Mono County and the Town of Mammoth Lakes Multi-Jurisdictional Hazard Mitigation Plan

(including the Mono County Community Wildfire Protection Plan)

MONO COUNTY

Michael Baker INTERNATIONAL

Mono County and the Town of Mammoth Lakes

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

(including the Mono County Community Wildfire Protection Plan)

Courtesy Review Draft

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TABLE OF CONTENTS

Tables

Figures

Appendices

Acronyms

AB	Assembly Bill
AFG	Assistance to Firefighters Grant
BLEVE	boiling liquid expanding vapor explosion
BLM	Bureau of Land Management
Cal Fire	California Department of Forestry and Fire Protection
Cal OES	California Governor's Office of Emergency Services
CalEPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CDBG	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CDPH	California Department of Public Health
CEC	California Energy Commission
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CGS	California Geological Survey
CHP	California Highway Patrol
CIP	Capital Improvement Plan
CNRA	California Natural Resources Agency
COW	cell-on-wheels
CPH	chains/hour
CRS	Community Rating System
CWPP	Community Wildfire Protection Plan
DMA 2000	Disaster Mitigation Act of 2000
DRI	Disaster Recovery Initiative
DSOD	Division of Safety of Dams
DTSC	California Department of Toxic Substances Control
DWR	Department of Water Resources
EMPG	Emergency Management Performance Grants
EMS	Emergency Medical Services
EPA	US Environmental Protection Agency
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FHSZ	fire hazard severity zones
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FRA	federal responsibility area
FRAP	Fire and Resource Assessment Program
FRCC	Fire Regime Condition Class
GIS	geographic information system
HFRA	Healthy Forest Restoration Act

Acronyms

HMGP	Hazard Mitigation Grant Program
HSGP	Homeland Security Grant Program
IRWM	Integrated Regional Water Management
IT	Information Technology
kts	knots
LADWP	Los Angeles Department of Water and Power
LHMP	Local Hazard Mitigation Plan
MCWD	Mammoth Community Water District
MEA	Master Environmental Assessment
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MMS, Mw, M	moment magnitude scale
mph	miles per hour
MREs	meals ready to eat
NFIP	National Flood Insurance Program
NFP	National Fire Plan
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
NSIDC	National Snow and Ice Data Center
NVEWS	National Volcano Early Warning System
PACE	Property Assessed Clean Energy
pCi/L	picocuries per liter
PDM	Pre-Disaster Mitigation
PDT	Pacific Daylight Time
PIO	Public Information Officer
psf	per square foot
REMSA	Regional Emergency Medical Services Authority
RPAC	Regional Planning Advisory Committee
SCE	Southern California Edison
SDD	Snow Deposition Design Overlay Zone
SFHA	Special Flood Hazard Area
SR	State Route
SRA	state responsibility area
SRL	Severe Repetitive Loss
SWGP	Storm Water Grant Program
SWRCB	State Water Resources Control Board
UCERF3	Third Uniform California Earthquake Rupture Forecast
USFS	United States Forest Service
USGS	US Geological Survey
W/m2	watts per square meter
WRID	Walker River Irrigation District
WUI	Wildland-Urban Interface

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1. INTRODUCTION

This document is the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP or Plan) for Mono County (County) and the Town of Mammoth Lakes (Town), California, and includes the Community Wildfire Protection Plan (CWPP) for Mono County. The MJHMP is an update from the 2006 adopted MJHMP. The MJHMP establishes strategies to reduce multiple hazard impacts affecting the County and the Town. The Mono County CWPP, presented in **Chapter 7**, provides a comprehensive analysis specific to wildfire-related hazards and risks in the Wildland-Urban Interface (WUI) areas of the County.

This chapter provides an overview of each plan's purpose and authority, and describes how the MJHMP and Mono County CWPP were adopted and how they are to be used, as well as hazard mitigation plan goals, the planning process, a description of how the public was involved, and the plans, studies, and other resources used for analysis.

Figure 1.1: Disaster Response Cycle

1.1 Plan Purpose

Different types of hazards cause different impacts, occur in different locations, and happen with varying degrees of severity. However, all have the potential to severely harm human health and safety, private and public property, ecosystems, and services. Like many other communities, Mono County and Mammoth Lakes could face substantial damage, injury or loss of life, interruptions to critical services, and other major challenges due to natural hazard impacts.

There are four phases of emergency management, as illustrated in **Figure 1.1**.

1. **Response**: Taking action to save lives, limit injury, and prevent further damage of infrastructure in a disaster.
2. **Recovery**: Returning actions to normal conditions directly following a disaster.
3. **Mitigation**: Establishing strategies to prevent future disasters and/or to minimize their impacts.
4. **Preparedness**: Preparing to save lives and critical infrastructure and to help response and rescue operations in and directly following a disaster.

This Plan focuses on the mitigation component of the cycle shown in **Figure 1.1**. Hazard mitigation plays an important role in reducing the impacts of disasters by identifying effective and feasible actions to reduce the risks posed by potential hazards. This Plan develops mitigation actions to strengthen community resilience, which helps ensure coordinated and consistent hazard mitigation activities across Mono County and Mammoth Lakes. The benefit of this process (and the Plan) is the development of a more unified strategy and increased coordination with federal, state, and local land-owning agencies. The County and the Town have developed this Plan to be consistent with current standards and regulations, ensuring that the understanding of hazards facing its communities reflects best available science and current conditions. This Plan is also consistent with Federal Emergency Management Agency (FEMA) requirements, and the mitigation measures included in the Plan are grounded in best practices and available resources.

1.2 Authority

1.2.1 Federal

The federal Robert T. Stafford Disaster Relief and Emergency Act (the Stafford Act), as amended by the Disaster Mitigation Act of 2000 (DMA 2000) and supported by various pieces of regulation, directs hazard mitigation planning activities such as this Plan. The Stafford Act requires state, local, and tribal governments that wish to be eligible for federal hazard mitigation grant funds to submit a hazard mitigation plan that outlines the processes for identifying the natural and man-made hazards, risks, and vulnerabilities of the jurisdiction (United States Code [USC] Title 42, Section 5156[a]). FEMA has promulgated Code of Federal Regulations (CFR) Title 44, Part 201 to carry out the hazard mitigation planning requirements in the Stafford Act. These regulations direct the planning process, plan content, and FEMA approval for hazard mitigation plans.

This MJHMP complies with the Stafford Act and DMA 2000, along with the appropriate sections of Title 44 of the CFR, including Parts 201, 206, and 322.

1.2.2 State

The state of California passed Assembly Bill (AB) 2140 in 2006, enacting California Government Code Sections 8685.9 and 65302.6. These sections concern federal requirements mandating that jurisdictions have a valid hazard mitigation plan to be eligible for certain grants. Specifically, Section 8685.9 limits the state of California to paying no more than 75 percent of disaster relief funds not covered by FEMA to a local community, unless the affected community (1) has a valid hazard mitigation plan that is consistent with DMA 2000 and (2) has adopted the hazard mitigation plan as part of its general plan. If this is the case, the state may pay for more than 75 percent of the disaster relief funds not covered by

FEMA. Section 65302.6 authorizes local communities to adopt hazard mitigation plans as part of their safety element or a comparable section of their general plan.

This MJHMP includes information required by relevant sections of the California Government Code.

1.3 Plan Adoption

Both the County and the Town will adopt this updated MJHMP following Plan approval by FEMA. The County will adopt the MJHMP through a resolution of the Board of Supervisors, while the Town will adopt the MJHMP through a resolution of the Town Council. This Plan will go into effect for each individual community upon adoption by the respective organization. **Appendix A** contains the adoption resolutions for this Plan.

1.4 Plan Use and Organization

The MJHMP objectives include the following:

- Establish and foster a basis for coordination and collaboration among County and Town agencies, other public organizations, private organizations and companies, and other key stakeholders.
- Work in conjunction with other planning efforts, including the County's and the Town's General Plans.
- Increase community awareness and empowerment.
- Meet the requirements of federal assistance grant programs, including FEMA's Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) funding.
- Reduce the risk of loss and damage from hazard events, especially repetitive loss and damage.
- Coordinate hazard mitigation planning activities between Mono County and the Town of Mammoth Lakes and in concert with resource management, land use planning, and emergency operation activities.

The MJHMP is made up of the following chapters:

- **Chapter 1 – Introduction**: Describes the background and purpose of this Plan, its goals and priorities, and the planning process used to develop it.
- **Chapter 2 – Community Profile**: Provides the history, physical setting, land use, and demographics of Mono County and Mammoth Lakes.

- **Chapter 3 – Hazards Assessment**: Identifies, describes, and prioritizes the hazards that threaten Mono County and Mammoth Lakes. This chapter discusses past events, risks of future events, and the effects of climate change for each type of hazard.
- **Chapter 4 – Risk Assessment**: Describes the risks posed by each hazard type to County and Town residents, particularly those who are more likely to be socially vulnerable, and to critical facilities.
- **Chapter 5 – Mitigation Actions**: Lists mitigation measures to reduce the risks from hazards facing Mono County and Mammoth Lakes. This chapter also provides an overview of the County's and the Town's existing capabilities to reduce vulnerability to hazard events.
- **Chapter 6 – Plan Maintenance and Capabilities**: Describes the process for implementing, monitoring, and evaluating the MJHMP, and opportunities for continued public involvement.
- **Chapter 7 – Community Wildfire Protection Plan**: Includes how the plan meets the requirements of the Healthy Forest Restoration Act; analysis of wildfire-related hazards and risks in the WUI; identifying ongoing and planned fuel management projects; and mitigation measures designed to prevent and/or reduce the damage associated with wildfire to WUI assets, also known as values.
- **Chapter 8 – References:** Reference documents used to develop the plan.

The MJHMP allows the County and the Town to "show their work" and illustrate compliance with FEMA guidelines. The Plan is supplemented by a Hazard Mitigation Implementation Handbook, which provides clear direction to the agency staff and elected leaders who are responsible for implementing this Plan.

1.5 Mitigation Goals

The County and the Town created goals as part of the Plan development process. There are 15 general goals for this Plan:

- GOAL 1. Avoid exposure of people and improvements to unreasonable risks of damage or injury from earthquakes and other geologic hazards.
- GOAL 2. Avoid exposure of people and improvements to unreasonable risks of damage or injury from flood hazards.
- GOAL 3. Avoid exposure of people and improvements to unreasonable risks of damage or injury from fire hazards.

- GOAL 4. Avoid exposure of people and improvements to unreasonable risks of damage or injury from avalanche hazards.
- GOAL 5. Avoid exposure of people and improvements to unreasonable risks of damage or injury from dam failure hazards.
- GOAL 6. Avoid exposure of people and improvements to unreasonable risks of damage or injury from disease and pest hazards.
- GOAL 7. Avoid exposure of people and improvements to unreasonable risks of damage or injury from drought hazards.
- GOAL 8. Avoid exposure of people and improvements to unreasonable risks of damage or injury from volcano hazards.
- GOAL 9. Avoid exposure of people and improvements to unreasonable risks of damage or injury from hazardous materials.
- GOAL 10. Avoid exposure of people and improvements to unreasonable risks of damage or injury from severe weather, heat, cold, and snow hazards.
- GOAL 11. Avoid exposure of people and improvements to unreasonable risks of damage or injury from wind hazards.
- GOAL 12. Reduce the risks from natural hazards by planning for safe development, increasing public awareness of the natural hazards in Mono County, and providing an integrated multiagency approach to emergency response.
- GOAL 13. Prepare for changing climate conditions in Mono County.
- GOAL 14. Keep Mono County and the Town of Mammoth Lakes a safe place to live, work, and play.
- GOAL 15. Maintain adequate emergency response capabilities.

1.6 Hazard Mitigation Planning Process

This Plan is the result of a process involving County departments, Town departments, stakeholder agencies, residents, businesses, and the general public. FEMA guidance suggests that the planning process meet the following objectives:

- Determine the planning area or areas, and the resources they contain.
- Establish the planning team.
- Create an outreach time.

- Review the communities' capabilities.
- Prepare a risk assessment.
- Develop a mitigation strategy.
- Keep the plan current.
- Review and adopt the plan.
- Create a safe and resilient community.

In keeping with FEMA recommendations, the County and the Town created a Multi-Jurisdictional Hazard Mitigation Planning Team (the Planning Team) composed of representatives from both jurisdictions and other key stakeholders (including special districts, neighboring communities, and regional and state agencies/departments), although not all representatives were able to attend every meeting. Stakeholders were invited, through email and follow-up phone calls to join Planning Team meetings and, when appropriate, participate in stakeholder interviews. Participants included representatives from the following agencies, departments, and local organizations:

Mono County

- Wendy Sugimura, Interim Director – Mono County Community Development Department
- Michael Draper, Planning Analyst – Mono County Community Development Department
- Tony Dublino, Assistant County Administrative Officer – Mono County
- Ingrid Braun, Sheriff-Coroner – Mono County Sheriff Office
- Bob Rooks, Chief – Mono County Emergency Medical Services (EMS)
- Louis Molina, Environmental Health Director – Mono County Health Department
- Gerry Le Francois, Principal Planner – Mono County Community Development Department
- Fred Stump, Mono County Supervisor

Town of Mammoth Lakes

- Al Davis, Chief of Police – Mammoth Lakes Police Department
- Grady Dutton, Public Works Director – Town of Mammoth Lakes
- Haislip Hayes, Engineering Manager – Town of Mammoth Lakes
- Daniel Holler, Town Manager – Town of Mammoth Lakes
- Pam Kobylarz, Assistant to the Town Manager – Town of Mammoth Lakes

Other Organizations

- Thom Heller, Fire Marshal – Mammoth Lakes Fire Protection District
- Frank Frievalt, Fire Chief – Mammoth Lakes Fire Protection District
- Mike Curti, Fire Chief – Antelope Valley Fire District
- Taro Pusina, Interagency Fire Management Officer – Inyo National Forest Supervisor's Office
- Matt Edmiston – California Department of Forestry and Fire Protection (Cal Fire)
- Sagar Fowler – Cal Fire, San Bernardino Unit, Battalion 4
- Temple Fletcher, Director – Regional Emergency Medical Services Authority (REMSA) Care Flight
- Shannon Anderson, Chief of Fire and Emergency Services – Marine Corps Mountain Warfare Fire Department
- Rodney Allen, S-7 Mission Assurance Director – Marine Corps Mountain Warfare Fire Department
- Brett D. Hawn, Chief of Police – Marine Corps Police Department, Marine Corps Mountain Warfare Training Center
- Doug Toskin, S-7 Emergency Manager – Marine Corps Mountain Warfare Fire Department
- Karen Farrel-Ingram – Wheeler Crest Fire Safe Council
- Bruce Woodworth – Antelope Valley Community Emergency Response Team (CERT)
- Chris Weibert, HR/Risk Analyst – Mammoth Community Water District
- Austin West, Transportation Planner – California Department of Transportation (Caltrans) District 9
- Greg Miller, Maintenance Manager – Caltrans District 9
- Lieutenant William "Bill" Boyes – Bridgeport California Highway Patrol (CHP)
- Karla Benedicto – California Governor's Office of Emergency Services (Cal OES)
- Andy Selters, President – Pine Glade Association, Inc.
- Steven Butler, Construction Manager – Los Angeles Department of Water and Power (LADWP)
- Ben Butler, Operations – LADWP
- Greg Loveland, Electrical/Waterworks Engineer – LADWP
- Bob Stiens, Public Affairs Liaison – Southern California Edison (SCE)

The Planning Team held five meetings during the plan development process. At these meetings, team members talked about the MJHMP objectives, identified hazards that threaten Mono County and Mammoth Lakes, and prepared and reviewed the mitigation measures to improve community resiliency to hazards. The following meetings were held:

- **Kickoff meeting** – June 15, 2017. Planning Team members discussed the goals and objectives of the project, outlined the Plan development process and requirements, determined the public outreach approach, and identified relevant hazards.
- **Meeting #2** – September 29, 2017. The Planning Team discussed an overview of the project and sought input on the goals, past and current efforts, current limitations, and information sources for the content of the MJHMP.
- **Meeting #3** – December 13, 2017. Planning Team members discussed the draft hazard profiles and the results of the hazard risk assessment and vulnerabilities, including impacts to critical facilities and social vulnerability.
- **Meeting #4** – January 25, 2018. Planning Team members discussed and revised the draft hazard mitigation measures.
- **Meeting #5** – April 5, 2018. Planning Team members reviewed and discussed the completed draft Plan.

At these meetings, the Planning Team and stakeholders were given presentations on the purpose, process, risk and vulnerability analysis results, and draft measures. The Planning Team and stakeholders reviewed the accuracy of community capacity and characteristics data, which were corrected as necessary; raised specific issues of concern, which were addressed in various chapters of the MJHMP; and identified a list of twenty priorities for the next 5 years as well as many additional lower priority measures. **Appendix B** shows copies of meeting materials and notes with details on comments from these meetings.

1.6.1 Regional Planning Advisory Committee (RPAC) Meetings

As part of the planning process, advisory meetings were conducted with the Mono County RPACs, listed below, for input and feedback throughout Plan development. Members of the plan development team presented to seven of the RPACs over the course of the planning process, shown in bold[1]. Mono County RPACs are:

- **Antelope Valley**

[1] Since Wheeler Crest RPACs are not held regularly, residents of this area were invited to join the presentation to the Long Valley RPAC.

- Benton/Hammil and Chalfant Valley
- **Bridgeport Valley**
- **June Lake Citizens Advisory Committee**
- **Long Valley/Paradise/Wheeler Crest**
- **Mono Basin**

RPAC meetings occur on a regular monthly schedule, or as needed, are open to the public, and post both agendas and meeting notes on their respective websites. These meetings were conducted alongside the four Planning Team meetings listed above.

RPAC members and any members of the public at these meetings were given short presentations on the process, and risk and vulnerability assessment results and comments were incorporated into the MJHMP.

1.6.2 Public Survey

The County and the Town prepared a public outreach and engagement process to give community members the opportunity to learn about the Plan and contribute to its development. This process included a web page hosted on the County website and survey, distributed through listservs as a PDF and available online through SurveyMonkey, for community members to offer input about hazard-related outcomes and actions to improve preparations for hazard events. Approximately 130 people responded to the survey. The key outcomes of the survey are discussed below, and a more detailed summary of the survey and its findings are included in **Appendix B**.

- Approximately 40 percent of respondents had been affected by a disaster in their current residence. Severe weather, fire, drought, and flooding were the most common disaster events.
- Earthquakes, severe weather, and flooding were the hazards of greatest concern to survey respondents.
- Nearly all respondents felt the County and Town should provide emergency notifications. A smaller number felt the jurisdictions should provide multiple other services such as training and education on how to reduce future damage and community outreach regarding emergency preparedness.
- Most respondents felt their homeowner's insurance was adequate for potential hazards.

1.6.3 Public Review Draft

The Public Review Draft Plan was published for public review on June 11, 2018 and remained open to public comment through July 30, 2018. The document was posted on the County's webpage. Community members were encouraged to comment using an online town hall application or via email to the staff leads. Over the course of this period, staff received four sets of comments from people and organizations who had not previously been part of the planning process. Most of the changes resulting from these comments involved additions to hazard histories and other minor corrections and clarifications; however, there were extensive technical revisions made to the avalanche and volcanic hazard profiles and CWPP based on input from the County's avalanche hazard consultant, USGS scientists, and Interagency Vegetation Management Team for Inyo National Forest and the Bureau of Land Management (BLM) Bishop Field Office. In addition, several stakeholders who had been involved with the Planning Team suggested additional edits to the document during this phase. A major change to the proposed secondary access route for Swall Meadows was raised in comments from the Wheeler Crest Fire Protection District and subsequently incorporated into the Plan with approval from County staff and the Board of Supervisors.

1.6.4 Planning Commissions

The Planning Team presented the Public Review Draft Plan to the Mammoth Lakes Town Planning and Economic Development Commission and the Mono County Planning Commission on June 13 and June 14, 2018, respectively. As a result of comments from commissioners, staff revised several mitigation measures and added additional hazards analysis for potential extreme heat events in Chalfant Valley.

1.6.5 Governing Bodies

The plan was presented to the County Board of Supervisors and Town Council on July 17 and July 18, 2018, respectively. In response to comments from supervisors and councilors, revisions were made to the Mitigation Strategy, including changes to the preferred secondary access routes for two communities and the addition of two hazard measures.

1.6.6 Integration into other Plans and Regulatory Documents

Integration of the 2006 Local Hazard Mitigation Plan (LHMP) into other planning mechanisms did not occur. However, upon completion of the draft of the updated 2018 MJHMP and CWPP, and as part of the same project and process, the Planning Team assessed and reviewed the County's Safety Element as well as the Town's Public Health and Safety Element for consistency and integrated new measures specific to those documents. Red-line changes were made to these documents, with a future action of being adopted by the County Board of Supervisors and Town Council. Other regulatory changes to the County and Town Municipal Code and other operational plans will be made as studies are completed

and updates to those documents are triggered by other updates and requirements. Future incorporation of the MJHMP into existing planning mechanisms is further discussed in **Section 6.4**.

1.6.7 Plans, Studies, and Technical Reports Used to Develop the Plan

The Planning Team relied on numerous plans, studies, technical reports, databases, and other resources to develop hazard discussions and mapping. **Table 1.1** shows the key resources used for different sections of the Plan; **Chapter 8**, **References,** contains a more extensive list.

Table 1.1 Key Resources Used to Develop the MJHMP

Section	Key Resource
Multiple hazards	• Cal-Adapt • California Climate Adaptation Planning Guide • California Multi-Hazard Mitigation Plan
Dam failure	• California Department of Water Resources (DWR) dam database • US Army Corps of Engineers National Inventory of Dams
Disease/pest management	• Owens Valley Mosquito Abatement Program
Drought	• US Drought Monitor • Tri-Valley Groundwater Management District
Flood	• FEMA flood maps
Geologic hazards	• US Geological Survey (USGS) volcano database
Hazardous materials	• California Department of Toxic Substances Control (DTSC) EnviroStor database • State Water Resources Control Board (SWRCB) cleanup sites database • SWRCB underground storage tanks database
Seismic hazards	• California Geological Survey (CGS) Fault Activity Map of California • USGS ShakeMaps
Severe weather	• California Environmental Protection Agency (CalEPA) and California Department of Public Health (CDPH) extreme heat preparation materials • California Contingency Plan for Extreme Cold/Freeze • National Oceanic and Atmospheric Administration (NOAA) severe weather database files • National Weather Service watch/warning/advisory records • Western Regional Climate Center

Table 1.1 Key Resources Used to Develop the MJHMP

Section	Key Resource
Wildfire	• Cal Fire Fire and Resource Assessment Program (FRAP) Mapping and Fire Hazard Severity Zones (FHSZ) • 2009 FlamMap Assessment

2. COMMUNITY PROFILE

The Community Profile chapter provides an overview of Mono County and Mammoth Lakes, including the physical setting, history, land use, and demographics. This information describes the conditions in the planning area and helps inform the hazard mitigation actions presented in **Chapter 7.**

2.1 Physical Setting

Mono County is located on the eastern slope of the Sierra Nevada, south of Lake Tahoe. Mono County is part of the Basin and Range province of North America, characterized by an alternating parallel series of mountain ranges and flat arid valleys. The County is a long, narrow strip of land—108 miles at its greatest length and 38 miles in average width—bounded to the west by the Sierra crest and to the east by the Nevada state line. In total, the County comprises 3,132 square miles of land area. Several mountain ranges, most notably the Sierra Nevada, as well as Mono Lake, the largest and oldest natural lake entirely within California, are located in the County. The ranges generally run north–south along the western side of the County and drop sharply off into the Long Valley Caldera and arid flatter stretches known as the Great Basin. Although dominated by a largely arid landscape, Mono County has numerous water sources, including hundreds of streams that drain into Mono Lake, the Walker River, or the Owens River. **Figure 2.1** identifies the location of Mono County and prominent geographic features.

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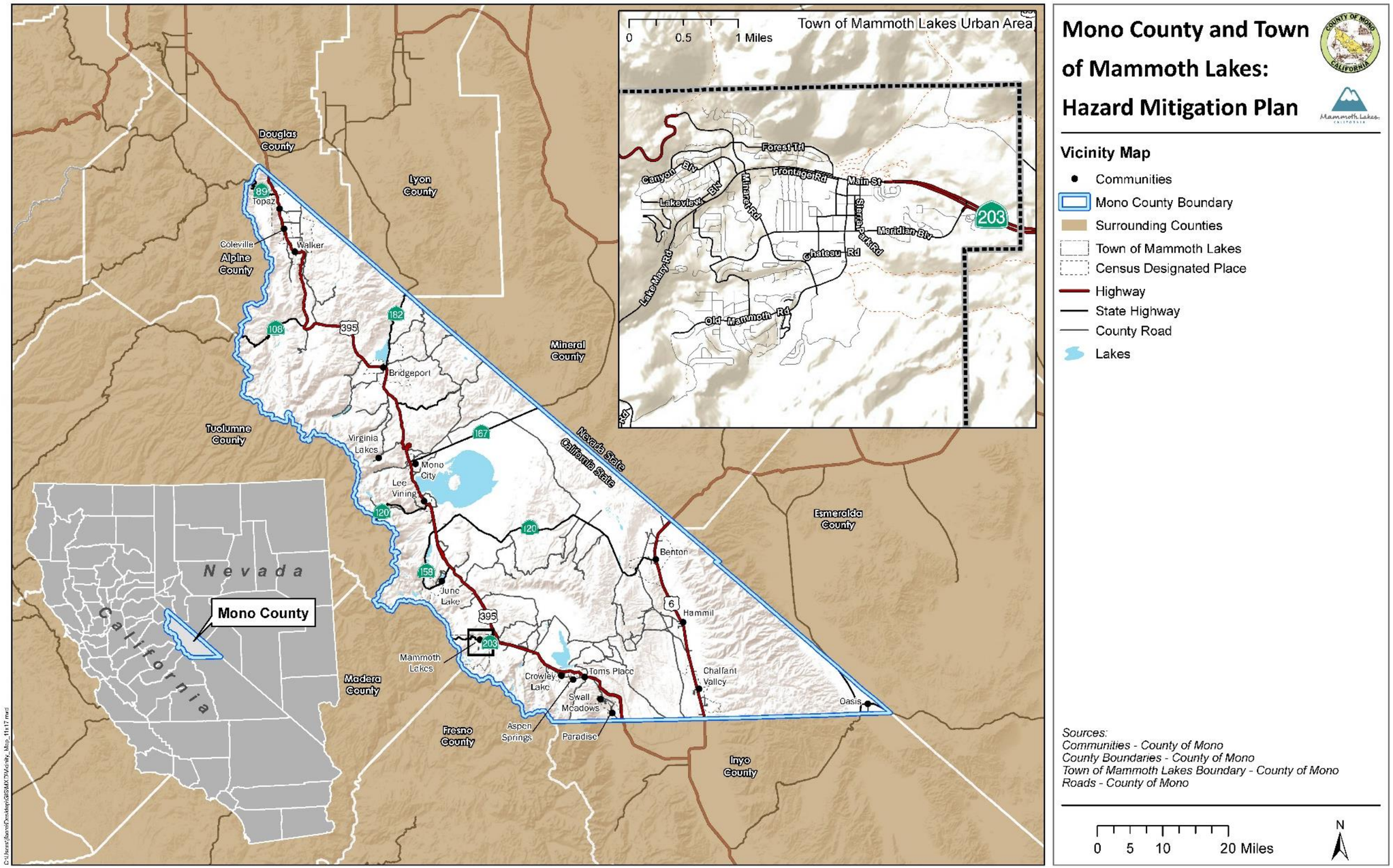
Figure 2.1: Mono County Vicinity Map



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2.1.1 Mono County

The geography and climate of the County make life in the County challenging and isolated. Mono County is rural and sparsely settled. According to the 2010 Census, the population of Mono County was 14,202 people. Despite its isolation, the County also attracts over 1.5 million visitors annually to places such as Mammoth Lakes and Mammoth Mountain and June Lake resorts, generating an estimated $451 million. Access remains limited to one main transportation route, US 395, which runs through the County along the foot of the Sierra for approximately 120 miles. US 6 also serves as main access to the Tri-Valley region of the County, which includes the communities of Chalfant Valley and Benton. Most of the resident population, as well as visitor housing and services, are located in small communities of 300 or less along this main roadway corridor.

By car, Los Angeles is six to seven hours south on US 395; Reno is three hours north on US 395; and the San Francisco Bay Area is six to seven hours west on various routes connecting to US 395. Two additional highways, open seasonally, run through the County connecting to Yosemite National Park and Nevada. The County also has three small public airports.

Approximately 94 percent of the land in the County is publicly owned; much of it is managed by the U.S. Forest Service (USFS) and the BLM. Publicly owned land includes two national forests, the Inyo National Forest and the Humboldt-Toiyabe National Forest, as well as three wilderness areas, the Hoover Wilderness, Ansel Adams Wilderness, and John Muir Wilderness. The LADWP also owns large parcels of land in the southern portion of the County. Mono County is adjacent to other mountainous counties with low and dispersed populations including Alpine, Tuolumne, Mariposa, Madera, Fresno, and Inyo Counties in California and Douglas, Lyon, Mineral, and Esmeralda Counties in Nevada.

2.1.2 Mammoth Lakes

Over half of the County's population lives in the Town of Mammoth Lakes, the only incorporated community in the County. The other half lives in a number of small communities scattered throughout the County. Mammoth Lakes is on the southwest side of the County, accessed by State Route (SR) 203 from US 395. The municipal boundary of the Town is roughly 25 square miles, with approximately 4 square miles in the urban growth boundary that makes up the developed area. It lies along the edge of the Long Valley Caldera, which is geologically active and contains numerous hot springs. SR 203 continues west to provide access to Mammoth Mountain Ski Area and the Devils Postpile National Monument. Lake Mary Road, Old Mammoth Road, Minaret Road, and Meridian Road are primary corridors that loop around the Town. The Mammoth Yosemite Airport is located approximately 8 miles southeast of Mammoth Lakes along US 395. The airport is owned and operated by the Town. Mammoth Lakes is bordered by the Ansel Adams and John Muir Wilderness Areas. The eastern entrance of Yosemite National Park, visited by nearly 4 million people each year, is located 32 miles north of town.

The Town's resident population is roughly 8,000, based on 2016 Census American Community Survey population estimates; however, the number of people in the Town can more than double during peak days of tourist seasons in the winter skiing months and summer recreation months, and reach nearly 40,000 during a holiday weekend.

2.2 History

2.2.1 Mono County

The region of Mono County was settled as early as 12,000 years ago, according to archaeological evidence. Early residents are believed to have initially been mobile hunter-gatherers. Starting around 4,000 to 8,000 years ago, the people of this region settled into more permanent sites. As with modern-day county residents, most native peoples lived in the Great Basin from north of Mono Lake to Owens Lake in Inyo County. The native residents included four tribes: the Owens Valley Paiute (also called the Eastern Mono), the Western Shoshone (also called the Panamint or Koso), the Southern Paiute, and the Kawaiisu (also called the Nuwa). The native peoples of the Inyo County region first came into contact with Europeans in the early 1800s, when fur trappers began to operate in the area.

Mono County was formed in 1861 from parts of Calaveras, Fresno, and Mariposa Counties. Mining was an extensive activity in early Mono County. Bodie—now a protected ghost town—became a boom town in 1876 after the discovery of gold, which attracted thousands of new residents to the town as well as to Mammoth Lakes, Bridgeport, Lee Vining, and other communities that remain populated today. Ranching followed mining as an important draw for residents and outlasted mining as a major economic driver into the early 1900s. The early 1900s also saw the exploitation of other natural resources in Mono County, when the City of Los Angeles controversially purchased large tracts of land in Mono County and neighboring Inyo County in order to divert water from Mono Lake and the Owens River into the Los Angeles Aqueduct, which was completed in 1913.

US 395, which is still the major route into and out of the County along with the limited access provided by US 6, was completed in the early 1930s. Tourism became an increasingly strong economic force in the following decades. Today, the County's economy is driven heavily by tourism, government, and land management activities. Natural resource obtainment (including renewables) and ranching continue to play important supporting roles.

2.2.2 Mammoth Lakes

Mammoth Lakes was initially founded by those interested in mining projects, like most other communities in the County. However, Mammoth's life as a mining town was short-lived and relatively unprofitable, and by the end of the first quarter of the twentieth century, tourism became the region's

number one industry. The Town has grown steadily due to its popularity as a center for outdoor recreation, and as a stop-off on the way to Yosemite National Park.

2.3 Community Demographics

Demographic information and community members' daily activities, travel habits, and level of knowledge about the area can help inform mitigation planners about potential vulnerabilities as well as about which public education-related mitigation actions will be most effective.

Demographic conditions in Mono County and Mammoth Lakes are provided below. Most data is provided for 2015; in cases where such recent data is not available, the year is included for reference. Information is drawn primarily from the 2011–2015 American Community Survey 5-Year Estimates and California Department of Finance 2010–2017 population estimates. It should be noted that modern-day Mono County and Mammoth Lakes remain tourism destinations with much of the economy and infrastructure shaped around this industry. Consequently, many residences and services are only used part of the year, and visitors may alter the population and jobs counts drastically over the course of the year; part-time residents are typically not captured in census or other common demographic survey data.

Table 2.1 identifies the basic demographic makeup of Mono County and the Town of Mammoth Lakes including age, household characteristics, income, race, and educational attainment, all of which can influence vulnerability in disaster events.

Table 2.1 Basic Demographics (2015)

Category	Mono County	Mammoth Lakes
Total population	14,146	8,104
Median age	38.5 years	32.6 years
Elderly population (65+ years)	1,881 (13.3%)	557 (6.9%)
Foreign-born population	2,364 (16.6%)	672 (8.3%)
Number of households	4,906	2,693
Average household size	2.82	2.95
Median household income	$56,944	$55,799
Rental households	1,987 (34.4%)	1,444 (43.7%)

Race/Ethnicity	Mono County		Mammoth Lakes	
	Population	Percentage	Population	Percentage
White	12,379	87.5%	6,938	88.4%

Table 2.1 Basic Demographics (2015)

Black or African American	140	1.0%	44	0.5%
American Indian and Alaska Native	485	3.4%	59	0.7%
Asian	345	2.4%	267	3.3%
Native Hawaiian and Other Pacific Islander	28	0.2%	0	0.0%
Some other or multiple race	1,291	9.1%	799	9.9%
Hispanic or Latino (of any race) *	3,862	27.3%	2,972	36.7%

* The US Census does not count Hispanic or Latino persons as a separate racial or ethnic category. Therefore, the Hispanic or Latino population reported here is also included in the other racial or ethnic categories.

Educational Attainment (25+ years)	Mono County		Mammoth Lakes	
	Population	Percentage	Population	Percentage
Less than 9th grade	890	6.2%	650	8.0%
9th grade to 12th grade (no diploma)	575	4.1%	275	3.4%
High school graduate or equivalent	1,626	11.5%	963	11.9%
Some college (no degree)	2,690	19.0%	1,230	15.2%
Associate degree	777	5.5%	433	5.3%
Bachelor's degree	2,243	15.9%	1,238	15.3%
Graduate or professional degree	889	6.3%	444	5.5%

Note: Due to rounding, the totals presented in this table may not equal the sum of all rows.
Sources: US Census Bureau, American Community Survey (2011–2015)

2.3.1 Mono County

As shown in the table above, over half of Mono County's population resides in Mammoth Lakes. Most of the remaining residents live within unincorporated communities of fewer than 300 full-time residents. Although the approximate number of permanent residents is listed below for each community, communities with a strong recreational attraction may have double or more the listed population from visitors on peak summer and winter tourist days. Unincorporated communities in the County include:

- **Topaz**: The northernmost town in Mono County, Topaz has a residential population of 50 but is a popular recreational destination for casinos, fishing, and water sports. The town abuts Topaz Lake and has moderate hillsides directly to the east along US 395. Topaz is part of Antelope Valley.
- **Coleville and Walker**: Also part of Antelope Valley, and running alongside the Walker River and US 395, the neighboring communities of Coleville and Walker have their history in ranching, with populations of 495 and 721, respectively. Ranching and farming remain an important activity today along with tourist attractions such as water sports and horseback riding. The areas near the river and adjacent to these towns include riparian vegetation, irrigated farmland, and grasses, while the hills to the west have rocky slopes, dry chaparral, and dispersed coniferous trees.
- **Bridgeport**: The county seat, Bridgeport, has a population of 575. It is located in the relatively lush and green Bridgeport Valley surrounded by grasses and farmland.
- **Mono City**: This is a small community of 172 residents located just north of Mono Lake. It is in a relatively flat landscape and is adjacent to Mill Creek, which runs into Mono Lake.
- **Lee Vining**: Located on the southwest side of Mono Lake and near the intersection of US 395 with SR 120, Lee Vining is a frequent shopping point for visitors headed to Yosemite in summer months. The community at the mouth of Lee Vining Creek sits at the foot of several steeply sloped mountains.
- **June Lake**: This community of 629 residents is spread alongside the tall Carson Peak and SR 158. SR 158, also known as the June Lake Loop, provides access to the scenic lakes including June Lake, as well as June Mountain Ski Area and numerous hiking trailheads.
- **Chalfant (or Chalfant Valley), Hammil Valley, and Benton**: These three communities, often referred to as the Tri-Valley area, are home to over 900 residents. US 6 runs north–south through the three communities and into Nevada, while SR 120 connects Benton to US 395. Located in a series of flat valleys, this area forms the largest agricultural basins in the County. While primarily an agricultural community, dramatic landscapes and several hot springs bring many recreational visitors to the area.
- **Crowley Lake/Aspen Springs/Hilton Creek and McGee Creek**: The communities of Crowley Lake/Hilton Creek and the much smaller McGee Creek are located adjacent to each other. On the south side of US 395, Aspen Springs can only be accessed via Crowley Lake Drive. Crowley Lake is a popular recreational destination for fishing and other water sports. With 45 miles of shoreline, Crowley Lake offers a marina, RV sites, boat rentals, and shops. Together the communities have a resident population of just over 1,000, making up the largest urbanized

population in the unincorporated county. Immediately south of the communities are prominent mountain peaks, including Mount Baldwin and Mount Morgan.

- **Tom's Place and Sunny Slopes**: Continuing south along Crowley Lake Drive from Aspen Springs are the small communities of Tom's Place and Sunny Slopes, located on USFS-owned land. Tom's Place is surrounded by dense coniferous forest and primarily made up of cabins, stores, and other facilities that make up Tom's Place Resort. Although the bulk of development is directly adjacent to US 395, several residences in Sunny Slopes are located on the other side of US 395 along Rock Creek Road, which follows Rock Creek for close to 10 miles before dead-ending at the Mosquito Flat trailhead in Inyo County.
- **Swall Meadows and Paradise**: Swall Meadows, and its smaller southern neighbor Paradise, have roughly 220 and 150 residents, respectively. They are residential communities partway up the sloping Sherwin Grade with no commercial development, and surrounded by Great Basin Sagebrush Scrub, Pinyon/Juniper, and Jeffry Pine plant communities. These communities can only be accessed via a single roadway, Lower Rock Creek Road to Swall Meadows Road.
- **Oasis:** The County's southernmost community, and located within 3 miles of the Nevada border along SR 168 where it intersects NV 266, Oasis is isolated from other Mono County communities. With a permanent population of approximately 20, it is also one of the County's smallest communities. Oasis is located in Fish Lake Valley and is surrounded by flat land with dry and bushy vegetation.

Many county residents do not work in the community in which they live. Many residents in the Antelope Valley commute to work in Bridgeport and in Gardnerville, Minden, and Carson City in Nevada; residents of the Tri-Valley area commute to work in Bishop, in Inyo County; and residents of Long Valley, June Lake, and Benton commute to work in Mammoth Lakes. Bridgeport is the only unincorporated community with a large portion of its residents working in the community. Development and rising housing prices in Mammoth Lakes are forcing many residents of Mammoth Lakes to move elsewhere (Crowley Lake, June Lake, Bishop, Chalfant) and commute to jobs in Mammoth Lakes.

Mono County also has many second homes and seasonal use homes. The County had a vacancy rate of nearly 65 percent in 2015 according to 5-year American Community Survey census data (source 2011–2015 DP04). This unusually high rate reflects the large number of vacation homes and seasonal use units in the area, many of which remain vacant for the majority of the year.

Development in most unincorporated Mono County communities is primarily residential, supported by small-scale commercial uses serving local and tourist/recreational needs. Limited light industrial uses, such as heavy equipment storage and road yards, occur in some communities. Most communities also

have some public facilities such as schools, libraries, community centers, and parks and ballfields, and some support government offices (i.e., Bridgeport).

2.3.2 Mammoth Lakes

The Town is a four-season resort community with a small permanent population and many seasonal or one-time visitors. Vacation residences and lodging facilities accommodate a substantially larger population of second homeowners and visitors than the Town's 8,000 permanent residents. The local economy is based primarily on tourism, especially during summer and winter months when visitation rates are highest. Winter conditions support skiing, snowboarding, and other outdoor recreational uses. In the summer, hiking, fishing, camping, bicycling (mountain and road), golfing, and sightseeing are popular resident and visitor activities. Since the Town's economy is tourist-driven, much of the resident population works in the service industry; other large employers include government and Mammoth Hospital.

Mammoth Lakes is located close to US 395, but can only be accessed via SR 203, seasonally by Sherwin Creek Road, and, except in heavy snowstorms, via Mammoth Scenic Loop. Southern portions of the city, notably Old Mammoth, the Bluffs, Valentine Reserve, and Lake Mary area, can only be accessed via Old Mammoth Road and Lake Mary Road. The Town is located on the lower slopes of Mammoth Mountain with dense coniferous forest.

2.4 Land Uses

2.4.1 Ownership

For the purposes of this Plan, understanding land ownership is important for developing mitigation actions and policies that are both appropriate and within the jurisdictional control of the County and Town. These are the areas the Plan will most directly be able to impact. Lands owned by the state or federal government have separate governing bodies that are responsible for ensuring appropriate mitigation of both natural and human-caused hazards. **Figure 2.2** identifies broad categories of ownership for the County and Town. **Table 2.2** shows the acreage distribution of these categories of ownership. While the entire County was analyzed regarding hazard and risk, lands identified as local and private are the focus of the mitigation actions in this Plan. **Table 2.3** shows similar ownership patterns within the Town of Mammoth Lakes' municipal boundary alone, also divided between public and private lands.

Table 2.2 Mono County Land Ownership

Owner	Acres	Percentage
Federal	1,720,939	85.54%
State	83,966	4.17%
Private	128,385	6.38%
Utilities	67,081	3.33%
County	2,266	0.11%
Town of Mammoth Lakes	*215*	*0.01%*
Right of Way	8,960	0.45%
Unknown	109	0.01%
Total	**2,011,921**	**100**

Mono County

Land uses in Mono County are dominated by open space and natural resource areas owned by various federal agencies. The state of California and the City of Los Angeles (as the LADWP) also own considerable amounts of land, which is generally used for open space, or water conveyance. Federal agencies, including the Humboldt-Toiyabe National Forest, Inyo National Forest, and BLM Bishop Field Office, own much of the remaining land, and parts of the County are also under the jurisdiction of tribal governments, which is calculated under the federal land category. SCE and other utilities own lands for dams, power conveyance, water storage, and similar uses. Private entities and individuals make up the remainder of land ownership in the County for agriculture and ranching, residential, industrial, and commercial uses. Most privately-owned land is contained within unincorporated community areas.

Mammoth Lakes

In Mammoth Lakes, most land is dedicated to residential uses, leisure and recreation facilities (particularly ski-related facilities), public and semipublic institutional uses, open space, industrial uses, Mammoth Yosemite Airport, and other commercial uses. The Town's 25-mile municipal boundary includes large swaths of land within National Forest and BLM, while most land within the Town's urban growth boundary is owned by private entities or individuals.

Figure 2.2: Land Ownership in Mono County

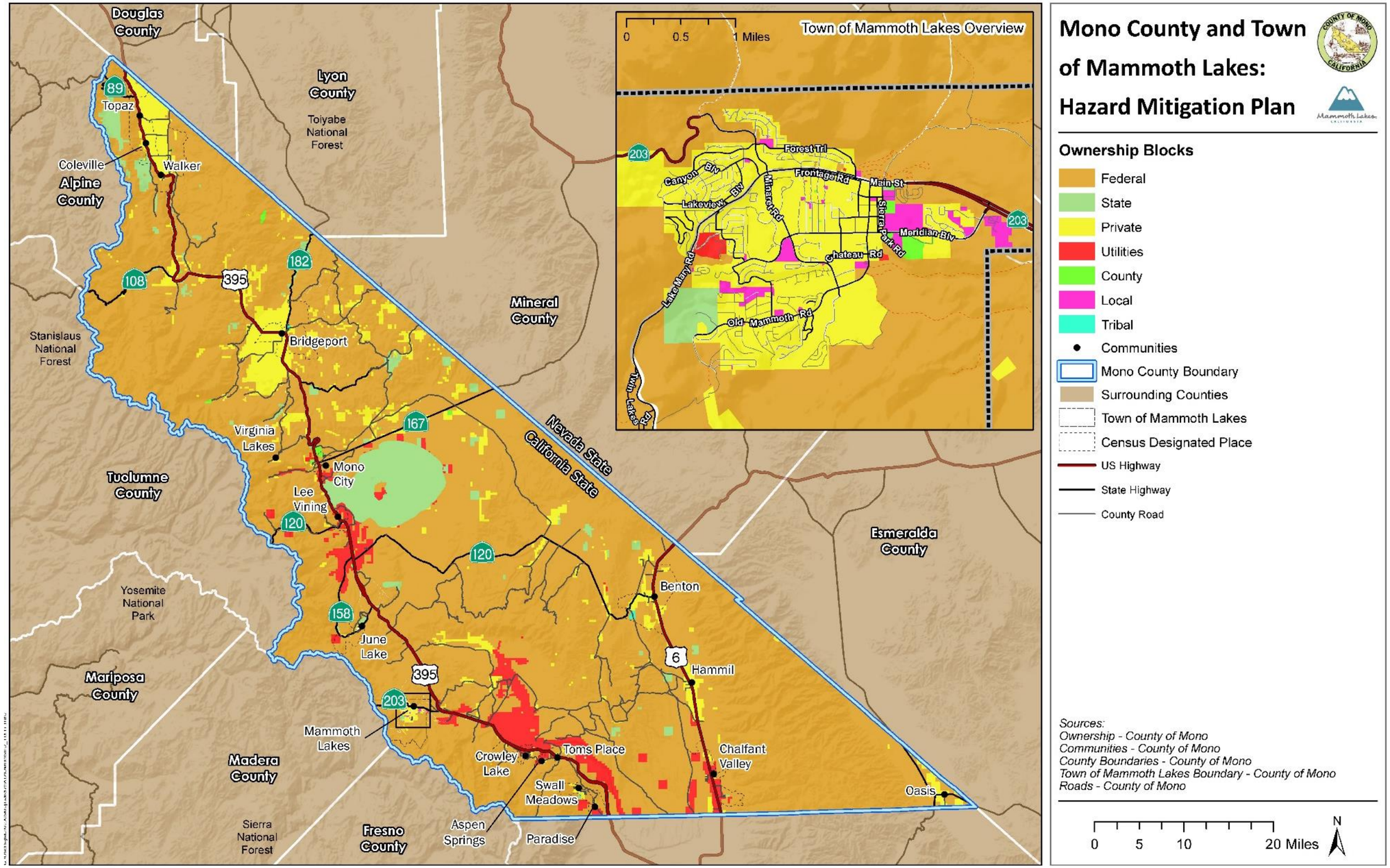

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Table 2.3 Mammoth Lakes Land Ownership within Municipal Boundary

Owner	Acres	Percentage
Federal	12,832	80.06%
State	2	0.01%
Private	2,387	14.89%
Utilities	37	0.23%
County	44	0.27%
Local	189	1.18%
Right of Way	537	3.35%
Total	**16,027**	**100.00**

Note: Due to rounding, the totals presented in this table may not equal the sum of all rows.
Source: Mono County 2017

2.4.2 Land Use Designations

Figure 2.3 identifies locations of various types of planned land uses in Mono County and the Town of Mammoth Lakes.

Mono County

The Mono County General Plan assigns a land use designation to all land located in the unincorporated areas of the County, including land that is not under the County's jurisdiction. No land may be developed or used in the County except in the manner permitted by its assigned designation. The General Plan also requires that potential development of land be evaluated in terms of potential natural hazards and available infrastructure, access, and public services and response, as described in the Land Use Designation Criteria section of the General Plan Land Use Element. Relevant portions of the County's Zoning Code, which provides more specific development requirements, are incorporated into the General Plan. **Table 2.4** shows land uses in the unincorporated areas and examples of uses permitted within those designations.

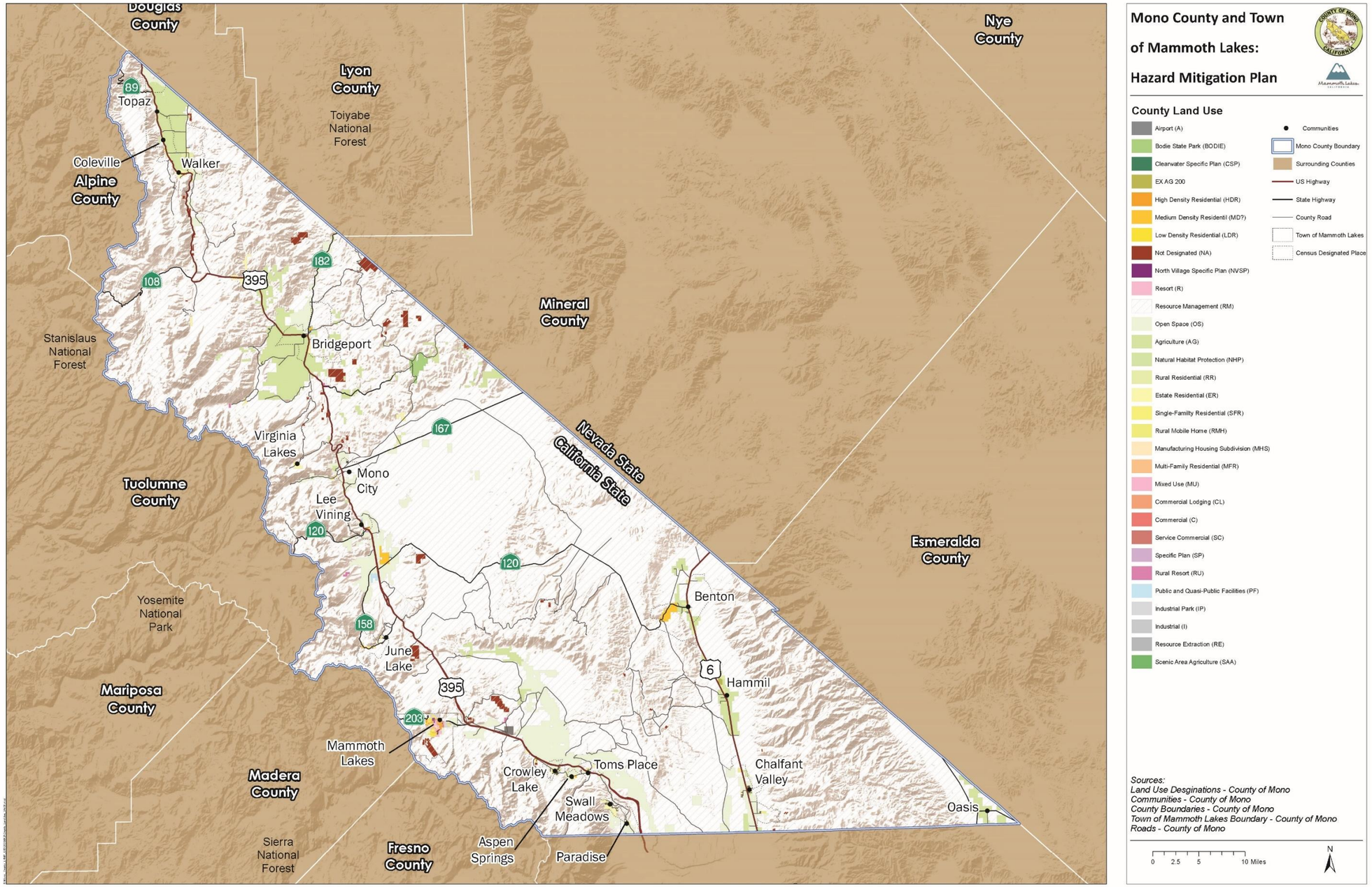
Table 2.4 Unincorporated Mono County Land Use Designations

Land Use Category	Example Land Uses
Agriculture	Cattle rangeland, croplands
Commercial	Retail, banks, offices
Commercial Lodging	Hotels, motels
Estate Residential	Single-family dwelling on large lot

Table 2.4 Unincorporated Mono County Land Use Designations

Land Use Category	Example Land Uses
Industrial	Manufacturing plant, heavy vehicle storage
Industrial Park	Office park, laboratory
Mixed Use	Book store + townhome, dental office + restaurant
Multi-family Residential	Condos, 4+ unit apartment building
Natural Habit Protection	Wildlife habitat, wetland
Open Space	Equestrian trail, cross-country ski touring
Public and Quasi-Public Facilities	Public utility building, airport
Resource Extraction	Mine, solar power plant
Resource Management	Avalanche-prone area, water conservation area
Rural Mobile Home	Mobile home on large lot
Rural Residential	Single-family dwelling unit w/ancillary rural uses
Rural Resort	Single-family dwelling unit, limited outdoor recreation and visitor-oriented facilities
Scenic Area Agriculture	Agricultural use consistent with the Mono Basin National Forest Scenic Act
Service Commercial	Car sales lot, plumbing services shop
Single-Family Residential	Single-family dwelling unit
Specific Plan	Planned development in areas outside existing communities complying with a specific plan
Source: Mono County General Plan	

Figure 2.3: Mono County Land Use Map



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

County Land Use

- Airport (A)
- Bodie State Park (BODIE)
- Clearwater Specific Plan (CSP)
- EX AG 200
- High Density Residential (HDR)
- Medium Density Residentil (MD?)
- Low Density Residential (LDR)
- Not Designated (NA)
- North Village Specific Plan (NVSP)
- Resort (R)
- Resource Management (RM)
- Open Space (OS)
- Agriculture (AG)
- Natural Habitat Protection (NHP)
- Rural Residential (RR)
- Estate Residential (ER)
- Single-Family Residential (SFR)
- Rural Mobile Home (RMH)
- Manufacturing Housing Subdivision (MHS)
- Multi-Family Residential (MFR)
- Mixed Use (MU)
- Commercial Lodging (CL)
- Commercial (C)
- Service Commercial (SC)
- Specific Plan (SP)
- Rural Resort (RU)
- Public and Quasi-Public Facilities (PF)
- Industrial Park (IP)
- Industrial (I)
- Resource Extraction (RE)
- Scenic Area Agriculture (SAA)

- Communities
- Mono County Boundary
- Surrounding Counties
- US Highway
- State Highway
- County Road
- Town of Mammoth Lakes
- Census Designated Place

Sources:
Land Use Desginations - County of Mono
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

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Community Planning Areas

In addition to the countywide Land Use Element and land use designations, land use in unincorporated communities is further guided by area plans. Area plans possess the same regulatory authority as countywide land use policies, serving to further refine those policies to address the needs of a community or area. Each community area also has identified opportunities and constraints, many of which relate to access, infrastructure, and vulnerability to hazards. While the entire County was analyzed regarding hazard and risk, the focus of many mitigation actions in this Plan will be upon needs and actions for specific community areas defined by the sixteen area plans. Large portions of the County are not located within any planning area; most of these portions are federal land with little or no population or development.

Regional Planning Advisory Committees

RPACs cover one or more planning areas and were established by the Board of Supervisors to assist the Planning Department in developing and updating planning policies and regulations. RPACs were established for Antelope Valley, Bridgeport, June Lake, Mono Basin (including Mono City and Lee Vining), and Long Valley. Residents of the Upper Owens area met to develop land use policies for that area; similarly, landowners in the Benton Hot Springs area met to develop land use policies for their valley. **Table 2.5** identifies key summary information about the planning areas. The planning areas with area plans are identified in **Figure 2.4**.

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Table 2.5 Community Planning Areas Summary

Community Planning Area	Communities	Community Advisory Body	Topography	Land Uses	Assumed Buildout (units)
Antelope Valley	Topaz, Coleville, Walker	Antelope Valley RPAC	Flat valley; gentle and steep slopes valley floor; several running waterways	Predominantly residential; limited commercial, lodging, agriculture, public uses	1,586
Benton Valley	Benton Valley	Benton/ Hammil Community Meetings	Flat valley; rolling hills; hot springs	Predominantly residential; limited commercial, lodging, public uses	729
Bodie Hills	Dispersed properties	Inactive	Low mountain range; steep valley floors	Low density residential; agriculture	317
Bridgeport	Bridgeport	Bridgeport Valley RPAC	Flat valley; steep slopes; adjacent to Bridgeport Reservoir	Mixed density residential; commercial; lodging; entertainment; public facilities	3,166
Chalfant	Chalfant	Chalfant Valley Community Meetings	Flat valley	---	542
Hammil Valley	Hammil Valley	Benton/Hammil Community Meetings	Flat valley	Low density residential; limited commercial; agriculture	285
June Lake	June Lake, Crestview	June Lake Citizens Advisory Committee	Gentle and steep slopes several water bodies	Predominantly residential; limited commercial, lodging, public uses	3,011

Table 2.5 Community Planning Areas Summary

Community Planning Area	Communities	Community Advisory Body	Topography	Land Uses	Assumed Buildout (units)
Crowley	Crowley Lake/Hilton Creek, Aspen Springs, Sunny Slopes, Tom's Place, McGee Creek	Long Valley RPAC	Gentle and steep slopes, valley floor; several water bodies	Predominantly residential; limited commercial, lodging, public uses	1,839
Mammoth Vicinity	Dispersed properties	None	Flat valley; gentle slopes	Low density residential; agriculture	17
Mono Basin/Mono Basin North	Mono City, Lee Vining	Mono Basin RPAC	Low slopes, adjacent to Mono Lake	Predominantly residential; limited commercial, lodging, public uses	880
Oasis	Oasis	Direct property owner contact	Flat valley	Limited residential; agriculture	102
Paradise	Paradise	Paradise Community Meetings	Flat valley adjacent to running water bodies and steep slopes	Limited residential; agriculture	199
Sonora Junction	Marine Corps Mountain Warfare Training Center	None	Gentle and steep slopes; high peaks; several small waterways	Low density residential; military; public facilities	138
Swauger Creek	Dispersed properties	Inactive	Gentle and steep slopes; high peaks; several small waterways	Wildlands	8
Upper Owens	Dispersed properties	Direct property owner contact	Flat valley; gentle and steep slopes	Low density residential; agriculture	52

Table 2.5 Community Planning Areas Summary

Community Planning Area	Communities	Community Advisory Body	Topography	Land Uses	Assumed Buildout (units)
Wheeler Crest	Swall Meadows	Wheeler Crest Community Meetings	Gentle and steep slopes	Low density residential; limited commercial; agriculture	389
Outside Planning Area	Virginia Lakes; Dispersed properties	None	Flat valley; gentle and steep slopes; high peaks; valley floor; several running waterways	Low density residential; limited commercial; agriculture; wildlands	670

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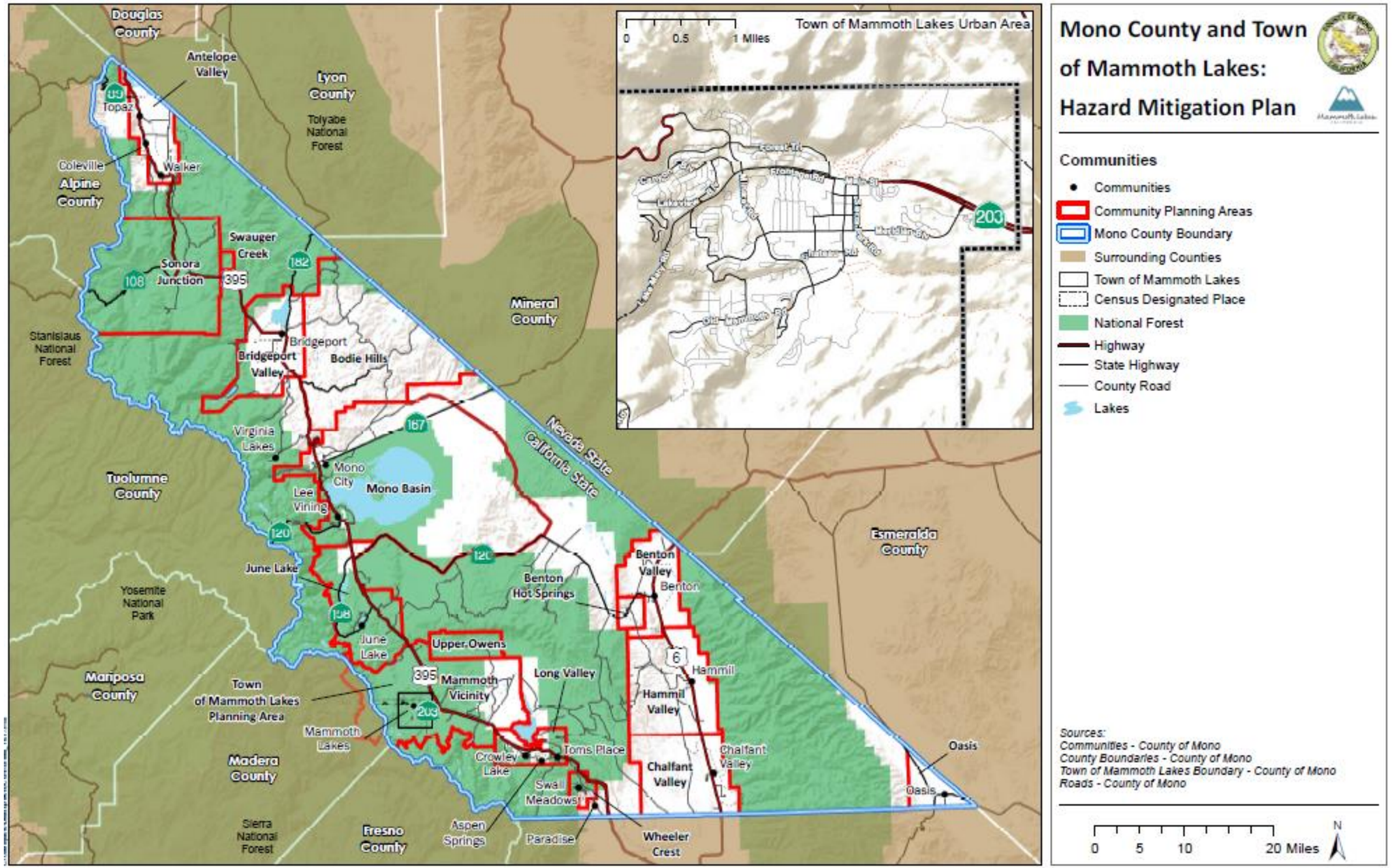
Figure 2.4: Community Planning Areas



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Mammoth Lakes

The Town includes areas within the town's current 25-square-mile municipal boundary, which includes both developed areas that make up the urban growth boundary and areas that are primarily federally owned open spaces with highly dispersed development and limited or no services provided. The Town's planning area extends beyond its municipal boundaries and encompasses some land in the Mammoth Vicinity Community Planning Area in unincorporated Mono County, extending from the Whitmore Recreation area on the east to the Mammoth Scenic Loop on the north, in which the Town does not have jurisdiction but provides some municipal services. The planning area also includes Inyo National Forest lands (located in Madera County) that have their sole vehicular access through the Town of Mammoth Lakes.

The Mammoth Lakes General Plan assigns a land use category to all land located within existing Town boundaries. The planning area outside the Town boundary that is within the Town's sphere of influence is directly guided by County land use designations.

In support of the land use categories, all property in the Town also has a zoning designation established by the Town's Zoning Code. The zoning designations specify allowable uses for real property and size restrictions for buildings constructed in these areas; the zoning ordinance helps implement the land use policies established in the General Plan. The Town's Zoning Code was originally adopted in 1984, but a comprehensive Zoning Code update was undertaken in 2014.

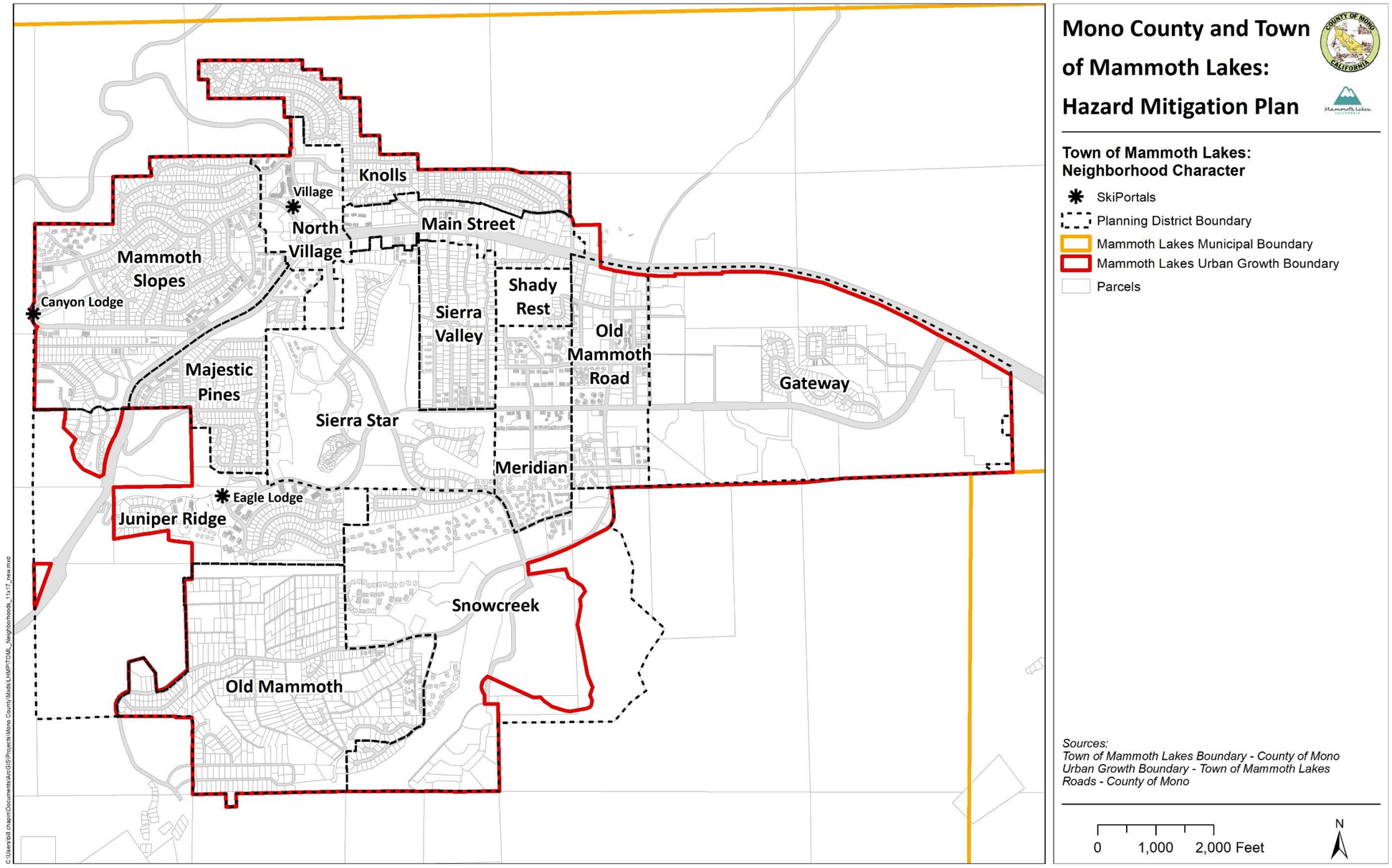
The Town's General Plan organizes land development and design and growth standards through specific districts within the Town. Mammoth Lakes is composed of approximately twelve districts and four mountain portals, which are further defined by specific, master, and district plans. District boundaries are defined by existing development, patterns of vegetation, topographic features, circulation patterns, and the pattern and relationships of land uses. Consequently, certain mitigation actions in this Plan may focus on or refer to specific districts or mountain portals, shown in **Figure 2.5** below.

The mix and composition of land uses, housing, employment, lodging, and amenities are subject to the character and objectives for the underlying district or portal. The Town's plan incorporates 14 distinct land use designations that guide development. **Table 2.6** shows land use designations and examples of uses permitted within those designations, and **Figure 2.6** identifies land use distribution in the Town.

Table 2.6 Mammoth Lakes Land Use Designations

Land Use Category	Example Land Uses
Low Density Residential 1 (LDR-1)	Single family detached residential development at a maximum density of two (2) dwelling units per acre.
Low Density Residential 2 (LDR-2)	Single-family detached residential development of up to four (4) units per acre.
High Density Residential 1 (HDR-1)	Residential multi-unit townhouses, condominiums, and apartments with density ranging from 6-12 units per acre.
High Density Residential 2 (HDR-2)	Transient visitor lodging and residential multi-unit style developments including townhouses, apartments, and condominiums.
Commercial 1 (C-1)	Medium scale commercial mixed uses.
Commercial 2 (C-2)	Medium and large scale commercial mixed uses.
Resort (R)	Commercial mixed uses including visitor lodging, amenities and services, and workforce housing.
Institutional Public (IP)	School, hospital, government offices and facilities, museums, and related uses.
North Village Specific Plan (NVSP)	Hotels and similar visitor accommodations along with supporting restaurants, retail, and services.
Industrial (I)	Light manufacturing and service uses such as heavy equipment storage and maintenance, batch plants, auto repair and service.
Airport (A)	Aviation, fueling, and fixed-base operator services at the Mammoth Yosemite Airport.
Open Space (OS)	Parks, athletic fields, golf courses, community gathering spaces and supporting facilities.
National Forest (NF)	National Forest lands administered by the Inyo National Forest.
Clearwater Specific Plan (CSP)	Hotel, condominium-hotel, workforce housing, street front retail along Old Mammoth Road and a large public plaza intended for use as an event venue.

Figure 2.5: Town of Mammoth Lakes Districts and Portals



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Town of Mammoth Lakes: Neighborhood Character

- SkiPortals
- Planning District Boundary
- Mammoth Lakes Municipal Boundary
- Mammoth Lakes Urban Growth Boundary
- Parcels

Sources:
Town of Mammoth Lakes Boundary - County of Mono
Urban Growth Boundary - Town of Mammoth Lakes
Roads - County of Mono

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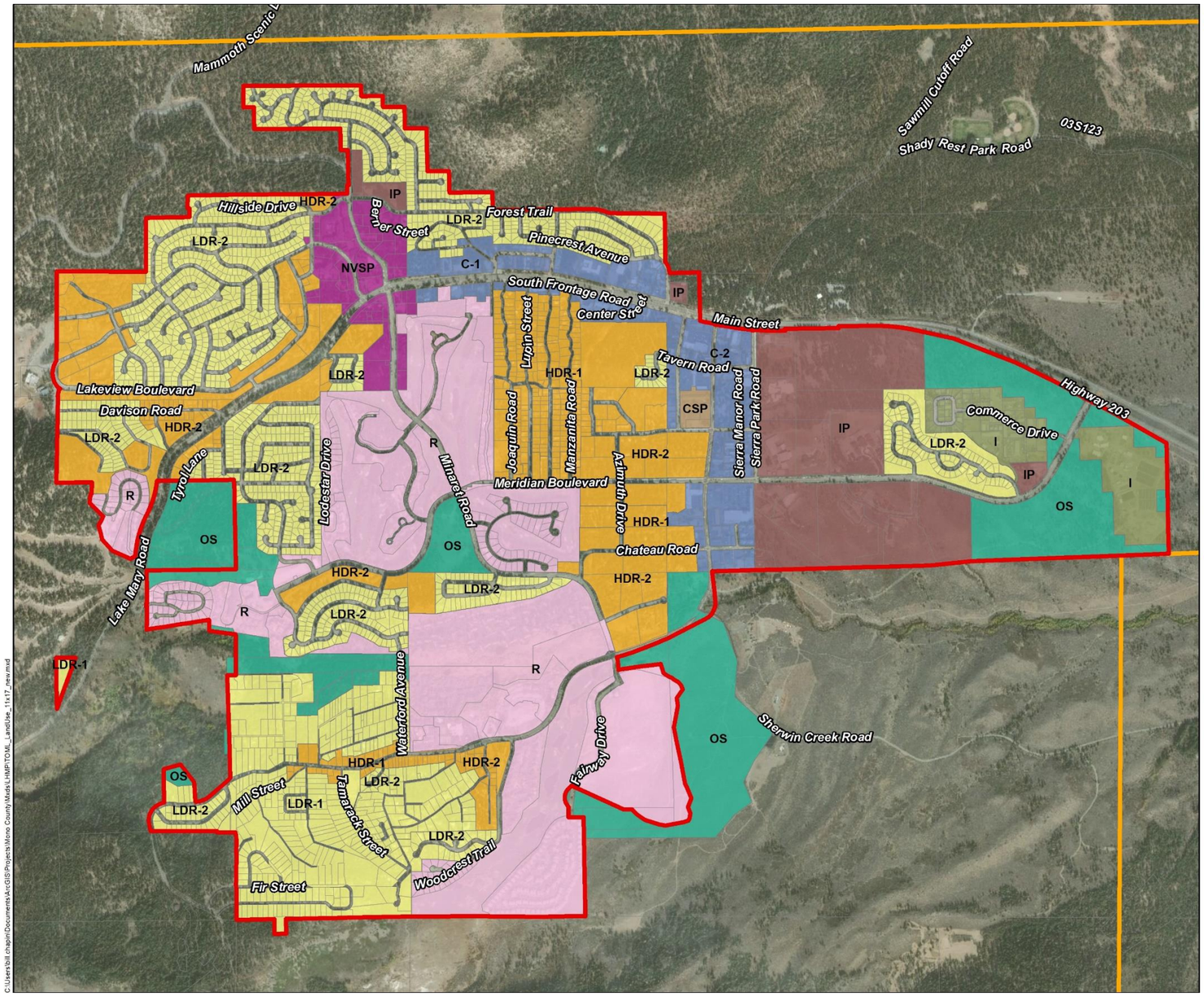
Figure 2.6: Town of Mammoth Lakes Land Use Map



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2.4.3 Agricultural Lands

Loss of agriculture and farmland to urban development can exacerbate natural hazards and vulnerabilities as well as impact other aspects of the County's economic, cultural, and environmental well-being. Consequentially, agricultural land uses are evaluated in this Plan and may be specifically addressed in mitigation actions. The 2012 Census of Agriculture reported that there were 72 farms in the County, a slight increase from the total of 63 farms reported in the 1997 Census of Agriculture. Total farmland acreage, however, decreased by more 12,427 acres in 1997 to 56,386. The value of Mono County agricultural production also fell from $18.3 million in 1997 to $17.9 million in 2012. This is consistent with statewide trends of loss of agricultural and farmland acreage and productivity.

Prime Farmland is defined as "land that has the best combination of physical and chemical characteristics for the production of crops." Numerous specific criteria relating to water availability, water table, soil chemistry, flooding, erodibility, and physical soil characteristics must be met for land to be considered Prime Farmland. The Soil Conservation Service (now the National Resource Conservation Service, NRCS) has mapped most of these characteristics for Mono County, but Mono County has not yet been included in the Farmland Mapping and Monitoring Program (NRCS 2017). Mono County has included a number of these attributes in an online geodatabase (https://www.bistatesagegrouse.com/general/page/geodatabase).

2.5 Development Trends and Future Development

2.5.1 Mono County

As previously discussed, nearly 94 percent of the County's 3,132 square miles are publicly owned and used mostly for resource conservation or open space due to a high percentage of lands under public ownership. Most developed property in the unincorporated county is located within 16 community areas, and roughly half of the population and economic activity occurs within the incorporated Town of Mammoth Lakes. The countywide growth rate over the next 20 years as projected by the California Department of Finance is between 0.55 percent and 0.80 percent annually. The unincorporated area will probably continue to house slightly less than half of the total County population (42 percent in 2010), although the population distribution among the unincorporated areas may shift over that time frame. A County staff report prepared for the Mono County Housing Authority in 2016 indicates that the County issued between 15 and 20 permits each month between 2010 and 2015, which included new development, replacement structures, and remodels or alterations. The County issued a total of 303 permits in the calendar year of 2015, representing the first time that total permits issued reached above the 300 mark since the housing boom years of 2006–2008. Staff attributed some of this increase to replacement and rebuilding efforts after the 2015 Round Fire. Most permits were for individual or small

batch residential units, with a small number of additional permits for commercial or restaurant uses. This development pattern is not anticipated to change, due to the small scale of communities in Mono County and the lack of employment opportunities in most communities. The County has had a decline in permits recently, with 206 permits issued in 2017 and 163 issued in 2016.

The County's General Plan Land Use Element contains policies that focus future growth in and adjacent to existing communities. Substantial additional development outside of existing communities is limited by environmental constraints, the lack of large parcels of private land, and the cost of providing infrastructure and services in isolated areas. Land use policies for unincorporated community areas focus on sustaining the livability and economic vitality of existing community areas. The General Plan also specifically allows for expansion and development at the Bryant Field and Lee Vining Airports and in the area surrounding each airport.

Since growth that has occurred since the last MJHMP update in 2006 has been limited and largely only occurred within existing communities, the only major changes in risk and vulnerability relate to density of development. This Plan identifies vulnerabilities of the few new areas that have been developed since 2006, and reemphasizes areas in currently developed areas where development should be discouraged or prohibited. Additionally, since the 2006 MJHMP, the County and Town have taken multiple actions to better enforce floodplain management (described in **Section 5.3**).

2.5.2 Mammoth Lakes

The Town of Mammoth Lakes maintains an urban growth boundary, as established in its General Plan. An overarching principle of the community is to maintain the Town's compact urban form, protect natural and outdoor recreation resources, and prevent sprawl. The Town's urban growth boundary limits the area available for future development to achieve these principles. Because of this, as well as the fact that the area outside the urban growth boundary is predominantly federal land, all new development will likely occur only within those boundaries.

Vacation residences and lodging facilities in town accommodate a substantially large population of second homeowners and visitors. Overall, the Town is prone to large fluctuations in the total non-resident population because of the seasonal nature of its tourism-dependent economy. During the winter tourist season, the community and ski area require a large number of seasonal employees (more than can be filled by the full-time resident community) to meet peak service demands. As a result, the resident population increases by approximately 3,000 during the peak tourism season in addition to the influx of tourists.

Accordingly, the Town considers the development needs of nonresident and visitor populations at peak tourist season as well as resident populations when planning for future growth. The Town's General

Plan anticipates that, at buildout, the projected number of residents, visitors, and workers on a winter weekend will grow to over 53,000; it thus establishes a policy of a total peak population of residents, visitors, and employees of 53,091 people. The General Plan anticipates that the permanent population will grow at a rate of between 1.4 percent and 2.4 percent per year.

To accommodate growth, the Town anticipates the development of a number of planned developments within the urban growth boundary. The bulk of this development will be a mix of resort-style development and new housing. The General Plan also anticipates that most new commercial development will take place in the Resort, North Village, and Commercial 1 and 2 land use designations. Industrial development will be limited primarily to the Industrial designation, although there will be a small amount of industrial development in other designations. The total amount of industrial development at buildout is anticipated to be approximately 500,000 square feet.

Between 2009 and 2014, very little new development occurred. In 2015, several new multifamily structures and a handful of new single-family homes were built in the Snowcreek neighborhood. The Town has a number of specific plans and large development master plan projects under review or entitled as of 2016. Most of these potential development areas are infill. Major projects approved or planned as of 2016 are described in **Table 2.7**.

Table 2.7 2016 Major Development Plans

Development Name	Description
Snowcreek VIII Master Plan	790 dwelling units, 400 hotel rooms, 20,000 sq. ft. commercial
Juniper Ridge Master Plan	106 dwelling units, 80,000 sq. ft. commercial (day lodge and other)
Lodestar at Mammoth Master Plan	500 hotel rooms, 82 dwellings units, 80,000 sq. ft. of commercial
Mammoth Crossings	742 hotel rooms total, 40,500 sq. ft. of commercial
Canyon Lodge Redevelopment	Reconfiguration of lodge and new skier service facility
Ritz Carlton Site	93 condominium units with lock-offs totaling 225 keys, 5,000 sq. ft. restaurant
Inn at the Village	67 hotel rooms, a spa, pool terrace
Sierra Star Area 2	210 dwelling units
Old Mammoth Place	487 resort hotel rooms, 40,000 sq. ft. of commercial, 9,500 sq. ft. of conference center use
Shady Rest Parcel	55 single family residential units, 117 multifamily apartment units, dedication of 6 acres for open space
DSES Wounded Warrior Center	Two-story mountain lodge with up to 38 full-time residents, flexible shared common space

The development that has already occurred and the development that is in progress does increase the Town of Mammoth Lake's overall vulnerability. However, this MJHMP update recognizes specific areas and neighborhoods that have expanded in the Town of Mammoth Lakes and identifies key infrastructure improvements and development requirements that are necessary in these areas. The identified infrastructure improvements and development requirements will help mitigate the increase in vulnerability that typically comes with development.

2.6 Infrastructure Systems and Critical Facilities

Much of the County and Town's ability to mitigate for, as well as prepare for and respond to, disaster relies on critical facilities. Most critical facilities in the County are provided either by the County, by the Town, or by special districts such as those for fire protection or public utilities. Critical facilities are typically focused on properties that are of specific value to the community. They include many key infrastructure systems: the transportation network including roads, airports, and helipads; communications including telephone, radio, and internet; lifeline utilities including electricity service, gas and propane service, water and sewer service facilities, and snow removal equipment; and hazardous materials disposal sites such as landfills. These systems are described in greater detail below. They also include emergency services facilities directly used by emergency responders such as police stations, fire stations, and paramedics stations. Additionally, critical facilities encompass public facilities that can act as emergency operations centers, such as community centers; county or town offices; and facilities that meet community needs, provide community gathering places and staging areas, and support vulnerable populations, such as medical facilities (e.g., hospitals, clinics), schools, and senior living centers.

Infrastructure systems, most notably roads and electricity lines, stretch across the entire County and are not itemized below, although overpasses, power stations, and substations are included. **Table 2.8** shows the number and values of different types of critical facilities for the County and Town. A full list of critical facilities by planning area is provided in **Appendix C**.

Table 2.8 Critical Facilities by Type

Facility Type	Unincorporated Mono County	Mammoth Lakes
Communications Facilities	9	10
Emergency Operations Center	8	4
Emergency Services	21	5
Hazardous Materials	10	0
Lifeline Utility Systems	46	9

Table 2.8 Critical Facilities by Type

Facility Type	Unincorporated Mono County	Mammoth Lakes
Medical Services	2	2
Schools	6	5
Transportation Systems	9	1
Vulnerable Populations (senior living facilities)	5	0
Total	**116**	**36**

Most of these facilities are located along or very near US 395 or SR 6. The largest concentrations of facilities are in the County seat, Bridgeport (27 facilities), or Mammoth Lakes (36 facilities). **Figure 2.7** identifies the locations of critical facilities by category in the County and Town.

2.6.1 Communications

Telecommunications infrastructure and services are critical components of emergency response, as well as long-term growth and sustainability for the County, as they provide the basic resources necessary for businesses to operate and add to the quality of life for its residents. Communications services cross several major technologies and infrastructure components and include basic telephone, wireless telephone, radio, and broadband internet. Due to the isolated locality of the County, inadequate infrastructure and service across all these communication technologies are major challenges.

An Information Technological Strategic Plan, completed in 2015 and adopted by both Mono County and the Town of Mammoth Lakes, provides goals for improving communications operations and infrastructure.

General Response Protocol

Any call to 911 placed from a landline phone from within the County is routed directly to Mono County Dispatch in Bridgeport. Any 911 call placed via a cell phone is routed to the CHP in Bishop or to Mono County Dispatch, depending on the caller's location and device capabilities. If the call is routed to CHP, it is then transferred to Mono County Dispatch. If Mono County Dispatch is down for any reason, all calls are routed to Inyo County Dispatch. There is solid coordination between the agencies to ensure that all 911 calls are answered and properly routed.

Internet and Mobile Broadband

Historically, Mono County has suffered from a lack of quality broadband due to its rural nature and low population with dispersed community areas. Landline phone, internet, and TV service was, and still is

for many communities, provided by only a few providers, including Frontier Communications and Verizon. Internet speeds with these services are typically very slow, and in some cases landline phone services are unreliable.

However, in 2013, a $120 million fiber optic project was completed which opened a new era of opportunity for the Eastern Sierra region. Known as Digital 395, the project completed an open-access network capable of delivering petabytes of data to Mono, Inyo, and eastern Kern Counties. The project encompassed 36 communities, six Native American reservations, two military bases, over 25,000 households, and 2,500 businesses. As of 2016, 85 percent of the households in Mono County have access to gigabit internet service at 50 percent of the cost per megabit (on a per capita basis), and installations are still ongoing. However, smaller communities located away from US 395, and which have so far not gone through the process to tap into the main line as part of the project, may still have limited to no internet access. To facilitate delivery of last-mile internet service off the Digital 395 backbone, Race Communications will install strand and fiber on existing utility poles and install fiber in existing underground conduit and newly proposed underground conduit, along with associated infrastructure (power vaults and distribution panels) in various Mono County communities. For these communities, final line connections may require long waits and the expense of several hundred to several thousand dollars. Some very small communities are not included in this project and may still not have broadband access after the project's completion.

Additionally, according to the Mono County General Plan, remaining issues include the data caps that are placed on customers, the overall cost of the service, and the typical requirement of a long-term contract to receive the service.

Cellular Service

Cellular coverage in the County is incomplete. Service in Mammoth Lakes and its mountain portals is generally reliable. For the most part, some form of cellular coverage also exists in almost every unincorporated community area; however, it is carrier-dependent. AT&T and Verizon are the two main carriers. Their coverage models overlap, but each carrier does not provide the same level of coverage in the same areas. Service in large portions of the County's primary highway corridors is spotty, and away from the main road and urbanized communities it is often unreliable or nonexistent.

Since the number of cell phone towers is limited and they are spread far apart, network capacity is also limited. Even in more developed areas with generally good service, network capacity may be quickly overloaded during an emergency event.

Cellular service is increasingly important as more and more households do away with landline connections, and with the increasing use of reverse 911 technology to reach community members during hazard events.

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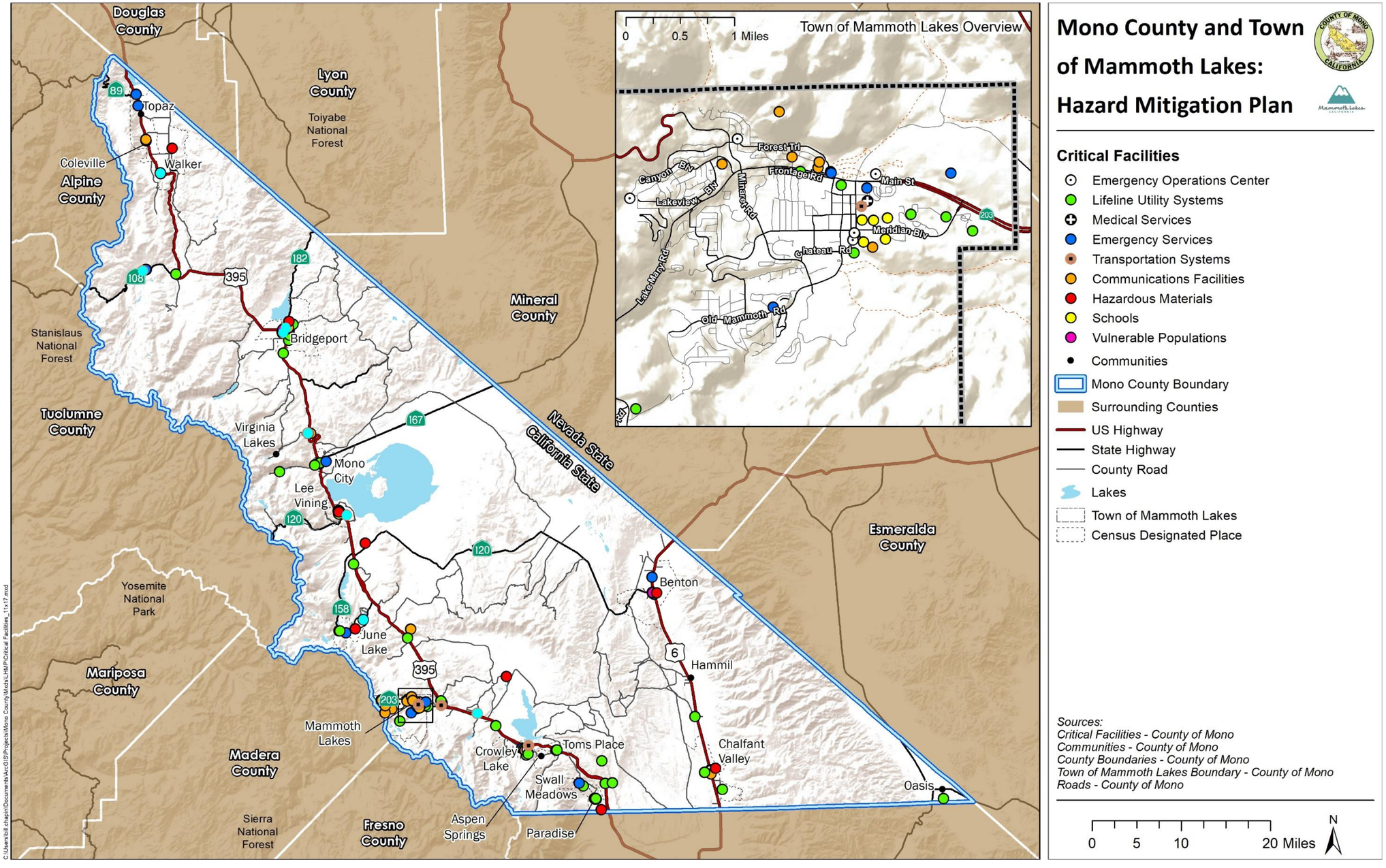
Figure 2.7: Critical Facilities



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Critical Facilities

- Emergency Operations Center
- Lifeline Utility Systems
- Medical Services
- Emergency Services
- Transportation Systems
- Communications Facilities
- Hazardous Materials
- Schools
- Vulnerable Populations
- Communities
- Mono County Boundary
- Surrounding Counties
- US Highway
- State Highway
- County Road
- Lakes
- Town of Mammoth Lakes
- Census Designated Place

Sources:
Critical Facilities - County of Mono
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

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Radio

Interoperable communications is one of the most critical components to emergency operations today. Responders rely heavily on the Mono County Public Safety Radio System (MCPSRS) to communicate with each another in the field, as well as with Dispatch while handling events. Though generally functional, this system is dated and in need of an upgrade, as there are a number of technical challenges at present, and ongoing concerns about reliability. Though the system was built with layers of redundancy to ensure that communications can take place even with certain failures, it is also complicated and has been built incrementally over time making it difficult to use, manage, and troubleshoot - especially during periods of crisis. Town, County, and State emergency response staff have indicated in the past that radio communications have been especially challenging due to a variety of technical reasons, and this has been identified as a priority area for both the County and Town for the coming years.

In 2015 the Mono County Information Technology Department took over the system and are now responsible for the maintenance, management, and long-term planning for radio communications for the County, Town, and other allied agencies. The current MCPSRS is comprised of 12 different County-owned repeater sites, 10 of which are on mountaintop locations above 7,500'. In 2016, Mono County IT contracted with Delta Wireless to perform a pier-to-pier assessment of the system and produce a Radio System Evaluation Report which would serve as a work plan and road map for the coming years. The report indicated nearly $600k worth of deferred maintenance work across all of these sites, and a number of issues which ranged from broken antennas to improperly tuned radios to lack of grounding and lighting protection. Since that time, the IT Department has been working diligently with Delta Wireless and other contractors to address a myriad of issues across the entire network and establish a programmatic approach to maintenance, management, and operations.

In addition to the work necessary to keep the current system operational, IT is spearheading a planning effort focused on a Next Generation system. This is a complex process which consists of both highly technical detailed planning, and careful, coordinated governance and policy conversations. The ultimate goal of these efforts is to arrive at a new radio system sometime in the next five years which is founded on current day industry best practices, and rooted in an Joint Powers Authority organizational structure that allows for clarity around responsibility, decision making, funding, and long-term maintenance.

2.6.2 Transportation

There are a limited number of major access roads in the County and these are critical for community mobility and emergency responders. Major access roads include the following:

- **US 395** is the major transportation route connecting the Eastern Sierra with Southern California and with the Reno/Tahoe region in northern Nevada. US 395 is also Main Street in Lee Vining, Bridgeport, Walker, Coleville, and Topaz. US 395 is, and will remain in the long term, the major access to and through Mono County. Most of the County's population resides in small communities of 300 or less along this main roadway corridor. By car, Los Angeles is five to six hours south on US 395, Reno is three hours north on US 395, and the San Francisco Bay Area is five to six hours west on various routes connecting to US 395. It is maintained and kept open throughout the year. Hazards—including winter storms, avalanches, landslides, and wildfire—may close portions of US 395 from time to time, as described in the risk and vulnerability sections of this Plan.
- **US 6**, from the Inyo County line north of Bishop to the Nevada state line, provides regional/interregional transportation connections. This route serves both local traffic and interregional trucking between Southern California, Reno, and the western mountain states (Washington, Idaho, and Montana). US 6 is also Main Street in the Tri-Valley communities. The route is kept open year-round and is subject to limited exposure to hazards.
- **SR 89** provides access from US 395 to Monitor Pass and is closed in the winter.
- **SR 108** provides access from US 395 west to Sonora Pass and is closed in the winter.
- **SR 120** provides access from US 395 west to Tioga Pass and east to Benton. The western segment is closed in the winter and the eastern segment may also be closed depending on snow conditions.
- **SR 158**, the June Lake Loop, provides access from US 395 to the community of June Lake and is Main Street through part of the June Lake Loop. A portion of SR 158 is closed in the winter.
- **SR 167** provides access from US 395 to the Nevada state line, north of Mono Lake, and access to the community of Mono City.
- **SR 168** provides access from US 395 at Big Pine in Inyo County north to Oasis in the southeast corner of Mono County.
- **SR 182** provides access from its junction with US 395 in Bridgeport northeast to the Nevada state line as well as main street access to a portion of the community of Bridgeport.
- **SR 203** provides access west from US 395 to Mammoth Lakes, becoming Main Street through town before turning up to the Mammoth Mountain Ski Area and continues on to the USFS Road to Reds Meadow and Devils Postpile National Monument. The potion of the road beyond Mammoth Mountain Ski Area is closed in the winter.
- **SR 266** provides access through Oasis in the southeast corner of the County.

- **SR 270** provides access east from US 395 to Bodie State Historic Park and is closed for a portion of the winter.

Mono County also has three small public airports. Two, Bryant Field and Lee Vining Airport, are operated by the County. The third, Mammoth Yosemite Airport, is operated by the Town of Mammoth Lakes. Several heliports, including the Marine Corps Mountain Warfare Training Center Airport, are also present. Transportation and access routes are shown in **Figure 2.8**, below.

Evacuation and Emergency Access Routes

For most of Mono County, US 395 is the primary evacuation and emergency access route. The communities of Paradise, Swall Meadows, Lundy Lake, Virginia Lakes, and Twin Lakes, as well as portions of June Lake, Crowley Lake, McGee Creek, and Chalfant Valley, all only have one access route. During evacuation and emergency response procedures, the lack of alternative routes could inhibit transportation in and out of most areas. For the Town of Mammoth Lakes, SR 203 is the primary access in and out of the community, and connects to US 395. The Mammoth Scenic Loop provides a secondary access route to US 395 when not closed during heavy storms in winter months. **Figure 2.8** identifies communities and neighborhoods without secondary access to major access roads identified above. Many of these communities are threatened by one or more hazards, as will be detailed in **Chapter 3** and **Chapter 4**, and thus secondary access for emergency situations is critical.

Developing secondary access routes is typically constrained by the presence of hazard zones and steep slopes, as well as procedural onus associated with establishing right-of-way on land owned by multiple private and public entities. **Chapter 5** includes more detailed information, as well as specific opportunities and constraints, regarding secondary access routes in six neighborhoods or communities which have single access identified as the highest priority to address.

Additionally, Mono County has identified development of an evacuation plan for animals and pets as a future project when time and funding allow. Such a project falls outside this plan's focus on mitigation, but an item was added to the list of recommended preparedness and response actions in **Table 7.10** as part of the Mono County CWPP.

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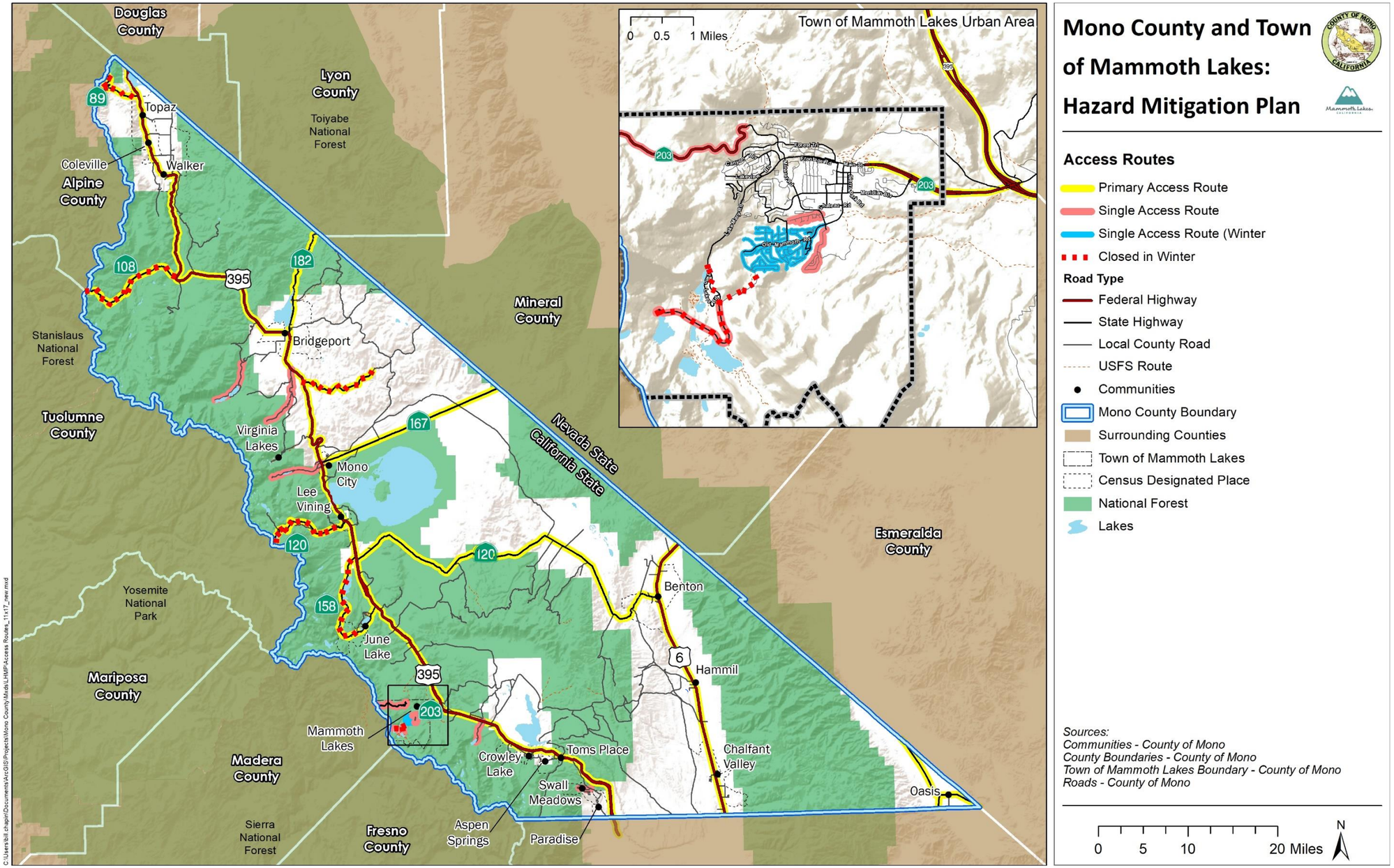
Figure 2.8: Transportation and Access for Mono County and Mammoth Lakes



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2.6.3 Water

Water and sewer services for unincorporated Mono County are provided by a variety of special districts and mutual water companies. Special districts for water distribution include June Lake Public Utility District, Lee Vining Public Utility District, and Bridgeport Public Utility District. Most of these districts depend primarily on groundwater wells or a mix of surface and groundwater wells for water supply. According to the Mono County General Plan, a number of these districts struggle to maintain aging piping and sewer treatment facilities, thereby threatening the quality and supply of water to their service areas.

Areas not served by these districts rely on private groundwater well systems and small septic systems. The LADWP has significant rights to surface water in the Mono Basin. The LADWP operates an extensive aqueduct system over thousands of acres of land; it diverts water that previously flowed into Mono Lake to the City of Los Angeles. All water coming out of the Mono Basin is heavily regulated by the state through the 1994 SWRCB Decision 1631. In recent drought years, the lake's water levels have dropped precipitously, threatening the County's scenic value and the ecosystem of the basin.

The Mammoth Community Water District (MCWD) supplies water to the Town of Mammoth Lakes from two sources: diversions from Mammoth Creek, which spills from Lake Mary (in the Lakes Basin), and from various wells around the Town. The MCWD's 5.7-square-mile service area lies entirely within the Town of Mammoth Lakes' incorporated boundary; most of the service area is within the much smaller urban growth boundary, which spans approximately 4 square miles. There are approximately 2,500 acres of private land within the service area. Most of the lands outside of the Town urban growth boundary are publicly owned federal lands managed by the USFS's Inyo National Forest.

The MCWD's existing sources of water include surface water, groundwater, recycled water, and savings from water conservation (demand management) measures. The MCWD stores and diverts Mammoth Creek surface water at Lake Mary. Groundwater supply comes from nine production wells within the Mammoth Groundwater Basin. Delivery of recycled water meeting Title 22 water standards for unrestricted irrigation use began in 2010. The MCWD operates three treatment plants and one wastewater/recycled water treatment plant (MCWD 2017).

2.6.4 Energy

Electricity infrastructure in Mono County is available in all community areas. The electricity network is critical for public health and safety, and the availability of electrical service is crucial after a disaster has occurred. This infrastructure may itself pose a hazard, such as the risk of downed power lines sparking a wildfire.

Electricity in Mono County is provided by three different agencies: SCE, a privately-owned utility company, serves most of Mono County, including all of Mammoth Lakes, and all unincorporated community areas with the exception of Coleville and Walker. Coleville and Walker are provided electricity as well as other utility services by Liberty Utilities, which operates within a service area that includes a region surrounding Lake Tahoe, including portions of El Dorado, Alpine, and northern Mono Counties. The southeastern tip of Mono County is served by Valley Electric Transmission, a member-owned electric utility that primarily operates in Nevada.

All three electricity providers receive their power from a variety of sources, including renewable energy, fossil fuels, and hydroelectric facilities. Mono County has nine power plants as identified by the California Energy Commission's (CEC) 2017 Annual Generation list. These include five hydroelectric facilities and three geothermal power plants. All of the hydroelectric facilities are fairly small, producing just over 21 megawatts of power, and are owned by SCE and LADWP. The geothermal operation, which includes three plant units near Mammoth Lakes in the unincorporated county, is owned by Mammoth Pacific LP.

Power is delivered through a network of power lines and facilities called substations. Mono County has three major power transmission lines, owned by SCE. One line runs parallel to US 395 in the southern half of the County. A second line connects from Nevada in mid-county and rounds south to meet the first. A third, smaller transmission line runs between and connects the two. There are 13 substations in Mono County, which convert high-voltage electricity carried by transmission lines to lower-voltage electricity that can be used by homes and businesses. Because of their remote location, Mono County and Mammoth Lakes rely on a limited electricity network. Any disruption to the two major power transmission lines or to the substations could cause a large and potentially countywide blackout. The loss of electric power due to failure of overhead power lines, as a result of natural hazards such as wildfire, wind, and avalanche, is one of the most frequent impacts on Mono County and Mammoth Lakes communities.

There is no natural gas service in the County and many households and businesses utilize propane for heat, cooking, and backup power generators. While propane is an adaptable and easily transportable power source, it may create new hazards in the County as accidents in transport, construction activities, heavy snow, or fires can cause propane leaks and related hazardous incidents such as intense fires near structures. A large number of residents also utilize wood stoves and pellet stoves for heating, which can also pose fire hazards.

3. HAZARDS ASSESSMENT

This chapter provides an overview of the types of hazard events in Mono County and Mammoth Lakes, including past hazard events and how these hazards may change in the future. This chapter also discusses the process used by Planning Team members to identify and prioritize hazards.

3.1 Hazard Analysis

3.1.1 Hazard Identification

FEMA's Hazard Summary Worksheet is a resource provided for communities in the agency's *Local Mitigation Planning Handbook* guidance document (FEMA 2013). The worksheet identifies 21 different hazards that local governments may wish to consider when conducting hazard mitigation planning efforts. Some of these events will not occur in Mono County or Mammoth Lakes because the necessary attributes for these events to occur are not present in the community (sea level rise, for example). The Planning Team reviewed a comprehensive list of hazards during its September 29, 2017, meeting, including the hazards in FEMA's guidance and additional hazards suggested by Planning Team members. This discussion resulted in identification of the hazards that pose a potential risk to Mono County and Mammoth Lakes. **Table 3.1** summarizes the Planning Team's discussion of each hazard and shows which hazards were identified for inclusion in this MJHMP. Wildfire is discussed in **Chapter 7** as part of the CWPP.

Table 3.1 Mono County and Town of Mammoth Lakes Hazard Identification

List of Hazards	In Hazard Area?		Discussion Summary
	Mono County	Town of Mammoth Lakes	
Agricultural Pests	No	No	The 2014 *Crop and Livestock Report* does not mention any specific agricultural pests of note.
Avalanche	**Yes**	**Yes**	Avalanches occur in the mountainous areas of the County, affecting portions of Mammoth Lakes, several unincorporated communities, and several important access roads.
Coastal Erosion/Bluff Failure	No	No	Not applicable. Mono County and Mammoth Lakes are not coastal communities.
Coastal Storm	No	No	Not applicable. Mono County and Mammoth Lakes are not coastal communities.

Table 3.1 Mono County and Town of Mammoth Lakes Hazard Identification

List of Hazards	In Hazard Area?		Discussion Summary
	Mono County	Town of Mammoth Lakes	
Dam Failure	**Yes**	No	The County is susceptible to inundation caused by failure of dams owned by SCE, LADWP, and other private entities, and have experienced warnings of potential dam failure in the recent past.
Disease and Pest Management	**Yes**	**Yes**	Invasive pests have the potential to damage trees; mosquitoes have the potential to spread disease.
Drought	**Yes**	**Yes**	Mono County and Mammoth Lakes both depend on groundwater and surface water, which are susceptible to drought.
Earthquake and Seismic Hazards	**Yes**	**Yes**	Mono County and Mammoth Lakes are susceptible to earthquake ground shaking, and certain areas may also experience liquefaction, fault rupture, and tectonic subsidence.
Expansive Soils	No	No	Not applicable. Expansive soil issues are not prevalent in the County.
Extreme Heat	**Yes**	No	Extreme heat that could be life endangering is an issue in the Tri-Valley portion of the County.
Flood	**Yes**	**Yes**	The Town and the County have 100- and 500-year flood zones, as mapped by FEMA.
Hailstorm	No	No	Although hailstorms have occurred within the area, they are rare. The Planning Team did not identify any local hailstorms of note.
Hazardous Materials	**Yes**	**Yes**	The County and the Town contain properties and transportation corridors with the potential for hazardous materials spills. This hazard will be discussed in association with propane explosions, a related human-caused hazard.
Human-Caused Hazards	No	No	With the exception of human-caused hazards related to hazardous materials, this Plan focuses on natural hazards.

Table 3.1 Mono County and Town of Mammoth Lakes Hazard Identification

List of Hazards	In Hazard Area?		Discussion Summary
	Mono County	Town of Mammoth Lakes	
Hurricane	No	No	Not applicable. Mono County and Mammoth Lakes are not coastal communities.
Landslides (Geologic Hazards)	**Yes**	No	The conditions for landslides are present near the hills and mountains of the unincorporated county, but not near Mammoth Lakes.
Land Subsidence	No	No	Not applicable. There are no historical or expected occurrences of non-tectonic subsidence in the County. Tectonic subsidence is addressed in the Earthquake section.
Sea Level Rise	No	No	Not applicable. Mono County and Mammoth Lakes are not coastal communities.
Severe Winter Weather and Snow	**Yes**	**Yes**	Severe winter storms and heavy snow frequently block roads, lead to dangerously low temperatures, and can affect utility services. These are frequent impacts for both Mono County and Mammoth Lakes. This hazard will be discussed with other winter weather effects including extreme cold.
Tornado	No	No	There are no recorded tornado hazards in Mono County or Mammoth Lakes.
Tsunami	No	No	Not applicable. Mono County and Mammoth Lakes are not coastal communities.
Volcano	**Yes**	**Yes**	The County and the Town are located in volcano hazard areas.
Wildfire	**Yes**	**Yes**	Wildfire hazards are a significant issue in this part of California.
Wildlife Collisions	**Yes**	**Yes**	Wildlife vehicle collisions are a common road hazard in the County, especially along US 395.
Wind	**Yes**	**Yes**	The County and Town are subject to high wind events, especially on exposed and high-altitude roadways, making travel hazardous, as well as downing power lines and causing electricity outages.

Table 3.1 Mono County and Town of Mammoth Lakes Hazard Identification

List of Hazards	In Hazard Area?		Discussion Summary
	Mono County	Town of Mammoth Lakes	
Windstorm	**Yes**	**Yes**	The County and Town are exposed to high wind events. This hazard will be combined with wind.
Climate Change	**Yes**	**Yes**	Climate change is not profiled as a distinct hazard, but rather a phenomenon that could exacerbate other hazards. Climate change will be considered as a factor for relevant identified hazards.

Some of the hazards addressed in this Plan combine multiple FEMA-identified hazards for organizational purposes. The Planning Team identified and prioritized 15 hazards that may impact Mono County and Mammoth Lakes, as shown in **Figure 3.1**.

Figure 3.1: Priority Hazards

3.1.2 Hazard Prioritization

The Planning Team used a Microsoft Excel–based tool to prioritize the identified hazards by assigning each hazard a ranking based on probability of occurrence and potential impact. These rankings were assigned based on group discussion, knowledge of past occurrences, and familiarity with the County's and Town's infrastructure vulnerabilities. Four criteria were used to establish priority:

- Probability (likelihood of occurrence)
- Location (size of potentially affected area)
- Magnitude (intensity of damage)
- Secondary Impacts (severity of impacts to community)

A value of 1 (low) to 4 (high) was assigned by each team member for each hazard/criterion pairing. The four criteria were then weighted based on the Planning Team's opinion of each criterion's importance. **Table 3.2** presents the results of this exercise, and shows the average ranking for each hazard among the Planning Team members and reflects the team's rating of the relative importance of the identified hazards in order to focus mitigation efforts. The table sorts rankings from highest to lowest. As shown, wildfire, winter-weather related hazards, and earthquake-related hazards were highest rated, followed

by volcano, climate change effects, and drought. The hazards in **Table 3.2** are consistent with the hazards identified as having potential to occur in the County and Town, as shown in **Table 3.1**.

Table 3.2 Mono County Hazard Ranking Worksheet Outcomes

Hazard Type[1]	Probability	Impact			Overall Rank
		Location	Primary Impact	Secondary Impacts	
Wildfire	3.7	3.1	3.1	3.4	3.4
Severe Winter Weather & Snow	3.9	3.6	2.6	2.7	3.2
Earthquake & Seismic Hazards	2.6	3.0	2.9	3.0	2.9
Volcano	1.1	2.7	3.7	3.6	2.8
Climate Change	2.3	3.3	2.3	3.0	2.8
Drought	2.7	3.3	2.0	2.3	2.6
Severe Wind	2.9	2.6	2.3	1.9	2.4
Flood	2.6	2.4	2.1	1.9	2.3
Landslide	2.6	2.6	1.9	1.9	2.2
Avalanche	2.6	1.7	2.0	2.1	2.1
Dam Failure	1.1	1.7	2.4	2.9	2.0
Hazardous Materials	2.1	2.3	1.4	1.8	1.9
Disease/ Pest Management	1.0	2.0	1.7	1.7	1.6

[1] Wildlife collisions and extreme heat were added as a priority hazard after the Planning Team completed the hazard ranking worksheet and are therefore not included in this table.

3.1.3 Climate Change Considerations

Climate change is expected to exacerbate existing hazards in the County and Town. As such, the Planning Team determined that it would be best to discuss climate change considerations throughout all applicable hazard profiles.

3.2 Hazard Profiles

For each hazard, a hazard profile is established to provide a general description of the hazard. The profile will also describe what locations the hazard is likely to affect as well as the potential magnitude of hazard events. Location will be discussed in terms of the following:

Land Ownership: The ownership of land and development affected by a hazard is an important consideration for the County and Town in order to develop effective policies and mitigation measures.

Measures for County-owned properties and facilities will be quite different than for those on private property or those under the jurisdiction of federal agencies with their own policies and procedures. A countywide snapshot of land ownership and locations is found in **Chapter 2**.

Planning Areas and Urban Communities: The specific urban communities and their unique geographic, economic, and political characteristics are important considerations for the County and Town in order to develop effective policies and mitigation measures. Planning areas and their urbanized communities will be identified and considered in the risk assessment. The locations and economic and political settings of the planning areas and urban communities are discussed in **Chapter 2**.

History: Historic events lead into understanding what locations are at risk and the magnitude of impacts likely to occur. Each profile thus includes a description of major hazard events in recent history, and, to the extent possible, a complete listing of hazard events by date and location.

Future Conditions: Changes to hazard area or magnitude may occur as the result of new development, new infrastructure, and, most significantly, climate change. How these changes could affect hazards is discussed briefly. A fuller analysis of potential changes in risk and vulnerability due to climate change can be found in the Risk Assessment, in **Chapter 4**.

Hazard profile information for wildfire is contained in **Chapter 7** as part of the CWPP. For hazard description and climate change considerations, no meaningful difference exists between Mono County and Mammoth Lakes. For the remaining topics (location and magnitude, hazard history/past occurrences, and risk of future hazard), specific information is provided for both the County and the Town.

3.2.1 Avalanche

Hazard Description

An avalanche is a mass of snow moving rapidly and sliding down a slope. Although avalanches can entrain rocks, soil, vegetation, and ice, they are typically less destructive and more frequent than other natural mountain-slope hazards such as landslide and debris flows. Avalanche risk is influenced by a variety of factors, including terrain, slope steepness, weather, temperature, and snowpack conditions. Avalanches are a concern from November through April in Mono County. Avalanches may be triggered by human activity or environmental factors such as wind, precipitation, or warming. Human-caused avalanches in the County generally occur far outside of development areas, and most incidents involve skiers or hikers that travel into undeveloped mountainous areas. Because these human-caused events are generally far from developed areas, they typically cause less damage and loss of life than a naturally caused avalanche near a development area would.

Snow avalanches can release as loose or slab avalanche, and can be further classified as wet or dry, depending on the moisture content of the snow. Loose avalanches involve snow near the surface and release when cohesion is lost between snow grains. Slab avalanches extend into deeper snow and release as a cohesive plate when a weaker layer within the snow fails. Slab avalanches can be wet or dry and can be extremely large and destructive. Both wet and dry slab avalanches can flow for long distances on gentle terrain and often damage or destroy buildings, transmission poles, and heavy equipment.

Avalanche terrain is characterized by steep slope angles ranging from 30 to 45 degrees. Avalanche paths consist of a starting zone where avalanches begin, a track where maximum velocity is reached, and a runout zone. Runout zones are lower gradient slopes where avalanches decelerate and debris deposits form. Numerous paths are found on the steep slopes of the eastern Sierra Nevada in Mono County. Many facilities, mountain communities, and county and state highways are located in the lower angle terrain of avalanche runout zones.

Location and Magnitude

The historical record of large and destructive avalanche occurrences in Mono County began in 1948, when a long-time resident, Pete Maron, documented a large avalanche that released on McGee Mountain and deposited 6 feet of debris on Crowley Lake Drive and State Highway 395. Avalanches are very frequent in the backcountry as well as popular ski areas with recreational infrastructure and frequent visitors. There are two triggers for avalanches: natural triggers and artificial (human-initiated) triggers.

The size of an avalanche may be described in terms of its width, the length it travels, or the depth of debris. One commonly used scale rates avalanches based on their destructive force, as shown in **Table 3.3**.

Table 3.3 Avalanche Size and Impact Scale

Avalanche Size	Avalanche Destructive Potential	Typical Mass (tons)	Typical Path Length (feet)	Typical Impact Pressure (pounds per square foot)
D1	Relatively harmless to people	Less than 10	33	21
D2	Could bury, injure, or kill a person	100	330	209
D3	Could bury and destroy a car, damage a truck, destroy a wood-frame house, or break a few trees	1,000	3,280	2,089

Table 3.3 Avalanche Size and Impact Scale

Avalanche Size	Avalanche Destructive Potential	Typical Mass (tons)	Typical Path Length (feet)	Typical Impact Pressure (pounds per square foot)
D4	Could destroy a railway car, large truck, several buildings, or a substantial amount of forest	10,000	6,562	10,443
D5	Could gouge the landscape; largest snow avalanche known	100,000	9,843	20,885
Sources: Snow Survey Associates 2018; American Avalanche Association. 2016				

Despite wide acceptance of the D-scale as a scientific scale for avalanche severity, avalanche records often do not include a D-scale rating. For example, of the 189 observed avalanches that have been logged by the Eastern Sierra Avalanche Center—which monitors areas that include the mountainous regions of Mono County—since December 2013, only 10 include a D-scale rating; eight were classified as D1 and two were classified as D2. (It should also be noted that the center's records primarily cover human-triggered events in unpopulated areas.)

Mono County

The first avalanche study in Mono County was conducted by Norm Wilson in 1973. Wilson identified potential avalanche areas in the June Lake Loop. After an avalanche fatality occurred in the Twin Lakes, Bridgeport area in February 1986, Mono County hired well-known avalanche consultant Art Mears, PE, to identify avalanche-prone areas on a map. Mears provided Mono County with maps delineating two zones: the "Red" or "High" avalanche zones, which have either avalanches on average every three to 30 years, or impact pressures of approximately 600 pounds per square foot (psf) or greater; and the "Blue" or "Moderate" zone, where avalanches occur every 10 to 100 years and have impact pressures of less than 600 psf. These impact pressure classifications do not precisely align with the D-scale shown in **Table 3.3**, but a typical Blue Zone avalanche could conceivably be rated D2, for example. Mears mapped avalanche hazard zones at eight locations in Mono County: Swall Meadows, Lee Vining, Lundy, Virginia Lakes, Twin Lakes, below Carson Peak, Long Valley, and Aspen Springs. In certain cases, Red Zones crossed roads and came up developed areas and campgrounds. For example, at McGee Creek the Red Zone extended across portions of US 395, Crowley Lake Drive, and McGee Creek Road near a trailer park.

The Mears report was submitted in 1987 but the report was not adopted by Mono County. Instead, the Mono County Board of Supervisors appointed local avalanche committees to compile "historical runout maps" based on committee members' recollections of runout distances of historic avalanches in Swall Meadows, McGee Mountain, and Twin Lakes, Bridgeport. Two avalanche areas were established: the

"Avalanche Influence Area" was defined as a community area in which privately owned property had experienced avalanche activity and where residents and visitors would be notified of avalanche hazards; and the "Conditional Development Areas" were defined as privately owned areas that had previously experienced avalanches that should be subject to development restrictions and conditions.

Significant advances in avalanche motion, impact pressures, and runout distances have been made since these studies, so these studies may not be considered current or accurate. Nonetheless, the 1986 Mears study, along with compilations of historic avalanche activity made by longtime residents, Snow Survey Associates, NOAA's Storm Center data, and the Eastern Sierra Avalanche Center data, can provide a strong indicator of areas that are likely to be affected by avalanches.

As identified in **Table 3.1** above, avalanche hazards are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes. **Table 3.4** identifies the communities most affected by avalanche hazards. Mono County has many roads that cross under significant avalanche paths. Roadway sections historically threatened by avalanches include portions of Lower Rock Creek Road; US 395 at the community of Long Valley northwest of McGee Creek, Wilson Butte, and north of Lee Vining; SR 158 entering June Lake; and several county roads entering eastern slope community areas. County equipment operators, residents, and tourists utilize these roads year-round. During winter months, significant snowstorms can create serious avalanche conditions which pose risks to communities in avalanche runout zones, anyone traveling on sections of certain roads, and recreational users in ski areas or mountainous backcountry areas. No deaths from avalanches have been recorded in Mono County since 2006, according to Avalanche.org, an online database which consolidates data from professional forecast centers to provide real-time avalanche information. However, avalanches have caused numerous road closures, power outages, and damage to property.

Table 3.4 Avalanche Hazards by Community Planning Area

Community Planning Area	Avalanche Hazard
Antelope Valley	None identified
Benton Valley	None identified
Bodie Hills	None identified
Bridgeport Valley	Yes; Twin Lakes Area
Chalfant Valley	None identified
Hammil Valley	None identified
June Lake	Yes; several areas
Lee Vining	Yes; Poole Power Plant Road

Table 3.4 Avalanche Hazards by Community Planning Area

Community Planning Area	Avalanche Hazard
Long Valley	Yes; several areas
Mammoth Vicinity	Yes; several areas
Mono Basin	Yes; several areas
Oasis	None identified
Sonora Junction	None identified
Swauger Creek	None identified
Upper Owens	None identified
Wheeler Crest	Yes; Swall Meadows
Development Outside Community Planning Areas	Yes; Virginia Lakes, Lundy Canyon
Sources: Mono County LHMP 2006; NOAA 2017; Eastern Sierra Avalanche Center 2017	

Avalanches threatening developed community areas in Mono County originate on public lands managed by the USFS. Mammoth Mountain Ski Area and June Mountain Ski Area use explosives and other means to control avalanches within ski area boundaries; however, these active mitigation measures are not possible on public lands above communities and roads. Mono County uses passive mitigation, mostly road closures, to manage the avalanche hazard. Although ski and backcountry avalanches are common, they are not the focus of this assessment, due to minimal mitigation measures that are possible. Consequently, assessment focuses on urbanized areas.

Town of Mammoth Lakes

Portions of Mammoth Lakes are within avalanche runout areas. In 1997, the Town adopted a Snow Deposition Design Zone where avalanche potential hazards have been found to exist. A survey of this area was conducted in 1995, triggered by a proposed development referred to as "The Bluffs," which indicated that the area is subject to naturally triggering avalanche. The southwest area of town, situated east and down slope of Mammoth Pass, was identified as being at high risk of avalanche due to the steepness, geologic shape, and orientation of the mountain as well as prevailing winds that create conditions that result in avalanches. Although no other specific avalanche studies have been conducted for outside of The Bluffs, avalanche hazards likely extend to much of the southwestern side of the town in proximity to Mammoth Pass and other similarly facing slopes.

Other areas known to be at risk from avalanche runout from Mammoth Mountain and Mammoth Pass include the Knolls and Sherwin areas, and along much of the entire extent of Lake Mary Road. Much of the Mammoth Mountain Ski Area is also within the hazard area.

Hazard History

Information on previous avalanche occurrences in Mono County can be found in Mono County Planning Department archives dating back to 1986 compiled by Snow Survey Associates, the Mammoth Ranger District Visitor Center, and Mammoth and June Mountain Ski Areas. Since 2015, Mono County has contracted with an avalanche consultant to provide weekly avalanche forecasts for roadways and avalanche zones in the County. Human-triggered avalanches, as well as the less common naturally occurring avalanches, are recorded online at the Eastern Sierra Avalanche Center website, www.esavalanche.org. The Eastern Sierra Avalanche Center is a nonprofit organization staffed by backcountry skiers who work under contract and provide avalanche information for recreationists in the John Muir and Ansel Adams wilderness areas.

The information below addresses avalanches that occurred in or adjacent to developed areas. The information available is often limited and usually does not include details of the hazard event or monetary estimations of the economic damages. Notable avalanches on McGee Mountain occurred in 1952, 1969, 1978, and 1981 through 1983. In 2017, a large avalanche released and crossed Crowley Lake Drive, damaging an occupied home.

Mono County

- **Mammoth Lakes:** An avalanche on March 3, 2018, occurred at the Mammoth Mountain Ski Resort. There were no missing persons or injuries, and the resort was reopened the next day.
- **Bridgeport Valley:** There have been at least 15 incidents of damage to buildings and other structures during the last 40 years, including 4 fatalities in the Twin Lakes Area. Destructive avalanches occurred in 1969, 1978, 1982, and 1986. In 1998, the Mono County Sheriff's Office reported that avalanches occurred in several places along US 395 near Bridgeport, resulting in highway closures. In 2005, a Sheriff's Department snow cat was destroyed in an avalanche. In 2006, three skiers were caught in a slab avalanche while crossing an open area on their way to Mt. Walt west of Twin Lakes; one of the skiers was killed in the accident.
- **June Lake:** Until North Shore Drive was constructed into June Lake as a secondary access route, SR 158, the main access into June Lake, was periodically closed due to avalanches, avalanche danger, or avalanche control; recent events occurred in 2014, 2016, and 2017. The community has also had to evacuate some parts of town following several big storms. According to the Eastern Sierra Avalanche Center, an avalanche was reported on Carson Peak in 2016 and on the slope between Hourglass and Negatives Bowls in 2017.
- **Long Valley and Crowley Lake:** Avalanches originating from McGee Mountain have extended across US 395. In 1992, an avalanche hit a barn, destroying the barn and killing two horses. An

avalanche in heavy snow storms of January 2017 resulted in closure of US 395, damaged a house, and took out electrical power in Crowley Lake and the surrounding communities of Long Valley. On January 22, 2017, the Sheriff's Office reported an avalanche in Long Valley with a runout 0.75 miles west of Crowley Lake Drive and north of McGee Creek.

- **Wheeler Crest:** A major dry-snow avalanche occurred in 1969 in Swall Meadows. Avalanche risk also exists on the Lower Rock Creek access road from a number of small east-facing paths that descend directly onto the road.
- **Sherwin Range:** A number of avalanches have occurred in the Sherwin Range, near Swall Meadows, including in 1986 and 2005. The 2005 avalanche was in the Sherwin Range and set off by a backcountry snowboarder; there was one injury.
- **Mono Basin:** Several large avalanche paths are known to extend east of US 395 approximately 1 to 2 miles north of Lee Vining. In 2001, 2005, and 2006, the highway was closed due to avalanches; there were no injuries or fatalities. Discussion with local residents indicates that seven buildings were destroyed there during two separate avalanches in the 1960s and 1970s near Lundy Lake. According to the Eastern Sierra Avalanche Center, an avalanche was triggered by a skier in 2017 on the eastern slope of Mt. Olsen.
- **Outside of the Community Planning Areas:** Virginia Lakes is primarily a seasonal residential area and is not regularly used during winter when the access road is not plowed. Seven buildings on the north side of the Virginia Lakes access road were destroyed by a large avalanche in 1982. In 1986, a large avalanche extended its path through a forest on the flat bottom of the valley before stopping on the south edge of Virginia Lakes Road. Lundy Canyon, west of Mono City, is also prone to avalanches.

Town of Mammoth Lakes

The Town of Mammoth Lakes also has a history of multiple avalanches occurring nearby. During the winter of 1983, avalanches destroyed many cabins at Lake Mary, Mammoth Knolls, and in the Mammoth Lakes Basin. That same year, a mud and snow slide damaged two homes on Forest Trail near Canyon Lodge, forcing residents to evacuate. A large avalanche in 1986 involved the whole bluff area south of Tamarack Street. Although there was no documented damage, the slide was observed to stop just short of several residences. In 1992, an avalanche in Old Mammoth killed a snowboarder and a dog. According to the Eastern Sierra Avalanche Center, avalanches were reported in Mammoth Bowl in 2013; in 2017, an avalanche was triggered by a skier above Lake Mary Road.

Avalanches are also a major concern for the Mammoth Mountain Ski Area. The resort is extremely important for the Town's economy and employs many of its residents. The last recorded death in the

ski area due to an avalanche occurred in 1980, but several other major avalanches since then have resulted in injuries and near fatalities. For example, in 2008, the *Mammoth Times* newspaper reported that an avalanche occurred at the Mammoth Mountain Ski Area during the early afternoon on Tuesday, December 16. The newspaper reported that the avalanche, in the Dragon's Tail area above Chair 9, was triggered by ski patrol performing avalanche control duties. According to the newspaper, a small, 2-foot crown broke above the ski patroller. As a result of the avalanche carrying him down the mountain and into a tree, the patroller suffered cracked or broken ribs. An avalanche triggered in March 2018 on Mammoth Mountain resulted in several rescue efforts and the closure of both ski resorts, although there was no damage to property and only minor injuries sustained. While no major incidents have occurred in the Sherwin area yet, with runout to Snowcreek V this could be a problem for future development identified as part of the Snowcreek Master Plan.

Risk of Future Hazards

Backcountry avalanches triggered by human activity are an annual occurrence in Mono County, but they typically do not threaten residents or property. Potentially destructive avalanches triggered by environmental conditions are less common but can occur as often as once every 10 years in the highest hazard areas near steep slopes.

Given the past avalanche events in Mono County and the Town of Mammoth Lakes and the expected continuation of winter storms, it is very likely that avalanches will continue to occur in the high mountain areas. Wet-snow avalanches that result from rain falling on high-elevation, recent storm snow present a real and unpredictable hazard to communities and roads. The risk is higher in unincorporated county areas and mountainous areas than the incorporated Town; however, vulnerable highways in all areas of Mono County will continue to be of primary concern. Caltrans utilizes Avalanche Control Systems (i.e., Gazex) at several locations on US 395 in Mono Basin and SR 158 to trigger manageable snow slides and then clear snow from the highways. This technique helps to mitigate the number of occurrences and intensity of future natural avalanches. However, the factors that contribute to avalanches are unlikely to decrease to any substantial degree.

In addition to property damage and road closures, avalanches can cause damage to and disruptions in electric grids and telecommunication networks which are vitally important to modern living conditions. While infrastructure damage from an avalanche is not as common, infrastructure damage can expand the impact of a very localized incident beyond its immediate surroundings.

Climate Change Considerations

According to the National Snow and Ice Data Center (NSIDC 2016), several factors may affect the likelihood of an avalanche, including weather, temperature, slope steepness, slope orientation (whether

the slope is facing north or south), wind direction, terrain, vegetation, and general snowpack conditions. Although research on the topic is sparse, some have suggested that warmer temperatures and increases in early calendar year rainfall can increase the conditions under which avalanches are likely to occur (Bellaire, Jamieson, and Statham 2013).

3.2.2 Dam Failure

Hazard Description

Dam failure occurs when a dam structure or its foundation is damaged to such a degree that the dam partially or completely loses its ability to hold back water. When this happens, some or all of the water impounded by the dam is suddenly released, causing a very fast-moving flood downstream of the dam. Like other flash floods, dam failures can cause widespread injury or loss of life, extensive property damage, and displacement of large numbers of people in the flood's path. If the failed dam is part of a water supply network, a dam failure may also cause local and regional disruption to water service if there is no sufficient alternative supply.

Dams can fail for a variety of reasons. Seismic or geologic hazards, such as earthquake shaking or a landslide, may damage the dam or its foundations, causing it to weaken to the point of failure. During intense rainfalls, the dam itself or the surrounding rock can erode sufficiently to cause a failure. Additionally, the dam itself may be poorly sited, designed, or maintained, and so may collapse independent of any other hazard event. At times, these factors can work together, such as if a design flaw in a dam causes the floodwaters from an intense rainfall to erode parts of the dam and lead to a failure.

Location and Magnitude

Dam failure hazards are anticipated to affect unincorporated Mono County, but not the Town of Mammoth Lakes. The Town is not located within the inundation zone of any dam, as shown in **Figure 3.2**.

Mono County

There are 22 dams in unincorporated Mono County. In addition, Rock Creek Lake Dam, in Inyo County, is located upstream of properties located in Mono County**. Table 3.5** lists these dams. None of the dams in the County is sizable enough to be considered a major dam.

Table 3.5 Mono County Dams

Name	Owner	Purpose(s)	Capacity (acre-feet)	Year Built
Agnew Lake	SCE	Hydroelectric	810	1916
Black Reservoir	Bently Family, LP	Water Supply	185	1905
Bridgeport	Walker River Irrigation District	Water Supply	44,100	1924
Gem Lake	SCE	Hydroelectric	17,228	1917
Grant Lake	LADWP	Water Supply	47,525	1940
Lake Mamie	United States Forest Service (USFS), Inyo National Forest	--	125	--
Lake Mary	USFS, Inyo National Forest	--	125	--
Lobdel Lake	Private Entity	Water Supply	640	1948
Long Valley	LADWP	Water Supply	183,465	1941
Lower Twin Lake	Centennial Livestock	Water Supply	4,011	1941
Lundy Lake	SCE	Hydroelectric	4,113	1911
Poore Lake Reservoir	Park Livestock Company	Water Supply	1,200	1900
Rhinedollar	SCE	Hydroelectric	490	1927
Rock Creek**	USFS, Inyo National Forest	--	--	--
Rush Creek Meadows	SCE	Hydroelectric	5,277	1925
Saddlebag	SCE	Hydroelectric	9,765	1921
Sardine	LADWP	Water Supply	385	--
Tioga Lake	SCE	Hydroelectric	1,254	1928
Topaz Lake	Walker River Irrigation District	Flood Control	59,600	1937
Twin Lakes	USFS, Inyo National Forest	--	150	--
Upper Gorge	LADWP	Other	26	1953
Upper Twin Lake	Centennial Livestock	Water Supply	2,070	1905
Walker Lake	LADWP	Water Supply	540	--

** Rock Creek Lake and Dam are located in Inyo County but would impact Mono County.

-- Information not available

Source: California Department of Water Resource's Division of Safety of Dams, September 2017

The majority of dams in Mono County are owned by public utility companies. Of the 22 dams in Mono County, five are owned by private entities. Based on the available records, dams in the County were built between 1900 and 1953 and have a capacity ranging from 26 to 183,465 acre-feet.

There are eight dam inundation areas in Mono County: Agnew Lake, Bridgeport Lake, Gem Lake, Grant Lake, Rhinedollar, Rush Creek Meadows, Saddlebag Lake, and Twin Lakes. Dam inundation hazard areas cover the following locations:

- **Agnew Lake:** The dam inundation hazard area runs northeast from the Agnew Lake Dam, covers Silver Lake and Grant Lake, and ends near Mono Lake.
- **Bridgeport Lake:** The dam inundation hazard area runs north along SR 182 to the edge of Mono County.
- **Gem Lake:** The dam inundation hazard area runs northeast from the Gem Lake Dam to Agnew Lake Dam, continues to cover Silver Lake and Grant Lake, and ends near Mono Lake.
- **Grant Lake:** The dam inundation hazard area runs north from Grant Lake Dam to Mono Lake.
- **Rhinedollar:** The dam inundation hazard area runs south of SR 120 through Lee Vining to Mono Lake.
- **Rush Creek Meadows:** The dam inundation hazard area covers Gem Lake and the stream between Rush Creek Meadows Dam and Gem Lake Dam.
- **Saddlebag Lake:** The dam inundation hazard area runs south from Saddlebag Dam to Rhinedollar Dam, then travels south of SR 120 through Lee Vining to Mono Lake.
- **Twin Lakes:** The dam inundation hazard area runs north from Lower Twin Lake Dam toward Bridgeport.

Figure 3.2 shows the dam inundation hazard areas in unincorporated Mono County.

Mammoth Lakes

There are no dam inundation hazard areas identified by existing inundation mapping in Mammoth Lakes. However, three dams, at Twin Lakes, Lake Mary, and Lake Mamie, all located in Inyo National Forest, do not have mapping of inundation modeling and analysis available from the Department of Water Resources. Mammoth Creek drains the Mammoth Lakes Basin, which contains more than a dozen lakes, including the three dammed lakes. Upon collecting water from the Sierra crest, the Mammoth Creek watercourse flows downstream through Lake Mary, Lake Mamie, and subsequently into Twin Lakes. Mammoth Creek exits the Mammoth Lakes Basin at the outlet of Twin Lakes and flows along the southern edge of the Town of Mammoth Lakes. Failure of any dam could result in significant flood

inundation within the Town of Mammoth Lakes urban area, affecting many structures along the creekside.

Hazard History

Mono County

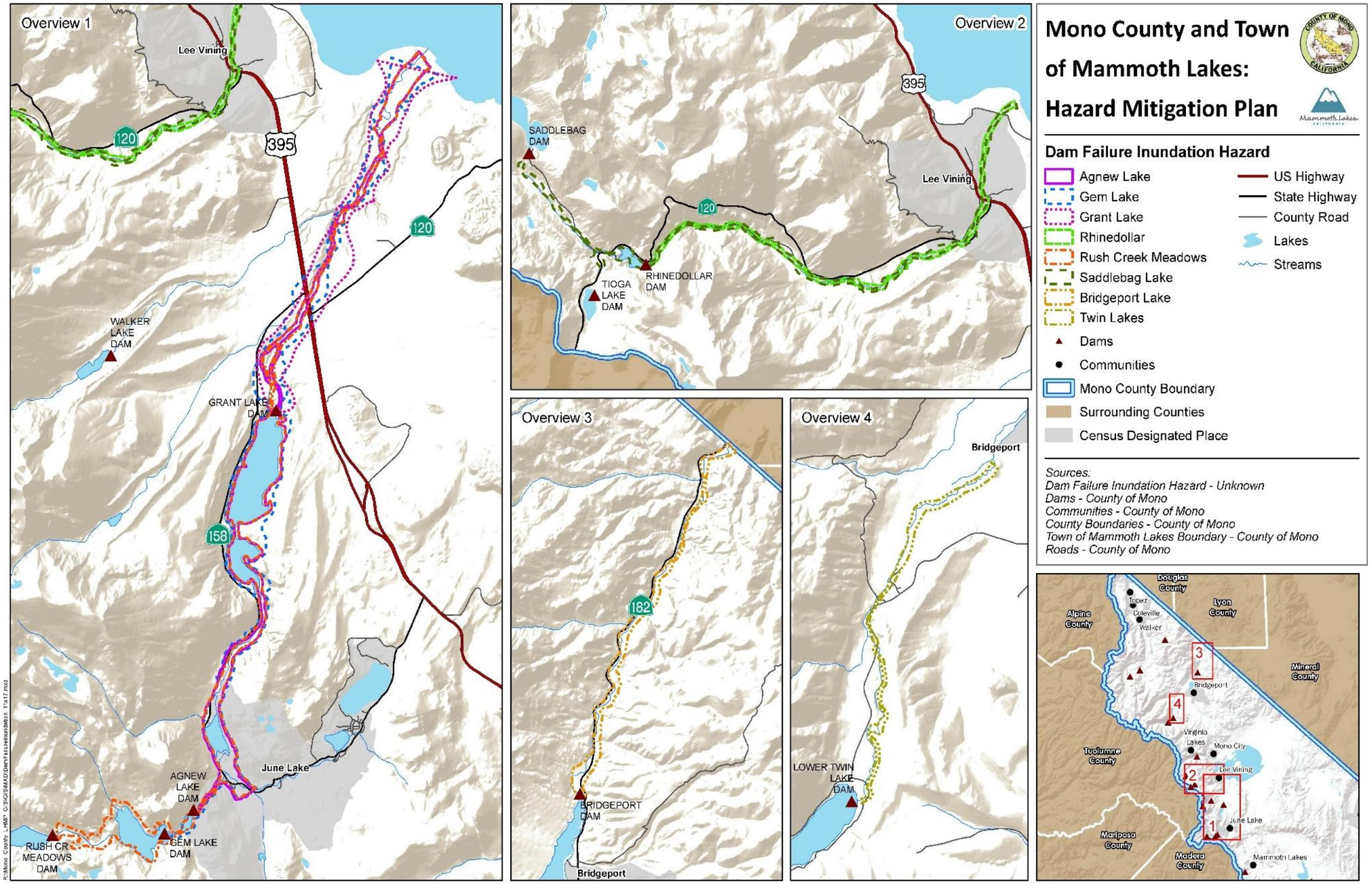
There have been no previous dam failures in Mono County. The significant snowpack over the 2016–2017 winter caused stress to the dams at Gem and Agnew Lakes. SCE installed a pump system at Agnew Lake to accommodate higher levels of water moving through the system to ensure that dams were maintained at safe levels.

According to the Mono County Emergency Operations Plan, seven dams—Lower and Upper Twin Lakes, Lundy Lake, Long Valley, Crowley Lake, Rush Creek Meadows, and Saddlebag—present some risk to downstream developed areas, anglers and recreation visitors, and people in campgrounds if dam failure were to occur. Overall, however, the dams in Mono County are not major threats.

Mammoth Lakes

There have been no previous dam failures affecting the Town of Mammoth Lakes.

Figure 3.2: Dam Inundation Hazard Areas in Unincorporated Mono County



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Risk of Future Hazards

The California DWR Division of Safety of Dams (DSOD) maintains a database of dams in the state; critical dam safety status information includes certification, downstream hazard, and condition assessment. The condition assessment is based on definitions established by the National Inventory of Dams, as well as additional criteria identified by the DSOD. The condition assessment has five possible ratings based on the described criteria, as shown in **Table 3.6**.

Table 3.6 Dam System Condition Assessment Rating System

Rating	National Inventory of Dams Definitions	California DSOD Additional Criteria
Satisfactory	No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.	None
Fair	No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.	Dam has a long-standing deficiency that is not being addressed in a timely manner Dam is not certified and its safety is under evaluation Dam is restricted and operation of the reservoir at the lower level does not mitigate the deficiency
Poor	A dam safety deficiency is recognized for loading conditions that may realistically occur. Remedial action is necessary. A poor rating may also be used when uncertainties exist as to critical analysis parameters that identify a potential dam safety deficiency. Further investigations and studies are necessary.	Dam has multiple deficiencies or a significant deficiency that requires extensive remedial work
Unsatisfactory	A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution	None
Source: DSOS 2017		

Table 3.7 shows the condition assessment result for dams evaluated in Mono County as established by the September 2017 DSOS report, "Dams Within Jurisdiction of the State of California." All rated dams were determined to be in fair or satisfactory condition, with the exception of Agnew Lake Dam, which

was determined to be in poor condition, although SCE is currently working on improvements to bring this dam up to a satisfactory level. The dam inundation area for Agnew Lake Dam runs northeast from the Agnew Lake Dam, covers Silver Lake and Grant Lake, and ends near Mono Lake. Dam failure may result in impacts to Grant Lake Dam downstream.

Table 3.7 Dam Condition Assessment

Dam Name	Condition Assessment
Agnew Lake	Poor*
Black Reservoir	Satisfactory
Bridgeport	Satisfactory
Gem Lake	Fair
Grant Lake	Satisfactory
Lake Mamie	--
Lake Mary	--
Lobdel Lake	Satisfactory
Long Valley	Satisfactory
Lower Twin Lake	Fair
Lundy Lake	Satisfactory
Poore Lake Reservoir	Satisfactory
Rhinedollar	Satisfactory
Rush Creek Meadows	Fair
Saddlebag	Satisfactory
Sardine	--
Tioga Lake	Satisfactory
Topaz Lake	Satisfactory
Twin Lakes	Satisfactory
Upper Gorge	Satisfactory
Upper Twin Lake	Fair
Walker Lake	Satisfactory

Source: DSOS 2017
http://www.water.ca.gov/damsafety/docs/Dams%20by%20County_Sept%202017.pdf

-- Information not available

*Modifications to Agnew Dam completed in 2017 will result in the reservoir retaining less water. A new condition assessment completed at that time showed the dam could meet the

Table 3.7 Dam Condition Assessment

Dam Name	Condition Assessment
criteria for a Satisfactory rating. As of December 2017, this information had been submitted to DSOD for re-classification.	

The lack of any previous dam failure events in Mono County renders it difficult to make a precise prediction about future probability. An independent forensic report on the 2017 Oroville Dam incident in Butte County identified systemic failures in dam safety regulations and industry practices, and suggested that dam owners may be overconfident in their assessments. Still, with only two actual failures among California's 1,500 dams in the last 90 years and none since 1963, future occurrences can still be regarded as extremely unlikely.

Mono County

Cal OES maps dam inundation zones to identify the projected areas that would be subject to inundation if a dam were to fail. According to best available information, 7,025 acres are located in a dam inundation zone. **Table 3.8** shows the dam inundation area in the unincorporated county by land administration or ownership. Approximately 3,333 acres are federal lands, 2,547 acres are owned by a public utility, 523 acres are state-owned, 380 acres are privately owned, and 241 acres are unknown. While these estimates are based on the best available data, local conditions may alter the specific flood path of water from a ruptured dam. Lands in the private category are of greatest concern, as the County has land use authority over these areas. The Agnew Lake Dam Inundation Area includes approximately 105 acres of private land that could be affected by dam failure.

Table 3.8 Area of Dam Inundation in Mono County by Land Administration or Ownership

Land Administration or Ownership	Acres	Percentage of Total
Mono County		
Federal	3,333	47%
Private	380	5%
State	523	7%
Unknown	241	3%
Utility	2,547	36%
Total	**7,024**	**100%**
Mammoth Lakes		

Table 3.8 Area of Dam Inundation in Mono County by Land Administration or Ownership

Land Administration or Ownership	Acres	Percentage of Total
None	--	--
Source: County of Mono 2017		

Table 3.9 shows dam inundation hazard areas by Community Planning Area. As shown, 36 percent of the dam inundation hazard areas are located outside of Community Planning Areas; 53 percent are located within the June Lake Community Planning Area, which includes the Agnew Lake Dam inundation area; 5 percent are located within the Bridgeport Community Planning Area; and 5 percent are located within the Mono Basin South Community Planning Area.

Table 3.9 Dam Inundation in Unincorporated Mono County by Community Planning Area

Community Planning Area	Acres	Percentage of Total
Bridgeport	350	5%
June Lake	3,699	53%
Mono Basin	433	6%
Outside of the Community Planning Areas	2,543	36%
Total	**7,025**	**100%**
Source: County of Mono 2017		

Town of Mammoth Lakes

There are no dam inundation hazard areas in the Town of Mammoth Lakes.

Climate Change Considerations

Many of the factors that may affect dam inundation risk, such as seismic activity or a dam's structural soundness, are not affected by climate change. However, as discussed in the Flood section, there is some evidence that climate change may cause an increase in the number and/or severity of intense storms affecting Mono County, including rain-on-snow events that are known for causing flooding and infrastructure damage. The increase in water flow, combined with the potential for increased erosion or landslides resulting from storm activity, may increase the risk of dam failure. However, more studies are likely needed to determine the vulnerability of Mono County's dams from severe storms relative to other risks.

3.2.3 Disease/Pest Management

Because there is no distinguishable difference in magnitude of disease and pest hazards within the County, the following discussion applies to both Mono County and the Town of Mammoth Lakes.

Hazard Description

Disease and pest management hazards are caused by undesirable organisms such as insects, bacteria, and viruses that cause serious harm to plants, animals, or humans. These organisms can threaten human health by infecting people, flora, and fauna with a number of diseases, some of which are potentially fatal. Pathogenic or disease-carrying organisms may also cause widespread devastation to forests, creating safety hazards and causing both environmental damage and economic impacts. Many communicable diseases are regularly monitored by Mono County Public Health and the Centers for Disease Control and Prevention, but many are not well understood or tracked in California.

Due to the rural nature of Mono County, diseases that impact forests and those that are carried by wildlife are of particular concern, in addition to those affecting human health. Several insects and rodents can be considered hazardous in Mono County:

- **Mosquitoes** are one of the most prevalent carriers of harmful pathogens known as arboviruses, such as West Nile virus, Western equine encephalomyelitis, St. Louis encephalitis, and Zika virus. The rate of infection is extremely low in California, but the symptoms can be severe and deadly.
- **Rodents** such as squirrels and mice can be carriers of hantavirus and plague. Hantavirus is transmitted through deer mouse urine, saliva, or feces, while plague is hosted within some rodents and transmitted to humans by fleas.
- **Pandemic influenza** is caused by an outbreak of a new type of influenza virus that is different from the more common ones that can be vaccinated against. When variations in the virus occur, such as in previous avian and swine flu outbreaks, infection can spread quickly with widespread effects.
- **Fir Engraver Beetles and Jeffrey Pine Beetles**, while not a threat to human health, have infested forests throughout the Sierra Nevada. Pests of this variety inhabit trees, weakening and often killing them. Massive outbreaks of beetles can kill vast swaths of forests, which in turn can exacerbate fire hazards by increasing potential fuel sources.

Other species of insects such as ticks may also carry disease, but have not caused substantial outbreaks in Mono County.

Location and Magnitude

Disease and pest management hazards are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes, although there are no meaningful distinctions in distribution of the hazard between the two geographies. Thus, the two areas are discussed together below.

As many diseases are transmitted by mosquitoes, areas with high mosquito populations, such as bodies of water and humid environments, will be significantly more at risk. Mosquitoes are seasonal pests, typically appearing during warm months and disappearing during the winter. Invasive tree pests typically occur in the forested area, but can also affect street and private trees in the developed areas of the County. Rodent-borne diseases are more likely to be prevalent in rural areas and areas near the wildland-urban interface.

Hazard History

Cases of disease outbreak in Mono County have mostly been limited to small numbers of infections. In 2015, there was a single case of plague, with no additional infected humans or rodents found. Two cases of hantavirus also occurred in 2015, and infections in a single person occurred in 2006 and another single person in 2010.

Beetle infestations have been prevalent in the Sierra Nevada due to drought conditions, killing tens of millions of trees since 2010. These infestations are not uncommon during drought conditions, but have been significantly worse in the last several years. The magnitude and location of tree mortality as a result of beetles in combination with other factors is covered in greater depth in the CWPP (**Chapter 7**).

Risk of Future Hazards

Despite ongoing abatement efforts, mosquitoes are expected to be prevalent in the warm and hot months through the foreseeable future. The County's trees and forests are also expected to be vulnerable to invasive beetles and other pests through the foreseeable future, especially as tree defenses are weakened by ongoing drought conditions.

Climate Change Considerations

Climate change is expected to substantially alter insect and disease vector habitat. Unusual climatic conditions are partly to blame for the boxelder bug infestation in 2015. Similarly, drought-stricken trees are less able to defend themselves against invasive and damaging beetles. Warmer weather and slightly milder winters may result in fewer insects dying during cold weather stints. With declining snowpack, there may be greater amounts of stagnant surface water. The combination of stagnant water and expected warmer temperatures could cause certain types of mosquitoes and other pests to become more abundant.

3.2.4 Drought

Hazard Description

A drought is a long-term water shortage caused by an extended period with below normal precipitation that can lead to a decline in available water supplies. Droughts may lead to increases in domestic water rates or the implementation of additional restrictions on water use. In severe cases, communities may not have enough available water to meet basic needs. Drought conditions can significantly harm agricultural operations, particularly in areas that grow water-intensive crops. Planted landscapes may become drought-stressed, causing them to weaken or die from lack of water. If drought conditions are severe enough, the lack of water may pose a human health risk.

Droughts also have many indirect impacts. The lack of precipitation can cause soil to harden and become less permeable so that when precipitation does eventually occur, the soil cannot absorb water as easily, potentially leading to increased flooding. Drier soil may become decompressed, increasing its susceptibility to sliding and eroding. Droughts may dry out wildland vegetation, potentially increasing the risk of fire. Water-stressed plants may also be more vulnerable to disease or pests.

Unlike most other hazards, droughts develop over a long period of time. It often takes multiple dry years to cause drought conditions, and these conditions may persist for years. Droughts are usually a region-wide hazard, and at times may extend statewide or cover multiple states. However, the location-specific impacts of a drought can depend on local conditions, including water supply systems, soil types, and land uses. As a result, two communities under similar drought conditions may experience different impacts. Droughts may also have a significant impact on communities not directly in the affected area. For example, if a community relies on imported water that travels a great distance, the community may be substantially impacted if a drought occurs at the source of the imported water, even if precipitation levels in the community itself are normal. Similarly, communities may face local drought conditions, but impacts may be minor if the community's water comes from a distant unaffected area.

Drought may also have significant impacts on groundwater supplies and quality. As droughts persist, groundwater levels may drop as recharge slows and communities withdraw more to counter the lack of surface supplies. Over time, this can result in serious impacts on the groundwater, including overdraft, subsidence, saline intrusion, and other water quality degradation.

Location and Magnitude

Drought hazards are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes. Droughts are regional in nature, although a large area such as Mono County with a wide variety of climates may experience significantly different drought conditions in different locations.

No single part of Mono County, including Mammoth Lakes, is substantially more or less at risk of conditions that result in drought, although some areas may be more impacted by droughts than others.

There are multiple ways to measure the severity of different drought conditions. The US Drought Monitor Classification Scheme, shown in **Table 3.10**, combines many of these systems into a single index.

Table 3.10 US Drought Monitor Classification Scheme

Category	Description	Possible Impacts
D0	Abnormally dry	Slower growth of crops and pastures compared to normal activities.
D1	Moderate drought	Some damage to crops and pastures. Streams, reservoirs, or wells low. Some water shortages may be developing or imminent.
D2	Severe drought	Likely crop and pasture losses. Water shortages are common, leading to restrictions.
D3	Extreme drought	Major crop and pasture losses. Widespread water shortages.
D4	Exceptional drought	Exceptional and widespread crop and pasture losses. Emergency shortages develop.
Source: US Drought Monitor 2016a		

The DWR identifies 10 groundwater basins in the County: Adobe Lake Valley, Antelope Valley, Bridgeport Valley, Fish Lake Valley, Little Antelope Valley, Long Valley, Mono Valley, Owens Valley, Slinkard Valley, and Sweetwater Flat. The Long Valley basin underlies portions of Mammoth Lakes. Over the last decade (2007–2017), overall water levels in the basins have not changed significantly, although drops of 2 to 3 feet were shown for the shorter period of time between 2012 and 2016.

Hazard History

Droughts are a common feature of the climate in much of California, and many of the state's native plants and animals have evolved strategies to survive during drought conditions. The state also has an extensive water supply network that helps to reduce the impacts of droughts with the assistance of large storage reservoirs and pipes that can move water from regions with available supplies to drought-affected areas, although this system primarily benefits the urban areas of California.

Historic droughts in California occurred from 1976 to 1977, 1986 to 1992, and 2007 to 2009. The most recent drought in California lasted from December 2011 to March 2017 and was declared a state of emergency by Governor Jerry Brown on January 17, 2014. Near the end of the drought in 2016, nearly all of Mono County was in extreme (D3) drought, with parts in the western portion of the County,

including Mammoth Lakes, in exceptional (D4) drought. A number of groundwater wells ran dry and new wells were dug during this time; four new wells were reported for Antelope Valley. Farmers in the Tri-Valley reported a drop of 5 to 6 feet in well water levels during this period.

Higher than average rainfall and snowpack in 2017 alleviated the most extreme conditions of the most recent drought, but it will take years for local water systems to fully recover.

Figure 3.3 shows statewide drought conditions in the most recent drought in 2016.

Figure 3.3: State Drought Conditions, 2016

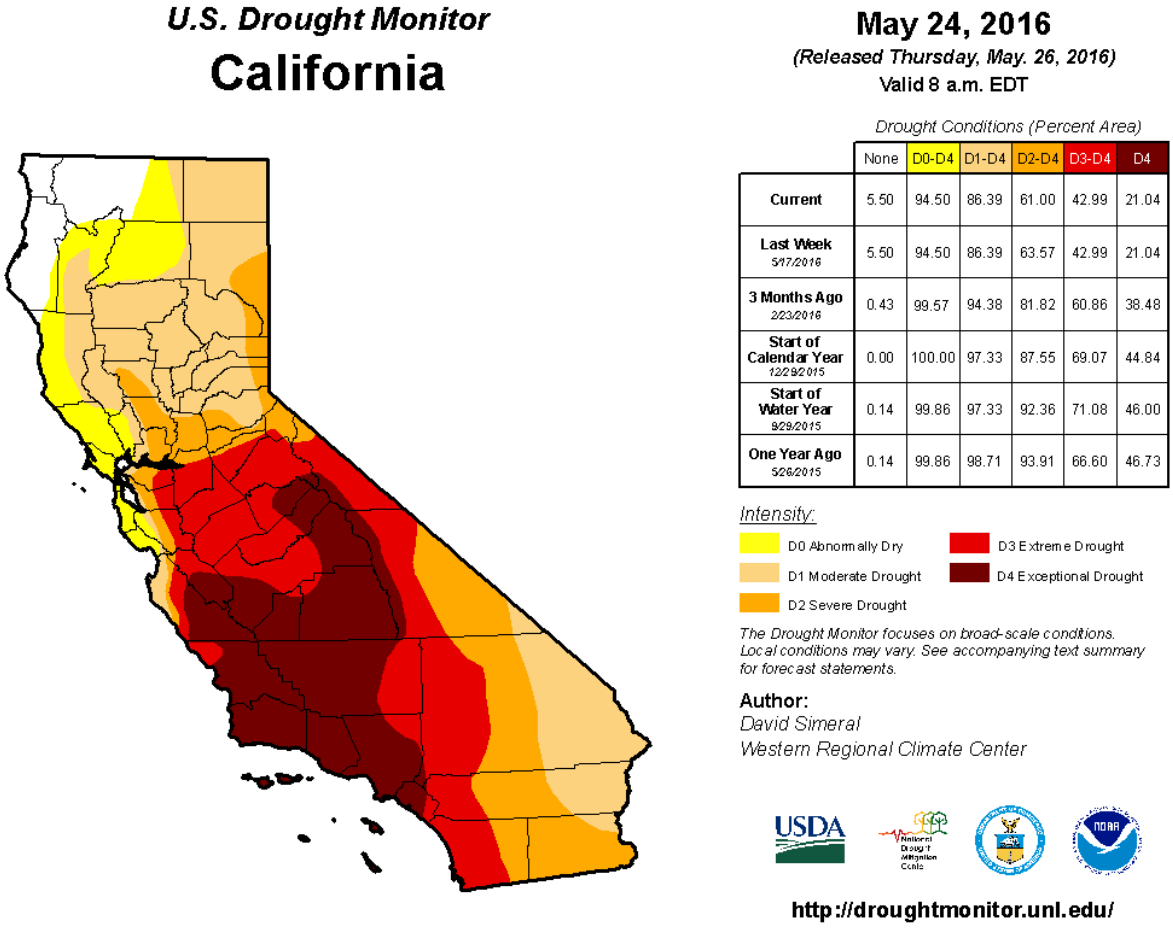


Figure 3.4 shows the impact of the most recent drought starting in 2013 year over year, and the recovery in 2017.

Risk of Future Hazards

As noted above, droughts are a regular feature in California. They are almost certain to continue to occur, with varying severity and duration. Since the US Drought Monitor began producing data in 2000,

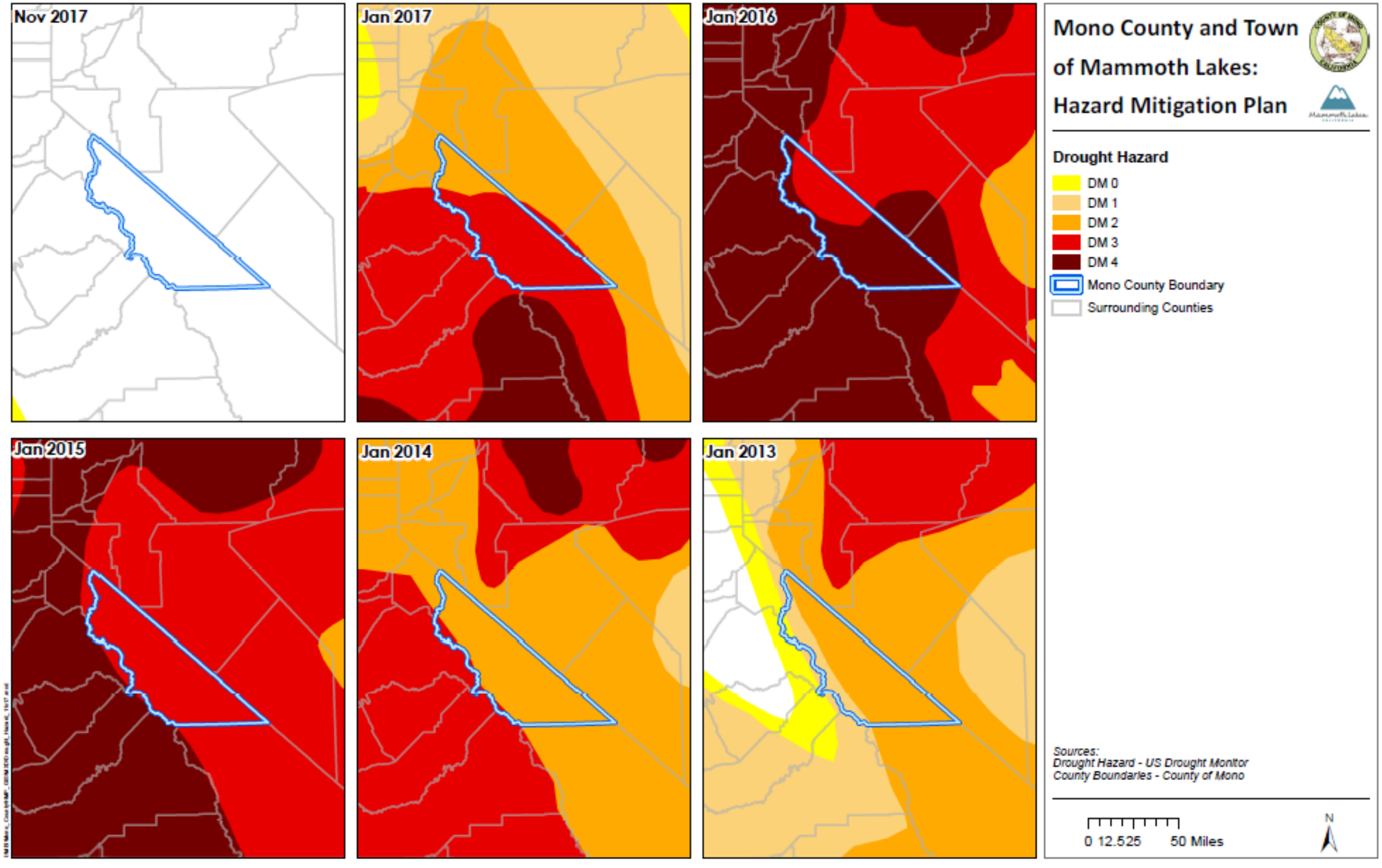
there have been 302 weeks when at least half of Mono County was classified as experiencing severe to exceptional drought based on US Drought Monitor categories, or about 30 percent of the time. Such frequencies are likely to increase in the future, as discussed below.

Mono County's numerous water systems, including community water systems and individual wells, rely on a combination of groundwater and local surface water. As a result, any local drought conditions may impact the water supply systems in Mono County and the Town of Mammoth Lakes, as there is no infrastructure to import water from elsewhere in California and, due to the location of the County in the upper portion of the watershed, there is little possibility to divert water from other areas without the cost of pipelines and pumping.

LADWP exports large amounts of water from the Mono Lake Basin and the Owens River. The Los Angeles Aqueduct supplies approximately one-third of the water for the City of Los Angeles, with the amount supplied being dependent on the amount of accumulated snow (snowpack) in the Eastern Sierra Nevada each year. In years of little snowpack, less water is delivered through the aqueduct and the City of Los Angeles must purchase additional water from the Metropolitan Water District. The LADWP 2015 Urban Water Management Plan projects 7 percent of the district's water to be obtained from Los Angeles Aqueduct deliveries in dry years, or 42 percent in average years, although exact amounts may vary depending on water conditions each year.

The California Water Code (Sections 10933 and 12924) requires the DWR to prioritize the overall importance of California's groundwater basins and sub-basins based on eight criteria, and to conduct groundwater basin assessments. The prioritization levels are very low, low, medium, high, or very high. The eight criteria are overlying population; projected growth of overlying population; public supply wells; total wells; overlying irrigated acreage; reliance on groundwater as the primary source of water; impacts on the groundwater, including overdraft, subsidence, saline intrusion, and other water quality degradation; and any other information determined to be relevant by the DWR. The DWR has determined that one groundwater basin underlying the County, the Owens Valley watershed, has a rating of medium. This basin runs alongside the White Mountains and underlies portions of the Tri-Valley communities. The other nine watersheds were ranked low or very low; this does not indicate that these basins are not at risk or that the communities they support are not vulnerable in drought conditions, only that they are not of highest priority to the state using the eight identified criteria.

Figure 3.4: Mono County in the 2013–2016 Drought



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Climate Change Considerations

Scientific evidence suggests that precipitation levels in California will generally decline as a result of climate change. In Mono County and the surrounding area, precipitation levels are expected to remain relatively steady, although with warming temperatures there may be more rain and less snow. Climate change is expected to impact the snowpack in the mountains, which normally melts slowly and provides a consistent supply of water during the summer and early autumn months before the rainy season returns. Decreases in precipitation are expected to reduce the size of the snowpack, which then also may melt faster as a result of warmer temperatures due to climate change. Overall, studies suggest that the snowpack in Mono County and surrounding areas may be reduced by more than 50 percent in some locations. Some recent studies found that the 2011–2017 drought was made worse by climate change and that climate change is likely to increase the risk of future extreme drought.

3.2.5 Earthquake and Seismic Hazards

Hazard Description

The category of seismic hazards includes four different but related hazard types—fault rupture, ground shaking, liquefaction, and tectonic subsidence—all of which are consequences of earthquakes. Earthquakes themselves are caused by the movement of large pieces of the earth's crust, called tectonic plates. As the tectonic plates move against each other, they can become stuck together, causing stress between the plates to build up until it eventually overcomes the friction holding them together. When this happens, the stress is released and the plates suddenly slip past each other, creating the shaking that is called an earthquake.

Earthquakes occur along boundaries called fault lines. These fault lines may be the actual border between plates, but they may also be borders between two sections of a single plate, created by the repeated process of accumulated and released stress. California sits on the boundary between the Pacific and North American tectonic plates. The motion between these plates occurs primarily on the faults of the San Andreas fault system and the Eastern California shear zone, a fault system that extends along the Eastern Sierra from Mono County south through Inyo County. About 10 millimeters per year of slip occurs on faults east of the Sierra Nevada. The eastern border of California from Mammoth Lakes heading north includes faults with poorly constrained or unknown slip rates with multiple fault strands distributed over a wide area.

Fault Rupture

Fault rupture is the actual movement of the ground's surface along a fault line when an earthquake occurs. This movement may be vertical, horizontal, or both, depending on the type of fault. Damage from fault rupture is limited to the area of the fault boundary itself, although depending on the amount

of movement along the fault, the damage may be severe. Some earthquakes, known as blind thrust earthquakes, occur without causing visible surface rupture, although they may still cause substantial damage. The 1994 Northridge earthquake, one of the most damaging in California history, was a blind thrust earthquake.

Ground Shaking

Ground shaking is generally the most damaging of seismic-related hazards and is the specific hazard most commonly associated with earthquakes. The severity of ground shaking is affected by local geology, but in general it will be most severe closest to the site of the earthquake, and decrease with distance. Ground shaking may occur in an up-and-down, side-to-side, or rolling motion, depending on the type of seismic waves produced by the earthquake.

Liquefaction

Liquefaction occurs when loosely packed sand or silt is saturated with water and then shaken hard enough for it to temporarily behave like a fluid. This causes the soil to lose its strength, which may in turn damage structures built on or in it. Liquefaction risk depends primarily on the height of the groundwater table and the composition of the soil.

Tectonic Subsidence

Subsidence is when the earth's surface sinks. Fault movement is one possible cause of subsidence. As noted in the Mono County Master Environmental Assessment (MEA 2001), "The most dramatic tectonic subsidence occurs during earthquakes, when areas can drop suddenly." This type of subsidence has been observed in Mono County.

Mono County covers an area that is relatively young by geologic standards. It is located at a stress point where the earth's crustal plates are exerting opposite pressures against each other. This combination creates both "tectonic" earthquakes (e.g., land mass movement) and volcanic activity that can trigger earth shaking (e.g., magma chamber movement and lava dyke formations). Up-to-date information concerning earthquake activity in the County is available from USGS (www.usgs.gov). The primary seismic hazard in the County is strong to severe ground shaking generated by movement along active faults (MEA 2001).

Location and Magnitude

Ground shaking is measured using either the moment magnitude scale (MMS, denoted as Mw or simply M) or the Modified Mercalli Intensity Scale. The MMS is a replacement for the Richter scale, which is still often referred to but is no longer actively used, as the Richter scale is not reliable when measuring large earthquakes (USGS 2014a). The weakest earthquakes measured by the MMS start at 1.0, with the numbers increasing with the strength of the earthquake. The strongest recorded earthquake, which

struck Chile in 1960, measured 9.5 on the MMS (USGS 2015a). Like the Richter scale, the MMS is a logarithmic scale, meaning the difference in strength between two earthquakes is much larger than the difference in their measurements. For example, a 6.0 Mw earthquake is 1,000 times stronger than a 4.0 Mw earthquake and about 1.4 times as strong as a 5.9 Mw event.

The Modified Mercalli Intensity Scale is based on the damage caused by the earthquake and how it is perceived, rather than an actual measurement. When comparing multiple earthquakes, one event may have a higher Mercalli rating than another even if it released less energy, and thus was measured lower on the MMS. The Mercalli scale ranges from I (instrumental, rarely felt by people) to XII (catastrophic, total damage and lines of sight are distorted). **Table 3.11** shows a general comparison between the MMS and the Modified Mercalli Intensity Scale. Note that there is some overlap toward the higher end of the Mercalli ratings, with certain intensities produced by multiple ranges of magnitude measurements.

Table 3.11 Comparison of MMS and Modified Mercalli Intensity Scale

Magnitude (MMS)		Modified Mercalli Intensity Scale	
		Intensity	Description
1.0 to 3.0		I	Not felt except by very few persons under especially favorable conditions.
3.0 to 3.9		II	Weak: Felt only by a few persons at rest, especially on upper floors of buildings.
		III	Weak: Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0 to 4.9		IV	Light: Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
		V	Moderate: Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0 to 5.9		VI	Strong: Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
	6.0 to 6.9	VII	Very Strong: 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.

Table 3.11 Comparison of MMS and Modified Mercalli Intensity Scale

Magnitude (MMS)		Modified Mercalli Intensity Scale	
		Intensity	Description
7.0 and greater		VIII	Severe: 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.
		IX	Violent: 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.
		X	Extreme: Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
		XI	Extreme: Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
		XII	Extreme: Damage total. Lines of sight and level are distorted. Objects thrown into the air.
Source: USGS 2017			

As identified in **Table 3.1** above, earthquake hazards are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes.

Mono County

California began extensive mapping of earthquake faults with the Alquist-Priolo Earthquake Fault Zoning Act of 1972. Mapping associated with the act has identified 11 named fault zones in Mono County. These are the Fish Slough, Hartley Springs, Hilton Creek, Mono Lake, and Round Valley fault zones, as well as numerous unnamed faults in the Volcanic Tableland, within the Long Valley Caldera-Mono Lake area; the Antelope Valley and West Walker River fault zones in northern Mono County; the Robinson Creek fault zone in the Bridgeport area; the Silver Lake fault zone near June Lake; the White Mountains fault zone in the Tri-Valley area; and the Fish Lake Valley fault zone in the Oasis area. Additional faults, located outside the County, could still have impacts in the County. Taken together, these faults are capable of producing strong to severe ground shaking in virtually every populated area of Mono County. **Figure 3.5** shows Alquist-Priolo fault lines in Mono County. Note that there are other faults in Mono County that are not identified as Alquist-Priolo faults. While state law does not require these faults to be mapped, their exclusion from these maps does not mean they do not pose a risk. With the exception of the relatively small West Walker River and Silver Lake faults, all these fault zones have been analyzed as part of the Third Uniform California Earthquake Rupture Forecast (UCERF3), and the USGS has developed scenarios to explore the effects of a major earthquake on each fault.

The entire County, except for a small portion of the Sierra crest, is in an area where intense ground shaking is possible. **Figure 3.6, Figure 3.7, and Figure 3.8** shows the likely affected area and intensity of shaking that would occur in the event of three different USGS earthquake scenarios. These three scenarios represent earthquakes on the faults within the County that have the greatest likelihood of causing a major earthquake in the next 30 years, according to UCERF3. Additional USGS earthquake scenarios and UCERF3 probability projections for Mono County are discussed in greater detail below.

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Figure 3.5: Mono County Alquist-Priolo Earthquake Faults and Historic Epicenters

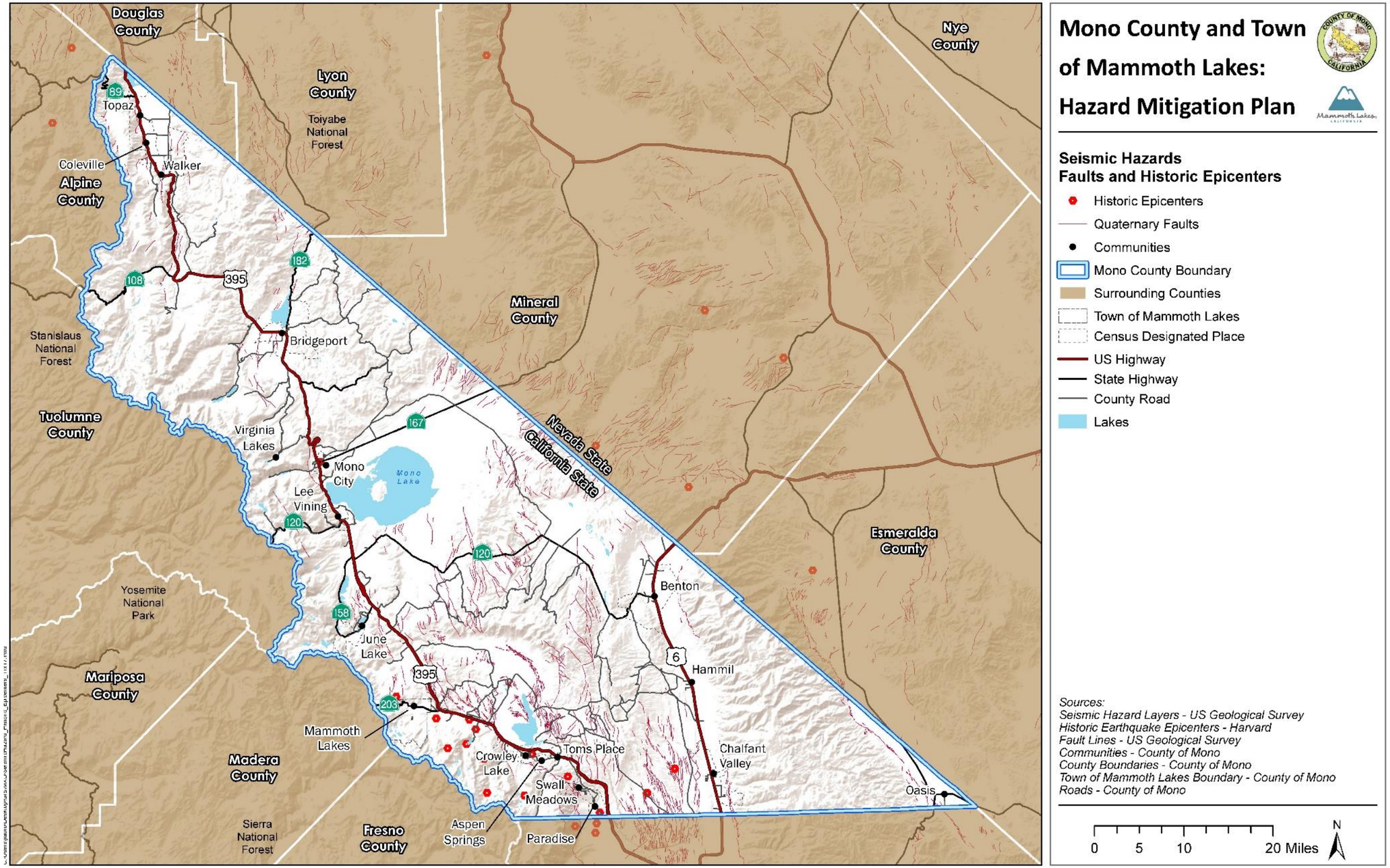

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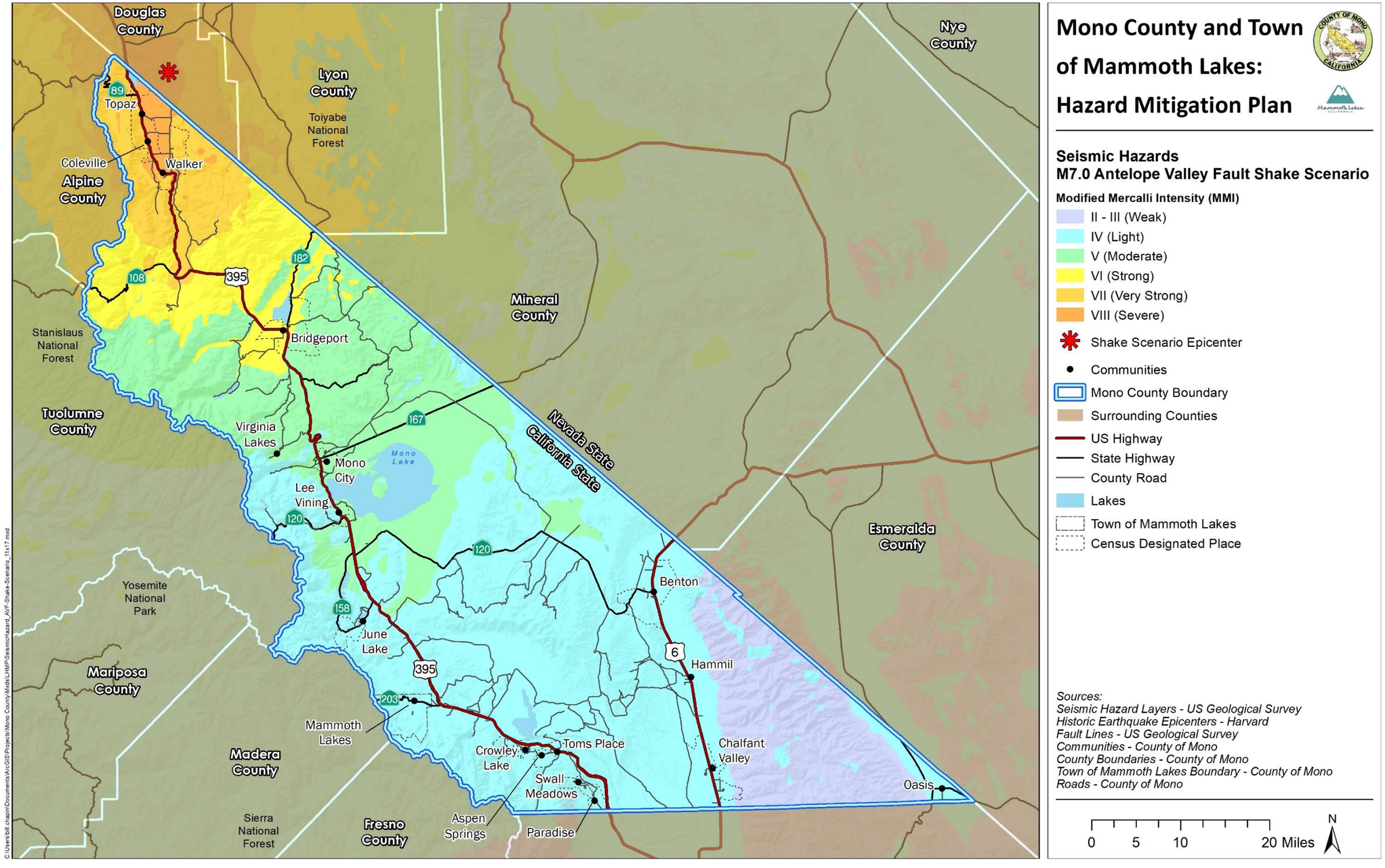
Figure 3.6: Antelope Valley Fault Shake Scenario



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Seismic Hazards
M7.0 Antelope Valley Fault Shake Scenario

Modified Mercalli Intensity (MMI)
- II - III (Weak)
- IV (Light)
- V (Moderate)
- VI (Strong)
- VII (Very Strong)
- VIII (Severe)

- Shake Scenario Epicenter
- Communities
- Mono County Boundary
- Surrounding Counties
- US Highway
- State Highway
- County Road
- Lakes
- Town of Mammoth Lakes
- Census Designated Place

Sources:
Seismic Hazard Layers - US Geological Survey
Historic Earthquake Epicenters - Harvard
Fault Lines - US Geological Survey
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

0 5 10 20 Miles N

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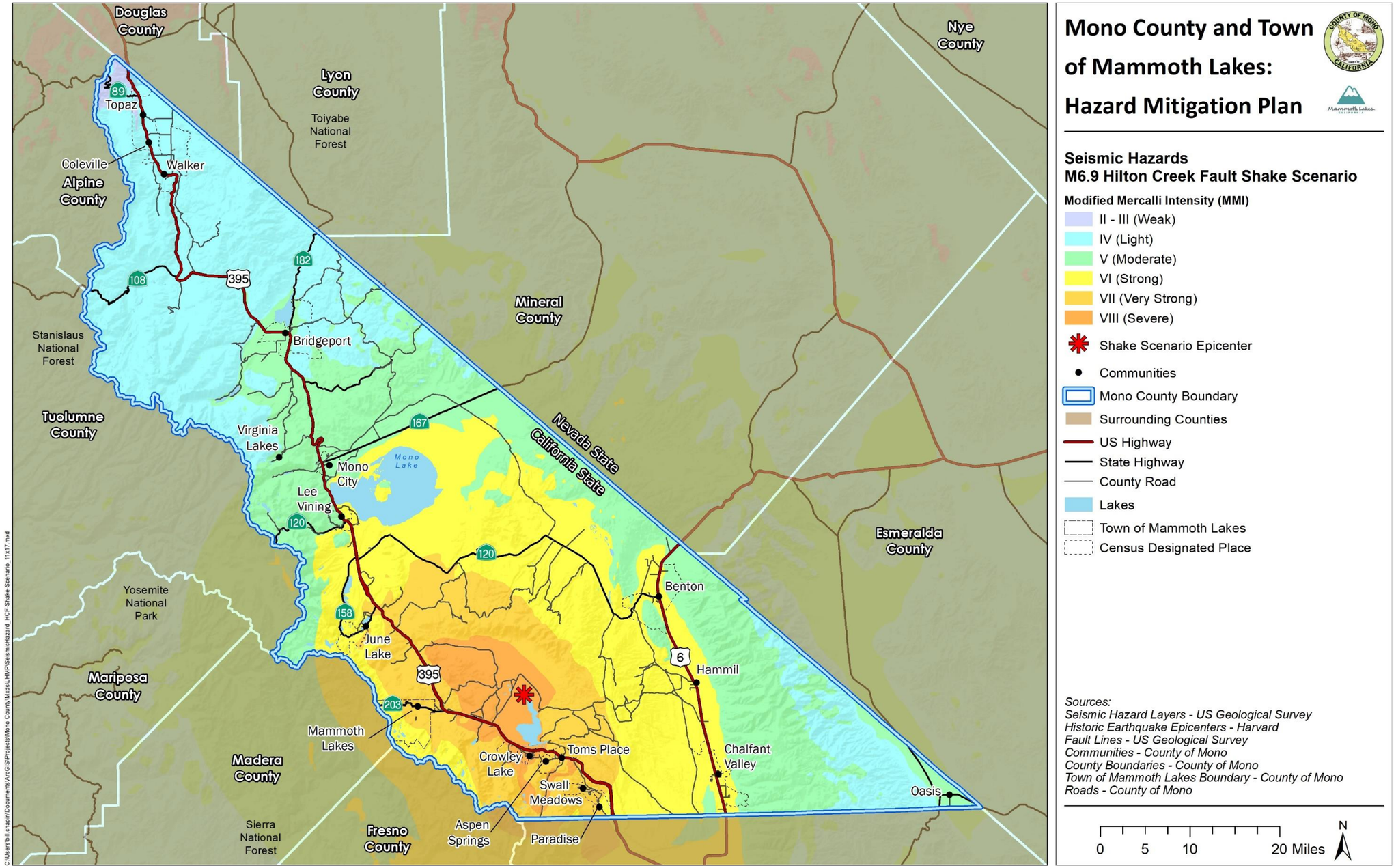
Figure 3.7: Hilton Creek Fault Shake Scenario



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Seismic Hazards
M6.9 Hilton Creek Fault Shake Scenario

Modified Mercalli Intensity (MMI)
- II - III (Weak)
- IV (Light)
- V (Moderate)
- VI (Strong)
- VII (Very Strong)
- VIII (Severe)
- Shake Scenario Epicenter
- Communities
- Mono County Boundary
- Surrounding Counties
- US Highway
- State Highway
- County Road
- Lakes
- Town of Mammoth Lakes
- Census Designated Place

Sources:
Seismic Hazard Layers - US Geological Survey
Historic Earthquake Epicenters - Harvard
Fault Lines - US Geological Survey
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

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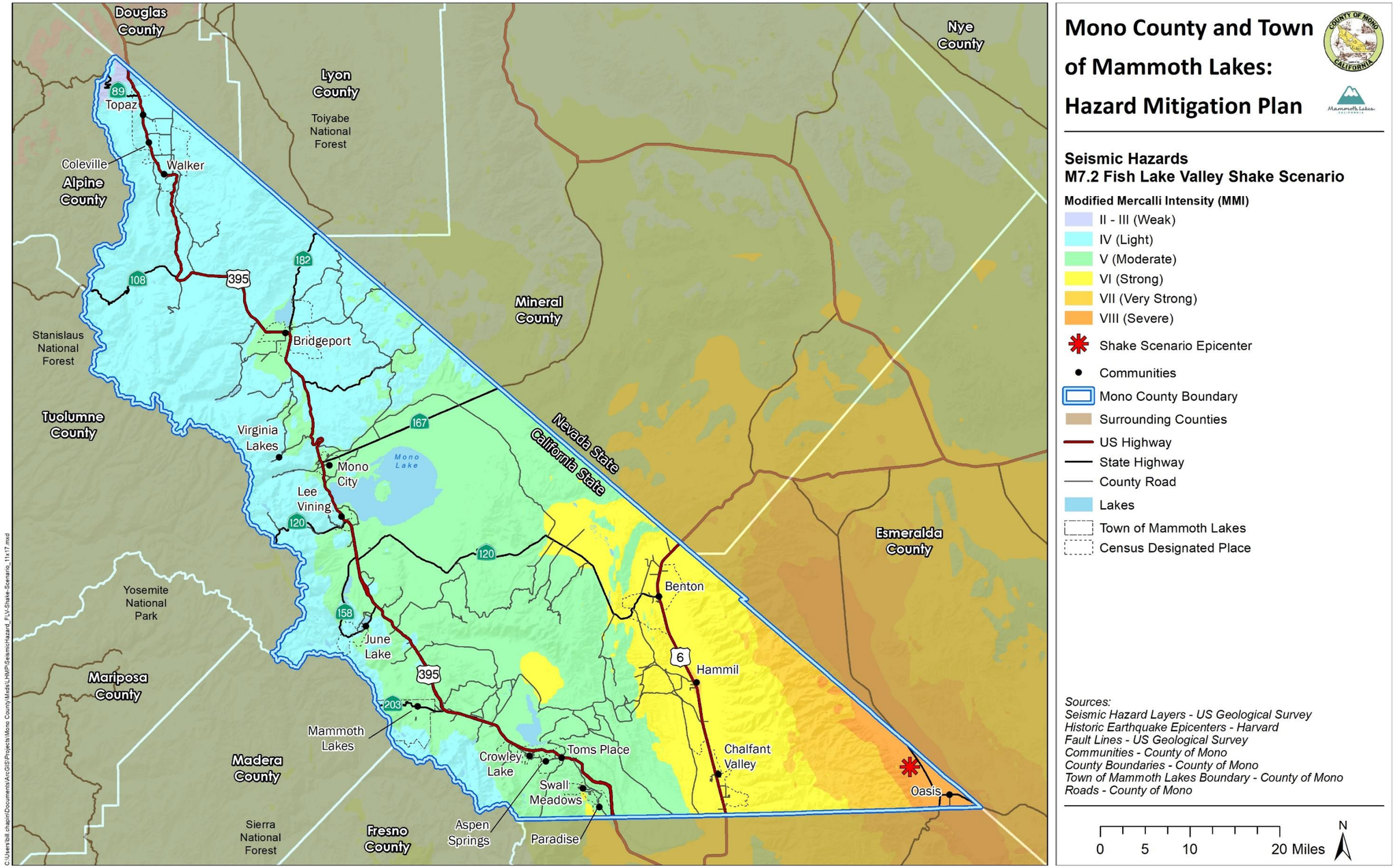
Figure 3.8: Fish Lake Valley Fault Shake Scenario



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Seismic Hazards
M7.2 Fish Lake Valley Shake Scenario

Modified Mercalli Intensity (MMI)
- II - III (Weak)
- IV (Light)
- V (Moderate)
- VI (Strong)
- VII (Very Strong)
- VIII (Severe)

- Shake Scenario Epicenter
- Communities
- Mono County Boundary
- Surrounding Counties
- US Highway
- State Highway
- County Road
- Lakes
- Town of Mammoth Lakes
- Census Designated Place

Sources:
Seismic Hazard Layers - US Geological Survey
Historic Earthquake Epicenters - Harvard
Fault Lines - US Geological Survey
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

0 5 10 20 Miles N

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The Mono County MEA includes the following details about where seismic hazards have been observed within the County:

- Groundshaking: "In addition to tectonic movement, the Long Valley-Mammoth Lakes region has experienced numerous earthquakes caused by the movement of magma below the earth's surface."
- Ground failure: "Ground failure induced by groundshaking includes liquefaction, lateral spreading, lurching, and differential settlement, all of which usually occur in soft, fine-grained, water-saturated sediments, typically found in valleys. During the 1980 Mammoth Lakes earthquake sequence, ground failure was prevalent at Little Antelope Valley, along margins of the Owens River in upper Long Valley, along the northwest margins of Lake Crowley, and along Hot Creek Meadow."
- Tectonic subsidence: "During the May 1980 sequence of earthquakes near Mammoth Lakes, there were several locations near the Hilton Creek Fault where the ground surface dropped about four inches on the northeast side of fractures. Along the 'Mammoth Airport fault zone,' up to 12 inches of vertical offset on the east side of ruptures was observed."

The area at risk of fault rupture is limited to areas in the immediate vicinity of a fault. **Table 3.12** shows the ownership and administration of lands affected by Alquist-Priolo fault zones in unincorporated areas of Mono County. In all, while the entire County is at risk from ground shaking, only about 56,846 acres are at direct risk of fault rupture from an Alquist-Priolo fault, or 2.8 percent of the entire County area.

Table 3.12 Areas at Risk of Fault Rupture in Unincorporated Mono County by Ownership

Land Ownership or Administration Category	Acres in Hazard Zone	Percentage of Total Ownership	Percentage of Total Mono County Area
County	13	0.6%	<0.1%
Federal	47,125	2.7%	2.3%
Private	4,993	3.9%	0.2%
State	618	0.7%	<0.1%
Utilities	3,538	5.3%	0.2%
Right of way, unknown ownership/ administration	559	6.2%	<0.1%
Total	**56,846**	**2.8%**	**2.8%**

Table 3.13 shows how much of the land within Alquist-Priolo fault zones lies within each of the planning areas defined by the Mono County General Plan.

Table 3.13 Areas at Risk of Fault Rupture in Mono County Planning Areas

Planning Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Antelope Valley	2,256	7.5%	0.1%
Benton Valley	1,235	3.1%	0.1%
Bodie Hills	0	0.0%	0.0%
Bridgeport	2,774	5.4%	0.1%
Chalfant Valley	20,525	34.1%	1.0%
Hammil Valley	1,745	2.6%	0.1%
June Lake	3,477	6.6%	0.2%
Long Valley	940	5.2%	<0.1%
Mammoth Vicinity	11,325	10.3%	0.6%
Mono Basin	1,070	0.5%	<0.1%
Oasis	1,591	9.8%	0.1%
Sonora Junction	371	0.3%	<0.1%
Swauger Creek	0	0.0%	0.0%
Upper Owens	207	1.3%	<0.1%
Wheeler Crest	772	13.4%	<0.1%

Mammoth Lakes

Parts of the Hartley Springs fault zone extend into the Town of Mammoth Lakes. In addition, the USGS earthquake scenarios discussed below show that a major earthquake on the Hilton Creek, Round Valley, or White Mountains faults could produce ground shaking in the Town that results in slight to considerable damage.

Table 3.14 shows how much of the land within Alquist-Priolo fault zones lies within the Mammoth Lakes planning area.

Table 3.14 Areas at Risk of Fault Rupture in Mammoth Lakes

Planning Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Town Municipal Boundary	332	2.07%	0.02%
Town Urban Limit	6	0.24%	0.00%

The California Department of Conservation Seismic Hazard Program delineates areas prone to earthquake-related hazards, including liquefaction. Liquefaction zones identify where the stability of foundation soils must be investigated, and countermeasures undertaken in the design and construction of buildings for human occupancy. Statutes require that counties and cities use these zones as part of their construction permitting process. While no complete mapping is available for liquefaction risk in the County or Town, past events suggest that the valley areas within the County face an elevated risk of liquefaction, particularly areas around dry lake beds. Potential areas occur in the area of June Lake near Boulder Drive, Dream Mountain, and Bridgeport Valley and up through Lakeside Drive). Within the Town, areas potentially subject to liquefaction are in the lower parts of the community including Sherwin Meadows and areas in Old Mammoth.

Hazard History

Earthquakes occur frequently in the Eastern Sierra, in Mono County, and particularly in the Long Valley area. The USGS Earthquake Catalog shows that earthquakes happen in the general vicinity weekly and almost daily, but most are under magnitude 3 and are not felt by people. There have been 145 earthquakes of at least magnitude 4.5 within 25 miles of Mono County since 1980, of which 94 had epicenters within the County borders. Of these, the largest measured magnitude 6.3 on May 25, 1980, during a sequence of earthquakes near Mammoth Lakes. Among the 46 earthquakes that measured at least magnitude 5.0, more than a third were related to the 1980 earthquake swarm and the 1986 Chalfant Valley earthquake, both of which are discussed below.

May 1980 Mammoth Lakes Earthquakes

McJunkin and Bedrossian (1980) noted the following in *California Geology* magazine concerning the 1980 earthquakes in Long Valley:

"On May 25, 1980 at 0933 Pacific Daylight Time (PDT) a magnitude 6.0 earthquake (all magnitudes are from Caltech Seismological Laboratory) occurred approximately 10.5 km east-southeast of Mammoth Lakes, California (figure 1). During the next 16 minutes, four magnitude 4.1 - 5.0 shocks and one 5.5 shock occurred. This seismic activity was the beginning of an earthquake sequence that produced 72 magnitude 4.0 - 4.9 events, six magnitude 5.0 - 5.5 events and three events of magnitude 6.0 - 6.3 during

the next 48 hours; thousands of magnitude < 3.9 earthquakes were generated during this same time period. The largest earthquake in the sequence was magnitude 6.3 and occurred at 1245 (PDT) on May 25. Seismic activity after this event was fairly continuous for the next three days; however, most events were less than magnitude 5.0.

"Damage from earthquake shaking was most pronounced in the Mammoth Lakes community and surrounding local areas. After the first event on May 25, Mammoth Lakes was without power until noon; during this period vital community services operated from auxiliary power supplies. Most damage to buildings was nonstructural and included broken windows and water mains, cracked plaster, and fallen chimneys. Damage to shelf stock and fixtures was moderate to severe in many stores, restaurants, and motels; in addition, extensive destruction to breakable contents in homes was commonly reported. Hot Creek Fish Hatchery and Mammoth Elementary School, east of U. S. 395, also received considerable nonstructural damage from earthquake shaking. Initial damage losses to schools, other public buildings, and roads in the Mammoth Lakes region was estimated to be $2 million."

1986 Chalfant Valley Earthquake

In an interview for the previous Hazard Mitigation Plan update, Dave Hill of the USGS Long Valley Observatory noted the following concerning the Chalfant Valley earthquake in 1986:

"The Chalfant Valley earthquake (M=6.4) occurred on July 21, 1986. It was preceded by a month-long foreshock sequence that began M=2.6 earthquake on July 3 and built up to a M~5.8 (as I recall) earthquake just 24 hours before the mainshock. The area had shown virtually no previous earthquake activity (since the mid-1970s anyway). The aftershock sequence was also rather energetic including three M>5.5 earthquake (the largest was close to M~6). I think the associated damage was minimal aside from rock falls in the mountains and a number of mobile homes in the Chalfant area that were toppled from their (unstable) foundations." (Dave Hill, pers. comm.)

There has not been a significant earthquake centered in Mono County since September 18, 2004, when three 5.4 events were recorded about 15 miles east of Mono Lake within a 40-minute period. Since the last Hazard Mitigation Plan update, there have been two significant events with epicenters nearby in Nevada: February 13, 2013, in Esmeralda County, and December 28, 2016, in Mineral County.

Risk of Future Hazards

Seismologists do not know when a large earthquake will hit the Eastern Sierra again but do know that one will occur. The County's location on and near numerous faults, including several capable of causing significant earthquakes, means that the County will continue to face threats from earthquakes and related hazards.

The UCERF3 forecast, developed in 2014 by the Working Group on California Earthquake Probabilities and led by the USGS, provides estimates of the magnitude, location, and likelihood of fault rupture for more than 350 fault segments throughout the state. **Table 3.15** lists faults in the region included in UCERF3, showing the probability for earthquakes of a particular magnitude within the next 30 years. Because the faults have multiple segments in Mono County, with different probabilities for each section, the full range of probabilities is shown. Depending on the magnitude and location of the earthquake, all of Mono County, including Mammoth Lakes, may be within the substantially affected area. Three faults—Antelope Valley, Fish Lake Valley, and Hilton Creek—have a greater than 1 percent chance of causing a magnitude 6.7 or greater earthquake within the next 30 years. Faults not identified in the forecast are still capable of causing significant earthquakes.

Table 3.15 UCERF3 30-Year Earthquake Probabilities by Fault

Fault	30-Year Earthquake Probability		
	6.7+ Mw	7.0+ Mw	7.5+ Mw
Antelope Valley	1.9 to 2.4%	0.4%	-
Fish Lake Valley	2.3 to 2.7%	1.9 to 2.0%	1.7 to 1.8%
Fish Slough	0.3%	0.1 to 0.2%	< 0.1%
Hartley Springs	0.5 to 0.7%	0.2%	-
Hilton Creek	1.0 to 1.3%	0.4 to 0.6%	-
Round Valley	0.5 to 0.8%	0.6%	-
White Mountains	0.4 to 0.5%	0.2 to 0.4%	0.0 to 0.1%

Scientists have analyzed numerous earthquake scenarios for the Long Valley Caldera-Mono Lake area, which includes portions of Mono County and all of Mammoth Lakes. A significant earthquake in this area would likely be widely felt throughout Mono County, and incur potentially serious impacts. A joint study by CGS and the USGS (USGS and CGS 2014) examined the potential consequences of significant earthquakes for the five faults in the area plus the nearby White Mountains fault, detailed below. Note that while this discusses potential impacts to Mono County through ground shaking, several faults are located in surrounding California counties or in Nevada:

- **Fish Slough Fault, magnitude 6.7**: Strong ground shaking in an area centered on Fish Slough but including parts of the Chalfant Valley (along U.S. 6) and northern Owens Valleys (along US 395 south of Bishop), extending up to 23 km from the fault trace (where the fault meets the ground surface). Severe perceived shaking and moderate to heavy potential damage limited to southern part of fault near Bishop and along U.S. Route 6 in Chalfant Valley. Maximum shaking in the Bishop area, where loose near-surface soil amplifies the shaking.

- **Hartley Springs Fault, magnitude 6.7:** Strong ground shaking in the Long Valley Caldera and the highlands between Long Valley and Mono Lake, extending up to 28 km from fault trace. Severe perceived shaking and moderate to heavy potential damage limited to small area northeast of June Lake Junction and smaller area near Mammoth Lakes.
- **Hilton Creek Fault, magnitude 6.5:** Strong ground shaking in the southern Long Valley Caldera and upper Rock Creek areas, extending up to 22 km from fault trace. Severe perceived shaking and moderate to heavy potential damage about 12 km from the fault in the hanging wall regions and 4 km in the footwall regions. Maximum shaking east of the fault and around Crowley Lake.
- **Mono Lake Fault, magnitude 6.7:** Strong ground shaking in the Mono Basin and Conway Summit areas, extending up to 32 km from the fault trace. Severe perceived shaking and moderate to heavy potential damage about 17 km from the fault in the hanging wall regions and 6 km in the footwall regions.
- **Round Valley Fault, magnitude 7.0:** Strong ground shaking in the southern Long Valley, Round Valley, and Bishop Creek areas, extending up to 35 km from the fault trace into the foothills of the White Mountains. Severe perceived shaking and moderate to heavy potential damage about 23 km from the fault in the hanging wall regions and 8 km in the footwall regions. Maximum shaking near the fault, particularly to the east.
- **White Mountains Fault, magnitude 7.35:** Strong ground shaking throughout the Chalfant and northern Owens River Valleys, extending up to 40 km from fault trace into the Long Valley Caldera and Mammoth Lakes. Severe perceived shaking and moderate to heavy potential damage about 15 km on either side of the fault. Maximum shaking extends farther on the western, valley side.

Full details for each of these scenarios are available in the joint report document.

In addition to the potential earthquake scenarios related to the Long Valley Caldera-Mono Lake area, scientists have analyzed the following scenarios for faults elsewhere in Mono County, as depicted on USGS Shakemaps:

- **Antelope Valley Fault, magnitude 7.0**: This rupture would produce severe perceived shaking (Mercalli intensity VIII) in Topaz, Coleville, and Walker, with strong shaking (Mercalli intensity VI) as far away as Bridgeport.
- **Fish Lake Valley Fault, magnitude 7.2:** This rupture would produce severe perceived shaking in Oasis, with strong shaking as far away as Chalfant Valley and Crowley Lake.

- **Robinson Creek Fault, magnitude 7.1:** This rupture would produce severe perceived shaking in Bridgeport, with strong shaking as far away as Mono Lake, Walker, and Coleville.

Liquefaction/ground failure is likely to occur in the future, especially in the event of an earthquake that produces strong ground shaking in areas of soft, fine-grained, water-saturated sediments, typically found in valleys. Liquefaction/ground failure can damage structures overlaying these soils or structures within the path of the failure. Infrastructure within the soils, such as water conveyance, can also be damaged resulting in loss of service within the area.

Climate Change Considerations

The likelihood, size, and severity of seismic events are not expected to be directly impacted by climate change. It is possible that anticipated changes to precipitation levels and storm intensity may affect groundwater aquifer levels, which could expand or contract areas of potential liquefaction in the planning area. Since the field of climate change science is dynamic, the Planning Team will review and summarize new research that occurs on this topic during the next update cycle.

3.2.6 Extreme Heat

Hazard Description

While there is no universally agreed-upon definition for extreme heat, it generally refers to a period of time in which the high temperature significantly exceeds normal conditions. A commonly used definition in California declares that an extreme heat day is any day in which the maximum temperature is higher than all but 2 percent of historical high temperatures (CalEPA and CDPH 2013).[2] Extreme heat is a factor not just of temperature but also of humidity, as high humidity can make already hot conditions feel even hotter; however, since humidity rarely exceeds 50 percent throughout Mono County, it is not considered a factor in the risk of extreme heat in this Plan. Multiple consecutive extreme heat days are known as heat waves. **Table 3.16** shows the National Weather Service's rating scale for the heat index at low humidity levels.

Table 3.16 Heat Index Rating Scale

Heat Index	Category	Description
80°F to 90°F	Caution	Fatigue is possible with prolonged exposure or physical activity.
90°F to 105°F	Extreme caution	Sunstroke, heat cramps, and heat exhaustion are possible with prolonged exposure or physical activity.

[2] More specifically, an extreme heat day is one where the maximum temperature exceeds all but 2 percent of the historic high temperatures between May and October from 1961 to 1990 (Cal EPA and CDPH 2013).

Table 3.16 Heat Index Rating Scale

Heat Index	Category	Description
105°F to 129°F	Danger	Sunstroke, heat cramps, and heat exhaustion are likely. Heatstroke is possible with prolonged exposure or physical activity.
130°F or higher	Extreme danger	Heatstroke risk is extremely high with continued exposure.
Source: Cal OES 2013a		

Extreme heat poses substantial health risks, including heat cramps, heat exhaustion, and heatstroke. Elderly persons and individuals who work outside are often most vulnerable to extreme heat. While extreme heat events generally do not damage property, they can damage or destroy agricultural crops and landscapes. Very high temperatures may also reduce the effectiveness of power infrastructure, leading to an increased risk of blackouts.

Location and Magnitude

Extreme heat affects small portions of Mono County, generally in areas of altitudes below 5,000 feet, such as in the Tri-Valley.

Mono County

In the Tri-Valley, the extreme heat threshold is approximately 97°F (CEC 2016). No other developed areas of the County experience annual extreme heat thresholds over 90°F.

Mammoth Lakes

Temperatures in the Town of Mammoth Lakes rarely exceed 80°F (CEC 2016). The extreme heat threshold for the Town is approximately 81°F (CEC 2016), which is generally not a risk to human health or infrastructure. Consequently, extreme heat is not considered a priority hazard for the Town.

Hazard History

A weather station in Benton, at the north end of the Tri-Valley, has been reporting daily temperature data since 1994. This station has recorded 434 days when the maximum temperature exceeded 97°F, or an average of 17.9 days per year. In the last five years, there have been seven occasions where the temperature exceeded 97°F for at least five consecutive days. The most severe of these heat waves lasted 14 days, with temperatures peaking at 104°F on July 28, 2016.

Risk of Future Hazards

Extreme heat events are likely to occur in the future, and potentially increase in temperature, longevity, and expand in area. According to Cal-Adapt, the number of extreme heat days that exceed the threshold of 97°F are likely to increase to over 40 days a year on average from 2070 to 2099 (CEC 2018).

3.2.7 Flood

Hazard Description

Flooding is a temporary condition in which dry land is partially or completely inundated. Flooding can happen in a variety of ways. The water levels in bodies such as streams, rivers, lakes, and reservoirs can exceed the water body's banks, causing water to overflow into nearby areas. Heavy precipitation can overwhelm the ability of soil to absorb water or of local storm drains to carry it away, causing water to build up on the surface. Flooding may also occur from infrastructure failure, such as a burst water tank or pipe. Dam inundation, a specific type of infrastructure failure flooding that occurs when a dam partially or completely collapses, is discussed separately under the Dam Failure hazard profile.

In Mono County, flooding is mainly the result of snowmelt and short, intense rainstorms when the ground is already saturated. Localized torrential rain during summer thunderstorms can produce sudden flash flooding, particularly in the Tri-Valley Area. This part of the south county is also subject to alluvial fan flooding, which occurs when runoff flows out of canyons and onto the adjacent, cone-shaped deposits of sediment. The rapidly moving water can pick up large boulders and other debris and then deposit them in runoff channels, blocking the flow of water. Flooding in alluvial fans often causes greater damage than clear-water flooding. A less common type of flooding that could potentially occur due to seiches, earthquake-generated waves within lakes and reservoirs; however, there is no evidence that seiches have occurred in Mono County in the past.

Regardless of the type of flood, a flood event can damage buildings and infrastructure both by debris carried along in the water or by the pressure of the water itself. Debris flows, which are a hazard of substantial concern in Mono County, are discussed under the Landslides profile. Floods can weaken foundations and wash away soils, increasing the risk of damage or destruction. According to California's Multi-Hazard Mitigation Plan, floods are the second most common disaster type in California, second only to fires (CNRA and Cal OES 2012). Flood severity is generally described in years, such as a 100-year event. This does not mean that such an event only occurs once every 100 years, but that the risk of such an event is 1 percent in any given year. Similarly, a 500-year flood event is one where the risk of such an event is 0.2 percent in any given year.

Location and Magnitude

Flooding is anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes.

Mono County

Mono County has three watersheds: the Owens River drainage, the Mono Lake drainage, and the Walker River drainage. Flooding can occur in all three drainages.

FEMA maps areas that are subject to a 100-year flood event as part of the National Flood Insurance Program. Mapping data for Mono County is incomplete, but does show that areas within these flood hazard zones include:

- **Antelope Valley** along the West Walker River—including the communities of Topaz, Coleville, and Walker—as well as the East Slough and much of the valley floor in between.
- **Pickel Meadow** along the West Walker River.
- **Bridgeport Valley**, along the East Walker River and creeks flowing into Bridgeport Reservoir, including the communities of Bridgeport and Twin Lakes.
- The **June Lake Loop** area, along Grant Lake and June Lake and the creeks that connect them.
- Throughout the center of the **Tri-Valley Area** on the valleys' flat floor, including stretches of U.S. 6 in Hammil Valley and Chalfant Valley.

Much of the development in the Tri-Valley along US 6 is subject to alluvial fan flooding and flash flooding from the surrounding mountains. Flows tend to be wide and shallow once they reach the valley floor due to the topography.

Table 3.17 shows the ownership and administration of lands within the 100-year and 500-year floodplains in Mono County. In all, about 75,327 acres have a 1 percent chance of flooding in any given year, while 86,616 acres have a 0.2 percent chance of flooding in any given year. In both cases, just over half of this land is owned or administered by the state of California.

Table 3.17 Areas at Risk of Flooding in Mono County by Ownership

Land Ownership or Administration Category	100-Year Flood Zone			100- Plus 500-Year Flood Zones		
	Acres in Hazard Zone	Percentage of Total in Ownership Category	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total in Category	Percentage of Total Mono County Area
County	105	4.6%	< 0.1%	151	6.7%	< 0.1%

Table 3.17 Areas at Risk of Flooding in Mono County by Ownership

Land Ownership or Administration Category	100-Year Flood Zone			100- Plus 500-Year Flood Zones		
	Acres in Hazard Zone	Percentage of Total in Ownership Category	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total in Category	Percentage of Total Mono County Area
Federal	7,683	0.4%	0.4%	16,192	0.9%	0.8%
Local	7	3.1%	< 0.1%	9	4.4%	< 0.1%
Private	14,169	11.0%	0.7%	16,446	12.8%	0.8%
State[1]	45,725	54.5%	2.3%	45,730	54.5%	2.3%
Utilities	7,129	10.6%	0.4%	7,397	11.0%	0.4%
Right of way, unknown ownership/ administration	442	4.9%	< 0.1%	623	7.0%	< 0.1%
Unknown (other)	67	4.4%	< 0.1%	68	4.4%	< 0.1%
Total	**75,327**	**3.7%**	**3.7%**	**86,616**	**4.3%**	**4.3%**

1: A large portion of the state-owned acreage in the Hazard Zone is part of Mono Lake.

Table 3.18 shows how much of the land in the 100- and 500-year flood zones is within each of the planning areas defined by the Mono County General Plan.

Table 3.18 Areas at Risk of Flooding in Mono County Planning Areas

Planning Area	100-Year Flood Zone			100- Plus 500-Year Flood Zones		
	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Antelope Valley	5,460	18.1%	0.3%	320	1.1%	< 0.1%
Benton Valley	1,983	5.02%	0.1%	8,001	20.3%	0.4%
Benton Hot Springs	260	3.9%	<0.1%	55	0.8%	0.0%
Bodie Hills	-	-	-	-	-	-

Table 3.18 Areas at Risk of Flooding in Mono County Planning Areas

Planning Area	100-Year Flood Zone			100- Plus 500-Year Flood Zones		
	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Bridgeport	5,892	11.4%	0.3%	-	-	-
Chalfant Valley	5,900	9.8%	0.3%	994	1.7%	< 0.1%
Hammil Valley	2,836	4.2%	0.1%	1,890	2.8%	0.1%
June Lake	2,039	3.9%	0.1%	-	-	-
Long Valley	152	0.8%	< 0.1%	-	-	-
Mammoth Vicinity	444	0.4%	< 0.1%	-	-	-
Mono Basin	45[1]	19.2%	2.3%	-	-	-
Oasis	-	-	-	-	-	-
Sonora Junction	356	0.3%	<0.1%	-	-	-
Swauger Creek	-	-	-	-	-	-
Wheeler Crest	-	-	-	-	-	-

1: A large portion of the Mono Basin acreage in the Hazard Zone is part of Mono Lake.

Mammoth Lakes

Flooding issues in Mammoth Lakes have been the result of shallow, overbank flooding. The Town's General Plan notes the Town "has generally low flood hazards with the exception of Mammoth Creek which can carry significant volumes during peak 100-year flood conditions." FEMA flood maps likewise show areas adjacent to Mammoth Creek in the Old Mammoth area as within the 100-year flood zone. The floodplain includes portions of the Snowcreek Resort, which have been assigned a land use designation of "Resort" in the General Plan, allowing commercial mixed uses including visitor lodging, amenities, and services, as well as workforce lodging. The floodplain also passes through some areas that the General Plan designates as Low-Density Residential and High-Density Residential.

The most significant flooding tends to occur with rain-on-snow events, when snowmelt is compounded by rain. Rain runoff gets channelized through the snow instead of being directed into the proper runoff infrastructure. As drains are blocked by snow, roads become the primary pathway of water.

Table 3.19 shows the acreage and percentage of land in the 100- and 500-Year Flood Zones for the Mammoth Lakes Planning Area.

Table 3.19 Areas at Risk of Flooding in Town of Mammoth Lakes

Planning Area	100-Year Flood Zone			100- Plus 500-Year Flood Zones		
	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Town Municipal Boundary	382	2.38%	0.02%	-	-	-
Town Urban Limit	45	1.77%	0.00%	21	0.82%	0.0%

Figure 3.9 shows the flood hazard areas for Mono County.

Hazard History

A flood in January 1997, discussed in greater detail below, caused damage in the Town of Mammoth Lakes and the unincorporated communities of Coleville, Walker, Topaz, and Bridgeport. The flooding followed a rain-on-snow event, with 8 inches of rain over a 36-hour period reported in Mammoth Lakes. The USGS stream gauge below the confluence of the Little Walker and West Walker Rivers measured a discharge of 12,300 cubic feet per second and a peak height of 10.1 feet, about 8.5 feet more than normal. According to a U.S. Army Corps of Engineers report on the event, the stream gauges downstream and upstream of Walker washed out prior to the storm's peak flow, but the rate in Walker could have reached as much as 14,000 cubic feet per second. This is approximately double the estimates for the flow that would be generated by a 100-year event on the river. The crest was estimated at over 12 feet. During the same storm, the stream gauge on Hot Creek near Mammoth Lakes recorded its greatest discharge on record, with a flow of 433 cubic feet per second, and a peak height of 4.4 feet, about 3.4 feet above normal levels. Floodwater depths reached 2 feet in central Bridgeport.

Mono County

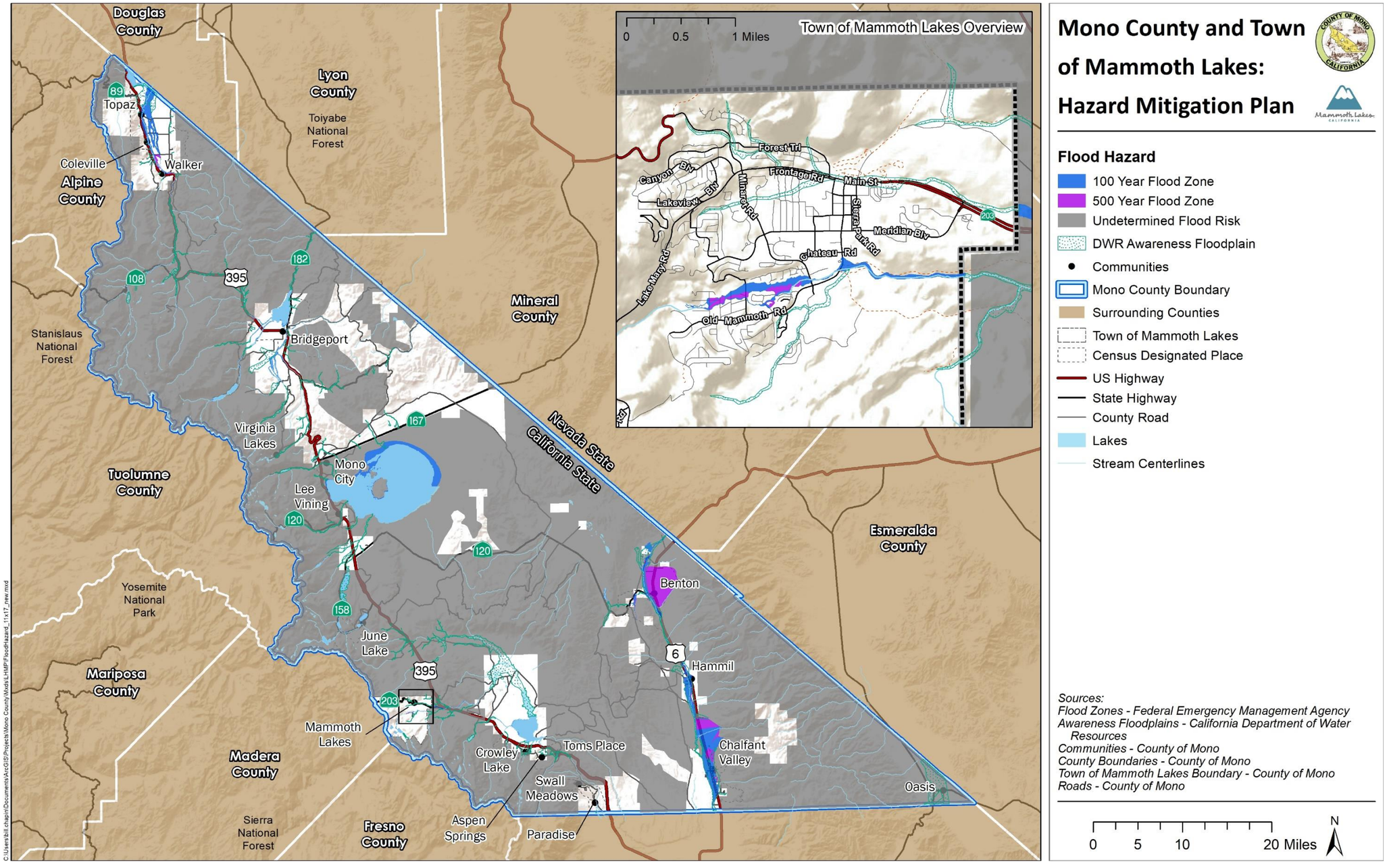
The flooding in January 1997 was the most significant event on record in Mono County. The floods were partially the result of two years of above-normal precipitation and a winter storm in December 1996 that deposited heavy snow in the Eastern Sierra. On January 1 and 2, an atmospheric river (or "Pineapple Express") brought a flow of warm, moist air from the subtropics, leading to heavy rainfall and snowmelt. Extensive damage occurred along the West Walker River in Walker River Canyon and Antelope Valley. The floods destroyed 111 homes and four businesses, at a cost of $25 million. Other damages included

$5 million to public facilities and $48 million to the federal highway system, including a 12-mile stretch of US 395.

FEMA's 2012 Flood Insurance Study for Mono County reports that flash flooding occurred along US 6 in the Tri-Valley Area in 1978, 1984, 1986, and 1989. The worst of these events occurred on August 9 and 10, 1989, following a combined total of 3.15 inches of rain. Water coming down the alluvial fan slopes of the White Mountains created a mudflow that crossed Spring Canyon Creek, sending a wall of water down US 6 at 20 miles per hour. The flood caused $1.5 million in damage to crops and more than $400,000 in damage to federal, state, and county roads. As many as 50 homes and 20 mobile homes were damaged at a cost of $700,000, although none were destroyed. The *Los Angeles Times* reported that most residents of Chalfant Valley had to be evacuated.

A 1996 report to Congress on the Sierra Nevada Ecosystem Project notes that "particularly large snowmelt floods in the Sierra Nevada have been documented in 1906, 1938, 1952, 1969, 1983, and 1995" with volumes two to four times larger than average.

Figure 3.9: Mono County Flood Hazard Areas



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Other notable events include floods in February 1986 that closed roads and caused damage throughout the County, and in March 1995 that destroyed two homes and damaged roads and utilities. A series of subtropical storms in December 1996 and into early 1997 caused significant flooding that affected the entire state, including Mono County. Forty-eight counties were declared disaster areas due to the flooding.

Since the 1997 event, smaller floods and flash floods have damaged or closed roadways, trails, and campgrounds throughout Mono County on numerous occasions. At least two flash floods have resulted in damage to homes. In July 2013, a slow-moving thunderstorm with heavy rain caused water damage to eight homes along SR 182 in Bridgeport; one home ended up with several inches of water on the main floor. In October 2015, thunderstorms over the White Mountains flooded Chalfant Valley, closing US 6 and damaging 20 homes, at least 4 of them severely.

Heavy storms of both rain and snow in January 2017 ultimately led to a federal disaster declaration for storms and flooding. Mammoth Lakes received more than 12 inches of rain that combined with recent snow, clogging up drainage systems with debris and ice. US 395 was temporarily closed due to flooding in both directions.

In June 2017, following heavy snows of the previous winter, residences in portions of the June Lake Loop, including several properties on Dream Mountain Drive, experienced flooding, in some cases resulting in property damage. The flooding events coincided with very high water levels in dams of the area and a warning by the dam owner, SCE, that month that some risk of dam inundation or overflow was possible. Dam failures ultimately did not occur; SCE utilized emergency pumps to regulate inflow of water to several of the dams during this time. **Table 3.20** summarizes recent flood history in Mono County.

Table 3.20 Mono County Flood History, 2000–2017

Incident	Date	Location
Flood	8/30/2000	Oasis
Flash Flood	7/18/2002	Lee Vining
Flash Flood	7/30/2003	Southwest Mono County
Flood	5/19/2006 to 5/31/2006	West Walker River
Flash Flood	7/18/2006	Walker
Flash Flood	7/25/2007	Mammoth Lakes
Flash Flood	7/15/2010	Bodie State Historic Park
Flash Flood	7/16/2010	Walker

Table 3.20 Mono County Flood History, 2000–2017

Incident	Date	Location
Flood	6/24/2011 to 6/30/2011	Benton Hot Springs, Bridgeport, Crestview, Lee Vining
Flash Flood	7/3/2013	Bridgeport
Flash Flood	9/1/2013	Benton Hot Springs
Flash Flood	10/18/2015	Chalfant Valley
Severe Winter Storms, Flooding, and Mudslides	1/18/17 to 1/23/17	Statewide
Severe Winter Storms, Flooding, and Mudslides	2/1/2017 to 2/23/2017	Statewide
Localized Flooding	6/1/2017 to 6/10/2017	June Lake

Mammoth Lakes

The January 1997 flooding event caused $1.2 million of damage in Mammoth Lakes. The Mammoth Lakes Police Department was under 6 inches of water.

On July 25, 2007, a thunderstorm produced flash flooding in Mammoth Lakes and the Mammoth Mountain Ski resort. More than 2.5 inches of rain fell in a three-hour period. The Town reported water flowing over roadways and flooding to a few houses.

The National Weather Service issued flood watches for Mammoth Lakes on several occasions during the winter storms of January and February 2017.

Recent flood history for the Town of Mammoth Lakes is summarized in **Table 3.20** above.

Risk of Future Hazards

Mono County

Areas within the flood hazard zones identified in **Figure 3.9** have a 1 percent chance of flooding in any given year. There is a 0.2 percent chance that a flood will occur in any given year in the 500-year floodplain areas indicated on the FEMA Flood Insurance Rate Maps (FIRMs). Some flooding may occur annually but it may not be as severe as a 100-year event, and it may not occur within the identified 100-year floodplain area. Significant, widespread flooding is most likely to occur when melting snow combines with heavy rains.

The risk of flooding can increase significantly in areas that have been burned by wildfire. Fires alter terrain and ground conditions, eliminating vegetation that can absorb rainfall. Flooding is also often more severe, as ash and debris left from the fire can contribute to mudflows. It can take more than five years before an adequate layer of vegetation is restored, due to the harsh climate of the area. See the Wildfire section (**Chapter 7**) for locations in Mono County that have burned recently and are at increased flood risk.

Mammoth Lakes

In the Town of Mammoth Lakes, locations with a 1 percent chance of flooding in any given year are generally those parts of Old Mammoth along Mammoth Creek.

Climate Change Considerations

There is some evidence that climate change may result in more frequent intense storms, known as atmospheric river events. Some studies suggest that, statewide, more years will have an increased number of atmospheric river events and that the largest of these atmospheric river events will be more intense than they have been historically (Dettinger 2011). In general, Northern California is expected to see more frequent atmospheric river events, potentially up to twice as many by year 2100 as the region currently does, while Southern California is expected to see the same number of atmospheric river events but with each individual storm an average of 10 to 20 percent more intense. However, the specific impacts on Mono County and the Eastern Sierra/Basin and Range region are not yet known (Oskin 2014).

As noted in the Drought section, dry conditions cause soil to harden, making it less absorbent to precipitation and increasing the risk of flooding, particularly at the beginning of the rainy season. Since drought conditions are expected to increase as a result of climate change, there is also a greater risk of flooding from these drought-induced changes in soil characteristics. These impacts may already be felt; in July 2015, Lieutenant Governor Gavin Newsom, acting temporarily as governor, issued a disaster proclamation for large parts of Southern California due to flooding and related hazards due to severe storms. In the proclamation, Lieutenant Governor Newsom noted the drought's impact of drying out soil and increasing the risk of flash floods (Office of the Governor 2015).

3.2.8 Landslides

Hazard Description

For the purposes of this Plan, landslides include landslides, rockfalls, mudflows, slope failures, and shallow debris flows. Other seismic hazards are discussed in the Earthquake and Seismic Hazards subsection.

Landslides occur when the soils of a slope, such as a hillside or mountain, become unstable. When this happens, the soils slide down toward the base of the slope, damaging or destroying structures built on the moving soil or in its path. While landslides are often thought of as fast-moving events, some landslides may happen slowly over a long period of time.

The types of materials that compose a slope and the steepness of the slope help determine the overall risk of a landslide occurring. Soil stability and time also contribute to the risk of rockfall, which is a particular risk along roadways and trails where a path or highway has been cut into a hillside, exaggerating the angle of repose and increasing the likelihood of rockfalls.

Landslides may be triggered by other hazard events. The shaking from an earthquake or the loss of soil stability as a result of earthquake-induced liquefaction can cause the soil to slide. Alternatively, precipitation can result in saturated soil and a loss of stability, or flowing water may erode the base of a slope. The risk of a landslide is often exacerbated in areas recently burned by wildfire, as the fire burns vegetation that can absorb water and hold back soil. Without the vegetation to stabilize a slope and prevent runoff, sediment and debris are more susceptible to sliding.

Landslide hazards in Mono County are primarily associated with seismic activity and heavy rainfall. Landslides in areas of hilly and mountainous terrain can be triggered by ground shaking, heavy rains, or human activities such as road cuts, grading, construction removal of vegetation, and changes in drainage. Mudflows involve very rapid downslope movement of saturated soil, sub-soil, and weathered bedrock. The movement of soil and debris by mudflow and other landslides over time is evident in the large alluvial fans at the edges of valley areas.

Throughout the western United States' vast Basin and Range Province, which includes the White Mountains, slopes are susceptible to the specific type of moisture-induced debris flows that form alluvial fans. These flows usually occur as a result of flash floods, which create torrents of water flowing down a steep mountain canyon. Flash floods often carry sediments and other debris, including boulders and trees. When the water is free of the confined canyon, it spreads out across a wide area, depositing debris in a broad, shallow slope called an alluvial fan. The alluvial fans themselves may be susceptible to further landslides due to their loose composition (CGS 2015a). A type of landslide called lateral spreading can occur on alluvial fans and other liquefaction-prone soils when liquefied soils become sufficiently fluid to spread across fairly shallow slopes. Flooding associated with alluvial fans is described in the Flood profile.

Location and Magnitude

As identified in **Table 3.1**, landslide hazards are anticipated to affect unincorporated Mono County, but not the Town of Mammoth Lakes.

Areas at risk for landslides are found throughout the County but mostly outside of populated community areas. The CGS has mapped areas at risk of deep-seated landslide. The map combines three classes of rock strength and eight classes of slope to create a matrix of susceptibility scores. **Figure 3.10** shows susceptibility scores for areas in Mono County. Areas with high levels of susceptibility include:

- Northeast boundary of the Long Valley Caldera, from Bald Mountain to Glass Mountain
- Many of the canyons along the eastern escarpment of the Sierra Nevada, from the county's southern border to the peaks north of Pickel Meadow
- Steep slopes north of Lee Vining
- Western slope of Slinkard Valley to the county border
- Slopes along Coyote Creek at the Nevada border
- Throughout the Bodie Hills area

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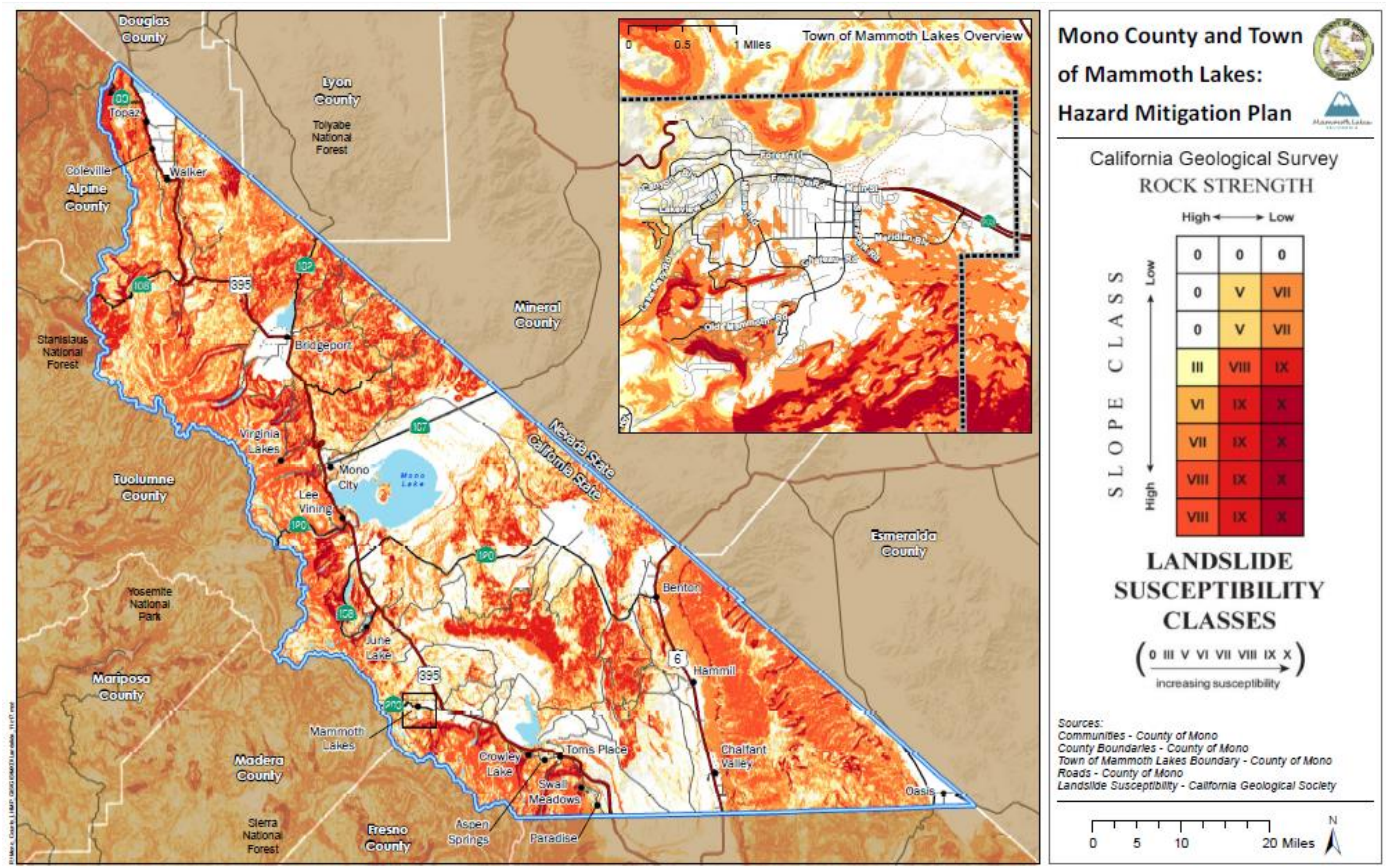
Figure 3.10: Landslide Susceptibility



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Certain sections of key access roads are at high risk of rockfall and have historically experienced numerous rockfalls. These areas include:

- US 395 north of Lee Vining near Mono Lake
- US 395 north of Mono City near Conway Summit
- CA 120 from Lee Vining to Tioga Pass
- Walker Canyon Road in Walker Canyon
- Lower Rock Creek Road, from Swall Meadows Road northbound to Highway 395

Rockfalls and landslides are particularly common along the very steep slopes of the eastern scarp of the Sierra Nevada, where talus slopes provide evidence of abundant past rockfalls. During the winter and spring months, rockfalls can be lubricated with snow and ice and can become extremely fast-moving and destructive. The May 1980 earthquakes triggered numerous rockfalls, especially at Convict Lake and in McGee Canyon (Bryant 1980) and "spectacular rockfalls" were observed in Chidago Canyon and the White Mountains during the July 21, 1986, earthquake in Chalfant Valley, according to the Mono County MEA (Mono County 2001).

Fire has similarly caused rockfall hazards at burn scar locations on slopes, due to the destruction of vegetation that formerly acted as anchors for rock and soil. The June 2016 Marina Fire burned steep slopes along the western side of US 395 north of Lee Vining, leaving the slopes destabilized and requiring the construction of extensive rockfall protection system alongside the roadway.

Landslides can generate large amounts of debris. A CGS report on the 1980 earthquakes noted that several backcountry roads and trails were buried by debris that locally was more than 30 meters thick. Near Mammoth Lakes, a boulder the size of a one-car garage was dislodged and rolled 500 meters.

Large, destructive mud and debris flows associated with alluvial fans are a risk in the Tri-Valley Area. Locations near the bottom of confined canyons are at risk of these flows, which can cover multiple square miles and contain millions of cubic yards of debris.

CGS's Landslide Inventory database does not include any data on landslides in Mono County, but it does offer a report on a 2008 event in neighboring Inyo County. Heavy rainfall on parts of the Oak Creek drainage that had previously been burned by wildfire caused large debris flows that deposited 2 million cubic yards of sediment over a 1.2-square-mile area. Surges moved at estimated speeds of 4.5 to 11 miles per hour (mph) and were 3 to 10 feet tall.

Hazard History

The most significant geological event in Mono County was the widespread landslides and rockfalls during the May 1980 earthquakes near Mammoth Lakes. The report on the earthquakes noted that rockfalls were common in the epicentral region in Convict and McGee Canyons, with debris partially or completely covering snowfields. Dust plumes were observed over the Sierra Nevada immediately following many quakes with magnitudes greater than 4.5. Outside of Mono County in Yosemite Valley, two hikers were severely injured by a rockfall during one quake (McJunkin et. al., 1980).

A flash flood on August 9 and 10, 1989, resulted in one of the County's largest mudflows. Water coming down the alluvial fan slopes of the White Mountains in the Tri-Valley Area picked up debris. The resulting mudflow crossed US 6, reached as far as Spring Canyon Creek, and caused further flooding in Chalfant Valley.

Heavy rains often result in debris flows that can shut down major roads. In March of 1995, rockfall and mudslides closed US 395 from the Nevada state line to Bridgeport.

The region immediately west of Mono Lake has seen several road closures in recent years due to mudslides, including Lundy Lake Road on July 17, 2014, and July 20, 2018, and parts of Tioga Pass Road (SR 120) on July 6, 2015, October 16, 2016, and July 20, 2018.

Risk of Future Hazards

Rockfalls and mudflows are an annual occurrence in the Eastern Sierra. The probability of a geologic hazard occurring in any given area is unknown, although landslide risks are likely to remain highest in the areas identified as having a high susceptibility, and the risk of alluvial fan flows will persist along the base of the mountain ranges in the County. The geologic conditions in the County that have been responsible for past landslide events are not expected to change.

Climate Change Considerations

Climate change may cause an increase in the frequency and/or intensity of storms that affect California, which in turn could make moisture-related landslides more common, particularly alluvial fan related events. Warmer temperatures and periods of drought resulting from climate change may cause soil to become less cohesive, making the material more unstable and potentially increasing landslide risk. More frequent and extensive fires may leave more area of burn scars which are subsequently more prone to landslides.

3.2.9 Hazardous Materials

Hazard Description

Under California law, a hazardous material is a substance that either causes "an increase in mortality or an increase in serious, irreversible, or incapacitating illness" or poses "a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, or disposed of, or otherwise managed" (DTSC 2010). Hazardous materials cover a wide range of substances and include flammable or explosive materials, corrosive substances such as acids, poisons, and infectious materials such as dangerous germs. Some materials are always hazardous, while others may only pose a danger under certain conditions (e.g., flammable materials can be inert and harmless until exposed to a spark or heat source). Hazardous materials are often thought of as human-made compounds, but they may also include naturally occurring substances, such as radon gas found naturally in some rock formations.

A hazardous material emergency usually occurs when the material leaks or escapes from its containment vessel, exposing people and objects in the vicinity to the material's harmful effects. This may occur because of another emergency, such as an earthquake or flood that breaks a hazardous material storage container. It may also happen because of human error or an equipment malfunction, or more rarely as a deliberate act. Hazardous materials may be released from a building such as a factory or storage facility, or from a vehicle such as a truck or train. US 395 is a major thoroughfare and carries hazardous and potentially hazardous materials through the communities of Mono County. Residents and visitors also frequently transport combustible fuel such as propane for personal use; when improperly stored or secured, leaks or explosions can occur. Hazardous materials in soils, either naturally occurring or accidental, may be washed into water bodies or groundwater basins during flood events, creating a potential risk of exposure. Other naturally occurring substances (e.g., radon) can filter up through the soil and into the air, and over long exposure cause health issues. Soils containing hazardous materials may also dry out and be blown by the wind, spreading the material over a potentially large area.

This section focuses on four forms of hazardous materials of particular concern to the County and Town: 1) transport of hazardous material such as fuel; 2) stationary propane in tanks and underground lines; 3) naturally occurring gases (specifically, radon and carbon monoxide); and 4) large hazardous sites resulting from old industrial or mining waste filtering up through the soil and into the air. The location and magnitude and historical occurrences are discussed for each of these four categories.

Hazardous Material Transport

Location and Magnitude

Mono County

US 395, US 6, and SR 120 are designated for the transport of hazardous materials in and through Mono County. These routes can transport a variety of hazardous materials for personal and business use, and materials from one of Mono County's waste transfer stations to a permanent location outside of Mono County. This creates the potential for hazards during transport and in the event of a vehicle accident. It is difficult to identify exactly which materials, how much, and when hazardous materials move through the County, but likely frequently these include propane, gasoline, household chemicals, and waste. The exact nature of materials or timing of their transport is not tracked by any agency, although the US Hazardous Materials Transportation Act does regulate procedures and packaging for transport of certain materials. Additionally, the Mono County Integrated Waste Management Plan contains a Hazardous Waste Management Element, which provides policies for the siting and transportation of hazardous materials. Inspection points along US 395, including in Victorville and Big Pine, help ensure these materials are being carried properly, mainly performed by Caltrans staff because the state highways are at highest risk. However, these regulations are often not adequate to ensure safe transport on road and weather conditions that occur frequently in Mono County, such as high winds, ice, and snow. The location of hazardous materials release is most likely to occur in relation to these other hazards.

Mammoth Lakes

Because the Town does not have any interstate corridors running through its boundaries, the likelihood of an incident involving these materials is somewhat lower than in other areas of Mono County. However, a hazardous material release along US 395 could affect the Town if gases or odors were carried by the wind, or if the release triggered other hazards such as fire, or resulted in blockage of key access into the Town. Additionally, a smaller number of vehicles carry hazardous materials for use in the Town, posing some risk.

Hazard History

There are records of two recent hazardous material incidents in Mono County, both of which occurred during transportation. In May 2013 and October 2014, accidents involving the transportation of freightliners occurred on US Highway 395. The May 2013 accident resulted in the death of the driver as the truck exploded. Both accidents required extensive hazardous material cleanup.

Propane

Location and Magnitude

Mono County

Propane is a colorless, odorless (although odor is often added for easier detection) liquified compressed gas frequently used for fuel by residents and visitors to Mono County. Propane is distributed by truck and sold at locations such as gas stations, hardware stores, and camping supply stores, and is often transported by personal vehicle and stored at the home or business. Hazards associated with propane use and transport include:

- **Inhalation**: Inhalation of propane in a closed environment can result in chronic health effects or, in extreme cases, suffocation.
- **Contact**: Direct contact with some liquefied propane can cause frostbite.
- **Explosion**: While propane tanks are typically stable and difficult to rupture, in the case of extreme concussions (e.g., major vehicle collision or earthquake) or extreme heat (e.g., wildfire), a boiling liquid expanding vapor explosion (BLEVE) can occur. A BLEVE occurs when the pressure in the tank exceeds that at which the safety relief valve can safely vent the excess pressure into the outside atmosphere. Relief valves are designed to vent tank pressure at a certain flow rate to the outside atmosphere once the pressure inside the propane tank reaches a certain level; they will close once the pressure in the tank falls below that level. Old or buried propane tanks can pose a special hazard, since the tank's systems degrade with age and because current landowners may not be aware of their location.

The dangers from propane leaks are aggravated in the County by winter weather, which freeze lines and valves, and heavy snow, which can disguise evidence of leaks for long periods of time as well as prevent access to tanks and lines by emergency responders. Although County and Town codes require residents to regularly check their tanks and to keep access clear during winter, these requirements can be difficult to enforce.

As propane is a commonly used fuel, proper storage and transport of propane cylinders is critical to prevent frequent hazards. While the tank types, maintenance, placement and storage of household or small business tanks are regulated by local and state codes, the location of all tanks is not currently tracked. Therefore, specific hazard zones from propane are not currently known. It is reasonable to assume that most parcels with habitable structures will have one or more propane tanks on-site.

Mammoth Lakes

In addition to small propane tanks on individual properties, Mammoth Lakes has an underground system of pipes that distribute propane to individual and group storage tanks in various parts of the

community. The lines are owned and operated by AmeriGas. The lines are supplied by several large propane tanks both inside the town and near its perimeter. The Town does not have data on the exact locations or status of these underground pipelines, which can pose hazards in the event of construction or maintenance activities as well as in the case of natural disaster, such as an earthquake or fire.

Hazard History

There were two fatalities in 1992 due to a propane leak in Mammoth Lakes, which resulted in several modifications of requirements for use of propane within the town. In February 2012, such a leak resulted in a deadly explosion in a family housing complex in Coleville that serves marines assigned to the Mountain Warfare Training Center in Bridgeport. The explosion killed one person, injured several others, and forced the evacuation of 38 families. Close calls also occurred in Mammoth Lakes when Digital 395 workers severed a main propane line operated by AmeriGas in July 2013 because AmeriGas had made an improper determination on the gas line location. In addition to freightliners, propane and fuel trucks have been involved in transportation/delivery incidents.

Radon and Carbon Monoxide

Location and Magnitude

Radon is a commonly occurring radioactive gas that is derived from the natural decay of uranium located in most soils. Radon filters up through the soil and into the air, which can then be trapped in buildings or distributed by well water usage. Exposure to radon is the second largest cause of lung cancer, and the number one cause in nonsmokers. Radon should be tested for and prevented or mitigated in buildings through design features such as proper ventilation, soil barriers, or soil depressurization.

The Radon Act 51 was passed by Congress to set the natural outdoor level of radon gas (0.4 picocuries per liter [pCi/L]) as the target radon level for indoor radon levels. The US Environmental Protection Agency (EPA) has set an "action level" of 4 pCi/L, at which point the EPA recommends that people take corrective measures to reduce exposure to radon gas. There is no safe level of radon exposure, however (EPA 2016).

The EPA classifies radon levels by three zones:

- Zone 1: Counties with predicted average indoor radon screening levels greater than 4pCi/L.
- Zone 2: Counties with predicted average indoor radon screening levels from 2 to 4 pCI/L.
- Zone 3: Counties with predicted average indoor radon screening levels less than 2pCi/L.

All of Mono County, including Mammoth Lakes, is designated as Zone 2 for radon levels. Radon testing is recommended by Mono County for all homes.

Similar to radon, carbon monoxide is a naturally occurring compound formed during combustion (usually wood, goal, or other fuels) but can also be present as the result of volcanic activity. Exposure to carbon monoxide can cause headaches, nausea, and with especially high concentrations, death.

Hazard History

It is difficult to directly link any given mortality to radon, but the EPA estimates that, nationally, 21,000 lung cancer deaths are caused by radon each year. Since average indoor radon levels are higher in Mono County than in the US as a whole, the rate of health incident and mortality is likely higher. Consequently, Mono County pursued and received a grant which allows the County's Public Health Department to provide free radon test kits to property owners. According to CDPH's most recent published data available, in 2010, a year after beginning the free testing, 32 radon tests had been done in the 93546 zip code (Mammoth Lakes and Crowley Lake); 10 of them (31%) resulted in radon levels above 4 pCi/L. In the nearby town of Bishop in Inyo County, 39 out of 111 tests (35%) had come back above 4pCi/L.

Volcanic vents in emitting carbon monoxide are present in small pockets throughout the Long Valley Caldera; while some areas are known, others may not yet be identified, and new output locations may occasionally form. At least one death in the County has been confirmed as a result of natural carbon monoxide inhalation, in 1998, when a man was found dead near Horseshoe Lake.

Hazardous Materials Cleanup Sites

Location and Magnitude

According to the California Department of Toxic Substances Control, the Marine Corps Mountain Warfare Training Center in Bridgeport is the only location in Mono County designated as a hazardous materials release site. Mono County Department of Public Works is the only registered hazardous waste transporter in the County.

The SWRCB maintains a separate list of sites with hazardous materials that may contaminate groundwater supplies. Mono County Welfare is the only facility in Mono County that currently has an open SWRCB case due to diesel ground contamination. The Mountain Warfare Training Center and the Mono County Senior Center were previously listed, but cleanup has been completed at both locations and the cases have been closed.

Table 3.21 shows the number of these facilities in Mono County and their status.

Table 3.21 SWRCB Cleanup Sites by Status in Mono County

Status	Description	Number of Facilities	
		Mammoth Lakes	Mono County
Completed – Case Closed	Cleanup activities have finished and formal case closure decision has been issued.	0	2
Open	Unspecified evaluation and/or cleanup activities are ongoing.	0	0
Open – Eligible for Closure	Cleanup activities have finished, although the case closure decision has not yet been issued.	0	0
Open – Inactive	There are no regulatory activities at the site.	0	0
Open – Proposed	Unspecified evaluation and/or cleanup activities are ongoing.	0	0
Open – Site Assessment	Evaluation activities are ongoing at the site.	1	0
Open – Verification Monitoring	Cleanup has finished, and monitoring activities are ongoing to ensure cleanup has been successful.	0	0
Total		**1**	**2**

Source: SWRCB 2016a

Risk of Future Hazards

The risk of hazardous material releases in the future is difficult to quantify. There is always some chance that another natural disaster, such as an earthquake or flood, may damage buildings or storage tanks and cause a release of hazardous materials. However, the occurrence of a natural disaster does not automatically result in a hazardous material release, and a hazardous material release may occur independently of any other natural disaster.

Considering the history of hazardous material incidents occurring during transport and that the number of transport trucks is increasing, another incident in the future is likely. In addition, propane is a significant portion of energy generation, and although strides are being made state- and countywide to increase renewable energy (a 2014 feasibility study examined the use of biomass as an alternative fuel), propane will remain a significant portion of fuel usage due to housing design, existing generators and equipment, and familiarity. Therefore, it is likely that incidents will continue to occur because of such personal use of propane.

Given the size and sparsely populated nature of Mono County, a hazardous material release may not necessarily pose a significant risk to human health if it occurs in an unpopulated area, although such events may result in environmental damage. Mammoth Lakes has a comparatively higher population density than the rest of Mono County, and any hazardous material release in or near Mammoth Lakes would likely pose a greater threat to human health and safety than elsewhere in the County.

Climate Change Considerations

Climate change is not directly linked to the frequency or severity of hazardous material releases. However, climate change may increase the frequency or severity of other hazards, such as severe storms or wildfires, which may in turn result in hazardous material releases.

3.2.10 Severe Wind

Hazard Description

Severe winds can occur as a consequence of an intense storm system or may happen independently of storms. Severe winds are generally winds above 47 mph, as this wind speed is usually the threshold for structural damage, although some property damage or minor injuries may occur at lower wind speeds. High winds may directly damage structures, can blow down trees or branches, and can create airborne debris which may cause further damage. Severe winds may also increase the risk of other hazards, particularly wildfires.

Location and Magnitude

As identified in **Table 3.1** above, severe winds are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes.

Wind speed can indicate the severity of a wind event, and records may include measurements for sustained winds, maximum gusts, or both. For the damaging wind events listed below in **Table 3.22**, top wind speeds ranged from 33 to 100 knots (kts), or 38 to 115 mph

Mono County

Severe wind events may occur virtually anywhere in Mono County, but they can be of particular concern near Crowley Lake, Coleville, Lee Vining, Swall Meadows, US 395, and US 6. Caltrans and CHP implement preemptive highway closures and high-profile vehicle closures to lessen the risk of impacts from severe wind conditions on vehicles and traveler safety.

In addition to road closures, severe winds can result in downed powerlines. One such event happened on February 6, 2015, when severe winds caused downed powerlines and igniting the Round fire. A state of emergency was declared for Mono County due to fires burning thousands of acres, destroying over

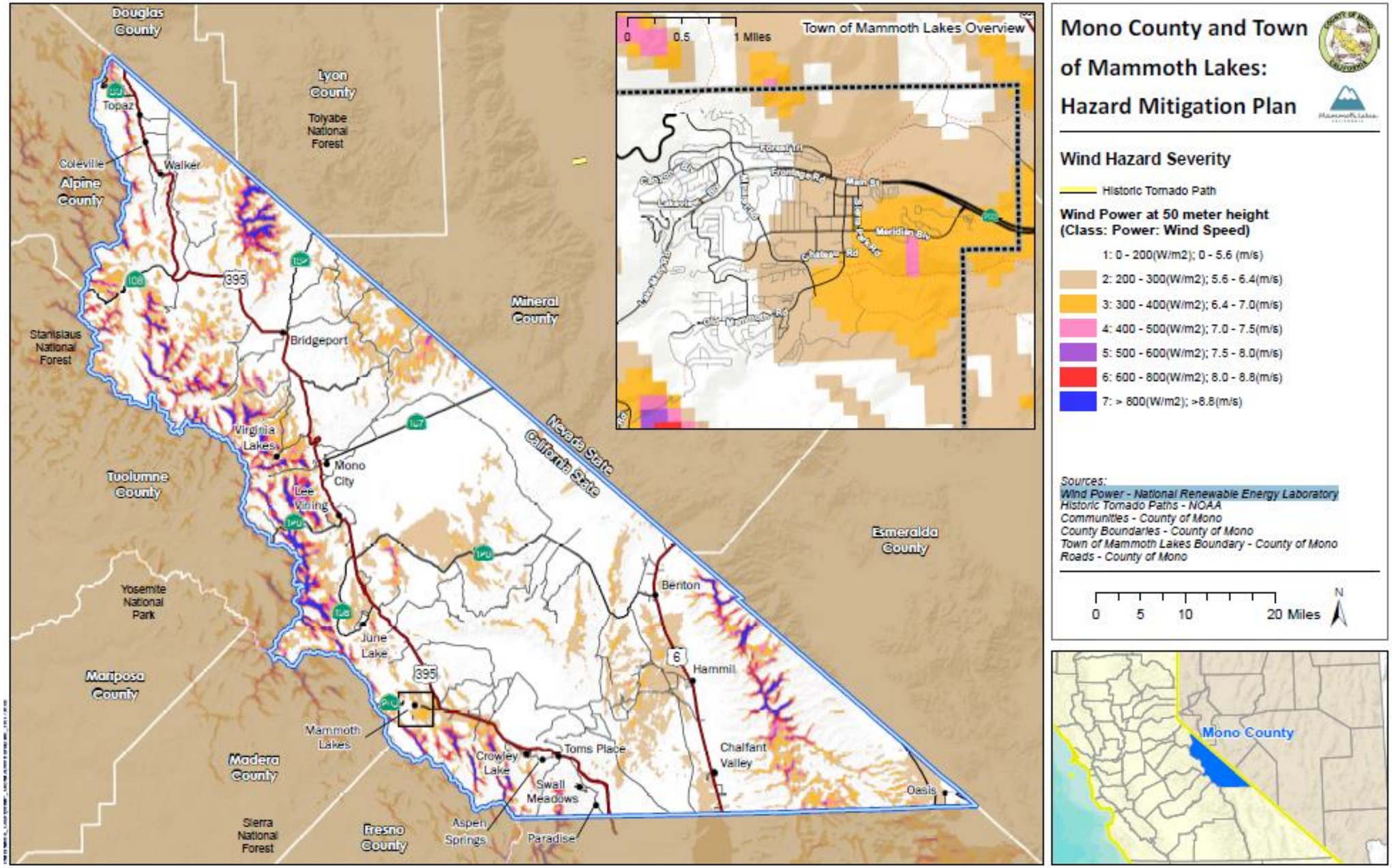
40 structures, including residences. Another severe wind event in Reds Meadow just over the Madera County border resulted in thousands of downed trees. Road closures along US 395 and US 6 due to high winds can severely limit mobility in the County.

Mammoth Lakes

Severe wind events in the town can result in road closures and downed powerlines and trees.

Figure 3.11 shows annual average wind power in the County and highlights locations where high winds are likely, based on wind resource assessments provided by the National Renewable Energy Laboratory. This national data estimates the annual average wind resource. The assigned wind power class represents the range of wind power densities, described as watts per square meter (W/m2), likely to occur at exposed sites, such as hilltops, ridge crests, mountain summits, large clearings, and other locations free of local obstructions. The wind resource assessment was based on surface wind data, coastal marine area data, and upper-air data, or, where data was not available, based on qualitative indicators such as topographic/meteorological indicators and state of existing vegetation.

Figure 3.11: Annual Average Wind Power



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Hazard History

Mono County has experienced 96 days of significant wind events since 1996. Twenty-four of these events caused substantial reported damage or injuries, as shown in **Table 3.22** (NOAA 2017c). Among the more significant events:

- On December 14, 2002, a strong cold front resulted in a day of winds gusting to 60 to 80 mph throughout northeast California and western Nevada, with stronger gusts along the crest of the Sierra. Across the region, the winds downed hundreds of trees and created power outages, resulting in nearly $10 million of damages.
- A gust of more than 60 mph on December 19, 2008, damaged some of the historic buildings in the ghost town at Bodie State Park.
- On November 30, 2011 to December 1, 2011, an unusually strong wind storm damaged thousands of trees in the Eastern Sierra, including Reds Meadow and the Mammoth Lakes Basin. In anticipation of the high wind event Tioga Road in Yosemite was temporarily closed.
- On February 5, 2015, high winds exacerbated the Round Fire, which destroyed 65 structures; this is addressed in **Chapter 7**. The windstorm also downed trees, broke windows, and damaged roofs in Mono City and caused widespread power outages north of Mammoth Lakes. Gusts as strong as 91 mph were measured near Bridgeport.

Table 3.22 Significant Wind Events in Mono County, 1996–2017

Date	Top Wind Speed (kts)	Affected Area(s)
11/18/1996	n/a	Crowley Lake
01/21/1999	61 kts.	Highway 395 near Crowley Lake
12/19/1999	n/a	Highway 395 in Lee Vining
01/11/2000	60 kts.	Near Mammoth Yosemite Airport
11/29/2000	73 kts.	Bridgeport Valley
02/06/2001	54 kts.	Crowley Lake
01/26/2002	52 kts.	Walker and Coleville
04/14/2002	60 kts.	June Lakes area
12/14/2002	100 kts.	Across the region
12/01/2005	87 kts.	Sherwin Grade near Tom's Place
12/26/2006	56 kts.	Across the region
02/25/2007	70 kts.	Crowley Lake

Table 3.22 Significant Wind Events in Mono County, 1996–2017

Date	Top Wind Speed (kts)	Affected Area(s)
12/19/2008	49 kts.	Bodie State Park
03/29/2010	53 kts.	Across the region
05/31/2011	70 kts.	Across the region
11/18/2011	75 kts.	Bridgeport
11/30/2011	45 kts.	Mammoth Lakes area
04/26/2012	48 kts.	Mammoth Lakes area
02/15/2014	66 kts.	Across the region
12/11/2014	92 kts.	Lee Vining
02/05/2015	79 kts.	Across the region
12/03/2015	33 kts.	Mammoth Yosemite Airport
02/18/2016	35 kts.	Mammoth Lakes
10/15/2016	35 kts	June Lakes
Source: NOAA 2017		

Risk of Future Hazards

Since 1996, on average there have been four significant wind events per year in Mono County, one of which typically results in damage or injuries. Given the history of past significant wind events in Mono County and the expected continuation of winter storms, it is very likely that severe winds will continue to occur throughout the County. The factors that contribute to severe winds are unlikely to decrease to any substantial degree.

Climate Change Considerations

Climate change may cause an increase in the frequency and/or intensity of storms that affect California, which in turn could make severe wind events more common. The effects of climate change on winds not related to storms are as yet unknown.

3.2.11 Severe Winter Weather and Snow

Hazard Description

This section covers several issues relating to severe winter weather including extreme cold and snow. Intense rainfall is discussed in the Flood profile; severe wind is discussed in the Severe Wind profile; and avalanches are discussed in the Avalanche profile.

Extreme Cold

Extreme cold events occur when the temperature drops well below historical averages. No specific definition exists for extreme cold, but an extreme cold even can generally be defined as temperatures at or below freezing for an extended period of time. However, in Mono County, freezing temperatures are a relatively normal event and residents are often prepared for these temperatures, making it less likely to result in risk until much lower temperatures occur. These events may occur as part of another severe weather event, such as a blizzard or ice storm, but can also happen during sunny days. The primary health risks of extreme cold are frostbite (a freezing of body tissue) and hypothermia (an abnormally low body temperature) (Cal OES 2013b). Extreme cold may also damage or destroy crops, and damage water and gas pipelines.

Snow

Snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32°F), when water vapor in the atmosphere condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into a snow crystal or snow pellet, which then falls to the ground. Excessive amounts of snow can cause roofs to collapse and people being stranded in their cars due to road closures.

Hail is a form of precipitation of rough spheres or lumps of ice. It occurs when water droplets are forced upward in a thundercloud by strong winds called updrafts. The water droplets are blown into areas where the air temperature drops below freezing, causing the drops to freeze and stick together, forming hailstones. Eventually the hailstones become too heavy for the updraft and they fall to the surface. The falling balls of ice can damage roofs, windows, and plants, including crops. In rare instances, large hail can cause more severe damage, and particularly massive hailstones can cause severe injury. Hail is distinct from sleet, which is much smaller balls of ice that form when snow melts and then refreezes, or from freezing rain, which is raindrops that have been cooled to temperatures below the freezing point but have not turned into ice. While hail may occur during winter storms, large, damaging hail in Mono County is typically associated with summer thunderstorms.

Location and Magnitude

As identified in **Table 3.1** above, severe winter storms and snow are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes. These conditions are regional in nature, although a large community such as Mono County with a wide variety of climates may experience significantly different conditions in different locations. No single part of Mono County, including Mammoth Lakes, is substantially more or less at risk of these conditions, although some areas may be more impacted by their occurrence than others.

Severe winter storms occur throughout Mono County but particularly along the eastern slope of the Sierra Nevada, in the western part of the County, and at higher elevations. Severe winter storms are classified as those that cause road closures, power outages, school closures, and associated avalanche hazards. They may include heavy snow, whiteout conditions, or ice storms. Developed areas may be subject to snow and ice shedding. When snow slides toward pedestrian areas, parking lots, or other structures, it poses a significant hazard. Excessive snowfalls and significant accumulations of snow can also block access to, and stress, propane lines and vents on roofs, which can result in dangerous carbon monoxide accumulations in structures.

Severe winter storms are a particular concern in Mammoth Lakes when large numbers of visitors are present. Visitors are often unfamiliar with driving in snow, using woodstoves, and other potentially hazardous winter weather situations. In addition, if large numbers of visitors become stranded in Mammoth Lakes, the town's resources may become stressed.

Just as extreme heat is a factor of air temperature and humidity, extreme cold can be measured as a factor of air temperature and wind, known as wind chill. A temperature of 10 degrees Fahrenheit (°F) may have a wind chill of 1°F in 5 mph winds, but may feel close to -20°F in wind speeds of 50 mph or more. According to the National Weather Service, frostbite can occur within 30 minutes when the wind chill falls below -18°F, which can occur with air temperatures as high as 10°F when coupled with 55 mph winds or conditions as calm as 5 mph winds with temperatures of -10°F.

The severity of a snowstorm depends on how much snow falls in a given time. Accumulations are greater at higher elevations, with significantly more snowfall often recorded at higher elevations. The high Sierra may get several feet of snow, while the same storm may leave only a few inches throughout most of the County. Maximum snowfall during winter storms in Mono County has generally ranged from about 1 foot to 3.5 feet, although three days of heavy snow starting on December 17, 2010, deposited almost 10 feet of snow at the Mammoth Ski Area.

Hail is measured in terms of its diameter. As shown in **Table 3.23**, hail greater than 1 inch in diameter, or the size of a quarter, is generally considered severe and capable of causing damage.

Table 3.23 Hail Severity

Severity	Diameter (inches)	Description
Non-severe	0.25	Pea
	0.5	Small marble, mothball
	0.75	Large marble, penny
	0.875	Nickel
Severe	1.0	Quarter
	1.25	Half dollar
	1.5	Ping-pong ball, walnut
	1.75	Golf ball
	2.0	Lime, egg
	2.5	Tennis ball
	2.75	Baseball
	3.0	Large apple, teacup
	4.0	Grapefruit
	4.5	Softball
Source: National Weather Service		

Hazard History

Heavy snow, cold, and severe winter storms occur every year in Mono County. Since 1996, 160 heavy snow events have been recorded in the NOAA Storm Events Database, and 26 events characterized as severe winter storm events have been reported. Since many of these events affected both Mammoth Lakes and unincorporated areas of the County, these events are documented together in **Table 3.24**.

Table 3.24 Severe Winter Storm Events in Mono County, 1995–2017

Date	Affected Community Area(s)
03/21/1995	Mammoth Lakes and Bridgeport
12/21/1996	Mammoth Lakes
12/26/1996	Mammoth Lakes
01/12/1997	Mammoth Lakes
12/05/1997	Mammoth Mountain
12/07/1997	Mammoth Lakes and Crowley Lake

Table 3.24 Severe Winter Storm Events in Mono County, 1995–2017

Date	Affected Community Area(s)
01/18/1998	Mammoth Mountain
03/03/2001	Mammoth Lakes, Lee Vining, and June Lake
03/09/2001	Mammoth Lakes and Walker
04/06/2001	Mammoth Lakes and Lee Vining
04/20/2001	June Lake
12/27/2004	Mammoth Lakes
01/06/2005	Mammoth Lakes
01/27/2008	Mammoth Lakes
12/12/2009	Bridgeport to Mammoth Lakes
01/18/2010	Lobdell Lake, Sonora Pass, Lee Vining, Bridgeport
01/20/2010	Mammoth Mountain and Lee Vining
02/26/2010	Mammoth Lakes
11/19/2010	Mammoth Lakes
12/17/2010	Mammoth Lakes
12/28/2010	Mammoth Mountain
02/16/2011	Mammoth Mountain
02/24/2011	Mammoth Mountain and June Lake
03/23/2011	Mammoth Lakes
12/21/2012	Mammoth Lakes and Crowley Lake
01/09/2017	Mammoth Lakes and Bridgeport
Sources: NOAA 2017; Mono County LHMP 2006	

There have been about a dozen periods since 2007 when conditions observed at Summit Meadow could have produced wind chills capable of causing frostbite. At least once during every winter except 2015-2016, low temperatures were near or below 0°F on days when wind speeds gusted to more than 10 mph.

Eight instances of hail have been reported in Mono County since 2000, two of which included observations of severe hail up to 1 inch in diameter. These occurred on July 3, 2013, and July 14, 2014, both in the Bridgeport area. Smaller hail has been reported in the Mammoth Lakes, Walker, Bodie, and Benton areas (NOAA 2018).

Risk of Future Hazards

Storms with heavy snowfall and extreme cold events are an annual occurrence in Mono County. Nearly every winter in the last decade has included at least one of these events, and often there are multiple events per season. Severe hail events are far more rare, with damaging hail occurring only once or twice every 10 years. At least in the short term, these hazard events are almost certain to continue occurring at similar frequencies.

Climate Change Considerations

As temperature increases as a result of climate change, the frequency of extreme cold events is likely to decline as annual average minimum temperatures increase. Between 1950 and 2005 the average annual temperature was 49.6°F, and the projected minimum temperature by 2075 is 54.2°F (Cal-Adapt 2017).

Climate change is expected to cause an increase in the number and/or severity of intense storms that affect California, which may in turn increase the frequency and/or intensity of thunderstorms, hail, and storm-related severe wind events that affect Mono County.

3.2.12 Volcanoes

Hazard Description

A volcano is an opening (or vent) in the earth's surface that erupts lava, ash, and gas stored deep within the planet. Volcanoes come in many sizes and shapes, from large mountains built up by layers of lava, to conical mounds of loose cinder, or low, crack-like fissures in the ground. Depending on the type of volcano and the nature of the materials it ejects, a number of potential hazards may occur. These are described in detail in the USGS California Volcano Observatory website (USGS 2017c) and are summarized in the California State Multi-Hazard Mitigation Plan. The information in **Table 3.25** describes the hazards that have typified past eruptions of California volcanoes.

Table 3.25 Hazards Associated with California Volcanoes

Name	Description
Pyroclastic flow	A sudden, fast-moving eruption of lava, ash, and gases. Pyroclastic flows can move down the sides of the volcano at speeds greater than 50 mph, faster than people can run. Damage occurs from the high temperatures of the material (400–1,300°F) and the fast-moving debris itself. Poisonous gases may also suffocate people or animals.

Table 3.25 Hazards Associated with California Volcanoes

Name	Description
Slow-speed lava flow	A slow-moving lava eruption, usually less than 30 mph. The lava itself may be fluid or thick. People are usually able to move out of the way, but the lava may bury structures and the high temperatures often ignite fires.
Lahar	A volcanic debris flow, usually a slurry-like mixture of ash, rock, and water, traveling at speeds of 20 to 40 mph. They can be hot, though not as hot as a lava eruption, and may carry large debris such as boulders for great distances. The speed and temperature of a lahar may cause injury or death, and the debris itself may bury people or structures.
Volcanic flood	A type of flash flood that occurs when snow or ice on the surface of the volcano is melted by intense heat from the volcano, or when debris deposited from a volcano causes a river or stream to overtop its banks. The effects are generally similar to other types of flash floods.
Fine ash fall	A "rain" of small ash particles ejected from a volcano during an eruption, sometimes reaching hundreds of miles from the volcano itself. The ash can cause short-term respiratory problems, although it is generally nonlethal. Buildings may be damaged by the weight of the ash, and accidents can occur if ash sufficiently reduces visibility. Ash particles may also clog wastewater systems, damage electronics, and harm crops and livestock. Air traffic can be disrupted by ash fall.
Coarse air fall	An ejection of large, hot pieces of lava or rock. The force of the ejecta may cause damage or injury, and the high temperatures may ignite fires. These are generally the size of a softball or smaller, although some volcanoes may eject boulder-size pieces.
Phreatic eruption	An eruption of steam, caused when volcanic heat causes water underground or on the surface to flash-boil. The steam may erupt violently, carrying ash and pieces of rock. Damage may be caused by the intense heat, the materials ejected by the steam, or poisonous gases that can accompany the eruption.
Sources: Cal OES 2013a; USGS 2016	

Table 3.25 does not include an exhaustive list of all possible hazards resulting from volcanoes; it is possible that an event not shown here may occur during an eruption of a California volcano.

Mono County contains the most significant volcanic center in California outside of the Cascade Range. The Long Valley-Mono Basin Region is dominated by two distinct but interrelated systems that have produced volcanic and seismic activity for millions of years. The region includes the Long Valley

Caldera, a 20-mile-by-10-mile, oval-shaped depression formed about 760,000 years ago. This was one of the largest eruptions in the earth's history, ejecting more than 70 times as much material as the famous Krakatoa explosion in 1883. A younger system, the Mono-Inyo Craters, runs from Mono Lake to Mammoth Mountain near the rim of the caldera. The chain has seen small to moderate eruptions, as recently as 250 to 350 years ago.

The impact of an eruption in the Long Valley area would depend on its location, size, and type as well as the wind direction. An eruption during the winter months could melt heavy snow packs, generating mudflows and locally destructive flooding. Smaller eruptions, similar to previous activity along the Mono-Inyo chain during the past 5,000 years, would typically begin with a series of steam blast explosions that can throw large blocks of rock and smaller fragments hundreds of feet in the air.

If magma reaches the surface, gases in it can escape explosively, hurling volcanic ash as high as 6 miles or more. Airborne volcanic ash would be carried downwind and the amount and size of the ash would diminish with distance from the eruption site. Accumulations of ash pose little threat to life but may collapse building roofs, close roads, and seriously disrupt utilities and communications. The ash produced by explosive volcanic eruptions poses a special hazard to aircraft. A small to moderate explosive eruption can send ash to elevations exceeding 30,000 feet, posing a serious hazard to commercial aircraft on transcontinental routes that pass over Mono County.

The center is also capable of producing effusive (nonexplosive) basaltic eruptions (the type common in Hawaii). The resulting hot, relatively fluid lava flows, while not a direct threat to life, can pose serious problems for built infrastructure.

The release of hot volcanic gases can create deep cavities in the snow containing lethal concentrations of carbon dioxide. Such conditions have been blamed in the deaths of a cross-country skier in 1998 and three ski patrol members in 2006 at Mammoth Mountain Ski Area.

The Long Valley Volcanic Center is one of 18 "very high threat" volcanoes listed in a ranking developed in 2005 as part of the National Volcano Early Warning System (NVEWS). The USGS conducted a systematic assessment of volcanic threat for all U.S. volcanoes. Volcanoes were evaluated using 25 threat factors: 15 for hazard type (e.g., explosivity index, pyroclastic flows, lahars) and 10 for societal exposure to hazards (e.g., nearby populations, infrastructure, transportation corridors). The composite NVEWS score (sum of the hazard factors multiplied by the sum of the exposure factors) translates into a specific threat-level grouping that ranges from "very high threat" to "very low threat." The rankings are periodically reevaluated by the USGS as new scientific data becomes available and/or nearby infrastructure and populations change. An update to the 2005 ranking is currently under way.

It is important to note that the NVEWS threat rankings do not express the probability of an eruption occurring, only the level of threat posed should an eruption occur. **Table 3.26** shows the threat levels of Mono County volcanoes.

Table 3.26 Mono County Region Volcano NEWS Scores

Volcano	NVEWS Score	Last Eruption
Long Valley Volcanic Center	Hazard score: 9/20 Overall threat ranking: 128 (Very High Threat)	16,000 to 17,000 years ago
Inyo Craters	Hazard score: 8/20 Overall threat ranking: 106 (High Threat)	600 years ago
Mono Craters	Hazard score: 8/20 Overall threat ranking: 89 (High Threat)	650 years ago
Mono Lake Volcanic Field	Hazard score: 5/20 Overall threat ranking: 55 (Moderate Threat)	250 years ago
Source: USGS 2005		

Location and Magnitude

As identified in **Table 3.1** above, volcanic-related hazards are anticipated to affect both unincorporated Mono County and the Town of Mammoth Lakes.

Mono County

Volcanic eruptions could occur in the Long Valley Caldera and along the Mono-Inyo Craters chain. Over the past 2,000 years, volcanic eruptions have occurred at an average rate of one per 100 years. Vents located along these chains are known to have produced explosive eruptions, resulting in pyroclastic flows or surges (violent eruptions of lava fragments) and tephra fall (solid material ejected during a volcanic eruption and transported through the air). USGS scientists estimate that pyroclastic flows and surges could travel as far as 10 miles from vents in the Long Valley Caldera's south moat area, which is located south of SR 203 between Mammoth Lakes and US 395. An explosion from the vents along the Mono-Inyo Craters chain could result in pyroclastic flows or surges traveling 7 to 8 miles to the east. To the west, those flows would be blocked by the high Sierra Nevada. Downwind deposits of ash produced by an explosive eruption could reach thicknesses of at least 8 inches at a distance of 22 miles from the eruption, 2 inches at 53 miles, and 0.5 inches at 185 miles. Significant ash fall could affect large portions of Mono County and surrounding areas, depending on the wind direction and size of the eruption.

Movement in the caldera has caused numerous earthquakes. Since 1974, the USGS has conducted ongoing monitoring of the caldera for volcano surveillance (earthquakes often serve as an early sign of volcanic unrest). Earthquake swarms occurred at Long Valley from 1978–1983, 1990–1995, 1996, and 1997–1998. The USGS indicates that the rate of earthquakes in recent years has been relatively low compared with the history since seismic monitoring started.

Figure 3.12 identifies the location of volcanoes, potential vent locations, and potential flow areas in the County.

Mammoth Lakes

The Town of Mammoth Lakes is near the southwest edge of the Long Valley Caldera. Mammoth Mountain and basaltic volcanic vents have been historically active within the town boundaries. In addition, an area of potential future volcanic vents, inferred based on seismic activity, extends into the town's east side. The entire town is within hazard areas for pyroclastic flows and tephra fall, as shown in **Figure 3.12**.

Hazard History

Since the Long Valley Caldera's formation 760,000 years ago, clusters of smaller volcanic eruptions have occurred in the caldera at roughly 200,000-year intervals. About 100,000 years ago, one of these eruptions along the caldera's ring fault resulted in the formation of the Mammoth Knolls, low hills just north of the Town of Mammoth Lakes. The most recent eruption within the topographic basin occurred 16,000 to 17,000 years ago on the mafic chain along the west rim.

The Mono-Inyo chain has erupted at intervals of 700 to 250 years over the last 3,000 years. Mammoth Mountain was formed by numerous eruptions 100,000 to 50,000 years ago, during which it erupted approximately 25 times. Basaltic vents around the mountain erupted approximately 35 times between 235,000 and 8,000 years ago, which contributed to the formation of the Red Cones. Mono and Inyo Craters were created between 400,000 and 5,000 years ago, and the latest eruptions took place about 8,000 years ago. The most recent activity in the chain occurred with the formation of Mono Lake's Paoha Island about 350 years ago.

Risk of Future Hazards

Volcanoes have been active in the area for millions of years and future eruptions are certain to occur. The pattern of volcanic activity suggests that future eruptions are more likely to occur along the Mono-Inyo volcanic chain than within the caldera. In general, the probability of such an eruption occurring in any given year is less than 1 percent, comparable to the odds for a great (magnitude 8) earthquake along the San Andreas fault in coastal California. The odds of a small eruption having a significant impact

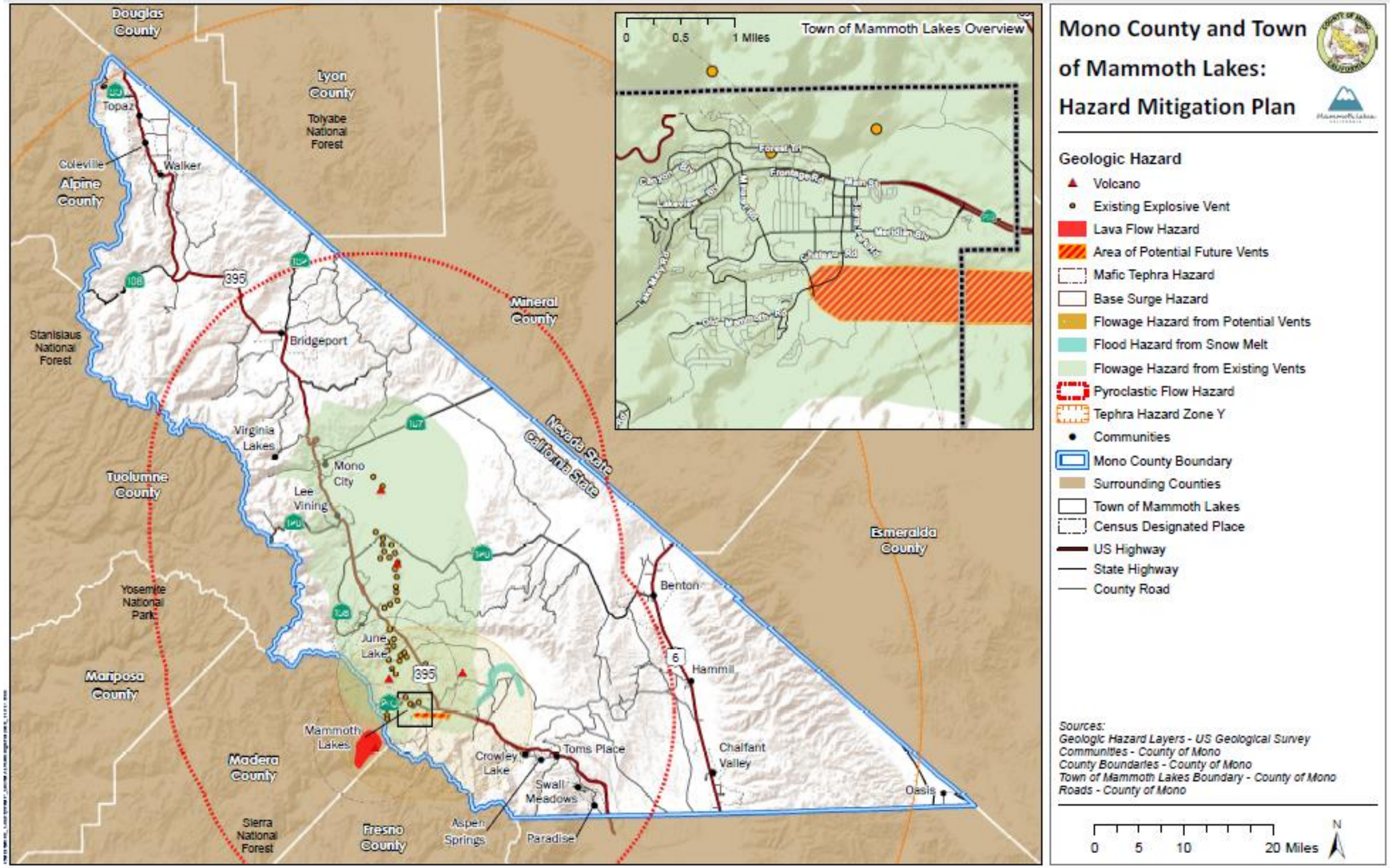
on any specified place along the chain in any given year is one in 1,000, or 0.1 percent. Future eruptions are likely to be explosive in style but small to moderate in size. Larger eruptions are possible but less likely. Scientists see no evidence pointing toward the possibility of a massive eruption along the lines of the one that formed the caldera 760,000 years ago.

Geologic unrest—including earthquake swarms, ground deformation, gas emissions, and fumarole activity—can signal a change in the likelihood of an eruption, depending on the nature, intensity, and location of the unrest. A period of ongoing geologic unrest in the Long Valley area began in 1978 with a magnitude 5.4 earthquake centered 6 miles southeast of the caldera. Since then, earthquake activity has increased. The most intense swarms occurred in May 1980 and included four strong magnitude 6 earthquakes. Between 1979 and 1980, the center of the caldera rose almost a foot, after decades of stability. The swelling continues, and to date totals more than 2.7 feet, suggesting magmatic activity beneath the caldera. During the early 1990s, trees began dying at several places on Mammoth Mountain at the southwest edge of Long Valley Caldera. Studies showed that the trees were being killed by large volumes of carbon dioxide gas seeping up through the soil from the magma below. Such tree mortality could have implications for other hazards such as wildfire and landslides.

Climate Change Considerations

There is no known or suspected connection between climate change and volcanic activity. Eruptions can trigger other hazards, such as landslides, that are affected by climate change.

Figure 3.12: Volcano Hazard Zones



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3.2.13 Wildlife Collisions

Hazard Description

Wildlife collisions are frequent in rural areas and where the rural areas met and interact with developed areas. Collisions can cause vehicle damage, driver injuries, and loss of vehicular control; they are generally most common during early morning and evening hours, when animals are active yet road visibility is low. Deer are the most common animal to be involved in a notable wildlife collision in Mono County (notable referring to a collision that is worth reporting and/or causes damage).

Location and Magnitude

In Mono County, wildlife collisions are most common on US 395. **Figure 3.13** shows the rate of deer mortality due to vehicular collisions on each of the County's major highways between 2002 and 2015.

Figure 3.13: Mono County Deer Mortality 2002–2015

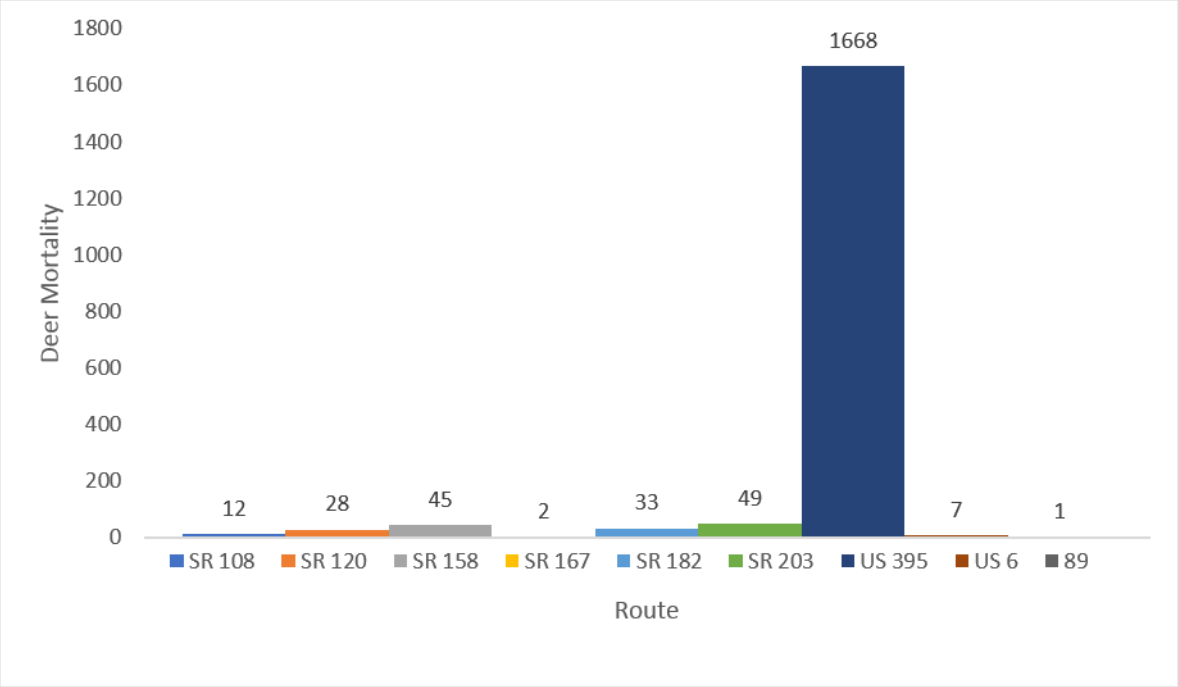
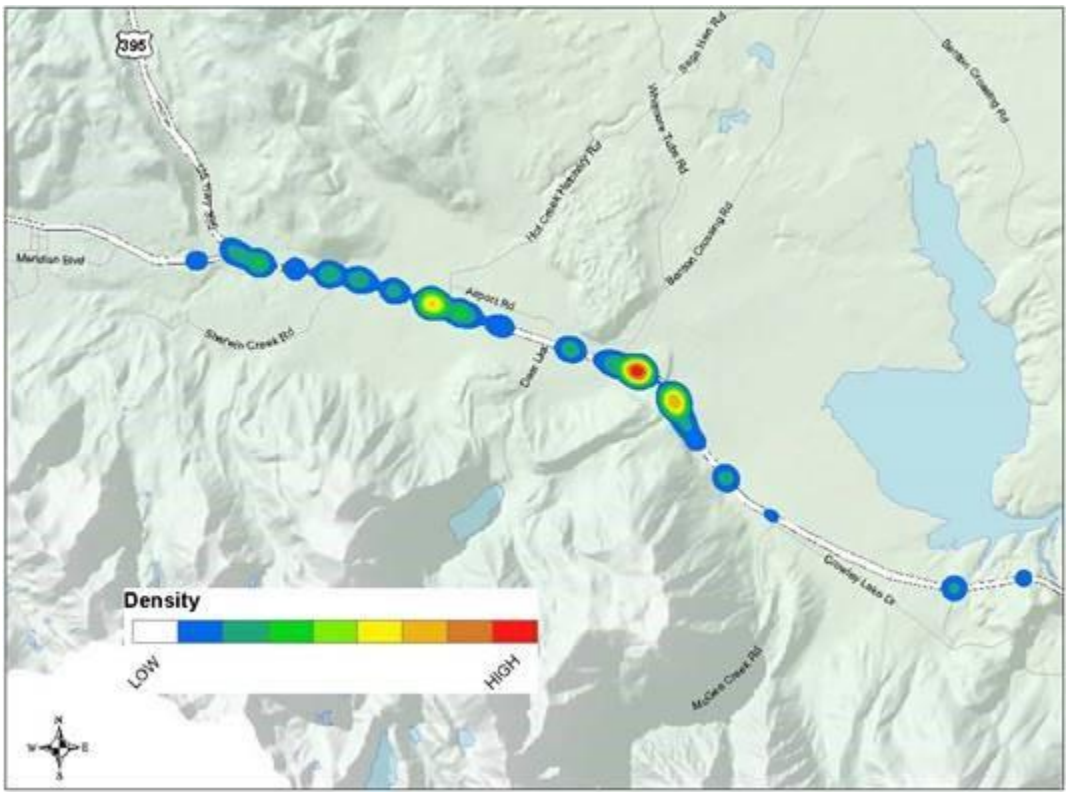


Figure 3.14 is a heat map of the wildlife collision hot spots along US 395 near Mammoth Yosemite Airport, where a study was conducted to assess problem areas and potential solutions for high-collision areas. Most collisions occur south of Benton Crossing Road and the area directly in front of the airport operated by the Town of Mammoth Lakes (Caltrans 2015).

Figure 3.14: Deer Collision Hot Spots



Mono County

Most Mono County highways with high collision risk are in unincorporated areas, but are under the jurisdiction of Caltrans. Unincorporated Mono County has higher risk of wildlife collisions due to the rural nature of the County.

Mammoth Lakes

The risk of wildlife collisions for Mammoth Lakes is significantly less than the unincorporated area due to its more developed nature and lower speed limits. SR 203 has shown the highest risk for collisions, with 49 deer mortalities between 2002 and 2015.

Hazard History

Wildlife vehicle collisions are common occurrence in the County. According to a Feasibility Study Report prepared by Caltrans assessing the number and location of wildlife vehicle collision reduction options on US-395 near Mammoth Lakes, between 2002 and 2015 there were over 1,845 collisions with deer and 33 collisions with bear in the County on US-395. The rates were nearly 10 times higher than on the similar roadways in surrounding counties. While such incidents occurred throughout the County, higher incidence of collisions occurred near intersections with SR-203, at McGee Creek Road, at Hot Creek Hatchery Road, and near Benton Crossing Road.

Risk of Future Hazards

Because vehicle traffic on risk likely to remain an inherent component of residential and commercial development and vehicle traffic are likely to remain a major part of the way of life in Mono County and potentially expand in areas, conflict between wildlife and vehicle traffic will continue to occur.

Climate Change Considerations

Climate change will not directly affect wildlife collision hazards. However, changing weather patterns will most likely affect animal propagation rates, migration patterns, and foraging range.

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4. RISK ASSESSMENT

The hazards described in **Chapter 3** vary in terms of past severity and in the likelihood and intensity of future events. However, the frequency and severity of future hazard events is, by itself, insufficient to describe Mono County's and Town of Mammoth Lakes' vulnerabilities to these hazards. A risk assessment is necessary to prepare a more accurate view of the threats that the County and the Town face due to the hazard events which may occur in the area. Risk was evaluated for all hazards, although more detailed assessments were possible for seismic-related hazard, dam failure, flood, and wildfire, as these have established geographic zones identified as being at risk. Wildfire risks are discussed in the CWPP in **Chapter 7**.

4.1 Risk Assessment Method

The risk assessment focuses on the vulnerability of specific community assets for the areas that each hazard could impact. They include the following:

Social Vulnerability: A single hazard event can cause substantially different impacts for different individuals, even if the intensity of the hazard was the same for the entire community. Certain groups of people may be more vulnerable to natural hazards due to physical condition, socioeconomic status, or other factors. For example, elderly residents may have less physical capacity to maintain a safe internal body temperature in very hot weather, which may make them more vulnerable to heat waves. In other instances, individuals with lower incomes may be less able to renovate their homes to be more resilient to hazards, meaning that they can face a higher likelihood of their home being damaged or destroyed if a hazard event occurs. A countywide snapshot of demographics that indicate social vulnerability is provided in **Chapter 2**. The social vulnerability assessment looks at the following metrics for different hazard zones:

Topic	Indicators
Median HH Income	Median household income
Poverty	Households at or below 2x federal poverty level
Linguistic Isolation	Households where no one over age 14 speaks English well
Elderly	Households with member over 65
Disability	Households with a disabled member
Total Population	Total population

Social vulnerability data was drawn from the US Census American Community Survey, and was available at the block group level of geographical unit size.

The risk assessment includes a social vulnerability analysis for flooding, fault rupture, dam inundation, and fire. Other hazards, such as ground shaking, drought, and extreme weather, are not analyzed because these hazards can affect the entire community, and hazard zones are generally not limited to specific locations or for which location-specific data is not available.

The social vulnerability assessment compares the areas in the hazard risk zones to the entire community to determine if social vulnerability is higher within the hazard risk zone. However, even if residents in the hazard risk zone are no more or less vulnerable than the entire community, this does not mean that there are no social vulnerability concerns for the hazard. The absence of a difference in social vulnerability between the hazard risk zone and the entire community does not mean social vulnerabilities are completely absent. It is possible that the entire community faces a high degree of social vulnerability from the hazard (for example, if there is a high proportion of households under the poverty limit in the community). Additionally, even if only a small number of residents are considered socially vulnerable, it does not mean that local governments do not need to work on reducing social vulnerability; neither can governments ignore any special needs or considerations that are applicable to these residents.

Critical Facilities: As discussed in **Chapter 2**, critical facilities in the County are essential for emergency response and recovery and include a wide range of facilities and infrastructure. **Appendix C** contains the full list of critical facilities. To the extent possible, such facilities should be located outside hazard zones. This is frequently not feasible, since the functioning and effectiveness of facilities are often location-dependent. Consequently, facilities should be defended or hardened against the impacts of hazards that may occur in those locations.

Property and Building Exposure: The exposure of property and structures, primarily in the urbanized communities, are a primary focus of mitigation planning efforts. For two key hazards, flood and earthquake, HAZUS-MH, a software program and standardized methodology for estimating potential monetary losses from these hazards, was used to model an estimate of the worth of buildings in the County, broken down by occupancy type. **Table 4.1** shows the County (including the Town of Mammoth Lakes) building exposure estimate.

Table 4.1 HAZUS Total Building Exposure Estimate

Occupancy	Exposure ($1,000)	% of Total
Residential	$2,459,157	89.2%
Commercial	$190,438	6.9%
Industrial	$29,199	1.1%

Table 4.1 HAZUS Total Building Exposure Estimate

Occupancy	Exposure ($1,000)	% of Total
Agricultural	$4,271	0.2%
Religion	$27,839	1.0%
Government	$23,498	0.9%
Education	$21,330	0.8%
Total	**$2,755,732**	**100.0%**

This was then used to evaluate potential losses as a result of particular flood or earthquake scenario that might occur in various parts of the County.

4.2 Hazard Risk Assessments

4.2.1 Avalanche

Although the avalanche risk area is generally limited to the national forests in the Sierra Nevada, there are communities and roadway sections at risk of property damage and loss of life due to avalanches.

Mono County

Communities at risk are:

- **Bridgeport Valley:** Twin Lakes has an area of concentrated residential development that is open for year-round use. The area experiences frequent, large avalanches. This area contains few permanently occupied homes but a number of seasonally occupied cabins, as well as recreational facilities such as boat docks, restrooms, stores, campground sites, parking lots, and trails. Few of these facilities are retrofitted in any way to help withstand or protect visitors in an avalanche event.
- **June Lake:** Portions of SR 158 are in the runout zone for avalanches, which would block the primary access route to neighborhoods and facilities along the June Lake loop, including more than 200 residential units and 500 permanent residents. Several dozen homes in the residential community are in the direct path of runout zones as well.
- **Long Valley:** Residential development in Long Valley is exposed to large avalanches originating from the northeast face of McGee Mountain and from slopes below Castle Rock, located directly above existing development. A portion of US 395 and residential, lodging, and commercial facilities in several small communities of the Crowley Lake area are directly in the runout area of frequent avalanches from McGee Mountain.

- **Wheeler Crest:** A major dry-snow avalanche occurred in 1969 in Swall Meadows. Avalanche risk also exists on the Lower Rock Creek access road from a number of small east-facing paths that descend directly onto the road.
- **Mono Basin:** Several large avalanche paths are known to extend east of US 395 approximately 1 to 2 miles north of Lee Vining. While few structures are in the runout zone, an avalanche could shut down and damage US 395 as well as major power lines.

  An area at the west end of Lundy Lake, which includes some private homes, is threatened by a large, steep avalanche path. At present, Lundy Lake is not occupied continuously during the avalanche season.

- **Outside of the Community Planning Areas:** Much of the development in Virginia Lakes is in a runout zone, as are several portions of the single access route to it—Virginia Lakes Road. This area is primarily a seasonal residential area, although a number of dispersed housing units are present. It is also frequented by recreational snowmobiles and backcountry skiers. It includes several dozen seasonal residence structures, as well as recreational infrastructure such as bathrooms, trailheads, and parking lots.

Critical facilities in these areas, including single-access routes, primary access routes, roads, and sub-stations and power lines, have an elevated risk of damage due to avalanches. There is insufficient data on the exact avalanche zone areas to accurately identify all critical facilities that could be at risk. A comprehensive on-site terrain analysis and avalanche flow modeling using the AVALANCHE module of the internationally accepted Rapid Mass Movements (RAMMS) would provide more accurate and detailed data on avalanche risk areas and what critical facilities are at greatest risk.

Specific road segments of concern identified by the County for avalanche monitoring in 2017 are shown in **Table 4.2**.

Table 4.2 2017 Road Segments at Risk of Avalanche Identified for Monitoring

Planning Area	Road	General Location
Bridgeport	Twin Lakes Road	South of Bridgeport
Long Valley	Crowley Lake Drive	At McGee Mountain
	Crowley Lake Drive	At Ojai Ridge
	Rock Creek Road Narrows	Near Tom's Place
June Lake	Lakeview Drive	Near June Lake
Mammoth Vicinity	Benton Crossing Road	Near Wildrose Summit

Table 4.2 2017 Road Segments at Risk of Avalanche Identified for Monitoring

Planning Area	Road	General Location
Mono Basin	Picnic Grounds Road	Near Lee Vining
Wheeler Crest	Mountain View Road, Foothill Road, and Swall Meadows Road	Swall Meadows
	Lower Rock Creek Road Narrows	North of Swall Meadows
Outside planning area	Virginia Lakes Road	Northwest of Mono City
	Lundy Lakes Road	Northwest of Lee Vining

Town of Mammoth Lakes

Avalanche damage to property is a risk in several areas of town, including homes in the Sherwin Range and Knolls neighborhoods. The Mammoth Mountain Ski resort contains no residential structures but does contain structures such as ski lifts and lodges; it is also at risk from runout paths off Mammoth Mountain. Thousands of visitors may be on the slope at any given time, even when avalanche risk has been determined to be high.

The Town's Zoning Code contains a Snow Deposition Design Overlay Zone (SDD), which identifies areas of avalanche risk. It includes areas immediately above, adjacent to, or within 150 feet of the 30-degree point of an avalanche starting zone. All development within the SDD requires a use permit, as well as certification from an expert in the occurrence, force, and behavior of avalanches. The SDD does not guarantee the safety of homes within the zone, nor is the zone intended to be fully comprehensive regarding all areas that are at potential risk from avalanche.

4.2.2 Dam Failure

There are 22 dams in Mono County. The California DWR rates each dam based on the potential downstream impacts to life and property in the event of dam failure while operating with a full reservoir. These ratings do not reflect how likely the dam is to fail, only how severe the results will be if it does. The ratings are described in **Table 4.3**, and each dam in Mono County with their respective downstream hazard classification is listed in **Table 4.4.** As noted in **Chapter 3**, only eight dams have possible inundation zones that have been identified by the state; these dams are shown in bold.

Table 4.3 Downstream Hazard

Downstream Hazard Classification	Loss of Human Life	Economic, Environmental, and Lifeline Losses
Low	None expected	Low and generally limited to owner's property
Significant	None expected	Yes
High	Probable (one or more expected)	Yes, but not necessary for this classification
Extremely High	Considerable	Yes, major impacts to critical infrastructure or property
Source: California DWR 2017		

Table 4.4 Mono County Dam Classifications

Dam No.	National ID No.	Dam Name	Downstream Hazard
104.038	CA00454	Agnew Lake	High
538.000	CA00646	Black Reservoir	Low
70.002	CA00284	Bridgeport	Significant
104.037	CA00453	Gem Lake	High
6.033	CA00089	Grant Lake	High
539.000	CA00647	Lobdell Lake	Low
6.034	CA00090	Long Valley	Extremely High
531.002	CA00644	Lower Twin Lake	High
104.035	CA00451	Lundy Lake	High
540.000	CA00648	Poore Lake Reservoir	Low
104.041	CA00457	Rhinedollar	High
104.034	CA00450	Rush Creek Meadows	High
104.039	CA00455	Saddlebag	High
104.040	CA00456	Tioga Lake	High
70.003	CA01473	Topaz Lake	Significant
6.042	CA00095	Upper Gorge	Low
531.000	CA00643	Upper Twin Lake	High
6.035	CA0091	Walker Lake	Low
Source: California DWR 2017			

There are two dams under the jurisdiction of U.S. Army Corps of Engineers. These dams are under federal jurisdiction, and information on downstream hazard ratings is not available. These dams are Lake Mamie and Lake Mary.

Because these two dams are in the same watershed as the Upper and Lower Twin Lakes Dam, the downstream hazard may be assumed to be the same risk level, i.e., high.

Mono County

While there are close to two dozen dams in the County with varying conditions, no single dam failure would result in risk to residences or commercial structures. However, two critical facilities are located in dam failure inundation areas, both of which are lifeline utility systems, in the June Lakes Area. Critical roadway infrastructure is at greatest risk of closure as well as extensive damage. Dam failure inundation zones cross two sections of US 395, several sections of CA 120, large portions of CA 168, and much of CA 102.

Town of Mammoth Lakes

The Town of Mammoth Lakes, located downstream of the Twin Lakes, Lake Mamie, and Lake Mary Dams, has a number of residential and nonresidential structures at risk. Homes on Mammoth Creek often experience flooding problems during major precipitation events and would likely experience flooding damage in the event of dam failures.

4.2.3 Disease/Pest Management

Mono County

Disease and pest management hazards are present throughout Mono County and in Mammoth Lakes. Because disease often travels through animal or insect vectors, as well as human contact, the risk is similar anywhere in the County. Areas of increased contact with wildlife may be somewhat more susceptible, as well as areas with high populations of mosquitoes. In Mono County, cases of bubonic plague, hantavirus, and tick-borne relapsing fever have been reported, and there is a possibility, although remote, of West Nile virus occurring in the region. Common carriers for these diseases include rodents such as mice and squirrels, ticks, fleas, and mosquitoes.

Occurrences of these diseases are rare in Mono County and generally identified quickly, which reduces the risk of a significant outbreak. Loss of life is therefore minimal, and the chances of an epidemic are remote. Critical facilities are not impacted by diseases and are generally unaffected by pests, although wooden buildings may be damaged by wood-eating insects.

Town of Mammoth Lakes

Disease and pest management hazards in the Town of Mammoth Lakes are similar to that of the rest of the County, with such hazards present throughout its area. As a tourist destination, the Town may be at higher risk from contagious diseases spread through human contact.

4.2.4 Drought

Mono County

The regional nature of drought hazards means that all of Mono County and Mammoth Lakes face an equal risk of drought, although the characteristics of a drought can vary widely across the region. While droughts typically do not pose a health or safety impact, in extreme cases normal water supplies may dry up and individuals may have to procure water from other sources, which may be difficult for lower-income residents. In addition, water is critical for activities that indirectly apply to human health, such as agriculture, livestock watering, and sanitation. There are also economic concerns, as skiing and the lakes in Mono County are a primary tourist attraction, and a decline in tourist activity can cause a sharp decline in revenue for local businesses and jurisdictions.

Much of the water used in Mono County comes from groundwater wells, which makes the water prone to both natural contamination such as metals and arsenic, and man-made contamination from pesticide and fertilizer runoff, and septic systems. In times of drought, the groundwater may not be recharged as quickly as water is extracted, potentially causing depletion of the groundwater. This results in lowering of the water table that can cause land subsidence, increased water costs, further reduced surface water supplies, and an increase in water quality concerns as contaminations become more concentrated.

The Owens Valley Groundwater Basin is considered a basin of medium importance by the DWR. The basin underlies the entire Owens Valley in neighboring Inyo County as well as the Tri-Valley area and communities of Benton, Hammil, and Chalfant. Like much of the rest of the County, these communities depend on groundwater as well as surface water supplies. These areas include agricultural activities, primarily alfalfa fields, which depend on groundwater. Per state law, the County is currently coordinating with neighboring jurisdictions to develop a Groundwater Sustainability Plan, which will identify needs for facilities, investigations, and management activities that should be undertaken to maintain and enhance sustainable groundwater management in the future.

Critical facilities are not physically affected by drought conditions, although droughts may have impacts for facility operations, such as water recreation facilities.

Town of Mammoth Lakes

As stated above, drought risks in Mammoth Lakes are consistent with risk throughout the County.

4.2.5 Earthquake and Seismic Hazards

As discussed in **Chapter 3**, seismic hazards include four related hazards: fault rupture, shaking, liquification, and tectonic subsidence. Faults are the only hazard where location-specific information is available. An earthquake centered at any one of these faults could result in strong shaking in much of the entire County, and potentially pose major risks to life and property throughout.

Consequently, this risk analysis focuses on fault locations, while acknowledging that seismic hazards are present throughout Mono County and the Town of Mammoth Lakes.

Mono County

Faults exist throughout Mono County. The parts of the unincorporated county at risk of fault rupture generally do not face a higher social vulnerability to this hazard than the rest of the unincorporated area.

Town of Mammoth Lakes

There is no calculated population within the fault rupture hazard zone for Mammoth Lakes. **Table 4.5** shows the social vulnerability of unincorporated Mono County to fault rupture.

Table 4.5 Social Vulnerability to Fault Rupture in Unincorporated County

Social Vulnerability Metric	Fault Rupture Hazard Zone	Entire Community
Population	413	6,042
Number of households	142	2,213
Median household income	$56,608	$59,386
Percentage of households under poverty limit	2.8%	5.1%
Percentage of elderly households	27.5%	35.2%
Percentage of adults with high school degree or higher	Unknown	87.9%
Percentage of adults with English competency	99.7%	95.5%
Percentage of households with a disabled member	12.7%	15.3%

HAZUS-MH, a software program and standardized methodology for estimating potential monetary losses from earthquake and select other hazards, was used to assess potential losses in Mono County. Three different earthquake scenarios, identifying several potential magnitude faults along specific faults

in various locations in the county, were evaluated using the program's generalized estimates for the number and value of these structures in the County. One scenario evaluated an earthquake along the Hilton Creek fault, located in Long Valley west of Crowley Lake. The Temblor Seismic Hazard Rank along the Hilton Creek Fault, 32, is significant. The Mammoth Lakes area experienced four M≥6 shocks in the 1980s, which ruptured parts of the Hilton Creek fault (Bryant 1980). The scenario assumes a magnitude of 6.9 along the fault. HAZUS estimates that in such a scenario, about 922 buildings will be at least moderately damaged, 124 would be extremely damaged, and 15 damaged beyond repair. The quake would also damage more than 40 segments of highway and more than 40 bridges. The total economic loss estimated for this earthquake would be more than $159.2 million, which includes building and lifeline-related losses based on the region's available inventory. Full reports provided by HAZUS are located in **Appendix D**.

Faults like Hilton Creek exist throughout Mono County, with many faults and historic earthquake epicenters located near US 395, especially in the southern third of the County. Various faults also cross portions of SR 120 and SR 158. Because these corridors are primary evacuation routes for the County, earthquakes near them could considerably hinder evacuation efforts and leave the County isolated from outside assistance.

Primary earthquake hazards are ground shaking, landslides, surface rupture or displacement, and liquefaction. While no complete mapping is available for liquefaction risk, past events suggest that the valley areas face an elevated risk of liquefaction, particularly areas around dry lake beds. Other secondary hazards associated with ground shaking and liquefaction include:

- Flooding from broken dams
- Fire from broken gas lines and power lines
- Damage to buildings and infrastructure
- Avalanches
- Seiches in large lakes and reservoirs
- Injury and death from falling debris or secondary hazards

Much of the damage and risk to life from an earthquake is a result of these secondary hazards. Vulnerability to these events depends on the location and population of nearby settlements, the concentration and structural integrity of buildings, and public warning systems and preparedness. Population density and building intensity is generally low in Mono County; however, the lack of comprehensive transportation networks and the rural nature of the County means response times could be high and access to necessary services could be heavily impacted.

Ground shaking from earthquakes has the potential to affect all areas of Mono County and Mammoth Lakes; no critical facility is considered completely safe from this hazard. There are eight critical facilities located within the fault zone, as shown in **Table 4.6**.

Table 4.6 Types of Mono County Facilities in Fault Rupture Hazard Zones

Facility Type	Number of Facilities Not at Risk	At Risk – Mammoth Lakes	At Risk – Unincorporated Mono County
Communication	18	0	1
Emergency Operations Center	11	0	1
Emergency Services	25	0	1
Hazardous Materials	10	0	0
Lifeline Utility Systems	52	1	2
Medical Services	4	0	0
Schools	10	0	1
Transportation Systems	9	0	1
Vulnerable Populations	5	0	0
Total	**144**	**1**	**7**

4.2.6 Extreme Heat

Extreme heat is a possible hazard in the Tri-Valley area, which includes the communities of Benton, Hammil, and Chalfant. The Tri-Valley has many older residents living in older homes with poor insulation and limited or no air conditioning. Senior individuals are more adversely affected by extreme temperatures and could experience health risks during one or more days at or above the extreme threshold. Other residents who typically have a greater social vulnerability (persons with disabilities, lower-income individuals, persons with limited English competency, etc.) are also likely to be at greater risk of health impacts resulting from extreme heat events.

Critical facilities, including pavement, asphalt, and the power grid, can be negatively affected by extreme heat and thus require more maintenance. A heat wave resulting in much higher than normal electricity draws to power air conditioning units could tax the electricity grid in the Tri-Valley and result in brownouts or blackouts; heat can also cause power lines to sag, causing additional hazards and risk of power disruption.

4.2.7 Flood

Flooding is especially prevalent in the Tri-Valley area, which includes the communities of Benton, Hammil, and Chalfant. June Lake, Antelope Valley, and Bridgeport Valley also have areas of flood risk, with 18 percent of Antelope Valley and just over 11 percent of Bridgeport Valley located in the 100-year flood zone. Overall, more than 50 percent of state land and 11 percent of privately owned land is vulnerable to flood risk. No households are located in the Mammoth Lakes' 100-year flood zone, while 7 percent of County residents live in the 100-year flood zone and 2 percent live in the 500-year flood zone. **Table 4.7** shows the social vulnerability of unincorporated Mono County for flood hazard zones/

Table 4.7 Social Vulnerability for Flood Hazard Zones – Unincorporated Mono County

Social Vulnerability Metric	100-Year Flood Zone	500-Year Flood Zone	Entire Community
Population	431	143	6,042
Number of households	182	70	2,213
Median household income	$44,817	$43,306	$59,386
Percentage of households under poverty limit	5.5%	5.7%	5.1%
Percentage of elderly households	28.6%	41.4%	35.2%
Percentage of adults with high school degree or higher	Unknown	Unknown	87.9%
Percentage of adults with English competency	98.8%	98.3%	95.5%
Percentage of households with a disabled member	22.5%	25.7%	15.3%

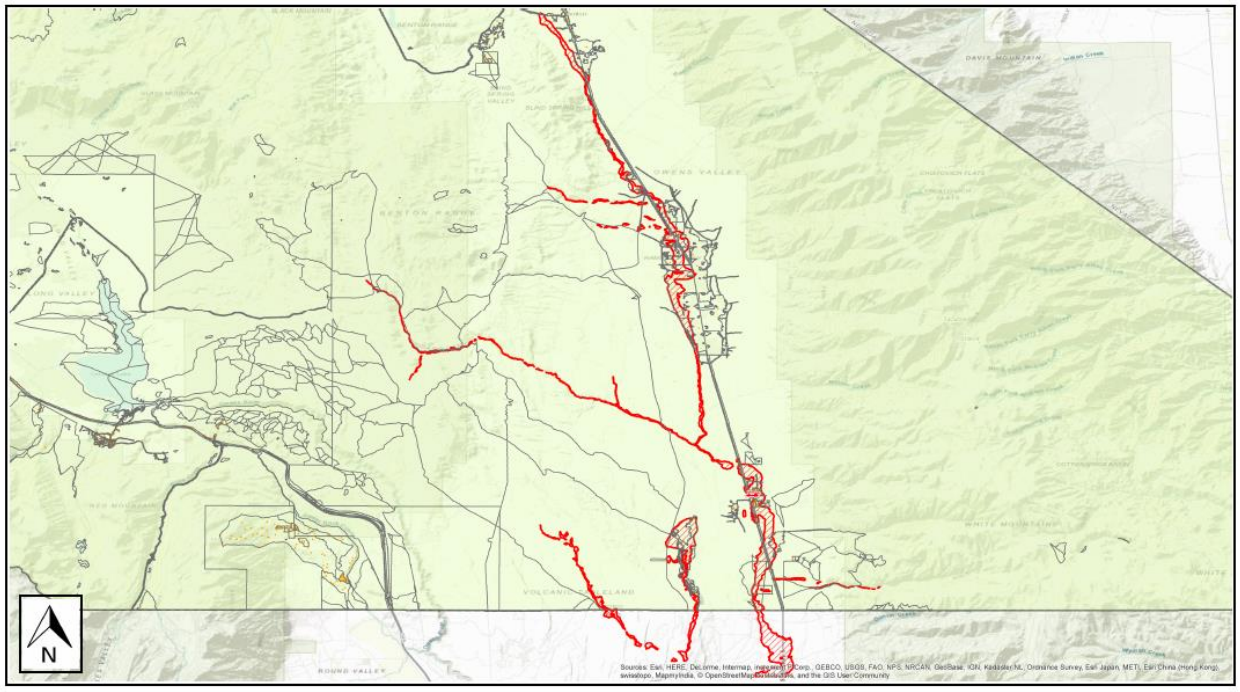
There is only one critical facility in a flood zones in Mammoth Lakes (the 500-year flood zone). Mono County has six critical facilities in the 100-year flood zone and eight critical facilities in the 500-year flood zone, including three senior living facilities and one school, see **Table 4.8**.

Table 4.8 Critical Facilities in Flood Hazard Zones – Unincorporated Mono County and Mammoth Lakes

Facility Type	Number of Facilities Not at Risk	At Risk – Mammoth Lakes		At Risk – Unincorporated Mono County	
		100-Year	500-Year	100-Year	500-Year
Communications Facilities	17	0	0	2	0
Emergency Operations Center	11	0	0	1	0
Emergency Services	23	0	0	1	2
Hazardous Materials	8	0	0	1	1
Lifeline Utility Systems	52	0	1	1	1
Medical Services	4	0	0	0	0
Schools	10	0	0	0	1
Transportation Systems	10	0	0	0	0
Vulnerable Populations	2	0	0	0	3
Total	**137**	**0**	**1**	**6**	**8**

HAZUS-MH modeling was used to assess potential losses due to flood in Mono County. Twelve different flood scenarios, identifying possible storms from a 100-year flood event in various locations in the County, were evaluated using the program's generalized estimates for the number and value of these structures in the County. One scenario evaluated a flood event along US 6 in Hammil and Chalfant Valleys, an area that historically floods most frequently in the County, as shown in **Figure 4.1**.

Figure 4.1: HAZUS Flood Scenario in the Tri-Valley



Under such a scenario, HAZUS estimates that about 62 buildings would be affected; twenty buildings would be moderately damaged and 48 buildings would be destroyed. The total building estimated losses in this case would total more $15.6 million. HAZUS also estimates that 123 households would be displaced due to the flood. Full reports provided by HAZUS are located in **Appendix C**.

FEMA's National Flood Insurance Program

In 1968, the US Congress created the National Flood Insurance Program (NFIP). Participation in the NFIP by a community is voluntary; however, in order to receive flood hazard funding from FEMA, a community is required to participate in the program. Mono County has participated in the NFIP since 1985, and Mammoth Lakes has participated since 1994

The Community Rating System (CRS) is a voluntary part of the NFIP that seeks to coordinate all flood-related activities, reduce flood losses, facilitate accurate insurance rating, and promote public awareness of flood insurance by creating incentives for a community to go beyond minimum discounts. CRS ratings are on a 10-point scale (from 10 to 1, with 1 being the best rating), with community residents who live in FEMA's Special Flood Hazard Areas (SFHAs) receiving a 5 percent reduction in flood insurance rates for every class improvement in the community's CRS rating. Neither Mono County nor the Town of Mammoth Lakes participates in the CRS (FEMA 2016).

Because eligibility for the NFIP is based on flood hazard mapping, statistics on participation in NFIP can indicate the flood risk in Mono County and the Town of Mammoth Lakes in addition to the social vulnerability and critical facilities assessment.

FEMA also operates a Severe Repetitive Loss (SRL) program. The primary objective of the SRL properties strategy is to eliminate or reduce the damage to residential property and the disruption to life caused by repeated flooding. Only one property has been identified as having multiple floods, a commercial property. FEMA identified no repetitive loss properties in the Town of Mammoth Lakes.

4.2.8 Landslides (Geologic Hazards)

There are no clearly defined landslide hazard zones in Mono County, and therefore precise figures on social vulnerability and impacts to critical facilities are not available. Any critical facilities located in areas near steep slopes or alluvial fans may be damaged by landslides, and individuals living in these areas face a higher social vulnerability to landslides than residents elsewhere in Mono County. The primary area of concern for landslide risk is along US 395 in the northern portion of the County and in the Lee Vining area, which are adjacent to steep slopes that are more susceptible to landslides that could block evacuation routes. The Town of Mammoth Lakes does not have any significant risk of landslide.

As indicated in the hazards assessment, volcano-related hazards that may affect Mono County for which there are clearly defined areas of elevated threats are pyroclastic flows and hazards from existing volcanic vents. Areas of Mono County, including the Town of Mammoth Lakes, within about 7 miles of the Mono-Inyo chain vents are at risk of pyroclastic flows. Critical facilities in these areas may be damaged if ash is not cleared off roofs (particularly during wet weather), and the ash may harm a facility's mechanical or electrical systems. Similarly, residents in the hazard zone may face respiratory health risks or have their homes damaged by volcanic ash. Volcanic vents have the potential to release volcanic gases, and there have been deaths in Mono County caused by falls into a snow cavern around the vent.

4.2.9 Hazardous Materials

The primary risk from hazardous materials in Mammoth Lakes and Mono County are from radon, carbon monoxide, propane, and hazardous material transportation. Because radon and propane are widespread throughout the County, there are no clearly defined hazard zones and therefore no identified critical facilities. In addition, no social vulnerability analyses can be performed. For hazardous material transportation, the main highways will be at higher risk for accidents that have the potential to cause spills and explosions.

4.2.10 Severe Winter Storm and Snow

Most types of severe weather have a roughly equal chance of occurring anywhere in Mono County, so all critical facilities and residents are considered potentially vulnerable to severe weather hazards. As a result, there are no critical facilities with a greater chance of being affected and no social vulnerability analyses for severe weather. However, residents who typically have a greater social vulnerability to other natural hazards (elderly residents and persons with disabilities, lower-income individuals, persons with limited English competency, etc.) are likely to face higher social vulnerability to severe weather.

4.2.11 Severe Wind

Severe wind is possible almost anywhere in Mono County, although tops of slopes and open areas with few trees experience the greatest wind speeds. All critical facilities and residents are considered potentially vulnerable to severe wind. Since most newer structures are built to withstand 90 mile-per-hour gusts, old structures and vehicles on the open road are typically at the greatest risk. No critical facilities are at risk except the historic County Courthouse building, built in 1880. The building has been structurally retrofitted to better withstand severe wind and weather events.

Residents who typically have a greater social vulnerability to other natural hazards (elderly residents and persons with disabilities, lower-income individuals, persons with limited English competency, etc.) are also likely to face higher social vulnerability to severe wind if caught outside or in vehicles.

4.2.12 Wildlife Collisions

Wildlife collisions are a hazard in most places of the County, and along major highways in particular. Because collisions will generally only affect the animal and vehicle involved, critical facilities are not at risk, although property damage and injury may occur, and wildlife movement patterns may be negatively affected. Vulnerable populations are not more or less affected by this than any other demographic in the County.

5. MITIGATION MEASURES

Outlining clear strategies to reduce the impacts of these identified hazards on community members and critical infrastructure provides a clear path forward for Mono County and the Town of Mammoth Lakes to achieve the goals set forth in this Plan. This section of the Plan provides recommendations for action, including responsible agencies and departments, potential funding sources, and related policy documents. The findings from the vulnerability and risk assessments in **Chapters 3** and **4** of this Plan were used to develop measures that reduce or possibly eliminate potential losses of life or property from the region's most pressing hazards.

5.1 Hazard Mitigation Overview

5.1.1 Hazard Mitigation Goals

As presented in **Chapter 1**, **Section 1.5**, goals for Mono County and the Town of Mammoth Lakes cover the various priority hazards.

These goals outline and guide the development of policy choices that protect community members, critical facilities, infrastructure, property, and regional natural resources from hazards. These goals shape future actions to be taken by Mono County and the Town of Mammoth Lakes to reduce risk and minimize losses from disaster. These goals will continue to ensure that implementation of the MJHMP is aligned with the original intent, and can serve as checkpoints for responsible departments to monitor the progress of measures. The mitigation measures either fall under multiple hazards, and thus generally provide improvements that can reduce long-term risk for multiple or all hazards, or are categorized under a specific hazard.

5.1.2 Hazard Mitigation Prioritization

At the January 25, 2018, meeting of the Planning Team, draft hazard mitigation measures were revised and prioritized. An initial list of high priority measures was established using data analysis of risk from each hazard as well as local knowledge about community members' priorities. Then as a group the Planning Team reviewed each "high priority" measure to determine if this measure should stay a priority measure and if additional priority measures should be included for each hazards. During the review process the Planning Team took into consideration the impact of each measures, community support for each measure and the cost benefit of each measure. By the end of the prioritization exercise, the Planning Team had identified a list of 14 High Priority measures that deserve the greatest focus over the five-year life of the plan (these measures are shown in **bold** in **Table 5.1** below). The 2006 adopted MJHMP had far more measures identified as short-term and high priority, making it difficult for staff to

truly prioritize action with limited funding. Limiting the total number of Highest Priority measures in this update will assist in addressing this issue. Notes from this discussion are located in **Appendix B**. The status of the 2006 measures, including measures that were completed since the last update in 2006, are also documented in **Appendix B**.

5.2 Hazard Mitigation Strategy

The Planning Team used data from the hazard vulnerability assessment in **Chapter 3**, the risk assessment in **Chapter 4**, and the capabilities assessment in **Section 5.3** of this chapter to inform the development of the following measures. Measures reflect the actions that the County and Town plan to take for preparedness, response, recovery, and mitigation. Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available. Measures that are the High Priority for this MJHMP period are shown in **bold**.

Table 5.1 identifies the hazards, proposed mitigation measures, the responsible party for implementation, and the priority ranking as determined by the Planning Team.

Recognizing the federal regulatory requirement to prioritize by benefit-cost, and the need for any publicly funded project to be cost-effective, the Planning Team was asked to consider cost-effectiveness in selecting highest priority measures. The County and Town will pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in **Table 5.1**. Cost-effectiveness will be considered in additional detail when seeking FEMA mitigation grant funding for eligible projects identified in this plan. In general, the County and Town have limited existing funds to implement measures. Education and ongoing maintenance measures are part of existing emergency response personnel duties and also heavily depend on collaboration with federal and state agencies. Measures relating to infrastructure and roadway improvements may draw upon CIP (Community Improvement Plan) and Community Service Infrastructure allocated funds and may also be funded through Caltrans grants. For all other measures, the County and Town must depend on other funding sources including but not limited to FEMA Hazard Mitigation Assistance Grants and other federal monies.

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
Multiple Hazards				
1.1	**When known, notify SCE of vulnerabilities and malfunctions in the local power grid, and support efforts to make the power grid more resilient to hazard events and reduce fire risk. Such efforts could include undergrounding line segments, prioritized by feasibility, community vulnerability to power loss, and locational risk of fire.**	**Mono County**	**Public Works, Community Development**	**Short-term**
1.2	**Study available alternative emergency communications technologies that may provide more reliable service than existing radio communications technology in use.**	**Mono County**	**Radio Governance Committee**	**Short-term**
1.3	**Require individuals, as well as companies, that provide home or accommodation rentals to clearly post available emergency evacuation routes for guests.**	**Mono County, Town of Mammoth Lakes**	**Community Development**	**Short-term**
1.4	**Collect parcel-specific information necessary to complete a more accurate "estimate losses" for inclusion in the next LHMP update. The County and Town should inventory existing development to obtain the following data: types of structures, construction type, building size, building footprints, structure value, and replacement value. Incorporate data into a geographic information system (GIS) and related databases.**	**Mono County, Town of Mammoth Lakes**	**Community Development, Information Technology, Assessor's Office**	**Short-term**

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
1.5	**Continue to work with state and federal agencies and wireless providers to expand and improve coverage and interoperability of cell and radio service throughout the County.**	**Mono County, Town of Mammoth Lakes**	**Sheriff's Office, Police, Fire, and EMS**	**Short-term**
1.6	**For communities with only one access route, evaluate options to provide an emergency access route, prioritized based on multi-hazard risk to existing access. Design and create the alternative access route(s) if an option is chosen, and if funding and resources are available.**	**Mono County, Town of Mammoth Lakes**	**Public Works, Community Development**	**Short-term**
1.7	Provide information to community members during emergencies through the following media: 1) coordinated through Public Information Officer (PIO); 2) local radio in English and Spanish; 3) reverse 911; 4) internet; and 5) local phone trees.	Mono County, Town of Mammoth Lakes	Sheriff's Office, Police, Fire, and EMS, PIO	Ongoing
1.8	Each department should have emergency supplies, including, at a minimum, drinking water and MREs (meals ready to eat) to support their personnel for 24-48 hours.	Mono County, Town of Mammoth Lakes	Sheriff's Office, Administration	Short-term
1.9	Require applicants for major development projects to conduct hazard assessment studies and to design new or significantly retrofitted structures to be resilient to identified priority hazards in this plan.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
1.10	Develop procedures that allow public infrastructure and service personnel with appropriate identification to access areas affected by a hazard event that have been deemed safe in order to assist in response and early recovery activities. Incorporate procedures in the Emergency Operations Plan upon its next update.	Mono County, Town of Mammoth Lakes	Sheriff's Office, Police, Fire, and EMS, Public Works	Short-term
1.11	In communities with limited evacuation options, review the ability for residents to obtain shelter within their community. For areas that do not have a suitable shelter location, evaluate locations for creating one and work with local resident groups and emergency response providers to do so.	Mono County, Town of Mammoth Lakes	Sheriff's Office, Community Development	Long-term
Wildfire				
2.1	**For communities and neighborhoods identified to be at highest fire risk, complete a parcel-level analysis. Incorporate into a GIS system, and use to prioritize parcel-level defensible space improvements. Upon completion of the analysis, update the CWPP to incorporate information.**	**Mono County, Town of Mammoth Lakes**	**Community Development, Information Technology**	**Short-term**
2.2	**Create a countywide hazard coordinator position to coordinate development of mitigation and response plans; coordinate community group efforts and public outreach efforts; enable communications to and between volunteer fire and first-response departments; and pursue funding opportunities.**	**Mono County**	**Sheriff's Department**	**Short-term**

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
2.3	**Request Caltrans to install more and higher visibility "fire awareness" signs for use along major highways to inform the public of the current fire danger and to promote fire prevention.**	**Mono County, Town of Mammoth Lakes**	**Public Works, Community Development**	**Short-term**
2.4	**In communities with outdated or inadequate water storage and pressure for firefighting, work with local fire departments to fund, site, permit, and install new tanks and related facilities.**	**Mono County**	**Community Development**	**Short-term**
2.5	Support efforts by Fire Safe Councils and community groups to promote fire prevention, fuels treatments, invasive species control, and defensible space in the WUI and assist in identifying and pursuing funding opportunities to complete these activities.	Mono County, Town of Mammoth Lakes	Community Development	Ongoing
2.6	Develop community-level fire plans for all communities with the highest fire risk, utilizing resources and assistance from the California Fire Alliance.	Mono County, Town of Mammoth Lakes	Fire, Police, and EMS	Long-term
2.7	Educate homeowners about forest health, fire prevention, and home defense and distribute information on fire prevention resources.	Mono County, Town of Mammoth Lakes	Fire, Police, and EMS, Community Development	Ongoing
2.8	Ensure that wildland fire hazards are disclosed during the building permit process, with emphasis on properties located in the WUI zone.	Mono County, Town of Mammoth Lakes	Community Development	Short-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
2.9	Encourage local landowners to participate in state and federal programs for fuel reduction on private property, such as the Cal Fire Vegetation Management Program, Cal Fire hazardous fuel reduction program, and BLM Wildland Urban Interface Grant Awards program.	Mono County, Town of Mammoth Lakes	Community Development	Ongoing
2.10	Support efforts by the U.S. Forest Service, the Bureau of Land Management, and other landowners to control or eradicate invasive and/or highly destructive forest pests.	Mono County, Town of Mammoth Lakes	Community Development	Short-term
2.11	Support measures and project priorities established in the Swall Meadows and Paradise CWPP with the same force and effect as other measures established in this plan (as well as all future CWPPs).	Mono County	Fire, Community Development	Short-term
2.12	Develop a grant program that provides residents who own older, non-compliant WUI structures the opportunity to make the exteriors code-compliant.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term
2.13	**Support fuels reduction, maintenance of treated areas, and broadcast burning in areas around the private land boundary.**	**Town of Mammoth Lakes**	**Fire, Police, and EMS**	**Mid-term**
2.14	Increase awareness, management, and control of cheatgrass (*Bromus tectorum*) to reduce ignition and fire spread.	Mono County	Community Development	Ongoing

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
2.15	Prepare for health impacts of smoke from wildfire, including designating clean air shelters in additional communities as needed and notifying residents of their locations.	Mono County, Town of Mammoth Lakes	Public Works, Public Health	Mid-term
Severe Winter Weather and Snow				
3.1	**Maintain a list of the residences and needs of vulnerable persons, including elderly residents, socially isolated persons, and immuno-compromised individuals, that could require special emergency response resources during hazard events. Develop a response plan for vulnerable persons for use by emergency operators during hazard events.**	**Mono County, Town of Mammoth Lakes**	**Public Health, Sheriff's Office, Fire, Police, and EMS**	**Short-term**
3.2	Coordinate and work with Caltrans and local snow removal resources to maintain key roadway operations.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
3.3	Educate community members about severe storm preparedness, including about home and vehicle supplies and public refuge locations.	Mono County, Town of Mammoth Lakes	Sheriff's Department, Fire, Police, and EMS	Mid-term
3.4	Operate and make accessible public refuge locations during severe storm events within 10 miles of all urbanized communities. Each location should be heated and have on-site backup generators, adequate parking, and supplies of food and water sufficient to serve vulnerable nearby residents and visitors.	Mono County, Town of Mammoth Lakes	Sheriff's Department, Social Services	Ongoing

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
Seismic				
4.1	Conduct a comprehensive survey of the structural condition of all public buildings and critical facilities, including identification of unreinforced masonry and soft-story structures. Prioritize surveying buildings and facilities in earthquake fault zones. Retrofit or replace structures, as funding allows, identified as being at high risk of collapse in a seismic event.	Mono County, Town of Mammoth Lakes	Public Works, Community Development	Mid-term
4.2	Continue to require new and retrofitted structures to meet minimum state seismic safety standards, and encourage property owners to exceed these standards.	Mono County, Town of Mammoth Lakes	Public Works, Community Development	Ongoing
4.3	Require property owners to locate new developments outside of known fault rupture hazard zones, or design to appropriate standards.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term
4.4	Design Town- and County-owned infrastructure in fault rupture zones to resist damage from fault rupture, and encourage other agencies to use similar strategies. Use similar strategies outside of fault rupture zones to the extent feasible.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
4.5	Require new development in areas susceptible to liquefaction to conduct a geotechnical evaluation and implement actions to mitigate liquefaction risk. Avoid development in areas where liquefaction risk cannot be adequately mitigated.	Mono County, Town of Mammoth Lakes	Public Works, Community Development	Ongoing

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
Volcano				
5.1	Distribute information regarding evacuation procedures in the event of potential volcanic lava, pyroclastic, or debris flow and ash distribution.	Mono County, Town of Mammoth Lakes	Sheriff's Department, Fire, Police, and EMS	Mid-term
5.2	Support efforts to improve volcanic forecasting strategies.	Mono County, Town of Mammoth Lakes	Information Technology	Long-term
Drought				
6.1	Encourage retrofits of private homes and businesses for increased water conservation. Continue to educate about and promote the Property Assessed Clean Energy (PACE) programs in funding retrofits.	Mono County, Town of Mammoth Lakes	Community Development	Short-term
6.2	Support the Tri-Valley Groundwater Management District's efforts to improve groundwater management through education and program implementation.	Mono County	Community Development	Mid-term
6.3	Provide resources to landowners about irrigation efficiency and crops with reduced water requirements. Encourage landowners to use plants that require little or no irrigation in new or retrofitted landscapes.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
6.4	Provide resources to local farmers about crop varieties that require little or no irrigation.	Mono County	Community Development, Inyo and Mono Counties Agriculture Department	Mid-term
Extreme Heat				
7.1	Identify ways to provide free or low-cost weatherization and energy-efficient heating and cooling appliances to lower-income residents without access to these devices.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term
7.2	Identify public buildings that can serve as cooling centers in the event of extreme heat events, particularly in the Tri-Valley area. Perform any upgrades necessary to ensure the facilities meet standards necessary for a cooling center, and inform residents about where these centers are located and any procedures for usage.	Mono County	Public Works, Public Health Department	Mid-term
Severe Wind				
8.1	Work with Caltrans to install a real-time wind and visibility tracking system for key access road segments, and incorporate warnings into online notifications and the emergency notification system.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
8.2	Encourage project applicants to incorporate wind-resistant design features into new or significantly renovated buildings.	Mono County, Town of Mammoth Lakes	Community Development	Mid-term
Flood				
9.1	**Develop and implement a program to provide funding for residents with homes in the 100-year floodplain to retrofit structures and raise them out of the floodplain.**	**Mono County**	**Public Works**	**Short-term**
9.2	Request FEMA to update the FIRM maps for the Walker River watershed communities, the June Lake Loop, and the Tri-Valley area. As maps are updated, conduct public outreach to affected communities regarding NFIP outcomes.	Mono County	Public Works	Mid-term
9.3	Document past flood events in the GIS system to identify historic flooding patterns that can be used to better understand where repetitive flooding hazards occur and enable the County and Town to minimize risks to existing development in those areas.	Mono County, Town of Mammoth Lakes	Community Development, Public Works, Information Technology	Ongoing
9.4	Through an ongoing public education program, ensure that property owners are aware of flood hazards and practices necessary to diminish the impacts of those hazards. This program should include information on participation in the NFIP.	Mono County, Town of Mammoth Lakes	Community Development, Public Works	Ongoing

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
9.5	Develop a Comprehensive Flood Management Strategy for the County and Town.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
9.6	Evaluate stormwater infrastructure in areas of recurrent flooding and identify needed improvements to be implemented as funding becomes available.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
Avalanche				
10.1	**Update parcel-level avalanche mapping for the County's GIS system, including data for the Town of Mammoth Lakes. Upon completion of mapping, develop a zoning overlay that requires fair warning of avalanche for all permits and an avalanche risk assessment for all new residential development that recommends required construction standards.**	**Mono County, Town of Mammoth Lakes**	**Community Development**	**Short-term**
10.2	Support efforts by the U.S. Forest Service and organizations such as the Eastern Sierra Avalanche Center to post information about avalanche risks and current conditions at trailheads throughout avalanche-prone areas, in visitor centers, and online.	Mono County, Town of Mammoth Lakes	Information Technology	Ongoing

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
10.3	Develop a map for the County website that identifies roadway segments at avalanche risk and educates communities about the risks, forecasting methods, and roadway operations within areas at avalanche hazard areas. As part of the countywide notification system, provide real-time avalanche conditions along the identified roadway segments.	Mono County, Town of Mammoth Lakes	Public Works, Information Technology	Mid-term
10.4	Work with federal agencies to transfer privately owned properties in avalanche hazard zones that are adjacent to or on public lands into federal ownership or into the ownership of land conservation organizations, and restrict their use to permanent open space use.	Mono County, Town of Mammoth Lakes	Community Development	Long-term
Dam Inundation				
11.1	Be aware of the dams in the County with condition assessment of fair or lower, and be prepared to respond to public health and safety needs in the event of an emergency.	Mono County	Public Works	Short-term
11.2	Work with owners of dams in the County to update information on the potential impacts and inundation areas in the case of dam failure. Develop land use standards and emergency response standards based on that information.	Mono County	Community Development, Sheriff's Office	Mid-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
Hazardous Waste				
12.1	Establish multiple sites for free or low-cost disposal of hazardous household wastes, including electronic waste.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
12.2	Support and publicize propane tank exchange and recycle programs.	Mono County, Town of Mammoth Lakes	Public Works	Mid-term
12.3	Support public information and enforcement of standards for proper installation and storage of propane tanks.	Mono County, Town of Mammoth Lakes	Community Development	Ongoing
Disease and Pest Management				
13.1	Continue to monitor the status of infectious diseases in Mono County, and issue public health alerts for diseases that are new to the area or are becoming more widespread.	Mono County	Public Health	Ongoing
13.2	Continue to monitor for agricultural diseases and pests, and take appropriate steps to contain or eradicate these diseases and pests.	Mono County	Inyo and Mono Agriculture Department	Ongoing
13.3	Practice Integrated Pest Management strategies on public landscapes, emphasizing a preventive approach and minimizing the use of chemicals.	Mono County, Town of Mammoth Lakes	Community Development, Public Works	Mid-term

Table 5.1 Plan Hazard Measures

Measure Number	Measure	Applicability	Responsible Department	Timeline*
*(Measures that are the High Priority for this MJHMP period are shown in **bold**.* *Mitigation measures that can provide for long-term reduction in risk to life and property are rows highlighted in blue; the intent of highlighting these measures is to assist staff in determining which measures to apply for FEMA mitigation grant funding when it becomes available.)*				
13.4	Conduct periodic educational campaigns through in-person events and various types of media to encourage community members to remove standing water and practice other mosquito prevention strategies.	Mono County, Town of Mammoth Lakes	Public Health, Police, Fire, and EMS	Mid-term
13.5	Support efforts by the U.S. Forest Service, the Bureau of Land Management, and other landowners to control or eradicate invasive and/or abnormally active forest pests.	Mono County, Town of Mammoth Lakes	Community Development	Ongoing
Wildlife Collisions				
14.1	Work with Caltrans to conduct an analysis of frequent collision areas to determine type and placement of appropriate wildlife crossings. Seek funding to implement proposed wildlife crossing projects.	Mono County	Community Development, Public Works	Mid-term
Climate Change				
15.1	Reevaluate changes to hazards and risks as a result of climate change every five years based on more current available information, and revise the LHMP to account for new information.	Mono County, Town of Mammoth Lakes	Community Development, Public Health	Short-term
*For Timeline: Short-term = 1-2 years Mid-term = 3 years Long-term – 4-5 years Ongoing = 1-2 years and ongoing thereafter				

5.2.1 Secondary Access Assessment

As discussed in **Chapters 2** and **7** of this Plan, both the unincorporated County and the Town of Mammoth Lakes have a number of neighborhoods and entire communities that have only one access route connecting them to community amenities, emergency services, and primary roadways. **Figure 2.8** in **Chapter 2** identifies all communities and neighborhoods without secondary access to major access roads. Many of these communities are threatened by one or more hazards. Developing secondary access routes is typically constrained by the presence of hazard zones and steep slopes, as well as procedural onus associated with establishing right-of-way on land owned by multiple private and public entities.

Based on input from the Mono County Board of Supervisors, Department of Public Works, and the community planning process, the Planning Team identified six communities for which to conduct more detailed analyses of opportunities and constraints in providing secondary access routes or other measures to reduce risk during a hazard event. These six communities and neighborhoods are:

- Swall Meadows; accessed by Swall Meadows Road
- Crowley Lake; neighborhoods accessed by Pearson Road (Lakeridge Ranch Estates)
- McGee Creek; neighborhoods accessed by Gregory Lane
- June Lake; neighborhoods accessed by Rainbow Street (Petersen Tract)
- Chalfant; neighborhoods accessed by Chalfant Road
- Chalfant; neighborhoods accessed by Tungsten Road (White Mountain Estates)

The following analyses in **Tables 5.2** through **5.7** are intended to support implementation efforts of Mitigation Measure 1.6.

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Table 5.2 Swall Meadows Community Secondary Access Assessment

Single Access Road: Swall Meadows Road
Existing Conditions
Swall Meadows is a residential community which includes second homes and a volunteer fire department, but no commercial development. Located in the Wheeler Crest Community Planning Area, it sits partway up the Sherwin Grade below the Wheeler Crest of the eastern Sierra Nevada. The community's single-access road is Swall Meadows Road, which in turn can only be accessed via Lower Rock Creek Road (aka Old Sherwin Grade Road). Lower Rock Creek Road connects to CA 395 to the north and to another small community, Tom's Place, and CA 395 to the south. The area contains approximately 106 homes and 146 structures. The population was reported as 194 in the 2016 American Community Survey 5-year estimates. As of mid-2018, a local CWPP for the Swall Meadows community is under development. This plan may provide additional analysis of potential access and secondary road siting options.
Land Ownership and Slope Conditions
Swall Meadows contains privately owned lots, most less than a quarter acre with single-family homes off of small cul-de-sacs. Land surrounding the community is owned by U.S. Forest Service, Bureau of Land Management, and LADWP. Slopes surrounding the community vary from 5 percent to over 20 percent with the steepest grades to the west toward Wheeler Crest Peak and along Rock Creek, running northwest of the community and south of CA 395. See details in **Figure 5.1** below.

Table 5.2 Swall Meadows Community Secondary Access Assessment

Single Access Road: Swall Meadows Road

Figure 5.1: Swall Meadows Community Secondary Access Analysis – Slopes and Land Ownership

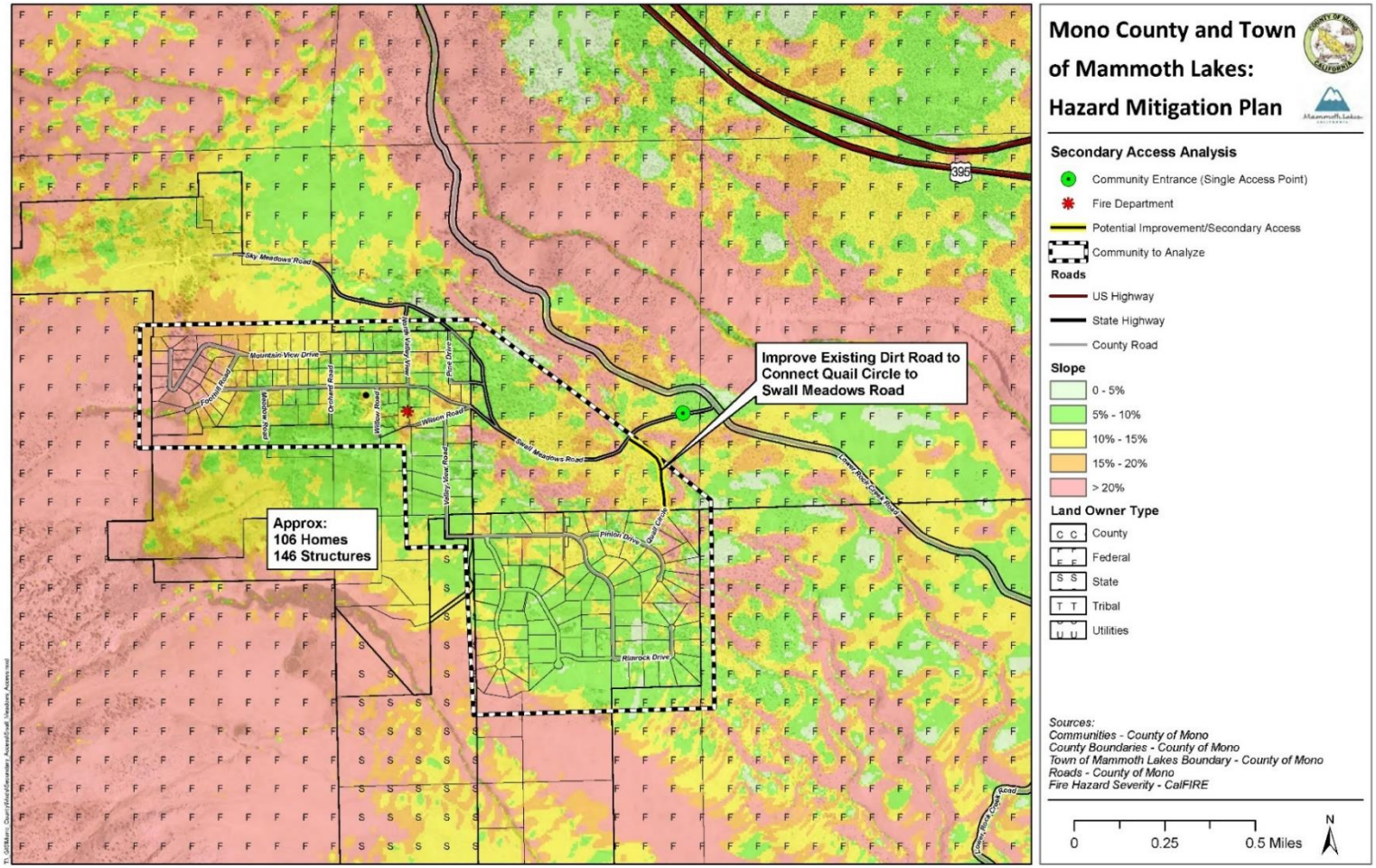


Table 5.2 Swall Meadows Community Secondary Access Assessment

Single Access Road: Swall Meadows Road
Hazard Conditions
The priority hazard posing greatest risk to the community is wildfire. The community itself is located in a Moderate Fire Hazard Severity Zone but is adjacent to High Fire Hazard Severity Zones. The community has also been threatened by a number of fires in the past and was directly in the path of the 2015 Round Fire, which burned 7,000 acres and many of the structures in the community. Portions of the community are also located within an Alquist-Priolo fault zone. Structures and infrastructure in the fault zone are at high risk of significant damage in the case of an earthquake. See details in **Figure 5.2** below.

Table 5.2 Swall Meadows Community Secondary Access Assessment

Single Access Road: Swall Meadows Road

Figure 5.2: Swall Meadows Community Secondary Access Analysis – Fault and Fire Zones

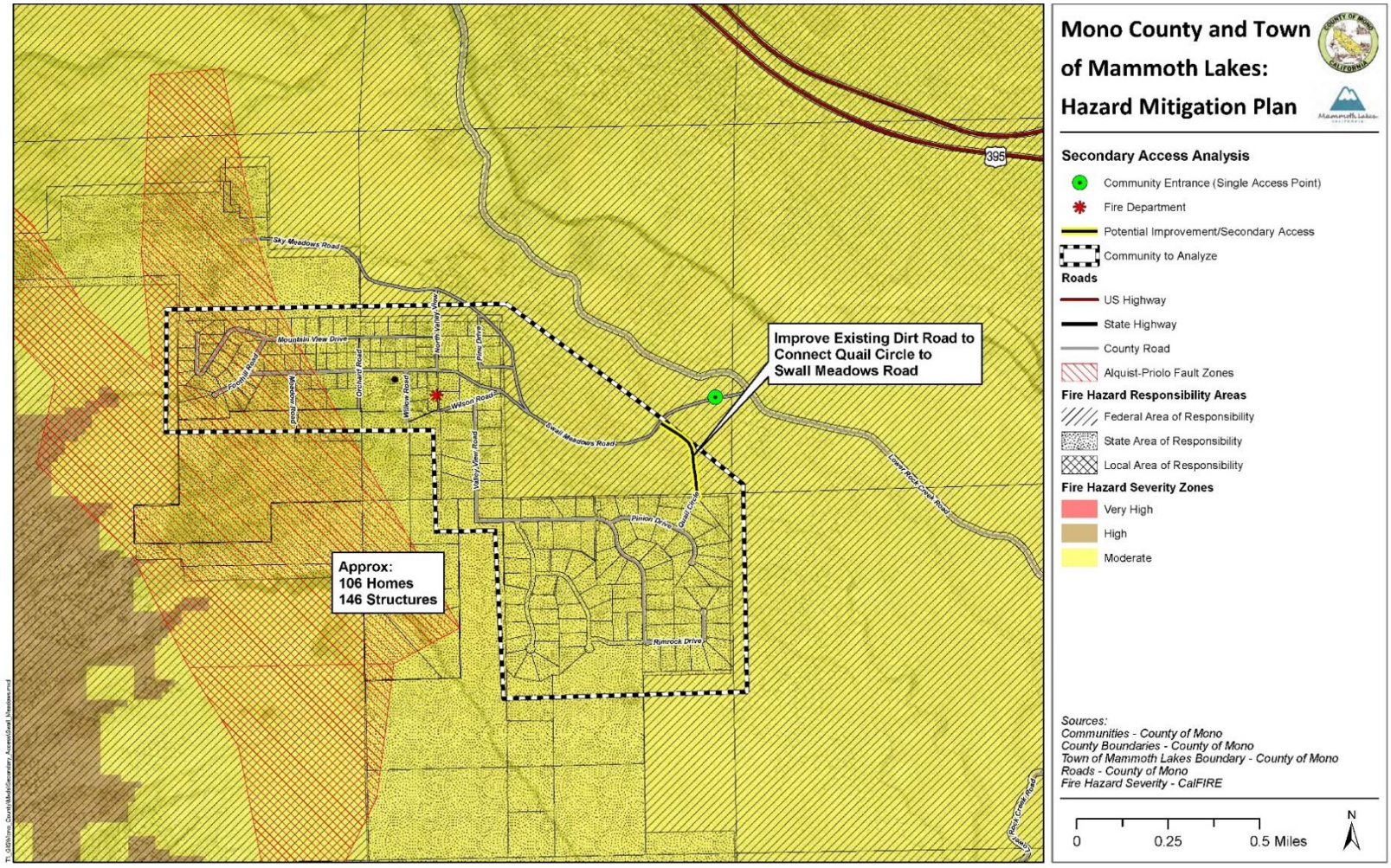


Table 5.2 Swall Meadows Community Secondary Access Assessment

Single Access Road: Swall Meadows Road	
Secondary Access and Risk Reduction Options	
Local topography and hazard conditions offer few options, none of which are ideal. The preferred secondary access route—which was identified with community input, has been reviewed by the Mono County Public Works Department, and has the support of the Wheeler Crest Fire Safe Council and Fire Department—would extend from Quail Circle to Swall Meadows Drive, just before it connects to Lower Rock Creek Road. Because this final 1,300-foot stretch doubles up with the existing access route, it is possible for a hazard event right at Swall Meadows Drive and Lower Rock Creek Road to block both routes. For this reason, the Planning Team added Mitigation Measure 1.11 to the Plan to identify or create sheltering locations within communities with limited options for access routes. See below for additional strengths and constraints of this route. Other access routes to serve Swall Meadows were considered and rejected during the planning process. One such route would have improved an existing dirt road that connects to a section of Lower Rock Creek Road farther south at Paradise. The access route would extend roughly 2.5 miles through a steep gully. Had evacuees used this route during the Round Fire in 2015, they could have been trapped in the canyon. Steep grades make additional roadway connections directly to CA 395 potentially difficult and costly. Another unnamed dirt road extends from Sky Meadow Road to US 395 near Tuff Campground, but this 4.5-mile route is extremely long and winding.	
Strengths	**Constraints**
• By utilizing an existing dirt road, development of the secondary access route may be more cost effective and reduce impacts on the visual and natural resources of the immediate area. • The proposed route avoids steeper slopes that surround the area. • The proposed route has undergone a preliminary feasibility study by Mono County Department of Public Works. • The route has strong support from local leaders and community members.	• The plan doubles the existing access route for the final 1,300 feet of Swall Meadows Drive. • The route would require an easement through Lot 5 and/or Lot 6 on Quail Circle. • The 10–15-foot elevation difference at Swall Meadows Drive would likely require an engineered earthwork ramp. • An 8.6 percent grade would require switchbacks to meet Cal Fire requirements for fire trucks. A topographic survey is needed to create road design.

Table 5.3 Crowley Lake Community Secondary Access Assessment

Single Access Road: Pearson Road (Lakeridge Ranch Estates)
Existing Conditions
The Crowley Lake community is located 12 miles south of the Town of Mammoth Lakes and encompasses both a residential community and the Crowley Lake ballfields. Pearson Road is the sole access point to the easternmost neighborhood, located north of Crowley Lake Drive, south of CA 395, and east of Whisky Creek. There are 32 homes and 35 additional structures in the neighborhood with single roadway access.
Land Ownership and Slope Conditions
The single access neighborhood includes residences, accessory buildings, and the Crowley Lake ballfields. Land surrounding the community is federally owned. Slopes surrounding the community vary from 5 percent to over 20 percent with the steepest grades to the north, west, and south. See details in **Figure 5.3** below.

Table 5.3 Crowley Lake Community Secondary Access Assessment

Single Access Road: Pearson Road (Lakeridge Ranch Estates)

Figure 5.3: Crowley Lake Community Secondary Access Analysis – Slopes and Land Ownership

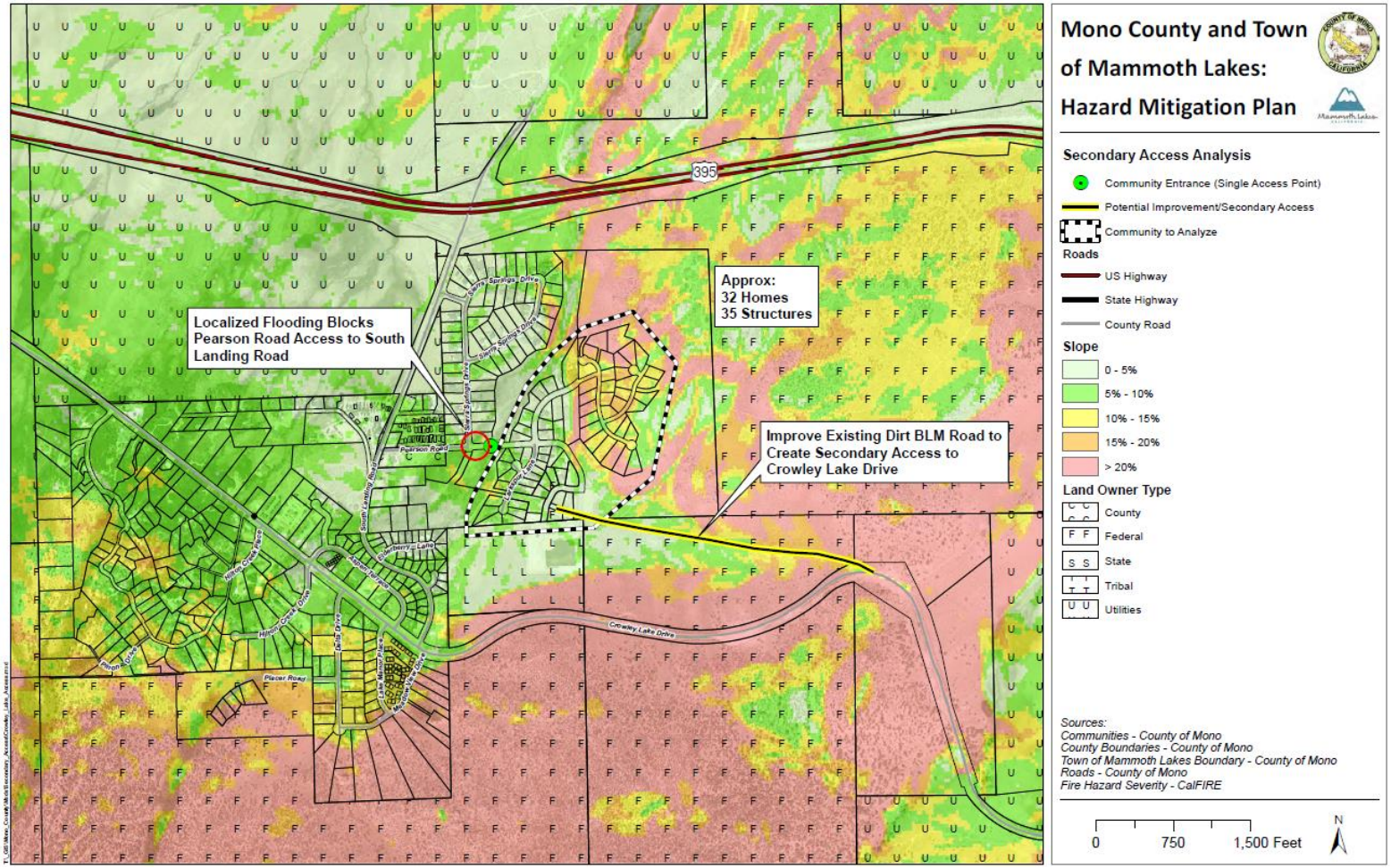


Table 5.3 Crowley Lake Community Secondary Access Assessment

Single Access Road: Pearson Road (Lakeridge Ranch Estates)
Hazard Conditions
The priority hazards posing greatest risk to the community are wildfire and local flooding. The community itself is located in a High Fire Hazard Severity Zone and is adjacent to Moderate Fire Hazard Severity Zones. Severe wind is also of concern in Crowley Lake, which can increase the magnitude of fires when they do occur. Portions of the community are located in a DWR Awareness Floodplain. Structures and infrastructure in the Awareness Floodplain have not been officially mapped under the FEMA NFIP, but could be at high risk of significant damage in the case of flooding. Localized flooding, which is not identified through FEMA's mapping program, is also known to affect portions of Pearson Road and inhibit access to South Landing Road. See details in **Figure 5.4** below.

Table 5.3 Crowley Lake Community Secondary Access Assessment

Single Access Road: Pearson Road (Lakeridge Ranch Estates)

Figure 5.4: Crowley Lake Community Secondary Access Analysis – Fire and Flood Zones

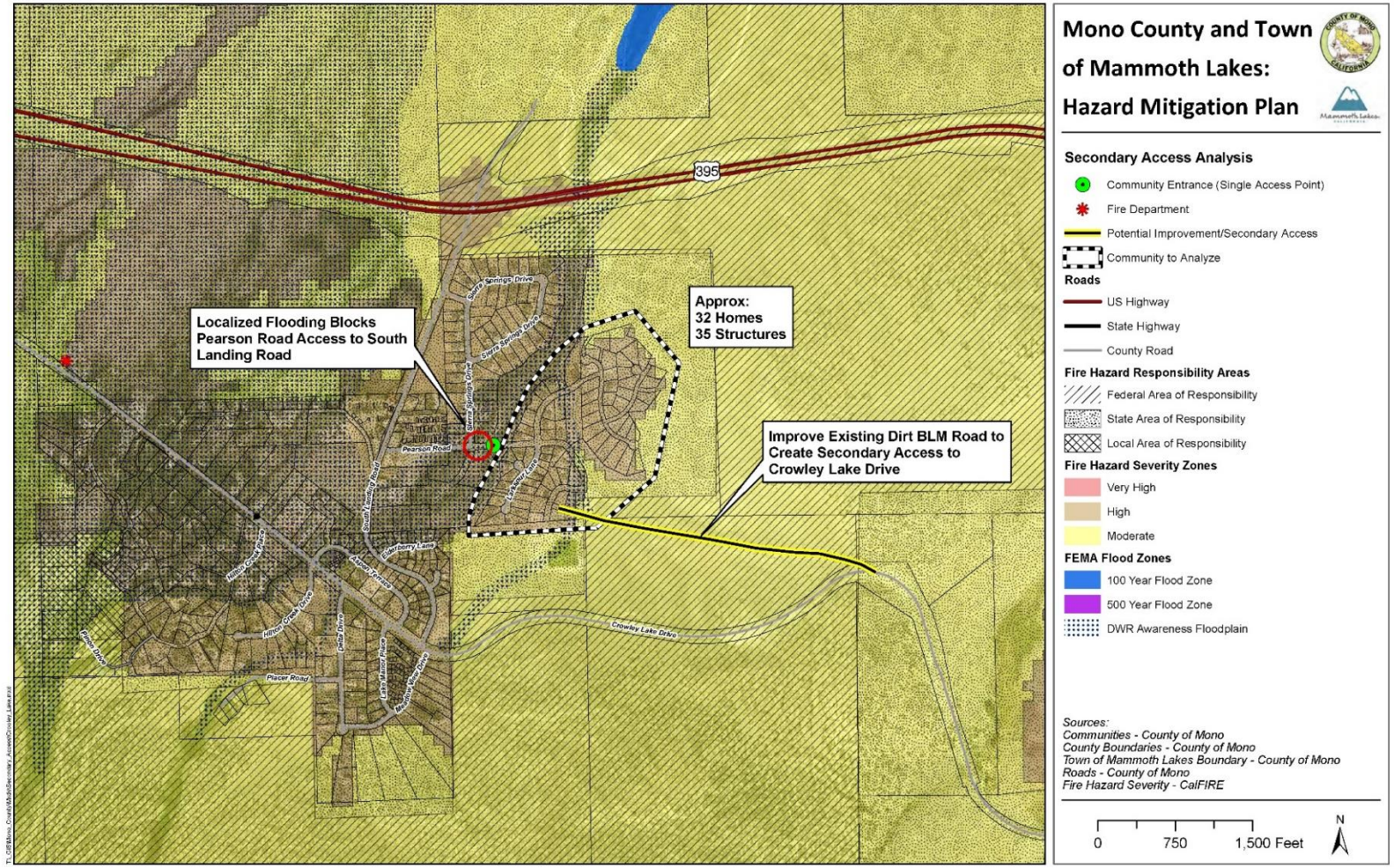


Table 5.3 Crowley Lake Community Secondary Access Assessment

Single Access Road: Pearson Road (Lakeridge Ranch Estates)	
Secondary Access and Risk Reduction Options	
A secondary access route could be developed by improving an existing dirt road utilized by the Bureau of Land Management, located north of Crowley Lake ballfields and connecting to Crowley Lake Drive to the east.	
Strengths	**Constraints**
• By utilizing an existing dirt road, development of the secondary access route may be more cost effective and reduce impacts on the visual and natural resources of the immediate area. • The proposed route avoids steeper slopes that surround the area. • The proposed route does not require an easement or eminent domain process of private property.	• The proposed secondary access route, which follows an existing dirt road connecting south Pearson Road to Crowley Lake Road, would require crossing federal land. • Although the proposed secondary access route avoids the steepest slopes in the area, it still must cross small sections with slope greater than 20 percent. • Although the proposed route provides secondary access leading out from a separate area of the community, it does not connect back to CA 395, a primary access road.

Table 5.4 McGee Creek Community Secondary Access Assessment

Single Access Road: Gregory Lane
Existing Conditions
The McGee Creek community is located on the southwestern side of Lake Crowley, south of CA 395. The community's single-access road is Gregory Lane, which in turn can only be accessed via Crowley Lake Drive. Crowley Lake Drive connects to CA 395 via McGee Creek Road north of the Crowley Lake community. The neighborhood with sole roadway access contains 15 homes, which are all privately owned, as well as 15-plus structures.
Land Ownership and Slope Conditions
The Gregory Lane area contains privately owned lots, most less than a quarter acre with single-family homes off of small cul-de-sacs. Land surrounding the community is owned by the Bureau of Land Management. Slopes on the side of the community connected back to the primary access route of CA 395 are generally moderate and vary from 5 percent to 15 percent. Steeper grades are located at the southern portion of the community and northwest of McGee Creek. See details in **Figure 5.5** below.

Table 5.4 McGee Creek Community Secondary Access Assessment

Single Access Road: Gregory Lane

Figure 5.5: McGee Creek Community Secondary Access Analysis – Slopes and Land Ownership

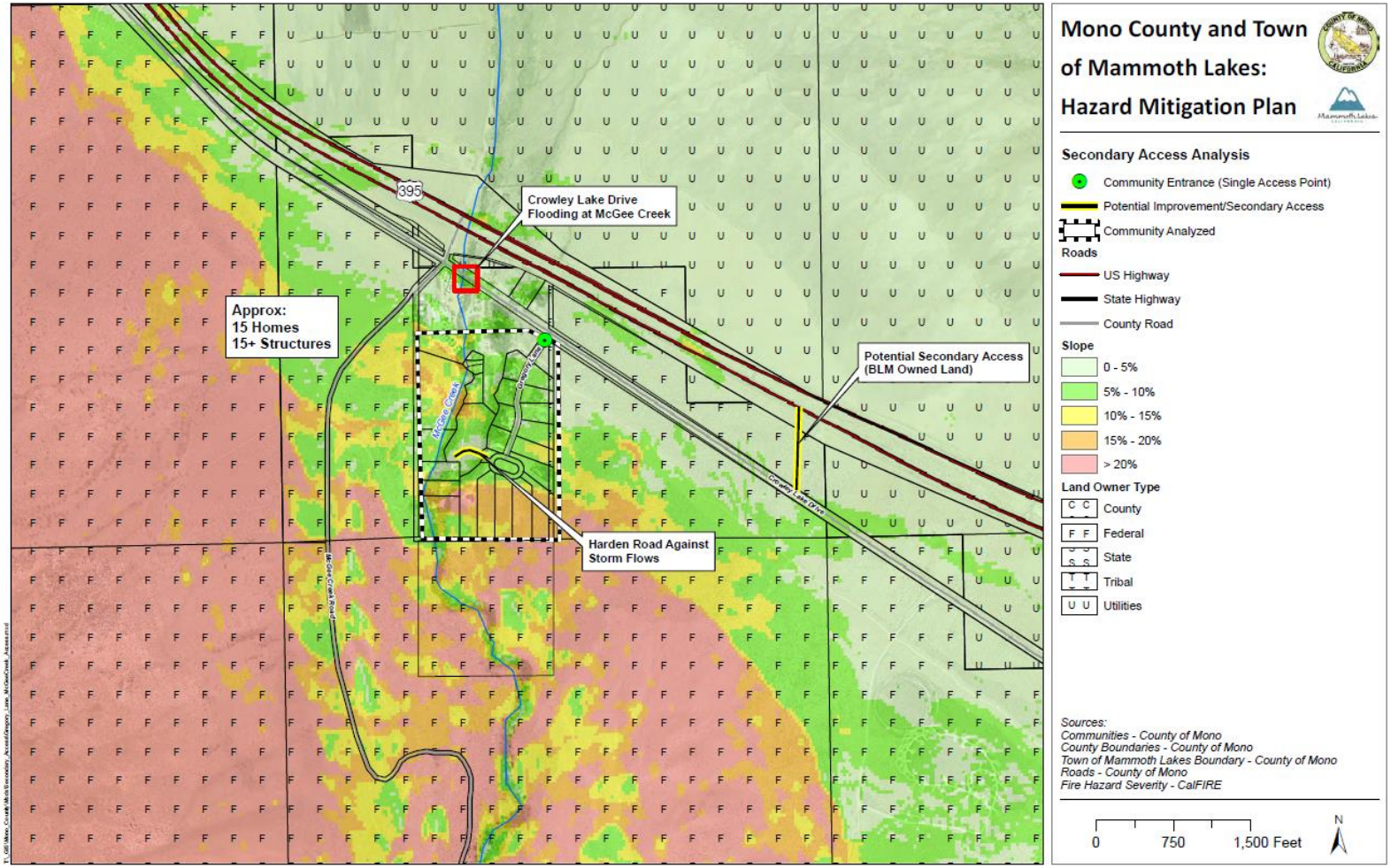


Table 5.4 McGee Creek Community Secondary Access Assessment

Single Access Road: Gregory Lane
Hazard Conditions
The priority hazards posing greatest risk to the community are flood and wildfire. The community itself is located in a High Fire Hazard Severity Zone and is surrounded by Moderate Fire Hazard Severity Zones. Portions of the community are also located in a DWR Awareness Floodplain as well as the 100-year flood zone, including sections of Gregory Lane, which frequently floods and occasionally washes out, cutting off a number of residential properties from access to Crowley Lake Drive and CA 395. In severe flooding, Crowley Lake Drive could be entirely cut off from CA 395. Structures and infrastructure in the Awareness Floodplain have not been officially mapped under the FEMA NFIP, but could be at high risk of significant damage in the case of flooding. See details in **Figure 5.6** below.

Table 5.4 McGee Creek Community Secondary Access Assessment

Single Access Road: Gregory Lane

Figure 5.6: McGee Creek Community Secondary Access Analysis – Fire and Flood Zones

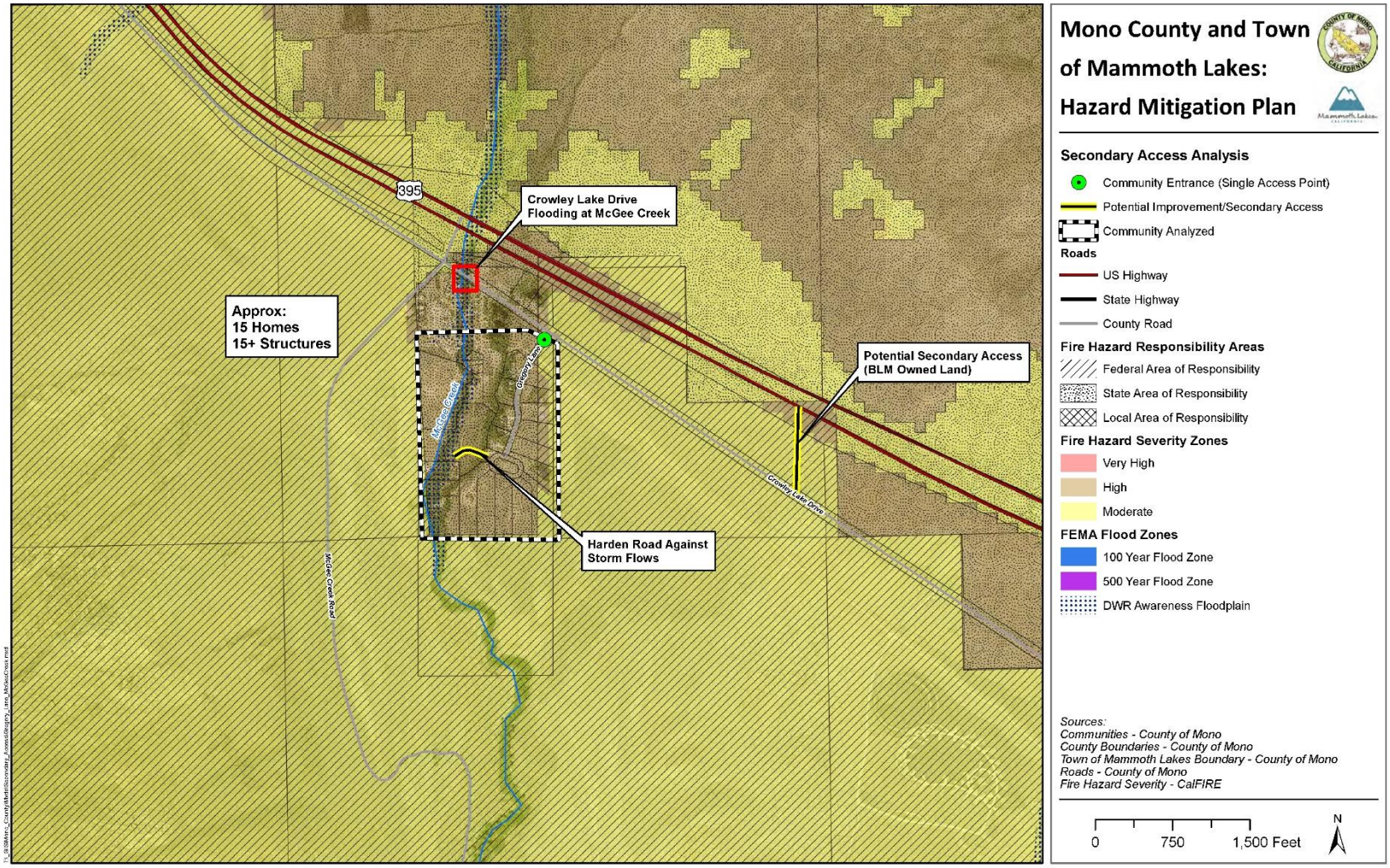


Table 5.4 McGee Creek Community Secondary Access Assessment

Single Access Road: Gregory Lane	
Secondary Access and Risk Reduction Options	
A secondary access route could be developed on BLM land by improving an existing dirt road that connects Crowley Lake Drive to CA 395 southeast of Gregory Lane. Additionally, the portion of Gregory Lane connecting to American Way, the section most frequently affected by flooding, could be hardened by installing flood walls or by raising the entire section out of the flood awareness zone.	
Strengths	**Constraints**
• By utilizing an existing dirt road, development of the secondary access route may be more cost effective and reduce impacts on the visual and natural resources of the immediate area. • The proposed secondary route avoids steeper slopes. • The proposed secondary route does not require an easement or eminent domain process of private property. • The proposed secondary route provides access to CA 395 to the south even if Gregory Lane, American Way, and Crowley Lake Drive are all affected by flooding on the creek. • The proposed hardening of Gregory Lane does not require any easements or eminent domain process.	• The proposed secondary access route, which follows an existing dirt road connecting south to Crowley Lake Drive, would require crossing federal land.

Table 5.5 June Lake Community Secondary Access Assessment

Single Access Road: Rainbow Street/Petersen Tract
Existing Conditions
The Petersen tract area is located south of CA 158 and west of the June Mountain Ski Area. There are 140 homes in this neighborhood, as well as a few commercial uses and an overnight lodge. The community's single access road is Rainbow Street, which in turn can only be accessed by CA 158. In 2005, the County authorized a Capital Facilities Plan by Service Category study for the June Lake Village area to be performed by Stantec. As a portion of this study, Stantec identified possible improvements to the roadway network to improve traffic flow and access, including in the Petersen tract. The study was evaluated as part of this assessment. The study produced similar but not identical proposed access route options based on a different set of evaluator parameters. Both this assessment and the Stantec study should be considered in making ultimate project decisions.
Land Ownership and Slope Conditions
The single-access neighborhood is predominantly privately owned residential lots, with select commercial uses organized in a modified grid layout with some streets leading to dead-ends rather than connecting through. Land surrounding the community is federally owned. Slopes surrounding the community vary from 5 percent to over 20 percent with the steepest grades in the southwest corner of the neighborhood to the west of Jessie Street. See details in **Figure 5.7** below.

Table 5.5 June Lake Community Secondary Access Assessment

Single Access Road: Rainbow Street/Petersen Tract

Figure 5.7: June Lake Community Secondary Access Analysis – Slopes and Land Ownership

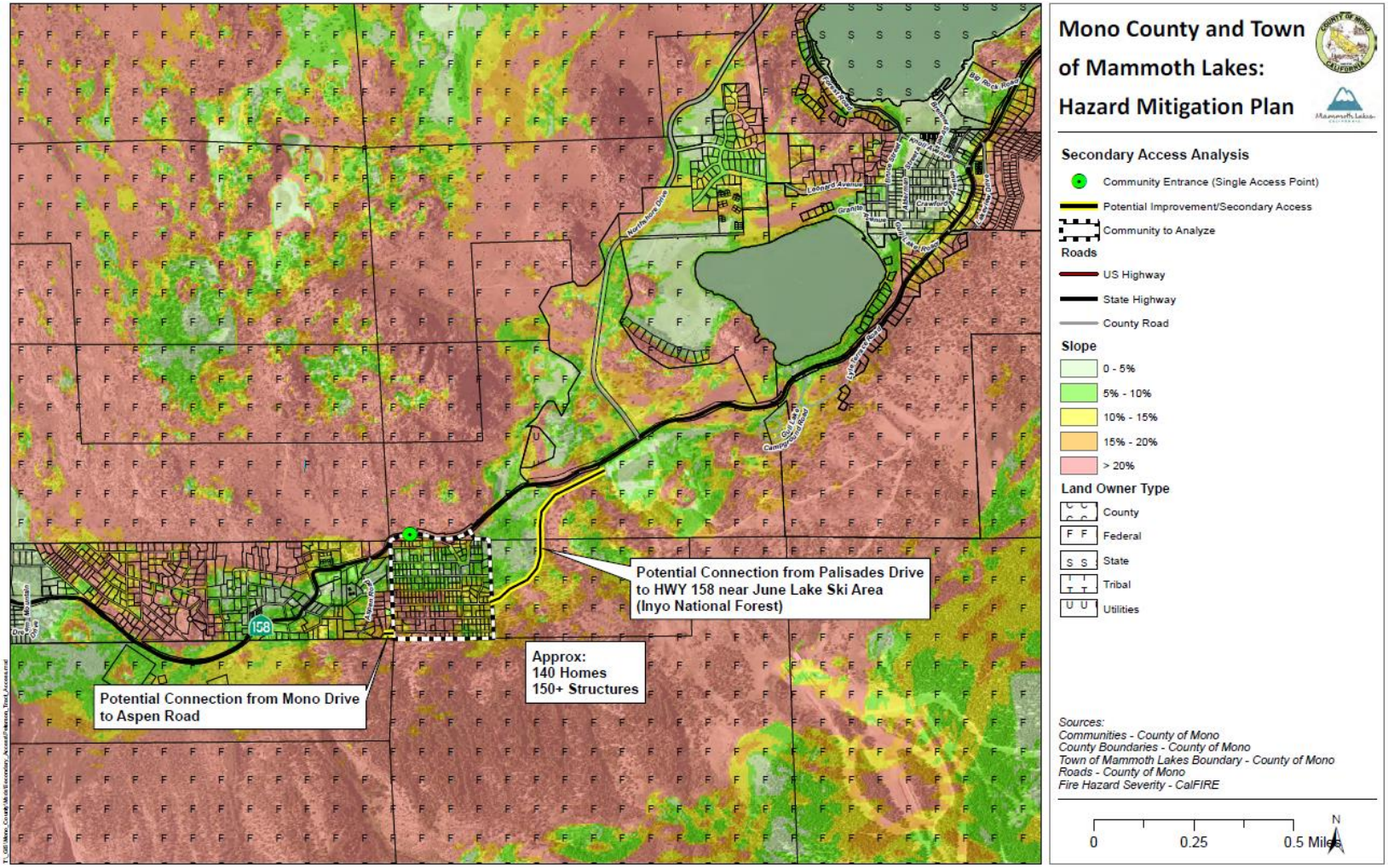


Table 5.5 June Lake Community Secondary Access Assessment

Single Access Road: Rainbow Street/Petersen Tract
Hazard Conditions
The priority hazard posing the greatest risk to the community is wildfire. The community itself is located in a Very High Fire Hazard Severity Zone and is adjacent to Moderate Fire Hazard Severity Zones. Severe wind is also of concern in June Lake, which can increase the magnitude of fires when they do occur. The community also has several creeks running through that are within the 100-year flood zone. A 100-year flood event could cut off much of the subdivision from CA 158. The community is not located within an Alquist-Priolo fault zone, but is within the vacinity of a few Alquist-Priolo fault zones. Structures and infrastructure near fault zones are at risk of damage in the case of an earthquake. See details in **Figure 5.8** below.

Table 5.5 June Lake Community Secondary Access Assessment

Single Access Road: Rainbow Street/Petersen Tract

Figure 5.8: June Lake Community Secondary Access Analysis – Fault, Fire and Flood Zones

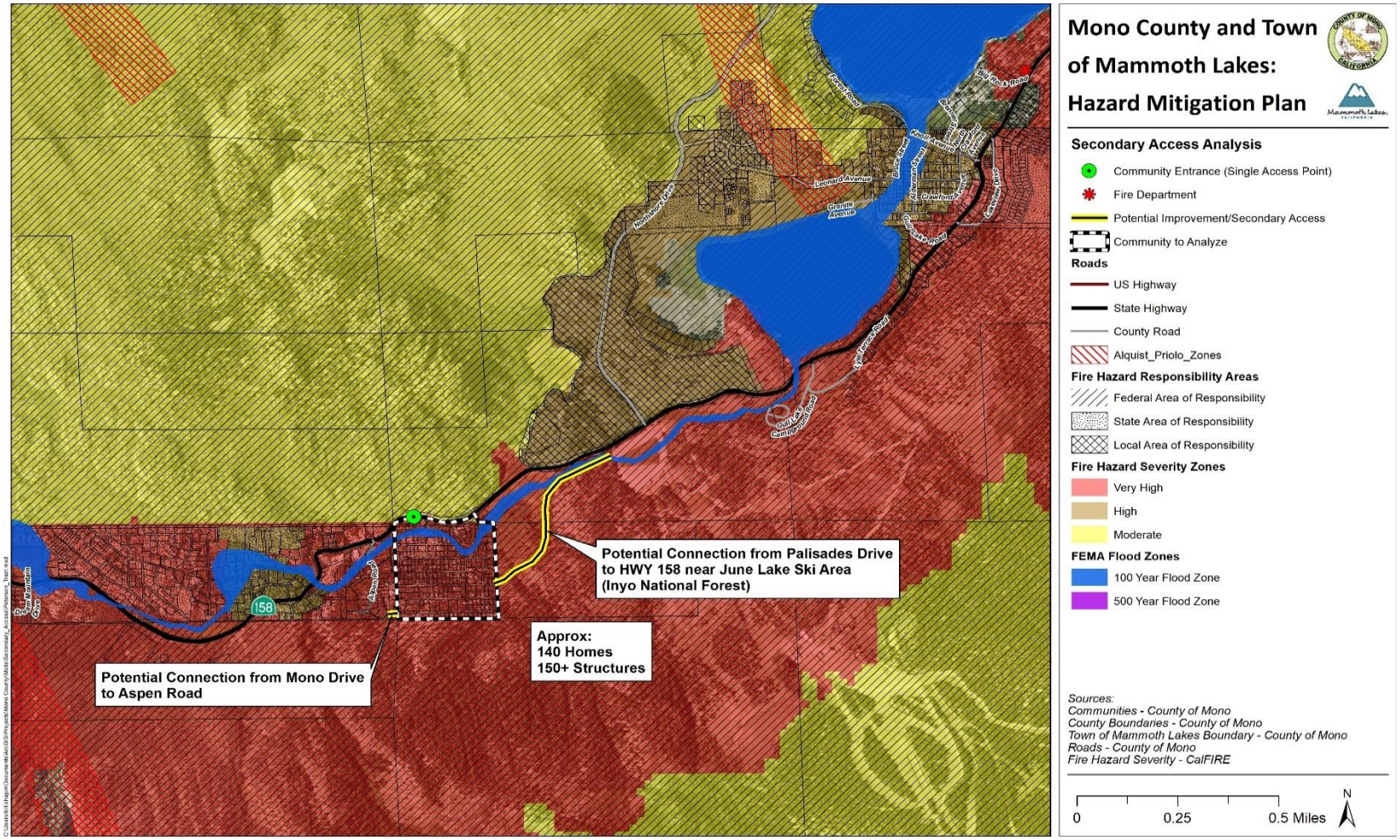


Table 5.5 June Lake Community Secondary Access Assessment

Single Access Road: Rainbow Street/Petersen Tract	
Secondary Access and Risk Reduction Options	
Two secondary access routes could be developed for this neighborhood. The first could extend Mono Drive to connect with Aspen Road to the west, and the second could extend Palisades Drive to CA 158 near the June Lake Ski Area to the northeast. The Mono Drive connection would occur on County-owned land, and the Palisades Drive extension would occur on federally owned land. Both routes would need to be designed to be elevated above the 100-year floodplain at Reversed Creek.	
Strengths	**Constraints**
• The proposed routes run alongside, but generally avoid, steeper slopes that surround the area. • The proposed routes would provide two additional access routes to the southern portion of the community. • The proposed routes connect to CA 158 near the connection with Northshore Drive, which provides more direct exit from High and Very High Hazard Severity Fire Zones.	• The proposed secondary access routes do not follow any existing dirt routes and would require crossing federal land. • The proposed secondary access routes are not existing roads and therefore would require higher utilization of resources and have potential impacts to environmental and visual resources. • The proposed routes may require an easement or eminent domain process of private property.

Table 5.6 Chalfant (West) Community Secondary Access Assessment

Single Access Road: West Chalfant Road
Existing Conditions
The West Chalfant community is located near Chalfant Valley on the western side of CA 6. It includes 67 homes, as well as some small-scale agricultural uses. Chalfant Road is the sole access point for the community, connecting at the northeastern corner and running south before terminating.
Land Ownership and Slope Conditions
West Chalfant contains privately owned lots with single-family homes arranged in cul-de-sacs. Land surrounding the community is owned by federal agencies to the west and south, and LADWP to the north and east. Slopes surrounding the community are mild, with most being less than 5 percent. The southwestern corner has slopes of 5–10 percent. See details in **Figure 5.9** below.

Table 5.6 Chalfant (West) Community Secondary Access Assessment

Single Access Road: West Chalfant Road

Figure 5.9: Chalfant (West) Community Secondary Access Analysis – Slopes and Land Ownership

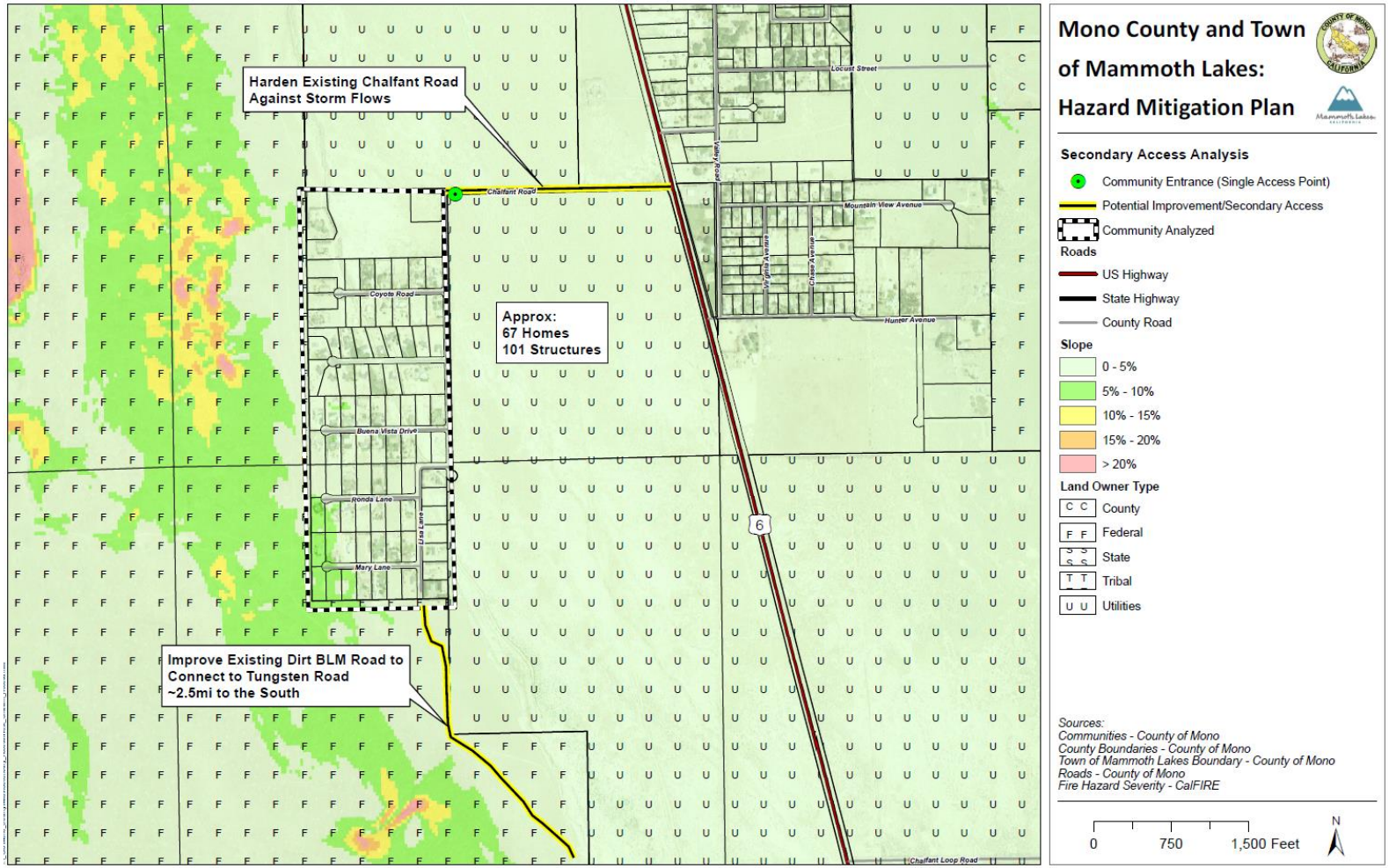


Table 5.6 Chalfant (West) Community Secondary Access Assessment

Single Access Road: West Chalfant Road
Hazard Conditions
The priority hazard posing greatest risk to the community is flooding. More than half of the community is located in the 100-year flood zone, and the rest is located in a DWR Awareness Floodplain. Small portions of the community are also located within the 500-year floodplain. Much of the primary emergency access road CA 6 is also located within the 100-year or 500-year floodplain within several miles of the community, and is subject to occasional closure from flooding and debris. In such events, access out of the community is entirely impractical and alternative methods of shelter in place options would be required. The community is not located within an Alquist-Priolo fault zone, but is within the vacinity of a Alquist-Priolo fault zone. Structures and infrastructure near a fault zone are at risk of damage in the case of an earthquake. See details in **Figure 5.10** below.

Table 5.6 Chalfant (West) Community Secondary Access Assessment

Single Access Road: West Chalfant Road

Figure 5.10: Chalfant (West) Community Secondary Access Analysis – Fault, Fire and Flood Zones

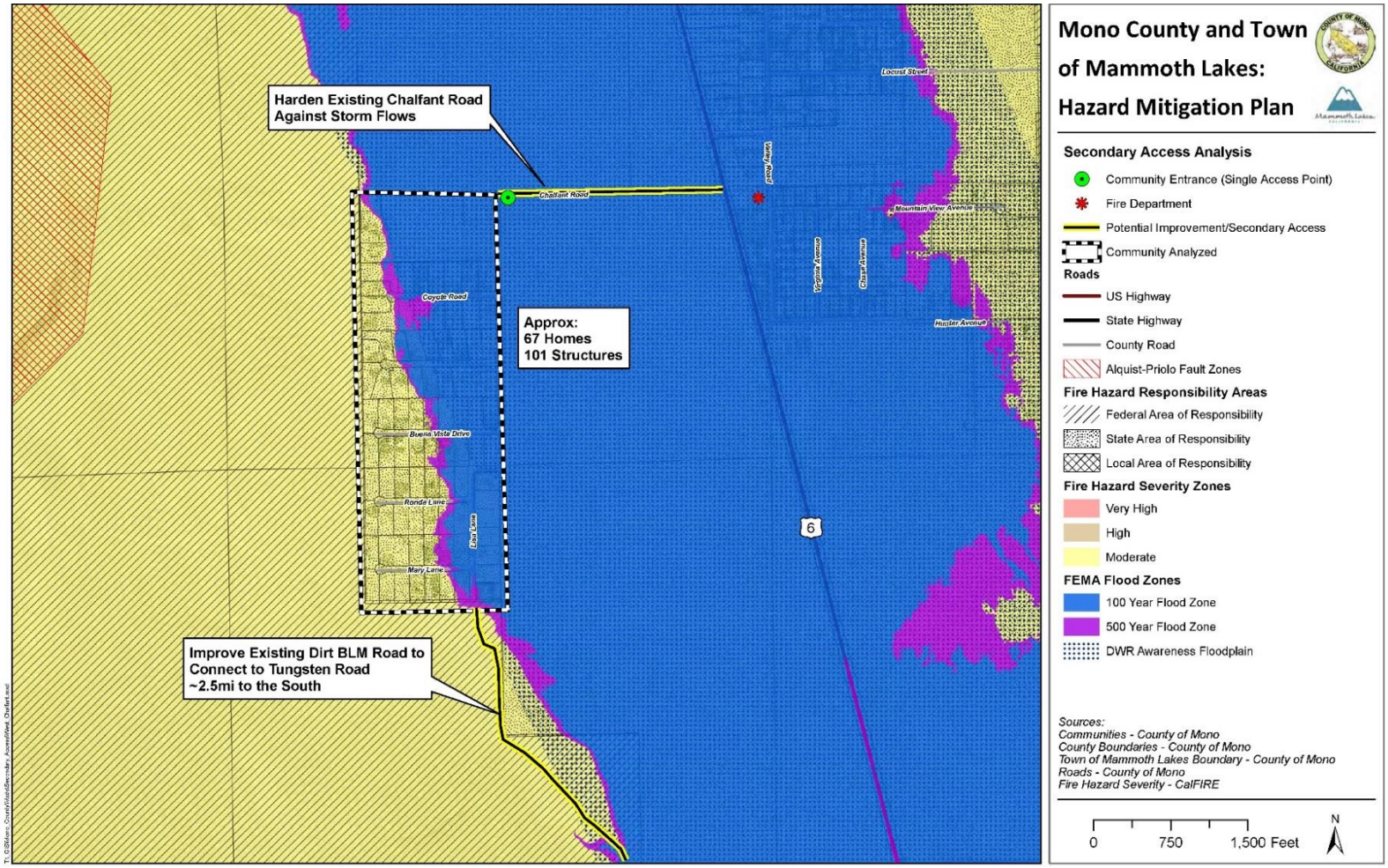


Table 5.6 Chalfant (West) Community Secondary Access Assessment

Single Access Road: West Chalfant Road	
Secondary Access and Risk Reduction Options	
A secondary access route could be developed by improving an existing dirt road that connects to the southeastern corner of the community. The access route would extend roughly 2.5 miles to the south and connect to Tungsten Road. Additionally, Chalfant Road could be improved to better withstand flooding and storm surges.	
Strengths	**Constraints**
• By utilizing an existing dirt road, development of the secondary access route may be more cost effective and reduce impacts on the visual and natural resources of the immediate area. • The proposed route does not require an easement or eminent domain process of private property.	• The proposed secondary access route would require crossing land owned by LADWP. • Although the proposed route provides secondary access leading out from a separate area of the community, it does not connect back to CA 6, the primary access road. • In the event that Chalfant Road is flooded, it is possible that the primary access road, CA 6, would also be flooded.

Table 5.7 Chalfant (White Mountain Estates) Community Secondary Access Assessment

Single Access Road: Tungsten Road
Existing Conditions
White Mountain Estates is located east of CA 6, south of Chalfant Valley. It is composed predominantly of privately owned residential lots, with 42 homes.
Land Ownership and Slope Conditions
White Mountain Estates contains privately owned lots with single-family homes in the western one-third of the community. The eastern two-thirds of the community is state-owned land. Land surrounding the community is owned by federal agencies to the north, east, and south, and LADWP to the west. Slopes surrounding the community range from less than 5 percent to more than 20 percent, although slopes on the west side of the community connecting back to the primary access road, CA 6, are generally less than 5 percent. Steeper slopes exist in the eastern region near the mountain range. See details in **Figure 5.11** below.

Table 5.7 Chalfant (White Mountain Estates) Community Secondary Access Assessment

Single Access Road: Tungsten Road

Figure 5.11: Chalfant (White Mountain Estates) Community Secondary Access Analysis – Slopes and Land Ownership

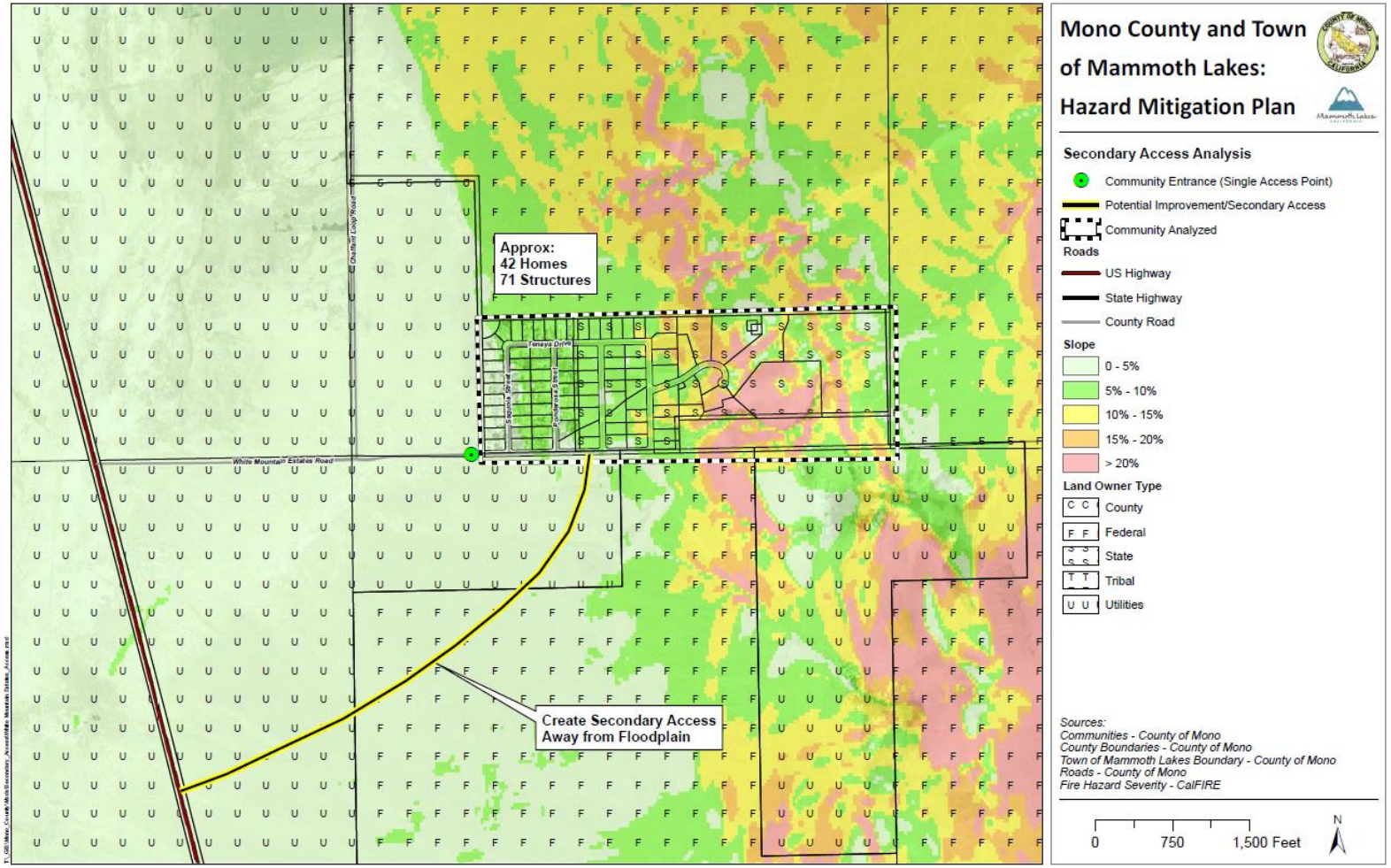


Table 5.7 Chalfant (White Mountain Estates) Community Secondary Access Assessment

Single Access Road: Tungsten Road
Hazard Conditions
The priority hazard posing the greatest risk to the community is flooding. The community is located outside of any flood zone, but Tungsten Road, its single access route (aka White Mountain Estates Road), is located within the 100-year flood zone. In a 100-year flood event, the community could therefore be cut off from the primary emergency access route, CA 6. Portions of the community are also located within an Alquist- Priolo fault zone. Structures and infrastructure in the fault zone are at high risk of significant damage in the case of an earthquake. See details in **Figure 5.12** below.

Table 5.7 Chalfant (White Mountain Estates) Community Secondary Access Assessment

Single Access Road: Tungsten Road

Figure 5.12: Chalfant (White Mountain Estates) Community Secondary Access Analysis – Fault, Fire and Flood Zones

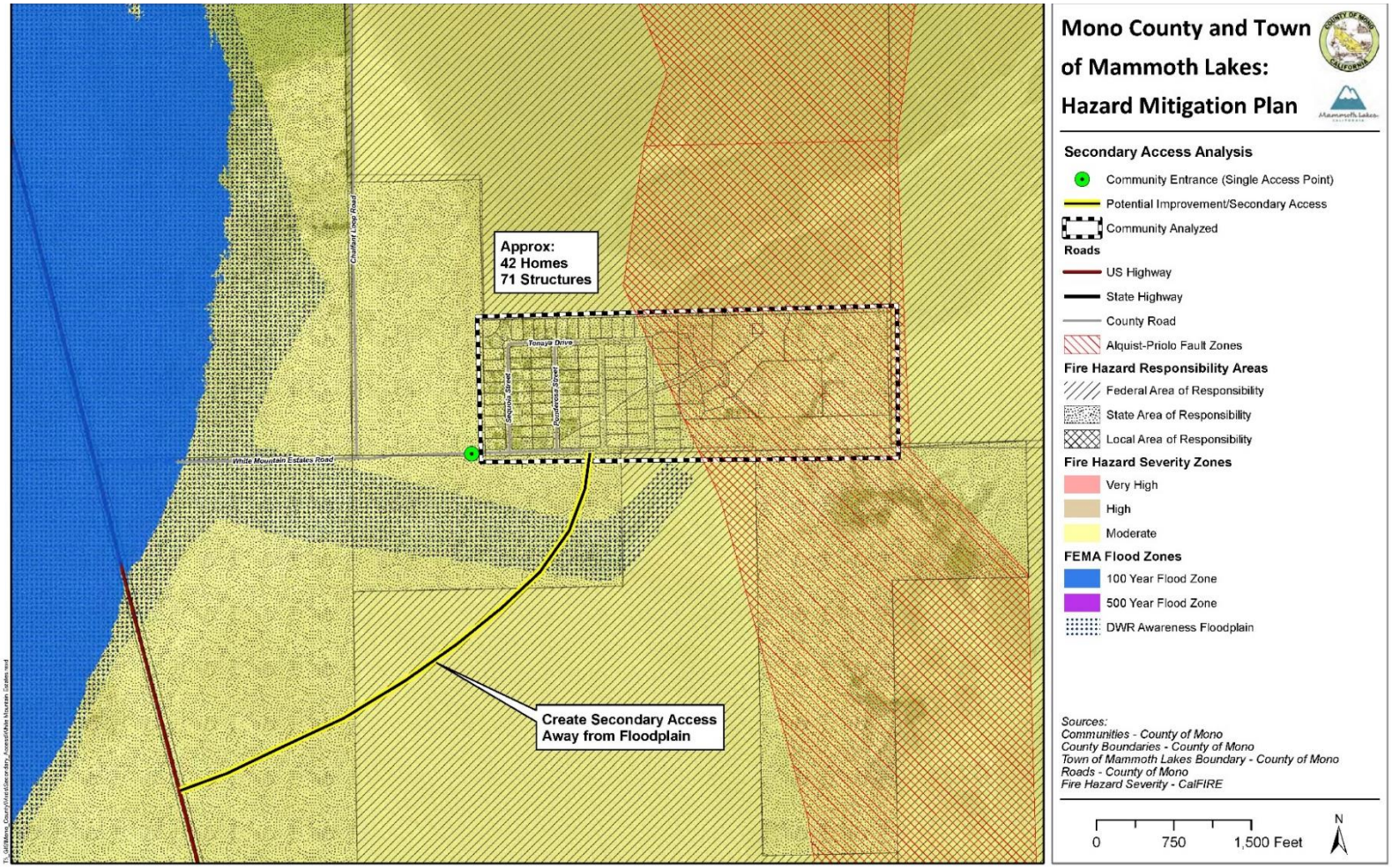


Table 5.7 Chalfant (White Mountain Estates) Community Secondary Access Assessment

Single Access Road: Tungsten Road	
Secondary Access and Risk Reduction Options	
A secondary access route could be developed on the south side of the community, connecting to CA 6 to the southwest. This route would pass through a DWR Awareness Floodplain but would be entirely outside the 100-year floodplain.	
Strengths	**Constraints**
• The proposed route does not require an easement or eminent domain process of private property. • The proposed route connects directly to CA 6 primary evacuation route. • The proposed route would pass through areas of little to no slope. • The proposed access route utilizes, in part, an existing dirt road.	• The proposed secondary access route would require crossing both federal and utilities land. • The proposed route would pass through a DWR Awareness Floodplain.

5.2.2 Shelter in Place

For many communities in Mono County, evacuation from a disaster may be infeasible or unneeded. For these locations and situations, having the ability to safely shelter in their homes or communities could be critical to avoiding injury or death. The Centers for Disease Control and Prevention (CDC) has a guide for planning care and shelter in the instance of natural disasters, including how to best develop shelter sites. Criteria for selecting ideal shelter sites include:

- Space for parking
- Space for sleeping (40 square feet per person)
- Toilet and shower facilities (one toilet per 40 people)
- Kitchen/cooking facilities
- Emergency generator on-site
- Safety features, such as fire extinguisher and sprinklers
- Building heating and cooling capacity
- Telephones
- Accessibility for people with disabilities
- Secured storage areas
- Separate rooms within the facility

Shelters should also consider space for the following:

- Registration area
- Shelter manager's office
- Health services area
- Food preparation or serving areas
- Recreation areas

Potential emergency shelter sites include schools, public facilities such as community centers or auditoriums, and religious congregations or meeting halls. The Mono County Health Department may also designate medical facilities such as hospitals and clinics as emergency shelter sites for those with high medical needs.

Resources for selecting a location and establishing an emergency shelter plan are provided by the CDC[3] and American Red Cross[4].

5.3 Capabilities Assessment

The capabilities assessment identifies existing resources the County and Town have that can support the hazard mitigation measures in this Plan. Existing resources include personnel, plans, public policy, and programs, as well as potential financial resources. This assessment helps determine the ability of Mono County and the Town of Mammoth Lakes to reduce damage from hazard events, providing a foundation to develop, consider, and prioritize future hazard mitigation measures. **Tables 5.8** and **5.9** present both personnel that are able to execute various aspects of the plan, and regulation which enable and enforce action. The potential financial resources are similar for the County and the Town and are therefore presented in a single table, **Table 5.10** (**Section 5.3.2**). The County has applicable Building Codes, General Plan policies, Subdivision Regulations, Capital Improvement Plan, and other regulatory development guidelines which enable it to provide specific support and expand upon and improve hazard mitigation activities throughout the County and in each of the unincorporated communities.

Mono County and the Town of Mammoth Lakes also participate in the NFIP. Additionally, the County and Town General Plans, Multi-jurisdictional Emergency Response Plan, and Disaster Recovery Plans provide additional authority. Since the publication of the previous plan, the County and Town have enforced floodplain management with the following actions:

- Incorporating into the Safety Element of the Mono County General Plan, and Public Health and Safety Element of the Mammoth Lakes General Plan, including updated flood area mapping and goals to reduce the potential for injury, property damage, and environmental damage from flooding.
- Providing a webpage and specific FEMA flood mapping information for the Tri-Valley area, where flooding is most frequent and communities most vulnerable. As part of this effort, community members have been encouraged to obtain a parcel-specific Floodplain Determination or inquire about existing Floodplain Determinations by contacting the County's Engineering Division.
- Upon receipt of updated digital FIRMs from FEMA, Mono County notified residents affected by any changes to the designation of flood-prone areas or SFHAs.

[3] https://www.cdc.gov/nceh/ehs/docs/guide_for_local_jurisdictions_care_and_shelter_planning.pdf
[4] https://www.readyrating.org/Resource-Center/Training-and-Exercises/establishing-a-red-cross-shelter

The County and Town will continue to work with appropriate local, state and federal agencies in maintaining the most current flood hazard and flood plain information to ensure continuing participation in the National Flood Insurance Program.

Table 5.8 Mono County MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Personnel	Mono County (Community Development Department--Building, Planning, Code Enforcement)	Overall knowledge of planning process and planning documents in Mono County, Mono County GIS system.
Personnel	Benton-Paiute Reservation	Cooperative planning for Benton-Paiute Reservation lands.
Personnel	Bridgeport Indian Colony	Cooperative planning for Bridgeport Indian Colony lands.
Personnel	Lahontan Regional Water Quality Control Board	Knowledge of water resource issues in the County.
Personnel	U.S. Forest Service, Inyo National Forest, Humboldt-Toiyabe National Forest	Information on lands managed by National Forest in Mono County and on particular resource issues, e.g., wildland fires, avalanche control.
Personnel	Mono County Assessor	Information on property values and past property losses.
Personnel	Mono County Department of Social Services	Information on emergency housing and Red Cross response in Mono County.
Personnel	Mono County Emergency Services Department (Sheriff's Office)	Knowledge of emergency planning and preparedness and hazards mitigation.
Personnel	Mono County Information Technology (IT)	Knowledge of Mono County's GIS system.
Personnel	Mono County Office of Education	Information on county schools and impacts of hazards on them.
Personnel	Mono County Public Health Department	Information on provision of health care services and emergency preparedness, GIS system.
Personnel	Mono County Public Works Department	Knowledge of hazards mitigation on county roadways, floodplain management in the County, County property including airports, Mono County GIS system.

Table 5.8 Mono County MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Personnel	Mono County Risk Manager	Knowledge of risk assessment planning and procedures.
Personnel	Inyo Mono Advocates for Community Action (IMACA)	Cooperative planning for emergency services for elderly and disabled citizens.
Personnel	Eastern Sierra Transit Authority	Cooperative planning for emergency transit services.
Personnel	Local fire protection districts and Fire Safe Councils	Cooperative planning for fire protection and suppression throughout Mono County.
Personnel	Local utility providers (water and sewer districts, etc.)	Cooperative planning for emergency preparedness and hazards planning for utilities.
Personnel	SCE	Electrical utility system in the County.
Personnel	Walker River Irrigation District (WRID)	Cooperative planning for hazards mitigation on the facilities owned and operated by the WRID (Bridgeport Reservoir, E. Walker River, Topaz Lake)
Plan	Mono County Emergency Operations Plan	Describes the responsibilities, roles, and resources of local agencies before, during, and directly after an emergency.
Regulation	Mono County Land Development Regulations (Revised Land Use Element)	Development regulations are included in the Land Use Element of the General Plan to guide the form and design of development to ensure safety and resiliency.
Plan	Mono County General Plan	Identifies overarching policies and programs that affect land use, public services, housing, natural resources, and safety, among other items. The General Plan can be updated to include information and mitigation measures identified in this Plan.
Regulation	Floodplain Regulations (Chapter 21 of the Land Development Regulations)	The floodplain regulations establish special development regulations for those areas of the County subject to inundation.

Table 5.8 Mono County MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Regulation	Fire Safe Regulations (Chapter 22 of the Land Development Regulations)	The fire safe regulations establish basic wildland fire protection standards for Mono County.
Regulation	Land Clearing, Earthwork and Drainage Facilities (Chapter 13.08 of the Mono County Code)	The grading ordinance establishes regulations for slopes (including driveways), cut and fill, and erosion control to minimize disturbances from geologic hazards.
Regulation	Emergency Services (Chapter 2.60 of the Mono County Code)	The emergency services ordinance provides for the preparation and implementation of plans to protect people and property during an emergency in Mono County. It also requires the coordination of emergency services provided by the Town with those provided by all other public agencies, corporations, organizations, and private persons.
Program	Mutual Aid Agreements	The County maintains mutual aid agreements with the Town of Mammoth Lakes, Mono County, the U.S. Forest Service, and the BLM to support each other in emergencies. In addition, all the fire protection organizations in the County (local fire protection districts, U.S. Forest Service, Bureau of Land Management, California Department of Forestry and Fire Protection, US Marine Corps Mountain Warfare Training Center) are trained and ready to cooperate with each under mutual aid agreements. A mutual aid agreement is currently under development between the County and the Fire Districts.

Table 5.8 Mono County MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Regulation	Avalanche Conditional Development Areas	Avalanche Conditional Development Areas are established in the Mono County General Plan. Conditional Development Areas are private properties that have previously experienced avalanche activity. Policies in the General Plan Safety Element limit development in Conditional Development Areas, promote seasonal rather than year-round use of those areas, and require the exploration of land trades or purchases for private property identified as being impacted by avalanches. General Plan policies also direct the County to work with the U.S. Forest Service and Caltrans to mitigate the effects of avalanches that start on public lands and that affect public highways.
Program	Avalanche Awareness Programs	There are a variety of active avalanche mitigation and awareness programs in Mono County, many of them aimed at backcountry skiers. The Mammoth Mountain Ski Patrol maintains a website with avalanche information (patrol.mammothmountain.com) and has instituted a ski patrol avalanche dog program to train avalanche search and rescue dogs. An Eastern Sierra avalanche bulletin is available at www.esavalanche.org. Additional avalanche and weather information is available at https://avalanche.org/national-avalanche-center, and https://www.wrh.noaa.gov/rev/avalanche/

Table 5.8 Mono County MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Program	Mono County Public Health Department Special Needs Database	In order to prepare for emergencies, the Mono County Public Health Department maintains a database of special needs clients on a GIS file. The file contains the GPS coordinates of the participant's daytime and nighttime driveways and front door, a building outline, and the assessor's parcel number of the participant's parcel. Once this data is entered in the database, the Public Health Officer sends the participant a letter thanking them for being proactive in planning for emergency preparedness and stressing the need to continue to plan for emergencies or disasters. The letter also includes brochures from FEMA, the Red Cross, and OES on how to prepare for an emergency or disaster. The database is reviewed annually and revised as necessary.
Opportunities to expand and improve upon the County's current capabilities are identified in the Mitigation Strategy, such as: • Obtaining parcel-specific information and incorporating this information into GIS related databases • Creating a countywide hazard coordinator position • Develop a Comprehensive Flood Management Strategy		

Table 5.9 Town of Mammoth Lakes MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Personnel	Town of Mammoth Lakes (Community Development Department-- Building, Planning, Code Enforcement)	Overall knowledge of Town's planning process and planning documents, Town GIS system.
Personnel	Mammoth Lakes-Yosemite Airport	Knowledge of Mammoth Lakes-Yosemite Airport and hazard mitigation planning.
Personnel	Mammoth Community Water District	Knowledge of Town's water and sewer systems.

Table 5.9 Town of Mammoth Lakes MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Personnel	Mammoth Hospital	Information on provision of EMS in Mammoth Lakes.
Personnel	Mammoth Lakes Fire Protection District	Information on provision of fire protection and suppression activities in and around Mammoth Lakes.
Personnel	Mammoth Unified School District	Knowledge of school district facilities and emergency preparedness.
Personnel	Town of Mammoth Lakes Police Department	Information on emergency preparedness in and around Mammoth Lakes.
Personnel	Burak, dba Snow Survey Associates	Real-time information on snowpack stability and avalanche hazard for communities and roads in Mono County.
Plan	Town of Mammoth Lakes General Plan	Identifies overarching policies and programs that affect land use, public services, housing, natural resources, and safety, among other items. The General Plan can be updated to include information and mitigation measures identified in this Plan.
Plan	Town of Mammoth Lakes Emergency Operations Plan	Describes the responsibilities, roles, and resources of local agencies before, during, and directly after an emergency.
Regulation	Snow Deposition Design Zone (Chapter 17.32, Special Purpose Zoning Districts, of the Town of Mammoth Lakes Municipal Code)	The intent of this zone is to minimize hazards related to avalanches in areas where avalanche potential has been found to exist after investigation and study.

Table 5.9 Town of Mammoth Lakes MJHMP Capabilities Assessment

Supporting Resource Type	Supporting Resource Name	Ability to Support Hazard Mitigation Activities
Regulation	Land Clearing, Earthwork, and Drainage Facilities (Chapter 12.08 of the Town of Mammoth Lakes Municipal Code)	The grading chapter regulates grading and earthwork in order to minimize disturbances from geologic hazards, erosion, siltation and flooding.
Regulation	Floodplain Management (Chapter 12.10 of the Town of Mammoth Lakes Municipal Code	This chapter establishes regulations for development in floodplain areas to minimize public and private losses due to flood conditions.
Regulation	Emergency Services (Chapter 2.48 of the Town of Mammoth Lakes Municipal Code)	The emergency services ordinance provides for the preparation and implementation of plans to protect persons and property during an emergency in Mammoth Lakes. It also requires the coordination of emergency services provided by the Town with those provided by all other public agencies, corporations, organizations and private persons.
Opportunities to expand and improve upon the Town's current capabilities are identified in the Mitigation Strategy, such as: • Obtaining parcel-specific information and incorporating this information into GIS related databases • Develop community-level fire plans. • Create a program that provides funding to mitigate houses in the 100-year floodplain.		

5.3.1 Spending and Budget

Local governments have the power to make expenditures in the public interest. Hazard mitigation principles can be made a routine part of all spending decisions made by the local government, including the adoption of budgets and a CIP. A CIP is a schedule for the provision of municipal or county services over a specified period of time. The County maintains both a CIP and a Comprehensive Facilities Plan, which will incorporate priority measures relating to select infrastructure needs.

5.3.2 Financial

In order to achieve the goals and objectives of the Mitigation Strategy, one or more of the following funding sources could be utilized: federal and state entitlements and grants, general fund, sales and property taxes, infrastructure user fees, impact fees, and new development impact fees (additional details provided in **Table 5.10**). All of the agencies studied have the necessary budgetary tools and practices in place to facilitate handling appropriate funds; however, funding sources are currently very limited.

Table 5.10 Potential Financial Resources (Mono County and Town of Mammoth Lakes)

Agency	Potential Resources, Programs, and/or Grants
Local Resources	• General fund • Sales and property taxes • Infrastructure user fees • New development impact fees • General obligation bonds • Special tax bonds
Department of Homeland Security – FEMA	• Homeland Security Grant Program (HSGP) • Emergency Management Performance Grants (EMPG) Program • Transit Security Grant Program • Assistance to Firefighters Grant (AFG) Program • HMGP (gain eligibility by having a FEMA-approved HMP) • PDM Grant Program (gain eligibility by having a FEMA-approved HMP) • Flood Mitigation Assistance (FMA) Program (gain eligibility by having a FEMA-approved HMP)
US Department of Housing and Urban Development	• Community Development Block Grant (CDBG) Program
US Department of the Interior	• Coastal Impact Assistance Program • USGS Research and Data Collection • WaterSMART Grants
US Department of Defense – US Air Force	Training Requirements Funding

Table 5.10 Potential Financial Resources (Mono County and Town of Mammoth Lakes)

Agency	Potential Resources, Programs, and/or Grants
US Department of Health and Human Services	Grants for Public Health Emergency Preparedness
US Department of Commerce	Coastal Resilience Networks
Cal OES	• Regional Catastrophic Preparedness Grant Program • Interoperable Emergency Communications Center Grant Program • Proposition 1B Grant • Citizens Corps Program • Metropolitan Medical Response System Program • Earthquake and Tsunami Grants Program
California Department of Housing and Community Development	Disaster Recovery Initiative (DRI)
California Department of Forestry and Fire Protection	Western States WUI Fire Assistance Grant
California DWR	Integrated Regional Water Management (IRWM) Grant Programs
State Water Resources Control Board	Storm Water Grant Program (SWGP)-Proposition 1
California Coastal Conservancy	Proposition 1 Grants
California Department of Fish and Wildlife	Watershed Restoration Grant Program

5.4 Fire Protection Districts

There are 12 fire protection districts in Mono County, which generally serve the communities, as shown in **Table 5.11**. Each fire protection district generally has only one station, which is operated entirely by volunteers. Mammoth Lakes Fire Protection District, however, has one engine that is staffed at all times with a combination of full-time and part-time personnel.

All land in the County is ultimately divided into local, state, and federal responsibility areas (FRAs) for providing fire protection. The majority of land in the County is federal land and is therefore a FRA, provided fire protection by the USFS or BLM resources. Fires in structures/buildings located on National Forest/BLM/National Park lands are suppressed by the nearest fire protection district with assistance as needed.

The Marine Corps Mountain Warfare Training Center, located several miles south of Walker, also operates the Mountain Warfare Fire Department, which defends the military-owned facilities and will respond in surrounding areas. State responsibility areas (SRA) are covered by the San Bernardino/Inyo/Mono Cal Fire Unit. With the exception of the Antelope Valley, and incorporated Town of Mammoth Lakes, all privately owned lands in Mono County are within the SRA. Mutual aid agreements between fire departments in Mono County and with surrounding counties in California and Nevada, as well as state and federal agencies involved in fire protection, allow for cooperation and pooling of resources when major fires occur. Much of the privately owned land in Mono County is outside of an existing fire district, and limited funding prevents expansion of service areas or the formation of new districts; these areas are protected, to the extent possible, by Cal Fire. In some cases, other agencies may assist or other resources may be available through mutual aid agreements.

Table 5.11 Fire Districts by Planning Area

Planning Area	Communities	Fire Districts
Antelope Valley	Topaz, Coleville, Walker	Antelope Valley Fire Protection District
Benton Valley	Benton	White Mountain Fire District
Bodie Hills	Dispersed properties	None - SRA
Bridgeport	Bridgeport	Bridgeport Fire Protection District
Chalfant	Chalfant	Chalfant Valley Fire Department
Hammil	Hammil	White Mountain Fire District
June Lake	June Lake, Crestview	June Lake Fire Department
Long Valley	Crowley Lake, Aspen Springs, Sunny Slopes, McGee Creek, Tom's Place, Pine Glade	Long Valley Fire Protection District
Mammoth Lakes	Mammoth Lakes	Mammoth Lakes Fire Protection District
Mammoth Vicinity	Dispersed properties	Long Valley Fire Protection District
Mono Basin	Mono City, Lee Vining	Mono City Fire District; Lee Vining Volunteer Fire Department
Oasis	Oasis	Fish Lake Valley Fire Protection District (NV)
Paradise	Paradise	Paradise Fire District
Sonora Junction	Marine Corps MWTC	None - SRA

Table 5.11 Fire Districts by Planning Area

Planning Area	Communities	Fire Districts
Swauger Creek	Dispersed properties	None - SRA
Upper Owens	Dispersed properties	None - SRA
Wheeler Crest	Swall Meadows	Wheeler Crest Fire District
No Planning Area	Virginia Lakes, Lundy Lake	None - SRA

Mono County agencies have a mutual aid agreement that ensure cooperation and sharing of resources to provide fire protection and emergency services. This agreement does not require the participating agencies to provide aid, but provides a framework for requesting and responding to requests for aid or resources. The following agencies are part of the agreement:

- Antelope Fire Protection District
- Bridgeport Fire Protection District
- Chalfant Fire Protection District
- June Lake Fire Protection District
- Lee Vining Fire Protection District
- Long Valley Fire Protection District
- Mammoth Lakes Fire Protection District
- Mono City Fire Protection District
- Paradise Fire Protection District
- Wheeler Crest Fire Protection District
- White Mountain Fire Protection District

In addition to the mutual aid agreement, agencies are improving communications interoperability to allow local, state, and federal agencies to coordinate emergency response radio systems, as well as external services through Verizon Wireless to improve communications in the event of an emergency. The system is still being tested and improvements are expected to be made.

Mammoth Lakes is a local responsibility area and is served by the Mammoth Lakes Fire Protection District. Governance is provided by a five-member Board of Fire Commissioners, and an appointed Fire Chief that serves at the will of the board. The department's boundaries are coterminous with the Town of Mammoth Lakes boundaries; the one exception is Mammoth Yosemite Airport, which is in the Town

but not the department's boundaries and is serviced by Long Valley Protection District. The department has two stations and eight full-time staff in addition to a larger part-time and volunteer force.

6. PLAN MAINTENANCE AND CAPABILITIES

In order to support lasting mitigation and safety efforts, it is imperative that this MJHMP remain up to date. Doing so ensures that Mono County and the Town of Mammoth Lakes are continually protected against changing hazards and that the communities remain eligible for federal and state funding. To keep the MJHMP living and active, this chapter describes the processes for updating this Plan to ensure it is usable, relevant, locally appropriate, and compliant with applicable state and federal requirements. The Plan's structure allows the County and the Town to update individual sections as information becomes available and needs arise, making it easier to keep the Plan current.

6.1 Plan Adoption

To comply with DMA 2000, Mono County will officially adopt the Mono County and the Town of Mammoth Lakes MJHMP within one year of receiving FEMA "approval pending adoption" status. The adoption of the MJHMP recognizes the community's commitment to reducing the impacts of natural hazards throughout Mono County. The adoption resolution is presented in **Appendix A.**

6.2 Plan Update and Coordinating Body

Maintaining and updating this Plan is the responsibility of the County Community Development Department, and the Town Administration Department, which includes the Town Manager and Assistant to the Town Manager. The primary department overseeing this process is the Mono County Planning Department, under the direction of its appointed MJHMP project manager. This individual will coordinate maintenance of this Plan, conduct the formal evaluation process, and prepare each five-year update. Beginning in summer of 2022, the project manager will initiate the update process, establishing a timeline, funding source for the update, informing decision-makers, and contacting key members of both jurisdiction agencies to kick-off the process. The key County and Town departments to be on the planning team are listed below.

Mono County

- Mono County Public Health Department
- Community Development Department
- Public Works Department
- Sheriff's Office

- Antelope Valley Regional Planning Advisory Committee
- Bridgeport Valley Regional Planning Advisory Committee
- June Lake Citizens Advisory Committee
- Long Valley Regional Planning Advisory Committee
- Mono Basin Regional Planning Advisory Committee

Town of Mammoth Lakes

- Town of Mammoth Lakes Planning Division
- Town of Mammoth Lakes Police Department
- Town of Mammoth Lakes Public Works Department
- Town of Mammoth Lakes Risk Management Division

Other Organizations

- Mammoth Lakes Fire Protection District
- Other Fire Protection Districts
- Inyo and Mono Counties Agricultural Commissioner's Office
- Cal Fire
- Caltrans
- CHP
- Cal OES
- Eastern Sierra Transit Authority
- LADWP
- Sierra Tactical Training and Active Response Resources
- SCE
- U.S. Forest Service
- USGS

The MJHMP project manager will facilitate the team meetings. This staff member will assign tasks, which may include collecting data, developing new mitigation actions, updating sections of the Plan, and presenting the Plan to other departments, stakeholders, and elected officials. Responsibility for implementation and evaluation of the Plan will be shared among all team members as appropriate.

6.3 Evaluation and Monitoring

Prior to the formal five-year update, the Planning Team will meet at least once annually, as initiated by the County Community Development Department. During this period, the team will focus on timing of Plan implementation, evaluating the implementation of the actions identified in this Plan, determining whether they are successful, revising priorities, if necessary, and helping to incorporate the Plan's mitigation actions into other planning documents. These annual meetings will commence in 2019 and should be timed with overall departmental planning and budgeting (fourth quarter of the fiscal year) that occurs leading up to the Town and County's annual budget development. As part of this evaluation and monitoring process, members of the team should look at the following:

- Any hazard events that occurred during the previous year and the impact of these hazards on the community.
- Mitigation actions in the Plan that have been successfully implemented.
- Mitigation actions in the Plan that were scheduled for implementation but have not begun.
- The schedule of future mitigation actions, and whether it is feasible or appropriate to adjust the timeline.
- Issues not covered by existing mitigation actions that could be addressed by new mitigation actions.
- Potential or actual changes in new funding opportunities, including grants, which may be used on mitigation-related activities.
- New scientific or mapping data that could inform updates to the Plan.
- Any other planning programs or initiatives in the community that involve hazard mitigation.

The team will summarize the information from this review into an annual progress report, which will be distributed to County and Town department heads for review as well as to the Town of Mammoth Lakes Town Council and the Mono County Board of Supervisors. The progress report will also be used to track and monitor progress on implementation of the measures contained in **Chapter 5**, and will include a section that details efforts made on the Priority Measures.

The progress report will also be posted on the County and Town's websites, with the ability for members of the public to provide comments, and will be distributed to local media, as appropriate.

6.4 Incorporation into Existing Planning Mechanisms

Another important maintenance mechanism is to incorporate the recommendations and underlying principles of the MJHMP into other community plans and mechanisms, such as comprehensive planning, capital improvement budgeting, economic goals and incentives, and regional plans. Both the County and the Town of Mammoth Lakes will be responsible for incorporating the 2018 MJHMP into their jurisdiction-specific documents. Incorporation of the MJHMP will occur as plans and policies are updated and when new plans and policies are developed. Key documents that have been identified for incorporating elements of the MJHMP include:

- Building/Development Codes and Ordinances
- Emergency Operations Plans
- General Plans
- Capital Improvement Plans

7. COMMUNITY WILDFIRE PROTECTION PLAN

The Mono County CWPP is a comprehensive, scientifically based analysis of wildfire-related hazards and risks in the WUI areas of Mono County, California. Prepared for Mono County (County) and the Town of Mammoth Lakes (Town) in concert with the MJHMP, it is an incisive update to the 2009 Community Wildfire Protection Plan. The MJHMP and CWPP were prepared based on a countywide effort that included extensive stakeholder engagement, the compilation of existing documents and GIS data, scientifically based analyses of risk and vulnerability, confirmation of field data gathered in 2009, and recommendations designed to reduce the threat of wildfire-related damages to assets, also known as values, at risk.

This document incorporates new and existing information relating to wildfire which will be valuable to citizens, policy makers, and public agencies in Mono County. Participants in this project include BLM, USFS, Regional Planning Advisory Councils, Mammoth Lakes Fire Department, Cal Fire, the LADWP, the County's volunteer fire departments, Fire Safe Councils, and stakeholders. A more detailed description of the planning and stakeholder process is included in **Chapter 1** of the MJHMP. A detailed description of the planning area is included in **Chapter 2** of the MJHMP. This document meets the requirements of the federal Healthy Forest Restoration Act (HFRA) of 2003 for community fire planning.

This document examines the wildfire hazard, vulnerabilities, and means of reducing risk for the County and Town, meeting the hazard-specific requirements of a MJHMP for both jurisdictions. In addition, the Mammoth Lakes Fire Protection District has elected to pursue developing its own, separate CWPP for the Town of Mammoth Lakes in order to consider more specific fire modeling. When complete, elements of this CWPPs may be incorporated into this document to further align the Town of Mammoth Lakes' efforts to reduce wildfire risk. The Wheeler Crest Fire Safe Council recently developed its own parcel-specific CWPP for Swall Meadows and Paradise (January 2019), as discussed in **Section 7.6**. The Wheeler Crest CWPP is attached as **Appendix I**.

7.1 Method

The assessment portion of this document is an evaluation and update of identified hazards and risks associated with wildland fire in proximity to communities; the assessment is based on stakeholder expertise, available state-level fire data, and recent growth patterns and fuel reduction activities. This information defines "areas of concern" for Mono County and allows for an updated prioritization of mitigation efforts. From the analysis of this data, solutions and mitigation recommendations are offered that will assist homeowners, land managers, and other interested parties in the process of developing

short-term and long-term fuels and fire management plans. Wildfire hazard data is derived from Cal Fire FRAP data and Wildfire Hazard Severity Zone maps, as well as fire behavior potential data developed in 2009 from Fire Family Plus, BEHAVE, and FlamMap fire behavior models.

The CWPP presents a two-fold evaluation of wildfire hazard, risk, and vulnerabilities. Section 7.3 presents a general hazard profile based on historic wildfire activity and wildfire hazard severity zones, as established by Cal Fire, and identifies vulnerable assets and populations located within high and very high wildfire severity zones. A detailed description of methodologies for the general hazard profile and vulnerabilities analysis is in **Chapter 3** of the MJHMP. Section 7.4 provides an assessment of potential fire behavior in the wildland urban interface, including flame length, rate of spread, and crown fire based on fire behavior modeling. It also identifies risk to communities in the WUI based on locations in hazard areas and potential fire behavior as well as infrastructure and development characteristics. Section 7.5 identifies changes since 2009 that affect fire behavior and community vulnerability, including updated development and infrastructure conditions, potential changes in fuel load that could lead to inaccuracies in existing state and local wildfire hazard mapping such as previous fires and tree mortality, completed and ongoing fuels reduction projects, as well as possible implications of climate change. **Section 7.6** presents priority projects and a set of actions the County and Town plan to take that can increase preparedness, response, and education of the community in relation to wildfire threats. These actions supplement mitigation and related measures provided in **Chapter 5** of the MJHMP.

7.2 Background

7.2.1 National Fire Plan (NFP) and the HFRA

In the year 2000, more than 8 million acres burned across the United States, marking one of the most devastating wildfire seasons in American history. One high-profile incident, the Cerro Grande fire at Los Alamos, New Mexico, destroyed more than 235 structures and threatened the Department of Energy's nuclear research facility.

Two reports addressing federal wildland fire management were initiated after the 2000 fire season. The first report, prepared by a federal interagency group, was titled "Review and Update of the 1995 Federal Wildland Fire Management Policy" (US Department of the Interior, et al. 2001). This report concluded, among other points, that the condition of America's forests were continuing to deteriorate.

The second report, titled "Managing the Impacts of Wildfire on Communities and the Environment: A Report to the President in Response to the Wildfires of 2000," was issued by the BLM and the USFS. It

became known as the NFP. This report, and the ensuing congressional appropriations, ultimately required actions to:

- Respond to severe fires
- Reduce the impacts of fire on rural communities and the environment
- Ensure sufficient firefighting resources

Congress increased its specific appropriations to accomplish these goals. 2002 was another severe season: more than 1,200 homes were destroyed and over 7 million acres burned. In response to public pressure, Congress and the Bush administration continued to designate funds specifically for actionable items such as preparedness and suppression. That same year, the Bush administration announced the HFRA initiative, which enhanced measures to restore forest and rangeland health and reduce the risk of catastrophic wildfires. In 2003, that act was signed into law.

Through these watershed pieces of legislation, Congress continues to appropriate specific funding to address five main subcategories: preparedness, suppression, reduction of hazardous fuels, burned-area rehabilitation, and state and local assistance to firefighters. The general concepts of the NFP blended well with the established need for community wildfire protection in the study area, which encompasses the entirety of the Town of Mammoth Lakes and Mono County. The spirit of the NFP is reflected in the Mono County CWPP.

The requirements of the HFRA are met by:

1. Identifying and prioritizing fuels reduction opportunities across the landscape (see Fuels Modification Projects, **Section 7.5.5**).
2. Addressing structural ignitability (see Home Mitigation, **Section 7.6**, and **Appendix F**).
3. Assessing community fire planning, response, and suppression capabilities (see MJHMP, **Chapter 5**).
4. Collaborating with stakeholders (see MJHMP, **Chapter 1**, and **Appendix B**).

7.2.2 Outcomes

Intended outcomes from this project include the following:

1. Enhance life safety for residents and responders.
2. Mitigate undesirable fire outcomes to property and infrastructure.

To accomplish these goals, the following objectives have been identified:

1. Establish an approximate level of risk (the likelihood of a significant wildfire event in the study area).
2. Provide a scientific analysis of the fire behavior potential of the study area.
3. Group values at risk into "communities" that represent relatively similar hazard factors.
4. Identify and quantify factors that limit (mitigate) undesirable fire effects to the values at risk (hazard levels).
5. Recommend specific actions that will reduce the vulnerability of the values at risk.

Other desired outcomes:

1. **To promote community awareness:** Quantifying the community's hazards and risk from wildfire will facilitate public awareness and assist in creating public action to mitigate the defined hazards.
2. **To improve wildfire prevention through education:** Community awareness, combined with education, will help to reduce the risk of unplanned human ignitions.

To facilitate and prioritize appropriate hazardous fuel reductions:

1. The identification of areas of concern will improve the focus and accuracy of pre-planning, and facilitate the implementation of cross-boundary, multi-jurisdictional projects.

7.3 Hazard and Risk Assessment

7.3.1 Hazard Description

The term wildfire refers to any fire that starts in a rural, sparsely populated or largely undeveloped area. In many parts of the world, wildfires form part of the ecosystem and often burn at a safe distance from areas of human settlement. Under dry conditions and when fanned by strong winds, however, fires can spread into heavily populated districts, causing major damage to property. Buildings may be set alight by radiant heat, contact with the flames, or flying embers. Smoke can also cause property damage, and indirect losses can result from business interruption.

A complex interplay of natural and anthropogenic (human-caused) factors influences the extent and magnitude of wildfires. Most significant factors include the type and dryness of vegetation, slope, and wind, and other climactic components such as temperatures and precipitation. Conflagration can result

in many circumstances as the result of lightning, downed or arcing power lines, or man-made fires accidentally or deliberately spread. These changing anthropogenic and natural factors make wildfires a risk that is extremely difficult to quantify. Even if hazard zones can be clearly identified, fires can cause significant losses in unexpected locations under unique circumstances.

7.3.2 Location and Magnitude

Wildland fires in Mono County have ranged from fires that burned less than 1 acre in size to the Cannon Fire in Walker in 2002, which burned 22,750 acres. With its sloped geography, vegetation, and climate, Mono County has many fire-prone landscapes, on both public and private lands. Wildfire burns indiscriminately across property boundaries, which means that the way potential fuels are managed on one piece of property can affect wildfire risk on neighboring lands. Public lands surrounding communities in the County contain highly flammable vegetation that in many cases has not been thinned in years. The area experiences high temperatures and high winds over mountainous terrain that makes firefighting difficult. Highway and air access to the area is limited, further increasing the difficulty of fighting wildland fires. Continued population growth into WUI areas, but unchanging relative isolation from resources, and an increasing frequency of elevated fire weather conditions present major challenges to county residents.

Cal Fire is required by state law to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as FHSZ, influence how people construct buildings and protect property to reduce risk associated with wildland fires. As required by law, the model evaluates hazard, but not risk. The model underlying FHSZ evaluates properties using characteristics that affect the probability of the area burning and potential fire behavior in the area. Many factors are considered such as fire history, existing and potential fuel, flame length, blowing embers, terrain, weather and the likelihood of buildings igniting. Fire hazard severity has two key components: probability of burning and expected fire behavior. The factors considered in determining hazard are: 1) how often an area will burn; and 2) when it does burn, what characteristics might lead to buildings being ignited?

Based on these factors, each area is assigned a zone, categorized as moderate, high, or very high. The FHSZ is intended to provide a broad-stroke understanding of level of wildfire hazard across the state and may not always reflect hazard from highly localized and fine-grained factors. A primer prepared by Cal Fire, contained in **Appendix G**, describes in greater detail the method and granularity of the FHSZ.

The FHSZ maps are the primary tool used to establish state and local rules and regulations governing building, infrastructure, and maintenance requirements. Consequently, **Table 7.1** of this analysis evaluates risk and vulnerability based on high and very high wildfire hazard zones of the FHSZ map. It

is worth noting that current FHSZ maps were last prepared in 2003 or earlier. While Cal Fire is in the process of developing new models and analysis to develop new maps, as of early 2018, these were not yet available. Consequently, maps may not reflect recent changes to natural or developed conditions in the County. **Table 7.2** evaluates hazard and risk analysis more tailored to the County and, within the WUI, recent changes to community conditions and their effects on risk and vulnerability.

As identified in **Table 7.1**, high and very high wildfire zones are present in both unincorporated Mono County and the Town of Mammoth Lakes.

Mono County

Table 7.1 shows the ownership and administration of lands within the high and very high wildfire severity zones in Mono County. In all, 183,755 acres are in the high severity zone, and 31,766 acres are in the very high severity zone.

Table 7.1 Wildfire Severity Zones by Landownership or Adminstration Category

Land Ownership or Administration Category	High Wildfire Severity Zone			Very High Wildfire Severity Zone		
	Acres in Hazard Zone	Percentage of Total in Category	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total in Category	Percentage of Total Mono County Area
County	191	8.4%	<1%	138	6.1%	<1%
Federal	158,865	9.2%	7.9%	27,671	1.6%	1.4%
Local[1]	115	53.3%	<1%	--	--	--
Private	8,874	6.9%	<1%	902	<1%	<1%
State	5,705	6.8%	<1%	2,565	3.1%	<1%
Utilities	8,434	12.6%	0.4%	126	<1%	<1%
Right of way/ administration	1,566	17.5%	<1%	361	4.0%	<1%
Other	6	<1%	<1%	2	<1%	<1%
Total	**183,755**	**9.1%**	**9.1%**	**31,766**	**1.6%**	**1.6%**

[1] Local includes; Mammoth Community Water District, Mammoth Lakes Fire Protection District; Mammoth Unified School District; Town of Mammoth Lakes

Table 7.2 shows the land within the high and very high wildfire severity zones in Mono County broken down by the planning areas defined in the Mono County General Plan. As shown, large percentages of

Mammoth Vicinity, Swauger Creek, Mono Basin, and June Lake are in high wildfire severity zones. Significant portions of June Lake and Sonora Junction are also within very high fire severity zones.

Table 7.2 Wildfire Severity Zones by Planning Areas

Planning Area	High Wildfire Severity Zone			Very High Wildfire Severity Zone		
	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area	Acres in Hazard Zone	Percentage of Total Planning Area	Percentage of Total Mono County Area
Antelope Valley	1,279	4.3%	<1%	-	-	-
Benton	-	-	-	-	-	-
Benton Hot Springs	-	-	-	-	-	-
Bodie Hills	-	-	-	-	-	-
Bridgeport	2,667	5.2%	<1%	333	<1%	<1%
Chalfant Valley	-	-	-	-	-	-
Hammil Valley	-	-	-	-	-	-
June Lake	12,613	23.8%	<1%	8,016	15.1%	<1%
Long Valley	3,649	20.2%	<1%	-	-	-
Mammoth Vicinity	42,216	51%	2.6%	1,514	1.6%	<1%
Mono Basin	4,428	2%	<1%	-	-	-
Oasis	-	-	-	-	-	-
Sonora Junction	7,419	6.5%	<1%	11,253	9.8%	<1%
Swauger Creek	663	35.0%	<1%	-	-	-
Upper Owens	4,304	28%	<1%	-	-	-
Wheeler Crest	244	4.2%	<1%	-	-	-

Mammoth Lakes

Wildfire is a concern for the entire Town; historically, wildfires have occurred on all sides of Town. However, certain portions of Mammoth Lakes have higher hazard exposure, including areas close to the Valentine Reserve Ecological Study Area and neighborhoods south of Old Mammoth Road (typically referred to as Old Mammoth and Lake Mary). **Figure 7.1** shows the FHSZs for Mono County and Mammoth Lakes, as well as local, state, and FRAs. Overall, roughly 3 percent of the incorporated town is in a very high fire severity zone and close to 34 percent is in a high fire severity zone, based on Cal Fire

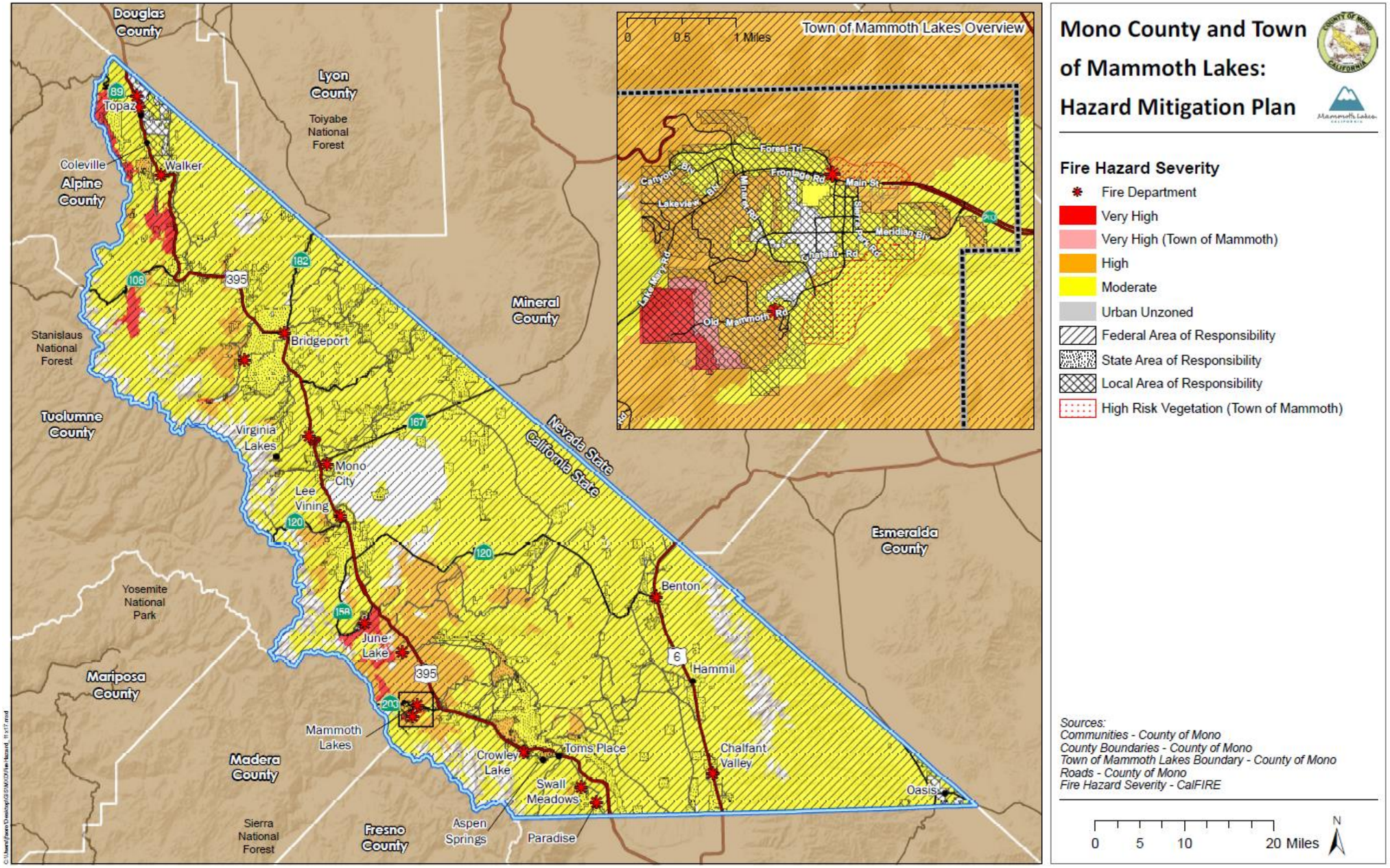
Hazard Severity Zone Mapping. The Town has identified additional areas for which it enforces very high severity zone regulations and requirements, as shown on the inset on **Figure 7.1**.

Table 7.3 gives the acreage and percentage of total land area located within high and very high wildfire severity zones, as well as the additional land area identified by the Town to be regulated as a very high wildfire zone.

Table 7.3 Wildfire Severity Zones in Mammoth Lakes

Planning Area	Total Town Area Acreage	High Wildfire Severity Zone (Cal Fire)		Very High Wildfire Severity Zone (Cal Fire)		Town Designated Very High Wildfire Severity Zone	
		Acres in Hazard Zone	Percentage of Total Town Area	Acres in Hazard Zone	Percentage of Total Town Area	Acres in Hazard Zone	Percentage of Total Town Area
Town Outside Urban Limit	13,299	4,186	31%	425	3.2%	16	0.1%
Town Inside Urban Limit	2,536	1,109	44%	51	2.0%	90	3.5%

Figure 7.1: Mono County Wildfire Hazard Severity Zones



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7.3.3 Hazard History

Dozens of fires of various sizes typically burn in the County each year. Swall Meadows, June Lake, and Antelope Valley are populated areas that have experienced one or more significant fires since 2000 and have a pattern of fires from prior years. There have been 16 significant fires, described below, that have affected the County since 2000, or more than one a year on average. Typically, these fires were wind-driven and consumed several thousand acres before suppression efforts were successful.

1. **Cannon Fire**. June 2002. Walker.

The Cannon Fire burned 22,750 acres. Three fatalities occurred due to an air-tanker crash, and one person was injured when a water truck was destroyed in a rollover accident. Economic damages from the fire totaled $7.9 million. The fire is thought to be human-caused but was strongly influenced by high winds (20–30 mph), dry fuel conditions, varied fuel types, and mountainous topography. Hundreds of evacuations occurred east and west of US 395 and portions of US 395 were closed.

2. **Gate Complex Fire** (Slinkard, Gate, Buckeye, and Coleville Fires). July 2002. West side of Antelope Valley.

The Complex Fire consisted of four fires that burned in the same region simultaneously. The Slinkard fire, the largest of the four, burned north from Slinkard Valley near SR 89 to the Topaz Lodge along US 395. In total, the fires burned roughly 9,866 acres and incurred more than $1.6 million in damages. Portions of US 395 (Bridgeport to Holbrook Junction) and SR 89 (Monitor Pass) closed. The fires are believed to have been started by lightning in a wildland area and spread quickly due to wind and dry ground conditions. Evacuations were required for all of Coleville and areas north to Nevada. All residents from the Monitor Pass turnoff north to the Nevada state line and from the Monitor Pass turnoff south to Topaz Lane were evacuated. Power and telephone outages occurred in Walker and Coleville. Just over 900 fire personnel were on scene, as well as helicopters and air tankers.

3. **Birch Fire**. July 2002. Birch Creek Canyon near Swall Meadows.

The Birch Fire was caused by a sparking power line, and resulted in 2,500 acres burned and $386,000 in damages. The entire Rock Creek drainage area (including USFS campgrounds), local residents (including the entire Swall Meadows community), and merchants were evacuated. Lower and Upper Rock Creek Roads closed. No structures were destroyed.

4. **Larsen Fire**. June 2007. West of Coleville in Antelope Valley.

The Larsen fire burned for close to 20 days, ultimately burning 1,080 acres. The blaze caused mandatory evacuations in portions of Coleville and U.S. Marine housing, school closures, and the closure of US 395 from Bridgeport to Holbrook Junction. High winds caused quick spreading. Lightning is believed to have started the blaze.

5. **Indian Fire**. August 2012. North of SA 120 and southwest of Mono Lake.

The Indian Fire burned for roughly a week but burned more than 12,576 acres in that time and required 571 personnel on-site. The fire was believed to be caused by a lightning strike. The fire did not threaten life or property but it destroyed critical habitat for sage grouse.

6. **Spring Peak Fire**. August 2013. East of Bodie State Park.

The Spring Peak Fire started in Nevada from a lightning strike and crossed into California a few days later. The fire came within miles of Bodie State Park. The roads to the park were closed, State Routes 267 and 170. The fire burned over 14,300.

7. **June Lake Fire**. September 2014. June Lake Mountain.

The June Fire, which started at the base of June Mountain, was caused by an employee of June Mountain operating heavy equipment on June Mountain Ski Area. The fire threatened residential structures and necessitated mandatory evacuations east of June Mountain and south of Highway 158. Highway 158 was closed at the south junction with Highway 395 and to the north to Rainbow Lane.

8. **Van Dyke Fire.** February 2015. Point Ranch, South of Bridgeport.

The Van Dyke Fire began west of Route 395 and north of Point Ranch, at one point it shut down Route 395 to thru traffic. The fire damaged a Southern California Edison power sub-station and residents of Evans Track south of the Bridgeport Ranger Station were evacuated. A total of 509 acres burned.

9. **Round Fire**. February 2015. Swall Meadows and Paradise.

The most destructive fire in recent history, the Round Fire burned 36 homes, most of them in Swall Meadows, and 7,000 acres. The communities of Paradise and Swall Meadows were placed under mandatory evacuation orders. The blaze was started when strong winds caused a tree to fall over power lines, which sparked.

10. **Walker Fire**. August 2015. Southwest of Lee Vining.

The fire burned for roughly two weeks and consumed 3,676 acres. It resulted in the temporary closure of SR 120 and Tioga Pass Road, and mandatory evacuations of several campgrounds and resorts near Lee Vining and Walker Lake. The fire was human-caused.

11. Marina Fire. June 2016. Hwy 395 & Mono Lake.

The Marina Fire burned on the slopes above Old Marina on Hwy 395 about one mile north of the town of Lee Vining. The fire caused parts of Hwy 395 to close. The Tioga Lodge and the Mono Inn were evacuated. An evacuation warning was issued for Lee Vining and Mono City. The fire was determined to be human-caused, but the exact cause and origin are still under investigation. A total of 650 acres burned.

12. Clark Fire. August 2016. On Bald Mountain, northeast of Mammoth.

A lightning-sparked wildfire in the Inyo National Forest south of Mono Lake, the Clark Fire burned 2,819 acres. Clark Canyon was evacuated as a precaution. Due to elevated particulate pollution levels (from the Clark Fire as well as a smaller fire, the Wilson Fire), the Mono County Health Department has issued a Stage 1 Air Pollution Health Advisory for Northern Mono County.

13. Rock Creek Fire. August 2016. North of Swall Meadows.

The Rock Creek fire was caused by a mountain biker, and was primarily carried by dry cheatgrass. No structures were burned, but an evacuation occurred in Swall Meadows.

14. Owens River Fire. November 2016. East of June Lake, Clark Canyon.

Burning for roughly a week, the fire covered 5,443 acres. The Big Springs Campground, Clark Canyon (a popular climbing area), and nearby ranches and developments were evacuated. The Owens River Road and Whitmore Springs Roads were closed and visitors were advised to avoid Bald Mountain Road, as well.

15. Slinkard Fire. September 2017. West slope of Antelope Valley, south of Topaz.

The Slinkard fire burned for roughly two weeks, burning more than 8,925 acres. The blaze was started by a lightning strike in Slinkard Valley. CA 395 was temporarily closed in both directions and voluntary evacuation notices were issued to residents in and around Topaz.

16. Boot Fire. September 2018. Southeast of Walker, north west of Bridgeport.

The Boot fire burned 6,974 acres, the cause of the fires is still under investigation (as of November 2018). Certain areas and campgrounds within the Humboldt-Tioyabe National Forest were closed, as well as portions of US 395 and CA 108.

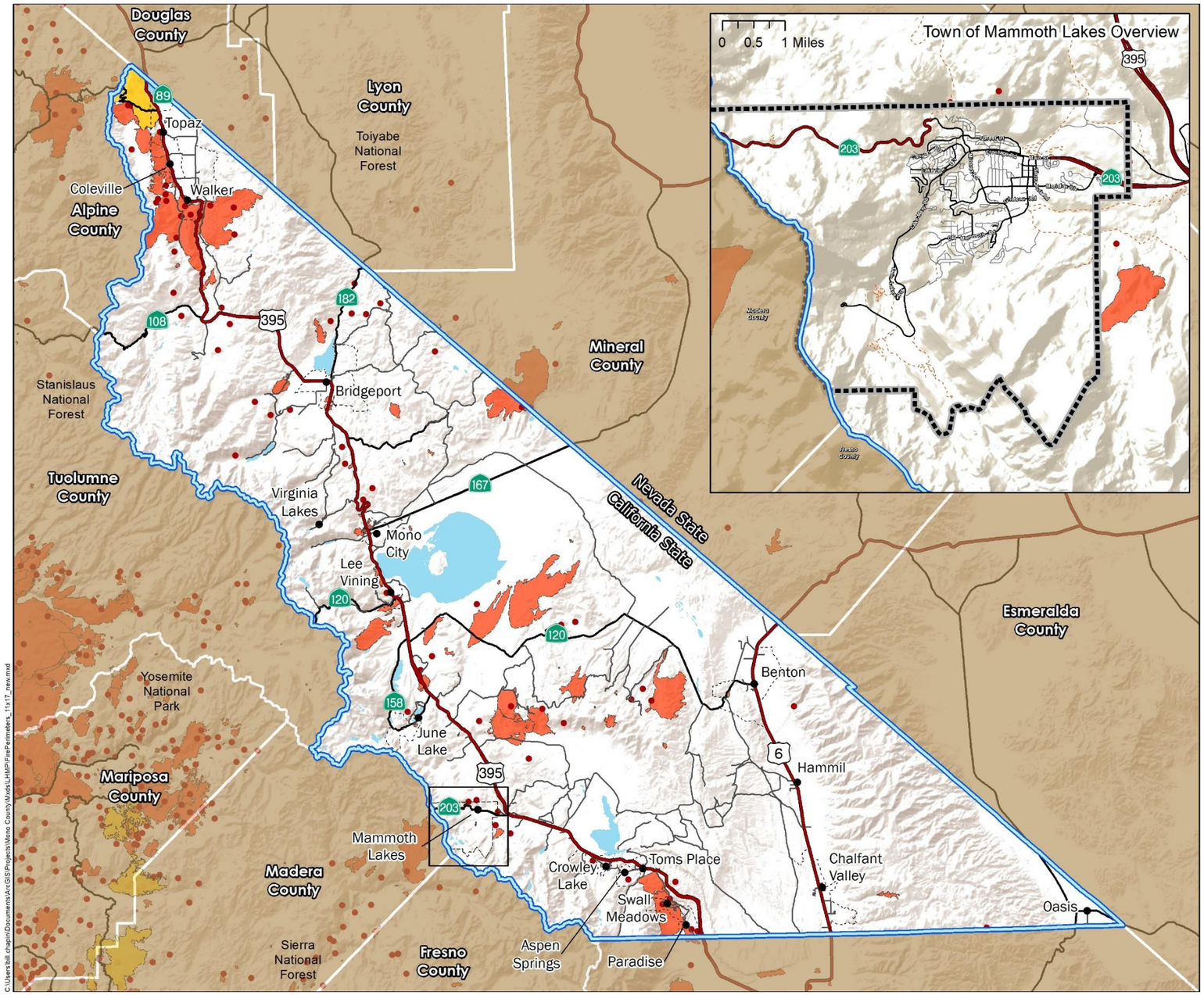
Mammoth Lakes

The Town of Mammoth Lakes regularly experiences wildfires in proximity to Town boundaries. Most of these fires are extinguished before growing over 100 acres. The major threats to the Town are fires that start on adjacent public lands and spread communities. As a result, most fire mitigation and prevention projects in the area focus on fuel breaks.

The most destructive fire that occurred within the vicinity of thein Town was the 1992 Rainbow Fire, which began near the Devils Postpile National Monument. In addition to a variety of other conditions, winds between 30 and 60 miles an hour fanned the fire, leading it to expand to more than 8,000 acres within 24 hours. In total the fire burned 8,347 acres; the fire burned more than 85 percent of the monument's acreage. The Rainbow Fire was ignited by lightning on August 20, 1992, in the Inyo National Forest, south of Devils Postpile National Monument. Fortunately, ideal weather conditions prevented the fire from reaching and spreading into the Town of Mammoth Lakes.

Figure 7.2 shows all fire perimeters from 1990 to 2017 as well as the general location (displayed as single dot) of fires going to back to 1900 for the County and Town of Mammoth Lakes. A full list of documented fires is contained in **Appendix H**.

Figure 7.2: Historic Fires



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Wildfire Hazard: Historic Fires

- Recent Fire Perimeters: 2017
- Fire Perimeters: 1990 to 2016
- Historic Wildfire Centroids: before 1990
- Communities
- Mono County Boundary
- Surrounding Counties
- Town of Mammoth Lakes
- Census Designated Place
- US Highway
- State Highway
- County Road
- Lakes

Sources:
Active Wildfire Perimeters - GeoMAC
Historic Wildfire Perimeter Layers - Cal FIRE
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono

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7.3.4 Risk and Vulnerability

The location, frequency, and severity of potential future wildfire hazard events is by itself insufficient to describe Mono County and Town of Mammoth Lakes' vulnerability to wildfire. A risk assessment is necessary to prepare a more accurate view of the threat that the county and the city face as a result of wildfire events likely to occur in their areas. Risk and vulnerability are assessed in terms of critical facilities and vulnerable populations that are located in high or very high wildfire severity zones. The approach and method for risk and vulnerability assessment are described in greater detail in **Chapter 4** of the MJHMP.

Social Vulnerability

A number of community members considered to have higher vulnerability in a hazard event reside within the high and very high hazard severity zones of both the county and town. Reflective of the overall area, a large number of individuals in Mammoth Lakes, nearly 2,130, and 798 households are in the high fire severity zone, and another 132 households are in the very high severity zone. However, there is no significant difference in social vulnerability between residents in the high wildfire hazard zones compared to residents in the entirety of the communities. A much lower percentage of total households in the unincorporated county are located in either zone. Vulnerable populations also do not seem to represent a much higher percentage than the overall population. **Tables 7.4 and 7.5** summarize the social vulnerability for unincorporated Mono County and Mammoth Lakes residents, respectively, in the high and very wildfire hazard zones.

Table 7.4 Social Vulnerability for Wildfire Hazard Zones – Unincorporated Mono County

Social Vulnerability Metric	Wildfire Hazard Zone		
	High	Very High	Mono County Total
Population	1,225	227	6,042
Number of households	485	52	2,469
Median household income†	$61,643	$40,533	$56,944†
Number of households under poverty limit	7.0%	<1%	5.1%
Percent elderly households	42.7%	<1%	35.2%
Percentage of adults with English competency	98.6%	99.4%	95.5%
Percentage of households with a disabled member	17.3%	15.4%	15.3%

† Median income for the unincorporated county was not available so the total county median is shown

Table 7.5 Social Vulnerability for Wildfire Hazard Zones – Mammoth Lakes

Social Vulnerability Metric	Wildfire Hazard Zone		
	High	Very High	Mammoth Lakes Total
Population	2,130	267	8,104
Number of households	798	132	3,299
Median household income	$68,947	$69,438	$55,799
Number of households under poverty limit	4.0%	1.5%	4.3%
Percentage elderly households	19.3%	12.1%	6.9%
Percentage of adults with English competency	90.9%	91.0%	88.7%
Percentage of households with a disabled member	15.8%	7.6%	12.0%

Critical Facilities

In Mono County, 35 critical facilities are in the high hazard severity zone and 5 in the very high hazard severity zones. Of these, 11 are in the Town of Mammoth Lakes. Facilities at risk include half the county's medical service centers and more than 40 percent of the emergency services and emergency operations centers. **Table 7.6** lists the number of facilities located in wildfire hazard zones for unincorporated Mono County and the Town of Mammoth Lakes. Additionally, the Digital 395 cables run through areas of moderate and high fire risk and major power lines run through all hazard severity zones.

Table 7.6 Critical Facilities in Wildfire Hazard Zones – Unincorporated Mono County and Mammoth Lakes

Facility Type	Number of Facilities Not at Risk	At Risk – Mammoth Lakes		At Risk – Unincorporated Mono County	
		High	Very High	High	Very High
Communications Facilities	15	1	0	3	0
Emergency Operations Center	7	1	0	4	0
Emergency Services	15	4	0	5	2
Hazardous Materials	9	0	0	0	1
Lifeline Utility Systems	42	3	0	8	2
Medical Services	2	1	0	1	0

Table 7.6 Critical Facilities in Wildfire Hazard Zones – Unincorporated Mono County and Mammoth Lakes

Facility Type	Number of Facilities Not at Risk	At Risk – Mammoth Lakes		At Risk – Unincorporated Mono County	
		High	Very High	High	Very High
Schools	11	0	0	0	0
Transportation Systems	7	1	0	2	0
Vulnerable Populations	4	0	0	1	0
Total	**112**	**11**	**0**	**24**	**5**

There are three facilities that meet the Environmental Protection Agency's standards for "cleaner air shelter" in the county: Lee Vining Community Center, Twin Lakes Annex, and June Lake Community Center. These shelters allow for residents to escape smoke and particulate pollutants that occur during wildfires and pose a significant health hazard. To qualify as a cleaner air shelter, locations must meet the following requirements:

- Tight-sealing windows and doors
- Public access
- A ventilation system that can significantly reduce or eliminate intake of outdoor air
- A central air filtration system of medium or high efficiency

The Crowley Lake Community Center meets three of the four requirements to be considered a cleaner air shelter, but does not have outside air ventilation. Only the June Lake Community Center is officially considered a critical facility in Mono County.

7.4 Potential Fire Behavior and Fuel Conditions in the Wildland Urban Interface

The WUI is defined as the area where structures and other human development meet or intermingle with undeveloped wildland. The WUI creates an environment in which fire can move readily between natural vegetation fuels to structures and from structures into the natural vegetation fuels.

All developed areas and communities in Mono County sit directly adjacent to huge swaths of forestland and open space lacking in human infrastructure. People come to this region to live in rural areas and

direct proximity to natural ecosystem areas with attractive recreational and aesthetic amenities, especially forests. Consequently, all urbanized areas in the county are within the WUI, and face significant risk and likelihood that wildfires will threaten structures and people. There are significant implications for both the character and development of structures and behavior within those communities and for the health and management of wildlands directly adjacent to those communities and the thousands of acres beyond them.

For the purpose of this CWPP, the County applies WUI boundaries developed by Cal Fire. Additionally, the entire Town of Mammoth Lakes is considered to be in the WUI, as approved by Town Council in 2007 and shown in **Figure 7.3**. Cal Fire considers three main components in the assessment of threat from wildland fire to WUI areas:

1. Ranking fuel hazard.
2. Assessing the probability of wildland fire.
3. Defining areas of suitable housing density that lead to WUI fire protection strategy situations.

These three independent components were then combined using GIS capabilities to identify WUI areas threatened by wildfire. In addition to mapping these areas, a list of communities was developed that summarized a nonspatial assessment of key areas within the vicinity of significant threat from wildland fire.

Figure 7.3 displays the WUI (shown in orange) for the county. The entire Town of Mammoth Lakes is in the WUI; the Fire Commissioners approved and the Town Mayor ratified WUI boundaries in 2007, as shown in **Figure 7.4**. The WUI is defined as a 1.5-mile buffer around developed areas with densities greater than 1 unit per 40 acres. As is the case with most defined WUIs, some homesteads and ranches may lie outside of the defined boundary, as they are too dispersed to be included. These are not considered communities and are therefore not within the scope of this CWPP, although they may fall within the defined WUI.

7.4.1 Fire Regime Condition Class (FRCC)

Historical fires can provide a great deal of information for understanding future fire risk. However, as noted above, a complex interaction of natural and human conditions greatly impact both hazard and risk. Wildfire is a natural component of many ecosystems, including high-altitude forest and grassland that is predominant in Mono County. However, changes in those ecosystems—many driven by human development and action, such as long-term fire suppression to protect homes and other structures—have altered conditions in ways that change fire-related risk. Many of California's largest fires in recent

decades resulted from changes to the ecosystem that drastically increased the fire risk and led to extremely large conflagrations.

The FRCC provides a landscape evaluation of expected fire behavior as it relates to the departure from historical norms. The FRCC is derived by comparing current conditions to an estimate of the historical range that existed prior to substantial settlement by Euro-Americans. The departure of the current condition from the historical baseline serves as a proxy to likely ecosystem effects. The condition class concept assumes that historical fire regimes accurately represent the conditions under which the components within a fire-adapted ecosystem naturally evolved.

The data used for this study is from California's FRAP vegetation data. Condition class measures are assigned, comparing natural fire regime and current fire conditions. FRCCs are defined as the "relative risk of losing key components that define an ecosystem." The conceptual basis is that for fire-adapted ecosystems, much of their ecological structure and processes are driven by fire. Departure from natural fire regimes creates instability and increases the risk to key components of that ecosystem. The method utilized follows that which is used at the national level, where lands are assigned one of three condition class levels—low, mixed, and high—which qualitatively rank the potential effects to the ecosystem based on the percentage of the dominant overstory vegetation that has been replaced. The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) and divided into the categories of 0–35 years, 35–100 years, and over 100 years. **Figure 7.5** shows the FRCC for Mono County and the Town of Mammoth Lakes.

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Figure 7.3: Mono County Wildland Urban Interface

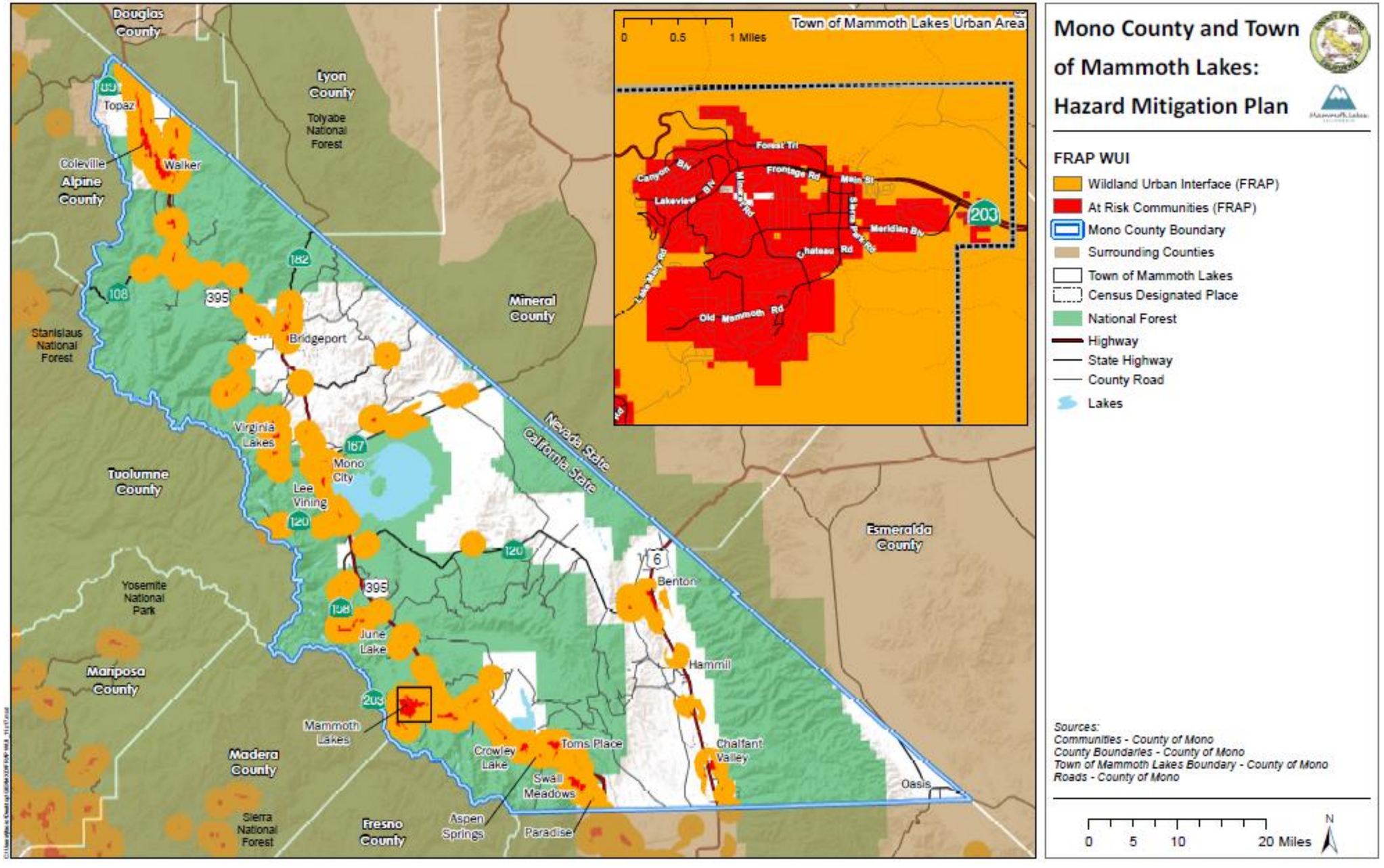

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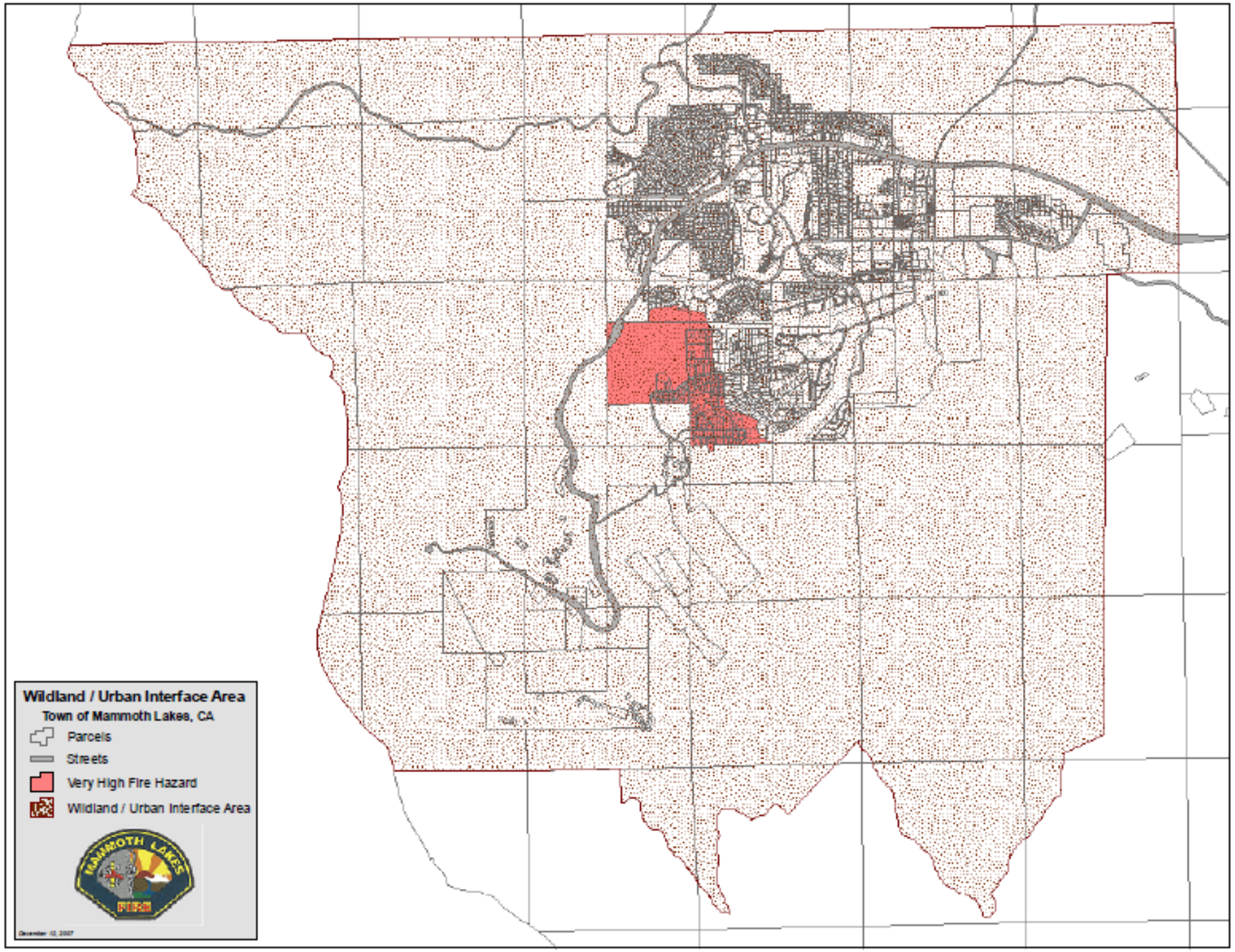
Figure 7.4: Town of Mammoth Lakes Approved Wildland Urban Interface



Source: Town of Mammoth Lakes 2007

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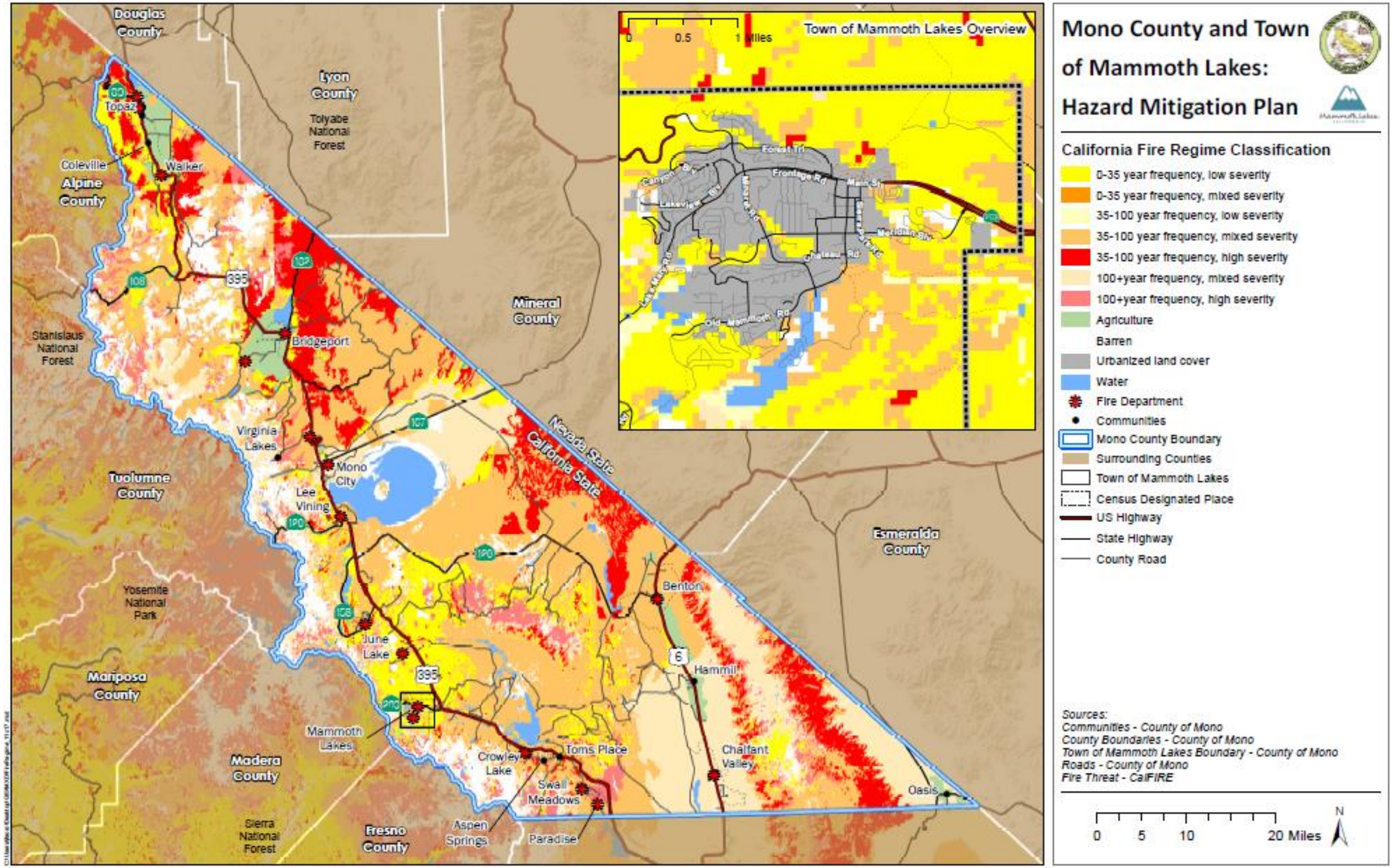
Figure 7.5: Fire Regimes Condition Class



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7.4.2 Fire Behavior Potential

This section predicts likely fire behavior in Mono County and the Town of Mammoth Lakes using three USFS software systems. The modeling evaluation was completed in 2009. The methodology used data inputs representing the three factors that determine fire behavior: the amount and arrangement of fuel, topography, and weather (Bennett et al. 2010). Weather observations, including measures of windspeed and moisture, were collected for a 20-year period (1986–2006) and used to define two scenarios (moderate and extreme) for modeling fire behavior potential. Other model inputs included the type and coverage of surface fuels based on Cal Fire's vegetation data and such topographical features as slope, elevation, and aspect.

Of these variables, only weather inputs could potentially be updated following the methodology described in the 2009 CWPP. Topographical inputs remain essentially unchanged. While there have been a number of projects implemented since 2009 to reduce or modify fuels within Mono County, as well as changes to the fire regime caused by wildfires, these are not reflected Cal Fire's surface fuels dataset; it remains the best vegetation data available, but it primarily dates to 2003. Given the data limitations, the Planning Team decided to re-use the 2009 modeling data for this update and explore any changes in conditions that could affect fire behavior, including fuels projects and dry conditions, in narrative form within **Section 7.5**.

For the model, values for moderate and extreme weather scenarios were calculated using Fire Family Plus software. These calculations were incorporated into the BEHAVE fire modeling system to calculate surface fire predictions, i.e. rate of spread and flame length. Finally, the FlamMap 3.0 mapping and analysis program combined the surface fire predictions with crown fire potential to generate a set of maps that display potential rate of spread, flame length, and crown fire activity for both weather scenarios. The model does not calculate the probability a wildfire will occur; it assumes an ignition occurrence for every cell. However, it does predict how a wildfire would behave in each given area based on the inputs mentioned above. Additional information on the assumptions and methodology used are contained in **Appendix F**.

Rate of Spread

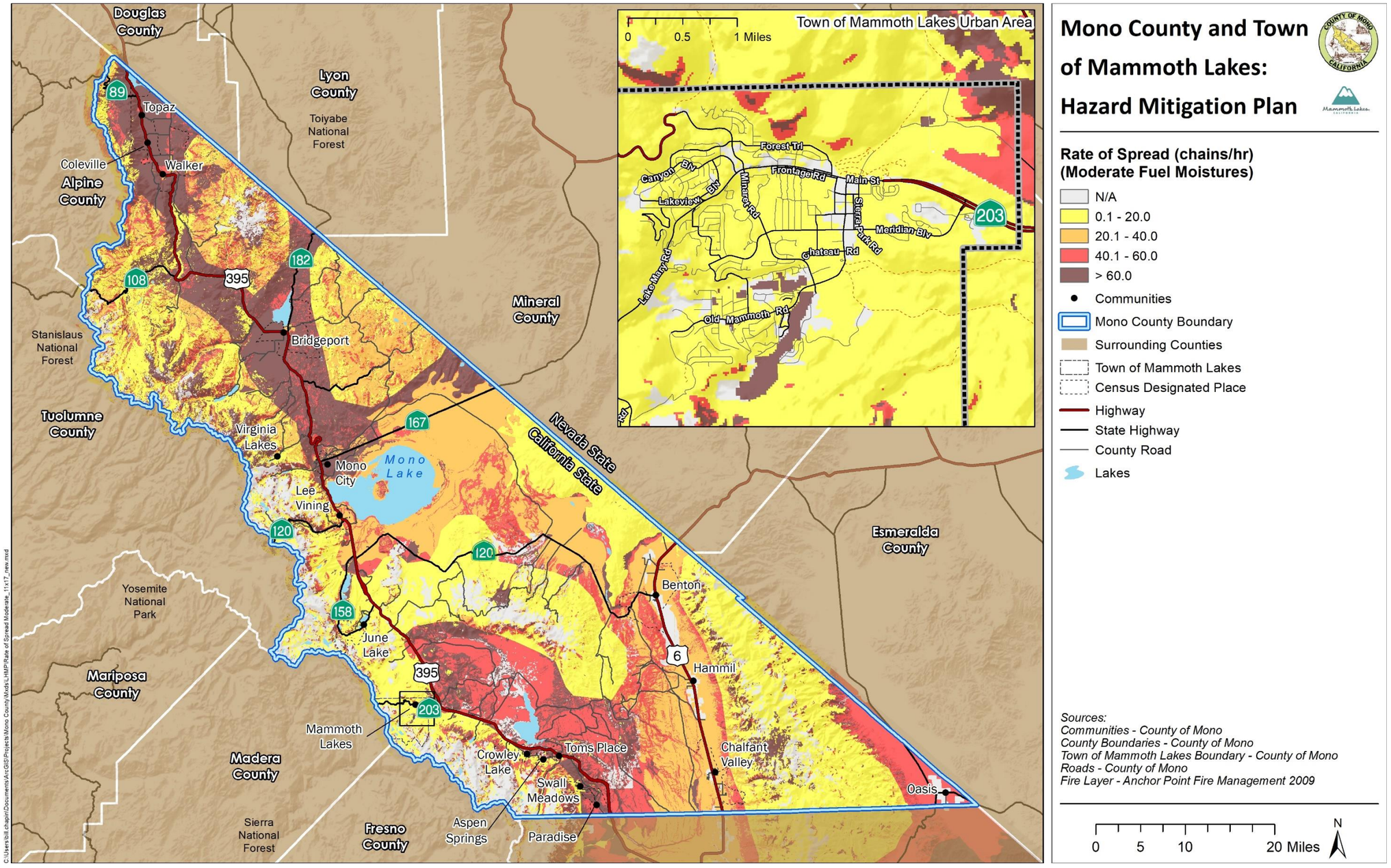
Figure 7.6 and **Figure 7.7** show the predicted rates of spread for the moderate fire weather and extreme fire weather scenarios, respectively. Rates of spread are expressed in chains/hour (CPH). A chain is a unit of measure commonly used by foresters and firefighters. It is equal to 66 feet; therefore, 1 mile equals 80 chains. Rates of fire spread are influenced primarily by the wind, slope steepness, fuel type/continuity, and fuel sheltering from the wind. Fire is the only force of nature which moves faster uphill than downhill. In areas where high to extreme rates of spread are predicted (rates of spread of >40 CPH or one-half mile per hour), it is possible fires could spread faster than humans can escape,

creating extremely dangerous conditions for firefighters and evacuating residents. High rates of spread also make suppression efforts less effective and increase the tactical complexity of the incident. Rates of spread in the Eastern Sierra can follow a pattern of strong down-winds that can cause fast-moving extreme fire behavior down drainages in the afternoons during summer days, especially associated with frontal passages.

In the moderate fire weather scenario, moderate to extreme rates of spread are predicted throughout the populated areas in the northern parts of the study area. High rates of spread (>40 CPH or one-half mile per hour, shown in red) are predicted for portions of the southwestern part of the county where desert grasses and shrubs with little sheltering from the wind are the dominant fuels, including parts of Upper Owens, Mono Vicinity, Long Valley, Wheeler Crest, and Oasis. Rates of spread increase to extreme levels (>60 CPH, shown in brown), where these conditions are combined with increasing slopes, most notably in the lower slopes of the Eastern Sierra and the mountain ranges of the desert areas in the eastern and southern portions of the county. These include smaller portions of Upper Owens and Wheeler Crest in the southern part of the county, as well as swaths of the northern county along the US 395 corridor, including virtually all of Antelope Valley and Bridgeport Valley as well as portions of Sonora Junction and the northern side of Mono Basin. These model results are consistent with recent historic wildfires, which have been most frequent and burned the most acreage in these areas with rates of spread predicted at greater than 60 CPH.

In the extreme fire weather scenario, extreme rates of spread are predicted for all of the urbanized communities in the county with the exception of the higher elevations of the Sierra and White Mountains and areas where combustible fuels are sparse or not present.

Figure 7.6: Rate of Spread, Moderate Weather Conditions



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Rate of Spread (chains/hr)
(Moderate Fuel Moistures)

- N/A
- 0.1 - 20.0
- 20.1 - 40.0
- 40.1 - 60.0
- > 60.0
- Communities
- Mono County Boundary
- Surrounding Counties
- Town of Mammoth Lakes
- Census Designated Place
- Highway
- State Highway
- County Road
- Lakes

Sources:
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono
Fire Layer - Anchor Point Fire Management 2009

0 5 10 20 Miles N

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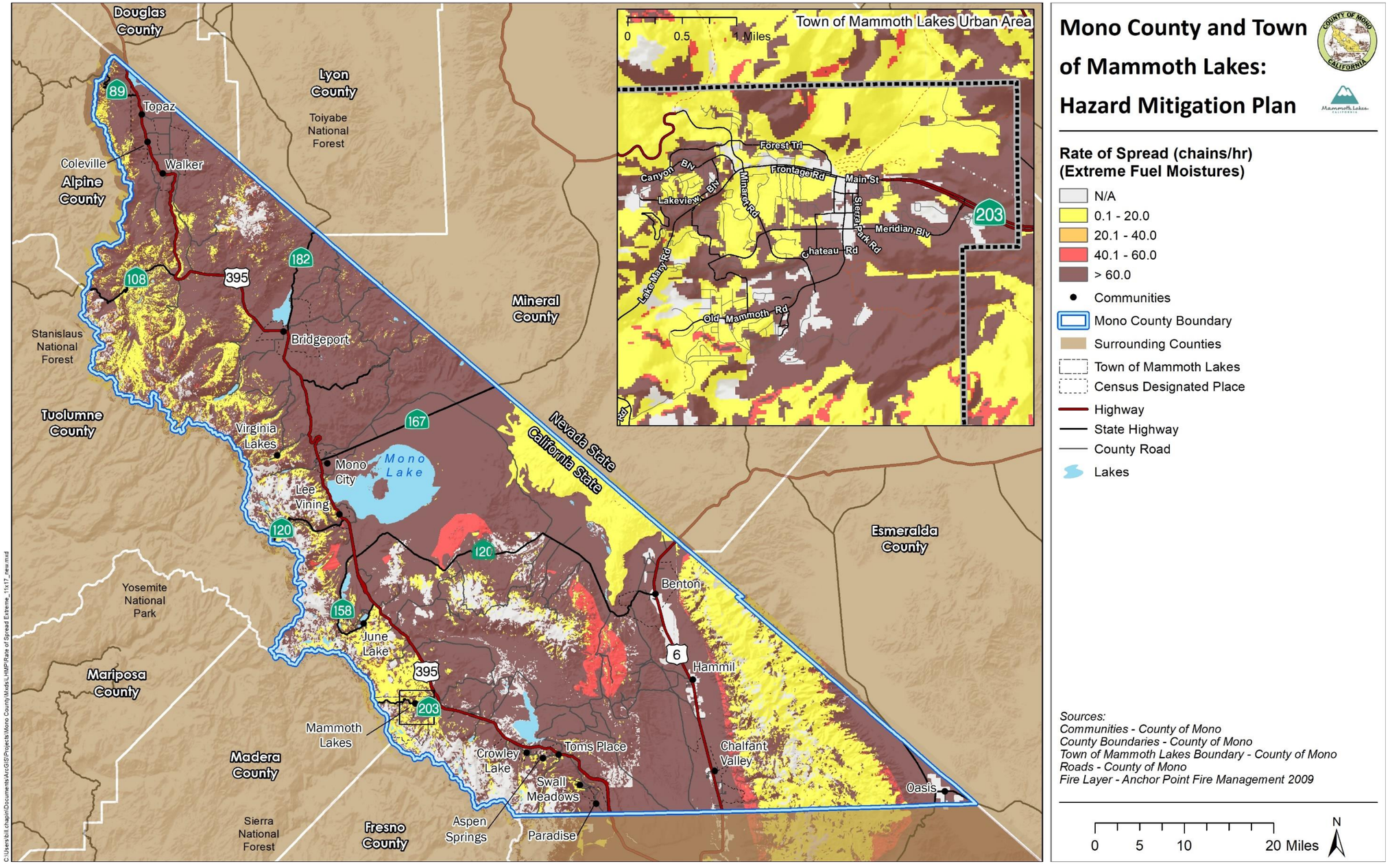
Figure 7.7: Rate of Spread, Extreme Weather Conditions



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Flame Length

Flame length is used as a proxy for fire intensity. It is important to note that flame length represents the entire distance from the base of the flame to the tip, irrespective of angle—not simply the flame height above the ground. In high wind conditions, it is possible to have very intense flames (high flame lengths) which are relatively close to the fuel bed.

Figure 7.8 and **Figure 7.9** display flame length in ranges that are meaningful and useful to firefighters. Flame lengths of 4 feet or less (shown in yellow) are considered low-enough intensity to be suitable for direct attack by hand crews, which represents the best chance of direct extinguishment and control. Flame lengths of less than 8 feet (shown in orange and yellow) are suitable for direct attack by equipment such as bulldozers and tractor plows. Flame lengths of 8 to 12 feet (shown in red) are usually attacked by indirect methods and aircraft. In conditions where flame lengths exceed 12 feet (shown in brown), the most effective tactic is fuel consumption ahead of the fire by burnouts or mechanical methods. Although indirect fire line and aerial attack are also used for such fires, flame lengths increase as the effectiveness of these tactics decrease. Their use in this case is generally intended to slow rates of spread and reduce fire intensity, especially in areas where values at risk are concentrated.

Even in the moderate fire weather scenario, most urbanized communities are located in areas with likely flame lengths of greater than 4 feet. Many areas—including the western side of Antelope Valley; portions of Sonora Junction, Bridgeport Valley, Bodie Hills, and Upper Owens; and nearly all of Mammoth Vicinity, Long Valley, and Swall Meadows—are predicted to have the potential for extreme flame lengths of 12 feet or greater.

Under the extreme fire weather scenario, high to extreme flame lengths are predicted throughout the areas covered by the WUI communities, with the exceptions of some small pockets, such as Tri-Valley and Oasis, where elevations and/or fuel conditions moderate the large-scale conditions. Under extreme weather and fuel moisture conditions, fire intensity is expected to be a genuine issue and control will be difficult and complex to establish and maintain.

Crown Fire Activity

The crown fire activity maps, shown in **Figure 7.10** and **Figure 7.11**, display the potential for fires to move from the surface into the canopy of trees and shrubs. The likelihood of progression from the surface into the aerial fuels is displayed in four categories. N/A ("not applicable") refers to areas where surface fires are unlikely to develop due to the lack of combustible fuels. These would include areas lacking a combustible fuel bed, such as rock, ice, snow fields, water, sand, or some urban landscapes. The surface fire category (shown in yellow) covers areas where fires are expected to be limited to the surface fuels and lack the energy to initiate and sustain vertical development into the aerial fuels. Areas

where grass fuels without overstory plants are dominant fall into this category, regardless of the energy produced by the fire, due to the lack of an aerial fuel bed. Areas designated by the torching category (shown in orange) are expected to experience isolated combustion of the tree crowns in individual trees and groups of trees. The active crown fire category (shown in red) includes areas where sustained horizontal movements through tree crowns are expected. Crown fires represent extreme fire behavior conditions and are notoriously resistant to all methods of suppression and control.

Weather variables had trivial effects on the development of crown fire in the study area, as shown by the limited differences displayed on the two figures. In general, there is a possibility of torching and/or active crown fire development wherever timber fuels are present, which includes most of the WUI, except for eastern Antelope Valley, Mono Basin, Tri-Valley, and Oasis.

Figure 7.8: Flame Length, Moderate Fire Weather Conditions

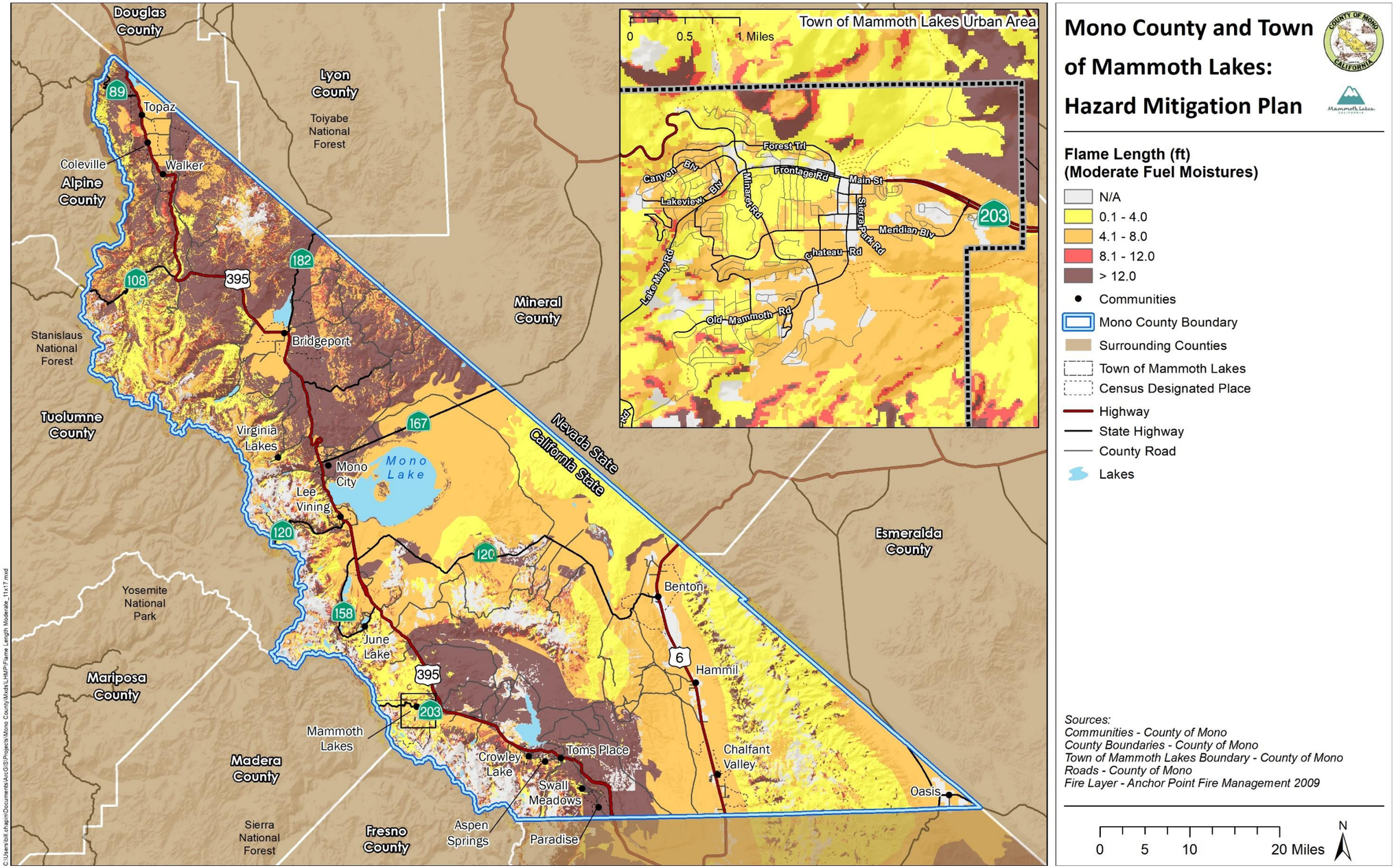

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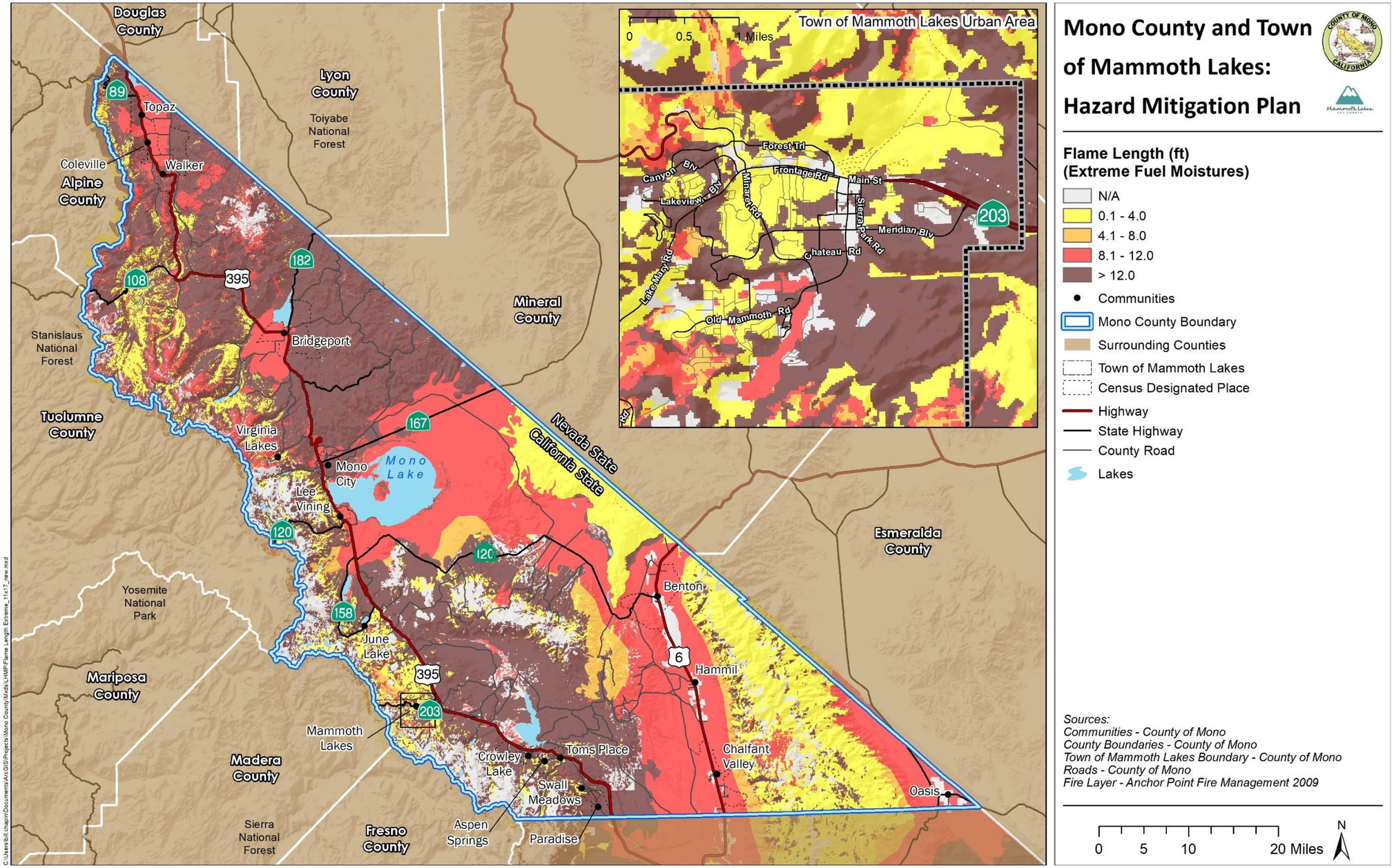
Figure 7.9: Flame Length, Extreme Fire Weather Conditions



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Flame Length (ft)
(Extreme Fuel Moistures)

- N/A
- 0.1 - 4.0
- 4.1 - 8.0
- 8.1 - 12.0
- > 12.0
- Communities
- Mono County Boundary
- Surrounding Counties
- Town of Mammoth Lakes
- Census Designated Place
- Highway
- State Highway
- County Road
- Lakes

Sources:
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono
Fire Layer - Anchor Point Fire Management 2009

0 5 10 20 Miles N

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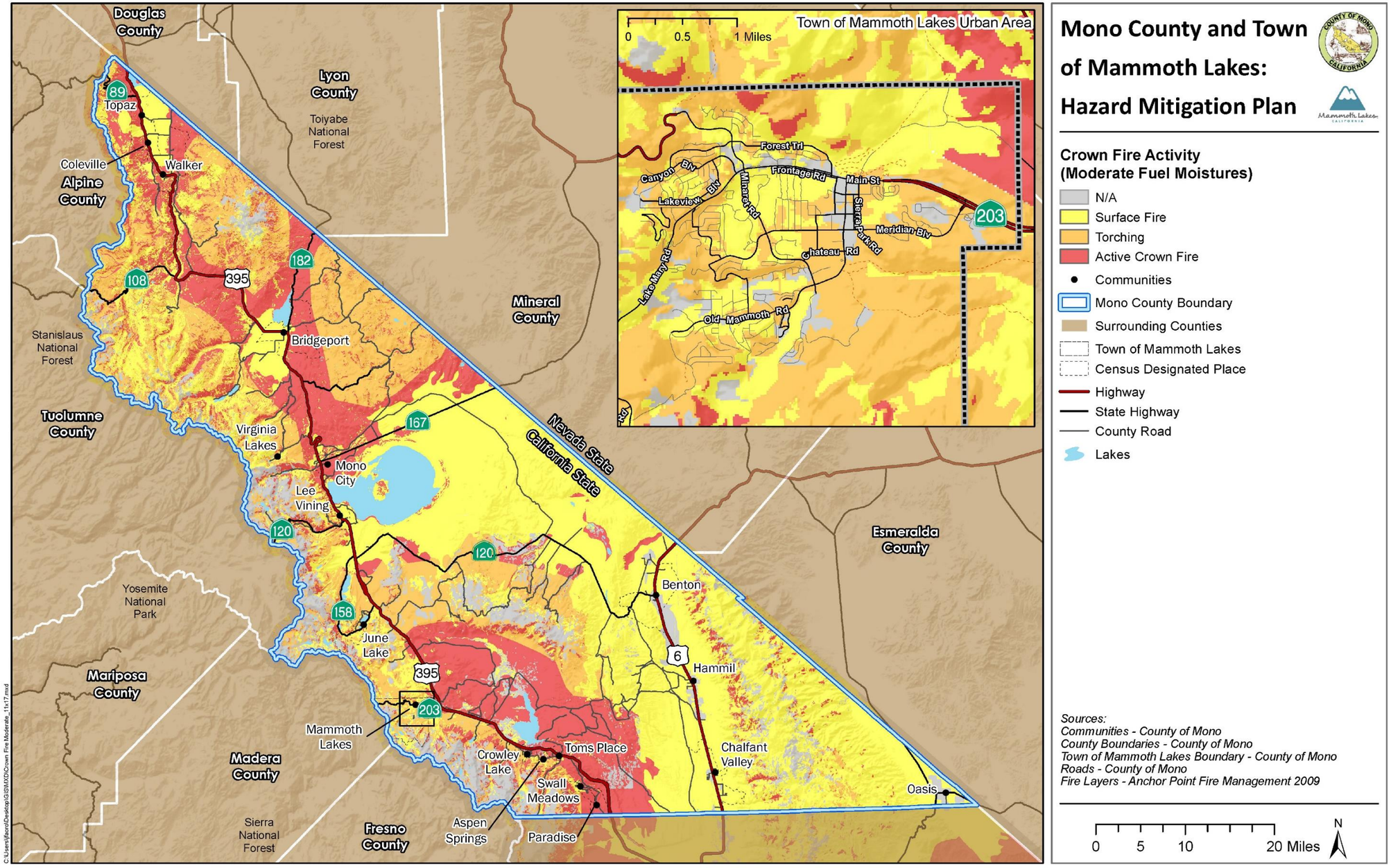
Figure 7.10: Crown Fire Activity, Moderate Fire Weather Conditions



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Crown Fire Activity (Moderate Fuel Moistures)

- N/A
- Surface Fire
- Torching
- Active Crown Fire
- Communities
- Mono County Boundary
- Surrounding Counties
- Town of Mammoth Lakes
- Census Designated Place
- Highway
- State Highway
- County Road
- Lakes

Sources:
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono
Fire Layers - Anchor Point Fire Management 2009

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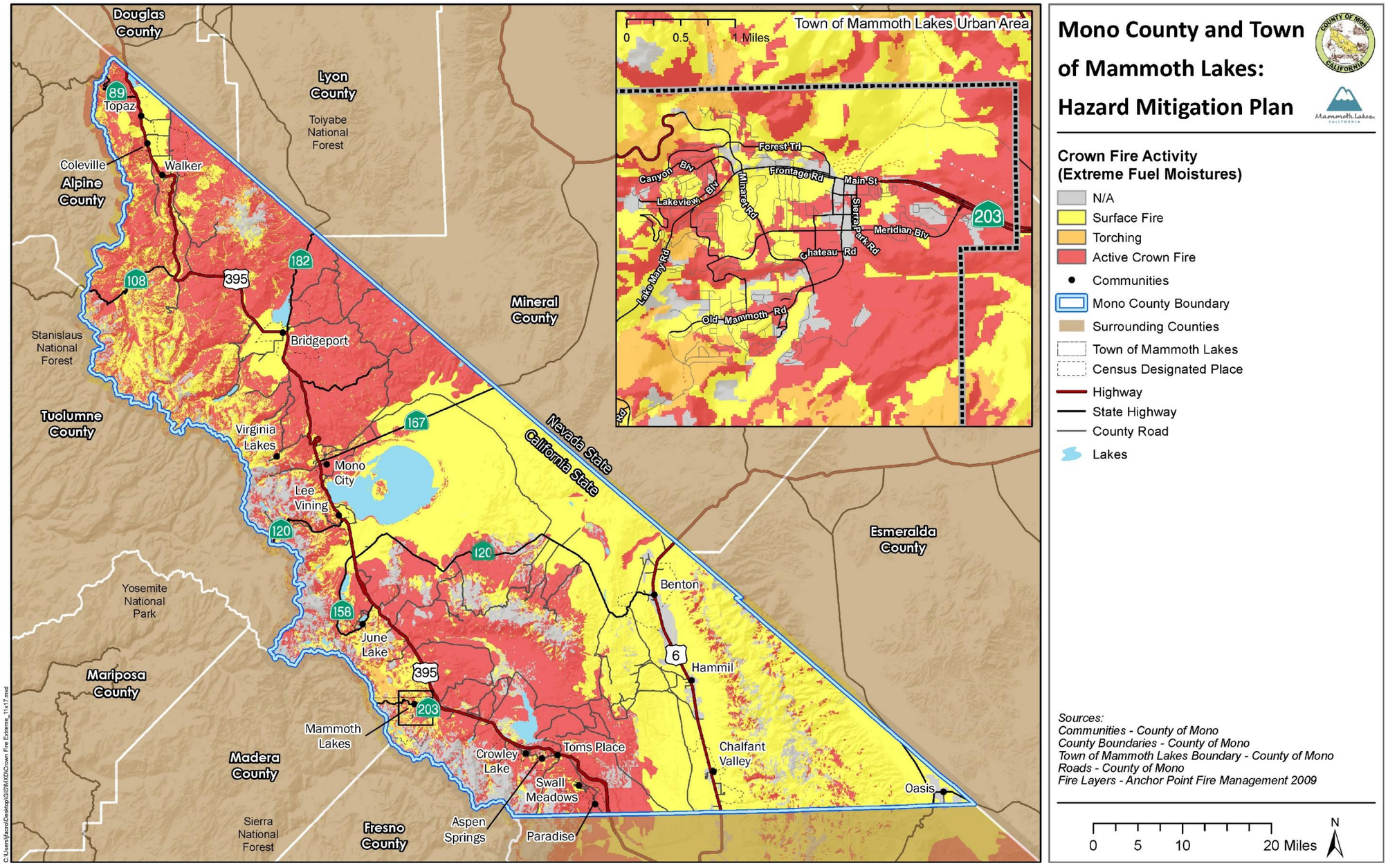
Figure 7.11: Crown Fire Activity, Extreme Fire Weather Conditions



Mono County and Town of Mammoth Lakes: Hazard Mitigation Plan

Crown Fire Activity (Extreme Fuel Moistures)

- N/A
- Surface Fire
- Torching
- Active Crown Fire
- Communities
- Mono County Boundary
- Surrounding Counties
- Town of Mammoth Lakes
- Census Designated Place
- Highway
- State Highway
- County Road
- Lakes

Sources:
Communities - County of Mono
County Boundaries - County of Mono
Town of Mammoth Lakes Boundary - County of Mono
Roads - County of Mono
Fire Layers - Anchor Point Fire Management 2009

0 5 10 20 Miles N

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7.4.3 Community Risk Assessment

In 2009, the County and Town, in coordination with BLM Bishop Field Office, conducted a community-specific wildfire risk assessment for 36 urbanized areas. The area boundaries were selected through a stakeholder process and took into account factors including physical development characteristics such as housing density, lot size, dominant construction types, roadway access and navigational ease; availability of water for fire suppression; and natural characteristics such as slope and vegetation types.

Each area was then assigned a hazard ranking of low, moderate, high, very high, or extreme, based on these characteristics and the fire behavior potential components described in **Section 7.4**. The identified communities and their hazard rankings are shown in **Figure 7.12**. The full methodology for ranking the community areas and profile descriptions of each are available in **Appendix F**.

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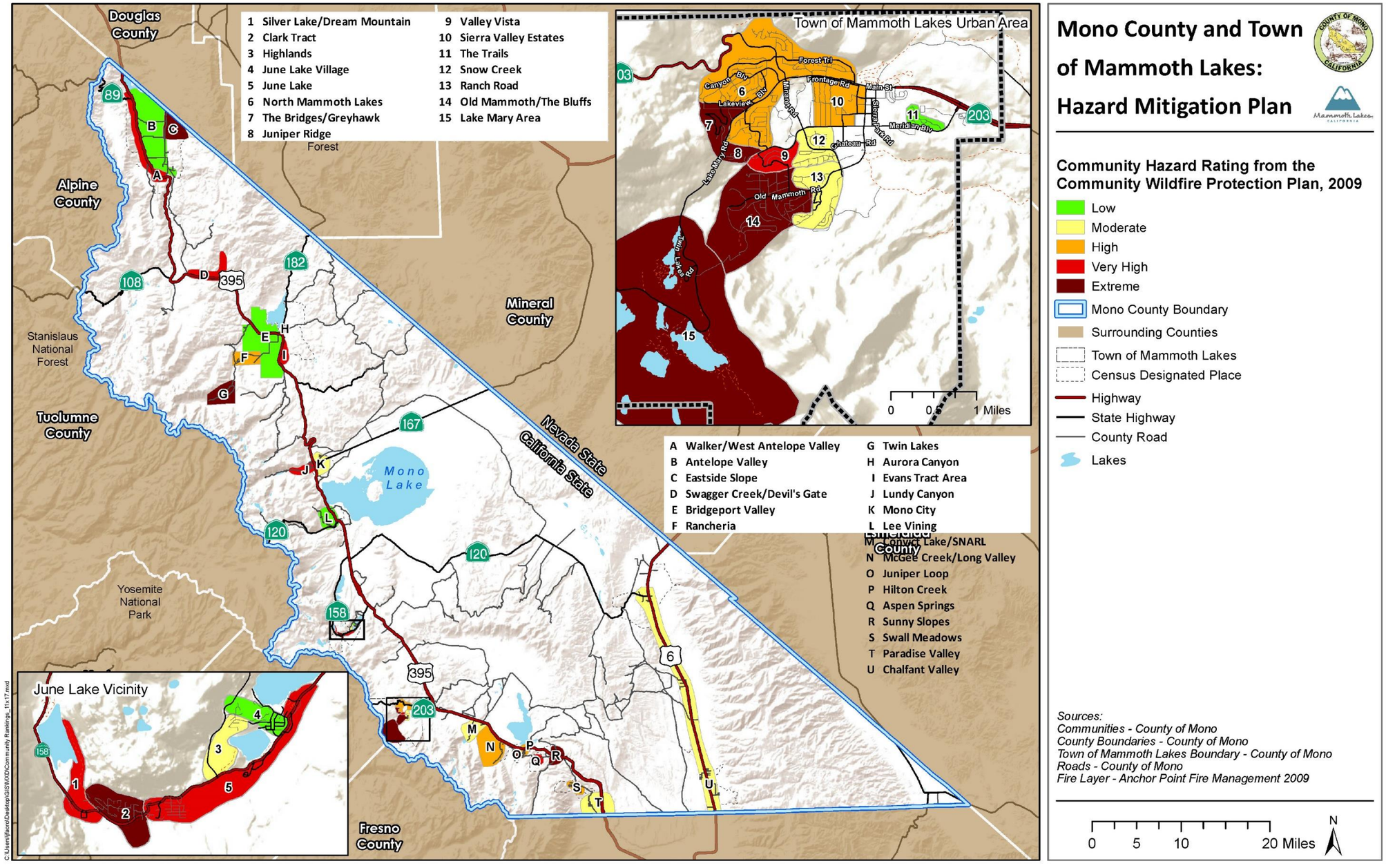
Figure 7.12: Community Area Specific Wildfire Hazard Ranking



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7.5 Changes in Conditions Over the Last Decade

As part of the 2018 CWPP update, physical development characteristics and development growth were reevaluated and confirmed. Each of the key infrastructure components are described below.

7.5.1 Single-Route Access

The communities of Paradise, Swall Meadows, Lundy Lake, Virginia Lakes, and Twin Lakes all only have one access route. Similarly, certain neighborhoods and subdivisions in Mammoth Lakes also have only one access route. Additionally, Mono City and portions of Tom's Place have secondary access routes that are narrow, poorly maintained, dirt roads. Addressing this issue can pose an especially great challenge in Mono County as the vast majority of land and roadways is owned by federal agencies, which are often short-handed on personnel. Identifying land for road siting and ensuring proper maintenance requires extensive coordination between the County, Town, and agencies.

During evacuation and emergency response procedures, the lack of alternative routes could inhibit transportation in and out of most areas. SR 203 is the primary access in and out of the Town of Mammoth Lakes, which connects to US 395. The Mammoth Scenic Loop provides a secondary access route to US 395 when not closed during winter months. Certain neighborhoods in the southern portion of the Town do not have secondary access to either SR 203 or US 395.

7.5.2 Steep, Narrow, and Blocked-Access Roads

In most of the urbanized communities built in sloped environments, many of the roads are very narrow with poor surfaces, are poorly maintained, or are dead ends. Many roads and driveways are dirt, and rutting and washboarding are typical. These inadequacies can make access for emergency vehicles and apparatus difficult or impossible. Fire engines typically require wide turning radius and pullouts for turnarounds on dead-end roads.

Another common obstacle is the existence of locked gates blocking private, state, or federally owned roads and driveways. While concerted multiagency efforts and education campaigns over the last decades have resulted in fewer locked gates or gates with special codes or keys for emergency personnel, the problem persists on some roadways.

7.5.3 Water Supply and Pressure

As with many of the mountainous and rural areas of California, water is a critical fire suppression issue in Mono County. Only a few communities have a reliable source of water via hydrants. Most of the communities are reliant on seasonal ponds and creeks. In areas with limited nearby surface water, large cisterns are necessary but often not available and are difficult to site.

7.5.4 Addressing

In most of the WUI communities in Mono County, missing or inadequate street signage and addressing is an issue. Where applicable, this problem is also noted in the community descriptions in **Appendix F**. Markers of all types, some homemade, are used throughout the study area with no particular order or system. In some parts of Mono County, street signs are broken or worn out. Address numbers on mailboxes, or on the post, are frequently the only indication of the address. In most cases, address marker poles and mailbox poles are made of wood.

There are some community driveways where multiple homes are accessed from a single driveway off the public road. Often these driveways use flagged addressing, a term describing the placement of multiple addresses on a single sign. Flagged addressing can be confusing and difficult to interpret for emergency responders.

Numerous properties throughout the county also have no address markers of any type, or have small, nonreflective addressing that is hidden from view, difficult to see, or mounted onto a flammable material.

The value of the time saved to the welfare of homes and evacuees, especially at night and in difficult conditions, cannot be overestimated. Knowing at a glance the difference between a road and a driveway (and which houses are on the driveway) cuts down on errors and time wasted interpreting maps.

7.5.5 Additional Developments Identified

As part of the 2018 reevaluation, the presence of new or excluded development was assessed. Certain smaller developments with clusters of structures were excluded from the original analysis; these additional areas have been added in **Table 7.7.** These include the Marine Warfare Mountain Training Center; several pockets of development along Sweetwater Road (CA 182) north of the identified Aurora Canyon area; and Crestview, a small clustering of homes and recreational structures both at Crestview directly alongside US 395 and farther west along Deadman Creek Road.

Table 7.7 Physical Development Characteristics

Planning Area	Community Area	Single-Route Access	Steep/ Narrow Roads	Water Supply	Lacks Water Supply/ Pressure	Lacks Adequate Addressing
Mammoth Lakes	Lake Mary Area	x	x	Draft	x	x
	Old Mammoth/ The Bluffs	x	x	Hydrants		x

Table 7.7 Physical Development Characteristics

Planning Area	Community Area	Single-Route Access	Steep/ Narrow Roads	Water Supply	Lacks Water Supply/ Pressure	Lacks Adequate Addressing
	The Bridges/Greyhawk		x	Hydrants	x	x
	The Trails			Hydrants		
	Valley Vista	x	x	Hydrants		x
	Snowcreek	x		Hydrants		
	North Mammoth Lakes		x	Hydrants		x
	Ranch Road	x		Hydrants		x
	Sierra Valley Estates			Hydrants		x
Antelope Valley[1]	Eastside Slope	x	x	None	x	x
	Antelope Valley/Topaz			Draft	x	x
	Walker	x	x	Draft	x	
Sonora Junction	Swauger Creek/Devil's Gate	x		Draft		x
	Mountain Warfare Training Center			Draft	x	
Bridgeport Valley	Bridgeport Valley			Hydrants		
	Twin Lakes	x	x	Draft	x	
	Virginia Lakes	x	x	Draft	x	x
	Rancheria-Bridgeport			Creek weir (portable pump)	x	
	Aurora Canyon	x		Hydrants		
	Sweetwater Road			Draft		x
	Evans Tract Area			Hydrants		x
Mono Basin	Lundy Canyon	x	x	Draft	x	
	Mono City		x	Hydrants	x	x
	Lee Vining			Hydrants		
June Lake	June Lake		x	Hydrants		x
	June Lake Village			Hydrants		

Table 7.7 Physical Development Characteristics

Planning Area	Community Area	Single-Route Access	Steep/ Narrow Roads	Water Supply	Lacks Water Supply/ Pressure	Lacks Adequate Addressing
	Clark Tract		x	Hydrants		x
	Petersen Tract	x		Hydrants		
	Highlands			Hydrants		
	Silver Lake & Dream Mountain			Hydrants		x
Mammoth Vicinity	Crestview		x	Draft		x
	Convict Lake & SNARL	x		Hydrants	x	
Crowley Lake	McGee Creek/ Long Valley			Hydrants		x
	Juniper Loop		x	None	x	x
	Sunny Slopes	x	x	Hydrants	x	
	Aspen Springs	x		Cistern	x	
	Hilton Creek	x		Hydrants		
Tri-Valley	Chalfant Valley		x	None	x	x
Swall Meadows	Swall Meadows	x	x	Tank/ Cisterns	x	x
	Swall Meadows – Rimrock Ranch			Tank/ Cisterns		
	Paradise	x		Hydrants		

[1]Water tanks may be required on properties in certain areas

In general, conditions in the developed areas have not changed significantly since the hazard rating was first completed in 2009. However, certain areas have either seen additional growth which may increase the number of community assets at risk, or were not included within an analyzed area despite densities of structures existing. These include:

- **Old Mammoth/The Bluffs**: As documented in **Chapter 2**, a number of new single-family and multifamily homes were built between 2015 and 2018 on the southern edge of the Old Mammoth neighborhood, such as the Snowcreek neighborhood and in The Bluffs subdivision.
- **Mono City**: Additional low-density housing development on the southern side of Mono City was built after 2009.

- **Paradise**: Additional residential units and complementary uses were approved on the site of a former lodge. The development was approved in 2010.

Table 7.7 summarizes 2018 characteristics for 39 identified areas. Projects identified in the table that address a lack of infrastructure are the highest priority for the County and Town.

7.5.6 Fuels and Vegetation

The amount and arrangement of fuels is one factor, along with weather and topography, that can alter fire behavior. A greater fuel load, or the amount of fuel in an area, is associated with an increase in fire intensity and the ability of surface flames to ignite a crown fire (Bennett et al. 2010).

Much of the available data for wildfire hazard location, intensity, and behavior potential in Mono County, including what is shown in this CWPP, is based on inputs from Cal Fire's vegetation and surface fuel mapping. Cal Fire FRAP data, in cooperation with California Department of Fish and Wildlife VegCamp program and extensive use of USFS Region 5 Remote Sensing Laboratory data, compiled the "best available" land cover data for California into a single comprehensive statewide data set, with data spanning a period from approximately 1990 to 2014. The Cal Fire surface fuels data is shown in **Figure 7.13**.

While Cal Fire's vegetation data is the most comprehensive available, the age of the data means it does not fully reflect 2018 conditions. Varied factors have changed the vegetation landscape of Mono County, and consequently the fuel load that directly influences fire hazard and fire behavior. These include:

Wildfire events

Of the more than 64 fires discussed above, more than 40 have occurred, burning more than 80,000 acres, since vegetation mapping was last updated in 2003 and incorporated into the state's wildfire hazard mapping. While many of these high-intensity fires greatly reduce fuel loads in the short term, those that reach highest intensities can completely change the fire regime, and ultimately the fire likelihood and behavior potential.

Fuels modification projects

Since 2009, the USFS has completed more than 800 fuel modification actions, such as fuel breaks, prescribed burns, and thinning in Inyo National Forest. Although these projects cannot noticeably alter wildfire hazard severity areas, they can reduce risk to communities by promoting forest health, minimizing the size of fires, and helping prevent them from reaching people and structures. Several major fuel reduction projects to protect specific communities have been undertaken by the USFS from 2009 to 2018. These projects are described below.

- **Crowley Communities Hazardous Fuels Reduction Project:** Removal of hazardous fuels, by fuel breaks, chipping, piling, and thinning around the communities of Aspen Springs, Crowley, McGee Creek, Sunny Slopes, and Tom's Place.
- **Three Creeks Jeffrey Pine Forest Health and Restoration Project:** Provides for healthy forest conditions, promotes establishment of old growth, and reintroduces fire to the ecosystem through pre-commercial and commercial thinning of trees, piling of fuels, burning of piles, and forest disease control measures.
- **June Lake Loop Hazardous Fuels Reduction Project:** Fuels reduction work on 4,578 acres within WUI defense and threat zones in the June Lake Loop. Treatments include tree thinning, shrub cutting or mowing, prescribed fire, conifer removal from aspen, and slash pile burn or chip.
- **Lake Mary Treatment Plant Hazardous Fuels Reduction Project:** Cooperative effort with Mammoth Community Water District to reduce fuels on 8 acres around the district's Lake Mary Water Treatment Plant. Treatments include thinning, chipping, cutting, piling and removal of fuels by carrying or dragging.
- **Lost Lane Fuels Reduction Project:** Cooperative effort with Mammoth Lakes Fire Protection District on a total of about 175 acres in the Old Mammoth area. Treatments include thinning, chipping, and removal of fuels by carrying or dragging.
- **Mill City Fuels Reduction Project:** Reduces the risk of catastrophic wildfire and protects community, water quality, and recreation values through vegetation treatments, primarily thinning, piling, burning, and chipping, on 55 acres of public land within and adjacent to the community of Mammoth Lakes.
- **Sherwin Scenic Loop Hazardous Fuels Reduction Project**: Treatment to reduce hazardous fuels such as brush and trees in the Sherwin Creek, Mammoth Creek, and Mammoth Scenic Loop areas surrounding the Mammoth Lakes community, including thinning, piling, and disease control measures.
- **Rust II**: Thinning to reduce fuels and improve forest health on approximately 500 acres of Jeffrey pine forest located off of Bald Mountain Road.

During this period, there was also continued maintenance of a fuel break near Swall Meadows, including burning of piled materials; environmental analysis was completed in 2017 for additional fuel treatments on 108 acres adjacent to Swall Meadows, intended to lower flame length and severity while providing defensible space and safe access for the public and firefighters. The maintenance and expansion of area covered by the 2011 Mono City Hazardous Fuel Reduction Project and additional projects in Bridgeport

Valley and Antelope Valley are also recommended. Both historic fire incidence and flame behavior modeling shows these planning areas to have the most extreme hazard from wildfire. In addition, since 2009 the BLM Bishop Field Office has overseen fuel breaks in Antelope and Benton valleys and to protect the Golden Gate Mill historic site, as well as multiple ecological restoration projects on BLM land with fuel-reduction benefits. The areas addressed by these projects are shown in **Figure 7.14.**

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Figure 7.13: Mono County Surface Fuels from Cal Fire

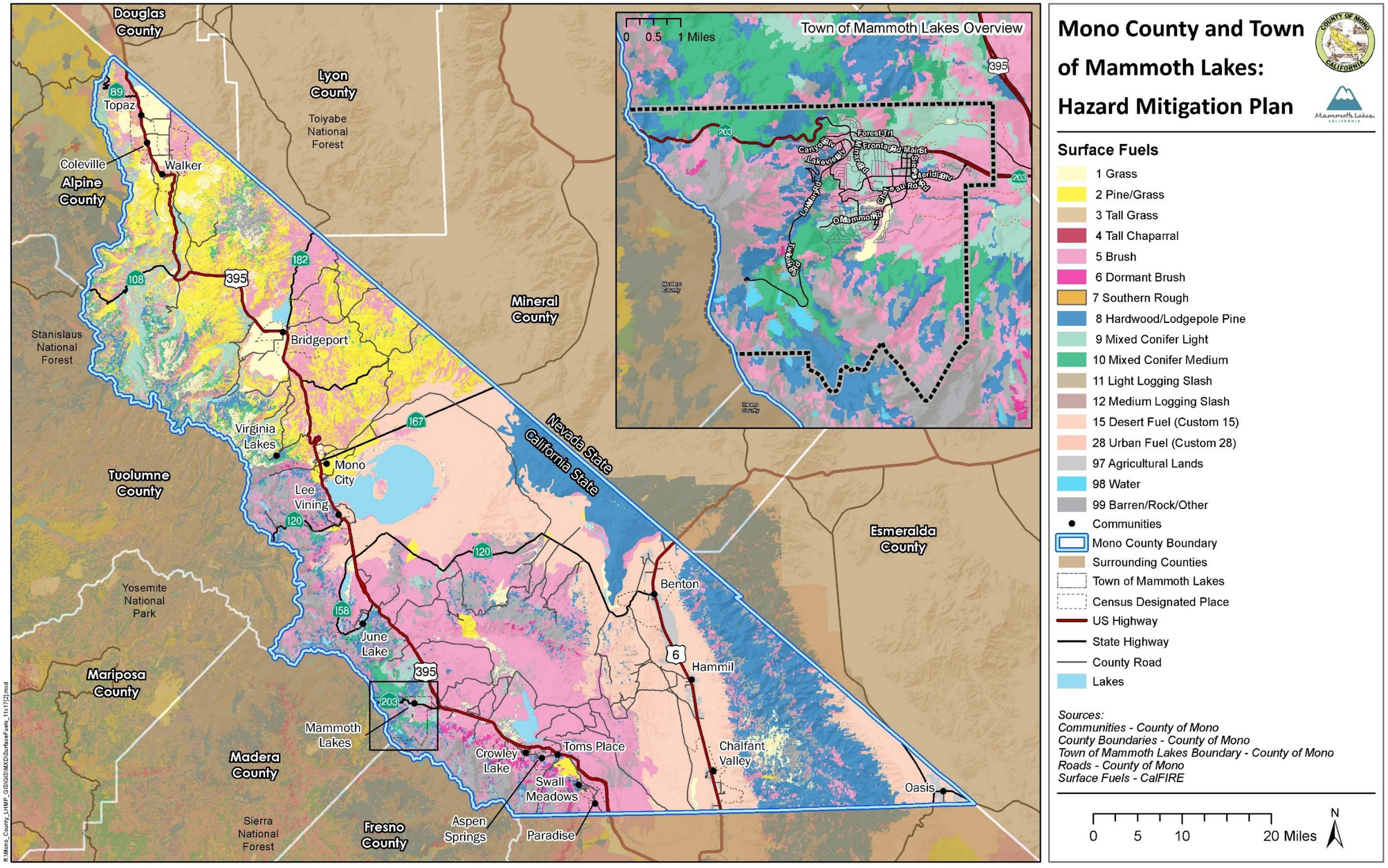

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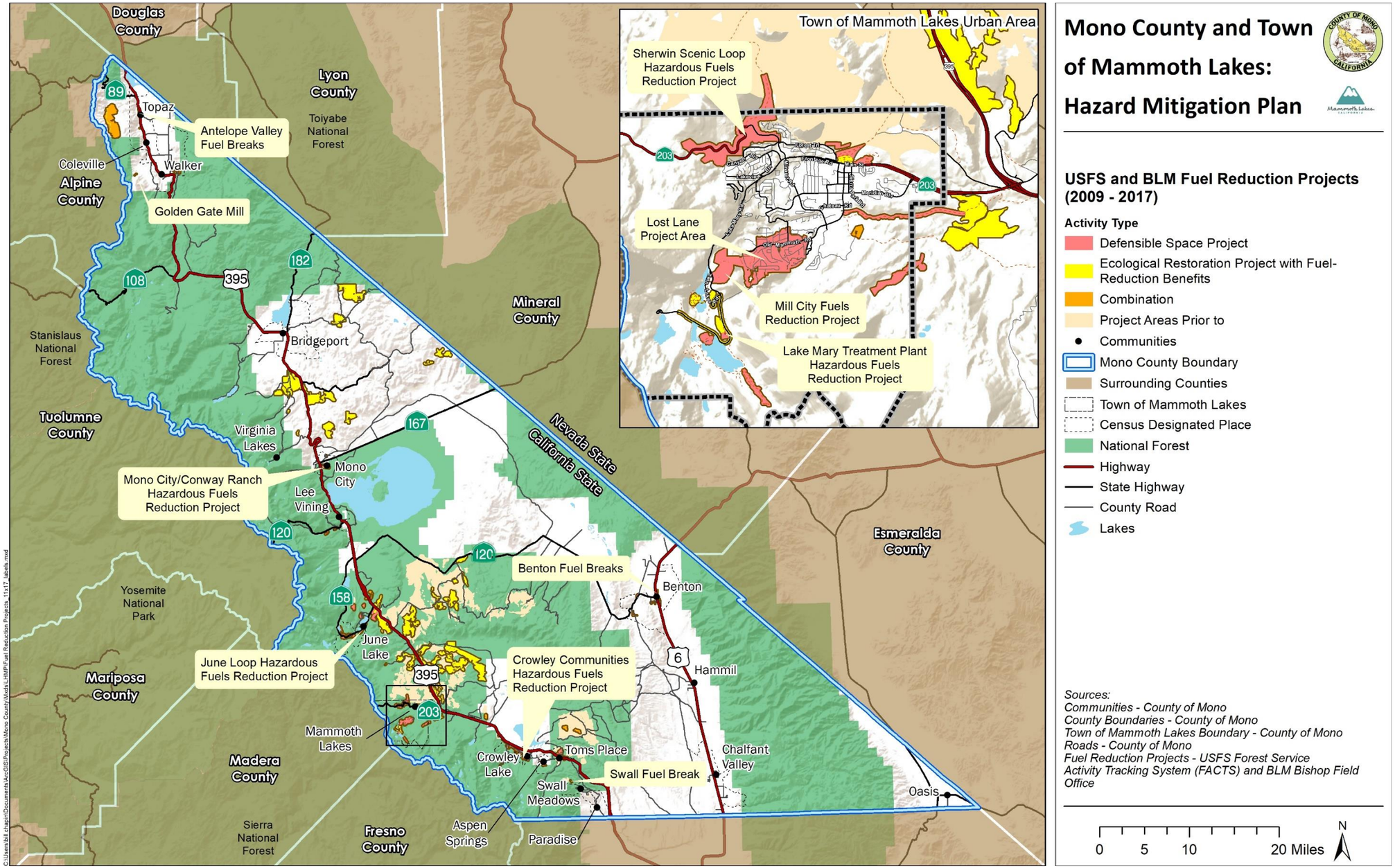
Figure 7.14: Major Fuel Reduction Projects in Mono County, 2009–2018



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The 2009 CWPP identified a total of 34 existing fuels modification projects within Mono County on federal land, including Inyo and Humboldt-Toiyabe national forests and public lands managed by the BLM's Bishop Field Office. These projects date back to 1999. In addition, the plan identified 11 future BLM projects. **Table 7.8** provides an update on the status of these projects along with any additional projects that were identified during the planning process. In some cases, work is currently in progress to expand the number of treated acres within the total project area, while in others there is ongoing maintenance. In still others, there is no current work being done. Maintenance of all projects in the coming years is vital.

Table 7.8 Status of Existing Fuels Modification Projects in Mono County

Project Name	General Location	Year Implemented	Acres Completed	Status
BLM Bishop Field Office				
Swall Meadows Fuelbreak	Swall Meadows	2001	46	Complete
Golden Gate Mill	Walker/Coleville/Topaz	2004	3	Complete
Mono City/Conway Ranch	Mono City/Conway Ranch	2004	15	Continuing maintenance
Pinyon MX	Virginia Creek Settlement	2004	1,000	Continuing maintenance
Virginia Creek Lodgepole Pine Removal/Aspen Habitat Improvement	Virginia Creek Drainage	2004	30	Complete
Evaluation of Pinyon Removal Effects Typical of a Wildland-Urban Interface Fuels Reduction	Mono Basin	2005	105	Complete
Invasive Weed and Hazardous Fuels Reduction Project for Marine Housing, Slinkard, Aristo Ranch, and Dry Canyon Allotments	Walker/Coleville/Topaz	2006	800 (7,000 planned)	In progress/ ongoing
Benton Fuelbreaks	Benton/Benton Hot Springs	2007	55	Continuing maintenance
Dog and Green Creek Aspen Drainages Habitat Improvement	Dog and Green Creek	2007	50	Complete
Fish Slough Prescribed Burn	Fish Slough	2008	176	Continuing maintenance

Table 7.8 Status of Existing Fuels Modification Projects in Mono County

Project Name	General Location	Year Implemented	Acres Completed	Status
Slinkard Valley Interagency	Walker/Coleville/Topaz	2011	2,307	Continuing maintenance
Aurora Canyon Sage-Grouse Habitat Improvement Project	East of Bridgeport	2012	627	Complete
Eastside Lane	Walker/Coleville/Topaz	2013	65	Continuing maintenance
Bodie Hills Upland Vegetation Restoration	Bodie/Bodie Hills	2016	Treatment started on 3,584 acres. Maximum 21,330-acre treatment area	In progress/ ongoing
USFS Inyo National Forest				
Swall Meadows Community Defense	Swall Meadows	1998	46	Complete
DeChambeau Ranch and Meadow	Mono Basin	1999	47	Complete
West Tunnel	June Lake Junction	1999	1,260	Complete
Mammoth Rehab Fuelbreak	Mammoth Lakes	2002	329	Complete
Railroad	Mono Mills	2003	3,058	Complete
Mono City	Mono City	2004	80 (93 planned)	In progress/ ongoing
Smoke, Lookout, Crestview, Aqueduct and Pilot Timber Compartment	Crestview/Bald Mountains	2004	11,672 (14,187 planned)	In progress/ ongoing
Swall - Witcher Fuels Reduction	Swall Meadows	2004	191	Complete
June Lakes Hazardous Fuels Reduction	June Lake	2005	35	Complete
Jeffrey Pine Forest Health and Fuels Reduction	Mammoth Lakes/June Lake	2007	4,228 (ongoing logging on 300 acres)	In progress/ ongoing

Table 7.8 Status of Existing Fuels Modification Projects in Mono County

Project Name	General Location	Year Implemented	Acres Completed	Status
Windmill Amendment to Smoke Lookout, Crestview, Aqueduct, and Pilot Timber Compartment	Owens River Road	2007	320	Complete
June Fire Forest Restoration	June Lake Junction	2008	86	Complete
Mill City	Mammoth Lakes	2008	130	Complete
Rust II Forest Heath and Fuels Reduction	Bald Mountain	2009	461	Complete
June Loop Hazardous Fuels Reduction Project	June Lake	2011	1,126 (4,578 planned)	In progress/ ongoing
Lake Mary Water Filtration Plant Hazardous Fuels Reduction Project	Mammoth Lakes	2011	9	Complete
Casa Diablo Understory Maintenance Burning	Casa Diablo	2017	Ongoing maintenance burning on 10,823-acre area	Continuing maintenance
USFS Humboldt-Toiyabe National Forest				
Camp Antelope Piles	Walker/Camp Antelope	2009	50	Complete
Mill Canyon	Walker/Camp Antelope	2009	380* (2,900 planned)	In progress/ ongoing
MWTC Sonora Pass	Sonora Pass	2009	180	Complete
Twin Lakes	Twin Lakes Drainage	2011	210* (1,874 planned)	In progress/ ongoing
* Work will occur during the 2018-2019 season.				
Interagency Projects				
Antelope Valley Interagency Hazardous Fuels Reduction (BLM, Humboldt Toiyabe National Forest)	Walker/Coleville/Topaz	2005	391	Complete
Doe Ridge Interagency Prescribed Fire (BLM, Inyo)	Long Valley	2009	995	Complete

Table 7.8 Status of Existing Fuels Modification Projects in Mono County

Project Name	General Location	Year Implemented	Acres Completed	Status
Crowley Communities Interagency (BLM, Inyo)	Crowley Lake	2011	341 (1,585 planned)	In progress/ ongoing

Table 7.9 identifies planned fuels modification projects within Mono County for both BLM and Inyo National Forest. There are currently no fuels modification projects within Mono County planned for Humboldt-Toiyabe National Forest other than ongoing work on existing projects. Previously proposed projects for which there has been no work completed thus far and no work is currently planned are not included in this CWPP update.

Table 7.9 Future Fuels Modification Projects in Mono County

Project Name	Agency	General Location	Acres Planned
Walker Fuelbreaks	BLM	Walker/Coleville/Topaz	0.2
Coldwater Campground Fuelbreak	Inyo NF	Mammoth Lakes Basin	0.2
Lakes Basin Hazardous Fuels Reduction Project	Inyo NF	Mammoth Lakes Basin	700
Lee Vining Creek Watershed Restoration and Hazardous Fuels Reduction Project	Inyo NF	Lee Vining	7,989
Reds Valley Hazardous Fuels Reduction Project	Inyo NF	Reds Meadow Valley	4,478
Swall Meadows Access Thinning	Inyo NF	Swall Meadows	108

Tree Mortality

Large numbers of trees have died in Mono County and across the state as the result of the record six-year drought from 2011 to 2017. The drought weakened trees and left millions of acres of forestland highly susceptible to bark beetle attacks. The drought stress was exacerbated in forests with too many trees competing for limited resources, especially water.

In 2015, Cal Fire identified areas of greatest tree mortality in the state and the potential impacts in relation to life and property, as shown in **Figure 7.15**. The figure shows the tree mortality that was recorded from 2012 through 2016 within two tiers. Tier 1 zones are areas identified by Cal Fire where tree mortality coincides with critical infrastructure such as roads, utilities, and public schools, which represents a direct threat to public safety. Tier 2 zones are areas defined by watersheds that have significant tree mortality as well as significant community and natural resource assets. Work at the Tier

2 level addresses the immediate threat of falling trees and fire risk, and also supports broader forest health and landscape-level fire prevention planning issues.

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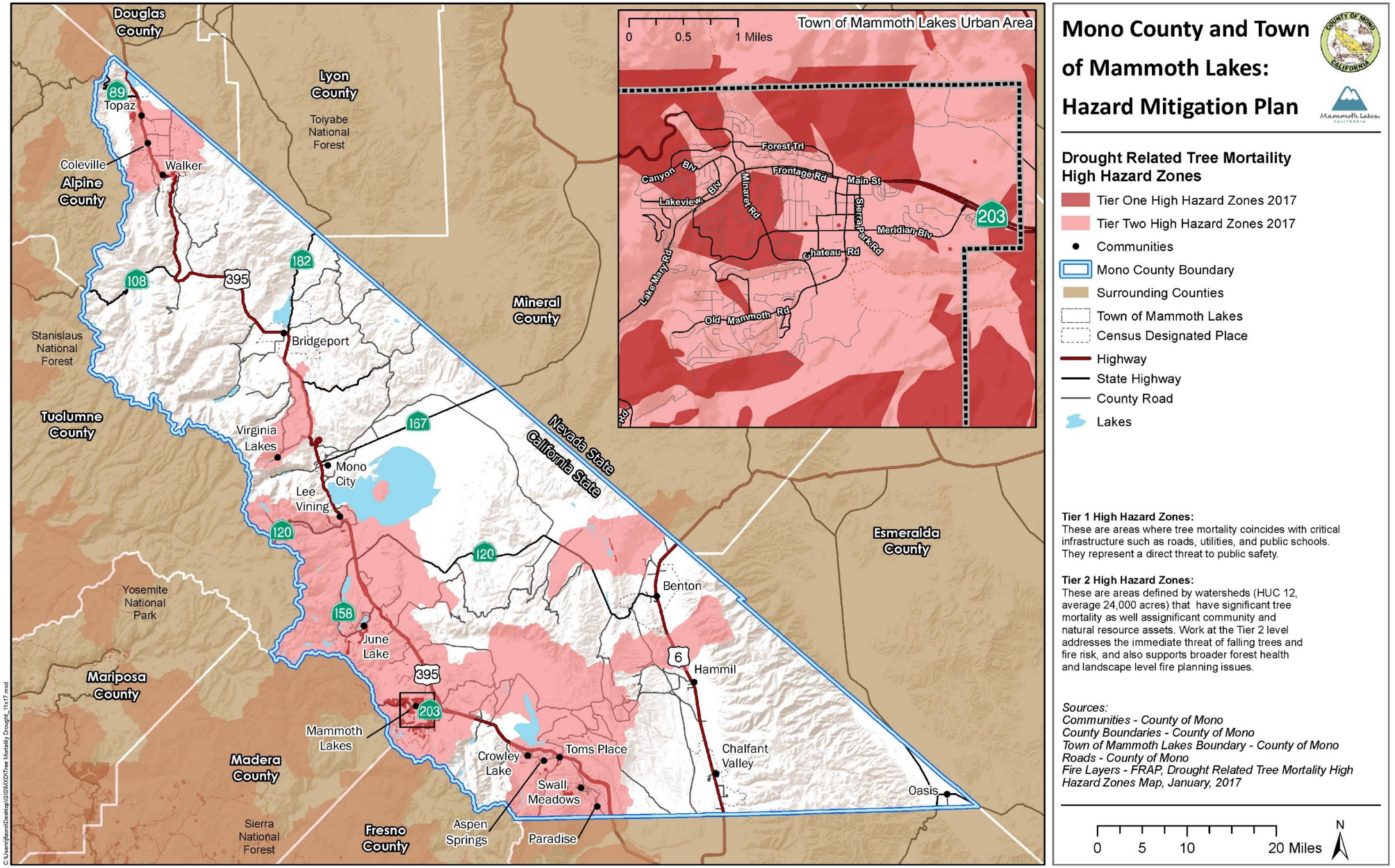
Figure 7.15: Drought-Related Tree Mortality and Hazard Zones



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7.5.7 Drought

Extended drought conditions reduce the moisture levels in fuels, which can lead to more fires of greater intensity (Bennett et al. 2010). Since the 2009 CWPP and associated fire modeling were completed, California experienced a historic, six-year drought. Near the end of the drought in 2016, nearly all of Mono County was in extreme drought conditions.

As discussed above, the drought resulted in an increase in tree mortality in the area. Additionally, given the length and severity of this drought, it is possible that a fire behavior model that incorporated weather observations since 2006 would show different results from the model presented in **Section 7.4**. Data collected at weather stations would likely show lower average measures of fuel moisture. As a result, the modeling for the moderate fire weather scenario, which represents an average day during fire season, would more closely resemble the extreme scenario, with longer flame lengths, faster spread rates, less torching, and more active crown fire activity in some locations.

7.5.8 Future Probability

Based on the recent frequency of major fires, in the next five years Mono County can expect about three wildfires that burn at least 1,000 acres. In addition, the probability of these wildfires causing damage to people or structures has increased within the past 20 years, as more people have built homes at the WUI and have chosen to become permanent residents of the region.

The impacts of climate change suggest a continuing and accelerated risk from wildfire. Climate change scenarios suggest more frequent droughts (Diffenbaugh et al. 2015) and higher fire severity in some portions of the state (Fried et al. 2007. Increasing temperatures have implications for vegetation distribution, which may further increase future fire extent and fire intensity (Lenihan et al. 2003). Some ecosystems may not be able to adapt fast enough to increasing drought stress, resulting in large-scale mortality from insects, fire, or disease). These future climate scenarios combined with continuing projections of residential growth into the wildland (Mann et al. 2014) suggest that existing wildfire-related problems are poised to become even larger in the near future.

Cal-Adapt estimates an increase of 1,500 to 2,600 hectares of burn area in the county by the year 2099. The estimated burn area in Mammoth Lakes is approximately double that of the annual mean burn area for the last several decades.

7.6 Wildfire Risk Reduction Actions

The information in the previous sections of this CWPP identifies the need for an action plan to mitigate the negative impacts from a wildland fire for the communities in Mono County. The entire intent of a CWPP is to provide a means to make WUI communities less vulnerable to the destructive forces of an

uncontrolled wildland fire. To best reduce risk and vulnerability, the County and Town prioritize the following:

Fuel Treatment Projects: Fuel treatment projects within the WUI and adjacent to urbanized communities, while recognizing that broader health and management of the larger wildland environment is also important for long-term mitigation.

Infrastructure Lacks: Projects that address infrastructure and response needs of community areas at greatest wildfire risk, as detailed in **Figure 7.12** and **Table 7.6**.

Parcel-Specific CWPPs: Projects recommended by local CWPPs. The County encourages its communities and Fire Safe Councils to prepare parcel-specific CWPPs, and, to the extent feasible, supports recommended projects that emerge from these plans, such as activities that educate community members about fire risk and how to prepare and protect their own properties against fire risk. While safety and fire management personnel in the county work to reduce risk as much as possible, community responsibility for self-protection from wildfire is essential. It is the priority of Mono County and the Town of Mammoth Lakes to work with communities and citizens to educate, inform, and involve them in all aspects of the wildfire issues facing its communities. Swall Meadows and Paradise recently completed a combined Cal Fire-funded parcel-specific CWPP (completed in January 2019). The Wheeler Crest Fire Safe Council obtained the grant and oversaw the project. The January 2019 Wheeler Crest CWPP is attached as **Appendix I**.

Home Improvements: Ensuring safety of homes and private property. Construction type, condition, age, the fuel loading of the structure/contents, and position are contributing factors in making homes more susceptible to ignition under even moderate burning conditions. There is also a likelihood of rapid fire growth and spread in these communities in general due to steep topography, fast-burning or flashy fuel components, and other topographic features that contribute to channeling winds and promote extreme fire behavior. Therefore, compliant, effective defensible space for every home in the study area is the most important element for protecting life and property. Defensible space is especially important for homes with wood roofs and homes located on steep slopes, in chimneys or saddles, or near any topographic feature that contributes to fire intensity. Due to the nature of the vegetation and topography, combined with the majority of homes situated on medium-sized parcels, an aggressive program of evaluating and implementing defensible space for all homes will do more to limit fire-related property damage than perhaps any other single recommendation in this report. Various high-quality reports and manuals are available to guide homeowners in construction and defensible space best practices, which supplement building codes from Cal Fire (California Code of Regulations (CCR), Title 24, Part 2), Mono County (Municipal Code Chapter 22), and the Town of Mammoth Lakes (Municipal Code Chapter 15.04).

Fire Management Best Management Practices for Sage-Grouse Conservation: Support of fire management best management practices for protection of sage-grouse habitat to minimize the risk of catastrophic wildfire, as directed by the Bi-State Action Plan. The County and Town will support and assist the USFS and BLM-Bishop in executing best management practices identified by those agencies. This includes active collaboration with the Bi-State Local Area Working Group and Bishop Field Office on cooperative habitat restoration projects. Recent projects have included conifer removal, improved grazing management, and fence marking. All projects are intended to further conservation of the Bi-State Distinct Population Segment of Greater Sage-Grouse, under the guidance of the Nevada Governor's Sage Grouse Conservation Team. The fire management best practices utilized by both BLM-Bishop and Inyo National Forest as they implement the Bi-State Action Plan's wildfire strategy are identified in Appendix C of BLM-Bishop's Fire Management Plan.

Table 7.10 summarizes recommended actions for Mono County and the Town of Mammoth Lakes to reduce wildfire risk. Measures directly linked to wildfire mitigation are located in **Chapter 5** of the MJHMP.

Table 7.10 Recommended Preparedness and Response Actions

Action Number	Action
C.1	Develop a regional training program to facilitate local training for structural and wildland firefighting.
C.2	Work with state and federal agencies to conduct basic wildfire suppression and multiagency Incident Command System (ICS) training.
C.3	Work with state and federal agencies to conduct the pack test and annual refresher courses to work with local fire department schedules.
C.4	Consider adopting "appropriate response" or indirect fire suppression tactics in remote areas, given the threat from heavy fuel loading and the lack of County resources.
C.5	Train local fire departments and fire safe councils on how to create defensible space around homes.
C.6	Provide minimum wildland personal protective equipment for all career and volunteer firefighters.
C.7	Maintain and distribute a list of frequencies for each fire department and list the associated channels.
C.8	Test hydrants annually to ensure they are operational, obstruction-free, and visible.
C.9	Operate a public information campaign for both residents and visitors to learn about and ensure their phone numbers are provided to the CodeRed Emergency Alert System database.

Table 7.10 Recommended Preparedness and Response Actions

Action Number	Action
C.10	Provide training for "stay and defend" tactics as a last resort for communities at highest fire risk.
C.11	Conduct annual Radio Rodeos, in coordination with state, federal, volunteer, and County staff, to share and consolidate procedures and equipment use.
C.12	Purchase and install fire-hardened structures to store gasoline for emergency-vehicle fueling along major evacuation routes.
C.13	Identify communities most in need of backup generators for water supply and work with those communities to obtain the appropriate equipment and permits.
C.15	Where secondary pressurized water sources exist (golf courses, development landscaping, or other types of sprinkler systems), develop a procedure for quickly activating these systems.
C.16	Ensure that any and all Address Map books are updated to reflect information stemming from this CWPP. Consider the development of a Wildfire Pre-Attack Plan.
C.17	Where dead-end and private road markers occur, the addresses of homes beyond the marker should be clearly posted.
C.18	Develop a grant program to renovate older structures with code-compliant exterior materials.
C. 19	Develop an animal evacuation plan as time and funding allow.

7.7 Website Resources

- American Red Cross, http://www.redcross.org/services/disaster
- Bureau of Land Management, http://www.blm.gov
- Cal Fire, http://www.fire.ca.gov
- California Department of Fish and Wildlife, https://www.wildlife.ca.gov
- California Governor's Office of Emergency Services, http://www.oes.ca.gov
- California Fire Alliance, http://www.cafirealliance.org
- Coarsegold Resource Conservation District, http://www.crcd.org
- Fire Effects Information System, http://www.fs.fed.us/database/feis
- Fire Safe Council, http://www.firesafecoucil.org
- Firewise, http://firewise.org
- Madera County, http://www.Madera-County.com
- National Fire Prevention Association, http://www.nfpa.org/codes
- North Fork Chamber of Commerce, http://www.north-fork-chamber.com
- Oakhurst Area Chamber of Commerce, http://www.oakhurstchamber.com
- Office of State Fire Marshal, http://www.osfm.fire.ca.gov
- Public Domain Software for the Wildland Fire Community, http://www.fire.org
- Sierra Nevada Alliance, http://www.sierranevadaalliance.org
- Threatened and endangered species, http://imaps.dfg.ca.gov/CNDDB_QuickViewer/list_county_species.asp
- United States Forest Service, http://www.fs.fed.us

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