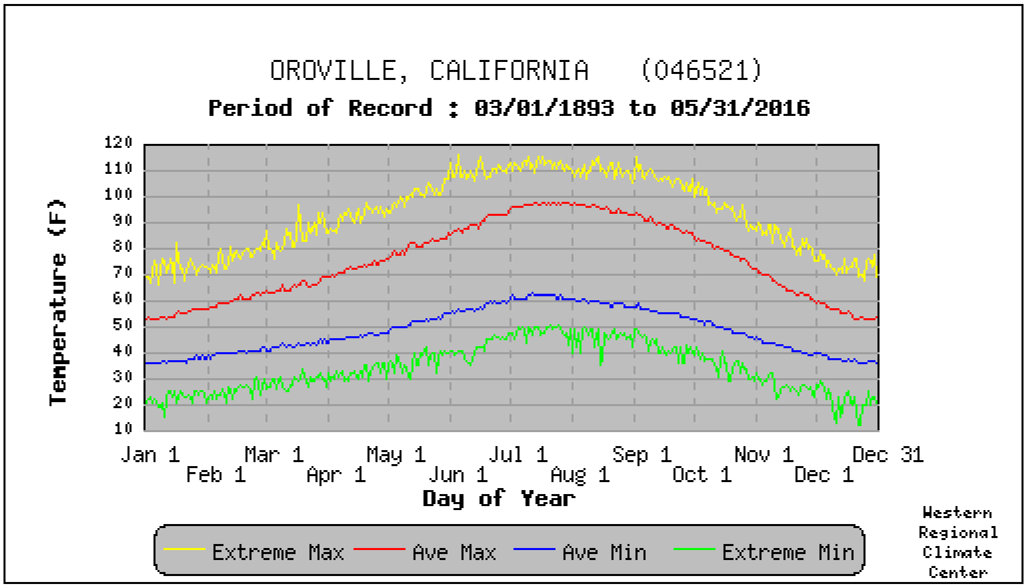
Source: National Weather Service

Information on cold from the Western Regional Climate Center's eastern and western coop station for the County are summarized below.

Western Butte County—Oroville Weather Station, Period of Record 1893 to 2016

According to the WRCC, in western Butte County monthly average minimum temperatures from November through April range from the mid-40s to low-50s. The lowest recorded daily extreme was 12°F on December 22, 1990. In a typical year, minimum temperatures fall below 32°F on 21.8 days with no days falling below 0°F. Table 4-12 shows the record low temperatures by month for Butte County. Average daily temperatures for Butte County are shown in Figure 4-6. Snowfall is rare in the County and occurs in upper elevations of the County.

Figure 4-6 Western Butte County— Daily Temperature Averages and Extremes



Source: Western Regional Climate Center

Table 4-12 Butte County – Record Low Temperatures 1893 to 2016

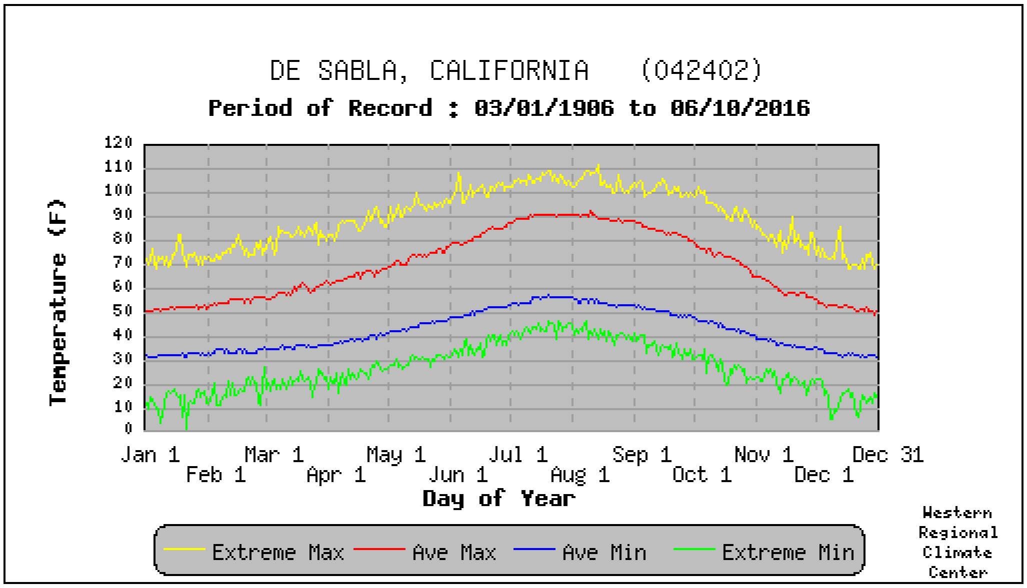
Month	Record Low	Date	Month	Record Low	Date
January	22°	1/2/1960	July	45°	7/3/2010
February	22°	2/3/1957	August	42°	8/31/1995
March	26°	3/3/1956	September	40°	9/16/1987
April	29°	4/2/1955	October	27°	10/27/2010
May	30°	5/12/1999	November	23°	11/26/2010
June	35°	6/11/1995	December	12°	12/2/1990

Source: Western Regional Climate Center

Eastern Butte County—De Sabla Weather Station, Period of Record 1906 to 2016

According to the WRCC, in eastern Butte County monthly average minimum temperatures from November through April range from the low-30s to low-40s. The lowest recorded daily extreme was -2°F on January 20, 1937. In a typical year, minimum temperatures fall below 32°F on 74.9 days with no days falling below 0°F. Table 4-13 shows the record low temperatures by month for Butte County. Average daily temperatures for Butte County are shown in Figure 4-8. Snowfall is rare in the County and occurs in upper elevations of the County.

Figure 4-7 Eastern Butte County— Daily Temperature Averages and Extremes



Source: Western Regional Climate Center

Table 4-13 Butte County – Record Low Temperatures 1906 to 2016

Month	Record Low	Date	Month	Record Low	Date
January	22°	1/2/1960	July	45°	7/3/2010
February	22°	2/3/1957	August	42°	8/31/1995
March	26°	3/3/1956	September	40°	9/16/1987
April	29°	4/2/1955	October	27°	10/27/2010
May	30°	5/12/1999	November	23°	11/26/2010
June	35°	6/11/1995	December	12°	12/2/1990

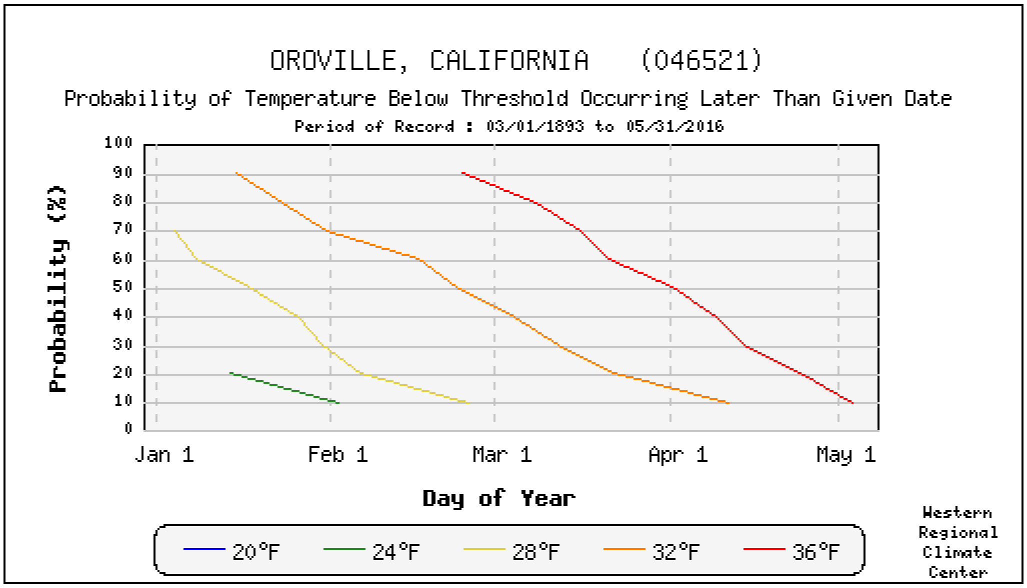
Source: Western Regional Climate Center

Location and Extent

Extreme cold and freeze events occur on a regional basis. Extreme cold can occur in any location of the County. All portions of the County are at risk to extreme cold, with the upper elevations at greater risk.

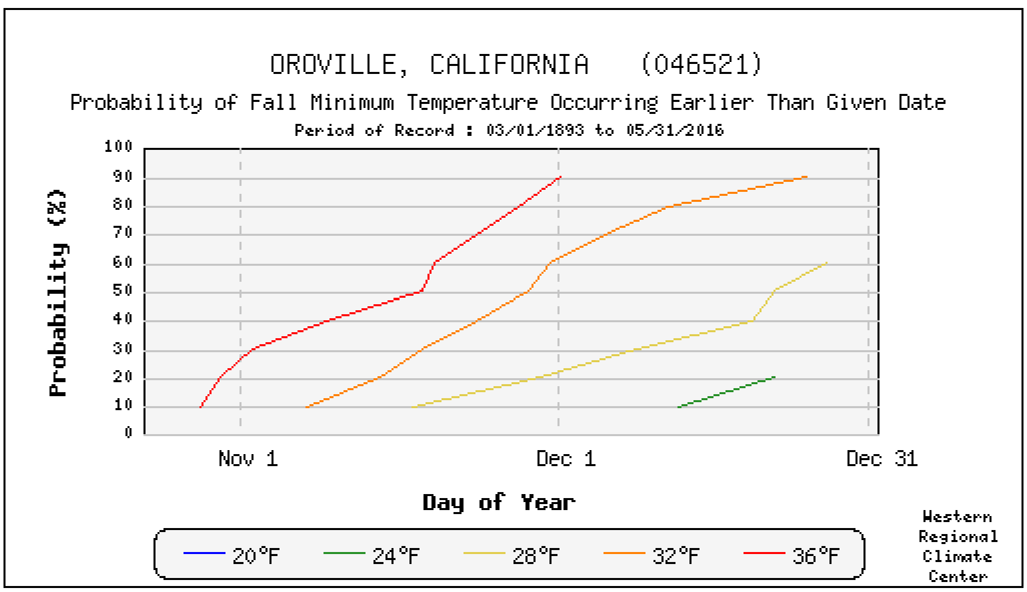
Extreme cold can also affect agricultural products in the County. Freeze damages reduce the values of agricultural crops. While there is no scale (i.e. Richter, Enhanced Fujita) to measure the effects of freeze, temperature data from the County from the WRCC indicates that there are 21.8 days that fall below 32°F in western Butte County. Freeze has a slow onset and can be generally be predicted in advance for the County. Freeze events can last for hours (in a cold overnight), or for days to weeks at a time. Figure 4-8 and Figure 4-9 show the probabilities in the County of freeze for both spring and fall in the western portion of the County, while Figure 4-10 and Figure 4-11 show the probabilities in the County of freeze for both spring and fall in the eastern portion of the County.

Figure 4-8 Western Butte County – Spring Freeze Probabilities



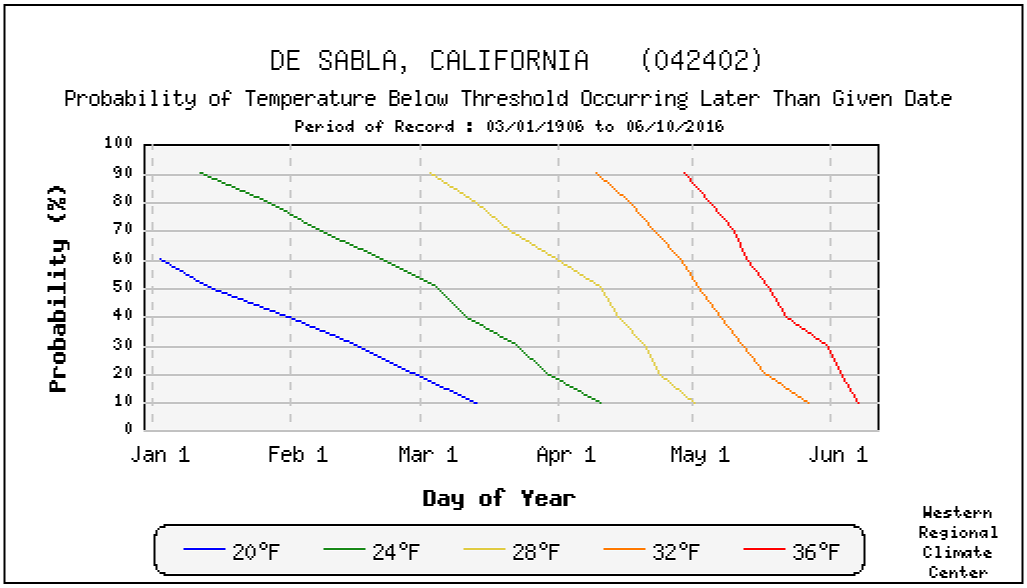
Source: Western Regional Climate Center

Figure 4-9 Western Butte County – Fall Freeze Probabilities



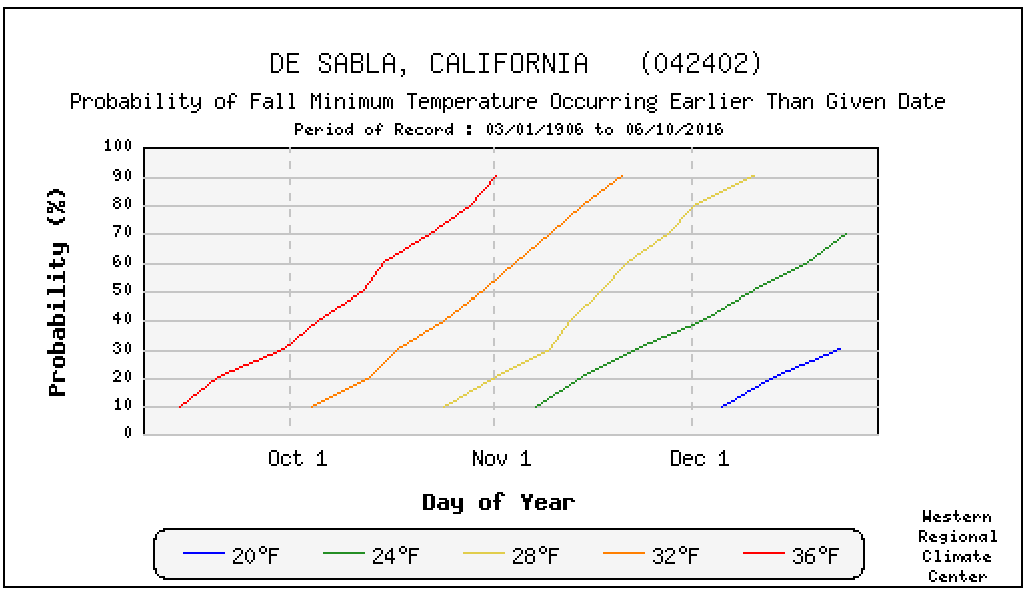
Source: Western Regional Climate Center

Figure 4-10 Eastern Butte County – Spring Freeze Probabilities



Source: Western Regional Climate Center

Figure 4-11 Eastern Butte County – Fall Freeze Probabilities



Source: Western Regional Climate Center

Winter Storm

Winter snowstorms can include snow, ice, and, in rare instances, blizzard conditions. Heavy snow can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns.

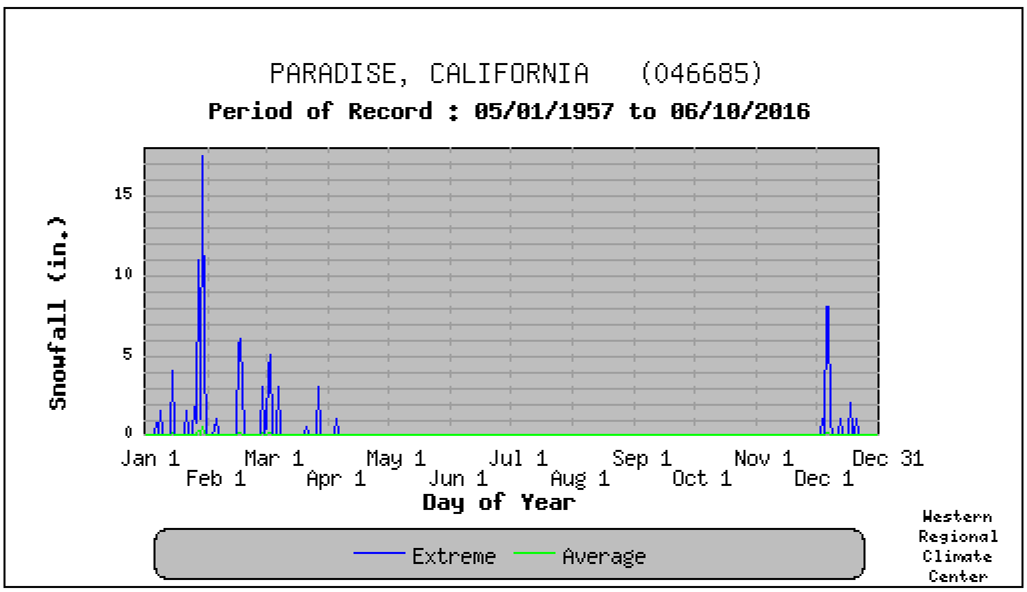
Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until the damage can be repaired. Power outages can have a significant impact on communities, especially critical facilities such as public utilities. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds accompanying these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibility to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents with injuries and deaths can result.

Location and Extent

Snowfall is measured in snowfall amounts and snow depths. In Butte County, while limited, snow falls primarily in and above the Town of Paradise, with snow occasionally falling at lower elevations. Between the period from 1957 to 2016, the annual average snowfall in the Town of Paradise was 2.2 inches of snow. The highest annual snowfall on record for the Town of Paradise was 32.4 inches occurring in the winter of 1972/1973. 18.8 inches of snow fell in December of 1972. Figure 4-12 illustrates the daily snowfall average and extreme for the Paradise Weather Station.

Figure 4-12 Town of Paradise Daily Average and Extreme Snowfall



Source: Western Regional Climate Center

The speed of onset of snow fall can often be predicted in advance. Snow stays on the ground until the ambient air temperature or ground temperature exceed 32°F.

Past Occurrences

Disaster Declaration History

The County has had two past federal and two past state disaster declarations for freeze or winter storm. Table 4-14 shows the dates of the disaster declarations.

Table 4-14 Butte County – State and Federal Disaster Declarations for Freeze 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Freeze	Freeze	2	1990, 2008	2

Source: Cal OES, FEMA

NCDC Events

The NCDC data shows 179 freeze and winter storm incidents for Butte County since 1993. Information for these events are shown in Table 4-11. Events with deaths, injuries, and damages in this table had no associated explanation in the NCDC database, therefore no events are described below the table.

*Table 4-15 NCDC Freeze and Winter Storm Events in Butte County 1993 to 10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Blizzard	1	0	0	0	0	$0	$0
Cold/Wind Chill	2	0	0	0	0	$2,400,000	$0
Frost/Freeze	5	0	0	0	0	$0	$0
Heavy Snow	25	1	0	0	0	$0	$0
Winter Storm	134	0	0	0	0	$150,000	$0
Winter Weather	12	0	0	0	0	$0	$0
Total	**179**	**1**	**0**	**0**	**0**	**$2,550,000**	**$0**

Source: NCDC
*Deaths, injuries, and damages are for the entire event, and may not be exclusive to the County.

HMPC Events

The HMPC noted the following freeze events:

- In **1993**, a severe winter storm in the spring caused damage to crops in Butte County. Almonds, kiwi, peaches, pistachios, prunes, and walnuts were affected. In excess of $8.8 million ($20 million in 2012 dollars) in damages were reported.
- In **March of 1995**, a severe winter storm affected crops in Butte County. Almonds and prune crops were affected. Damages to these crops exceeded $50 million. In addition, many orchards were flooded, leading to an additional $50 million in damages to irrigation systems, ditches, levees, pumps, roads, and buildings.

- In **March of 1998**, a severe winter storm affected crops in Butte County. Prunes, kiwi, walnuts, peaches, almonds, wheat, rice, barley, and alfalfa were affected. Damages to these crops exceeded $29 million.
- On **April 8 and 9 of 2001**, freeze damage affected crops in Butte County. Prunes, kiwi, walnuts, peaches, and almonds were affected. Damages to these crops exceeded $24 million.

The HMPC also noted that there were SBA Agriculture Disaster Declarations for Butte County in March-May 2016 (excessive rain, high winds, cold temps and hail), FEMA 4308 in February 2017 winter storms, flooding and mudslides, FEMA 4301 for severe winter storms in January 2017, and FEMA 4434 February 2019 winter storms declarations.

Likelihood of Future Occurrence

Highly Likely—Freeze and winter storms are likely to continue to occur annually in the Butte County Planning Area. In a typical year, minimum temperatures fall below 32°F on 21.8 and 74.9 days in the western and eastern County, respectively. This equates to a likelihood of future occurrences being considered highly likely.

Climate Change and Freeze and Snow

According to the CAS, freezing spells are likely to become less frequent in California as climate temperatures increase; if emissions increase, freezing events could occur only once per decade in large portion of the State by the second half of the 21st century. According to a California Natural Resources Report in 2014, it was determined that while fewer freezing spells would decrease cold related health effects, too few freezes could lead to increased incidence of disease as vectors and pathogens do not die off.

4.2.4. Severe Weather: Heavy Rains and Storms

Hazard/Problem Description

Storms in the Butte County Planning Area occur throughout the Planning Area 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. Heavy precipitation in the Butte County area falls mainly in the fall, winter, and spring months.

Heavy Rain and Storms

The NWS reports that storms and thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger.

The falling droplets create a downdraft of air that spreads out at Earth's surface and causes strong winds associated with thunderstorms.

According to the HMPC, short-term, heavy storms can cause both widespread flooding as well as extensive localized drainage issues. With the increased growth of the area, the lack of adequate drainage systems has become an increasingly important issue. In addition to the flooding that often occurs during these storms, strong winds, when combined with saturated ground conditions, can down very mature trees and powerlines.

Location and Extent

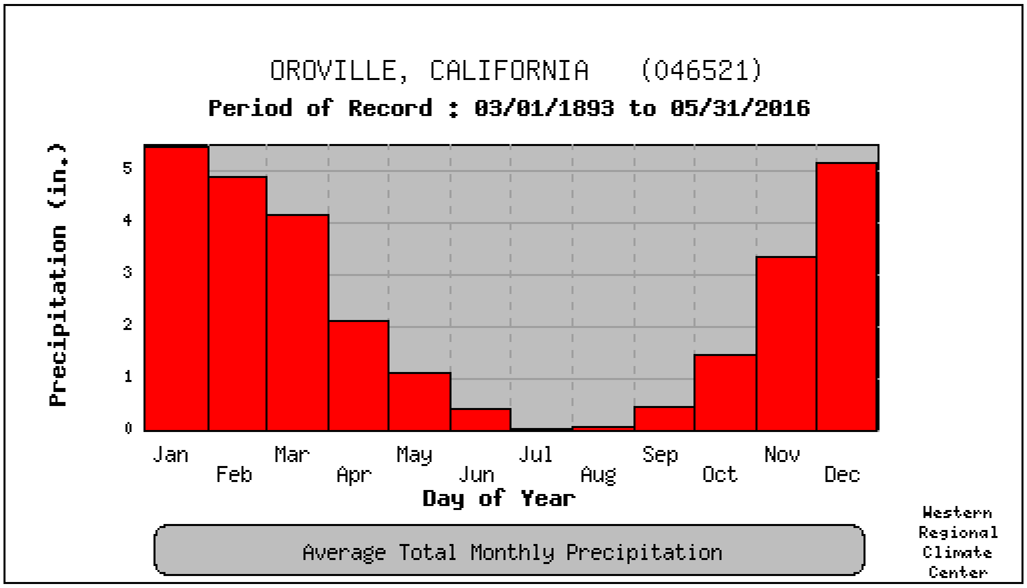
Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the County. All portions of the County are at risk to heavy rains. Most of these rains occur during the winter months, as discussed below.

There is no scale by which heavy rains are measured – usually it is measured in terms of rainfall amounts. 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 thunderstorms in California is often short, ranging from minutes to hours. Information from the Butte WRCC stations in the eastern and western County are summarized below.

Western Butte County—Oroville Weather Station, Period of Record 1893 to 2016

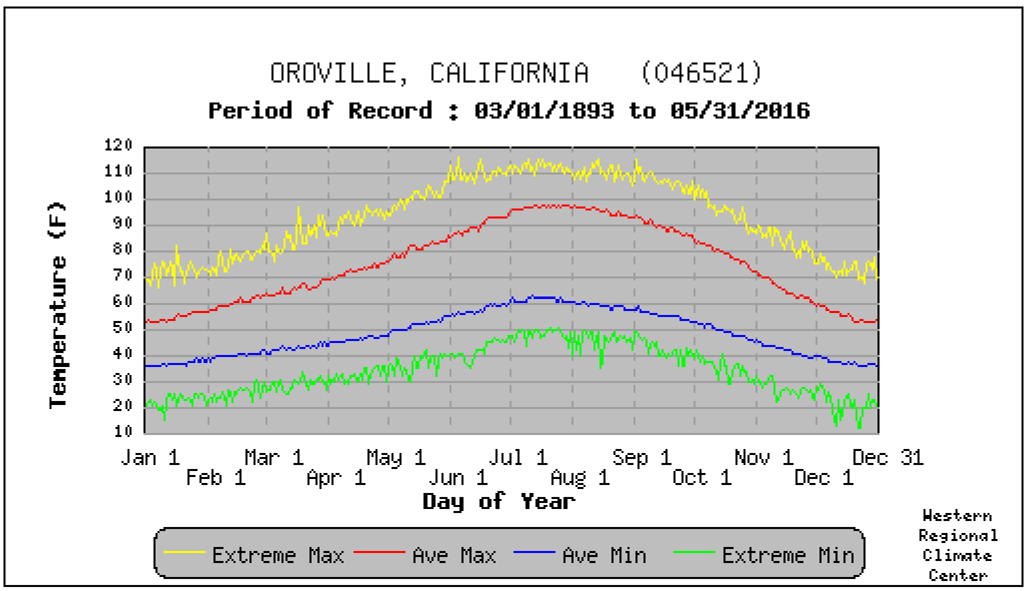
According to the WRCC, average annual precipitation in western Butte County is 28.69 inches per year. The highest recorded annual precipitation is 59.98 inches in 1983; the highest recorded precipitation for a 24-hour period is 5.06 inches on October 13, 1962. The lowest recorded annual precipitation was 15.46 inches in 1971. Average monthly precipitation for western Butte County is shown in Figure 4-13. Daily average and extreme precipitations are shown in Figure 4-14.

Figure 4-13 Western Butte County—Monthly Average Total Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Figure 4-14 Western Butte County—Daily Average and Extreme Precipitation

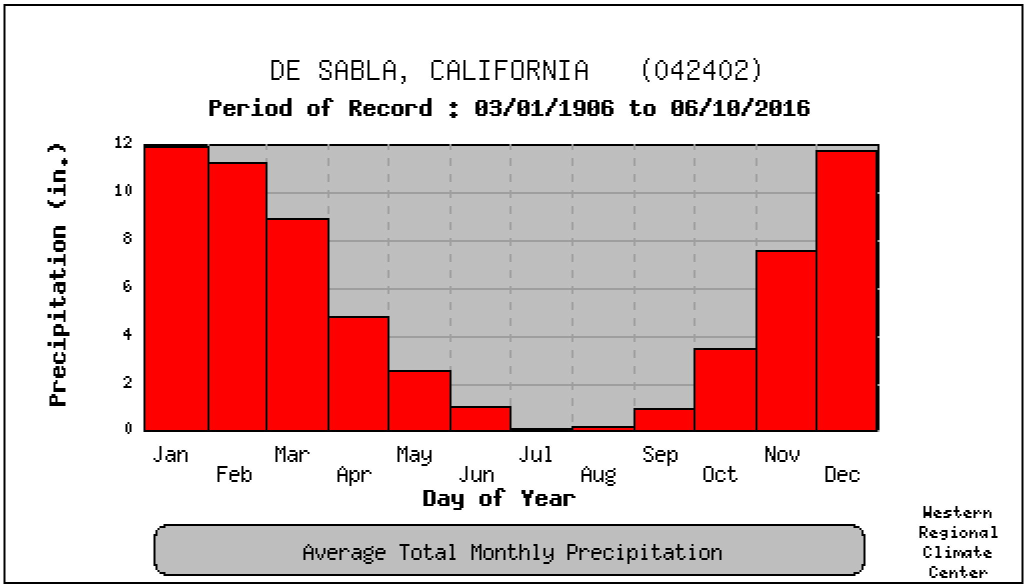


Source: Western Regional Climate Center, www.wrcc.dri.edu/

Eastern Butte County—De Sabla Weather Station, Period of Record 1906 to 2016

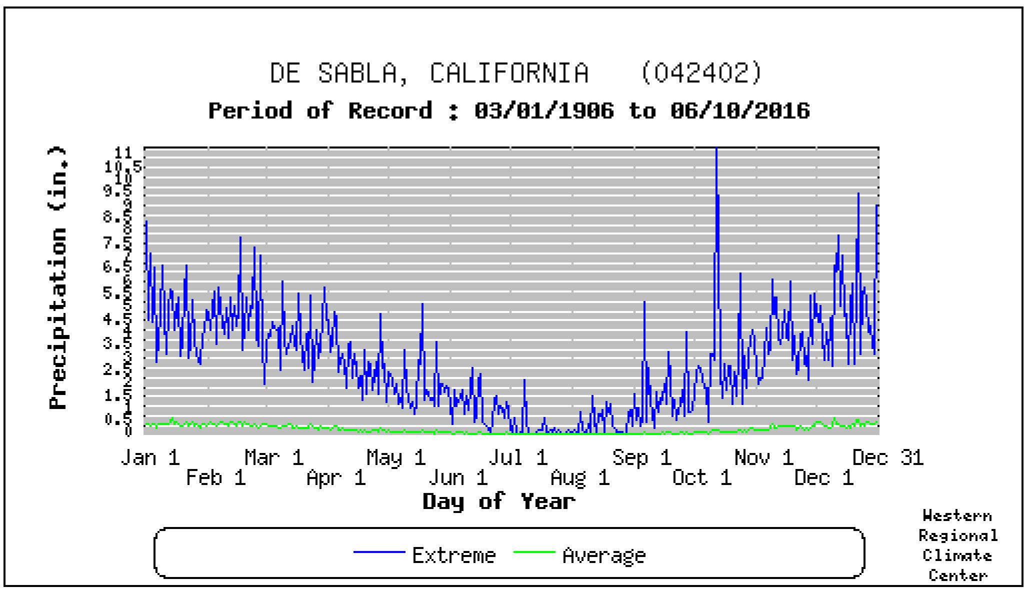
According to the WRCC, average annual precipitation in eastern Butte County is 64.07 inches per year. The highest recorded annual precipitation is 121.24 inches in 1983; the highest recorded precipitation for a 24-hour period is 11.27 inches on December 12, 1964. The lowest recorded annual precipitation was 22.66 inches in 1976. Average monthly precipitation for eastern Butte County is shown in Figure 4-15. Daily average and extreme precipitations are shown in Figure 4-16.

Figure 4-15 Eastern Butte County—Monthly Average Total Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

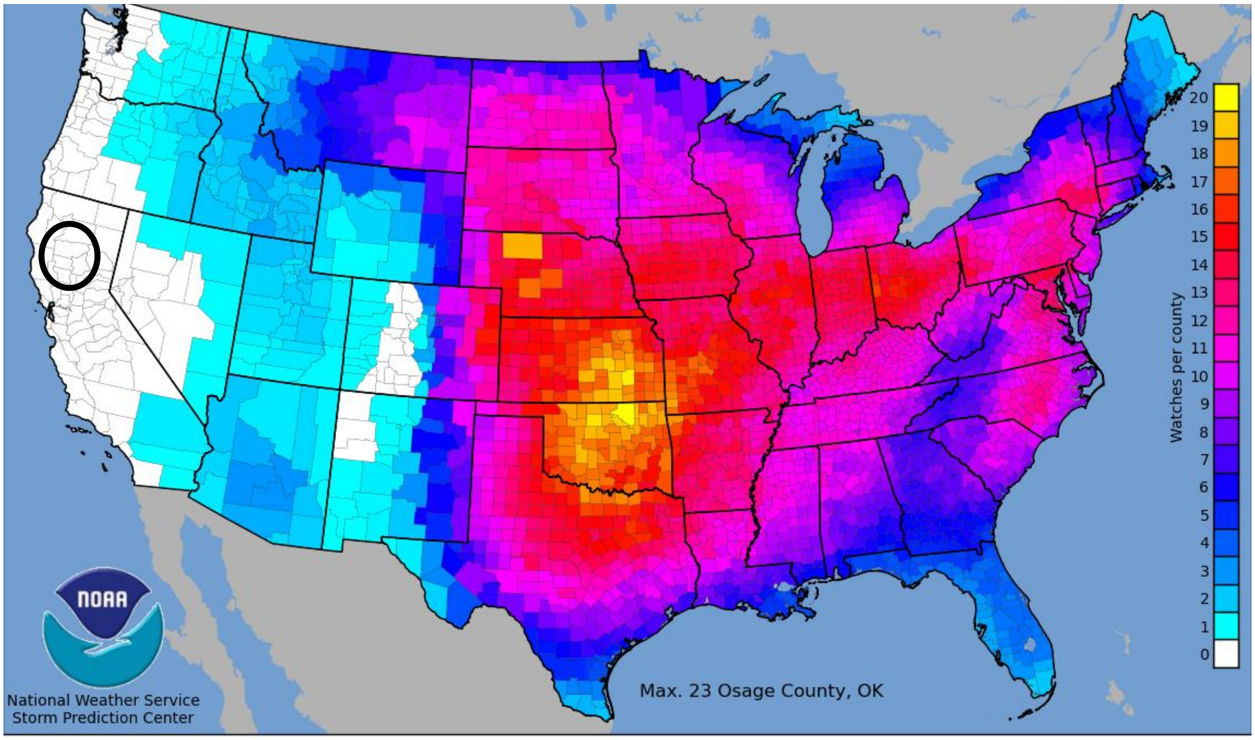
Figure 4-16 Eastern Butte County—Daily Average and Extreme Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

The NOAA Storm Prediction Center tracks thunderstorm watches on a county basis. Figure 4-17 shows thunderstorm watches in Butte County and the United States for a 20-year period between 1993 and 2012.

Figure 4-17 Butte County – Average Thunderstorm Watches per Year (1993 to 2012)



Source: NOAA Storm Prediction Center

Hail

Hail can occur throughout the Planning Area during storm events, though it is rare in the County. Hail is formed when water droplets freeze and thaw as they are thrown high into the upper atmosphere by the violent internal forces of thunderstorms. Hail is sometimes associated with severe storms within the Butte County Planning Area. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph). Severe hailstorms can be quite destructive, causing damage to roofs, buildings, automobiles, vegetation, and crops.

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-16 indicates the hailstone measurements utilized by the National Weather Service.

Table 4-16 Hailstone Measurements

Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball
.75 inch	Dime/Penny
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball

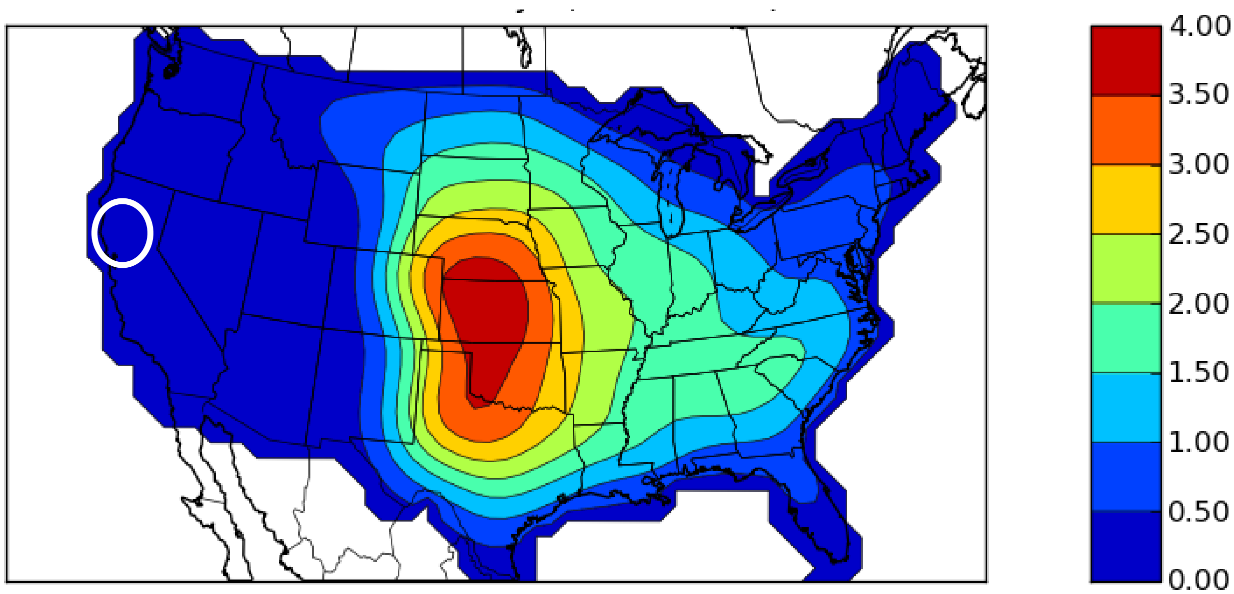
Average Diameter	Corresponding Household Object
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

Location and Extent

Hail events can occur in any location of the County. All portions of the County are at risk to hail. Hail tends to be rare in California and the Planning Area. There is no scale in which to measure hail, other than hail stone size as detailed above. The speed of onset of hail can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms that can cause hail in California is often short, ranging from minutes to hours. Hail events last shorter than the duration of the total thunderstorm. The National Weather Service tracks hail events. Figure 4-18 shows the average days each year where hail of greater than 1" in diameter occurred during a 20-year period from 1990 to 2009.

Figure 4-18 Butte County – Average Hail Days per Year (1990 to 2009)



Source: National Weather Service

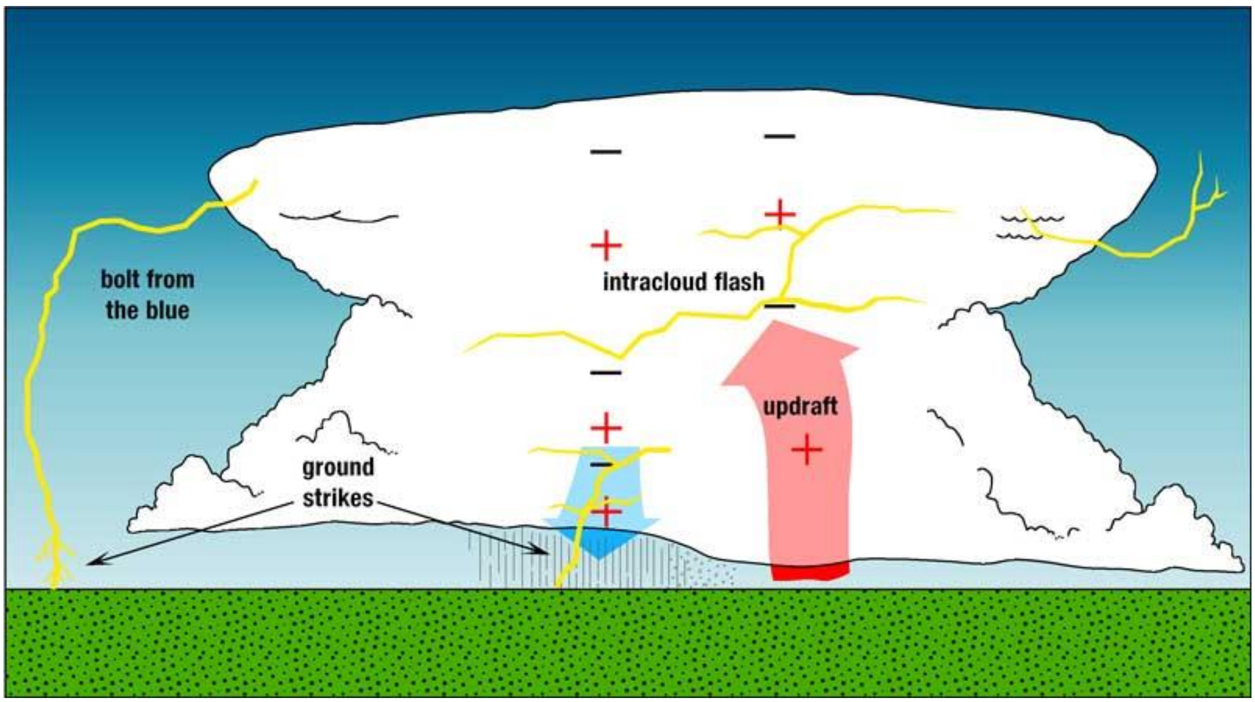
Lightning

Lightning can occur throughout the County during storm events. Lightning is defined by the NWS as any and all of the various forms of visible electrical discharge caused by thunderstorms. Thunderstorms and lightning are usually (but not always) accompanied by rain. Cloud-to-ground lightning can kill or injure people by direct or indirect means. Objects can be struck directly, which may result in an explosion, burn, or total destruction. Or, damage may be indirect, when the current passes through or near an object, which generally results in less damage.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat (see Figure 4-19). Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

Figure 4-19 Cloud to Ground Lightning



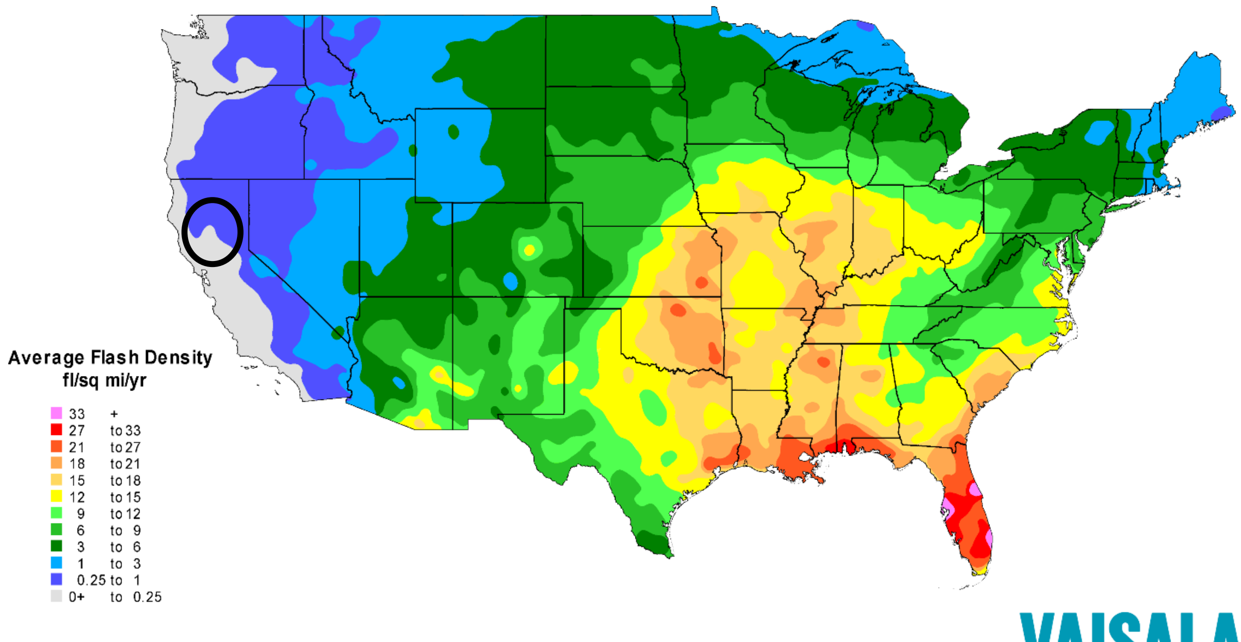
Source: National Weather Service

Lightning in the County is also a concern due to the number of fires that are started by lightning strikes. Wildfire is discussed in more detail in Section 4.2.19.

Location and Extent

Lightning events can occur in any location of the County and are often associated with thunderstorms. All portions of the County are at risk to lightning. Lightning in the County can occur during thunderstorms. The speed of onset of thunderstorms that can cause lightning can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms in California is often short, ranging from minutes to hours. Thunderstorms and lightning are rare in the County. Vaisala maintains the National Lightning Detection Network. It tracks cloud to ground lightning incidences in the United States. Figure 4-20 shows lightning incidences in the County and the rest of the United States from 1997 to 2012.

Figure 4-20 Butte County – Lightning Incidence Map 1997 to 2012



Source: Vaisala National Lightning Detection Network

Past Occurrences

Disaster Declaration History

A search of FEMA and Cal OES disaster declarations turned up multiple events. Heavy rains and storms have caused flooding in the County. Events where heavy rains and storms and resultant flooding resulted in a state or federal disaster declaration are shown in Table 4-17.

Table 4-17 Butte County – Disaster Declarations from Heavy Rain and Storms 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (including heavy rain and storms)	17	1955, 1958, 1962, 1964, 1969, 1970, 1982, 1986, 1995 (twice), 1997, 1998, 2005, 2017 (three times), 2019	17	1950,1955, 1958 (twice), 1962, 1963, 1969, 1970, 1982, 1986, 1990, 1995 (twice), 1997, 1998, 2008, 2017

Source: FEMA, Cal OES

NCDC Events

The NCDC data recorded 31 heavy rain, hail, and lightning incidents for Butte County since 1950. A summary of these events is shown in Table 4-18. Text below the table details events where damages, injuries, or deaths occurred. More information on past occurrences of heavy rains can be found in the flood profile in Section 4.2.10 and in the localized flood profile in Section 4.2.11.

*Table 4-18 NCDC Severe Weather Events in Butte County 1950-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Hail	9	0	0	0	0	$0	$0
Heavy Rain	19	0	0	0	0	$6,000	$0
Lightning	3	0	0	0	0	$135,000	$0
Total	**31**	**0**	**0**	**0**	**0**	**$141,000**	**$ 0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Butte County

6/5/2007 - Lightning struck a deodora cedar tree, causing an explosion which sent debris up to 300 feet away. Pieces of flying wood damaged an apartment awning, the roof of a home, and several vehicles. Another lightning strike on a transformer left 1,800 customers without power for up to four hours. $80,000 in damages occurred. No injuries or deaths were reported.

3/3/2009 - Lighting struck a dentist office, damaging a swamp cooler on the roof, the office computer, and the phone system. No injuries or deaths were reported, but damages of $10,000 were sustained.

October 2, 2016 – Hail up to 1 inch in diameter was reported in Chico. No injuries or deaths were reported. Damage estimates were unavailable.

4/13/2017 - Lightning struck a very large oak tree near Bidwell Mansion in Chico. Large tree limbs came down, damaging 9 cars, causing $45,000 in damages. No injuries or deaths were reported.

Hazard Mitigation Planning Committee Events

The HMPC also noted the following events:

- The EOC was activated for storms in January of 2018, as well as for storms in February of 2019. The 2019 event resulted in a federal disaster declaration.

The HMPC also noted that there were SBA Agriculture Disaster Declarations for Butte County in March-May 2016 (excessive rain, high winds, cold temps and hail), FEMA 4308 in February 2017 winter storms, flooding and mudslides, FEMA 4301 for severe winter storms in January 2017, and FEMA 4434 February 2019 winter storms

Likelihood of Future Occurrence

Highly Likely – Based on NCDC data and HMPC input, 31 heavy rain and storm incidents over a 69-year period (1950-2018) equates to a severe storm event every 2.22 years. As noted, this database likely doesn't capture all heavy rain, hail, lightning, and winter weather events. Severe weather is a well-documented seasonal occurrence that will continue to occur often in the Butte County Planning Area.

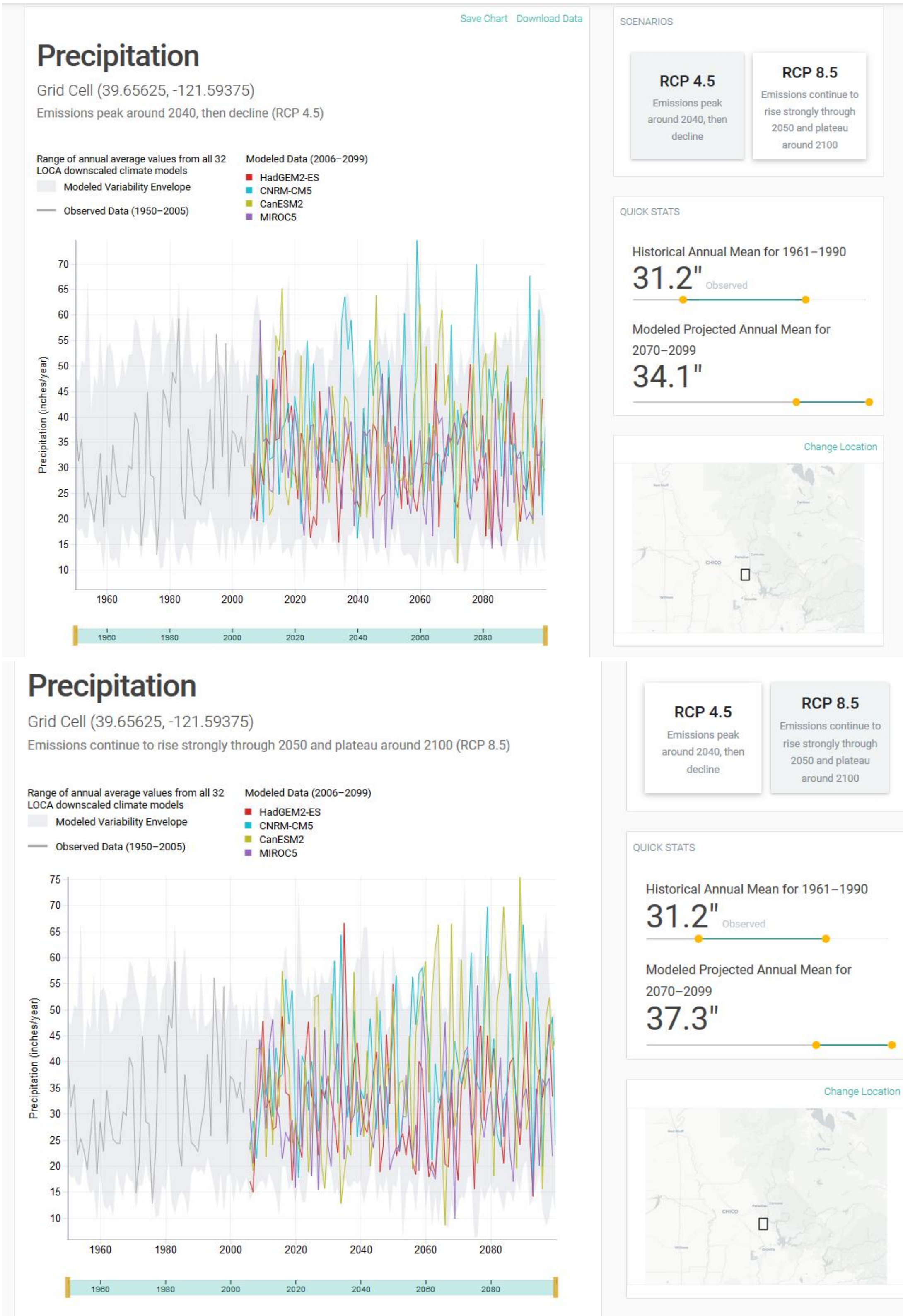
Climate Change and Heavy Rains and Storms

According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is unlikely that hail will become more common in the County. The amount of lightning is not projected to change.

Cal-Adapt noted that, on average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century. The Mediterranean seasonal precipitation pattern is expected to continue, with most precipitation falling during winter from North Pacific storms. One of the four climate models projects slightly wetter winters, and another projects slightly drier winters with a 10 to 20 percent decrease in total annual precipitation. However, even modest changes would have a significant impact because California ecosystems are conditioned to historical precipitation levels and water resources are nearly fully utilized. Future precipitation estimates for the County are shown in Figure 4-21.

- The upper chart shows annual averages of observed and projected Precipitation values for the selected area on map under the RCP 4.5 scenario. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.
- The lower chart shows annual averages of observed and projected Precipitation values for the selected area on map under the RCP 8.5 scenario. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.

Figure 4-21 Butte County– Future Precipitation Estimates: High and Low Emission Scenarios



Source: Cal-Adapt – Precipitation: Decadal Averages Map

4.2.5. Severe Weather: High Winds and Tornadoes

Hazard/Problem Description

High Winds

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.

Straight-line winds may also exacerbate existing weather conditions by increasing the effect on temperature and decreasing visibility due to the movement of particulate matters through the air, as in dust and snowstorms. The winds may also exacerbate fire conditions by drying out the ground cover, propelling fuel around the region, and increasing the ferocity of exiting fires. These winds may damage crops, push automobiles off roads, damage roofs and structures, and cause secondary damage due to flying debris.

Location and Extent

The entire Planning Area is subject to significant, non-tornadic (straight-line), winds. Each area of the County 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. Figure 4-22 shows the Beaufort wind scale.

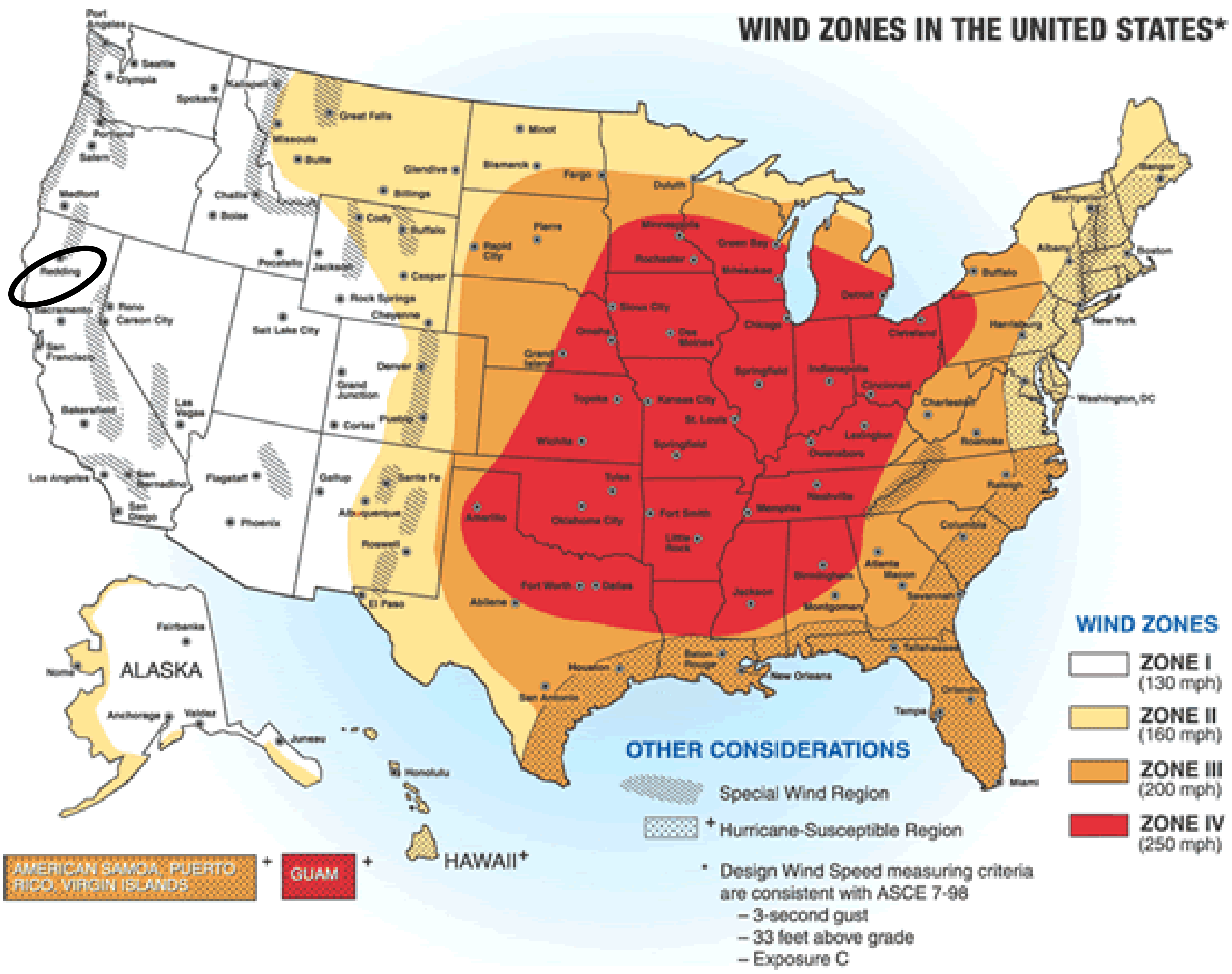
Figure 4-22 Beaufort Wind Scale

Beaufort Number	Wind Speed (miles/hour)	Wind Speed (km/hour)	Wind Speed (knots)	Description	Wind Effects on Land
0	< 1	< 1	< 1	Calm	Calm. Smoke rises vertically.
1	1-3	1-5	1-3	Light Air	Wind motion visible in smoke.
2	4-7	6-11	4-6	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	12-19	7-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	20-28	11-16	Moderate Breeze	Dust and loose paper are raised. Small branches begin to move.
5	19-24	29-38	17-21	Fresh Breeze	Small trees begin to sway.
6	25-31	39-49	22-27	Strong Breeze	Large branches are in motion. Whistling is heard in overhead wires. Umbrella use is difficult.
7	32-38	50-61	28-33	Near Gale	Whole trees in motion. Some difficulty experienced walking into the wind.
8	39-46	62-74	34-40	Gale	Twigs and small branches break from trees. Cars veer on road.
9	47-54	75-88	41-47	Strong Gale	Larger branches break from trees. Light structural damage.
10	55-63	89-102	48-55	Storm	Trees broken and uprooted. Considerable structural damage.
11	64-72	103-117	56-63	Violent Storm	Widespread damage to structures and vegetation.
12	> 73	> 117	> 64	Hurricane	Considerable and widespread damage to structures and vegetation. Violence.

Source: National Weather Service

Figure 4-23 depicts wind zones for the United States. The map denotes that Butte County falls into Zone I, which is characterized by high winds of up to 130 mph.

Figure 4-23 Wind Zones in the United States

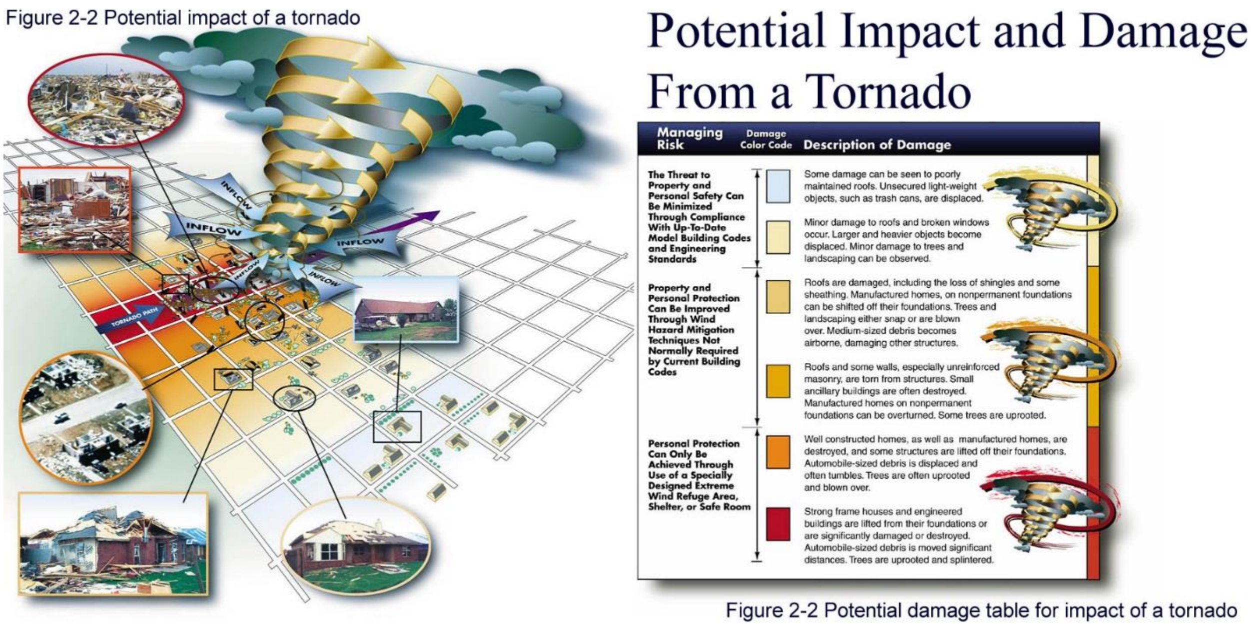


Source: FEMA

Tornadoes

Tornadoes and funnel clouds can also occur during these types of severe storms. Tornadoes are another severe weather hazard that, though rare, can affect areas in the Valley in the Butte County Planning Area, primarily during the rainy season in the late fall and early spring. Tornadoes form when cool, dry air sits on top of warm, moist air. Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes are the most powerful storms that exist. They can have the same pressure differential across a path only 300 yards wide or less as 300-mile-wide hurricanes. Figure 4-24 illustrates the potential impact and damage from a tornado.

Figure 4-24 Potential Impact and Damage from a Tornado



Source: FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes

Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, the majority of injuries and deaths generally result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

Location and Extent

Tornadoes, while rare, can occur at any location in the County. The areas in the Valley in the County tend to be at greater risk than the areas in the foothills and at elevation. Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table 4-19 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 4-20 shows the wind speeds associated with the Enhanced Fujita Scale ratings.

Table 4-19 Original Fujita Scale

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/f-scale.html

Table 4-20 Enhanced Fujita Scale

Enhanced Fujita (EF) Scale	Enhanced Fujita Scale Wind Estimate (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/ef-scale.html

It is difficult to predict a tornado or the conditions that preclude a tornado far in advance. Tornadoes can strike quickly with very little warning. In California it is rare for tornadoes to exceed EF3 magnitude. Most tornadoes that touch down are not long lived.

Past Occurrences

Disaster Declaration History

There have been no past federal or state disaster declarations due to high winds or tornadoes, according to Table 4-4.

NCDC Events

The NCDC data recorded 43 high wind and 16 tornado incidents for Butte County since 1950. A summary of these events is shown in Table 4-21. Events where damages occurred in the County are discussed below the table.

*Table 4-21 NCDC High Wind and Tornado Events in Butte County 1950-10/31/2018**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
High Winds	34	3	0	2	0	$11,425,000	$30,000,000
Strong Wind	2	0	1	0	0	$300,000	$0
Thunderstorm Wind	7	0	0	0	0	$1,020,000	$0
Tornado	16	0	0	6	0	$8,230,500	$50
Total	**59**	**3**	**1**	**8**	**0**	**$20,975,500**	**$30,000,050**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Butte County

June 28, 1970 – An F1 tornado touched down in the County. No injuries or deaths were reported. No property damages were reported.

March 4, 1978 – A tornado touched down in the County. Its magnitude on the F Scale was unknown. No injuries or deaths were reported. $3,000 in property damages was reported.

March 23, 1978 – A tornado touched down in the County. Its magnitude on the F Scale was unknown. No injuries or deaths were reported. $25,000 in property damages was reported.

January 22, 1981 – An F0 tornado touched down in the County. No injuries or deaths were reported. $3,000 in property damages was reported.

December 17, 1992 – An F1 tornado touched down in the County. 4 injuries and 0 deaths were reported. $2,500,000 in property damages was reported.

January 7, 1993 – An F1 tornado touched down in the County near Biggs. A barn roof was tossed 75 feet and 2 vehicles were damaged by the tornado. No injuries or deaths were reported. $50,000 in property damages was reported.

April 17, 1993 – An F0 tornado touched down in the County in Chico. A tornado touched down in the center of Chico near Fourth Street and Chico State University. The brief touchdown resulted in damage to a number of trees, and was observed by local authorities. No injuries or deaths were reported. $10,000 in property damages was reported.

February 10, 1994 – An F2 tornado touched down in the County near Oroville. A tornado formed behind a cold front and traveled through a housing subdivision in Oroville. A total of 47 homes were damaged. One home was destroyed while 25 others suffered major damage. 2 injuries and 0 deaths were reported. $5,000,000 in property damages was reported.

March 10, 1994 – An F0 tornado touched down in the County near Oroville. A resident saw the tornado illuminated by a lightning strike as it uprooted trees in his neighborhood. The falling trees damaged houses, and knocked out power lines. No injuries or deaths were reported. $500,000 in property damages was reported.

April 25, 1994 – An F0 tornado touched down in the County near Honcut. Fire department officials spotted the tornado as it briefly touched down in southern Butte County. No injuries or deaths were reported. No property damages were reported.

May 16, 1998 – An F0 tornado touched down in the County near Richvale. No injuries or deaths were reported. No property damages were reported.

January 8, 2005 – An F1 tornado touched down in the County near Oroville. Brief touchdown reported south of Oroville damaging two structures. No injuries or deaths were reported. $20,000 in property damages was reported.

April 8, 2005 – An F0 tornado touched down in the County near Durham. Minor damage was done to a residence and nearby trees. No injuries or deaths were reported. $10,000 in property damages was reported.

January 4, 2008 - High wind was recorded across the area including a 69-mph wind gust at Yuba City, a 66-mph wind gust at Chico airport, and a 61-mph wind gust at Marysville airport. A Yuba County employee was killed along Griffith Avenue just south of North Beale Road in Linda when he was struck by a falling eucalyptus tree branch while clearing roads of debris. There were many power outages due to power poles down from fallen trees and hundreds of customers were without power for up to seven days. Fallen trees and branches and flying debris also damaged cars and buildings. Damages in the area (both inside Butte County and in surrounding counties) total $10 million, with an additional $30 million in crop damages.

May 25, 2011 – An F2 tornado touched down in the County near Thermalito. Three tornadoes moved through Glenn and Butte Counties the evening of May 25, 2011. Significant damage was caused to several structures and thousands of almond trees were destroyed. No injuries or deaths were reported. $120,000 in property damages was reported.

March 25, 2014 – An EF0 tornado touched down near Highway 99 between Skyway Road and Neal Road at around 7:15pm. Winds were estimated to be 65mph. A rotted tree along Neal Road was blown down, and branches were blown off of surrounding trees. Swirl marks were on the ground, but the tornado was no more than 10-15 yards wide. No injuries or damages were reported.

March 29, 2014 - At approximately 7:40pm, a trained spotter saw a funnel cloud associated with a supercell near Nord, CA while travelling on Highway 99 just east of Cana Highway. He witnessed the funnel cloud briefly touch down to the ground and then lift again. NWS storm survey found an uprooted tree in an orchard where the touchdown occurred, and swirl marks in the ground surrounding the tree. No injuries or damages were reported.

December 30, 2014 - Northeast winds behind a cold front brought down large trees in Paradise, Butte County. At 7:19 am PST, 2 large trees fell on a residence on Lofty Lane, which resulted in the death of an adult male. Numerous trees and powerlines were knocked down in Paradise and Magalia. There were over 3000 customers without power. Winds gusted to 66 mph at Jarbo Gap. In total, $4 million in property damage was recorded.

November 2, 2015 – A collapsing thunderstorm resulted in a downburst which brought strong straight-line winds which snapped 6 power poles along east Eaton Rd. and Godman Ave in Chico. There were 10,000

PG&E customers without power. No injuries or deaths were reported, but $1 million in property damages were attributed to these winds.

November 15, 2015 – Trees and power lines were knocked down in east Biggs by winds from a microburst. The California Highway Patrol, Cal Fire-Butte County and Pacific Gas and Electric responded to reports of downed power lines on Dos Rios Road in East Biggs. PG&E's outage map indicated that about 104 residences were affected by the outage. No injuries or deaths were reported, but $20,000 in property damages were attributed to these high winds.

HMPC Events

The County noted that while wind and tornado can occur with frequency in the County, past events not included in the NCDC data above could not be recalled.

Likelihood of Future Occurrence

Highly Likely/Likely – Based on NCDC data and HMPC input, 59 wind and tornado incidents over a 63-year period (1955-2017) equates to a severe wind/tornado event every 3.3 years. However, as noted, this database likely doesn't capture all wind events. High winds are a well-documented seasonal occurrence that will continue to occur annually in the Butte County Planning Area. Tornadoes tend to be rarer in the County, and warrant a likelihood of future occurrence rating of likely.

Climate Change and High Winds

According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual thunderstorm events is likely to increase during the 21st century. This may bring stronger thunderstorm winds. The CAS does not discuss non-thunderstorm winds.

4.2.6. Climate Change

Hazard/Problem Description

Climate change is the distinct change in measures of weather patterns over a long period of time, ranging from decades to millions of years. More specifically, it may be a change in average weather conditions such as temperature, rainfall, snow, ocean and atmospheric circulation, or in the distribution of weather around the average. While the Earth's climate has cycled over its 4.5-billion-year age, these natural cycles have taken place gradually over millennia, and the Holocene, the most recent epoch in which human civilization developed, has been characterized by a highly stable climate – until recently.

This LHMP Update is concerned with human-induced climate change that has been rapidly warming the Earth at rates unprecedented in the last 1,000 years. Since industrialization began in the 19th century, the burning of fossil fuels (coal, oil, and natural gas) at escalating quantities has released vast amounts of carbon dioxide and other greenhouse gases responsible for trapping heat in the atmosphere, increasing the average temperature of the Earth. Secondary impacts include changes in precipitation patterns, the global water cycle, melting glaciers and ice caps, and rising sea levels. According to the Intergovernmental Panel on

Climate Change (IPCC), climate change will "increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" if unchecked.

Through changes to oceanic and atmospheric circulation cycles and increasing heat, climate change affects weather systems around the world. Climate change increases the likelihood and exacerbates the severity of extreme weather – more frequent or intense storms, floods, droughts, and heat waves. The 2018 Butte County Climate Change Vulnerability Assessment noted that there are direct and secondary impacts:

- Direct Impacts
  - ✓ Increase in average temperature
  - ✓ Changes in annual precipitation
- Secondary Impacts
  - ✓ Increased frequency, intensity, and duration of extreme heat days and heat waves/events
  - ✓ Increased flooding
  - ✓ Increased wildfire
  - ✓ Loss of snowpack and decreased water supplies

Consequences for human society include loss of life and injury, damaged infrastructure, long-term health effects, loss of agricultural crops, disrupted transport and freight, and more. Climate change is not a discrete event but a long-term hazard, the effects of which communities are already experiencing.

Climate change adaptation is a key priority of the State of California. The 2018 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

In Butte County, the HMPC noted that each year it seems to get a bit warmer. It was also noted that 2017 was one of the wettest years ever. California's Adaptation Planning Guide: Understanding Regional Characteristics has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. Butte County falls within the Northern Central Valley Region characterized as an agricultural, inland region with over 3.7 million people, with substantial cities, the largest being the state capitol, Sacramento. Agriculture is the predominant economic activity. The agricultural operations in this region include rice, dairy, and nut trees (almond and walnut). The region's agricultural activity is one of the most productive in the nation. Table 4-22 provides a summary of Cal-Adapt Climate Projections for the North Central Valley Region.

Table 4-22 Butte County – Cal Adapt Climate Projections

Effect	Ranges
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)

Effect	Ranges
Precipitation	Annual precipitation is projected to decline by approximately one to two inches by 2050 and three to six inches by 2100. (Community Climate System Model Version 3 (CCSM3) climate model; high carbon emissions scenario)
Heat wave	Heat wave is defined as five days over 102°F to 105°F, except in the mountainous areas to the east. Two to three more heat waves per year are expected by 2050 with five to eight more by 2100.
Wildfire	By 2085, the north and eastern portions of the region will experience an increase in wildfire risk, more than 4 times current levels in some areas. (Geophysical Fluid Dynamics Laboratory (GFDL) climate model; high carbon emissions scenario)

Source: Cal-Adapt

Location and Extent

Climate change is a global phenomenon. It is expected to affect the whole of the County. There is no scale to measure the extent of climate change. Climate change exacerbates other hazards, such as drought, extreme heat, flooding, wildfire, and others. The speed of onset of climate change is very slow. The duration of climate change is not yet known, but is feared to be tens to hundreds of years.

Past Occurrences

Disaster Declaration History

Climate change has never been directly linked to any declared disasters, as shown in Table 4-4.

NCDC Events

The NCDC does not track climate change events.

Hazard Mitigation Planning Committee Events

While the HMPC noted that climate change is of concern, no specific impacts of climate change could be recalled. HMPC members noted that the strength of storms does seem to be increasing and the temperatures seem to be getting hotter.

Likelihood of Future Occurrence

Highly Likely – Climate change is virtually certain to continue without immediate and effective global action. According to NASA, 2018 was on track to be one of the hottest years on record, and 15 of the 17 hottest years ever have occurred since 2000. Without significant global action to reduce greenhouse gas emissions, the IPCC concludes in its Fifth Assessment Synthesis Report (2014) that average global temperatures are likely to exceed 1.5 C by the end of the 21st century, with consequences for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges.

Climate Scenarios

The United Nations IPCC developed several greenhouse gas (GHG) emissions scenarios based on differing sets of assumptions about future economic growth, population growth, fossil fuel use, and other factors. The emissions scenarios range from "business-as-usual" (i.e., minimal change in the current emissions trends) to more progressive (i.e., international leaders implement aggressive emissions reductions policies). Each of these scenarios leads to a corresponding GHG concentration, which is then used in climate models to examine how the climate may react to varying levels of GHGs. Climate researchers use many global climate models to assess the potential changes in climate due to increased GHGs.

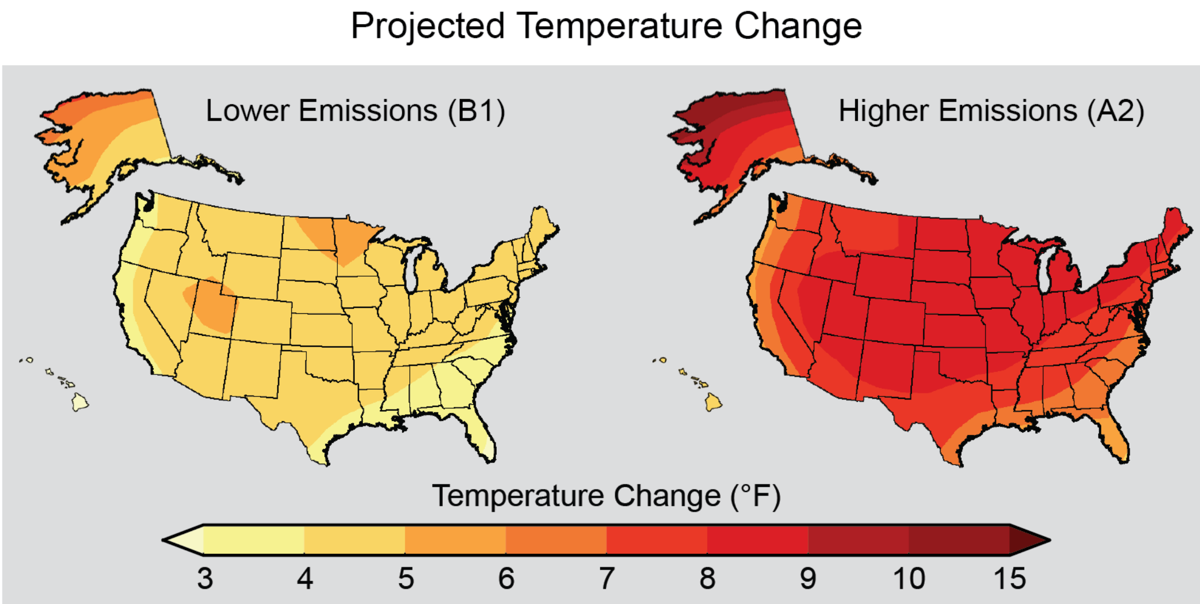
Key Uncertainties Associated with Climate Projections

- Climate projections and impacts, like other types of research about future conditions, are characterized by uncertainty. Climate projection uncertainties include but are not limited to:
  - ✓ Levels of future greenhouse gas concentrations and other radiatively important gases and aerosols,
  - ✓ Sensitivity of the climate system to greenhouse gas concentrations and other radiatively important gases and aerosols,
  - ✓ Inherent climate variability, and
  - ✓ Changes in local physical processes (such as afternoon sea breezes) that are not captured by global climate models.

Even though precise quantitative climate projections at the local scale are characterized by uncertainties, the information provided can help identify the potential risks associated with climate variability/climate change and support long term mitigation and adaptation planning.

Maps show projected change in average surface air temperature in the later part of this century (2071-2099) relative to the later part of the last century (1970-1999) under a scenario that assumes substantial reductions in heat trapping gases and a higher emissions scenario that assumes continued increases in global emissions. These are shown in Figure 4-25.

Figure 4-25 Projected Temperature Change – Lower and Higher Emissions Scenario



Source: National Climate Assessment

According to the California Natural Resource Agency (CNRA), climate change is already affecting California and is projected to continue to do so well into the foreseeable future. Current and projected changes include increased temperatures, sea level rise, a reduced winter snowpack altered precipitation patterns, and more frequent storm events. Over the long term, reducing greenhouse gases can help make these changes less severe, but the changes cannot be avoided entirely. Unavoidable climate impacts can result in a variety of secondary consequences including detrimental impacts on human health and safety, economic continuity, ecosystem integrity and provision of basic services.

The CNRA's 2014 Climate Adaptation Strategy (CAS) delineated how climate change may impact and exacerbate natural hazards in the future, including wildfires, extreme heat, floods, and drought:

- Climate change is expected to lead to increases in the frequency, intensity, and duration of extreme heat events and heat waves in Butte County and the rest of California, which are likely to increase the risk of mortality and morbidity due to heat-related illness and exacerbation of existing chronic health conditions. Those most at risk and vulnerable to climate-related illness are the elderly, individuals with chronic conditions such as heart and lung disease, diabetes, and mental illnesses, infants, the socially or economically disadvantaged, and those who work outdoors.
- Higher temperatures will melt the Sierra snowpack earlier and drive the snowline higher, resulting in less snowpack to supply water to California users.
- Droughts are likely to become more frequent and persistent in the 21st century.
- Intense rainfall events, periodically ones with larger than historical runoff, will continue to affect California with more frequent and/or more extensive flooding.
- Storms and snowmelt may coincide and produce higher winter runoff from the landward side, while accelerating sea-level rise will produce higher storm surges during coastal storms. Together, these changes may increase the probability of floods and levee and dam failures, along with creating issues related to saltwater intrusion.

- Warmer weather, reduced snowpack, and earlier snowmelt can be expected to increase wildfire through fuel hazards and ignition risks. These changes can also increase plant moisture stress and insect populations, both of which affect forest health and reduce forest resilience to wildfires. An increase in wildfire intensity and extent will increase public safety risks, property damage, fire suppression and emergency response costs to government, watershed and water quality impacts, vegetation conversions and habitat fragmentation.

4.2.7. Dam Failure

Hazard/Problem Description

Dams are manmade structures built for a variety of uses including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they are usually engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped or fail. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can also result from any one or a combination of the following causes:

- Earthquake;
- Inadequate spillway capacity resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage, or piping or rodent activity;
- Improper design;
- Improper maintenance;
- Negligent operation; and/or
- Failure of upstream dams on the same waterway.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, and homes. Electric generating facilities and transmission lines could also be damaged and affect life support systems in communities outside the immediate hazard area. Associated water supply, water quality and health concerns could also be an issue. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

In general, there are three types of dams: concrete arch or hydraulic fill, earth and rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously; the flood wave builds up rapidly to a peak then gradually declines. An earth-rockfill dam fails gradually due to erosion of the breach; a flood wave will build gradually to a peak and then decline until the reservoir is empty. And, a concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

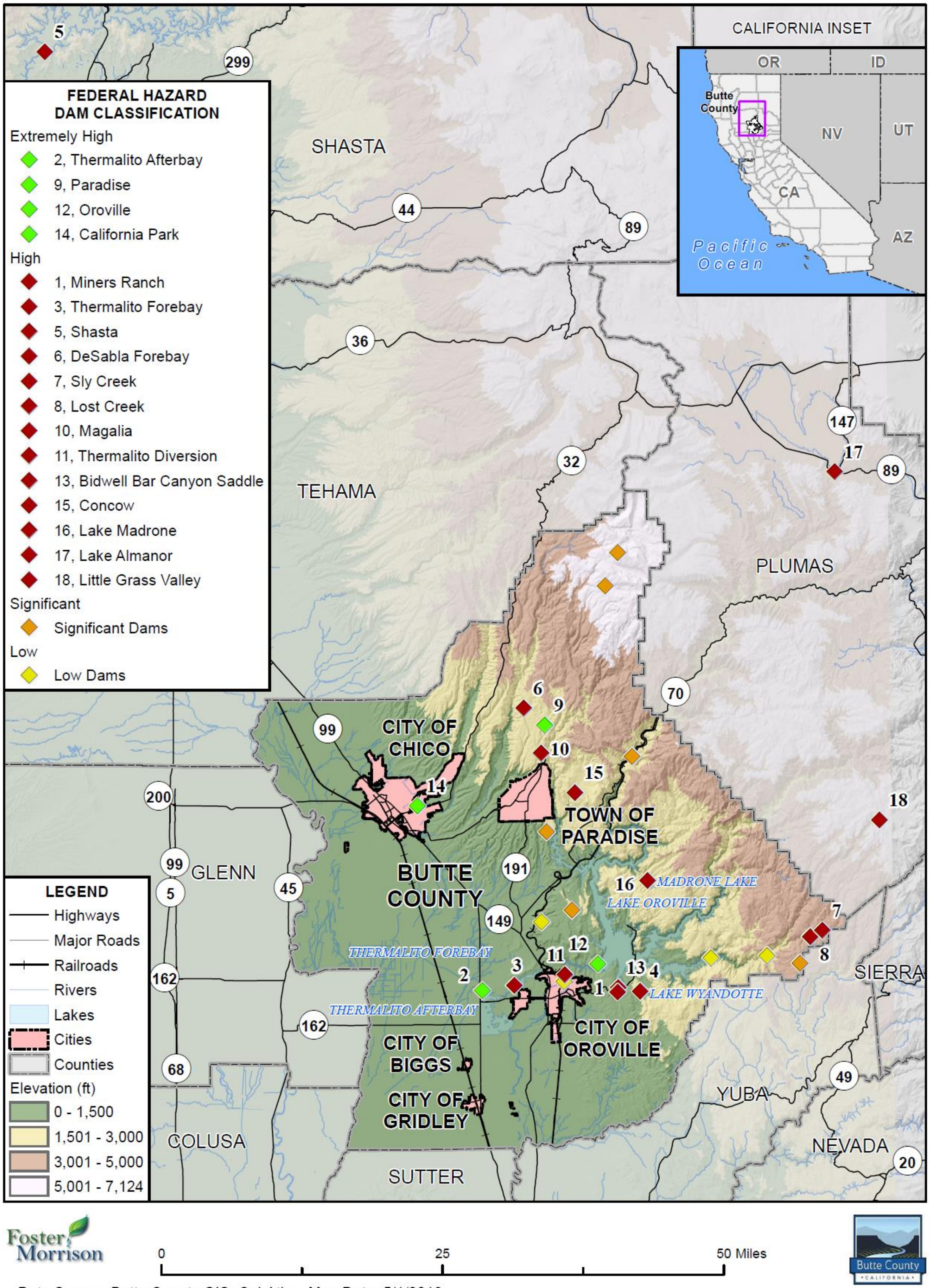
The California Department of Water Resources (Cal DWR) Division of Safety of Dams (DSOD) has jurisdiction over impoundments that meet certain capacity and height criteria. Embankments that are less than six feet high and impoundments that can store less than 15 acre-feet are non-jurisdictional. Additionally, dams that are less than 25 feet high can impound up to 50 acre-feet without being jurisdictional. Cal DWR, DOSD assigns hazard ratings to large dams within the State. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in four categories that identify the potential hazard to life and property:

- **Extremely High Hazard** – Expected to cause considerable loss of human life or would result in an inundation area with a population of 1,000 or more
- **High Hazard** – Expected to cause loss of at least one human life.
- **Significant Hazard** – No probable loss of human life but can cause economic loss, environmental damage, impacts to critical facilities, or other significant impacts.
- **Low Hazard** – No probable loss of human life and low economic and environmental losses. Losses are expected to be principally limited to the owner's property.

Location and Extent

According to data provided by Butte County, Cal DWR, and Cal OES, there are 35 dams in Butte County. These dams provide the County and parts of the state with drinking water, irrigation water, stock water, recreation, and power production. Of the 35 dams located inside the County, 4 are rated as extremely high, 11 are rated as high hazard, 6 as significant hazard, and 4 as low hazard. 10 dams in the County have an unknown hazard class. Figure 4-26 identifies the dams located in the Butte County Planning Area. Table 4-23 gives information on each of the dams in the County, and the dams outside the County that could affect areas in Butte County.

Figure 4-26 Butte County Dam Inventory



Data Source: Butte County GIS, Cal-Atlas; Map Date: 5/1/2019.

Table 4-23 Butte County – Dam Inventory

Name of Dam	Hazard Class	Stream	Type	Capacity (acre-feet*)	Dam Height	Year Built
A. L. Chaffin	Low	Tributary of Cottonwood Creek	Earth	450	65	1957
Apple Tree**	–	–	–	–	–	Unknown
Bidwell Bar Canyon Saddle	High	Feather River	–	3,540,000	47	1968
Butte Creek Head**	–	–	–	–	–	Unknown
California Park	Extremely High	Dead Horse Slough	Earth	335	23	1986
Cannon Ranch	Significant	Tributary of Oregon Gulch	Earth	176	18	1870
Concow	High	Concow Creek	Concrete Arch	6,370	94	1925
DeSalba Forebay	High	Middle Butte Cr	Earth	280	53	1903
Feather River Hatchery**	Low	Feather River	Gravity	580	63	1964
Forbestown Diversion	Low	South Fork of Feather River	Concrete Arch	358	99	1962
Grizzly Creek	Significant	Grizzly Creek	Earth	76	50	1964
Grub Flat**	–	Tributary of Feather River	Earth	49	18	1863
Hendricks Head	–	W Branch Feather River	Earth	130	15	1907
Intake**	–	North Fork of Feather River	–	–	–	Unknown
Kunkle	Significant	Tributary W Br Feather R	Earth	253	54	1907
Lake Madrone	High	Berry Creek	Earth	200	35	1931
Lake Wyandotte	High	North Honcut Creek	Earth	313	46	1924
Littlefield	–	Tributary of Feather River	Earth	–	18	1863
Lost Creek	High	Lost Creek	Concrete Arch	5,680	122	1924
Magalia	High	Little Butte Creek	Hydraulic Fill	2,900	103	1918
Miners Ranch	High	Tributary of North Honcut Creek	Earth and Rock	895	55	1962
Morgan	–	–	–	–	–	Unknown
Olive Products**	–	–	–	–	–	Unknown
Oroville	Extremely High	Feather River	Earth	3,537,577	742	1968
Paradise	Extremely High	Little Butte Creek	Earth	11,500	175	1957
Parish Camp Saddle Dam	–	–	–	–	–	–

Name of Dam	Hazard Class	Stream	Type	Capacity (acre-feet*)	Dam Height	Year Built
Philbrook	Significant	Philbrook Creek	Earth	5,180	85	1926
Poe	Significant	North Fork of Feather River	Concrete Arch	1,150	62	1959
Ponderosa Diversion	Low	South Fork of Feather River	Earth	4,750	157	1962
Round Valley	Significant	West Tributary of Feather River	Earth	1,147	30	1877
Sly Creek	High	Lost Creek	Earth	65,050	271	1961
Sutter Butte Diversion**	–	–	–	–	–	Unknown
Thermalito Afterbay	Extremely High	Tributary of Feather River	Earth	57,041	38	1967
Thermalito Diversion	High	Feather River	Concrete, Earth, Gravity	13,328	128	1967
Thermalito Forebay	High	Tributary of Cottonwood Creek	Earth	11,768	75	1967

Source: Cal OES and the National Performance of Dams Program
*One Acre Foot=326,000 gallons

The County is also vulnerable to the following three dams located outside the County, as shown in Table 4-24. These dams, coupled with the significant, high, and extremely high hazard dams make up the dams of concern list for the County.

Table 4-24 Butte County – Dams Outside the County

Name of Dam	Hazard Class	Stream	Type	Capacity (acre-feet*)	Dam Height	Year Built
Shasta	High	Sacramento River	Concrete Gravity	4,661,860	610	1945
Little Grass Valley	High	South Fork of Feather River	Rockfill	93,010	210	1961
Lake Almanor	High	North Fork of Feather River	Earth	1,140,000	91	1927

Source: Cal OES and the National Performance of Dams Program
*One Acre Foot=326,000 gallons

The County HMPC has noted dams of concern to the County. Those with mapped inundation areas are shown in Table 4-25.

Table 4-25 Butte County Planning Area – Dams of Concern

Dam Inundation Areas	Dam Count
Extremely High	
Oroville	1
Paradise	1

Dam Inundation Areas	Dam Count
Thermalito AB	1
Extremely High Total	**3**
High	
Bidwell Bar Canyon Saddle	1
De Sabla FB	1
Lake Almanor	1
Lake Wyandotte	1
Magalia	1
Miners Ranch	1
Shasta	1
Thermalito Diversion	1
High Total	**8**
Significant	
Kunkle	1
Philbrook	1
Poe	1
Significant Total	**3**
Grand Total	**14**

Source: Cal OES, Butte County

In addition to these, the County is concerned about the following ten dams that did not have mapped inundation areas:

- Sly Creek (H)
- Lost Creek (High)
- Grizzly Creek, (Significant)
- Lake Madrone (High)
- AL Chaffin (Low)
- Canyon Ranch (Significant)
- Concow (High)
- Little Grass Valley (High)
- Round Valley (Significant)
- California Park (Extremely High).

Most substantial among all the dams of concern is the Oroville Dam, located northeast of the city of Oroville, which has a storage capacity of over 3.5 million acre-feet.

Dam failure is a natural disaster from two perspectives. First, the inundation from released waters resulting from dam failure is related to naturally occurring floodwaters. Second, dam failure would most probably happen in consequence of the natural disaster triggering the event. There is no scale with which to measure dam failure. While a dam may fill slowly with runoff from winter storms, a dam break can have a very quick speed of onset. The duration of dam failure is not long, depending on the nature of the failure. Duration of a major failure is only as long as it takes to empty the reservoir of water the dam held back.

Dam inundation affects discrete areas of the City. As previously mentioned, multiple dams would affect the unincorporated County and each City. The HMPC noted that dam failure is most likely not going to be a total dam failure but likely would be a failure of part of the dam. This extent discussion focuses on a total dam failure, which the HMPC does not think will likely happen. Methodologies for this analysis and maps showing extent can be found in Section 4.3.4. GIS analysis was performed to determine what percentages of each jurisdiction would be inundated (using Cal OES dam inundation data). This was broken down for each jurisdiction, by dam inundation area, to show whether it affects improved or unimproved parcels and what percentage of these parcels area affected. This can be seen in Table 4-26.

Table 4-26 Butte County Planning Area – Dam Inundation Geographical Extents

Dam Inundation Area / Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
Oroville	474	0.04%	201	0.06%	272	0.04%
Thermalito AB	474	0.04%	201	0.06%	272	0.04%
City of Chico						
Magalia	46	0.00%	45	0.01%	1	0.00%
Paradise	46	0.00%	45	0.01%	1	0.00%
Shasta	126	0.01%	0	0.00%	126	0.02%
City of Gridley						
Lake Almanor	85	0.01%	0	0.00%	85	0.01%
Oroville	1,184	0.11%	696	0.19%	488	0.07%
Thermalito AB	1,142	0.11%	696	0.19%	446	0.06%
Thermalito Diversion	79	0.01%	0	0.00%	79	0.01%
City of Oroville						
Lake Almanor	1,804	0.17%	789	0.22%	1,015	0.14%
Miners Ranch	27	0.00%	0	0.00%	27	0.00%
Oroville	6,166	0.58%	2,310	0.65%	3,856	0.55%
Thermalito Diversion	213	0.02%	7	0.00%	206	0.03%
Unincorporated Butte County						
Bidwell Bar Canyon Saddle	5,338	0.50%	3,686	1.03%	1,652	0.24%
De Sabla FB	711	0.07%	302	0.08%	409	0.06%
Kunkle	68	0.01%	20	0.01%	48	0.01%

Dam Inundation Area / Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Lake Wyandotte	691	0.07%	441	0.12%	250	0.04%
Lake Almanor	31,922	3.01%	20,814	5.82%	11,108	1.58%
Magalia	13,724	1.29%	11,036	3.09%	2,688	0.38%
Miners Ranch	1,450	0.14%	840	0.23%	611	0.09%
Oroville	209,331	19.75%	89,665	25.09%	119,665	17.03%
Paradise	14,040	1.32%	11,127	3.11%	2,912	0.41%
Philbrook	2,885	0.27%	66	0.02%	2,818	0.40%
Poe	2,467	0.23%	14	0.00%	2,453	0.35%
Shasta	126,044	11.89%	65,844	18.42%	60,200	8.57%
Thermalito AB	90,803	8.57%	40,040	11.20%	50,763	7.23%
Thermalito Diversion	10,943	1.03%	3,550	0.99%	7,393	1.05%
Grand Total	522,280	49.27%	252,435	70.63%	269,846	38.41%

Source: Cal OES

Past Occurrences

Disaster Declaration History

There has been one disaster declaration related to dam failure in Butte County, as shown in Table 4-4.

Table 4-27 Butte County Dam Failure Disaster Declarations, 1950-2019

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2017	California Potential Failure of the Emergency Spillway at Lake Oroville Dam	Flood	Storms	EM-3381	–	2/14/2017

Source: Cal OES, FEMA

NCDC Events

There have been no NCDC dam failure events in Butte County. An event of flooding was reported that threatened Oroville Dam on 2/12/2017. This flooding was related to the Oroville spillway event. More information on that event can be found in the Past Occurrences of flooding in Section 4.2.10.

National Performance of Dams Program Events

The National Performance of Dams data shows five dam incidents for Butte County since 1932. However, these incidents were quite limited in scope and since the incidents occurred, improvements to the dam system have been made.

1932 – An incident occurred at the De Sabla Forebay dam which is owned by PG&E. It is unclear if the dam breached. There was a piping incident in the fill at the downstream toe. There was also cavitation in the upstream slope.

May 1938 – The Slate Creek dam was overtopped and breached near the outlet. A section of dam washed out. Cause of failure: no spillway provision. Dam was not rebuilt.

1965 – Since the mid-1960's the porous concrete of the Lost Creek dam had spalled and cracked. This contributed to further deterioration of the downstream face of the dam due to freeze-thaw. The dam did not fail, and was repaired. In 1997, a geomembrane was installed to stop leakage through the dam.

July 5, 1997 – A gate failure on Cresta Dam sent a surge of water (measured as 14.5 feet high at the nearest downstream gage) through the north fork of the Feather River. Several people trapped by the sudden surge had to be rescued by helicopter. The release contributed to a four-inch rise in the level of Lake Oroville.

February 11, 2017 – Heavy rainfall during the 2017 California floods damaged the main spillway on February 7, so California DWR stopped the spillway flow to assess the damage and contemplate its next steps. The rain eventually raised the lake level until it flowed over the emergency spillway, even after the damaged main spillway was reopened. As water flowed over the emergency spillway, headward erosion threatened to undermine and collapse the concrete weir, which could have sent a 30-foot wall of water into the Feather River below and flooded communities downstream. No collapse occurred, but the water further damaged the main spillway and eroded the bare slope of the emergency spillway. Due to the threat of collapse, an evacuation order was given on February 12th for those residing immediately in the dam inundation area. In total, 188,000 people were evacuated.

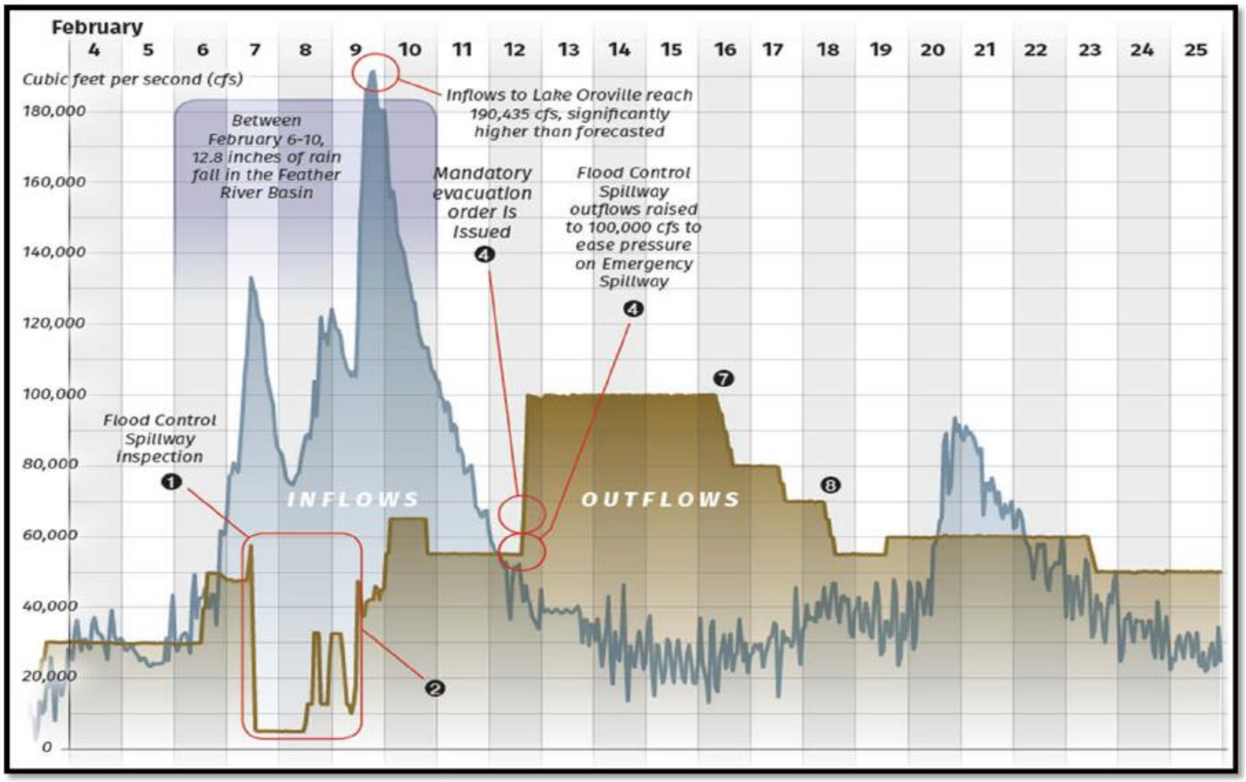
Hazard Mitigation Planning Committee Events

The HMPC noted the Independent Forensic Team Report of the Orville Dam Spillway Incident that was completed in January of 2018. The report gave a chronology of the 2017 Oroville Dam Spillway Incident.

In January and February 2017, the service spillway experienced its first significant discharges since 2011, when the maximum discharge was 31,500 cubic feet per second (cfs) on March 20, 2011. There had been some discharges in 2012, 2013, and 2016, but all were less than 10,000 cfs. In 2017, there were reportedly no spillway discharges from January 1 through 12, 2017. Starting midday on January 13, spillway discharge was ramped up to about 9,700 cfs and maintained at that level through the rest of the day. The discharge was then reduced to about 6,600 cfs and maintained at that level through the afternoon of January 18, at which time the discharge was reduced to about 1,370 cfs for several hours, then further reduced to about 1,170 cfs for several more hours. The discharge was increased to about 3,000 cfs at 3:00 am on January 19 and maintained at that level for several hours, after which it was reduced slowly in steps starting at about 8:00 am, January 19, until the gates were fully closed at about 12:00 pm, January 20.

The gates remained closed through 4:00 pm, January 30, after which the spillway discharge was ramped up in several steps ranging from about 7,000 to 15,000 cfs. From February 1, 2017 through the morning of February 3, 2017, service spillway discharges were generally about 15,000 cfs; then discharges were increased to about 25,000 cfs and maintained at that level until mid-day on February 6, 2017, at which time the discharges were increased to between 42,000 and 45,000 cfs and held in that range until the morning of February 7. Figure 4-27 illustrates the chronology of the incident from February 4 through 25.

Figure 4-27 Chronology of the February 2017 Oroville Dam Spillway Incident



Source: Independent Forensic Team Report – Oroville Dam Spillway Incident.

At about 10:00 am on February 7, 2017, service spillway discharges were increased again, starting at about 42,500 cfs, reaching about 52,500 cfs at about 10:20 am. Substantial disturbance in the service spillway chute flow was noticed by on-site DWR personnel at about 10:10 am on February 7, while the spillway discharge was being ramped up to 52,500 cfs. After the observation of the disturbance in the chute flow, on-site DWR personnel contacted DWR headquarters in Sacramento, and an order to close the spillway gates was issued at about 11:15 am on February 7, 2017. Gate closure appears to have started at about 11:25 am, and the gates were fully closed by about 12:25 pm.

After the gates were closed, it was found that a significant section of the service spillway chute slab was missing, and a large erosion hole existed in the area where the slab sections were missing. This initial erosion hole at the service spillway was examined by a climb team on the morning of February 8, 2017. DWR knew that it would want to operate the damaged service spillway because of expected inflow to the reservoir, hence it was decided to begin opening the spillway gates to test service spillway capabilities in the damaged condition. The gates were reopened at about 4:00 pm on February 8, 2017, and, on February

8 through 10, DWR tried several test discharge rates ranging from 20,000 cfs to 65,000 cfs and monitored the associated progression of erosion at the service spillway. Spillway discharge reached 65,000 cfs at 3:00 am on February 10, and was held there for about 17 hours. At about 8:00 pm on February 10, the service spillway discharge was reduced to about 55,000 cfs and maintained at that level through 3:35 pm on February 12.

Meanwhile, inflows to the reservoir continued to increase due to a rainfall event, which was a major event, but not the largest in the history of the project. Sometime between about 7:00 and 8:00 am on February 11, the reservoir level exceeded Elevation 901, and water flowed over the emergency spillway crest structure for the first time in the facility's history. The reservoir level increased to a maximum level of about Elevation 902.6, about 1.6 feet above the emergency spillway crest, at about 3:00 pm on February 12, about 31 hours after the flow over the emergency spillway began. The flow over the emergency spillway at the peak reservoir level was estimated to be about 12,500 cfs. The emergency spillway discharge channelized as it flowed across the natural terrain downstream of the crest structure and caused extensive erosion, with some of the erosion areas headcutting aggressively toward the emergency spillway crest structure. According to Incident Command notes, at 3:44 pm on February 12, an evacuation order was issued for about 188,000 downstream residents, because of the rapidly advancing erosion areas in the emergency spillway discharge channel.

DWR opened the service spillway gates more, beginning at 3:35 pm on February 12, nine minutes before the evacuation order according to the Incident Command notes. Service spillway discharge increased to about 100,000 cfs by about 7:00 pm on February 12. The 100,000 cfs service spillway discharge was maintained through 8:00 am on February 16. Discharge over the emergency spillway crest ceased at about 8:00 pm on February 12, about 36 hours after it began and about 5 hours after the flow had peaked. At about 3:30 pm on February 14, the evacuation order was changed to an evacuation warning, under which residents were advised to monitor the media and be prepared to evacuate again, if necessary. No further evacuation orders were necessary, and the evacuation warning was lifted five weeks after the evacuation order was first issued.

DWR established a target reservoir level at Elevation 850, which is 50 feet below normal full pool level. Beginning February 16, service spillway discharges were adjusted based on estimated inflows to reach the target reservoir level. At 3:00 pm on February 20, the reservoir level reached about Elevation 849, and it was held at about Elevation 850 for the remainder of the month of February, through spillway discharges ranging from 80,000 to 50,000 cfs between February 16 and 27. At about 7:00 am on February 27, gate closure commenced, with the gates fully closed by about 1:00 pm the same day. On-site investigations to support remedial actions began at that time. After that time, investigations and remedial actions were interrupted occasionally for service spillway releases to manage the reservoir. The service spillway gates were closed for the season on May 19, 2017, so that construction of spillway repairs could begin. During service spillway operations between February 8, 2017 and May 19, 2017, additional spillway chute slab sections were lost and the erosion at the service spillway enlarged significantly, as shown in Figure 4-28.

Figure 4-28 Ultimate Damage at Oroville Dam Spillway

Source: Independent Forensic Team Report – Oroville Dam Spillway Incident.

Likelihood of Future Occurrence

Occasional—The County remains at risk to dam breaches/failures from numerous dams under a variety of ownership and control and of varying ages and conditions. There have been 5 past dam incidents. In addition, given the number and types of dams of concern to the County and their ages, a potential exists for future dam issues, including failures, in the Butte County Planning Area. Thus, the HMPC determined the likelihood of future occurrence to be occasional.

Climate Change and Dam Failure

Increases in both precipitation and heat causing snow melt in areas upstream of dams could increase the potential for dam failure and uncontrolled releases in Butte County.

4.2.8. Drought and Water Shortage

Hazard/Problem Description

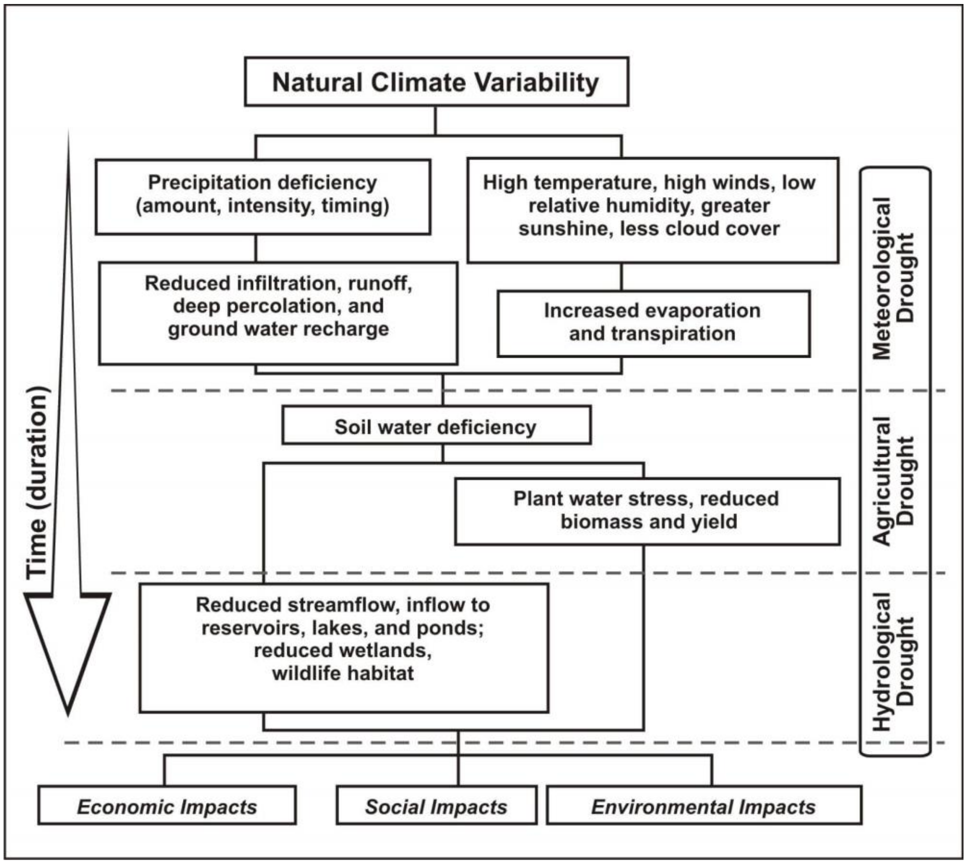
Drought

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Water districts normally require at least a 10-year planning horizon to implement a multiagency improvement project to mitigate the effects of a drought and water supply shortage.

Drought is a complex issue involving (see Figure 4-29) many factors—it occurs when a normal amount of precipitation and snow is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects:

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

Figure 4-29 Causes and Impact of Drought



Source: National Drought Mitigation Center (NDMC)

The 2030 General Plan Water Resources Element noted that the primary water source in Butte County is surface water, which serves 69 percent of the county's water needs, followed by groundwater, serving 31 percent of the water needs. Based on 2000 data, the Butte County water demand is approximately 90 percent agricultural followed by wildlife at 5 percent and residential at 5 percent.

The HMPC noted that drought can cause increased wildfire risk, discussed in Section 4.2.19.

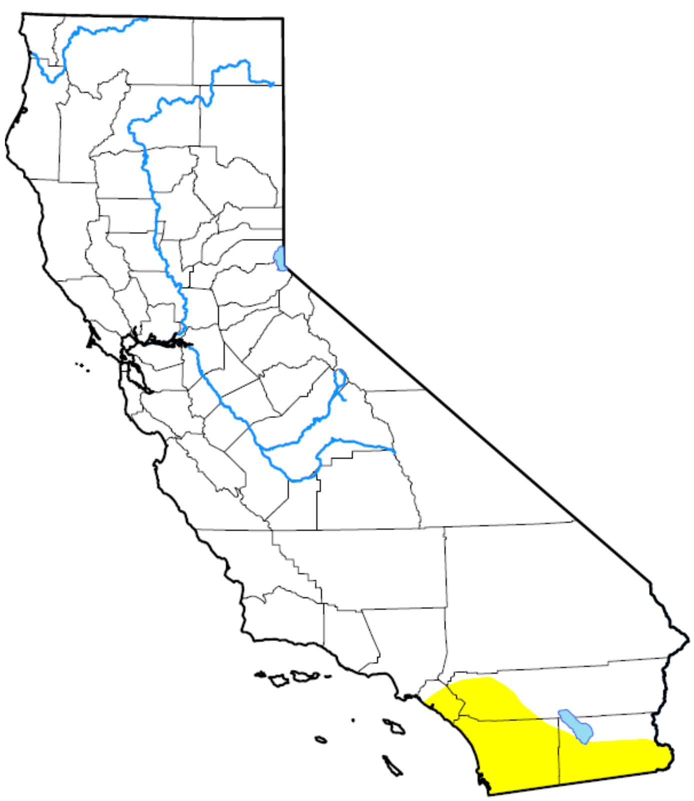
Location and Extent

Since drought is a regional phenomenon, it affects the whole of the County. Speed of onset of drought is slow, while the duration varies from short (months) to long (years) Drought in the United States is monitored by the National Integrated Drought Information System (NIDIS). A major component of this portal is the U.S. Drought Monitor. The Drought Monitor concept was developed jointly by the NOAA's Climate Prediction Center, the NDMC, and the USDA's Joint Agricultural Weather Facility in the late 1990s as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state, and academic scientists who are intimately familiar with the conditions in their respective regions. A snapshot of the drought conditions in California and the Planning Area can be found in Figure 4-30. Snapshots from 2013 and 2018 is shown in Figure 4-31.

Figure 4-30 Butte County – Current Drought Status

U.S. Drought Monitor

California



May 14, 2019

(Released Thursday, May. 16, 2019)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	94.03	5.97	0.00	0.00	0.00	0.00
Last Week *05-07-2019*	94.03	5.97	0.00	0.00	0.00	0.00
3 Months Ago *02-12-2019*	36.77	63.23	10.55	1.63	0.00	0.00
Start of Calendar Year *01-01-2019*	7.77	92.23	75.17	14.12	2.10	0.00
Start of Water Year *09-25-2018*	12.18	87.82	47.97	22.82	4.94	0.00
One Year Ago *05-15-2018*	30.49	69.51	37.15	20.83	2.80	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

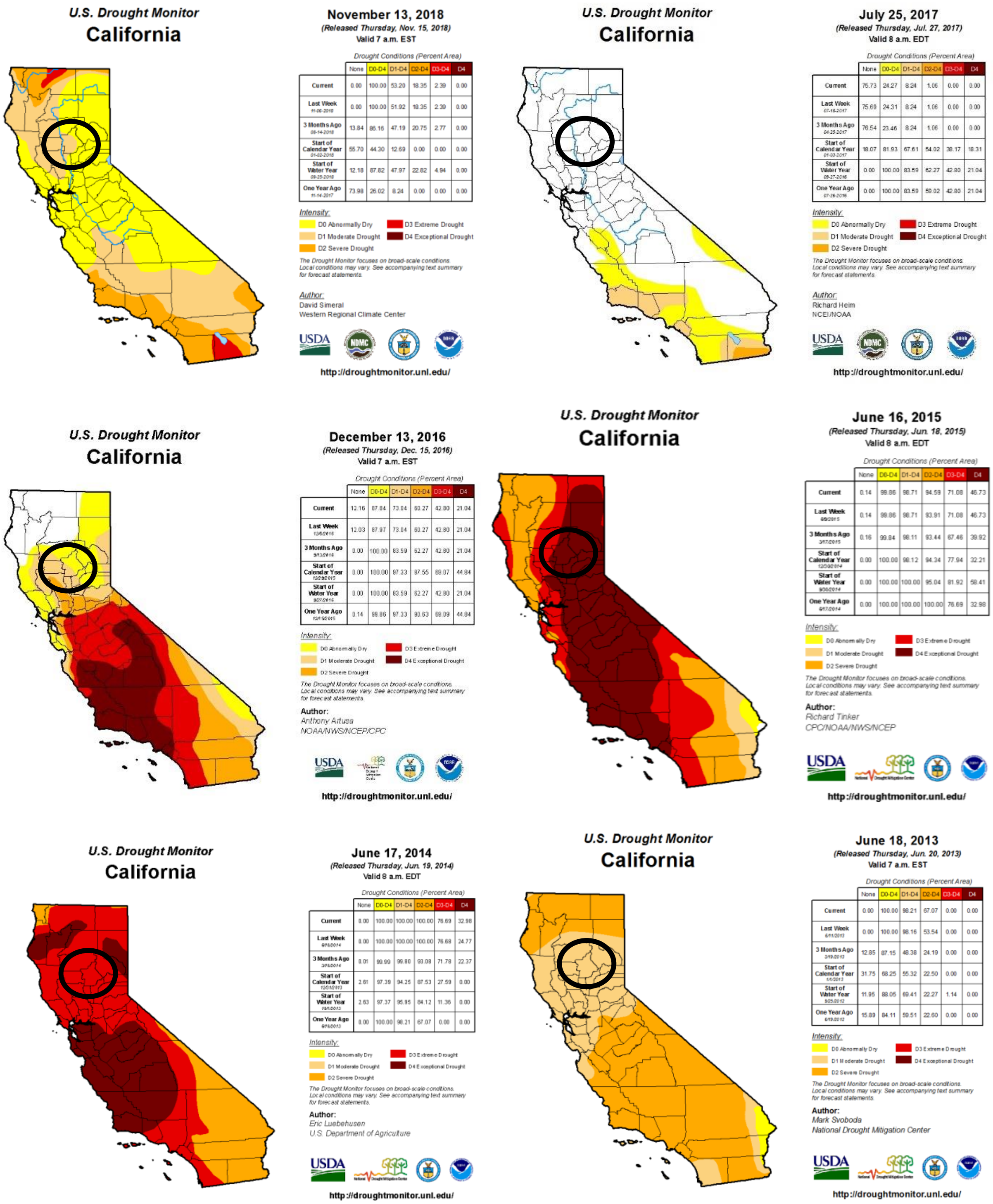
Author:
Curtis Riganti
National Drought Mitigation Center

USDA

droughtmonitor.unl.edu

Source: US Drought Monitor

Figure 4-31 Previous Drought Status in Butte County



Source: US Drought Monitor

Cal DWR says the following about drought:

> ***One dry year does not normally constitute a drought in California. California's extensive system of water supply infrastructure—its reservoirs, groundwater basins, and inter-regional conveyance facilities—mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Hydrologic conditions constituting a drought for water users in one location may not constitute a drought for water users elsewhere, or for water users having a different water supply. Individual water suppliers may use criteria such as rainfall/runoff, amount of water in storage, or expected supply from a water wholesaler to define their water supply conditions.***

The drought issue in California is further compounded by water rights. Water is a commodity possessed under a variety of legal doctrines. The prioritization of water rights between farming and federally protected fish habitats in California contributes to this issue.

As shown on the previous figures, drought is tracked by the US Drought Monitor. The Drought Monitor includes a scale to measure drought intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)

Water Shortage

Northern Sacramento Valley counties, including Butte County, generally have sufficient groundwater and surface water supplies to mitigate even the severest droughts of the past century. Many other areas of the State, however, also place demands on these water resources during severe drought. For example, Northern California agencies, including those from Butte County, were major participants in the Governor's Drought Water Bank of 1991, 1992, and 1994.

The HMPC and the 2030 General Plan Water Resources Element noted that surface water resources in Butte County lie within the Sacramento River watershed. Primary waterways include the Feather River and its several tributaries, as well as Butte Creek and Big Chico Creek. The majority of the County's surface water supply is used for local agriculture. The majority of the surface water supply used by Butte County residents and businesses originates in the Feather River watershed and accumulates in Lake Oroville as part of the State Water Project. Local irrigation districts' surface water rights are provided through the California water rights priority system, which recognizes the right to the use of water based on a first-in-time, first-in-line basis.

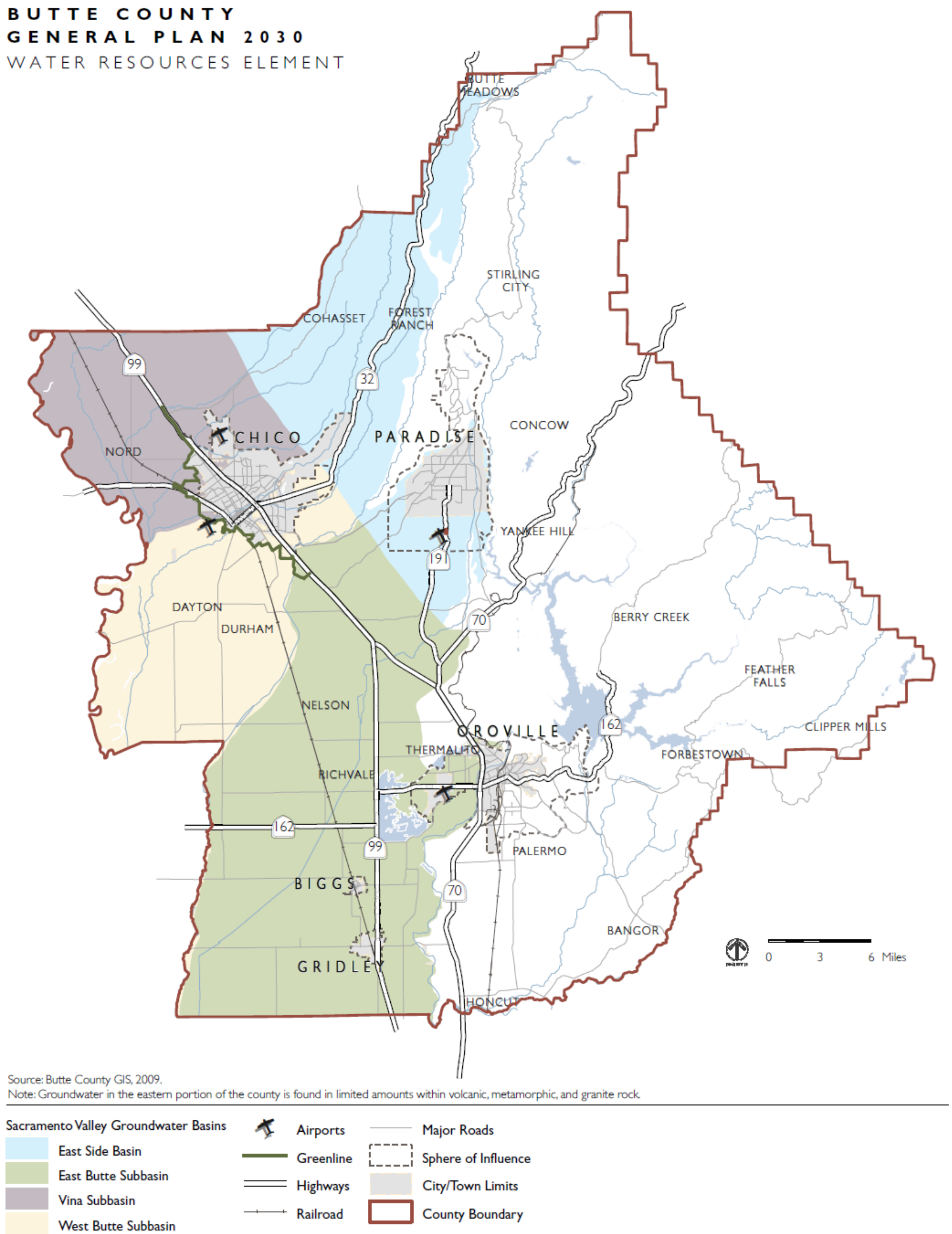
Prior to the development of the Oroville Dam, Butte County negotiated with the State of California to receive an allocation of water for growth and future needs within the county as a State Water Project

Contractor. Butte County sells a portion of their State Water Project Table A allocation to the Del Oro Water Company and California Water Company – Oroville.

The Butte County General Plan 2030 Water Resources Element noted that approximately 75 percent of the residential water supply is extracted from groundwater. The availability of groundwater in an area depends largely upon its geologic, hydrologic and climatic conditions. In Butte County, reserves of groundwater are found in the thick sedimentary deposits of the Sacramento Valley and the mountainous areas to the east and north. Groundwater is found in perched, unconfined and confined zones in the valley portion of Butte County. Perched groundwater zones are most common in shallow, consolidated soils with low permeability. Major portions of groundwater are unconfined or semi-confined, occurring in floodplain and alluvial fan deposits. High permeability in these soils yields large amounts of water to shallow domestic and irrigation wells. The Tuscan Formation contains an important deep aquifer that is theorized to underlie most of the valley area. Confined water occurs in the Tuscan and Laguna Formations, and in the younger alluvium, where it is overlain by flood basin deposits. Although moderate amounts of water are yielded from the fine-grained strata of the Laguna Formation, permeable sand and gravel zones are infrequent and minor in extent and thickness. The highest producing wells in alluvial uplands occur when older alluvium or the deeper Tuscan volcanic rocks are tapped. Groundwater can also be found in more limited amounts in mountainous areas of the county within volcanic, metamorphic and granitic rock with a total volume of water stored estimated to be less than 2 percent of the rock volume.

Figure 4-32 maps the Sacramento Valley groundwater basin and its subbasins, which are found within the western portion of Butte County; groundwater in the eastern portion of the county is found in more limited amounts within volcanic, metamorphic and granite rock.

Figure 4-32 Butte County – Groundwater Basins and Subbasins



Source: 2030 Butte County General Plan Water Resource Element

The major sources of groundwater recharge in Butte County are precipitation, infiltration from streams, subsurface inflow and deep percolation of applied irrigation water in agricultural areas.

Throughout a large portion of Butte County, fresh water reportedly extends to a depth of 800 to 1,350 feet below the ground surface, though groundwater levels can change due to extraction and natural processes. Change in groundwater storage is dependent on the annual rate of groundwater extraction and the annual rate of groundwater recharge, which commonly fluctuate within a given year and from year to-year. During periods of drought, groundwater in storage typically declines, but it increases during periods of above normal precipitation. Groundwater storage also declines during the summer as groundwater is extracted for municipal and agricultural use, and recovers as extraction slows and seasonal precipitation increases recharge. There has been very little change in groundwater levels in most areas of the valley since the 1970s and 1980s. However, groundwater has declined over the past several years in specific areas, and long-term comparison of groundwater levels from the 1950s and 1960s with today's levels indicates a trend of slightly declining groundwater levels in some areas of the West Butte and Vina subbasins.

Location and Extent

Since water shortage happens on a regional scale, the entirety of the County is at risk. There is no established scientific scale to measure water shortage. The speed of onset of water shortage tends to be lengthy. The duration of water shortage can vary, depending on the severity of the drought that accompanies it.

Past Occurrences

Disaster Declaration History

There have been two federal disasters related to drought and water shortage in Butte County issued in 1976 and 2008. There have been two state disasters related to drought and water shortage in Butte County issued in 1976 and 2014. This can be seen in Table 4-28.

Table 4-28 Butte County – Disaster Declarations from Drought 1950-2019

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Drought	2	1976, 2014	2	1976, 2008

Source: FEMA, Cal OES

NCDC Events

There have been 12 NCDC drought events in Butte County, all related to events in the 2014 to 2016 drought. No damages, deaths, or injuries were reported to the NCDC from these events.

Hazard Mitigation Planning Committee Events

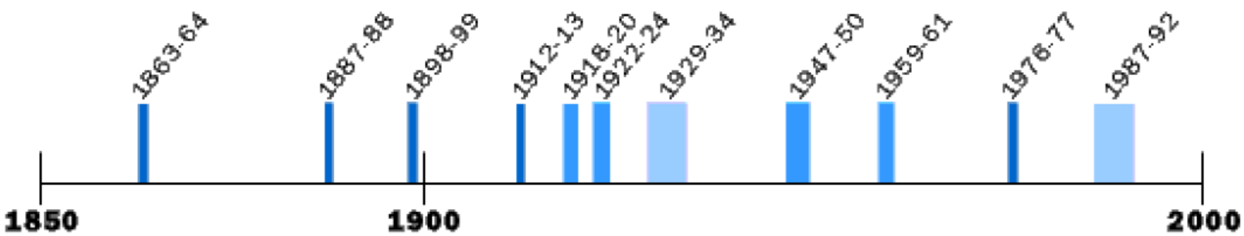
Historically, California has experienced multiple severe droughts. According to the DWR, droughts exceeding three years are relatively rare in Northern California, the source of much of the State's developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large northern California reservoirs. Table 4-29 compares the 1929-34 drought in the Sacramento and San Joaquin Valleys to the 1976-77, 1987-92, and 2007-09 droughts. Figure 4-33 depicts California's Multi-Year Historical Dry Periods, 1850-2000.

Table 4-29 Severity of Extreme Droughts in the Sacramento and San Joaquin Valleys

Drought Period	Sacramento Valley Runoff		San Joaquin Valley Runoff	
	(maf*/yr)	(percent Average 1901-96)	(maf*/yr)	(percent Average 1906-96)
1929-34	9.8	55	3.3	57
1976-77	6.6	37	1.5	26
1987-92	10.0	56	2.8	47
2007-09	11.2	64	3.7	61

Source: California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources.
*maf=million acre feet

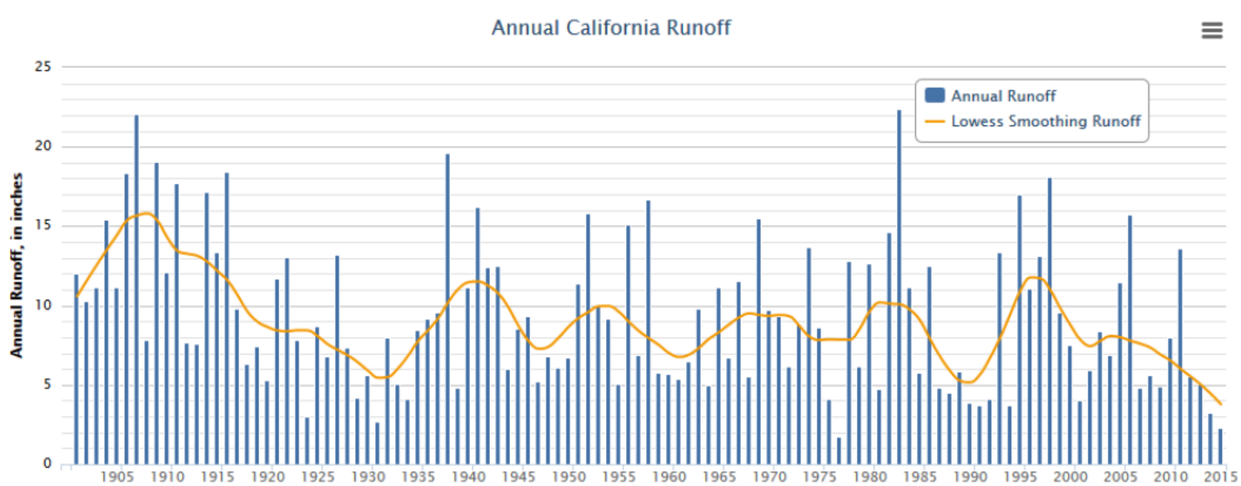
Figure 4-33 California's Multi-Year Historical Dry Periods, 1850-2000



Source: California Department of Water Resources, www.water.ca.gov/
Notes: Dry periods prior to 1900 estimated from limited data; covers dry periods of statewide or major regional extent

Figure 4-34 depicts runoff for the State from 1900 to 2015. This gives a historical context for the 2014-2015 drought to compare against past droughts.

Figure 4-34 Annual California Runoff –1900 to 2015



Source: California DWR

The 2018 California State Hazard Mitigation Plan fleshed out the major droughts from 1900 to 2017. This discussion below appends to the tables and figures above.

The 1975-1977 Drought

From November 1975 through November 1977, California experienced one of its most severe droughts. Although people in many areas of the state are accustomed to very little precipitation during the growing season (April to October), they expect it in the winter. In 1976 and 1977, the winters brought only one-half and one-third of normal precipitation, respectively. Most surface storage reservoirs were substantially drained in 1976, leading to widespread water shortages when 1977 turned out to be even drier. 31 counties were affected, resulting in $2.67 billion in crop damages. The HMPC noted that there were reports that residents with fractured water wells ran dry, residents were having to dig deeper wells. Butte County had a water distribution program for qualified residents to fill up containers with potable water.

The 1987-1992 Drought

From 1987 to 1992, California again experienced a serious drought due to low precipitation and run-off levels. The hardest-hit region was the Central Coast, roughly from San Jose to Ventura. In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry-farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered, recreational use of lakes and rivers decreased, forestry losses and fires increased, and hydroelectric power production decreased. In February 1991, DWR and Cal OES surveyed drought conditions in all 58 California counties and found five main problems: extremely dry rangeland, irrigated agriculture with severe surface water shortages and falling groundwater levels, widespread rural areas where individual and community supplies were going dry, urban area water rationing at 25 to 50 percent of normal usage, and environmental impacts.

Storage in major reservoirs had dropped to 54 percent of average, the lowest since 1977. The shortages led to stringent water rationing and severe cutbacks in agricultural production, including threats to survival of permanent crops such as trees and vines. Fish and wildlife resources were in critical shape as well. Not since the 1928-1934 drought had there been such a prolonged dry period. In response to those conditions, the Governor established the Drought Action Team. This team almost immediately created an emergency drought water bank to develop a supply for four critical needs: municipal and industrial uses, agricultural uses, protection of fish and wildlife, and carryover storage for 1992. The large-scale transfer program, which involved over 800,000 acre-feet of water, was implemented in less than 100 days with the help and commitment of the entire water community and established important links between state agencies, local water interests, and local governments for future programs. The HMPC noted that there were reports that residents with fractured water wells ran dry, residents were having to dig deeper wells. Butte County had a water distribution program for qualified residents to fill up containers with potable water.

The 2007-2009 Drought

Water years 2007-2009 were collectively the 15th driest three-year period for DWR's eight-station precipitation index, which is a rough indicator of potential water supply availability to the State Water Project (SWP) and Central Valley Project (CVP). Water year 2007 was the driest single year of that drought, and fell within the top 20 percent of dry years based on computed statewide runoff. In June 2008, a state emergency proclamation was issued due to water shortage in selected Central Valley counties. In February 2009, for the first time in its history, the State of California proclaimed a statewide drought. The state placed unprecedented restrictions on CVP and SWP diversions from the Delta to protect listed fish species, a regulatory circumstance that exacerbated the impacts of the drought for water users.

The greatest impacts of the 2007–2009 drought were observed in the CVP service area on the west side of the San Joaquin Valley, where hydrologic conditions combined with reduced CVP exports resulted in substantially reduced water supplies (50 percent supplies in 2007, 40 percent in 2008, and 10 percent in 2009) for CVP south-of Delta agricultural contractors. Small communities on the west side highly dependent on agricultural employment were especially affected by land fallowing due to lack of irrigation supplies, as well as by factors associated with current economic recession. The coupling of the drought and economic recession necessitated emergency response actions related to social services, such as food banks and unemployment assistance. The HMPC noted that there were reports that residents with fractured water wells ran dry, residents were having to dig deeper wells. Butte County had a water distribution program for qualified residents to fill up containers with potable water.

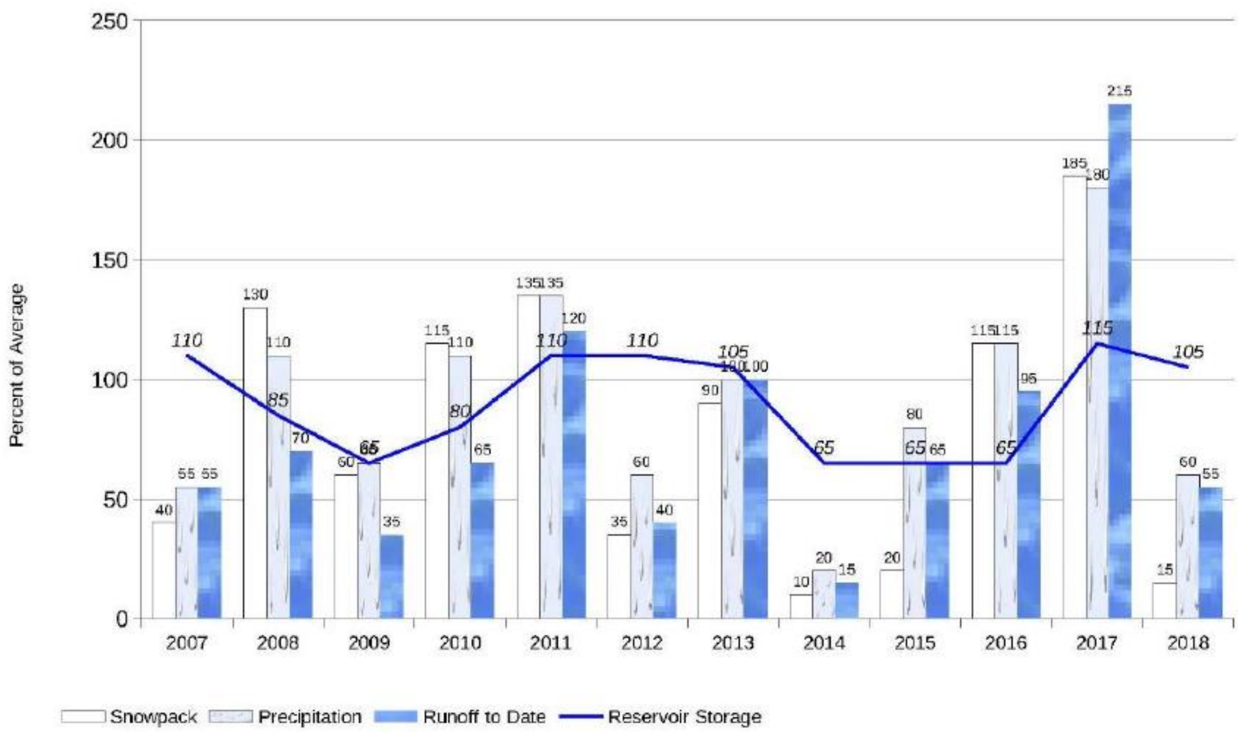
The 2012-2017 Drought

The statewide drought of 2012-2017 will be remembered as one of the most severe and costliest droughts of record in California. The drought that spanned water years 2012 through 2017 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra-Cascades snowpack on record (2015, with 5 percent of average). It was marked by extraordinary heat: 2014, 2015, and 2016 were California's first, second, and third warmest years in terms of statewide average temperatures. By the time the drought was declared officially over in April 2017, the state had expended $6.6 billion in drought response and mitigation programs, and had been declared a federal disaster area. The following discussion outlines the chronology of events and milestones reached during the drought as well as a summary of Executive Orders issued by the Governor, disaster assistance programs initiated, and grant programs designed to alleviate the impacts of the drought. Butte County was affected in many ways. The drought led to USDA disaster declarations for farmers in the County. Wildfires were worse that summer. 2015 had multiple state and federal disaster declarations due to drought and resultant fires.

Water Shortage

Figure 4-35 illustrates several indicators commonly used to evaluate water conditions in California. The percent of average values are determined by measurements made in each of the ten major hydrologic regions. The chart describes water conditions in California between 2007 and 2018. The chart illustrates the cyclical nature of weather patterns in California.

Figure 4-35 Water Supply Conditions, 2007 to 2018



Source: 2018 State of California Hazard Mitigation Plan

Beginning in 2012, snowpack levels in California dropped dramatically. 2015 estimates place snowpack as 5 percent of normal levels. Snowpack measurements have been kept in California since 1950 and nothing in the historic record comes close to 2015's severely depleted level. The previous record for the lowest snowpack level in California, 25 percent of normal, was set both in 1976-77 and 2013-2014. In "normal" years, the snowpack supplies about 30 percent of California's water needs, according to the California Department of Water Resources. Snowpack levels began to increase in 2016, and in 2017 snowpack increased to the largest in 22 years, according to the State Department of Water Resources. In late 2017 and early 2018, drought conditions began to return to southern California but have been dampened by periods of above average rainfall in the first part of 2019.

With a reduction in water, water supply issues based on water rights becomes more evident. Irrigation of agricultural lands is an ongoing concern in the Planning Area. Some agricultural uses, such as fruit and nuts, are severely impacted through limited water supply. Drought and water supply issues will continue to be a concern to the Planning Area. Irrigation of agricultural lands also continues to be a concern in the Planning Area.

Likelihood of Future Occurrence

Drought

Likely—Historical drought data for the Butte County Planning Area and region indicate there have been 5 significant droughts in the last 85 years. This equates to a drought every 17 years on average or a 5.9

percent chance of a drought in any given year. However, based on this data and given the multi-year length and cyclical nature of droughts, the HMPC determined that future drought occurrences in the Planning Area are likely.

Water Shortage

Occasional — Recent historical data for water shortage indicates that Butte County may at some time be at risk to both short and prolonged periods of water shortage. Based on this it is possible that water shortages will affect the County in the future during extreme drought conditions. However, to date, Butte County has continued to have relatively consistent water supply.

Climate Change and Drought and Water Shortage

Climate scientists studying California find that drought conditions are likely to become more frequent and persistent over the 21st century due to climate change. The experiences of California during recent years underscore the need to examine more closely the state's water storage, distribution, management, conservation, and use policies. The Climate Adaptation Strategy (CAS) stresses the need for public policy development addressing long term climate change impacts on water supplies. The CAS notes that climate change is likely to significantly diminish California's future water supply, stating that:

California must change its water management and uses because climate change will likely create greater competition for limited water supplies needed by the environment, agriculture, and cities.

The regional implications of declining water supplies as a long-term public policy issue are recognized in a Southern California Association of Governments July 2009 publication of essays examining climate change topics. In one essay, Dan Cayan observes:

In one form or another, many of Southern California's climate concerns radiate from efforts to secure an adequate fresh water supply…Of all the areas of North America, Southern California's annual receipt of precipitation is the most volatile – we only occasionally see a "normal" year, and in the last few we have swung from very wet in 2005 to very dry in 2007 and 2008….Southern California has special challenges because it is the most urban of the California water user regions and, regionwide, we import more than two-thirds of the water that we consume.

Members of the HMPC noted a report published in Science magazine in 2015 that stated:

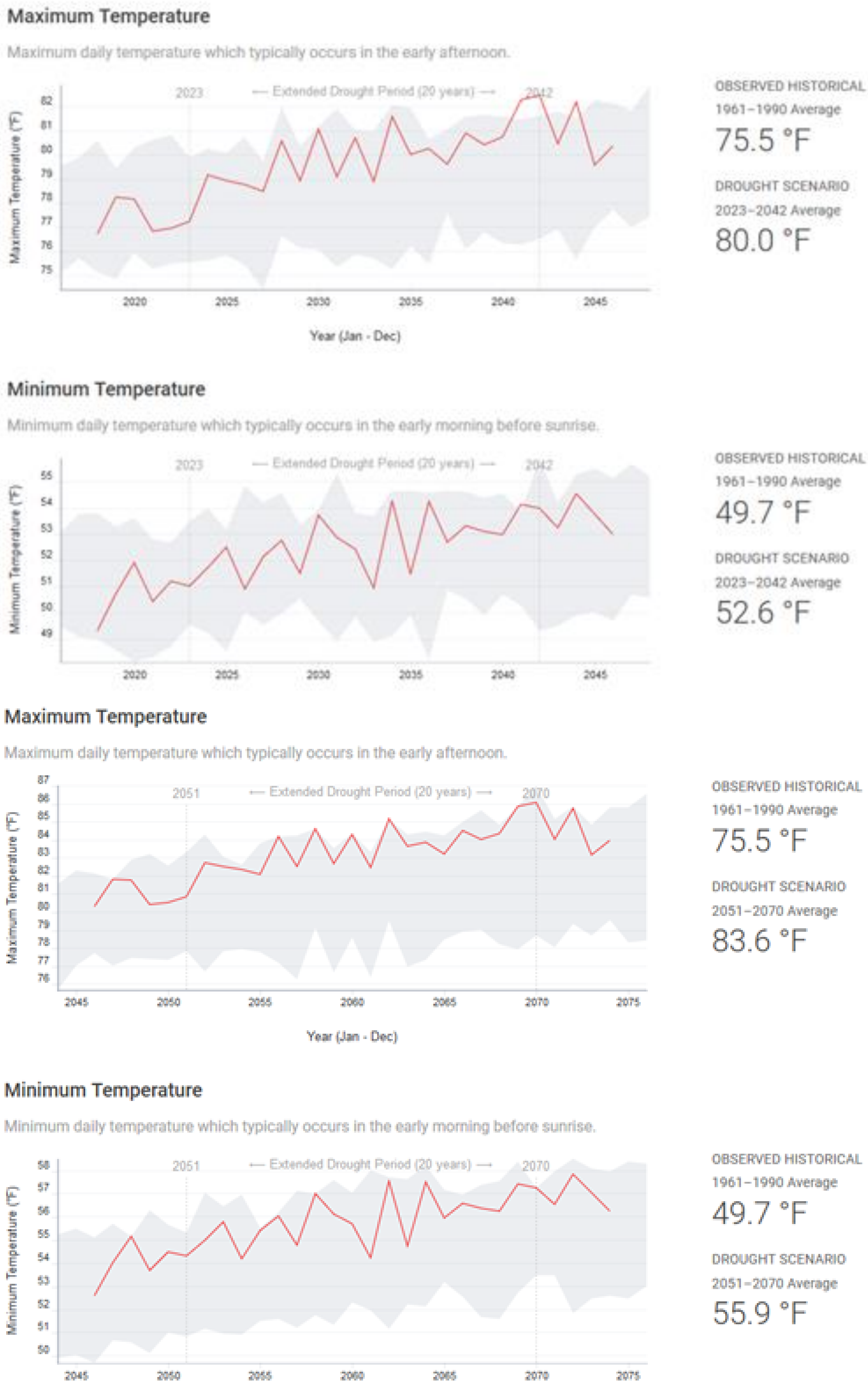
> ***Given current greenhouse gas emissions, the chances of a 35+ year "megadrought" striking the Southwest by 2100 are above 80 percent.***

The HMPC also noted a report from the Public Policy Institute of California that thousands of Californians – mostly in rural, small, disadvantaged communities – already face acute water scarcity, contaminated groundwater, or complete water loss. Climate change would make these effects worse.

Cal-Adapt has modeled future risk of drought. Recent research suggests that extended drought occurrence ("mega-drought") could become more pervasive in future decades. This tool explores data for two 20-year drought scenarios derived from LOCA downscaled meteorological and hydrological simulations (Figure 4-36) – one for the earlier part of the 21st century, and one for the latter part:

- The upper chart represents a mid-century dry spell from 2023-2042 identified from the HadGEM2-ES RCP 8.5 simulation. The extended drought scenario is based on the average annual precipitation over 20 years. This average value equates to 78% of historical median annual precipitation averaged over the North Coast and Sierra California Climate Tracker regions.
- The lower chart represents a late century dry spell from 2051–2070 identified from the HadGEM2-ES RCP 8.5 simulation. The extended drought scenario is based on the average annual precipitation over 20 years. This average value equates to 78% of historical median annual precipitation averaged over the North Coast and Sierra California Climate Tracker regions.

Figure 4-36 Butte County – Future Extended Drought Scenarios



Source: Cal Adapt – Extended Drought Scenarios

4.2.9. Earthquake and Liquefaction

Hazard/Problem Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, gas, communication, and transportation. Earthquakes may also cause collateral emergencies including dam and levee failures, seiches, hazmat incidents, fires, avalanches, and landslides. The degree of damage depends on many interrelated factors. Among these are: the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surface deposits or bedrock, degree of consolidation of surface deposits, presence of high groundwater, topography, and the design, type, and quality of building construction. This section briefly discusses issues related to types of seismic hazards.

Ground Shaking

Ground shaking is motion that occurs as a result of energy released during faulting. The damage or collapse of buildings and other structures caused by ground shaking is among the most serious seismic hazards. Damage to structures from this vibration, or ground shaking, is caused by the transmission of earthquake vibrations from the ground to the structure. The intensity of shaking and its potential impact on buildings is determined by the physical characteristics of the underlying soil and rock, building materials and workmanship, earthquake magnitude and location of epicenter, and the character and duration of ground motion.

Actual ground breakage generally affects only those buildings directly over or nearby the fault. Ground shaking generally has a much greater impact over a greater geographical area than ground breakage. The amount of breakage and shaking is a function of earthquake magnitude, type of bedrock, depth and type of soil, general topography, and groundwater. As with most communities in Northern California near active faults, much of Butte County would be susceptible to violent ground shaking. Much of the County is located on alluvium which increases the amplitude of the earthquake wave. Ground motion lasts longer and waves are amplified on loose, water-saturated materials than on solid rock. As a result, structures located on alluvium typically suffer greater damage than those located on solid rock. Conservatively, ground motions as strong as those observed during the 1975 Oroville earthquake (Modified Mercalli Intensity VIII) can be expected anywhere in Butte County.

Seismic Structural Safety

Older buildings constructed before building codes were established, and even newer buildings constructed before earthquake-resistance provisions were included in the codes, are the most likely to be damaged during an earthquake. Buildings one or two stories high of wood-frame construction are considered to be the most structurally resistant to earthquake damage. Older masonry buildings without seismic reinforcement (unreinforced masonry) and soft story buildings are the most susceptible to the type of structural failure that causes injury or death.

The susceptibility of a structure to damage from ground shaking is also related to the underlying foundation material. A foundation of rock or very firm material can intensify short-period motions which affect low-rise buildings more than tall, flexible ones. A deep layer of water-logged soft alluvium can cushion low-rise buildings, but it can also accentuate the motion in tall buildings. The amplified motion resulting from softer alluvial soils can also severely damage older masonry buildings.

Other potentially dangerous conditions include, but are not limited to building architectural features that are not firmly anchored, such as parapets and cornices; roadways, including column and pile bents and abutments for bridges and overcrossings; and above-ground storage tanks and their mounting devices. Such features could be damaged or destroyed during strong or sustained ground shaking.

As mentioned in the Dam Failure profile in Section 4.2.7 of this plan, the DSOD is concerned that if the epicenter of an earthquake of significant magnitude were to occur nearby a dam, the likelihood of a structural failure is high. Local dams vulnerable to earthquake damage are hydraulic-filled embankment dams built with sluicing materials from an adjacent area and depositing the slurry into the embankment, such as the Magalia and De Salba Dams.

Liquefaction Potential

Liquefaction is a process whereby soil is temporarily transformed to a fluid formed during intense and prolonged ground shaking. Areas most prone to liquefaction are those that are water saturated (e.g., where the water table is less than 30 feet below the surface) and consist of relatively uniform sands that are loose to medium density. In addition to necessary soil conditions, the ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction.

Liquefaction during major earthquakes has caused severe damage to structures on level ground as a result of settling, titling, or floating. Such damage occurred in San Francisco on bay-filled areas during the 1989 Loma Prieta earthquake, even though the epicenter was several miles away. If liquefaction occurs in or under a sloping soil mass, the entire mass may flow toward a lower elevation. Also of particular concern in terms of developed and newly developing areas are fill areas that have been poorly compacted.

Mapping developed by Butte County for its 2006 Flood Mitigation Plan indicates that much of the west and southwestern part of the County is considered to have a moderate to high potential for liquefaction. A map of vulnerability to liquefaction in the County is shown in Figure 4-106 in the vulnerability assessment.

Settlement

Settlement can occur in poorly consolidated soils during ground shaking. During settlement, the soil materials are physically rearranged by the shaking to result in a less stable alignment of the individual minerals. Settlement of sufficient magnitude to cause significant structural damage is normally associated with rapidly deposited alluvial soils or improperly founded or poorly compacted fill. These areas are known to undergo extensive settling with the addition of irrigation water, but evidence due to ground shaking is not available.

Location and Extent

California is seismically active because it sits on the boundary between two of the earth's tectonic plates. Most of the state - everything east of the San Andreas Fault - is on the North American Plate. The cities of Monterey, Santa Barbara, Los Angeles, and San Diego are on the Pacific Plate, which is constantly moving northwest past the North American Plate. The relative rate of movement is about two inches per year. The San Andreas Fault is considered the boundary between the two plates, although some of the motion is taken up on faults as far away as central Utah.

Faults

A fault is defined as "a fracture or fracture zone in the earth's crust along which there has been displacement of the sides relative to one another." For the purpose of planning there are two types of faults, active and inactive. Active faults have experienced displacement in historic time, suggesting that future displacement may be expected. Inactive faults show no evidence of movement in recent geologic time, suggesting that these faults are dormant. This does not mean, however, that faults having no evidence of surface displacement within the last 11,000 years are necessarily inactive. For example, the 1975 Oroville earthquake, the 1983 Coalinga earthquake, and the 1987 Whittier Narrows earthquake occurred on faults not previously recognized as active. Potentially active faults are those that have shown displacement within the last 1.6 million years (Quaternary). An inactive fault shows no evidence of movement in historic (last 200 years) or geologic time, suggesting that these faults are dormant.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible ground shaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

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. Following is a description of the active faults in or near Butte County and the potential affect they have on the County.

- **Inside Butte County**
  - ✓ **Cleveland Hills Fault**. As of 2018, there is only one identified active fault located within Butte County - the Cleveland Hills fault. The State Geologist has mapped and studied it since 1977. It is subject to the Alquist-Priolo Act and is identified pursuant to AB6x as an earthquake fault zone. This is known by the CGS to be in the Bangor Quadrangle. This fault was responsible for the 1975 Oroville earthquake of Richter magnitude 5.7, an event that produced surface displacement along about 2.2 miles of the fault. Ground motions corresponding to MMI VIII were experienced at Gridley and Oroville. Significant structural damage occurred to unreinforced masonry buildings in Oroville. Geologic studies indicate that the total length of the Cleveland Hills fault is probably 11

to 15 miles. The maximum credible earthquake on this fault is probably about magnitude 6.5 to 6.7. An event of this magnitude would cause substantially more damage than the 1975 event.

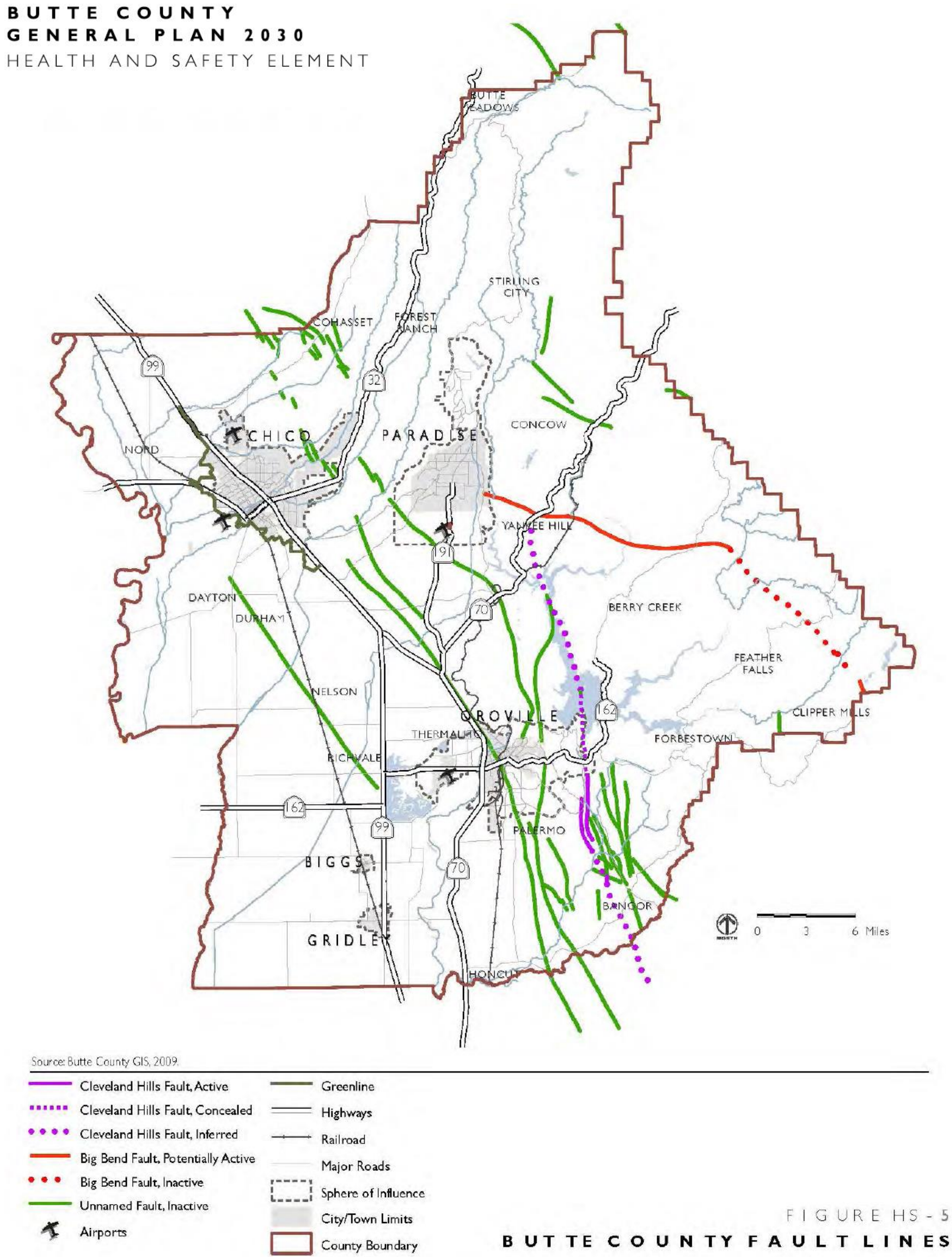
- ✓ **Big Bend Fault**. Some geologists consider the Big Bend fault zone potentially active, also located within the County. This fault could produce a magnitude 7.0 earthquake with MMI of IX or X in Butte County. Intensities this high would result in major damage.

- **Outside of Butte County**
  - ✓ **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.
  - ✓ **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 DSOD, 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.
  - ✓ **Chico Monocline Fault**. The Chico Monocline fault which extends northwesterly from Chico was considered potentially active in an unpublished 1988 report by the California Geological Survey. Based on its length, this fault could produce at least a magnitude 7.0 earthquake which would cause major damage in Chico and elsewhere in Butte County.
  - ✓ **Willows Fault**. West of Butte County is the 40-mile long Willows fault which could produce a Magnitude 7 earthquake and could yield a MMI as high as VIII in Butte County (comparable to the intensity experienced during the 1975 Oroville earthquake).
  - ✓ **Willows Fault**. West of Butte County is the 40-mile long Willows fault which could produce a Magnitude 7 earthquake and could yield a MMI as high as VIII in Butte County (comparable to the intensity experienced during the 1975 Oroville earthquake).
  - ✓ **Coast Ranges Thrust Zone**. The Coast Ranges Thrust Zone is approximately 35 miles west of Butte County. This fault zone could potentially produce a magnitude 8.0 earthquake which could be experienced in Butte County as MMI IX or X. An event of this magnitude would cause major damage to Butte County.
  - ✓ **San Andreas Fault System**. The San Andreas fault, along with related faults such as the Hayward and Calaveras faults, is one of the most active faults in California. Total displacement along this fault has been at least 450 miles and could possibly be as much as 750 miles. This fault system was responsible for the magnitude 8.0 San Francisco earthquake of 1906 as well as numerous other damaging earthquakes, including the 1989 Loma Prieta earthquake. At its nearest point, the San Andreas fault is about 95 miles west of Butte County. The 1906 earthquake was strongly felt in Butte County, at approximately MMI V and VI in western Butte County and IV to V in eastern Butte County, but there was little damage.
  - ✓ **Hayward-Calaveras Fault**. The Hayward-Calaveras fault complex is considered to be a branch of the San Andreas fault. An 1868 earthquake is reported to have caused strong fluctuations in the water level in the Sacramento River near Sacramento and in a slough near Stockton.
  - ✓ **Midland-Sweitzer Fault**. The 80-long Midland-Sweitzer fault lies approximately 40 miles southwest of Butte County. Historically, earthquakes of Richter magnitudes between 6.0 and 6.9 have occurred on or near this fault, including two strong earthquakes in 1892. Based on the fault length and the historic activity, this fault is capable of producing a magnitude 7.0 earthquake which would be experienced in Butte County with MMI as high as VIII or IX.

- ✓ **Eastern Sierra Faults/Russell Valley Fault**. The Eastern Sierra contain a number of active faults including the Russell Valley fault, which produced the 1966 Truckee earthquake of magnitude approximately 6.0, and several faults in the Last Chance and Honey Lake fault zones, which have produced several magnitude 5.0 to 5.9 earthquakes. These fault zones are approximately 50 miles east of Butte County. Earthquakes on these faults could be experienced in Butte County with MMI as high as VII or VIII.
- ✓ **Last Chance-Honey Lake Fault Zones**. The Last Chance-Honey Lake fault zones are approximately 100 miles long and trend north-northwest along the California-Nevada border. These faults are active and have resulted in earthquakes ranging between 5 and 5.9 Richter.
- ✓ **Other Potentially Active Faults**. Other potentially active faults which could result in significant ground motion in Butte County include the Sutter Butte faults, Dunnigan fault, Camel's Peak fault, Melones-Dogwood Peak faults and the Hawkins Valley fault. All of these faults should be considered potentially active due to geologic, historic, or seismic data. Other potentially active faults may also exist within the County.

Figure 4-37 shows fault locations in and near Butte County.

Figure 4-37 Active Faults in and near Butte County



Source: Butte County General Plan

Earthquakes have a short duration and a sudden speed of onset. 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. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales. One of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology. The Richter Magnitude Scale is used to quantify the magnitude or strength of the seismic energy released by an earthquake. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface (see Table 4-30). Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Table 4-30 Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors; by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, and great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Multi-Hazard Identification and Risk Assessment, FEMA 1997

Geographical liquefaction potential extents by jurisdiction from the Butte County 2030 General Plan are shown in Table 4-31.

Table 4-31 Butte County – Geographical Extents of Liquefaction Potential by Jurisdiction

Liquefaction Potential	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
Generally High	0	0.00%	0	0.00%	0	0.00%
Generally Moderate	474	0.05%	201	0.06%	272	0.04%

Liquefaction Potential	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Generally Low	0	0.00%	0	0.00%	0	0.00%
City of Biggs Total	**474**	**0.05%**	**201**	**0.06%**	**272**	**0.04%**
City of Chico						
Generally High	0	0.00%	0	0.00%	0	0.00%
Generally Moderate	10,159	0.97%	6,376	1.79%	3,783	0.54%
Generally Low	8,478	0.81%	1,661	0.47%	6,818	0.98%
City of Chico Total	**18,638**	**1.77%**	**8,037**	**2.26%**	**10,601**	**1.52%**
City of Gridley						
Generally High	0	0.00%	0	0.00%	0	0.00%
Generally Moderate	1,184	0.11%	696	0.20%	488	0.07%
Generally Low	0	0.00%	0	0.00%	0	0.00%
City of Gridley Total	**1,184**	**0.11%**	**696**	**0.20%**	**488**	**0.07%**
City of Oroville						
Generally High	0	0.00%	0	0.00%	0	0.00%
Generally Moderate	2,586	0.25%	1,100	0.31%	1,486	0.21%
Generally Low	5,212	0.50%	1,782	0.50%	3,430	0.49%
City of Oroville Total	**7,798**	**0.74%**	**2,882**	**0.81%**	**4,916**	**0.71%**
Town of Paradise						
Generally High	0	0.00%	0	0.00%	0	0.00%
Generally Moderate	0	0.00%	0	0.00%	0	0.00%
Generally Low	10,780	1.02%	8,431	2.37%	2,349	0.34%
Town of Paradise Total	**10,780**	**1.02%**	**8,431**	**2.37%**	**2,349**	**0.34%**
Unincorporated Butte County						
Generally High	61,183	5.82%	31,850	8.96%	29,332	4.21%
Generally Moderate	265,954	25.29%	161,904	45.55%	104,050	14.94%
Generally Low	685,810	65.20%	141,407	39.79%	544,403	78.17%
Unincorporated Butte County Total	**1,012,948**	**96.30%**	**335,162**	**94.30%**	**677,786**	**97.33%**

Liquefaction Potential	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Grand Total	**1,051,821**	**100.00%**	**355,409**	**100.00%**	**696,412**	**100.00%**

Source: Butte County General Plan 2030

Other Hazards

Earthquakes can also cause landslides and dam failures. Earthquakes may cause landslides (discussed in Section 4.2.11), particularly during the wet season, in areas of high water or saturated soils. Finally, earthquakes can cause dams and levees to fail (see Section 4.2.6 Dam Failure and Section 4.2.16 Levee Failure).

Past Occurrences

Disaster Declaration History

There have been no federal and one state disaster declarations in the County related to earthquakes, as shown on Table 4-32. This was from the 1975 Oroville earthquake.

Table 4-32 Butte County – State and Federal Disaster Declarations Summary 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Earthquake	1	1975	0	–

Source: Cal OES, FEMA

NCDC Events

Earthquake events are not tracked by the NCDC database.

USGS Events

The USGS National Earthquake Information Center database contains data on earthquakes in the Butte County area. Table 4-33 shows the approximate distances earthquakes can be felt away from the epicenter. According to the table, a magnitude 5.0 earthquake could be felt up to 90 miles away. The USGS database was searched for magnitude 5.0 or greater on the Richter Scale within 90 miles of the City of Oroville in Butte County. These results are detailed in Table 4-34.

Table 4-33 Approximate Relationships between Earthquake Magnitude and Intensity

Richter Scale Magnitude	Maximum Expected Intensity (MMI)*	Distance Felt (miles)
2.0 - 2.9	I – II	0
3.0 - 3.9	II – III	10
4.0 - 4.9	IV – V	50

Richter Scale Magnitude	Maximum Expected Intensity (MMI)*	Distance Felt (miles)
5.0 - 5.9	VI – VII	90
6.0 - 6.9	VII – VIII	135
7.0 - 7.9	IX – X	240
8.0 - 8.9	XI – XII	365

*Modified Mercalli Intensity Scale.

Source: United State Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977.

*Table 4-34 Magnitude 5.0 Earthquakes or greater within 90 Miles of Butte County**

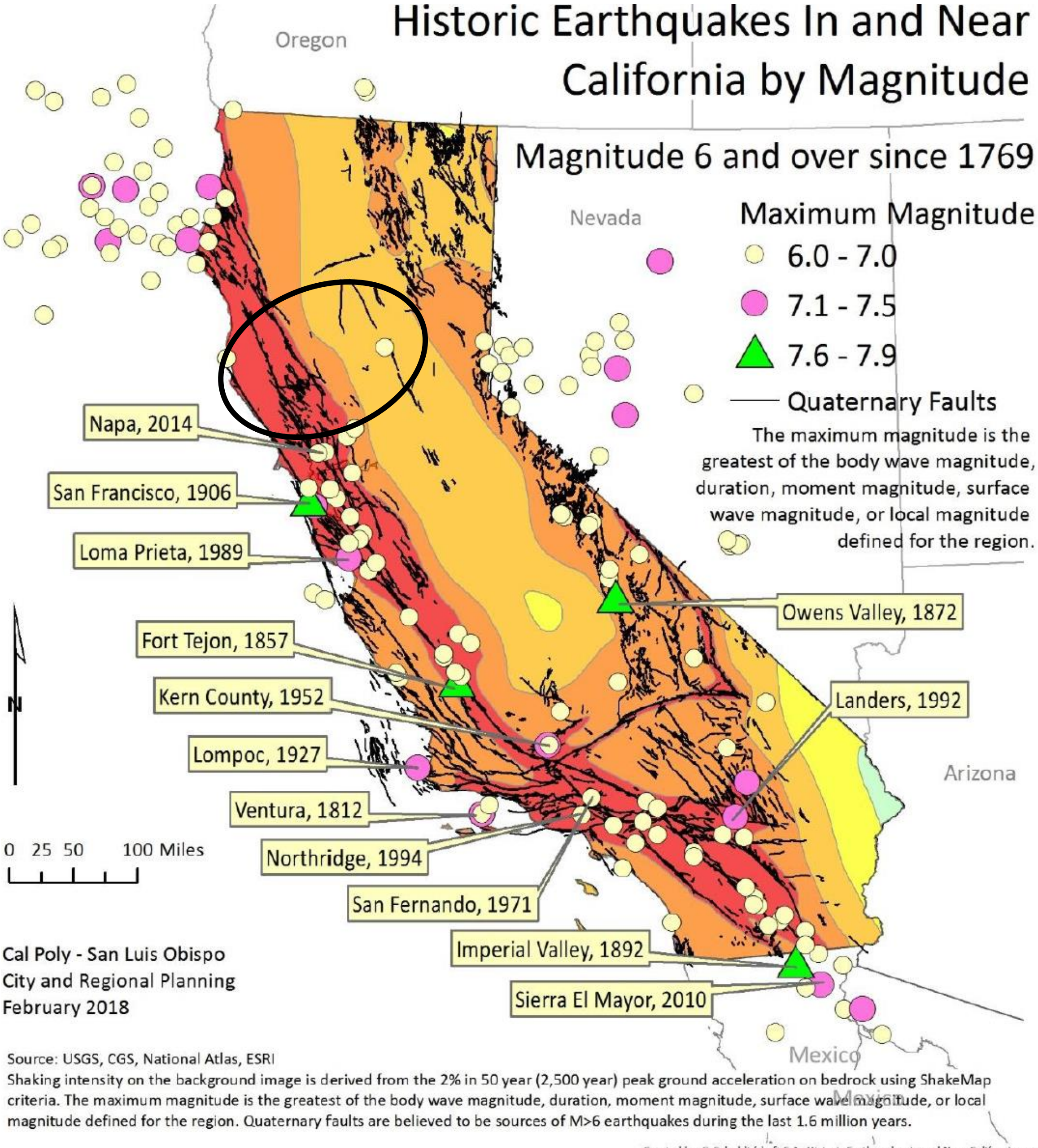
Date	Richter Magnitude	Location
12/14/2016	5.01	8 km NW of The Geysers, California
8/10/2016	5.09	20 km NNE of Upper Lake, California
5/24/2013	5.69	10 km WNW of Greenville, California
4/26/2008	5.1	1 km NW of Mogul, Nevada
8/10/2001	5.2	Northern California
11/26/1998	5.1	7 km NW of Redding, CA
11/28/1980	5.1	Northern California
2/22/1979	5.3	Northern California
8/2/1975	5.2	Northern California
8/2/1975	5.1	Northern California
8/1/1975	5.7	0 km WSW of Palermo, California
9/12/1966	5.9	Northern California

Source: USGS

*Search dates 1950 – April 1, 2019

Figure 4-38 shows major historical earthquakes in California from 1769 to 2017.

Figure 4-38 Historic Earthquakes in California 1769 to 2017



	MMI	Damage	Effects
	X	Very Heavy	Some well-built, wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
	IX	Heavy	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
	VIII	Moderate to Heavy	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
	VII	Moderate	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly-built or badly designed structures; some chimneys broken.
	VI	Light	Felt by all, many frightened. Some heavy furniture moved; a few instance of fallen plaster. Damage slight.
	V	Very Light	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

Source: 2018 State of California Multi-Hazard Mitigation Plan

Hazard Mitigation Planning Committee Events

The HMPC noted that the Sierra foothills contain literally hundreds of mapped faults, dozens of which are located within Butte County. Most of these faults are not now considered active. However, most of these faults are very short and thus are probably not capable of producing severely damaging earthquakes.

- **August 1, 1975 Oroville Earthquake -** The greatest amount of ground shaking experienced in the County occurred on August 1, 1975, when a 5.7 Richter magnitude earthquake, known as the Oroville quake, shook Butte County. 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. This earthquake was associated with the first recorded surface faulting in the western foothills of the Sierra Nevada. New fractures in the ground were observed in a 3.8-km-long north- to north-northwest-trending zone. The earthquake was felt over a large area of northern California and western Nevada. The Oroville earthquake resulted in a state disaster declaration (DC 75-03) for the area in and around Butte County.

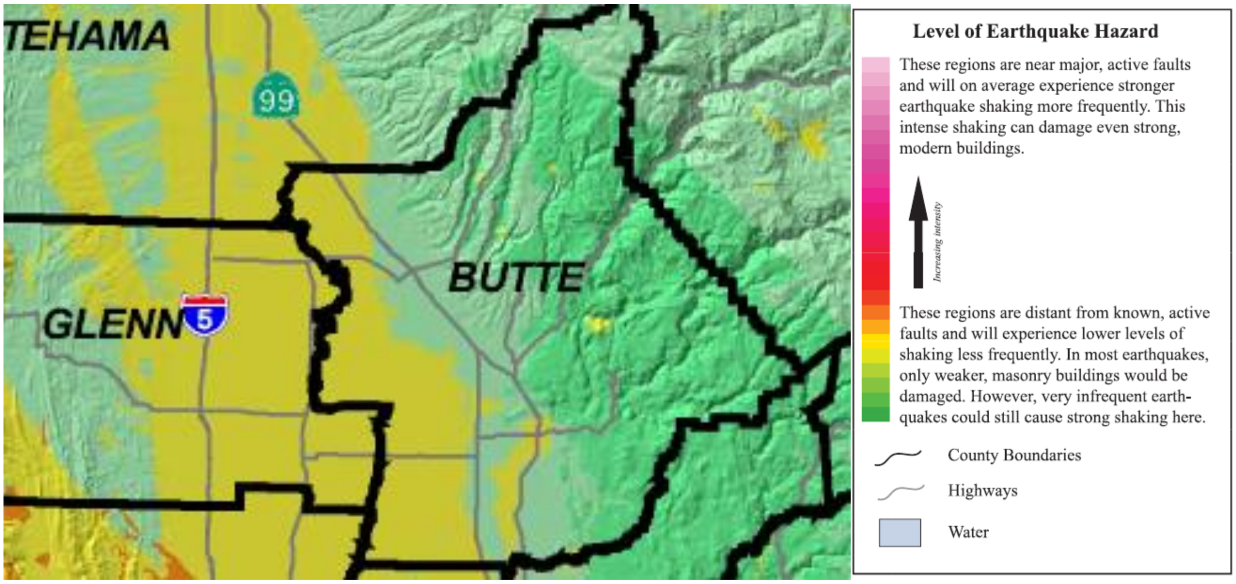
Likelihood of Future Occurrence

Unlikely (major earthquake); Occasional (minor earthquake)—Butte County's 2030 General Plan Safety Element notes that there is potential that the area will be subject to at least moderate earthquake shaking one or more times over the next century. As discussed above, Butte County could be affected by earthquake activity from several local and regional fault systems. The combination of plate tectonics and associated California coastal mountain range building geology make minor earthquakes more likely as a result of the periodic release of tectonic stresses.

Mapping of Future Occurrences

Maps indicating the maximum expectable intensity of ground shaking for the County are available through several sources. Figure 4-39, prepared by the California Division of Mines and Geology, shows the expected relative intensity of ground shaking and damage in California from anticipated future earthquakes. The shaking potential is calculated as the level of ground motion that has a 2% chance of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2,500-year average repeat time. Although the greatest hazard is in areas of highest intensity as shown on the map, no region is immune from potential earthquake damage.

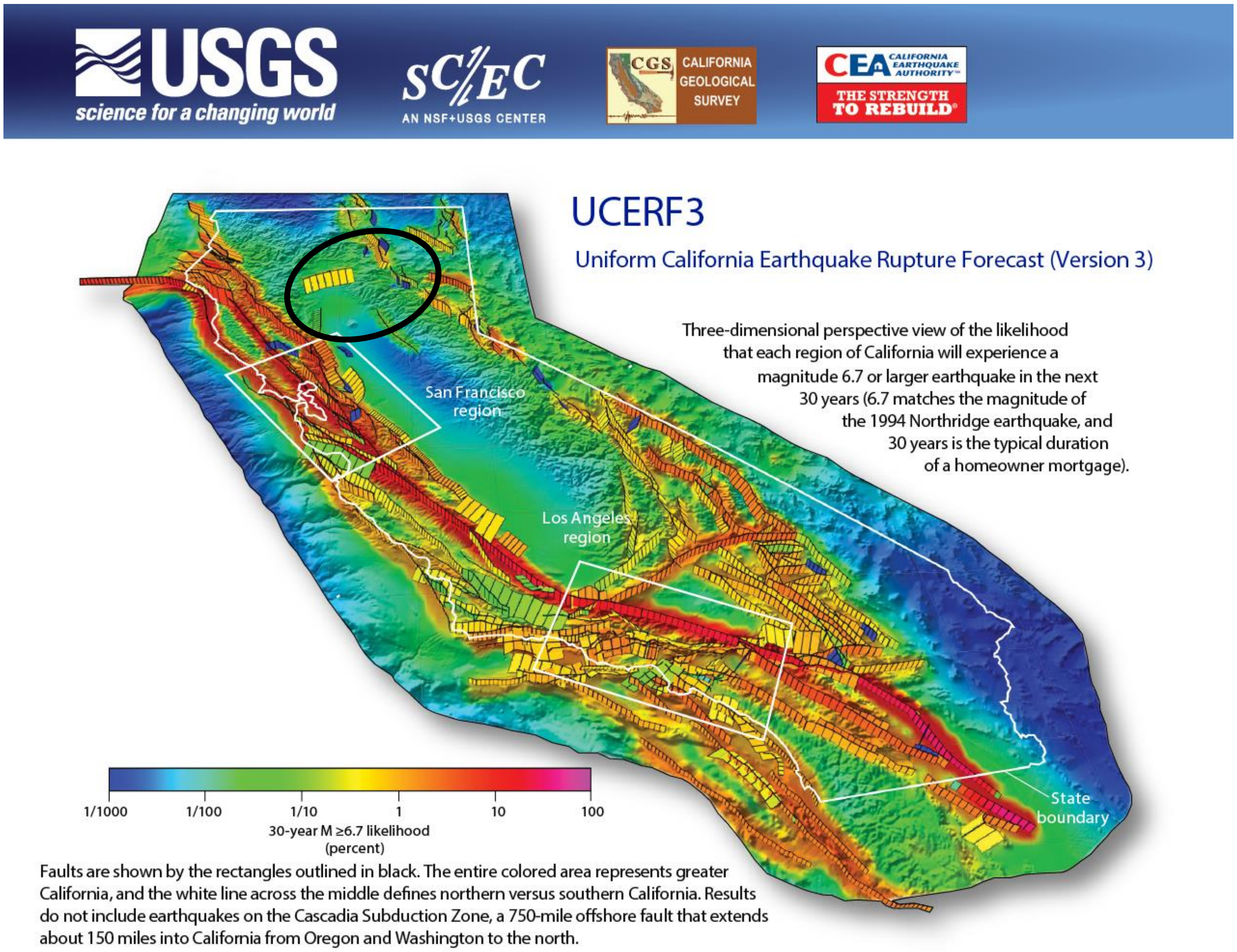
Figure 4-39 Maximum Expectable Earthquake Intensity – 2% Chance in 50 Years



Source: California Division of Mines and Geology

In 2014, the USGS and the California Geological Survey (CGS) released 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 map is shown in Figure 4-40 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.

Figure 4-40 Probability of Earthquake Magnitudes Occurring in 30 Year Time Frame



Source: United States Geological Survey Open File Report 2015-3009

Climate Change and Earthquake

Climate changes is unlikely to increase earthquake frequency or strength.

4.2.10. Flood: 100-/200-/500-year

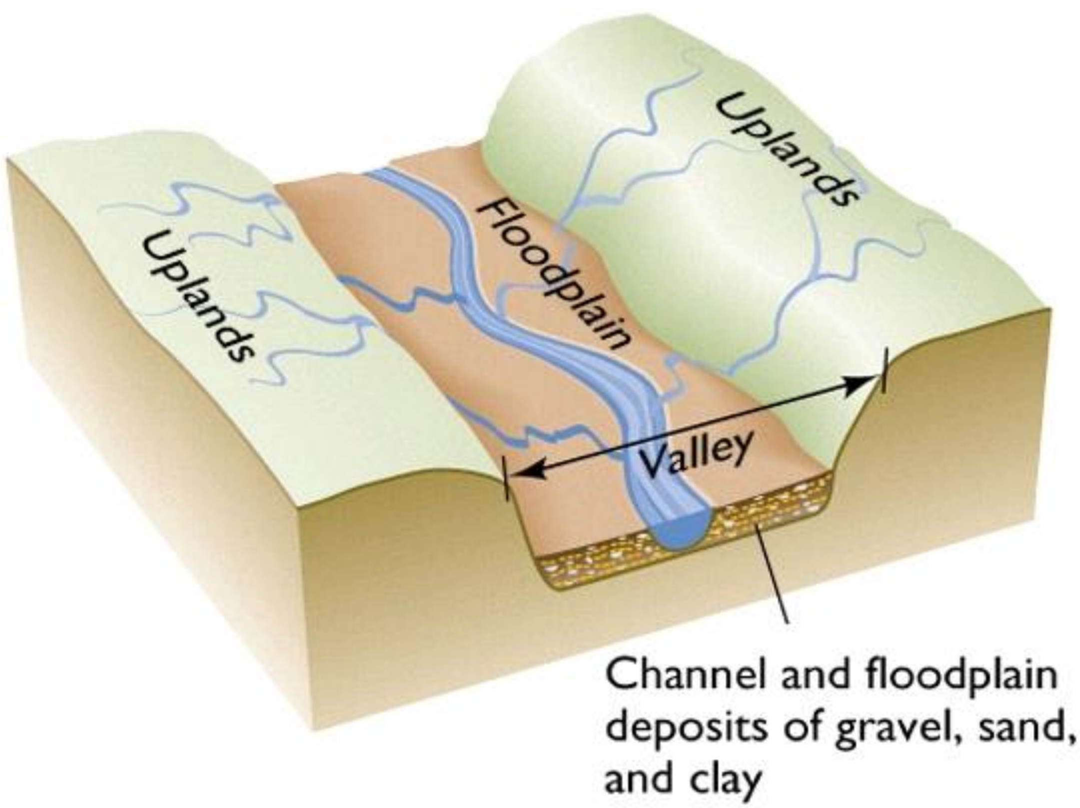
Hazard/Problem Description

Flooding is the rising and overflowing of a body of water onto normally dry land. History clearly highlights floods as one of the natural hazards impacting Butte County. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Floods can be extremely dangerous, and even six inches of moving water can knock over a person given a strong current. A car will float in less than two feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else. During a flood, people can also suffer heart attacks or electrocution due to electrical equipment short outs. Floodwaters can transport large objects downstream which can damage or remove stationary structures, such as dam spillways. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utility lines and interrupt services. Standing water can cause damage to crops, roads, foundations, and electrical circuits. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts from any type of flooding.

Location and Extent

The area adjacent to a channel is the floodplain (see Figure 4-41). Floodplains are illustrated on inundation maps, which show areas of potential flooding and water depths. In its common usage, the floodplain most often refers to that area that is inundated by the 1% annual chance (or 100-year) flood, the flood that has a one percent chance in any given year of being equaled or exceeded. The 1% annual chance flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program. The 500-year flood is the flood that has a 0.2% chance of being equaled or exceeded in any given year. The 200-year flood is one that has 0.5% chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

Figure 4-41 Floodplain Schematic



Source: FEMA

The Butte County Planning Area is susceptible to various types of flood events as described below.

- **Riverine flooding** – Riverine flooding, defined as when a watercourse exceeds its bank-full‖ capacity, generally occurs as a result of prolonged rainfall, or rainfall that is combined with snowmelt and/or already saturated soils from previous rain events. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include one or more independent river basins. The onset and duration of riverine floods may vary from a few hours to many days and is often characterized by high peak flows combined with a large volume of runoff. Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization. In the Butte County Planning Area, riverine flooding can occur anytime from November through April and is largely caused by heavy and continued rains, sometimes combined with snowmelt, increased outflows from upstream dams, and heavy flow from tributary streams. These intense storms can overwhelm the local waterways as well as the integrity of flood control structures. Flooding is more severe when antecedent rainfall has resulted in saturated ground conditions. The warning time associated with slow rise riverine floods assists in life and property protection.
- **Flash flooding** – Flash flooding describes localized floods of great volume and short duration. This type of flood usually results from a heavy rainfall on a relatively small drainage area. Precipitation of this sort usually occurs in the winter and spring. Flash floods often require immediate evacuation within the hour and thus early threat identification and warning is critical for saving lives
- **Localized/Stormwater flooding** – Localized flooding problems are often caused by flash flooding, severe weather, or an unusual amount of rainfall. Flooding from these intense weather events usually occurs in areas experiencing an increase in runoff from impervious surfaces associated with development and urbanization as well as inadequate storm drainage systems. More on localized flooding can be found in Section 4.2.11.
- **Dam failure flooding** – Flooding from failure of one or more upstream dams is also a concern to the Butte County Planning Area. A catastrophic dam failure could easily overwhelm local response capabilities and require mass evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result, and there could be associated health concerns as well as problems with the identification and burial of the deceased. Dam failure is further addressed in Section 4.2.6 Dam Failure.

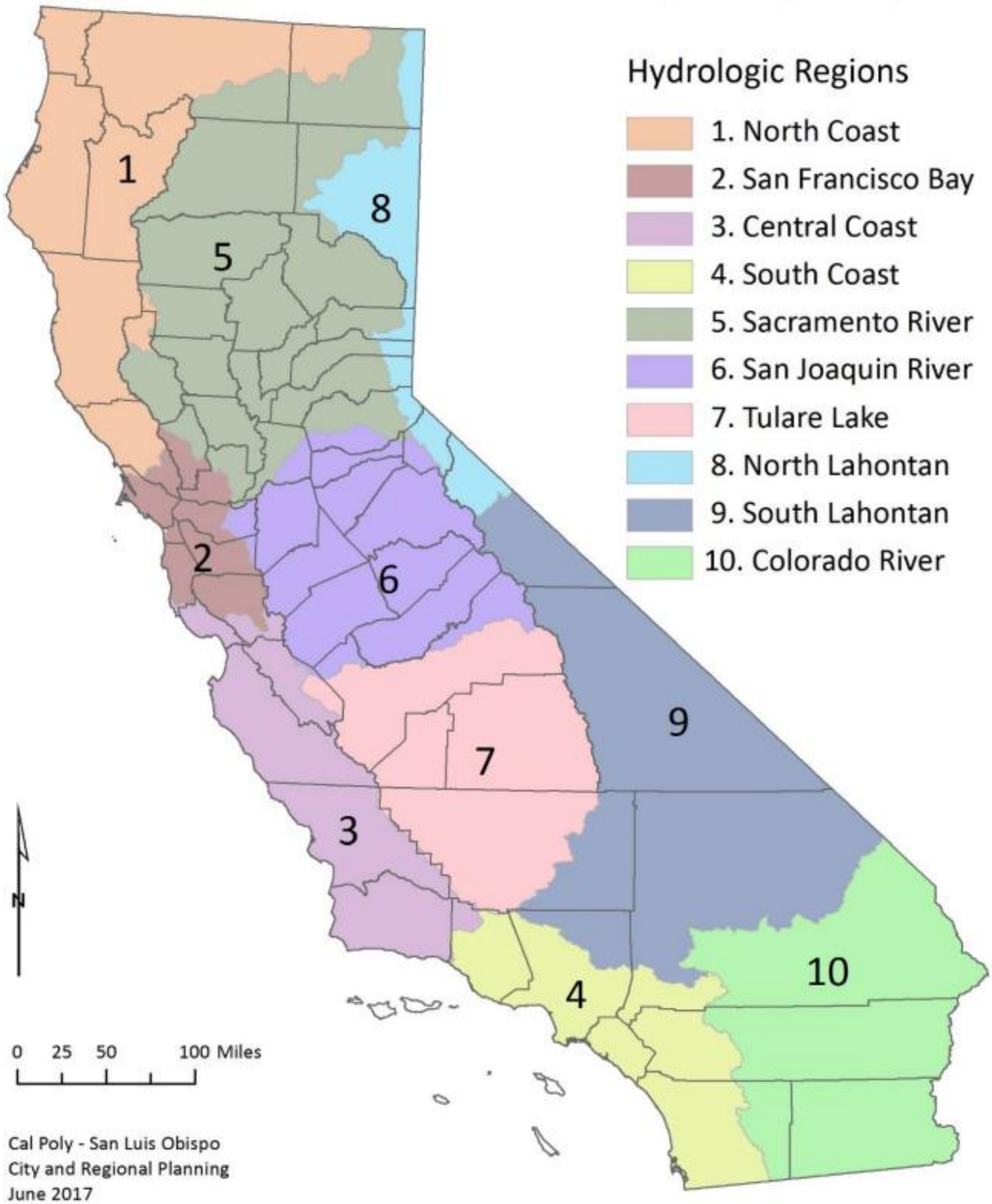
California Hydrologic Regions

California has 10 hydrologic regions. Butte County sits in the Sacramento hydrologic region.

- The Sacramento River hydrologic region covers approximately 17.4 million acres (27,200 square miles). The region includes all or large portions of Modoc, Siskiyou, Lassen, Shasta, Tehama, Glenn, Plumas, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, Sacramento, El Dorado, Yolo, Solano, Lake, and Napa counties. Small areas of Alpine and Amador counties are also within the region. Geographically, the region extends south from the Modoc Plateau and Cascade Range at the Oregon border, to the Sacramento-San Joaquin Delta. The Sacramento Valley, which forms the core of the region, is bounded to the east by the crest of the Sierra Nevada and southern Cascades and to the west by the crest of the Coast Range and Klamath Mountains. The Sacramento metropolitan area and surrounding communities form the major population center of the region. With the exception of Redding, cities and towns to the north, while steadily increasing in size, are more rural than urban in nature, being based in major agricultural areas.

A map of the California's hydrological regions is provided in Figure 4-42.

Figure 4-42 California Hydrologic Regions



Source: 2018 State of California Hazard Mitigation Plan

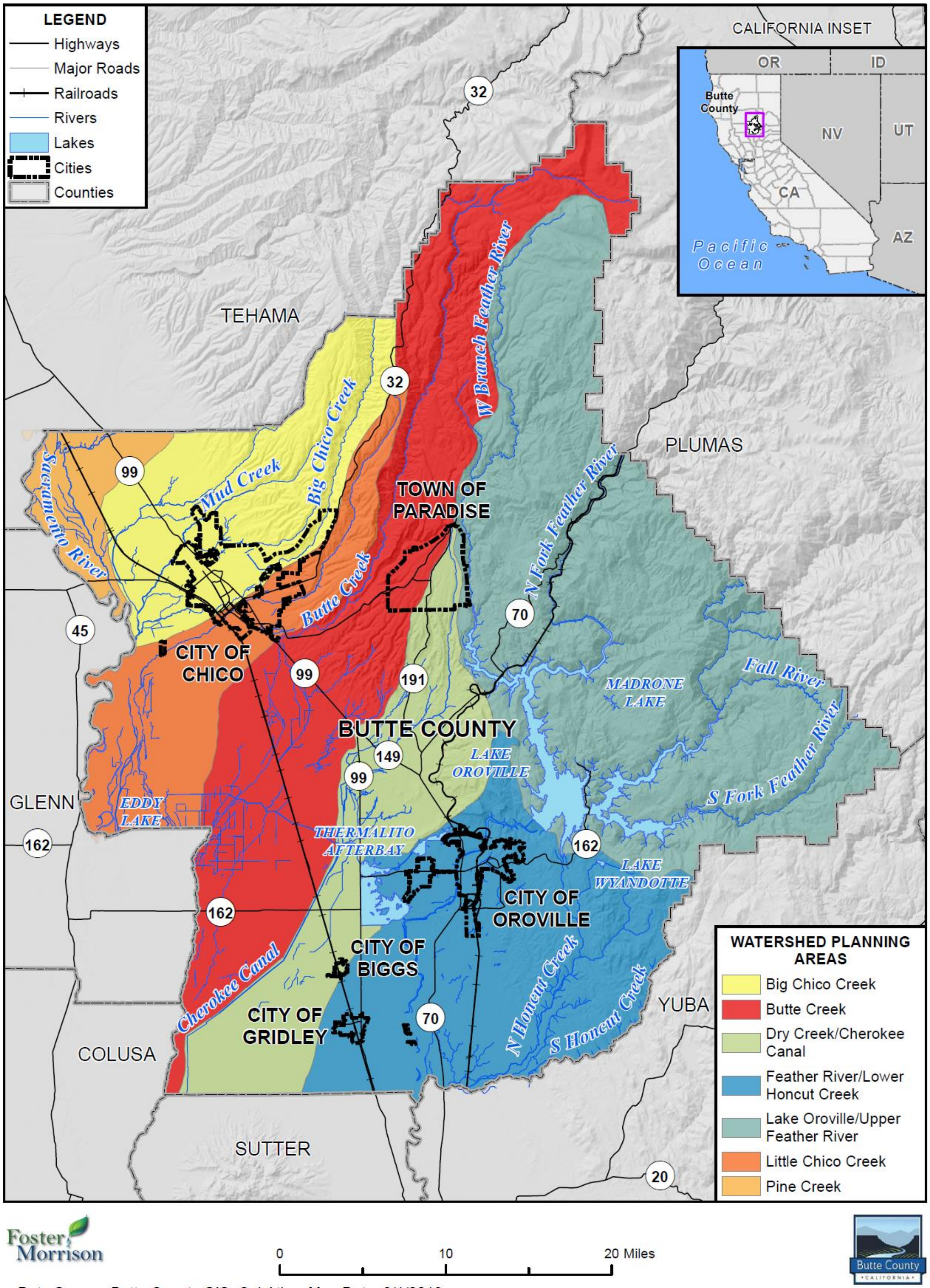
Butte County Waterway System and Major Sources of Flooding

The watersheds of Butte County include numerous watersheds contained within the County as well as several watersheds that drain into Butte County from surrounding counties. For the purposes of this Plan Update, the watershed delineation set forth by the Butte County Department of Water and Resource Conservation is used, which includes:

- Big Chico Creek Watershed
- Butte Creek Watershed
- Dry Creek/Cherokee Canal Watershed
- Feather River/Lower Honcut Creek Watershed
- Lake Oroville/Upper Feather River Watershed
- Little Chico Creek Watershed
- Pine Creek Watershed

Figure 4-43 illustrates the watersheds of Butte County. Table 4-35 and Figure 4-44 detail the watersheds in Butte County.

Figure 4-43 Butte County – Watershed Planning Areas



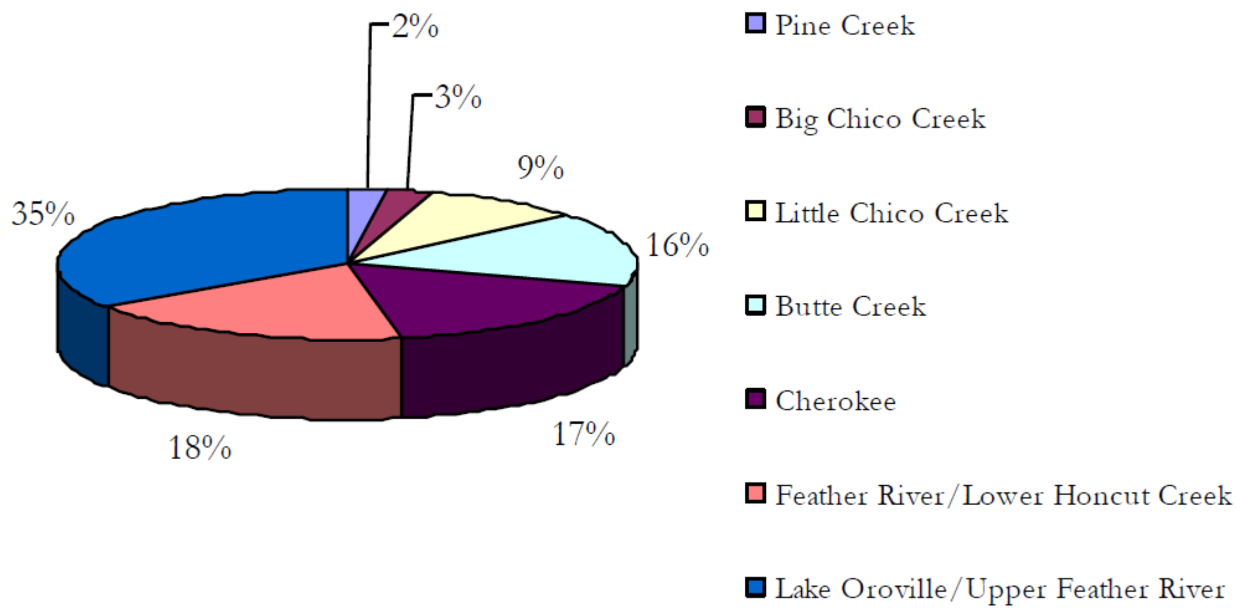
Data Source: Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Table 4-35 Watershed Acreage in Butte County

Watershed Name	Area (acres)	Watershed Name	Area (acres)
Big Chico Creek	107,949	Lake Oroville/Upper Feather River	340,669
Butte Creek	162,199	Little Chico Creek	87,137
Dry Creek/Cherokee Canal	167,053	Pine Creek	29,938
Feather River/Lower Honcut Creek	178,925		

Source: Butte County GIS

Figure 4-44 Butte County –Watershed Acreage



Source: 2006 Butte County Flood Mitigation Plan

In Butte County, there are three main rivers, the Sacramento River, the Feather River, and Butte Creek. All surface water originating in or passing through Butte County discharges to the ocean via the Sacramento and San Joaquin Rivers, which join at the head of Suisun Bay, the easternmost arm of San Francisco Bay. With a combined tributary drainage area of approximately 60,000 square miles, these rivers provide most of the freshwater inflow to San Francisco Bay.

High water levels along the Sacramento and Feather Rivers are a common occurrence in the winter and early spring months due to increased flow from storm runoff and snowmelt. An extensive system of dams, levees, overflow weirs, drainage pumping plants, and flood control bypass channels strategically located on the Feather River has been established to protect the area from flooding. These facilities control floodwaters by regulating the amount of water passing through a particular reach of the river. The amount of water flowing through the levee system can be controlled by Oroville Dam on the Feather River. However, flood problems in Butte County are still quite a concern. Numerous areas of the County are still subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms.

Big Chico Creek Watershed

The Butte County FIS noted that Big Chico Creek originates from a series of springs that flow off of the Sierra Mountains to form a main channel at Butte Meadows. Big Chico Creek flows a distance of 45 miles from its origin, crossing portions of Butte and Tehama counties, to its confluence with the Sacramento River. The Big Chico Creek watershed also encompasses three smaller drainages to the north: Sycamore, Mud, and Rock Creeks. Closest to Big Chico Creek is Sycamore Creek, which originates at approximately 1,600 feet and is a tributary to Mud Creek. Mud and Rock Creek, further north, originate between 3,600-3,800 feet. Mud Creek drains off of Cohasset Ridge to the south, flowing 26 miles to its confluence with Big Chico Creek. Rock Creek drains the north side of Cohasset Ridge and flows 28.5 miles before it joins Mud Creek (Big Chico Creek Watershed Alliance, 2004). Flooding hazards within the Big Chico Creek watershed is attributed to potential high flows from Lindo Channel, Sycamore Creek, Rock Creek, Keefer Slough, and Big Chico Creek. The flooding hazards in the Big Chico Creek Watershed are summarized below:

- Lindo Channel: At the Lindo Channel diversion, located at Five-Mile Park levee erosion, lack of freeboard, and the accumulation of large, woody debris at the entrance to the Sycamore Creek Diversion Structure has historically resulted in flooding in the area during high flow events. This also contributes to high flows into Lindo Channel. Lindo Channel does not have constructed flood control levees and thus can easily exceed its channel capacity during high flows. The majority of Lindo Channel flows through the City of Chico.
- Sycamore Creek: At the Sycamore Creek Diversion Structure there has accumulated a significant amount of sediment and debris both upstream and downstream of the structure. This sediment and debris can force higher than normal flows to flow down Lindo Channel. At the end of the Sycamore Creek diversion channel near Marigold Avenue, the channel and its banks show signs of severe erosion which provides the sediment source for deposition in the downstream reaches of Sycamore and Mud Creek that have milder slopes and slower velocities, such as the Cohasset Road Bridge. In addition to sediment deposits, large woody debris has plugged the bridge and the levees in this area have been overtopped during high flow events in the past.
- Keefer Slough: At the split of Rock Creek and Keefer Slough just upstream of Hagenridge Road increased accumulation of sediment and debris on the Rock Creek side of the fork have forced a majority of the upstream flow of Rock Creek down the Keefer Slough side in high flow events. This causes damages to areas adjacent to Keefer Slough because it does not have capacity to carry this additional amount of flow. Keefer Slough crosses State Route 99 (SR99) just north of the City of Chico and during these high flow events the slough has inundated SR99 causing CalTrans to close the highway. Once Keefer Slough crosses SR99 it can leave its defined channel and spread out through the agricultural areas west of SR99 and north of Nord Highway flooding the orchards and fields. The flows than join other waters near the community of Nord and cause flooding in Nord and the surrounding area. There are no formal flood control facilities along Keefer Slough and the slough runs on private property for its entire length.
- Confluence of Big Chico Creek and Lindo Channel: At the confluence of Big Chico Creek and Lindo Channel, a private levee near Meridian Road and Grape Way broke during a recent high flow event, leaving the residents vulnerable to flooding.
- Rock Creek: From its split with Keefer Slough Rock Creek flows in a well-defined but somewhat narrow channel west toward SR99. The channel in much of this stretch of the creek is chocked with sediment and debris which reduces the channel capacity of the creek. The creek does not have any

certified levees but does have embankments that retain the flow within the channel on this stretch of the creek. West of SR99 Rock Creek flows in a wider well-defined channel with more substantial levees until it intersects the UPRR tracks just north of the community of Nord. These levees were built by local farmers and not to any design standard and are thus not recognized as a certified flood control facility. The lower reaches of this section of Rock Creek periodically inundate the agricultural areas north of Nord and leave it vulnerable to flooding. South of the UPRR tracks Rock Creek flows in a wide well-defined channel until it empties into the lower end of the Mud/Sycamore Creek Flood Control system just south of West Sacramento Ave. west of the City of Chico. This stretch of the creek has no formal levees except in areas where a farmer may have pushed up material to keep the creek flows from flooding his fields. Where this portion of the creek crosses West Sacramento Ave. it has flooded the road especially when debris is washed up against the bridge.

- Sacramento River: The Sacramento River has cut away approximately 65 feet of bank along the stretch of River Road between West Sacramento Avenue and Big Chico Creek. River Road is only approximately four feet away from the Sacramento River. The Butte County Department of Public Works has placed a temporary concrete barrier along the roadway; however, a more permanent solution is necessary to protect the people and the road.

Butte Creek Watershed

Butte Creek originates in the Lassen National Forest at over 7,000 feet. Butte Creek travels through canyons through the northwestern region of Butte County and through the valley, entering the floor near Chico. The northern Sierra and southern Cascade mountain ranges divide the valley section from the mountainous section of the Butte Creek watershed in Butte County. Once Butte Creek enters the valley section of the watershed near Chico, it travels approximately 45 miles before it enters the Sacramento River (Butte Creek Existing Conditions Report, 2000). Levees were constructed along Butte Creek in the 1950s by the Corps of Engineers. These levees extend for over 14 miles along the Butte Creek channel. The primary flooding hazards are summarized below:

- Butte Creek Levees: According to the FEMA FIS and DFIRMs, the water surface elevations under a 100-year and 500-year storm event would encroach on the levee freeboard and overtop parts of the levees along Butte Creek. The BFE ranges between approximately 104 ft to 230 ft as indicated on the FEMA DFIRM dated January 6, 2011. The Butte Creek levees were constructed in the 1950s and the condition of the levees at this time, with respect to US Army Corps of Engineers levee certification criteria, is not known. Butte Creek contained a flow greater than the 100-year event, as published in the FEMA FIS, in 1997, confirming that the floodplain provided in the FEMA FIRMs from Butte Creek is largely due to theoretical levee failure. This method of floodplain determination near levees is adopted by FEMA for levees that are not certified.

Dry Creek/Cherokee Canal Watershed

Cherokee Canal, which was originally constructed to protect agricultural land from mining debris, now serves as an irrigation drainage canal. Dry Creek becomes Cherokee Canal northeast of Richvale, and Gold Run and Cottonwood Creek join the Cherokee Canal upstream of the Richvale Road crossing. Cherokee Canal eventually enters Butte Creek near the southwestern corner of Butte County, south of Highway 162 in an area called the “Butte Sink.” The primary flooding hazards within the Cherokee Watershed is caused by sedimentation and structures located within the FEMA SFHA.

- Cherokee Canal: According to a 1970 report by DWR entitled, "Debris Deposition in the Cherokee Canal Flood Control Project," Cherokee Canal experiences flooding due to heavy rains and valley flooding. After several historical attempts to rectify the sediment and debris loading of the channel and in response to the Sacramento River Major and Minor Tributaries Flood Control Act of 1944, the USACOE developed the "Review of Interim Flood Control Survey Report on Sacramento River and Tributaries, Cherokee Canal and Butte Creek, 15 June 1948." The report recommended building a levee and channel flood control project and the present Cherokee Canal was constructed in 1960 based upon the recommendations in the report.
  - ✓ According to a recent study of the hydrologic, hydraulic, and sediment yield/transport in the Dry Creek and Cherokee Canal (U.S. Army Corps of Engineers, 2003), Dry Creek contributes the most sediment to Cherokee Canal. According to the report, it is estimated that 103,000 tons of sediment would be delivered to Cherokee Canal in a 100-year event. An example of the effects of sedimentation and debris on constricting the channel was seen clearly at the bridge crossing at Nelson-Shippee Road during an April 2005 field visit.
  - ✓ Chemical Facilities Storage in the FEMA SFHA: Structures that store fertilizers and chemicals for the Butte County Rice Growers Association (BCRGA) are located in the FEMA-designated SFHA along Cherokee Canal. The U.S. Department of Agriculture (USDA) rice storage warehouses are also located in the Cherokee Canal FEMA designated 100-year SFHA. The consequences of flooding in these storage warehouses would be extensive, as floodwater would mix with the chemicals stored in these facilities and potentially release chemicals into surface water, groundwater, and surrounding areas. Public health would also be a major concern.

Feather River/Lower Honcut Creek Watershed

After the Feather River flows through the Oroville Dam it enters the City of Oroville, and continues south, joining with the Yuba River at Marysville and Yuba City, and eventually the Sacramento River. The Feather River/Lower Honcut Creek watershed also contains a Dry Creek, unrelated to the Dry Creek in the Cherokee Watershed. This Dry Creek is located within the City of Oroville and contains three tributaries that join together and the main channel ends within the City of Oroville. Wyman Ravine, which originates south of the City of Oroville, drains the southern portion of the watershed and flows into Honcut Creek. Flooding in the Feather River/Lower Honcut Creek watershed has been attributed to several sources: Dry Creek and its tributaries, stormwater drainage in the City of Oroville, the Feather River, and Wyman Ravine. The three major forks of Dry Creek originate and join within the City of Oroville urban area. The flood hazards witnessed in this watershed include:

- Dry Creek: During high flow events, the northernmost fork of Dry Creek exceeds channel capacity and inundates the Oroville urban area. There are seven detention basins on the three forks. One of these detention basins is the Argonaut basin, located on the middle fork of Dry Creek, which fills up before all others in the system. Channel erosion in the tributaries of Dry Creek was evident through the developed areas in the City of Oroville.
- Dry Creek Tributaries Confluence: Heavy development and excessive erosion near the confluence of the three main forks of Dry Creek in the City of Oroville urban area exposes nearby residents to potential flooding.
- City of Oroville Stormwater Drainage: The limited capacity of the urban stormwater drainage pipes in the downtown area restrict the volume of water that can be conveyed to the Feather River, leading to local flooding at different locations in the City.

- Feather River: During high flows in the Feather River water rises through the gravel deposits in the industrial area near Feather River Boulevard on the west side of the City of Oroville. The severity of this problem is proportional to the water surface elevation in the Feather River, which is contained by levees above the adjacent ground, through the industrial area. A boil in the Feather River concrete levee near 4th Street and Safford Street creates a leak during high flow events. This levee is maintained and operated by the City of Oroville.
- Wyman Ravine: Wyman Ravine, which is located south of the City of Oroville and runs northeast to southwest, floods nearby houses and a number of County roads including Railroad Avenue, Cox Lane, Central House Road, Middle Honcut Road and Lower Honcut Road in the lower reaches before it spills into North Honcut Creek.
- Wyandotte Creek: Wyandotte Creek, which is located south of the unincorporated community of Palermo and runs northeast to southwest, can flood nearby houses and a number of County roads including Cox Lane, Central House Road, Middle Honcut Road and Lower Honcut Road before it spills into North Honcut Creek.
- North Honcut Creek: North Honcut Creek, which is located south of the unincorporated community of Honcut runs east to west, it can flood nearby houses and Lower Honcut Road before it merges with South Honcut Cree before spilling into the Feather River.

Lake Oroville/Upper Feather River Watershed

The North Fork of the Feather River originates in northern California in the Lassen Volcanic National Park. It flows south into Lake Oroville, where it joins the south and middle forks of the Feather River. Oroville Dam, constructed in 1968, houses six power generation units and four additional units in the Thermalito Power Plant. The Thermalito Forebay and Afterbay are holding reservoirs, located downstream of Lake Oroville, that allow water released from Lake Oroville to generate power during established peak periods and to be pumped back into the lake during off-peak periods. Other smaller creeks in the watershed flow into Lake Oroville, including Cirby and Concow creeks, which initially join to flow into the Concow Reservoir upstream of Lake Oroville. Flooding hazards occur primarily upstream of the Concow Reservoir at several road crossings at Concow Creek and at Cirby Creek.

- Concow Creek: The region near the Concow Reservoir, north of Lake Oroville, has experienced periodic inundation and several crossings are severely deteriorated. In particular, the Hoffman Road Bridge at Concow Creek has limited capacity and is inundated during annual storms. The bridge has severely deteriorated and cannot handle heavy traffic that would be expected during rescue and evacuation. The culverts underneath the bridge are severely damaged and large sections of concrete have fallen into the creek and show signs of continuing erosion. The Hoffman Road Bridge serves as the only route out of the area for the close to thirty residents who live on the right bank of Concow Creek.
- Cirby Creek: The Camelot Subdivision, just upstream of the Hoffman Road Bridge, contains many privately-owned bridges, such as the Cirby Creek Road crossing at Cirby Creek that have limited capacity to convey heavy flows and suffer debris blockage in high flow events. Many of the bridges cannot handle the heavy traffic that would be needed for rescue and evacuation purposes.

Little Chico Creek Watershed

Little Chico Creek originates on the northwestern boundary of the Butte Creek watershed and flows through canyons before reaching the City of Chico. Before Little Chico Creek enters the City of Chico urban area, it passes a diversion structure constructed in the 1960"s, which is intended to divert high flow from Little Chico Creek into Butte Creek. Little Chico Creek flows through the City of Chico before entering the valley, at which point it disperses through numerous waterways within the region (Butte Creek Watershed Existing Conditions Report, 2000).

Flooding in Little Chico Creek has largely affected residents within the City of Chico urban area; however, during high flow events the lower section of the watershed has experienced substantial damage. Flooding hazards are primarily excessive vegetation in the Little Chico Creek channel, flooding from Dead Horse Slough, flooding in the lower reaches of Little Chico Creek, and the levees along the Little Chico Creek-Butte Creek Diversion channel.

- Vegetation in Little Chico Creek: Excessive invasive vegetation has reduced the channel capacity and accumulating storm drainage from Dead Horse Slough and the Chico urban area has reduced the capacity of the channel. Recent hydraulic analysis of the Little Chico Creek channel that was done as part of the Butte Creek Watershed Floodplain Management Plan, showed that the current channel capacity of Little Chico Creek is approximately 1,800 cfs, compared to the estimated 2,350 cfs used to map the SFHA in the FEMA FIS. Due to the limited channel capacity of Little Chico Creek, the 100-year SFHA along the Chico urban area, as determined by FEMA in the early 1990s, would actually be larger if remapped today.
- Dead Horse Slough: The Dead Horse Slough crossing at El Monte Avenue experiences periodic inundation and nearby structures have inundated as recently as 1997. In the lower reaches of Little Chico Creek, the Little Chico Creek crossing at Alberton Avenue and at Taffee Avenue has experienced levee overtopping, sheet flow flooding, and levee seepage.
- Drainage in Little Chico Creek: Inadequate Storm Drainage System in the City of Chico results in excessive drainage and pollution into Little Chico Creek.
- Uncertified Levee: The levees along the Little Chico Creek-Butte Creek Diversion channel were constructed in 1957. The condition of the levees and its foundation are not known and are not certified by the USACOE, thus the floodplain shown on the FEMA FIRM reflects an inadequate levee in relation to the out-of-bank flooding that can occur from Butte Creek upstream.

Pine Creek Watershed

The Pine Creek watershed is located in the northeastern section of Butte County. Pine Creek, as well as Rock Creek and Keefer Slough (which are located in the Big Chico Creek watershed), drain part of the northern region of the Big Chico Creek watershed and eventually drain into the Sacramento River. Flooding in the Pine Creek watershed has been attributed to limited channel capacities due to excessive vegetation and sediment deposits, which occur in both Pine Creek and its main tributary, Singer Creek. Some County roads in the area can experience flooding where they cross Pine Creek and its main tributary, Singer Creek. Those roads include Wilson Landing Road, Nord Gianella Road, and Bennett Road.

Other Flood--Related Hazards: Bridges

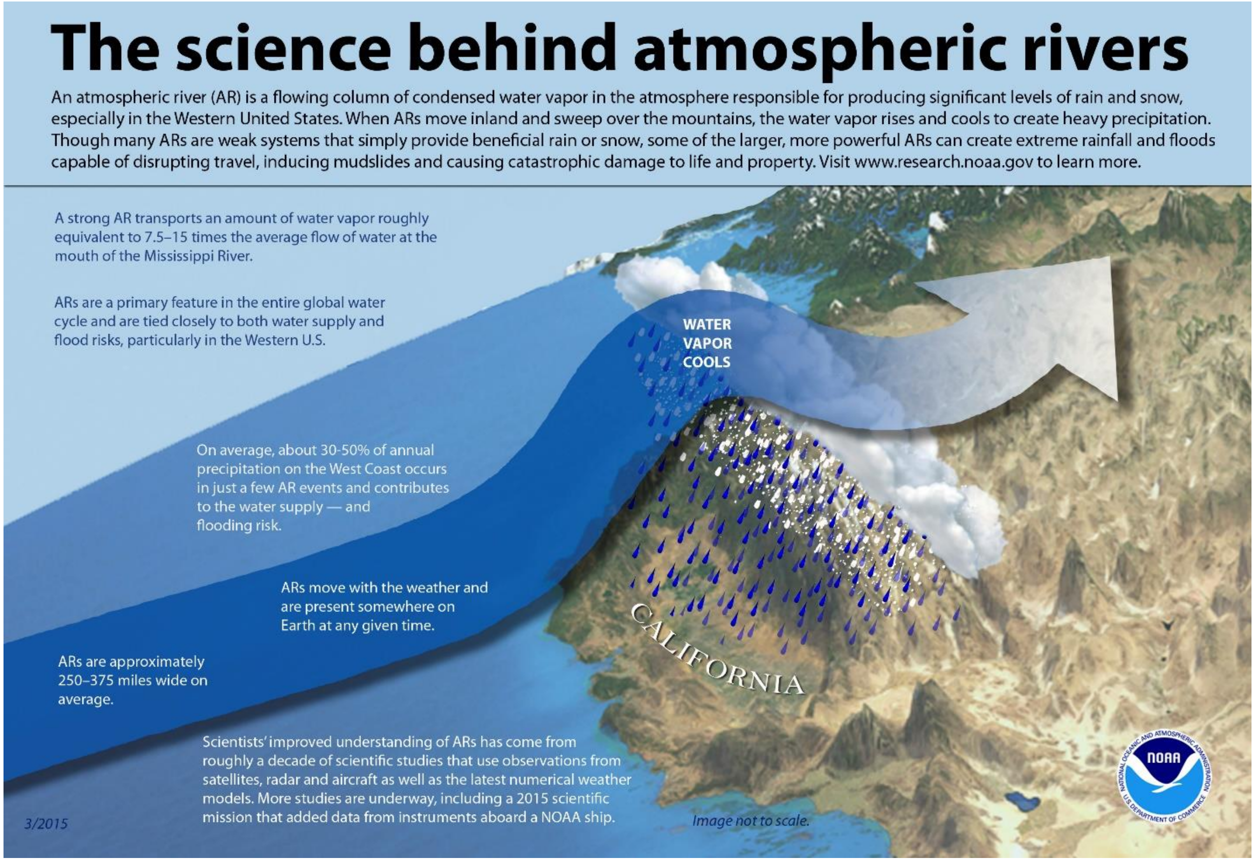
Bridge damage and collapse due to high velocity flow and excess debris pose a risk to life and can cause damage to property and structures. According to Flood Damage Survey Reports (DSR) conducted by Natural Resource and Conservation Service (NRCS) and Butte County for FEMA, the flood event in 1997 caused:

- Embankment failure to the Oroville-Chico Highway, 1.1 miles east of Midway Road. The eroded material was replaced with rock fill to the original profile, resulting in $21,000 in repairs.
- The Butte Creek Bridge on Nelson Road, eight miles west of Highway 99, had extensive damage to the support columns and embankment, resulting in $68,000 in repairs.
- Erosion of the piers and the bank on the north side of the Honey Run Covered Bridge had to be repaired to its original condition, costing $16,000.
- Damage to the Butte Creek Bridge at Humboldt road due to excessive rock, trees, and debris carried by floodwaters resulted in over $25,000 in repairs.
- The bridge at Humbert Road and Colby Creek sustained damage to the bridge abutment and guardrail and cost over $12,000 in repairs.
- The Sycamore Valley Road junction with Cohasset Road at Cohasset Bridge sustained damages behind the bridge wingwall, where floodwaters overtopped the roadway, washing out behind the bridge wingwall and cost over $6,000 in repairs.
- The Meridian Road Bridge was overtopped causing pavement deterioration and washout of the riprap, resulting in a portion of a $7,000 repair.
- The Pine Creek Bridge on Nord Gianella Road sustained debris damage resulting in almost $6,000 in repairs.
- The Skyway Bridge at Butte Creek sustained damages that cost almost $4,000 in repairs.

Other Sources of Flooding

Butte County and the rest of Northern California can be affected by a phenomenon known as an atmospheric river. According to the NOAA, atmospheric rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. These columns of vapor move with the weather, carrying an amount of water vapor roughly equivalent to the average flow of water at the mouth of the Mississippi River. When the atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow. This can be seen in Figure 4-45.

Figure 4-45 Atmospheric Rivers



Source: NOAA

Although atmospheric rivers come in many shapes and sizes, those that contain the largest amounts of water vapor and the strongest winds can create extreme rainfall and floods, often by stalling over watersheds vulnerable to flooding. These events can disrupt travel, induce mudslides and cause catastrophic damage to life and property. A well-known example is the "Pineapple Express," a strong atmospheric river that is capable of bringing moisture from the tropics near Hawaii over to the U.S. West Coast.

Not all atmospheric rivers cause damage; most are weak systems that often provide beneficial rain or snow that is crucial to the water supply. Atmospheric rivers are a key feature in the global water cycle and are closely tied to both water supply and flood risks — particularly in the western United States.

While atmospheric rivers are responsible for great quantities of rain that can produce flooding, they also contribute to beneficial increases in snowpack. A series of atmospheric rivers fueled the strong winter storms that battered the U.S. West Coast from western Washington to southern California from Dec. 10–22, 2010, producing 11 to 25 inches of rain in certain areas. These rivers also contributed to the snowpack in the Sierras, which received 75 percent of its annual snow by Dec. 22, the first full day of winter.

Floodplain Mapping

FEMA established standards for floodplain mapping studies as part of the National Flood Insurance Program (NFIP). The NFIP makes flood insurance available to property owners in participating communities adopting FEMA-approved local floodplain studies, maps, and regulations. Floodplain studies that may be approved by FEMA include federally funded studies; studies developed by state, city, and regional public agencies; and technical studies generated by private interests as part of property annexation and land development efforts. Such studies may include entire stream reaches or limited stream sections depending on the nature and scope of a study. A general overview of floodplain mapping and associated products is provided in the following paragraphs.

Flood Insurance Study (FIS)

The FIS develops flood-risk data for various areas of the community that will be used to establish flood insurance rates and to assist the community in its efforts to promote sound floodplain management. The current Butte County FIS is dated January 6, 2011.

Digital Flood Insurance Rate Maps (DFIRM)

As part of its Map Modernization program, FEMA is converting paper FIRMS to digital FIRMs (DFIRMs). These digital maps:

- Incorporate the latest updates (Letters of Map Revision (LOMRs) and Letters of Map Amendment (LOMAs));
- Utilize community supplied data;
- Verify the currency of the floodplains and refit them to community supplied base maps;
- Upgrade the FIRMs to a GIS database format to set the stage for future updates and to enable support for GIS analyses and other digital applications; and
- Solicit community participation.

DFIRMs for Butte County have been developed and are dated January 6, 2011. These have been updated with 8/30/2017 LOMRs, which is being used for the flood analysis for this LHMP. This is shown in Section 4.3.7. It should be noted that the FEMA DFIRMs only include 1% and 0.2% annual chance floodplains. The DFIRMs do not include any 0.5% annual chance floodplains. The only 0.5% annual chance floodplains in the Butte County Planning Area are found in the Chico area. More information on their 0.5% floodplains can be found in the Chico Annex to this LHMP.

Department of Water Resource (DWR) Floodplain Mapping

Also to be considered when evaluating the flood risks in Clearlake are various floodplain maps developed by Cal DWR for various areas throughout California, including Butte County.

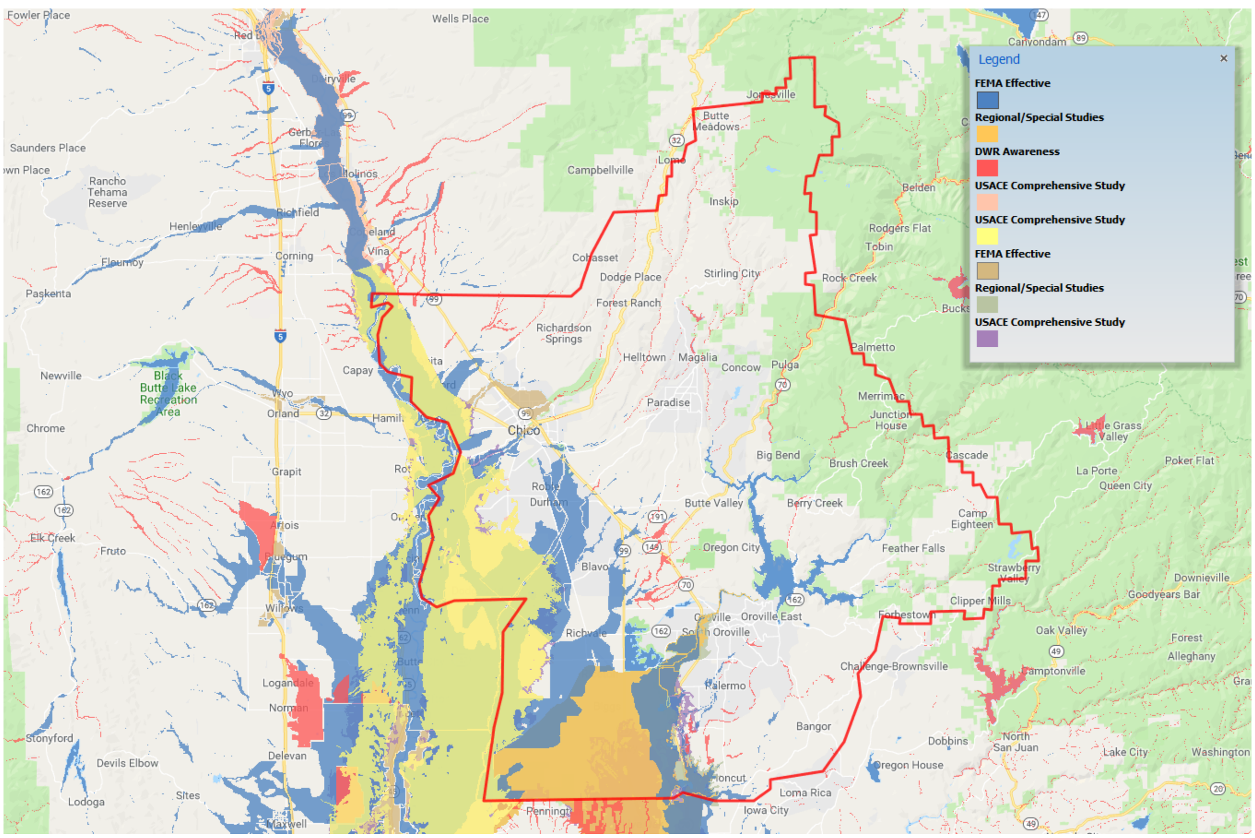
DWR Best Available Maps

The FEMA regulatory maps provide just one perspective on flood risks in Butte County. Senate Bill 5 (SB 5), enacted in 2007, authorized the California DWR to develop the Best Available Maps (BAM) displaying 100- and 200-year floodplains for areas located within the Sacramento-San Joaquin (SAC-SJ) Valley watershed. SB 5 requires that these maps contain the best available information on flood hazards and be provided to cities and counties in the SAC-SJ Valley watershed. This effort was completed by DWR in 2008. DWR has expanded the BAM to cover all counties in the State and to include 500-year floodplains.

Different than the FEMA DFIRMs which have been prepared to support the NFIP and reflect only the 100-year event risk, the BAMs are provided for informational purposes and are intended to reflect current 100- and 500-year event risks using the best available data. The 100-year floodplain limits on the BAM are a composite of multiple 100-year floodplain mapping sources. It is intended to show all currently identified areas at risk for a 100-year flood event, including FEMA's 100-year floodplains. The BAM maps are comprised of different engineering studies performed by FEMA, Corps, and DWR for assessment of potential 100- and 500-year floodplain areas. These studies are used for different planning and/or regulatory applications. They are for the same flood frequency; however, they may use varied analytical and quality control criteria depending on the study type requirements.

The value in the BAMs is that they provide a bigger picture view of potential flood risk to the Butte County and incorporated jurisdictions than that provided in the FEMA DFIRMs. This provides the community and residents with an additional tool for understanding potential flood hazards not currently mapped as a regulated floodplain. Improved awareness of flood risk can reduce exposure to flooding for new structures and promote increased protection for existing development. Informed land use planning will also assist in identifying levee maintenance needs and levels of protection. By including the FEMA 100-year floodplain, it also supports identification of the need and requirement for flood insurance. These floodplain maps for Butte County can be seen in Figure 4-46.

Figure 4-46 Butte County – Best Available Map



Source: California DWR, map created 1/21/2019

Legend explanation: Blue - FEMA 100-Year, Orange – Local 100-Year (developed from local agencies), Red – DWR 100-year (Awareness floodplains identify the 100-year flood hazard areas using approximate assessment procedures.), Pink – USACE 100-Year (2002 Sac and San Joaquin River Basins Comp Study), Yellow – USACE 200-Year (2002 Sac and San Joaquin River Basins

Comp Study), Tan – FEMA 500-Year, Grey – Local 500-Year (developed from local agencies), Purple – USACE 500-Year (2002 Sac and San Joaquin River Basins Comp Study).

Flood extents are usually measured in depths of flooding, geographical extent of the floodplain, as well as flood zones that a location falls in (i.e. 1% or 0.2% annual chance flood). Expected flood depths in the County vary and are not well defined. Flood durations in the County and incorporated jurisdictions tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Geographical flood extent from the FEMA DFIRMs is shown in Table 4-36.

Table 4-36 Butte County – Geographical Flood Hazard Extents in FEMA DFIRM Flood Zones

Flood Zone / Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
1% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
0.2% Annual Chance Flood Hazard	474	0.03%	201	0.04%	272	0.03%
Other Areas	0	0.00%	0	0.00%	0	0.00%
City of Biggs Total	**474**	**0.03%**	**201**	**0.04%**	**272**	**0.03%**
City of Chico						
1% Annual Chance Flood Hazard	17,402	1.20%	798	0.15%	16,604	1.82%
0.2% Annual Chance Flood Hazard	9,044	0.62%	2,672	0.50%	6,372	0.70%
Other Areas	17,380	1.20%	5,448	1.02%	11,932	1.31%
City of Chico Total	**43,826**	**3.03%**	**8,919**	**1.66%**	**34,907**	**3.82%**
City of Gridley						
1% Annual Chance Flood Hazard	98	0.01%	0	0.00%	98	0.01%
0.2% Annual Chance Flood Hazard	1,087	0.08%	696	0.13%	390	0.04%
Other Areas	0	0.00%	0	0.00%	0	0.00%
City of Gridley Total	**1,184**	**0.08%**	**696**	**0.13%**	**488**	**0.05%**

Flood Zone / Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Oroville						
1% Annual Chance Flood Hazard	1,382	0.10%	67	0.01%	1,315	0.14%
0.2% Annual Chance Flood Hazard	924	0.06%	394	0.07%	530	0.06%
Other Areas	7,801	0.54%	2,753	0.51%	5,048	0.55%
City of Oroville Total	**10,107**	**0.70%**	**3,213**	**0.60%**	**6,894**	**0.76%**
Town of Paradise						
1% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
0.2% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
Other Areas	10,780	0.74%	8,431	1.57%	2,349	0.26%
Town of Paradise Total	**10,780**	**0.74%**	**8,431**	**1.57%**	**2,349**	**0.26%**
Unincorporated Butte County						
1% Annual Chance Flood Hazard	425,313	29.36%	213,153	39.79%	212,160	23.24%
0.2% Annual Chance Flood Hazard	64,108	4.43%	33,277	6.21%	30,831	3.38%
Other Areas	892,622	61.63%	267,803	49.99%	624,819	68.46%
Unincorporated Butte County Total	**1,382,042**	**95.42%**	**514,233**	**95.99%**	**867,810**	**95.08%**
Grand Total	**1,448,413**	**100.00%**	**535,692**	**100.00%**	**912,721**	**100.00%**

Source: FEMA 1/6/2011 DFIRM

Past Occurrences

Disaster Declaration History

A list of state and federal disaster declarations for Butte County from flooding, (including heavy rains and storms) is shown on Table 4-37.

Table 4-37 Butte County – State and Federal Disaster Declaration from Flood 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (including heavy rain and storms)	17	1955, 1958, 1962, 1964, 1969, 1970, 1982, 1986, 1995 (twice), 1997, 1998, 2005, 2017 (three times), 2019	17	1950,1955, 1958 (twice), 1962, 1963, 1969, 1970, 1982, 1986, 1990, 1995 (twice), 1997, 1998, 2008, 2017

Source: Cal OES, FEMA

NCDC Events

The NCDC tracks flooding events for the County. Events have been tracked for flooding since 1993. Table 4-38 shows the 30 events in Butte County since 1993. Details of specific events where damage occurred can be found below the table.

*Table 4-38 NCDC Flood Events in Butte County 1993 to 10/31/2018**

Date	Event	Deaths (direct)	Injuries (direct)	Property Damage	Crop Damage	Injuries (indirect)	Deaths (indirect)
12/31/1996	Flood	0	0	$0	$0	0	0
1/1/1997	Flood	0	0	$0	$0	0	0
1/1/1997	Flood	0	0	$0	$0	0	0
1/1/1997	Flood	0	0	$0	$0	0	0
1/22/1997	Flash Flood	0	0	$0	$0	0	0
1/22/1997	Flash Flood	0	0	$0	$0	0	0
1/22/1997	Flash Flood	0	0	$0	$0	0	0
7/5/1997	Flood	0	0	$0	$0	0	0
2/2/1998	Flood	0	0	$0	$0	0	0
2/2/1998	Flood	0	0	$0	$0	0	0
2/2/1998	Flood	0	0	$0	$0	0	0
3/1/1998	Flood	0	0	$0	$0	0	0
2/11/2000	Flood	0	0	$0	$0	0	0
3/5/2000	Flood	0	0	$0	$0	0	0
10/3/2008	Flash Flood	0	0	$0	$0	0	0
10/31/2008	Flash Flood	0	0	$0	$0	0	0
12/1/2012	Flood	0	0	$0	$0	0	0
12/1/2012	Flood	0	0	$0	$0	0	0
2/9/2014	Flash Flood	0	0	$700,000	$0	0	0
12/11/2014	Flood	0	0	$25,000	$0	0	0
12/11/2014	Flood	0	0	$250,000	$0	0	0
1/7/2017	Flood	0	0	$0	$0	0	0
1/7/2017	Flood	0	0	$0	$0	0	0

Date	Event	Deaths (direct)	Injuries (direct)	Property Damage	Crop Damage	Injuries (indirect)	Deaths (indirect)
1/7/2017	Flood	0	0	$0	$0	0	0
1/8/2017	Flood	0	0	$0	$0	0	0
2/6/2017	Flood	0	0	$0	$0	0	0
2/8/2017	Flood	0	0	$2,370,000	$0	0	0
2/12/2017	Flood	0	0	$549,000,000	$0	0	0
4/6/2018	Flood	0	0	$0	$0	0	0
4/6/2018	Flood	0	0	$0	$0	0	0
Totals	**30**	**0**	**0**	**$552,345,000**	**$0**	**0**	**0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, much of which fell outside of Butte County

February 9, 2014 – A heavy band of rain moved through Chico at approximately 10pm on Sunday, Feb. 9th, through past midnight. The City of Chico received approximately 0.80 inches in 30-40 minutes, and approximately 1.00 inch in an hour, with additional heavy rainfall on the foothills to the east. A new subdivision that was under construction had pour drainage causing occupied homes to flood, particularly on Bancroft Drive. The houses that reported significant damage were addresses 2855, 2857, 2859, 2861, and 2863 on Bancroft Drive located near East 20th St, just east of Bruce Road. A wall of water came from the foothills to the east that overwhelmed the drains filling up the surrounding area and rose as high as 2 ft into some of the homes causing significant damage. Note: the area selected includes the significantly damaged homes, but reports of flooded streets extended through many of the subdivisions in the area with no damage reported. Damage estimates were $700,000.

December 11, 2014 - There were 5 to 11 homes with minor flooding in Nord. There were 25 homes with minor flooding in Palermo. Over $275,000 in damages were reported.

February 8, 2017 – HWY 70 was closed from Jarbo Gap in Butte County to Greenville Wye in Plumas County due to flooding. Flooding cause almost $2.4 million in damages.

February 12, 2017 – A mass evacuation of over 180,000 people located downstream of Oroville Dam was ordered for a possible flash flood, due to the projected near failure of the emergency spillway. The emergency spillway was used when the main spillway was discovered to have suffered severe erosion during releases back on and around February 7th. Releases from Lake Oroville had been increased due to rising lake levels due to inflow from heavy rains. A Presidential Disaster Declaration provided $274 million for emergency response costs from Feb. 7 though the end of May. The money targeted stabilizing the emergency and main spillways, as well as debris removal and work on the downed Hyatt Powerplant. A bid for long term repairs to the spillway was accepted at $275 million. Together, these total $549 million, though final costs could be much higher.

FIS Events

The latest Flood Insurance Study for Butte County was released on January 6, 2011. In the study, past occurrences were broken up by stream groups in the County. The following discussion is sourced from this discussion.

Butte Creek

Floods of record in Butte Creek occurred in December 1937, December 1955, December 1964, and February 1986. The recurrence intervals for these flows are approximately 20 years (1937), 30 years (1955), 50 years (1964), and 50 years (1986), respectively.

Keefer Slough

Flooding along Keefer Slough is primarily due to water being diverted into Keefer Slough from Rock Creek. The frequency of flooding has historically been dependent on the debris and vegetation in Rock Creek between State Highway 99 and its confluence with Keefer Slough.

Farmers in the vicinity have periodically cleared Rock Creek to reduce spills into Keefer Slough. During periods when Rock Creek has not been cleared, Keefer Slough has spilled its banks. The most notable recent flood occurred in March 1983 when Keefer Slough flooded homes in the vicinity of Keefer Road and the area southwest of State Highway 99. State Highway 99 was overtopped for 11.5 hours. These flood flows continued southwest, affecting much of the area between State Highway 99 and the Union Pacific Railroad, including the community of Nord and its vicinity.

Little Chico Creek

Flows of record measured in Little Chico Creek occurred in December 1964, March 1978, and March 1974. The recurrence intervals for these three storms are approximately 10 years, 15 years, and 30 years, respectively. Ruddy Creek and Ruddy Creek Tributary Areas of flooding along Ruddy Creek have been at the crossings of Nelson, Tehama, and Biggs Avenues. Minor flood damage was reported after the February 1986 storm. The March 1983 storm caused the most recent widespread flooding.

Wyman Ravine and Tributaries

As Wyman Ravine flows out of the steep foothills, its bed slope flattens, downstream of Lincoln Boulevard. Sheet flow and shallow flooding occur every few years in the orchards west of the Western Pacific Railroad. Flood flows over Palermo Road have extended east of Wyman Ravine almost as far as Occidental Avenue. With few exceptions, the reach of Wyman Ravine between Stimpson Lane and Lone Tree Road experiences annual flooding. The storm of February 1986 produced flow over Lone Tree Road, extending 500 feet north and 1,000 feet south of the creek.

The area to the south of Wyman Ravine Tributary 1, between the Western Pacific Railway embankment and Melvina Avenue, experiences chronic flooding, flow historically crosses over Melina Avenue south of Wyman Ravine Tributary 1 and continues west and southwest across the farm fields. Additional flow spills to the south between the Western Pacific Railway embankment and Railroad Avenue.

Palermo Tributary floods during the 10-percent-annual-chance flood and greater discharges. Sheet flow across roads and between homes occurs between approximately once in five years.

Hazard Mitigation Planning Committee Events

The HMPC noted no other historical flood events in the County than those captured above.

Likelihood of Future Occurrence

1% Annual Chance Flood

Occasional— The 1% annual chance flood (100-year) is the flood that has a 1 percent chance of being equaled or exceeded in any given year. This, by definition, makes the likelihood of future occurrence occasional. However, the 100-year flood could occur more than once in a relatively short period of time.

0.5% and 0.2% Annual Chance Flood

Unlikely—The 0.5% (200-year) and 0.2% annual chance flood (500-year) is the flood that have a 0.5 and 0.2 percent chance of being equaled or exceeded in any given year, respectively. This, by definition, makes the likelihood of future occurrence unlikely.

Climate Change and Flood

According to the CAS, climate change may affect flooding in Butte County. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Reduced snowpack and increased number of intense rainfall events are likely to put additional pressure on water infrastructure which could increase the chance of flooding associated with breaches or failures of flood control structures such as levees and dams. Future precipitation projections were shown in Figure 4-21 in Section 4.2.3. Also according to the National Center for Atmospheric Research in Boulder, Colorado, Atmospheric Rivers are likely to grow more intense in coming decades, as climate changes warms the atmosphere enabling it to hold more water.

4.2.11. Flood: Localized Flooding

Hazard/Problem Description

Flooding occurs in areas other than the FEMA mapped floodplains. Flooding may be from drainages not studied by FEMA, lack of or inadequate drainage infrastructure, or inadequate maintenance. Localized, stormwater flooding occurs throughout the County during the rainy season from November through April. Urban storm drainpipes and pump station have a finite capacity. When rainfall exceeds this capacity, or the system is clogged, water accumulates in the street until it reaches a level of overland release. This type of flooding may occur when intense storms occur over areas of development.

According to Butte County, numerous parcels and roads throughout the County not included in the FEMA 100- and 500-year floodplains are subject to flooding in heavy rains. Several issues cause drainage problems that lead to flooding in the watershed. Ditches and storm water systems are needed to convey storm water away from developed areas; however, in some areas the topography prevents surface water from draining quickly to a ditch, stream, or storm drain during an intense rainfall event. Examples can be seen in Figure 4-47.

Figure 4-47 Butte County Localized Flooding

Source: Butte County Office of Emergency Management

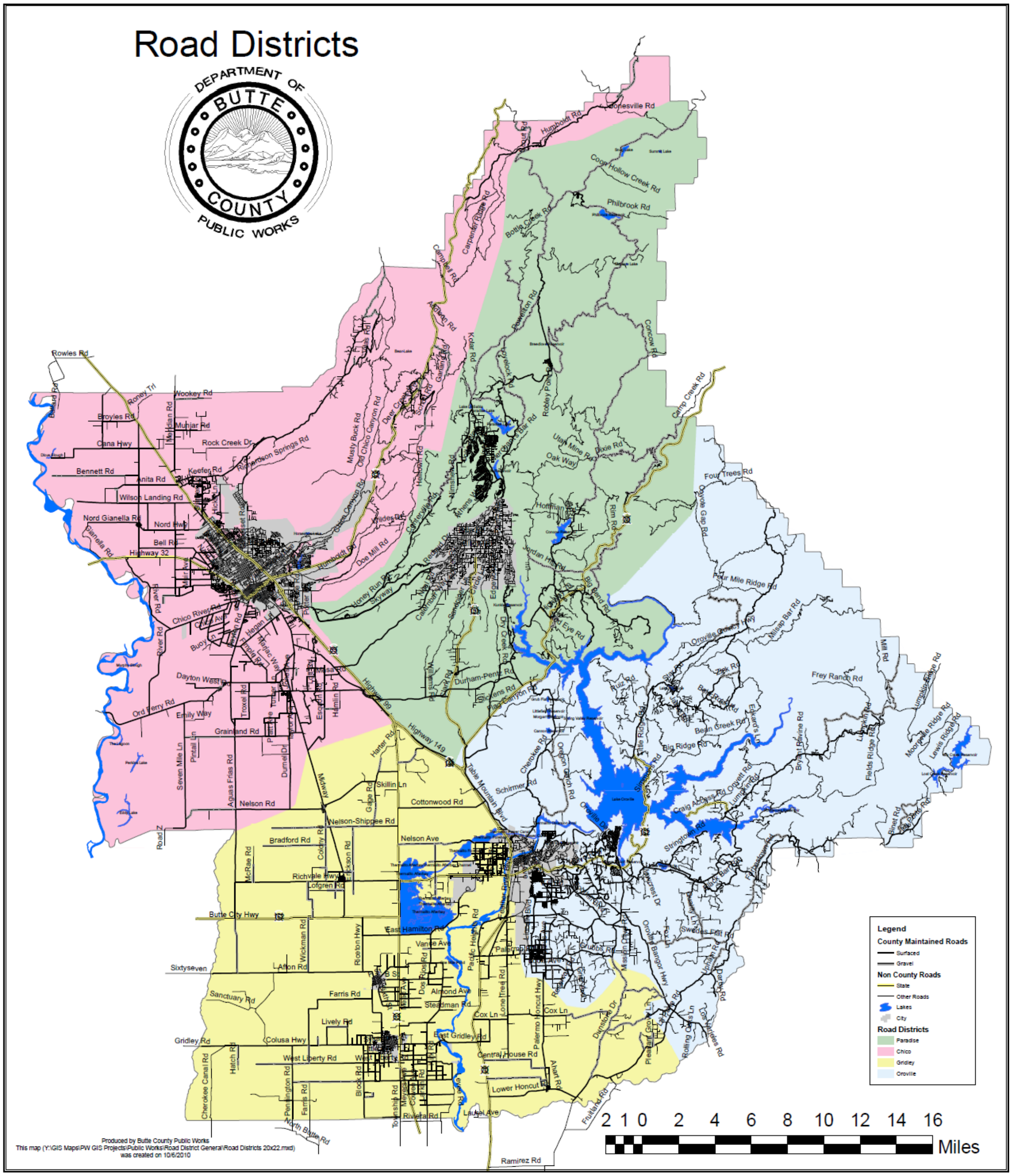
Typically, storm water systems are designed to handle storm runoff for events smaller than the 100-year event, such as a 10-year event. Older storm water systems were typically designed to convey the 10-year storm or less. These systems became inadequate as additional watershed development and associated runoff increases occurred in these developed areas. In recent years the County has implemented a requirement that new development must not increase the peak flows from the development and must retain the peak runoff within the development projects site. Storm water systems, ditches, and other waterways can also be blocked by debris, resulting in ponding storm water prior to the storm water system clearing. Many roads not in the FEMA-designated floodplains have experienced damage in the past due to this type of localized flooding.

In addition to flooding, damage to these areas during heavy storms can include pavement deterioration, washouts, landslides/mudslides, debris areas, and downed trees. The amount and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff.

Location and Extent

Butte County tracks localized flooding areas by District. These Districts are shown in Figure 4-48. Affected localized flood areas identified by the County (by District) are summarized in Table 4-39.

Figure 4-48 Butte County – Road Districts



Source: Butte County

Table 4-39 Butte County Localized Flooding Areas

Road No.	Road Name	Flooding	Washouts	High Water / Creek Crossing	Landslides / Mudslides	Debris	Downed Trees	Other
Paradise Road District								
54545-A	Bardees Bar Rd.		X		X		X	
76555-F	Camp Creek Rd.		X		X		X	
54345-A1&2	Centerville Rd.	X			X		X	
45435-A	Clear cr. Cem.			X				
52515-A1&2	Concow Rd.				X		X	
52513	Concow Rd.		X		X		X	
50545-A	Dark Canyon				X		X	
66553	Dixie Rd.				X		X	
52283-1&2	Honey Run Rd.				X		X	
91513	Humbug Summit		X		X		X	
55515-A	Jordan Hill							Washboard
62451	New Skyway					x		
92523	Philbrook				X		X	
76555-G	Pulga Rd.				X		X	
51261-3	Skyway						X	
51262-1	Skyway						X	
Chico Road District								
65065-E	Bennett Rd.	X						
54205-A&B, 54211	Bidwell Ave.						X	
60135-D & 65065-D	Cana Hwy.	X	X			X		
65065-D	Cana Pine Creek Rd.	X	X					
60135-A	Carmen Lane	X	X					
61201	Cohasset Rd.				X		X	
32253	Durnell Rd.	X	X					
49203	Elk Ave.	X						

Road No.	Road Name	Flooding	Washouts	High Water / Creek Crossing	Landslides / Mudslides	Debris	Downed Trees	Other
46213	Fimple Rd.	X						
31151	Nelson Rd.	X	X					
60102	Nord Hwy.	X						
42071	Ord Ferry Rd.	X					X	
41123	River Rd.	X	X			X	X	
30141 & 30142	Seven Mile Lane	X						
76335-B	Vilas Rd.						X	
–	Victor Rd	X						
54123 & 54191	W. Sacramento Ave.	X					X	
65065-G & 60135-F	Wilson Landing Rd.		X					
Oroville Road District								
16505-M	Alice Ave.	X						
44605-A	Bald Rock Rd.						X	
25665-A	Black Bart Rd.				X			
29483	Cherokee Rd.				X		X	
15665-A	Darby Rd.			X				
21571, 21574 & 21581	Foothill Blvd.						X	
27581-1&2, 29745-D	Forbestown Rd.				X	X		
27595-A	Hurelton Rd.	X						
29515-G & 29511	Long Bar Rd.						X	
16505-K & 16515-D	Louis Ave.	X						
27672 & 40805-A	Lumpkin Rd.				X			
37505-A	Oregon Gulch Rd.						X	
16505-C	Railroad Ave.	X						
27625-A	Stringtown Rd.	X					X	
44665-A	Zink Rd.						X	

Road No.	Road Name	Flooding	Washouts	High Water / Creek Crossing	Landslides / Mudslides	Debris	Downed Trees	Other
Gridley Road District								
16181 & 16182	Afton Rd	X						
08443	Central House Rd	X						
09161	Colusa Hwy	X						
04451	Lower Honcut Rd.	X						
05505-B	Middle Honcut Rd	X						
10445-B & 10453	Stimpson Rd.	X						
05263	West Evans Reimer Rd.	X						

Source: Butte County

There is no established scientific scale or measurement system for localized flooding. Localized flooding is generally measured by volume, velocities, and depth of flooding and the area affected. Localized flooding often happens quickly and has a short speed of onset. Localized flooding often has a short duration.

Past Occurrences

Disaster Declarations

There are no identified state or federal disaster declarations for localized flooding, as shown in Table 4-4. However, localized flooding was likely an issue during previous declarations for severe storms, heavy rains and floods.

NCDC Events

The past occurrences of localized flooding are included in the 1% and 0.2% annual chance flood hazard profile in Section 4.2.10.

Hazard Mitigation Planning Committee Events

The community of Nord is located in a FEMA A Zone. The HMPC noted that there has been extensive localized flooding in the community of Nord. This happens when Keefer Slough and Rock Creek flood due to inadequate carrying capacity of those drainages. When that happens, it sends a sheet of water over Highway 99 north of Chico that keeps flowing west toward the Sacramento River. The moving lake advances over orchard land and right into the Nord area. An example 2012 flooding in the Nord community can be seen in Figure 4-49 and Figure 4-50. High water marks are easily seen roughly two feet up on each of the structures.

Figure 4-49 Nord – Localized Flooding

Source: Butte County

Figure 4-50 Nord – Localized Flooding

Source: Butte County

Likelihood of Future Occurrence

Highly Likely—With respect to the localized, stormwater flood issues, the potential for flooding may increase as storm water is channelized due to land development. Such changes can create localized flooding problems in and outside of natural floodplains by altering or confining natural drainage channels. Urban storm drainage systems have a finite capacity. When rainfall exceeds this capacity or systems clog, water accumulates in the street until it reaches a level of overland release. With older infrastructure, this type of flooding will continue to occur on an annual basis during heavy rains.

Climate Change and Localized Flood

Even if average annual rainfall may decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century, increasing the likelihood of overwhelming stormwater systems built to historical rainfall averages. This makes localized flooding more likely.

4.2.12. Hazardous Materials Transport

Hazard/Problem Description

According to the Environmental Protection Agency (EPA), a hazardous material is any item or agent (biological, chemical, physical) which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Hazardous materials can be present in any form; gas, solid, or liquid. Environmental or atmospheric conditions can influence hazardous materials if they are uncontained.

The U.S. Occupational Safety and Health Administration's (OSHA) definition of hazardous material includes any substance or chemical which is a "health hazard" or "physical hazard," including: chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists or smoke which may have any of the previously mentioned characteristics.

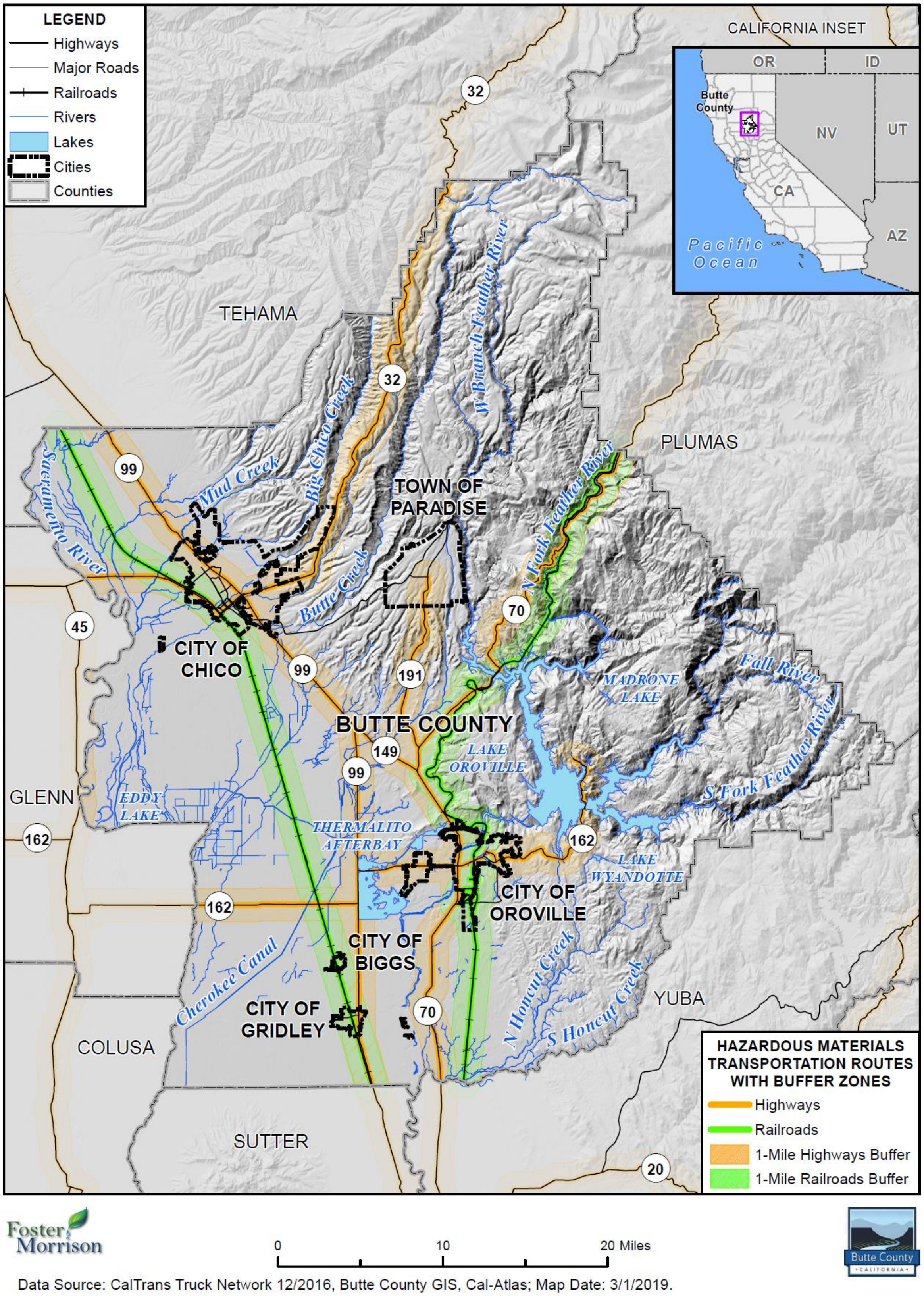
The EPA incorporates the OSHA definition, and adds any item or chemical which can cause harm to people, plants, or animals when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment. The EPA maintains a list of 366 chemicals that are considered extremely hazardous substances (EHS). This list was developed under the Superfund Amendments and Reauthorization Act. The presence of EHSs in amounts in excess of a threshold planning quantity requires that certain emergency planning activities be conducted.

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

Location and Extent

Highways and railways constitute a major threat due to the myriad chemicals and hazardous substances, including radioactive materials, transported in vehicles, trucks, and rail cars. In Butte County, hazardous materials routes include Highways 32, 70, 99, 149, 162, and 191. Two Union Pacific rail lines serve Butte County. The first connects Chico, Biggs, and Gridley north to Oregon and south to Sacramento. The second runs through Oroville, up the Feather River Canyon toward Idaho, and south to Sacramento. These are shown on Figure 4-51.

Figure 4-51 Butte County – Hazardous Materials Routes



In addition, while most routes are known, the County has not quantified the amount of hazardous materials that are transported through it en route to local deliveries or to adjoining counties. Chemicals supporting local industries, such as agriculture operations and agriculture support operations, may transport hazardous materials to and from the facilities and fields.

Accidents involving the transportation of hazardous materials could be just as catastrophic as accidents involving stored chemicals, possibly more so, since the location of a transportation accident is not predictable. The U.S. Department of Transportation (USDOT) divides hazardous materials into nine major hazard classes. A hazard class is a group of materials that share a common major hazardous property, i.e., radioactivity, flammability, etc. These hazard classes include:

- Class 1—Explosives
- Class 2—Compressed Gases
- Class 3—Flammable Liquids
- Class 4—Flammable Solids; Spontaneously Combustible Materials; Dangers When Wet Materials/Water-Reactive Substances
- Class 5—Oxidizing Substances and Organic Peroxides
- Class 6—Toxic Substances and Infectious Substances
- Class 7—Radioactive Materials
- Class 8—Corrosives
- Class 9—Miscellaneous Hazardous Materials/Products, Substances, or Organisms

The speed of onset of a hazardous materials spill is generally short. The duration is typically short as well, though certain chemicals can pollute earth and groundwater for long periods of time. The actual extent of any given incident will depend on the type of release, location, and nature and extent of any release.

Past Occurrences

Disaster Declaration History

There have been no federal or state disaster declarations for hazardous materials in Butte County, as shown on Table 4-4.

NCDC Events

The NCDC does not track hazardous materials events.

Pipeline and Hazardous Materials Safety Administration Events

The USDOT Pipeline and Hazardous Materials Safety Administration's (PHMSA) Office of Hazardous Materials Safety performs a range of functions to support the safe transport of hazardous materials. One of these functions is the tracking of hazardous materials incidents in the United States. The database was searched for hazardous materials incidents in Butte County. A summary of rail and highway incidents since 1970 in the Butte County Planning Area are shown in Table 4-40. 22 separate events were contained in the database.

Table 4-40 Butte County Hazardous Materials Incidents Since 1970

Date of Incident	Incident City	Incident Route	Mode of Transportation	Commodity Short Name	Quantity Released	Amount of Damages
2/2/1992	Soda Springs	–	Rail	Ferric Chloride Solution	200 gallons	$0
8/24/1992	Oroville	2985 S Fifth Street	Rail	Ammonium Nitrate Fertilizer	200 lbs.	$30,000
4/25/1993	Oroville	29858 5th Ave	Rail	Carbon Dioxide Refrigerated	19,771 lbs.	$0
11/29/1995	Chico	East Ave Hwy 32	Highway	Tetrachloroethylene	15 gallons	$152
7/29/1996	Oroville	Hwy 70 Exit	Highway	Diesel Fuel	1,117 gallons	$66000
6/18/1998	Soda Springs	E Bound I80 Castle Peak Rest A	Highway	Flammable Liquids N.O.S.	10 gallons	$5,754
6/2/1999	Oroville	2800 Feather River Blvd	Highway	Corrosive Liquids N.O.S.	2 gallons	$3,500
12/13/1999	Richvale	–	Rail	Ammonium Nitrate Fertilizer	100,000 lbs.	$10,000
10/22/2001	Los Molinos	Highway 99 & Taft Lane	Highway	Diesel Fuel	4,000 gallons	$309,280
2/2/2003	Chico	Midway and Speedway	Highway	Petroleum Gases Liquefied	9,145 gallons	$76,402
8/7/2003	Durham	700 Keenan Ct	Highway	Organophosphorus Pesticides	0.125 gallons	$50
10/30/2003	Chico	14300 St Hwy 99/Meridian Rd	Highway	Gasoline	1,500 gallons	$138,296
3/23/2004	Richvale	Hwy 162 Westbound Nearest Cros	Highway	Ammonia Anhydrous	0	$0
9/18/2006	Chico	State Hwy 32 @ Butte Meadows	Highway	Gasoline	700 gallons	$228,000
9/19/2007	Chico	–	Highway	Compounds Cleaning Liquids	15 gallons	$41,500
6/9/2009	Chico	401 Otterson Dr.	Highway	–	1.1 lbs.	$0
5/5/2010	Chico	1000 Ft. North Of 99but44.320	Highway	Gasoline	4,000 gallons	$14,6700
9/14/2011	Unicorp Oroville	Sb 70 Eb But 42.080	Highway	Gasoline	1,800 gallons	$58,7319
5/4/2015	Chico	–	Highway	Oxygen Refrigerated Liquid	3740.26	$2,500
7/9/2015	Oroville	1000 CAL OAK RD	Highway	Isopropanol or Isopropyl	0.5 gallons	$0

Date of Incident	Incident City	Incident Route	Mode of Transportation	Commodity Short Name	Quantity Released	Amount of Damages
12/24/2016	Durham	101 BOOK FARM ROAD	Highway	Sodium Hydroxide Solution	0.5 gallons	0
3/3/2018	Durham	101 Book Farm Rd	Highway	Flammable Liquids N.O.S.	0.007809 gallons	0

Source: PHMSA Database – Search dates 01/01/1970 – 05/01/2019

Hazard Mitigation Planning Committee Events

In addition to what was reported to the PHMSA, the HMPC reported the following hazardous materials transportation events:

- 2007
  - ✓ 8/30/07: Truck & trailer T/C, leaked 100 gallons fuel onto roadway and shoulder
  - ✓ 9/19/07: Box van truck in T/C, chlorine and other acids/bases
  - ✓ 11/6/07: Big rig fuel tank leak, 120 gallons of fuel onto state hi-way
- 2008
  - ✓ 3/26/08: Gasoline tank truck T/C, set of doubles, overturned on state hi-way, fuel spill
  - ✓ 4/3/08: Gasoline tank truck T/C, set of doubles, overturned on state hi-way, fuel spill
  - ✓ 8/6/08: BNSF locomotive ruptured fuel tank in FR Canyon. 300 gal fuel spill
- 2009
  - ✓ 9/15/09: Big rig T/C, ruptured saddle tanks, fuel leak on roadway
- 2010:
  - ✓ 5/5/12: Gasoline tank truck T/C with fire and fatality, 6,000 gallons product burned/released
- 2011
  - ✓ 3/21/11: UPRR derailment, LPG tank car overturned
  - ✓ 9/14/11: Gasoline tank truck T/C and overturn in FR Canyon, fuel spill
- 2012
  - ✓ 5/20/12: Tank truck T/C and overturn, released Ammonium Phosphate

The railroad tracks run in Butte County through the middle of cities and next to and over the Feather River. Those trains can and often do carry hazardous materials, chemicals as well as oil and other liquid and gaseous fuels. Highways 70 and 99 are heavily traveled corridors for trucks potentially loaded with hazardous materials.

Likelihood of Future Occurrence

Likely – Given that 22 hazardous materials incidents have happened in transport through the County in the past 49 years (and many other releases go unreported to national databases), it is likely a hazardous materials incident will occur in Butte County. Small hazardous materials spills happen often and are cleaned up locally and go unreported to national databases. According to Caltrans, most incidences are related to releases during loading and unloading of cargo, and during transport of materials from the transporting vehicles themselves and not the cargo.

Climate Change and Hazardous Materials

Climate change is unlikely to affect hazardous materials transportation incidents.

4.2.13. Invasive Species: Pests/Plants

Hazard/Problem Description

Invasive species are organisms that are introduced into an area beyond their natural range and become a pest in the new environment. This hazard addresses the issues related to invasive pests including that pose a significant threat to the agricultural industry and are therefore a concern in the Butte County Planning Area. This hazard does not address pest and plants that cause impacts to human health, as those issues are addressed in other planning mechanisms in the County.

Farming and related agricultural industries are not only the backbone of Butte County's economy, they also play a central role in the way of life of County residents and help define the character of the County. Agriculture has always been an integral part of Butte County and has continually grown and changed along with the County. Today, the soils and climate of Butte County make it an ideal area to sustain many agricultural endeavors. Agriculture in Butte County is a mosaic of farmland intermingled with other uses in the rural setting which typifies much of the County. This land provides marketable products, open space, wildlife habitat, watershed and an aesthetic environment. According to the California Department of Conservation's Farmland Mapping and Monitoring Program (FMPP), the County has 192.651 acres of prime farmland, 21.598 acres of farmland of statewide importance, 23,279 acres of unique farmland, and 400,165 acres of grazing land. These numbers have been reduced since 2004 due in part to increased development in the County. (see Table 4-41).

Table 4-41 Butte County Farmland Inventory, 2004, 2016

Soil Category	2004 Acres	2016 Acres
Prime Farmland	197,557	192,561
Farmland of Statewide Importance	22,323	21,598
Unique Farmland	24,957	23,279
Farmland of Local Importance	0	0
Grazing Land	406,401	400,165
Urban and Built-Up Land	43,820	46,647
Other Land	355,572	365,964
Water area	22,624	23,050
Total Area Inventoried	**1,073,254**	**1,073,264**

Source: State of California Department of Conservation Farmland Mapping and Monitoring Program, www.conservation.ca.gov/

According to the 2017 Butte County Crop Report, many commodities are grown in Butte County. This includes vegetable crops; nursery and flower products; timber products; fruit and nut crops; livestock and poultry; apiary, eggs, and wool products; and pasture and rangeland. The top three commodities for the County in 2017 were walnuts, almonds, and rice.

According to the 2017 crop report, the gross value of Butte County Agriculture production for 2016 was $696,563,214. This represents a small increase when compared to 2016 production values, but us less than years 2013-2015. The gross value for almonds in the amount of $301,223,000 exceeded the value of rice at $197,023,000 as the top commodity. Walnuts, processing tomatoes and miscellaneous fruit and vegetable crops were three, four and five respectively. Gross value of the top five commodities accounted for $646,826,000 or approximately 82% of the total gross value of commodities within Butte County. It is important to note that figures within this report show gross values only, and do not reflect a net return to the producer.

A summation of crop production values, sourced from the Butte County Agricultural Commissioner's Annual Crop Reports, from 2013-2017 for Butte County is shown in Table 4-42.

Table 4-42 Butte County – Value of Agricultural Production 2013-2017

CROP	2013	2014	2015	2016	2017
APIARY PRODUCTS	$7,977,000	$10,865,340	$10,586,121	$10,586,121	$11,198,212
FIELD CROPS	$220,799,346	$168,290,698	$151,013,590	$135,340,039	$153,907,456
FRUIT & NUT CROPS	$557,225,178	$556,649,028	$532,653,396	$475,230,758	$453,611,637
LIVESTOCK	$12,099,000	$12,520,000	$12,781,800	$14,478,648	$12,744,180
NURSERY STOCK	$29,458,000	$17,819,000	$14,111,000	$11,664,000	$13,877,606
SEED CROPS	$18,510,000	$18,683,294	$14,091,107	$14,677,834	$12,186,168
VEGETABLE CROPS	$1,785,000	$1,503,000	$1,743,626	$1,524,973	$1,601,222
ORGANIC CROPS	$13,448,637	$15,935,500	$21,930,572	$23,759,940	$23,902,017
CROP TOTALS	$861,302,161	$802,265,860	$758,911,212	$687,262,313	$683,028,498
TIMBER	$8,292,000	$8,639,538	$13,728,672	$8,525,004	$13,534,716
GRAND TOTAL	**$869,594,161**	**$810,905,398**	**$772,639,884**	**$695,787,317**	**$696,563,214**

Source: Butte County Agricultural Commissioner

According to the HMPC, agricultural losses occur on an annual basis and are usually associated with severe weather events, including heavy rains, floods, heat, and drought. The 2018 State of California Multi-Hazard Mitigation Plan attributes most of the agricultural disasters statewide to drought, freeze, and insect infestations. Other agricultural hazards include fires, crop and livestock disease, insects, and noxious weeds.

Natural Disasters and Severe Weather

According to the US Department of Agriculture (USDA), every year natural disasters, such as droughts, earthquakes, extreme heat and cold, floods, fires, earthquakes, hail, landslides, and tornadoes, challenge agricultural production. Because agriculture relies on the weather, climate, and water availability to thrive, it is easily impacted by natural events and disasters. Agricultural impacts from natural events and disasters most commonly include: contamination of water bodies, loss of harvest or livestock, increased susceptibility to disease, and destruction of irrigation systems and other agricultural infrastructure. These impacts can have long lasting effects on agricultural production including crops, forest growth, and arable lands, which require time to mature.

Insect Pests

Butte County is at risk from many insects and plants that, under the right circumstances, can cause severe economic, environmental, or physical harm. Invasive pest species affecting crop production can result in economic disasters in a very short period of time. These hazards can have a major economic impact on farmers, farm workers, packers, and shippers of agricultural products.

They can also cause significant increases in food prices to the consumer due to increases in production cost and shortages. Under some conditions, pest species that have been present, and relatively harmless, can become invasive hazards. For example, severe drought conditions can weaken tree and vine crops and make them more susceptible to insect attack and disposing them to secondary microbial attack.

This hazard addresses the issues related to pests and plants that pose a concern to the Butte County Planning Area.

Location and Extent

Insect pests can affect the whole of the County. The speed of onset can be short, while the duration of the infestation varies, but can be long. Insect pests affecting crop production result in economic disasters. These hazards can have a major economic impact on farmers, farm workers, packers, and shippers of agricultural products. They can also cause significant increases in food prices to the consumer due to shortages. Under some conditions, insects that have been present and relatively harmless can become hazardous. For example, severe drought conditions can weaken trees and make them more susceptible to destruction from insect attacks. The major forms of insects are:

- Chewing insects are defoliating insects. They generally strip plants of green matter such as leaves. Caterpillars and beetles make up the largest proportion of chewing insects. Under normal conditions, trees can usually bounce back from an attack of these defoliators, though repeat infestation will weaken a tree and can eventually kill it by starving it of energy.
- Boring, or tunneling, insects cause damage by boring into the stem, roots, or twigs of a tree. Some lay eggs which then hatch, and the larvae burrow more deeply into the wood, blocking off the water-conducting tissues of the tree. Boring insects generally feed on the vascular tissues of the tree. If the infestation is serious, the upper leaves are starved of nutrients and moisture, and the tree can die. Signs of borer infestation include entry/exit holes in the bark, small mounds of sawdust at the base, and sections of the crown wilting and dying.
- Sucking insects do their damage by sucking out the liquid from leaves and twigs. Many sucking insects are relatively immobile, living on the outside of a plant and forming a hard protective outer coating while they feed on the plant's juices. Quite often they will excrete a sweet, sticky substance known as honeydew which contains unprocessed plant material. Honeydew can cause sooty mold to form on leaves and can become a nuisance. Signs of infestation include scaly formations on branches, dieback of leaves, and honeydew production.
- Also, while not technically an insect, it is worth noting that pathogens such as fungi can kill large stands of trees. For example, *Phytopthora ramorum*, the cause of Sudden Oak Death, which is devastating not only for oaks, but for many other species of trees as well, is spreading rapidly.

Pest detection is a proactive program that seeks to identify exotic, invasive insects. These pests have a wide host ranges and are difficult and costly to manage once established. Early detection is essential for quick and efficient eradication. Public participation is critical to the success of this program, since staff relies on the goodwill of property owners who allow traps to be placed on their properties. A total of 1,026 traps were placed throughout the County to detect the presence of pests. The trap total included 300 Mediterranean, Oriental and Melon Fruit Fly traps, 77 Japanese Beetles traps, 214 traps for the Gypsy Moth, 243 Glassy-winged Sharpshooter traps, 157 Asian Citrus Psyllid traps, and 35 European Grapevine Moth traps. Approximately 4,068 shipments were inspected for live exotic pests including the Glassy-winged Sharpshooter and Sudden Oak Death resulting in the issuance of 8 Notice of Rejections.

The California Conservation Corp assists in mitigating the impacts of insect pests by providing human resources to assist in state and local eradication efforts, including surveying private yards and business landscapes to detect the Glassy Winged Sharpshooter, striping citrus fruit infected by the Mexican Fruitfly, and helping eradicate the Exotic Newcastle Disease by cleaning and disinfecting backyards.

Weeds

Noxious weeds, defined as any plant that is or is liable to be troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate, are also of concern. Noxious weeds within the Planning Area include those listed on Table 4-43.

Table 4-43 Butte County Weeds of Concern

Species of Concern					
Barb Goatgrass	Giant Reed	Red Brome	Downybrome	Yellow Starthistle	Spotted Knapweed
Pampasgrass	Scotch Broom	Brazilian Egeria	Water Hyacinth	Fennel	French Broom
English Ivy	Hydrilla	Perrenial pepperweed	Urugray and creeping water primrose	Creeping Water Primrose	Purple loosestrife
Parrotfeather	Eurasian watermilfoil	Himalayan blackberry	Red sesbania	Spanish broom	Medusahead
Smallflower tamarisk	Saltcedar	Tamarix			

Source: California Invasive Plant Council

The Butte County Department of Agriculture uses mechanical and chemical control measures to contain all of these agricultural pests. Weeds pest location that were eradicated or controlled in 2017 are shown on Figure 4-52.

Figure 4-52 Butte County Planning Area – 2017 Pest Management Activities

Weed Control Projects		Control Activity	Chemical	Distribution
Skeleton Weed	*Chondrilla juncea*	Herbicide	Aminopyralid	5 sites ~ 15 acres
Knap Weed, species	*Centaurea species*	Herbicide	Aminopyralid	3 sites ~ 35 acres
Oblong Spurge	*Euphorbia oblongata*	Herbicide	Triclopyr	Paradise 1 site in Thermalito 1 site Chico
Sesbania	*Sebania punicea*	Herbicide	Triclopyr	Multiple locations in Oroville
Broom, species – In 2016 a total of 92 linear miles were treated with herbicide in Butte County				
Spanish	*Spartium junceum*	Herbicide	Triclopyr	Multiple County Locations
French	*Genista monspessulana*	Herbicide	Triclopyr	Multiple County Locations
Scotch	*Cytisus scoparius*	Herbicide	Triclopyr	Multiple County Locations
Purple Loosestrife	*Lythrum salicaria*	Bio-control	Various Agents	>500 acres in Oroville
White Horsenettle	*Solanum elaeagnifolium*	Herbicide	Triclopyr	1 site South Gridley Hwy 99
Winged Water Primrose	*Ludwigia decurrens*	Herbicide	Glyphosate	Limited locations in Richvale

Source: 2017 Butte County Crop Report

Noxious weeds have been introduced in the Planning Area by a variety of means. An absence of natural controls, combined with the aggressive growth characteristics and unpalatability of many of these weeds, allows these weeds to dominate and replace more desirable native vegetation. Negative effects of weeds include the following:

- Loss of wildlife habitat and reduced wildlife numbers;
- Loss of native plant species;
- Reduced livestock grazing capacity;
- Increased soil erosion and topsoil loss;
- Diminished water quality and fish habitat;
- Reduced cropland and farmland production; and
- Reduced land value and sale potential.

According to the HMPC, the consequences of agricultural disasters to the Planning Area include ruined plant crops, dead livestock, ruined feed and agricultural equipment, monetary loss, job loss, and possible multi-year effects (i.e., trees might not produce if damaged, loss of markets, food shortages, increased prices, possible spread of disease to people, and loss or contamination of animal products). When these hazards cause a mass die-off of livestock, other issues occur that include the disposal of animals, depopulation of affected herds, decontamination, and resource problems. Those disasters related to severe weather may also require the evacuation and sheltering of animal populations. Overall, any type of severe agricultural disaster can have significant economic impacts on both the agricultural community and the entire Butte County Planning Area.

Location and Extent

Agricultural hazards, including issues associated with insects and pests, occur throughout the County where lands are used for farming and grazing. The County has large swaths of agricultural lands. These are shown in the Land Use Map for the County on Figure 4-93 later in this document in Section 4.3.1. Areas not as greatly affected by insects and pests are the cities in the County, as well as the upper portions of elevation of the County which all contain fewer agricultural acres. However, while the cities may not be directly affected, they are indirectly affected economically when agricultural losses occur.

There is no scale that measures agricultural hazards. Agriculture in the County is at risk to many hazards: insects, weeds, severe weather, as well as downturns in commodity prices. Each of these has a different duration and speed of onset. Some, such as freeze, can have a short onset and a short duration. Drought can have a long onset and long duration. Insects and weeds can have short or long onset, and short or long durations. All agricultural losses can have a significant impact on affected communities.

Past Occurrences

Disaster Declaration History

There are no state or federal disaster declarations issued by Cal OES or FEMA, as shown in Table 4-4. However, disaster declarations directly related to agriculture are issued by the US Secretary of Agriculture for the disbursement of USDA funds. The agricultural lands of Butte County have historically been affected by weather related events such as freeze, heavy rain, and drought. The severe weather events can have devastating effects leading to losses in yield and affecting quality. The US Farm Services Agency provided information on disaster declarations from 2012 through 2018. These are shown in Table 4-44.

Table 4-44 Butte County – USDA Disaster Declarations 2012 to March 31, 2019

Year	Disaster Number	Date Disaster Declared	Description of Disaster	Primary or Contiguous County
2018	S4349	7/18/2018	Freeze	Contiguous
2016	S4170	4/28/2017	Excessive rain, high winds, cold temperatures, and hail	Primary
2016	S4164	3/31/2017	Severe weather including excessive rainfall and high winds	Contiguous
2017	S4163	3/22/2017	Drought	Contiguous
2016	S3592	2/17/2016	Drought	Contiguous
2015	S3784	2/4/2015	Drought	Primary
2014	S3743	9/17/2014	Drought	Primary
2014	S3797	2/25/2014	Drought	Contiguous
2014	S3637	1/23/2014	Drought	Primary
2013	S3569	8/21/2013	Drought	Primary

Year	Disaster Number	Date Disaster Declared	Description of Disaster	Primary or Contiguous County
2012	S3379	9/5/2012	Drought	Contiguous
2012	S3268	7/12/2012	Drought-FAST TRACK	Primary
2012	S3248	5/31/2012	Drought	Contiguous
2012	S3248	5/3/2012	Freezing temperatures	Contiguous

Source: Butte County Agricultural Commissioner, US Farm Service Agency
* Disaster declarations for 2019 were released, but no disasters have yet been declared for the 2019 agricultural year

NCDC Events

The NCDC does not track invasive species events.

Hazard Mitigation Planning Committee Events

The HMPC noted that agriculture events occur yearly, though with varying levels of damages to a variety of crops.

Likelihood of Future Occurrence

Highly Likely—As long as severe weather events, insects, and weeds continue to be an ongoing concern to the Butte County Planning Area, the potential for agricultural losses remains.

Climate Change and Agricultural Hazards

According to the CAS, addressing climate change in agriculture will encompass reducing vulnerability through adapting to the ongoing and predicted impacts of climate. Agriculture in California is vulnerable to predicted impacts of climate change, including less reliable water supplies, increased temperatures, and increased pests.

4.2.14. Invasive Species: Aquatic

Hazard/Problem Description

Invasive species are organisms that are introduced into an area beyond their natural range and become a pest in the new environment. The terms: ―Marine Invasive Species and ―Non-native Aquatic Species (NAS) are used interchangeably.

This hazard addresses the economic and environmental issues related to invasive pests of a marine and freshwater nature, particularly euryhaline organisms. These are species having the ability to tolerate a wide range of salinity and can transition in and out of fresh and saltwater. There are two forms: anadromous and catadromous species.

The introduction of NAS into coastal marine estuarine and delta waters can cause significant and enduring economic and environmental impacts. One of the most widespread mechanisms by which introductions occur is through transport of ballast water in boats. Ballast water is taken on and released by a vessel during cargo loading and discharging operations to maintain the vessel's trim and stability. Ships ballast water obtained from some other foreign location (state, or country) can include non-native organisms, untreated sewage, and other contaminants. Once introduced, NAS are likely to become a permanent part of an ecosystem and may flourish, creating environmental imbalances and economic havoc.

Butte County Aquatic/Hydraulic Resources

Water and the natural and manmade conveyances' and infrastructure are among Butte County's most important natural and industrial resources. Aquatic/hydraulic resources refer to water and its multiple roles as a natural resource supporting the ecosystem and human endeavors; it encompasses all the possible roles for water as an essential component of the regional economy. Butte County's water systems are the critical component for many of the environmental and agricultural cycles both terrestrial and aquatic.

Significant hydrologic features exist within the county, including: Lake Oroville and the hydroelectric dam, the Fore and After Bays, the Western Canal, the Feather River, Butte Creek, Big Chico Creek and the Sacramento River. Seven geologically distinctive watersheds are overlaid by 13 Irrigation and Reclamation District serviced by several major water purveyors. 90 % of the Counties water demands are in support of the agricultural industry which is the foundation of the County economy.

The Marine Invasive NAS

Invertebrates

Quagga and zebra mussels are an invasive species of the same genus, *Dreissena*. The two species appear similar and can be mistaken for the other. These mussels are native to Eurasia and have spread across the United States. They have the ability to multiply rapidly and have no natural predator in the United States. When established in a waterbody the mussels become an ecological and economical threat. They can remove food and nutrients necessary for other species, clog pipes, damage boat motors. Quagga and zebra mussels are the size of a thumbnail (see Figure 4-53).

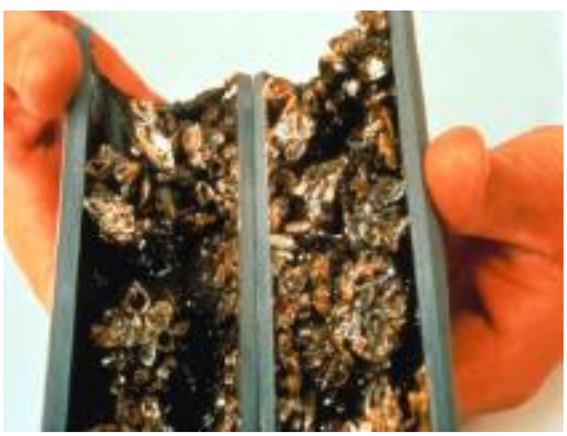
The introduction of quagga mussels (often referred to as Dreissenids) to the Pacific Southwest Region brings the potential to extend devastating impacts into a geographical area already challenged with water-related problems.

Figure 4-53 Quagga and Zebra Mussels

Source: US Fish and Wildlife Service

Zebra mussels are an invasive species first recognized in Lake St. Clair, near Detroit, Michigan, in 1988; shortly thereafter, the quagga mussel was identified. Since then, the Quagga mussel has rapidly spread across much of the western United States and in 2007 was detected at Lake Mead in Nevada. Later surveys found Quagga mussels in Lake Mohave in Nevada, Lake Havasu in Arizona, and the Colorado River Aqueduct System which serves Southern California. In California the first confirmed find of zebra mussels occurred at San Justo Lake in 2008. These mussels have the ability to survive for a number of days on land by their ability to retain moisture. As a result, there is concern these mussels can spread into Butte County by transportation on recreational boats. The mussels reproduce quickly, disrupting the ecosystem, and have the potential to clog drinking water intakes and motorboat engines, and litter beaches with jagged, foul smelling shells. Figure 4-54 is an example of mussels clogging a pipe.

Figure 4-54 Mussels Clogging a Pipe



Source: Don Schloesser, USGS, Biological Resources Division

Invasive Fish Species

The number of freshwater fish species in California is increasing due to the introduction of non-native fishes becoming established at a rate of about 1 species every 3 years. Although no introduction of a NAS has unambiguously caused the extinction of native species, evidence suggests that their introduction is contributed to the decline.

Of the native fishes, 5 species are now extinct in California. Thus, the actual number of species maintaining populations in the state is 120. Of extant native species, 15 (22%) are threatened with extinction in the near future. Only 27 native species (40%) can be regarded as having secure populations. The effects of nonnative fish on native fish are generally in the form of predation and competition for food and breeding sites

There are multiple nonnative invasive fish species in the waterways of the County. Many of these fish were introduced for sport fishing or to provide forage for sport fish.

Centrarchids, the sunfish family (sunfish, crappie, and bass) are voracious predators and are known to eat a variety of native fish species and invertebrate. Smallmouth bass have been associated with the decline in the native Hardhead minnow (*Mylopharodon conocephalus*) in the plan area. Introductions of multiple species of centrarchids have been associated with the extirpation of Sacramento perch (not actually a perch but the only native California sunfish) from the Sacramento River watershed, also in the plan area.

Tilapia, Mozambique and Blue: Oreochromis mossambicus, and aureus

Tilapias are true euryhalines, able to live in freshwater or marine habitats. Two populations of tilapia have been introduced to the U.S. through escapes from fish farms: the Mozambique and Blue Tilapia, native to the Middle East and parts of Northern Africa. Tilapias are a threat to native species because of competition for food and habitat; the presence of invasive tilapia populations will lead to further declines in wild populations of native fish.

It is legal (with a permit) to have Tilapia in only 6 counties of California (San Diego, Riverside, San Bernardino, Los Angeles, Imperial and Orange). In any other county in California, it's illegal to possess any type of Tilapia. Wild populations occur in the many different parts of the country. It will not be long before they appear in the Sacramento River and spread throughout the estuary. There is a thriving wild population of Mozambique T. in Salton Sea, in Imperial, Riverside county California.

Non-native Aquatic Weeds

Many varieties of non-native aquatic weeds compete for the entire water column and shoreline in Butte County, crowding out native species and degrading the aquatic and riparian habitat.

- Water Hyacinth (*Eichhornia crassipes*) a floating plant native to Brazil, is among the most serious of weed problems occurring in the California Delta. If has invaded many waterways, lakes and streams. There is no known chemical free eradication method in the world for Water Hyacinth once a water course is completely occluded. It will jam rivers and lakes streams and ponds with uncounted thousands of tons of floating plant matter. The Sacramento-San Joaquin Delta and several of the rivers drained by this delta are heavily infested (Thomas and Anderson 1984). One known infestation in Butte County on the Gold Run first reported 1998. Presently no funded mitigation/control projects are in place in Butte County.
- Hydrilla (*Hydrilla verticillata*), native to Asia, Europe, Africa, highly resistant to salinity (>1-100000ppt) compared to many other freshwater aquatic plants. It is considered among the most serious aquatic weed problems in the world and California. It is the last remaining funded California Department of Food and Agriculture (CDFA) weed eradication program as of 2012, conducting eradication efforts in nine counties. It can quickly take over lakes and streams, crowding out native animals and plants and blocking hydroelectric plants, impeding water flow and delivery in any

conveyance. Its rapid growth and ease of spread makes it critical to detect early and eradicate. Past infestations have occurred in Butte County. All have been eradicated.

- Arundo, loosestrife, Sesbania: By far the greatest threat to the dwindling riparian resources of California is caused by three alien invasive species known as: *Arundo donax*, *Lythrum salicria* and *Sesbania punicea* (ALS). Over the last 40 years the riparian forests and waterways of northern California have become infested. ALS spread by flood-fragmentation and dispersal of vegetative and seed propagules. They dramatically alter the ecological/successional processes in riparian systems and ultimately degrade the riparian habitats towards pure stands of these noxious invasive species. The drainage is systematically impeded. Unchecked, ALS fills in all open areas and banks down to the waterline exacerbating flood prone areas. Presently no funded mitigation/control projects are in place in Butte County.
- South American Spongeplant (*Limnobium laevigatum*): a recently established invasive aquatic plant that has been introduced into northern and central California, having all of the negative characteristics of water hyacinth.

Location and Extent

All freshwater lakes, streams, and rivers are potentially at risk from aquatic invasive species. There is no established scale for aquatic invasive species. Magnitude is measured by the presence and counts of aquatic invasive species in waterways in Butte County. Speed of onset of these invasive species is short, as it only takes a careless boater to accidentally introduce an invasive species. However, the impacts associated with the introduction of a new invasive species can last years.

Past Occurrences

Disaster Declaration History

There are no state or federal disaster declarations issued by Cal OES or FEMA, as shown in Table 4-4.

NCDC Events

The NCDC does not track aquatic invasive species events.

Hazard Mitigation Planning Committee Events

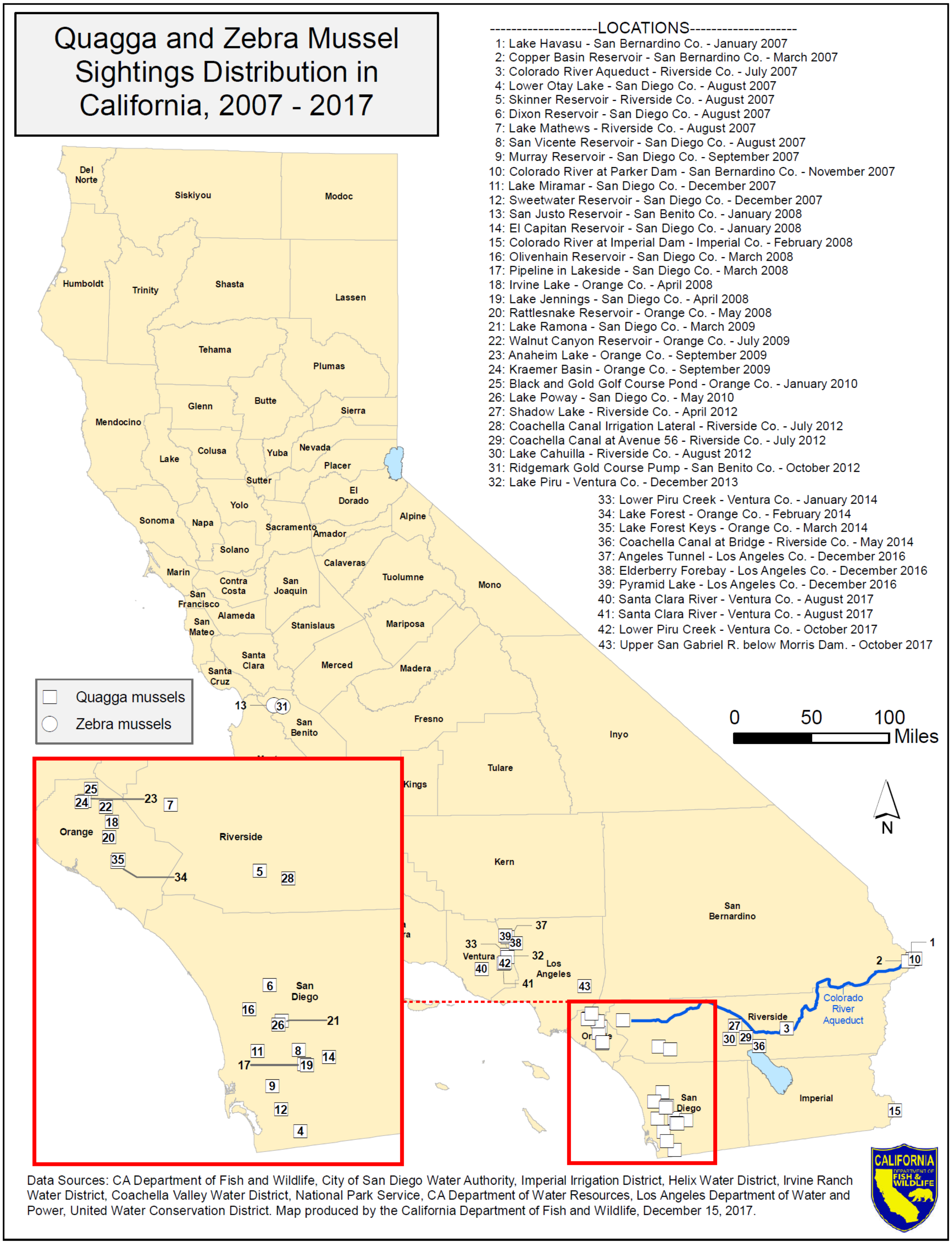
The HMPC noted that once introduced, invasive species are likely to become a permanent part of an ecosystem and may flourish, creating environmental imbalances and wreaking economic havoc. Some of California‘s most serious weed problems occur in waterways, lakes and streams.

There are also several non-fish, nonnative invasive species found in aquatic natural communities that can damage such communities. Giant reed, considered the state’s most invasive riparian weed, and salt cedar can grow in dense monocultures along riparian areas, crowding out native species and causing changes to hydrologic regimes in aquatic communities. The introduced bullfrog is an important riparian invasive in the plan area. This species has been implicated as a primary driver of native ranid frog declines in Butte County.

In addition to waterways, aquatic invasive species can damage wetland natural communities. Giant reed is found at both Gray Lodge Wildlife Area and at Llano Seco NWR, where efforts to remove the species are ongoing. Feral cats are also an important nonnative invasive that can impact many native bird species in wetland natural communities, for example the tricolored blackbird.

There have been no past occurrences of the quagga or zebra mussels in the County, according to the HMPC. Figure 4-55 illustrates the quagga and zebra mussel sightings in California as of 2007. Most of the mussel sightings are in Southern California. No mussel sightings have been officially detected in Butte County. The nearest infected body of water to Butte County was reported in 2008 in the San Justo Lake located in San Benito County, about three miles southwest of Hollister.

Figure 4-55 Quagga and Zebra Mussel Sightings in California 2007 to 2017



Source: California Department of Fish and Wildlife

The Chinese Mitten Crab

The Chinese mitten crab (*Eriocheir sinensis*) named for the dense patches of hairs on the claws of juveniles and adults. A euryhaline, catadromous species, adults reproduce in saltwater and the offspring migrate to fresh water to mature.

It is a native to the coastal rivers and estuaries of the Yellow Sea. In Asia, the crab is a delicacy and crabs have been imported alive to markets in Los Angeles and San Francisco. The most probable introduced to the San Francisco estuary was either deliberate release to establish a fishery or accidental release of vessel ballast water.

First collected in 1992 by commercial shrimp trawlers in South San Francisco Bay it has spread rapidly throughout the estuary. It was collected in San Pablo Bay in fall 1994 and the Delta in September 1996. As of August 1998, the known distribution of the Chinese mitten crab in the Sacramento River drainage was, east to Roseville (Cirby Creek) and eastern San Joaquin County near Calaveras County, extending north of Colusa County to Hunter's Creek (near Delevan National Wildlife Refuge) within 5 miles of the Butte County southern boundary.

Mitten crabs are adept walkers on land, and, in their upstream migration, they readily move across banks or levees to bypass obstructions, such as dams or weirs. They were found in rice field ditches in Butte County. Mitten crabs are omnivores, with juveniles eating mostly vegetation, but preying upon animals, especially small invertebrates, Although the mitten crab damages rice crops no control measure have been reported.

Based on the impacts of mitten crabs in their native range and Europe, they pose several possible hazards. The crab is the secondary intermediate host for the Oriental lung fluke, with mammals, including humans, as the final host. Humans become infested by eating raw or poorly cooked mitten crabs. However, neither the lung fluke nor any of the freshwater snails that serve as the primary intermediate host for the fluke in Asia have been found in the San Francisco Estuary. It has been noted that several species of freshwater snails which could possibly serve as an intermediate host are present in the estuary and watershed.

The ecological impact of a large mitten crab population is the least understood of all the potential impacts. A large population of mitten crabs could reduce populations of native invertebrates through predation and change the biotic structure of the Estuary's fresh and brackish water benthic invertebrate communities. They burrow into soil, which can exacerbate levee, riverbank erosion and weaken and damage rice field checks and berms.

Likelihood of Future Occurrence

Highly Likely— The rate of NAS discoveries continues to increase. As of the December 2011 the CDFG survey, 257 invertebrates and algae have established populations in California. San Francisco Bay is the most invaded estuary in the United States. Only two other regions in the world, the eastern Mediterranean and the Hawaiian Islands, have comparable numbers of reported marine invasions. Butte County is directly connected to the San Francisco Bay via the Sacramento and Feather River. Butte County‘s rice crop is the most water dependent and most at risk to impacts from non-native aquatic invasive species, with an annual harvested acreage ranging from 95,000 to 120,000 acres equating to the 2011 crop value of $141,515,000 dollars the adjusted economic impact to the County economy could be as high as $424 million dollars/ year. Due to the high number of incidents of invasive species in the Delta and Sacramento River, it is likely that future infestation of marine and aquatic pests will occur in Butte County.

Climate Change and Aquatic Invasive Species

A report by the USDA from Cornell University research note that quagga mussels are usually restricted to the bottom of the lake and therefore depend on sedimentation and water circulation to access food. Water circulation is in turn affected by the morphometry of lakes and by temperature increases associated with climate change. These two drivers of ecological change (invasive mussels and climate change) will interact, but the degree of interactions and the magnitude of ecological change to the lakes will depend on the morphometry of the lake. Therefore, ecological forecasting requires consideration of both lake physics and lake biology. Climate change will likely affect quagga mussel proliferation, if they ever enter Butte County.

4.2.15. Landslides, Mudslides, and Debris Flows

Hazard/Problem Description

According to the California Geological Survey, landslides refer to a wide variety of processes that result in the perceptible downward and outward movement of soil, rock, and vegetation under gravitational influence. Common names for landslide types include slump, rockslide, debris slide, lateral spreading, debris avalanche, earth flow, and soil creep. Landslides may be triggered by both natural and human-induced changes in the environment that result in slope instability.

The susceptibility of an area to landslides depends on many variables including steepness of slope, type of slope material, structure and physical properties of materials, water content, amount of vegetation, and proximity to areas undergoing rapid erosion or changes caused by human activities. These activities include mining, construction, and changes to surface drainage areas. Landslide events can be determined by the composition of materials and the speed of movement. A rockfall is dry and fast while a debris flow is wet and fast. Regardless of the speed of the slide, the materials within the slide, or the amount of water present in the movement, landslides are a serious natural hazard.

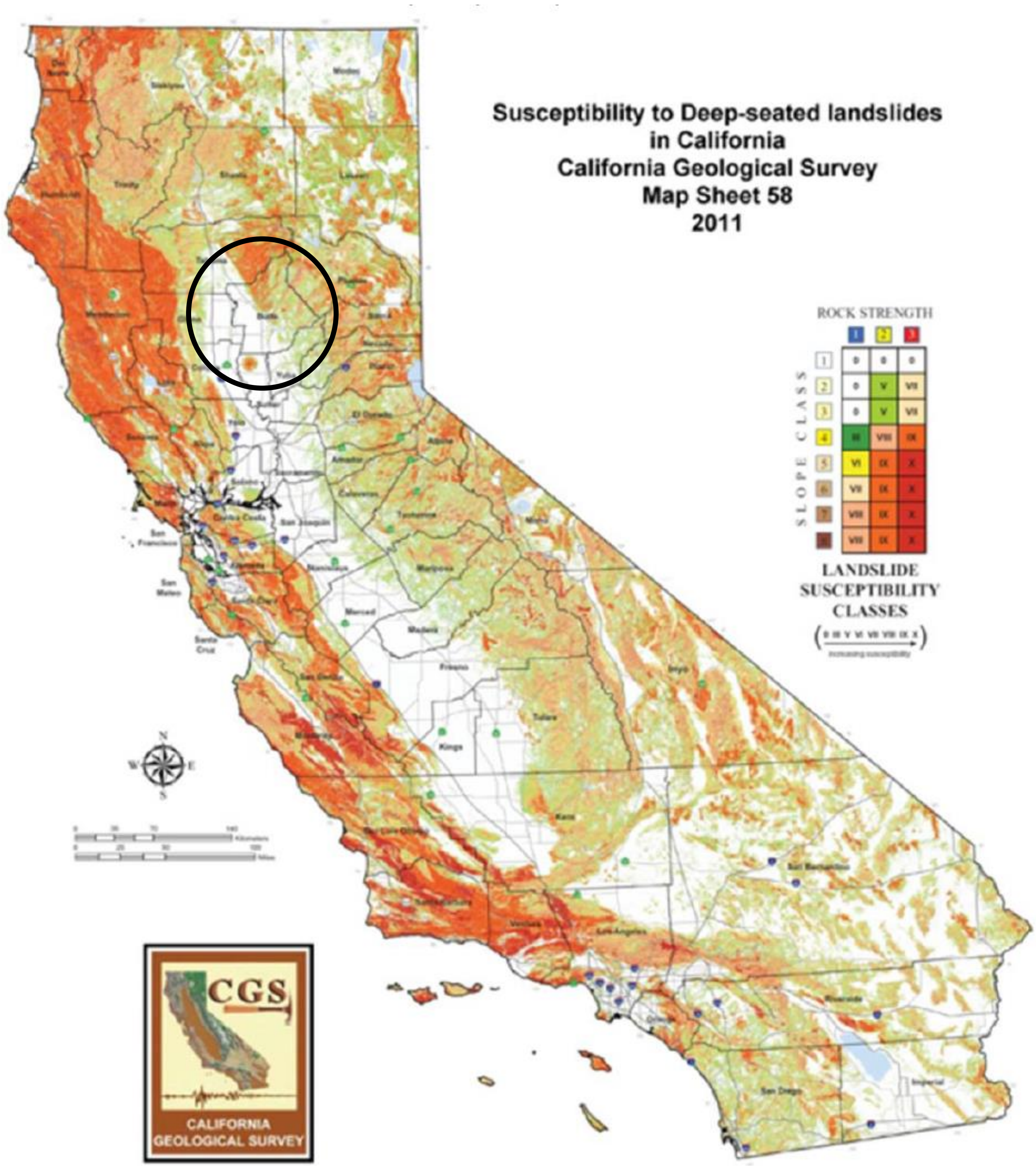
Landslides often accompany or follow other natural hazard events, such as floods, wildfires, or earthquakes. A discussion on the effects of wildfire on landslides is included in the wildfire profile in Section 4.2.19. Landslides can occur slowly or very suddenly and can damage and destroy structures, roads, utilities, and forested areas, and can cause injuries and death.

Soil erosion is another common form of soil instability. Erosion is a function of soil type, slope, rainfall intensity, and groundcover. It accounts for a loss in many dollars of valuable soil, is aesthetically displeasing, and often induces even greater rates of erosion and sedimentation. Sedimentation is simply the accumulation of soil as a result of erosion. Construction activities often contribute greatly to erosion and sedimentation. Besides being a pollutant in its own right, sediment acts as a transport medium for other pollutants, especially nutrients, pesticides, and heavy metals, which adhere to the eroded soil particles. As the sediment drains into watercourses, the combination of these pollutants adversely affects water quality.

Location and Extent

Figure 4-56 was included in the 2018 State of California Multi-Hazard Mitigation Plan. It indicates that portions of the eastern County are at moderate to high risk for landslides.

Figure 4-56 Landslide Susceptibility Areas



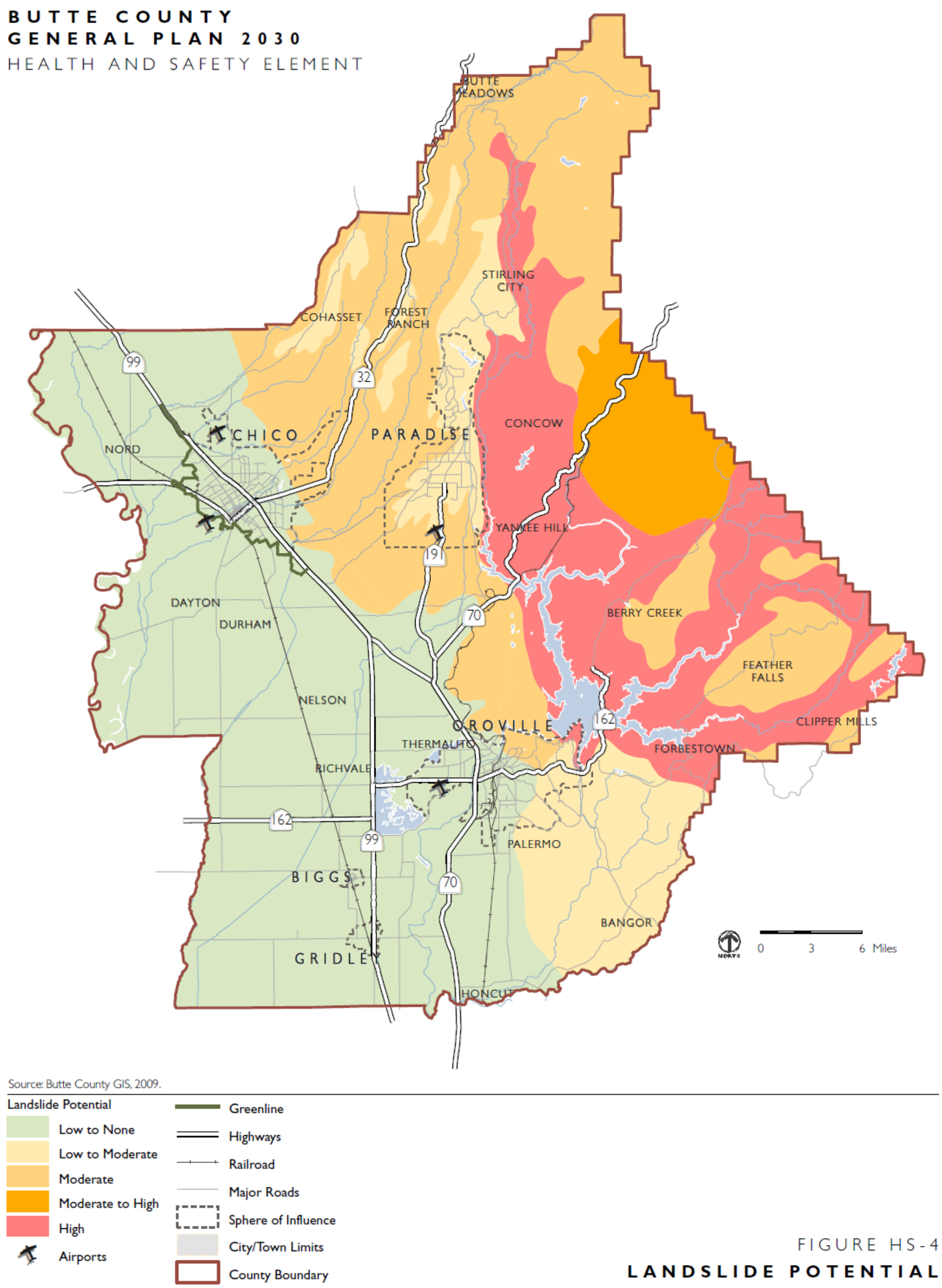
Source: 2018 State of California Multi-Hazard Mitigation Plan

The legend on Figure 4-56 shows the measurement system that the California Geological Survey uses to show the possible magnitude of landslides. It is a combination of slope class and rock strength. The speed of onset of landslide is often short, especially in post-wildfire burn scar areas, but it can also take years for a slope to fail. Landslide duration is usually short, though digging out and repairing landslide areas can take some time.

According to the Butte County General Plan Environmental Impact Report, the eastern portion of Butte County includes rolling foothills, mountainous peaks and deep stream-cut valleys. The steep slopes associated with this terrain can become saturated and lose strength, causing slope instability and landslides. Other natural causes of landslides include weak rock, inclined planes of weakness, undercutting by streams and waves, intense rainfall, vegetation removal by fire, and earthquakes. Slope instability can be exacerbated through human activities such as improper road and/or building design, excavation of the top of a slope or excess loading of the top of a slope, vegetation removal, mining, and human-introduced water sources, such as lawn watering, leach fields, leaking storm drains, and water lines. Landslide potential for different areas of Butte County is shown in Figure 4-57.

Areas of greatest slope instability include excessively steep slopes, locations of past landslides, hillsides where clay and silt-rich soils or weathered rock absorb water, and areas of weak or stratified rock with bedding or foliation parallel to surface slopes. In addition, slope failure may occur where faults have fractured rock and along the base of slopes or cliffs where supporting material has been removed by stream erosion, flowing water, past wildfire events, or human activities.

Figure 4-57 Butte County – Landslide Risk



Source: Butte County 2030 General Plan Safety Element

GIS analysis of potential landslide areas from the Butte County 2030 General Plan were analyzed. Geographical extents of each landslide potential type are shown by jurisdiction in Table 4-45.

Table 4-45 Butte County – Geographical Extent of Liquefaction Potential by Jurisdiction

Landslide Potential	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
High	0	0.00%	0	0.00%	0	0.00%
Moderate to High	0	0.00%	0	0.00%	0	0.00%
Moderate	0	0.00%	0	0.00%	0	0.00%
Low to Moderate	0	0.00%	0	0.00%	0	0.00%
Low to None	474	0.04%	201	0.05%	272	0.03%
City of Biggs Total	**474**	**0.04%**	**201**	**0.05%**	**272**	**0.03%**
City of Chico						
High	0	0.00%	0	0.00%	0	0.00%
Moderate to High	0	0.00%	0	0.00%	0	0.00%
Moderate	6,429	0.48%	334	0.08%	6,096	0.67%
Low to Moderate	0	0.00%	0	0.00%	0	0.00%
Low to None	18,932	1.42%	7,885	1.87%	11,047	1.21%
City of Chico Total	**25,362**	**1.90%**	**8,219**	**1.95%**	**17,143**	**1.87%**
City of Gridley						
High	0	0.00%	0	0.00%	0	0.00%
Moderate to High	0	0.00%	0	0.00%	0	0.00%
Moderate	0	0.00%	0	0.00%	0	0.00%
Low to Moderate	0	0.00%	0	0.00%	0	0.00%
Low to None	1,184	0.09%	696	0.17%	488	0.05%
City of Gridley Total	**1,184**	**0.09%**	**696**	**0.17%**	**488**	**0.05%**
City of Oroville						
High	0	0.00%	0	0.00%	0	0.00%
Moderate to High	0	0.00%	0	0.00%	0	0.00%
Moderate	879	0.07%	581	0.14%	298	0.03%

Landslide Potential	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Low to Moderate	0	0.00%	0	0.00%	0	0.00%
Low to None	7,180	0.54%	2,405	0.57%	4,776	0.52%
City of Oroville Total	**8,060**	**0.60%**	**2,986**	**0.71%**	**5,074**	**0.55%**
Town of Paradise						
High	319	0.02%	282	0.07%	38	0.00%
Moderate to High	0	0.00%	0	0.00%	0	0.00%
Moderate	2,260	0.17%	1,303	0.31%	957	0.10%
Low to Moderate	9,704	0.73%	7,596	1.80%	2,108	0.23%
Low to None	0	0.00%	0	0.00%	0	0.00%
Town of Paradise Total	**12,283**	**0.92%**	**9,181**	**2.18%**	**3,103**	**0.34%**
Unincorporated Butte County						
High	233,376	17.46%	28,320	6.72%	205,056	22.40%
Moderate to High	57,143	4.27%	366	0.09%	56,777	6.20%
Moderate	349,830	26.17%	55,164	13.09%	294,666	32.18%
Low to Moderate	143,599	10.74%	53,329	12.65%	90,270	9.86%
Low to None	505,672	37.82%	262,957	62.40%	242,715	26.51%
Unincorporated Butte County Total	**1,289,620**	**96.46%**	**400,137**	**94.95%**	**889,483**	**97.15%**
Grand Total	**1,336,982**	**100.00%**	**421,420**	**100.00%**	**915,563**	**100.00%**

Source: Butte County 2030 General Plan

Past Occurrences

Disaster Declaration History

There have been no disaster declarations associated with landslides in Butte County, as shown in Table 4-4.

NCDC Events

The NCDC contains no direct records for landslides in Butte County. It does however, contain a heavy rain event on January 9, 2017 caused a rock/mud slide covered the northbound lane of Highway 162 near the intersection with Simmons Rd. on the east side of Lake Oroville.

Hazard Mitigation Planning Committee Events

Butte County has a history of landslides and has experienced several landslides in the past.

- **May 22, 1990 -** A huge boulder loosened by weekend rains careened onto a road in eastern Butte County and crushed a car, killing two people and seriously injuring two others, authorities said. The Ford Bronco was driving at 5 m.p.h. when a rockslide tumbled down the mountainside and hit the vehicle on a country road about 20 miles northeast of Oroville, California.
- **October 31, 2008** –The California Highway Patrol reported multiple locations of rock and mud debris on Highway 70 near Yankee Rd and the town of Concow. A wildfire had burned this area earlier in the year, making it susceptible to debris slides.
- **March 28, 2009** – Severe winter weather caused two landslides that closed Oro Quincy highway from French Creek Road to Bald Rock Road. The road was closed until November of 2011. The Federal Highways Administration oversaw the work that repaired damage done from a slide above the road and another slide on the downhill side of the road. About $900,000 was spent on the repairs.
- **January 2017**, severe winter weather caused a major road to slip out that closed Oro Quincy highway at Mountain House Road, The FHWA repaired the road and it was re-opened in August 2019. February 2019 a slide on upper Centerville Rd. caused that road to be closed, it is in the process of being fixed. There were other erosion issues for private property owners during this event as well.

The HMPC noted that new erosion concerns in the Camp Fire burn scar have been initially addressed and best management practices (BMPs) have been utilized. The HMPC expect many changes through the winter with sediment coming down into the canal systems.

Likelihood of Future Occurrence

Likely—Most landslides in Butte County occur on slopes greater than 15 percent, and most new landslides occur in areas that have experienced previous landslides. The areas of highest landslide potential are in the mountainous central area of the County where well-developed soils overly impervious bedrock on steep slopes which at times undergo heavy rainfall. The slopes around flat uplands, such as Table Mountain, are also highly susceptible to landslides. These portions of the County, coupled with the number of previous occurrences, equates to a likelihood of future occurrence of likely.

Climate Change and Landslide and Debris Flows

According to the CAS, climate change may result in precipitation extremes (i.e., wetter wet periods and drier dry periods). More information on precipitation increases can be found in Section 4.2.3. While total average annual rainfall may decrease only slightly, rainfall is predicted to occur in fewer, more intense precipitation events. The combination of a generally drier climate in the future, which will increase the chance of drought and wildfires, and the occasional extreme downpour is likely to cause more mudslides, landslides, and debris flows.

4.2.16. Levee Failure

Hazard/Problem Description

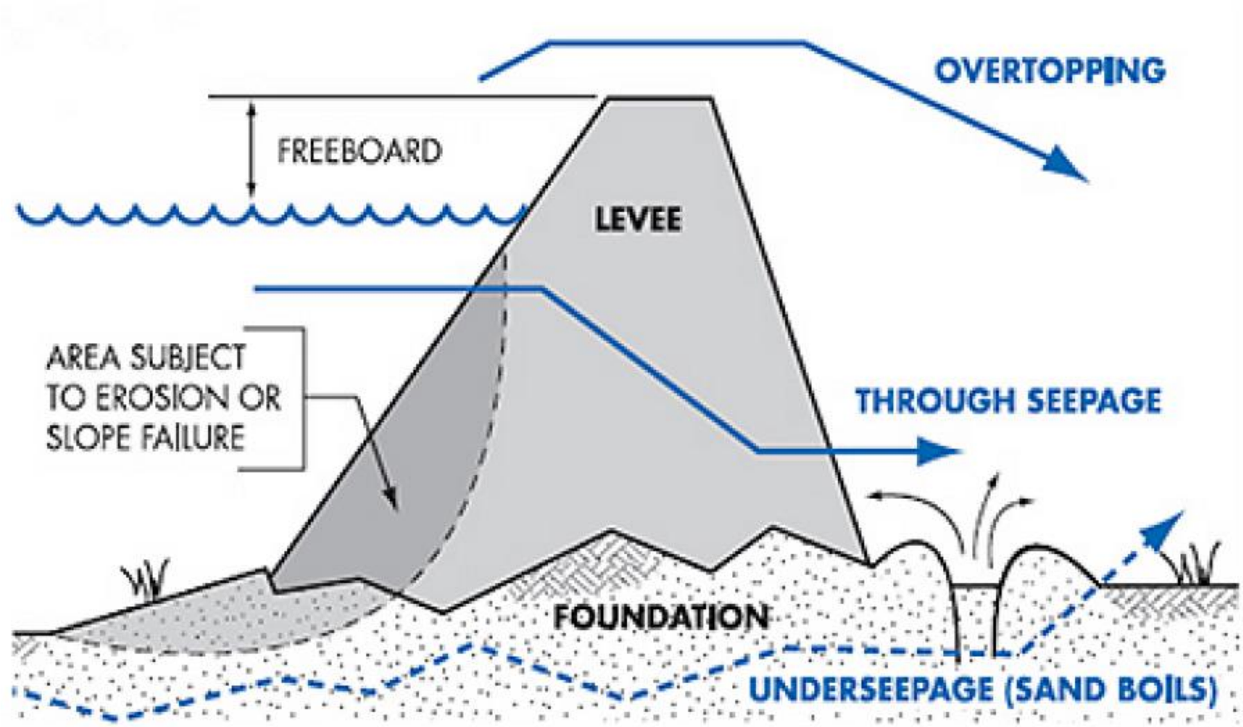
A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower steam channel, levees can also increase the speed of the water. Levees can be natural or man-made. Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or dam failure. Levees reduce, not eliminate, the risk to individuals and structures located behind them.

A levee system failure or overtopping can create severe flooding and high-water velocities. It's important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

Under-seepage refers to water flowing under the levee through the levee foundation materials, often emanating from the bottom of the landside slope and ground surface and extending landward from the landside toe of the levee. Through-seepage refers to water flowing through the levee prism directly, often emanating from the landside slope of the levee. Both conditions can lead to failure by several mechanisms, including excessive water pressures causing foundation heave and slope instabilities, slow progressing internal erosion, and piping leading to levee slumping.

Rodents burrowing into and compromising the levee system is a significant issue in the Planning Area. Erosion can also lead to levee failure. Figure 4-58 depicts the causes of levee failure.

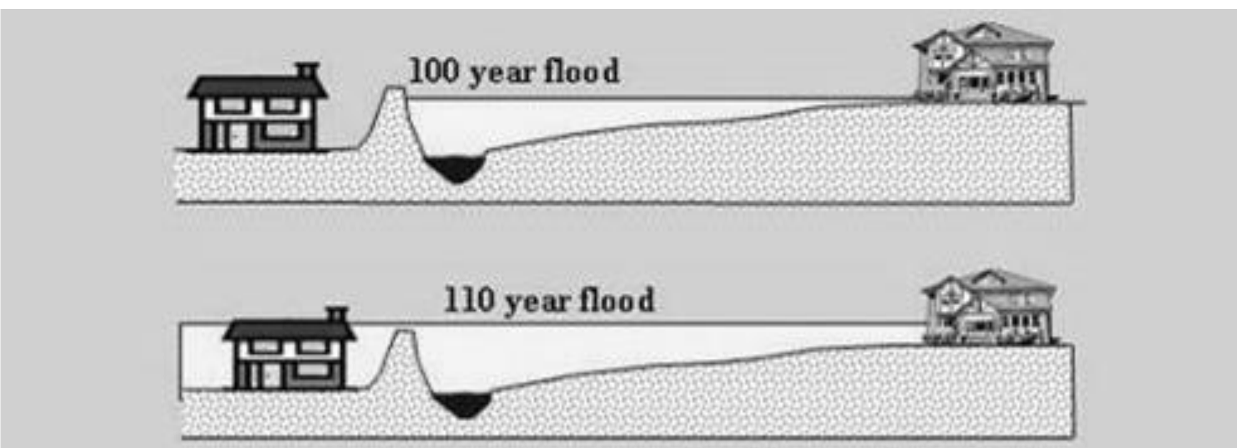
Figure 4-58 Potential Causes of Levee Failure



Source: USACE

Overtopping failure occurs when the flood water level rises above the crest of a levee. As shown in Figure 4-59, overtopping of levees can cause greater damage than a traditional flood due to the often lower topography behind the levee.

Figure 4-59 Flooding from Levee Overtopping



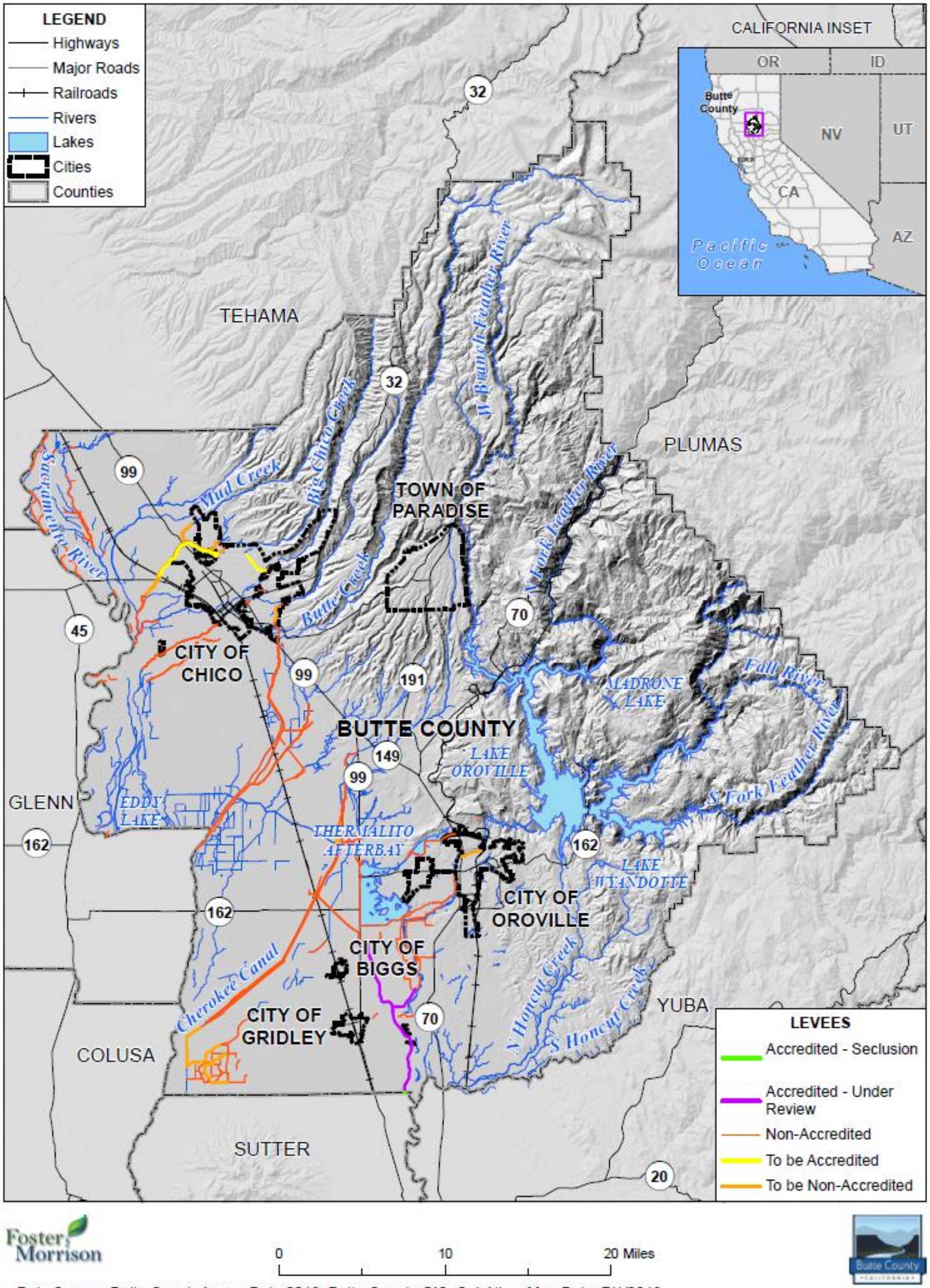
Source: Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR.

High water levels along the Sacramento and Feather Rivers are a common occurrence in the winter and early spring months due to increased flow from storm runoff and snowmelt. An extensive system of dams, levees, overflow weirs, drainage pumping plants, and flood control bypass channels strategically located on the Feather River has been established to protect the area from flooding. These facilities control floodwaters by regulating the amount of water passing through a particular reach of the river. The amount of water flowing through the levee system can in some instances be controlled by Oroville Dam on the Feather River. However, flood problems in Butte County are still quite a concern. Numerous areas of the County are still subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms.

Location and Extent

Levees occur throughout Butte County. They are primarily located in the western half of the County. An updated map of these levees and their certification status based on data providing by Butte County Water and Resource Conservation is shown in Figure 4-60 and detailed by jurisdiction and levee type in Table 4-46.

Figure 4-60 Butte County – Levees



Data Source: Butte County Levee Data 2019, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-46 Butte County – Levees by Type and Jurisdiction

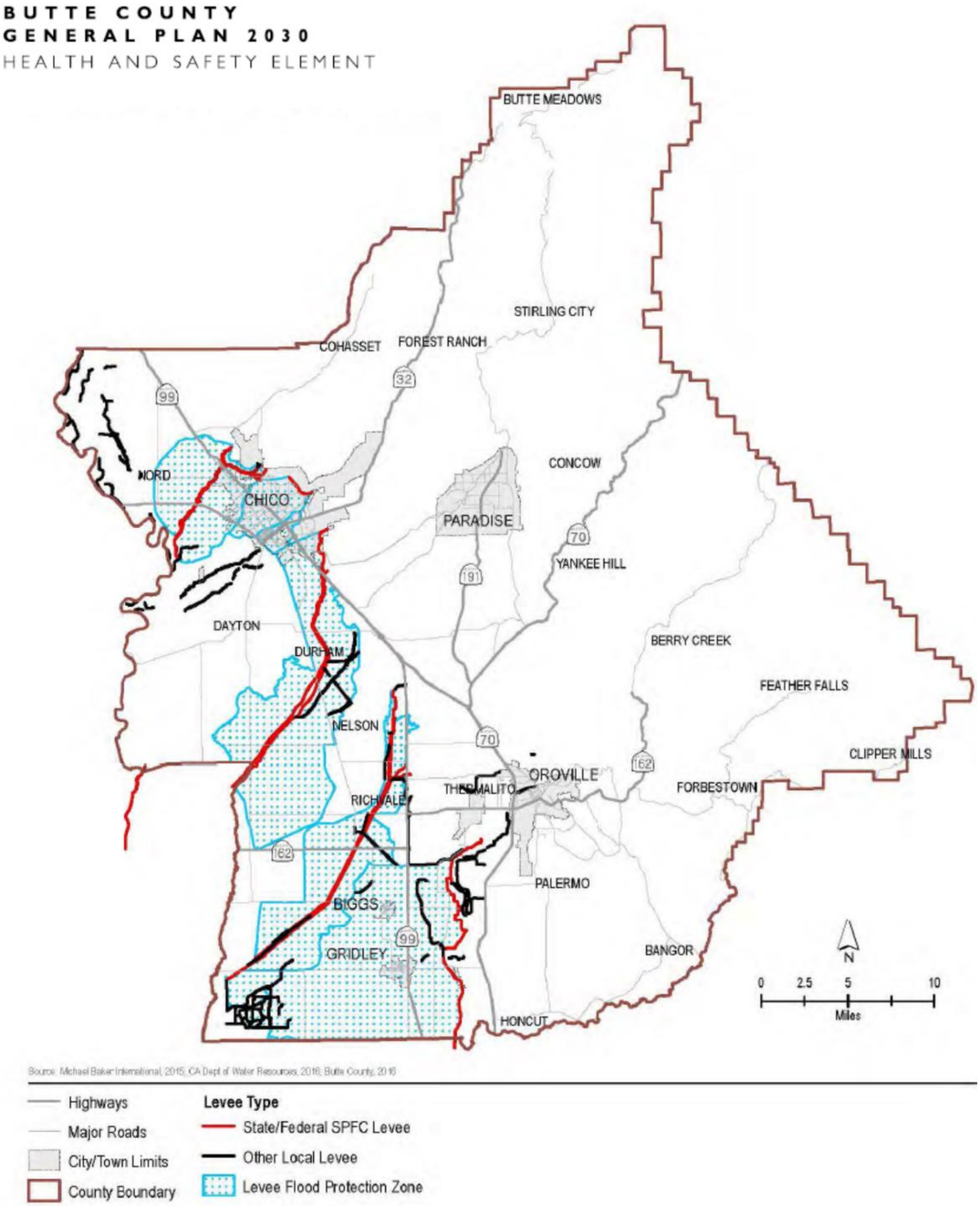
Levees	Levee Count
City of Chico	
Accredited	0
Non-Accredited	7
PAL	5
City of Chico Total	**12**
City of Gridley	
Accredited	1
Non-Accredited	0
PAL	0
City of Gridley Total	**1**
City of Oroville	
Accredited	
Non-Accredited	1
PAL	1
City of Oroville Total	**2**
Unincorporated Butte County	
Accredited	6
Non-Accredited	74
PAL	4
Unincorporated Butte County Total	**84**
Grand Total	**99**

Source: FEMA, Butte County 2019

The National Levee Database counts levee structures differently than FEMA, and notes that there are 91 levee systems in Butte County, containing 246 miles of levees. There are 180 levee structures in the County, with the average age of these levees of 58 years.

Butte County's General Plan Safety Element shows levee protected areas in the County. These are shown on Figure 4-61.

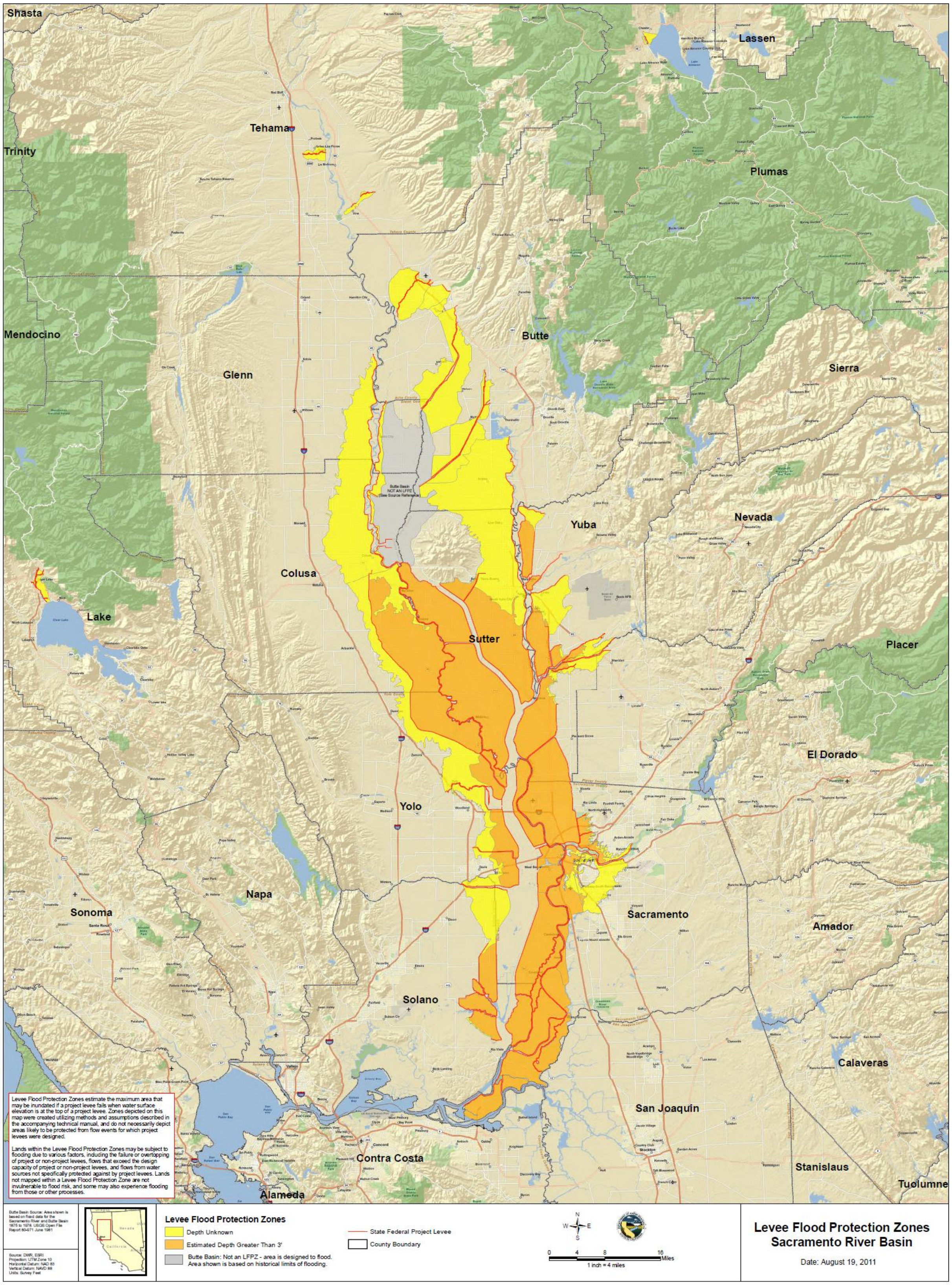
Figure 4-61 Butte County – Levees and Levee Flood Protection Zones



Source: Butte County General Plan Safety Element

There is not a scientific scale or measurement system in place for levee failure. It us usually measured in the nature of the breach, the affected area, flow volume and velocity, and depth of flooding. Maps showing inundation depths due to a levee failure in the County are shown on Figure 4-62 based on Cal DWR data from 2011. As shown, flood depths in Butte County range from unknown to greater than 3 feet. The speed of onset is slow as the river rises, but if a levee fails the warning times are short for those in the inundation area. The duration of levee failure can be hours to weeks, depending on the river flows that the levee holds back and the nature of the breach.

Figure 4-62 Butte County - Levee Flood Protection Zones and Flood Depths



Source: Cal DWR

Past Occurrences

Disaster Declaration History

There have been no disasters declarations related to levee failure in Butte County, as shown on Table 4-5.

NCDC Events

There have been no NCDC levee failure events in Butte County.

Hazard Mitigation Planning Committee Events

Evidence of the success of levees in reducing flood loss, Butte County has only experienced four significant flood events since the levees were constructed. These record flood events occurred in 1955, 1964, 1986, and 1997, and were not related to levee failures.

Although no levee breaks occurred in Butte County, levees did fail in nearby areas. Major flooding occurred in Yuba City and Nicolaus in Sutter County due to levee breaks on December 24, 1955. Nearly 100,000 acres flooded during a series of storms, resulting in 38 deaths and 3,200 injuries (Sutter Butte Flood Control Agency, 2009). A series of storms in 1986 caused a levee break near the town of Linda in Yuba County. In January 1997, significant rain occurred at high elevations in the Sierra Nevada Mountains after deep accumulation of snow. This caused the Feather River to flood and a levee failure to occur south of Olivehurst in Yuba County.

Likelihood of Future Occurrence

Likely – It is important to remember that no levee provides protection from events for which it was not designed: they are not fail-safe. Changes to the bottom of the river have affected the protection the levee provides. Proper maintenance is necessary to reduce the probability of failure. Due to the number and age of levees in Butte County, future levee failures are currently considered likely.

Climate Change and Levee Failure

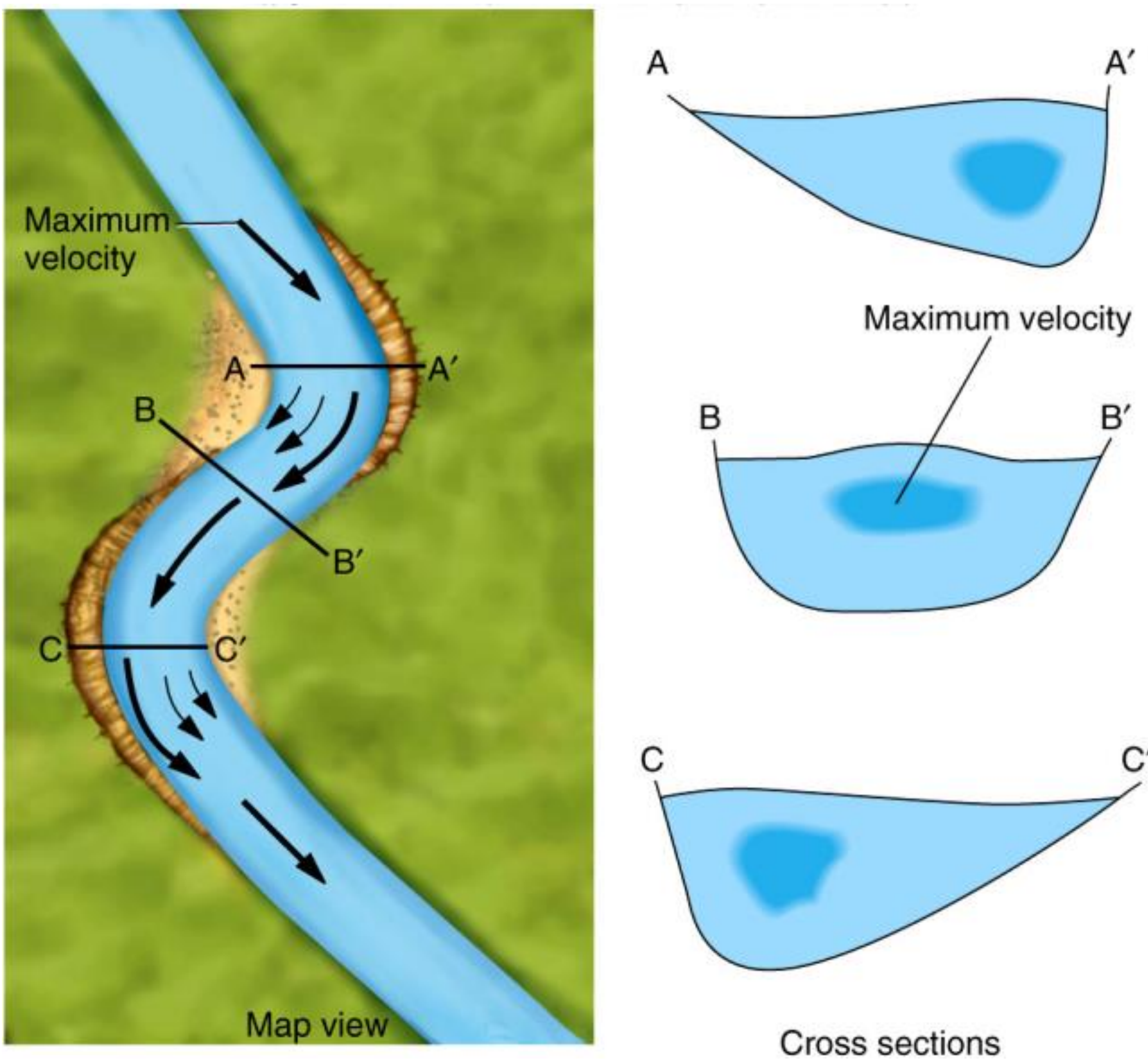
In general, increased flood frequency in California is a predicted consequence of climate change. Mechanisms whereby climate change leads to an elevated flood risk include more extreme precipitation events and shifts in the seasonal timing of river flows. This threat may be particularly significant because recent estimates indicate the additional force exerted upon the levees is equivalent to the square of the water level rise. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods.

4.2.17. Stream Bank Erosion

Hazard/Problem Description

According to the DWR, any flowing body of water (brook, creek, stream, river) is a stream. Stream flow is expressed as volume per unit time, usually cubic meters per second, cubic feet per second, sometimes cubic kilometers per second, or acre-feet per second or day. Stream flow varies tremendously with time. Short term effects come from rainfall, snowmelt, and evaporation conditions. Long term effects come from land use, soil, groundwater state, and rock type.

Figure 4-63 Meanders and Stream flows



Stream bank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Stream bank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. The vegetation rooting characteristics can protect banks from fluvial entrainment and collapse, and also provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. Stream bank aggradation or degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization. Numerous studies have demonstrated that stream bank erosion contributes a large portion of the annual sediment yield.

Determining the cause of accelerated streambank erosion is the first step in solving the problem. When a stream is straightened or widened, streambank erosion increases. Accelerated streambank erosion is part of the process as the stream seeks to re-establish a stable size and pattern. Damaging or removing streamside vegetation to the point where it no longer provides for bank stability can cause a dramatic increase in bank erosion. A degrading streambed results in higher and often unstable, eroding banks. When land use changes occur in a watershed, such as clearing land for agriculture or development, runoff increases. With this increase in runoff the stream channel will adjust to accommodate the additional flow, increasing streambank erosion. Addressing the problem of streambank erosion requires an understanding of both stream dynamics and the management of streamside vegetation.

As farmers settled the valleys, the Gold Rush drew prospectors to the hills. As mining in the Sierra Nevada turned to the more efficient methods of hydraulic mining, the use of environmentally destructive high-pressure water jets washed entire mountainsides into local streams and rivers. Hydraulic gold mining in the northern Sierra Nevada foothills produced 1.1 billion cubic meters of sediment. Approximately 38% of the total hydraulic-mining sediment produced was stored in piedmont deposits of the Yuba and Bear Rivers and the lower Feather River. As a result, the enormous amounts of silt deposited in the riverbeds of the Central Valley increased flood risk. These low-lying, unconsolidated deposits reside below all dams and reservoirs and are largely between modern levees. As a remedy to these rising riverbeds, levees were built very close to the river channels to keep water velocity high and thereby scour away the sediment. However, the design of these narrow channels has been too successful. While the Gold Rush silt is long gone, the erosive force of the constrained river continues to eat away at stream banks and the levee system.

Since the construction of the Oroville Dam and Thermalito Afterbay, sediment loads from waters discharged from the dams into the Feather River have decreased significantly. This lack of suspended sediment in the river has caused the river to become more erosive in the northern portion of the alignment, transporting the mining debris and older alluvium downstream. Data from a 1978 study on the effects of Oroville Dam on sediment transport indicated sediment yield increased between Gridley and Marysville, which was attributed to channel erosion accelerated by the clear-water dam releases and to change in frequency and magnitude of flow rates.

Erosion and deposition are occurring continually at varying rates over the Planning Area. Swiftly moving floodwaters cause rapid local erosion as the water carries away earth materials. This is especially problematic in leveed areas. Severe erosion removes the earth from beneath bridges, roads and foundations of structures adjacent to streams. By undercutting it can lead to increased rockfall and landslide hazard. The deposition of material can block culverts, aggravate flooding, destroy crops and lawns by burying them, and reduce the capacity of water reservoirs as the deposited materials displace water (see Figure 4-64). In addition, the 2030 Butte County General Plan Water Resources Element also noted that fire-related erosion can also lead to streambank instability when protective vegetation that anchors the land surrounding streams and in the watershed is lost to fire.

Figure 4-64 Butte County – Clogged Culverts after Erosion

Source: Butte County Office of Emergency Management

Streambank erosion increases the sediment that a stream must carry, results in the loss of fertile bottomland and causes a decline in the quality of habitat on land and in the stream. High velocity flows can erode material from the outboard or waterside of the levee (see Section 4.2.16), which may lead to instability and failure. Erosion can occur at once or over time as a function of the storm cycle and the scale of the peak storms.

Location and Extent

Stream bank erosion occurs on rivers, streams, and other moving waterways, including leveed areas, in the County Planning Area. These were shown on Figure 4-60. As noted above, since the construction of the Oroville Dam and Thermalito Afterbay, sediment loads from waters discharged from the dams into the Feather River have decreased significantly. This lack of suspended sediment in the river has caused the river to become more erosive in the northern portion of the alignment, transporting the mining debris and older alluvium downstream. The speed of onset of this erosion is slow, as the erosion takes place over periods of years. Duration of erosion is extended. Greater erosion occurs during periods of high stream flow and during storm and wind events when wave action contributes to the extent and speed of streambank erosion.

Past Occurrences

Disaster Declarations

There have been no federal or state disaster declarations related to erosion, as shown in Table 4-4.

NCDC Events

The NCDC does not track erosion events.

HMPC Events

According to the HMPC, erosion from heavy rains occurs along the stream banks on an annual basis in the County.

In 2006, after the City of New Orleans was flooded, concern was raised for the threat of flooding to the Sacramento Valley. In February 2006, the governor of California declared a state of emergency for the Central Valley levees. Soon after, all the sites that were defined as critical in the 2005 inventory were repaired. Repairs have continued every year since and over 100 sites have been repaired since the declaration through the combined efforts of the US Army Corps of Engineers and the California Department of Water Resources.

While sites are currently being repaired, more sites enter the erosion inventory every year. The number of erosion sites within the system is large and even with repairs being completed every year, the number of stream bank erosion sites shows little decline year over year. With the large number of sites, a ranking system was developed to help determine which sites should be considered the highest priority for repair. Based on a 2007 field investigation, the total number of erosion sites within Butte County was 4 sites.

At the Sycamore Creek diversion near Marigold Avenue, the channel and its banks show signs of severe erosion which provides the sediment source for deposition in the downstream reaches that have milder slopes and slower velocities, such as the Cohasset Road Bridge.

Figure 4-65 Evidence of Erosion in South Sycamore Creek

Source: 2006 Butte County Flood Mitigation Plan

The Sacramento River has cut away approximately 65 feet of bank along the stretch of River Road between West Sacramento Avenue and Big Chico Creek. River Road is only approximately four feet away from the Sacramento River. The Butte County Department of Public Works has placed a temporary concrete barrier along the roadway; however, a more permanent solution is necessary to protect the people and the road.

Figure 4-66 Erosion along River Road

Source: 2006 Butte County Flood Mitigation Plan

Past channel erosion in the County has also happened in the tributaries of Dry Creek in the developed areas of the City of Oroville.

Likelihood of Future Occurrence

Highly Likely – Due to the high number of linear feet of levees and stream and creek banks within the Butte County Planning Area and the fact that erosion is constantly occurring, the likelihood of future occurrences of streambank erosion in Butte County is highly likely.

Climate Change and Erosion

According to the CAS, climate change may affect flooding and thereby erosion in Butte County. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Reduced snowpack and increased number of intense rainfall events are likely to put additional pressure on water infrastructure which could increase the chance of flooding associated with breaches or failures of flood control structures such as levees and dams. Future precipitation projections were shown in Figure 4-21 in Section 4.2.3. Also according to the National Center for Atmospheric Research in Boulder, Colorado, atmospheric rivers are likely to grow more intense in coming decades, as climate changes warms the atmosphere enabling it to hold more water. All of the events above could exacerbate stream bank erosion in the County.

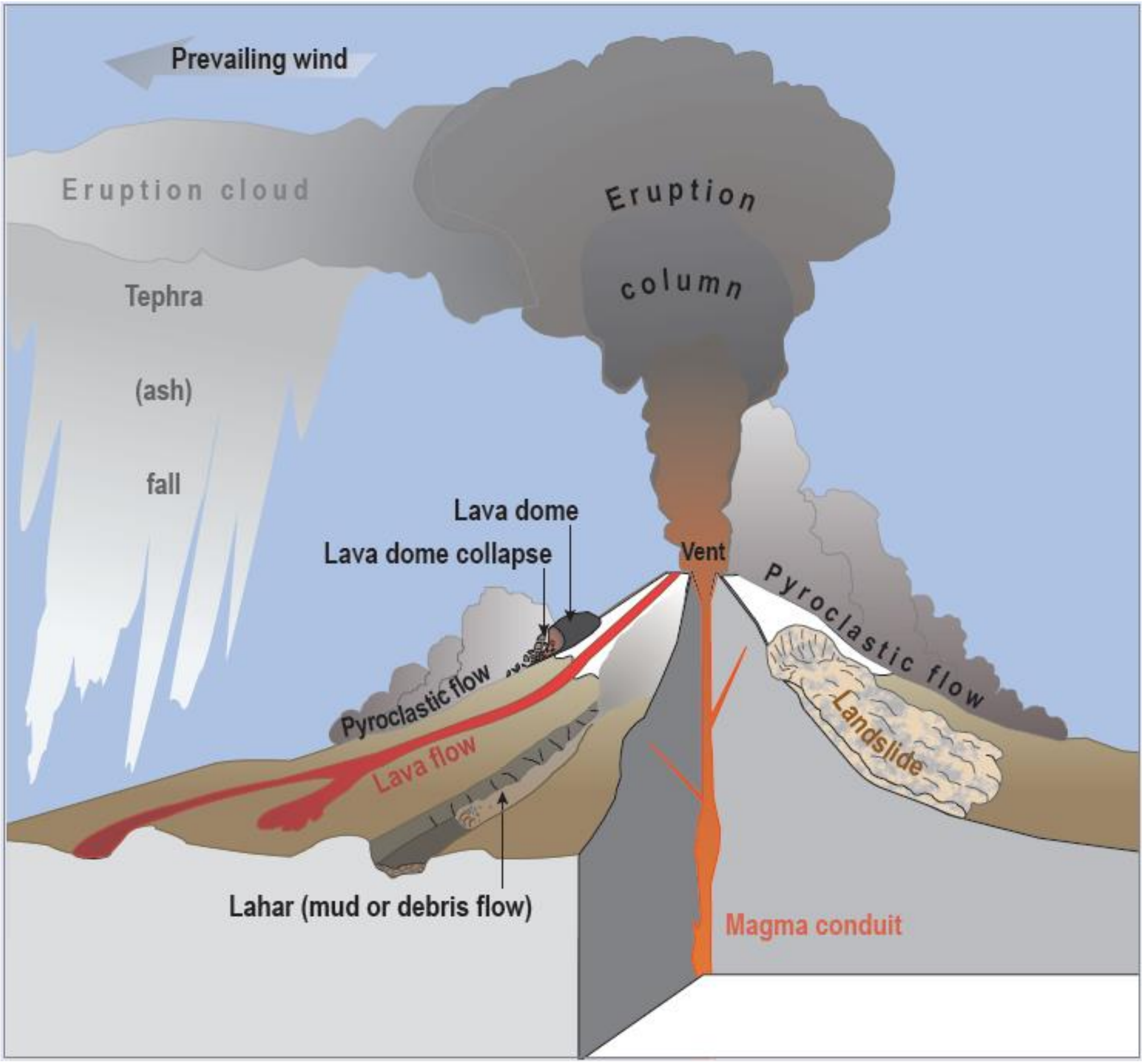
4.2.18. Volcano

Hazard/Problem Description

The California State Hazard Mitigation Plan identifies volcanoes as one of the hazards that can adversely impact the State. However, there have been few losses in California from volcanic eruptions.

As shown in Figure 4-67, active volcanoes pose a variety of natural hazards. Explosive eruptions blast lava fragments and gas into the air with tremendous force. The finest particles (ash) billow upward, forming an eruption column that can attain stratospheric heights in minutes. Simultaneously, searing volcanic gas laden with ash and coarse chunks of lava may sweep down the flanks of the volcano as a pyroclastic flow. Ash in the eruption cloud, carried by the prevailing winds, is an aviation hazard and may remain suspended for hundreds of miles before settling to the ground as ash fall. During less energetic effusive eruptions, hot, fluid lava may issue from the volcano as lava flows that can cover many miles in a single day. Alternatively, a sluggish plug of cooler, partially solidified lava may push up at the vent during an effusive eruption, creating a lava dome. A growing lava dome may become so steep that it collapses, violently releasing pyroclastic flows potentially as hazardous as those produced during explosive eruptions.

Figure 4-67 Volcanoes and Associated Hazards

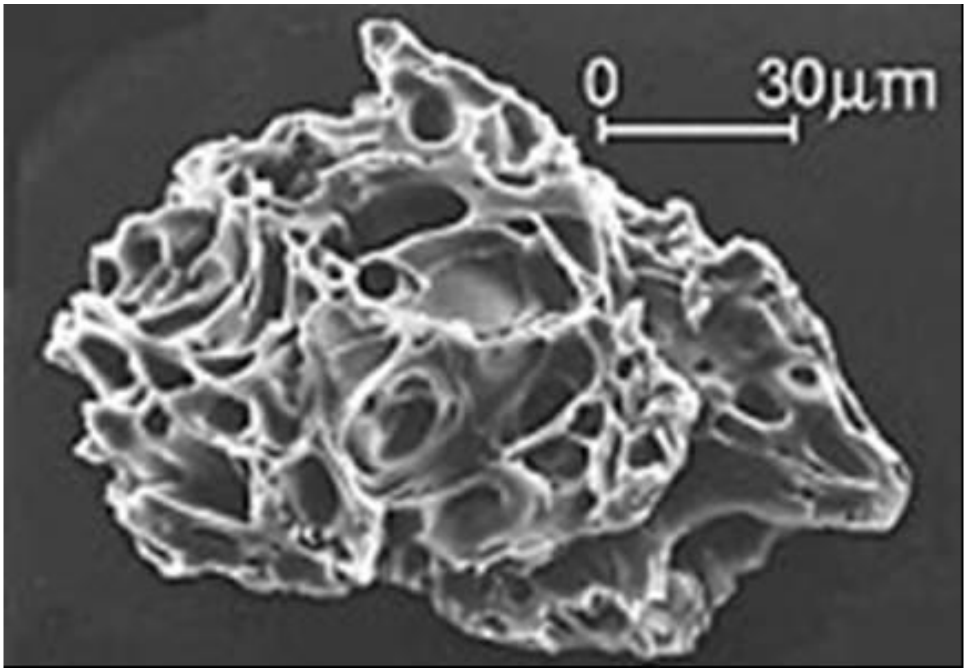


Source: USGS Publication 2014-3120

During and after an explosive or effusive eruption, loose volcanic debris on the flanks of the volcano can be mobilized by heavy rainfall or melting snow and ice, forming powerful floods of mud and rock (lahars) resembling rivers of wet concrete. These can rush down valleys and stream channels as one of the most destructive types of volcano hazards.

Populations living near volcanoes are most vulnerable to volcanic eruptions and lava flows, although volcanic ash can travel and affect populations many miles away and cause problems for aviation. The USGS notes specific characteristics of volcanic ash. Volcanic ash is composed of small jagged pieces of rocks, minerals, and volcanic glass the size of sand and silt, as shown in Figure 4-68. Very small ash particles can be less than 0.001 millimeters across. Volcanic ash is not the product of combustion, like the soft fluffy material created by burning wood, leaves, or paper. Volcanic ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

Figure 4-68 Ash Particle from 1980 Mt. St Helens Eruption Magnified 200 Times



Source: US Geological Survey: Volcanic Ash: Effect & Mitigation Strategies.

Volcanic ash is formed during explosive volcanic eruptions. Explosive eruptions occur when gases dissolved in molten rock (magma) expand and escape violently into the air, and also when water is heated by magma and abruptly flashes into steam. The force of the escaping gas violently shatters solid rocks. Expanding gas also shreds magma and blasts it into the air, where it solidifies into fragments of volcanic rock and glass. Once in the air, wind can blow the tiny ash particles tens to thousands of miles away from the volcano.

The average grain-size of rock fragments and volcanic ash erupted from an exploding volcanic vent varies greatly among different eruptions and during a single explosive eruption that lasts hours to days. Heavier, large-sized rock fragments typically fall back to the ground on or close to the volcano and progressively smaller and lighter fragments are blown farther from the volcano by wind. Volcanic ash, the smallest particles (2 mm in diameter or smaller), can travel hundreds to thousands of kilometers downwind from a volcano depending on wind speed, volume of ash erupted, and height of the eruption column.

The size of ash particles that fall to the ground generally decreases exponentially with increasing distance from a volcano. Also, the range in grain size of volcanic ash typically diminishes downwind from a volcano (becoming progressively smaller). At specific locations, however, the distribution of ash particle sizes can vary widely.

The impact of coarse air fall is limited to the immediate area of the volcanic vent. Structures may be damaged by accumulation of falling lava fragments or burnt by their high heat. Wildfires may be ignited by coarse ash. Although generally non-lethal, fine ash fall is the most widespread and disruptive volcanic hazard. People exposed to fine ash commonly experience various eye, nose, and throat symptoms. Short-term exposures are not known to pose a significant health hazard. Long-term health effects have not been demonstrated conclusively. Ash deposited downwind of the volcano covers everything like a snowfall, but also infiltrates cracks and openings in machinery, buildings, and electronics. Falling ash can obscure sunlight, reducing visibility to zero. When wet, it can make paved surfaces slippery and impassable. Fine ash is abrasive, damaging surfaces and moving parts of machinery, vehicles, and aircraft. Life-threatening and costly damage can occur to aircraft that fly through fine ash clouds. Newly fallen volcanic ash may result in short-term physical and chemical changes in water quality. Close to the volcano, heavy ash fall may cause roofs to collapse, wastewater systems to clog, and power systems to shut down. In agricultural areas, fine ash can damage crops, and sicken livestock. Resuspension of ash by human activity and wind cause continuing disruption to daily life.

Location and Extent

Of the approximately 20 volcanoes in the State, only a few are active and pose a threat. Of these, the Clear Lake Volcano and Lassen Peak are the closet potential threats to Butte County. Figure 4-69 shows volcanoes in or near California and their location relative to the Butte County Planning Area.

Figure 4-69 Active Volcanoes in California and in the Butte County Area

Source: 2018 State of California Hazard Mitigation Plan

Information on these volcanic areas is as follows:

- According to the USGS, the Clear Lake volcanic field lies in the northern Coast Ranges, California. The volcanic field consists of lava dome complexes, cinder cones, and maars of basaltic-to-rhyolitic composition. Mount Konocti, a dacitic lava dome on the south shore of Clear Lake, is the largest volcanic feature. The area has intense geothermal activity, caused by a large, still hot silicic magma chamber about 14 km wide and 7 km beneath the surface. It provides the heat source for the Geysers, the world's largest producing geothermal field on the SW side of the volcanic field. Its geothermal power plants can generate approximately 2,000 megawatts, enough to power two cities the size of San Francisco. The latest volcanic activity happened about 10,000 years ago and formed maars and cinder cones along the shores of Clear Lake, the largest natural freshwater lake in California. Volcanism around Clear Lake is related to the complex San Andreas transform fault system.

- According to the USGS, Lassen Volcanic Center lies in Lassen Volcanic National Park 55 mi east of Redding. The park draws over 350,000 visitors each year with its spectacular volcanic landscapes. Lassen Volcanic Center is located at the southern edge of the Cascade Range, which is bounded on the west by the Sacramento Valley and the Klamath Mountains, on the south by the Sierra Nevada, and on the east by the Basin and Range geologic provinces. Volcanism in the Lassen segment is a result of subduction of the Juan de Fuca oceanic plate eastward beneath the North American continental plate.

Volcano extent is traditionally measured in magma production and ashfall. Maps showing ashfall or magma affected areas have not been created for the Clear Lake nor for the Lassen Volcanics Area. However, the USGS noted:

- If the magma chamber beneath the Clear Lake field were tapped again, eruptions might occur in the lake. These eruptions would be phreatomagmatic and would pose ash-fall and wave hazards to the lakeshore and ash-fall hazards to areas within a few kilometers of the vent. Eruptions away from the lake would produce silicic domes, cinder cones and flows and would be hazardous within a few kilometers of the vents. Future eruptions would be signaled by heightened earthquake activity.
- Basaltic eruptions may build cinder cones as high as a few hundred meters (around 1,000 ft) and blanket many square kilometers with ash a few centimeters to meters thick. However, these eruptions would not typically impact human life if they occurred at Lassen volcanic center, because they are relatively nonviolent. More devastating ash eruptions occur when dacite magma charged with volcanic gases reaches the surface. In this case, an explosive vertical column of gas and ash may rise several kilometers into the atmosphere. Fallout from the eruption column can blanket areas within a few kilometers of the vent with a thick layer of tephra and high-altitude winds may carry finer ash tens to hundreds of kilometers from the volcano and pose a hazard to aircraft.

Past Occurrences

Disaster Declarations

There have been no federal or state disaster declarations related to volcano, as shown on Table 4-4.

NCDC Events

The NCDC does not track volcanic activity.

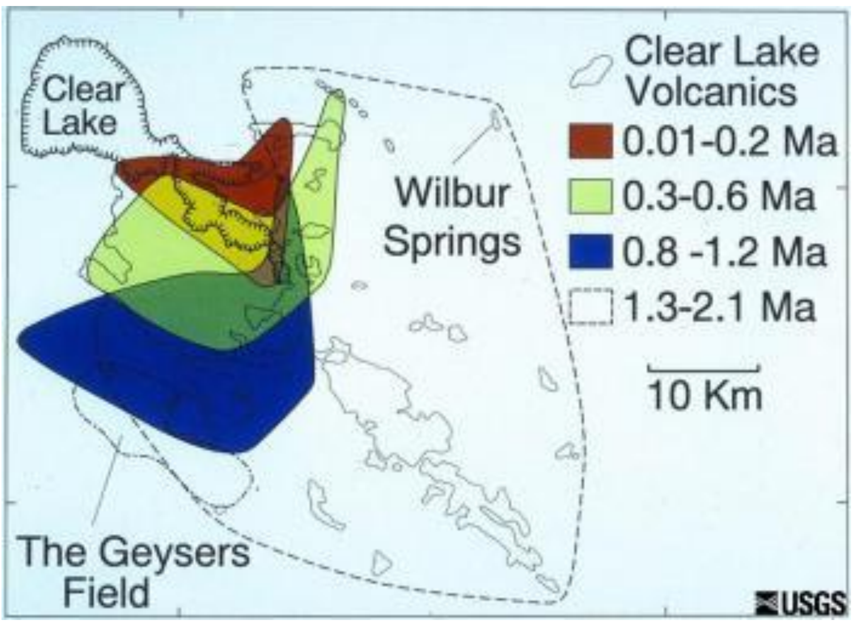
USGS Events

Clear Lake Volcanic Field

The Clear Lake volcanics erupted during four periods of time beginning at about 2 million years ago. There is a general decrease in age northward from 2 million years ago in the south to about 10,000 years in the north. Geophysical data suggests there is currently a spherical to cylindrical magma chamber about 8.7 miles in diameter and about 4.3 mi from the surface. Seismic studies indicate that the vertical extent is approximately 18.6 miles deep.

Four eruptive episodes have been recognized: 2.1-1.3 million years ago, 1.1-0.8 million years ago, 0.65-0.30 million years ago., and 100,000-10,000 years ago. These can be seen on Figure 4-70. The total volume of about 100 individual eruptions exceeds 70 cubic kilometers. Eruptive products from the first activity episode are found in the east of the field. The second activity episode constructed Cobb Mountain (1 million years ago) and Mount Hannah (0.9 million years ago). The third episode of activity was at the Mount Konocti–Thurston Lake area, the most voluminous dacite and rhyolite feature of the Clear Lake volcanics. The most recent activity, up to about 10,000 years ago were small mostly basaltic and andesitic eruptions in the north of the field.

Figure 4-70 Clear Lake – Past Eruptions

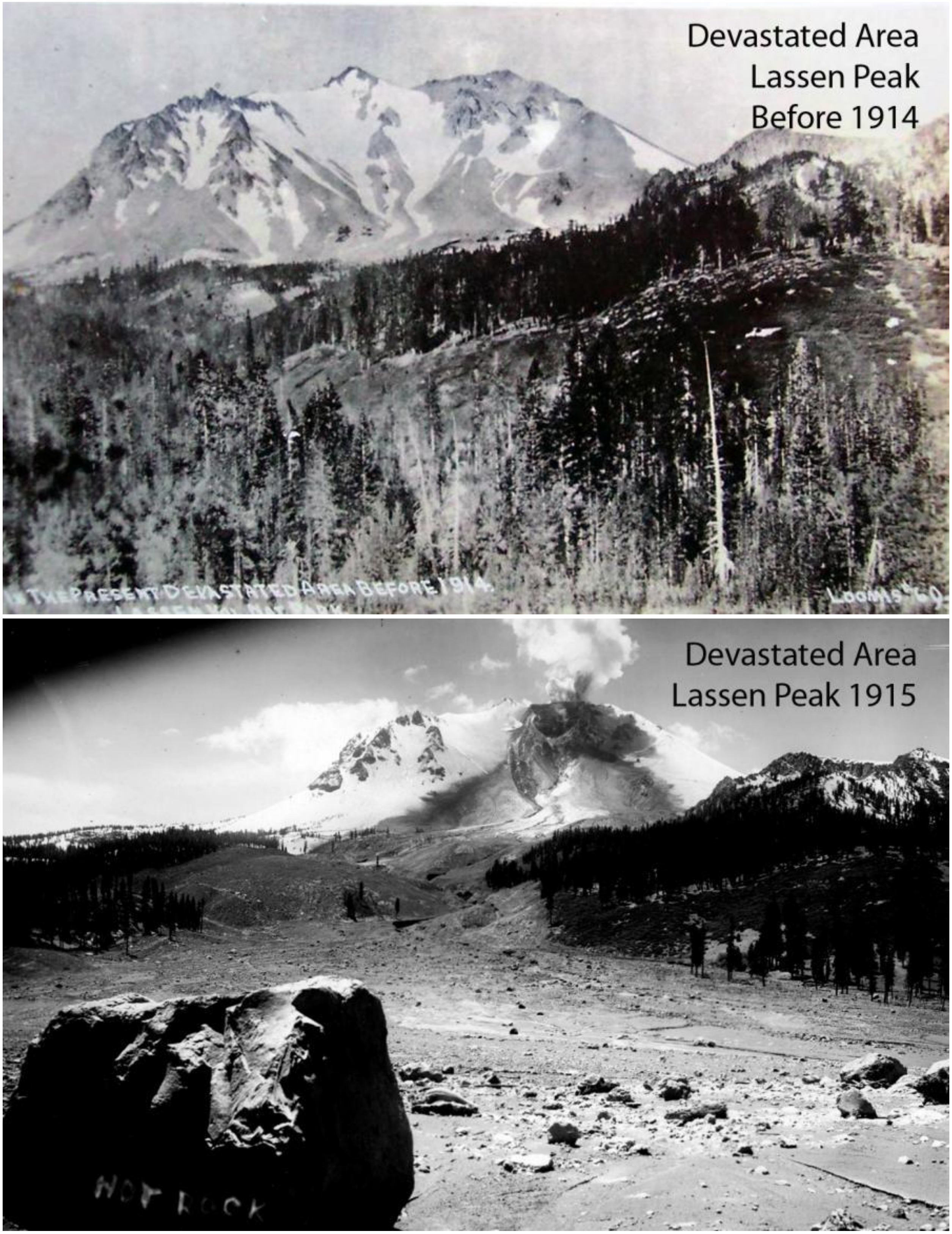


Source: USGS
*Ma = million years ago

Lassen Peak Volcanic Field

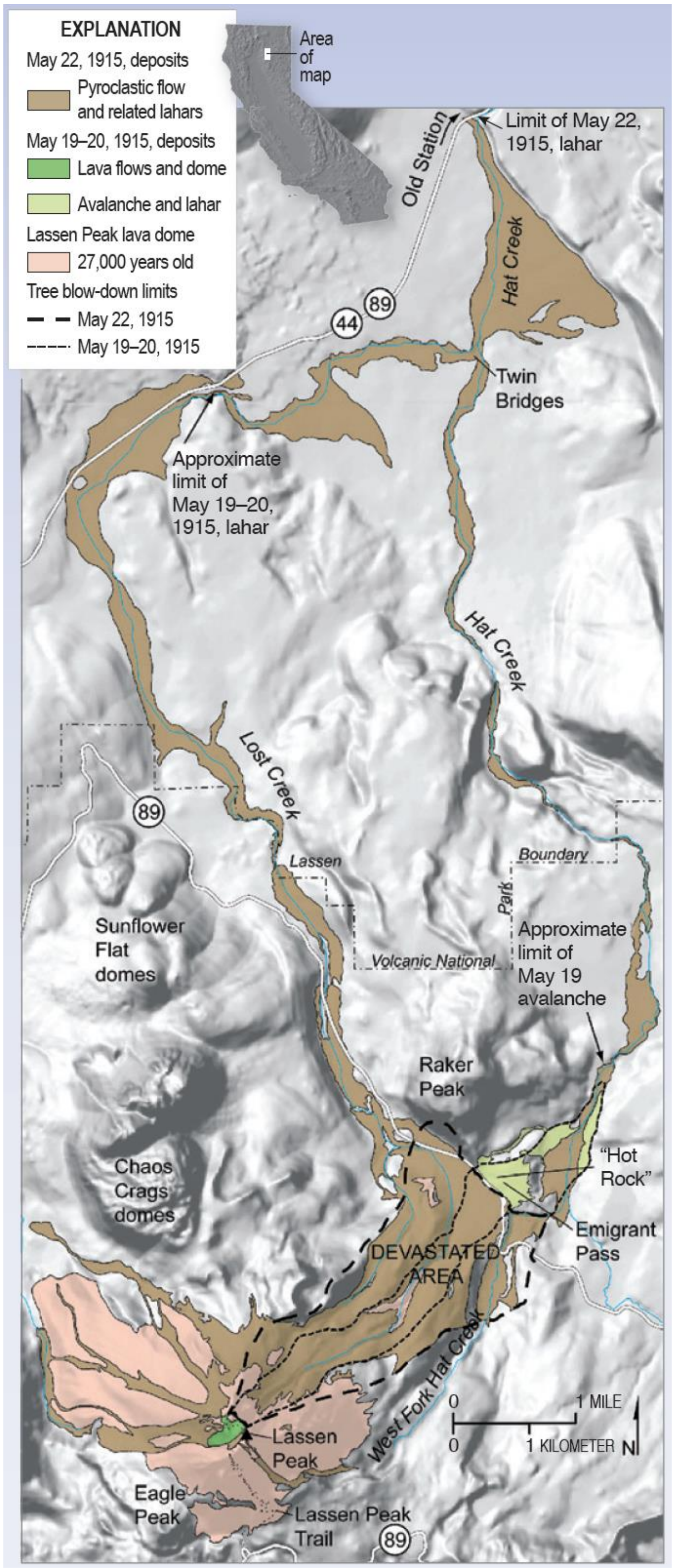
Within the last 825,000 years, hundreds of explosive eruptions came from vents scattered over approximately 200 mi^2. Surrounding Lassen Volcanic Center, over fifty effusive (non-explosive) eruptions have occurred in the last 100,000 years. The area has been relatively quiet for the last 25,000 years with three notable exceptions—the Chaos Crags eruption (1,100 years ago), the eruption of Cinder Cone (1666 A.D.), and the Lassen Peak eruption (A.D. 1914 to 1917). The Lassen Peak eruption consisted mostly of sporadic steam blasts. In May of 1915, however, partially molten rock oozing from the vent began building a precarious lava dome. The dome collapsed on May 19 sending an avalanche of hot rock down the north flank of the volcano. Three days later, a vertical column of ash exploded from the vent reaching altitudes of 30,000 feet. The ash column spawned a high-speed ground flow of hot gas and fragmented lava. Ash from the top of the column drifted downwind 200 miles to the east, as far as Winnemucca, NV. On both days, melting snow fueled mudflows, flooding drainages 20-30 miles away. Before and after pictures are shown on Figure 4-71, while Figure 4-72 shows the extent of damages due to the eruption.

Figure 4-71 1915 Lassen Volcano Eruption



Source: USGS

Figure 4-72 Deposits from Lassen Peak May 1915 Eruptions



Source: USGS – A Sight "Fearfully Grans" – Eruptions of Lassen Peak California, 1914 to 1917

The older Chaos Crags eruption was similar in style, but considerably larger in magnitude. Lassen Volcanic Center hosts a vigorous geothermal system, numerous hot springs, steam vents, and boiling mud pots. Volcanic earthquakes are common, although most are too small to be felt. Non-volcanic earthquakes along regional faults also occur—earthquake swarms in 1936, 1945-1947, and 1950 included several events above magnitude 4.0, with the two largest registering 5.0 and 5.5. Ground surveys show localized subsidence of the volcano, probably due to motion on regional faults.

Hazard Mitigation Planning Committee Events

The HMPC noted no volcanic events.

Likelihood of Future Occurrences

Unlikely—According to the USGS, the complex eruptive history over the past 2 million years and the 10,000-year age of the youngest eruption indicate that the Clear Lake magmatic system is not extinct and that future eruptions are likely. Such a long period of multiple volcanic events and the large volume magma chamber suggest that the Clear Lake system could be in pre-caldera early evolutionary stage. Although future eruptions are likely in the Clear Lake field, prediction of the timing is difficult because activity has been episodic in the past. From dates and numbers of ash beds beneath Clear Lake, and the apparent lack of eruptions in the past 10,000 years is a geologically brief lull in activity after frequent eruptions (about 34, or averaging one every 1,800 years) in the previous 60,000 years. Episodes of volcanic activity have typically continued for at least 300,000 years, so that the youngest episode, which began about 100,000 years ago could be in an early stage and may continue for another 200,000 years. Eruptions are likely to be located close to, beneath, or northeast of Clear Lake, especially around the east arm of the lake. Volcanoes in the Lassen area tend to erupt infrequently, and may be inactive for periods lasting centuries or even millennia. The most recent eruptions in the Lassen area were the relatively small events that occurred at Lassen Peak between 1914 and 1917. The most recent large eruption produced Chaos Crags about 1,100 years ago. Such large eruptions in the Lassen area have an average recurrence interval of about 10,000 years. However, the geologic history of the Lassen area indicates that volcanism there is episodic, having periods of relatively frequent eruptions separated by long quiet intervals. For example, the last large event before Chaos Crags eruption was the one that built Lassen Peak 27,000 years.

Climate Change and Volcano

Climate change is unlikely to influence volcanic eruptions.

4.2.19. Wildfire

Hazard/Problem Description

Wildland fire is an ongoing concern for the Butte County Planning Area. 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.

Potential losses from wildfire include human life, structures and other improvements, natural and cultural resources, quality and quantity of water supplies, cropland, timber, and recreational opportunities. Economic losses could also result. Smoke and air pollution from wildfires can be a severe health hazard. In addition, catastrophic wildfire can create favorable conditions for other hazards such as flooding, landslides and mudflows, and erosion during the rainy season.

Location and Extent

The County ranges in elevation from 60 feet to 7,000 feet above sea level and is divided in half with two topographical features. The Sacramento Valley section in the western portion of the county is relatively flat and is predominantly grassland and farmland. The foothills and mountainous region of the northern Sierra Nevada and southern Cascade Mountains comprise the eastern portion of the county. This area is scattered with homes and communities intermixed amongst woodland fuels creating a serious Wildland Urban Interface (WUI) problem.

Wildland Urban Interface (WUI)

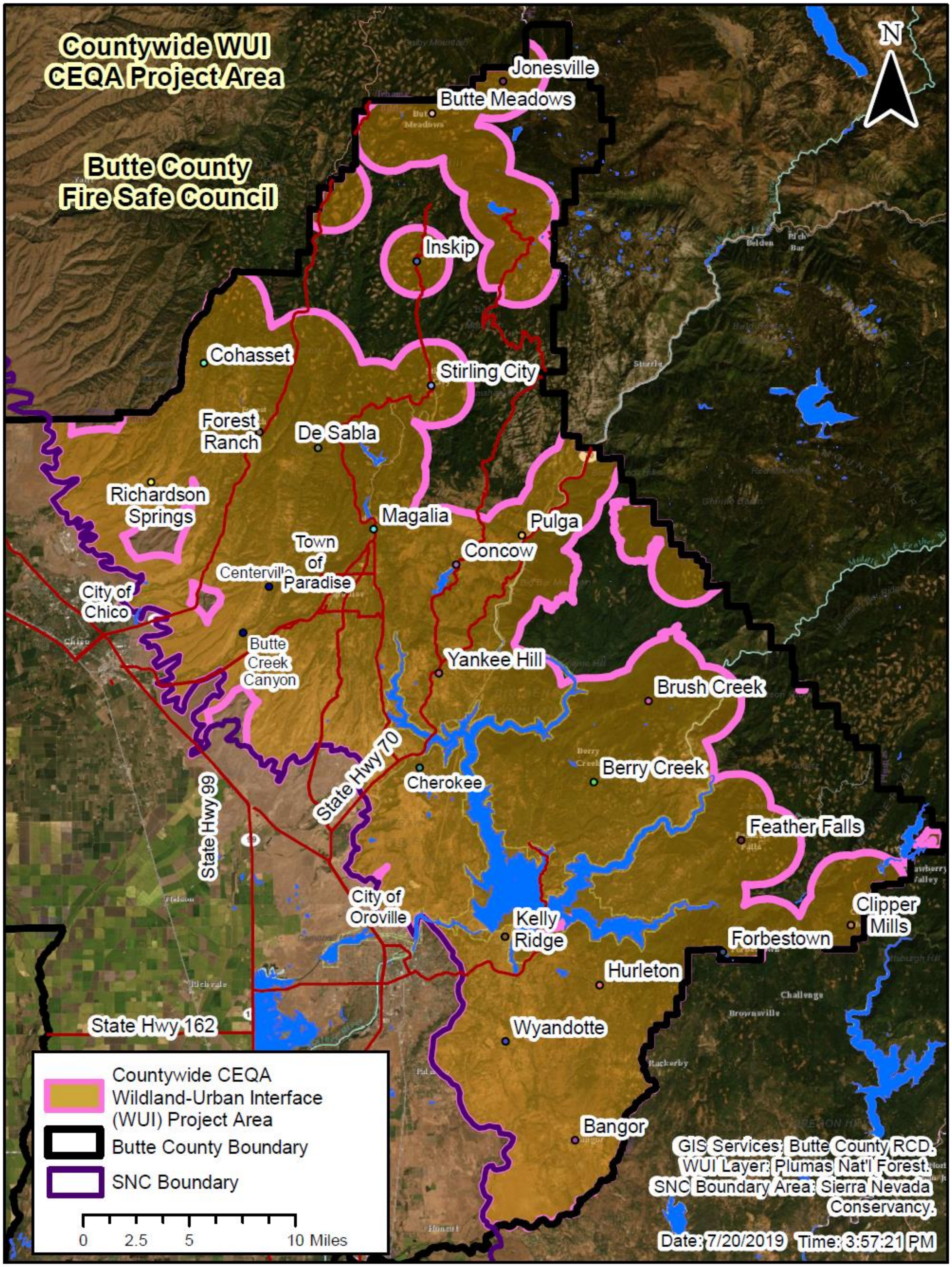
Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire control practices have affected the natural cycle of the ecosystem. While wildfire risk is predominantly associated with WUI areas, significant wildfires can also occur in heavily populated areas. The wildland urban interface is a general term that applies to development adjacent to landscapes that support wildland fire. The WUI defines the community development into the foothills and mountainous areas of California. 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 WUI for Butte County consists of communities at risk (shown in in Section 4.2.18) as well as the area around the communities that pose a fire threat.

There are two types of WUI environments. The first is the true urban interface where development abruptly meets wildland. For Butte County the Town of Paradise and the community of Paradise Pines are examples of high-density housing meeting wildland.

The second WUI environment is referred to as the wildland urban intermix. Wildland urban intermix communities are rural, low density communities where homes are intermixed in wildland areas. For Butte County the communities of; Cohasset, Forest Ranch, Concow, Yankee Hill, Berry Creek and Forbestown are some of these examples. Wildland urban intermix communities are difficult to defend because they are sprawling communities over a large geographical area with wild fuels throughout. This profile makes access, structure protection, and fire control difficult as fire can freely run through the community.

WUI fires are often the most damaging. WUI fires occur where the natural and urban development intersect. Even relatively small acreage fires may result in disastrous damages. WUI fires occur where the natural forested landscape and urban-built environment meet or intermix. The damages are primarily reported as damage to infrastructure, built environment, loss of socio-economic values and injuries to people. WUI areas in Butte County can be seen on Figure 4-73.

Figure 4-73 Butte County Wildland Urban Interface Areas



Source: Butte County Fire Safe Council

Butte County Wildfire Setting

As previously stated, there are significant areas in the County that are prone to wildfire. Wildland fires affect grass, forest, and brushlands, as well as any structures located within them. Where there is human access to wildland areas the risk of fire increases due to a greater chance for human carelessness and historical fire management practices. Generally, there are four major factors that sustain wildfires and allow for predictions of a given area's potential to burn. These factors include fuel, topography, weather, and human actions.

- **Fuel** – Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. The 2015 - 2020 Community Wildfire Protection Plan (CWPP) noted that vegetation is grouped into three general fuel types: grass, brush and timber. There are a number of factors such as fuel type and size, loading (tons/acre), arrangement (vertical & horizontal), chemical composition, and dead and live fuel moisture that contribute to the flammability characteristics of vegetation. The valley and lower foothills, up to approximately 1000' elevation, are covered by the grass fuel type. This fuel type is comprised of fine dead grasses and leaf litter which is the main carrier of fire. Fires in this fuel type react dramatically to changes in weather, particularly low relative humidity and high wind speed. Grassland fires can be very difficult to control during gusty wind conditions and often spread over a large area quickly, threatening life and property. The mid-foothill and lower mountain areas, generally between 1000' and 2000' elevation, are dominated by brush. Fire in this fuel type can burn readily, especially later in the summer as live fuel moistures drop to critical levels. Brush fuel, unlike grass fuel, does not react readily to changes in relative humidity. Brush fires can be difficult to control under normal summer burning conditions when their fuel moistures reach critical levels and become very difficult to control on steep topography and when subjected to strong winds. The mountainous areas above 2000' elevation are generally covered by the timber fuel type. Timber fires burn readily, especially if they occur in overstocked stands, in stands with down dead material, and/or later in the summer as live fuel moistures drop. Timber fires can be difficult to control under normal summer burning conditions, but they become very difficult to control on steep topography and when subjected to strong winds.
- **Topography** – An area's terrain and land slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes. The CWPP noted certain topographic elements in the County. Butte County's foothills and mountains are carved up by several river drainages, the largest being the Feather River watershed which culminates in Lake Oroville. The Feather River watersheds include the West Branch of the North Fork east of Paradise, the North Fork separating Yankee Hill from Berry Creek, the Middle Fork separating Berry Creek and Feather Falls, and the South Fork separating Feather Falls from Forbestown and the La Porte Road communities. The northern part of Butte County is bisected by Butte Creek to the west of Paradise and by Big Chico Creek which separates the Forest Ranch and Cohasset ridges. The topography in these drainages differs significantly from the deep and very steep, heavily timbered drainages of the Feather River watershed to the moderately steep wide and generally brush filled Butte Creek and Chico Creek drainages. The drainages are oriented toward south and west aspects which lead to prolonged sun exposure and diminished fuel moisture in the wildland fuels.
- **Weather –** Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires,

creating a situation where fuel will ignite more readily and burn more intensely. Thus, during periods of drought, the threat of wildfire increases. Wind is the most treacherous weather factor. The greater a wind, the faster a fire will spread and the more intense it will be. In addition to wind speed, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. Lightning also ignites wildfires, often in difficult to reach terrain for firefighters. The CWPP noted that the predominant summer weather pattern includes high to very high temperatures, low humidity and light to moderate south winds associated with high pressure weather gradients. Occasionally during the summer, dry weather fronts will approach northern California bringing increased wind speeds from the south on approach, then changing direction to northwest winds after passing the area. Each year, especially in the autumn months, north wind events bring high temperatures, very low humidity and strong winds. These north wind events usually produce red flag warning conditions and provide the highest potential for extreme fire behavior. With the fuels already at their driest moisture content, north winds can create a severe fire weather situation. Lightning is cyclic and is generally a minor occurrence. However, there have been lightning storms that have started numerous, damaging fires.

- **Human Actions** – Most wildfires are ignited by human action, the result of direct acts of arson, carelessness, or accidents. Many fires originate in populated areas along roads and around homes, and are often the result of arson or careless acts such as the disposal of cigarettes, use of equipment or debris burning. Recreation areas that are located in high fire hazard areas also result in increased human activity that can increase the potential for wildfires to occur.

Wildfires tend to be measured in structure damages, injuries, and loss of life as well as on acres burned. CAL FIRE measures fuels in the areas as part of their Fire Hazard Severity maps. Extents are measured in the following categories (discussed in more detail in Section 4.3.18):

- Very High
- High
- Moderate
- Non-Wildland/Non-Urban
- Urban/Unzoned

Fires can have a quick speed of onset, especially during periods of drought. Fires can burn for a short period of time, or may have durations lasting for a week or more. In Butte County, the areas more at risk for burning tend to be those areas in the eastern portion of the County. Geographic extents of the Fire Hazard Severity Zones, discussed in more detail in Section 4.3.19, are included by jurisdiction in Table 4-47.

Table 4-47 Butte County – Geographical Extent of FHSZs by Jurisdiction

Fire Hazard Severity Zones	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
Very High	0	0.00%	0	0.00%	382,185	54.88%
High	0	0.00%	0	0.00%	90,453	12.99%
Moderate	0	0.00%	0	0.00%	90,335	12.97%

Fire Hazard Severity Zones	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Non-Wildland/Non-Urban	228	0.02%	37	0.01%	113,682	16.32%
Urban Unzoned	246	0.02%	164	0.05%	1,155	0.17%
City of Biggs Total	**474**	**0.05%**	**201**	**0.06%**	**677,810**	**97.33%**
City of Chico						
Very High	124	0.01%	0	0.00%	2,066	0.30%
High	4,743	0.45%	679	0.19%	206	0.03%
Moderate	4,455	0.42%	811	0.23%	77	0.01%
Non-Wildland/Non-Urban	657	0.06%	240	0.07%	0	0.00%
Urban Unzoned	8,660	0.82%	6,308	1.77%	0	0.00%
City of Chico Total	**18,638**	**1.77%**	**8,037**	**2.26%**	**2,349**	**0.34%**
City of Gridley						
Very High	0	0.00%	0	0.00%	124	0.02%
High	0	0.00%	0	0.00%	4,064	0.58%
Moderate	0	0.00%	0	0.00%	3,644	0.52%
Non-Wildland/Non-Urban	315	0.03%	79	0.02%	417	0.06%
Urban Unzoned	869	0.08%	617	0.17%	2,352	0.34%
City of Gridley Total	**1,185**	**0.11%**	**696**	**0.20%**	**10,601**	**1.52%**
City of Oroville						
Very High	0	0.00%	0	0.00%	0	0.00%
High	1,565	0.15%	972	0.27%	0	0.00%
Moderate	4,018	0.38%	807	0.23%	0	0.00%
Non-Wildland/Non-Urban	99	0.01%	1	0.00%	191	0.03%
Urban Unzoned	2,117	0.20%	1,102	0.31%	82	0.01%
City of Oroville Total	**7,799**	**0.74%**	**2,882**	**0.81%**	**272**	**0.04%**
Town of Paradise						
Very High	10,113	0.96%	8,046	2.26%	0	0.00%
High	528	0.05%	322	0.09%	0	0.00%

Fire Hazard Severity Zones	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Moderate	140	0.01%	63	0.02%	0	0.00%
Non-Wildland/Non-Urban	0	0.00%	0	0.00%	236	0.03%
Urban Unzoned	0	0.00%	0	0.00%	252	0.04%
Town of Paradise Total	**10,780**	**1.02%**	**8,431**	**2.37%**	**488**	**0.07%**
Unincorporated Butte County						
Very High	438,964	41.73%	56,779	15.97%	0	0.00%
High	144,426	13.73%	53,973	15.18%	592	0.09%
Moderate	134,274	12.76%	43,940	12.36%	3,210	0.46%
Non-Wildland/Non-Urban	288,878	27.46%	175,195	49.28%	99	0.01%
Urban Unzoned	6,525	0.62%	5,370	1.51%	1,016	0.15%
Unincorporated Butte County Total	**1,013,067**	**96.30%**	**335,258**	**94.30%**	**4,917**	**0.71%**
Grand Total	**1,051,943**	**100.00%**	**355,506**	**100.00%**	**696,437**	**100.00%**

Source: CAL FIRE

Post-Wildfire Landslides and Debris Flows

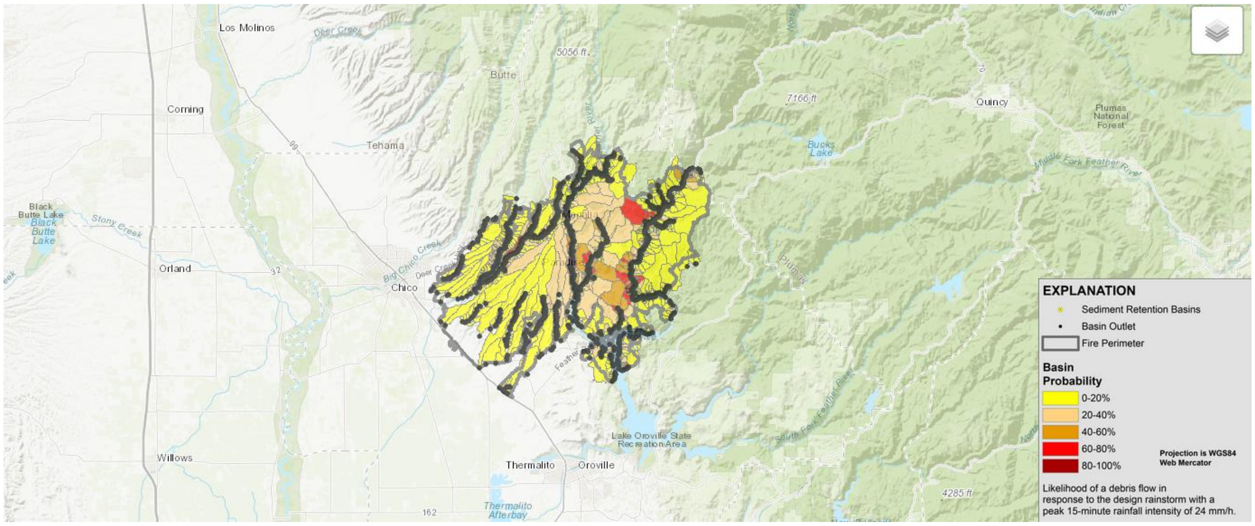
Post-wildfire landslides and debris flows are a concern in Butte County, though the fires usually burn in areas that are less populated. Fires that burn in hilly areas, which comprise the eastern portion of Butte County, remove vegetation that holds hillsides together during rainstorms. Once that vegetation is removed, the hillside may be compromised, resulting in landslides and debris flows. Mapping of these areas has begun to occur.

2018 Camp Fire Landslide and Debris Flow Mapping

Post-fire debris flow hazard assessments for the Camp Fire were performed by the USGS. These assessments are prepared at the request of land and emergency management agencies responsible for managing wildfires impacts. The assessments are presented as a series of maps and geospatial data showing the probability of debris flows and their expected volume for burned drainage basins. Other landslide hazard assessments produced by the USGS are performed at the request of government agencies or sometimes as demonstration products from research to improve methods of hazard and risk assessment.

Figure 4-74 estimates of the likelihood of debris flow (in %), potential volume of debris flow (in m^3), and combined relative debris flow hazard from the Pawnee Fire. These predictions are made at the scale of the drainage basin, and at the scale of the individual stream segment. Estimates of probability, volume, and combined hazard are based upon a design storm with a peak 15-minute rainfall intensity of 24 millimeters per hour (mm/h)

Figure 4-74 2018 Camp Fire Landslide Debris Flow Probabilities



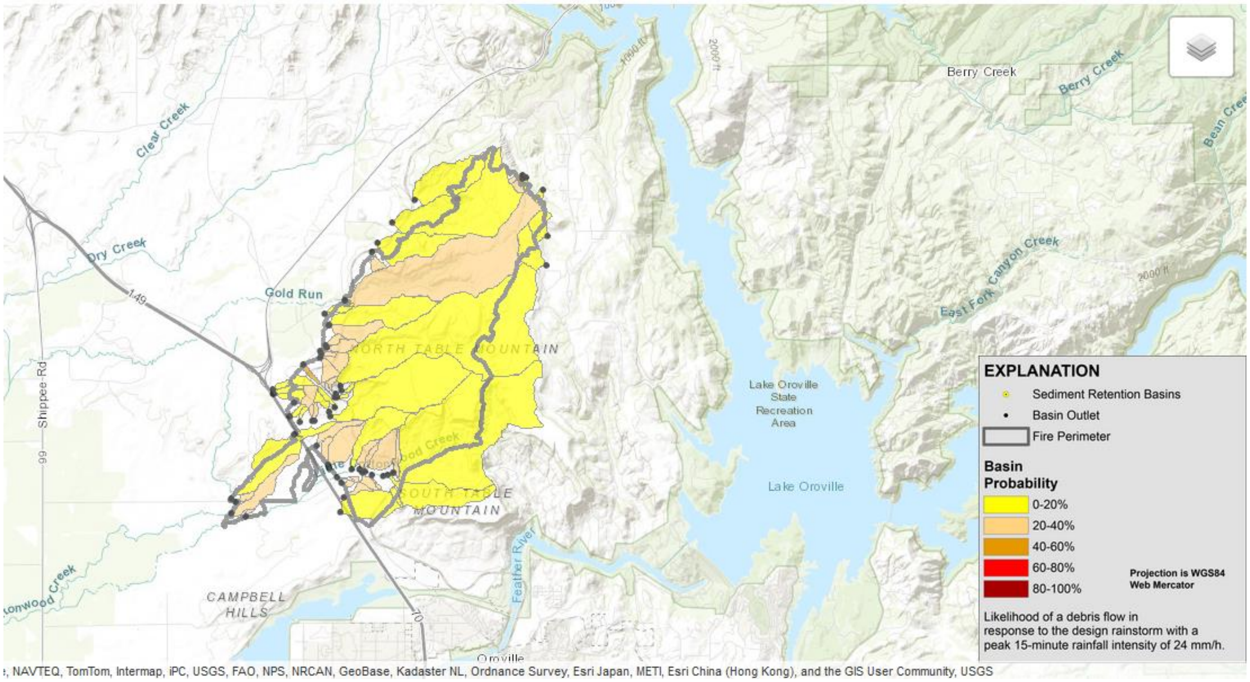
Source: USGS (https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=250)

2017 Cherokee Fire Landslide and Debris Flow Mapping

Post-fire debris flow hazard assessments for the Cherokee Fire were performed by the USGS. These assessments are prepared at the request of land and emergency management agencies responsible for managing wildfires impacts. The assessments are presented as a series of maps and geospatial data showing the probability of debris flows and their expected volume for burned drainage basins. Other landslide hazard assessments produced by the USGS are performed at the request of government agencies or sometimes as demonstration products from research to improve methods of hazard and risk assessment.

Figure 4-74 estimates of the likelihood of debris flow (in %), potential volume of debris flow (in m^3), and combined relative debris flow hazard from the Pawnee Fire. These predictions are made at the scale of the drainage basin, and at the scale of the individual stream segment. Estimates of probability, volume, and combined hazard are based upon a design storm with a peak 15-minute rainfall intensity of 24 millimeters per hour (mm/h).

Figure 4-75 2017 Cherokee Fire Landslide Debris Flow Probabilities



Source: USGS (https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=250)

Past Occurrences

Disaster Declaration History

A search of FEMA and Cal OES disaster declarations turned up multiple state and federal disaster declarations. This is shown in Table 4-48.

Table 4-48 Butte County – State and Federal Disaster Declaration from Wildfire 1950-2019

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Wildfire	10	1999, 2004, 2008, 2017 (four times), 2018 (three times)	8	1961, 1987, 1999, 2008 (twice), 2017 (three times)

Source: Cal OES, FEMA

NCDC Events

The NCDC has tracked wildfire events in the County dating back to 1993. The 19 events in Butte County in the database are shown in Table 4-49. Some of these events happened on the same day, but may have happened at different locations in the County.

*Table 4-49 NCDC Wildfire Events in Butte County 1993 to 10/31/2018**

Date	Event	Injuries (direct)	Deaths (direct)	Property Damage	Crop Damage	Injuries (indirect)	Deaths (indirect)
8/23/1999	Wildfire	0	0	$0	$0	0	0
9/1/1999	Wildfire	0	0	$0	$0	0	0
10/15/1999	Wildfire	5	0	$480,000	$0	0	0
9/18/2000	Wildfire	0	0	$1,900,000	$0	0	0
6/11/2008	Wildfire	0	0	$0	$0	8	0
6/21/2008	Wildfire	0	0	$0	$0	0	0
6/21/2008	Wildfire	0	0	$0	$0	6	0
6/21/2008	Wildfire	0	0	$0	$0	0	0
7/1/2008	Wildfire	0	0	$0	$0	65	1
7/1/2008	Wildfire	0	0	$0	$0	0	0
8/3/2008	Wildfire	0	0	$0	$0	0	0
8/6/2008	Wildfire	0	0	$0	$0	0	0
8/16/2009	Wildfire	0	0	$0	$0	0	0
9/19/2009	Wildfire	0	0	$0	$0	0	0
9/5/2016	Wildfire	0	0	$0	$0	3	0
7/7/2017	Wildfire	0	0	$0	$0	6	0
8/29/2017	Wildfire	2	0	$0	$0	0	0
10/8/2017	Wildfire	0	0	$0	$0	1	4
6/9/2018	Wildfire	0	0	$0	$0	0	0
Total		**7**	**0**	**$2,380,000**	**$0.00**	**89**	**5**

Source: NCDC

*Deaths, injuries, and damages are for the entire event, and may not be exclusive to the County.

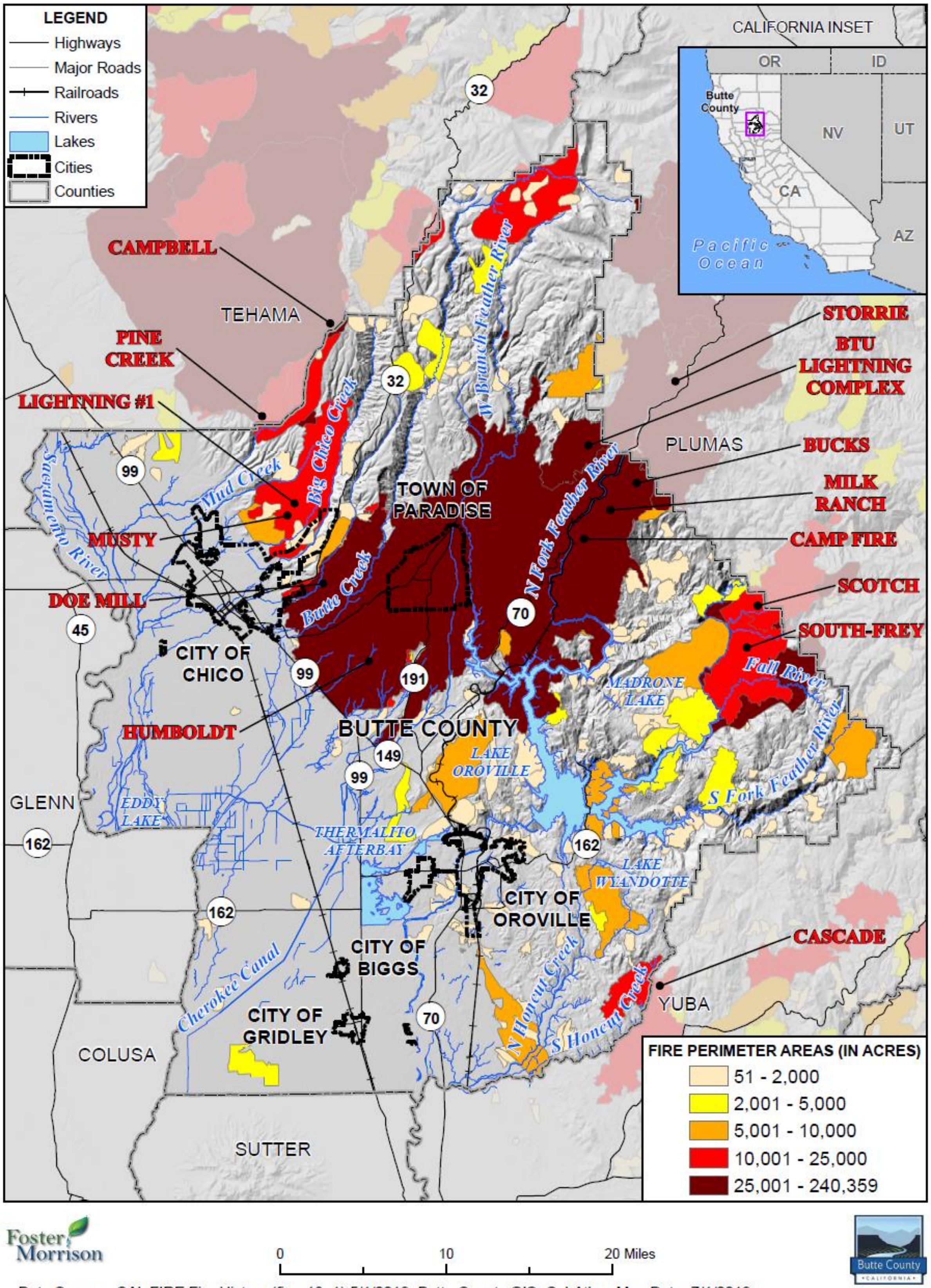
CAL FIRE Events

CAL FIRE, USDA Forest Service Region 5, Bureau of Land Management (BLM), the National Park Service (NPS), Contract Counties and other agencies jointly maintain a comprehensive fire perimeter GIS layer for public and private lands throughout the state. The data covers fires back to 1878 (though the first recorded incident for the County was in 1917). For the National Park Service, Bureau of Land Management, and US Forest Service, fires of 10 acres and greater are reported. For CAL FIRE, timber fires greater than 10 acres, brush fires greater than 50 acres, grass fires greater than 300 acres, and fires that destroy three or more residential dwellings or commercial structures are reported. CAL FIRE recognizes the various federal, state, and local agencies that have contributed to this dataset, including USDA Forest Service Region 5, BLM, National Park Service, and numerous local agencies.

Fires may be missing altogether or have missing or incorrect attribute data. Some fires may be missing because historical records were lost or damaged, fires were too small for the minimum cutoffs, documentation was inadequate, or fire perimeters have not yet been incorporated into the database. Also, agencies are at different stages of participation. For these reasons, the data should not be used for statistical or analytical purposes.

The data provides a reasonable view of the spatial distribution of past large fires in California. Using GIS, fire perimeters that intersect Butte County were extracted and are listed in Table 4-50. There are 261 fires recorded in this database for Butte County greater than 50 acres. Each of them was tracked by CAL FIRE. Many more small fires have occurred, but were not included in the analysis. Figure 4-76 shows fire history for the County, colored by the size of the acreage burned. This map contains fires from 1950 to 2018, while the detailed tables of wildfire shown in Table 4-50 (for the largest 20 fires in the County) and in Appendix H (for the entire record of fires) contain fires from 1910 to 2017, though the first recorded wildfire in this database in Butte County is from 1911.

Figure 4-76 Butte County Wildfire History – CAL FIRE 1910 to 2018



Data Source: CAL FIRE Fire History (firep18_1) 5/1/2019, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-50 Butte County – Largest 20 Wildfires from 1910-2018

YEAR	FIRE NAME	ALARM DATE	CAUSE	GIS_ACRES
2018	Camp	11/8/2018	Power line	153,336
1990	Campbell	8/13/1990	Equipment Use	131,504
2000	Storrie	8/17/2000	Railroad	56,076
2008	BTU Lightning Complex	7/2/2008	Lightning	53,699
1931	–	–	Miscellaneous	42,078
1999	Bucks	8/23/1999	Lightning	34,236
1927	–	–	Unknown/Unidentified	27,841
2008	Humboldt	6/11/2008	Arson	23,344
1918	–	–	Miscellaneous	22,232
1951	Milk Ranch	9/11/1951	Miscellaneous	21,979
1999	Musty	8/23/1999	Lightning	16,757
2017	Cascade	10/8/2017	Unknown/Unidentified	16,141
2008	Scotch	6/21/2008	Lightning	13,008
1917	–	–	Miscellaneous	12,701
1926	–	–	Miscellaneous	12,536
2008	South-Frey	6/21/2008	Lightning	12,402
1943	Pine Creek	7/21/1943	Unknown/Unidentified	11,360
1999	Doe Mill	8/23/1999	Lightning	10,857
1964	Lightning #1	7/12/1964	Unknown/Unidentified	9,876
1927	–	–	Unknown/Unidentified	8,541

Source: CAL FIRE

Hazard Mitigation Planning Committee

The HMPC noted that fire has played a significant historical role in Butte County. The following includes some of the more significant named fires in Butte County.

1999 Oregon Incident

A civilian caused fire burned 200 acres, injured 5 people, and destroyed several homes and outbuildings. Damages were estimated at over $480,000.

1999 Butte Complex

In August of 1999, lightning caused a fire that burned 33,294 acres in Butte County. 3 residences and 11 outbuildings were destroyed. Damage estimates were unavailable. 1 death was reported.

Concow Fire

The Concow Fire broke out on June 19, 2000. Northwest of Pinkston Canyon Road and South of Deadwood Creek near the community of Concow (15 miles north of Oroville). A local emergency was declared. The fire burned over 1,845 acres within 2 days, and was human caused. 9 firefighters injured fighting the blaze. 1 death was attributed to the fire. In total, 10 residences, 6 mobile homes, and 28 vehicles destroyed. 5 residences damaged and 12 outbuildings were either damaged or destroyed. Initial estimate of damage to residential buildings exceeded $1 million dollars.

Poe Fire

The Poe fire broke out on September 6, 2001. It was caused by a dry branch falling on a live PG&E power pole near the Yankee Hill community 14 miles north of Oroville. A local disaster was declared. The fire burned 8,333 acres. Several roads were closed. 49 homes, 120 outbuildings, 4 commercial structures and 55 vehicles destroyed. 3 homes damaged. The estimated loss of burned structures, outbuildings and contents were $6.2 million. There was also a loss of over 43 private wells. No human injuries or deaths were reported, but many cattle and horses were lost.

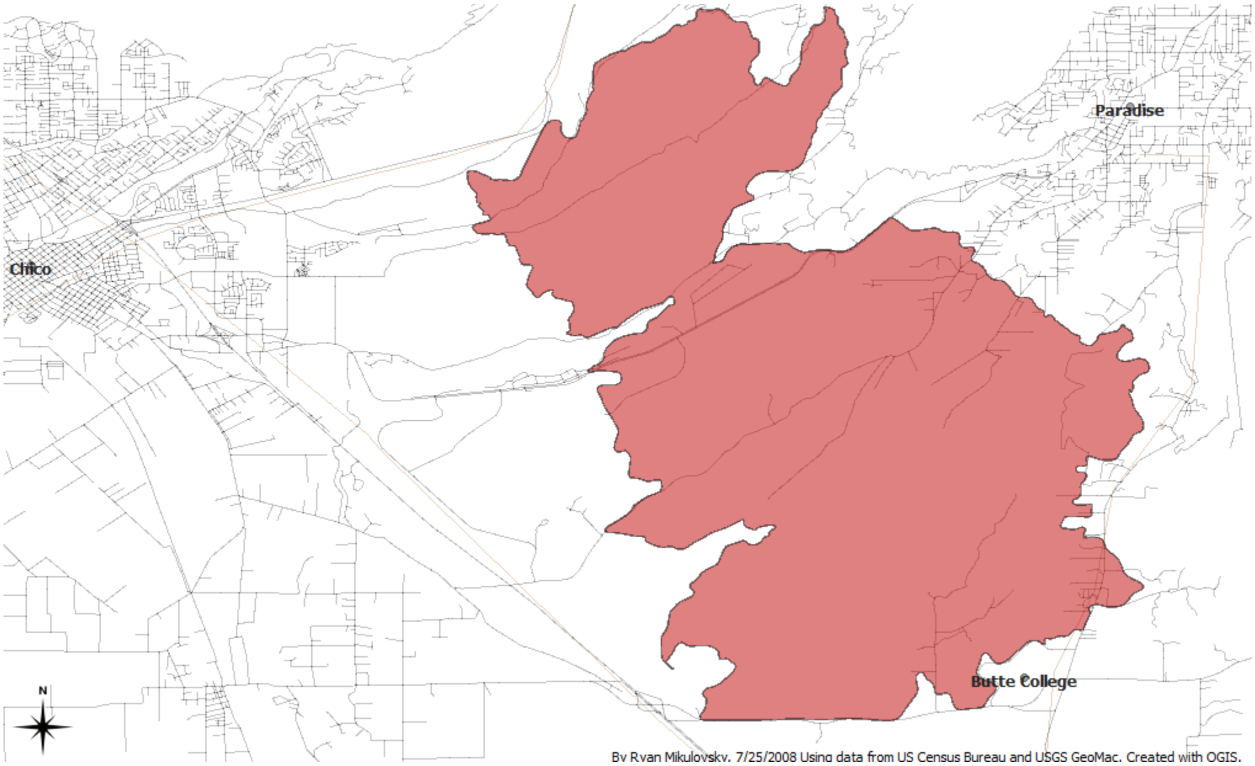
Oregon Fire

The Oregon fire broke out on August 11, 2004 on Oregon Gulch Road at Potters Ranch Road (West side of Lake Oroville near the Community of Cherokee). The origin of the fire was unknown. In total, 2,030 acres of vegetation burned. 1 house, 2 cabins, 1 dozer (privately owned) and 2 trailers were destroyed. Estimated damage was $98,000.

Humboldt Fire

The Humboldt Fire broke out around noon June 11, 2008, in the vicinity of Highway 32 and Humboldt Road. It has burned thousands of acres and forced the evacuation of thousands of people in the area of Butte Creek Canyon. On July 17th, CAL FIRE publicly announced that it was caused by arson and that they were pursuing all leads to find those responsible. A $10,000 reward for the arrest of those responsible was offered. Governor Schwarzenegger declared a state of emergency in Butte County as a result of the fire. Over 9,000 people were evacuated from their homes. The fire was contained on June 16th. This fire burned 23,344 acres, destroyed 87 homes, damaged 7 more, and destroyed 167 outbuildings. CAL FIRE estimated costs and damages from the fire at $20.5 million. 10 injuries were sustained by those who fought the fire. The perimeter of the burn area is shown in Figure 4-77.

Figure 4-77 Humboldt Fire Burn Perimeter

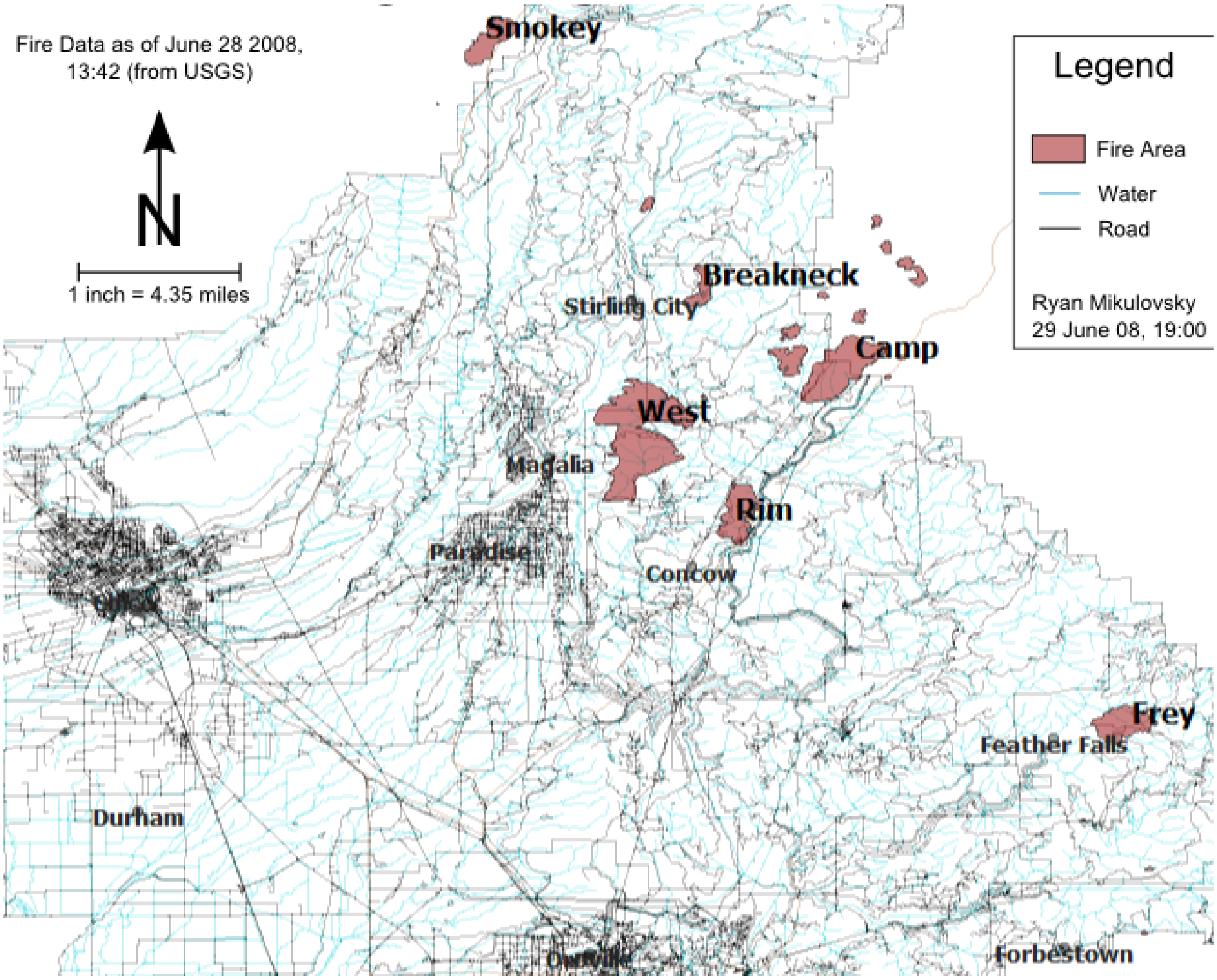


Source: chicowiki.org

Butte Lightning Complex

The Butte Lightning Complex (also known as the BTU Lightning Complex) began after an episode of dry lightning strikes on June 21, 2008, around the Concow area. At its height, it had 27 fires, many of which are/were in remote areas. This complex threatens the communities of Paradise, Magalia, Concow, and various communities in between. This fire caused Butte County to be declared in a state of emergency on June 11th by Governor Arnold Schwarzenegger, allowing more free flowing funds towards the suppression and extinguishing on the fire. In total, the fire burned for more than three weeks and consumed 59,440 acres of land. 202 residences and 11 outbuildings were destroyed. Costs of fighting the fire and damages to property exceeded $85 million. Figure 4-78 shows the fire areas consumed by these fires.

Figure 4-78 Butte Lightning Complex Fires



Source: chicowiki.org

2015 Fire Season

The 2015 fire season was affected by the droughts that occurred in northern California. As a result, two wildfires occurred in the County:

- **August 2015 Swedes Fire** – A fire started on July 29 and was extinguished on August 3. The fire started on Swedes Flat Road, about 3 miles north of Bangor. 400 acres were burned, which destroyed 2 residential buildings and 14 outbuildings. The EOC was activated for this fire.
- **September 2015 Lumpkin Fire** – A fire started on September 11 and was extinguished on September 17. The fire burned 1,042 acres off Lumpkin Road and Forbestown Road near Robinson Mill. An evacuation order was given for residents near the fire, and Ponderosa Way was only open to local traffic. 1 injury occurred.

2016 Fire Season

Droughts continued during the 2016 fire season. Four fires occurred in the County:

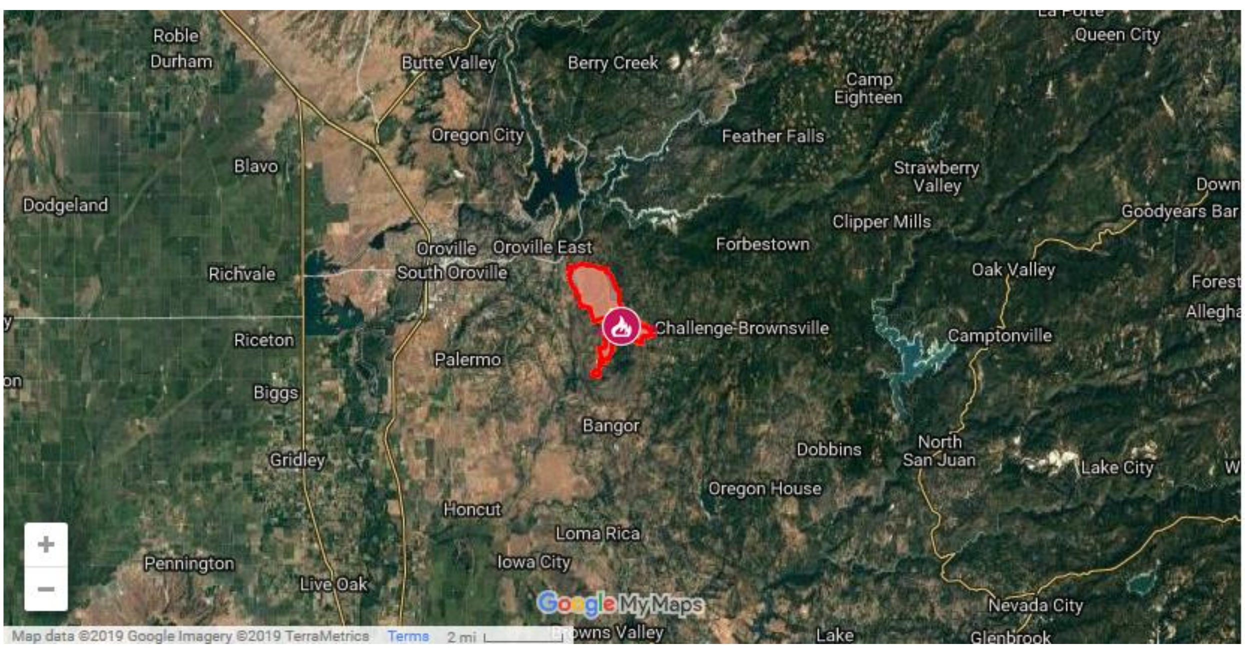
- **July 23 Golf Fire** – a small fire occurred that was quickly extinguished.
- **August 2 99 Incident** – a small fire occurred that was quickly extinguished.
- **August 26 Santos Incident** – A small fire occurred of Highway 32 at Santos Ranch Road, south of Forest Ranch. Evacuation warnings were issued, but the fire was extinguished before evacuations became necessary.
- **September 6 Saddle Fire** – On September 5th, 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 Logo Vista to Messilla Valley Road. Evacuation shelters were opened, as were animal shelters. The blaze consumed 850 acres before being extinguished, causing 3 injuries and destroying 3 structures.

2017 Fire Season

The 2017 fire season had three fires affect the County:

- **July Wall Fire** – Cal Fire said the fire was reported in the afternoon of July 7, 2017. The EOC was activated during this fire. An immediate evacuation order was put into effect for Hurleton Swedes Flat Road from Grand Oak to Swedes Flat as well as all connecting roads. An evacuation center was set up at the Church of the Nazarene in South Oroville. Governor Brown issued a State Disaster Declaration on July 9. The fire burned 6,033 acres, destroying 41 homes, and damaging 3 more. The fire damaged or destroyed an additional 57 structures before it was ultimately contained on July 15, 2017. Cal Fire-Butte County fire investigators determined the July 2017 fire was started by a defective electrical panel at a home on Chinese Wall Road north of Bangor. A federal Fire Management Assistance Grant was awarded to the County due to this fire.

Figure 4-79 Wall Fire Burn Area



Source: Cal FIRE

August Ponderosa Fire – The Ponderosa Fire was a wildland fire near Forbestown. The EOC was activated for this fire. The fire started on August 29, 2017 and was 100% contained on September 23, after it had burned 4,016 acres. The fire began at Ponderosa Way and Lumpkin Road, two miles northwest of Forbestown. There were two injuries and 54 buildings destroyed, including 32 homes. The Ponderosa Fire was located in an inaccessible, steep area that experienced 100 degree and higher temperatures. It comprises a mix of grass, brush, and timber litter in a very dry area. Parts of Lumpkin Road were closed between Forbestown Road and Mill Road. Evaluation orders were in place for all areas and residences on Lumpkin Road and the community of Forbestown, but those were canceled by September 4.

October Cherokee/Laporte Fire – The Cherokee Fire broke out on the evening of Sunday, October 8, near Oroville in Butte County just after 9 PM PDT. Reportedly igniting near Cherokee Road, the fire quickly expanded from hundreds to thousands of acres within a few hours of burning as it threatened nearby Oroville and surrounding rural neighborhoods. The EOC was activated for this fire. The flames reached Highway 70, closing the road from Highway 149 south to the Table Mountain Overcrossing. Smoke impacted areas near Oroville, Bangor and southern Butte County downwind of the fire. Firefighters also battled the 3,500-acre La Porte Fire off Avacado and Dunstone roads near Bangor. An evacuation warning was issued for Cox Lane and all areas south, including Honcut, south to the Yuba County Line.

2018 Fire Season

November Camp Fire – The 2018 Camp Fire in Butte County was the worst suffered in both the County and the State's history. It resulted in and EOC activation and a federal disaster declaration. There had been previous worry about a fire of this nature affecting the Town of Paradise. In 2005, CAL FIRE released a fire management plan for the region, which warned that the town of Paradise was at risk for an ember-driven conflagration similar to the Oakland firestorm of 1991. The report stated "the greatest risk to the ridge communities is from an East Wind driven fire that originates above the communities and blows downhill through developed areas." The Camp Fire started in an area that experienced 13 large wildfires since 1999. The area was most recently burned in 2008 following the Humboldt Fire and the larger Butte Lightning Complex fires. In June 2009, a Butte County civil grand jury report concluded that the roads leading from Paradise and the Upper Ridge communities had "significant constraints" and "capacity limitations" that limited their use as an evacuation route.

Certain conditions earlier in 2018 leading up to and during the fire combined to create a highly combustible fuel load. This included:

- Heavy grass cover due to a wet spring
- An unusually dry fall
- Decreased humidity due to several recent wind events (23% dropping to 10%)
- Unusually dry fuel (5% 1,000-hr. moisture level)
- Hot dry gusting (25-35 mph) continual high winds (including a Red Flag Warning) the day of the fire, similar to the Diablo Wind or the Santa Ana winds of the Coastal Range Mountains.

Pacific Gas and Electric Company (PG&E) notified customers for two days before Nov. 8 that it might shut down power due to a forecast of high winds and low humidity. However, ultimately, PG&E did not. On Thursday, November 8, 2018 around 6:15 a.m., there was a problem on a PG&E power transmission line above Poe Dam near Pulga, California in Butte County. Around the same time, the "Jarbo winds" formed;

a hot katabatic wind that has been heated by compression as the elevation drops. The National Weather Service had issued a red flag warning for most of Northern California's interior, as well as Southern California, through the morning of November 9.

A fire under power transmission lines near Poe Dam was reported to Cal Fire by a PG&E Rock Creek Powerhouse worker at 6:33 a.m. The fire was first reported to the Rock Creek Powerhouse by a PG&E field crew. The location is accessed by Camp Creek Road above Poe Dam and the Feather River railroad tracks. Soon after this report, a size-up fire officer was dispatched. Within the next 5–10 minutes, a few other people, most of them other PG&E workers, called in about the fire. An electrical machinist took two photos of the fire at 6:44 AM and four minutes later two other employees sent in 21 photos and three videos. That afternoon airborne observers noted that an insulator had separated from the tower. PG&E later reported that power lines were down.

Arriving ten minutes later, the first unit on scene, observed rapid fire growth and extreme fire behavior. Possibly saving many, he radioed in a request for resources and evacuations with a note, "this has got potential for a major incident," and that he was "still working on [finding a way to] access [the fire]." Access to the fire was by a narrow mountain road which the fire engines were too large to navigate. Air resources had to wait until 30 minutes after sunrise (6:44 a.m. on Nov 8) which would be 7:14 a.m., but due to winds, aircraft were not on the fire until the afternoon.

Figure 4-80 Camp Fire from a Distance - November 8th at 7:04 am; Initial Suppression Efforts

Source: Butte County Office of Emergency Management

By 8 a.m. the fire entered the Town of Paradise. Several minutes later, the Butte County Fire Department notified Paradise dispatchers of their orders to evacuate the entire town which would be in a sequence of zones beginning with the east side of town. At some point that day, emergency shelters were established. Wind speeds approached 50 miles per hour, allowing the fire to grow rapidly. Most residents of Concow and many residents of Paradise were unable to evacuate before the fire arrived. Due to the speed of the fire, firefighters for the most part never attempted to prevent the flames from entering Concow or Paradise, and instead sought to help people get out alive.

The first hours saw a cascade of failures in the emergency alert system, rooted in its patchwork, opt-in nature, and compounded by a loss of 17 cell towers. This point of failure in a fast-moving emergency allowed no room for error. Thousands of 911 calls inundated two emergency dispatchers on duty. Emergency alerts suffered human error as city officials failed to include four at-risk areas of the Town in evacuation orders and technical error as emergency alerts failed to reach 94 percent of residents in some areas.

On November 10, an estimate placed the number of structures destroyed at 6,713 which surpassed the Tubbs Fire as the most destructive wildfire in California history. By November 15, 5,596 firefighters, 622 engines, 75 water tenders, 101 fire crews, 103 bulldozers, and 24 helicopters from all over the Western United States were deployed.

Figure 4-81 Butte County EOC During Camp Fire

Source: Butte County

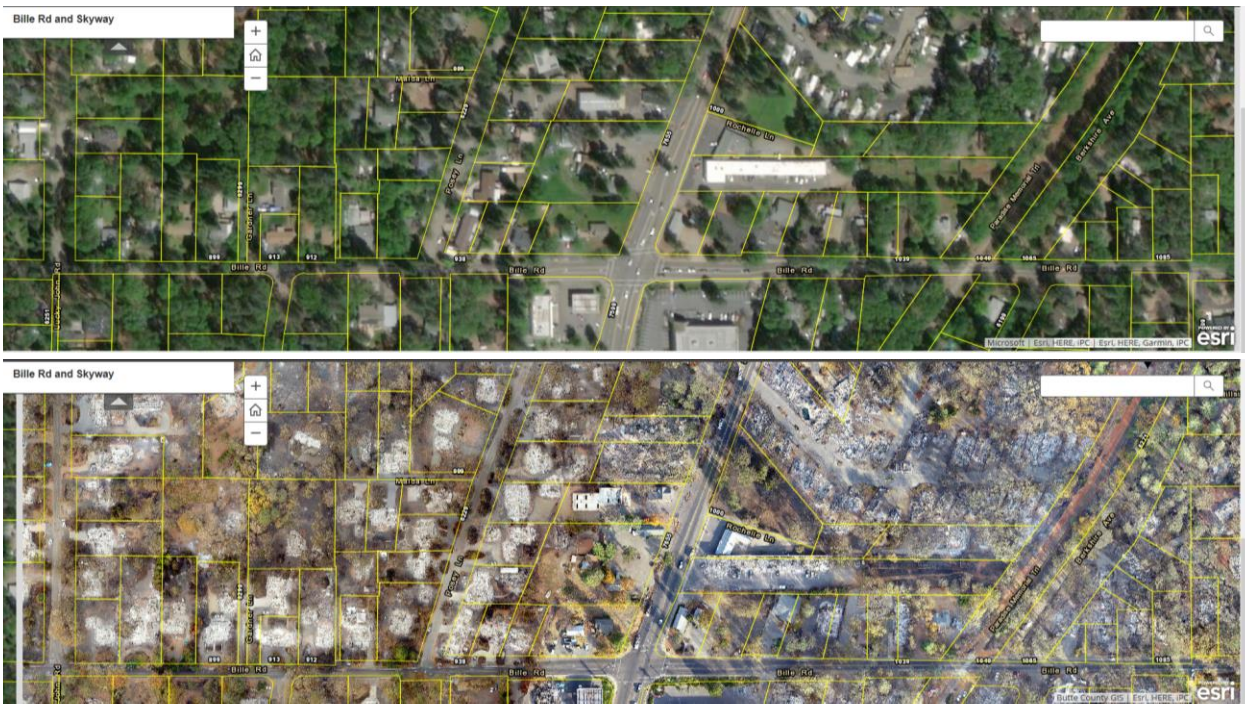
In the first week the fire burned tens of thousands of acres per day. Containment on the western half was achieved when the fire reached primary highway and roadway arteries that formed barriers. In the second week the fire expanded by several thousand acres per day along a large uncontained fire line. Each day containment increased by 5 percent along the uncontained eastern half of the fire that expanded into open timber and high country.

- November 9, the fire had burned 20,000 acres (8,100 ha).
- November 10, the fire was 100,000 acres (40,000 ha) and 20 percent contained.
- November 13, the fire was 125,000 acres (51,000 ha) and 30 percent contained.
- November 14 PG&E employees noted a broken C hook and a disconnected insulation anchor on a nearby tower.
- November 15, the fire was 140,000 acres and 40 percent contained.
- November 16, the fire was 146,000 acres and 50 percent contained.
- November 17, the fire was 149,000 acres and 55 percent contained.
- November 21, 85 percent containment; with rain falling, fire activity from Nov 21-on described as minimal.
- November 22, 90 percent containment.

Heavy rain fell starting on Wednesday, November 21 which helped contain the fire. Fire crews pulled back and let the rain put out the remaining fires while teams searched for victims. On November 25, 2018, Cal Fire announced that the fire had reached 100 percent containment.

In the following figures, the total devastation suffered from the Camp Fire can be seen. The images are split from right to left. The upper images show the Town of Paradise before the Camp Fire, while the lower images show the same locations after the Camp Fire.

Figure 4-82 Camp Fire Before and After – Bille Road and Skyway



Source: Butte County Recovers

Figure 4-83 Camp Fire Before and After – Oliver Road and Skyway

Source: Butte County Recovers

Figure 4-84 Camp Fire Before and After – Merril Road and Pentz Road

Source: Butte County Recovers

CAL FIRE utilizes damage inspection (DINS) criteria established by the Office of the State Fire Marshal to correlate data with California State Building Codes and Fire Safety Regulations. These criteria follow

FIRESCOPE (Firefighting Resources of California Organized for Potential Emergencies) standards established for damage inspections as well as current FEMA guidelines where applicable. The DINS data evaluates or identifies fire damage to infrastructure, mobile equipment, or other miscellaneous parcel improvements as determined. Table 4-51 provides the category of damage levels used during the inspections:

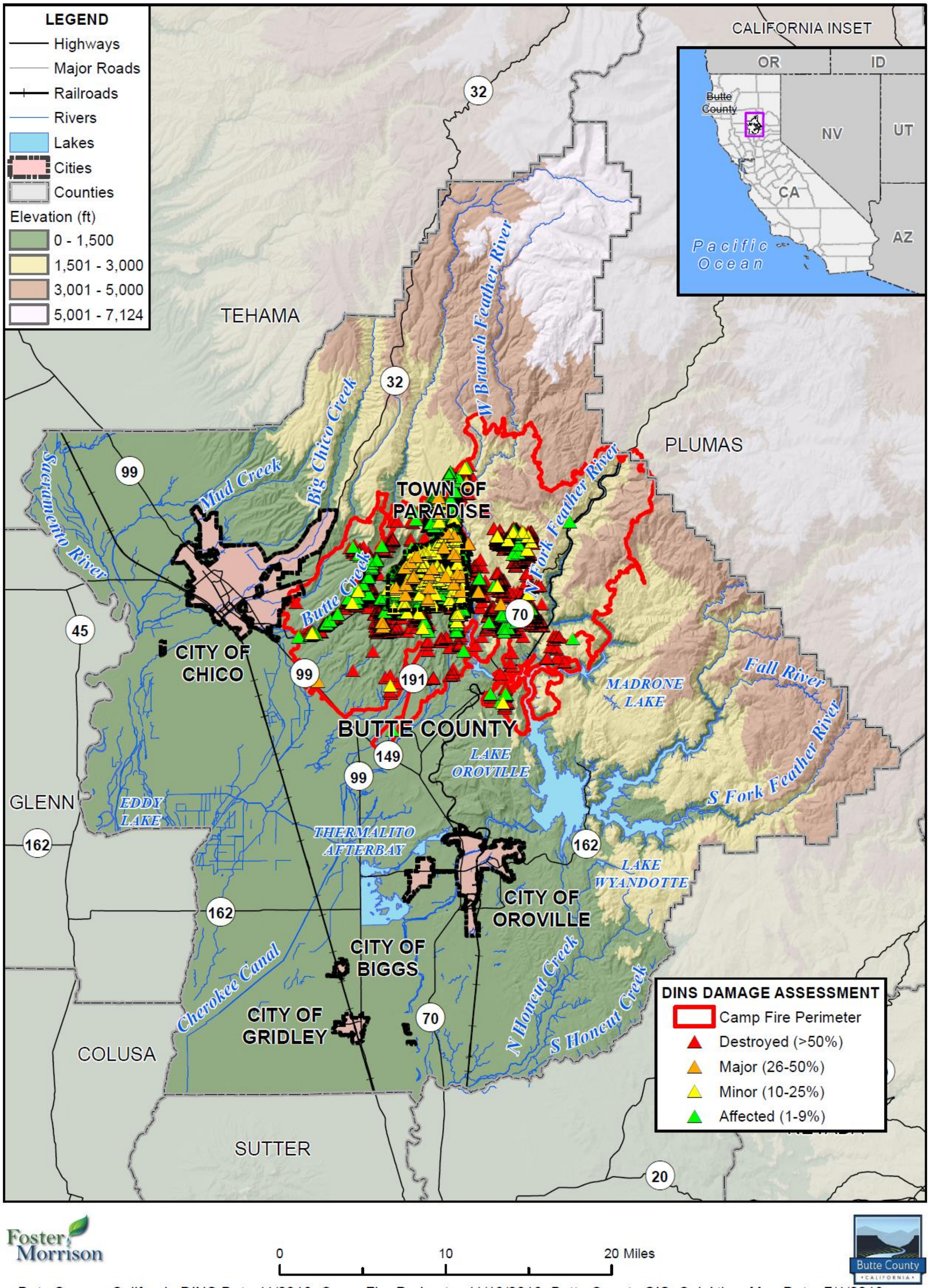
Table 4-51 CAL FIRE DINS Criteria

Category of Damage	Definition	Examples
Affected (1-9%)	Minimal damage to the exterior and/or contents of the building. Building is habitable/usable and requires mostly cosmetic repairs.	Partially damaged shingles or siding, but roof structure is intact. Cosmetic damages such as paint discoloration, blistering or melted siding. Broken windows. Gutter damage. Damage to an attached structure like a deck, porch, carport, or patio cover.
Minor (10-25%)	Encompasses a wide range of damage that does not affect the structural integrity of the building. Building is not habitable/usable.	Nonstructural damage to roof components (e.g. roof covering, fascia board, soffit, flashing, and skylight). Nonstructural damage to the interior wall components to (e.g. drywall and insulation). Nonstructural damage to exterior components (e.g. door and windows. Substantial damage to exterior covering (e.g. siding, vinyl or stucco). Damage to mechanical components (e.g. furnace, boiler, water heater, HVAC, etc.).
Major (26-50%)	A building that has sustained significant structural damage and requires extensive repairs. Building is not habitable/usable.	Failure or partial failure of structural elements to include rafters, ceiling joists, ridge boards, etc. Failure or partial failure to structural elements of the walls to include framing, sheathing, etc.
Destroyed (>50%)	The building is a total loss, or damaged to such an extent that repair is not feasible.	Complete failure to major components (foundation, walls, roof, etc.). Two or more walls destroyed and roof substantially damaged. Only the foundation remains. The building will have to be torn down and rebuilt as it is unsafe.

Source: CAL FIRE

The DINS data for the Camp Fire was mapped in GIS and tabular analysis was created. Figure 4-85 shows the totality of the County and DINS properties affected by the Camp Fire. Figure 4-86 zooms in to the affected area to show how the Camp Fire affected the Paradise area. Table 4-52 shows the DINS criteria broken into a structure count by jurisdiction.

Figure 4-85 Butte County Planning Area – DINS Damage Assessment



Data Source: California DINS Data 11/2018, Camp Fire Perimeter 11/19/2018, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Figure 4-86 Butte County Planning Area – DINS Damage Assessment Zoomed-in

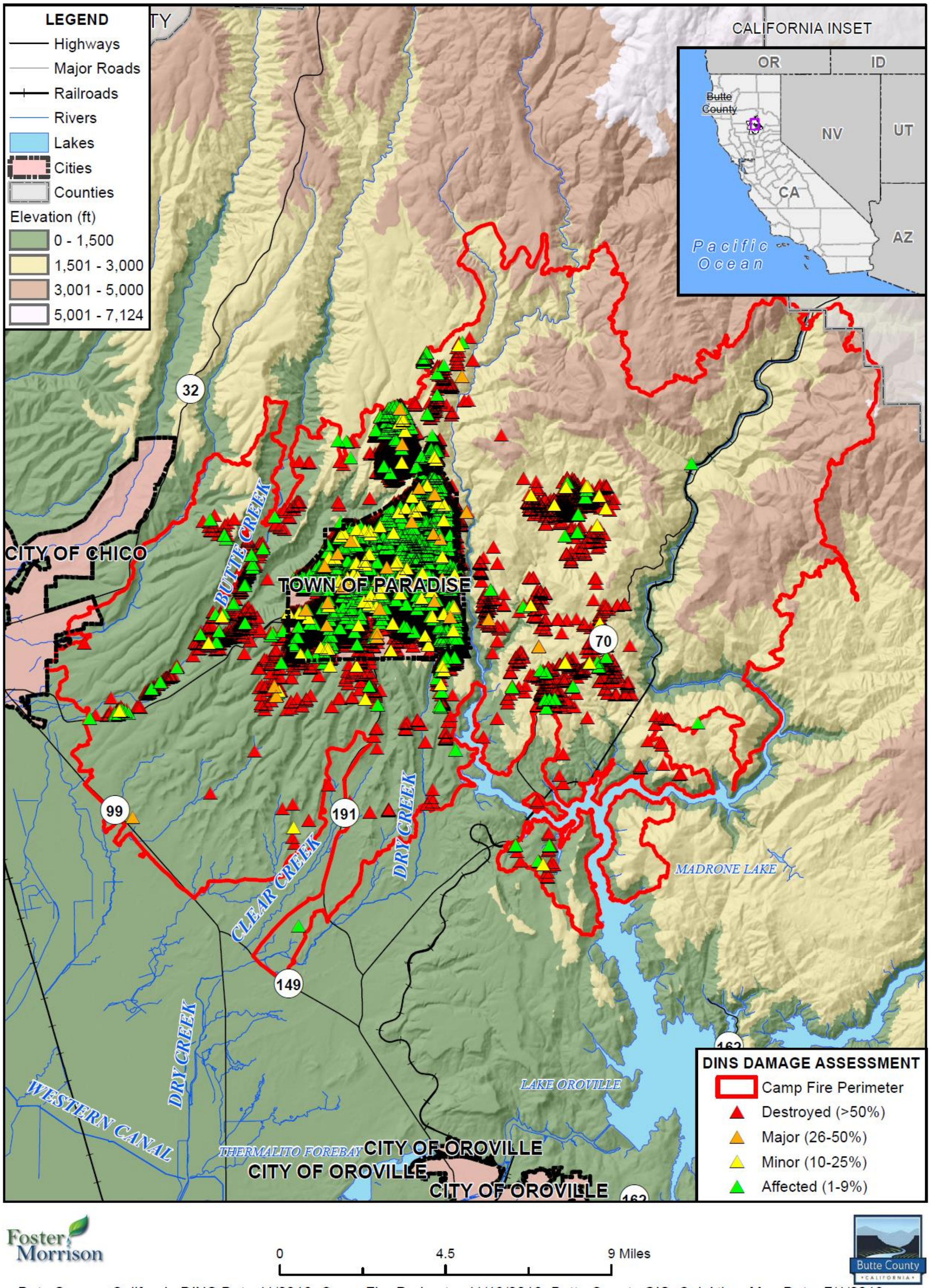


Table 4-52 Butte County Planning Area – DINS Damage Assessment and Structure Count

Damage Assessment / Jurisdiction	Damaged Structure Count	% of Total Damaged Structure Count
City of Chico		
Destroyed (>50%)	0	0.0%
Major (26-50%)	0	0.0%
Minor (10-25%)	0	0.0%
Affected (1-9%)	0	0.0%
No Damage	37	0.1%
City of Chico Total	**37**	**0.1%**
Town of Paradise		
Destroyed (>50%)	16,845	64.0%
Major (26-50%)	26	0.1%
Minor (10-25%)	87	0.3%
Affected (1-9%)	545	2.1%
No Damage	1,633	6.2%
Town of Paradise Total	**19,136**	**72.7%**
Unincorporated Butte County		
Destroyed (>50%)	4,569	17.3%
Major (26-50%)	9	0.0%
Minor (10-25%)	35	0.1%
Affected (1-9%)	150	0.6%
No Damage	2,402	9.1%
Unincorporated Butte County Total	**7,165**	**27.2%**
Grand Total	**26,338**	**100.0%**

Source: CAL FIRE

2019 Fire Season

While no large fires occurred, PSPS events occurred in the County on June 8-9 of 2019, August 23-25 of 2019, and again on September 23-24 of 2019.

Likelihood of Future Occurrence

Highly Likely — From May to October of each year, Butte County faces a serious wildland fire threat. While generally limited to the less populated, forested areas in the eastern portion of the County, fires will continue to occur on an annual basis in the Butte County Planning Area. The threat of wildfire and potential losses are constantly increasing as human development and population increase and the wildland urban interface areas expand. Due to its high fuel load and long, dry summers, portions of Butte County continue to be at risk from wildfire.

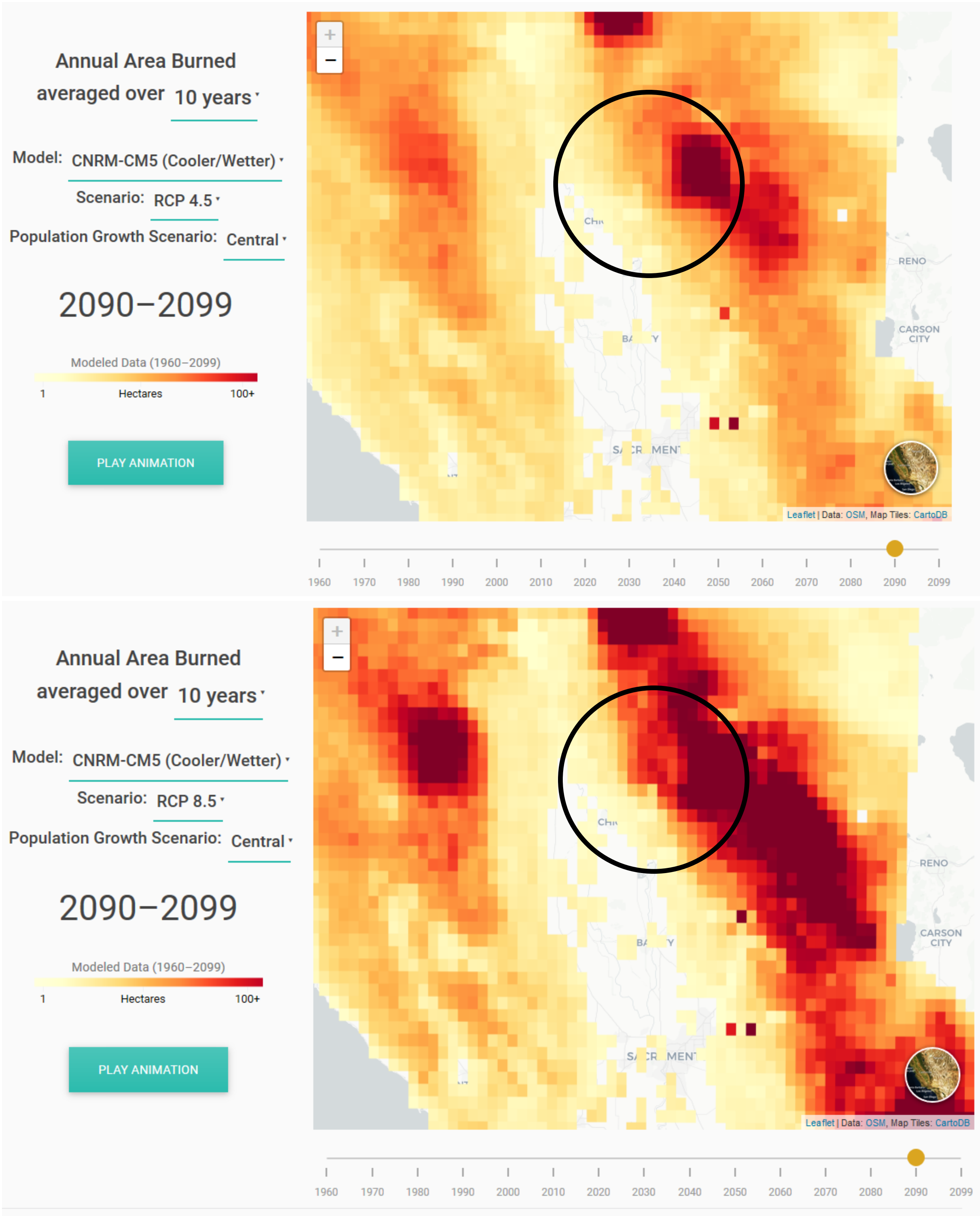
Climate Change and Wildfire

Warmer temperatures can exacerbate drought conditions. Drought often kills plants and trees, which serve as fuel for wildfires. Warmer temperatures could increase the number of wildfires and pest outbreaks, such as the western pine beetle Cal Adapt has modeled climate change effects on wildfire. Wildfire scenario projections were done by the University of California Merced, based on statistical modeling from historical data of climate, vegetation, population density, and fire history. The fire modeling ran simulations on five variables on a monthly time step

- Large fire presence/absence
- Number of fires given presence
- Area burned in a grid cell given a fire
- High severity burned area given a fire and
- Emissions

The modeling used the LOCA climate projections as inputs, as shown on Figure 4-87. The upper chart shows the RCP 4.5 scenario, while the lower chart shows the RCP 8.5 scenario.

Figure 4-87 Cal-Adapt Wildfire Projections



Source: Cal Adapt

4.2.20. Natural Hazards Summary

Table 4-53 summarizes the results of the hazard identification and hazard profile for the Butte County Planning Area based on the hazard identification data and input from the HMPC. For each hazard profiled in Section 4.3, this table includes the likelihood of future occurrence and whether, after the hazard profiles, the hazard is considered a priority hazard for the Butte County Planning Area for purposes of conducting a vulnerability assessment of the hazard. At the completion of the risk assessment, an additional hazard prioritization was conducted to determine priority hazards for mitigation strategy planning.

Table 4-53 Hazard Identification/Profile Summary and Determination of Priority Hazards

Hazard	Likelihood of Future Occurrence	Priority Hazard
Climate Change	Likely	Y
Dam Failure	Occasional	Y
Drought & Water shortage	Likely	Y
Earthquake: Large	Unlikely	Y
Floods: 100/200/500 year	Likely	Y
Floods: Localized Stormwater	Highly Likely	Y
Hazardous Materials Transportation	Likely	Y
Invasive Species: Aquatic	Likely	Y
Invasive Species: Pests/Plants	Highly Likely	Y
Landslide, Mudslide, and Debris Flow	Likely	Y
Levee Failure	Occasional	Y
Severe Weather: Extreme Heat	Highly Likely	Y
Severe Weather: Freeze and Winter Storm	Highly Likely	Y
Severe Weather: Heavy Rain and Storms (Hail, Lightning)	Highly Likely	Y
Severe Weather: Wind and Tornado	Highly Likely/Likely	Y
Stream Bank Erosion	Highly Likely	Y
Volcano	Unlikely	N
Wildfire	Highly Likely	Y

4.3 Vulnerability Assessment

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

With Butte County's hazards identified and profiled, based on the initial prioritization the HMPC conducted a vulnerability assessment to describe the impact that each hazard would have on the County Planning Area. The vulnerability assessment quantifies, to the extent feasible using best available data, assets at risk to natural hazards and estimates potential Butte County (and the incorporated areas) as a whole.

This vulnerability assessment followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses*. This vulnerability assessment first describes the total vulnerability and assets at risk for the Butte County Planning Area followed by the unincorporated County and then discusses vulnerability for these areas by hazard.

Data Sources

Data used to support this assessment included the sources listed below. Where data and information from these studies, plans, reports, and other data sources were used, the source is referenced as appropriate throughout this vulnerability assessment.

- 2006 Butte County Flood Mitigation Plan
- 2018 California State Hazard Mitigation Plan
- ArkStorm at Tahoe - Stakeholder Perspectives on Vulnerabilities and Preparedness for an Extreme Storm Event in the Greater Lake Tahoe, Reno and Carson City Region. 2014.
- Butte County 2030 General Plan Conservation Element
- Butte County 2030 General Plan Land Use Element
- Butte County 2030 General Plan Safety Element
- Butte County 2030 General Plan Water Resources Element
- Butte County Assessor's Office
- Butte County Building Department
- Butte County Digital Flood Insurance Rate Map January 6, 2011 (updated with 8/30/2017 LOMRs)

- Butte County Emergency Operations Plan
- Butte County Flood Insurance Study January 6, 2011
- Butte County General Plan Environmental Impact Report
- Butte County GIS data
- Butte County Housing Element
- Cal Atlas
- CAL FIRE GIS datasets
- Cal-Adapt
- California Adaptation Planning Guide
- California Department of Conservation
- California Department of Finance, E-1 Report
- California Department of Finance, E-4 Report
- California Department of Finance, P-1 Report
- California Department of Fish and Wildlife's Natural Diversity Database
- California Department of Food and Agriculture
- California Department of Parks and Recreation Office of Historic Preservation
- California Department of Water Resources Best Available Maps
- California Department of Water Resources DAC Mapping Tool
- California Department of Water Resources Division of Safety of Dams
- California Native Plant Society
- California Natural Diversity Database – BIOS Viewer Tool
- California Office of Emergency Services – Dam Inundation Data
- California Office of Historic Preservation
- Cal-IPC
- CalTrans, Truck Networks on California State Highways. 2015.
- Climate Change and Health Profile Report – Butte County
- County and City staff
- Existing plans and studies
- FEMA's HAZUS-MH 3.2 GIS-based inventory data
- Kenward, Alyson PhD, Adams-Smith, Dennis, and Raja, Urooj. Wildfires and Air Pollution – The Hidden Health Hazards of Climate Change. Climate Central. 2013.
- Liu, J.C., Mickley, L.J., Sulprizio, M.P. et al. Climatic Change. 138: 655. doi:10.1007/s10584-016-1762-6. 2016.
- National Drought Mitigation Center – Drought Impact Reporter
- National Levee Database
- National Park Service – Historic American Buildings Survey and Historic American Engineering Record
- Personal interviews with planning team members and staff from the County and participating jurisdictions
- Proceedings of the National Academy of Sciences
- Public Health Alliance of Southern California
- Sacramento River Reclamation District
- Statewide GIS datasets from other agencies such as Cal OES, FEMA, USGS, CGS, Cal Atlas, and others
- University of California
- U.S. Census Bureau 2010 Household Population Estimates

- U.S. Department of Transportation's Emergency Response Guidebook
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service's National Wetlands Inventory maps
- U.S. Geological Survey
- U.S. Geological Survey Landslide Maps
- U.S. Forest Service GIS datasets
- Written descriptions of inventory and risks provided by Butte County

4.3.1. Butte County Vulnerability and Assets at Risk

As a starting point for analyzing the Butte County Planning Area's vulnerability to identified hazards, the HMPC used a variety of data to define a baseline against which all disaster impacts could be compared. If a catastrophic disaster was to occur in the Planning Area, this section describes significant assets at risk in the Planning Area. Data used in this baseline assessment included:

- Total values at risk;
- Critical facility inventory;
- Cultural, historical, and natural resources; and
- Growth and development trends.

Total Values at Risk

Parcel Inventory and Assessed Values

This analysis captures the values associated with assessed values located within Butte County. Two data sets were used for the basis of this analysis:

- 2018 Butte County Parcel/Assessor's data (for pre-Camp Fire values)
- 3/28/2019 Butte County Parcel/Assessor data (for post-Camp Fire values)

Two data sets were used, since there were major changes to structure values after the Camp Fire severely damaged the Town of Paradise. This data provided by Butte County represents best available data.

Understanding the total assessed value of Butte County is a starting point to understanding the overall value of identified values at risk in the County. When the total assessed values are combined with potential values associated with other community assets such as public and private critical infrastructure, historic and cultural resources, and natural resources, the big picture emerges as to what is potentially at risk and vulnerable to the damaging effects of natural hazards within the County.

Methodology

Butte County's 2018 and 3/28/2019 Assessor Data and the County's GIS parcel data were used as the basis for the inventory of assessed values for both improved and unimproved parcels within the County. This data provides the land and improved values assessed for each parcel, along with key information such as property use. Other GIS data, such as jurisdictional boundaries, roads, streams, and area features, was also obtained from Butte County and Cal Atlas to support countywide mapping and analysis of values at risk.

The Butte County GIS parcel data contained 94,660 (2018) and 94,835 (3/28/2019) parcels, including the areas of the cities of Biggs, Chico, Gridley, Oroville, the Town of Paradise, and the unincorporated areas of Butte County. ***Note***: Parcel counts may vary due to large parcels being subdivided.

GIS was used to convert the parcel polygons into centroids representing each record in the assessor database. For the purposes of this analysis, the centroids which were not coincident in locations were re-positioned to overlay on the corresponding polygons so that each assessor record (with a unique assessor parcel number) was spatially positioned on the corresponding parcel. In addition, multiple parcels polygons in the GIS data were constructed as multi-part features, of which only one centroid was representative of each parcel polygon. The position of the centroids may result in less accurate hazard analysis overlay results. The data did not contain duplicate records. In total, 94,660 (2018) and 94,835 (3/28/2019) parcels records were utilized for the analysis.

Data Limitations & Notations

Although based on best available data, the resulting information should only be used as an initial guide to overall values in the County. In the event of a disaster, structures and other infrastructure improvements are at the greatest risk of damage. Depending on the type of hazard and resulting damages, the land itself may not suffer a significant loss. For that reason, the values of structures and other infrastructure improvements are of greatest concern. As such, it is critical to note a specific limitation to the assessed values data within the County, created by Proposition 13. Instead of adjusting property values annually, no adjustments are made until a property transfer occurs. As a result, overall property value information is most likely low and may not reflect current market or true potential loss values for properties within the County.

Another limitation to this data is found in the Williamson Act, also known as the California Land Conservation Act of 1965, that enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. When the County enters into a contract with the landowners under the Williamson Act, the landowner agrees to limit the use of the land to agriculture and compatible uses for a period of at least ten years and the County agrees to tax the land at a rate based on the agricultural production of the land rather than its real estate market value. This further affects the County’s overall values for assessed taxable lands.

Property Use Categories

Butte County’s GIS data contained land use designations which provide detailed descriptive information about how each property is generally used, such as agricultural, commercial, industrial, recreational, residential, right of way, and unknown. The land use codes were refined and categorized into five property use categories and linked back to the Butte County Assessor data. The final property use categories for Butte County are shown in Table 4-54.

Table 4-54 Butte County Planning Area – Property Use Categories

Butte County Assessor’s Description	Butte County Property Use Categories
Agricultural	Agricultural

Butte County Assessor's Description	Butte County Property Use Categories
Commercial	Commercial
Industrial	Industrial
Residential	Residential
Unknown	Unknown

Source: Butte County

Once the Property Use descriptions were grouped into categories, the number of total and improved parcels, as well as land, improved, and other values were inventoried for the County by property use. ***Note***: The other value is present in the tables as a total value of the miscellaneous property values, such as personal property, mobile home personal property, fixture, and other exempt values. The total values in the analysis were then the summation of the land, improved, and other values.

Estimated Content Replacement Values

Butte County's assigned property use categories were used to develop estimated content replacement values (CRVs) that are potentially at loss from hazards. FEMA's standard CRV factors were utilized to develop more accurate loss estimates for all mapped hazard analyses. FEMA's CRV factors estimate value as a percent of improved structure value by property use. Table 4-55 shows the breakdown of the different property uses in the County and their estimated CRV factors.

Table 4-55 Butte County – Content Replacement Factors by Property Use

Butte County Property Use Categories	Hazus Property Use Categories	Hazus Content Replacement Values
Agricultural	Agricultural	100%
Commercial	Commercial	100%
Industrial	Industrial	150%
Residential	Residential	50%
Unknown	–	0%

Source: Hazus

Butte County Values at Risk Results

Values associated with land, improved structure, and other values were identified and summed in order to determine total assessed values at risk in the Butte County Planning Area. Together, the land value, improved structure value, and other values make up the majority of assessed values associated with each identified parcel or asset. Improved parcel counts were based on the assumption that a parcel was improved if a structure value was present. To analyze the values at risk, this section is broken out into the following sections:

- Butte County Planning Area (which includes the unincorporated County and all jurisdictions)
- Unincorporated Butte County

Butte County Planning Area Values at Risk with Contents

The tables in this section shows the total values or exposure for the entire Butte County Planning Area (using CRV multipliers from Table 4-55). These tables are important as potential losses to the Butte County Planning Area include structure contents. In addition, loss estimates contained in the hazard vulnerability sections of this Chapter will use calculations based on the total values, including content replacement values. Values are shown in the following tables:

- Table 4-56 shows the total parcels and values in each jurisdiction prior to the Camp Fire.
- Table 4-57 shows the total parcels and values in each jurisdiction after the Camp Fire.
- Table 4-58 shows the change, in total value and in percentage, of improved structure values in each jurisdiction pre-and post-fire.
- Table 4-59 shows the total parcels and values in each jurisdiction in the County by property use using post-fire values.

Table 4-56 Butte County Planning Area – Pre-Fire Total Values at Risk by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Total Value
City of Biggs	766	674	$26,022,313	$69,188,866	$10,556,358	$105,767,537
City of Chico	26,367	24,575	$3,137,615,708	$5,979,251,150	$54,425,259	$9,171,292,117
City of Gridley	2,451	2,201	$113,742,355	$290,301,864	$5,421,891	$409,466,110
City of Oroville	7,142	5,504	$322,717,617	$889,333,119	$62,802,183	$1,274,852,919
Town of Paradise	11,500	10,602	$782,644,284	$1,600,569,206	$14,493,754	$2,397,707,244
Unincorporated Butte County	46,434	33,878	$3,647,230,927	$4,630,052,115	$328,096,487	$8,605,379,529
Grand Total	**94,660**	**77,434**	**$8,029,973,204**	**$13,458,696,320**	**$475,795,932**	**$21,964,465,456**

Source: Butte County 2018 Parcel/Assessor's Data

Table 4-57 Butte County Planning Area – Post-Fire Total Values at Risk by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Total Value
City of Biggs	765	674	$26,022,313	$69,188,866	$10,556,358	$106,238,998
City of Chico	26,497	24,560	$3,130,686,862	$5,972,599,859	$54,385,979	$8,488,678,633
City of Gridley	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$369,326,649
City of Oroville	7,145	5,501	$320,351,638	$884,175,248	$61,341,363	$1,131,495,618
Town of Paradise	11,501	10,594	$782,342,823	$1,023,339,240	$13,675,031	$1,627,157,865
Unincorporated Butte County	46,475	33,867	$3,636,780,199	$4,541,860,927	$326,304,904	$8,427,558,321
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$20,150,456,084**

Source: Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-58 Butte County Planning Area – Improved Structure Values Pre- and Post-Fire by Jurisdiction

Jurisdiction	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	Value Change	% change
City of Biggs	$69,188,866	$69,188,866	$0	0.0%
City of Chico	$5,979,251,150	$5,972,599,859	-$6,651,291	-0.1%
City of Gridley	$290,301,864	$290,324,198	$22,334	0.0%
City of Oroville	$889,333,119	$884,175,248	-$5,157,871	-0.6%
Town of Paradise	$1,600,569,206	$1,023,339,240	-$577,229,966	-36.1%
Unincorporated Butte County	$4,630,052,115	$4,541,860,927	-$88,191,188	-1.9%
Grand Total	**$13,458,696,320**	**$12,781,488,338**	**-$677,207,982**	**-5.0%**

Source: Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-59 Butte County Planning Area – Post-Fire Total Value at Risk by Property Use and Jurisdiction and Property Use

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Agricultural	23	4	$683,709	$271,477	$57,958	$271,477	$1,289,594
Commercial	2,087	1,732	$605,649,324	$1,443,726,949	$46,677,852	$1,443,726,949	$3,103,973,488
Industrial	360	286	$74,990,957	$173,110,896	$7,462,437	$259,666,344	$508,890,547
Residential	23,620	22,532	$2,448,579,133	$4,354,452,062	$187,732	$2,177,226,031	$8,753,615,340
Unknown	407	6	$783,739	$1,038,475	$0	$0	$1,800,465
City of Chico Total	**26,497**	**24,560**	**$3,130,686,862**	**$5,972,599,859**	**$54,385,979**	**$3,880,890,801**	**$12,369,569,434**
City of Gridley							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unknown	64	0	$0	$0	$0	$0	$0
City of Gridley Total	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934
City of Oroville							
Agricultural	9	0	$1,291,076	$0	$7,947	$0	$1,299,023
Commercial	1,042	699	$107,833,747	$338,951,493	$19,007,806	$338,951,493	$706,417,512
Industrial	227	72	$26,057,297	$40,098,771	$42,318,610	$60,148,157	$192,568,485
Residential	5,705	4,728	$185,105,000	$504,810,718	$7,000	$252,405,359	$882,337,953
Unknown	162	2	$64,518	$314,266	$0	$0	$377,654
City of Oroville Total	**7,145**	**5,501**	**$320,351,638**	**$884,175,248**	**$61,341,363**	**$651,505,009**	**$1,783,000,627**
Town of Paradise							
Agricultural	5	1	$161,851	$24,379	$11,631	$24,379	$222,240
Commercial	724	597	$103,002,892	$273,582,659	$13,392,101	$273,582,659	$525,827,820
Industrial	16	14	$2,525,218	$3,598,536	$165,000	$5,397,804	$11,782,558
Residential	10,646	9,979	$676,226,190	$745,996,179	$106,299	$372,998,090	$1,740,765,982
Unknown	110	3	$426,672	$137,487			$562,197
Town of Paradise Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Unincorporated Butte County							
Agricultural	5,215	2,642	$1,108,022,765	$390,665,683	$288,530,991	$390,665,683	$2,253,177,820
Commercial	827	609	$94,317,384	$211,546,436	$6,460,089	$211,546,436	$483,276,937
Industrial	309	236	$51,608,669	$186,270,288	$21,899,250	$279,405,432	$553,290,049
Residential	38,539	30,367	$2,379,787,695	$3,751,764,543	$8,703,654	$1,875,882,272	$7,888,203,371
Unknown	1,585	13	$3,043,686	$1,613,977	$710,920		$7,109,967
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: Butte County 3/28/2019 Parcel/Assessor's Data

Unincorporated Butte County – Values at Risk with Contents

The tables in this section shows the total values or exposure for the unincorporated County (using CRV multipliers from Table 4-55). These tables are important as potential losses to the unincorporated County include structure contents. In addition, loss estimates contained in the hazard vulnerability sections of this Chapter will use calculations based on the total values, including content replacement values. Values are shown in the following tables:

- Table 4-60 shows the total parcels and values in the unincorporated County prior to the Camp Fire.
- Table 4-61 shows the total parcels and values in the unincorporated County after the Camp Fire.
- Table 4-62 shows the change, in total value and in percentage, of improved structure the unincorporated County pre-and post-fire.

Table 4-60 Unincorporated Butte County – Pre-Fire Total Value at Risk by Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Agricultural	5,239	2,649	$1,114,927,473	$392,966,358	$289,404,395	$392,966,358	$2,190,264,584
Commercial	826	608	$95,799,666	$220,803,924	$7,371,164	$220,803,924	$544,778,678
Industrial	309	236	$51,608,669	$186,270,853	$21,899,250	$279,406,280	$539,185,052
Residential	38,541	30,371	$2,381,835,592	$3,828,359,297	$8,710,758	$1,914,179,649	$8,133,085,296
Unknown	1,519	14	$3,059,527	$1,651,683	$710,920	$0	$5,422,130
Unincorporated Butte County Total	**46,434**	**33,878**	**$3,647,230,927**	**$4,630,052,115**	**$328,096,487**	**$2,807,356,210**	**$11,412,735,739**

Source: Butte County 2018 Parcel/Assessor's Data

Table 4-61 Unincorporated Butte County – Post-Fire Total Value at Risk by Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Agricultural	5,215	2,642	$1,108,022,765	$390,665,683	$288,530,991	$390,665,683	$2,253,177,820
Commercial	827	609	$94,317,384	$211,546,436	$6,460,089	$211,546,436	$483,276,937
Industrial	309	236	$51,608,669	$186,270,288	$21,899,250	$279,405,432	$553,290,049
Residential	38,539	30,367	$2,379,787,695	$3,751,764,543	$8,703,654	$1,875,882,272	$7,888,203,371
Unknown	1,585	13	$3,043,686	$1,613,977	$710,920	$0	$7,109,967
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-62 Unincorporated Butte County – Improved Structure Value Pre- and Post-Fire by Property Use

Property Use	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	Value Change	% change
Agricultural	$392,966,358	$390,665,683	-$2,300,675	-0.6%
Commercial	$220,803,924	$211,546,436	-$9,257,488	-4.2%
Industrial	$186,270,853	$186,270,288	-$565	0.0%
Residential	$3,828,359,297	$3,751,764,543	-$76,594,754	-2.0%
Unknown	$1,651,683	$1,613,977	-$37,706	-2.3%

Property Use	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	Value Change	% change
Town of Paradise Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: Butte County 3/28/2019 Parcel/Assessor's Data

Critical Facility Inventory

The Butte County worked with members of the HMPC to develop a definition of critical facilities for the Butte County Planning Area. For purposes of this plan, a critical facility is defined as:

> ***Any facility, including without limitation, a structure, infrastructure, property, equipment or service, that if adversely affected during a hazard event may result in severe consequences to public health and safety or interrupt essential services and operations for the community at any time before, during and after the hazard event.***

A critical facility is classified by the following categories: (1) Essential Services Facilities, (2) At-risk Populations Facilities, (3) Hazardous Materials Facilities.

- **Essential Services Facilities** – include, without limitation, public safety, emergency response, emergency medical, designated emergency shelters, communications, public utility plant facilities and equipment, and government operations. Sub-Categories:
  - ✓ Public Safety - Police stations, fire and rescue stations, emergency operations centers
  - ✓ Emergency Response - Emergency vehicle and equipment storage and essential governmental work centers for continuity of government operations.
  - ✓ Emergency Medical - Hospitals, emergency care, urgent care, ambulance services.
  - ✓ Designated Emergency Shelters.
  - ✓ Communications - Main hubs for telephone, main broadcasting equipment for television systems, radio and other emergency warning systems.
  - ✓ Public Utility Plant Facilities - including equipment for treatment, generation, storage, pumping and distribution (hubs for water, wastewater, power and gas).
  - ✓ Essential Government Operations - Public records, courts, jails, building permitting and inspection services, government administration and management, maintenance and equipment centers, and public health.
- **At Risk Population Facilities** – include, without limitation, pre-schools, public and private primary and secondary schools, before and after school care centers with 12 or more students, daycare centers with 12 or more children, group homes, and assisted living residential or congregate care facilities with 12 or more residents.
- **Hazardous Materials Facilities** – include, without limitation, any facility that could, if adversely impacted, release hazardous material(s) in sufficient amounts during a hazard event that would create harm to people, the environment and property.

Note: The Hazardous Materials Facilities, while considered critical facilities for purposes of this Plan Update, are not mapped in this Plan due to the lack of an available GIS layer.

A summary of critical facilities in the Butte County Planning Area can be found in Figure 4-88 and Table 4-63. Table 4-64 gives details of critical facilities in each jurisdiction by category. Details of individual critical facilities can be found in Appendix F of this Plan.

Figure 4-88 Butte County Planning Area – Critical Facilities

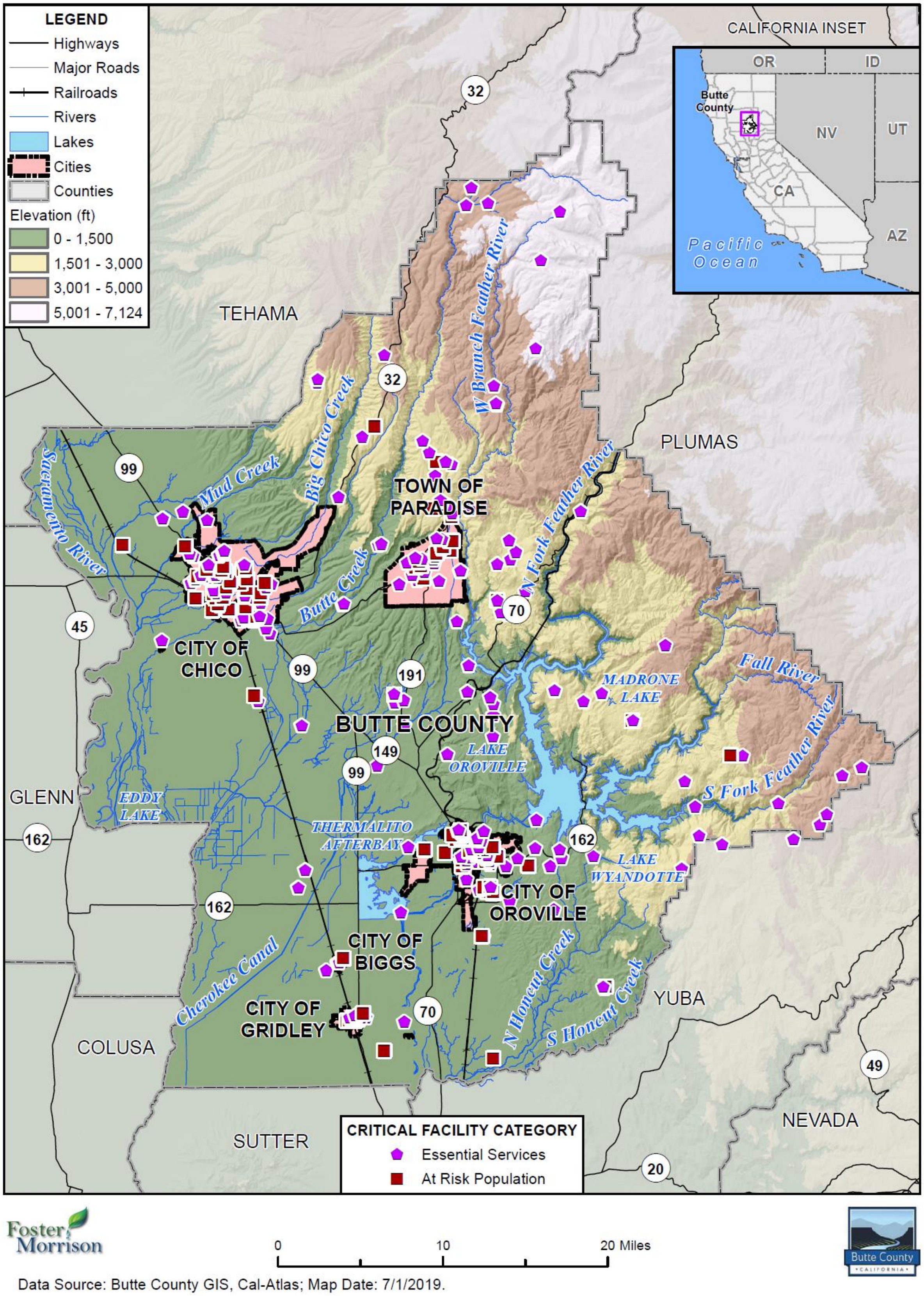


Table 4-63 Butte County Planning Area – Critical Facility Summary by Jurisdiction

Jurisdiction / Critical Facility Category	Facility Count
City of Biggs	
Essential Services Facilities	3
At Risk Population Facilities	4
City of Biggs Total	**7**
City of Chico	
Essential Services Facilities	50
At Risk Population Facilities	31
City of Chico Total	**81**
City of Gridley	
Essential Services Facilities	11
At Risk Population Facilities	6
City of Gridley Total	**17**
City of Oroville	
Essential Services Facilities	40
At Risk Population Facilities	20
City of Oroville Total	**60**
Town of Paradise	
Essential Services Facilities	21
At Risk Population Facilities	12
Town of Paradise Total	**33**
Unincorporated Butte County	
Essential Services Facilities	112
At Risk Population Facilities	30
Unincorporated Butte County Total	**142**
Outside of Butte County	
Essential Services Facilities	1
At Risk Population Facilities	0
Outside of Butte County Total	**1**
Grand Total	**341**

Source: Butte County GIS

Table 4-64 Butte County Planning Area – Critical Facilities by Jurisdiction and Facility Type

Jurisdiction / Critical Facility Category	Facility Type	Facility Count
City of Biggs		
Essential Services Facilities	Wastewater Treatment Plant	1

Jurisdiction / Critical Facility Category	Facility Type	Facility Count
	Fire	1
	Public Assembly Point / Evacuation Center	1
	Total	**3**
At Risk Population Facilities	School	4
	Total	**4**
City of Biggs Total		**7**
City of Chico		
Essential Services Facilities	Wastewater Treatment Plant	1
	Fire	3
	Health Care	38
	Law Enforcement	4
	Public Assembly Point / Evacuation Center	1
	Radio Sites	1
	Dam	1
	Logistics Hub	1
	Total	**50**
At Risk Population Facilities	School	31
	Total	**31**
City of Chico Total		**81**
City of Gridley		
Essential Services Facilities	Wastewater Treatment Plant	1
	Fire	2
	Health Care	5
	Law Enforcement	2
	Public Assembly Point / Evacuation Center	1
	Total	**11**
At Risk Population Facilities	School	6
	Total	**6**
City of Gridley Total		**17**
City of Oroville		
Essential Services Facilities	Wastewater Treatment Plant	1
	Fire	3
	Health Care	19
	Law Enforcement	3
	Public Assembly Point / Evacuation Center	2
	Radio Sites	3
	Logistics Hub	6

Jurisdiction / Critical Facility Category	Facility Type	Facility Count
	Emergency Operation Center	1
	DOC	1
	Emergency Animal Shelter	1
	Total	**40**
At Risk Population Facilities	School	20
	Total	**20**
City of Oroville Total		**60**
Town of Paradise		
Essential Services Facilities	Fire	3
	Health Care	15
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	2
	Total	**21**
At Risk Population Facilities	School	12
	Total	**12**
Town of Paradise Total		**33**
Unincorporated Butte County		
Essential Services Facilities	Wastewater Treatment Plant	1
	Fire	36
	Health Care	3
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	30
	Radio Sites	11
	Dam	29
	Emergency Animal Shelter	1
	Total	**112**
At Risk Population Facilities	School	30
	Total	30
Unincorporated Butte County Total		**142**
Outside of Butte County		
Essential Services Facilities	Public Assembly Point / Evacuation Center	1
	Total	**1**
Outside of Butte County Total		**1**
Grand Total		**341**

Source: Butte County GIS

Cultural, Historical, and Natural Resources

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

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

Cultural and Historical Resources

Butte County has a large stock of historically significant homes, public buildings, and landmarks. To inventory these resources, the HMPC collected information from a number of sources. The California Department of Parks and Recreation Office of Historic Preservation (OHP) was the primary source of information. The OHP is responsible for the administration of federally and state mandated historic preservation programs to further the identification, evaluation, registration, and protection of California's irreplaceable archaeological and historical resources. OHP administers the National Register of Historic Places, the California Register of Historical Resources, California Historical Landmarks, and the California Points of Historical Interest programs. Each program has different eligibility criteria and procedural requirements.

- The **National Register of Historic Places** is the nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.
- The **California Register of Historical Resources** program encourages public recognition and protection of resources of architectural, historical, archeological, and cultural significance and identifies historical resources for state and local planning purposes; determines eligibility for state historic preservation grant funding; and affords certain protections under the California Environmental Quality Act. The Register is the authoritative guide to the state's significant historical and archeological resources.
- **California Historical Landmarks** are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Landmarks #770 and above are automatically listed in the California Register of Historical Resources.
- **California Points of Historical Interest** are sites, buildings, features, or events that are of local (city or county) significance and have anthropological, cultural, military, political, architectural, economic,

scientific or technical, religious, experimental, or other value. Points designated after December 1997 and recommended by the State Historical Resources Commission are also listed in the California Register.

Historical resources included in the programs above are identified in Table 4-65.

Table 4-65 Butte County Planning Area – Historical Resources

Resource Name (Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/ Community
14 Mile House Site (P636)				X	11/16/1984	Chico
A H Chapman House / "The Little Chapman Mansion" (P573)				X	9/11/1981	Chico
Allen--Sommer--Gage House (N481)	X				4/13/1977	Chico
Bidwell Mansion (N165)	X				3/24/1972	Chico
Bidwell's Bar (330)		X			8/8/1939	Oroville
Bidwells Mill Site, Bidwell Millstones (P90)				X	6/7/1968	Chico
BR #12C-8 / Honey Run Covered Bridge (P3)				X	8/5/1966	Paradise
Butte County Railroad Depot (P575)				X	12/21/1981	Paradise
California-Oregon Railroad Depot (P184)				X	1/19/1971	Gridley
Centerville Schoolhouse (P185)	X			X	1/19/1971	Paradise
Chapman, A. H., House (N1008)	X				1/28/1982	Chico
Cherokee Townsite And Adjoining Spring Valley Mine (P557)				X	12/19/1980	Oroville
Chico African Methodist Episcopal Church South (P792)				X	3/11/1994	Chico
Chico Forestry Station and Nursery (840)		X			3/20/1970	Chico
Chinese Cemetery (P584)				X	3/1/1982	Oroville
Chinese Temple (770)		X			1/31/1962	Oroville
Discovery Site of the Last Yahi Indian (809)		X			10/5/1965	Oroville
Dogtown Nugget Discovery Site (771)		X			1/31/1962	Magalia
Durham, W. W., House (N1761)	X				4/2/1992	Durham
Fagan House (P727)				X	8/17/1990	Gridley
Forks of Butte (N2220)	X				1/2/2004	Paradise
Garrott's Saw Mill (P116)				X	6/6/1969	Oroville
Gianella Bridge, Br #12-54 Site (P812)				X	8/23/1995	Chico Hamilton City
Hazel Hotel (N2137)	X				7/13/2001	Gridley

Resource Name (Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/ Community
Honey Run Covered Bridge (N1562)	X				6/23/1988	Chico
Hooker Oak (313)		X			7/12/1939	Chico
Inskip Hotel (N355)	X				5/2/1975	Stirling City
Jewish Cemetery (P585)				X	3/1/1982	Oroville
Lee, Fong, Company (N1057)	X				3/11/1982	Oroville
Long's Bar (P576)				X	12/21/1981	Oroville
Lott Museum-Sank Park (P2)				X	8/5/1966	Oroville
Magalia Community Church (N985)	X				1/11/1982	Magalia
Manzanita School (P89)				X	6/7/1968	Gridley
Mud Creek Canyon (N254)	X				8/14/1973	Chico
Old Chinese Cemetery (P413)				X	8/7/1975	Oroville
Old Suspension Bridge (314)		X			7/12/1939	Oroville
Oregon City (807)		X			6/28/1965	Oroville
Oroville Carnegie Library (N2362)	X				5/8/2007	Oroville
Oroville Cemetery (P583)				X	3/1/1982	Oroville
Oroville Chinese Temple (N431)	X				7/30/1976	Oroville
Oroville Commercial District (Old) (N1211)	X				7/28/1983	Oroville
Oroville Inn (N1635)	X				9/13/1990	Oroville
Oroville Odd Fellows Home Site, Bella Vista Hotel (P726)				X	8/17/1990	Oroville
Patrick Ranch House (N149)	X				2/23/1972	Chico
Patrick Rancheria (N150)	X				2/23/1972	Chico
Rancho Chico and Bidwell Adobe (329)		X			8/8/1939	Chico
Richardson Springs Resort Hotel, Lodge, And Home (P650)				X	3/19/1985	Chico
Silberstein Park Building (N1177)	X				2/17/1983	Chico
South of Campus Neighborhood (N1700)	X				6/24/1991	Chico
Southern Pacific Depot (N1477)	X				1/29/1987	Chico
St. John's Episcopal Church (N999)	X				1/21/1982	Chico
Stansbury House (N366)	X				6/5/1975	Chico
State Theatre (N1731)	X				9/13/1991	Oroville
US Post Office--Chico Midtown Station (N1320)	X				1/11/1985	Chico

Source: California Department of Parks and Recreation Office of Historic Preservation

It should be noted that these lists may not be complete, as they may not include those currently in the nomination process and not yet listed. Additionally, as defined by the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by CEQA and NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Natural Resources

Natural resources are important to include in cost/benefit analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetlands areas protects sensitive habitat as well as reducing the force of and storing floodwaters.

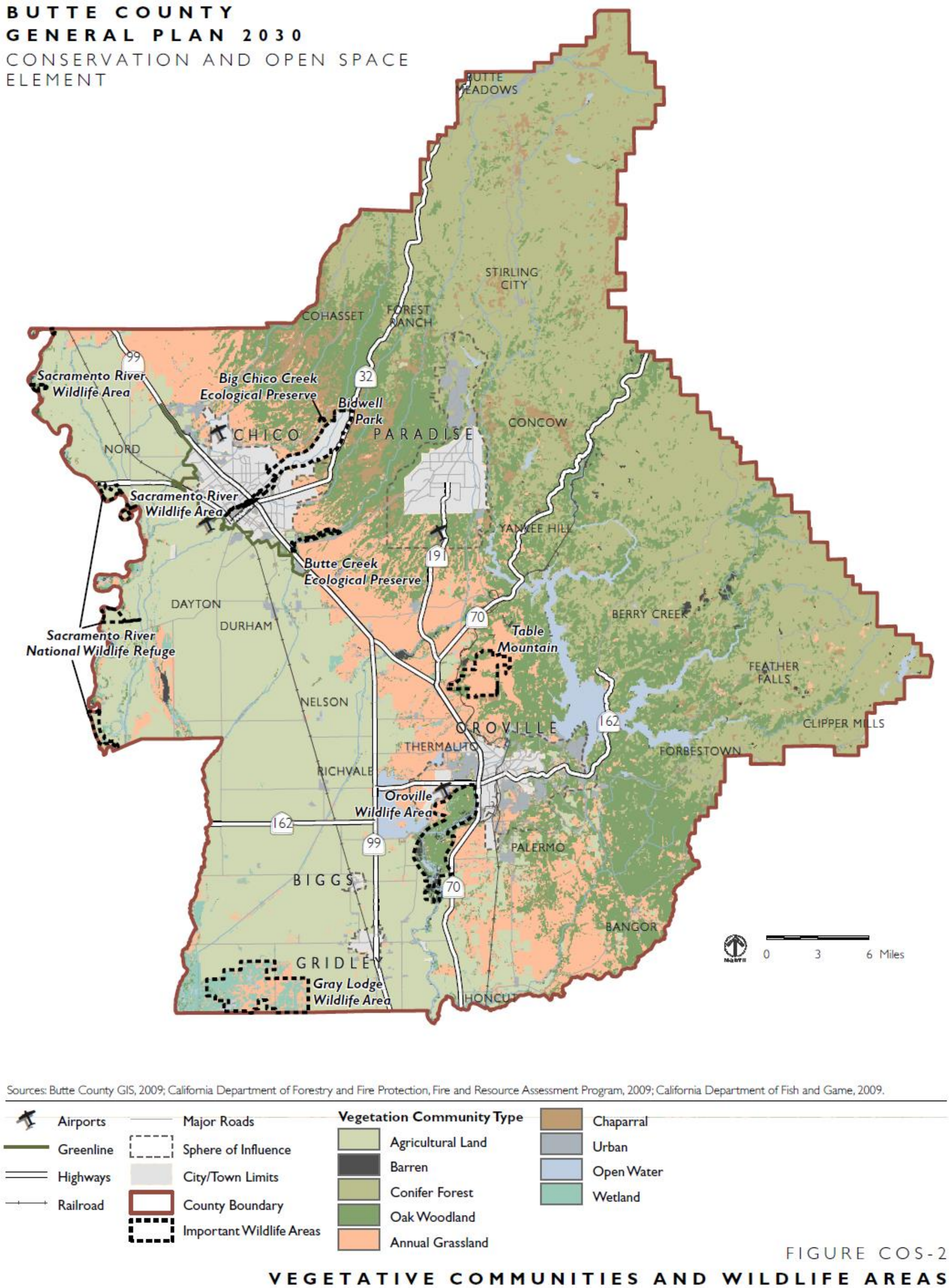
Ten general types of biological communities occur in Butte County. The distribution of these communities is closely associated with the varying topography and hydrology of the geographic subregions. These ten communities include:

- **Conifer Forest**. Several types of conifer forest occur in Butte County, including montane hardwood-conifer, ponderosa pine, Sierran mixed conifer, red fir and subalpine conifer. The forest types vary in the dominant species and elevations at which they occur. Conifer forests provide habitat for a large number of wildlife species.
- **Oak Woodland**. Oak woodland community types include valley oak woodland, blue oak woodland and blue oak-foothill pine. Oak woodlands are scattered throughout the county, but are concentrated in the transition area between the lower valley and higher elevations of the county. Oak woodlands provide wildlife with nesting sites, cover and food. Oak woodlands are common locally and regionally; however, native oak trees and woodland habitats are declining statewide because of development and land management practices.
- **Riparian Woodland**. Riparian areas occur where land meets fresh water, such as a wetland or a streambank. Riparian woodlands occur along portions of the Sacramento River, Feather River, Thermalito Afterbay and Forebay, Thermalito Diversion Pool and along numerous smaller perennial and ephemeral drainages. Riparian woodlands are typically dominated by a mixture of trees and shrubs, and provide food, water and migration and dispersal corridors, as well as nesting and thermal cover for many wildlife species. Riparian habitats are considered sensitive natural communities and should be given special consideration because they provide several important ecological functions, including streambank stabilization, water quality maintenance, and essential habitat for wildlife and fisheries resources.
- **Chaparral**. Chaparral occurs on foothill slopes, within the understory of woodlands, and at higher elevations of Butte County. This community provides habitat for a variety of birds and mammals.
- **Annual Grasslands**. Large, open areas of annual grasslands occur primarily in the central portion of the county and are typically grazing pastures for livestock. Annual grasslands encompass vernal pool terrains and form the understory for oak woodland and occur as vacant parcels in developed areas. Annual grasslands provide foraging and breeding habitat for many wildlife species.

- **Open Water**. Open water communities in Butte County include several large reservoirs, numerous small ponds throughout agricultural areas, and perennial and ephemeral drainages. These communities provide habitat for fish, resident and migratory birds, amphibians, aquatic reptiles and some mammals.
- **Wetlands**. Wetland communities in Butte County include freshwater marshes along the margins of drainages and open water habitats, wet meadows at higher elevations in the eastern portion of the county and vernal pools in the central portion of the county. Wetlands are considered sensitive natural communities by several resource agencies and should be given special consideration because they provide a variety of important ecological functions and essential habitat for wildlife resources, including several special status species. Natural wetland habitats are steadily declining compared to their historical distribution, as a result of land management practices and development activities. The US Army Corps of Engineers, US Fish and Wildlife Service and DFG have policies and regulations that protect wetland habitats.
- **Agricultural Land**. Much of the western half of the county is used for agriculture. Row crops and rice fields can provide relatively high-value habitat for wildlife, particularly as foraging habitat.
- **Barren Land**. Unvegetated land may include areas of vertical riverbanks and exposed rock, as well as unvegetated lands in urban areas. Although barren ground has limited use for most wildlife, some species prefer areas with limited or very low-growing vegetation.
- **Urban Areas**. Biological communities in urbanized areas are relatively limited and generally provide low value for wildlife.

Important wildlife areas in Butte County are public lands that have been conserved for the benefit of wildlife, including the Big Chico Creek Ecological Preserve, the Butte Creek Ecological Preserve, Bidwell Park, Table Mountain, the Gray Lodge Wildlife Area, the Oroville Wildlife Area, the Sacramento River Wildlife Area and the Sacramento River National Wildlife Refuge. These important wildlife areas are shown, along with the ten vegetative communities, on Figure 4-89.

Figure 4-89 Butte County – Vegetative Communities and Wildlife Areas



Source: 2030 Butte County General Plan Conservation and Open Space Element

Special Status Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the Planning Area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

The California Natural Diversity Database, a program that inventories the status and locations of rare plants and animals in California, was queried to create an inventory of special status species in Butte County. A summary list of these species is found below in Table 4-66. Appendix E list the name, federal status, state status, California Department of Fish and Wildlife status, and the California Rare Plant rank of species in Butte County.

Table 4-66 Butte County Planning Area – Summary of Special Status Species

Type	Number
Animals - Amphibians	7
Animals - Birds	41
Animals - Crustaceans	5
Animals - Fish	11
Animals - Insects	4
Animals - Mammals	18
Animals – Mollusks	4
Animals – Reptiles	3
Community – Terrestrial	8
Plant – Bryophytes	9
Plants – Lichens	1
Plants – Vascular	113

Source: California Natural Diversity Database

Wetlands

Wetlands are habitats in which soils are intermittently or permanently saturated or inundated. Wetland habitats vary from rivers to seasonal ponding of alkaline flats and include swamps, bogs, marshes, vernal pools, and riparian woodlands. Wetlands are considered to be waters of the United States and are subject to the jurisdiction of the U.S. Army Corps of Engineers as well as the California Department of Fish and Wildlife (CDFW). Where the waters provide habitat for federally endangered species, the U.S. Fish and Wildlife Service may also have authority.

Wetlands are a valuable natural resource for communities providing beneficial impact to water quality, wildlife protection, recreation, and education, and play an important role in hazard mitigation. Wetlands provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation is vital, and reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water.

Wetlands in Butte County were discussed in the biological communities discussion above, and their locations were shown on Figure 4-89 above.

Wetlands Natural and Beneficial Functions

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flow. Wetlands perform a variety of ecosystem functions including food web support, habitat for insects and other invertebrates, fish and wildlife habitat, filtering of waterborne and dry-deposited anthropogenic pollutants, carbon storage, water flow regulation (e.g., flood abatement), groundwater recharge, and other human and economic benefits.

Wetlands, and other riparian and sensitive areas, provide habitat for insects and other invertebrates that are critical food sources to a variety of wildlife species, particularly birds. There are species that depend on these areas during all parts of their lifecycle for food, overwintering, and reproductive habitat. Other species use wetlands and riparian areas for one or two specific functions or parts of the lifecycle, most commonly for food resources. In addition, these areas produce substantial plant growth that serves as a food source to herbivores (wild and domesticated) and a secondary food source to carnivores.

Wetlands slow the flow of water through the vegetation and soil, and pollutants are often held in the soil. In addition, because the water is slowed, sediments tend to fall out, thus improving water quality and reducing turbidity downstream.

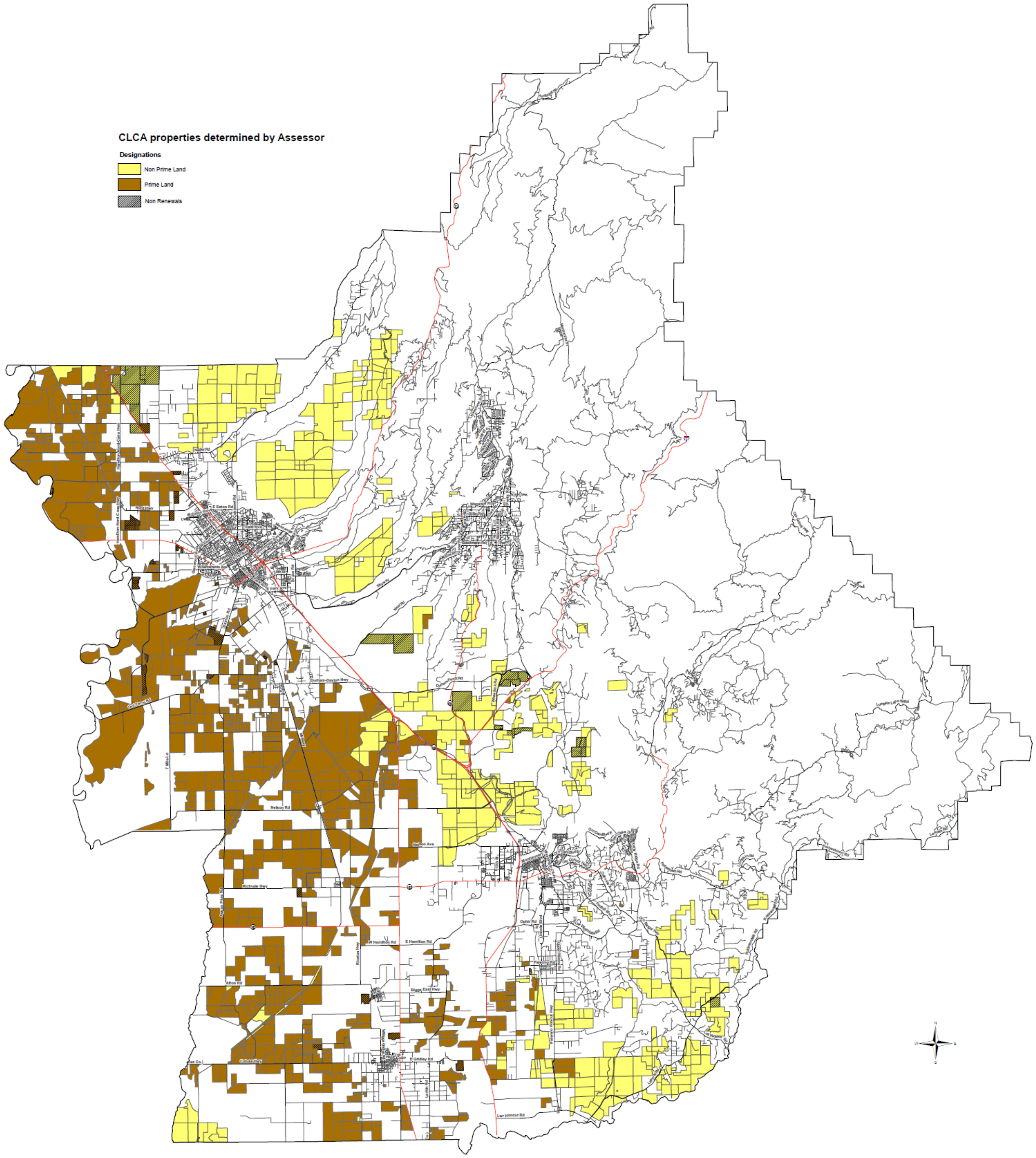
These natural floodplain functions associated with the natural or relatively undisturbed floodplain that moderates flooding, such as wetland areas, are critical for maintaining water quality, recharging groundwater, reducing erosion, redistributing sand and sediment, and providing fish and wildlife habitat. Preserving and protecting these areas and associated functions are a vital component of sound floodplain management practices for the Butte County Planning Area.

Farmlands

Williamson Act

The Williamson Act, also known as the California Land Conservation Act of 1965, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. When the County enters into a contract with the landowners under the Williamson Act, the landowner agrees to limit the use of the land to agriculture and compatible uses for a period of at least ten years and the County agrees to tax the land at a rate based on the agricultural production of the land rather than its real estate market value. This affects the County's overall values for assessed taxable lands. The County has designated areas as agricultural preserves within which the county will enter into contracts for the preservation of the land in agriculture. As of 2017, 1,425 parcels and 210,155 acres are enrolled in the Williamson Act. Locations can be seen on Figure 4-90.

Figure 4-90 Butte County – Williamson Act Lands



Source: California Department of Conservation, 2015

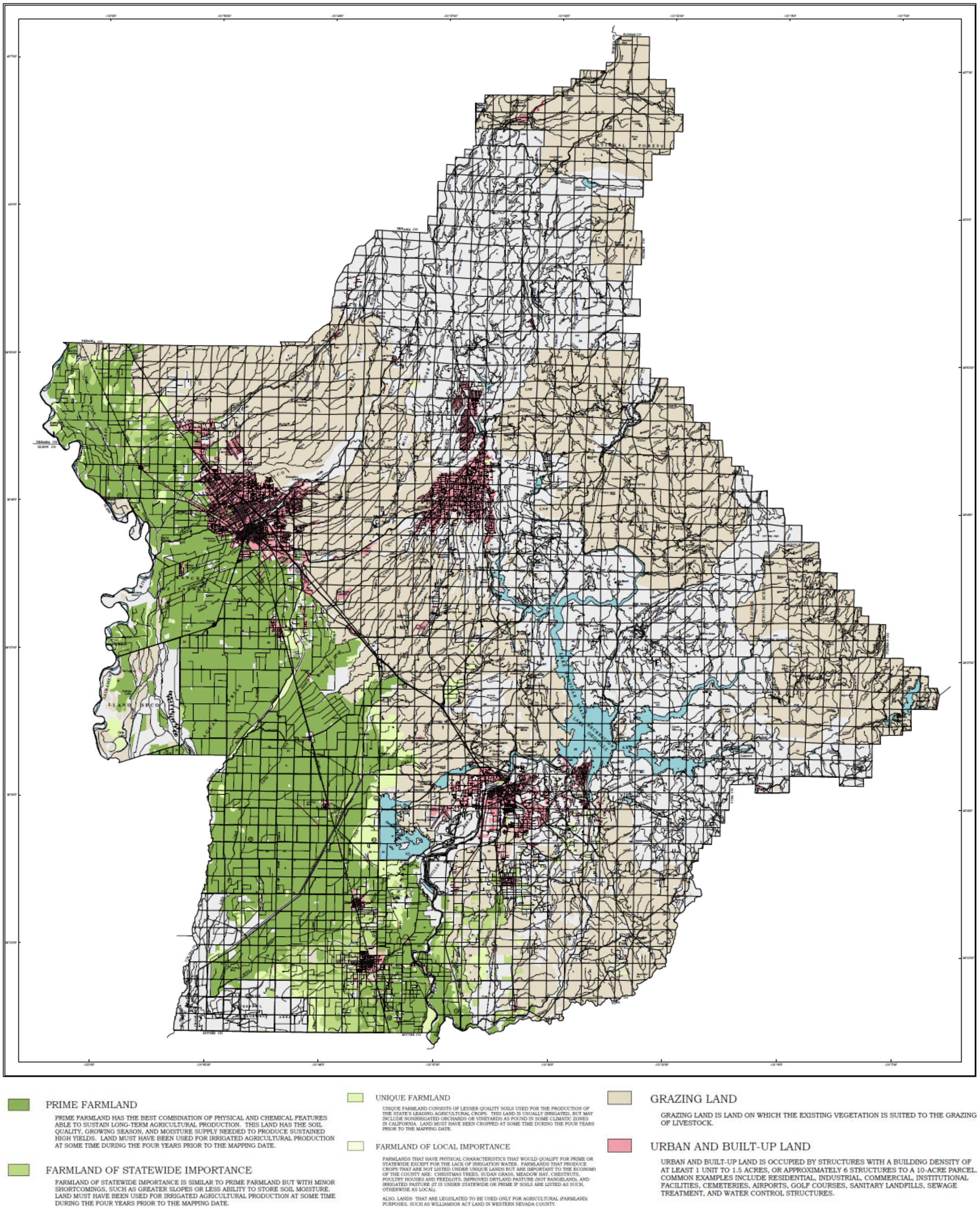
State Inventory of Important Farmland

The Farmland Mapping and Monitoring Program was established in 1984 to document the location, quality, and quantity of agricultural lands and conversion of those lands over time. The program provides impartial analysis of agricultural land use changes throughout California. For inventory purposes, several categories were developed to describe the qualities of land in terms of its suitability for agricultural production. The State Department of Conservation utilizes the following classification system:

- The Prime Farmland category describes farmland with the best combination of physical and chemical features able to sustain long term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Farmland of Statewide Importance is farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Unique Farmland is farmland of lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.
- Farmland of Local Importance is either currently producing crops or has the capability of production. This farmland category is determined by each county's board of supervisors and a local advisory committee.

The 2016 maps are the most recent versions. These lands are shown in Figure 4-91.

Figure 4-91 Butte County – Map of Important Farmlands 2016



Source: State of California Department of Conservation

Growth and Development Trends

As part of the planning process, the HMPC looked at changes in growth and development, both past and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability over time. Information from the Butte County General Plan Housing Element, the California Department of Finance, the US Census Bureau, and input from the participating jurisdictions form the basis of this discussion.

Current Status and Past Development

The estimated population of Butte County (both incorporated communities and the unincorporated County) for January 1, 2019 was 226,466, representing a fivefold increase from 42,840 people in 1940. Table 4-67 illustrates the pace of population growth in Butte County dating back to 1940. The data on population and housing growth shows that Butte County saw tremendous growth during the late 20th century. That growth tapered slightly but continued between 2000 and 2010, and the County has seen smaller population growth since 2010. Details on population growth in the cities is included in their respective annexes to this Plan Update.

Table 4-67 Butte County Planning Area - Population Growth 1940-2018

Year	Population	Percent Increase
1940	42,840	–
1950	64,930	51.6%
1960	82,030	26.3%
1970	101,969	24.3%
1980	143,851	41.1%
1990	182,120	26.6%
2000	203,171	11.6%
2010	220,000	8.3%
2018	226,466	2.9%

Sources: Butte County Housing Element, California Department of Finance, US Census Bureau

Special Populations and Disadvantaged Communities

The 2014-2022 Housing Element noted that numerous special needs populations are present throughout the Unincorporated Area, requiring special needs housing that meets their particular needs, indicating that the greatest unmet needs occur among the elderly, disabled, and the homeless. Currently, 2000 is the most recent year with Census data for disabilities. As of 2000, approximately 27,774 persons in the Unincorporated Area ages 5–64 had a disability. Elderly persons ages 65 years and older comprise 18 percent of the total population in the Unincorporated Area in 2010. In 2011, single female-headed households represented approximately 13 percent of total households. Female-headed households with children constituted 9 percent of total households, whereas female-headed households without children comprised 4 percent of total households. Farmworker data indicate that approximately 5,021 persons work as either full-time or seasonal employees in Butte County. Some farmworkers have special housing needs due to the seasonal nature of their work, along with their need to migrate based on seasonal demand for their services. Additionally, in 2012, Butte County had roughly 760 homeless individuals, with approximately 513 of these individuals unsheltered. These special needs populations have diverse and unique housing needs. The County, in conjunction with the incorporated municipalities, must work together to find ways to provide additional shelters to the homeless.

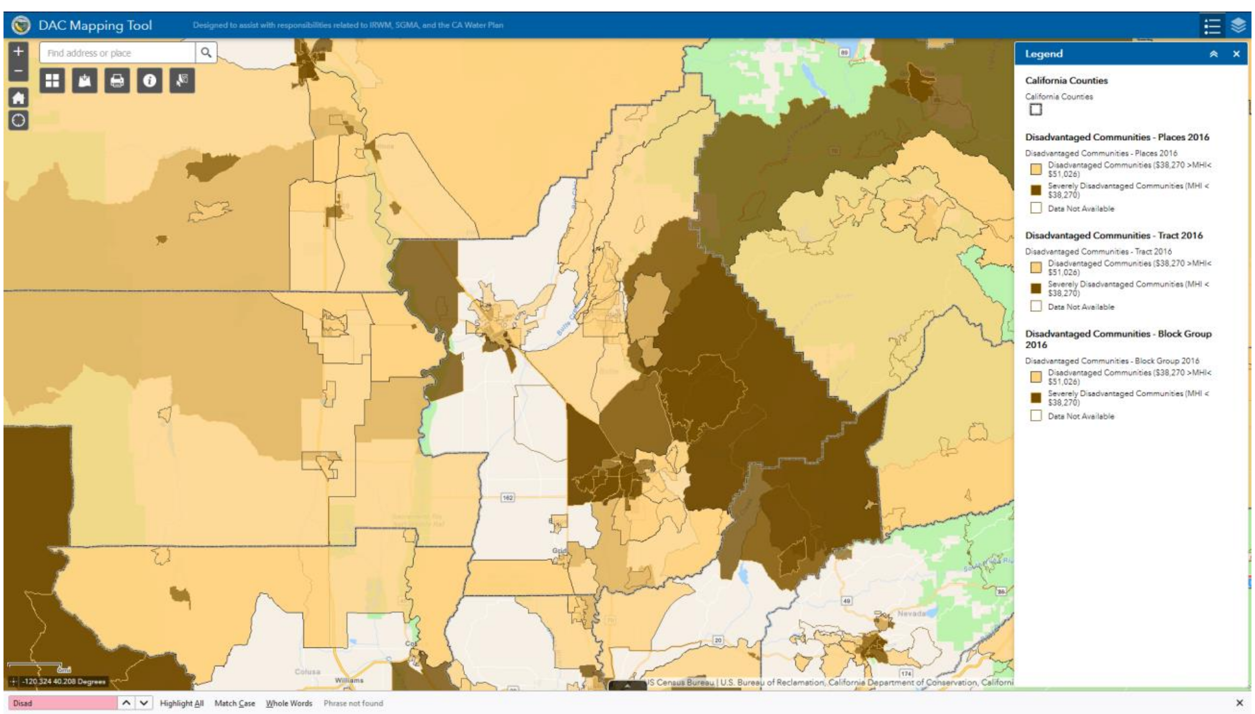
Cal DWR Special Population and Disadvantaged Community Mapping

Cal DWR has developed a web-based application to assist local agencies and other interested parties in evaluating disadvantaged community (DAC) status throughout the State, using the definition provided by Proposition 84 Integrated Regional Water Management (IRWM) Guidelines (2015). The DAC Mapping Tool is an interactive map application that allows users to overlay the following three US Census geographies as separate data layers:

- Census Place
- Census Tract
- Census Block Group

Only those census geographies that meet the DAC definition are shown on the map (i.e., only those with an annual median household income (MHI) that is less than 80 percent of the Statewide annual MHI (PRC Section 75005(g)). In addition, those census geographies having an annual MHI that is less than 60 percent of the Statewide annual MHI are shown as "Severely Disadvantaged Communities" (SDAC). The DAC map for Butte County is shown in Figure 4-92.

Figure 4-92 Butte County – Disadvantaged Communities



Source: Cal DWR

Climate Change and Health Profile Report – Butte County

The 2017 Climate Change and Health Profile Report for Butte County was done by the California Department of Public Health and the University of California-Davis. The report noted that there are special populations in the County.

> ***In 2010, the age-adjusted death rate in Butte County was lower than the state average. Disparities in death rates among race/ethnicity groups highlight how certain populations disproportionately experience health impacts. Within the county, the highest death rate occurred among African-Americans and the lowest death rate occurred among Hispanics/Latinos. In 2012, nearly 47% of adults (83,740) reported one or more chronic health conditions including heart disease, diabetes, asthma, severe mental stress or high blood pressure. In 2012, 21% of adults reported having been diagnosed with asthma. In 2012, approximately 24% of adults were obese (statewide average was 25%). In 2012, nearly 17% of residents aged 5 years and older had a mental or physical disability (statewide average was 10%).***
>
> ***In 2005-2010, there was an annual average of 41 heat-related emergency room visits and an age-adjusted rate of 18 emergency room visits per 100,000 persons (the statewide age-adjusted rate was 10 emergency room visits per 100,000 persons).***
>
> ***Among climate-vulnerable groups in 2010 were 12,409 children under the age of 5 years and 33,817 adults aged 65 years and older. In 2010, there were approximately 4,942 people living in nursing homes, dormitories, and other group quarters where institutional authorities would need to provide transportation in the event of emergencies.***
>
> ***Social and demographic factors and inequities affect individual and community vulnerability to the health impacts of climate change. In 2010, 3% of households (2,476) did not have a household member 14 years or older who spoke English proficiently (called linguistically isolated; statewide average was 10%).***
>
> ***In 2010, approximately 14% of adults aged 25 years and older had less than a high school education (statewide average was 19%). In 2010, 18% of the population had incomes below the poverty level (the statewide average was 14%).***
>
> ***Nineteen percent of households paid 50% or more of their annual income on rent or a home mortgage (statewide average was 22%). In 2012, approximately 32,000 (44%) low-income residents reported they did not have reliable access to***

a sufficient amount of affordable, nutritious food (called food insecurity; statewide average was 42%).

In 2010, Butte County had approximately 6,419 outdoor workers whose occupation increased their risk of heat illness. In 2010, roughly seven percent of households did not own a vehicle that could be used for evacuation (statewide average was 8%).

In 2009, approximately 8% of households were estimated to lack air conditioning, a strategy to counter adverse effects of heat (statewide average was 36%). In 2011, tree canopy, which provides shade and other environmental benefits, was present on 26% of the county's land area (statewide average was 8%).

In 2010, Butte County experienced approximately 3 violent crimes per 1,000 residents (statewide rate was 4 per 1,000 residents).

Development since 2014 Plan

The Butte County Community Development Department sought to track total building permits issued since 2014 for unincorporated Butte County. A summary of this development is shown in Table 4-68. Development by known flood and fire hazard areas is shown in Table 4-69. All development in the identified hazard areas, including the 1% annual chance floodplains and high wildfire risk areas, were completed in accordance with all current and applicable development codes and standards. Thus, with the exception of more people living in the area potentially exposed to natural hazards, this growth should not cause a significant change in vulnerability of the County to identified priority hazards.

Table 4-68 Butte County Development 2014-2018 Summary

Property Use	2015	2016	2017	2018
Residential	149	108	204	150
Commercial	19	28	25	21
Industrial	1	7	1	10
Other	117	112	127	117
Total	**286**	**255**	**357**	**298**

Source: Butte County Building Department and Planning Department

Table 4-69 Butte County Development in Hazard Areas since 2014

Property Use	1% Annual Chance Flood	Wildfire Risk Area
Residential	39	307
Commercial	16	12
Industrial	8	4
Other	56	220

Property Use	1% Annual Chance Flood	Wildfire Risk Area
Total	**119**	**543**

Source: Butte County Building Department and Planning Department

Future Development

Future development in the County is discussed in the sections below.

Population Projections

As indicated in the previous section, Butte County had been steadily growing from 1940 to 2010, with a recent slowing in population growth. Long term forecasts by the California Department of Finance project population growth in Butte County continuing through the 2060. Table 4-70 shows the population projections for the County as a whole through 2060.

Table 4-70 Population Projections for Butte County (incorporated and unincorporated), 2020-2060

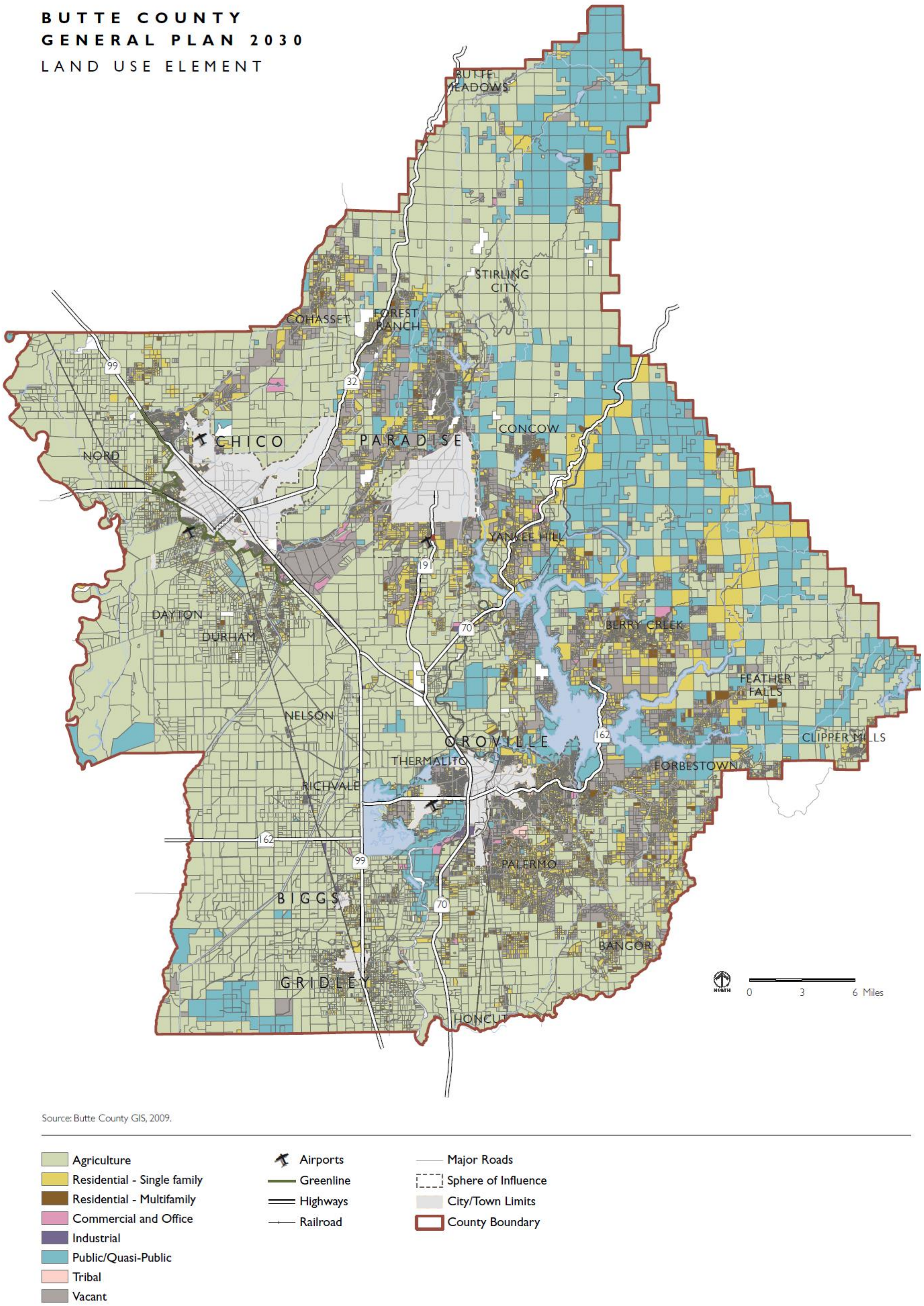
	2020	2025	2030	2035	2040	2045	2050	2055	2060
Butte	230,282	237,844	246,880	255,884	264,271	271,471	279,618	2287,417	295,432

Source: California Department of Finance, P-1 Report

Future Land Use

The future use of land in the County is fundamental to attaining the vision of a balanced, self-sustaining community. A land use pattern which balances growth between rural and urban areas, as well as providing a balance between housing, employment, natural resources, and services in the County is a key element in maintaining the quality of life and unique character of the County. Descriptions of allowed uses for each classification are detailed in the 2030 Butte County General Plan Land Use Element. Figure 4-93 is sourced from this section.

Figure 4-93 Butte County General Plan Land Use



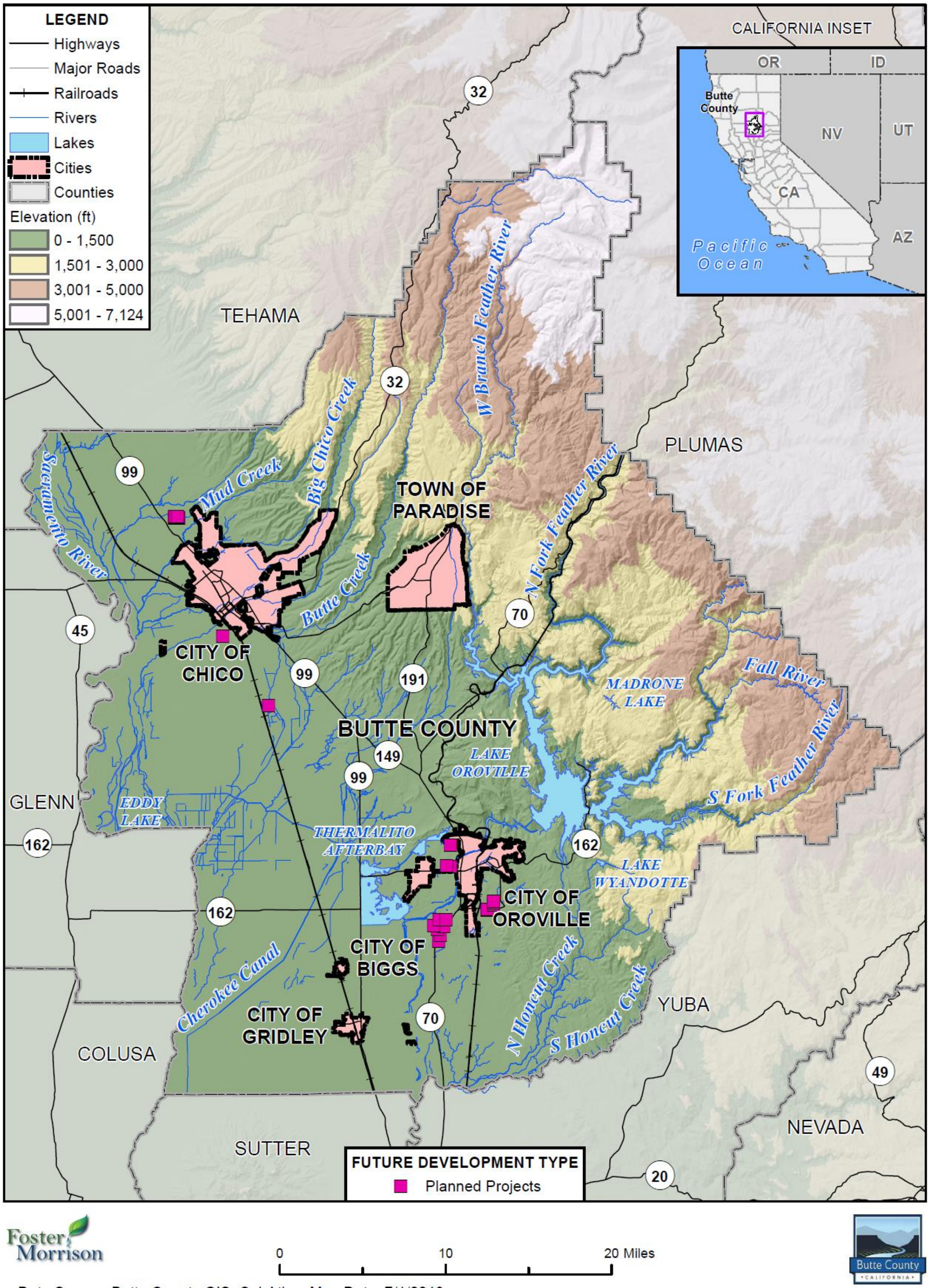
Source: 2030 Butte County General Plan Land Use Element

Future Development Area Analysis

Using GIS, the following methodology was used in determining parcel counts and values associated with future development in the unincorporated Butte County Planning Area.

Butte County's 3/28/2019 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. The Butte County Planning Department provided a table containing the assessor parcel numbers (APNs) for the 42 parcels representing eight different future development projects or areas. Using the GIS parcel spatial file and the APNs, the eight future development projects were mapped. These areas can be seen on Figure 4-94 and detailed in Table 4-71.

Figure 4-94 Butte County – Future Development Areas



Data Source: Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-71 Butte County – Future Development Areas

Future Development	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista	1	0	9.7
Creekside Estates	1	1	47.4
Diamond Oak	2	1	7.9
Lincoln and Ophir Garden Oak Estates	2	0	50.4
Mandville Park	25	0	22.6
Rio d Oro - Phase 1	7	0	664.2
Southlands Subdivision	3	0	48.8
Stanley Ave	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: Butte County GIS

4.3.2. Butte County Vulnerability to Specific Hazards

The Disaster Mitigation Act regulations require that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. This section summarizes the possible impacts and quantifies, where data permits, the Butte County Planning Area's vulnerability to each of the hazards identified as a priority hazard in Section 4.2.20 Natural Hazards Summary.

Defining Significance (Priority) of a Hazard

Defining the significance or priority of a hazard to a community is based on a subjective analysis of several factors. This analysis is used to focus and prioritize hazards and associated mitigation measures for this LHMP. These factors include the following:

- **Past Occurrences**: Frequency, extent, and magnitude of historic hazard events.
- **Likelihood of Future Occurrences**: Based on past hazard events.
- **Ability to Reduce Losses through Implementation of Mitigation Measures**: This looks at both the ability to mitigate the risk of future occurrences as well as the ability to mitigate the vulnerability of the County to a given hazard event.

Based on information developed for the hazard profiles and this initial prioritization process, the priority hazards evaluated further as part of this vulnerability assessment include:

- Climate Change
- Dam Failure
- Drought & Water shortage
- Earthquake: Large
- Floods: 100/200/500 year
- Floods: Localized Stormwater
- Hazardous Materials Transportation
- Invasive Species: Aquatic
- Invasive Species: Pests/Plants

- Landslide, Mudslide, and Debris Flow
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Freeze and Winter Storm
- Severe Weather: Heavy Rain and Storms (Hail, Lightning)
- Severe Weather: Wind and Tornado
- Stream Bank Erosion
- Wildfire

Volcano was determined not to be priority hazards during the initial prioritization process based on information obtained during development of the hazard profiles.

An estimate of the vulnerability of the Butte County Planning Area (the unincorporated County and the incorporated jurisdictions) to each identified priority hazard, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**—Very widespread with catastrophic impact.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical community facilities, historic structures, and valued natural resources. Together, this information conveys the impact, or vulnerability, of that area to that hazard.

The HMPC identified six hazards in the Planning Area for which specific geographical hazard areas have been defined and for which sufficient data exists to support a quantifiable vulnerability analysis. These six hazards are dam failure, earthquake, flood, hazardous materials transportation, landslide, and wildfire. The vulnerability of the flood (1%/0.2% annual chance), landslide, hazardous materials transportation, and wildfire hazards were analyzed using GIS and County parcel and assessor data.

The HMPC used FEMA's loss estimation software, HAZUS-MH, to analyze the County's vulnerability to earthquakes.

For dam failure, earthquake (liquefaction), flood (1%/0.2% annual chance), hazardous materials transportation, landslide, and wildfire, the HMPC inventoried the following for each community, to the extent possible, to quantify vulnerability in identified hazard areas:

- General hazard-related impacts, including impacts to life, safety, and health
- Values at risk (i.e., types, numbers, and value of land and improvements)
- Identification of population at risk
- Identification of critical facilities at risk
- Overall community impact
- Future development/development trends within the identified hazard area

The vulnerability and potential impacts from priority hazards that do not have specific mapped areas nor the data to support additional vulnerability analysis are discussed in more general terms. These include:

- Climate Change
- Drought & Water shortage
- Floods: Localized Stormwater
- Invasive Species: Aquatic
- Invasive Species: Pests/Plants
- Levee Failure
- Severe Weather: Extreme Heat
- Severe Weather: Freeze and Winter Storm
- Severe Weather: Heavy Rain and Storms (Hail, Lightning)
- Severe Weather: Wind and Tornado
- Stream Bank Erosion

The vulnerability sections below are presented alphabetically.

4.3.3. Climate Change Vulnerability Assessment

Likelihood of Future Occurrence—Likely
Vulnerability—Medium

The 2018 Draft Butte County Climate Change Vulnerability Assessment noted that climate change is already affecting and will continue to alter the physical environment throughout the Central Valley and Butte County; however, the specific implications of climate change effects vary with differing physical, social, and economic characteristics of the County. For this reason, it is important to identify the projected severity of climate change impacts on Butte County and ways the County can reduce its vulnerability to them. This section sources multiple documents that focus on Butte County's climate change vulnerability:

- California Adaptation Planning Guide
- Proceedings of the National Academy of Sciences
- Butte County Climate Action Plan
- Climate Change Vulnerability Assessment

California Adaptation Planning Guide

The California Adaptation Planning Guide (APG) prepared by California OES and CNRA was developed to provide guidance and support for local governments and regional collaboratives to address the unavoidable consequences of climate change.

The APG: Defining Local and Regional Impacts focuses on understanding the ways in which climate change can affect a community. According to this APG, climate change impacts (temperature, precipitation, sea level rise, ocean acidification, and wind) affect a wide range of community structures, functions and populations. These impacts further defined by regional and local characteristics are discussed by secondary impacts and seven sectors found in local communities: Public Health, Socioeconomic, and equity impacts; Ocean and Coastal Resources; Water Management; Forest and Rangeland; Biodiversity and Habitat; Agriculture; and Infrastructure.

The APG: Understanding Regional Characteristics identified the following impacts specific to the Northern Central Valley region in which the Butte County Planning Area is part of:

- Temperature increases – particularly nighttime temperature
- Reduced precipitation
- Flooding – increase flows, snowmelt, levee failure in the Delta
- Reduced agricultural productivity (e.g., nut trees, dairy)
- Reduced water supply
- Wildfire in the Sierra foothills
- Public health and heat
- Reduced tourism

California's Adaptation Guide: Understanding Regional Characteristics provides input on adaptation considerations for the Northern Central Valley Region. As detailed in this guide, climate change has the potential to disrupt many features that characterize the region, including ecosystems health, snowpack, and the tourist economy. Specific regional impacts include the following:

Flooding. The eastern part of the Northern Central Valley contains the foothills of the Sierra Nevada mountain range. The mountainous areas of the state are projected to have less precipitation falling as snow and to be subject to rapid melt events. This will result in extreme, high-flow events and flooding in the Central Valley. Communities should evaluate local floodplains and recognize areas where a small increase in flood height would inundate large areas and potentially threaten structures, infrastructure, agricultural fields, and/or public safety. As the rivers of the region flow toward San Francisco Bay, the land decreases in elevation and is protected by levees, many of which are vulnerable, particularly to seismic events.

Agriculture. The Northern Central Valley is one of the largest agricultural producing regions, not only in California, but in the United States. Between climate change impacts on water availability and seasonal temperature regimes, the health of livestock, and productivity of trees and crops are likely to be affected. Agriculture in this region is varied, with rice, nuts (almonds, walnuts, pistachios), and dairy being three of the most predominant products. Others include pears, cattle, wine grapes, chicken, sweet potatoes, and plums. Each crop is likely to react slightly differently to alteration in seasonal temperature regimes and water availability. Rice is projected to experience a moderate loss in productivity (less than 10%). In the case of nut trees, it is the reduction in nighttime cooling that may have the most impact. Jurisdictions reliant on almonds, walnuts, pistachios, or other nuts should specifically evaluate projected changes in daily low temperatures and/or loss of nighttime chill hours. It is difficult to specifically project the production impact on crops because this relates to many factors in addition to temperature and precipitation, including pest regimes, availability of imported or groundwater irrigation water, and management practices. As with crops, climate change impacts on dairy cows can occur and depend on a variety of factors.

The impact of climate change on agricultural productivity has the potential to alter a community's economic continuity, including its employment base.

Public Health, Socioeconomic, and Equity Impact. Increased temperatures and more frequent heat waves are expected in the region. Impervious surfaces are increasing in the Central Valley, increasing the potential impacts of heat islands. Farm employment or lodging and food services are among the top five employment sectors in several of the counties in this region. Agricultural workers and employees in the tourist industry are more susceptible to heat events. Regardless of their occupation, the poor are less likely to have the adaptive capacity to prevent and address impacts for reasons stated above.

Water Supply. Shorter rainfall events and rapid snowmelt will reduce the region's water supply by making water more difficult to capture in reservoirs or retain for groundwater recharge. Recreation and tourism in the region are also likely to suffer due to lower water levels in waterways and reservoirs and declining snowpack. Agriculture will also be impacted due to reduced or altered precipitation. Water supply (for irrigation) can alleviate some of the other climate stresses (altered temperature or precipitation) or, in the case of reduced water supply, exacerbate them. The challenge of climate change is that water supply is projected to be reduced and water that is available will be more costly for users. Employees of water-reliant industries such as agriculture may become more economically vulnerable because of unstable working conditions.

Fire. Fire risk is projected to increase in the foothills lining the eastern edge of the region. The areas northeast of Sacramento, due to population density and fire risk, are projected to have large property loss. Jurisdictions should pay careful attention to the wildland-urban interface and enforcement of mitigation measures such as residential vegetation and setbacks.

Proceedings of the National Academy of Sciences

In addition to the APG, the HMPC provided a report from the Proceedings of the National Academy of Sciences (PNAS) stating that some of the recent fire impacts may have been attributed to climate change. The PNAS report posits that climate influences wildfire potential primarily by modulating fuel abundance in fuel-limited environments, and by modulating fuel aridity in flammability-limited environments. Increased forest fire 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. Those most vulnerable to high levels of ozone and particulate matter include people who work or spend a lot of time outdoors, such as residents of this region who are employees of the tourist industry. Households eligible for energy utility financial assistance programs are an indicator of potential impacts. These households may be more at risk of not using cooling appliances, such as air conditioning, due to associated energy costs.

Butte County Climate Action Plan

Additionally, the 2014 Butte County Climate Action Plan noted that:

- Changes in precipitation (rain and snowfall), humidity, and temperature have the cumulative effect of increasing conditions where wildfires could occur with greater frequency and severity. As evidenced by the 2013 Swedes Fire, Butte County has a large potential wildfire fuel source as well as homes, infrastructure, and business located within the wildland-urban interface.
- Changes in precipitation patterns may affect snowpack in the mountains to the east of the county as well as reduce groundwater recharge. Both of these effects can reduce access to drinking water and agricultural irrigation and could impact food processing operations, some of which are intense water users. Even though overall precipitation levels may decline under future climate conditions, it is likely that precipitation events that do occur will be more extreme.
- With foothills in the east draining into a large valley in the west, Butte County is already vulnerable to flooding. Increases in extreme precipitation events are likely to affect the county's most vulnerable populations and the economy through flooding and may additionally increase erosion in the long term. As the climate continues to change, extreme heat events are likely to occur more frequently and last longer.
- Heat affects Butte County in multiple ways including effects on agricultural production, stressors to disadvantaged populations with limited access to reliable cooling, and through the generation of troposphere ozone in the more urbanized areas of the unincorporated county.

Climate Change Vulnerability Assessment

The draft 2018 Butte County Climate Change Vulnerability Assessment noted the following vulnerabilities:

- Annual average temperatures in Butte County are projected to increase steadily. Butte County's historical average temperature, based on data from 1961 to 1990, is 71.1 °F (Cal-Adapt, 2017). Under the low emissions scenario, Butte County's average temperature will rise from 71.1°F to 75.5°F by 2050 and to 77°F by 2090 (Cal-Adapt, 2017)
- Butte County's annual average low temperature (minimum temperature), based on historical data from 1961 to 1990, is 44.6 °F. The annual average low temperature using the low emissions scenario is projected to be at 48.6°F by 2050 and 50.0 °F by 2090 (Cal-Adapt, 2017). The annual average low temperature under the high-emissions scenario is projected to increase to 49.6°F by 2050 and to 53.9°F by 2090 (Cal-Adapt 2018)
- Increased average temperatures are expected to lead to secondary climate change impacts, including increases in the frequency, intensity, and duration of extreme heat days and multi-day heat waves in California. Cal-Adapt defines the extreme heat day threshold for Butte County as 100.2°F or higher. Butte County has a historical average of four extreme heat days a year. 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 (Cal-Adapt, 2017), including 26 extreme heat days in 2015. Under the low emissions scenario; Butte County is expected to experience 22 extreme heat days by 2050 and 33 a year by 2090 (Cal-Adapt, 2017). Under the high-emissions scenario, Cal-Adapt predicts that Butte County will experience 29 extreme heat days per year in 2050 and 59 days per year by 2090 (Cal-Adapt, 2017)

- Depending on location, precipitation events may increase or decrease in intensity and frequency. They are also notoriously difficult to predict (Cal-Adapt, 2017). Reduced precipitation could lead to a higher risk of drought, while increased precipitation could cause flooding and soil erosion (CNRA 2014:25).
- It's anticipated that climate change may lead to an increase in the frequency and intensity of storms, resulting from increased precipitation and harsh flooding's. According to future climate projections, it is also anticipated to result in more prolonged periods of drought (Cal- Adapt, 2017)
- Cal-Adapt provides a historical annual average rate of precipitation of about 41.9 inches for Butte County. Overall precipitation in Butte County is expected to increase over the course of the century. Under the low emissions scenario, precipitation is expected to increase from 41.9 inches to 46 inches by 2050 and to 45.1 inches by 2090 (Cal-Adapt, 2017). Under the high emission scenario, it is predicted that Butte County will see an increase from 41.9 inches to 46.8 inches in 2050 and an increase to 49.9 inches in 2100 (Cal-Adapt, 2017)
- Climate change is predicted to alter the frequency, intensity, and duration of extreme storm events, with sustained periods of heavy precipitation and increased rainfall. 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. 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 (IPCC 2001)
- Changes in weather patterns resulting from increases in global average temperature could result in a decreased proportion and the total amount of precipitation falling as snow. This phenomenon is predicted to result in an overall reduction of snowpack in the Sierra Nevada. For this assessment, data from the North-Eastern Sierra Nevada Region was analyzed. This region encompasses areas within Butte County watersheds. The historic average snow water equivalent, a common measurement of snowpack, for the North-Eastern Sierra Nevada Region is 1.4 inches (Cal-Adapt, 2017). Under the low emissions scenario, CAL-Adapt predicts the snow water equivalent to be at 0.5 inches by 2050 and 0.4 inches feet by 2100 (Cal-Adapt, 2017). Under the high emission scenario, by 2050 the average snow water equivalent will be 0.3 inches and 0.1 inches by 2100 (Cal-Adapt, 2017)
- Precipitation in the form of rain and snow could affect local aquifer recharge for groundwater supplies (Sacramento County 2011a).
- 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 will alter the distribution and character of natural vegetation and associated moisture content of plants and soils (CNRA 2012b:11). Increased temperatures will increase the rate of evapotranspiration in plants, resulting in a greater presence of dry fuels in forests creating a higher potential for wildfires (CNRA 2012b).

Future Development

Butte County in general could see population fluctuations as a result of climate impacts relative to those experienced in other regions, and these fluctuations are expected to impact demand for housing and other development. For example, extended drought can have an effect on the agricultural industry in the County. Other interior western states may experience an exodus of population due to challenges in adapting to heat even more extreme than that which is projected to occur here. While there are currently no formal studies of specific migration patterns expected to impact the Butte County region, climate-induced migration was recognized within the UNFCCC Conference of Parties Paris Agreement of 2015 and is expected to be the focus of future studies.

Climate change, coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental and habitat benefits but also for its ability to sequester carbon, help mitigate the accumulation of greenhouse gas in the atmosphere and slow down the global warming trend. Higher flood risks, especially if coupled with increased federal flood insurance rates, may decrease market demand for housing and other types of development in floodplains, while increased risk of wildfires may do the same for new developments in the urban-wildland interface. Flood risks may also inspire new development and building codes that elevate structures while maintaining streetscapes and neighborhood characteristics.

Climate change will stress water resources. Water is an issue in every region, but the nature of the potential impacts varies. Drought, related to reduced precipitation, increased evaporation, and increased water loss from plants, is an important issue in many U.S. regions, especially in the West. Floods, water quality problems, and impacts on aquatic ecosystems and species are likely to be amplified by climate change. Declines in mountain snowpack are important in the Sierra Nevada Mountains and across the state, where snowpack provides vital natural water storage and supply. The ability to secure and provide water for new development requires on-going monitoring and assurances. It is recommended that the ability to provide a reliable water supply from the appropriate water purveyor, continue to be in the conditions for project approval, and such assurances shall be verified and in place prior to issuing building permits.

Similarly, protecting and enhancing water supply will also need to be addressed. California's Sustainable Groundwater Management Act (SGMA) will contribute to addressing groundwater and aquifer recharge needs. Good groundwater management will provide a buffer against drought and climate change, and contribute to reliable water supplies regardless of weather patterns. 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. Protection of critical recharge areas should be addressed across the County in the respective Groundwater Management Plans. Further, these plans should include provisions that guide development or curtail development in areas that would harm or compromise recharge areas.

Climate change will affect transportation. The transportation network is vital to the county and the region's economy, safety, and quality of life. While it is widely recognized that emissions from transportation have impacts on climate change, climate will also likely have significant impacts on transportation infrastructure and operations. Examples of specific types of impacts include softening of asphalt roads and warping of railroad rails; damage to roads; flooding of roadways, rail routes, and airports from extreme events; and interruptions to flight plans due to severe weather. Climate change impacts considered in the plan include: extreme temperatures; increased precipitation, runoff and flooding; increased wildfires; and landslides. Although landslides are not a direct result of climate change, these events are expected to increase in frequency due to increased rainfall, runoff, and wildfire. These events have the potential to cause injuries or fatalities, environmental damage, property damage, infrastructure damage, and interruption of operations. During flood events, these trails serve as secondary transportation facilities when roadways are blocked or otherwise impassible. During Hurricane Sandy, bicycles were one of the primary modes used to deliver food and water to residents stranded in their homes due to flood. Including dual or multi-purpose facilities and amenities as part of all new development provides not just desirable community amenities but critical infrastructure for climate resiliency.

Climate change will affect land uses and planning. Climate change coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space, urban greening, green infrastructure, tree canopy expansion and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental, and habitat, and physical and mental health benefits but also for its ability to sequester carbon and cool the surrounding environment.

Climate change will affect Utilities. California is already experiencing impacts from climate change such as an increased number of wildfires, sea level rise and severe drought. Utility efforts to deal with these impacts range from emergency and risk management protocols to new standards for infrastructure design and new resource management techniques. Utilities are just beginning to build additional resilience and redundancy into their infrastructure investments from a climate adaptation perspective, but have been doing so from an overall safety and reliability perspective for decades. Significant efforts are also being made in those areas that overlap with climate change mitigation such as diversification of resources, specifically the addition of more renewables to the portfolio mix, as well as implementation of demand response efforts to curb peak demand. Efforts are also under way to upgrade the distribution grid infrastructure, which should add significant resilience to the grid as well. Next, they will issue a guidance document that expands upon the vulnerability assessments phase and includes plans for resilience solutions including cost/benefit analysis methodologies. The outcomes of this work will help to inform next steps on how infrastructure, the grid and other related operations will be modified to address climate change. New development will have to adapt and incorporate these new approaches as they evolve. Existing and new development will be affected from impacts that include not only diminished capacity from all of the utility assets from generation to transmission and distribution, but also the cost consequences resulting from prevention, replacement, outage, and energy loss. These have the potential for greatly impacting not just residential development but commercial and industrial and all utility users.

Addressing Heat Events. During heat waves in Butte County, a heat alert is issued and news organizations are provided with tips on how vulnerable people can protect themselves. Programs used by health departments to engage with thousands of block captains to check on elderly and other vulnerable residents, along with public cooling places extending their hours, or local businesses welcoming residents into their businesses for purposes of staying cool are examples of programs and services that will be necessary. Other programs to consider that could further involve hospitals and clinics are operating a “heatline” with nurses or other healthcare professionals ready to assist callers with heat-related health problems. In addition, continued funding for weatherization, reduced utility rates and similar programs that offers assistance to elderly, low-income residents to install roof insulation, solar, trees and cool surfaces to save energy and lower indoor temperatures.

4.3.4. Dam Failure Vulnerability Assessment

Likelihood of Future Occurrence—Occasional
Vulnerability—High

Dam failure flooding can occur as the result of partial or complete collapse of an impoundment. Dam failures often result from prolonged rainfall and flooding. The primary danger associated with dam failure is the high velocity flooding of those properties downstream of the dam.

A dam failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions.

Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding. Based on the risk assessment, it is apparent that a major dam failure could have a devastating impact on the Planning Area. Dam failure flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect crops and livestock as well as lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

The DSOD is concerned that if the epicenter of an earthquake of significant magnitude were to occur nearby a dam, the likelihood of a structural failure is high. Local dams vulnerable to earthquake damage are hydraulic-filled embankment dams built with sluicing materials from an adjacent area and depositing the slurry into the embankment, such as the Magalia and De Salba Dams.

Division personnel inspect the DSOD Dams each year. The DSOD has also evaluated the seismic safety of the dams at Lake Wyandotte, Lost Creek, and Round Valley. As a result of the study done for Lake Wyandotte, the spillway has been lowered to contain the reservoir in the event of dam lowering in an earthquake. Lost Creek dam personnel submitted their study and are in the process of studying several faults of special concern. Round Valley has also submitted a study which found the dam in compliance with earthquake standards. The main focus of this study was correcting seepage. According to the area engineer for the DSOD, this problem has been corrected.

Past Dam Vulnerability and Mitigation

Magalia Dam (which threatens the Town of Paradise) has been identified by the DSOD as at risk to failure in the event of significant seismic activity. In the event of such failure floodwater would cause significant damages in the Little Butte Creek and Butte Creek Canyons and the town of Durham, and exceed the capacity of the downstream Butte Creek levees. The Town of Paradise would be affected since the water treatment plant and the 42-inch supply line that provides drinking water for the residents in the community could be severely damaged since it is located at the downstream toe of the dam. The primary access road to the Pines Community would be eliminated and impact 10,000 residents. Reconstruction of the damaged facilities would be difficult, cause a significant water outage, take many months to restore, and the repair costs would be very high.

In a 1992 study of Magalia Dam it was concluded that the upstream slope of the dam was found to have inadequate stability under seismic loading conditions. In 1997 in response to this concern, the DSOD required the water storage in the reservoir to be decreased to 800 acre-feet. If stabilized, the capacity of Magalia Reservoir could be restored to 2,570 acre-feet. The change in water level elevation from 2,225 feet when full, was lowered to the current restricted operating level of 2,199 feet, or a reduction of 26 feet. Each year the DSOD conducts a dam inspection and the District prepares a "Surveillance Report", with assistance from the URS Corporation.

In 2004, the Paradise Irrigation District constructed a diversion structure above Magalia Reservoir and a pipeline to the water treatment plant. This improvement will supply water to the treatment plant during any reconstruction of Magalia Dam, or the widening of Skyway across Magalia Dam. The Paradise Irrigation District is working on extending its water rights permits, which must be secured before further work is contemplated on Magalia Dam.

The County is doing preliminary engineering on a project to widen the Skyway across Magalia Dam. The Paradise Irrigation District's preferred alternative for the widening project involves stabilizing the dam and would permit the restoration of the design water level behind Magalia Dam.

The DSOD also identified an additional safety hazard at the Lake Madrone dam. The spillway is below the minimum design standard. It has been certified as safe for a 500-year flood, whereas the normal minimum level is for a 1,000-year flood event. However, minimum levels differ in various locations and depend on construction type, terrain, seismic features in the area, and habitat (human and otherwise) in the downstream flood zone. This facility is under court order to increase dam spillway capacity. Of the remaining dams, Kunkle is typical of several dams whose use has been restricted to a particular storage level. The DSOD believes these dams are safe at a particular fill level and has restricted their use to that level or lower.

Since the February 2017 Spillway Incident, the DWR has hired a contractor to complete new construction on the spillway, auxiliary spillway and surrounding property

Dams of Concern

Butte County is at risk to multiple dams. The specific dams of concern were discussed in the dam failure hazard profile in Section 4.2.7. Dam inundation maps have been required in California since 1972, following the 1971 San Fernando Earthquake and near failure of the Lower Van Norman Dam.

Available inundation maps were gathered from Cal OES. As detailed in Section 4.2.7, the County is vulnerable many dams. It should be noted that not all dams of concern in the County had mapped inundation areas. The remainder of the discussion below focuses on the dams that had inundation mapping available.

Dams with inundation areas are shown in Table 4-72, and shown on Figure 4-95 (extremely high hazard dams), Figure 4-96 (high hazard dams), and Figure 4-97 (significant hazard dams).

Table 4-72 Butte County Planning Area – Dams of Concern with Inundation Layer

Dam Inundation Classifications/ Dams	Dam Count
Extremely High	
Oroville	1
Paradise	1
Thermalito AB	1
Extremely High Total	**3**
High	
Bidwell Bar Canyon Saddle	1
De Sabla FB	1
Lake Almanor	1
Lake Wyandotte	1
Magalia	1
Miners Ranch	1
Shasta	1
Thermalito Diversion	1
High Total	**8**
Significant	
Kunkle	1
Philbrook	1
Poe	1
Significant Total	**3**
Grand Total	**14**

Source: Cal OES, Butte County

Figure 4-95 Butte County Planning Area – Extremely High Hazard Dam Inundation Areas

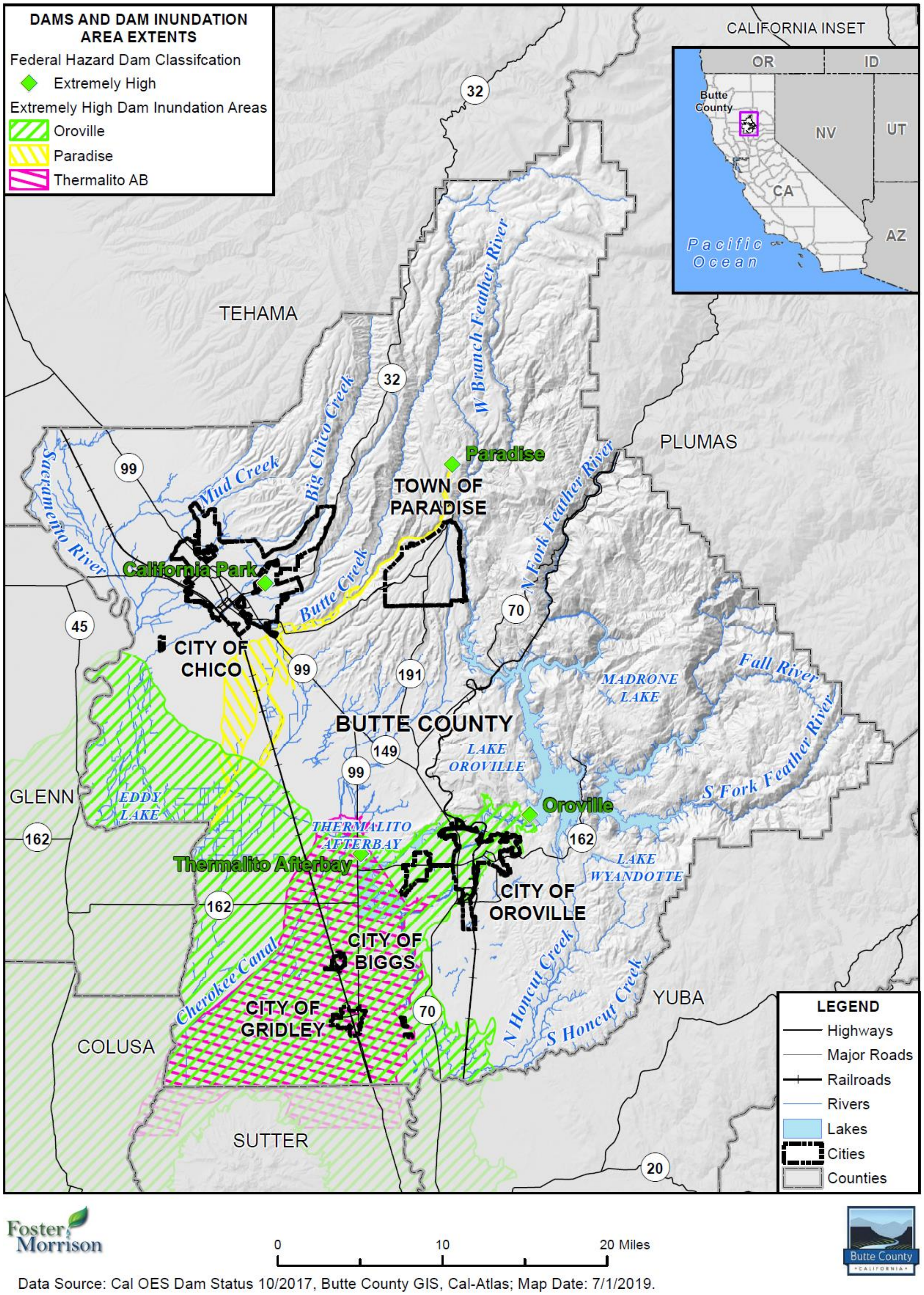
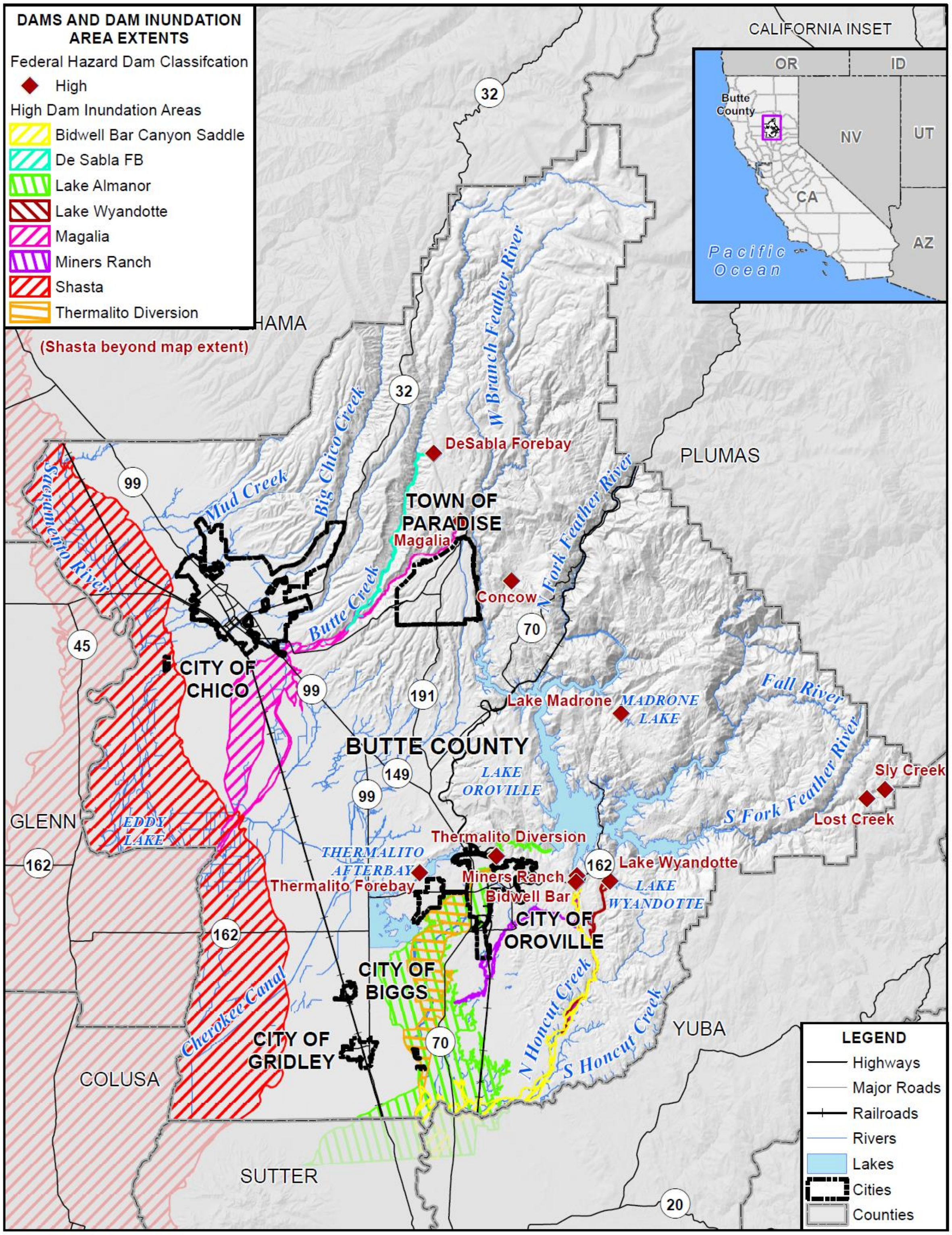
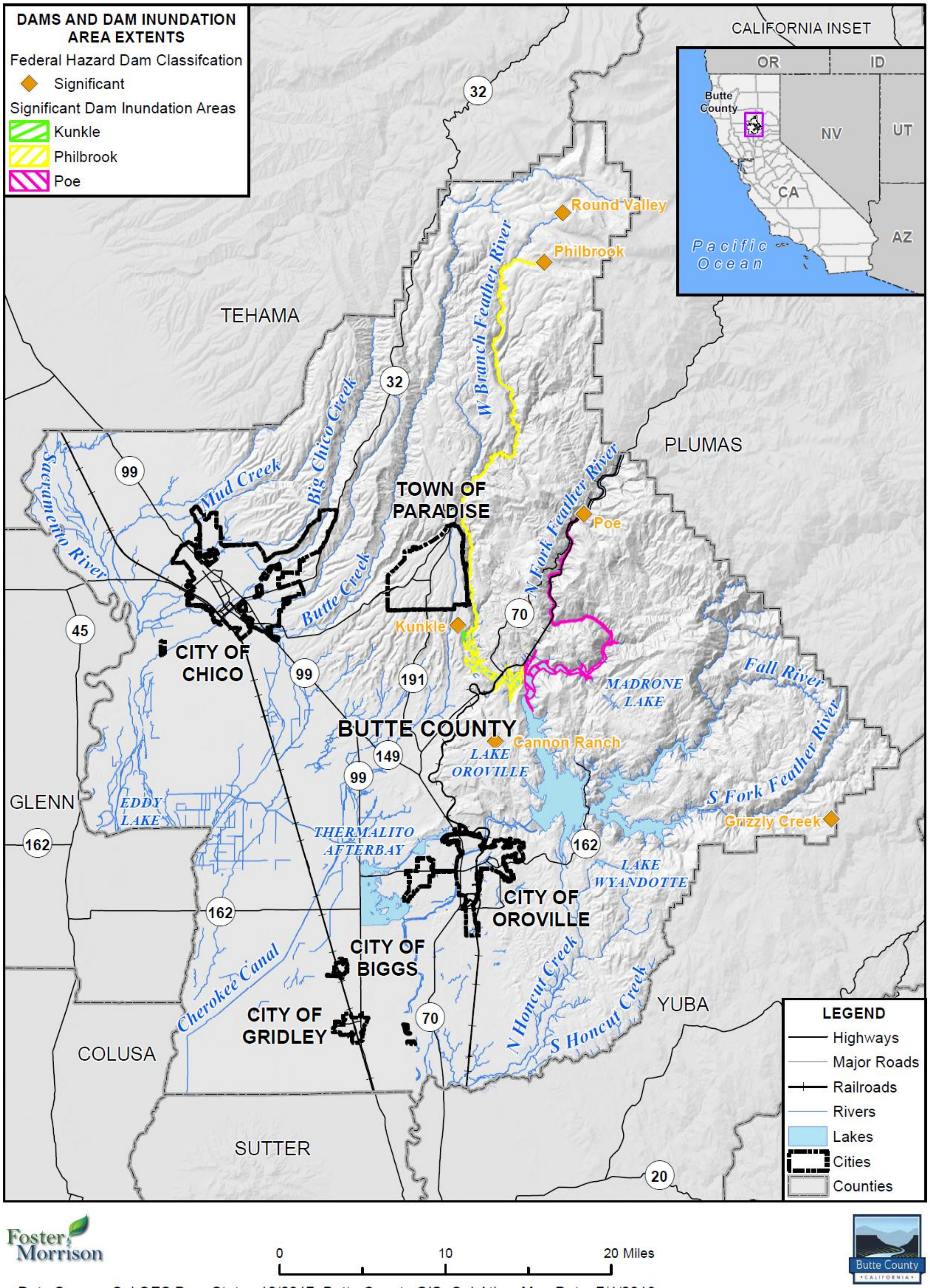


Figure 4-96 Butte County Planning Area –High Hazard Dam Inundation Areas



Data Source: Cal OES Dam Status 10/2017, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Figure 4-97 Butte County Planning Area –Significant Hazard Dam Inundation Areas



Data Source: Cal OES Dam Status 10/2017, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Values at Risk

Dam inundation areas for the 14 dams of concern, as obtained from Cal OES, were used as the basis of this dam inundation analysis. Multiple dams can affect the County. Dams were grouped by hazard rating in order to perform analysis. The depth of flooding due to the failure of these dams is unknown.

Methodology and Results

Butte County's 2018 (pre-Camp Fire) and 3/28/2019 (post-Camp Fire) Assessor Data and the County's GIS parcel data, obtained from Butte County, were used for the county inventory of parcels and values. GIS was used to create a centroid, or point representing the center of the parcel polygon. The dam inundation areas, obtained from Cal OES, were then overlaid on the parcel layer. For the purposes of this analysis, if the dam inundation layer intersected a parcel centroid, the entire parcel was considered to be in the dam inundation area. The parcels were segregated and analyzed in this fashion for the Butte County Planning Area. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessors database and the GIS parcel layer.

Breakdowns by land use by dam inundation area for the incorporated jurisdictions can be found in their respective annexes to this LHMP Update. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the dam inundation areas due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Extremely High Hazard Dams

Dam analysis was performed for the mapped extremely high hazard dams in the County with available inundation data. This includes Oroville, Paradise, and Thermalito Afterbay. Analysis for these dams is presented in the following tables:

- Table 4-73 shows the total parcel counts, improved parcel counts, their improved structure and land values in all extremely high hazard dam inundation areas prior to the Camp Fire.
- Table 4-74 shows the total parcel counts, improved parcel counts, their improved structure and land values in all extremely high hazard dam inundation areas after the Camp Fire.
- Table 4-75 compares the improved structure values in all extremely high hazard dam inundation areas in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-76 breaks down Table 4-74 into more detail, and shows post-fire values in all extremely high hazard dam inundation areas by property use type.

Table 4-73 Butte County Planning Area – Pre-Fire Count and Value of Parcels in All Extremely High Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	766	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$154,953,655
City of Chico	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Gridley	2,451	2,201	$113,742,355	$290,301,864	$5,421,891	$184,884,784	$594,350,894
City of Oroville	6,259	4,805	$278,890,155	$782,031,867	$62,433,273	$591,177,078	$1,714,532,373
Town of Paradise	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County	8,877	6,304	$932,575,174	$863,049,570	$135,020,049	$615,252,519	$2,545,897,312
Grand Total	**18,354**	**13,985**	**$1,352,982,392**	**$2,005,690,785**	**$213,431,571**	**$1,442,178,425**	**$5,014,283,173**

Source: Cal OES, Butte County 2018 Parcel/Assessor's Data

Table 4-74 Butte County Planning Area – Post-Fire Count and Value of Parcels in All Extremely High Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	765	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$155,425,116
City of Chico	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940
City of Gridley	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934
City of Oroville	6,262	4,802	$276,524,176	$776,873,996	$60,972,453	$585,978,221	$1,584,003,840
Town of Paradise	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County	8,884	6,301	$926,929,942	$852,082,103	$134,042,369	$605,750,180	$2,554,691,445
Grand Total	**18,364**	**13,980**	**$1,344,967,769**	**$1,989,587,781**	**$210,993,071**	**$1,427,525,730**	**$4,852,929,274**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-75 Butte County Planning Area – Comparison of Pre- and Post-Fire Structure Values at Risk to Extremely High Hazard Dam Inundation

Jurisdiction	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
City of Biggs	$69,188,866	$69,188,866	$0	0.0%
City of Chico	$1,118,618	$1,118,618	$0	0.0%
City of Gridley	$290,301,864	$290,324,198	$22,334	0.0%
City of Oroville	$782,031,867	$776,873,996	-$5,157,871	-0.7%
Town of Paradise	$0	$0	$0	0.0%
Unincorporated Butte County	$863,049,570	$852,082,103	-$10,967,467	-1.3%
Grand Total	**$2,005,690,785**	**$1,989,587,781**	**-$16,103,004**	**-0.8%**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-76 Butte County Planning Area - Count and Value of Parcels in All Extremely High Hazard Dam Inundation Zones by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	**1**	**1**	**$1,752,395**	**$1,118,618**	**$0**	**$1,677,927**	**$4,548,940**
City of Gridley							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991
Unknown	64	0	$0	$0	$0	$0	$0
City of Gridley Total	**2,452**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**
City of Oroville							
Agricultural	6	0	$658,274	$0	$7,947	$0	$666,221
Commercial	1,007	678	$100,544,300	$315,471,114	$18,639,996	$315,471,114	$657,575,440
Industrial	221	71	$25,400,597	$39,962,799	$42,318,610	$59,944,199	$191,571,855
Residential	4,873	4,051	$149,856,487	$421,125,817	$5,900	$210,562,909	$733,812,671
Unknown	155	2	$64,518	$314,266	$0	$0	$377,654
City of Oroville Total	**6,262**	**4,802**	**$276,524,176**	**$776,873,996**	**$60,972,453**	**$585,978,221**	**$1,584,003,840**
Town of Paradise							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
Town of Paradise Total	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unincorporated Butte County							
Agricultural	2,102	1,160	$572,390,792	$158,139,860	$116,041,436	$158,139,860	$1,047,993,782
Commercial	172	133	$15,968,559	$35,343,916	$1,669,926	$35,343,916	$82,432,761
Industrial	96	63	$15,175,577	$83,339,608	$12,110,442	$125,009,412	$244,052,098
Residential	5,989	4,940	$322,107,434	$574,513,983	$3,708,182	$287,256,992	$1,175,772,790
Unknown	525	5	$1,287,580	$744,736	$512,383	$0	$4,440,014
Unincorporated Butte County Total	**8,884**	**6,301**	**$926,929,942**	**$852,082,103**	**$134,042,369**	**$605,750,180**	**$2,554,691,445**
Grand Total	**18,364**	**13,980**	**$1,344,967,769**	**$1,989,587,781**	**$210,993,071**	**$1,427,525,730**	**$4,852,929,274**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

The dam inundation analysis results for the Butte County Planning Area were also broken out by individual dam inundation area. For each extremely high dam a table was created showing the total and improved number of parcels and values at risk in each jurisdiction in the Butte County Planning Area to dam failure for each individual extremely high hazard dam. These are shown for each dam inundation area:

- Oroville (Table 4-77)
- Paradise (Table 4-78)
- Thermalito (Table 4-79)

Table 4-77 Butte County Planning Area – Count and Value at Risk in Oroville Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Gridley							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991
Unknown	64	0	$0	$0	$0	$0	$0
City of Gridley Total	**2,452**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**
City of Oroville							
Agricultural	6	0	$658,274	$0	$7,947	$0	$666,221
Commercial	1,007	678	$100,544,300	$315,471,114	$18,639,996	$315,471,114	$657,575,440
Industrial	221	71	$25,400,597	$39,962,799	$42,318,610	$59,944,199	$191,571,855
Residential	4,873	4,051	$149,856,487	$421,125,817	$5,900	$210,562,909	$733,812,671
Unknown	155	2	$64,518	$314,266	$0	$0	$377,654
City of Oroville Total	**6,262**	**4,802**	**$276,524,176**	**$776,873,996**	**$60,972,453**	**$585,978,221**	**$1,584,003,840**
Unincorporated Butte County							
Agricultural	1,817	920	$516,165,953	$122,804,898	$92,610,268	$122,804,898	$890,323,052
Commercial	142	110	$11,846,335	$28,505,464	$820,956	$28,505,464	$65,039,854
Industrial	74	46	$7,644,249	$71,792,207	$10,005,908	$107,688,311	$199,963,124
Residential	5,100	4,144	$219,245,655	$399,569,846	$2,782,373	$199,784,923	$813,631,027
Unknown	498	5	$1,287,339	$744,736	$512,383		$4,440,014
Unincorporated Butte County Total	**7,631**	**5,225**	**$756,189,531**	**$623,417,151**	**$106,731,888**	**$458,783,596**	**$1,973,397,071**
Grand Total	**17,110**	**12,903**	**$1,172,474,963**	**$1,759,804,211**	**$183,682,590**	**$1,278,881,219**	**$4,267,085,960**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-78 Butte County Planning Area – Count and Value at Risk in Paradise Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	**1**	**1**	**$1,752,395**	**$1,118,618**	**$0**	**$1,677,927**	**$4,548,940**
Unincorporated Butte County							
Agricultural	295	238	$56,617,617	$35,804,964	$23,431,168	$35,804,964	$158,628,732
Commercial	30	23	$4,122,224	$6,838,452	$848,970	$6,838,452	$17,392,907
Industrial	22	17	$7,531,328	$11,547,401	$2,104,534	$17,321,102	$44,088,975
Residential	887	795	$102,781,779	$174,579,137	$925,809	$87,289,569	$361,521,263
Unknown	28	0	$22,204	$0	$0	$0	$21,963
Unincorporated Butte County Total	**1,262**	**1,073**	**$171,075,152**	**$228,769,954**	**$27,310,481**	**$147,254,086**	**$581,653,839**
Grand Total	**1,263**	**1,074**	**$172,827,547**	**$229,888,572**	**$27,310,481**	**$148,932,013**	**$586,202,779**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-79 Butte County Planning Area – Count and Value at Risk in Thermalito Afterbay Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Gridley							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991
Unknown	63	0	$0	$0	$0	$0	$0
City of Gridley Total	**2,451**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	1,182	651	$265,531,562	$81,809,849	$55,468,586	$81,809,849	$507,825,991
Commercial	43	30	$2,461,948	$8,131,071	$103,840	$8,131,071	$16,230,073
Industrial	29	27	$3,288,841	$60,884,973	$7,638,990	$91,327,460	$164,886,124
Residential	1,826	1,601	$113,544,972	$202,958,797	$2,357,652	$101,479,399	$424,132,029
Unknown	317	2	$436,873	$220,918	$85,120	$0	$1,696,507
Unincorporated Butte County Total	**3,397**	**2,311**	**$385,264,196**	**$354,005,608**	**$65,654,188**	**$282,747,778**	**$1,114,770,723**
Grand Total	**6,613**	**5,187**	**$525,025,452**	**$713,518,672**	**$81,632,437**	**$516,867,180**	**$1,824,455,772**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

High Hazard Dams

Dam analysis was performed for the mapped high hazard dams in the Butte County Planning Area. This includes Bidwell Bar, Canyon Saddle, De Sabla Forebay, Lake Almanor, Lake Wyandotte, Magalia, Miners Ranch, Shasta, and Thermalito Diversion. Analysis for these dams is presented in the following tables:

- Table 4-80 shows the total parcel counts, improved parcel counts, their improved structure and land values in all high hazard dam inundation areas prior to the Camp Fire.
- Table 4-81 shows the total parcel counts, improved parcel counts, their improved structure and land values in all high hazard dam inundation areas after the Camp Fire.
- Table 4-82 compares the improved structure values in all high hazard dam inundation areas in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-83 breaks down Table 4-81 into more detail, and shows post-fire values in all high hazard dam inundation areas by property use type.

Table 4-80 Butte County Planning Area – Pre-Fire Count and Value of Parcels in All High Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	0	0	$0	$0	$0	$0	$0
City of Chico	2	0	$0	$0	$0	$0	$0
City of Gridley	2	0	$0	$0	$0	$0	$0
City of Oroville	1,562	1,099	$93,973,757	$237,849,110	$45,672,487	$221,580,561	$599,075,915
Town of Paradise	0	0	$0	$0	$0	$0	$0

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County	2,488	1,608	$495,447,541	$259,044,548	$124,092,058	$209,917,861	$1,088,502,008
Grand Total	**4,054**	**2,707**	**$589,421,298**	**$496,893,658**	**$169,764,545**	**$431,498,422**	**$1,687,577,923**

Source: Cal OES, Butte County 2018 Parcel/Assessor's Data

Table 4-81 Butte County Planning Area – Post-Fire Count and Value of Parcels in All High Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	0	0	$0	$0	$0	$0	$0
City of Chico	3	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940
City of Gridley	2	0	$0	$0	$0	$0	$0
City of Oroville	1,563	1,094	$91,571,747	$232,439,950	$44,211,667	$216,261,801	$577,213,784
Town of Paradise	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County	3,670	2,609	$658,036,083	$480,172,262	$149,170,987	$356,000,677	$1,673,946,509
Grand Total	**5,238**	**3,704**	**$751,360,225**	**$713,730,830**	**$193,382,654**	**$573,940,404**	**$2,255,709,232**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-82 Butte County Planning Area – Comparison of Pre- and Post-Fire Structure Values at Risk to High Hazard Dam Inundation

Jurisdiction	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
City of Biggs	$0	$0	$0	0.0%
City of Chico	$0	$1,118,618	$1,118,618	0.0%
City of Gridley	$0	$0	$0	0.0%
City of Oroville	$237,849,110	$232,439,950	-$5,409,160	-2.3%
Town of Paradise	$0	$0	$0	0.0%
Unincorporated Butte County	$259,044,548	$480,172,262	$221,127,714	85.4%
Grand Total	**$496,893,658**	**$713,730,830**	**$216,837,172**	**43.6%**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-83 Butte County Planning Area - Count and Value of Parcels in All High Hazard Dam Inundation Zones by Jurisdiction and Property Use

Jurisdiction/ Property Use /	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Biggs Total	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940
Residential	2	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	**3**	**1**	**$1,752,395**	**$1,118,618**	**$0**	**$1,677,927**	**$4,548,940**
City of Gridley							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	1	0	$0	$0	$0	$0	$0
Unknown	1	0	$0	$0	$0	$0	$0
City of Gridley Total	**2**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
City of Oroville							
Agricultural	6	0	$0	$0	$0	$0	$0
Commercial	589	389	$48,631,011	$129,523,449	$3,349,747	$129,523,449	$291,332,935
Industrial	147	48	$21,260,503	$35,437,234	$40,861,920	$53,155,851	$174,080,348
Residential	749	655	$21,616,845	$67,165,001	$0	$33,582,501	$111,422,847
Unknown	78	2	$63,388	$314,266	$0	$	$377,654
City of Oroville Total	**1,563**	**1,094**	**$91,571,747**	**$232,439,950**	**$44,211,667**	**$216,261,801**	**$577,213,784**
Town of Paradise							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0

Jurisdiction/ Property Use /	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
Town of Paradise Total	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unincorporated Butte County							
Agricultural	1,380	949	$459,312,979	$167,348,892	$141,109,577	$167,348,892	$964,783,505
Commercial	94	67	$11,000,154	$16,467,520	$1,530,900	$16,467,520	$44,856,161
Industrial	75	45	$13,275,282	$24,237,553	$3,661,962	$36,356,330	$83,030,406
Residential	1,873	1,545	$173,386,072	$271,655,870	$2,233,568	$135,827,935	$578,308,861
Unknown	248	3	$1,061,596	$462,427	$634,980	$0	$2,967,576
Unincorporated Butte County Total	**3,670**	**2,609**	**$658,036,083**	**$480,172,262**	**$149,170,987**	**$356,000,677**	**$1,673,946,509**
Grand Total	**5,238**	**3,704**	**$751,360,225**	**$713,730,830**	**$193,382,654**	**$573,940,404**	**$2,255,709,232**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

The dam inundation analysis results for the Butte County Planning Area were also broken out by individual dam inundation area. For each high hazard dam a table was created showing the total and improved number of parcels and values at risk in each jurisdiction in the Butte County Planning Area to dam failure for each individual high hazard dam. These are shown for each dam inundation area:

- Bidwell Bar Canyon Saddle (Table 4-84)
- De Sabla Forebay (Table 4-85)
- Lake Almanor (Table 4-86)
- Lake Wyandotte (Table 4-87)
- Magalia (Table 4-88)
- Miners Ranch (Table 4-89)
- Shasta (Table 4-90)
- Thermalito Diversion (Table 4-91)

Table 4-84 Butte County Planning Area – Count and Value at Risk in Bidwell Bar Canyon Saddle Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	35	25	$13,728,228	$3,816,744	$4,053,152	$3,816,744	$25,807,593
Commercial	10	6	$1,631,118	$925,222	$15,000	$925,222	$3,496,562

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Industrial	0	0	$0	$0	$0	$0	$0
Residential	97	60	$4,957,922	$6,461,868		$3,230,934	$14,385,584
Unknown	7	0	%0	$0	$0	$0	$0
Unincorporated Butte County Total	**149**	**91**	**$20,317,268**	**$11,203,834**	**$4,068,152**	**$7,972,900**	**$43,689,739**
Grand Total	**149**	**91**	**$20,317,268**	**$11,203,834**	**$4,068,152**	**$7,972,900**	**$43,689,739**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-85 Butte County Planning Area – Count and Value at Risk in De Sabla Forebay Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	1	1	$21,530	$8,777	$0	$8,777	$11,808
Industrial	0	0	$0	$0	$0	$0	$0
Residential	80	58	$8,696,711	$13,228,784	$0	$6,614,392	$28,102,017
Unknown	6	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**87**	**59**	**$8,718,241**	**$13,237,561**	**$0**	**$6,623,169**	**$28,113,825**
Grand Total	**87**	**59**	**$8,718,241**	**$13,237,561**	**$0**	**$6,623,169**	**$28,113,825**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-86 Butte County Planning Area – Count and Value at Risk in Lake Almanor Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Gridley							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	1	0	$0	$0	$0	$0	$0
Unknown	1	0	$0	$0	$0	$0	$0

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Gridley Total	**2**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
City of Oroville							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	588	389	$48,610,851	$129,523,449	$3,349,747	$129,523,449	$291,312,775
Industrial	147	48	$21,260,503	$35,437,234	$40,861,920	$53,155,851	$174,080,348
Residential	749	655	$21,616,845	$67,165,001	$0	$33,582,501	$111,422,847
Unknown	78	2	$63,388	$314,266	$0	$0	$377,654
City of Oroville Total	**1,562**	**1,094**	**$91,551,587**	**$232,439,950**	**$44,211,667**	**$216,261,801**	**$577,193,624**
Unincorporated Butte County							
Agricultural	336	264	$99,804,899	$29,741,225	$31,871,683	$29,741,225	$198,283,225
Commercial	36	25	$4,093,590	$7,856,709	$615,230	$7,856,709	$20,683,655
Industrial	39	16	$3,565,252	$4,600,640	$1,365,798	$6,900,960	$17,006,289
Residential	422	329	$27,447,065	$36,009,402	$666,711	$18,004,701	$82,430,413
Unknown	117	2	$876,694	$326,000	$436,443	$0	$2,448,027
Unincorporated Butte County Total	**950**	**636**	**$135,787,500**	**$78,533,976**	**$34,955,865**	**$62,503,595**	**$320,851,609**
Grand Total	**2,514**	**1,730**	**$227,339,087**	**$310,973,926**	**$79,167,532**	**$278,765,396**	**$898,045,233**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-87 Butte County Planning Area – Count and Value at Risk in Lake Wyandotte Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	1	1	$16,513	$2,057	$0	$2,057	$20,627
Commercial	1	1	$29,127	$23,829	$0	$23,829	$76,785
Industrial	0	0	$0	$0	$0	$0	$0
Residential	23	19	$1,666,684	$952,025	$0	$476,013	$3,031,722
Unknown	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**25**	**21**	**$1,712,324**	**$977,911**	$0	**$501,899**	**$3,129,134**
Grand Total	**25**	**21**	**$1,712,324**	**$977,911**	$0	**$501,899**	**$3,129,134**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-88 Butte County Planning Area – Count and Value at Risk in Magalia Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	1	1	$1,752,395	$1,118,618	$0	$1,677,927	$4,548,940
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	**1**	**1**	**$1,752,395**	**$1,118,618**	$0	**$1,677,927**	**$4,548,940**
Unincorporated Butte County							
Agricultural	296	243	$58,932,287	$38,161,997	$23,532,727	$38,161,997	$164,685,899
Commercial	28	21	$3,949,188	$6,306,253	$848,970	$6,306,253	$16,501,364
Industrial	25	19	$9,198,751	$14,028,921	$821,674	$21,043,382	$48,941,998
Residential	842	745	$100,467,346	$171,118,053	$860,682	$85,559,027	$353,938,156
Unknown	27	0	$5,519	$0	$0	$0	$5,202
Unincorporated Butte County Total	**1,218**	**1,028**	**$172,553,091**	**$229,615,224**	**$26,064,053**	**$151,070,658**	**$584,072,618**
Grand Total	**1,219**	**1,029**	**$174,305,486**	**$230,733,842**	**$26,064,053**	**$152,748,585**	**$588,621,558**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-89 Butte County Planning Area – Count and Value at Risk in Miner's Ranch Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Oroville							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	1	0	$20,160	$0	$0	$0	$20,160
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Oroville Total	**1**	**0**	**$20,160**	$0	$0	$0	**$20,160**
Unincorporated Butte County							
Agricultural	9	6	$1,327,725	$216,540	$28,514	$216,540	$1,785,259

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Commercial	18	14	$1,469,601	$1,714,205	$51,700	$1,714,205	$4,987,661
Industrial	0	0	$0	$0	$0	$0	$0
Residential	220	159	$9,797,218	$13,054,502	$1,196	$6,527,251	$28,906,043
Unknown	8	0	$4,367	$0	$0	$0	$4,367
Unincorporated Butte County Total	**255**	**179**	**$12,598,911**	**$14,985,247**	**$81,410**	**$8,457,996**	**$35,683,330**
Grand Total	**256**	**179**	**$12,619,071**	**$14,985,247**	**$81,410**	**$8,457,996**	**$35,703,490**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-90 Butte County Planning Area – Count and Value at Risk in Shasta Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	2	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	**2**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unincorporated Butte County							
Agricultural	739	432	$298,084,117	$99,072,129	$85,456,178	$99,072,129	$598,340,664
Commercial	6	4	$433,881	$192,959		$192,959	$819,799
Industrial	11	10	$511,279	$5,607,992	$1,474,490	$8,411,988	$17,082,119
Residential	271	224	$26,408,194	$37,818,284	$704,979	$18,909,142	$83,717,416
Unknown	83	1	$175,016	$136,427	$198,537		$509,980
Unincorporated Butte County Total	**1,110**	**671**	**$325,612,487**	**$142,827,791**	**$87,834,184**	**$126,586,218**	**$700,469,978**
Grand Total	**1,112**	**671**	**$325,612,487**	**$142,827,791**	**$87,834,184**	**$126,586,218**	**$700,469,978**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-91 Butte County Planning Area – Count and Value at Risk in Thermalito Diversion Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Gridley							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	1	0	$0	$0	$0	$0	$0
Unknown	1	0	$0	$0	$0	$0	$0
City of Gridley Total	**2**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
City of Oroville							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	6	2	$212,547	$291,443	$184,125	$291,443	$982,248
Industrial	9	1	$331,356	$150,858	$0	$226,287	$708,501
Residential	14	2	$584,056	$385,261	$0	$192,631	$1,157,948
Unknown	8	0	$0	$0	$0	$0	$0
City of Oroville Total	**37**	**5**	**$1,127,959**	**$827,562**	**$184,125**	**$710,361**	**$2,848,697**
Unincorporated Butte County							
Agricultural	42	29	$11,457,231	$2,618,679	$4,785,311	$2,618,679	$21,803,550
Commercial	17	11	$2,107,040	$2,226,480	$154,000	$2,226,480	$7,143,000
Industrial	30	12	$1,721,196	$4,012,389	$1,294,298	$6,018,584	$13,510,106
Residential	101	61	$5,605,236	$4,970,090	$308,684	$2,485,045	$13,653,495
Unknown	67	2	$805,236	$326,000	$436,443		$2,388,341
Unincorporated Butte County Total	**257**	**115**	**$21,695,939**	**$14,153,638**	**$6,978,736**	**$13,348,788**	**$58,498,492**
Grand Total	**296**	**120**	**$22,823,898**	**$14,981,200**	**$7,162,861**	**$14,059,148**	**$61,347,188**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Significant Hazard Dams

Dam analysis was performed for the mapped significant hazard dams in the Butte County Planning Area. This includes Kunkle, Philbrook, and Poe. Analysis for these dams is presented in the following tables:

- Table 4-92 shows the total parcel counts, improved parcel counts, their improved structure and land values in all significant hazard dam inundation areas prior to the Camp Fire.

- Table 4-93 shows the total parcel counts, improved parcel counts, their improved structure and land values in all significant hazard dam inundation areas after the Camp Fire.
- Table 4-94 compares the improved structure values in all significant hazard dam inundation areas in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-95 breaks down Table 4-93 into more detail, and shows post-fire values in all significant hazard dam inundation areas by property use type.

Table 4-92 Butte County Planning Area – Pre-Fire Count and Value of Parcels in All Significant Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	0	0	$0	$0	$0	$0	$0
City of Chico	0	0	$0	$0	$0	$0	$0
City of Gridley	0	0	$0	$0	$0	$0	$0
City of Oroville	0	0	$0	$0	$0	$0	$0
Town of Paradise	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County	39	1	$567,619	$200,000	$0	$100,000	$867,619
Grand Total	**39**	**1**	**$567,619**	**$200,000**	**$0**	**$100,000**	**$867,619**

Source: Cal OES, Butte County 2018 Parcel/Assessor's Data

Table 4-93 Butte County Planning Area – Post-Fire Count and Value of Parcels in All Significant Hazard Dam Inundation Areas by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs	0	0	$0	$0	$0	$0	$0
City of Chico	0	0	$0	$0	$0	$0	$0
City of Gridley	0	0	$0	$0	$0	$0	$0
City of Oroville	0	0	$0	$0	$0	$0	$0
Town of Paradise	0	0	$0	$0	$0	$0	$0
Unincorporated Butte County	39	1	$567,619	$200,000	$0	$100,000	$867,619
Grand Total	**39**	**1**	**$567,619**	**$200,000**	**$0**	**$100,000**	**$867,619**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-94 Butte County Planning Area – Comparison of Pre- and Post-Fire Structure Values at Risk to Significant Hazard Dam Inundation

Jurisdiction	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
City of Biggs	$0	$0	$0	0.0%
City of Chico	$0	$0	$0	0.0%
City of Gridley	$0	$0	$0	0.0%
City of Oroville	$0	$0	$0	0.0%
Town of Paradise	$0	$0	$0	0.0%
Unincorporated Butte County	$200,000	**$200,000**	$0	0.0%
Grand Total	**$200,000**	**$200,000**	**$0**	**0.0%**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-95 Butte County Planning Area - Count and Value of Parcels in All Significant Hazard Dam Inundation Zones by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Biggs Total	0	0	$0	$0	$0	$0	$0
City of Chico							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Chico Total	0	0	$0	$0	$0	$0	$0
City of Gridley							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unknown	0	0	$0	$0	$0	$0	$0
City of Gridley Total	0	0	$0	$0	$0	$0	$0
City of Oroville							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
City of Oroville Total	0	0	$0	$0	$0	$0	$0
Town of Paradise							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	0	0	$0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0	$0
Town of Paradise Total	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unincorporated Butte County							
Agricultural	2	0	$58,537	$0	$0	$0	$58,537
Commercial	1	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	18	1	$509,082	$200,000	$0	$100,000	$809,082
Unknown	18	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**39**	**1**	**$567,619**	**$200,000**	$0	**$100,000**	**$867,619**
Grand Total	**39**	**1**	**$567,619**	**$200,000**	**$0**	**$100,000**	**$867,619**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

The dam inundation analysis results for the Butte County Planning Area were also broken out by dam inundation area. For each significant hazard dam a table was created showing the total and improved number of parcels and values at risk in each jurisdiction in the Butte County Planning Area to dam failure for each individual significant hazard dam. These are shown for each dam inundation area:

- Kunkle Dam (Table 4-96)
- Philbrook Dam (Table 4-97)

- Poe Dam (Table 4-98)

Table 4-96 Butte County Planning Area – Count and Value at Risk in Kunkle Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	3	1	$298,204	$200,000	$0	$100,000	$598,204
Unknown	1	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**4**	**1**	**$298,204**	**$200,000**	**$0**	**$100,000**	**$598,204**
Grand Total	**4**	**1**	**$298,204**	**$200,000**	**$0**	**$100,000**	**$598,204**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-97 Butte County Planning Area – Count and Value at Risk in Philbrook Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	2	0	$58,537	$0	$0	$0	$58,537
Commercial	1	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	11	0	$210,878	$0	$0	$0	$210,878
Unknown	5	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**19**	**0**	**$269,415**	**$0**	**$0**	**$0**	**$269,415**
Grand Total	**19**	**0**	**$269,415**	**$0**	**$0**	**$0**	**$269,415**

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-98 Butte County Planning Area – Count and Value at Risk in Poe Dam Inundation Area by Jurisdiction and Property Use

Jurisdiction/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	4	0	$0	$0	$0	$0	$0
Unknown	12	0	$0	$0	$0	$0	$0
Unincorporated Butte County Total	**16**	**0**	$0	$0	$0	$0	$0
Grand Total	**16**	**0**	$0	$0	$0	$0	$0

Source: Cal OES, Butte County 3/28/2019 Parcel/Assessor's Data

Dam Inundation - Flooded Acres

In addition to the centroid analysis used to obtain numbers of parcels and values at risk to the dam failure hazard, parcel boundary analysis was performed to obtain total acres and flooded acres by dam inundation area. The following is an analysis of inundated or flooded acres associated with dam failures and inundation areas in the County.

Methodology

GIS was used to calculate acres flooded by each Cal OES dam inundation area. The parcel layer was intersected with the Cal OES dam inundation area data to obtain the acres inundated by dam. The Butte County parcel layer and inundation areas were intersected, and each segment divided by the intersection of inundation area and parcels was calculated for acres. The resulting data tables with flooded acreages were then imported into a database and linked back to the original parcels, including total acres by parcel number. Once this was completed, each parcel contained acreage values for flooded acre by dam inundation area within the parcel.

Limitations

One limitation created by this type of analysis is that with respect to the improved acres analysis, improvements are uniformly found throughout the parcel, while in reality, only portions of the parcel are improved, and improvements may or may not fall within the inundated portion of a parcel; thus, areas of improvements inundated, calculated through this method, may be higher or lower than those actually seen in a similar real-world event.

Analysis Results

The following tables represent a summary and detailed analysis of total acres for each dam inundation area in the Planning Area. Table 4-99 gives summary information by jurisdiction and dam inundation area for the entire Butte County Planning Area.

Table 4-99 Butte County Planning Area – Flooded Acres by Jurisdiction and Dam Inundation Area

Jurisdiction/ Dam Inundation Area	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
Oroville	474	0.04%	201	0.06%	272	0.04%
Thermalito AB	474	0.04%	201	0.06%	272	0.04%
City of Chico						
Magalia	46	0.00%	45	0.01%	1	0.00%
Paradise	46	0.00%	45	0.01%	1	0.00%
Shasta	126	0.01%	0	0.00%	126	0.02%
City of Gridley						
Lake Almanor	85	0.01%	0	0.00%	85	0.01%
Oroville	1,184	0.11%	696	0.19%	488	0.07%
Thermalito AB	1,142	0.11%	696	0.19%	446	0.06%
Thermalito Diversion	79	0.01%	0	0.00%	79	0.01%
City of Oroville						
Lake Almanor	1,804	0.17%	789	0.22%	1,015	0.14%
Miners Ranch	27	0.00%	0	0.00%	27	0.00%
Oroville	6,166	0.58%	2,310	0.65%	3,856	0.55%
Thermalito Diversion	213	0.02%	7	0.00%	206	0.03%
Unincorporated Butte County						
Bidwell Bar Canyon Saddle	5,338	0.50%	3,686	1.03%	1,652	0.24%
De Sabla FB	711	0.07%	302	0.08%	409	0.06%
Kunkle	68	0.01%	20	0.01%	48	0.01%
Lake Wyandotte	691	0.07%	441	0.12%	250	0.04%
Lake Almanor	31,922	3.01%	20,814	5.82%	11,108	1.58%
Magalia	13,724	1.29%	11,036	3.09%	2,688	0.38%
Miners Ranch	1,450	0.14%	840	0.23%	611	0.09%

Jurisdiction/ Dam Inundation Area	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Oroville	209,331	19.75%	89,665	25.09%	119,665	17.03%
Paradise	14,040	1.32%	11,127	3.11%	2,912	0.41%
Philbrook	2,885	0.27%	66	0.02%	2,818	0.40%
Poe	2,467	0.23%	14	0.00%	2,453	0.35%
Shasta	126,044	11.89%	65,844	18.42%	60,200	8.57%
Thermalito AB	90,803	8.57%	40,040	11.20%	50,763	7.23%
Thermalito Diversion	10,943	1.03%	3,550	0.99%	7,393	1.05%

Source: Cal OES, Butte County 3/21/2019 Parcel/Assessor's Data

Population at Risk

A separate analysis was performed to determine population in dam inundation areas for dams with available inundation maps. Using GIS, the dam inundation area dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect an inundation area were counted and multiplied by the Census Bureau average household size for jurisdictions in Butte County. Table 4-100 shows the populations at risk to dam failure flooding for extremely high hazard dams. According to this analysis, for the entire Planning Area, there is a population of 42,973 in extremely high hazard dam inundation areas. It is unlikely that all dams that could affect Butte County would fail at the same time.

Table 4-100 Butte County Planning Area – Residential Population at Risk in Extremely High Hazard Dam Inundation Area by Jurisdiction

Jurisdiction	Oroville	Paradise	Thermalito	All Dams
Biggs	1,566	0	1,566	3,132
Chico	0	0	0	0
Gridley	4,844	0	4,844	9,688
Oroville	10,533	0	0	10,533
Paradise	0	0	0	0
Unincorporated County	12,432	2,385	4,803	19,620
Total	**29,375**	**2,385**	**11,213**	**42,973**

Source: Cal OES; Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Table 4-101 shows the populations at risk to dam failure flooding for high hazard dams. According to this analysis, for the entire Planning Area, there is a population of 18,898 in high hazard dam inundation areas. It is unlikely that all dams that could affect Butte County would fail at the same time.

Table 4-101 Butte County Planning Area – Residential Population at Risk in High Hazard Dam Inundation Area by Jurisdiction

Jurisdiction	Bidwell Bar Canyon Saddle	De Sabla Forebay	Lake Almanor	Lake Wyandotte	Magalia	Miners Ranch	Shasta	Thermalito Diversion	All Dams
Biggs	0	0	0	0	0	0	0	1,566	
Chico	0	0	0	0	3	0	0	0	0
Gridley	0	0	0	0	0	0	0	5,852	5,852
Oroville	0	0	1,703	0	0	0	0	0	1,703
Paradise	0	0	0	0	0	0	0	0	0
Unincorporated County	180	174	987	57	2,235	2,235	672	4,803	11,343
Total	**180**	**174**	**2,690**	**57**	**2,238**	**2,235**	**672**	**12,221**	**18,898**

Source: Cal OES; Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Table 4-102 shows the populations at risk to dam failure flooding for significant hazard dams. According to this analysis, for the entire Planning Area, there is a population of 3 in significant hazard dam inundation areas.

Table 4-102 Butte County Planning Area – Residential Population at Risk in Significant Hazard Dam Inundation Area by Jurisdiction

Jurisdiction	Kunkle	Philbrook	Poe	All Dams
Biggs	0	0	0	0
Chico	0	0	0	0
Gridley	0	0	0	0
Oroville	0	0	0	0
Paradise	0	0	0	0
Unincorporated County	3	0	0	3
Total	**3**	**0**	**0**	**3**

Source: Cal OES; Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Butte County and all jurisdictions to determine critical facilities in the areas affected dam failure. Using GIS, the Cal OES dam inundation areas were overlayed on the critical facility GIS layer. The analysis was broken up by dam hazard classification:

- Figure 4-95 shows the critical facilities and extremely high hazard dam inundation areas. Table 4-103 shows a summary of critical facilities in extremely high dam inundation areas by jurisdiction. Table 4-104 details the critical facilities in the unincorporated County that fall in extremely high dam inundation zones.

- Figure 4-96 shows the critical facilities and high hazard dam inundation areas. Table 4-105 shows a summary of critical facilities in high hazard dam inundation areas by jurisdiction Table 4-106 details the critical facilities in the unincorporated County that fall in high dam inundation zones.
- Figure 4-97 shows the critical facilities and significant hazard dam inundation areas. Table 4-107 shows the breakdown of critical facilities in significant hazard dam inundation areas by jurisdiction. As shown in this table, there are no critical facilities in the significant hazard dam inundation areas in the County. As such, no detail table is provided for the unincorporated County.

Information on critical facilities in the incorporated jurisdictions in the County can be found in their respective annexes to this LHMP Update. Details of critical facility definition, type, name and address and jurisdiction by dam inundation area are listed in Appendix F.

Figure 4-98 Butte County Planning Area – Critical Facilities and Extremely High Hazard Dam Inundation Areas

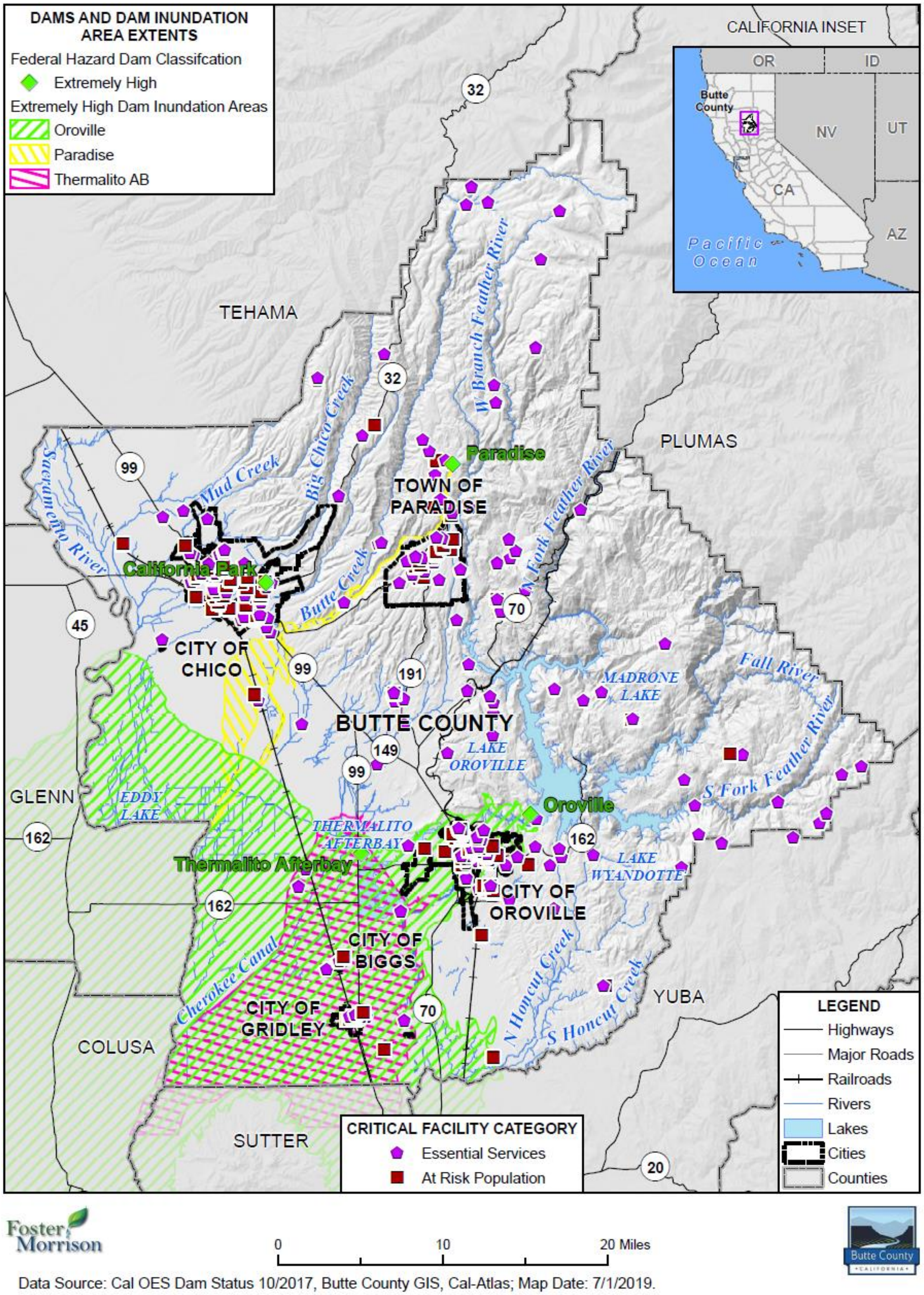


Table 4-103 Butte County Planning Area – Critical Facilities in Extremely High Hazard Dam Inundation Areas by Jurisdiction and Facility Category

Jurisdiction / Critical Facility Category	Facility Count
City of Biggs	
Essential Services Facilities	3
At Risk Population Facilities	4
City of Biggs Total	**7**
City of Chico	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Chico Total	**0**
City of Gridley	
Essential Services Facilities	11
At Risk Population Facilities	6
City of Gridley Total	**17**
City of Oroville	
Essential Services Facilities	38
At Risk Population Facilities	19
City of Oroville Total	**57**
Town of Paradise	
Essential Services Facilities	0
At Risk Population Facilities	0
Town of Paradise Total	**0**
Unincorporated Butte County	
Essential Services Facilities	8
At Risk Population Facilities	6
Unincorporated Butte County Total	**14**
Outside of Butte County	
Essential Services Facilities	0
At Risk Population Facilities	0
Outside of Butte County Total	**0**
Grand Total	**95**

Source: Cal OES, Butte County GIS

Table 4-104 Unincorporated Butte County – Critical Facilities in Extremely High Hazard Dam Inundation Zones by Facility Category and Type

Critical Facility Category / Critical Facility Type	Oroville	Paradise	Thermalito AB
	Facility Count		
Essential Service Facilities			
Wastewater Treatment Plant	1	0	1
Fire	2	1	2
Dam	4	0	1
Essential Services Facilities Total	**7**	**1**	**4**
At Risk Population Facilities			
School	3	3	1
At Risk Population Facilities Total	**3**	**3**	**1**
Unincorporated Butte County Total	**10**	**4**	**5**

Source: Cal OES, Butte County GIS

Figure 4-99 Butte County Planning Area – Critical Facilities and High Hazard Dam Inundation Areas

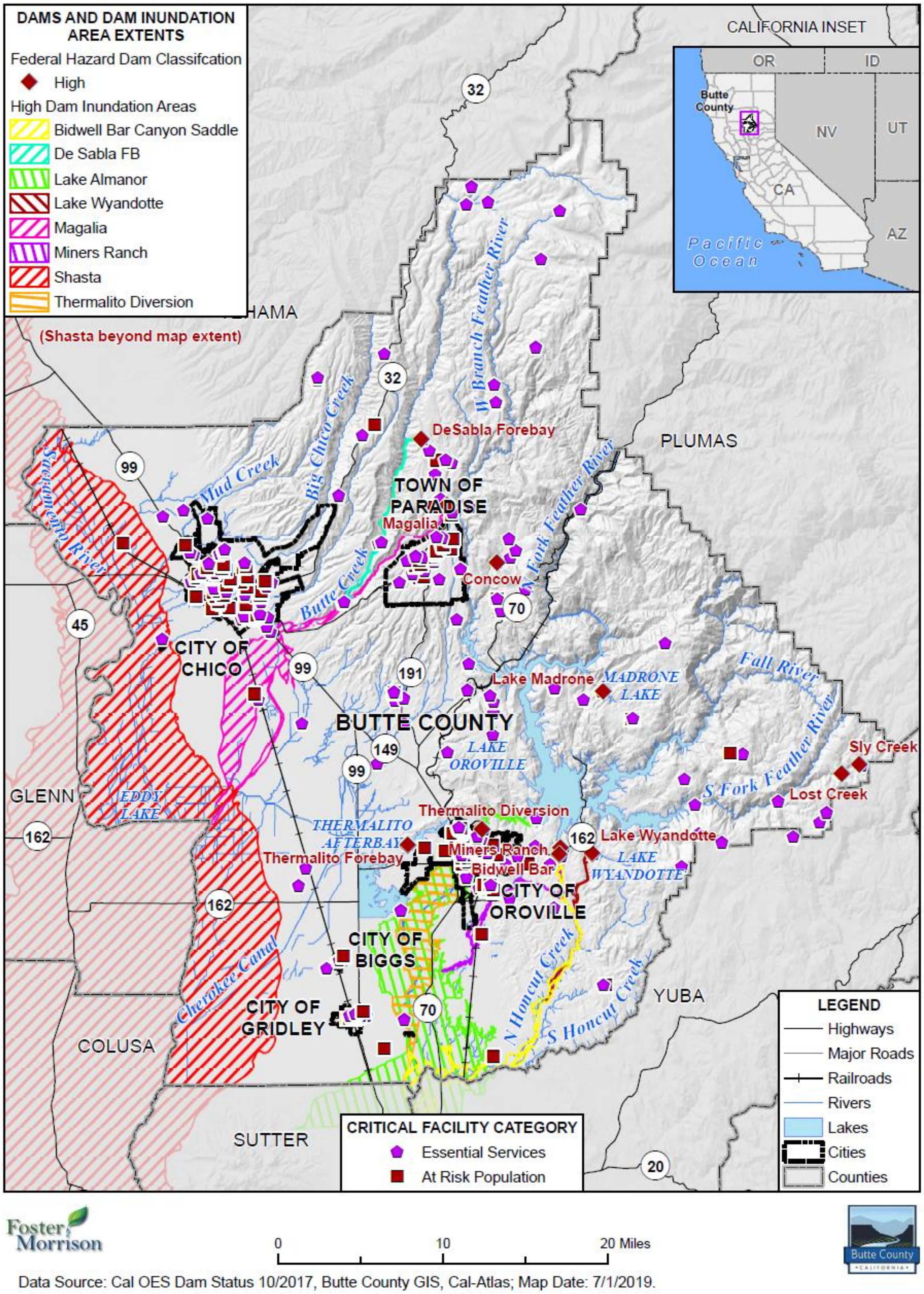


Table 4-105 Butte County Planning Area – Critical Facilities in High Hazard Dam Inundation Areas by Jurisdiction and Facility Category

Jurisdiction / Critical Facility Category	Facility Count
City of Biggs	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Biggs Total	**0**
City of Chico	
Essential Services Facilities	1
At Risk Population Facilities	0
City of Chico Total	**1**
City of Gridley	
Essential Services Facilities	1
At Risk Population Facilities	0
City of Gridley Total	**1**
City of Oroville	
Essential Services Facilities	9
At Risk Population Facilities	6
City of Oroville Total	**15**
Town of Paradise	
Essential Services Facilities	0
At Risk Population Facilities	0
Town of Paradise Total	**0**
Unincorporated Butte County	
Essential Services Facilities	7
At Risk Population Facilities	6
Unincorporated Butte County Total	**11**
Outside of Butte County	
Essential Services Facilities	0
At Risk Population Facilities	0
Outside of Butte County Total	**0**
Grand Total	**28**

Source: Cal OES, Butte County GIS

Table 4-106 Unincorporated Butte County – Critical Facilities in Significant Hazard Dam Inundation Area by Facility Category and Type

Critical Facility Category / Critical Facility Type	Bidwell Bar Canyon Saddle	De Sabla FB	Lake Almanor	Lake Wyandotte	Magalia	Miners Ranch	Shasta	Thermalito Diversion
	Facility Count							
Essential Services Facilities								
Wastewater Treatment Plant	0	0	0	0	0	0	0	0
Fire	0	1	0	0	1	0	0	
Dam	0	0	2	0		0	0	2
Essential Services Facilities Total	**0**	**1**	**2**	**0**	**1**	**0**	**0**	**2**
At Risk Population Facilities								
School	0	0	0	0	3	0	0	0
At Risk Population Facilities Total	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
Unincorporated Butte County Total	**0**	**1**	**2**	**0**	**4**	**0**	**0**	**2**

Source: Cal OES, Butte County GIS

Figure 4-100 Butte County Planning Area – Critical Facilities and Significant Hazard Dam Inundation Areas

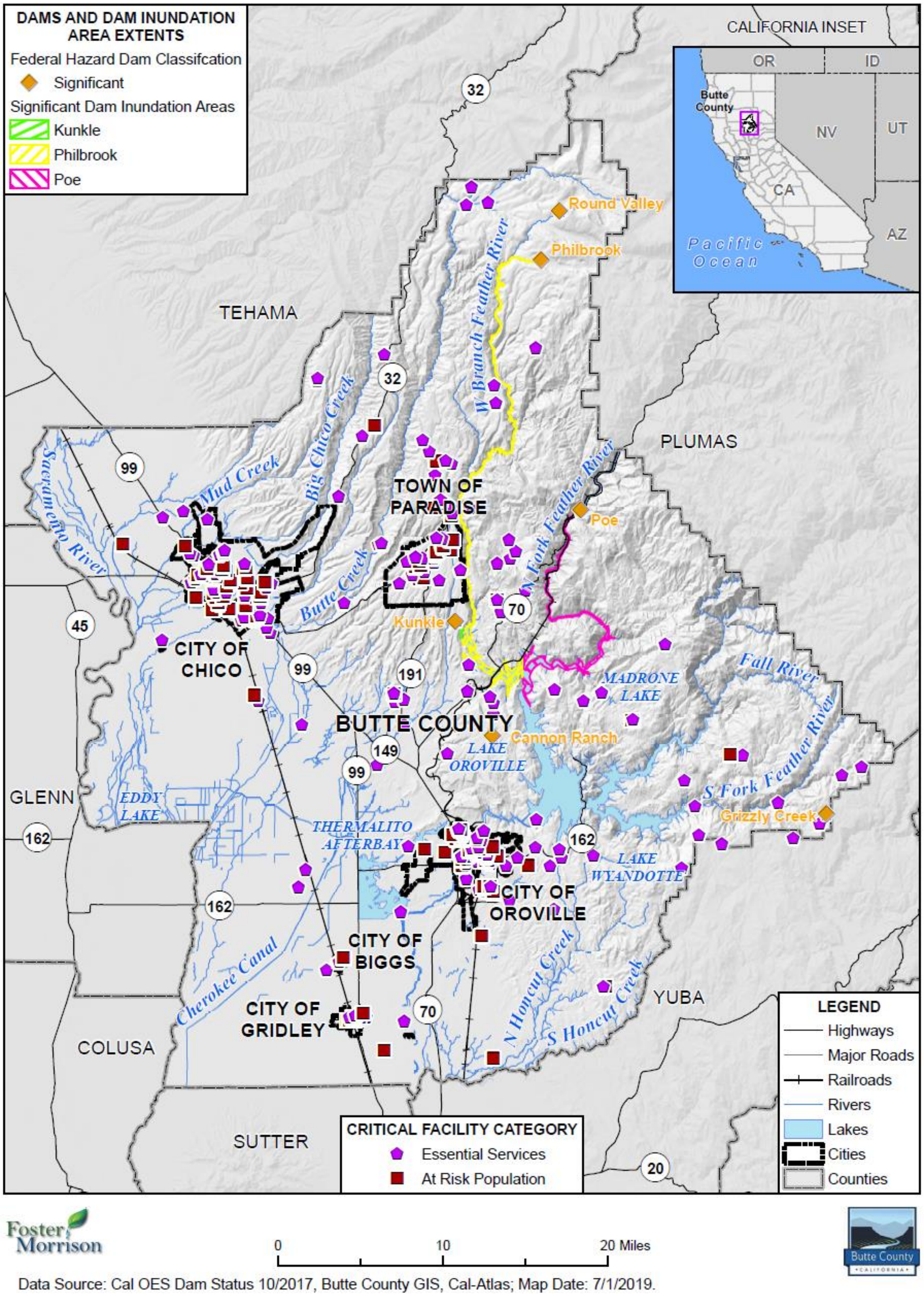


Table 4-107 Butte County Planning Area – Critical Facilities in Significant Hazard Dam Inundation Areas by Jurisdiction and Facility Type

Jurisdiction / Critical Facility Category	Facility Count
City of Biggs	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Biggs Total	**0**
City of Chico	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Chico Total	**0**
City of Gridley	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Gridley Total	**0**
City of Oroville	
Essential Services Facilities	0
At Risk Population Facilities	0
City of Oroville Total	**0**
Town of Paradise	
Essential Services Facilities	0
At Risk Population Facilities	0
Town of Paradise Total	**0**
Unincorporated Butte County	
Essential Services Facilities	0
At Risk Population Facilities	0
Unincorporated Butte County Total	**0**
Outside of Butte County	
Essential Services Facilities	0
At Risk Population Facilities	0
Outside of Butte County Total	**0**
Grand Total	**0**

Source: Cal OES, Butte County GIS

Overall Community Impact

Dam failure floods and their impacts vary by location and severity of any given dam failure event and will likely only affect certain areas of the Butte County Planning Area during specific times. Based on the risk assessment, it is evident that dam failure floods have the potential for devastating life safety, property, environmental, and economic impacts to certain areas of the County. Impacts that are not always quantified, but can be anticipated in a large dam failure event, include:

- Injury and loss of life;
- Impacts to agricultural production;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.
- Impact on the overall mental health of the community.

Future Development

Although new growth and development corridors would fall in the area inundated by a dam failure, given the limited potential of total dam failure and the large area that a dam failure would affect, development in the dam inundation areas will continue to occur.

Future Development GIS Analysis

Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of dam inundations to the 8 future development projects.

Methodology

Butte County's 3/28/2019 Parcel/Assessor's data and data provided by County Planning were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas. Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file and the APNs, the 8 future development projects were identified. For the dam inundation analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected with the dam inundation areas to determine the parcel counts and acreage within each inundation area.

Extremely high hazard dams and future development areas are shown on Figure 4-101 and parcels and acreages in those areas are shown in Table 4-108. High hazard dams and future development areas are shown on Figure 4-102 and parcels and acreages in those areas are shown in Table 4-109.

Figure 4-101 Unincorporated Butte County – Future Development in Extremely High Hazard Dam Inundation Areas

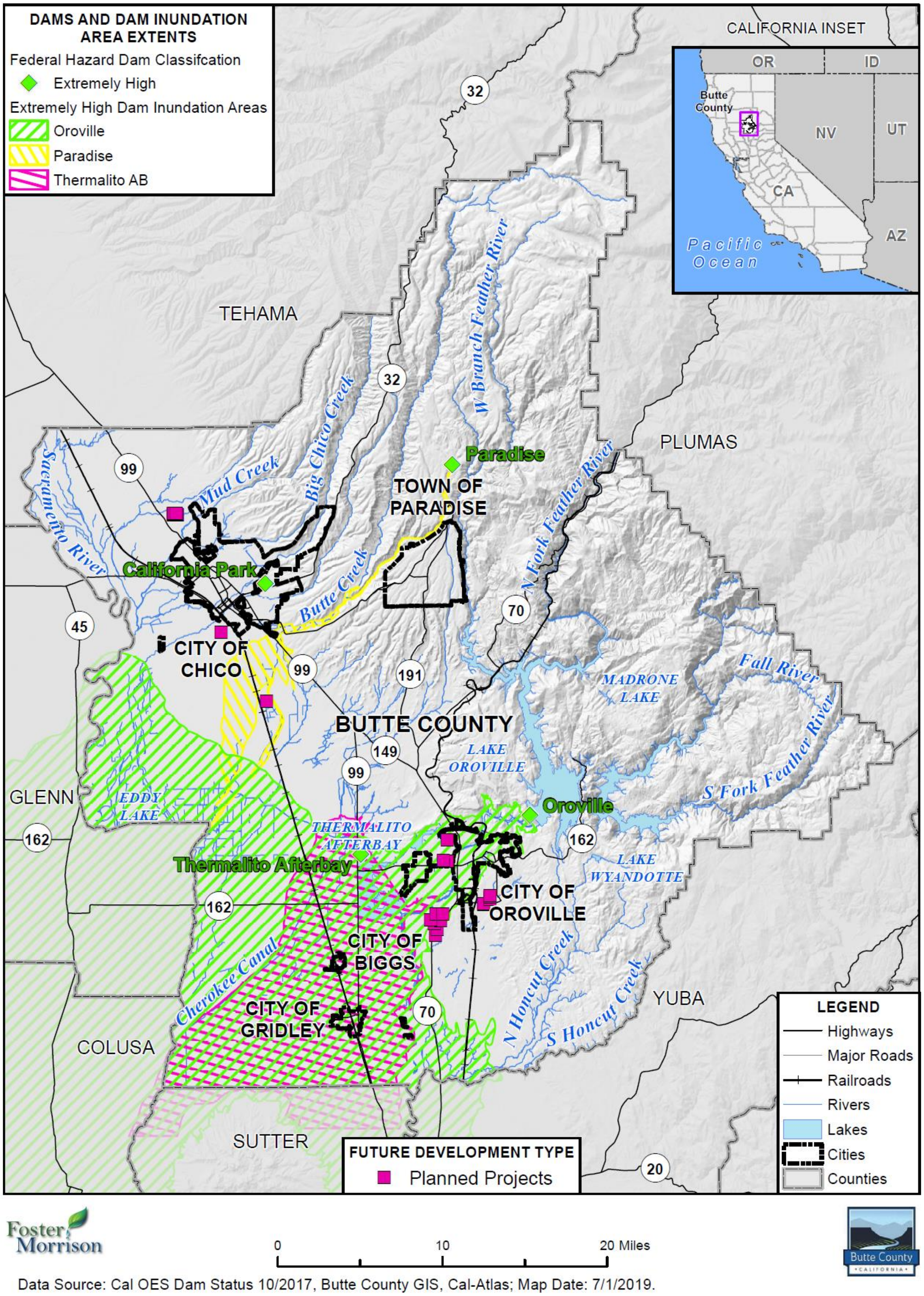
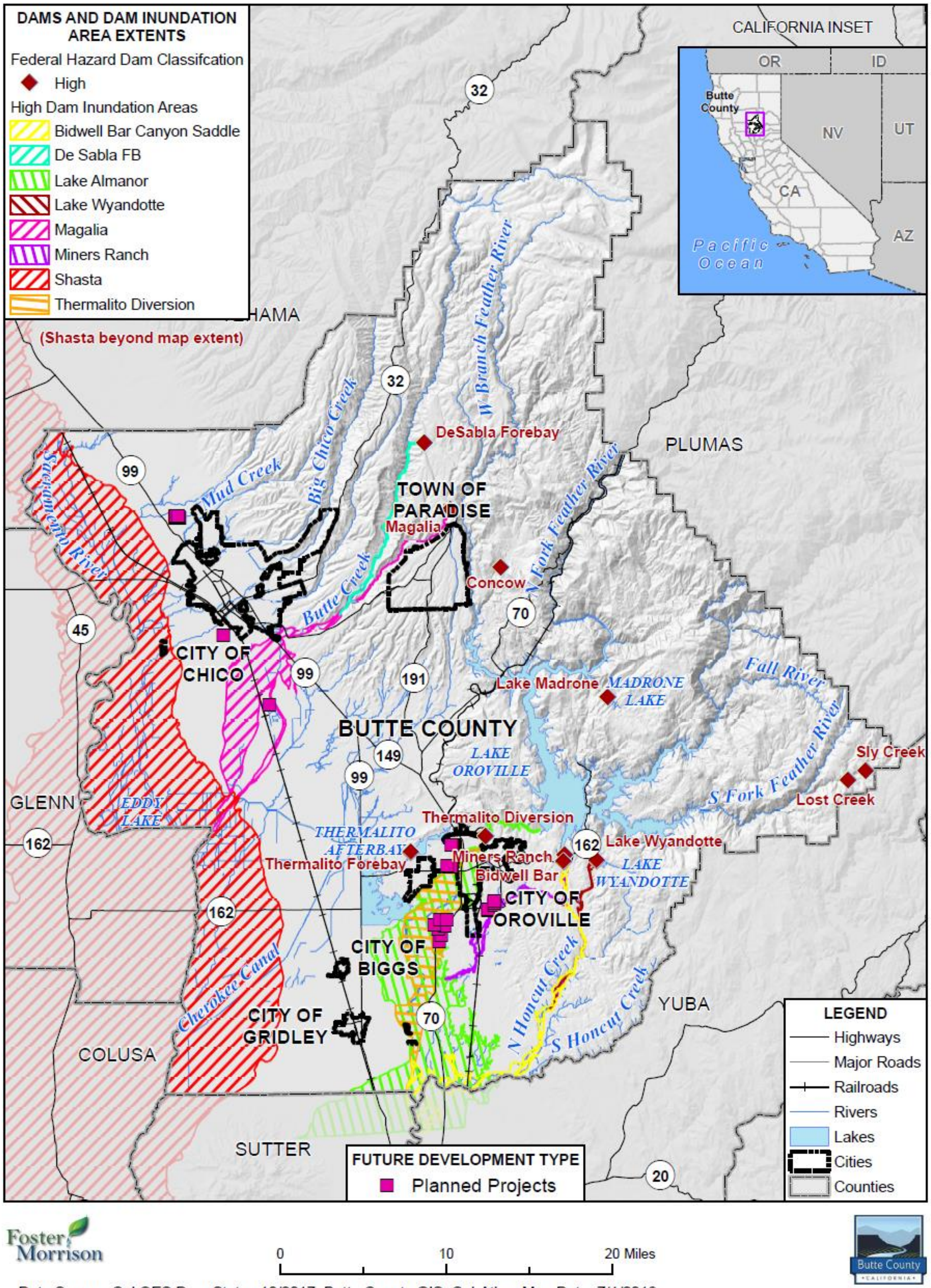


Table 4-108 Unincorporated Butte County – Future Development Parcels and Acreage in Extremely High Hazard Dam Inundation Areas

Extremely High Dam Inundation Areas / Future Development	Total Parcel Count	Improved Parcel Count	Total Acres
Lake Almanor Dam Inundation Area			
Rio d Oro - Phase 1	1	0	0.9
Oroville Dam Inundation Area			
Butte Vista	1	0	9.7
Diamond Oak	2	1	7.9
Rio d Oro - Phase 1	5	0	508.3
Total	**8**	**1**	**525.9**

Source: Cal OES, Butte County GIS

Figure 4-102 Unincorporated Butte County – Future Development in High Hazard Dam Inundation Areas



Data Source: Cal OES Dam Status 10/2017, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-109 Unincorporated Butte County – Future Development Parcels and Acreage in High Hazard Dam Inundation Areas

High Dam Inundation Areas / Future Development	Total Parcel Count	Improved Parcel Count	Total Acres
Thermalito Diversion Dam Inundation Area			
Rio d Oro - Phase 1	1	0	0.9
Total	**1**	**0**	**0.9**

Source: Cal OES, Butte County GIS

4.3.5. Drought and Water Shortage Vulnerability Assessment

Likelihood of Future Occurrence—Likely (Drought)/Occasional (Water Shortage)
Vulnerability—Medium

Drought is not initially recognized as a problem because it normally originates in what is considered good weather, which typically includes a dry late spring and summer in Mediterranean climates, such as in California. This is particularly true in Northern California where drought impacts are delayed for most of the population by the wealth of stored surface and ground water. The drought complications normally appear more than a year after a drought begins. In most areas of California, ranchers that rely on rainfall to support forage for their livestock are the earliest and most affected by drought. Even below normal water years could affect ranchers depending on the timing and duration of precipitation events. It is difficult to quantitatively assess drought impacts to Butte County because not many county-specific studies have been conducted. Some factors to consider include the impacts of fallowed agricultural land, habitat loss and associated effects on wildlife, the drawdown of the groundwater table, and the impact on the wildfire risk. The most direct and likely most difficult drought impact to quantify is to local economies, especially agricultural economies. The State has conducted some empirical studies on the economic effects of fallowed lands with regard to water purchased by the State's Water Bank; but these studies do not quantitatively address the situation in Butte County. It can be assumed, however, that the loss of production in one sector of the economy would affect other sectors.

The drawdown of the groundwater table is one factor that has been recognized to occur during repeated dry years. Lowering of groundwater levels results in the need to deepen wells, which subsequently lead to increased pumping costs. These costs are a major consideration for residents relying on domestic wells and agricultural producers that irrigate with groundwater and/or use it for frost protection. Some communities in higher elevations with shallow bedrock do not have a significant source of groundwater.

Drought has the potential to affect the entire Butte County Planning Area. 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. Also, during a drought, allocations go down and water costs increase, which results in reduced water availability. Voluntary conservation measures are a normal and ongoing part of system operations and 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.

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. Tracking drought impacts can be difficult. The Drought Impact Reporter from the NDMC is a useful reference tool that compiles reported drought impacts nationwide. Table 4-110 show drought impacts for the Butte County Planning Area from 1850 to May 2019. The data represented is skewed, with the majority of these impacts from records within the past ten years.

Table 4-110 Butte County Drought Impacts

Category	Number of Impacts
Agriculture	57
Business and Industry	11
Energy	5
Fire	15
Plants & Wildlife	32
Relief, Response, and Restrictions	92
Society and Public Health	44
Tourism and Recreation	7
Water Supply and Quality	91
Total	**354**

Source: National Drought Mitigation Center, 1/1/1850-5/15/2019

Tree Mortality

One of the specific vulnerabilities of drought in Butte County is the increased risk to trees from beetle kill and other tree mortality issues. Bark beetles mine the inner bark (the phloem-cambial region) on twigs, branches, or trunks of trees and shrubs. This activity often starts a flow of tree sap in conifers, but sometimes even in hardwoods like elm and walnut. The sap flow (pitch tube) is accompanied by the sawdust like frass created by the beetles. Frass accumulates in bark crevices or may drop and be visible on the ground or in spider webs. Small emergence holes in the bark are a good indication that bark beetles were present. Removal of the bark with the emergence holes often reveals dead and degraded inner bark and sometimes new adult beetles that have not yet emerged. Bark beetles frequently attack trees weakened by drought, disease, injuries, or other factors that may stress the tree. Bark beetles can contribute to the decline and eventual death of trees; however only a few aggressive beetle species are known to be the sole cause of tree mortality (see Figure 4-103).

Figure 4-103 Monterey Pine Killed by Engraver Beetles

Source: University of California

In addition to attacking larger limbs, some species such as cedar and cypress bark beetles feed by mining twigs up to 6 inches back from the end of the branch, resulting in dead tips. These discolored shoots hanging on the tree are often referred to as "flagging" or "flags." (see Figure 4-104) Adult elm bark beetles feed on the inner bark of twigs before laying eggs. If an adult has emerged from cut logs or a portion of a tree that is infected by Dutch elm disease, the beetle's body will be contaminated with fungal spores. When the adult beetle feeds on twigs, the beetle infects healthy elms with the fungi that cause Dutch elm disease. Elms showing yellowing or wilting branches in spring may be infected with Dutch elm disease.

Figure 4-104 Flag Tips from Cypress Bark Beetle Feeding

Source: University of California

Tree mortality issues have contributed to the wildfire hazard in the Butte County Planning Area. More information regarding tree mortality is discussed in the wildfire vulnerability in Section 4.3.18.

Future Development

According to the HMPC, Butte County has access to large quantities of water through its groundwater as well as surface water. However, population growth in the County will add additional pressure to water companies during periods of drought and water shortage. Water companies will need to continue to plan for and add infrastructure capacity for population growth. Population growth will be a challenge not only with regard to Butte County's water access for ag production, but state- and nation-wide with regard to food production. As more cropland is taken out of production to provide housing to accommodate for population growth, it is noted that more food production would also be needed to provide for that same population growth. As Butte's food production is reduced, it seems likely that there would be less of a demand on the water tables. However, more homes require more home water service which will be taken from ground wells. Crops can be sustained from river water and canals: people cannot. Not, at least, until wastewater treatment facilities are added. And the food needed to feed the increasing population nationwide will have to be grown somewhere else and shipped in.

4.3.6. Earthquake and Liquefaction Vulnerability Assessment

Likelihood of Future Occurrence—Unlikely
Vulnerability—High

Earthquake vulnerability is primarily based on population and the built environment. Urban areas in high seismic hazard zones are the most vulnerable, while uninhabited areas are less vulnerable. The combination of plate tectonics and associated California coastal mountain range building geology essentially guarantees earthquake as a result of the periodic release of tectonic stresses. Fault ruptures itself contributes very little to damage unless the structure or system element crosses the active fault

Ground shaking is the primary earthquake hazard. Many factors affect the survivability of structures and systems from earthquake-caused ground motions. These factors include proximity to the fault, direction of rupture, epicentral location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems. Ground motions become structurally damaging when average peak accelerations reach 10 to 15 percent of gravity, average peak velocities reach 8 to 12 centimeters per second, and when the Modified Mercalli Intensity Scale is about VII (18-34 percent peak ground acceleration), which is considered to be very strong (general alarm; walls crack; plaster falls).

Seismic events can have particularly negative effects on older buildings constructed of unreinforced masonry (URM), including materials such as brick, concrete and stone. 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. Butte County is within the less hazardous Zone 3.

In general, newer construction is more earthquake resistant than older construction due to enforcement of these improved building codes. Manufactured housing is also very susceptible to damage because their foundation systems are rarely braced for earthquake motions. Locally generated earthquake motions, even from very moderate events, tend to be more damaging to smaller buildings, especially those constructed of unreinforced masonry as previously described, as was seen in the Oroville, Coalinga, Santa Cruz, and Paso Robles earthquakes.

According to Butte County a URM inventory has been conducted identifying several URMs in Butte County, with most of these being single- or two-story buildings. The County has conducted some earthquake retrofits on key public buildings and critical infrastructure, but more remain to be addressed.

The primary impacts of concern are life safety and property damage. Impacts to the County would include damages to infrastructure (roads, bridges, railroad tracks, etc.), damages to utilities, damages to residential and commercial buildings, and possible loss of life.

Estimating Potential Losses

Earthquake losses will vary across the Butte County Planning Area depending on the source and magnitude of the event. To further evaluate potential losses associated with earthquake activity in the Planning Area, a HAZUS-MH probabilistic earthquake scenario was run for this 2019 LHMP Update.

2019 Earthquake Scenario

HAZUS-MH 4.2.2 was utilized to model earthquake losses for the Butte County Planning Area, which includes all incorporated communities. Specifically, the probable magnitude used for Butte County utilized a 7.0 magnitude earthquake, based on data from the Butte County General Plan. Level 1 analyses were run, meaning that only the default data was used and not supplemented with local building inventory or hazard data. There are certain data limitations when using the default data, so the results should be interpreted accordingly; this is a planning level analysis.

The methodology for running the probabilistic earthquake scenario used probabilistic seismic hazard contour maps developed by the U.S. Geological Survey (USGS) for the 2002 update of the National Seismic Hazard Maps that are included with HAZUS-MH. The USGS maps provide estimates of potential ground acceleration and spectral acceleration at periods of 0.3 second and 1.0 second, respectively. The 2,500-year return period analyzes ground shaking estimates with a 2 percent probability of being exceeded in 50 years, from the various seismic sources in the area. The International Building Code uses this level of ground shaking for building design in seismic areas and is more of a worst-case scenario.

The results of the probabilistic scenario are captured in Table 4-111. A loss map from the scenario can be found on Figure 4-105. Key losses included the following:

- Total economic loss estimated for the earthquake was $6,242.87 million, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $6,078.07 million.
- Over 40 percent of the buildings in the County were at least moderately damaged. 4,200 buildings were completely destroyed.
- Over 48 percent of the building- and income-related losses were residential structures.
- 18 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake caused the most casualties: 380.
- 35.7 percent of the households experienced power failure after the first day of the earthquake.
- 45.9 percent of the households experienced a loss of potable water the first day after the earthquake.

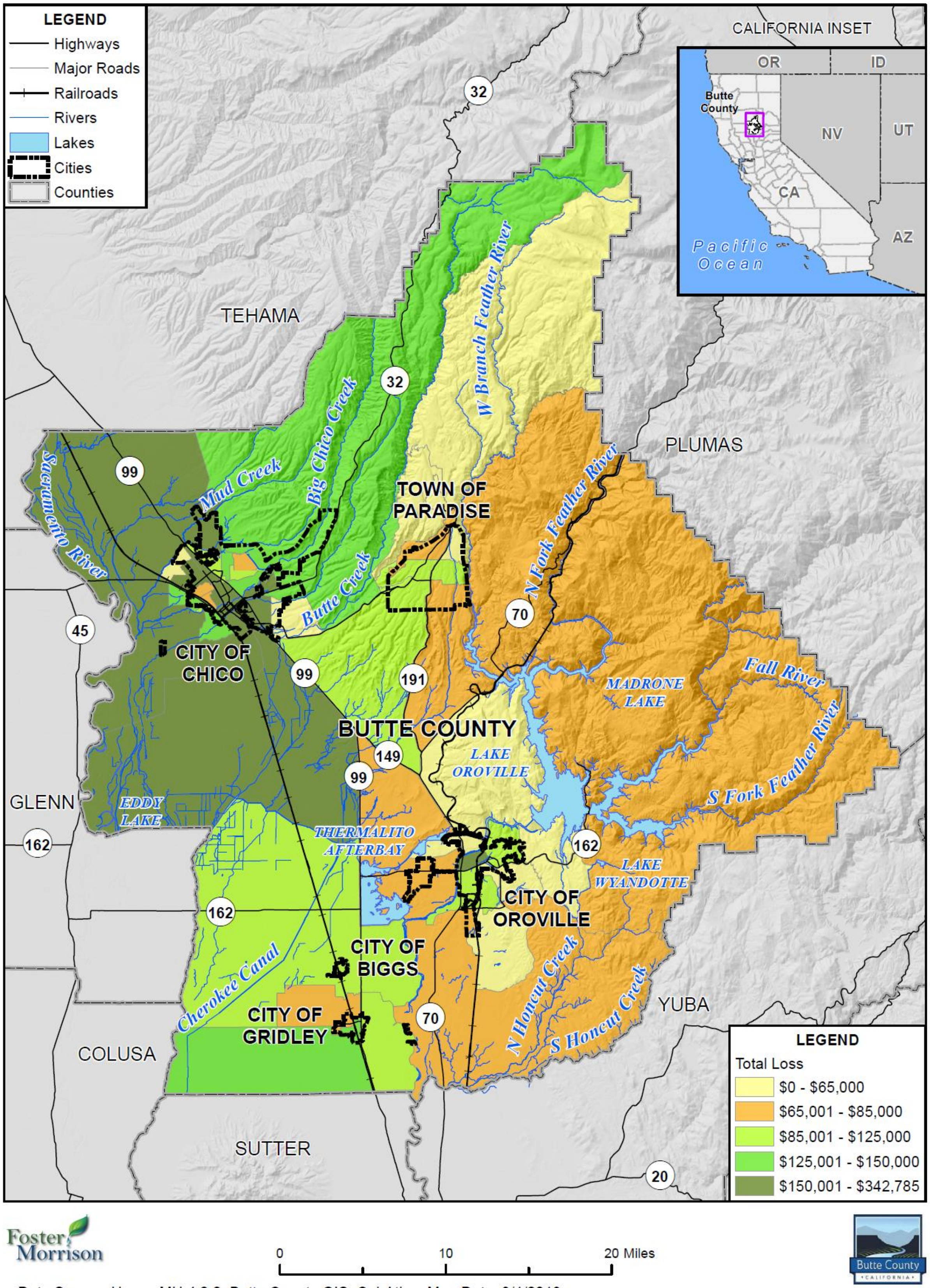
Table 4-111 HAZUS-MH Earthquake Loss Estimation 2,500-Year Scenario Results

Type of Impact	Impacts to Butte County Planning Area
Total Buildings Damaged (based on 87,000 buildings)	Slight: 26,295 Moderate: 21,093 Extensive: 9,657 Complete: 4,200
Building and Income Related Losses	$6,078.07 million 48 percent of damage related to residential structures

Type of Impact	Impacts to Butte County Planning Area	
	18 percent of loss due to business interruption	
Total Economic Losses (Includes building, income and lifeline losses)	$6,242.87 million	
Casualties (Based on 2 a.m. time of occurrence)	Without requiring hospitalization: 962 Requiring hospitalization: 223 Life threatening: 26 Fatalities: 50	
Casualties (Based on 2 p.m. time of occurrence)	Without requiring hospitalization: 3,712 Requiring hospitalization: 1,141 Life threatening: 195 Fatalities: 380	
Casualties (Based on 5 p.m. time of occurrence)	Without requiring hospitalization: 2,378 Requiring hospitalization: 722 Life threatening: 141 Fatalities: 233	
Damage to Transportation Systems	30 highway bridges with moderate damage 2 airport facilities with moderate damage 1 rail facility with moderate damage	
Damage to Essential Facilities	4 hospitals with at least moderate damage	
Damage to Utility Systems	1 potable water facility with at least moderate damage 3 wastewater facilities with moderate damage 1 oil facility with moderate damage 1 electrical power facility with moderate damage 17 communication facilities with at least moderate damage 1,000 potable water line breaks, 502 wastewater line breaks, and 172 natural gas line breaks	
Households without Power/Water Service (Based on 87,618 total households)	Power loss, Day 1: 31,342 Power loss, Day 3: 17,570 Power loss, Day 7: 6,201 Power loss, Day 30: 1,040 Power loss, Day 90: 48	Water loss, Day 1: 40,185 Power loss, Day 3: 38,040 Power loss, Day 7: 33,464 Water loss, Day 30: 3,865 Water loss, Day 90: 0
Displaced Households	4,577 households	
Shelter Requirements	3,031 people	
Debris Generation	1,482 million tons	

Source: HAZUS-MH 4.2.2

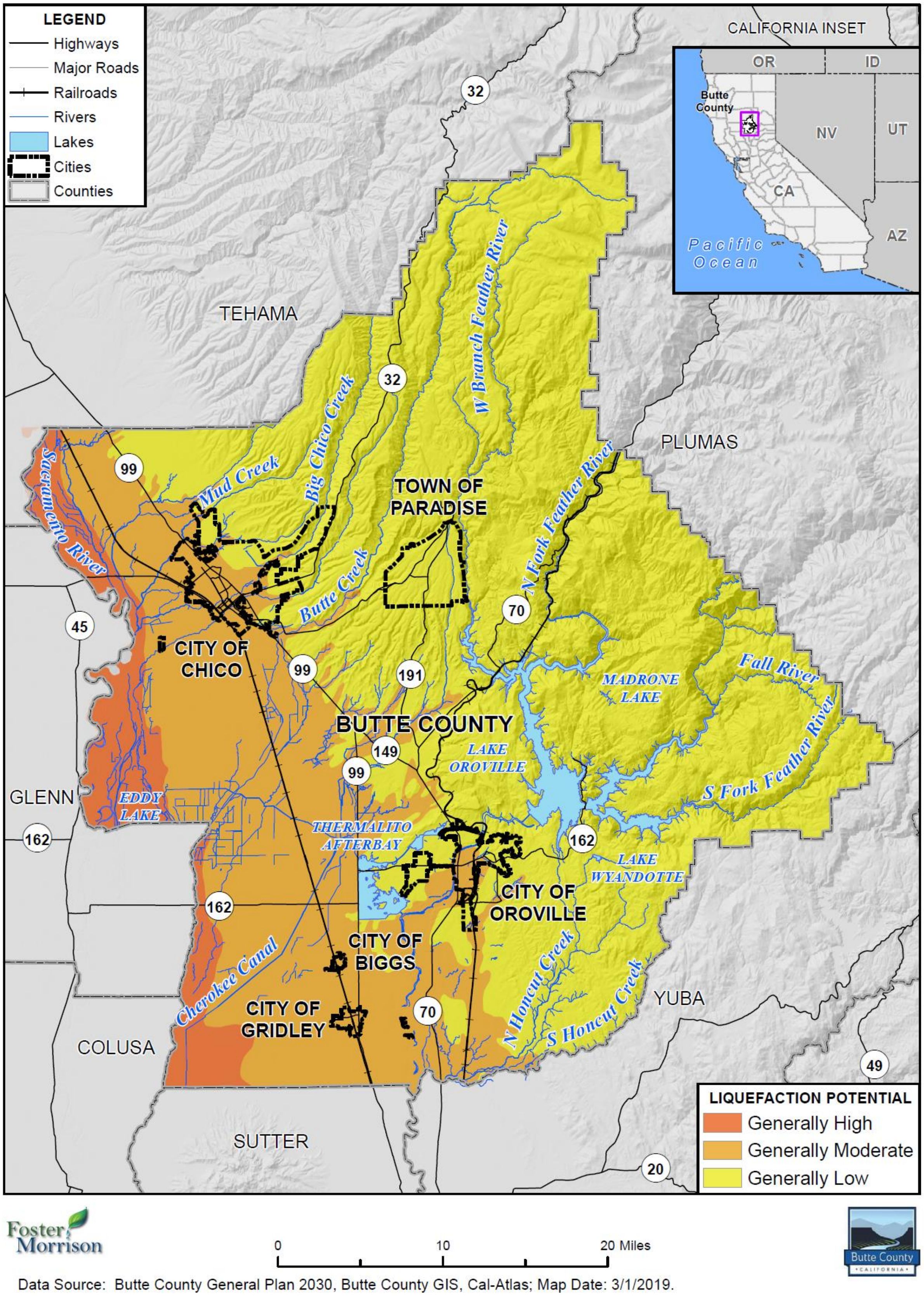
Figure 4-105 Butte County Planning Area – Total Loss Map from 7.0 Magnitude Event



Liquefaction Analysis

Seismic hazards like earthquake induced liquefactions are an identified hazard of concern in Butte County. The County has been mapped into three liquefaction potentials: generally high, generally moderate and generally low. Impacts from liquefaction primarily involve life safety concerns and damage to infrastructure, utility systems, and roads. Road closures can further impact emergency response and evacuation efforts and interrupt business and school activities. Historically, liquefactions resulting in losses have not occurred within the County. Specific problem areas are detailed in Figure 4-106. As Figure 4-106 illustrates, there is a higher risk to liquefaction in the western portions of the county where the majority of the population is located. Based on available hazard data, the potential for liquefactions to occur within the Planning Area exists.

Figure 4-106 Butte County Planning Area – Liquefaction Potential Areas



Values at Risk

According to the layer provided by the Butte County Development Services from the Butte County General Plan, there are liquefaction areas with a potential to impact the Planning Area. The County's parcel layer was used as the basis for the inventory of developed parcels. GIS was used to overlay the seismic liquefaction hazard layer with the parcel layer and where the seismic zones intersected a parcel centroid, it was assigned with that hazard zone for the entire parcel. Analysis results are provided for the Planning Area as a whole, then broken down in more detail for the unincorporated County. Detailed tables for the jurisdictions are provided in their respective annexes to this Plan.

Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the landslide potential areas due primarily to Proposition 13 and to a lesser extent, properties falling under the Williamson Act.

Butte County Planning Area

Analysis results for the Butte County Planning Area is presented in multiple tables (all using the estimated contents replacement based on the CRV factors detailed in Table 4-55) below:

- Table 4-112 shows the total parcel counts, improved parcel counts, their improved structure and land values in the liquefaction potential areas prior to the Camp Fire.
- Table 4-113 shows the total parcel counts, improved parcel counts, their improved structure and land values in the liquefaction potential areas after the Camp Fire.
- Table 4-114 compares the improved structure values in the liquefaction potential areas in the Planning Area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-115 breaks down Table 4-113 into more detail, and shows post-fire in the liquefaction potential areas by property use type.

Table 4-112 Butte County Planning Area – Pre-Fire Count and Value of Parcels in Liquefaction Potential Areas by Jurisdiction

Liquefaction Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally High	296	162	$112,977,635	$37,309,825	$29,267,507	$37,121,697	$216,676,664
Generally Moderate	41,153	36,326	$4,533,386,991	$7,602,714,397	$402,002,682	$5,096,220,162	$17,634,324,232
Generally Low	53,211	40,946	$3,383,608,578	$5,818,672,098	$44,525,743	$3,414,900,268	$12,661,706,687
Grand Total	**94,660**	**77,434**	**$8,029,973,204**	**$13,458,696,320**	**$475,795,932**	**$8,548,242,126**	**$30,512,707,582**

Source: Butte County General Plan, Butte County 2018 Parcel/Assessor's Data

Table 4-113 Butte County Planning Area – Post-Fire Count and Value of Parcels in Liquefaction Potential Areas

Liquefaction Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally High	296	161	$108,411,258	$36,256,445	$29,267,507	$36,068,317	$213,624,574
Generally Moderate	41,220	36,306	$4,524,174,394	$7,578,228,680	$398,727,998	$5,075,574,110	$16,939,890,246
Generally Low	53,319	40,931	$3,377,337,126	$5,167,003,213	$43,690,021	$3,064,375,540	$11,172,959,231
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: Butte County General Plan, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-114 Butte County Planning Area – Comparison of Pre-Fire and Post-Fire Improved Structure Values in Liquefaction Potential Areas

Liquefaction Potential	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ Change	% change
Generally High	$37,309,825	$36,256,445	-$1,053,380	-2.8%
Generally Moderate	$7,602,714,397	$7,578,228,680	-$24,485,717	-0.3%
Generally Low	$5,818,672,098	$5,167,003,213	-$651,668,885	-11.2%
Grand Total	**$13,458,696,320**	**$12,781,488,338**	**-$677,207,982**	**-5.0%**

Source: Butte County General Plan, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-115 Butte County Planning Area – Post-Fire Count and Value of Parcels in Liquefaction Potential Areas by Jurisdiction and Property Use

Jurisdiction / Liquefaction Potential / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Generally Moderate							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
Generally Moderate Total	765	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$155,425,116
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Generally Moderate							

Jurisdiction / Liquefaction Potential / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Agricultural	15	3	$458,773	$195,090	$57,958	$195,090	$913,541
Commercial	1,815	1,517	$503,640,623	$1,232,255,786	$44,046,832	$1,232,255,786	$2,585,901,334
Industrial	253	205	$57,135,392	$116,734,773	$6,869,827	$175,102,160	$352,348,717
Residential	18,321	17,697	$1,849,054,900	$3,366,318,290	$171,955	$1,683,159,145	$6,696,513,655
Unknown	312	4	$466,876	$537,312	$0	$0	$983,788
Generally Moderate Total	**20,716**	**19,426**	**$2,410,756,564**	**$4,716,041,251**	**$51,146,572**	**$3,090,712,181**	**$9,636,661,035**
Generally Low							
Agricultural	8	1	$224,936	$76,387	$0	$76,387	$376,053
Commercial	272	215	$102,008,701	$211,471,163	$2,631,020	$211,471,163	$518,072,154
Industrial	107	81	$17,855,565	$56,376,123	$592,610	$84,564,185	$156,541,831
Residential	5,299	4,835	$599,524,233	$988,133,772	$15,777	$494,066,886	$2,057,101,685
Unknown	95	2	$316,863	$501,163	$0	$0	$816,677
Generally Low Total	**5,781**	**5,134**	**$719,930,298**	**$1,256,558,608**	**$3,239,407**	**$790,178,621**	**$2,732,908,400**
City of Chico Total	**26,497**	**24,560**	**$3,130,686,862**	**$5,972,599,859**	**$54,385,979**	**$3,880,890,801**	**$12,369,569,434**
City of Gridley							
Generally Moderate							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991
Unknown	64	0	$0	$0	$0	$0	$0
Generally Moderate Total	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934
City of Gridley Total	**2,452**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**
City of Oroville							
Generally Moderate							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	741	526	$69,671,761	$168,438,596	$4,544,566	$168,438,596	$386,467,487
Industrial	185	66	$23,812,762	$38,806,805	$42,318,610	$58,210,208	$187,094,035
Residential	1,812	1,618	$36,767,964	$117,290,539	$0	$58,645,270	$196,401,042
Unknown	97	2	$63,388	$314,266	$0	$0	$377,654
Generally Moderate Total	**2,835**	**2,212**	**$130,315,875**	**$324,850,206**	**$46,863,176**	**$285,294,073**	**$770,340,217**

Jurisdiction / Liquefaction Potential / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally Low							
Agricultural	9	0	$1,291,076	$0	$7,947	$0	$1,299,023
Commercial	301	173	$38,161,986	$170,512,897	$14,463,240	$170,512,897	$319,950,025
Industrial	42	6	$2,244,535	$1,291,966	$0	$1,937,949	$5,474,450
Residential	3,893	3,110	$148,337,036	$387,520,179	$7,000	$193,760,090	$685,936,912
Unknown	65	0	$1,130	$0	$0	$0	$0
Generally Low Total	**4,310**	**3,289**	**$190,035,763**	**$559,325,042**	**$14,478,187**	**$366,210,936**	**$1,012,660,410**
City of Oroville Total	**7,145**	**5,501**	**$320,351,638**	**$884,175,248**	**$61,341,363**	**$651,505,009**	**$1,783,000,627**
Town of Paradise							
Generally Low							
Agricultural	5	1	$161,851	$24,379	$11,631	$24,379	$222,240
Commercial	724	597	$103,002,892	$273,582,659	$13,392,101	$273,582,659	$525,827,820
Industrial	16	14	$2,525,218	$3,598,536	$165,000	$5,397,804	$11,782,558
Residential	10,646	9,979	$676,226,190	$745,996,179	$106,299	$372,998,090	$1,740,765,982
Unknown	110	3	$426,672	$137,487	$0	$0	$562,197
Generally Low Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Town of Paradise Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Unincorporated Butte County							
Generally High							
Agricultural	233	141	$106,344,879	$32,428,632	$28,385,890	$32,428,632	$203,118,890
Commercial	4	3	$402,319	$150,871	$0	$150,871	$704,061
Industrial	4	3	$294,639	$1,718,556	$668,920	$2,577,834	$5,318,039
Residential	25	13	$1,216,368	$1,821,959	$14,160	$910,980	$3,995,567
Unknown	30	1	$153,053	$136,427	$198,537	$0	$488,017
Generally High Total	**296**	**161**	**$108,411,258**	**$36,256,445**	**$29,267,507**	**$36,068,317**	**$213,624,574**
Generally Moderate							
Agricultural	3,217	2,152	$849,717,009	$323,909,277	$254,504,119	$323,909,277	$1,828,247,420
Commercial	330	260	$44,645,612	$96,616,974	$2,906,418	$96,616,974	$231,790,188
Industrial	244	197	$39,500,505	$166,715,077	$19,251,370	$250,072,616	$486,892,087
Residential	10,113	9,177	$908,223,130	$1,589,699,175	$7,565,711	$794,849,588	$3,271,863,819
Unknown	548	6	$1,254,443	$883,656	$512,383	$0	$4,410,432

Jurisdiction / Liquefaction Potential / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally Moderate Total	14,452	11,792	$1,843,340,699	$2,177,824,159	$284,740,001	$1,465,448,454	$5,823,203,945
Generally Low							
Agricultural	1,765	349	$151,960,877	$34,327,774	$5,640,982	$34,327,774	$221,811,510
Commercial	493	346	$49,269,453	$114,778,591	$3,553,671	$114,778,591	$250,782,688
Industrial	61	36	$11,813,525	$17,836,655	$1,978,960	$26,754,983	$61,079,924
Residential	28,401	21,177	$1,470,348,197	$2,160,243,409	$1,123,783	$1,080,121,705	$4,612,343,986
Unknown	1,007	6	$1,636,190	$593,894	$0	$0	$2,211,518
Generally Low Total	**31,727**	**21,914**	**$1,685,028,242**	**$2,327,780,323**	**$12,297,396**	**$1,255,983,052**	**$5,148,229,625**
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: Butte County General Plan, Butte County 3/28/2019 Parcel/Assessor's Data

Unincorporated Butte County

Analysis results for unincorporated Butte County is presented in multiple tables (all using the estimated contents replacement values in the buffer zones based on the CRV factors detailed in Table 4-55) below:

- Table 4-116 shows the total parcel counts, improved parcel counts, their improved structure and land values in the liquefaction potential areas prior to the Camp Fire.
- Table 4-117 shows the total parcel counts, improved parcel counts, their improved structure and land values in the liquefaction potential areas after the Camp Fire.
- Table 4-118 compares the improved structure values in the liquefaction potential areas in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-119 breaks down Table 4-117 into more detail, and shows post-fire in the liquefaction potential areas by property use type.

Table 4-116 Unincorporated Butte County – Pre-Fire Count and Value of Parcels in Liquefaction Potential Areas

Liquefaction Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally High	296	162	$112,977,635	$37,309,825	$29,267,507	$37,121,697	$216,676,664
Generally Moderate	14,414	11,796	$1,847,678,373	$2,193,004,023	$286,514,585	$1,477,148,551	$5,804,345,532
Generally Low	31,724	21,920	$1,686,574,919	$2,399,738,267	$12,314,395	$1,293,085,963	$5,391,713,544

Liquefaction Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County Total	**46,434**	**33,878**	**$3,647,230,927**	**$4,630,052,115**	**$328,096,487**	**$2,807,356,210**	**$11,412,735,739**

Source: Butte County General Plan, Butte County 2018 Parcel/Assessor's Data

Table 4-117 Unincorporated Butte County –Post-Fire Count and Value of Parcels in Liquefaction Potential Areas

Liquefaction Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Generally High	296	161	$108,411,258	$36,256,445	$29,267,507	$36,068,317	$213,624,574
Generally Moderate	14,452	11,792	$1,843,340,699	$2,177,824,159	$284,740,001	$1,465,448,454	$5,823,203,945
Generally Low	31,727	21,914	$1,685,028,242	$2,327,780,323	$12,297,396	$1,255,983,052	$5,148,229,625
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: Butte County General Plan, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-118 Unincorporated Butte County – Comparison of Pre-Fire and Post-Fire Improved Structure Values in Liquefaction Potential Areas

Liquefaction Potential	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ Change	% change
Generally High	$37,309,825	$36,256,445	-$1,053,380	-2.8%
Generally Moderate	$2,193,004,023	$2,177,824,159	-$15,179,864	-0.7%
Generally Low	$2,399,738,267	$2,327,780,323	-$71,957,944	-3.0%
Unincorporated Butte County Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: Butte County General Plan, Butte County 2018 Parcel/Assessor's Data

Table 4-119 Unincorporated Butte County – Post-Fire Count and Value of Parcels in Liquefaction Potential Areas by Jurisdiction and Property Use

Liquefaction Potential/ Property Use	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ Change	% change
Generally High				
Agricultural	$33,482,012	$32,428,632	-$1,053,380	-3.1%
Commercial	$150,871	$150,871	$0	0.0%
Industrial	$1,718,556	$1,718,556	$0	0.0%
Residential	$1,821,959	$1,821,959	$0	0.0%
Unknown	$136,427	$136,427	$0	0.0%
Generally High Total	**$37,309,825**	**$36,256,445**	**-$1,053,380**	**-2.8%**

Liquefaction Potential/ Property Use	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ Change	% change
Generally Moderate				
Agricultural	$324,733,230	$323,909,277	-$823,953	-0.3%
Commercial	$104,013,351	$96,616,974	-$7,396,377	-7.1%
Industrial	$166,715,077	$166,715,077	$0	0.0%
Residential	$1,596,658,709	$1,589,699,175	-$6,959,534	-0.4%
Unknown	$883,656	$883,656	$0	0.0%
Generally Moderate Total	**$2,193,004,023**	**$2,177,824,159**	**-$15,179,864**	**-0.7%**
Generally Low				
Agricultural	$34,751,116	$34,327,774	-$423,342	-1.2%
Commercial	$116,639,702	$114,778,591	-$1,861,111	-1.6%
Industrial	$17,837,220	$17,836,655	-$565	0.0%
Residential	$2,229,878,629	$2,160,243,409	-$69,635,220	-3.1%
Unknown	$631,600	$593,894	-$37,706	-6.0%
Generally Low Total	**$2,399,738,267**	**$2,327,780,323**	-$71,957,944	-3.0%
Unincorporated Butte County Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: Butte County General Plan, Butte County 3/28/2019 Parcel/Assessor's Data

Population at Risk

To determine the populations at risk from a liquefaction, an analysis was performed using GIS to determine the residential population that resides within each liquefaction potential area in the Butte County Planning Area. Using GIS, the liquefaction potential areas were overlaid on the improved residential parcel data and results tabulated for the jurisdictions in the Planning Area, as found in Table 4-120. Those residential parcel centroids that intersect each liquefaction potential area were counted and multiplied by the 2010 Census Bureau average household factors for the jurisdictions in Butte County. According to the analysis, there is a population of 92,916 in the Planning Area that reside in the Generally Moderate liquefaction potential area. 27,525 residents of the unincorporated County reside in the Generally Moderate liquefaction potential area, with 39 in the Generally High liquefaction potential area.

Table 4-120 Butte County Planning Area – Residential Populations at Risk in Liquefaction Potential Areas by Jurisdiction

	Generally Moderate		Generally High	
Jurisdiction	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Biggs	639	1,566	0	0
Chico	17,697	53,445	0	0
Gridley	1,977	5,852	0	0
Oroville	1,618	4,207	0	0

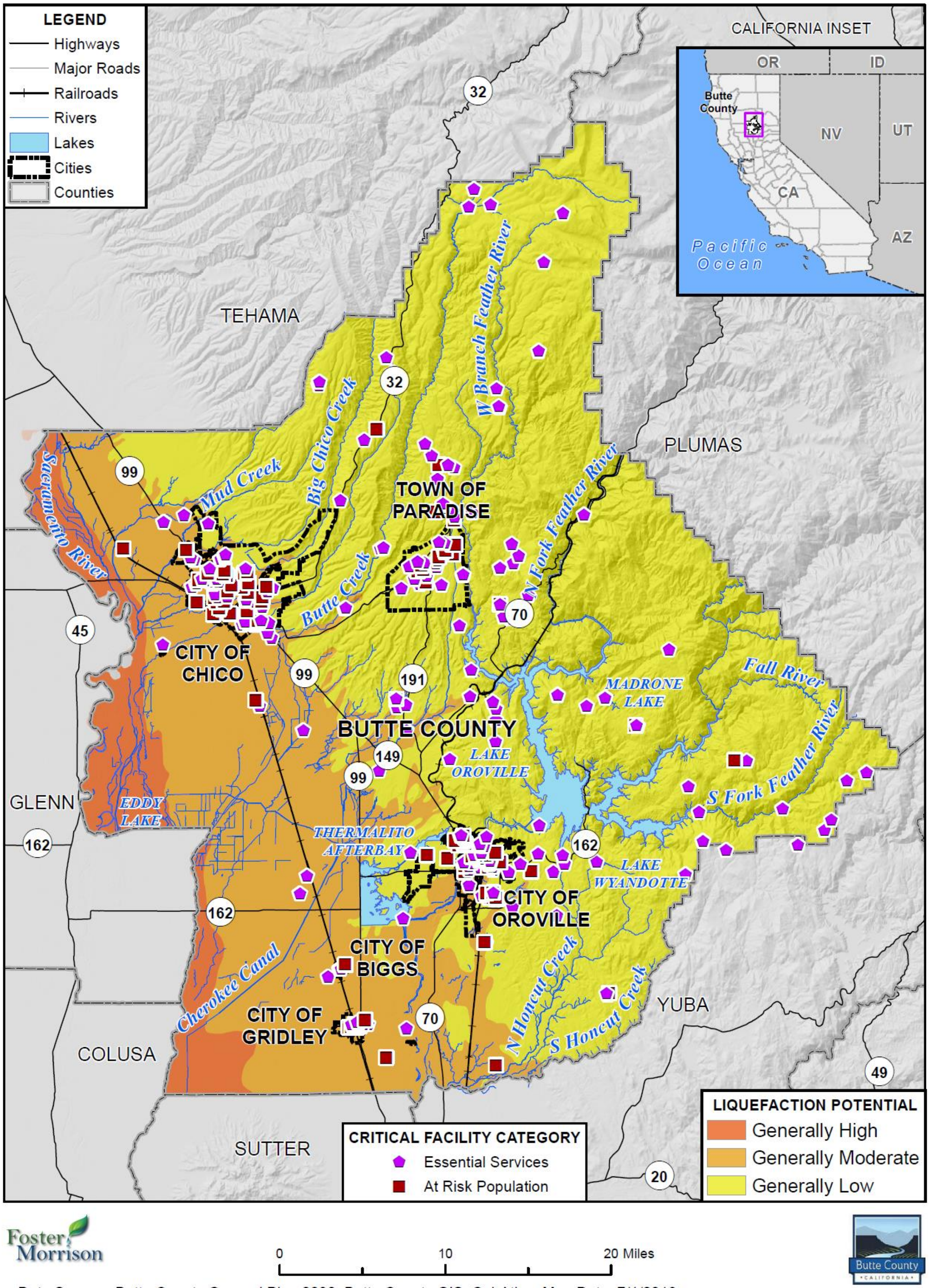
Jurisdiction	Generally Moderate		Generally High	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Paradise	0	0	0	0
Unincorporated County	9,177	27,528	13	39
Total	**31,108**	**92,598**	**13**	**39**

Source: Butte County 2030 General Plan Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Butte County and all jurisdictions to determine critical facilities in the areas affected by liquefaction. Using GIS, the liquefaction potential areas were overlayed on the critical facility GIS layer. Figure 4-107 shows critical facilities, as well as the areas of liquefaction potential. Table 4-121 summarizes facility counts in the County in liquefaction areas. Table 4-123 details critical facilities by facility type and count by jurisdiction for the Butte County Planning Area. Table 4-123 details critical facilities by facility type for the unincorporated County. Information on critical facilities in the incorporated jurisdictions in the County can be found in their respective annexes to this LHMP Update. Details of critical facility definition, type, name and address and jurisdiction by liquefaction potential area are listed in Appendix F.

Figure 4-107 Butte County Planning Area – Critical Facilities and Liquefaction Potential Areas



Data Source: Butte County General Plan 2030, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-121 Butte County Planning Area – Summary of Critical Facilities in Liquefaction Potential Areas by Facility Category

Liquefaction Potential / Facility Category	Facility Count
Generally Moderate	
Essential Services Facilities	87
At Risk Population Facilities	58
1% Annual Chance Flood Hazard Total	**145**
Generally Low	
Essential Services Facilities	151
At Risk Population Facilities	45
0.2% Annual Chance Flood Hazard Total	**196**
Grand Total	**341**

Source: USGS, Butte County GIS

Table 4-122 Butte County Planning Area – Critical Facilities in Liquefaction Areas by Jurisdiction and Facility Category

Jurisdiction / Liquefaction Potential / Critical Facility Category	Facility Count
City of Biggs	
Generally Moderate	
Essential Services Facilities	3
At Risk Population Facilities	4
Generally Moderate Total	**7**
City of Biggs Total	**7**
City of Chico	
Generally Moderate	
Essential Services Facilities	41
At Risk Population Facilities	31
Generally Moderate Total	**72**
Generally Low	
Essential Services Facilities	9
At Risk Population Facilities	
Generally Low Total	**9**
City of Chico Total	**81**
City of Gridley	
Generally Moderate	
Essential Services Facilities	11
At Risk Population Facilities	6

Jurisdiction / Liquefaction Potential / Critical Facility Category	Facility Count
Generally Moderate Total	**17**
City of Gridley Total	**17**
City of Oroville	
Generally Moderate	
Essential Services Facilities	18
At Risk Population Facilities	6
Generally Moderate Total	**24**
Generally Low	
Essential Services Facilities	22
At Risk Population Facilities	14
Generally Low Total	**36**
City of Oroville Total	**60**
Town of Paradise	
Generally Low	
Essential Services Facilities	21
At Risk Population Facilities	12
Generally Low Total	**33**
Town of Paradise Total	**33**
Unincorporated Butte County	
Generally Moderate	
Essential Services Facilities	14
At Risk Population Facilities	11
Generally Moderate Total	**25**
Generally Low	
Essential Services Facilities	98
At Risk Population Facilities	19
Generally Low Total	**117**
Unincorporated Butte County Total	**142**
Outside of Butte County	
Generally Low	
Essential Services Facilities	1
At Risk Population Facilities	0
Generally Low Total	**1**
Outside of Butte County Total	**1**
Grand Total	341

Source: USGS, Butte County GIS

Table 4-123 Unincorporated Butte County – Critical Facilities in Liquefaction Potential Areas by Facility Category and Type

Liquefaction Potential	Critical Facility Category / Critical Facility Type	Facility Count
Generally Moderate		
Generally Moderate	**Essential Services Facilities**	
	Wastewater Treatment Plant	1
	Fire	7
	Health Care	1
	Public Assembly Point / Evacuation Center	3
	Radio Sites	1
	Dam	1
	Essential Services Facilities Total	**14**
	At Risk Population Facilities	
	School	11
	At Risk Population Facilities Total	**11**
	Total	**25**
Generally Low		
Generally Low Total	**Essential Services Facilities**	
	Fire	29
	Health Care	2
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	27
	Radio Sites	10
	Dam	28
	Emergency Animal Shelter	1
	Essential Services Facilities Total	**98**
	At Risk Population Facilities	
	School	19
	At Risk Population Facilities Total	**19**
	Total	**117**
Unincorporated Butte County Total		**142**

Source: USGS, Butte County GIS

Future Development

Although new growth and development corridors would fall in the area affected by earthquake, including earthquake liquefaction, given the small chance of major earthquake and the building codes in effect, development in the earthquake and liquefaction areas will continue to occur.

Future Development GIS Analysis

Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of liquefaction within the County to the 8 future development projects.

Methodology

Butte County's 3/28/2019 Parcel/Assessor's data were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas. Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file and the APNs, the 8 future development projects were identified. For this liquefaction potential analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected to determine the parcel counts and acreage within the liquefaction potential areas.

Liquefaction potential and future development areas are shown on Figure 4-108 and parcels and acreages in those areas are shown in Table 4-124.

Figure 4-108 Unincorporated Butte County – Future Development in Liquefaction Potential Areas

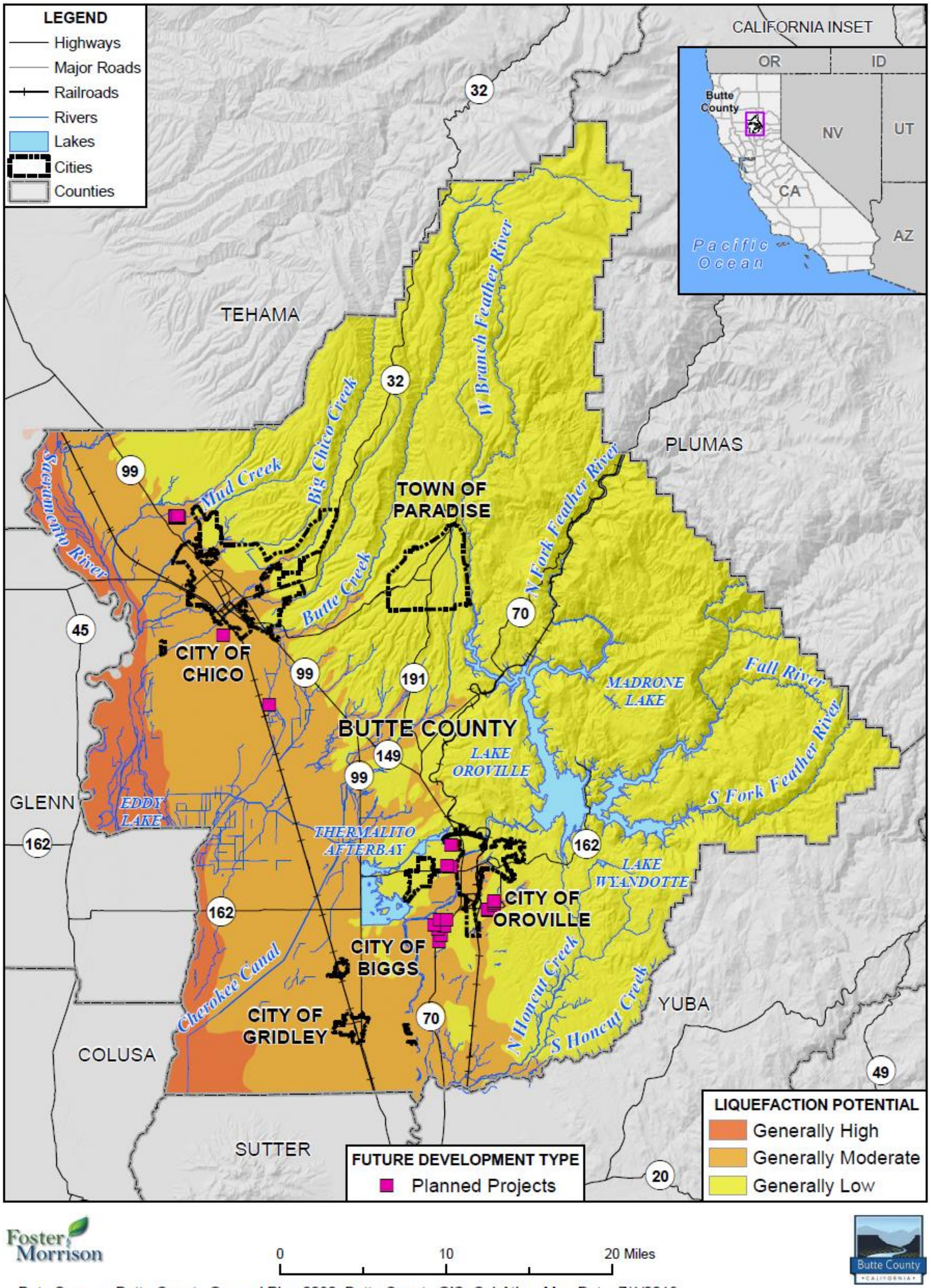


Table 4-124 Unincorporated Butte County – Future Development Parcels and Acreage in Liquefaction Potential Areas

Future Development /Liquefaction Potential Areas	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista			
Generally Low	1	0	9.7
Creekside Estates			
Generally Moderate	1	1	47.4
Diamond Oak			
Generally Low	2	1	7.9
Lincoln and Ophir Garden Oak Estates			
Generally Low	2	0	50.4
Mandville Park			
Generally Moderate	25	0	22.6
Rio d Oro - Phase 1			
Generally Moderate	2	0	172.9
Generally Low	5	0	491.3
Southlands Subdivision			
Generally Low	3	0	48.8
Stanley Ave			
Generally Moderate	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: Butte County 2030 General Plan Butte County GIS

4.3.7. Flood: 100-/200-/500-Year Vulnerability Assessment

Likelihood of Future Occurrence—1%– Occasional; 0.2% – Unlikely
Vulnerability—High

Flooding is a significant problem in Butte County. Historically, Butte County has always been vulnerable to flooding because of its relatively flat terrain in populated areas and the number of water courses that traverse the County. The Butte County Planning Area has been at risk to flooding primarily during the winter and spring months when river systems in the County swell with heavy rainfall and snowmelt runoff. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. Flood zones in Butte County are quite extensive. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage. Flooding has occurred both within the 1% and 0.2% annual chance floodplains and in other localized areas. The only community with 0.5% annual chance floodplains is the City of Chico. A discussion of this flooding can be found in their annex. The vulnerability of the County to severe flooding is extremely high as it can result in significant life safety, property damage, infrastructure damage, critical facility damage, and damage to the environment.

High water levels are a common occurrence in winter and spring months due to increased flow from stormwater runoff and snowmelt. Several areas of the County are subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms. In addition to the major rivers, there are many streams, channels, canals, and creeks that serve the drainage needs of the County. There is significant threat of flooding in large areas of the County from several of these streams. Many of these streams are prone to rapid flooding with little notice.

Historically, much of the growth in the County has occurred adjacent to rivers or streams, resulting in significant damages to property, and losses from disruption of community activities during periods of flooding. Additional development in the watersheds of these streams affects both the frequency and duration of damaging floods through an increase in stormwater runoff. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Predominantly, the effects of flooding are generally confined to areas near the waterways of the County. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat. This threatens structures in the floodplain. Structures can also be damaged from trees falling as a result of water-saturated soils. Electrical power outages happen, and the interruption of power causes major problems. Loss of power is usually a precursor to closure of governmental offices and community businesses. Public schools may also be required to close or be placed on a delayed start schedule. Roads can be damaged and closed, causing safety and evacuation issues. People may be swept away in floodwaters, causing injuries or deaths.

Health Hazards from Flooding

Certain health hazards are also common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle, hogs, and other livestock are kept, or their wastes are stored can contribute polluted waters to the receiving streams.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e. coli and other disease-causing agents.

The second type of health problems arise after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If a city or county water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Flood Hazard Assessment

This risk assessment for the Butte County LHMP Update assessed the flood hazard specific to Butte County. This included an evaluation of multiple flood hazards including the Special Flood Hazard Area (SFHA) shown on the DFIRM; Repetitive Loss (RL) Areas; localized, stormwater flooding areas; other areas that have flooded in the past, but not identified on the DFIRM; other areas of shallow flooding identified through other studies and sources; levee failure flooding; dam failure flooding; and mudflow flooding especially in significant post-burn areas. This comprehensive flood risk assessment included an assessment of less-frequent flood hazards, areas likely to be flooded, and flood problems that are likely to get worse in the future as a result of changes in floodplain development and demographics, development in the watershed, and climate change or sea level rise. Existing studies, maps, historical data, and federal, state, and local community expertise and knowledge contributed to this current flood assessment for Butte County. An evaluation of the success of completed and ongoing flood control projects and associated maintenance aspects contributed to this flood hazard assessment and the resulting flood mitigation strategy for the Butte County Planning Area. This flood risk assessment for this LHMP Update also includes an assessment of future flooding conditions based on historic development in the floodplains and proposed future development as further described throughout this plan. The flood vulnerability assessment that follows focuses on the flood hazard based on FEMA DFIRMs.

Flood Analysis

The Butte County Planning Area has mapped FEMA flood hazard areas. GIS was used to determine the possible impacts of flooding within the County and how the risk varies across Planning Area.

FEMA DFIRMs

Flood Parcel Inventory and Assessed Values

Butte County has a FEMA effective DFIRM dated January 6, 2011, with digital LOMR updates dated August 30, 2017, which was obtained from the National Flood Hazard Layer in early 2019 to perform the flood analysis.

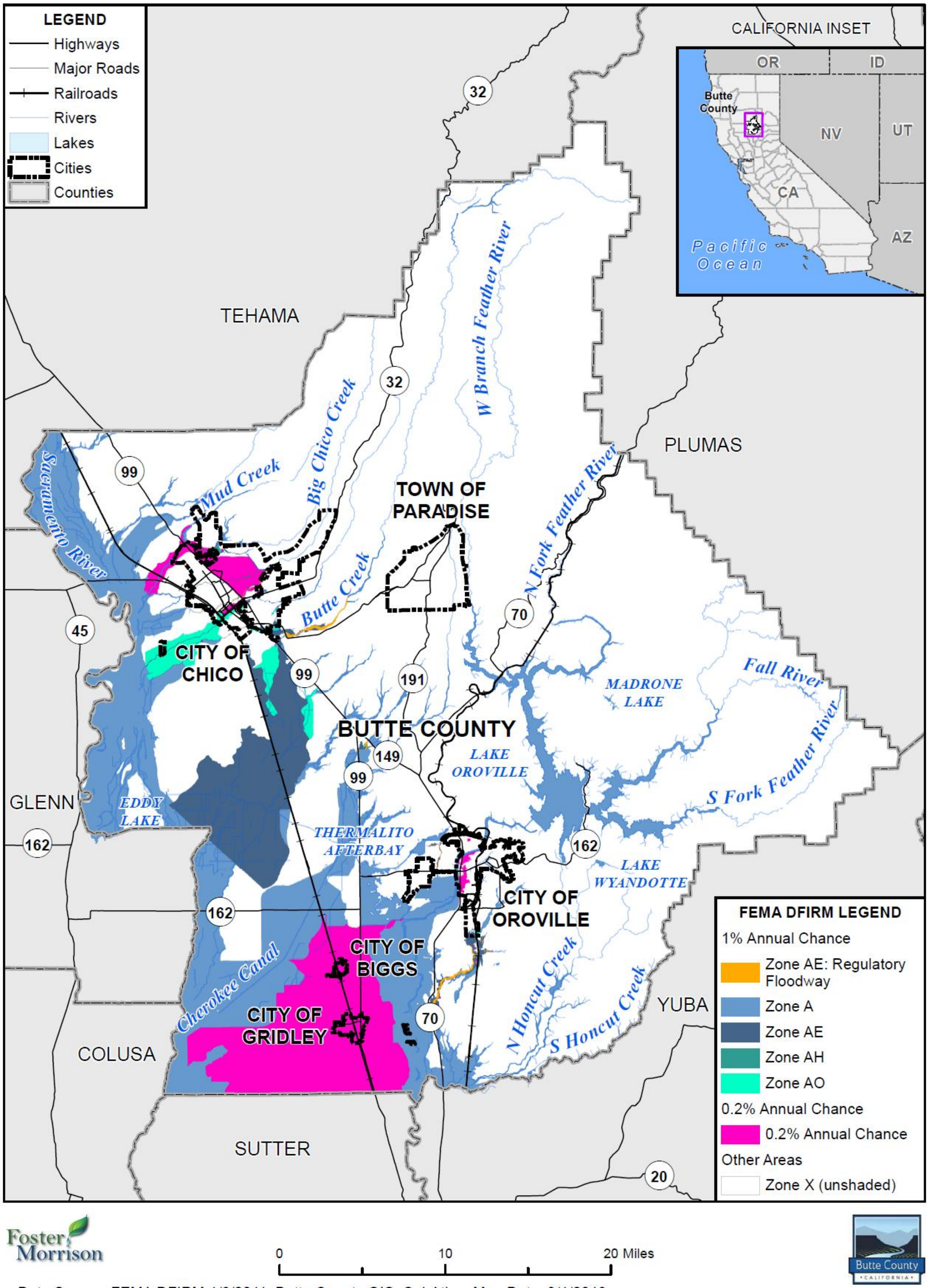
Each of the DFIRM flood zones that begins with the letter 'A' depict the Special Flood Hazard Area, or the 1% annual chance flood event (commonly referred to as the 100-year flood). Table 4-125 explains the difference between DFIRM mapped flood zones within the 1% annual chance flood zone as well as other flood zones located within the County and details the flood zones present by jurisdiction. The effective DFIRM maps for the Butte County Planning Area are shown on Figure 4-109.

Table 4-125 Butte County Planning Area – DFIRM Flood Hazard Zones

Flood Zone	Description	Flood Zone Present in City of Biggs	Flood Zone Present in City of Chico	Flood Zone Present in City of Gridley	Flood Zone Present in City of Oroville	Flood Zone Present in Town of Paradise	Flood Zone Present in unincorporated County
A	100-year Flood: No base flood elevations provided	X	X	X	X		X
AE	100-year Flood: Base flood elevations provided	X	X		X		X
AH	100-year Flood: Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet.	X	X				X
AO	100-year Flood: River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet.	X	X		X		X
Shaded X	500-year Flood: The areas between the limits of the 1% annual chance flood and the 0.2-percent-annual-chance (or 500-year) flood	X	X	X	X		X
X (unshaded)	No flood hazard	X	X	X	X	X	X

Source: FEMA

Figure 4-109 Butte County – DFIRM Flood Zones



Data Source: FEMA DFIRM 1/6/2011, Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Values at Risk

Quantifying the values at risk and estimating losses within mapped FEMA floodplains in the County is an important element in understanding the risk and vulnerability of the Butte County Planning Area to the flood hazard. The following methodology was used to determine the parcels and values at risk to the 1% annual chance (i.e., 100-year) and 0.2% annual chance (i.e., 500-year) flood events.

Methodology

Flood Parcel Inventory and Assessed Values

Butte County's 2018 (pre-fire) and March 2019 (post-fire) Assessor Data and the County's GIS parcel data, obtained from Butte County, and were used as the basis for the county inventory of parcels, values, and acres. Butte County utilized the FEMA DFIRM dated January 6, 2011, with digital LOMR updates dated August 30, 2017, to perform the flood analysis.

In some cases, there are parcels in multiple flood zones, such as Zone A, Zone X, or Shaded X. GIS was used to create a centroid, or point representing the center of the parcel polygon. DFIRM flood data was then overlaid on the parcel layer. For the purposes of this analysis, the flood zone that intersected a parcel centroid was assigned the flood zone for the entire parcel. The parcels were segregated and analyzed in this fashion for the Butte County Planning Area. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessors database and the GIS parcel layer.

The property use categories for the County (derived from land use codes from the GIS parcel layer descriptions) were used to develop estimated content replacement values (CRVs) that are potentially at loss from hazards, using FEMA Hazus methodologies as previously described in Section 4.3.1. The CRVs were added to the improved parcel values.

Flood Loss Estimate

The loss estimate for flood is based on the total of improved and contents value. Improved parcels include those with improved structure values identified in the Assessor's database. Only improved parcels and the value of their structure and other improvements were included in the flood loss analysis. The value of land is not included in the loss estimates as generally the land is not at loss to floods, just the value of improvements and structure contents. The land value is represented in the detailed flood tables, but are only present to show the value of the land associated with each flood zone.

Once the potential value of affected parcels was calculated, a damage factor was applied to obtain loss estimates by flood zone. When a flood occurs, seldom does the event cause total loss of an area or building. Potential losses from flooding are related to a variety of factors including flood depth, flood velocity, building type, and construction. The percent of damage is primarily related to the flood depth. FEMA's flood benefit/cost module uses a simplified approach to model flood damage based on building type and flood depth. The values at risk in the flood analysis tables were refined by applying an average damage estimation of 20% of the total building value. The 20% damage estimate utilized FEMA's Flood Building

Loss Table based on an assumed average flood depth of 2 feet. The end result of the flood hazard analysis is an inventory of the numbers, types, and values of parcels subject to the flood hazard.

Limitations

It also should be noted that the flood analysis and loss estimates may actually be more or less than that presented in the below tables as the County may include structures located within the 1% or 0.2% annual chance floodplain that are elevated at or above the level of the base flood elevation, according to local floodplain development requirements. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the floodplain due primarily to Proposition 13, and to a lesser extent, properties falling under the Williamson Act.

Other Values at Risk to Flood

In addition to the information in the tables below, the Sacramento River Reclamation District pointed out that there are values associated with resources other than the improved parcels in the County.

> ***Values within the Sacramento River Reclamation District of trees with a lifespan of 20-35 years and the annual crop production from those trees is probably equally valuable to the commercial, industrial, residential properties through Pine Creek.***

While Foster Morrison could not calculate the value of trees and annual crop production for the entire County, it should be noted that there is substantial economic risk to the County from flood that aren't captured in the tables below.

Values at Risk and Flood Loss Estimates Results

The end result of the values at risk and flood loss estimates analysis is an inventory of the numbers, types, and values of parcels and estimated losses subject to the flood hazard by flood zone. Results are presented here first for the Butte County Planning Area and secondly for unincorporated County. Results for the incorporated jurisdictions are presented in their annexes to the Plan.

Butte County Planning Area

Analysis results for the Butte County Planning Area is presented in multiple tables (all using the estimated contents replacement values based on the CRV factors detailed in Table 4-55) below:

- Table 4-126 shows the total parcel counts, improved parcel counts, their improved structure and land values in the DFIRM flood zones prior to the Camp Fire.
- Table 4-127 shows the total parcel counts, improved parcel counts, their improved structure and land values in the DFIRM flood zones after the Camp Fire.
- Table 4-128 compares the improved structure values in DFIRM flood zones in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-129 breaks down Table 4-127 into more detail, and shows post-fire values in the DFIRM flood zones by property use type.

Table 4-126 Butte County Planning Area– Pre-Fire Count and Value of Parcels by 1% and 0.2% Flood Zone

Flood Zone	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	5,624	4,083	$829,326,008	$776,140,749	$141,692,522	$542,118,113	$2,289,277,392
0.2% Annual Chance Flood Hazard	16,499	14,868	$1,532,338,401	$2,539,737,276	$67,712,700	$1,531,991,540	$5,671,779,917
Other Areas	72,537	58,483	$5,668,308,795	$10,142,818,295	$266,390,710	$6,474,132,474	$22,551,650,274
Total	**94,660**	**77,434**	**$8,029,973,204**	**$13,458,696,320**	**$475,795,932**	**$8,548,242,126**	**$30,512,707,582**

Source: FEMA 1/6/2011 DFIRM, Butte County 2018 Parcel/Assessor's Data

*With respect to improved parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-127 Butte County Planning Area – Post-Fire Count and Value of Parcels by 1% and 0.2% Flood Zone

Flood Zone	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	5,631	4,075	$823,333,487	$771,519,702	$140,708,738	$539,203,205	$2,275,229,710
0.2% Annual Chance Flood Hazard	16,600	14,864	$1,527,677,330	$2,533,754,574	$66,742,900	$1,525,811,596	$5,516,460,460
Other Areas	72,604	58,459	$5,658,911,961	$9,476,214,062	$264,233,888	$6,111,003,165	$20,534,783,880
Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improved parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-128 Butte County Planning Area – Comparison of Pre- and Post-Fire Improved Structure Values

Flood Zone	Pre-Fire Improved Structure Value*	Post-Fire Improved Structure Value*	Value Change	% change
1% Annual Chance Flood Hazard	$776,140,749	$771,519,702	-$4,621,047	-0.6%
0.2% Annual Chance Flood Hazard**	$2,539,737,276	$2,533,754,574	-$5,982,702	-0.2%
Other Areas	$10,142,818,295	$9,476,214,062	-$666,604,233	-6.6%

Flood Zone	Pre-Fire Improved Structure Value*	Post-Fire Improved Structure Value*	Value Change	% change
Total	**$13,458,696,320**	**$12,781,488,338**	**-$677,207,982**	**-5.0%**

Source: FEMA 1/6/2011 DFIRM, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-129 Butte County Planning Area – Count and Value of Parcels by 1% and 0.2% Flood Zone by Jurisdiction

Jurisdiction/ Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
1% Annual Chance Flood Hazard	0	0	$0	$0	$0	$0	$0
0.2% Annual Chance Flood Hazard	765	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$155,425,116
Other Areas	0	0	$0	$0	$0	$0	$0
City of Biggs Total	765	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$155,425,116
City of Chico							
1% Annual Chance Flood Hazard	1,093	947	$117,274,854	$217,681,041	$3,034,290	$137,805,361	$447,749,040
0.2% Annual Chance Flood Hazard	9,488	8,870	$987,627,038	$1,689,343,088	$3,522,563	$963,823,454	$3,531,988,125
Other Areas	15,916	14,743	$2,025,784,970	$4,065,575,730	$47,829,126	$2,779,261,987	$8,389,832,270
City of Chico Total	**26,497**	**24,560**	**$3,130,686,862**	**$5,972,599,859**	**$54,385,979**	**$3,880,890,801**	**$12,369,569,434**
City of Gridley							
1% Annual Chance Flood Hazard	3	0	$0	$0	$0	$0	$0
0.2% Annual Chance Flood Hazard	2,449	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934
Other Areas	0	0	$0	$0	$0	$0	$0
City of Gridley Total	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934

Jurisdiction/ Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Oroville							
1% Annual Chance Flood Hazard	94	51	$6,584,673	$15,062,584	$358,940	$12,087,296	$32,245,879
0.2% Annual Chance Flood Hazard	604	452	$43,419,507	$91,016,487	$2,052,234	$78,213,094	$214,554,239
Other Areas	6,447	4,998	$270,347,458	$778,096,177	$58,930,189	$561,204,619	$1,536,200,509
City of Oroville Total	7,145	5,501	$320,351,638	$884,175,248	$61,341,363	$651,505,009	$1,783,000,627
Town of Paradise							
1% Annual Chance Flood Hazard	0	0	$0	$0	$0	$0	$0
0.2% Annual Chance Flood Hazard	0	0	$0	$0	$0	$0	$0
Other Areas	11,501	10,594	$782,342,823	$1,023,339,240	$13,675,031	$652,002,932	$2,279,160,797
Town of Paradise Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Unincorporated Butte County							
1% Annual Chance Flood Hazard	4,441	3,077	$699,473,960	$538,776,077	$137,315,508	$389,310,548	$1,795,234,791
0.2% Annual Chance Flood Hazard	3,294	2,666	$356,869,529	$393,881,935	$45,189,854	$249,655,646	$1,060,233,047
Other Areas	38,740	28,124	$2,580,436,710	$3,609,202,915	$143,799,542	$2,118,533,629	$8,329,590,306
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance floodplain, exclusive of the 1% annual chance floodplain. The 0.2% annual chance flood also includes all parcels in the 1% annual chance floodplain.

Table 4-130 shows a summary table of loss estimates by 1% and 0.2% annual chance flood zone for the Butte County Planning Area. The loss ratio is the loss estimate divided by the total potential exposure (i.e., total of improved and contents value for all parcels located in the Planning Area) and displayed as a percentage of loss. FEMA considers loss ratios greater than 10% to be significant and an indicator that a community may have more difficulties recovering from a flood. The County should keep in mind that the loss ratio could increase with additional development in the 1% and 0.2% annual chance flood zone, unless development is elevated in accordance with the local floodplain management ordinance.

Table 4-130 Butte County Planning Area – Flood Loss Estimate

Flood Zone	Total Parcel Count	Improved Parcel Count	Improved Structure Value	Other Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance	5,631	4,075	$771,519,702	$140,708,738	$539,203,205	$1,451,431,645	$290,286,329	1.37%
0.2% Annual Chance	16,600	14,864	$2,533,754,574	$66,742,900	$1,525,811,596	$4,126,309,070	$825,261,814	3.88%
Grand Total	**22,231**	**18,939**	**$3,305,274,276**	**$207,451,638**	**$2,065,014,801**	**$5,577,740,715**	**$1,115,548,143**	**5.25%**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual flood zone, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

According to the information in Table 4-126 through Table 4-130, the Butte County Planning Area has 4,075 improved parcels and roughly $1.45 billion of structure and contents value in the 1% annual chance flood zone. There are an additional 14,864 improved parcels and roughly $4.13 billion of structure and contents value in the 0.2% annual chance flood event. A loss ratio of 5.25% indicates that the County has a significant number of values in the FEMA regulated floodplains.

Butte County Planning Area Watershed Analysis

In addition, analysis was performed for the Planning Area on values at risk by watershed, grouped by 1% and 0.2% annual chance flood zone. Due to the length of this table, it is shown as Table G-1 in Appendix G.

Unincorporated Butte County

Analysis results for the unincorporated Butte County is presented in multiple tables (all using the estimated contents replacement values based on the CRV factors detailed in Table 4-55) below:

- Table 4-131 shows the total parcel counts, improved parcel counts, their improved structure and land values in the DFIRM flood zones prior to the Camp Fire.
- Table 4-132 shows the total parcel counts, improved parcel counts, their improved structure and land values in the DFIRM flood zones after the Camp Fire.
- Table 4-133 compares the improved structure values in DFIRM flood zones in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-134 breaks down Table 4-132 into more detail, and shows post-fire values in the DFIRM flood zones by property use type.

Table 4-131 Unincorporated Butte County – Pre-Fire Count and Value of Parcels by DFIRM Flood Zone

Flood Zone	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	4,433	3,078	$704,467,657	$542,567,222	$138,299,292	$391,810,081	$1,777,144,252
0.2% Annual Chance Flood Hazard**	3,289	2,668	$358,962,288	$400,884,975	$46,167,534	$257,006,172	$1,063,020,969
Other Areas	38,712	28,132	$2,583,800,982	$3,686,599,918	$143,629,661	$2,158,539,958	$8,572,570,519
Unincorporated Butte County Total	**46,434**	**33,878**	**$3,647,230,927**	**$4,630,052,115**	**$328,096,487**	**$2,807,356,210**	**$11,412,735,739**

Source: FEMA 1/6/2011 DFIRM, Butte County 2018 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

Table 4-132 Unincorporated Butte County – Post-Fire Count and Value of Parcels by DFIRM Flood Zone

Flood Zone	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	4,441	3,077	$699,473,960	$538,776,077	$137,315,508	$389,310,548	$1,795,234,791
0.2% Annual Chance Flood Hazard**	3,294	2,666	$356,869,529	$393,881,935	$45,189,854	$249,655,646	$1,060,233,047
Other Areas	38,740	28,124	$2,580,436,710	$3,609,202,915	$143,799,542	$2,118,533,629	$8,329,590,306
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

Table 4-133 Unincorporated Butte County – Comparison of Pre- and Post-Fire Improved Structure Values

Flood Zone	Pre-Fire Improved Structure Value*	Post-Fire Improved Structure Value*	Value Change	% change
1% Annual Chance Flood Hazard	$542,567,222	$538,776,077	-$3,791,145	-0.7%

Flood Zone	Pre-Fire Improved Structure Value*	Post-Fire Improved Structure Value*	Value Change	% change
0.2% Annual Chance Flood Hazard**	$400,884,975	$393,881,935	-$7,003,040	-1.7%
Other Areas	$3,686,599,918	$3,609,202,915	-$77,397,003	-2.1%
Unincorporated Butte County Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: FEMA 1/6/2011 DFIRM, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

Table 4-134 Unincorporated Butte County – Post-Fire Count and Value of Parcels by DFIRM Flood Zone and Property Use

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard							
Agricultural	1,455	885	$454,749,200	$143,541,622	$122,485,806	$143,541,622	$896,336,245
Commercial	86	52	$9,580,483	$13,981,342	$696,040	$13,981,342	$38,421,440
Industrial	70	42	$9,148,189	$41,394,804	$11,109,952	$62,092,206	$127,081,400
Residential	2,496	2,095	$224,684,216	$339,390,756	$2,363,690	$169,695,378	$729,994,492
Unknown	334	3	$1,311,872	$467,553	$660,020	$0	$3,401,214
1% Annual Chance Flood Hazard Total	**4,441**	**3,077**	**$699,473,960**	**$538,776,077**	**$137,315,508**	**$389,310,548**	**$1,795,234,791**
0.2% Annual Chance Flood Hazard**							
Agricultural	784	487	$172,259,377	$55,573,190	$37,409,098	$55,573,190	$337,861,586
Commercial	40	35	$5,289,382	$13,015,713	$318,230	$13,015,713	$28,199,669
Industrial	19	17	$1,697,215	$18,420,227	$5,073,720	$27,630,341	$54,567,363
Residential	2,272	2,127	$177,611,009	$306,872,805	$2,388,806	$153,436,403	$639,591,884
Unknown	179	0	$12,546	$0	$0	$0	$12,546
0.2% Annual Chance Flood Hazard Total	**3,294**	**2,666**	**$356,869,529**	**$393,881,935**	**$45,189,854**	**$249,655,646**	**$1,060,233,047**
Other Areas							
Agricultural	2,976	1,270	$481,014,188	$191,550,871	$128,636,087	$191,550,871	$1,018,979,989

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Commercial	701	522	$79,447,519	$184,549,381	$5,445,819	$184,549,381	$416,655,828
Industrial	220	177	$40,763,265	$126,455,257	$5,715,578	$189,682,886	$371,641,287
Residential	33,771	26,145	$1,977,492,470	$3,105,500,982	$3,951,158	$1,552,750,491	$6,518,616,995
Unknown	1,072	10	$1,719,268	$1,146,424	$50,900		$3,696,207
Other Areas Total	**38,740**	**28,124**	**$2,580,436,710**	**$3,609,202,915**	**$143,799,542**	**$2,118,533,629**	**$8,329,590,306**
Grand Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

Table 4-135 Unincorporated Butte County – Flood Loss Estimates

Flood Zone	Total Parcel Count	Improved Parcel Count*	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance	4,441	3,077	$699,473,960	$538,776,077	$137,315,508	$389,310,548	$1,065,402,133	$213,080,427	0.96%
0.2% Annual Chance**	3,294	2,666	$356,869,529	$393,881,935	$45,189,854	$249,655,646	$688,727,435	$137,745,487	0.62%
Grand Total	**7,735**	**5,743**	**$1,056,343,489**	**$932,658,012**	**$182,505,362**	**$638,966,194**	**$1,754,129,568**	**$350,825,914**	**1.58%**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood also includes all parcels in the 1% annual chance flood zone.

According to Table 4-135, unincorporated Butte County has 3,077 improved parcels and roughly $10.7 billion of structure and contents value in the 1% annual chance flood zone. The unincorporated County has 2,666 improved parcels and roughly $668 million in structure and contents values in the 0.2% annual chance flood zone. These values can be refined a step further. Applying the 20 percent damage factor as previously described, there is a 1% chance in any given year of a flood event causing roughly $213 million in damage in the unincorporated areas of Butte County. Applying the same factor, there is a 0.2% chance of a flood event causing $137 million in damage to the unincorporated County. A loss ratio of 1.58% indicates that while the unincorporated County has values at risk in the floodplain, flood losses would be moderate compared to the total built environment and the community would likely be able to recover adequately.

Unincorporated Butte County Watershed Analysis

Additional analysis was performed in unincorporated Butte County to show values at risk by watershed. All values are post-fire. These are shown in Table G-2 to G-4 in Appendix G.

Flooded Acres

In addition to the centroid analysis used to obtain numbers of parcels and values at risk to flood hazards, parcel boundary analysis was performed to obtain total acres and flooded acres by flood zone. The following is an analysis of flooded acres associated with FEMA DFIRM floodzones in the County.

Methodology

GIS was used to calculate acres flooded by FEMA flood zones to obtain the flooded acres in each flood zone. The Butte County parcel layer and FEMA DFIRM were intersected to obtain the flooded acres in each FEMA flood zone.

Limitations

One limitation created by this type of analysis is that with respect to the improved acres analysis, improvements are uniformly found throughout the parcel, while in reality, only portions of the parcel are improved, and improvements may or may not fall within the flood zone portion of a parcel; thus, areas of improvements flooded calculated through this method may be higher or lower than those actually seen in a similar real-world event.

The following tables represent a summary and detailed analysis of total acres for each FEMA DFIRM flood zone in the Planning Area. Table 4-136 gives summary information for the Planning Area by 1% and 0.2% annual chance flood zone for the entire Butte County Planning Area, as described in the Total Values at Risk Section. Table 4-137 shows the specific DFIRM flood zone designations that make up the 1% and 0.2% annual chance flood zones for the unincorporated County. Details on flooded acres by detailed flood zone for the incorporated jurisdictions in the County are shown in their respective annexes to this Plan. In all of these tables, the Other Areas are areas (Zone X Unshaded – areas outside mapped flood hazard areas) where there is no mapped flood hazard area.

Table 4-136 Butte County Planning Area – Flooded Acres in 1% and 0.2% Annual Chance Flood Zone by Jurisdiction

Jurisdiction / Flood Zone /	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Biggs						
1% Annual Chance Flood Hazard	0		0	0.00%	0	0.00%
0.2% Annual Chance Flood Hazard	474	0.03%	201	0.04%	272	0.03%

Jurisdiction / Flood Zone /	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Other Areas	0	0.00%	0	0.00%	0	0.00%
City of Biggs Total	**474**	**0.03%**	**201**	**0.04%**	**272**	**0.03%**
City of Chico						
1% Annual Chance Flood Hazard	17,402	1.20%	798	0.15%	16,604	1.82%
0.2% Annual Chance Flood Hazard	9,044	0.62%	2,672	0.50%	6,372	0.70%
Other Areas	17,380	1.20%	5,448	1.02%	11,932	1.31%
City of Chico Total	**43,826**	**3.03%**	**8,919**	**1.66%**	**34,907**	**3.82%**
City of Gridley						
1% Annual Chance Flood Hazard	98	0.01%	0	0.00%	98	0.01%
0.2% Annual Chance Flood Hazard	1,087	0.08%	696	0.13%	390	0.04%
Other Areas	0	0.00%	0	0.00%	0	
City of Gridley Total	**1,184**	**0.08%**	**696**	**0.13%**	**488**	**0.05%**
City of Oroville						
1% Annual Chance Flood Hazard	1,382	0.10%	67	0.01%	1,315	0.14%
0.2% Annual Chance Flood Hazard	924	0.06%	394	0.07%	530	0.06%
Other Areas	7,801	0.54%	2,753	0.51%	5,048	0.55%
City of Oroville Total	**10,107**	**0.70%**	**3,213**	**0.60%**	**6,894**	**0.76%**
Town of Paradise						
1% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
0.2% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
Other Areas	10,780	0.74%	8,431	1.57%	2,349	0.26%

Jurisdiction / Flood Zone /	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Town of Paradise Total	**10,780**	**0.74%**	**8,431**	**1.57%**	**2,349**	**0.26%**
Unincorporated Butte County						
1% Annual Chance Flood Hazard	425,313	29.36%	213,153	39.79%	212,160	23.24%
0.2% Annual Chance Flood Hazard	64,108	4.43%	33,277	6.21%	30,831	3.38%
Other Areas	892,622	61.63%	267,803	49.99%	624,819	68.46%
Unincorporated Butte County Total	**1,382,042**	**95.42%**	**514,233**	**95.99%**	**867,810**	**95.08%**
Grand Total	1,448,413	100.00%	535,692	100.00%	912,721	100.00%

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-137 Unincorporated Butte County – Flooded Acres by Detailed DFIRM Flood Zones

Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
1% Annual Chance Flood Hazard						
Zone A	311,689	21.52%	131,861	24.62%	179,828	19.70%
Zone AE	81,682	5.64%	53,459	9.98%	28,222	3.09%
Zone AE Floodway	7,222	0.50%	4,705	0.88%	2,517	0.28%
Zone AH	77	0.01%	3	0.00%	74	0.01%
Zone AO	24,644	1.70%	23,125	4.32%	1,519	0.17%
1% Annual Chance Flood Hazard Total	**425,313**	**29.36%**	**213,153**	**39.79%**	**212,160**	**23.24%**
0.2% Annual Chance Flood Hazard						
Zone X (shaded)	64,108	4.43%	33,277	6.21%	30,831	3.38%
0.2% Annual Chance Flood Hazard Total	**64,108**	**4.43%**	**33,277**	**6.21%**	**30,831**	**3.38%**
Other Areas						
Zone X (unshaded)	892,622	61.63%	267,803	49.99%	624,819	68.46%
Other Areas Total	**892,622**	**61.63%**	**267,803**	**49.99%**	**624,819**	**68.46%**

Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Unincorporated Butte County Total	**1,382,042**	**95.42%**	**514,233**	**95.99%**	**867,810**	**95.08%**

Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data

Insurance Coverage, Claims Paid, and Repetitive Losses

Unincorporated Butte County joined the NFIP on September 29, 1989. The County does not participate in the CRS program. NFIP insurance data indicates that as of July 19, 2018, there were 1,518 policies in force in the unincorporated County, resulting in $378,498,100 of insurance in force and $1,314,575 in annual premiums paid. Of these, 1,378 are for residential properties and 140 are nonresidential. 845 of these are in A zones; and 673 policies are for parcels in the B, C, & X zones.

There have been 181 closed paid losses totaling $3,416,356.71. 175 of these were for residential properties and 6 were for nonresidential. Of these 181 paid losses, 119 were parcels in A zones, 54 parcels were in B, C, & X zones, and 8 were in unknown zones. Of the 181 claims, 148 claims were associated with pre-FIRM structures and 27 with post-FIRM structures, with 6 being unknown. There have been 10 substantial damage claims since 1978. There are 29 repetitive loss (RL) properties and 2 severe repetitive loss (SRL) properties in the unincorporated County. According to FEMA none of the RL and SRL have been mitigated.

Based on this analysis of insurance coverage, Butte County has values at risk to the 1% and 0.2% annual chance and greater floods. Of the 3,077 improved parcels within the 1% annual chance flood zone, 845 (or 27.5 percent) of those parcels maintain flood insurance. This can be seen on Table 4-138 along with insurance policies for the five unincorporated communities that comprise the Planning Area. Flood insurance details specific to the incorporated communities are included in their jurisdictional annexes.

Table 4-138 Butte County Planning Area – Percentage of Policy Holders to Improved Parcels in the 1% Annual Chance Floodplain

Jurisdiction	Improved Parcels in SFHA (1% Annual Chance) Floodplain*	Insurance Policies in the SFHA (1% Annual Chance) Floodplain	Percentage of 1% Annual Chance Floodplain Parcels Currently Insured
City of Biggs	0	0	–
City of Chico	947	354	37.3%
City of Gridley	0	0	–
City of Oroville	51	14	26.9%
Town of Paradise	0	0	–
Unincorporated County	3,077	845	27.5%
Total	**4,075**	**1,213**	**29.8%**

Source: FEMA 1/6/2011 DFIRM, Butte County 2018 Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Population at Risk

A separate analysis was performed to determine population in flood zones. Using GIS, the DFIRM Flood dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect a flood zone were counted and multiplied by the Census Bureau average household size for each jurisdiction; and tabulated by flood zone (see Table 4-139). According to this analysis, there is a population of 8,824 residing in the 1% annual chance flood zone, and 39,559 in the 0.2% annual chance flood zone.

Table 4-139 Butte County Planning Area – Residential Population at Risk to 1% and 0.2% Annual Chance Flooding

Jurisdiction	1 % Annual Chance Flooding		0.2% Annual Chance Flooding	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Biggs	0	0	639	1,566
Chico	816	2,464	8,476	25,598
Gridley	0	0	1,977	5,140
Oroville	29	75	338	874
Paradise	0	0	0	0
Unincorporated County	2,095	6,285	2,127	6,381
Total	**2,940**	**8,824**	**13,557**	**39,559**

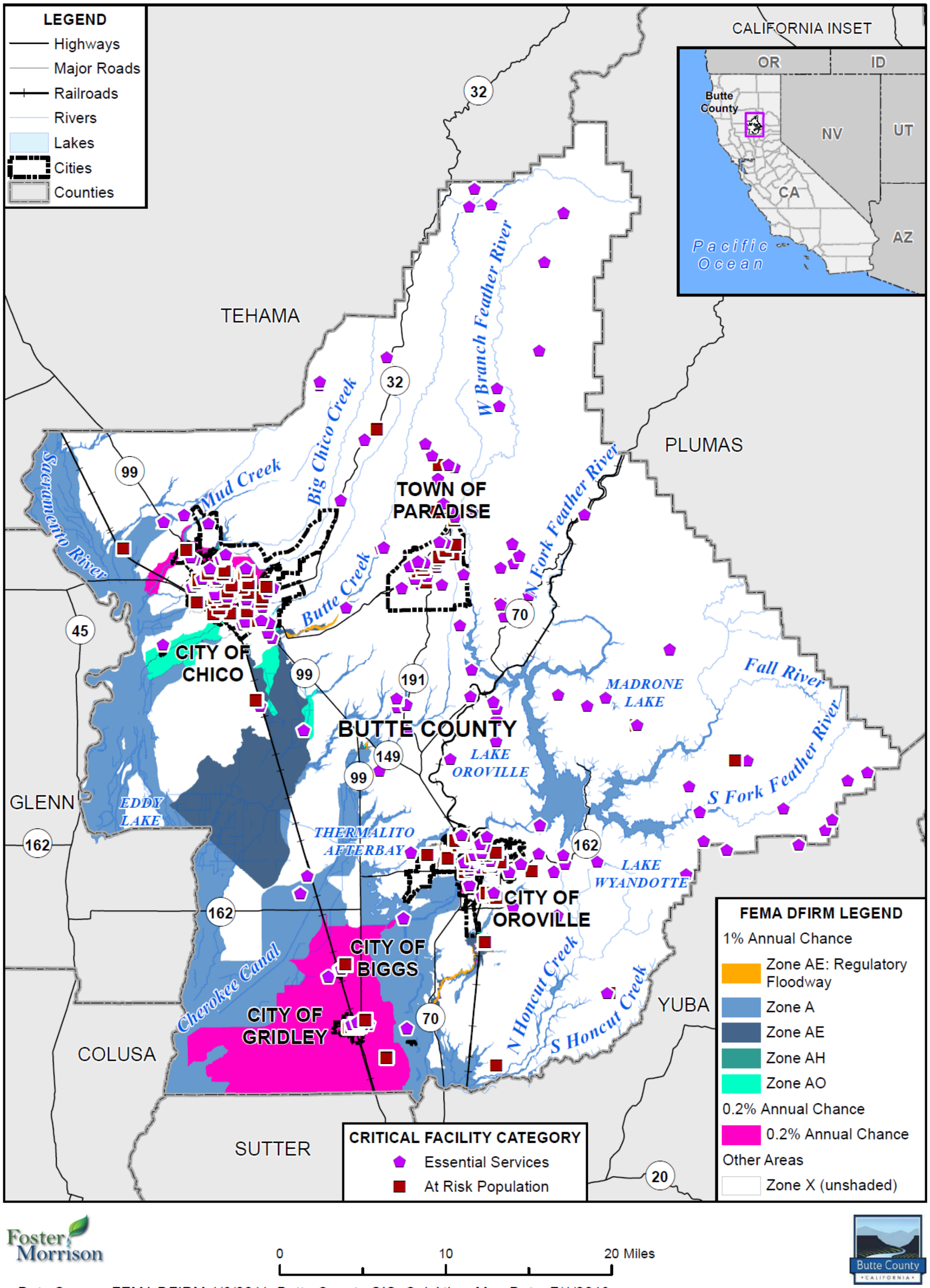
Source: FEMA 1/6/2011 DFIRM, Butte County 3/28/2019 Parcel/Assessor's Data, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Butte County and all jurisdictions to determine critical facilities in the 1% and 0.2 annual chance floodplains. Using GIS, the DFIRM flood zones were overlayed on the critical facility GIS layer. Figure 4-110 shows critical facilities, as well as the DFIRM flood zones. Table 4-140 summarizes the critical facilities in the County by DFIRM flood zone. Table 4-141 details critical facilities by facility type and count by jurisdiction for the Planning Area. Table 4-142 details critical facilities by facility type for the unincorporated County. Information on critical facilities in the incorporated jurisdictions in the County can be found in their respective annexes to this Plan Update. Details of critical facility definition, type, name and address and jurisdiction by flood zone are listed in Appendix F.

Figure 4-110 Butte County Planning Area – Critical Facilities and DFIRM Flood Zones



Data Source: FEMA DFIRM 1/6/2011, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-140 Butte County Planning Area – Summary of Critical Facilities in DFIRM Flood Zones

Flood Zone / Critical Facility Category	Facility Count
1% Annual Chance Flood Hazard	
Essential Services Facilities	20
At Risk Population Facilities	2
1% Annual Chance Flood Hazard Total	**22**
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	21
At Risk Population Facilities	22
0.2% Annual Chance Flood Hazard Total	**43**
Other Areas	
Essential Services Facilities	196
At Risk Population Facilities	79
Other Areas Total	**275**
Grand Total	**340**

Source: FEMA 1/6/2011 DFIRM, Butte County GIS

Table 4-141 Butte County Planning Area – Critical Facilities in DFIRM Flood Zones by Jurisdiction and Facility Category

Jurisdiction / Flood Zone / Critical Facility Category	Facility Count
City of Biggs	
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	3
At Risk Population Facilities	4
0.2% Annual Chance Flood Hazard Total	7
City of Biggs Total	**7**
City of Chico	
1% Annual Chance Flood Hazard	
Essential Services Facilities	2
At Risk Population Facilities	1
1% Annual Chance Flood Hazard Total	**3**
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	6
At Risk Population Facilities	10
0.2% Annual Chance Flood Hazard Total	**16**
Other Areas	

Jurisdiction / Flood Zone / Critical Facility Category	Facility Count
Essential Services Facilities	42
At Risk Population Facilities	20
Other Areas Total	**62**
City of Chico Total	**81**
City of Gridley	
1% Annual Chance Flood Hazard	
Essential Services Facilities	1
At Risk Population Facilities	0
1% Annual Chance Flood Hazard Total	**1**
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	10
At Risk Population Facilities	6
0.2% Annual Chance Flood Hazard Total	**16**
City of Gridley Total	**17**
City of Oroville	
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	1
At Risk Population Facilities	1
0.2% Annual Chance Flood Hazard Total	**2**
Other Areas	
Essential Services Facilities	39
At Risk Population Facilities	19
Other Areas Total	**58**
City of Oroville Total	**60**
Town of Paradise	
Other Areas	
Essential Services Facilities	21
At Risk Population Facilities	12
Other Areas Total	**33**
Town of Paradise Total	**33**
Unincorporated Butte County	
1% Annual Chance Flood Hazard	
Essential Services Facilities	17
At Risk Population Facilities	1
1% Annual Chance Flood Hazard Total	18
0.2% Annual Chance Flood Hazard	
Essential Services Facilities	1

Jurisdiction / Flood Zone / Critical Facility Category	Facility Count
At Risk Population Facilities	1
0.2% Annual Chance Flood Hazard Total	**2**
Other Areas	
Essential Services Facilities	94
At Risk Population Facilities	28
Other Areas Total	**122**
Unincorporated Butte County Total	**142**
Outside of Butte County	
Other Areas	
Essential Services Facilities	1
At Risk Population Facilities	0
Other Areas Total	**1**
Outside of Butte County Total	**1**
Grand Total	341

Source: FEMA 1/6/2011 DFIRM, Butte County GIS

Table 4-142 Unincorporated Butte County – Critical Facilities in Detailed DFIRM Flood Zones by Critical Facility Category and Type

Flood Zone	Critical Facility Category / Critical Facility Type	Facility Count
1% Annual Chance Flood Hazard		
Zone AE	**Essential Services Facilities**	
	Dam	1
	Essential Services Facilities Total	1
	Total	**1**
Zone A	**Essential Services Facilities**	
	Wastewater Treatment Plant	1
	Fire	2
	Dam	11
	Emergency Animal Shelter	1
	Essential Services Facilities Total	**15**
	At Risk Population Facilities	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**16**
Zone AE Floodway	Essential Services Facilities	
	Public Assembly Point / Evacuation Center	1

Flood Zone	Critical Facility Category / Critical Facility Type	Facility Count
	Essential Services Facilities Total	**1**
	Total	**1**
1% Annual Chance Flood Hazard Total		**18**
0.2% Annual Chance Flood Hazard		
Zone X (shaded)	**Essential Services Facilities**	
	Fire	1
	Essential Services Facilities Total	**1**
	At Risk Population Facilities	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**2**
0.2% Annual Chance Flood Hazard Total		**2**
Other Areas		
Zone X (unshaded)	**Essential Services Facilities**	
	Fire	33
	Health Care	3
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	29
	Radio Sites	11
	Dam	17
	Essential Services Facilities Total	**94**
	At Risk Population Facilities	
	School	28
	At Risk Population Facilities Total	**28**
	Total	**122**
Other Areas Total		**122**
Unincorporated Butte County Total		**142**

Source: FEMA 1/6/2011 DFIRM, Butte County GIS

Overall Community Impact

Floods and their impacts vary by location and severity of any given flood event and will likely only affect certain areas of the County during specific times. Natural areas, such as wetlands and riparian areas within the floodplain, often benefit from periodic flooding as a naturally recurring phenomenon. These natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters. Preserving and protecting these areas and associated functions are a vital component of sound floodplain management practices for Butte County. Based on the risk assessment, it is evident that floods will continue to have potentially devastating economic impacts to certain areas of the County. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.
- Impact on the overall mental health of the community.

Future Development and Future Flood Conditions

This section provides an analysis of the flood hazard and proposed future development within the County based on FEMA DFIRMs and also discusses considerations in evaluating future flooding conditions.

Future Development: General Considerations

Communities that participate in the NFIP adopt regulations and codes that govern development in special flood hazard areas, and enforce those requirements through their local floodplain management ordinances through the issuance of permits. Butte County's floodplain management ordinance provides standards for development, subdivision of land, construction of buildings, and improvements and repairs to buildings that meet the minimum requirements of the NFIP.

The International Residential Code (IRC) and International Building Code (IBC), by reference to ASCE 24, include requirements that govern the design and construction of buildings and structures in flood hazard areas. FEMA has determined that the flood provisions of the I-Codes are consistent with the requirements of the NFIP (the I-Code requirements shown either meet or exceed NFIP requirements). ASCE 24, a design standard developed by the American Society of Civil Engineers, expands on the minimum NFIP requirements with more specificity, additional requirements, and some limitations.

With the adoption of more current versions of the International Code, communities have been moving towards a more stringent approach to regulatory floodplain management, beyond the minimum requirements of the NFIP. The adoption and enforcement of disaster-resistant building codes is a core community action to promote effective mitigation. When communities ensure that new buildings and infrastructure are designed and constructed in accordance with national building codes and construction standards, they significantly increase local resilience now and in the future. With continued advancements in building codes, local ordinances should be reviewed and updated to meet and exceed standards as practicable to protect new development from future flood events and to further promote disaster resiliency.

One of the most effective ways to reduce vulnerability to potential flood damage is through careful land use planning that fully considers applicable flood management information and practices. Master planning will also be necessary to assure that open channel flood flow conveyances serving the smaller internal streams and drainage areas are adequately prepared to accommodate the flows. Preservation and maintenance of natural and riparian areas should also be an ongoing priority to realize the flood control benefits of the natural and beneficial functions of these areas. Also to be considered in reducing flooding in areas of existing and future development is to promote implementation of stormwater program elements and erosion and sediment controls, including the clearing of vegetation from natural and man-made drains that are critical to flood protection. Both native and invasive species can clog drains, and reduce flows of floodwaters, which slow that natural drainage process and can exacerbate flooding.

Future Development: DFIRM Analysis

Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of flooding to the 8 future development projects.

Methodology

Butte County's 3/28/2019 Parcel/Assessor's data and data provided by County Planning were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas. Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file and the APNs, the 8 future development projects were identified. For the flood analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the Assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected to determine the parcel counts and acreage within each FEMA flood zone.

DFIRM flood zones and future development areas are shown on Figure 4-111 and parcels and acreages in those areas are shown in Table 4-143.

Figure 4-111 Unincorporated Butte County – Future Development in DFIRM Flood Zones

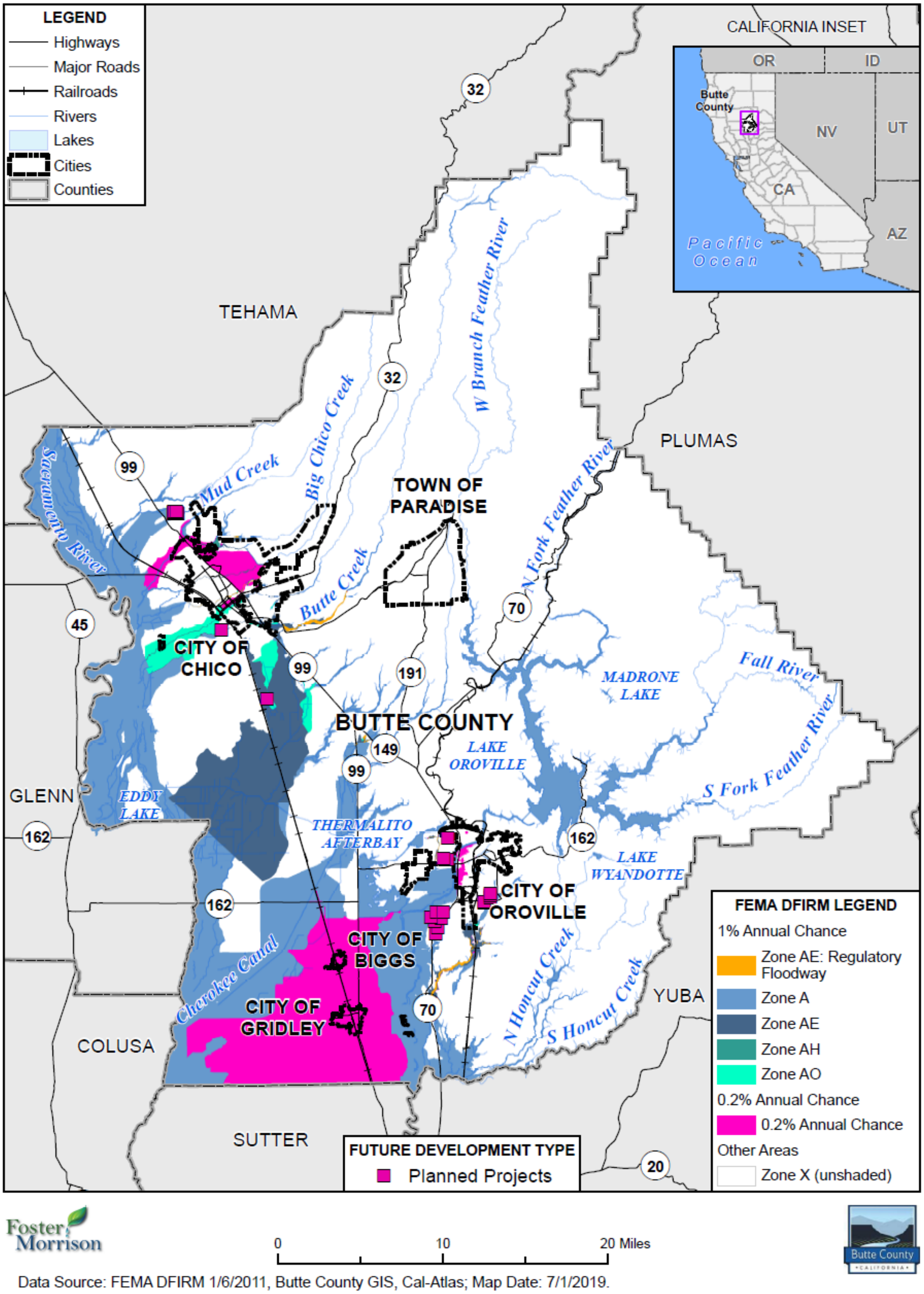


Table 4-143 Unincorporated Butte County – Future Development Parcels and Acreage in DFIRM Flood Zones

Future Development /DFIRM Flood Zone	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista			
Zone X (unshaded)	1	0	9.7
Creekside Estates			
Zone AO	1	1	47.4
Diamond Oak			
Zone X (unshaded)	2	1	7.9
Lincoln and Ophir Garden Oak Estates			
Zone X (unshaded)	2	0	50.4
Mandville Park			
Zone A	3	0	3.4
Zone X (unshaded)	22	0	19.2
Rio d Oro - Phase 1			
Zone X (unshaded)	**7**	**0**	664.2
Southlands Subdivision			
Zone X (unshaded)	3	**0**	48.8
Stanley Ave			
Zone X (unshaded)	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: FEMA 1/6/2011 DFIRM, Butte County GIS

Future Flood Conditions: The Effects of Climate Change

The effects of climate change on future flood conditions should also be considered. While the risk and associated short and long-term impacts of climate change are uncertain, experts in this field tend to agree that among the most significant impacts include those resulting from increased heat and precipitation events that cause increased frequency and magnitude of flooding. Changes associated with climate change and flooding could be significant given the higher elevations in the County where winter snow could turn to more significant rain events. Increases in damaging flood events will cause greater property damage, public health and safety concerns displacement, and loss of life. In addition, an increase in the magnitude and severity of flood events can lead to potential contamination of potable water and contamination of food crops given the agricultural industry in the County. Displacement of residents can include both temporary and long-term displacement, increase in insurance rates or restriction of coverage in vulnerable areas.

Butte County will continue to study the risk and vulnerability associated with future flood conditions, both in terms of future growth areas and other considerations such as climate change, as they evaluate and implement their flood mitigation and adaptation strategy for the Butte County Planning Area.

Future Flood Conditions: ARkStorm Scenario

Also to be considered in evaluating potential "worst case" future flood conditions, is the ARkStorm Scenario. Although much attention in California's focuses on the "Big One" as a high magnitude earthquake, there is the risk of another significant event in California – a massive, statewide winter storm. The last such storms occurred in the 19th century, outside the memory of current emergency managers, officials, and communities. However, massive storms are a recurring feature of the state, the source of rare but inevitable disasters. The USGS Multi Hazards Demonstration Project's (MHDP) developed a product called ARkStorm, which addressed massive U.S. West Coast storms analogous to those that devastated California in 1861-1862. Over the last decade, scientists have determined that the largest storms in California are the product of phenomena called Atmospheric Rivers, and so the MHDP storm scenario is called the ARkStorm, for Atmospheric River 1000 (a measure of the storm's size).

Scientific studies of offshore deposits in northern and southern California indicate that storms of this magnitude and larger have occurred about as often as large earthquakes on the southern San Andreas Fault. Such storms are projected to become more frequent and intense as a result of climate change. This scientific effort resulted in a plausible flood hazard scenario to be used as a planning and preparation tool by hazard mitigation and emergency response agencies.

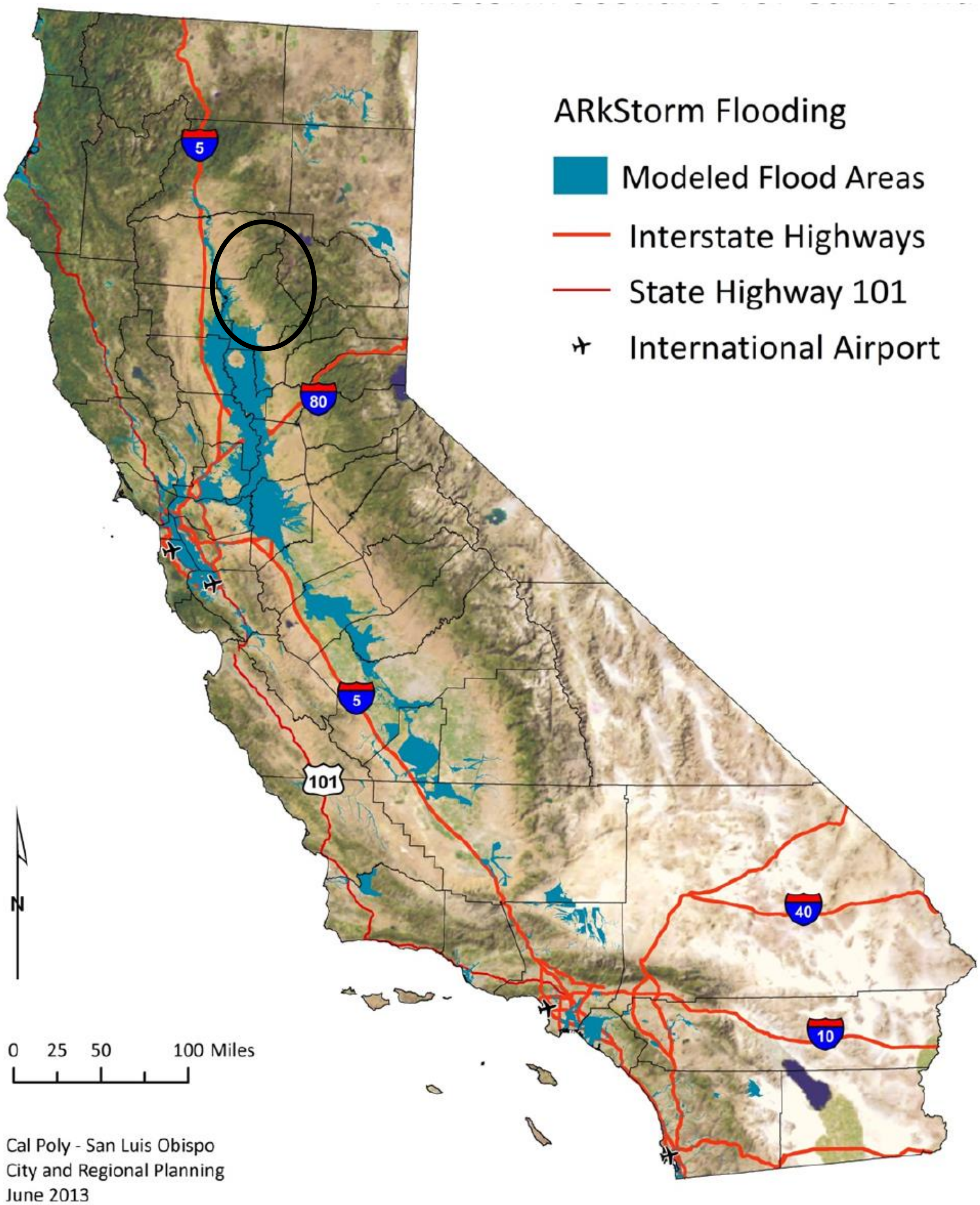
For the ARkStorm Scenario, experts designed a large, scientifically realistic meteorological event followed by an examination of the secondary hazards (e.g., landslides and flooding), physical damages to the intense winter storms of 1861-62 that left California's Central Valley impassible. Storms far larger than the ARkStorm, dubbed megastorms, have also hit California at least six times in the last two millennia.

The ARkStorm produces precipitation in many places exceeding levels experienced on average every 500 to 1,000 years. Extensive flooding in many cases overwhelms the state's flood protection system, which is at best designed to resist 100- to 200-year runoffs (many flood protection systems in the state were designed for smaller runoff events). The Central Valley experiences widespread flooding. Serious flooding also occurs in Orange County, Los Angeles County, San Diego, the San Francisco Bay Area, and other coastal communities. In some places, winds reach hurricane speeds, as high as 125 miles per hour. Hundreds of landslides occur, damaging roads, highways, and homes. Property damage exceeds $300 billion, most of it from flooding. Agricultural losses and other costs to repair lifelines, dewater flooded islands, and repair damage from landslides brings the total direct property loss to nearly $400 billion, of which only $20 to $30 billion would be recoverable through public and commercial insurance. Power, water, sewer, and other lifelines experience damage that takes weeks or months to restore. Flooding evacuation could involve over one million residents in the inland region and Delta counties.

A storm of ARkStorm's magnitude has important implications: 1) it raises serious questions about the ability of existing national, state, and local disaster policy to handle an event of this magnitude; 2) it emphasizes the choice between paying now to mitigate, or paying a lot more later to recover; 3) innovative financing solutions are likely to be needed to avoid fiscal crisis and adequately fund response and recovery costs; 4) responders and government managers at all levels could be encouraged to conduct self-assessments and devise table-top exercises to exercise their ability to address a similar event; 5) the scenario can be a reference point for application of FEMA and Cal OES guidance connecting federal, state, and local natural hazards mapping and mitigation planning under the NFIP and Disaster Mitigation Act of 2000; and 6) common messages to educate the public about the risk of such an extreme event could be developed and consistently communicated to facilitate policy formulation and transformation.

Figure 4-112 depicts an ARkStorm modeled scenario showing the potential for flooding primarily in the Central Valley as the result of a large storm. In Butte County, the modeled scenario suggests the County would face significant inundation in the western portion of the County.

Figure 4-112 Projected ARkStorm Flooding in California



Source: USGS ArkStorm

4.3.8. Flood: Localized Stormwater Flooding Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Historically, the Planning Area has been at risk to flooding primarily during the winter and spring months when stream systems in the County swell with heavy rainfall. Localized flooding also occurs throughout the Planning Area at various times throughout the year with several areas of primary concern unique to each community. Butte County tracks localized flooding areas as shown in Table 4-39 in Section 4.2.10.

Localized flooding can cause damage to roads, infrastructure and utilities, as well as to buildings in the County. Temporary road closures due to localized flooding can be a significant issue in the County. Public infrastructure is often upgraded when it is replaced due to age or when roads are upgraded.

Future Development

The risk of stormwater/localized flooding to future development can be minimized by accurate recordkeeping of repetitive localized storm activity. Mitigating the root causes of the localized stormwater flooding or choosing not to develop in areas that often are subject to localized flooding will reduce future risks of losses due to stormwater/localized flooding.

Much of the growth in Butte County is occurring through expansion of the urban areas, causing an increase in peak flow and stormwater runoff. Such growth will consume previously undeveloped acres, and the impacts may overwhelm existing drainage and flood control facilities.

The potential for flooding may increase as stormwater is channeled due to land development. Such changes can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. Floodplain modeling and master planning should be based on build out property use to ensure that all new development remains safe from future flooding. While local floodplain management, stormwater management, and water quality regulations and policies address these changes on a site-by-site basis, their cumulative effects can have a negative impact on the floodplain.

4.3.9. Hazardous Materials Transport Vulnerability Assessment

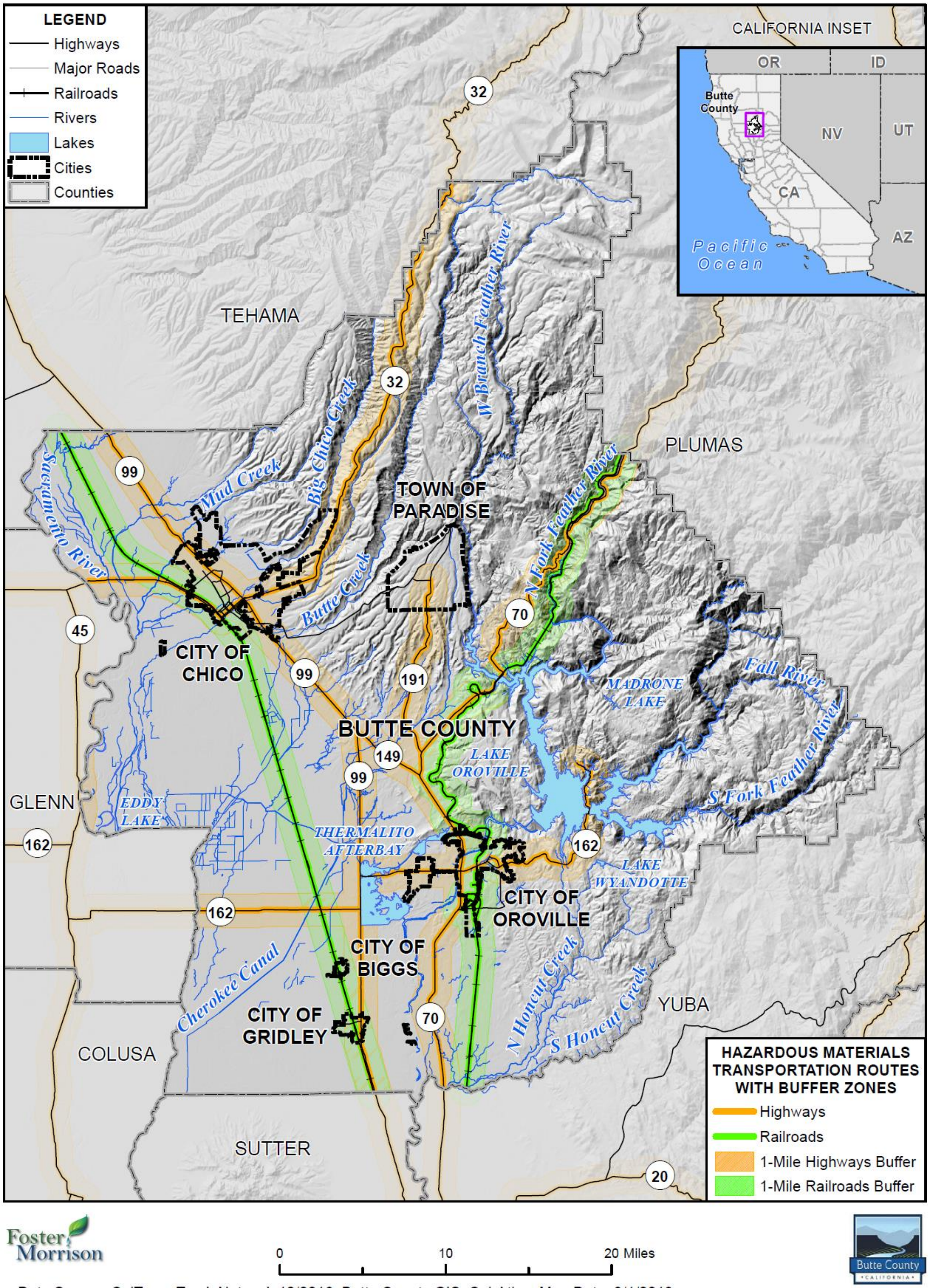
Likelihood of Future Occurrence—Likely
Vulnerability—Medium

It is often quite difficult to quantify the potential losses from human-caused hazards. While the facilities themselves have a tangible dollar value, loss from a human-caused hazard often inflicts an even greater toll on a community, both economically and emotionally. The impact to identified values will vary from event to event and depend on the type, location, and nature of a specific hazardous material incident. The most significant impact from hazardous materials transport is life safety. Given the difficulty in quantifying the losses associated with technological hazards, this section focuses on analyzing key Planning Area values relative to the hazardous materials transportation corridors identified above in Section 4.2.12. Figure 4-113 shows the hazardous materials transportation corridors (for roadways and rail) in Butte County as well as the one-mile buffer zone (on each side of the corridor for a two-mile total buffer) used this analysis as detailed further in the methodology below.

Methodology: Buffer Zone

An analysis of the potential vulnerability of the Planning Area to a transportation-related hazardous materials release was conducted using GIS within identified transportation corridors. To evaluate the areas most vulnerable, a one-mile buffer was applied to both sides of Highways 32, 70, 99, 149, 162, and 191, as well as the United Pacific Railroad. The result is a two-mile buffer zone around each transportation corridor that is used for this analysis. The buffer distance was based on guidelines in the U.S. Department of Transportation's Emergency Response Guidebook that suggest distances useful to protect people from vapors resulting from spills involving dangerous goods considered toxic if inhaled. The recommended buffer distance referred to in the guide as the "protective action distance" is the area surrounding the incident in which people are at risk of harmful exposure. For purposes of this plan, a buffer distance of one mile was used on either side of the transportation corridor. Actual buffer distances will vary depending on the nature and quantity of the release, whether the release occurred during the night or daytime, and prevailing weather conditions.

Figure 4-113 Butte County – Hazardous Materials Routes with Buffer Zones



Data Source: CalTrans Truck Network 12/2016, Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Values at Risk

During a hazardous materials transportation spill, it is generally the people that are at risk to the effects of the spill. During a spill, buildings, property, and their values are at a lessor risk; however, given the location of hazardous materials routes in the County, an analysis is performed here. Analysis results are provided for the Planning Area as a whole, then broken down in more detail for the unincorporated County. Detailed tables for the jurisdictions are provided in their respective annexes to this Plan.

Butte County Planning Area

Analysis results for the Butte County Planning Area is presented in multiple tables (all using the estimated contents replacement values in the buffer zones based on the CRV factors detailed in Table 4-55) below:

- Table 4-144 shows the total parcel counts, improved parcel counts, their improved structure and land values in the hazardous materials buffer zones prior to the Camp Fire.
- Table 4-145 shows the total parcel counts, improved parcel counts, their improved structure and land values in the hazardous materials buffer zones after the Camp Fire.
- Table 4-146 compares the improved structure values in the hazardous materials buffer zones in the Planning area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-147 breaks down Table 4-145 into more detail, and shows post-fire values in the hazardous materials buffer zones by property use type.

Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the hazardous material buffer corridors and buffer zones due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Table 4-144 Butte County Planning Area – Pre-Fire Count and Value of Parcels in Hazardous Materials Buffer Zones by Jurisdiction

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Highways and Railroads	91	77	$2,503,454	$5,617,995	$0	$2,808,998	$10,930,447
Railroads	675	597	$23,518,859	$63,570,871	$10,556,358	$46,377,120	$144,023,208
City of Biggs Total	**766**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$154,953,655**
City of Chico							
Highways	14,602	13,636	$1,804,868,531	$3,235,290,674	$16,145,721	$2,076,063,063	$7,132,367,989
Highways and Railroads	7,351	6,882	$788,178,654	$1,734,272,975	$35,511,018	$1,144,466,104	$3,702,428,751
Railroads	71	58	$23,868,742	$70,421,765	$1,069,190	$100,494,609	$195,854,306

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Chico Total	**22,024**	**20,576**	**$2,616,915,927**	**$5,039,985,414**	**$52,725,929**	**$3,321,023,775**	**$11,030,651,045**
City of Gridley							
Highways and Railroads	1,950	1,769	$92,102,043	$237,511,054	$5,349,177	$158,219,013	$493,181,287
Railroads	441	384	$18,152,682	$44,214,498	$67,967	$22,375,065	$84,810,212
City of Gridley Total	**2,391**	**2,153**	**$110,254,725**	**$281,725,552**	**$5,417,144**	**$180,594,078**	**$577,991,499**
City of Oroville							
Highways	1,442	1,042	$63,035,868	$144,274,441	$253,410	$79,893,747	$287,457,466
Highways and Railroads	5,417	4,259	$245,809,411	$709,821,864	$62,548,773	$557,563,190	$1,575,743,238
Railroads	119	84	$6,003,172	$15,528,702	$0	$9,231,214	$30,763,088
City of Oroville Total	**6,978**	**5,385**	**$314,848,451**	**$869,625,007**	**$62,802,183**	**$646,688,151**	**$1,893,963,792**
Town of Paradise							
Highways	2,911	2,633	$193,145,200	$364,769,405	$1,489,751	$235,353,008	$794,757,364
Town of Paradise Total	**2,911**	**2,633**	**$193,145,200**	**$364,769,405**	**$1,489,751**	**$235,353,008**	**$794,757,364**
Unincorporated Butte County							
Highways	10,507	8,415	$914,129,051	$1,342,519,115	$43,767,325	$791,670,199	$3,092,085,690
Highways and Railroads	3,817	3,057	$368,750,081	$530,229,013	$30,955,999	$347,563,831	$1,277,498,924
Railroads	4,930	3,736	$373,293,961	$514,012,133	$69,246,936	$369,498,360	$1,326,051,390
Unincorporated Butte County Total	**19,254**	**15,208**	**$1,656,173,093**	**$2,386,760,261**	**$143,970,260**	**$1,508,732,390**	**$5,695,636,004**
Grand Total	**54,324**	**46,629**	**$4,917,359,709**	**$9,012,054,505**	**$276,961,625**	**$5,941,577,518**	**$20,147,953,357**

Source: Cal Trans, Butte County 2018 Parcel/Assessor's Data

Table 4-145 Butte County Planning Area – Post-Fire Count and Value of Parcels in Hazardous Materials Buffer Zones by Jurisdiction

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Highways and Railroads	91	77	$2,503,454	$5,617,995	$0	$2,808,998	$10,636,294
Railroads	674	597	$23,518,859	$63,570,871	$10,556,358	$46,377,120	$144,788,822
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Highways	14,627	13,631	$1,803,530,620	$3,232,082,534	$16,106,441	$2,072,884,209	$6,904,865,474
Highways and Railroads	7,353	6,873	$786,565,935	$1,733,389,824	$35,511,018	$1,143,867,646	$3,291,598,587
Railroads	71	58	$23,868,742	$70,421,765	$1,069,190	$100,494,609	$187,486,110
City of Chico Total	**22,051**	**20,562**	**$2,613,965,297**	**$5,035,894,123**	**$52,686,649**	**$3,317,246,463**	**$10,383,950,170**
City of Gridley							
Highways and Railroads	1,951	1,770	$92,098,631	$237,533,388	$5,349,177	$158,267,514	$455,530,020
Railroads	441	384	$18,152,682	$44,214,498	$67,967	$22,375,065	$82,789,579
City of Gridley Total	**2,392**	**2,154**	**$110,251,313**	**$281,747,886**	**$5,417,144**	**$180,642,579**	**$538,319,599**
City of Oroville							
Highways	1,443	1,043	$63,081,244	$144,433,264	$253,410	$79,973,159	$276,809,166
Highways and Railroads	5,419	4,255	$243,398,056	$704,525,978	$61,087,953	$552,295,325	$1,439,007,204
Railroads	119	84	$6,003,172	$15,507,894		$9,220,810	$30,277,004
City of Oroville Total	**6,981**	**5,382**	**$312,482,472**	**$864,467,136**	**$61,341,363**	**$641,489,294**	**$1,746,093,374**
Town of Paradise							
Highways	2,911	2,633	$193,145,200	$236,290,352	$1,246,020	$160,605,111	$558,295,771
Town of Paradise Total	**2,911**	**2,633**	**$193,145,200**	**$236,290,352**	**$1,246,020**	**$160,605,111**	**$558,295,771**
Unincorporated Butte County							
Highways	10,531	8,412	$911,488,292	$1,336,182,250	$43,786,295	$788,455,191	$3,049,907,699
Highways and Railroads	3,816	3,058	$369,016,274	$530,145,201	$30,955,999	$347,521,925	$1,279,954,248
Railroads	4,943	3,732	$372,252,185	$513,384,539	$68,235,152	$369,140,110	$1,319,541,444

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County Total	**19,290**	**15,202**	**$1,652,756,751**	**$2,379,711,990**	**$142,977,446**	**$1,505,117,226**	**$5,649,403,391**
Grand Total	**54,390**	**46,607**	**$4,908,623,346**	**$8,867,300,353**	**$274,224,980**	**$5,854,286,790**	**$19,031,487,420**

Source: Cal Trans, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-146 Butte County Planning Area – Comparison of Pre-Fire and Post-Fire Structure Values

Jurisdiction / Hazardous Materials Transportation Route	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
City of Biggs				
Highways and Railroads	$5,617,995	$5,617,995	$0	0.0%
Railroads	$63,570,871	$63,570,871	$0	0.0%
City of Biggs Total	**$69,188,866**	**$69,188,866**	**$0**	**0.0%**
City of Chico				
Highways	$3,235,290,674	$3,232,082,534	-$3,208,140	-0.1%
Highways and Railroads	$1,734,272,975	$1,733,389,824	-$883,151	-0.1%
Railroads	$70,421,765	$70,421,765	$0	0.0%
City of Chico Total	**$5,039,985,414**	**$5,035,894,123**	**-$4,091,291**	**-0.1%**
City of Gridley				
Highways and Railroads	$237,511,054	$237,533,388	$22,334	0.0%
Railroads	$44,214,498	$44,214,498	$0	0.0%
City of Gridley Total	**$281,725,552**	**$281,747,886**	**$22,334**	**0.0%**
City of Oroville				
Highways	$144,274,441	$144,433,264	$158,823	0.1%
Highways and Railroads	$709,821,864	$704,525,978	-$5,295,886	-0.7%
Railroads	$15,528,702	$15,507,894	-$20,808	-0.1%
City of Oroville Total	**$869,625,007**	**$864,467,136**	**-$5,157,871**	**-0.6%**
Town of Paradise				
Highways	$364,769,405	$236,290,352	-$128,479,053	-35.2%
Town of Paradise Total	**$364,769,405**	**$236,290,352**	**-$128,479,053**	**-35.2%**
Unincorporated Butte County				
Highways	$1,342,519,115	$1,336,182,250	-$6,336,865	-0.5%
Highways and Railroads	$530,229,013	$530,145,201	-$83,812	0.0%

Jurisdiction / Hazardous Materials Transportation Route	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
Railroads	$514,012,133	$513,384,539	-$627,594	-0.1%
Unincorporated Butte County Total	**$2,386,760,261**	**$2,379,711,990**	**-$7,048,271**	**-0.3%**
Grand Total	**$9,012,054,505**	**$8,867,300,353**	**-$144,754,152**	**-1.6%**

Source: Cal Trans, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-147 Butte County Planning Area – Post-Fire Count and Value of Parcels in Hazardous Materials Buffer Zones by Property Use

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Highways and Railroads							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	86	77	$2,503,454	$5,617,995	$0	$2,808,998	$10,636,294
Unknown	5	0	$0	$0	$0	$0	$0
Highways and Railroads Total	**91**	**77**	**$2,503,454**	**$5,617,995**	**$0**	**$2,808,998**	**$10,636,294**
Railroads							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	605	562	$20,923,106	$47,095,161	$6,630	$23,547,581	$89,610,680
Unknown	13	0	$0	$0	$0	$0	$0
Railroads Total	674	597	$23,518,859	$63,570,871	$10,556,358	$46,377,120	$144,788,822
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Highways							
Agricultural	12	1	$410,788	$76,387	$0	$76,387	$563,562
Commercial	1,194	964	$444,236,976	$847,977,181	$13,259,759	$847,977,181	$2,066,058,436
Industrial	71	58	$22,992,540	$33,277,826	$2,739,420	$49,916,739	$113,571,802
Residential	13,156	12,604	$1,335,303,828	$2,349,827,803	$107,262	$1,174,913,902	$4,723,182,849

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unknown	194	4	$586,488	$923,337	$0	$0	$1,488,825
Highways Total	**14,627**	**13,631**	**$1,803,530,620**	**$3,232,082,534**	**$16,106,441**	**$2,072,884,209**	**$6,904,865,474**
Highways and Railroads							
Agricultural	5	3	$249,987	$195,090	$57,958	$195,090	$704,755
Commercial	739	641	$124,426,712	$497,924,025	$32,320,233	$497,924,025	$815,808,494
Industrial	113	99	$13,067,884	$28,158,261	$3,061,217	$42,237,392	$86,754,238
Residential	6,351	6,129	$648,751,571	$1,207,022,279	$71,610	$603,511,140	$2,388,170,551
Unknown	145	1	$69,781	$90,169	$0	$0	$160,550
Highways and Railroads Total	**7,353**	**6,873**	**$786,565,935**	**$1,733,389,824**	**$35,511,018**	**$1,143,867,646**	**$3,291,598,587**
Railroads							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	3	3	$1,434,773	$10,276,078	$0	$10,276,078	$21,986,929
Industrial	66	55	$22,433,969	$60,145,687	$1,069,190	$90,218,531	$165,499,181
Residential	0	0	$0	$0	$0	$0	$0
Unknown	2	0	$0	$0	$0	$0	$0
Railroads Total	**71**	**58**	**$23,868,742**	**$70,421,765**	**$1,069,190**	**$100,494,609**	**$187,486,110**
City of Chico Total	**22,051**	**20,562**	**$2,613,965,297**	**$5,035,894,123**	**$52,686,649**	**$3,317,246,463**	**$10,383,950,170**
City of Gridley							
Highways and Railroads							
Agricultural	9	5	$1,424,301	$1,249,241	$153,324	$1,249,241	$4,075,063
Commercial	234	192	$21,751,402	$53,215,814	$2,645,949	$53,215,814	$114,225,031
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	1,621	1,551	$64,746,836	$170,800,041	$154	$85,400,021	$298,501,884
Unknown	56	0	$0	$0	$0	$0	$0
Highways and Railroads Total	1,951	1,770	$92,098,631	$237,533,388	$5,349,177	$158,267,514	$455,530,020
Railroads							
Agricultural	2	2	$84,315	$9,080	$25,582	$9,080	$128,057
Commercial	3	3	$90,592	$526,552	$9,730	$526,552	$788,267
Industrial	0	0	$0	$0	$0	$0	$0
Residential	429	379	$17,977,775	$43,678,866	$32,655	$21,839,433	$81,873,255
Unknown	7	0	$0	$0	$0	$0	$0

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Railroads Total	**441**	**384**	**$18,152,682**	**$44,214,498**	**$67,967**	**$22,375,065**	**$82,789,579**
City of Gridley Total	**2,392**	**2,154**	**$110,251,313**	**$281,747,886**	**$5,417,144**	**$180,642,579**	**$538,319,599**
City of Oroville							
Highways							
Agricultural	1	0	$299,890	$0	$0	$0	$299,890
Commercial	44	17	$3,577,860	$15,513,053	$252,310	$15,513,053	$28,956,212
Industrial	29	0	$1,095,539	$0	$0	$0	$1,095,539
Residential	1,345	1,026	$58,107,955	$128,920,211	$1,100	$64,460,106	$246,457,525
Unknown	24	0	$0	$0	$0	$0	$0
Highways Total	1,443	1,043	$63,081,244	$144,433,264	$253,410	$79,973,159	$276,809,166
Highways and Railroads							
Agricultural	3	0	$358,384	$0	$7,947	$0	$366,331
Commercial	992	679	$103,464,205	$320,181,396	$18,755,496	$320,181,396	$670,155,530
Industrial	195	72	$24,955,273	$40,098,771	$42,318,610	$60,148,157	$191,466,461
Residential	4,100	3,502	$114,555,676	$343,931,545	$5,900	$171,965,773	$576,641,229
Unknown	129	2	$64,518	$314,266	$0	$0	$377,654
Highways and Railroads Total	5,419	4,255	$243,398,056	$704,525,978	$61,087,953	$552,295,325	$1,439,007,204
Railroads							
Agricultural	3	0	$632,802	$0	$0	$0	$632,802
Commercial	4	2	$71,302	$2,933,726	$0	$2,933,726	$5,938,754
Industrial	1	0	$6,485	$0	$0	$0	$6,485
Residential	104	82	$5,292,583	$12,574,168	$0	$6,287,084	$23,698,963
Unknown	7	0	$0	$0	$0	$0	$0
Railroads Total	119	84	$6,003,172	$15,507,894	$0	$9,220,810	$30,277,004
City of Oroville Total	**6,981**	**5,382**	**$312,482,472**	**$864,467,136**	**$61,341,363**	**$641,489,294**	**$1,746,093,374**
Town of Paradise							
Highways							
Agricultural	2	1	$60,724	$24,379	$11,631	$24,379	$121,113
Commercial	267	218	$36,533,129	$78,876,933	$1,049,413	$78,876,933	$175,486,070
Industrial	10	9	$1,909,514	$3,009,279	$165,000	$4,513,919	$9,700,712
Residential	2,591	2,405	$154,526,936	$154,379,761	$19,976	$77,189,881	$372,874,942

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unknown	41	0	$114,897	$0	$0	$0	$112,935
Highways Total	**2,911**	**2,633**	**$193,145,200**	**$236,290,352**	**$1,246,020**	**$160,605,111**	**$558,295,771**
Town of Paradise Total	**2,911**	**2,633**	**$193,145,200**	**$236,290,352**	**$1,246,020**	**$160,605,111**	**$558,295,771**
Unincorporated Butte County							
Highways							
Agricultural	789	403	$203,076,176	$46,873,639	$35,316,618	$46,873,639	$338,636,025
Commercial	210	163	$30,132,404	$72,282,697	$1,779,649	$72,282,697	$166,310,012
Industrial	71	58	$24,893,055	$61,377,408	$4,750,314	$92,066,112	$189,870,255
Residential	9,218	7,781	$651,958,495	$1,154,465,486	$1,313,914	$577,232,743	$2,351,053,408
Unknown	243	7	$1,428,162	$1,183,020	$625,800	$0	$4,037,999
Highways Total	**10,531**	**8,412**	**$911,488,292**	**$1,336,182,250**	**$43,786,295**	**$788,455,191**	**$3,049,907,699**
Highways and Railroads							
Agricultural	498	281	$84,662,581	$30,589,488	$20,062,149	$30,589,488	$171,940,023
Commercial	128	103	$19,559,751	$32,286,647	$701,495	$32,286,647	$83,340,569
Industrial	97	65	$13,734,576	$51,011,257	$8,452,806	$76,516,886	$153,110,245
Residential	2,940	2,609	$251,017,981	$416,257,809	$1,739,549	$208,128,905	$871,522,027
Unknown	153	0	$41,385	$0	$0	$0	$41,385
Highways and Railroads Total	**3,816**	**3,058**	**$369,016,274**	**$530,145,201**	**$30,955,999**	**$347,521,925**	**$1,279,954,248**
Railroads							
Agricultural	671	432	$156,976,859	$81,341,785	$58,783,231	$81,341,785	$390,829,214
Commercial	147	113	$10,946,853	$32,604,667	$424,290	$32,604,667	$67,714,754
Industrial	54	38	$6,264,954	$55,611,281	$7,808,430	$83,416,922	$156,895,017
Residential	3,855	3,145	$197,757,457	$343,553,473	$1,143,261	$171,776,737	$702,488,482
Unknown	216	4	$306,062	$273,333	$75,940	$0	$1,613,978
Railroads Total	**4,943**	**3,732**	**$372,252,185**	**$513,384,539**	**$68,235,152**	**$369,140,110**	**$1,319,541,444**
Unincorporated Butte County Total	**19,290**	**15,202**	**$1,652,756,751**	**$2,379,711,990**	**$142,977,446**	**$1,505,117,226**	**$5,649,403,391**
Grand Total	**54,390**	**46,607**	**$4,908,623,346**	**$8,867,300,353**	**$274,224,980**	**$5,854,286,790**	**$19,031,487,420**

Source: Cal Trans, Butte County 3/28/2019 Parcel/Assessor's Data

Unincorporated Butte County

Analysis results for unincorporated Butte County is presented in multiple tables (all using the estimated contents replacement values in the buffer zones based on the CRV factors detailed in Table 4-55) below:

- Table 4-148 shows the total parcel counts, improved parcel counts, their improved structure and land values in the hazardous materials buffer zones prior to the Camp Fire.
- Table 4-149 shows the total parcel counts, improved parcel counts, their improved structure and land values in the hazardous materials buffer zones after the Camp Fire
- Table 4-150 compares the improved structure values in the unincorporated County in the hazardous materials buffer zones pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-151 breaks down Table 4-149 in more detail and shows post-fire values in the hazardous materials buffer zones by property use type.

Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the hazardous material corridors and buffer zones due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Table 4-148 Unincorporated Butte County– Pre-Fire Count and Value of Parcels in Hazardous Materials Buffer Zones by Property Use

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Highways	10,507	8,415	$914,129,051	$1,342,519,115	$43,767,325	$791,670,199	$3,092,085,690
Highways and Railroads	3,817	3,057	$368,750,081	$530,229,013	$30,955,999	$347,563,831	$1,277,498,924
Railroads	4,930	3,736	$373,293,961	$514,012,133	$69,246,936	$369,498,360	$1,326,051,390
Unincorporated Butte County Total	**19,254**	**15,208**	**$1,656,173,093**	**$2,386,760,261**	**$143,970,260**	**$1,508,732,390**	**$5,695,636,004**

Source: Cal Trans, Butte County 2018 Parcel/Assessor's Data

Table 4-149 Unincorporated Butte County– Post-Fire Count and Value of Parcels in Hazardous Materials Buffer Zones by Property Use

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Highways	10,531	8,412	$911,488,292	$1,336,182,250	$43,786,295	$788,455,191	$3,049,907,699
Highways and Railroads	3,816	3,058	$369,016,274	$530,145,201	$30,955,999	$347,521,925	$1,279,954,248
Railroads	4,943	3,732	$372,252,185	$513,384,539	$68,235,152	$369,140,110	$1,319,541,444

Jurisdiction / Hazardous Materials Transportation Route	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County Total	**19,290**	**15,202**	**$1,652,756,751**	**$2,379,711,990**	**$142,977,446**	**$1,505,117,226**	**$5,649,403,391**

Source: Cal Trans, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-150 Unincorporated Butte County – Comparison of Pre-Fire and Post-Fire Structure Values

Jurisdiction / Hazardous Materials Transportation Routes/	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
Highways	$1,342,519,115	$1,336,182,250	-$6,336,865	-0.5%
Highways and Railroads	$530,229,013	$530,145,201	-$83,812	0.0%
Railroads	$514,012,133	$513,384,539	-$627,594	-0.1%
Unincorporated Butte County Total	**$2,386,760,261**	**$2,379,711,990**	**-$7,048,271**	**-0.3%**

Source: Cal Trans, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-151 Unincorporated Butte County – Count and Value of Parcels in Buffer Zones by Route and Property Use

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Highways							
Agricultural	789	403	$203,076,176	$46,873,639	$35,316,618	$46,873,639	$338,636,025
Commercial	210	163	$30,132,404	$72,282,697	$1,779,649	$72,282,697	$166,310,012
Industrial	71	58	$24,893,055	$61,377,408	$4,750,314	$92,066,112	$189,870,255
Residential	9,218	7,781	$651,958,495	$1,154,465,486	$1,313,914	$577,232,743	$2,351,053,408
Unknown	243	7	$1,428,162	$1,183,020	$625,800	$0	$4,037,999
Highways Total	**10,531**	**8,412**	**$911,488,292**	**$1,336,182,250**	**$43,786,295**	**$788,455,191**	**$3,049,907,699**
Highways and Railroads							
Agricultural	498	281	$84,662,581	$30,589,488	$20,062,149	$30,589,488	$171,940,023
Commercial	128	103	$19,559,751	$32,286,647	$701,495	$32,286,647	$83,340,569
Industrial	97	65	$13,734,576	$51,011,257	$8,452,806	$76,516,886	$153,110,245
Residential	2,940	2,609	$251,017,981	$416,257,809	$1,739,549	$208,128,905	$871,522,027
Unknown	153	0	$41,385	$0	$0	$0	$41,385

Jurisdiction / Hazardous Materials Transportation Route / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Highways and Railroads Total	**3,816**	**3,058**	**$369,016,274**	**$530,145,201**	**$30,955,999**	**$347,521,925**	**$1,279,954,248**
Railroads							
Agricultural	671	432	$156,976,859	$81,341,785	$58,783,231	$81,341,785	$390,829,214
Commercial	147	113	$10,946,853	$32,604,667	$424,290	$32,604,667	$67,714,754
Industrial	54	38	$6,264,954	$55,611,281	$7,808,430	$83,416,922	$156,895,017
Residential	3,855	3,145	$197,757,457	$343,553,473	$1,143,261	$171,776,737	$702,488,482
Unknown	216	4	$306,062	$273,333	$75,940	$0	$1,613,978
Railroads Total	**4,943**	**3,732**	**$372,252,185**	**$513,384,539**	**$68,235,152**	**$369,140,110**	**$1,319,541,444**
Unincorporated Butte County Total	**19,290**	**15,202**	**$1,652,756,751**	**$2,379,711,990**	**$142,977,446**	**$1,505,117,226**	**$5,649,403,391**

Source: Cal Trans, Butte County 3/28/2019 Parcel/Assessor's Data

Population at Risk

To determine the populations at risk from a transportation-related hazardous materials release within identified transportation corridors, an analysis was performed using GIS to determine the residential population that resides within the two-mile buffer zone of the highway corridors. Using GIS, the buffered corridor was overlaid on the improved residential parcel data and results tabulated for the jurisdictions in the Planning Area, as found in Table 4-152. Those residential parcel centroids that intersect the buffered corridor were counted and multiplied by the 2010 Census Bureau average household factors for the jurisdictions in Butte County.

Table 4-152 Butte County Planning Area–Residential Populations at Risk in Hazardous Materials Buffer Zones by Jurisdiction

Jurisdiction / Hazardous Materials Transportation Route	Improved Residential Parcels	Population
City of Biggs		
Highways Only	0	0
Highways and Railroads	77	189
Railroads Only	562	1,377
City of Biggs Total	**639**	**1,566**
City of Chico		
Highways (Highway 32 and 99) Only	12,605	38,067
Highways (Highway 32 and 99) and Railroads	6,137	18,534
Railroads Only	0	0
City of Chico Total	**18,742**	**56,601**

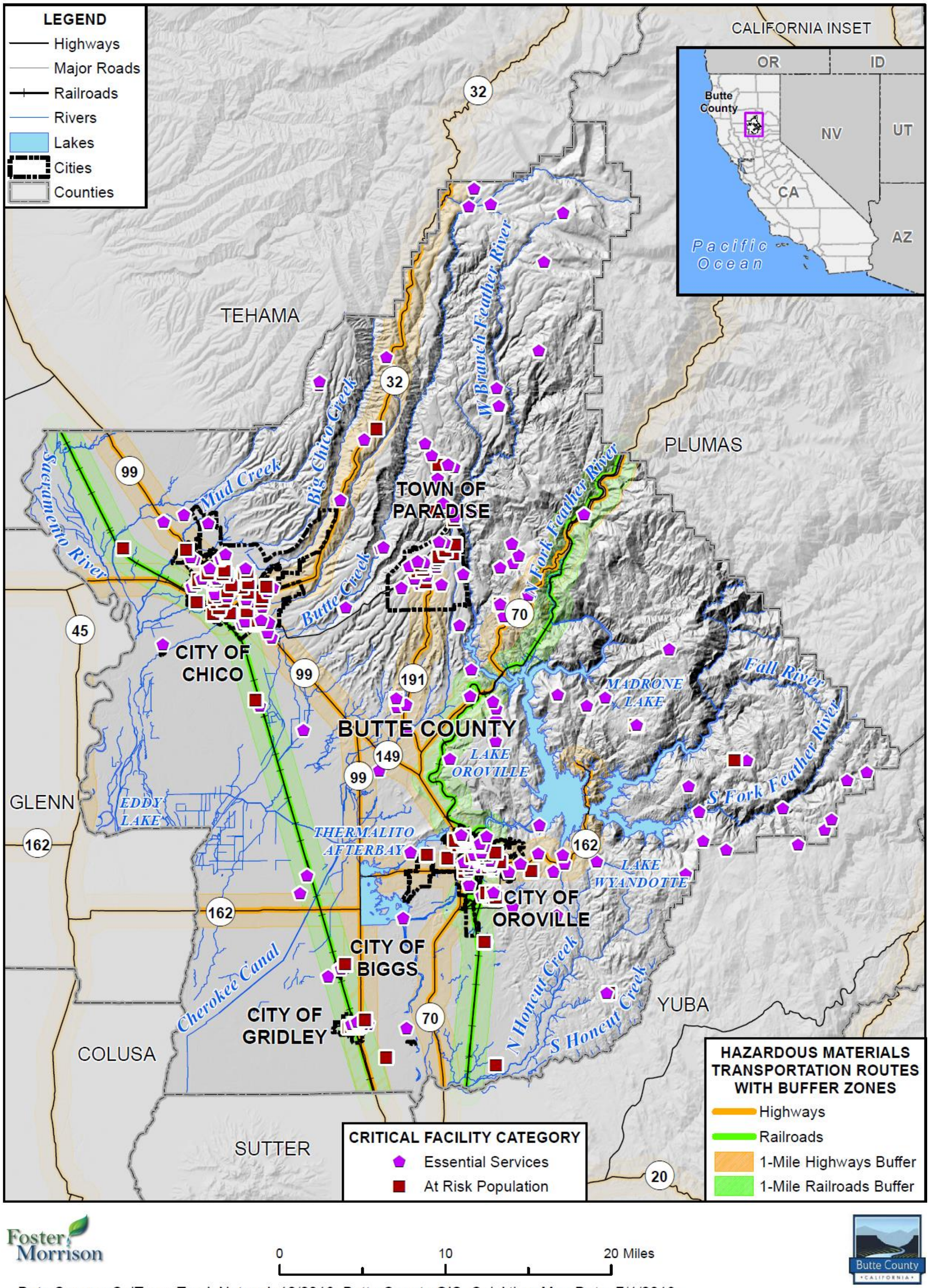
Jurisdiction / Hazardous Materials Transportation Route	Improved Residential Parcels	Population
City of Gridley		
Highways Only	0	0
Highways and Railroads (Highway 99)	1,551	4,591
Railroads Only	379	1,122
City of Gridley Total	**1,930**	**5,713**
City of Oroville		
Highways Only	1,025	2,665
Highways and Railroads (Highway 70 and 162)	3,501	9,103
Railroads Only	82	213
City of Oroville Total	**4,608**	**11,981**
Town of Paradise		
Highways (Highway 191) Only	2,405	5,219
Highways and Railroads	0	0
Railroads Only	0	0
City of Oroville Total	**2,405**	**5,219**
Unincorporated County		
Highways (Highway 32, 45, 70, 99, 149, 162, and 191) Only	7,783	23,349
Highways and Railroads (Highway 32, 45, 70, 99, 149, 162, and 191)	2,608	7,824
Railroads Only	3,149	9,447
Unincorporated County Total	**13,540**	**40,620**

Source: Cal Trans, Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Critical Facilities at Risk

To determine the critical facilities at risk from a transportation-related hazardous materials release within identified transportation corridors, an analysis was performed using GIS to determine the facilities located within the two-mile buffer zone of the highway and railroad corridors. Using GIS, the buffered corridor was overlaid on the Butte County critical facilities layer and results tabulated for the Planning Area, as shown on Figure 4-114. Table 4-153 breaks the critical facilities up by route. Table 4-154 shows the critical facilities in the buffer zone by jurisdiction, route, and facility type. Table 4-155 shows only the critical facilities in the buffer zone in the unincorporated County.

Figure 4-114 Butte County Planning Area – Critical Facilities in Hazardous Materials Buffer Zones



Data Source: CalTrans Truck Network 12/2016, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-153 Butte County Planning Area – Summary of Critical Facilities in the Hazardous Materials Buffer Zones by Route

Critical Facility Category	HWY 32	HWY 32 and 99	HWY 99	HWY 70	HWY 70 and 162	HWY 149	HWY 162	HWY 191
Inside of Hazardous Materials Routes Areas								
Essential Services Facilities	12	7	43	19	19	1	26	10
At Risk Population Facilities	9	8	23	7	7	0	9	8
Total	**21**	**15**	**69**	**26**	**26**	**1**	**16**	**18**

Source: Cal Trans, Butte County GIS

Table 4-154 Butte County Planning Area –Critical Facilities in the Hazardous Materials Buffer Zones by Jurisdiction and Route

Jurisdiction/Hazardous Materials Route/Critical Facility Category	Facility Count
City of Biggs	
Hwy 99	
Essential Services Facilities	0
At Risk Population Facilities	4
Hwy 99 Total	**4**
City of Biggs Total	**4**
City of Chico	
Hwy 32	
Essential Services Facilities	6
At Risk Population Facilities	8
Hwy 32 Total	**14**
Hwy 99	
Essential Services Facilities	30
At Risk Population Facilities	12
Hwy 99 Total	**42**
Hwy 32 and Hwy 99	
Essential Services Facilities	7
At Risk Population Facilities	8
Hwy 32 and Hwy 99 Total	**15**
City of Chico Total	**71**
City of Gridley	
Hwy 99	
Essential Services Facilities	10
At Risk Population Facilities	6
Hwy 99 Total	**16**
City of Gridley Total	**16**

Jurisdiction/Hazardous Materials Route/Critical Facility Category	Facility Count
City of Oroville	
Hwy 70	
Essential Services Facilities	12
At Risk Population Facilities	7
Hwy 70 Total	**19**
Hwy 70 and Hwy 162	
Essential Services Facilities	9
At Risk Population Facilities	6
Hwy 70 and Hwy 162 Total	**15**
Hwy 162	
Essential Services Facilities	19
At Risk Population Facilities	7
Hwy 162 Total	**26**
City of Oroville Total	**60**
Town of Paradise	
Hwy 191	
Essential Services Facilities	6
At Risk Population Facilities	7
Hwy 191 Total	**13**
Town of Paradise Total	**13**
Unincorporated Butte County	
Hwy 32	
Essential Services Facilities	6
At Risk Population Facilities	1
Hwy 32 Total	**7**
Hwy 70	
Essential Services Facilities	7
At Risk Population Facilities	0
Hwy 70 Total	**7**
Hwy 70 and Hwy 162	
Essential Services Facilities	0
At Risk Population Facilities	1
Hwy 70 and Hwy 162 Total	**1**
Hwy 99	
Essential Services Facilities	3
At Risk Population Facilities	1
Hwy 99 Total	**4**

Jurisdiction/Hazardous Materials Route/Critical Facility Category	Facility Count
Hwy 149	
Essential Services Facilities	1
At Risk Population Facilities	0
Hwy 149 Total	**1**
Hwy 162	
Essential Services Facilities	7
At Risk Population Facilities	2
Hwy 162 Total	**9**
Hwy 191	
Essential Services Facilities	4
At Risk Population Facilities	1
Hwy 191 Total	**5**
Unincorporated Butte County Total	**34**
Grand Total	**198**

Source: Cal Trans, Butte County GIS

Table 4-155 Unincorporated Butte County – Critical Facilities in Hazardous Materials Buffer Zones by Route

Hazardous Materials Route	Critical Facility Category / Critical Facility Type	Facility Count
Hwy 32		
Hwy 32	**Essential Services Facilities**	
	Fire	3
	Public Assembly Point / Evacuation Center	1
	Radio Sites	2
	Essential Services Facilities Total	6
	At Risk Population Facilities	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**7**
Hwy 70		
Hwy 70	**Essential Services Facilities**	
	Fire	3
	Public Assembly Point / Evacuation Center	3
	Dam	1
	Essential Services Facilities Total	**7**
	Total	**7**

Hazardous Materials Route	Critical Facility Category / Critical Facility Type	Facility Count
Hwy 70 and Hwy 162		
Hwy 70 and Hwy 162	**At Risk Population Facilities**	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**1**
Hwy 149		
Hwy 149	**Essential Services Facilities**	
	Dam	1
	Essential Services Facilities Total	**1**
	Total	**1**
Hwy 162		
Hwy 162	**Essential Services Facilities**	
	Fire	1
	Public Assembly Point / Evacuation Center	2
	Radio Sites	1
	Dam	3
	Essential Services Facilities Total	**7**
	At Risk Population Facilities	
	School	2
	At Risk Population Facilities Total	**2**
	Total	**9**
Hwy 191		
Hwy 191	**Essential Services Facilities**	
	Fire	1
	Public Assembly Point / Evacuation Center	2
	Emergency Animal Shelter	1
	Essential Services Facilities Total	4
	At Risk Population Facilities	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**5**
Hwy 99		
Hwy 99	**Essential Services Facilities**	
	Fire	2
	Radio Sites	1
	Essential Services Facilities Total	3
	At Risk Population Facilities	

Hazardous Materials Route	Critical Facility Category / Critical Facility Type	Facility Count
	School	1
	At Risk Population Facilities Total	**1**
	Total	**4**
Unincorporated Butte County Total		**34**

Source: Cal Trans, Butte County GIS

Overall Community Impacts

Impacts from hazardous materials transportation incidents vary by location and severity of any given event and will likely only affect certain areas of the County during specific times. Based on the risk assessment, it is evident that hazardous materials spills will continue to have potential economic impacts to certain areas of the County. However, many of the spills in the County are minor, localized events that are more of a nuisance than a disaster. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure and services;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community;
- Negative impact on commercial and residential property values; and
- Impact on the overall mental health of the community.

Future Development

Development will continue to happen within hazardous materials transportation corridors. Those who choose to develop in these areas should be made aware of the risks associated with living within close proximity to a hazardous materials transportation route.

GIS Analysis

Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of hazardous materials within the County to the 8 future development projects.

Methodology

Butte County's 3/28/2019 Parcel/Assessor's data and data provided by County Planning were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas. Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file, the 8 future development projects were identified. For the hazardous materials transportation analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected with the hazardous materials transportation routes and corridors to determine the parcel counts and acreage within each inundation area.

Hazardous materials buffer zones and future development areas are shown on Figure 4-115 and parcels and acreages in those areas are shown in Table 4-156.

Figure 4-115 Unincorporated Butte County – Future Development in Hazardous Materials Buffer Zones

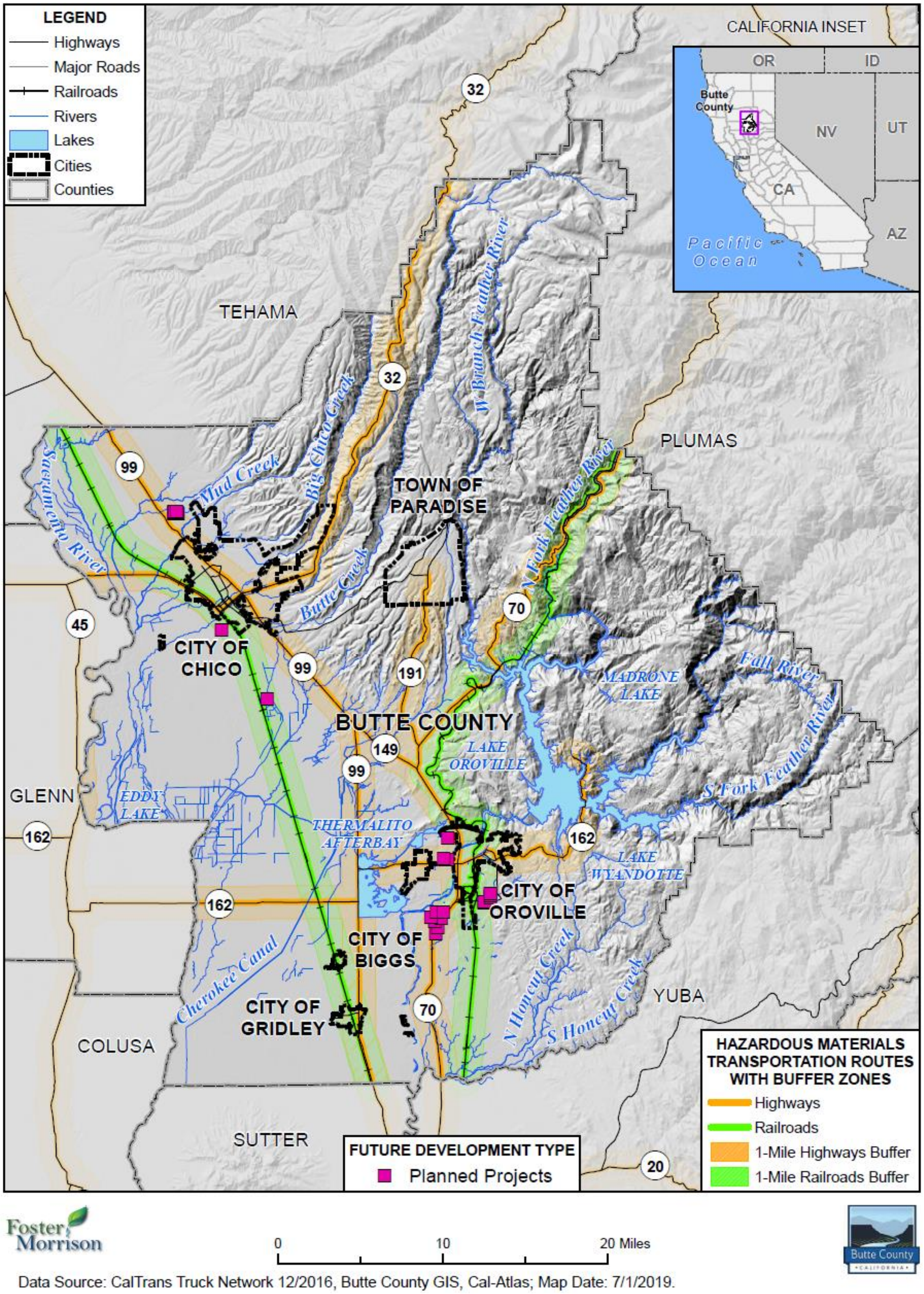


Table 4-156 Unincorporated Butte County – Future Development Parcels and Acreage in Hazardous Materials Buffer Zones

Future Development/ Hazardous Materials Route	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista			
Highways	1	0	9.7
Creekside Estates			
Railroads	1	1	47.4
Diamond Oak			
Highways	2	1	7.9
Lincoln and Ophir Garden Oak Estates			
Railroads	2	0	50.4
Mandville Park			
Highways	25	0	22.6
Rio d Oro - Phase 1			
Highways	**7**	0	664.2
Southlands Subdivision			
Railroads	3	0	48.8
Stanley Ave			
Railroads	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: Cal Trans, Butte County GIS

4.3.10. Invasive Species: Pests/Plants Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Given the importance of agriculture to Butte County, agricultural hazards continue to be an ongoing concern. The primary causes of agricultural losses are severe weather events, such as drought, freeze, and extreme heat; insect/pest infestations; and noxious weeds. According to the HMPC, agricultural losses occur on an annual basis throughout the County and are usually associated with these types of events.

According to the USDA, every year natural disasters, such as droughts, earthquakes, extreme heat and cold, floods, fires, earthquakes, hail, landslides, and tornadoes, challenge agricultural production. Because agriculture relies on the weather, climate, and water availability to thrive, it is easily impacted by natural events and disasters. Agricultural impacts from natural events and disasters most commonly include: contamination of water bodies, loss of harvest or livestock, increased susceptibility to disease, and destruction of irrigation systems and other agricultural infrastructure. These impacts can have long lasting effects on agricultural production including crops, forest growth, and arable lands, which require time to mature. Specific impacts by hazard are listed below:

- Drought's most severe effects on agriculture include water quality and quantity issues. Other impacts include decreased crop yields, impact to feed and forage, and altered plant populations.
- Earthquakes, though rare in Butte County, can strike without warning and cause dramatic changes to the landscape of an area that can have devastating impacts on agricultural production and the environment. These impacts could include loss of harvest or livestock and destruction of irrigation systems and other agricultural infrastructure.
- Extreme cold may result in loss of livestock, increased deicing, downed power lines, and increased use of generators. Deicing can impact agriculture by damaging local ecosystems and contaminating water bodies. Downed power lines cause people to run generators more often, which can release harmful air pollutants.
- Hot weather and extreme heat can worsen ozone levels and air quality as well as leading to drought conditions. Excessive heat and prolonged dry or drought conditions can impact agriculture by creating worker safety issues for farm field workers, severely damaging crops, and reducing availability of water and food supply for livestock.
- Wildfires can spread quickly and devastate thousands of acres of land, which may include agricultural lands. This devastation could lead to large losses in crops, forestry, livestock, and agricultural infrastructure.
- Flooding causes many impacts to agricultural production, including water contamination, damage to crops, loss of livestock, increased susceptibility of livestock to disease, flooded farm machinery, and environmental damage to and from agricultural chemicals.
- Landslides and debris flow occur in all 50 states and commonly occur in connection with other major natural disasters such as earthquakes, volcanoes, wildfires, and floods. Some of the threats from landslides and debris flow include rapidly moving water and debris that can cause trauma; broken electrical, water, gas, and sewage lines; and disrupted roadways and railways. This can lead to agricultural impacts including contamination of water, change in vegetation, and harvest and livestock losses.

In addition to threats to agriculture from weather and other natural hazard events, agriculture in the County is at risk from insects, pests and noxious weeds. Establishment of an invasive species would be detrimental to the agricultural industry of Butte County because of product losses, stringent quarantine regulations, loss of exporting opportunities and increased treatment costs. The introduction of exotic plants influences wildlife by displacing forage species, modifying habitat structure—such as changing grassland to a forb-dominated community—or changing species interactions within the ecosystem. In addition, invasive plants:

- Increase wildfire potential
- Reduce water resources
- Accelerate erosion and flooding
- Threaten wildlife
- Degrade rangeland, cropland, and timberland
- Diminish outdoor recreation opportunities.

Invasive plants cost California $82 million every year (2008 Cal-IPC). Estimates on exact yearly losses in Butte County varies and was not available for the County. Due to the high economic value of crops in the County, invasive species have the ability to cause immense financial harm.

Future Development

Future development in the County is likely to have an impact on agricultural hazards in Butte County to the extent that agricultural lands are taken out of production as new development occurs reducing available land for agricultural uses, including those related to farming, timber production and grazing. However, the HMPC did note that with additional development in the County, there will be additional competition for water resources thus possibly impacting the agricultural industry.

4.3.11. Invasive Species: Aquatic

Likelihood of Future Occurrence—Likely
Vulnerability—Medium

Marine invasive species can jeopardize and damage any part of the entire system ranging from human economy dependent infrastructure to natural aquatic, riparian and wetland habitat. Entire watersheds can be affected when an aggressive NAS infests the rivers, shorelines, tributaries, drainage, irrigation and domestic delivery systems.

Quagga and zebra mussels are an invasive, non-native species that breed very fast, have no known predators, and can quickly colonize new areas within California waters. Once established, these mussels can clog water intake and delivery pipes; dam intake gates and pipes; adhere to boats, pilings, and most hard and some soft substrates, and litter beaches and shores with jagged, foul smelling shells.

The most serious measurable economic impacts are suffered by water districts and other users of lake water who may have increased maintenance costs due to plugged water pipes, intake screens, and possible damage to pumps and other equipment. It even impacts citizens who don't use the lakes through increased costs for drinking water and food prices passed along to consumers by the water and agriculture industries brought on by their increased costs in maintenance and equipment repair. It impacts the local fisheries, and in some lakes, has caused a collapse in the populations of sport fish.

These mussels have the ability to tolerate a wide range of conditions and are extremely adaptable. Once they have infected a water body, they cannot be eradicated. They have no predators native to the US. They cannot be prevented from spreading into downstream waters. Should quagga mussels reach Butte County, the economic impacts would be substantial to all communities.

Other aquatic species of concern to the county include hydrilla and Arundo donax.

Future Development

With regards to the quagga and zebra mussels, public education and monitoring programs must continue into the future (and possibly expand) so this hazard can continue to be prevented in the County. Other aquatic invasive species will be dealt with in the future either by eradication or by public education. Aquatic invasive species are unlikely to affect future development in the County.

4.3.12. Landslide and Debris Flows Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Landslides in Butte County include a wide variety of processes resulting in downward and outward movement of soil, rock, and vegetation. Common names for landslide types include slumps, rockslides, debris slides, lateral spreading, debris avalanches, earth flows, and soil creep. Although landslides are primarily associated with slopes greater than 15 percent, they can also occur in relatively flat areas and as cut-and-fill failures, river bluff failures, lateral spreading landslides, collapse of wine-waste piles, failures associated with quarries, and open-pit mines. Landslides may be triggered by both natural- and human-caused activity. Impacts from landslide and debris flow are limited in the County, as the location in which they occur tends to be less populated or on federal lands. Impacts in the County may be to structures, infrastructure, and to life safety.

Although this hazard also includes related issues such as mudslides and debris flows, available mapped hazard data was limited to landslides; thus, the remainder of this section is focused on the mapped landslide vulnerability.

Values at Risk

Analysis results are provided for the Planning Area as a whole, then broken down in more detail for the unincorporated County. Detailed tables for the jurisdictions are provided in their respective annexes to this Plan.

Methodology

The landslide potential data are a digital version of U.S. Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States dated 2001. The map and digital data delineate areas in the conterminous United States where large numbers of landslides have occurred and areas which are susceptible to landsliding. These were provided by Butte County and were used in their 2030 General Plan.

The 2001 Landslide Incidence and Susceptibility data was obtained for the Butte County Planning Area. According to the landslide layer obtained from Butte County, the landslide incidence ranges from low to high in the Planning Area, with most of the Planning Area falling in the low, with small amounts in the eastern portion of the County falling in the moderate or high areas. Areas of high landslide risk exist in the northwestern portion of the County, which is sparsely populated. The County’s parcel layer was used as the basis for the inventory of all parcels within Butte County. GIS was used to overlay the landslide hazard layer onto the parcel layer centroids, and where the landslide potential areas intersected a parcel centroid, it was assigned with that hazard zone for the entire parcel. Note that the value of the improved land is also included in the total of values at risk as the land itself is at risk to landslide.

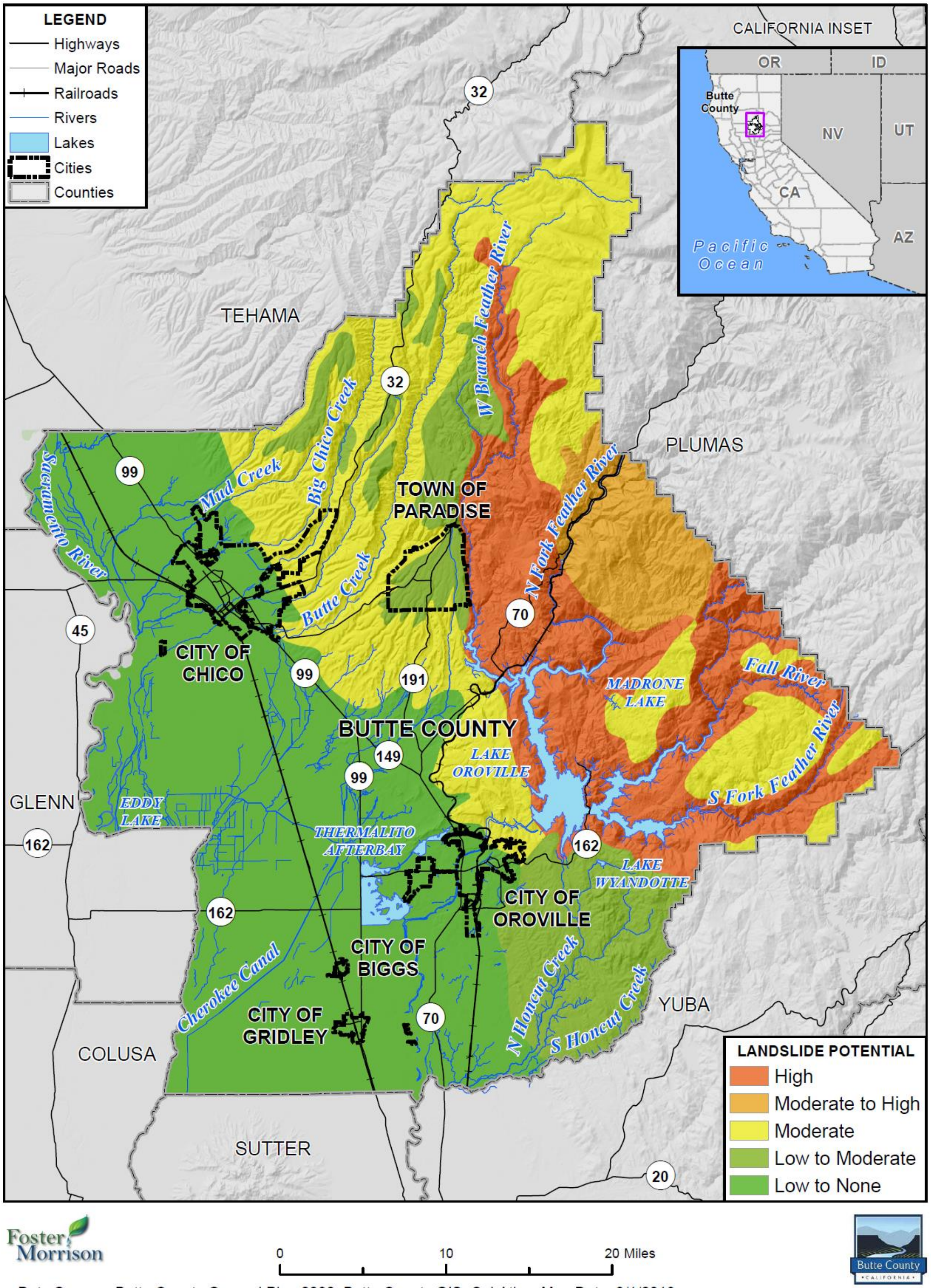
Butte County Planning Area

The USGS landslide layer from the Butte County 2030 General Plan was overlaid with the Butte County parcel layer in GIS to obtain results. Areas of landslide potential in the Butte County Planning Area is shown in Figure 4-116. Analysis results for the Butte County Planning Area is presented in multiple tables (all using the estimated contents replacement values in the buffer zones based on the CRV factors detailed in Table 4-55) below:

- Table 4-157 shows the total parcel counts, improved parcel counts, their improved structure and land values in landslide potential areas prior to the Camp Fire.
- Table 4-158 shows the total parcel counts, improved parcel counts, their improved structure and land values in landslide potential areas after the Camp Fire.
- Table 4-159 compares the improved structure values in landslide potential areas in the Planning Area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-160 breaks down Table 4-158 into more detail, and shows post-fire values in landslide potential areas by property use type.

Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the landslide potential areas due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Figure 4-116 Butte County Planning Area – Landslide Potential Areas



Data Source: Butte County General Plan 2030, Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Table 4-157 Butte County Planning Area – Pre-Fire Count and Value of Parcels in Landslide Susceptibility and Incidence Areas

Landslide Incidence and Susceptibility	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
High	5,382	2,505	$221,240,279	$220,539,823	$669,474	$112,849,744	$555,299,320
Moderate to High	257	10	$2,603,191	$412,476	$0	$224,611	$3,240,278
Moderate	9,166	5,850	$632,833,915	$976,790,755	$3,791,923	$514,224,575	$2,127,641,168
Low to Moderate	23,854	20,509	$1,433,001,323	$2,611,859,964	$17,001,182	$1,493,437,980	$5,555,300,449
Low to None	56,001	48,560	$5,740,294,496	$9,649,093,302	$454,333,353	$6,427,505,217	$22,271,226,368
Grand Total	**94,660**	**77,434**	**$8,029,973,204**	**$13,458,696,320**	**$475,795,932**	**$8,548,242,126**	**$30,512,707,582**

Source: USGS, Butte County 2018 Parcel/Assessor's Data

Table 4-158 Butte County Planning Area – Post-Fire Count and Value of Parcels in Landslide Susceptibility and Incidence Areas

Landslide Incidence and Susceptibility	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
High	5,381	2,503	$220,588,902	$211,316,612	$669,474	$108,146,782	$527,691,741
Moderate to High	257	10	$2,603,191	$412,476	$0	$224,611	$3,211,994
Moderate	9,167	5,847	$632,477,421	$867,241,606	$3,731,468	$457,261,465	$1,922,186,514
Low to Moderate	23,856	20,504	$1,432,796,761	$2,075,005,735	$16,215,189	$1,205,100,641	$4,479,913,693
Low to None	56,174	48,534	$5,721,456,503	$9,627,511,909	$451,069,395	$6,405,284,467	$21,393,470,108
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: USGS, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-159 Butte County Planning Area – Comparison of Improved Stricture Values Pre- and Post-Fire

Landslide Incidence and Susceptibility	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
High	$220,539,823	$211,316,612	-$9,223,211	-4.2%
Moderate to High	$412,476	$412,476	$0	0.0%
Moderate	$976,790,755	$867,241,606	-$109,549,149	-11.2%
Low to Moderate	$2,611,859,964	$2,075,005,735	-$536,854,229	-20.6%
Low to None	$9,649,093,302	$9,627,511,909	-$21,581,393	-0.2%
Grand Total	**$13,458,696,320**	**$12,781,488,338**	**-$677,207,982**	**-5.0%**

Source: USGS, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-160 Butte County Planning Area – Count and Value of Parcels in Landslide Susceptibility and Incidence Areas by Property Use

Jurisdiction / Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Low to None							
Agricultural	6	3	$151,112	$151,082	$810	$151,082	$854,126
Commercial	36	24	$717,577	$3,616,969	$109,175	$3,616,969	$7,405,502
Industrial	14	8	$1,727,064	$12,707,659	$10,439,743	$19,061,489	$46,918,515
Residential	691	639	$23,426,560	$52,713,156	$6,630	$26,356,578	$100,246,973
Unknown	18	0	$0	$0	$0	$0	$0
Low to None Total	765	674	$26,022,313	$69,188,866	$10,556,358	$49,186,118	$155,425,116
City of Biggs Total	765	674	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Moderate							
Agricultural	3	0	$0	$0	$0	$0	$0
Commercial	3	2	$684,576	$1,405,250	$0	$1,405,250	$3,495,076
Industrial	0	0	$0	$0	$0	$0	$0
Residential	392	319	$75,816,521	$143,057,877	$0	$71,528,939	$288,539,279
Unknown	30	1	$189,393	$476,194	$0	$0	$665,587
Moderate Total	**428**	**322**	**$76,690,490**	**$144,939,321**	**$0**	**$72,934,189**	**$292,699,942**
Low to None							
Agricultural	20	4	$683,709	$271,477	$57,958	$271,477	$1,289,594
Commercial	2,084	1,730	$604,964,748	$1,442,321,699	$46,677,852	$1,442,321,699	$3,100,478,412
Industrial	360	286	$74,990,957	$173,110,896	$7,462,437	$259,666,344	$508,890,547
Residential	23,228	22,213	$2,372,762,612	$4,211,394,185	$187,732	$2,105,697,093	$8,465,076,062
Unknown	377	5	$594,346	$562,281	$0	$0	$1,134,878
Low to None Total	26,069	24,238	$3,053,996,372	$5,827,660,538	$54,385,979	$3,807,956,613	$12,076,869,493
City of Chico Total	**26,497**	**24,560**	**$3,130,686,862**	**$5,972,599,859**	**$54,385,979**	**$3,880,890,801**	**$12,369,569,434**
City of Gridley							
Low to None							
Agricultural	13	8	$1,886,899	$1,263,421	$178,906	$1,263,421	$4,591,603

Jurisdiction / Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Commercial	237	195	$21,841,994	$53,742,366	$2,655,679	$53,742,366	$115,013,298
Industrial	31	22	$4,176,092	$12,268,292	$2,549,750	$18,402,438	$38,728,042
Residential	2,107	1,977	$85,833,958	$223,050,119	$37,556	$111,525,060	$395,926,991
Unknown	64	0	$0	$0	$0	$0	$0
Low to None Total	2,452	2,202	$113,738,943	$290,324,198	$5,421,891	$184,933,285	$554,259,934
City of Gridley Total	**2,452**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**
City of Oroville							
Moderate							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	5	3	$859,321	$1,117,124	$2,640	$1,117,124	$2,327,335
Industrial	0	0	$0	$0	$0	$0	$0
Residential	765	667	$34,033,729	$86,635,673	$60	$43,317,837	$160,440,060
Unknown	5	0	$0	$0	$0	$0	$0
Moderate Total	**775**	**670**	**$34,893,050**	**$87,752,797**	**$2,700**	**$44,434,961**	**$162,767,395**
Low to None							
Agricultural	9	0	$1,291,076	$0	$7,947	$0	$1,299,023
Commercial	1,037	696	$106,974,426	$337,834,369	$19,005,166	$337,834,369	$704,090,177
Industrial	227	72	$26,057,297	$40,098,771	$42,318,610	$60,148,157	$192,568,485
Residential	4,940	4,061	$151,071,271	$418,175,045	$6,940	$209,087,523	$721,897,894
Unknown	157	2	$64,518	$314,266	$0	$0	$377,654
Low to None Total	6,370	4,831	$285,458,588	$796,422,451	$61,338,663	$607,070,048	$1,620,233,232
City of Oroville Total	**7,145**	**5,501**	**$320,351,638**	**$884,175,248**	**$61,341,363**	**$651,505,009**	**$1,783,000,627**
Town of Paradise							
High							
Agricultural	0	0	$0	$0	$0	$0	$0
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	15	9	$850,153	$893,297	$0	$446,649	$2,162,251
Unknown	0	0	$0	$0	$0	$0	$0
High Total	**15**	**9**	**$850,153**	**$893,297**	**$0**	**$446,649**	**$2,162,251**
Moderate							
Agricultural	1	0	$42,929	$0	$0	$0	$42,929

Jurisdiction / Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Commercial	40	32	$3,694,410	$4,228,301	$226,913	$4,228,301	$11,878,297
Industrial	3	2	$311,922	$102,005	$0	$153,008	$566,935
Residential	1,371	1,276	$89,491,033	$98,537,076	$34,610	$49,268,538	$231,055,376
Unknown	15	0	$0	$0	$0	$0	$0
Moderate Total	**1,430**	**1,310**	**$93,540,294**	**$102,867,382**	**$261,523**	**$53,649,847**	**$243,543,537**
Low to Moderate							
Agricultural	4	1	$118,922	$24,379	$11,631	$24,379	$179,311
Commercial	684	565	$99,308,482	$269,354,358	$13,165,188	$269,354,358	$513,949,523
Industrial	13	12	$2,213,296	$3,496,531	$165,000	$5,244,797	$11,215,624
Residential	9,260	8,694	$585,885,004	$646,565,806	$71,689	$323,282,903	$1,507,548,355
Unknown	95	3	$426,672	$137,487	$0	$0	$562,197
Low to Moderate Total	10,056	9,275	$687,952,376	$919,578,561	$13,413,508	$597,906,437	$2,033,455,010
Town of Paradise Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Unincorporated Butte County							
High							
Agricultural	302	31	$13,298,649	$1,668,801	$451,774	$1,668,801	$15,989,193
Commercial	25	19	$1,577,432	$3,308,151	$151,211	$3,308,151	$7,860,296
Industrial	3	0	$5,918	$0	$0	$0	$5,918
Residential	4,735	2,444	$204,712,001	$205,446,363	$66,489	$102,723,182	$501,529,335
Unknown	301	0	$144,749	$0	$0	$0	$144,749
High Total	**5,366**	**2,494**	**$219,738,749**	**$210,423,315**	**$669,474**	**$107,700,134**	**$525,529,491**
Moderate to High							
Agricultural	61	1	$1,212,716	$36,746	$0	$36,746	$1,286,208
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	98	9	$1,387,517	$375,730	$0	$187,865	$1,922,828
Unknown	98	0	$2,958	$0	$0	$0	$2,958
Moderate to High Total	**257**	**10**	**$2,603,191**	**$412,476**	**$0**	**$224,611**	**$3,211,994**
Moderate							
Agricultural	662	79	$52,476,584	$8,996,081	$223,513	$8,996,081	$65,803,616
Commercial	77	56	$12,955,099	$25,633,416	$1,383,950	$25,633,416	$54,743,120
Industrial	11	7	$3,195,407	$3,209,344	$1,748,574	$4,814,016	$18,082,315

Jurisdiction / Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Residential	5,476	3,400	$357,760,549	$493,597,913	$111,208	$246,798,957	$1,083,344,097
Unknown	308	3	$965,948	$245,352	$0	$0	$1,202,494
Moderate Total	**6,534**	**3,545**	**$427,353,587**	**$531,682,106**	**$3,467,245**	**$286,242,470**	**$1,223,175,642**
Low to Moderate							
Agricultural	332	85	$27,178,607	$8,333,185	$955,568	$8,333,185	$44,534,244
Commercial	261	171	$23,921,686	$50,800,180	$1,438,303	$50,800,180	$118,059,785
Industrial	1	1	$134,669	$86,187		$129,281	$350,137
Residential	13,030	10,970	$693,172,473	$1,095,863,117	$407,810	$547,931,559	$2,282,742,823
Unknown	176	2	$436,950	$344,505	$0	$0	$771,695
Low to Moderate Total	**13,800**	**11,229**	**$744,844,385**	**$1,155,427,174**	**$2,801,681**	**$607,194,204**	**$2,446,458,683**
Low to None							
Agricultural	3,858	2,446	$1,013,856,209	$371,630,870	$286,900,136	$371,630,870	$2,125,564,559
Commercial	464	363	$55,863,167	$131,804,689	$3,486,625	$131,804,689	$302,613,736
Industrial	294	228	$48,272,675	$182,974,757	$20,150,676	$274,462,136	$534,851,680
Residential	15,200	13,544	$1,122,755,155	$1,956,481,420	$8,118,147	$978,240,710	$4,018,664,289
Unknown	702	8	$1,493,081	$1,024,120	$710,920	$0	$4,988,071
Low to None Total	**20,518**	**16,589**	**$2,242,240,287**	**$2,643,915,856**	**$319,366,504**	**$1,756,138,405**	**$6,986,682,335**
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: USGS, Butte County 3/28/2019 Parcel/Assessor's Data

Unincorporated Butte County

Analysis results for landslide potential areas in unincorporated Butte County is presented in multiple tables (all using the estimated contents replacement values based on the CRV factors detailed in Table 4-55) below:

- Table 4-161 shows the total parcel counts, improved parcel counts, their improved structure and land values in landslide potential areas prior to the Camp Fire.
- Table 4-162 shows the total parcel counts, improved parcel counts, their improved structure and land values in landslide potential areas after the Camp Fire
- Table 4-163 compares the improved structure values in the unincorporated County in landslide potential areas pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.

➢ Table 4-164 breaks down Table 4-162in more detail and shows post-fire values in landslide potential areas by property use type.

Potential damages to the incorporated jurisdictions in the County by landslide potential and property use type may be found in their respective annexes to this Plan Update.

Table 4-161 Unincorporated Butte County – Pre-Fire Count and Value of Parcels in Landslide Potential Areas

Landslide Potential	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
High	5,367	2,496	$220,390,126	$218,456,046	$669,474	$111,807,855	$551,323,501
Moderate to High	257	10	$2,603,191	$412,476	$0	$224,611	$3,240,278
Moderate	6,533	3,546	$427,685,456	$559,612,324	$3,457,075	$300,618,376	$1,291,373,231
Low to Moderate	13,799	11,228	$744,772,111	$1,197,840,040	$2,839,576	$629,033,479	$2,574,485,206
Low to None	20,478	16,598	$2,251,780,043	$2,653,731,229	$321,130,362	$1,765,671,890	$6,992,313,524
Unincorporated Butte County Total	**46,434**	**33,878**	**$3,647,230,927**	**$4,630,052,115**	**$328,096,487**	**$2,807,356,210**	**$11,412,735,739**

Source: USGS, Butte County 2018 Parcel/Assessor's Data

Table 4-162 Unincorporated Butte County – Post-Fire Count and Value of Parcels in Landslide Susceptibility and Incidence Areas

Landslide Incidence and Susceptibility	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
High	5,366	2,494	$219,738,749	$210,423,315	$669,474	$107,700,134	$525,529,491
Moderate to High	257	10	$2,603,191	$412,476		$224,611	$3,211,994
Moderate	6,534	3,545	$427,353,587	$531,682,106	$3,467,245	$286,242,470	$1,223,175,642
Low to Moderate	13,800	11,229	$744,844,385	$1,155,427,174	$2,801,681	$607,194,204	$2,446,458,683
Low to None	20,518	16,589	$2,242,240,287	$2,643,915,856	$319,366,504	$1,756,138,405	$6,986,682,335
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: USGS, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-163 Unincorporated Butte County – Comparison of Improved Structure Values in Landslide Susceptibility and Incidence Areas Pre- and Post-Fire

Landslide Incidence and Susceptibility	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ change	% change
High	$218,456,046	$210,423,315	-$8,032,731	-3.7%
Moderate to High	$412,476	$412,476	$0	0.0%
Moderate	$559,612,324	$531,682,106	-$27,930,218	-5.0%
Low to Moderate	$1,197,840,040	$1,155,427,174	-$42,412,866	-3.5%
Low to None	$2,653,731,229	$2,643,915,856	-$9,815,373	-0.4%
Grand Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: USGS, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-164 Unincorporated Butte County – Count and Value of Parcels in Landslide Susceptibility and Incidence Areas by Property Use

Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
High							
Agricultural	302	31	$13,298,649	$1,668,801	$451,774	$1,668,801	$15,989,193
Commercial	25	19	$1,577,432	$3,308,151	$151,211	$3,308,151	$7,860,296
Industrial	3	0	$5,918	$0	$0	$0	$5,918
Residential	4,735	2,444	$204,712,001	$205,446,363	$66,489	$102,723,182	$501,529,335
Unknown	301	0	$144,749	$0	$0	$0	$144,749
High Total	5,366	2,494	$219,738,749	$210,423,315	$669,474	$107,700,134	$525,529,491
Moderate to High							
Agricultural	61	1	$1,212,716	$36,746	$0	$36,746	$1,286,208
Commercial	-	0	$0	$0	$0	$0	$0
Industrial	-	0	$0	$0	$0	$0	$0
Residential	98	9	$1,387,517	$375,730	$0	$187,865	$1,922,828
Unknown	98	0	$2,958	$0	$0	$0	$2,958
Moderate to High Total	**257**	**10**	**$2,603,191**	**$412,476**	**$0**	**$224,611**	**$3,211,994**
Moderate							
Agricultural	662	79	$52,476,584	$8,996,081	$223,513	$8,996,081	$65,803,616
Commercial	77	56	$12,955,099	$25,633,416	$1,383,950	$25,633,416	$54,743,120
Industrial	11	7	$3,195,407	$3,209,344	$1,748,574	$4,814,016	$18,082,315
Residential	5,476	3,400	$357,760,549	$493,597,913	$111,208	$246,798,957	$1,083,344,097

Landslide Incidence and Susceptibility / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unknown	308	3	$965,948	$245,352	$0	$0	$1,202,494
Moderate Total	**6,534**	**3,545**	**$427,353,587**	**$531,682,106**	**$3,467,245**	**$286,242,470**	**$1,223,175,642**
Low to Moderate							
Agricultural	332	85	$27,178,607	$8,333,185	$955,568	$8,333,185	$44,534,244
Commercial	261	171	$23,921,686	$50,800,180	$1,438,303	$50,800,180	$118,059,785
Industrial	1	1	$134,669	$86,187	$0	$129,281	$350,137
Residential	13,030	10,970	$693,172,473	$1,095,863,117	$407,810	$547,931,559	$2,282,742,823
Unknown	176	2	$436,950	$344,505	$0	$0	$771,695
Low to Moderate Total	13,800	11,229	$744,844,385	$1,155,427,174	$2,801,681	$607,194,204	$2,446,458,683
Low to None							
Agricultural	3,858	2,446	$1,013,856,209	$371,630,870	$286,900,136	$371,630,870	$2,125,564,559
Commercial	464	363	$55,863,167	$131,804,689	$3,486,625	$131,804,689	$302,613,736
Industrial	294	228	$48,272,675	$182,974,757	$20,150,676	$274,462,136	$534,851,680
Residential	15,200	13,544	$1,122,755,155	$1,956,481,420	$8,118,147	$978,240,710	$4,018,664,289
Unknown	702	8	$1,493,081	$1,024,120	$710,920	$0	$4,988,071
Low to None Total	20,518	16,589	$2,242,240,287	$2,643,915,856	$319,366,504	$1,756,138,405	$6,986,682,335
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: USGS, Butte County 3/28/2019 Parcel/Assessor's Data

It should be noted that maps and analysis represent analyses based on best available data. There have been past occurrences of landslides in areas not shown to be at risk to landslide. Generally, landslide risk maps detail areas prone to slope failure; the maps rarely include the runout areas where the failed slope will go. By way of example, a landslide on March 22, 2014, killed 43 people when it wiped out a rural neighborhood in Oso, northeast of Seattle. While the failed slope area was mapped as prone to landslides, the runout area was not. It was the runout area that resulted in devastating loss. Thus, mapping of landslide potential areas should be considered as one part of the equation. Damages to the area that could be inundated by such slope failure should also be considered by communities.

Populations at Risk

Those residential parcel centroids that intersect the landslide potential areas were counted and multiplied by the 2010 Census Bureau average household factors for each jurisdiction in the Planning Area. This is shown in Table 4-165. According to this analysis, there is a total population of 23,048 residents in the Butte County Planning Area are risk to moderate incidence or greater landslide, all of which are in the unincorporated County.

Table 4-165 Butte County Planning Area –Residential Parcels and Population by Landslide Incidence and Susceptibility Areas

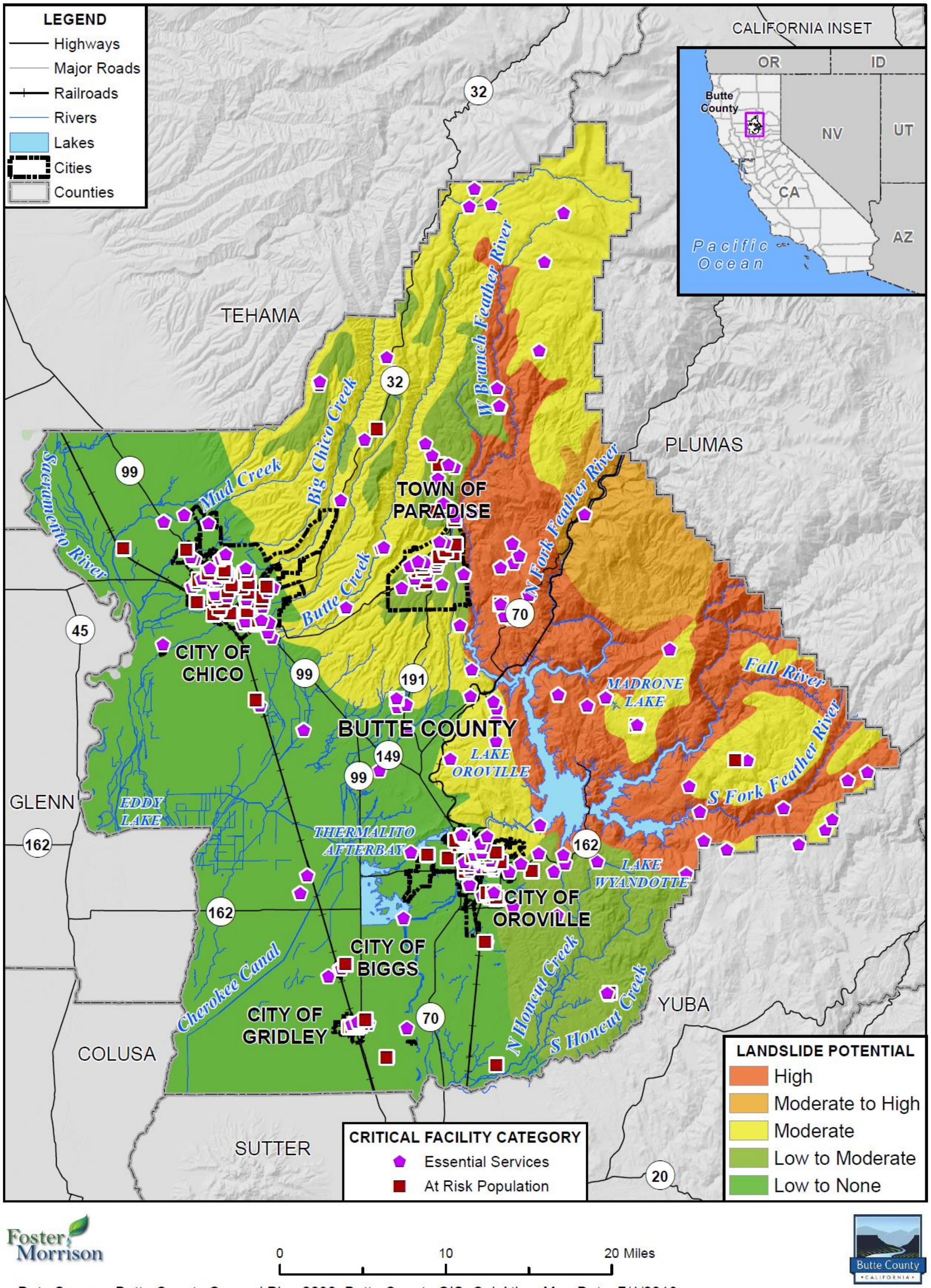
Jurisdiction	Moderate		Moderate to High		High	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Biggs	0	0	0	0	0	0
Chico	319	963	0	0	0	0
Gridley	0	0	0	0	0	0
Oroville	667	1,734	0	0	0	0
Paradise	1,276	2,773	0	0	9	19
Unincorporated County	3,400	10,200	9	27	2,444	7,332
Total	**5,662**	**15,670**	**9**	**27**	**2,453**	**7,351**

Source: Butte County 2030 General Plan Butte County GIS, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Butte County and all jurisdictions to determine critical facilities in the landslide potential areas. Using GIS, the UGSG landslide potential areas were overlayed on the critical facility GIS layer. Figure 4-117 shows critical facilities, as well as the landslide potential areas. Table 4-166 summarized critical facilities in landslide potential areas. Table 4-167 details critical facilities by facility type and count by jurisdiction for the Planning Area. Table 4-168 details critical facilities by facility type for the unincorporated County. Information on critical facilities in the incorporated jurisdictions in the County can be found in their respective annexes to this Plan Update. Details of critical facility definition, type, name and address and jurisdiction by flood zone are listed in Appendix F.

Figure 4-117 Butte County Planning Area – Critical Facilities and Landslide Incidence and Susceptibility Areas



Data Source: Butte County General Plan 2030, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-166 Butte County Planning Area – Summary of Critical Facilities in Landslide Incidence and Susceptibility Areas

Landslide Incidence and Susceptibility Zone / Critical Facility Category /	Facility Count
High	
Essential Services Facilities	26
At Risk Population Facilities	2
High Total	**28**
Moderate to High	
Essential Services Facilities	1
At Risk Population Facilities	0
Moderate Total	**1**
Moderate	
Essential Services Facilities	34
At Risk Population Facilities	4
Moderate Total	**38**
Low to Moderate	
Essential Services Facilities	50
At Risk Population Facilities	18
Low to Moderate Total	**68**
Low	
Essential Services Facilities	126
At Risk Population Facilities	79
Low Total	**205**
Grand Total	**340**

Source: USGS, Butte County GIS

Table 4-167 Butte County Planning Area - Critical Facilities in Landslide Incidence and Susceptibility Areas by Jurisdiction

Jurisdiction / Landslide Incidence and Susceptibility / Jurisdiction / Critical Facility Category	Facility Count
City of Biggs	
Low to None	
Essential Services Facilities	3
At Risk Population Facilities	4
Low to None Total	7
City of Biggs Total	7
City of Chico	
Low to None	

Jurisdiction / Landslide Incidence and Susceptibility / Jurisdiction / Critical Facility Category	Facility Count
Essential Services Facilities	50
At Risk Population Facilities	31
Low to None Total	**81**
City of Chico Total	**81**
City of Gridley	
Low to None	
Essential Services Facilities	11
At Risk Population Facilities	6
Low to None Total	**17**
City of Gridley Total	**17**
City of Oroville	
Low to None	
Essential Services Facilities	40
At Risk Population Facilities	20
Low to None Total	**60**
City of Oroville Total	**60**
Town of Paradise	
Moderate	
Essential Services Facilities	1
At Risk Population Facilities	0
Moderate Total	1
Low to Moderate	
Essential Services Facilities	20
At Risk Population Facilities	12
Low to Moderate Total	32
Town of Paradise Total	**33**
Unincorporated Butte County	
High	
Essential Services Facilities	26
At Risk Population Facilities	2
High Total	**28**
Moderate to High	
Essential Services Facilities	1
At Risk Population Facilities	0
Moderate to High Total	**1**
Moderate	

Jurisdiction / Landslide Incidence and Susceptibility / Jurisdiction / Critical Facility Category	Facility Count
Essential Services Facilities	33
At Risk Population Facilities	4
Moderate Total	**37**
Low to Moderate	
Essential Services Facilities	30
At Risk Population Facilities	6
Low to Moderate Total	**36**
Low to None	
Essential Services Facilities	22
At Risk Population Facilities	18
Low to None Total	**40**
Unincorporated Butte County Total	**142**
Outside of Butte County	
Moderate	
Essential Services Facilities	1
At Risk Population Facilities	0
Moderate Total	**1**
Outside of Butte County Total	**1**
Grand Total	**341**

Source: USGS, Butte County GIS

Table 4-168 Unincorporated Butte County – Critical Facilities in Landslide Incidence and Susceptibility Areas by Critical Facility Category and Type

Landslide Incidence and Susceptibility	Critical Facility Category / Critical Facility Type	Facility Count
High		
High	**Essential Services Facilities**	
	Fire	9
	Public Assembly Point / Evacuation Center	6
	Radio Sites	3
	Dam	8
	Essential Services Facilities Total	**26**
	At Risk Population Facilities	
	School	2
	At Risk Population Facilities Total	**2**
	Total	**28**

Landslide Incidence and Susceptibility	Critical Facility Category / Critical Facility Type	Facility Count
Moderate to High		
Moderate to High	**Essential Services Facilities**	
	Dam	1
	Essential Services Facilities Total	**1**
	Total	**1**
Moderate		
Moderate	**Essential Services Facilities**	
	Fire	12
	Public Assembly Point / Evacuation Center	9
	Radio Sites	3
	Dam	9
	Essential Services Facilities Total	**33**
	At Risk Population Facilities	
	School	4
	At Risk Population Facilities Total	**4**
	Total	**37**
Low to Moderate		
Low to Moderate	**Essential Services Facilities**	
	Fire	9
	Health Care	2
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	9
	Radio Sites	3
	Dam	6
	Essential Services Facilities Total	**30**
	At Risk Population Facilities	
	School	6
	At Risk Population Facilities Total	6
	Total	**36**
Low to None		
Low to None	**Essential Services Facilities**	
	Wastewater Treatment Plant	1
	Fire	6
	Health Care	1
	Public Assembly Point / Evacuation Center	6
	Radio Sites	2
	Dam	5

Landslide Incidence and Susceptibility	Critical Facility Category / Critical Facility Type	Facility Count
	Emergency Animal Shelter	1
	Essential Services Facilities Total	**22**
	At Risk Population Facilities	
	School	18
	At Risk Population Facilities Total	**18**
	Total	**40**
Unincorporated Butte County Total		**142**

Source: USGS, Butte County GIS

Overall Community Impact

Landslides, debris flows, and mud flow impacts vary by location and severity of any given event and will likely only affect certain areas of the Planning Area during specific times. Based on the risk assessment, it is evident that landslides will potentially have economic impacts to certain areas of the County. However, many of the landslides in the Planning Area are minor, localized events that are more of a nuisance than a disaster. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure, utilities, and services;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community; and
- Negative impact on commercial and residential property values

Future Development

Although new growth and development corridors could fall in the area affected by moderate or higher risk of landslide, given the small chance of a major landslide and the building codes and erosion ordinance in effect regarding the siting and construction of structures in the risk areas, development in the landslide potential areas will continue to occur. The County requires engineered foundations and grading plans where appropriate, thereby mitigating risk for development in landslide areas.

GIS Analysis

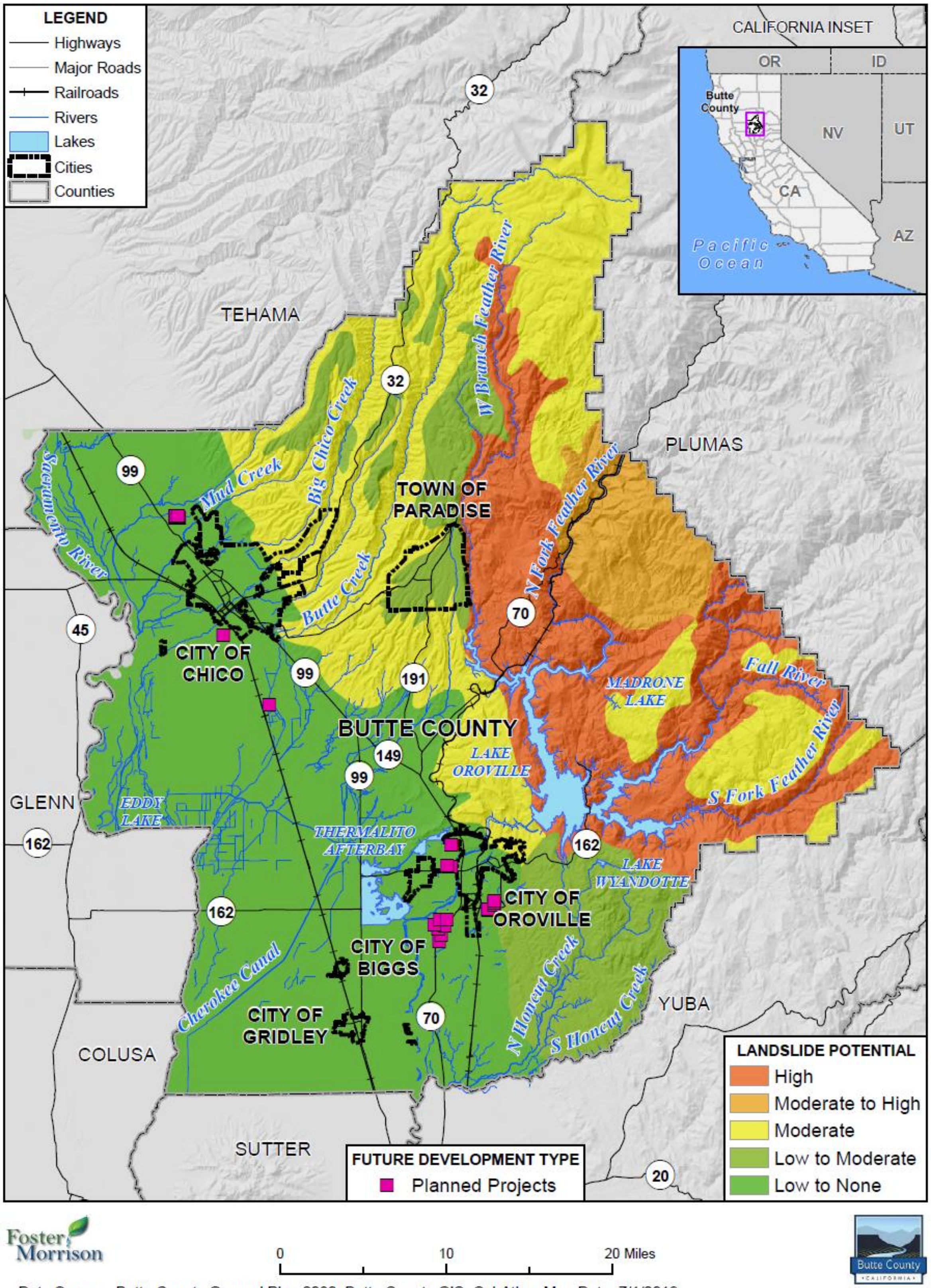
Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of landslide within the County and to the 8 future development projects.

Methodology

Butte County's 3/28/2019 Parcel/Assessor's data and data provided by County Planning were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas. Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file and the APNs, the 8 future development projects were identified. For the landslide potential analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected with the landslide potential areas to determine the parcel counts and acreage within each landslide area.

Landslide potential areas and future development areas are shown on Figure 4-118 and parcels and acreages in those areas are shown in Table 4-169.

Figure 4-118 Unincorporated Butte County – Future Development in Landslide Potential Areas



Data Source: Butte County General Plan 2030, Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-169 Unincorporated Butte County – Future Development Parcels and Acreage in Landslide Potential Areas

Future Development/ Landslide Potential Areas	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista			
Low to None	1	0	9.7
Creekside Estates			
Low to None	1	1	47.4
Diamond Oak			
Low to None	2	1	7.9
Lincoln and Ophir Garden Oak Estates			
Low to None	2	0	50.4
Mandville Park			
Low to None	25	0	22.6
Rio d Oro - Phase 1			
Low to None	**7**	0	664.2
Southlands Subdivision			
Low to None	3	0	48.8
Stanley Ave			
Low to None	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: USGS, Butte County GIS

4.3.13. Levee Failure

Likelihood of Future Occurrence—Occasional
Vulnerability—High

Levee failure flooding can occur as the result of partial or complete collapse of an impoundment, and often results from prolonged rainfall and flooding. The primary danger associated with dam or levee failure is the high velocity flooding of those properties downstream of the breach.

A levee failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to levee failures is generally confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions.

Levee failure 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 critical facilities and lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, agricultural industry, and the local and regional economies.

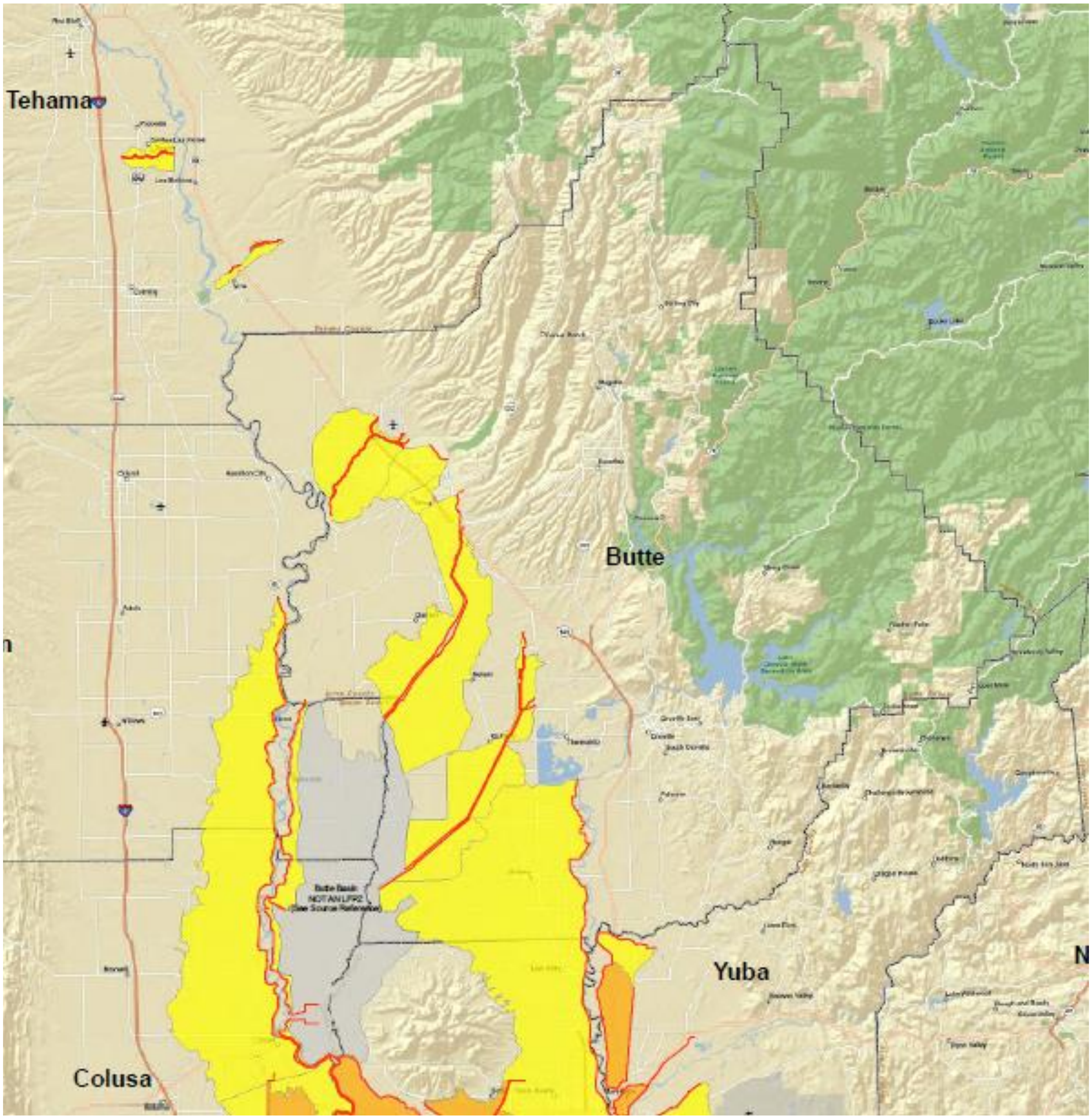
There are numerous levee systems in Butte County, both agricultural and engineered, as discussed in Section 4.2.16. There is no available mapped GIS data for the Planning Area detailing areas protected by levees. As well, the levee certification status of Butte County levees is in a state of flux. Levees determined to provide protection from the 1% annual chance flood in the current DFIRMs, have in some instances, been decertified whether through expired PAL agreements or general lack of certification. Likewise, there are also several levee certification projects underway on area levees that will result in future certification of levee segments. All of this will change the levee status and areas determined to be protected by levees in the next DFIRM update for the County. Due to this, no GIS analysis was performed on leveed areas in the County.

According to the Butte County Water Resources Department, most levees are considered to provide protection to the 1% annual chance flood even if not certified. That said, the Sutter Butte Flood Control Agency is in process with several levee certification projects. Specifically, all Feather River levees will be certified to the 1% annual chance flood with the levees on the West Feather River being certified to the 0.5% 2(00- year) annual chance flood. However, with the numbers and types of levees present within the Planning Area, buildings and people living and working in areas protected by levees will continue to be vulnerable to future levee failures or storms that exceed the design capacity of levees.

While not available in GIS, Levee Flood Protection Zones (LFPZs) estimate the maximum area that may be inundated if a project levee fails when water surface elevation is at the top of a project levee. Zones depicted on Figure 4-119 do not necessarily depict areas likely to be protected from flow events for which project levees were designed. Figure 4-119 illustrates the depths of flooding should a levee that protects that area fail.

Lands within the Levee Flood Protection Zones may be subject to flooding due to various factors, including the failure or overtopping of project or non-project levees, flows that exceed the design capacity of project or non-project levees, and flows from water sources not specifically protected against by project levees. Lands not mapped within a Levee Flood Protection Zone may also experience flooding from these or other related events.

Figure 4-119 Butte County Planning Area – Expected Flood Depths from Levee Failure based on LFPZs



Source: USGS, Cal DWR 12/31/2008

The Butte County 2030 General Plan also provides detail on areas considered to be protected by levees based on the current Butte County DFIRMs. These can be seen in Figure 4-109.

Future Development

Future development built in the areas protected by levees is subject to being built to the standards in the Butte County Floodplain Ordinance. As described above, Butte County is also evaluating the feasibility of projects to bring some area levees up to a 0.1% and 0.5% annual chance or greater level of protection which will also change future development standards and other requirements in levee protected areas.

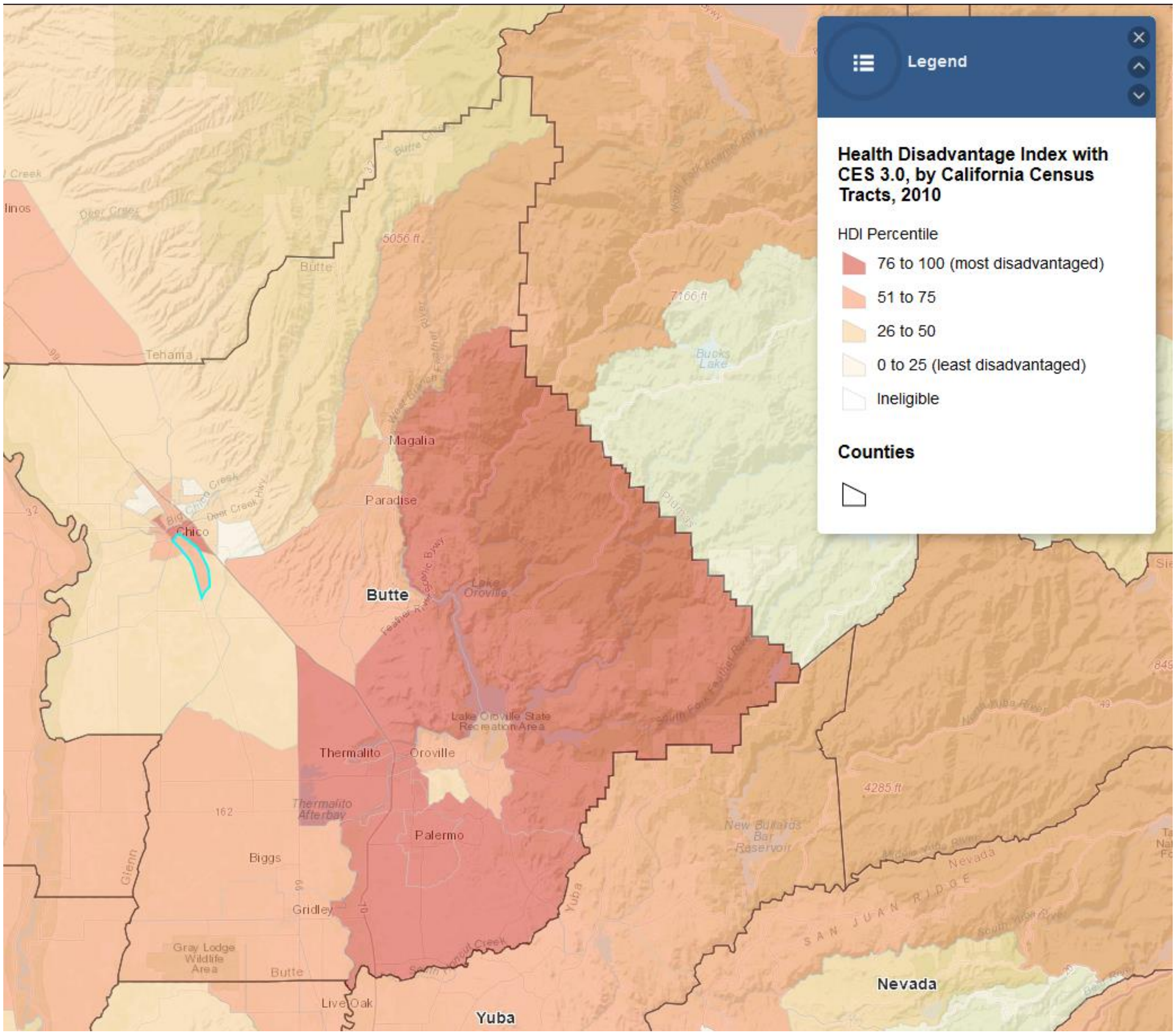
4.3.14. Severe Weather: Extreme Heat Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Extreme heat happens in Butte County each year. Extreme heat may overload demands for electricity to run air conditioners in homes and businesses during prolonged periods of exposure and presents health concerns to individuals outside in the temperatures. Extreme heat may also be a secondary effect of droughts, or may cause drought-like conditions in a temporary setting. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. Extreme heat, when combined with wind, can lead to PSPS events in the County.

The Public Health Alliance has developed a composite index to identify cumulative health disadvantage in California. Factors such as those bulleted above were combined to show what areas are at greater risk to hazards like extreme heat. This is shown on Figure 4-120.

Figure 4-120 Health Disadvantage Index by California Census Tract



Source: Public Health Alliance of Southern California

Vulnerable populations to extreme heat include:

- Homeless
- Infants and children under age five
- Elderly (65 and older)
- Individuals with disabilities
- Individuals dependent on medical equipment
- Individuals with impaired mobility

In addition to vulnerable populations, pets and livestock are at risk to extreme heat.

Future Development

As the County shifts in demographics, more residents will become senior citizens. 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 (PSPS). Low income residents and homeless populations are also vulnerable. Cooling centers for these populations should be utilized when necessary.

4.3.15. Severe Weather: Freeze and Winter Storm Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Winter storms typically involve snow and ice, occasionally accompanied by high winds, which can cause downed trees and power lines, power outages, accidents, and road closures. Transportation networks, communications, and utilities infrastructure are the most vulnerable physical assets in the County. The ability for the County to continue to operate during periods of winter storm and freeze is paramount. Although freeze can burst pipes, freeze normally does not impact structures, but can be a life safety issue. Secondary impacts of freeze 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.

Vulnerable populations to cold and freeze include:

- Homeless
- Infants and children under age five
- Elderly (65 and older)
- Individuals with disabilities
- Individuals dependent on medical equipment
- Individuals with impaired mobility

Of significant concern is the impact to populations with special needs such as the elderly and those requiring the use of medical equipment. 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 and freeze. In addition to vulnerable populations, pets and livestock are at risk to freeze and cold.

The varying elevations in the County, in part, determine the extent to which a given area is affected by freeze and cold. The agricultural industry is especially vulnerable to extreme temperatures. Freezing temperatures can cause significant loss to crops. Historically, extreme cold and freeze have caused losses to agricultural crops and have resulted in several USDA disaster declarations in Butte County.

Impacts to the County as a result of extreme cold and freeze include damage to infrastructure, frozen pipes, utility outages, road closures, traffic accidents, road closures and interruption in business and school activities. Delays in emergency response services can also be of significant concern.

Future Development

Future development built to code should be able to withstand snow loads from severe winter storms. Pipes at risk of freezing should be mitigated by 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.

4.3.16. Severe Weather: Heavy Rains and Storms Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

According to historical hazard data, severe weather is an annual occurrence in Butte County. Damage and disaster declarations related to severe weather have occurred and will continue to occur in the future. Heavy rains and severe storms are the most frequent type of severe weather occurrences in the County. Wind and lightning sometimes accompany these storms and have caused damage in the past. Hail is rare in the County. Impacts from heavy rains include damages to property and infrastructure. However, actual damage associated with the primary effects of severe weather have been limited. It is the secondary hazards caused by weather, such as floods, fire, and agricultural losses that have had the greatest impact on the County. The risk and vulnerability associated with these secondary hazards are discussed in other sections of this plan (Section 4.3.7 Flood: 1%/0.2% Annual Chance, Section 4.3.8 Flood: Localized Stormwater, , Section 4.3.3 Dam Failure, and Section 4.3.19 Wildfire).

Future Development

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

4.3.17. Severe Weather: High Winds and Tornadoes

Likelihood of Future Occurrence—Highly Likely
Vulnerability—High

The County is subject to potentially destructive straight-line winds and tornadoes. High winds are common throughout the area and can happen during most times of the entire year and outside of a severe storm event. Tornadoes are less common and tend to occur mostly in the western portion of the County. Straight line and tornadoes winds are primarily a public safety and economic concern. Windstorms and tornadoes can cause damage to structures and power lines which in turn can create hazardous conditions for people. Debris flying from high wind or tornado events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered.

Impacts from straight line winds and tornadoes include:

- Increased wildfire risk

- Erosion (soil loss)
- Wave action erosion impacts to stream and levee banks
- Dry land farming seed loss
- Windblown weeds
- Downed trees
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs

While there has been some scattered record keeping describing the impacts of windstorms, there is little information to indicate that straight-line winds are little more than a nuisance. For example, while winds can blow weeds that can create an additional expense for farmers, they often cause little long-term damage and there is little justification for allocating resources to combat them. As detailed in the wildfire discussion, one of the most significant concerns in the County is the effect of high winds in fueling wildfires. Even before a wildfire starts, high winds can cause PG&E to put PSPS events into effect.

Campers, mobile homes, barns, and sheds and their occupants are particularly vulnerable as windstorm events in the region can be sufficient in magnitude to overturn these lighter structures. Overhead power lines are vulnerable and account for the much of the historical damages. State highways can be vulnerable to high winds and dust storms, where high profile vehicles may be overturned by winds and lowered visibility can lead to multi-car accidents.

Winds have caused downed trees that have fallen on homes and have blocked roadways. This is common in the City of Chico and the Town of Paradise.

Future Development

Future development projects should consider windstorm and tornado hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Whether high winds and tornadoes will occur, where, when, and of what intensity are all factors that evolve over the days and hours before they form and after they do. Improved weather forecasts coupled with new information technologies, including social media, has resulted in an increasingly large volume of risk information that is available to people when tornadoes threaten. Development trends in the County are not expected to increase vulnerability to this hazard.

4.3.18. Streambank Erosion Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Erosion is the general process whereby rocks and soils are broken down, removed by weathering, or fragmented and then deposited in other places by water or air. Stream bank erosion poses problems for Butte County. The rate of erosion depends on many variables, including the soil or rock texture and composition, soil permeability, slope, extent of vegetative cover, and precipitation amounts and patterns. Erosion increases with increasing slope and precipitation and with decreasing vegetative cover, which includes areas where protective vegetation has been removed by fire, construction, or cultivation. Butte County is traversed by many waterways, including leveed areas. These locations are all subject to bank erosion. Levees are at risk to erosion as well, due to the channelization due to narrow river channels. Significant erosion can cause degradation and loss of levee stability. This is a primary concern regarding erosion in Butte County.

Since dredging the river bottom has been limited on the Sacramento River, the bottom of the river has become higher, thus the water levels reach higher on the banks of the rivers and levees. When northern California reservoirs are nearing maximum capacity, they release water through the river systems, causing additional burdens on levees in the County. As a result, the potential for levee and stream bank erosion damage has increased and erosion of levees can and does occur throughout the levee system.

Other impacts from stream bank erosion include greater levee maintenance and increased risk of levee failure. Should the levees fail, the area protected by the levees would be flooded.

Future Development

Planned developments should take erosion risk areas into account during the construction of new homes and commercial properties. Erosion to streambanks may increase as development increases the amount of impervious surface that would normally hold or slow rainwaters. The County will continue to enforce the zoning and subdivision ordinances that are discussed in Section 4.4.1.

4.3.19. Wildfire Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Extremely High

Risk and vulnerability to the Butte County Planning Area from wildfire is of significant concern, with some areas of the Planning Area being at greater risk than others as described further in this section. High fuel loads in the Planning Area, along with geographical and topographical features, create the potential for both natural and human-caused fires that can result in loss of life and property. These factors, combined with natural weather conditions common to the area, including periods of drought, high temperatures, low relative humidity, and periodic winds, can result in frequent and sometimes catastrophic fires. During the now year-round fire season, the dry vegetation and hot and sometimes windy weather, combined with continued growth in the WUI areas, results in an increase in the number of ignitions. Any fire, once ignited, has the potential to quickly become a large, out-of-control fire. As development continues throughout the Planning Area, especially in these interface areas, the risk and vulnerability to wildfires will likely increase.

Wildfires can cause short-term and long-term disruption to the County. Fires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the County by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. Fires may result in casualties and can destroy buildings and infrastructure.

Although the physical damages and casualties arising from wildland-urban interface fires may be severe, it is important to recognize that they also cause significant economic impacts by resulting in a loss of function of buildings and infrastructure. In some cases, the economic impact of this loss of services may be comparable to the economic impact of physical damages or, in some cases, even greater. Economic impacts of loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Fires can cause major damage to power facilities and lines, and other critical facilities needed to provide continued services to the community.

In Butte County, past wildfires have caused significant damages to the County. The County has suffered loss of structures, loss of tax revenue, high costs to battle fires, and loss of lives.

Public Safety Power Shutoff (PSPS)

Recent wildfires have started as a result of downed power lines or electrical equipment. This was the case for the Camp Fire in 2018. As a result, California's three largest energy companies (including PG&E), at the direction of the California Public Utilities Commission (CPUC), are coordinating to prepare all Californians for the threat of wildfires and power outages during times of extreme weather. To help protect customers and communities during extreme weather events, electric power may be shut off for public safety in an effort to prevent a wildfire. This is called a Public Safety Power Shutoff (PSPS).

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

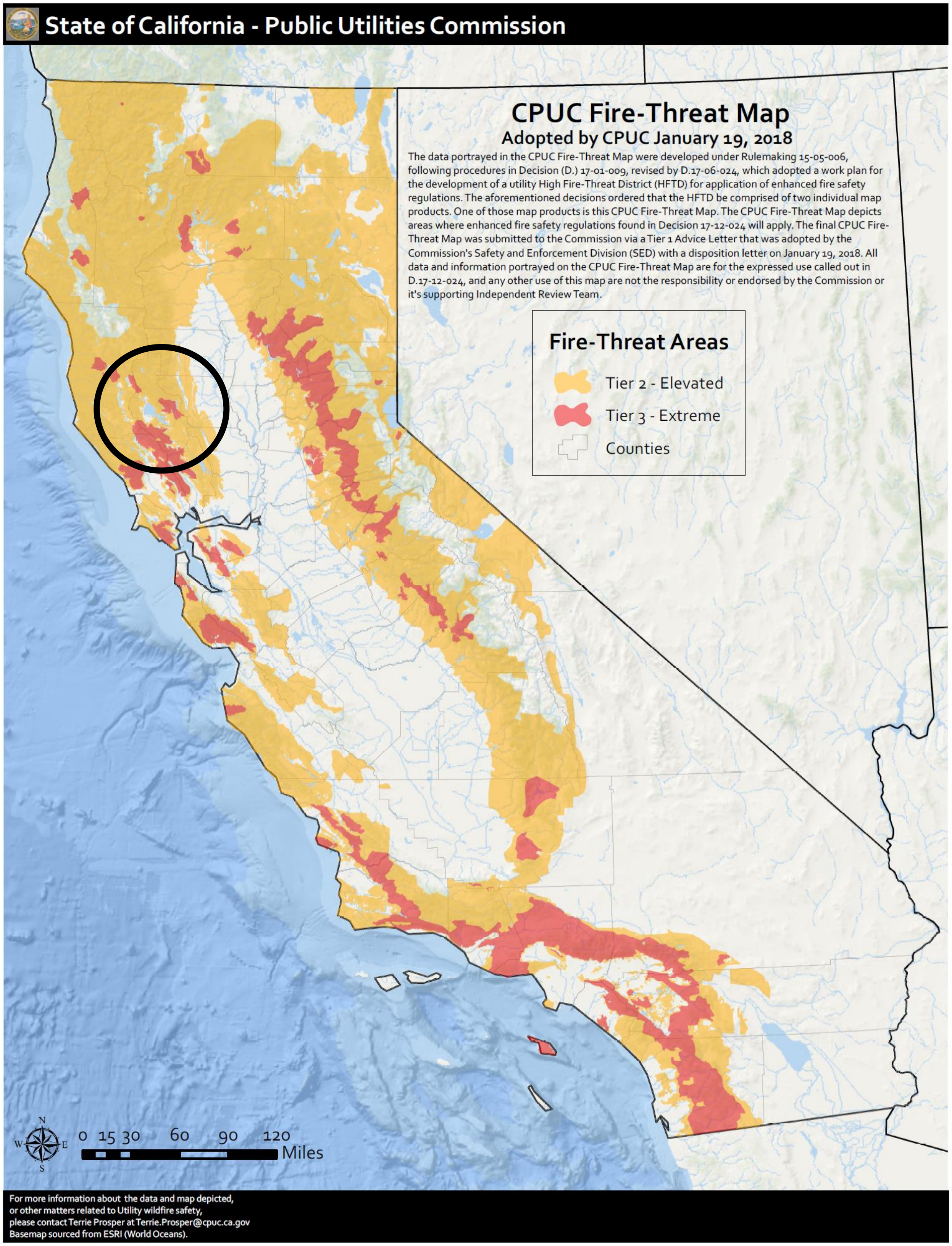
Public Safety Power Shutoff Criteria

The Wildfire Safety Operations Center (WSOC) monitors fire danger conditions across PG&E service area and evaluates whether to turn off electric power lines in the interest of safety. While no single factor will drive a Public Safety Power Shutoff, some factors include:

- A Red Flag Warning declared by the National Weather Service
- Low humidity levels generally 20% and below
- Forecasted sustained winds generally above 25 mph and wind gusts in excess of approximately 45 mph, depending on location and site-specific conditions such as temperature, terrain and local climate
- Condition of dry fuel on the ground and live vegetation (moisture content)
- On-the-ground, real time observations from PG&E's WSOC and field observations from PG&E crews

The most likely electric lines to be considered for shutting off for safety will be those that pass through areas that have been designated by the California Public Utilities Commission (CPUC) as at elevated (Tier 2) or extreme (Tier 3) risk for wildfire (seen on Figure 4-121). This includes both distribution and transmission lines. The specific area and number of affected customers will depend on forecasted weather conditions and which circuits PG&E needs to turn off for public safety. Although a customer may not live or work in a high fire-threat area, their power may also be shut off if their community relies upon a line that passes through an area experiencing extreme fire danger conditions. This means that any customer who receives electric service from PG&E should be prepared for a possible public safety power outage.

Figure 4-121 State of California Tier 2 and 3 Areas



PG&E noted that extreme weather threats can change quickly. When possible, PG&E will provide customers with advance notice prior to turning off the power, as well as updates until power is restored. Timing of notifications (when possible) are:

- Approximately 48 hours before power is turned off
- Approximately 24 hours before power is turned off
- Just before power is turned off
- During the public safety outage
- Once power has been restored

Butte County Communities at Risk to Wildfire

The National Fire Plan is a cooperative, long-term effort between various government agency partners with the intent of actively responding to severe wildland fires and their impacts to communities while ensuring sufficient firefighting capacity for the future. For purposes of the National Fire Plan, CAL FIRE generated a list of California communities at risk for wildfire. The intent of this assessment was to evaluate the risk to a given area from fire escaping off federal lands. Three main factors were used to determine the wildfire threat in the wildland-urban interface areas of California: fuel hazards, probability of fire, and areas of suitable housing density that could create wildland urban interface fire protection strategy situations. The preliminary criteria and methodology for evaluating wildfire risk to communities is published in the Federal Register, January 4, 2001. The National Fire Plan identifies 24 "Communities at Risk" in Butte County.

- Bangor
- Berry Creek
- Butte Creek
- Butte Meadows
- Chico
- Cohasset
- Concow
- Durham
- Feather Falls
- Forbestown
- Forest Ranch
- Hurleton
- Inskip
- Jonesville
- Magalia
- Oroville
- Oroville East
- Palermo
- Paradise
- Pentz
- Robinson Mills
- South Oroville
- Stirling City
- Thermalito

Tree Mortality

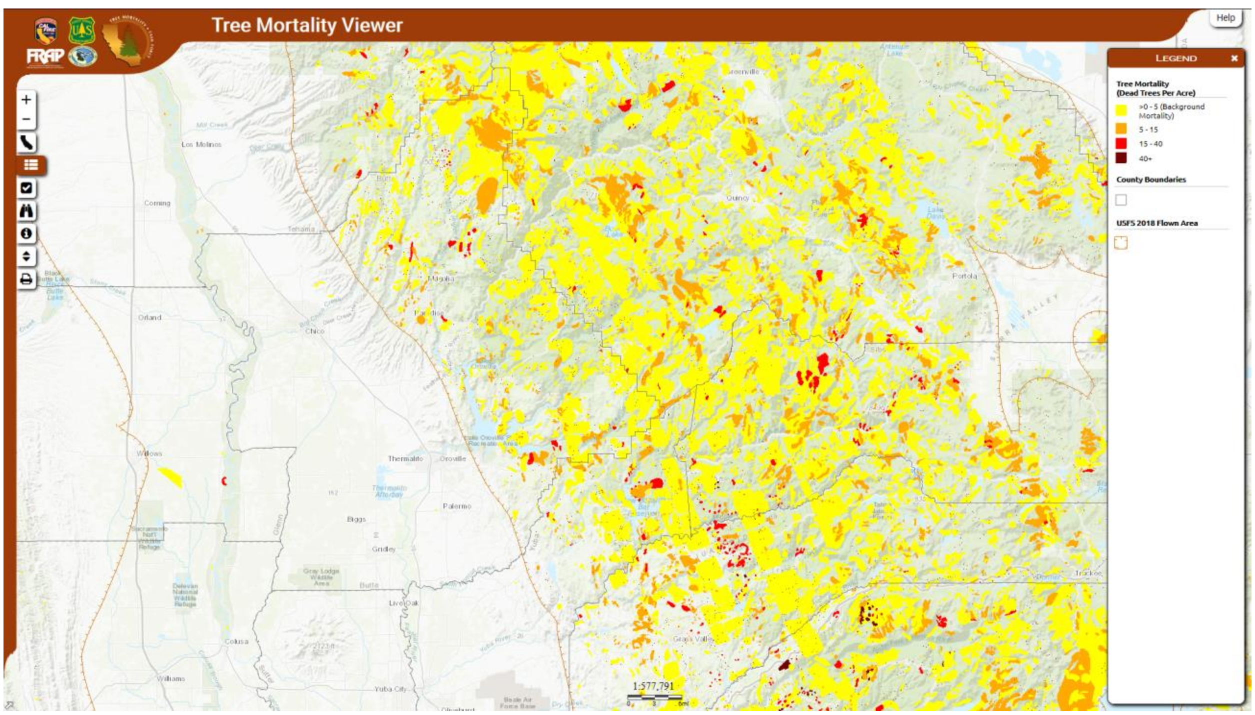
Drought can weaken trees, making them less resistant to bark beetles and other pests and diseases. These types of infestations attack trees, weaken them, and can kill them. These trees then become fuel for wildfires. This is discussed in greater detail in Section 4.3.5.

On October 30, 2015, Governor Brown proclaimed a State of Emergency and included provisions to expedite the removal and disposal of dead and dying hazardous trees. As a result, costs related to identification, removal, and disposal of dead and dying trees caused from drought conditions may be eligible for California Disaster Assistance Act (CDAA) reimbursement.

Many areas in Butte County have seen increases in tree mortality. The County has mapped these areas, and that map is shown in Figure 4-122. Shown are results of 2012-2018 aerial tree-mortality surveys. Using a color legend, the map shows:

- ➢ Deep burgundy depicting areas with more than 40 dead trees per acre
- ➢ Red depicting 40 - 15 dead trees per acre
- ➢ Orange depicting 15-5 dead trees per acre
- ➢ Yellow depicting 5 or less dead trees per acre

Figure 4-122 Butte County – Tree Mortality Areas



Source: CAL FIRE

Wildfire (Smoke) and Air Quality

During many summer months in past years, Butte County residents have had to breathe wildfire smoke, from fires both within and outside of the County. Smoke from wildfires is made up of gas and particulate matter, which can be easily observed in the air. While the summer of 2015 brought wildfires along with severe smoke impacts to numerous locations in California, including Butte County. During the summers of 2013 and 2014, several wildfire incidents occurred in Northern California which significantly influenced the PM2.5 concentration measurements within Butte County. In 2018, the Camp Fire caused air quality issues in much of Butte County and throughout Northern California.

Air quality standards have been established to protect human health with the pollutant referred to as PM2.5 which consists of particles 2.5 microns or less in diameter. These smaller sizes of particles are responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract.

Cal-Adapt is an online tool put together by the California Energy Commission that downscales global climate models to the California level with projections for sea-level rise, drought, temperature increase, heat, and wildfire, from 2020 out to 2085. Figure 4-87in Section 4.2.19 showed the 2090 wildfire projection for Butte County. Air quality in these areas of the County would be lower due to wildfire if the scenario projected is accurate.

Insurance in WUI Areas

The HMPC noted that in the WUI areas, there has been increased difficulty in obtaining home insurance and the cost of insurance premiums. This increases costs to those who live in the WUI, and in some instances insurance is no longer available.

Wildfire Analysis

The Butte County Planning Area has mapped CAL FIRE fire hazard severity zones based on fire responsibility areas as further described below. GIS was used to determine the possible impacts of wildfire within the County and how the wildfire risk varies across the Planning Area. The wildfire analysis includes an analysis of affected parcels and values by Fire Responsibility areas and by CAL FIRE's Fire Hazard Severity Zones.

Fire Responsibility Area Analysis

There are numerous wildland fire protection agencies that have responsibility within the County, including the USDA Forest Service (USFS), the Bureau of Land Management (BLM), the BIA, and CAL FIRE. There are also numerous fire departments and fire protection districts that serve local areas, many of whom have mutual aid agreements with each other as well as state and federal agencies for fire suppression and protection. Fire Responsibility areas are generally categorized by Federal Responsibility Areas (FRA), State Responsibility Areas (SRA) and Local Responsibility Areas (LRA).

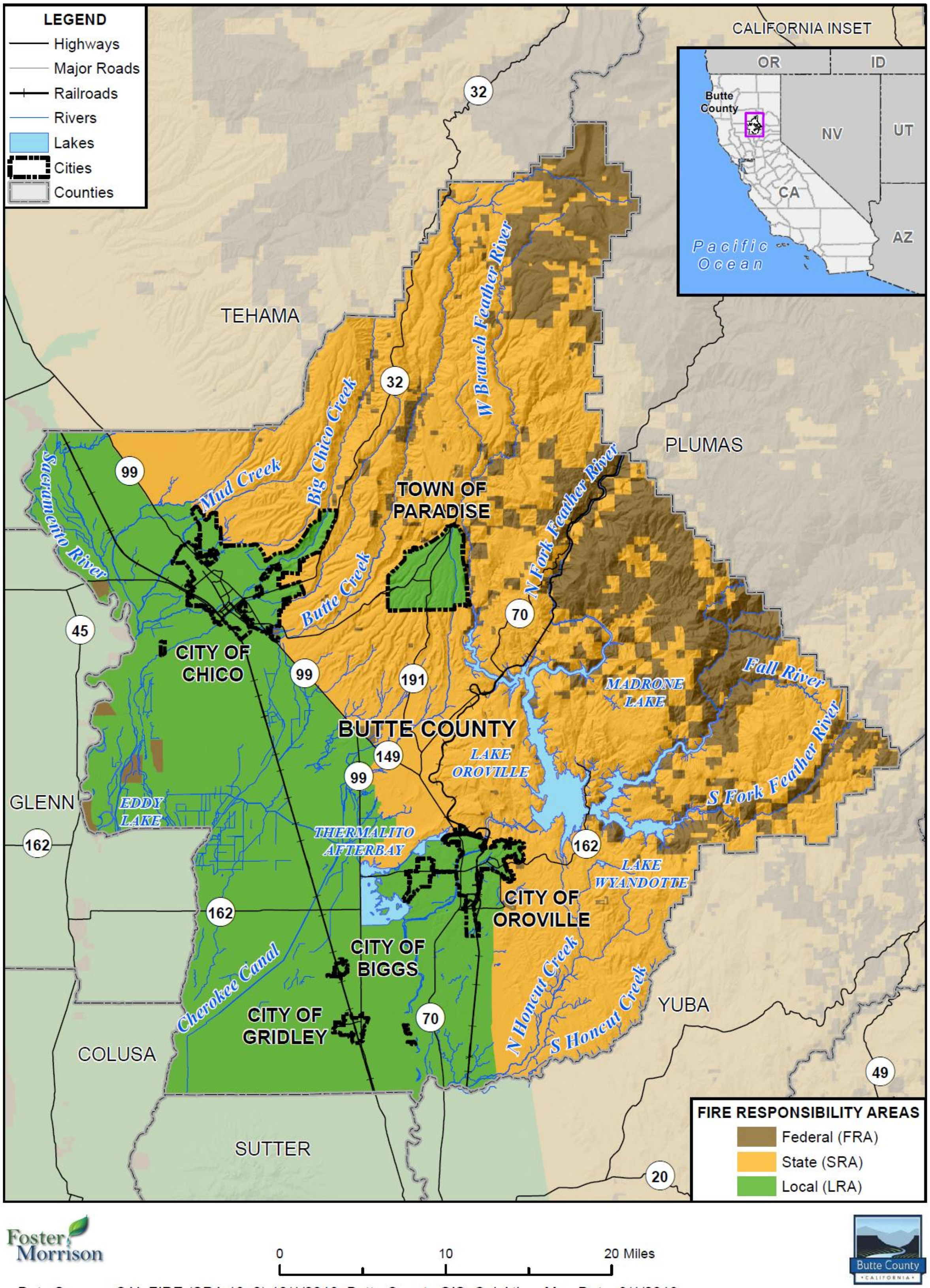
The CAL FIRE data, detailing Fire Responsibility Areas within the County Planning Area, was utilized to determine the locations, numbers, types, and values of land and structures falling within each Fire Responsibility Area. The following sections provide details on the methodology and results for this analysis.

Methodology

CAL FIRE has a legal responsibility to provide fire protection on all SRA lands, which are defined based on land ownership, population density and land use. CAL FIRE's State Responsibility Area layer was used in this analysis to show Butte County's parcel counts and values by FRA, SRA, and LRA.

The fire responsibility area layer was overlaid with the parcel data. Since it is possible for any given parcel to intersect with multiple fire responsibility areas, for purposes of this analysis, the parcel centroid was used to determine which fire responsibility area to assign to each parcel. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessor's database and the FIS parcel layer. Based on this approach, the fire responsibility areas for the Butte County Planning Area were determined and further broken out by jurisdiction and property use and included information on both land and improved values. Locations of each responsibility area are shown in Figure 4-123.

Figure 4-123 Butte County Planning Area – Fire Responsibility Areas by FRA, SRA, LRA



Data Source: CAL FIRE (SRA 18_2) 10/1/2018, Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Fire Responsibility Areas and Values at Risk

The FRA and SRA in the County encompass the eastern half (save the Town of Paradise) of the County in physical area. The FRA contains 620 parcels, none of which are improved. The SRA contains 18,918 improved parcels, with over $3.77 billion in total value. The LRA has 58,516 improved parcels with $7.37 billion in total value. It should be noted that fire does not just affect structural values, fire can also affect land values. As such the Assessor's land values and all parcels were accounted for in this analysis to represent total county values at risk. However, it is highly unlikely the whole County will ever be on fire at once. The County parcel inventory and associated values by fire responsibility area are provided in Table 4-170 for the entire Butte County Planning Area, as described in the Total Values at Risk in Section □. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the fire hazard severity zones due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Table 4-170 Butte County Planning Area – Count and Value of Parcels by Local, State, and Federal Responsibility Areas by Property Use

Fire Responsibility Area / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
FRA							
Agricultural	61	3	$945,017	$62,748	$0	$62,748	$1,070,513
Commercial	0	0	$0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0	$0
Residential	222	61	$4,523,989	$6,138,604	$0	$3,069,302	$13,527,295
Unknown	418	0	$2,958	$0	$0	$0	2,958
FRA Total	**701**	**64**	**$5,471,964**	**$6,201,352**	**$0**	**$3,132,050**	**$14,600,766**
SRA							
Agricultural	1,685	312	$149,134,822	$31,855,766	$5,701,479	$31,855,766	$213,029,504
Commercial	420	287	$46,188,347	$98,219,124	$3,484,265	$98,219,124	$221,035,257
Industrial	93	78	$9,935,129	$19,054,040	$1,320,120	$28,581,060	$60,570,949
Residential	26,609	19,792	$1,528,258,783	$2,332,290,064	$999,519	$1,166,145,032	$4,932,145,381
Unknown	547	5	$1,547,647	$589,857	$0	$0	$2,118,938
SRA Total	**29,354**	**20,474**	**$1,735,064,728**	**$2,482,008,851**	**$11,505,383**	**1,324,800,982**	**5,428,900,029**
LRA							
Agricultural	3,525	2,343	$962,117,573	$360,457,528	$283,086,764	$360,457,528	$2,047,334,389
Commercial	4,533	3,569	$887,174,571	$2,226,947,748	$84,818,437	$2,226,947,748	$4,720,879,300
Industrial	864	560	$151,150,168	$409,000,402	$83,514,670	$613,500,603	$1,291,607,246
Residential	54,477	50,369	$4,266,175,764	$7,294,358,109	$8,049,352	$3,647,179,055	$14,815,423,933
Unknown	1,381	19	$2,768,010	$2,514,348	$710,920	$0	$7,728,387
LRA Total	**64,780**	**56,860**	**$6,269,386,086**	**$10,293,278,135**	**$460,180,143**	**$6,848,084,934**	**$22,882,973,255**

Fire Responsibility Area / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: CAL FIRE, Butte County 3/28/2019 Parcel/Assessor's Data

Fire Hazard Severity Zone Analysis

As part of the Fire and Resource Assessment Program (FRAP), CAL FIRE was mandated to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZ), then define the application of various mitigation strategies to reduce risk associated with wildland fires.

Fire hazard is a way to measure the physical fire behavior so that people can predict the damage a fire is likely to cause. Fire hazard measurement includes the speed at which a wildfire moves, the amount of heat the fire produces, and most importantly, the burning fire brands that the fire sends ahead of the flaming front.

The fire hazard model developed by CAL FIRE considers the wildland fuels. Fuel is that part of the natural vegetation that burns during the wildfire. The model also considers topography, especially the steepness of the slopes. Fires burn faster as they burn up-slope. Weather (temperature, humidity, and wind) has a significant influence on fire behavior. The model recognizes that some areas of California have more frequent and severe wildfires than other areas. Finally, the model considers the production of burning fire brands (embers) how far they move, and how receptive the landing site is to new fires.

In 2007, CAL FIRE updated its FHSZ maps for the State of California to provide updated map zones, based on new data, science, and technology that will create more accurate zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. The zones will provide specific designation for application of defensible space and building standards consistent with known mechanisms of fire risk to people, property, and natural resources. The program is still ongoing with fire hazard severity zone maps being updated based on designated responsibility areas: FRA, SRA, and LRA. It should be noted that Cal Fire is in the process of updating the FHSZ maps statewide.

The CAL FIRE data, detailing FHSZs within the Butte County Planning Area, was utilized to determine the locations, numbers, types, and values of land and structures falling within each FHSZ. The following sections provide details on the methodology and results for this analysis.

Methodology

CAL FIRE mapped the SRA FHSZs, or areas of significant fire hazard, based on fuels, terrain, weather, and other relevant factors. Zones are designated with Very High, High, Moderate, Non-Wildland/Non-Urban and Urban Unzoned hazard classes. The goal of this mapping effort is to create more accurate fire hazard zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. The fire hazard zones will provide specific designation for application of defensible space and building standards consistent with known mechanisms of fire risk to people, property, and natural resources.

The "Draft" LRA FHSZ (c6fhszl06_1) dated September 2007 layer and the Adopted SRA FHSZ (fhszs06_3_6) dated November 2007 were used to get a complete coverage of Fire Hazards.

Analysis was performed using the FHSZ datasets, and using GIS, the parcel layer was overlaid on the FHSZ layers. For the purposes of this analysis, if the parcel centroid intersects a specific zone's area, it will be assumed that the entire parcel is in that area. This analysis illustrates the Fire Hazard Severity Zones specific to the Planning Area.

Fire Hazard Severity Zones Analysis Results: Values at Risk

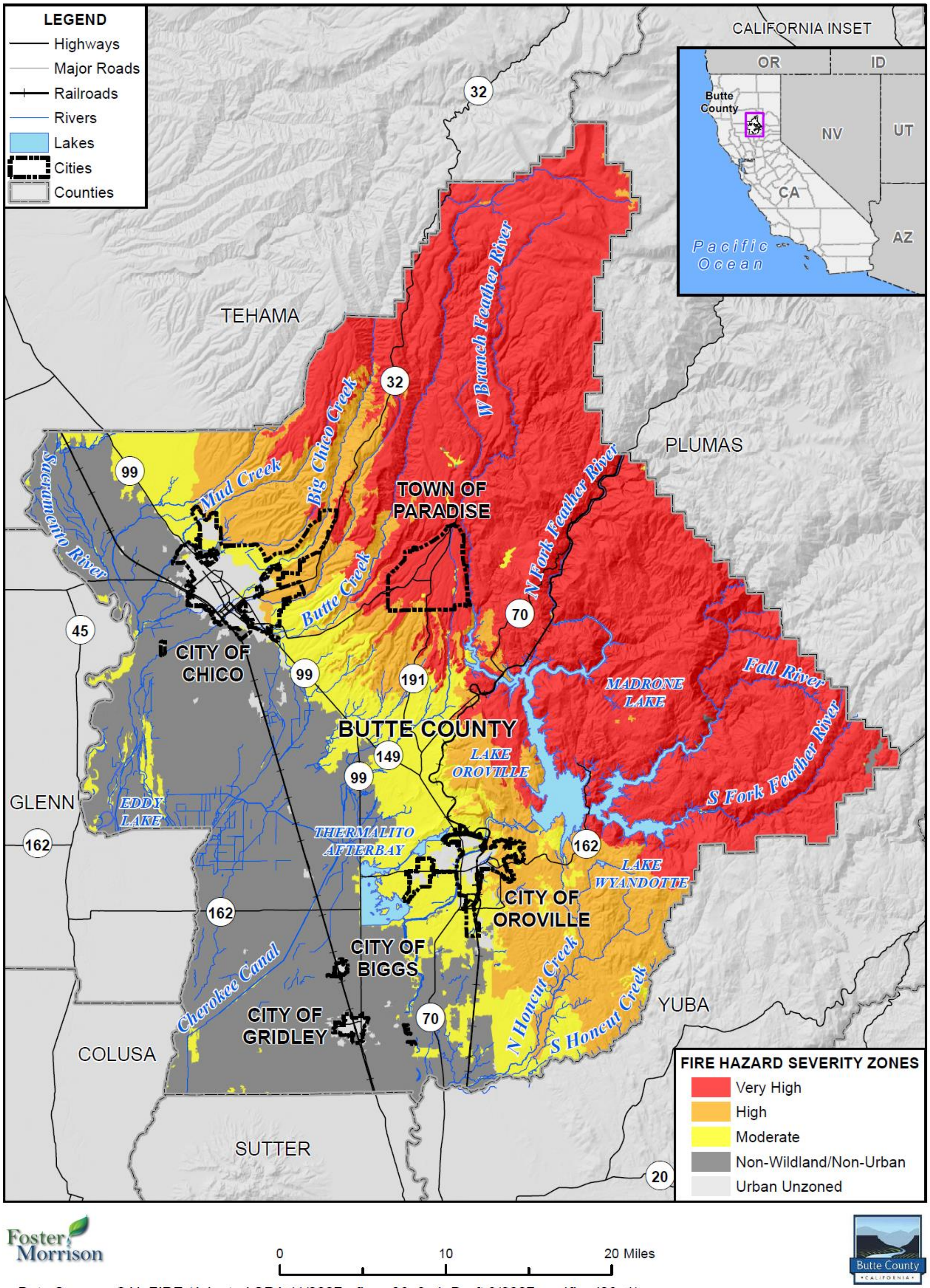
Results are presented in this section for the Butte County Planning Area and the unincorporated County. Detail tables for the incorporated communities in Butte County are included in their respective annexes to this LHMP Update.

Butte County Planning Area

The Fire Hazard Severity Zones are shown in Figure 4-124. Analysis results for the entire Butte County Planning Area are summarized in the following tables:

- Table 4-171 shows the total parcel counts, improved parcel counts, their improved structure and land values in FHSZs prior to the Camp Fire.
- Table 4-172 shows the total parcel counts, improved parcel counts, their improved structure and land values in FHSZs after the Camp Fire.
- Table 4-173 compares the improved structure values in FHSZs in the Planning Area pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-174 breaks down Table 4-172 into more detail, and shows post-fire values in FHSZ by jurisdiction.

Figure 4-124 Butte County Planning Area – Fire Hazard Severity Zones



Data Source: CAL FIRE (Adopted SRA 11/2007 - fhszs06_3_4, Draft 9/2007 - c4fhszl06_1), Butte County GIS, Cal-Atlas; Map Date: 3/1/2019.

Table 4-171 Butte County Planning Area – Pre-Fire Count and Value of Parcels in Fire Hazard Severity Zones by Jurisdiction

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Very High	26,882	20,373	$1,468,897,425	$2,548,466,731	$17,842,210	$1,463,505,991	$5,498,712,357
High	12,873	9,912	$968,563,870	$1,651,856,849	$16,441,526	$946,856,818	$3,583,719,063
Moderate	12,401	9,315	$1,021,737,526	$1,704,426,004	$31,951,257	$993,145,884	$3,751,260,671
Non-Wildland/Non-Urban	7,218	5,236	$1,313,620,562	$1,056,737,299	$288,454,993	$831,139,410	$3,489,952,264
Urban Unzoned	35,286	32,598	$3,257,153,821	$6,497,209,437	$121,105,946	$4,313,594,024	$14,189,063,228
Grand Total	**94,660**	**77,434**	**$8,029,973,204**	**$13,458,696,320**	**$475,795,932**	**$8,548,242,126**	**$30,512,707,582**

Source: CAL FIRE, Butte County 2018 Parcel/Assessor's Data

Table 4-172 Butte County Planning Area – Post-Fire Count and Value of Parcels in Fire Hazard Severity Zones by Jurisdiction

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Very High	26,881	20,362	$1,467,844,089	$1,918,697,033	$16,995,938	$1,126,676,153	$4,275,477,144
High	12,877	9,914	$968,398,704	$1,630,743,279	$16,450,150	$936,054,906	$3,414,448,380
Moderate	12,530	9,312	$1,015,637,117	$1,696,564,353	$31,953,183	$986,764,639	$3,671,828,390
Non-Wildland/Non-Urban	7,232	5,232	$1,306,336,579	$1,048,279,191	$286,680,409	$822,314,976	$3,521,061,149
Urban Unzoned	35,315	32,578	$3,251,706,289	$6,487,204,482	$119,605,846	$4,304,207,292	$13,443,658,988
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: CAL FIRE, Butte County 3/28/2019 Parcel/Assessor's Data

Table 4-173 Butte County Planning Area – Comparison of Pre- vs Post-Fire Improved Structure Values

Fire Hazard Severity Zone	Pre-Fire Improved Structure Value	Post-Fire Improved Structure Value	$ Change	% Change
Very High	$2,548,466,731	$1,918,697,033	-$629,769,698	-24.7%
High	$1,651,856,849	$1,630,743,279	-$21,113,570	-1.3%
Moderate	$1,704,426,004	$1,696,564,353	-$7,861,651	-0.5%
Non-Wildland/Non-Urban	$1,056,737,299	$1,048,279,191	-$8,458,108	-0.8%
Urban Unzoned	$6,497,209,437	$6,487,204,482	-$10,004,955	-0.2%
Grand Total	**$13,458,696,320**	**$12,781,488,338**	**-$677,207,982**	**-5.0%**

Source: CAL FIRE, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-174 Butte County Planning Area – Count and Value of Parcels at Risk by Jurisdiction and FHSZ

Jurisdiction / Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
City of Biggs							
Non-Wildland/Non-Urban	77	64	$3,409,703	$12,076,714	$6,630	$10,159,412	$25,532,079
Urban Unzoned	688	610	$22,612,610	$57,112,152	$10,549,728	$39,026,706	$129,893,037
City of Biggs Total	**765**	**674**	**$26,022,313**	**$69,188,866**	**$10,556,358**	**$49,186,118**	**$155,425,116**
City of Chico							
Very High	4	3	$334,506	$567,273	$0	$431,016	$1,325,795
High	5	4	$1,395,897	$261,762	$0	$130,881	$1,774,540
Moderate	26,362	24,475	$3,115,437,501	$5,955,503,267	$54,160,569	$3,868,254,939	$12,324,285,851
Non-Wildland/Non-Urban	3	1	$747,503	$113,173	$0	$113,173	$973,849
Urban Unzoned	123	77	$12,771,455	$16,154,384	$225,410	$11,960,793	$41,209,400
City of Chico Total	**26,497**	**24,560**	**$3,130,686,862**	**$5,972,599,859**	**$54,385,979**	**$3,880,890,801**	**$12,369,569,434**
City of Gridley							
Non-Wildland/Non-Urban	26	8	$2,958,728	$6,292,691	$2,597,603	$8,749,022	$21,782,274
Urban Unzoned	2,426	2,194	$110,780,215	$284,031,507	$2,824,288	$176,184,263	$532,477,660
City of Gridley Total	**2,452**	**2,202**	**$113,738,943**	**$290,324,198**	**$5,421,891**	**$184,933,285**	**$554,259,934**
City of Oroville							
High	1,988	1,663	$81,040,528	$255,349,705	$14,264,880	$174,383,234	$455,316,711
Moderate	1,761	1,063	$84,356,508	$184,006,372	$15,771,435	$123,656,024	$388,367,444
Non-Wildland/Non-Urban	6	-	$347,035	$0	$5,473	$0	$352,508
Urban Unzoned	3,390	2,775	$154,607,567	$444,819,171	$31,299,575	$353,465,751	$938,963,964
City of Oroville Total	**7,145**	**5,501**	**$320,351,638**	**$884,175,248**	**$61,341,363**	**$651,505,009**	**$1,783,000,627**
Town of Paradise							
Very High	11,382	10,507	$771,940,349	$1,005,115,678	$13,675,031	$642,723,961	$2,241,782,496
High	75	56	$6,355,387	$11,866,158	$0	$5,945,269	$23,900,814
Moderate	44	31	$4,047,087	$6,357,404	$0	$3,333,702	$13,477,487

Jurisdiction / Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Town of Paradise Total	**11,501**	**10,594**	**$782,342,823**	**$1,023,339,240**	**$13,675,031**	**$652,002,932**	**$2,279,160,797**
Unincorporated Butte County							
Very High	15,499	9,855	$695,903,740	$913,581,355	$3,320,907	$483,952,192	$2,033,694,648
High	9,068	6,739	$619,935,889	$903,128,722	$1,191,644	$487,524,386	$1,970,580,778
Moderate	7,833	5,674	$579,107,561	$884,738,739	$15,986,028	$509,504,356	$1,963,424,384
Non-Wildland/Non-Urban	1	-	$82,201	$0	$0	$0	$82,201
Urban Unzoned	6,525	4,710	$1,196,774,847	$813,850,822	$283,022,263	$647,349,654	$3,022,361,765
Unincorporated Butte County Total	**7,549**	**6,889**	**$544,975,961**	**$1,026,561,289**	**$22,784,062**	**$629,169,235**	**$2,194,914,368**
Grand Total	**94,835**	**77,398**	**$8,009,922,778**	**$12,781,488,338**	**$471,685,526**	**$8,176,017,966**	**$28,326,474,050**

Source: CAL FIRE, Butte County 3/28/2019 Parcel/Assessor's Data

Unincorporated Butte County

Analysis results for unincorporated Butte County are summarized in the following tables:

- Table 4-175 shows the total parcel counts, improved parcel counts, their improved structure and land values in the unincorporated County in FHSZs prior to the Camp Fire.
- Table 4-176 shows the total parcel counts, improved parcel counts, their improved structure and land values in the unincorporated County in FHSZs after the Camp Fire.
- Table 4-177 compares the improved structure values in FHSZs in the unincorporated County pre- and post-fire, and shows the changes in terms of absolute dollar figures, as well as in percentages.
- Table 4-178 breaks down Table 4-176 into more detail, and shows post-fire values in the unincorporated County in FHSZ by jurisdiction.

Table 4-175 Unincorporated Butte County – Pre-Fire Count and Value of Parcels in Fire Hazard Severity Zone by Property Use

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Very High	15,499	9,855	$695,903,740	$913,581,355	$3,320,907	$483,952,192	$2,033,694,648
High	9,068	6,739	$619,935,889	$903,128,722	$1,191,644	$487,524,386	$1,970,580,778
Moderate	7,834	5,674	$579,189,762	$884,738,739	$15,986,028	$509,504,356	$1,963,506,585
Non-Wildland/Non-Urban	6,525	4,710	$1,196,774,847	$813,850,822	$283,022,263	$647,349,654	$3,022,361,765
Urban Unzoned	7,549	6,889	$544,975,961	$1,026,561,289	$22,784,062	$629,169,235	$2,194,914,368

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: CAL FIRE, Butte County 2018 Parcel/Assessor's Data

Table 4-176 Unincorporated Butte County – Post-Fire Count and Value of Parcels in Fire Hazard Severity Zone by Property Use

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Very High	15,499	9,855	$695,903,740	$913,581,355	$3,320,907	$483,952,192	$2,033,694,648
High	9,068	6,739	$619,935,889	$903,128,722	$1,191,644	$487,524,386	$1,970,580,778
Moderate	7,834	5,674	$579,189,762	$884,738,739	$15,986,028	$509,504,356	$1,963,506,585
Non-Wildland/Non-Urban	6,525	4,710	$1,196,774,847	$813,850,822	$283,022,263	$647,349,654	$3,022,361,765
Urban Unzoned	7,549	6,889	$544,975,961	$1,026,561,289	$22,784,062	$629,169,235	$2,194,914,368
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: CAL FIRE, Butte County 3/28/2018 Parcel/Assessor's Data

Table 4-177 Unincorporated Butte County – Post-Fire Count and Value of Parcels in Fire Hazard Severity Zone by Property Use

Fire Hazard Severity Zone	Pre-Fire Improved Structure Value	Post-fire Improved Structure Value	$ change	% Change
Very High	$970,227,291	$913,581,355	-$56,645,936	-5.8%
High	$922,244,681	$903,128,722	-$19,115,959	-2.1%
Moderate	$888,019,453	$884,738,739	-$3,280,714	-0.4%
Non-Wildland/Non-Urban	$822,308,930	$813,850,822	-$8,458,108	-1.0%
Urban Unzoned	$1,027,251,760	$1,026,561,289	-$690,471	-0.1%
Total	**$4,630,052,115**	**$4,541,860,927**	**-$88,191,188**	**-1.9%**

Source: CAL FIRE, Butte County 2018 and 3/28/2019 Parcel/Assessor's Data

Table 4-178 Unincorporated Butte County – Post-Fire Count and Value of Parcels by FHSZ and Property Use

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Very High							
Agricultural	799	65	$35,240,828	$4,276,096	$722,156	$4,276,096	$42,497,783

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Commercial	247	162	$24,874,699	$50,203,990	$2,440,742	$50,203,990	$112,988,326
Industrial	4	1	$26,996	$283	$0	$425	$27,704
Residential	13,808	9,625	$634,950,033	$858,943,362	$158,009	$429,471,681	$1,877,214,833
Unknown	641	2	$811,184	$157,624	$0	$0	$966,002
Very High Total	**15,499**	**9,855**	**$695,903,740**	**$913,581,355**	**$3,320,907**	**$483,952,192**	**$2,033,694,648**
High							
Agricultural	454	104	$46,133,689	$9,618,199	$555,302	$9,618,199	$61,748,507
Commercial	114	88	$12,759,055	$34,957,068	$224,323	$34,957,068	$75,181,095
Industrial	73	68	$6,331,519	$13,912,697	$37,260	$20,869,046	$41,069,316
Residential	8,270	6,475	$553,962,078	$844,160,147	$374,759	$422,080,074	$1,791,374,185
Unknown	157	4	$749,548	$480,611	$0	$0	$1,207,676
High Total	**9,068**	**6,739**	**$619,935,889**	**$903,128,722**	**$1,191,644**	**$487,524,386**	**$1,970,580,778**
Moderate							
Agricultural	635	213	$98,354,122	$27,627,779	$9,283,766	$27,627,779	$164,067,090
Commercial	157	111	$19,773,215	$40,917,534	$1,150,120	$40,917,534	$95,532,369
Industrial	96	52	$17,446,540	$33,075,970	$4,912,078	$49,613,955	$110,412,959
Residential	6,669	5,296	$443,461,131	$782,690,176	$640,064	$391,345,088	$1,593,054,699
Unknown	277	2	$154,754	$427,280	$0	$0	$439,468
Moderate Total	**7,834**	**5,674**	**$579,189,762**	**$884,738,739**	**$15,986,028**	**$509,504,356**	**$1,963,506,585**
Non-Wildland/Non-Urban							
Agricultural	3,288	2,238	$925,138,797	$342,340,068	$267,612,793	$342,340,068	$1,956,987,420
Commercial	42	24	$3,213,174	$9,708,405	$1,077,323	$9,708,405	$20,506,439
Industrial	28	24	$6,993,334	$64,672,219	$6,432,658	$97,008,329	$179,017,040
Residential	2,767	2,420	$260,109,798	$396,585,705	$7,188,569	$198,292,853	$861,366,539
Unknown	400	4	$1,319,744	$544,425	$710,920	$0	$4,484,328
Non-Wildland/Non-Urban Total	**6,525**	**4,710**	**$1,196,774,847**	**$813,850,822**	**$283,022,263**	**$647,349,654**	**$3,022,361,765**
Urban Unzoned							
Agricultural	39	22	$3,155,329	$6,803,541	$10,356,974	$6,803,541	$27,877,020
Commercial	267	224	$33,697,241	$75,759,439	$1,567,581	$75,759,439	$179,068,708
Industrial	108	91	$20,810,280	$74,609,119	$10,517,254	$111,913,679	$222,763,032
Residential	7,025	6,551	$487,304,655	$869,385,153	$342,253	$434,692,577	$1,765,193,116
Unknown	110	1	$8,456	$4,037	$0	$0	$12,493
Urban Unzoned Total	**7,549**	**6,889**	**$544,975,961**	**$1,026,561,289**	**$22,784,062**	**$629,169,235**	**$2,194,914,368**

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Other Value	Estimated Contents Value	Total Value
Unincorporated Butte County Total	**46,475**	**33,867**	**$3,636,780,199**	**$4,541,860,927**	**$326,304,904**	**$2,757,499,823**	**$11,185,058,144**

Source: CAL FIRE, Butte County 3/28/2019 Parcel/Assessor's Data

Population at Risk

A separate analysis was performed to determine population residing in fire hazard severity zones. Using GIS, the CAL FIRE fire hazard severity zones datasets were overlayed on the improved residential parcel data. Those parcel centroids that intersect each fire severity zone were counted and multiplied by the Census Bureau average household size for each jurisdiction and the unincorporated County; results were tabulated by jurisdiction and fire severity zone (see Table 4-179). According to this analysis, there is a population of 104,073 residing in the moderate or higher fire hazard severity zone categories in the unincorporated County.

Table 4-179 Butte County Planning Area – Residential Populations at Risk in Moderate or Higher Fire Hazard Severity Zones

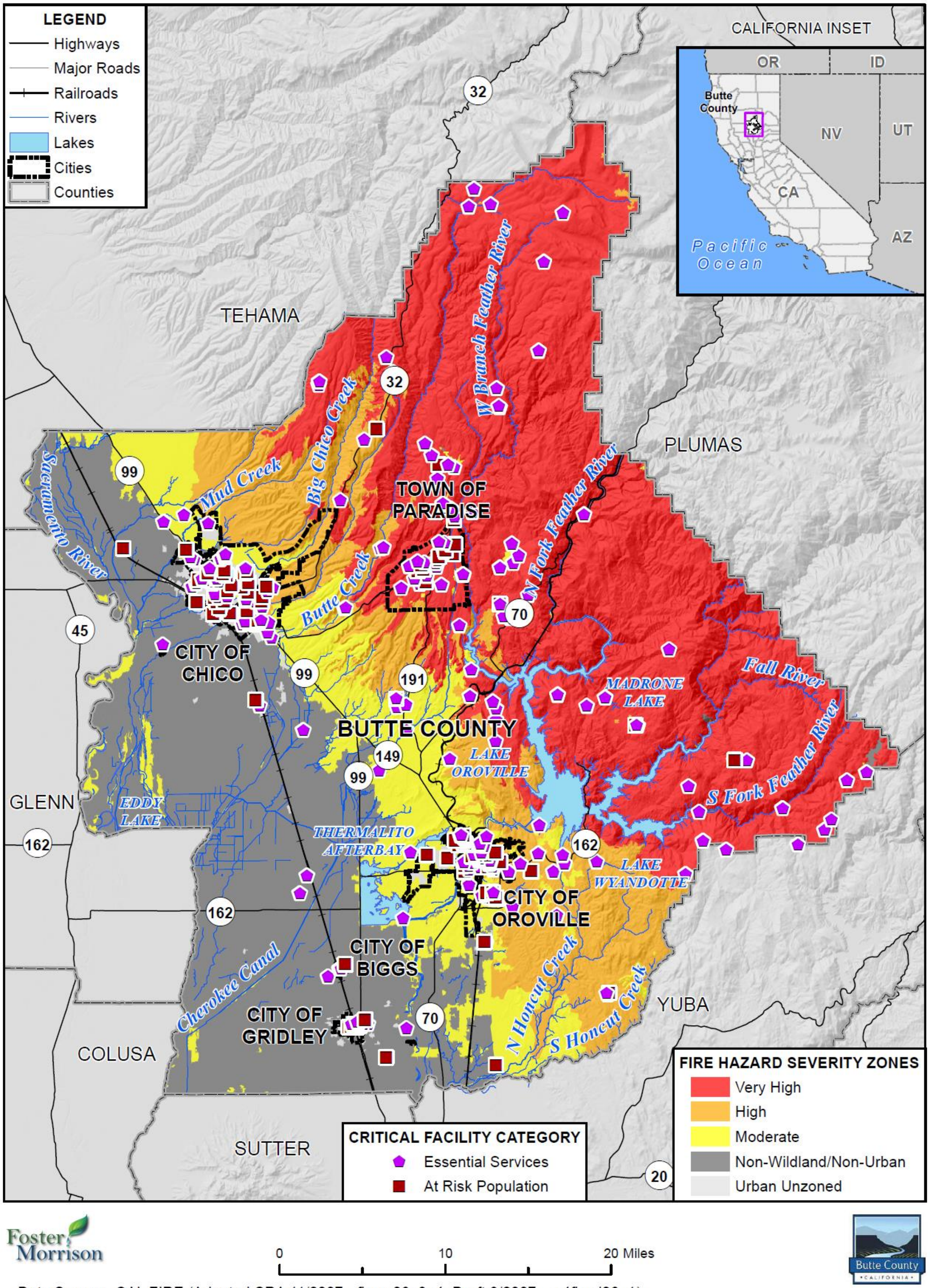
Jurisdiction	Moderate		High		Very High	
	Improved Residential Parcels	Population	Improved Residential Parcels	Population	Improved Residential Parcels	Population
Biggs	0	0	0	0	0	0
Chico	2,467	7,450	1,366	4,125	0	0
Gridley	0	0	0	0	0	0
Oroville	979	2,456	1,604	4,170	0	0
Paradise	30	65	55	119	9,894	21,500
Unincorporated County	5,296	15,888	6,475	19,425	9,625	28,875
Total	**8,772**	**25,859**	**9,500**	**27,839**	**19,519**	**50,375**

Source: CAL FIRE, US Census Bureau 2010 Estimates (Biggs – 2.45, Chico – 3.02, Gridley – 2.96, Oroville – 2.60, Paradise – 2.17, unincorporated County – .3.0)

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Butte County and all jurisdictions to determine critical facilities in the Fire Hazard Severity Zones. Using GIS, the CAL FIRE, Fire Hazard Severity Zones were overlayed on the critical facility GIS layer. Figure 4-125 shows critical facilities, as well as the Fire Hazard Severity Zones. Table 4-180 details critical facilities by facility type and count for the Planning Area. Table 4-181 details critical facilities by facility type for the unincorporated County. Information on critical facilities in the incorporated jurisdictions in the County can be found in their respective annexes to this Plan Update. Details of critical facility definition, type, name and address and jurisdiction by flood zone are listed in Appendix F.

Figure 4-125 Butte County Planning Area – Critical Facilities and Fire Hazard Severity Zones



Data Source: CAL FIRE (Adopted SRA 11/2007 - fhszs06_3_4, Draft 9/2007 - c4fhszl06_1), Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-180 Butte County Planning Area – Critical Facilities in Fire Hazard Severity Zones by Jurisdiction

Jurisdiction / Fire Hazard Severity Zone / Critical Facility Category	Facility Count
City of Biggs	
Non-Wildland/Non-Urban	
Essential Services Facilities	1
At Risk Population Facilities	0
Non-Wildland/Non-Urban Total	**1**
Urban Unzoned	
Essential Services Facilities	2
At Risk Population Facilities	4
Urban Unzoned Total	**6**
City of Biggs Total	**7**
City of Chico	
Non-Very High	
Essential Services Facilities	49
At Risk Population Facilities	31
Non-Very High Total	**80**
Urban Unzoned	
Essential Services Facilities	1
At Risk Population Facilities	0
Urban Unzoned Total	**1**
City of Chico Total	**81**
City of Gridley	
Non-Wildland/Non-Urban	
Essential Services Facilities	1
At Risk Population Facilities	1
Non-Wildland/Non-Urban Total	2
Urban Unzoned	
Essential Services Facilities	10
At Risk Population Facilities	5
Urban Unzoned Total	15
City of Gridley Total	**17**
City of Oroville	
High	
Essential Services Facilities	14
At Risk Population Facilities	0
High Total	**14**

Jurisdiction / Fire Hazard Severity Zone / Critical Facility Category	Facility Count
Moderate	
Essential Services Facilities	1
At Risk Population Facilities	3
Moderate Total	**4**
Urban Unzoned	
Essential Services Facilities	25
At Risk Population Facilities	17
Urban Unzoned Total	**42**
City of Oroville Total	**60**
Town of Paradise	
Very High	
Essential Services Facilities	21
At Risk Population Facilities	12
Very High Total	**33**
Town of Paradise Total	**33**
Unincorporated Butte County	
Very High	
Essential Services Facilities	62
At Risk Population Facilities	9
Very High Total	**71**
High	
Essential Services Facilities	17
At Risk Population Facilities	4
High Total	**21**
Moderate	
Essential Services Facilities	20
At Risk Population Facilities	5
Moderate Total	**25**
Non-Wildland/Non-Urban	
Essential Services Facilities	7
At Risk Population Facilities	1
Non-Wildland/Non-Urban Total	**8**
Urban Unzoned	
Essential Services Facilities	6
At Risk Population Facilities	11
Urban Unzoned Total	**17**
Unincorporated Butte County Total	**142**

Jurisdiction / Fire Hazard Severity Zone / Critical Facility Category	Facility Count
Outside of Butte County	
Very High	
Essential Services Facilities	1
At Risk Population Facilities	0
Very High Total	**1**
Outside of Butte County Total	**1**
Grand Total	**341**

Source: CAL FIRE, Butte County GIS

Table 4-181 Unincorporated Butte County – Critical Facilities in Fire Hazard Severity Zones by Facility Category and Type

Fire Hazard Severity Zones	Critical Facility Category / Critical Facility Type	Facility Count
Very High		
Very High	**Essential Services Facilities**	
	Fire	22
	Health Care	2
	Law Enforcement	1
	Public Assembly Point / Evacuation Center	17
	Radio Sites	6
	Dam	14
	Essential Services Facilities Total	**62**
	At Risk Population Facilities	
	School	9
	At Risk Population Facilities Total	**9**
	Total	**71**
High		
High	**Essential Services Facilities**	
	Fire	5
	Public Assembly Point / Evacuation Center	6
	Radio Sites	3
	Dam	3
	Essential Services Facilities Total	**17**
	At Risk Population Facilities	
	School	4
	At Risk Population Facilities Total	**4**
	Total	**21**

Fire Hazard Severity Zones	Critical Facility Category / Critical Facility Type	Facility Count
Moderate		
Moderate	**Essential Services Facilities**	
	Fire	4
	Health Care	1
	Public Assembly Point / Evacuation Center	4
	Radio Sites	1
	Dam	9
	Emergency Animal Shelter	1
	Essential Services Facilities Total	**20**
	At Risk Population Facilities	
	School	5
	At Risk Population Facilities Total	**5**
	Total	**25**
Non-Wildland/Non-Urban		
Non-Wildland/Non-Urban	**Essential Services Facilities**	
	Wastewater Treatment Plant	1
	Fire	2
	Radio Sites	1
	Dam	3
	Essential Services Facilities Total	**7**
	At Risk Population Facilities	
	School	1
	At Risk Population Facilities Total	**1**
	Total	**8**
Urban Unzoned		
Urban Unzoned	**Essential Services Facilities**	
	Fire	3
	Public Assembly Point / Evacuation Center	3
	Essential Services Facilities Total	**6**
	At Risk Population Facilities	
	School	11
	At Risk Population Facilities Total	**11**
	Total	**17**
Unincorporated Butte County Total		**142**

Source: CAL FIRE, Butte County GIS

Overall Community Impact

The overall impact to the community from a severe wildfire includes:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Decreased water quality in area watersheds;
- Increase in post-fire hazards such as flooding, sedimentation, and debris flows/mudslides;
- Damage to natural resource habitats and other resources, such as crops, timber and rangelands;
- Loss of water, power, roads, phones, and transportation, which could impact, strand, and/or impair mobility for emergency responders and/or area residents;
- Economic losses (jobs, sales, tax revenue) associated with loss of commercial structures;
- Negative impact on commercial and residential property values;
- Loss of churches, which could severely impact the social fabric of the community;
- Loss of schools, which could severely impact the entire school system and disrupt families and teachers, as temporary facilities and relocations would likely be needed; and
- Impact on the overall mental health of the community.

In addition, there are natural resources at risk when wildland-urban interface fires occur. One is the watershed and ecosystem losses that occur from wildland fires. This includes impacts to water supplies and water quality as well as air quality. Another is the aesthetic value of the area. Major fires that result in visible damage detract from that value. Other assets at risk include wildland recreation areas, wildlife and habitat areas, and rangeland resources. The loss to these natural resources can be significant.

Future Development

Population growth and development in Butte County has recently slowed; however, additional growth and development within the WUI and other high fire hazard areas of the County would place additional values at risk to wildfire. The pattern of increased damages is directly related to increased urban growth spread into historical forested areas that have wildfire as part of the natural ecosystem. Many WUI fire areas have long histories of wildland fires that burned only vegetation in the past. However, with new development, a wildland fire following a historical pattern now burns developed areas. Also to be considered is the redevelopment that will be occurring throughout the Town of Paradise and the areas within the unincorporated County that were devastated by the recent Camp Fire. Much thought will need to go into the wildfire building codes for new development in these and other fire prone areas of the County.

GIS Analysis

Unincorporated Butte County has identified 8 future development projects within the unincorporated County area. GIS was used to determine the possible impacts of wildfire within the County to the 8 future development areas.

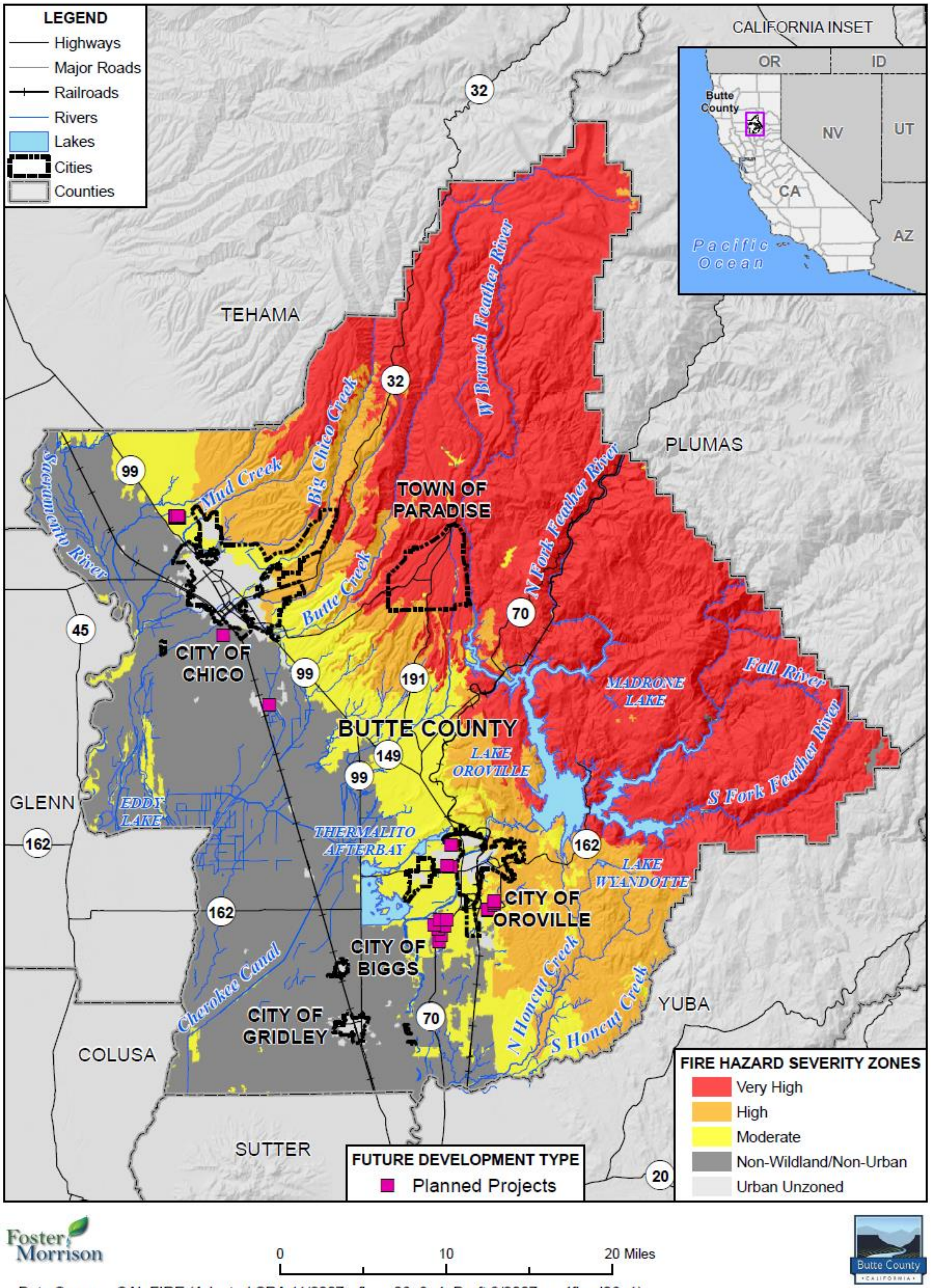
Methodology

Butte County's 3/28/2019 Parcel/Assessor's data and data provided by County Planning were used as the basis for the Planning Area inventory of parcels and acres of Butte County's future development areas.

Butte County provided a table containing the assessor parcel numbers (APNs) for the 42 parcels associated with the 8 future development projects. Using the GIS parcel spatial file and the APNs, the 8 future development projects were identified. For the fire hazard severity zone analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected with the fire hazard severity zones to determine the parcel counts and acreage within each i area.

FHSZs and future development areas are shown on Figure 4-126 and parcels and acreages in those areas are shown in Table 4-182.

Figure 4-126 Unincorporated Butte County – Future Development in FHSZs



Data Source: CAL FIRE (Adopted SRA 11/2007 - fhszs06_3_4, Draft 9/2007 - c4fhszl06_1), Butte County GIS, Cal-Atlas; Map Date: 7/1/2019.

Table 4-182 Unincorporated Butte County – Future Development Parcels and Acreage in FHSZs

Future Development/ Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Acres
Butte Vista			
Urban Unzoned	1	0	9.7
Creekside Estates			
Non-wildland/Non-urban	1	1	47.4
Diamond Oak			
Moderate	1	1	4.7
Urban Unzoned	1	0	3.2
Lincoln and Ophir Garden Oak Estates			
Moderate	2	0	50.4
Mandville Park			
Moderate	25	0	22.6
Rio d Oro - Phase 1			
Moderate	**7**	0	664.2
Southlands Subdivision			
Moderate	3	0	48.8
Stanley Ave			
Non-wildland/Non-urban	1	1	5.0
Grand Total	**42**	**3**	**856.1**

Source: CAL FIRE, Butte County GIS

4.4 Capability Assessment

Thus far, the planning process has identified the natural hazards posing a threat to the Butte County Planning Area and described, in general, the vulnerability of the County to these risks. The next step is to assess what loss prevention mechanisms are already in place. This part of the planning process is the mitigation capability assessment. Combining the risk assessment with the mitigation capability assessment results in the County's net vulnerability to disasters, and more accurately focuses the goals, objectives, and proposed actions of this plan.

The HMPC used a two-step approach to conduct this assessment for the County. First, an inventory of common mitigation activities was made through the use of matrixes. The purpose of this effort was to identify policies and programs that were either in place, needed improvement, or could be undertaken if deemed appropriate. Second, the HMPC conducted an inventory and review of existing policies, regulations, plans, and programs to determine if they contributed to reducing hazard-related losses or if they inadvertently contributed to increasing such losses.

This section presents the County's mitigation capabilities that are applicable to the County. These are in addition to, and supplement, the many plans, reports, and technical information reviewed and used for this LHMP Update as identified in Chapter 3 and in Chapter 4.

Similar to the HMPC's effort to describe hazards, risks, and vulnerability of the County, this mitigation capability assessment describes the County's existing capabilities, programs, and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This assessment is divided into four sections: regulatory mitigation capabilities are discussed in Section 4.4.1; administrative and technical mitigation capabilities are discussed in Section 4.4.2; fiscal mitigation capabilities are discussed in Section 4.4.3; and mitigation education, outreach, and partnerships are discussed in Section 4.4.4.

4.4.1. Butte County's Regulatory Mitigation Capabilities

Table 4-183 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Butte County. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 4-183 Butte County Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
General Plan	Y, 2010	Y, Y, Y. This was a comprehensive update to the County's General Plan in 2010, and additional amendments in 2012, including the following Elements: Land Use; Housing; Economic Development; Agriculture; Water Resources; Circulation; Conservation & Open Space; Health & Safety; Public Facilities & Services; and Area and Neighborhood Plans.
Capital Improvements Plan	Y, 2018	N, N, N
Economic Development Plan	Y, 2011	
Local Emergency Operations Plan	Y, 2011	Y, Y, Y
Continuity of Operations Plan		
Transportation Plan		
Stormwater Management Plan/Program	Y,	Per State/federal requirements.
Engineering Studies for Streams	Y,	FIRM and FIS incorporated, by Ordinance, into Butte County Code.
Community Wildfire Protection Plan	Y, 2015	Y, Y, Y
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		

Building Code, Permitting, and Inspections	Y/N	Are codes adequately enforced?
Building Code	Y	Version/Year: 2011
Building Code Effectiveness Grading Schedule (BCEGS) Score	Y	Score: 4
Fire department ISO rating:		Rating:
Site plan review requirements	Y, 1995	Y. Found in the Zoning Ordinance in Chapter 24, California Building & Residential Code 2010.
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	Y, 1995	Y, Y. Found in Chapter 24 Butte County Code (BCC). The County completed a comprehensive update to the entire Zoning Ordinance in 2012, including the Zoning Map, as an outcome of the adopted General Plan 2030.
Subdivision ordinance	Y, 1995	Y, Y. BBC Chapter 20. Most of the Subdivision Ordinance is from 1995 or earlier with amendments up to 2010.
Floodplain ordinance	Y, 2011	Y, Y. BCC Chapter 26, Article IV – Flood Hazard Prevention.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Y, 2008	Y, Y. Chapter 50 – Stormwater Management and Discharge Control.
Flood insurance rate maps	Y, 2011	Y, Y. FEMA, effective 1/6/2011.
Elevation Certificates	Y, 2011	Y, Y
Acquisition of land for open space and public recreation uses		
Erosion or sediment control program	Y, 2011	Y, Y. 2010 California Green Building Code, 2010 California Building Code, BMP's.
Other		
How can these capabilities be expanded and improved to reduce risk?		
One of the issues brought about by the Camp Fire was that housing stock was affected. Some of those who work for the County who lost homes moved away taking their skill and expertise with them. This will continue to be the case while housing stock in the County is low.		

As indicated in the tables above, Butte County has several plans and programs that guide the County's mitigation of development of hazard-prone areas. Starting with the Butte County General Plan, which is the most comprehensive of the County's plans when it comes to mitigation, some of these are described in more detail below.

2030 Butte County General Plan (2012)

A general plan is a legal document, required by state law, that serves as a community's "constitution" for land use and development. The plan must be a comprehensive, long-term document, detailing proposals for the "physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Government Code §65300 et seq.). Time horizons vary, but the typical general plan looks 10 to 20 years into the future. The law specifically requires that the general plan address seven topics or "elements." These are land use, circulation (transportation), housing, conservation, open space, noise, and safety. The plan must analyze issues of importance to the community, set forth policies in text and diagrams for conservation and development, and outline specific programs for implementing these policies

Goals and policies related to mitigation from the General Plan include the following:

Land Use Element

Goal LU-1	**Continue to uphold and respect the planning principles on which the County's land use map is based.**
LU-P1.10	The County shall limit development in foothill and mountain areas that are constrained by fire hazards, water supply, migratory deer habitat, or infrastructure.

Housing Element

Goal H-1	**Provide for the County's regional share of new housing for all income groups and future residents as identified in the Housing Needs Assessment.**
H-A1.1	Provide Adequate Sites for Housing by Expanding Infrastructure: The County shall work with the incorporated cities to expand the supply of developable land, particularly for multifamily housing projects within each city's sphere of influence. a. Apply for available state and federal funding for water, sewer, and storm drainage improvements.

Water Resources Element

Goal W-2	**Ensure an abundant and sustainable water supply to support all uses in Butte County.**
W-P2.1	The County supports solutions to ensure the sustainability of community water supplies.
W-P2.5	The expansion of public water systems to areas identified for future development on the General Plan land use map is encouraged.
W-P2.6	The County supports water development projects that are needed to supply local demands.

Goal W-3	**Effectively manage groundwater resources to ensure a long-term water supply for Butte County.**
W-P3.1	The County shall continue to ensure the sustainability of groundwater resources, including groundwater levels, groundwater quality and avoidance of land subsidence, through a basin management objective program that relies on management at the local level, utilizes sound scientific data and assures compliance.
W-P3.2	Groundwater transfers and substitution programs shall be regulated to protect the sustainability of the County's economy, communities and ecosystem, pursuant to Chapter 33 of the Butte County Code.

Goal W-3	Effectively manage groundwater resources to ensure a long-term water supply for Butte County.
W-P3.3	The County shall protect groundwater recharge and groundwater quality when considering new development projects.

Goal W-6	Improve streambank stability and protect riparian resources.
W-P6.1	Any alteration of natural channels for flood control shall retain and protect riparian vegetation to the extent possible while still accomplishing the goal of providing flood control. Where removing existing riparian vegetation is unavoidable, the alteration shall allow for reestablishment of vegetation without compromising the flood flow capacity.
W-P6.2	Where streambanks are already unstable, as demonstrated by erosion or landslides along banks, tree collapse, or severe in channel sedimentation, proponents of new development projects shall prepare a hydraulic and/or geomorphic assessment of on-site and downstream drainageways that are affected by project area runoff.

Circulation Element

Goal CIR-9	Provide a circulation system that supports public safety.
CIR-P9.1	All new road systems, both public and private, shall provide for safe evacuation of residents and adequate access to fire and other emergency services by providing at least two means of emergency access to an interconnected collector system. New road systems will include reduction and maintenance of roadside vegetation.

Safety Element

Goal HS-2	Protect people and property from flood risk.
HS-P2.1	The County supports the efforts of regional, State and federal agencies to improve flood management facilities along the Sacramento River while conserving the riparian habitat of the river.
HS-P2.2	The County supports the efforts of private landowners and public agencies to maintain existing flood management facilities.
HS-P2.3	The County supports the Flooding Mitigation Action Plan in the Butte County Local Hazard Mitigation Plan.

Goal HS-2	Protect people and property from flood risk.
HS-P2.4	Development projects on lands within the 100-year flood zone, as identified on the most current available maps from FEMA [the most current available map at the time of the publication of General Plan 2030 is shown on Figure HS-1], shall be allowed only if the applicant demonstrates that it will not:* a. Create danger to life and property due to increased flood heights or velocities caused by excavation, fill, roads and intended use. b. Create difficult emergency vehicle access in times of flood. c. Create a safety hazard due to the height, velocity, duration, rate of rise and sediment transport of the flood waters expected at the site. d. Create excessive costs in providing governmental services during and after flood conditions, including maintenance and repair of public facilities. e. Interfere with the existing water conveyance capacity of the floodway. f. Substantially increase erosion and/or sedimentation g. Require significant storage of material or any substantial grading or substantial placement of fill that is not approved by the County through a development agreement, discretionary permit, or other discretionary entitlement; a ministerial permit that would result in the construction of a new residence; or a tentative map or parcel map. h. Conflict with the provisions of the applicable requirements of Government Code Sections 65865.5, 65962 or 66474.5.
HS-P2.5	The lowest floor of any new construction or substantial improvement within Flood Zones A, AE, AH and AO, as shown in Figure HS-1 or the most current maps available from FEMA, shall be elevated 1 foot or more above the 100-year flood elevation. (County Flood Ordinance Sec. 26-22).
HS-P2.6	The County shall make specific findings prior to approval of a development agreement, tentative or parcel map, a subdivision or discretionary permit or other discretionary entitlement, or any ministerial permit that would result in the construction of a new residence. Findings shall be consistent with California Department of Water Resources (DWR) Urban Level of Flood Protection Criteria within the 200-year floodplain, if applicable.
HS-P2.7	The County shall not, and will encourage other agencies within its bounds to not, locate new essential government service facilities (as defined in Section 2) and essential health-care facilities in Flood Zones A, AE, AH and AO, as shown in Figure HS-1 or the most current maps available from FEMA, and within the 200-year floodplain, as shown in Figure HS-2, and as defined in Government Code Section 65007. Essential facilities in these areas shall have heightened flood protection.

Goal HS-3	Prevent and reduce flooding.
HS-P3.1	Watersheds shall be managed to minimize flooding by minimizing impermeable surfaces, retaining or detaining stormwater and controlling erosion.
HS-P3.2	Applicants for new development projects shall provide plans detailing existing drainage conditions and specifying how runoff will be detained or retained on-site and/or conveyed to the nearest drainage facility and shall provide that there shall be no increase in the peak flow runoff to said channel or facility.*
HS-P3.3	All development projects shall include stormwater control measures and site design features that prevent any increase in the peak flow runoff to existing drainage facilities.*
HS-P3.4	Developers shall pay their fair share for construction of off-site drainage improvements necessitated by their projects

Goal HS-4	Reduce risks from levee failure.
HS-P4.1	The County supports the efforts of regional, State or federal agencies to study levee stability throughout the county, particularly levees that were designed and constructed to provide a minimum 100-year level of protection.
HS-P4.2	The County supports the efforts of levee owners and regional, State or federal agencies to design and reconstruct levees that do not meet flood protection standards (200-year for urban or urbanizing areas, 100-year flood zones for all other areas) to bring them into compliance with adopted State and/or federal standards.
HS-P4.3	New development proposals in levee inundation areas shall consider risk from failure of these levees.

Goal HS-5	Reduce risks from dam inundation.
HS-P5.1	New development proposals in dam inundation areas, as mapped in Figure HS-4 or the most current available mapping, shall consider risks from failure of these dams.
HS-P5.2	Risk of failure on new development proposals in the dam inundation areas for the Black Butte, Whiskeytown and Shasta dams shall be coordinated between the Bureau of Reclamation, Butte County Department of Development Services and Butte County Office of Emergency Management.

Goal HS-6	Reduce risks from earthquake
HS-P6.1	Appropriate detailed seismic investigations shall be completed for all public and private development projects in accordance with the Alquist-Priolo Earthquake Fault Zoning Act.
HS-P6.2	Geotechnical investigations shall be completed prior to approval of schools, hospitals, fire stations and sheriff stations, as a means to ensure that these critical facilities are constructed in a way that mitigates site-specific seismic hazards.

Goal HS-7	Reduce risks from steep slopes and landslides.
HS-P7.1	Site-specific geotechnical investigations shall be required to assess landslide potential for private development and public facilities projects in areas rated "Moderate to High" and "High" in Figure HS-4 or the most current available mapping.

Goal HS-8	Reduce risks from erosion.
HS-P8.1	Site-specific geotechnical investigations shall be required to assess erosion potential for private development projects and public facilities in areas rated "Very High" in Figure HS-7 or the most current available mapping.

Goal HS-9	Reduce risks from expansive soils.
HS-P9.1	Site-specific geotechnical investigations shall be required to assess risks from expansive soils for private development projects and public facilities in areas rated "High" in Figure HS-8 or the most current available mapping.

Goal HS-10	Avoid subsidence from groundwater withdrawal.
HS-P10.1	Continue to work with water providers and regulatory agencies to ensure that groundwater withdrawals do not lead to subsidence problems.
HS-P10.2	Existing programs to monitor potential subsidence activity shall be supported.

Goal HS-11	Reduce risks from wildland and urban fire
HS-P11.1	Fire hazards shall be considered in all land use and zoning decisions, environmental review, subdivisions review and the provision of public services.
HS-P11.2	Create communities that are resistant to wildfire by supporting the implementation of community wildfire protection plans and wildfire fuel load reduction measures in coordination with the appropriate government, community group, or non-profit organization and California Department of Forestry and Fire Protection (CAL FIRE).
HS-P11.3	The County supports the Wildfire Mitigation Action Plan, the Butte County Local Hazard Mitigation Plan (LHMP), and the Butte Unit Community Wildfire Protection Plan prepared by CAL FIRE and will cooperate with the Butte County Fire Department and the Butte County Fire Safe Council in implementing these plans.
HS-P11.4	New development projects shall meet current fire safe ordinance standards for adequate emergency water flow, emergency vehicle access, signage, evacuation routes, fuel management, defensible space, fire safe building construction and wildfire preparedness.

Goal HS-12	Protect people and property from wildland or urban fires.
HS-P12.1	Regulations regarding vegetation clearance around structures, including the removal of ladder fuels, shall be maintained and enforced.
HS-P12.2	Fuel breaks shall be required along the edge of developing areas in High and Very High Fire Hazard Severity Zones, as shown in Figure HS-9 or the most current data available from CAL FIRE.
HS-P12.3	Fire resistant landscaping and fuel breaks shall be required in residential areas.
HS-P12.4	All development projects in wildland urban interface areas in High or Very High Fire Hazard Severity Zones shall provide, at a minimum, small-scale water systems for fire protection.
HS-P12.5	After wildfires, the County shall assess risks of landslide, erosion and flooding in burn areas and cooperate with other appropriate agencies on plans to mitigate these risks.

Goal HS-13	Identify safe and effective evacuation routes and access for fire prevention and suppression.
HS-P13.1	New development in High or Very High Fire Hazard Severity Zones, as shown in Figure HS-9, shall identify access and egress routes and make improvements or contribute to a fund to develop, upgrade and maintain these routes.

Goal HS-14	Reduce risks from the harmful effects of hazardous materials.
HS-P14.1	The County supports the Hazardous Materials Emergency Response Plan (Area Plan).
HS-P14.2	Hazardous materials carrier routes shall be designated to direct hazardous materials transport away from populated areas.

Goal HS-14	Reduce risks from the harmful effects of hazardous materials.
HS-P14.3	Hazardous and toxic materials shall be transported only along the designated highway and rail routes shown in Figure HS-11.
HS-P14.4	Proponents of new hazardous waste management facilities shall demonstrate that potential environmental impacts can be mitigated as a condition of approval.
HS-P14.5	Environmental assessment and/or investigation shall be required prior to General Plan Amendment or Rezone approval that would allow uses with sensitive receptors, such as residential developments, schools, or care facilities, on sites previously used for commercial, industrial, agricultural or mining uses to determine whether soils, groundwater and existing structures are contaminated and require remediation. Policies and oversight authority shall follow Health and Safety Code Division 20, Chapters 6.5 and 6.8 when determining jurisdiction

Goal HS-15	Ensure that Butte County is prepared for emergency situations
HS-P15.1	The County shall conduct continuous advance planning to anticipate potential threats and improve emergency response effectiveness.
HS-P15.2	Critical emergency response facilities such as fire, police, emergency service facilities and utilities shall be sited to minimize their exposure to flooding, seismic effects, fire, or explosion.
HS-P15.3	Emergency access routes shall be kept free of traffic impediments.
HS-P15.4	Streets and developed properties shall be clearly marked to enable easy identification.

Butte County Ordinances

Butte County has ordinances that directly relate to mitigating hazards. These include the following.

Emergency Organization (Butte County Code Chapter 8.1)

The declared purposes of this chapter are to provide for the preparation and execution of plans for the protection of persons, the environment, and property within the County of Butte in the event of an emergency, the direction of the emergency management organization and the coordination of the emergency functions of the County of Butte with the Cities of Chico, Oroville, Gridley, Biggs and the Town of Paradise and all other affected public agencies, corporations, organizations and private persons within the County of Butte.

Building Code (Butte County Code Chapter 26-1)

This ordinance establishes the adoption of the 2010 California Building Code as the building code applicable to the County, which are based on the International Building Codes. The building code includes the Building, Electrical, Mechanical, Plumbing, Energy, Fire, and the NEW Green Building Code - A Guide to the California Green Building Standards Code (Low-Rise Residential).

Butte County Land Grading Ordinance (Butte County Code, Chapter 13.1)

The purpose of this article is the control of erosion and siltation, the enhancement of slope stability, the protection of said resources and the prevention of related environmental damage by establishing standards and requiring permits for grading. Butte County is noted for its scenic natural beauty, for its streams, creeks, and vernal pools, for its diversity of vegetation including rare and endangered plant species, for its fish and other wildlife, and for its sources of water. All of the said resources are subject to serious damage by improper and uncontrolled grading, including, but not limited to, erosion and siltation jeopardizing or destroying fish and other wildlife and the disruption or contamination of sources of water being used for domestic and other purposes.

Fire Prevention and Protection (Butte County Code Chapter 38A)

It is the intent of this chapter to require the owners and occupants of real property in the unincorporated areas of the county to maintain said properties to:

- Reduce the risk of uncontrolled fires and the harm they may cause to individuals;
- Minimize the spread of any fire to other properties and buildings;
- Reduce obstructions to fire suppression efforts if a fire does occur;
- Increase the opportunity for firefighters to successfully protect lives, residences and other valuable buildings from wildfires;
- Protect populated areas, such as metropolitan areas, suburban areas, and urban and rural subdivisions from encroaching wildfires;
- Reduce the spread of residential and other building fires into the wildland vegetation; and
- Prevent interference with fire hazard abatement activities.

It is the further intent of the county to seek voluntary compliance with this chapter and to provide remedies if such compliance is not obtained.

Zoning Ordinance (Butte County Code Title 24)

This chapter divides the unincorporated territory of the county into geographical districts designated as zoning districts. It establishes regulations limiting the use of land and structures, location, height and bulk of the structures, the open spaces about buildings and provides for such other measures as will accomplish the purposes of this chapter. This chapter is adopted to promote and protect the public health, safety and general welfare for the following more particularly specified purposes:

- To assist in providing a definite plan of development for the county, and to facilitate, encourage, guide, control and regulate the future growth of the county.
- To protect the character, social and economic stability of agricultural, residential, commercial, industrial and other areas within the county; to assure the orderly and beneficial development of such areas; and more particularly, to provide adequate light and air; to avoid undue concentration of population; to facilitate the adequate provision for transportation, water, sewage, drainage facilities, schools, parks and other public developments; to conserve and develop natural resources; to protect the food supply; to conserve property values; to conserve energy; and to promote efficient urban design and arrangement, and to secure economy in governmental expenditures.

- To obviate the menace to the public safety resulting from the location of buildings, and uses of buildings and of land, adjacent to streets and highways which are a part of the streets and highways element of the general plan of the county, or other thoroughfares, so that existing or prospective traffic circulation on said highways will be facilitated.
- To implement the policies of the Butte County general plan.

It is expressly declared that all of the provisions of this chapter shall apply to all property within the unincorporated territory of Butte County whether owned by private persons, firms or corporations, or by the government of the United States of America, or any of its agencies, or by the State of California or any of its political subdivisions or agencies, unless the federal or state activity is specifically exempted from local review, or by any county including the County of Butte, town or municipal corporation or any of its or their agencies, or by any district formed under the laws of the State of California.

The board of supervisors shall have the authority to decide any question involving the interpretation or application of any provision of this chapter. Said provisions of this chapter and the applications thereof shall be held to be the minimum requirements necessary to promote the public health, safety and general welfare. Except as specifically herein provided, it is not intended by this chapter to repeal, abrogate, annul or in any way to impair or interfere with any existing provision of law or ordinance, or any rule, regulation or permit previously adopted or issued or which may be adopted or issued pursuant to law relating to the use of buildings or premises, or relating to the erection,, construction, establishment, moving, alteration or enlargement of any building improvement; nor is it intended by this chapter to interfere with or abrogate or annul any easement, covenant or other agreement between parties or to annul or abrogate the public improvements emplaced and paid for by property owners pursuant to previously adopted county plans; provided, however, that in cases in which this chapter imposes a greater restriction upon the erection, construction, establishment, moving, alteration or enlargement of buildings or the use of any such building or premises in said several districts, or any of them, than is imposed or required by such existing provisions of law or ordinance, or by such rules, regulations or permits, or by such easements, covenants or agreements, then in such case the provisions of this chapter shall control.

Subdivision Ordinance (Butte County Code Title 20)

This chapter is enacted to facilitate and insure orderly development of lands in the unincorporated areas in the county. This chapter shall implement the objectives established for the development of the county in conformance with its general plan, and the master streets and highways plan. A proposed subdivision or land division shall be considered in relation to such plans. This chapter shall provide standards governing the surveys, designs and improvements of subdivisions; and the submission of maps, plans and specifications for the construction of improvements.

This chapter shall provide for governing standards for health and sanitation requirements, and the construction and installation of streets, roads, highways, public utilities and other improvements. The Butte County Board of Supervisors shall provide a fee schedule for services rendered by the county. This chapter shall provide for the creation of reasonable building sites by establishing adequate road widths, proper alignment of roads, adequate lot sizes and means of ingress and egress to and from the property.

This chapter shall control the division of land which is subject to inundation by flooding from natural streams or artificial ponding caused by man, and other detrimental influences which may cause land to be unsuitable for satisfactory development. This chapter shall control the division of land which may be subject to dangerous or unsuitable soil conditions of any type, or subject to any other impediments affecting the use of the land for human habitation. This chapter shall provide rules and regulation governing the contents of tentative and final subdivision maps, land divisions and parcel maps; it shall establish methods for the processing and filing of the maps and regulate other related matters.

This chapter shall provide for the numbering of all final subdivision maps in addition to the name given by the subdivider. Such numbers shall give the last two (2) digits of the year in which the map was filed and the number, in order, of the subdivision map submitted in that year.

Floodplain Management Ordinance (Butte County Code Chapter 26, Article IV)

The department of Development Services is authorized and directed to enforce all the provisions of this article. The director of the Department of Public Works or his duly authorized designee is designated as the "flood plain administrator."

Additional requirements in flood hazard zones

Within flood hazard Zones A, AE, AH and AO, on the official maps there are additional requirements in conjunction with the issuance of development permits for new construction, substantial improvements and other developments, including the placement of manufactured homes and prefabricated buildings, as set forth in this article.

Application

To obtain a development permit in said zones, the applicant shall first file an application therefore in writing on a county form furnished for that purpose by the Department of Development Services and approved by the Director of Development Services. Every such application shall:

- Identify and describe the work to be covered by the permit for which application is made;
- Describe the land on which the proposed work is to be done by lot, block, tract and house and street address, or similar description that will readily identify and definitely locate the proposed building or work;
- Indicate the use or occupancy for which the proposed work is intended;
- Be accompanied by plans and specifications for the proposed development drawn to scale, and showing the dimensions and elevation of the site on which the proposed work is to be done, existing and/or proposed structures, fill, storage of materials and drainage facilities;
- Be signed by the permittee or his authorized agent who may be required to submit evidence to indicate such authority;
- Be accompanied by:
  - ✓ The proposed National Geodetic Vertical Datum ("NGVD") elevation of the lowest floor of all structures or, in the case of any nonresidential structure which will be floodproofed, the proposed NGVD elevation to which it will be floodproofed; or
  - ✓ In AO zones, the minimum vertical distance above the highest adjacent grade for the lowest floor;

- Be accompanied by all appropriate certifications required for lowest floor elevations for all structures, floodproofing of nonresidential structures, wet floodproofing and floodway encroachments;
- Give such other information as reasonably may be required by the county.

Stormwater Management and Discharge Control Ordinance (Butte County Code Chapter 50)

This chapter implements the Butte County Storm Water Management Program (Program) (2003) which is a comprehensive program comprised of various elements and activities designed to reduce storm water pollution to the maximum extent practicable and eliminate prohibited non-storm water discharges in accordance with federal and state laws and regulations. These laws and regulations are implemented through National Pollutant Discharge Elimination System (NPDES) municipal storm water discharge permits. The plan includes processes for accomplishing the goals of minimizing construction site runoff as well as post-construction stormwater management in newly developed and redeveloped areas.

4.4.2. Butte County's Administrative/Technical Mitigation Capabilities

Table 4-184 identifies the County personnel responsible for activities related to mitigation and loss prevention in the County.

Table 4-184 Butte County Administrative/Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	Y	Y
Mitigation Planning Committee	Y	Y
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Y
Mutual aid agreements	Y	Y
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Y/FT	Y, Y, Y
Floodplain Administrator	Y	Y, Y, Y
Emergency Manager	Y	Y, Y, Y
Community Planner	Y	Y, Y, Y
Civil Engineer	Y	Y, Y, Y
GIS Coordinator	Y	Y, Y, Y
Other		

Technical	Y/N	Describe capability Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Y
Hazard data and information	Y	Y
Grant writing	Y	Y
Hazus analysis	Y	Y – nationwide/FEMA
Other		
How can these capabilities be expanded and improved to reduce risk?		
One of the issues brought about by the Camp Fire was that housing stock was affected. Some of those who work for the County who lost homes moved away taking their skill and expertise with them. This will continue to be the case while housing stock in the County is low.		

4.4.3. Butte County's Fiscal Mitigation Capabilities

Table 4-185 identifies financial tools or resources that the County could potentially use to help fund mitigation activities.

Table 4-185 Butte County Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	N	N, N
Authority to levy taxes for specific purposes	N	N, N
Fees for water, sewer, gas, or electric services	Y	Table A water
Impact fees for new development	T	Used for impacts of new development to the community, not for mitigation.
Storm water utility fee	N	
Incur debt through general obligation bonds and/or special tax bonds	N	Must be voted on
Incur debt through private activities	Y	
Community Development Block Grant	Y	
Other federal funding programs	Y	Y
State funding programs	Y	Y
Other		
How can these capabilities be expanded and improved to reduce risk?		
These will be difficult to expand until after the dust settles from the Camp Fire. Many people were relocated, and the County is starting to feel the effects of those changes.		

4.4.4. Butte County Mitigation Education, Outreach, and Partnerships

Table 4-186 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information.

Table 4-186 Butte County Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	Fire Safe Councils and projects for resilience and vegetation management.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	Public outreach through many departments for safe homes, properties, and preparedness.
Natural disaster or safety related school programs	Y	Fire Pals
StormReady certification	Y	Y
Firewise Communities certification	Y	Yankee Hill,
Public-private partnership initiatives addressing disaster-related issues	Y	Combine presentations at community meetings to support mitigation activities.
Other		
How can these capabilities be expanded and improved to reduce risk?		
Outreach in the County is done well, but additional focus, staff time, and budgets are needed to expand these programs.		

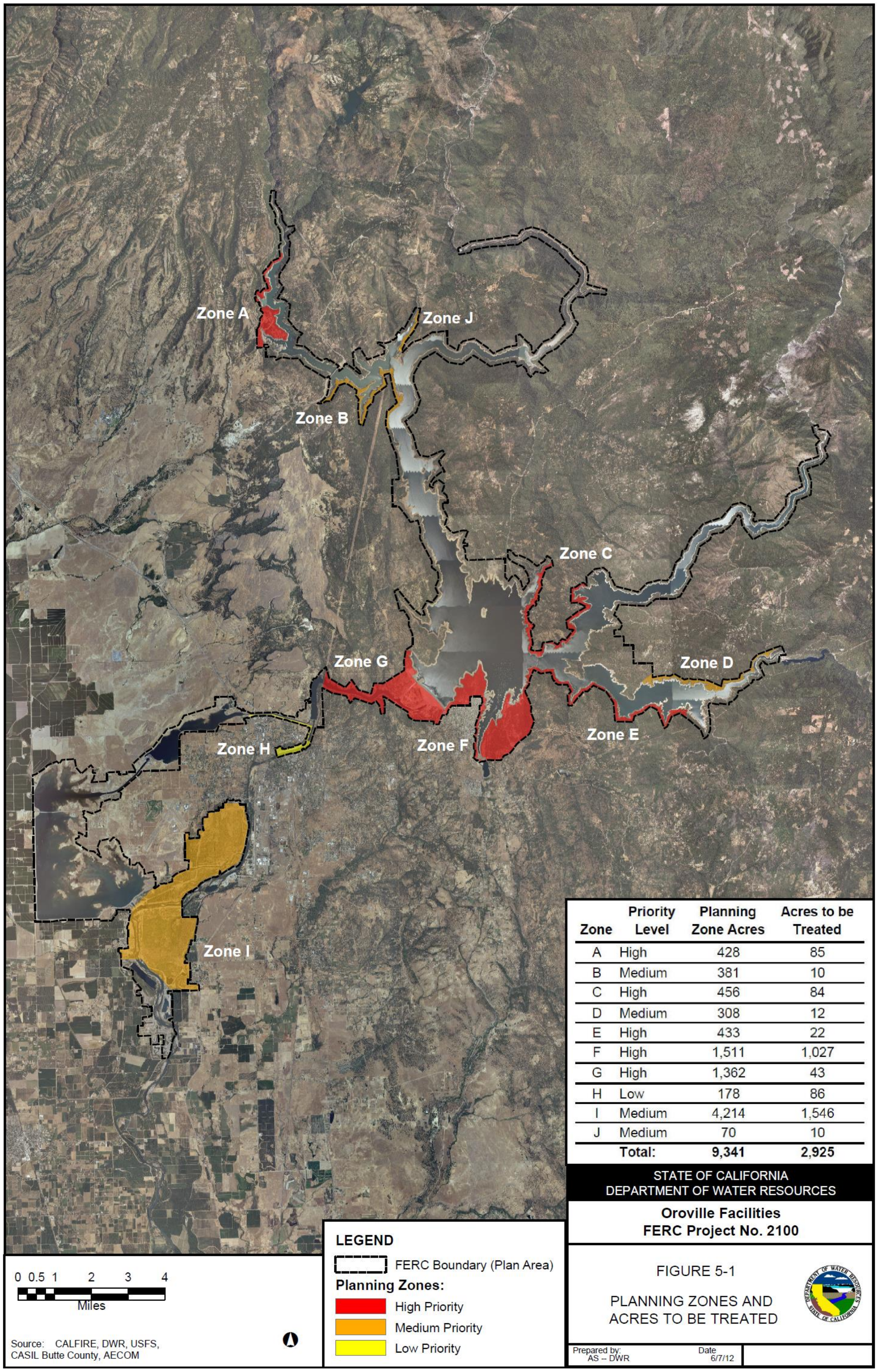
4.4.5. Other Mitigation Efforts

Butte County – Storm Ready – December 13, 2011

Yankee Hill – Firewise Community – 2009. Efforts are underway to certify more communities.

Fuel loads have been treated in areas of the County. The "Treatment Zones" on Figure 4-127 shows the high, medium, and low priority areas based on the Fuel Load Management Plan. The Completed Areas North (Figure 4-128) and South (Figure 4-129) maps show the areas DWR has completed treatment on from 2012-2019.

Figure 4-127 Butte County Vegetation Management Treatment Areas

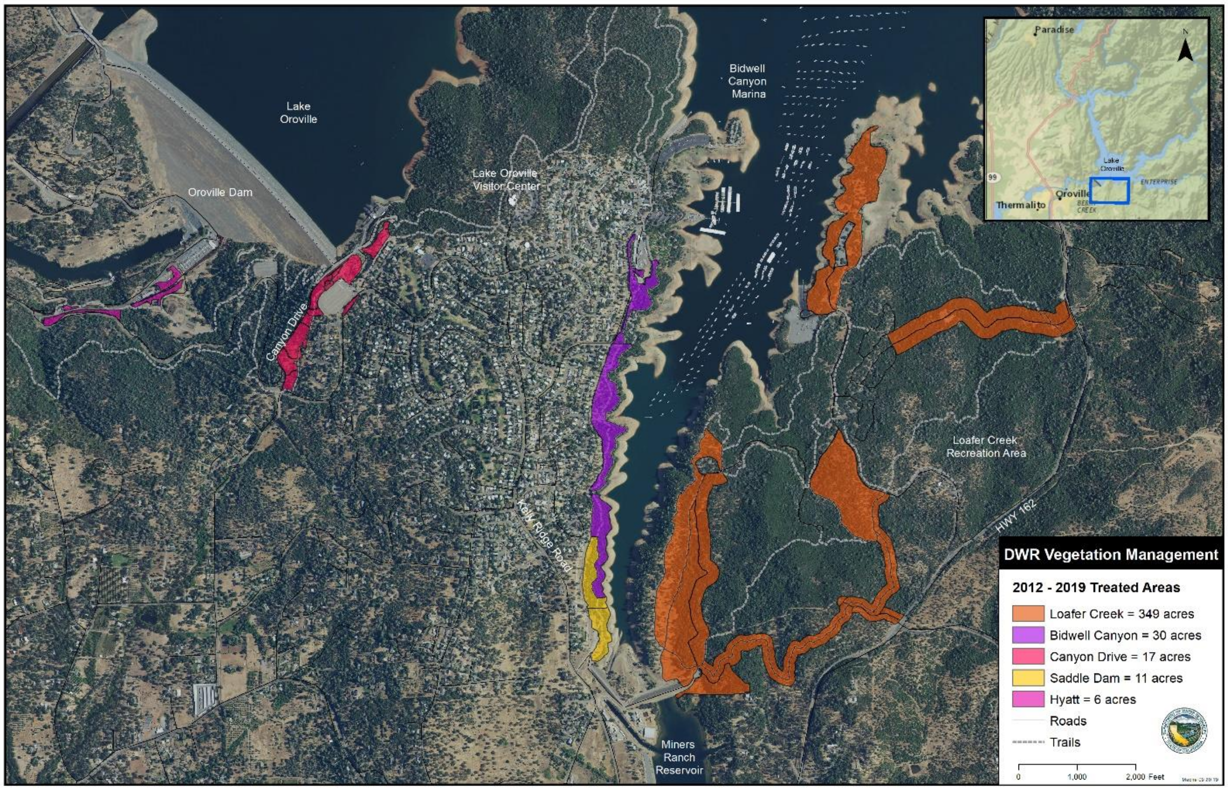


Zone	Priority Level	Planning Zone Acres	Acres to be Treated
A	High	428	85
B	Medium	381	10
C	High	456	84
D	Medium	308	12
E	High	433	22
F	High	1,511	1,027
G	High	1,362	43
H	Low	178	86
I	Medium	4,214	1,546
J	Medium	70	10
	Total:	**9,341**	**2,925**

Figure 4-128 Butte County - Vegetation Management North Zone

Source: Butte County

Figure 4-129 Butte County - Vegetation Management North Zone



Source: Butte County