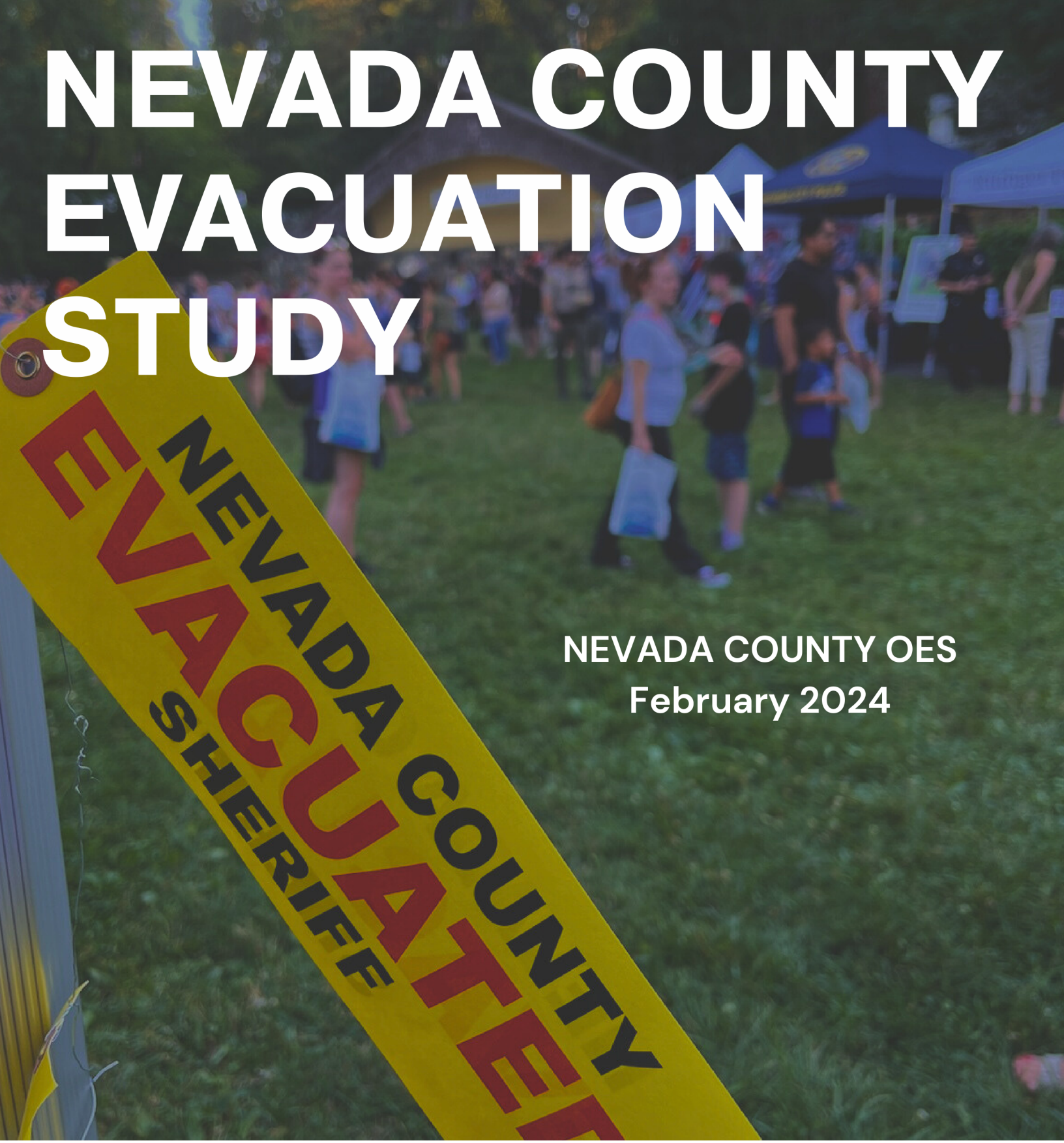
NEVADA COUNTY EVACUATION STUDY



NEVADA COUNTY OES
February 2024

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NEVADA COUNTY CALIFORNIA

LADRIS™

February 2024

NEVADA COUNTY EVACUATION STUDY

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OFFICE OF EMERGENCY SERVICES

NEVADA COUNTY CALIFORNIA | Office of Emergency Services

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ASPOA	Alta Sierra Property Owners Association
BehavePlus	Software Fire Modeling System
Board	Board of Forestry and Fire Protection
Caltrans	California Department of Transportation
CAL FIRE	California Department of Forestry and Fire Protection
CCR	Covenants, Conditions, and Restrictions
CH/H	Chains Per Hour
CHP	California Highway Patrol
CIP	Capital Improvement Plan
ECT	Evacuation Clearance Time
ERC	Energy Release Component
FBAN	Fire Behavior Analyst
FEMA	Federal Emergency Management Agency
HOA	Homeowner Association
IFTDSS	Interagency Fuel Treatment Decision Support System
LAFCO	Local Agency Formation Commission
LF	LANDFIRE
LOS	Level of Service
LRA	Local Responsibility Area
MOU	Memorandum of Understanding
MPH	Miles Per Hour
NCTC	Nevada County Transportation Commission
NFDRS	US National Fire Danger Rating
NID	Nevada Irrigation District
OES	Office of Emergency Services
OPR	California Office of Planning and Research
PODS	Potential wildland fire Operational Delineations
PRC	Public Resource Code
RAWS	Remote Automated Weather Station
SB 99	California Senate Bill 99
SRA	State Responsibility Area
SSDE	Safe Separation Distances Evaluation
TU5	Timber Understory 5
TRA	Temporary Refuge Areas
USDA Forest Service	United States Department of Agriculture Forest Service
VHFHSZ	Very High Fire Hazard Severity Zones
WUI	Wildland-Urban Interface

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1 Executive Summary

Nevada County, known for its diverse landscapes encompassing both the 7,000-foot Donner Summit and Sierra Nevada mountains as well as 1,000-foot foothill oak woodlands, faces significant challenges due to the escalating wildfire risks in its wildland-urban interface (WUI). This evacuation study, conducted by PyroAnalysis, LLC, in partnership with local departments, and state agencies and with Ladris Technologies' expertise, tackles these challenges through a comprehensive, community-informed, and data-driven approach. By analyzing fire behavior, human behavior, traffic management, and infrastructure capacity, this study aims to develop actionable plans that establish a resilient strategy for effective emergency evacuations.

While Nevada County has yet to experience the level of wildfire devastation seen in other California counties over the past decade, it is not immune to the impacts of climate change and increasingly severe wildfires. The inevitability of wildfires in the region necessitates proactive planning. Qualitative information combined with quantitative traffic operations data, analyzed using Ladris software, offers valuable insights for community planners and first responders as they develop strategies to improve the wildfire resiliency of their communities and the safety of evacuation routes.

1.1 Key Elements of the Study

1. **Document Research**: Examining county and regional planning efforts and conducting a literature review to identify evacuation planning best practices and emergency readiness.
2. **Stakeholder Interviews**: Engaging in in-depth discussions with local emergency services, community leaders, and decision-makers to gain insights into practical evacuation challenges and past experiences.
3. **Field Surveys**: Inspecting crucial evacuation routes and critical infrastructure to assess real-world conditions, bottlenecks, and practical evacuation challenges.
4. **Data Analysis**: Conducting extensive data analysis using advanced traffic and fire behavior modeling techniques to comprehend and predict fire spread scenarios and traffic flow.
5. **SB 99 Accessibility Assessment**: Reviewing evacuation routes and infrastructure compliance with the standards set by California Senate Bill 99, with a focus on accessibility and safety.
6. **Emergency Evacuation Assessment**: Utilizing Ladris evacuation modeling software for dynamic traffic assessment, along with a review of fire behavior studies and stakeholder input to develop comprehensive evacuation outcome improvements.
7. **Human Behavioral Considerations**: Emphasizing public awareness, education, and the importance of clear and timely communication to address the critical human behavioral aspects of successful evacuation.
8. **Fire Behavior Analysis**: Conducting a historical and predictive analysis of fire behavior in Nevada County, incorporating various climatic and topographic factors to understand and plan for potential wildfire scenarios.

1.2 Outcomes and Recommendations

The comprehensive deliverable of the Evacuation Study is a written document that includes:

- Mapped evacuation routes and tailored strategies for the five most evacuation-vulnerable areas in Nevada County
- Analysis of fire behavior and traffic dynamics essential for effective evacuation planning
- Recommendations for roadway improvements and wildfire mitigation projects to enhance evacuation route safety and capacity

This study evaluated each of the focus areas based on the significant potential for catastrophic wildfire events (Alta Sierra and Greenhorn Road had the greatest potential) and evacuation clearance time (Lake of the Pines had the longest), among other factors. The conclusion is that all areas require efforts to enhance their wildfire resilience. This study recommends focusing on two broad areas: (1) evacuation route improvements and (2) wildfire mitigation strategies. While specific details vary for each area, the following are recommended across all study areas:

Roadways

- Continue to collaborate with Nevada County Transportation Commission and Caltrans.
- Add turnouts.
- Expand shaded fuel breaks.
- Expand collector roads and widen shoulders.

Wildfire Mitigation

- Vegetation Management
  - Drastically reduce fuel loads along roads and near homes.
  - Ensure defensible space standards are met or exceeded, including establishing an ember-resistant zone in defensible space (“Zone 0”).
  - Limb and thin trees.
  - Open the tree canopy to prevent crown fires.
  - Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners in working with regulatory agencies to achieve wildfire resilience outcomes on private land.
- Home Hardening
  - Enhance building regulations to align with Very High Fire Hazard Severity Zones.
  - Replace flammable materials with limited, noncombustible, or flame-resistant materials.

This study provides a road map for enhancing community resilience against wildfires, emphasizing the importance of a multifaceted, collaborative approach in emergency planning. By combining scientific analysis with real-world applicability, the findings and recommendations aim to ensure that Nevada County is better prepared and equipped to manage and mitigate the risks associated with wildfires.

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2 Introduction

Rural Nevada County is home to over 100,000 people dispersed over 974 square miles that stretch from the gently sloping oak woodlands in the west, over Donner Summit, and down into the east-Sierra destination town of Truckee. The county is widely recognized for its Gold Rush–era significance and has long been touted for its picturesque landscapes, including beautiful forests and historic towns and cities; resources like fresh water and timber; and vibrant, diverse communities, including two of California's 14 Cultural Districts. This part of North Central California is also becoming known for its wildfire risks. The wildland-urban interface (WUI), defined as the area where structures are in or near wildland vegetation, is the area where wildfires pose the greatest risk to people due to the proximity of flammable vegetation.[1] Considering Nevada County's setting with Tahoe National Forest to the east and the oak woodlands to the west, wildfire risks are severe and ever-present, challenging the communities' way of life and the geography and infrastructure that people rely upon.

Three primary factors have produced gradual but significant change across western North American landscapes in recent decades: the warming and drying climate, the buildup of fuels, and the expansion of the WUI.[2] This has created harsh consequences in California:

> Between 2017 and 2019, California experienced a series of devastating wildfires that together led over one million people to be ordered to evacuate. Due to the speed of these wildfires, residents across California found themselves in challenging evacuation situations, often at night and with little time to escape. These evacuations placed considerable stress on public resources and infrastructure for both transportation and sheltering.[3]

The combination of these elements necessitates a strategic, data-driven, and comprehensive evacuation study to guide Nevada County in developing strategies to prepare for wildfire.

PyroAnalysis, LLC, a consulting firm with experience and expertise in fire and emergency management, community evacuation planning, land use planning and development solutions, fire behavior and threat analysis, and traffic analysis, was the consultant selected to lead the Nevada County Evacuation Study. The objective was to create an evacuation study that uses scientific analysis and real-world applicability, with the goal to enhance Nevada County communities' resilience to the threat of wildfires.

The Nevada County Evacuation Study illustrates the fire behavior and traffic patterns across the five highest-priority areas in Nevada County identified through a modeling exercise led by Ladris. Ladris is an artificial intelligence software company that conducts simulations of disaster scenarios before they occur to plan emergency management and promote community awareness. This data-dense exercise plays a crucial role in shaping our understanding of potential fire trajectories, capacities of the road network, and ensuing challenges to efficient and safe evacuation. The PyroAnalysis team not only analyzed the data but also provided maps and visuals to show these patterns clearly.

A thorough validation of the Ladris product is fundamental to ensuring that its simulations are not only viable but also resilient under the most challenging scenarios. A licensed traffic engineer has

[1] Radeloff et al.
[2] Schoennagel et al.
[3] Wong et al. (2020), p. 11

simultaneously produced a parallel review using applicable engineering standards and methods. This step provides the necessary validation requirement for the Ladris proprietary software.

Various departments and agencies have provided data, knowledge and insight, and experiences that have enhanced the study. These include the Nevada County Office of Emergency Services (OES), Planning Department, Public Works Department, Transportation Commission, and Sheriff's Office, which have all offered ground-level perspectives and data critical to the development of a pragmatic evacuation study. Further, the California Department of Forestry and Fire Protection (CAL FIRE), the California Highway Patrol (CHP), and the California Department of Transportation (Caltrans) have extended their expertise and data, fortifying the analysis with an understanding and specialized knowledge in fire behavior, traffic management, and infrastructure capacity.

2.1 Disclaimer

This evacuation study for Nevada County, California, is provided "as is" without warranty of any kind, express or implied. While efforts have been made to ensure accuracy, completeness, and usefulness of the information, the authors and distributors of this study do not accept any liability for errors, omissions, or inaccuracies in the content, nor for any actions taken based on this information.

Users of this study are advised to consult with appropriate emergency management professionals and authorities and to exercise their own judgment in applying any strategies or recommendations contained herein. The study is not intended as a substitute for professional advice or judgment, especially in emergency situations. Regular updates and local conditions should be considered in planning and response efforts.

This disclaimer does not negate the need for responsible planning and decision-making, and it is recommended that users validate the information with current, authoritative sources and seek expert advice as necessary.

3 Approach and Methodology

This evacuation study was conducted with the aim of improving emergency readiness in five areas of Nevada County, California: the communities of (1) Alta Sierra, (2) Greenhorn, (3) Cascade Shores/Banner Mountain, (4) Lake of the Pines, and (5) Lake Wildwood. Qualitative and quantitative methods, summarized here, were used in combination to develop the evacuation study.

Of note is the study's collaborative approach. Drawn from the expertise of various local departments, state agencies, community experts, and PyroAnalysis' own multidisciplinary team, this comprehensive perspective integrates with hard data from studies in fire behavior, traffic management, and evacuation planning. This strategy allowed for the production of a thorough report based on the specific requirements of each area that will ultimately strengthen community resilience and promote safety amid the challenges posed by wildfires.

3.1 Document Research

This study incorporates an analysis of county and regional planning efforts, supplemented by a comprehensive literature review. Best practices and improvements were identified by comparing these local plans with research from various disciplines. The literature review enriches the analysis by including recent developments in evacuation modeling, human behavior considerations, and vegetation treatment.

3.2 Interviews

Key stakeholders were interviewed, including local emergency service personnel and community leaders who have had active involvement in recent collaborative, evacuation-related projects and roles in decision-making processes. These interviews were structured to gain valuable insights into the practical realities and challenges of evacuation in the five study areas, including previous evacuation experiences, perceived challenges, and suggestions for improvement. Emergency personnel provided information on logistical and operational hurdles, while community leaders offered perspectives on coordination and communication effectiveness. Interview responses were analyzed to identify common themes and area-specific concerns.

This qualitative data played a crucial role in shaping the study's recommendations and ensured they are well-informed, context specific, and aligned with the needs and experiences of those most affected by evacuation protocols. Importantly, this approach allowed for an analysis of both the breadth and depth of stakeholder collaboration in the region, offering a nuanced understanding of the factors that contribute to successful partnerships and the common obstacles encountered. Engagement with stakeholders to align evacuation strategies with community needs and resources should be ongoing.

3.3 Field Surveys

Key evacuation routes for the five study areas and local infrastructure critical to the evacuation process were inspected. This assessment provided valuable insight into the bottlenecks and other practical challenges that might not be evident in written plans. Observations from these visits were instrumental in evaluating the real-world feasibility of evacuation routes, the adequacy of signage and route accessibility, and the community's preparedness levels. This on-site investigation ensured that the study's recommendations would be grounded in the actual conditions and needs of Nevada County, leading to more effective and tailored evacuation strategies.

California Senate Bill 99 (SB 99), requiring cities and counties to review the efficacy of evacuation routes, was kept in mind during the field surveys. The objectives of the SB 99 Accessibility Assessment are to focus on evaluating the compliance of existing facilities and infrastructure with accessibility standards. Through site visits, key areas to be assessed for evacuation routes were identified, such as entrances, exits, signage, parking, and pathways.

3.4 Data Analysis

Data was gathered from the Nevada County Office of Emergency Services, Planning Department, Public Works Department, and Sheriff's Office and CAL FIRE, Caltrans, and the CHP.

These data included historical and predicted fire incidents and current traffic flow patterns, road network information, climate conditions, demographic data, and community infrastructure and land use. Maps and GIS layers were studied and advanced traffic and fire behavior modeling techniques used.

With the expertise of highly regarded fire behavior analysts (FBAN), dynamic fire spread models were applied to simulate various wildfire scenarios, and included factors like complex weather data, vegetation, and topography. Finally, a comparative review of preexisting models and studies, including the Ladris modeling, cross-verified and enhanced the reliability of the Ladris evacuation modeling platform (see Appendix B for Ladris software assessment).

3.5 Summary

This approach and methodology present a complete path to a community-specific evacuation study. The final output of this analysis is an evacuation study document that includes mapped evacuation routes and tailored strategies. It also features an analysis of fire behavior and traffic dynamics, crucial for planning effective evacuations. Additionally, the study provides practical guidelines for implementation during wildfire emergencies and offers recommendations for infrastructure improvements. This document aims to enhance preparedness in targeted communities, ensuring a more effective and efficient evacuation process during wildfire events.

4 SB 99 Accessibility Assessment

The California Office of Planning and Research (OPR) staff have introduced a draft Evacuation Planning Technical Advisory.[4] This guide supports cities and counties as they revise the safety component of their general plans to meet evacuation mandates set by SB 99 (2019), AB 747 (2019), and AB 1409 (2021), as delineated in GC Sections 65302(g) and 65302.15. Collectively, these regulations compel local governments to identify in their safety plans both the residential developments in any designated hazard area lacking a minimum of two emergency evacuation routes (GC § 65302(g)) and the details of evacuation routes, including their capacity, security, and functionality alongside potential evacuation sites for various emergency circumstances (GC § 65302.15).

The California Office of the State Fire Marshal Subdivision Review Program was formed pursuant to Assembly Bill 2911,[5] which added Section 4290.5 to the Public Resources Code (PRC). PRC 4290.5 requires the Board of Forestry and Fire Protection (Board) to identify existing subdivisions with more than 30 dwelling units, located in the State Responsibility Area (SRA) or Local Responsibility Area (LRA) Very High Fire Hazard Severity Zone, which are at significant fire risk and lack a secondary egress route. Such subdivisions are identified pursuant to Government Code Section 51178, in consultation with the State Fire Marshal and local jurisdictions. Areas of the study have been identified for modes of ingress/egress

[4] Governor's Office of Planning and Research, p. 6
[5] Assembly Bill, 2018

and other fire safety factors. The results of those surveys, and ensuing recommendations, if any, are found in Appendix B.

Cul-de-sac locations in the study areas, while often characterized by constrained flow due to their unique design, have been typically constructed in compliance with Public Resource Code 4290 standards. As such, even though cul-de-sacs inherently have limited ingress and egress, their construction adheres to safety guidelines which include specifications for road width, turnarounds, and clearance to facilitate emergency vehicle access and egress. Consequently, in the context of Senate Bill 99 (SB 99), cul-de-sacs were not inherently identified as problematic.

Areas of limited ingress/egress roads and maps have also been analyzed and produced in the *READY Nevada County Extreme Climate Event Mobility and Adaptation Plan* by Nevada County Transportation Commission, May 2022. These constrained road segments and limited access areas at elevated risk due to increased climate hazards can be found in the plan's Appendix A, Figures 59–74. "Resident input has already impacted strategic development of these efforts (as submitted via the READY Nevada County Plan interactive map and public comment). The Access Limited Roads and Communities map in the plan's Appendix A provides an important foundation, as will the future evacuation planning studies for individual communities."[6]

5 Emergency Evacuation Assessment

5.1 Evacuation Assessment Methodology

Based upon the findings provided by computer-generated evacuation traffic modeling and intensive research by the PyroAnalysis team, including the review of fire behavior studies and input from Nevada County staff and other stakeholders, evacuation constraints have been identified in each of the five study areas and recommendations developed for hazardous fuel–modification projects and roadway improvements to increase evacuation route safety and capacity.

The study areas were selected after Ladris modeled more than 468 potential transportation demand scenarios involving over 156,000 road segments in Nevada County to identify the road networks that are likely to be most severely impacted during an evacuation. Based on the modeling results, the population density of the subdivision or community, and the historic wildfire threat in the area, the communities were ranked for priority by representatives from Nevada County OES, Nevada County Sheriff's Office, CAL FIRE, and the CHP.

5.1.1 Ladris Evacuation Modeling Software

To analyze traffic and other transportation and movement components of fire evacuation, community expertise was paired with science-based modeling from Ladris, a nimbler, more exact, and ultimately more useful tool than traditional traffic engineer studies.

[6] Nevada County Transportation Commission, *READY Nevada County*, p. 57

Ladris software, by Ladris Technologies, provides visual and statistical analysis of traffic patterns for every segment, road, vehicle, address, origin, and destination at every moment in time over the course of an evacuation simulation. It allows for transportation demand modeling, dynamic traffic assessment, and multimodal transportation analysis to help communities plan for safe evacuation. This software is commonly used by state and local government agencies across the US.

Traditional traffic engineer studies are extremely expensive and are not designed to provide dynamic, map-based visual models that permit city and county emergency management departments, fire protection districts, and law enforcement agencies to see how traffic patterns change over time or during a community or regional evacuation scenario.

Ladris has no constraints on the type or extent of the geographic region that can be modeled. Consequently, emergency response teams can select and change geographic areas for modeling evacuations across jurisdictions, allowing for better joint regional planning. Moreover, this capability allows community planners and first responders to model scenarios in their community as traffic conditions and patterns in the community change.

5.1.2 Estimated Travel Times

The scenarios modeled in the five study areas provide estimated travel times to assist in evacuation planning. Not all possible evacuation scenarios were modeled. Evacuation modeling software does not account for all potential evacuation scenarios, vehicle collisions, roads compromised by fire, erratic human behavior during an emergency event, or regional evacuations.

Assumptions used to calculate the estimated travel times were chosen based on the authors' observations during their field surveys and from their extensive experience with evacuations during large-scale wildfire incidents. These assumptions were chosen to provide a worst-case analysis of the evacuation routes. It was assumed that every home in the community was occupied when the evacuation order was given and that all the evacuation zones, as listed in the Zonehaven (Genesys Protect) Evacuation Zone table found in each study area discussion, were evacuated simultaneously. Some of these zones include parcels within the preexisting Zonehaven evacuation planning zones, which are outside the study area. These parcels were considered for the travel time analysis because they will likely be included in an evacuation of the subject study area.

Unless otherwise specified, the following assumptions were used to calculate the estimated travel time:

- All zones shown in Table 1 are ordered to evacuate concurrently.
- Every home is occupied at the time of the evacuation order.
- 2.5 vehicles exit each residence (based on average occupancy rate in Nevada County and the high number of vehicles observed at each residence during our field surveys)[7].
- 0.02% of the vehicles pull a travel, utility, or stock trailer (based on the number of stock trailers and travel trailers observed during field surveys).
- All available egress routes are used.
- The endpoint for all evacuees is the Nevada County Fairgrounds.

[7] Wong et al. (2020), p. 56

Table 1: Summary of Ladris Estimated Evacuation Travel Times

Study Area	Max Trip Time	Average Trip Time	Passenger Cars	Heavy Vehicles
Alta Sierra	3 hours 47 minutes	3 hours 25 minutes	5,625	1,406
Greenhorn	1 hour 10 minutes	1 hour 5 minutes	1,036	259
Cascade Shores/Banner Mountain	2 hours 4 minutes	1 hour 36 minutes	2,496	624
Lake of the Pines	4 hours 29 minutes	3 hours 39 minutes	5,302	589
Lake Wildwood	4 hours 21 minutes	2 hours 50 minutes	6,345	705

5.1.3 Evacuation Clearance Time

Calculated from the time an evacuation order is issued, the evacuation clearance time (ECT) is the total time required for all evacuees to leave the threatened area. This includes the time needed for evacuees to secure their property, collect pets, gather belongings, and travel the evacuation route to safety. Ladris evacuation simulation modeling does not account for the time from the report of a fire to the evacuation order being issued or for the reflex time required for the evacuees to leave their residences. It is assumed that 30 minutes or more are needed for evacuees not immediately threatened by the fire to begin their journey. The ECT derived from this analysis was conducted to assist Nevada County in identifying evacuation road network constraints and prioritizing hazard mitigation projects to improve evacuation routes and enhance evacuees' safety.

5.1.4 Human Behavioral Considerations

Known for its natural beauty and resources, Nevada County has always attracted people to take up residence in the WUI. Communities continue to grow as people seek respite from the cost of living in cities. Modern technological conveniences allow this to happen for more and more new arrivals to this rural area. This also means that an increasing number of people are at risk from wildfires. So, to ensure the safety of residents and first responders, the preservation of the environment, and the efficacy of fire response plans and resources, when planning for wildfire evacuations, it is essential to address key human behavioral aspects.

This begins with accepting that, when it comes to managing humans alongside fire, there is no one-size-fits-all response in the moment of emergency: "Regardless of residents' intended behaviors during a wildfire event, it is important to remember that decisions to act upon those plans are largely contingent on the circumstances of each fire event and are subject to change depending on human interactions."[8] The key to success, then, lies with empowering individuals well before an emergency so that each one is prepared to act in that moment. "There is a need to better prepare residents to make proactive, informed decisions before and during fire based on their own household's level of preparation and mitigation that consider but are not reliant upon others' actions."[9]

[8] Edgeley and Paveglio, p. 24
[9] Edgeley and Paveglio, p. 24

This includes raising awareness and educating the community about wildfire risks and evacuation procedures including traffic management, ensuring clear and timely communication to avoid panic, and understanding that stress may affect rational decision-making. Individuals receive and process information in different ways, so it is also "imperative for emergency managers to disseminate timely evacuation orders through various channels"[10] and to continue to do so throughout the emergency. This is for the benefit of not only those who choose to stay and defend during nonmandatory evacuations but those who leave, so they continue to understand the reasons behind the evacuation and the response occurring.

Examples of why clear, consistent, and timely communication and education before, as well as during and after an emergency, are necessary not just for the general population but for specific groups such as the following.

- Current decisions are affected by past experiences. If a neighborhood has experienced wildfires or been previously evacuated, agencies may have difficulty convincing those residents of the necessity of future evacuations.[11]

- Vulnerable populations—such as the elderly,[12] those with disabilities, and those without transportation—are more likely to be unable to respond and evacuate unless there has been detailed attention paid to them ahead of the emergency.

- Considerations for pets and livestock are vital as many with animals will not evacuate without them: "Pet/animal owners without emergency plans for their animals are more vulnerable than non-pet owners when they need to flee from disaster."[13]

Agencies need to have multiple strategies in place to encourage compliance with evacuation orders and would be wise to incorporate in their plans, and be prepared to enact, last resort measures to support all residents, including those for whom early communication and education have not worked. "Results also found that for one wildfire (Carr Wildfire), agencies may need to target long-time residents and lower-income households with mandatory evacuation orders (i.e., such as with greater frequency or more delivery methods)."[14]

Much of the research on human behavior regarding wildfires comes out of Australia. Two large studies of communities affected by the Black Saturday bushfires of 2009 provide information on what percentage of a population are likely to evacuate or stay. In one, 25% of respondents "adopted a 'wait and see' approach." Of those who stayed in order to help defend against the fire, approximately 33% ended up evacuating due to either lack of or failed resources or an increased perception of threat. Of those who left, about 50% said they "left late." In the other study, 70% of those who said they would not immediately evacuate eventually evacuated. Of those, 20% changed their minds early and evacuated; about 25% left in particularly dangerous conditions. Twenty-seven percent stayed during the whole event.[15]

A small study of people who had been threatened by wildfires in three American states indicated that nearly half would not self-evacuate or immediately leave upon evacuation orders but wait and see before

[10] Xu et al., p. 816
[11] Wong et al. (2023), p. 20
[12] Melton et al., p. 6252
[13] Onukem, "Findings,"
[14] Wong et al. (2023), p. 21
[15] Strahan, p. 2

deciding.[16] Researchers of evacuation decision-making during the Kincade Fire of 2019 found similar numbers: 79% choosing to evacuate and 21% staying.[17]

Though the authors of the paper discussing the Black Saturday fires cautioned that "clear-cut conclusions are not able to be drawn from these studies," it is important to note that a relatively large percentage of respondents would apply a "wait and see" strategy.[18] As the Kincade researchers said, "People's decision to evacuate or stay during natural hazards is often dependent on their assessment of threat and risk" in the moment, with no "significant relationship between experience [with wildfires] and evacuation decision-making."[19] What can matter is advice from trusted officials as well as friends and neighbors; related is, if people don't think their community is safe or if they're worried about their loved ones evacuating, they too will stay.[20] "Delay occurs because it is part of a complex, dynamic, and mostly highly charged decision process. Delay is not always a failure to act but in many cases is part of deciding about protective action."[21]

Keeping human behavior in mind after a fire event is also important. Providing psychological support after, in addition to during, the evacuation and gathering feedback post-evacuation are necessary steps to addressing trauma and anxiety and improving future evacuation plans, all of which will increase safety and efficiency during the next fire event.

Looking even further ahead, there is evidence that experience with a wildfire event can lead communities to become more vocal about the use, or increased pace and scope, of forest management efforts.[22] Early, useful, and appropriate preparation of communities is the first step to individuals being better stewards of the land and their property.

5.2 Fire Behavior Analysis

5.2.1 Fire History

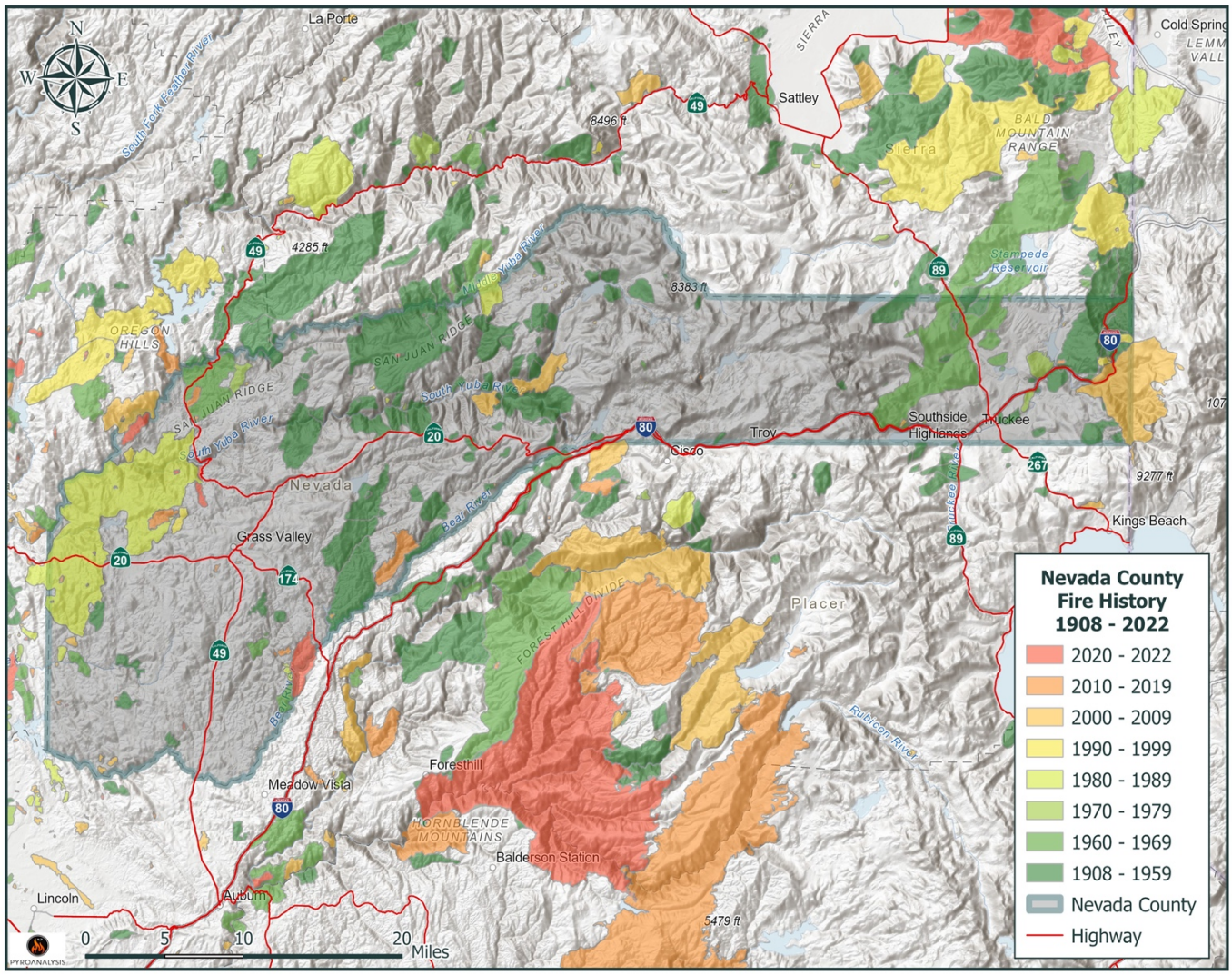
Except for the 49er Fire, which burned through Lake Wildwood, Smartsville, and Rough and Ready in 1988, consuming 33,700 acres before being brought under control, and the River Fire that burned 2,619 acres and destroyed 142 structures in 2021, Nevada County has had relatively few major fires in the last five decades (see Figure 1). Among the factors that have contributed to the rapid control of wildfires in the county includes the fortunate location of the Grass Valley Air Attack Base, which facilitates swift suppression of new starts. Nevada County is also home to more Firewise Communities than any other county in the nation, which indicates a motivated and aware constituency of local residents.

Nonetheless, the changing climate and accumulation of heavy fuel loads within the county portend an increase in the number and severity of fires in coming years. The READY Nevada County Extreme Climate Event Mobility and Adaptation Plan stresses that the annual average of acres burned in the county may increase by "48.2 percent to 107.4 percent" in the coming decades, especially in Nevada County's mid-to-high elevation areas. This increase is attributed to two factors: the higher temperatures resulting from a changing climate, and as a "result of effective fire suppression since the 1930s,

[16] Strahan, pp 2-3
[17] Xu, p. 799
[18] Strahan, p. 2
[19] Xu, p. 797
[20] Xu, pp. 797-798
[21] Strahan, p. 7
[22] Carroll, pp. 25-37

vegetation has continued to grow and accumulate, resulting in an increase in hazardous fuels throughout the County."[23]

Figure 1: Nevada County Fire History 1908 through 2022



Dense vegetation, combined with years of prolonged drought, make forests vulnerable to pests including bark beetle infestations, which have led to higher-than-normal tree mortality rates. Forest conditions are drastically different today than they were historically. Where once trees forested the Sierra Nevada as described by John Muir in 1894, "in groves, or in small, irregular groups, enabling one to find a way nearly everywhere, along sunny colonnades groves with large open spaces,"[24] trees now grow in thick stands of timber intertwined with brush. Where open space exists between trees instead of ladder fuels, fire intensity is reduced, crown fire is prevented, and fires are quickly controlled.

Nevada County has proactively pursued funding for fuel-modification projects to enhance the fire resiliency of county communities by removing vegetation from around homes and along roadways and developing and maintaining shaded fuel breaks. A continued, decades-long commitment to **drastically**

[23] Nevada County Transportation Commission, *READY Nevada County*, p. 33
[24] Muir, Chapter 8

reducing the fuel load within the wildland-urban interface (WUI) remains essential to mitigating the risk of catastrophic wildfire in the coming years.

5.2.2 Fire Behavior Modeling

Nevada County is geographically and climatically diverse, necessitating the use of multiple data sets and analysis tools to model fire behavior. Weather and fuels data was collected then analyzed to determine the most likely and the worst-case weather conditions and predicted fire behavior.

Fire management agencies use historic weather and fuels data to predict fire behavior. Weather data for this study was collected from a lower-elevation RAWS (Remote Automated Weather Station), located in Reader Ranch at an elevation of 1,968 feet and from White Cloud at an elevation of 4,302 feet.[25] The weather data was run through the FireFamilyPlus fire modeling tool. Developed by the Missoula Fire Sciences Laboratory, this program "is a software package used to calculate fuel moistures and indices from the US National Fire Danger Rating System (NFDRS) using hourly or daily fire weather observations primarily from Remote Automated Weather Stations,"[26] which permits an analyst to graphically evaluate the weather and display the weather based on percentiles over a given time period, allowing patterns to be observed and displayed. From this the area's worst-case-scenario Energy Release Component (ERC) and the most common wind direction and wind speed were determined, along with prognosticated rare wind events.

The ERC is the burning condition of an area based on available live and dead fuel. An ERC in the 90th percentile was used for modeling. This means that only 10% of the days over the past 30 years had worse conditions than what were considered.

Once the weather was assessed, these data were run through two fire behavior programs: BehavePlus (version 7) and the Interagency Fuel Treatment Decision Support System (IFTDSS). BehavePlus was used to predict fire spread rate, flame lengths for crown fire (or fire that spreads across a forest canopy), and spotting distances, and was used as a point source ignition to validate the fire behavior findings from IFTDSS. IFTDSS is a geospatial fire behavior modeling program that allows users to modify fuel regimes and to "perform a Quantitative Wildfire Risk Assessment"[27] of proposed fuel breaks and fuel-modification projects and to develop community action plans. BehavePlus and IFTDSS use the Rothermel mathematical fire spread equation and must be used by a fire behavior expert experienced and trained to evaluate the data used to model fire behavior and the appropriate interpretation of the resulting model-generated fire behavior predictions.[28]

Fuels data used in the IFTDSS program was downloaded from LANDFIRE (a geospatial database used by fire and resource management planners); this data is based on the 2022 fuels survey that is drawn from some 800,000 sample areas in the United States. As found in LANDFIRE's product description, "Vegetation data drawn from these sources and used by LF include natural community occurrence records, estimates of canopy cover and height per plant taxon, and measurements (such as diameter, height, crown ratio, crown class, and density) of individual trees. Fuel data used include biomass estimates of downed woody material, percentage cover and height of shrub and herb layers, and canopy base height estimates."[29] Therefore, these data sources are ideally suited for studying the fuels, canopy, and fuel load in the Nevada County study areas.

[25] The National Interagency Fire Center manages 1,700 RAWS around the US and its territories. RAWS units measure wind speed and direction, air temperature and humidity, and precipitation, among other details important for fire management.
[26] Bradshaw
[27] Interagency Fuel Treatment Decision Support System
[28] USDA Forest Service
[29] United States Forest Service

5.2.2.1 Fuels

South and central Nevada County are characterized by timber fuels with areas of oak woodlands and some brush on west- and south-facing slopes. The area is in the ponderosa pine–Douglas-fir zone, with some white fir, incense cedar, gray pine, and sugar pine. California black oak and Pacific madrone are abundant. Nevada County experienced tree mortality as a result of insect kill during the drought of 2012–2016, but the outcome was not nearly as severe as the mortality in the Sierra south of Nevada County. **Extractive land-management practices, coupled with suppression of wildfires over the last century, have resulted in even-aged and in some cases monocultural dense trees and brush that have created an extreme fuel load in the county.** Fuel models most prevalent in the area are Scott and Burgan fuel models 165, heavy timber and shrub, and 183, moderate-load timber litter. Fuel models 145, heavy-load shrub, exist on the west.

5.2.2.2 Weather

The lower elevations of Nevada County are in a Mediterranean climate zone, experiencing warm, dry summers and falls, and wet winters. Lightning-caused fires often occur in the late summer and early fall. Winds are dominated by the diurnal wind pattern typical of mountainous terrain, with upslope winds in daytime and light downslope winds at night. Some delta breeze penetration occurs on very warm summer days, increasing the southwest wind component. Strong downslope northerly or northeasterly winds can occur in the area from September to December, associated with Great Basin high-pressure systems. Strong westerly winds can result from a late-summer breakdown of an upper-level ridge and tend to set in for long periods. As the ridge moves out, strong, gusty west winds can develop. Explosive fire growth can be expected when these conditions persist during a prolonged heat wave.

5.2.3 Modeling Results

After comprehensive field surveys were conducted, IFTDSS modeling was done based on observations and sample data extrapolated from each study area to evaluate predicted flame lengths and rates of spread. Using the 90th percentile ERC for the calculations, two different wind scenarios were considered, both common over 30 years of fire seasons that last from May through October. These wind scenarios were similar to the winds that were factors in the explosive fire growth experienced during the Camp and Dixie Fires of 2018 and 2022, respectively.

The first scenario was the predominant wind during peak fire season, a southwest alignment (direction from which the wind blows). Wind speed was input at 12 miles per hour (mph) at 20 feet above the ground. The second was a northeast alignment, which is usually a dry offshore flow seen in the fall. Wind was input at 25 mph, also at 20 feet. (RAWS wind meters measure speeds from the ground up to 20 feet.)[30] In both scenarios, a fire burning under these conditions is predicted to transition to a crown fire in timber and fully consume brush and scrub.

IFTDSS modeling for each study area found spread rates to range from 8.3 mph to 18.5 mph when under the influence of strong winds; flame lengths exceeded the maximum software output of 25 feet. BehavePlus was used to estimate flame lengths and spotting potential. A crown fire in timber was shown to generate flame lengths as high as 533 feet, with average flame lengths of approximately 80 feet; flame lengths in the brush were as high as 70 feet.

[30] It should be noted IFTDSS modeling does not consider wind gusts that would most likely cause the fires to spread faster and be more intense than what the model predicts.

For the Alta Sierra, Cascade Shores/Banner Mountain, and Greenhorn study areas, rates of spread expected in scenario one (southwest alignment) are 1,320 feet per hour to 3,300 feet per hour (20 to 50 ch/h). In scenario two, (northeast alignment) with winds of 25 mph, rates of spread of 50 to 150 ch/h, or nearly 2 mph are predicted in these extreme burning conditions.[31]

Lake of the Pines and Lake Wildwood modeling indicated rates of 1,320 feet to 3,300 feet per hour (20 to 50 ch/h) in scenario one and less than 1,320 feet per hour (20 ch/h) in scenario two. Flame lengths exceeding 25 feet are expected where heavy fuels are growing in alignment with topography and wind. These findings are consistent with the results of the risk assessment conducted as part of the Lake Wildwood's Firewise Action Plan.[32]

5.2.4 Evacuation Corridor Fuel Modification

Throughout the county, numerous fuel-reduction projects are underway or planned, with 300 miles of roadway prioritized to improve life safety on evacuation routes.[33] However, much more fuel reduction is needed to moderate fire intensity near egress roads. Evacuation clearance times for the areas studied are extended as a result of constrained road networks that do not have the capacity for the influx of vehicles expected during an evacuation. Traffic modeling for this report does not consider regional evacuations that would include the population of Nevada City and Grass Valley. Clearly, such a scenario will exponentially increase evacuee travel times and result in miles long vehicle queues on egress corridors. Making expansive upgrades to the highways and county roads is a long-term goal that requires hundreds of millions of dollars in funding.[34]

Road segments on Greenhorn, Red Dog, Alta Sierra, and Combie Roads were analyzed to estimate the total fuel-reduction required along roadways to provide a reasonable degree of fire and life safety for evacuees if the routes were impacted by fire during an evacuation. The fuel model used to predict fire behavior **without** fuel modifications was a Timber Understory 5 (TU5).[35] The weather was input into the Safe Separation Distances Evaluator (SSDE)[36] using conditions like those experienced during the Dixie and Caldor Fires. This program is designed to assist firefighters in assessing the minimum separation from the fuel bed required to prevent burn injuries or death.[37]

To provide safe egress routes for evacuees in vehicles in burning conditions such as those experienced during the Dixie and Caldor Fires,[38] the proposed fuel modifications must convert the fuels to a Timber Litter 5 fuel model.[39] This requires a shaded fuel break on both sides of the roadway of no less than 100 feet, as measured from the centerline of the road, with all snags, slash, brush, and trees 8 feet in height or less removed; trees of a height of 8 feet or more are to be limbed to a height of 8 to 12 feet; large trees must be thinned to provide separation in the canopy of 25 feet or more; grass must be maintained at 4 inches or less in height. SSDE modeling, as illustrated in Table 2, indicates that fuel treatments as outlined above will reduce head fire flame lengths from 9 feet to 1.4 feet and prevent a crown fire on

[31] A chain equals 66 feet. There are 80 chains in a mile.
[32] Whitlock, p. 18
[33] Nevada County Office of Emergency Services. https://nevadacountyca.gov/3804/Roadside-Vegetation-Management
[33] Nevada County Office of Emergency Services. https://nevadacountyca.gov/3804/Roadside-Vegetation-Management
[34] Nevada County Transportation Commission, pp. 41, 42
[35] Timber Understory 5 is defined as a mixed conifer understory with an understory of small trees and brush.
[36] University of Utah Department of Geography
[37] The dangers from smoke exposure are not evaluated by SSDE. https://geog.utah.edu/news/0323-campbell.php
[38] Due to the limited history of large-scale wildfires in Nevada County, the Dixie, Caldor, and Mosquito Fires were used as case studies as part of the fire behavior analysis.
[39] National Wildfire Coordinating Group

evacuation routes, providing a reasonable degree of safety. Even with fire behavior moderated, evacuees will face the inherent hazards associated with a fast-moving wildfire: smoke, down powerlines, and erratic human behavior.

Table 2: Safe Separation Distance Evaluator Results

Predicted Head Fire without Fuel Modification		Predicted Head Fire with Fuel Modification	
Surface Fire Rate of Spread	838.2 ft/hour	**Surface Fire Rate of Spread**	171.6 ft/hour
Surface Fire Flame Length	9.0 ft	**Surface Fire Flame Length**	1.4 ft
Transition to Crown Fire	Yes	**Transition to Crown Fire**	No

5.2.5 Fire Behavior Scenarios

In each of the five study areas, wildfire scenarios were modeled to demonstrate the fire spread potential in relation to the ECT. These scenarios were used to analyze the evacuation routes and the relative risk to the evacuees on the egress roads during a worst-case wildfire event. The scenarios chosen for the modeling are not probabilistic and do not indicate the likelihood of such a scenario occurring.

Area-specific fire spread modeling was conducted using the FlamMap 6 software package from the Missoula Fire Sciences Laboratory, including the FlamMap and FARSITE programs. The basis of the software is the Rothermel mathematical fire spread equation. The Rothermel fire model is limited in its simulation of fire spread in the forest canopy. Therefore, it is likely to underestimate fire spread by a factor of 2 or more if a crown fire develops. Modeling software is used for incident and project planning and does not consider the effects of fire suppression efforts on fire spread or fire spread from structure to structure in the WUI.[40]

A southwesterly wind and northeasterly wind scenario were modeled for each study area. The weather used for all scenarios was from the Reader Ranch RAWS. As shown in Table 3 weather similar to September 6, 2022, was used for the southwest wind scenario, as those conditions resulted in the Mosquito Fire's rapid growth. A typical October northerly wind situation was used for the northeast wind scenario. Winds are moderate at around 20 mph at 20 feet above the ground. Both scenarios assume the fire occurred after a typically rainless summer, with the fires escaping the efforts of initial attack forces.

Table 3: Area-Specific Fire Behavior Scenario Weather Values

Scenario	Date	Start Time	Temp	RH	Average Windspeed
Southwest Wind	September 6, 2022	10:00	106	13%	3–4 mph
Northeast Wind	October 29, 2019	10:00	62	18%	20–25 mph

5.3 Study Area Assessments

5.3.1 Alta Sierra

Alta Sierra, located six miles south of Grass Valley and accessed by Highway 49 from the west and Dog Bar Road from the east, is a planned golfing community composed of several hundred single-family

[40] Scott and Burgan, p. 20

residential homes surrounding the Alta Sierra Country Club's 18-hole golf course. A shopping/business center and an airport serve the community's 6,000+ residents.

Built at an elevation of approximately 2,300 feet, the development is characterized by steep topography covered with conifer, black oaks, and chaparral. Most of the homes in the densely built subdivision are of wood-frame construction with combustible wood siding. Landscaping includes pockets of highly flammable native and decorative vegetation between and abutting structures. In many areas of the subdivision, the conifer canopy is contiguous, and the roofs of homes are covered in pine needles and leaf litter.

The road network within the subdivision is meandering and narrow, punctuated by switchbacks through dense vegetation in canyons and draws. Many roads that appear to exit the subdivision are blocked by private developments, dead ends, or gates. Navigating in and out of the subdivision is extremely difficult for those not intimately familiar with the layout of the community. Evacuees from Alta Sierra will exit via Highway 49 or Dog Bar Road. Dog Bar Road, south of Alta Sierra Drive, is a curving two-lane roadway with few turnouts or shoulders, and speeds are limited to 10 to 20 mph in some areas.

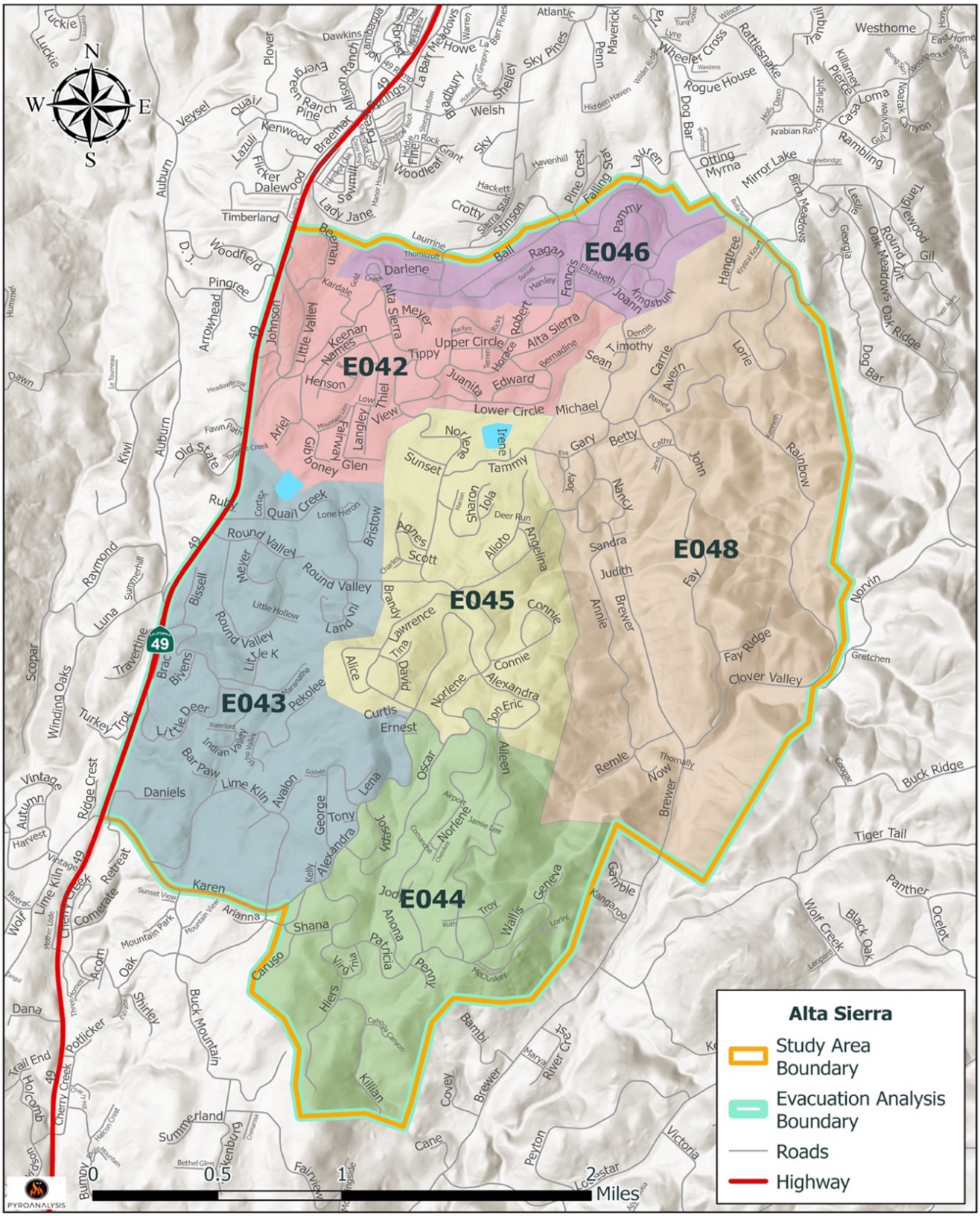
Of the five areas studied, Alta Sierra has the most significant potential for a catastrophic wildfire event. There is a high probability that a fire burning during a high or extreme fire weather event will resist containment and develop into a WUI conflagration. Many of the homes are built on mid-slope roads, in canyons, or at the top of steep slopes, and **the parcels with contiguous tree canopies are prone to a crown fire that may entrap both residents and firefighters**. Only a limited number of the lots have adequate defensible space for safe firefighting operation, making large sections of the development unsafe for firefighters to engage a well-developed firefront.

5.3.1.1 Area-Specific Fire Behavior Analysis

5.3.1.1.1 Topography

Alta Sierra's terrain is broken by deep dissected canyons, such as the Wolf Creek Canyon to the east and where the Bear River cuts through the Sierra Nevada to the southeast. Elevations range from 1,600 feet in the Wolf Creek to 2,600 feet at Wolf Mountain. Most of the homes built in the urban intermix are built at an elevation of approximately 2,200 feet. Aspects are varied, and slope steepness ranges from flat to 173% but is typically 20–40%.

Figure 2: Alta Sierra Study Area



5.3.1.1.2 Fire Behavior

Fires in this area can range from small surface-litter fires to extremely intense independent crown fires that, in late summer and fall, may resist control during the initial attack to become extended-attack or major fires. **Almost all fires in the built-up Alta Sierra area will immediately threaten structures**, diverting fire resources from fire perimeter control to defend structures and rescue fire victims. Under extreme conditions, embers carried by the wind can start spot fires a mile or more ahead of the main fire, creating additional concerns for structural ignition in a densely habituated community like Alta Sierra.

5.3.1.1.3 Fire Behavior Modeling

The Alta Sierra southwest wind scenario envisions an ignition near the intersection of Travertine Court and State Highway 49 on the east side of the road. The fire spreads uphill into the community and impacts structures immediately. Within three hours, the fire is 30 acres and impinging on Maranatha Place. Within the first day, the fire is 120 acres and well established to the north of the ignition point. Typically, changing conditions slow or stop the fire spread on most summer and fall evenings (Figure 3).

The northeast wind scenario is a fire starting on Dog Bar Road near La Barr Meadows Road. It impacts the community immediately. In the first few hours, it burns to Sweethaven Court along Dog Bar Road. The fire spreads through the crowns of the thickly growing conifers and burns more than 900 acres by the end of the day (Figure 4).

Figure 3: Southwesterly Wind Fire Behavior Modeling

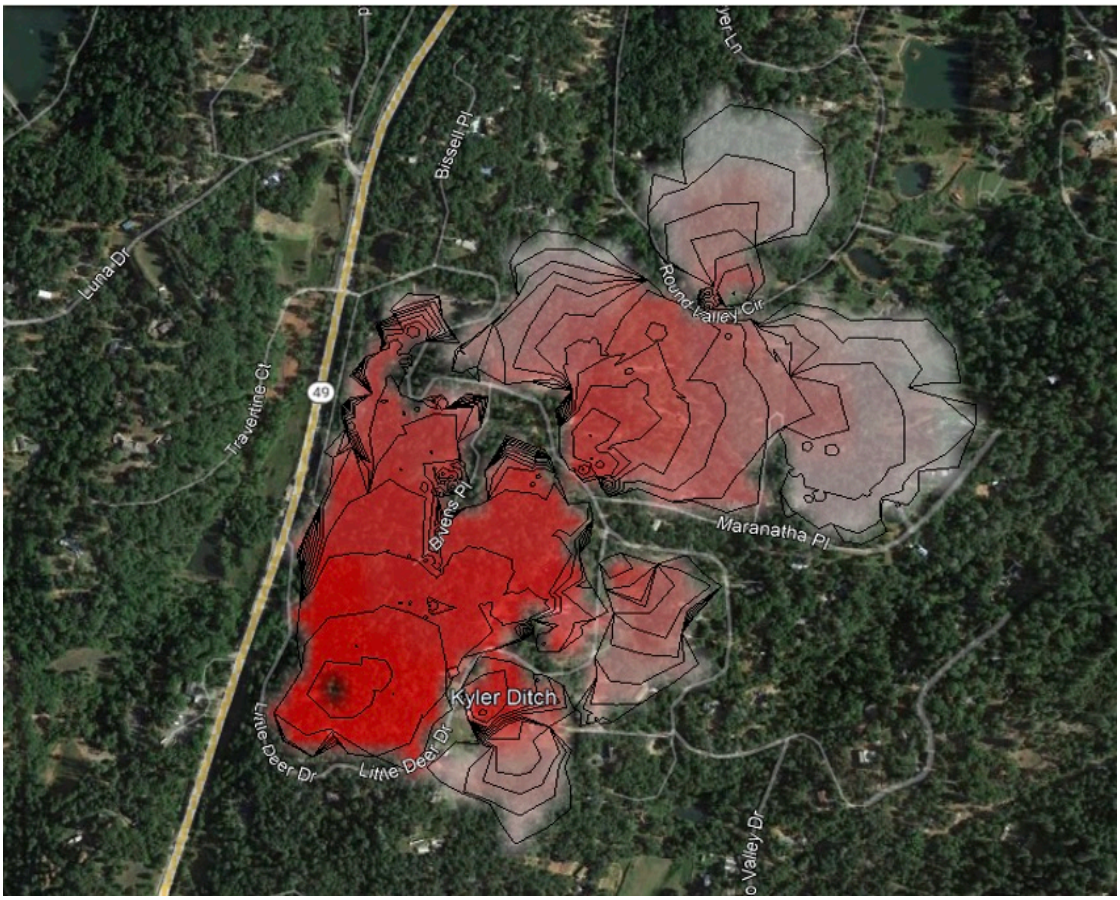
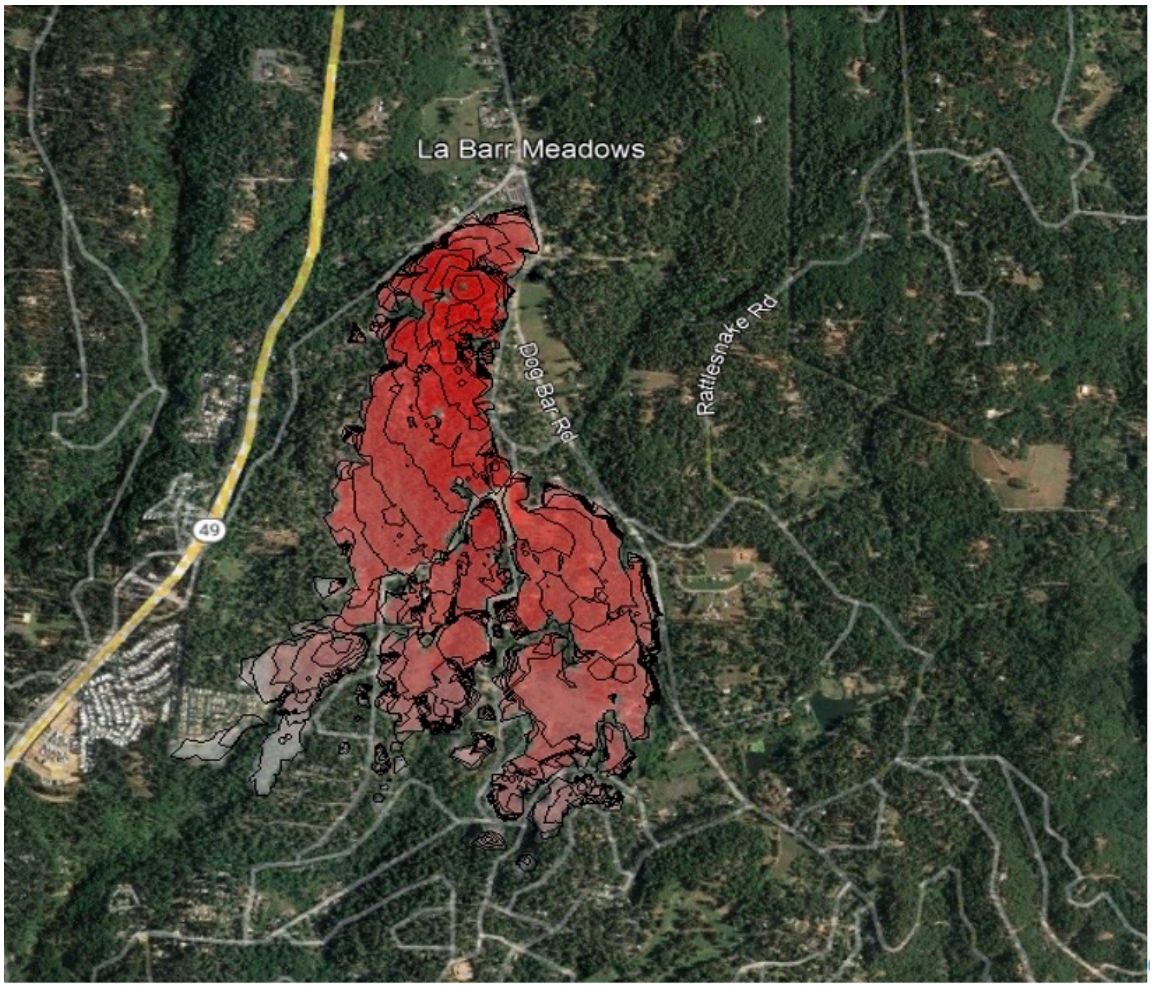


Figure 4: Northeasterly Wind Fire Behavior Modeling



5.3.1.2 Ladris Evacuation Modeling Results

Evacuating Alta Sierra in the face of a wildfire will challenge even the most prepared first responders. As the fire behavior modeling illustrates, the steep topography and heavy fuel loading in and surrounding the community present an extreme risk for a WUI conflagration. A building or wildland fire starting on a hot, dry, and windy day would have the contiguous fuels available to develop a rapidly spreading firefront with flame lengths of several hundred feet. Flying embers will ignite adjacent homes and start spot fires up to a mile or more downwind. In such a scenario, fire and smoke will impact the road network, preventing access and egress from some of the most hazardous road sections. **For this reason, it is imperative that first responders quickly request an evacuation of the community when a fire is confirmed during extreme fire weather events.**

Ladris modeling estimated the travel time during an evacuation from Alta Sierra to the Nevada County Fairgrounds to be approximately 3 hours 47 minutes, making the ECT 4.2 hours or more.

The following road segments, shown in Figure 5, were the most severely congested in the simulation:

- Dog Bar Road northbound to La Barr Meadows Road
- Highway 49
- Magnolia Road to Highway 49
- Allison Ranch Road northbound to Grass Valley

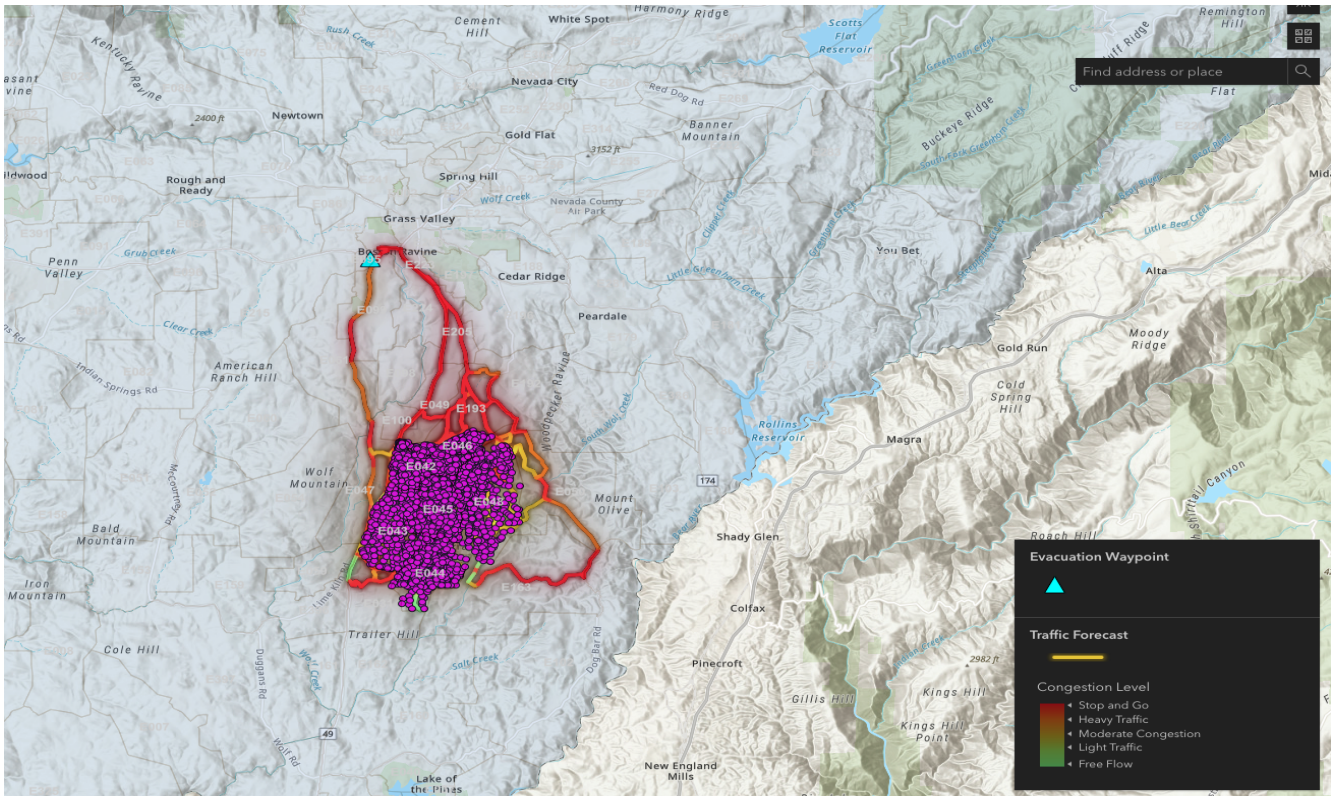
Table 4: Zones Used to Calculate Evacuation Travel Time

Zone ID	Population
NCO-E046	911
NCO-E042	1,340
NCO-E048	1,281
NCO-E045	1,311
NCO-E043	812
NCO-E044	1,372

Table 5: Estimated Evacuation Travel Time

Metric	Value
Worst-Case Single Vehicle	3 hours 47 minutes
Average Single Vehicle	3 hours 25 minutes
Passenger Cars	5,625
Heavy Vehicles	1,406

Figure 5: Ladris Modeling



5.3.1.3 Evacuation Assessment Observation and Recommendations

5.3.1.3.1 Roadway Improvements

An emphasis must be placed on creating safe evacuation corridors along the most congested roadways, as identified previously. It is recommended that, where possible, 10 feet of shoulder be improved and cleared of all vegetation. From the centerline of each road, trees and brush of 12 inches in diameter and less should be removed or masticated to provide a shaded fuel break of 100 feet on both sides of the road. Trees over 12 inches in circumference should be removed as required to provide frequent breaks in the tree canopy.

In all evacuation scenarios modeled for Alta Sierra, Highway 49 became heavily congested. Analysis of past evacuations in the county during wildfires confirmed that highway traffic was slowed and stalled for a considerable time, preventing emergency responder access and a timely evacuation of residents. The limited capacity of the highways prevents the free flow of traffic during an evacuation event, creating queuing of vehicles on the highway and making them vulnerable to a fast-moving fire that may entrap evacuees in their cars. Thus, Nevada County should continue to work with Caltrans to identify highway improvements that will increase evacuation capacity without increasing daily trip capacity. Examples to consider are added turnouts, extending the width of paved shoulders on each side of the highway, and expanding fuel treatments along the highways to provide at least 100 feet of shaded fuel breaks on both sides of the roadway as measured from the highway's centerline.

Egress options to the southeast of Alta Sierra are limited, and Dog Bar Road south of Alta Sierra Drive is narrow and curvy. As part of the Woodpecker Ravine wildfire mitigation project, the improvement of Mt.

Olive Road from Dog Bar Road to Hwy 174 should be considered as an additional emergency evacuation route. On the community's west side, Round Valley Road has an undeveloped section that blocks access to Highway 49. If this section of road can be completed and, if necessary, gated with a remotely operated emergency egress gate, traffic congestion on Norlene Way can be reduced with access to Highway 49 available to evacuees from both Quail Creek Drive and Round Valley Road. As proposed in the *READY Nevada County Extreme Climate Event Mobility and Adaptation Plan* prepared in May 2022,[41] efforts to secure funding and further study the benefits of increasing the capacity of Highway 49, by adding additional traffic lanes where the roadway narrows to two lanes, must be included in the long-term strategy to address the limited evacuation capacity provided by the state highways.

Roadway Improvement Recommendations

Continue to work with Caltrans to support improvements and wildfire mitigation efforts that increase roadway capacity and enhance evacuee safety.

  - Consider adding turnouts, expanding the shaded fuel breaks, and widening roadway shoulders.

  - Add traffic lanes on Highway 49 north of Alta Sierra Drive, south of Lime Kiln Road, and at the merge point south of McKnight Way.[42]

- Improve Mt. Olive Road from Dog Bar Road to Highway 174 in conjunction with the Woodpecker Ravine wildfire mitigation project.

- Connect Round Valley Road to provide emergency egress to Highway 49 from Norlene Way.

5.3.1.3.2 Wildfire Mitigation Projects and Initiatives

Alta Sierra Property Owners Association (ASPOA) has proactively pursued the development of a Firewise Community.[43] However, the dense fuel loading within the community continues to pose a significant wildfire hazard. More aggressive vegetation removal programs are required to reduce the risk and create a fire-resilient community. Removal of vegetation near roadways and around homes must be a priority.

The following wildfire mitigation projects and initiatives are recommended:

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.

- Masticate or remove dense pockets of vegetation in drainages and along mid-slope roads.

- Remove and replace highly flammable decorative plantings with fire-resistant plant species.

- Remove conifers to create an open tree canopy, thereby reducing the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.

- Limb remaining conifer trees to a height of 12 or more feet.

[41] Nevada County Transportation Commission (2022), p. *58*
[42] Nevada County Transportation Commission (2022), pp.58-59
[43] National Fire Protection Association. https://www.nfpa.org/education-and-research/wildfire/firewise-usa?l=334

- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of zero to five feet from the house, in accordance with Assembly Bill 3074.[44] Where intervening property lines make this difficult, the ASPOA can assist with neighborhood education and information-sharing campaigns.

- Support added capacity for defensible space inspectors across all jurisdictions.

  - Increase the frequency of defensible space inspections.

  - Aggressively enforce the existing ordinance(s).

Home Hardening and Construction Standards

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.

- Add signs throughout the community to identify the primary arterials to Highway 49 and Dog Bar Road.

- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

Initiatives

- Encourage the ASPOA to actively engage the community in strengthening homeowner association (HOA) standards to address properties that are not compliant with defensible space regulations.

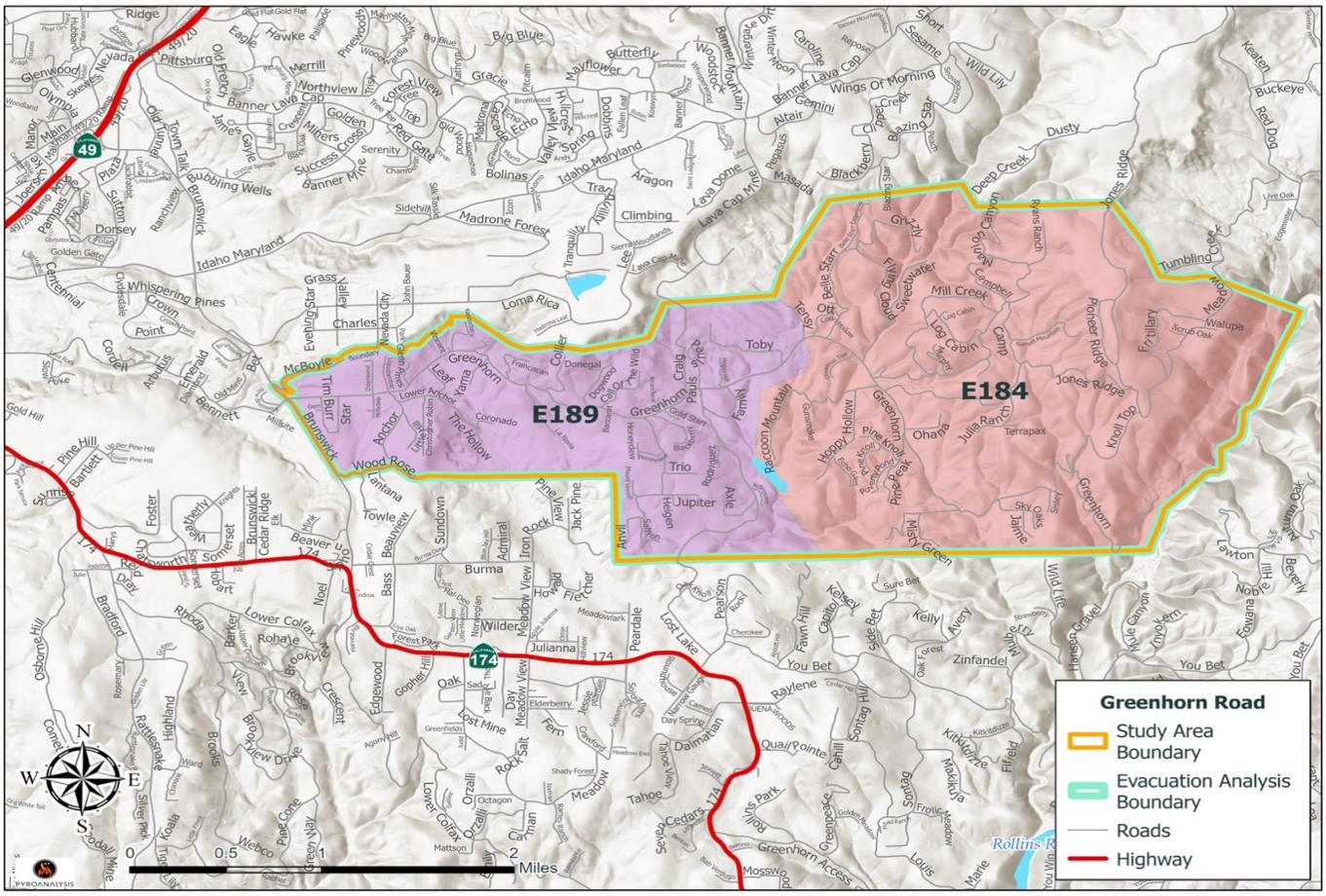
- Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners working with regulatory agencies and to navigate the regulatory impediment to successfully implementing wildfire mitigation actions on private property.

5.3.2 Greenhorn Road

Greenhorn Road is a narrow, winding road running through the heavily forested Greenhorn drainage and along the ridgelines east of Grass Valley, with a population of approximately 1,300 in the evacuation study area (see Figure 6). Homes within the area are a combination of semi-rural ranchettes built on parcels of several acres and subdivisions with dozens of homes on parcels accessed by roads, some less than 12 feet in width and overgrown with dense vegetation.

[44] CAL FIRE

Figure 6: Greenhorn Road Study Area



5.3.2.1 Area-Specific Fire Behavior Analysis

5.3.2.1.1 Topography

The Greenhorn region runs along the base of several canyons and ravines with varying changes of elevation, between 2,000 and 3,000 feet. The area is bifurcated by several prominent drainages including Little Greenhorn Creek and Clipper Creek, which are part of the watershed of Greenhorn Creek. The flora is one of coniferous forests dominated by species such as pine, Douglas-fir, and incense cedar. Some elements of chaparral are present at the lower elevations. Most of the homes built are in the urban intermix and spread through the rural environment. Aspects are varied, and slope steepness ranges from flat to more than 100%.

5.3.2.1.2 Fire Behavior

Fires in this area can range from small surface-litter fires to intense crown fires. Seasonal drying in late summer and fall creates conditions that may resist control efforts during the initial attack to become extended-attack or major fires. Under extreme conditions, common under a north wind event, fires will overcome any sheltering element created by the region's topography and spread flames downslope, with spotting potential of over a mile. Prolonged drought and increase in chaparral shrub species such as manzanita, chamise, and ceanothus, will contribute to a more volatile fire environment.

5.3.2.1.3 Fire Behavior Modeling

The Greenhorn southwesterly wind scenario simulates an ignition at Loma Rica Drive and Madrona Leaf Court. The fire spreads along the steep slopes and drainages above the Yuba Reservoir and then is pushed by the southwest wind to the northeast. It burns 208 acres on the first day (Figure 7). Structures are impacted, but the relatively moderate fire behavior would allow for aggressive aerial and ground-based fire suppression.

The northeasterly wind scenario results in a much larger fire. The ignition point is in Clipper Creek west of Deep Creek Road. Within five hours, the fire grows to 1,500 acres, burning down canyon toward Greenhorn Road. Structures are impacted, with crown fire and long-range spotting ahead of the fire hampering suppression efforts. The fire burns 3,032 acres the first day, crosses Greenhorn Creek and You Bet Road, stopping approximately half a mile north of Rollins Lake.

Figure 7: Southwesterly Wind Fire Behavior Scenario

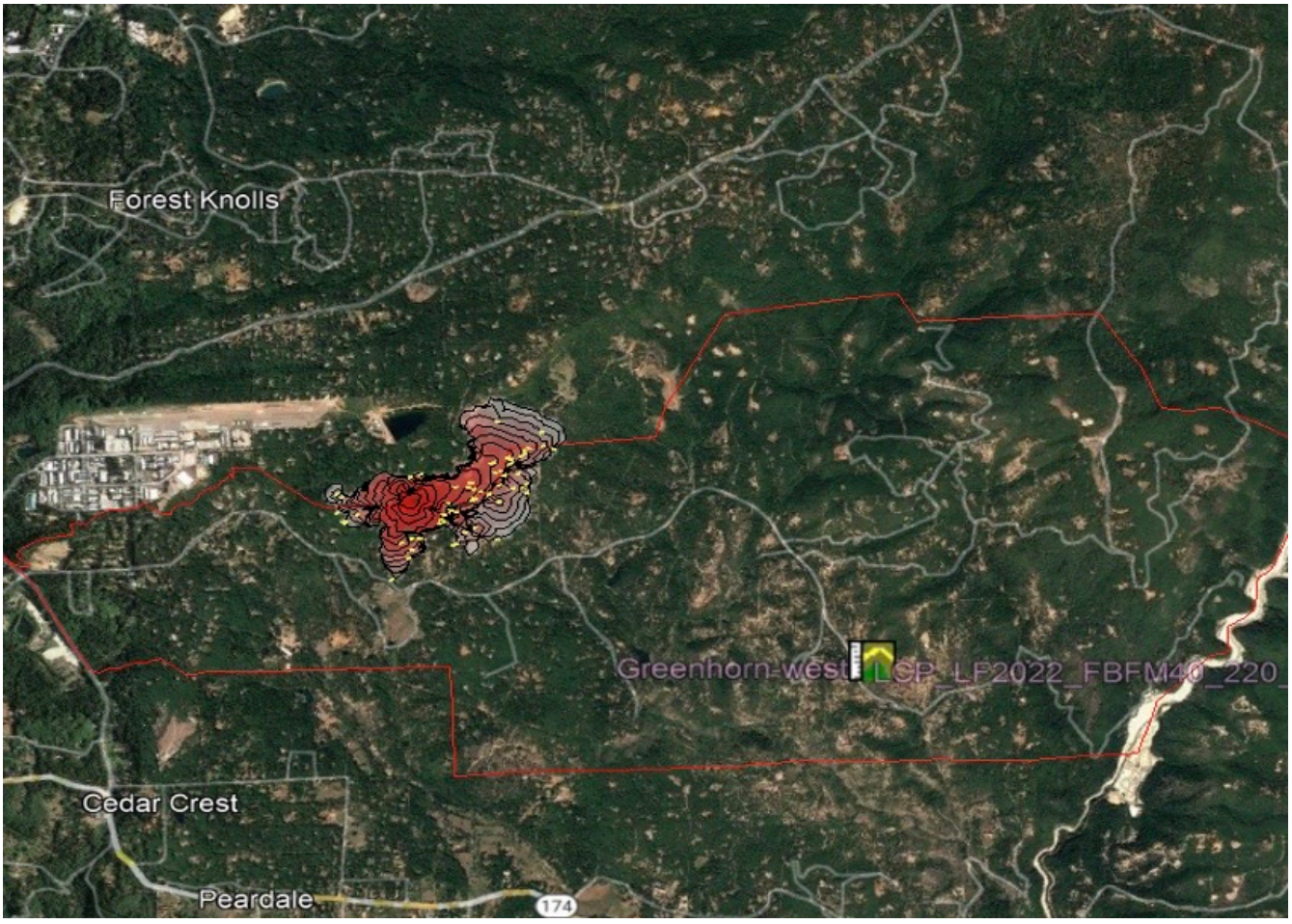
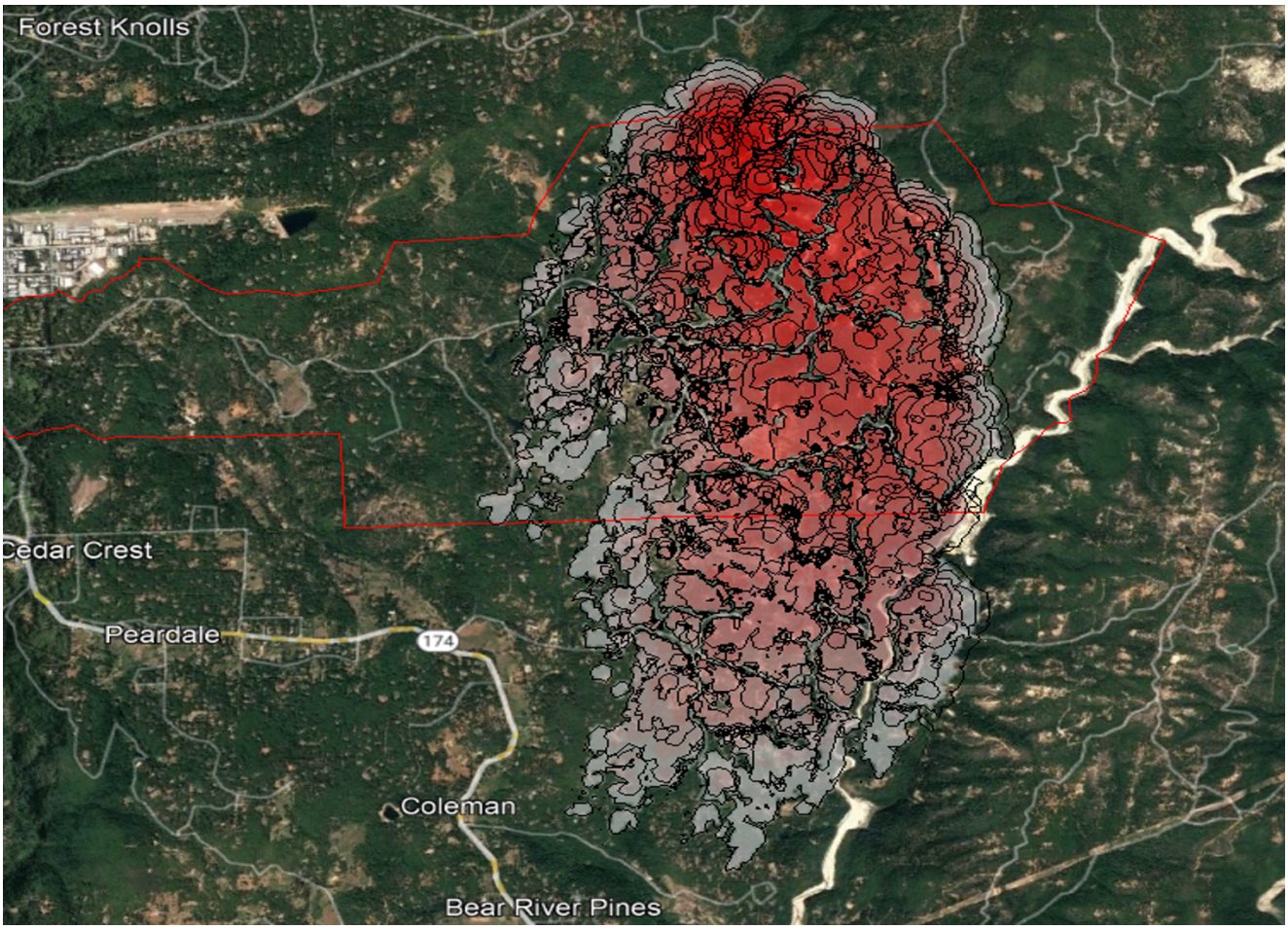


Figure 8: Northeasterly Wind Fire Behavior Scenario



5.3.2.2 Ladris Evacuation Modeling Results

As in Alta Sierra, a fast-moving fire in the Greenhorn drainage may compromise the primary evacuation routes, forcing some residents to use less-traveled mountain roads to escape. Few of the homes have adequate defensible space, and large portions of Greenhorn Road are lined with heavy vegetation. **The potential for a crown fire in the dense timber stands is exceptionally high.**

Table 6: Zones Used to Calculate Evacuation Travel Time

Zone ID	Population
NCO-E189	578
NCO-E184	716

Ladris modeling estimated the travel time during an evacuation, using all available routes out of the Greenhorn study area, from Greenhorn Road to the Nevada County Fairgrounds, at approximately 1 hour 10 minutes, making the ECT 1.8 hours or more.

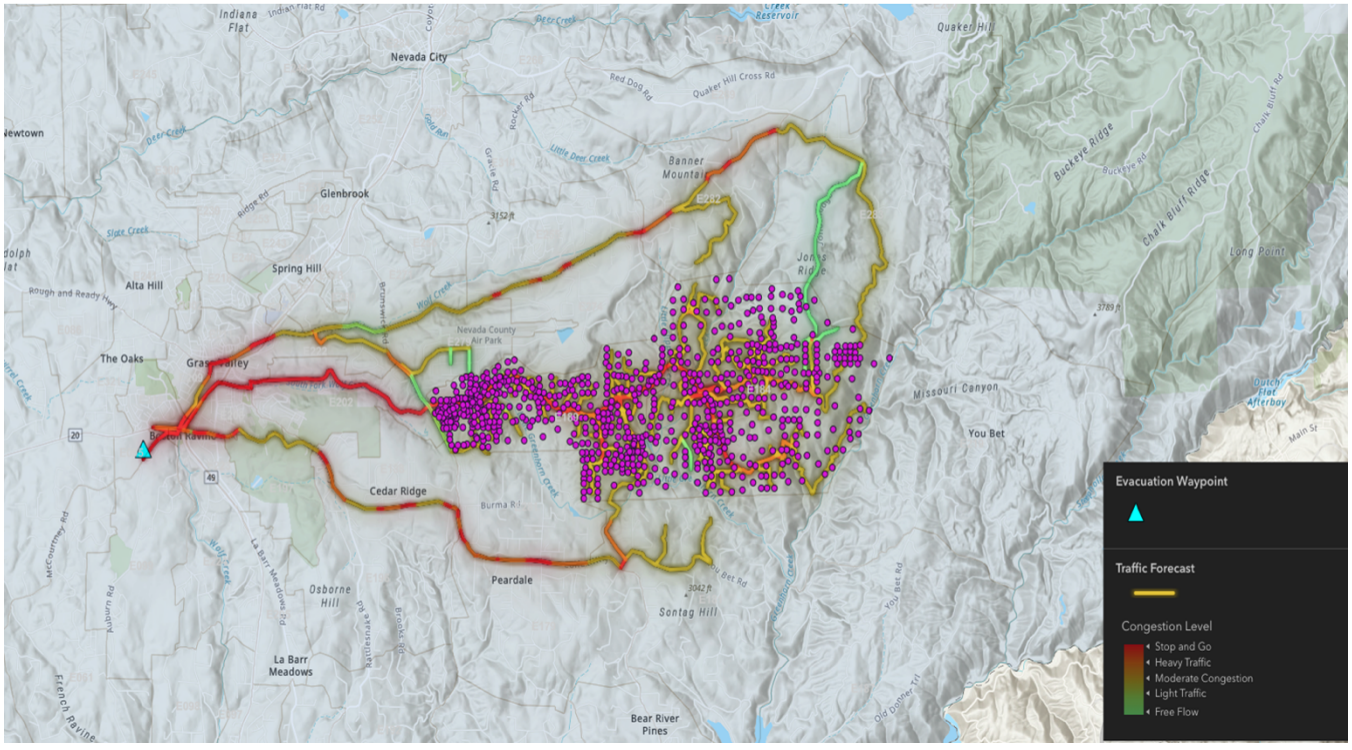
Table 7: Estimated Evacuation Travel Time

Metric	Value
Worst-Case Single Vehicle	1 hour 10 minutes
Average Single Vehicle	1 hour 5 minutes
Passenger Cars	1036
Heavy Vehicles	259

The following road segments, shown in Figure 9, were the most severely congested in the simulation:

- Greenhorn Road to Brunswick Road
- Brunswick Road northbound to Grass Valley
- Brunswick Road southbound to Colfax Highway (State Route 174)
- East Bennet toward Grass Valley
- Colfax Highway (State Route 174) southbound

Figure 9: Ladris Modeling



5.3.2.3 Evacuation Assessment Observations and Recommendations

5.3.2.3.1 Roadway Improvements

The evacuation modeling shows that Greenhorn Road needs to be widened and improved to increase traffic flow and capacity. Since it is unlikely that funding is available for such an ambitious project, the removal of vegetation along the primary evacuation corridors should be prioritized. **Fuel hazard reduction projects along Greenhorn Road, extending northwest from Dogwood Road to the Brunswick Road intersection, must include the removal of large-diameter trees** and shaded fuel breaks of sufficient width from the centerline of the roadway (estimated at 100 to 200 feet) to create a safe route for evacuees. The same strategy should be studied for Brunswick Road from Greenhorn to Grass Valley and East Bennett Road from Brunswick to Lava Rock Avenue. A fuel-modification project of this scale will require community support and a comprehensive environmental analysis as part of the planning process to ensure an environmentally responsible approach to reducing hazardous vegetative fuels.

In addition, Lost Lake Road needs to be improved with an all-weather surface capable of being "navigable by a passenger vehicle weighing 6,000 pounds or less, of equal construction standards to the primary road."[45]

Adding an alternative evacuation route by connecting Greenhorn Road to Lava Cap Mine Road was recommended in the *READY Nevada County Extreme Climate Event Mobility and Adaptation Plan* prepared in May 2022.[46] This northern egress route is needed for the safe evacuation of residents east of Lost Lake Road if Greenhorn Road westbound is obstructed or a fire is approaching from the south.

Roadway Improvement Recommendations

- Expand fuel hazard reduction to include the removal of large-diameter trees on evacuation routes leading into Grass Valley, to include Greenhorn, Brunswick, and East Bennett Roads.
- Improve Lost Lake Road to the standards required for a secondary egress.
- Add an alternative evacuation route by connecting Greenhorn Road to Lava Cap Mine Road.
- Evaluate the viability of Jones Ridge Road as an alternative evacuation route.
- Add road signs that provide clear egress directions to main arterial roads. Signs labeled with "Evacuation Route" are not recommended, as the direction of evacuation must be provided once the fire location is known.

5.3.2.3.2 Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.
- Masticate or remove dense pockets of vegetation in drainages and along roads.
- Remove and replace highly flammable decorative plantings with fire-resistant plant species.

[45] California Code of Regulations, pp. 1-4
[46] Nevada County Transportation Commission, *READY Nevada County*, pp A-16

- Remove conifers to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb remaining conifer trees to a height of 12 feet or more.[47]
- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of zero to five feet from the house, in accordance with Assembly Bill 3074.[48]
- Support added capacity for defensible space inspectors across all jurisdictions.
  - Increase the frequency of defensible space inspections.
  - Aggressively enforce the existing ordinance(s).

Home Hardening and Construction Standards

- Require any new residential homes and developments to provide a minimum 20-foot fire department access/egress road of an all-weather surface and a fire apparatus turnaround for dead-end roads of 150 feet or more in length.[49]
- Harden homes by replacing wood decks and lattice work, flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.
- Enforce building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

[47] Nevada County General Code
[48] CAL FIRE
[49] International Code Council (2021), *IFC 503.1*

Figure 10: Vegetation Encroaching on Narrow Roadway

5.3.3 Cascade Shores/Banner Road Study Area

Cascade Shores is a lake community nestled in the forest on the south shore of Scotts Flat Reservoir. It sits at an elevation of 3,200 feet, with a population of approximately 500. Cascade Shores to Nevada City is a drive of 6.5 miles using Quaker Hill Cross Road to Red Dog Road; Grass Valley is approximately 10 miles to the southwest of the hamlet and is accessed by either Idaho Maryland Road or Banner Lava Cap Road.

The closely built homes within the community are shaded by the large conifer trees that are ubiquitous within the subdivision. Some vegetation management work has been performed on a few parcels; nevertheless, **the extreme fuel load and closed canopy observed during our field survey must be drastically reduced to prevent a disastrous wildfire event**. Access to the lake is limited, with a locked gate blocking the boat ramp (Figure 12). The parking area is relatively small, with trees lining the lot and adjacent shoreline.

Homes along Red Dog and Banner Lava Cap Roads tend to be built on large parcels, separated by large trees and brush. Many of the landowners have provided defensible space around their homes.

Figure 11: Cascade/Banner Study Area

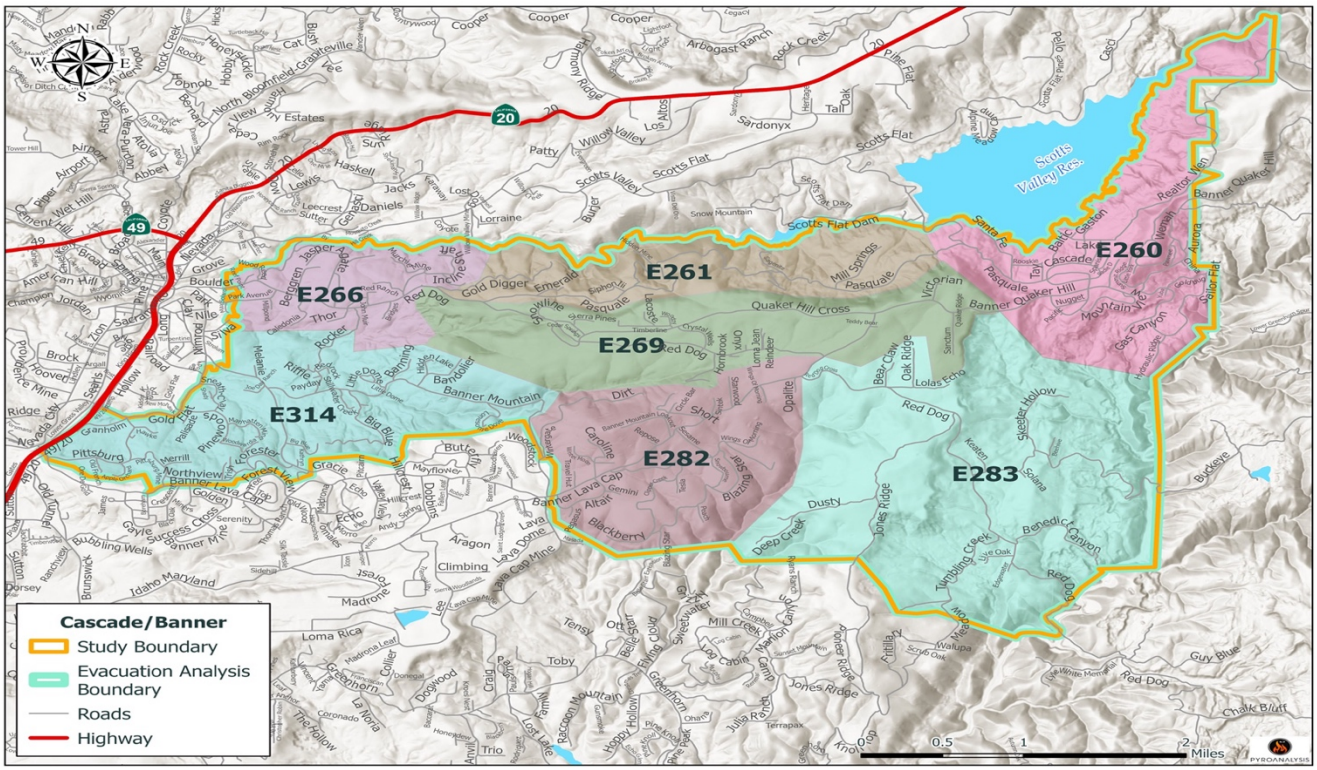


Figure 12: Locked Gate at Cascade Shores Boat Launch

5.3.3.1 Area-Specific Fire Behavior Analysis

5.3.3.1.1 Topography

The Cascade Shores/Banner Mountain region is a forested ridge location bordered on the north by the rugged Deer Creek drainage and on the south by the diverse Greenhorn Creek watershed. Hallmark features include Scotts Flat Reservoir, which lies at 3,000 feet in elevation, and Banner Mountain that tops out at 3,902 feet. Homes are spread out across the landscape in an urban intermix setting with the exception of the enclave of Cascade Shores, which has a higher density of structures. Several creek drainages dissect the Greenhorn watershed, resulting in rugged ridges, ravines, bluffs and hills. The prominent species of trees are ponderosa pine, Douglas fir, and cedar. North aspects south of Scotts Flat Reservoir have very dense stands of timber including substantial groves of madrone trees.

5.3.3.1.2 Fire Behavior

The mixed-conifer forest may experience surface-litter fires; however, during extreme weather, high winds can easily spread fire to the tree crowns, resulting in very large high-severity wildfire where most trees may be killed. Recent history of drought, higher temperatures, and bark beetle mortality further intensify the potential for fires with a high rate of spread, prolific crowning and/or spotting, and strong convective column production. The general layout of the ridge top location has a high probability of being influenced by both watersheds on the north and south of the location, which can produce erratic fire

behavior. During a north wind event, the area may experience extreme fire behavior with spotting over one mile. Fires under such conditions may result in an extended-attack or a major fire.

5.3.3.1.3 Fire Behavior Modeling

For the southwesterly wind scenario, a fire starts in the area of Pittsburg and Pittsburg Mine Roads. The fire burns 267 acres the first day. As with the Greenhorn scenario, the moderate fire behavior allows fire suppression resources to actively engage in perimeter control, and to defend structures that have adequate defensible space clearance.

In a northeasterly wind scenario, an ignition is simulated in the area of State Highway 20 and Willow Valley Road. Within the first four hours, 1,500 acres are consumed and dozens of structures impacted as the fire makes crown runs through the tree canopy and ignites spot fires up to a mile ahead of the main firefront. The fire crosses Quaker Hill Cross Road and Red Dog Road, before running upslope toward Banner Lava Cap Road. Dangerous rates of spread and crown fire limit fire control and structure defense opportunities. The fire burns 3,470 acres in the first 13 hours.

Figure 13: Southwesterly Wind Fire Behavior Scenario

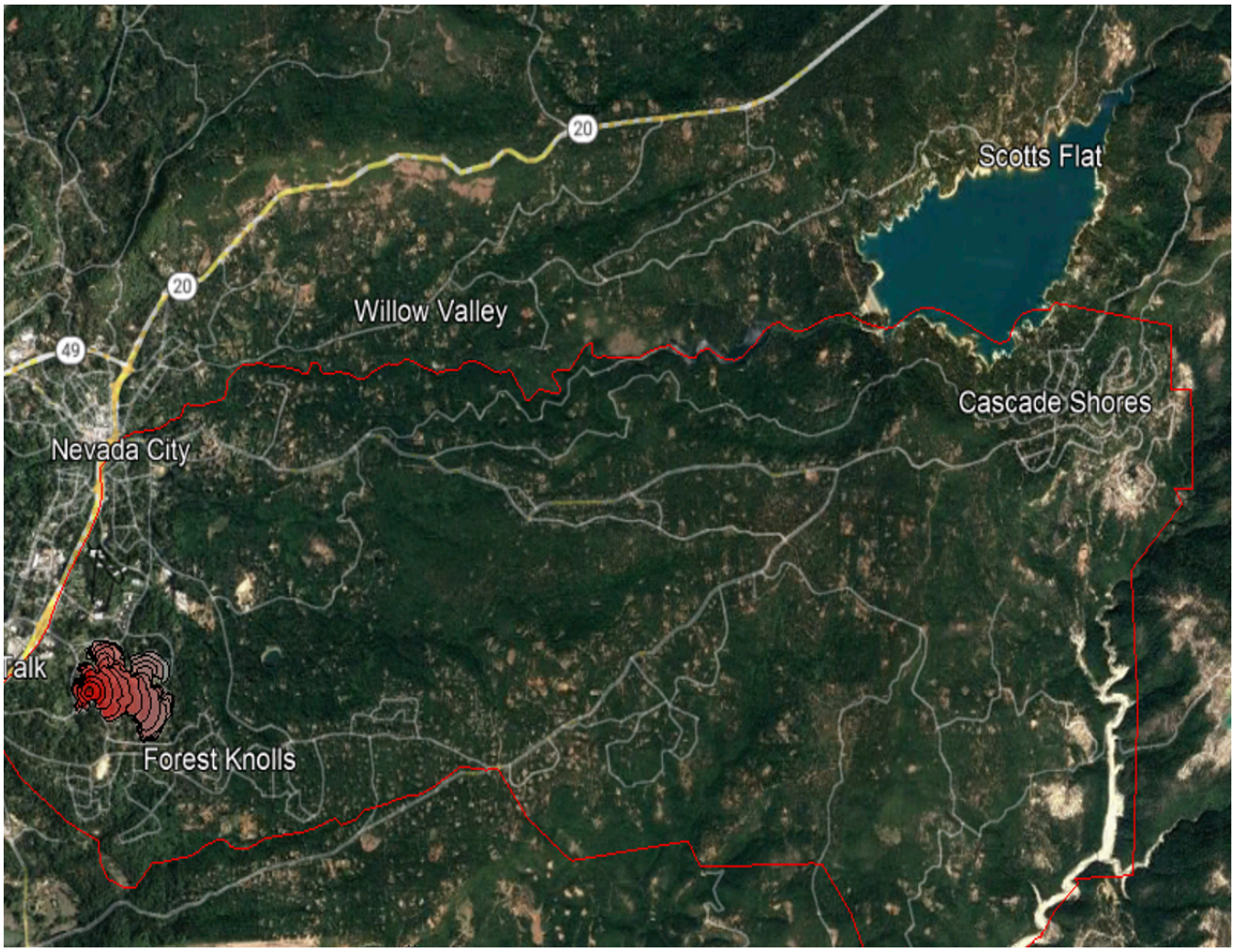
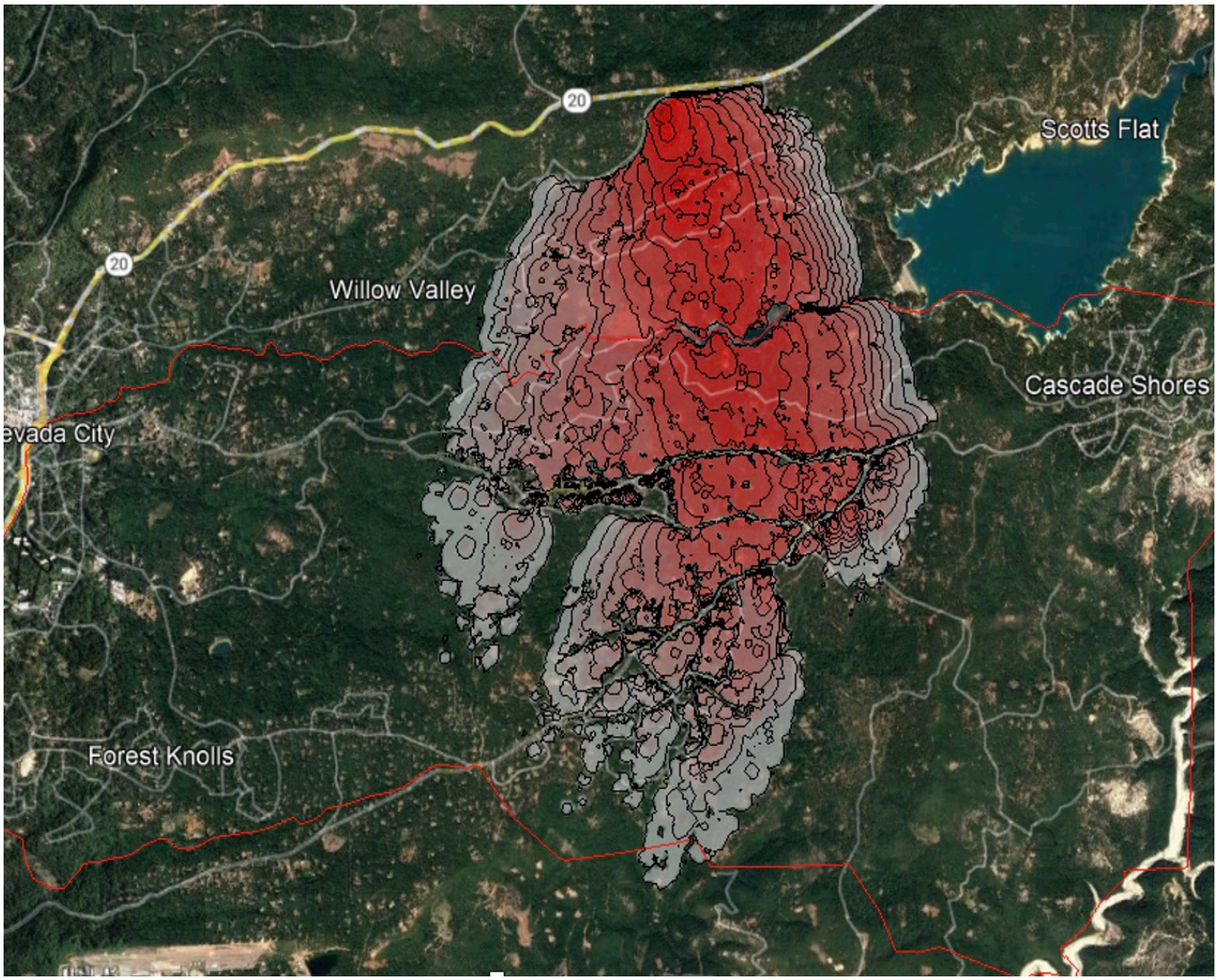


Figure 14: Northeasterly Wind Fire Behavior Scenario



5.3.3.2 Ladris Evacuation Modeling Results

The estimated ECT for the Cascade Shores/Banner Mountain study area assumes a simultaneous evacuation of an estimated population of 500 from Cascade Shores and approximately 2,600 from the homes to the east of Scotts Flat Reservoir along Banner Lava Cap and Red Dog Roads and the adjoining road network.

As observed in Alta Sierra and along Greenhorn Road, the dense vegetation and closed timber canopy that exists within the Cascade Shores/Banner Mountain study area makes intense crown fire runs likely during extreme fire weather days. Such fire behavior may render some evacuation routes impassible, due to fire and smoke impacts, falling trees, or disabled vehicles.

Table 8: Zones Used to Calculate Evacuation TravelTtime

Zone ID	Population
NCO-E266	470
NCO-E314	570
NCO-E282	533
NCO-E283	164
NCO-E269	707
NCO-E261	161
NCO-E260	508

Ladris modeling estimated the travel time for the worst-case single vehicle trip as 2 hours 4 minutes, making the total ECT approximately 2.5 hours.

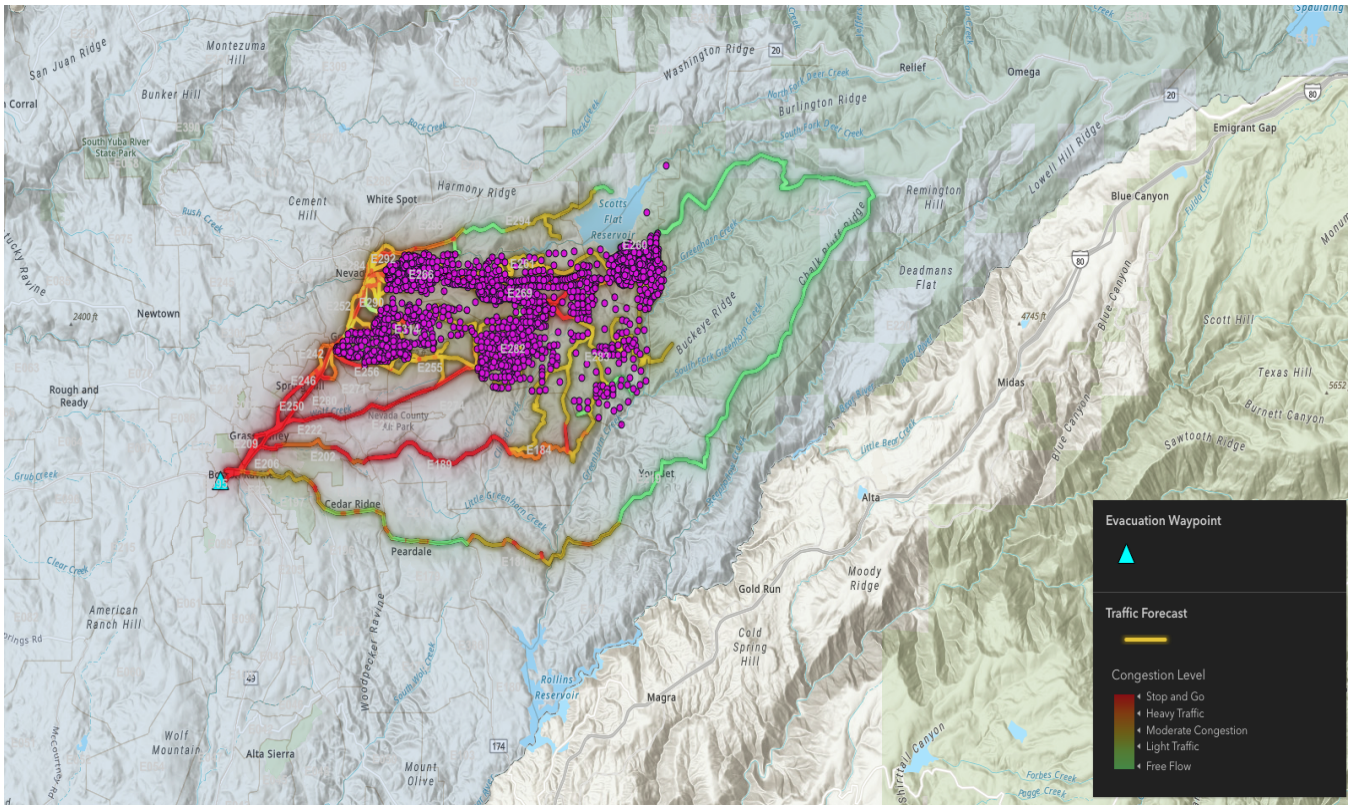
The following road segments, shown in Figure 15, were the most severely congested in the simulation:

- Banner Quaker Hill Road to Red Dog Road, culminating at Broad Street, Nevada City
- South Red Dog Road at Broad Street in Nevada City
- Gracie Road at the intersection with Gold Flat Road
- Idaho Maryland Road

Table 9: Estimated EvacuationTtravel Times

Metric	Value
Worst-Case Single Vehicle	2 hours 4 minutes
Average Single Vehicle	1 hour 36 minutes
Passenger Cars	2,496
Heavy Vehicles	624

Figure 15: Ladris Modeling



5.3.3.3 Evacuation Assessment Observations and Recommendations

5.3.3.3.1 Roadway Improvements

On a typical day, the six-mile drive from Cascade Shores to Nevada City is a 12-minute trip. But the congested intersecting road network at the on-ramp to Highway 49 becomes a pinch point during an evacuation. Most concerning is the continuity of vegetation along the entire roadway leading into the city centers of Nevada City and Grass Valley. If a wildfire that originated near Scotts Flat Reservoir during extreme fire weather conditions was to follow the drainages in a westerly progression into Nevada City, it is possible that vehicles queued up on Red Dog Road, Banner Quaker Hill Road, and the other roads leading to Highway 49 would be overrun by the firefront. Barring major infrastructure projects to reduce congestion on Highway 49 or to develop a viable egress route to the east, the only way to provide safe evacuation routes is to **drastically reduce the fuel loading** along the egress corridors.

Many of these evacuation routes are identified for vegetation management projects in Nevada County's 300-mile grant-funded Roadside Vegetation Abatement Program. It is imperative that the resulting vegetation removal project include the removal of large trees to break the contiguous tree canopy and prevent a crown fire from developing along critical evacuation routes. Shaded fuel breaks need to be of sufficient width (100 feet or more as measured from the centerline of the road) to reduce fire intensity if the roadway is impacted by fire during an evacuation. Pasquale Road is not recommended as an evacuation route due to the dense stands of timber and madrone and the narrow, winding nature of the road.

Roadway Improvement Recommendations

- Drastically reduce the heavy fuel loading along Red Dog and Banner Quaker Hill Roads.
- Develop safe evacuation corridors with shaded fuel breaks of 100 feet or more in width along evacuation routes.

5.3.3.3.2 Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.
- Masticate or remove dense pockets of vegetation in drainages and along roads.
- Remove and replace highly flammable decorative plantings with fire-resistant plant species.
- Remove conifers to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb remaining conifer trees to a height of 12 feet or more.[50]
- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of 0–5 feet from the house, in accordance with Assembly Bill 3074.[51]
- Support added capacity for defensible space inspectors across all jurisdictions.
  - Increase the frequency of defensible space inspections.
  - Aggressively enforce the existing ordinance(s).

Home Hardening and Construction Standards

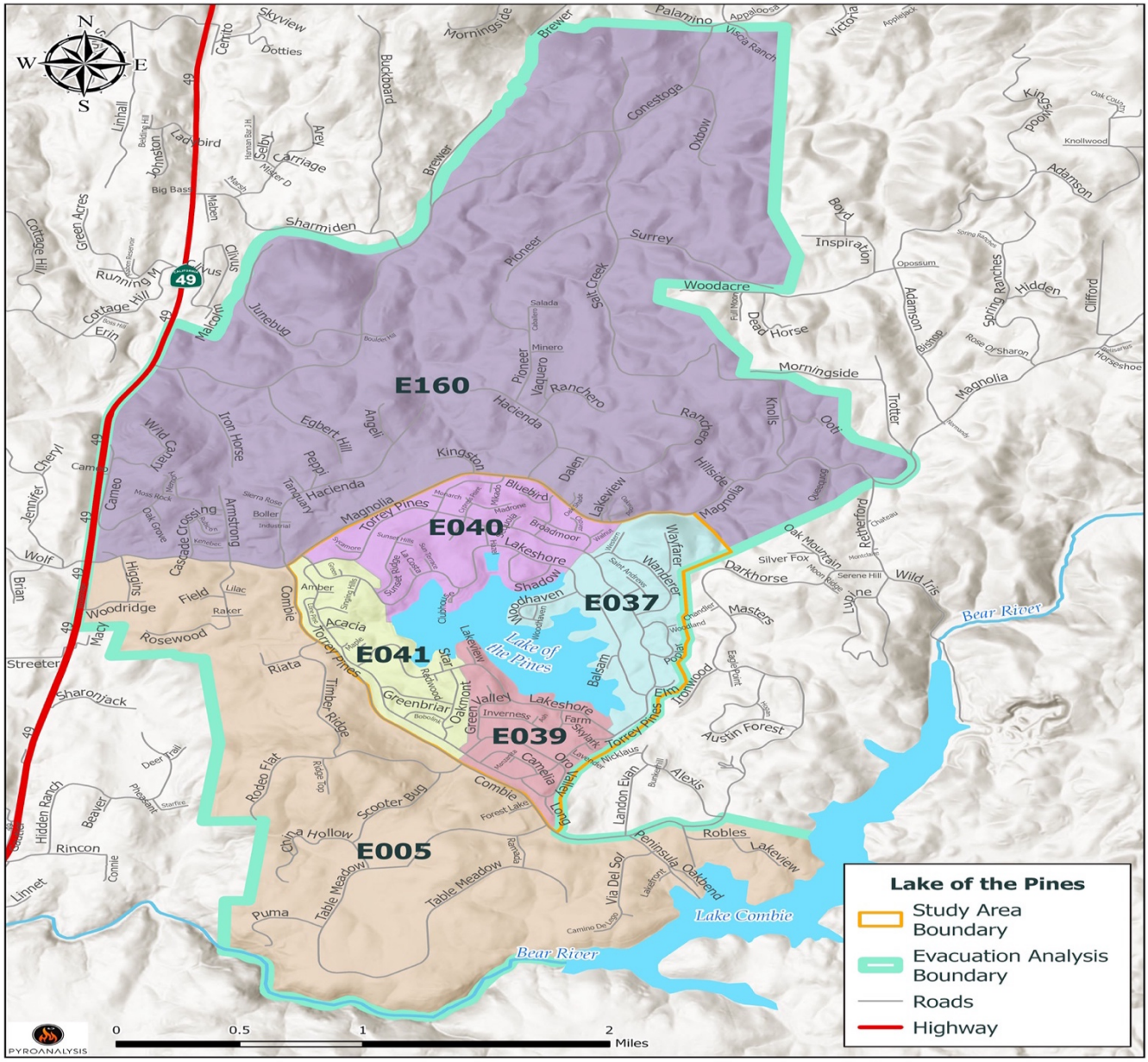
- Require any new residential homes and developments to provide a minimum 20-foot fire department access/egress road of an all-weather surface and a fire apparatus turnaround for dead-end roads of 150 feet or more in length.
- Harden homes by replacing wood decks and lattice work and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.
- Enforce building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

[50] Nevada County General Code
[51] CAL FIRE

5.3.4 Lake of the Pines

Lake of the Pines is a gated residential golf course community developed in the 1960s. It surrounds a 230-acre reservoir that is frequented by boaters and swimmers who enjoy the lake's beaches and water sports. Various recreational activities are available at any of the six parks and the golf course, which includes a clubhouse, restaurant, and bar. A small shopping center and grocery store are found a short distance west of the community at the intersection of Combie and Magnolia Roads.

Figure 16: Lake of the Pines Study Area



Within the community, highly flammable landscaping materials, such as ornamental junipers, are being removed and replaced with Firewise landscaping. A green waste and fuel-reduction program funded by the HOA supports the effort to become a fire-safe community. In 2018, Lake of the Pines capitalized on their Firewise designation, conducting tabletop evacuation exercises and a community evacuation drill. The DarkHorse Golf Club and Lake Combie to the southeast and Bear River High School and associated recreation and commercial development to the north create a massive fuel break around the development. This, combined with the relatively light oak woodland fuels that are characteristic of the area, make Lake of the Pines the most defensible of the communities studied.

5.3.4.1 Area-Specific Fire Behavior Analysis

5.3.4.1.1 Topography

Lake of the Pines is located on a plateau above the Bear River drainage north of Lake Combine at an elevation of 1,500 feet. The area is primarily rolling oak woodlands with gentle, undulating hills coupled with open meadows and grasslands. The terrain is primarily flat with some isolated locations between 15% and 20% slope. Most of the homes are built around the lake and golf course and generally have a prominent west aspect, with minor aspect changes in areas in and around hill locations.

5.3.4.1.2 Fire Behavior

The Lake of the Pines area is in the oak woodlands and is populated primarily by black, blue, and live oak with an annual grass understory. Some areas outside of the subdivision have pockets of chaparral, but the prominent fuel is grass, leaf litter, and dead and downed tree debris. Fires in this area will generally carry through the grass understory quickly and intensify in pockets of denser fuel accumulation. The area is subject to north wind events, which lead to lower humidity levels, strong, gusty winds, fire spotting potential in excess of half a mile, and the potential of extreme fire spread. Fires starting under a north wind event may resist control efforts on initial attack and become an extended-attack or major fire. Fires within the subdivision will impact structures immediately, given the high density and low separation between structures, impacting suppression efforts.

5.3.4.1.3 Fire Behavior Modeling

For the southwesterly ignition scenario, a fire start was modeled at 11:00 AM on Highway 49 just south of Higgins Corner. With no fire suppression activity, modeling results indicate moderate fire behavior in the oak woodlands and grass. The fire spreads into the community within the first day, reaching 250 acres by midnight. Structure defense and perimeter control efforts are expected to be successful in such fire weather conditions.

A much larger fire results from the northeasterly scenario. The ignition is simulated north of Lake of the Pines near Salt Creek Road at Woodacre Road. This simulated fire reaches 3,500 acres by midnight and penetrates Lake of the Pines along the entirety of the community's eastern edge. Fire spread from structure to structure is not modeled,[52] but structure-to-structure ignitions and ember cast are expected to damage and destroy numerous structures. Once fire is established within the community, it will be carried downwind through the intertwined stringers of closely growing conifers.

[52] Current wildfire fire behavior modeling programs do not estimate fire spread rates in structure-to-structure WUI conflagrations.

Figure 17: Southwesterly Wind Fire Behavior Scenario

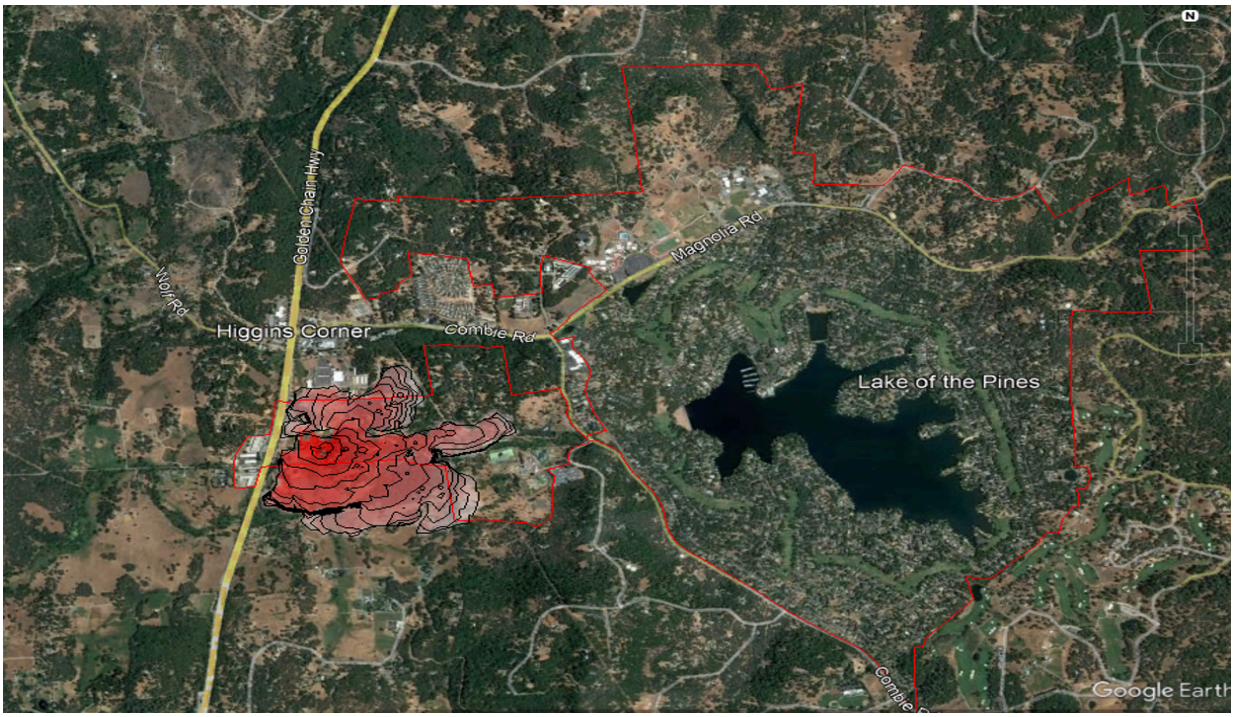
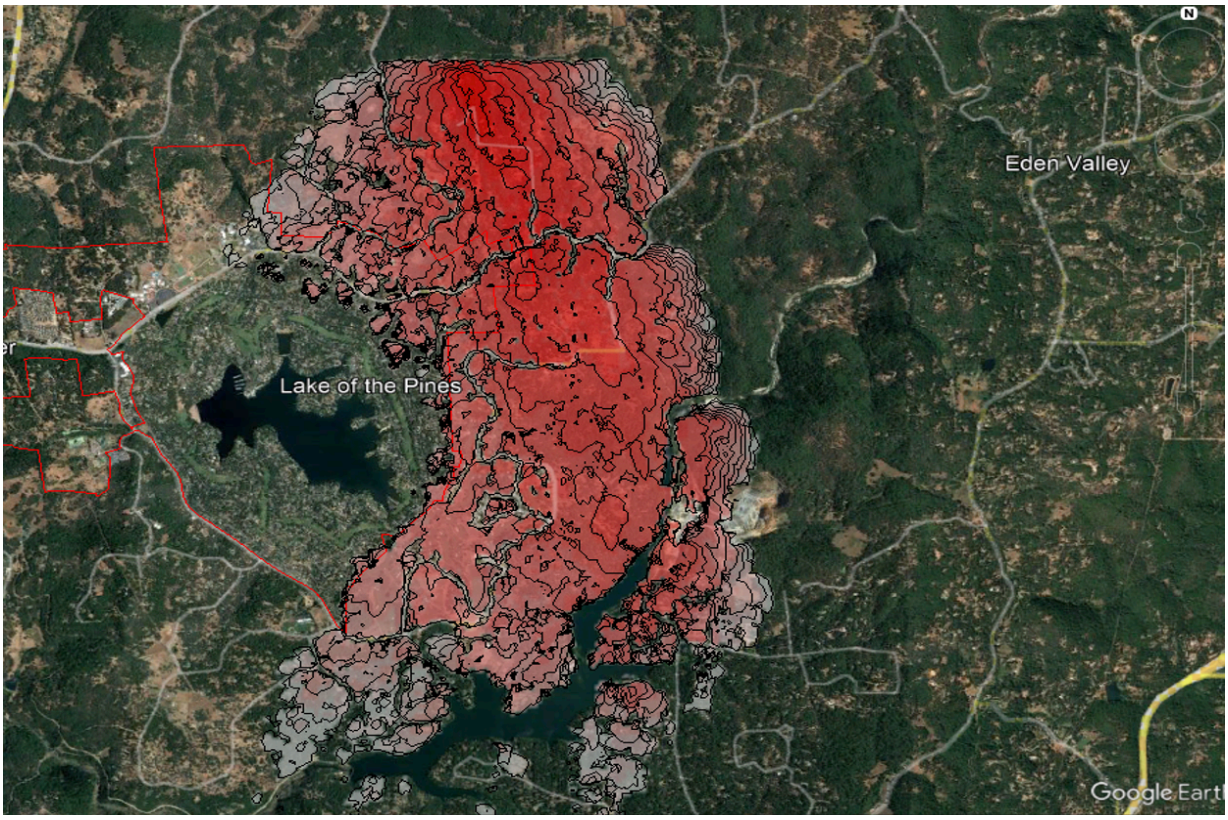


Figure 18: Northeasterly Wind Fire Behavior Scenario



5.3.4.2 Ladris Evacuation Modeling Results

During our field survey, travel trailers and recreational vehicles were absent from the streets and driveways, and egress roads were clearly marked. Egress from the gated community is via the main gate at Magnolia Road or through three chained and locked emergency exit gates located at Oro Valley Road to Combie Road, Sunset Ridge Drive to Magnolia Road, and Foothill Road to Magnolia Road. Highway 49 is accessed one mile west of Lake of the Pines' main gate via Magnolia Road to Combie Road. Vehicles moving eastbound can travel from Magnolia Road to Dog Bar Road to eventually reach Grass Valley to the north or Highway 80 to the east.

It was assumed that an evacuation order for Lake of the Pines would necessitate the evacuation of the surrounding zones; therefore, zones outside Lake of the Pines were included in the travel time study (see Table 10). Different from what was determined appropriate for the other study areas, a factor of 0.1 was used for heavy vehicles to consider stock trailers or travel trailers being pulled by vehicles evacuating the rural parcels and ranchettes in the zones evacuated that are outside the Lake of the Pines study area.

Ladris modeling estimated the average travel time during an evacuation from Lake of the Pines to the Nevada County Fairgrounds to be approximately 4 hours and 50 minutes, making the ECT 5.3 hours or more.

The following road segments, shown in Figure 19, were the most severely congested in the simulation:

- Combie Road to Highway 49
- Highway 49 northbound
- Magnolia to Dog Bar Road
- Magnolia Road
- Lakeshore exiting Lake of the Pines

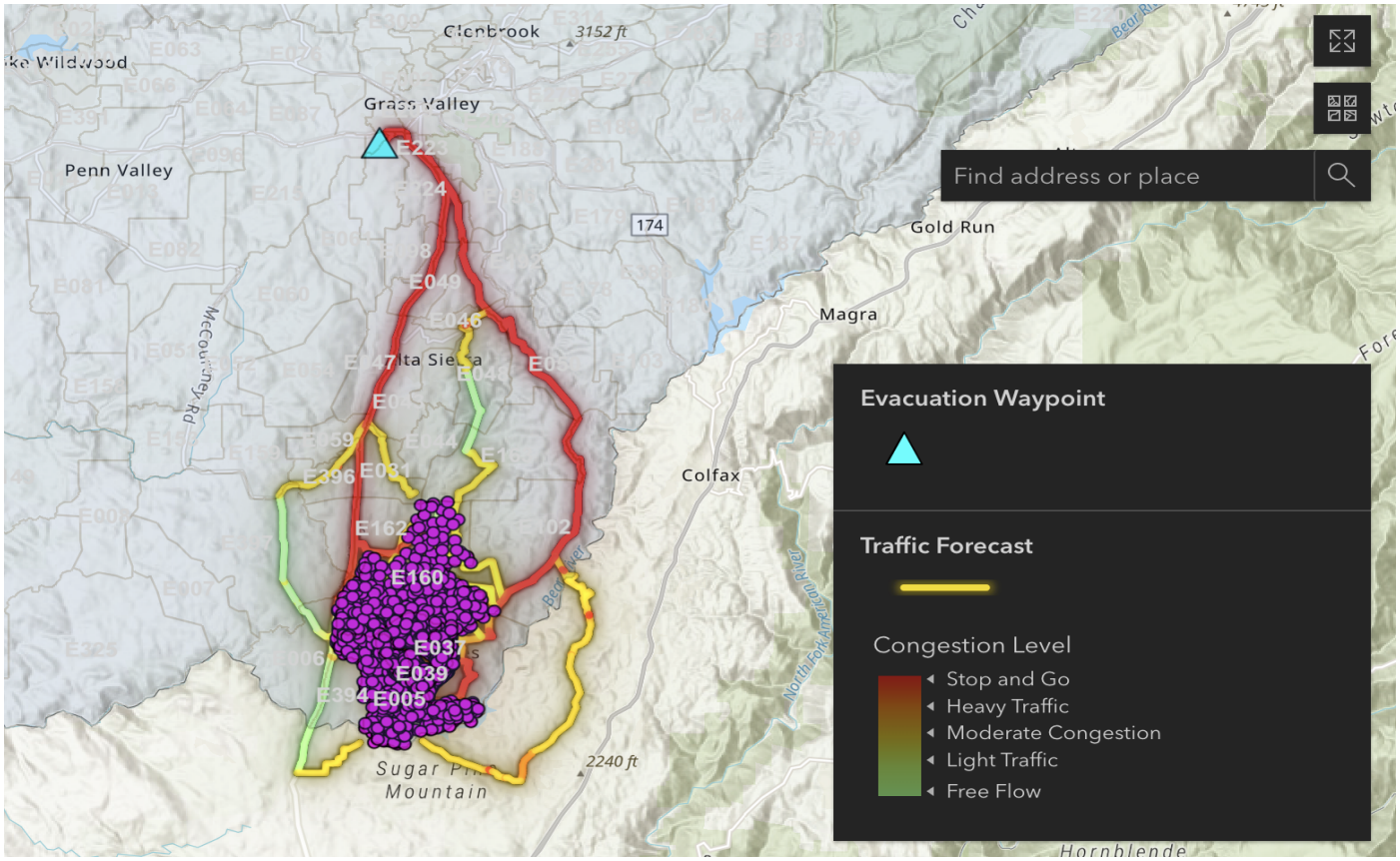
Table 10: Zones Used to Calculate EvacuationTravel Time

Zone ID	Population
NCO-E040	1,281
NCO-E041	722
NCO-E037	973
NCO-E039	954
NCO-E005	741
NCO-E160	1,215

Table 11: Estimated Evacuation Travel Times

Metric	Value
Worst-Case Single Vehicle	4 hours 50 minutes
Average Single Vehicle	3 hours 39 minutes
Passenger Cars	5302
Heavy Vehicles	589

Figure 19: Ladris Modeling



5.3.4.3 Evacuation Assessment Observations and Recommendations

5.3.4.3.1 Roadway Improvements

Of the communities studied, Lake of the Pines has the longest estimated ECT at nearly 5 hours. Even when evacuees reach the highways, speed is reduced to stop-and-go traffic northbound to the Nevada County Fairgrounds. The traffic flow analysis makes it clear that the lack of capacity on the highways is the most apparent constraint to a timely evacuation. Magnolia Road northbound is a two-lane county road that has few turnouts. Trees and brush impinge on the roadway in some areas along the route to Dog Bar Road.

Roadway Improvement Recommendations

- Work with Caltrans to continue highway improvements and wildfire mitigation efforts to increase capacity and to enhance evacuee safety.
  - Consider adding turnouts, expanding the shaded fuel breaks along the highway, and widening roadway shoulders.
  - Add additional traffic lanes to Highway 49 northbound from Cameo Drive.
- Improve and widen Magnolia Road from Sunset Ridge Drive westbound to Combie Road. It is recommended that the culvert running down the north side of the roadway be covered and paved as a pedestrian walking and bike path that can be used as a driving lane during emergencies to increase the capacity of Magnolia Road.
- Remove and replace padlocked emergency egress gates with cellular-/radio-controlled mechanical gates that can be opened remotely by security staff if an evacuation is ordered.
- Continue roadway improvements with shaded fuel breaks northbound to Grass Valley along Magnolia Road and Dog Bar Road.

5.3.4.3.2 Wildfire Mitigation Projects and Initiatives

Strict enforcement of the community's CCRs (Covenants, Conditions, and Restrictions) has done much to improve the fire readiness of the community. New or updated landscaping is required to conform to Firewise standards, hazardous trees are being removed, and a 10-foot fuel-modification zone is maintained along the roadway.[53] These efforts are commendable, but more needs to be done to ensure the community is fire resilient. This is especially important considering the constrained road network and extended evacuation travel times.

The following wildfire mitigation projects and initiatives are recommended:

Vegetation Management

- Proactively remove and replace highly flammable landscaping with Firewise plant species.
- Remove large trees as needed to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb trees to a height of 12 or more feet based on the tree species.
- Ensure that an ember-resistant zone of 0–5 feet from the house is provided.
- Create a shaded fuel break on the south side of Combie Road from Magnolia Road to Highway 49. Fuel modification should remove large trees as needed to open the tree canopy and remove all brush and ladder fuels to a minimum depth of 100 feet from the centerline of the roadway.

[53] Lake of the Pines Association (2023)

Home Hardening

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.

- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

5.3.5 Lake Wildwood

Developed in the late 1960s as a gated golf community surrounding a man-made lake, Lake Wildwood has a population of approximately 5,000. Amenities include five parks, a golf course and clubhouse, a community center, a tennis facility, and a community pool.

Having been impacted by the 49er Fire in 1988 and then evacuated in 2017 when threatened by the Lobo Fire, many residents understand the wildfire risk. They have actively worked to mitigate the hazards while planning for future evacuations. Underscoring these efforts, they commissioned a Firewise Action Plan Study funded by a grant from CAL FIRE's California Climate Investment Fire Prevention Program. This comprehensive study evaluated the fire risk with fire behavior modeling, identified evacuation travel time constraints, and provided fuel modification guidance and numerous emergency readiness recommendations.[54]

Supported by the report findings, the HOA has invested heavily in delivering public education programs to collaborate with their membership in a whole-community approach to wildfire mitigation. They have developed a robust community evacuation plan, and the CCRs have been revised to directly address the ongoing hazard reduction initiatives needed to become Firewise and fire resilient. In addition, a fire management operations division was established to complete fuel-reduction projects on the roadsides and common areas of the community.

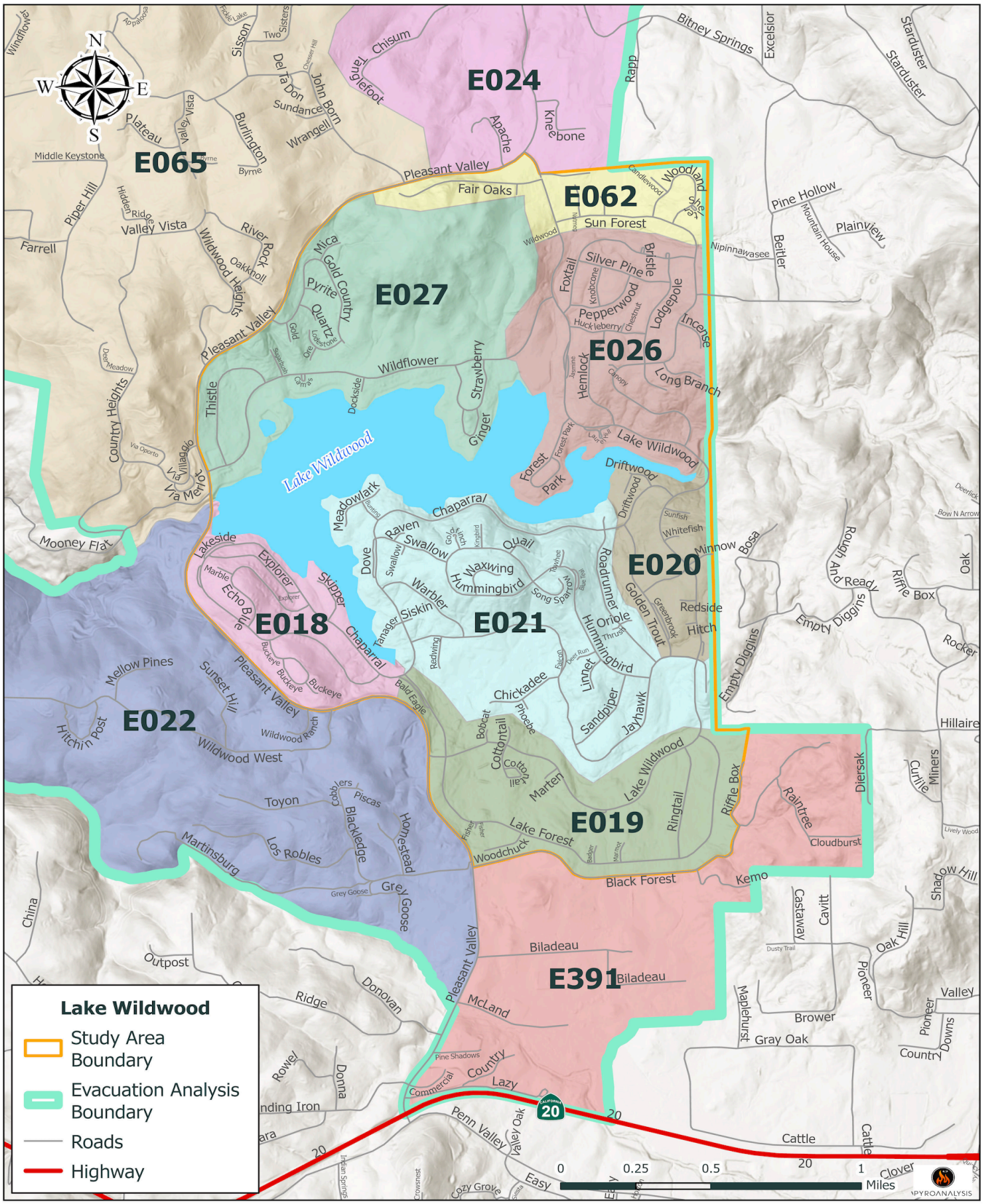
5.3.5.1 Area-Specific Fire Behavior Analysis

5.3.5.1.1 Topography

The Lake Wildwood community lies between elevations of 900 and 2,000 feet, in the lower sections of the Deer Creek drainage upstream from the confluence of the Yuba River. Terrain ranges from flat to just over 30% slope with structures built in and along hillsides, ravines, draws, and flat lake-frontage lots. The predominant aspect of the subdivision faces southwest; however, a substantial north aspect exists in the southern portion of the development. The terrain outside of the subdivision is more complex and rugged. The Deer Creek drainage below the Lake Wildwood Dam is narrow, steep, and more than 80% slope. Other areas outside the subdivision consist of rolling oak woodlands with some areas of heavier fuels in drainages and pockets of chaparral.

[54] Whitlock

Figure 20: Lake Wildwood Study Area



5.3.5.1.2 Fire Behavior

Fire in this area can range from small surface-litter fires to extremely intense mixed-chaparral-and-oak-woodland fires. Chaparral consists of highly flammable shrubs, such as manzanita, chamise, and ceanothus, which can contribute to rapid fire spread. Oak woodland tree species include blue oak, black oak, live oak, and scattered pine (foothill and ponderosa), with willow trees along waterways. The region is subject to north wind events typically associated with dry air masses. As the winds descend from higher elevations, they can compress and warm, leading to lower humidity levels and strong, gusty winds in excess of 20 mph, resulting in extreme fire spread potential. The largest threat comes from outside the subdivision, as there are pockets of dense chaparral scattered throughout the oak woodlands. Late summer and fall fires may resist control during the initial attack to become extended- attack or major fires. Fires in Lake Wildwood have the potential to immediately threaten structures, diverting fire resources from fire control to the defense of structures and rescue of fire victims. Under extreme conditions, embers carried by the wind can start spot fires more than half a mile away and produce flame heights exceeding 200 feet.

5.3.5.1.3 Fire Behavior Modeling

A fire starting under southwesterly wind conditions was simulated with an ignition point near Pleasant Valley Road and Mellow Pines Drive. The fire develops parallel to Pleasant Valley Road as the road acts a barrier to fire growth to the east. Without fire suppression, it is probable that the fire would spot across the Pleasant Valley Road and burn into Lake Wildwood in the vicinity of Tanglewood Loop. In this scenario, fire service resources would successfully control the fire and defend structures with adequate defensible space.

An ignition along Pleasant Valley Road near Apache Court burning under the influence of a northeasterly wind crosses Pleasant Valley Road within the first hour and impacts structures within Lake Wildwood. In this scenario, it is likely the fire would burn south along the heavily vegetated drainage that parallels Lake Wildwood Drive, resulting in structure-to-structure ignitions with dozens of structures damaged or destroyed on the north side of the lake. Modeling indicates that long-range spotting will carry the fire across the lake to ignite spot fires near Chaparral Drive and Kingbird Court.

In such a scenario, the heavy fuel loading associated with the conifer and live oak trees growing within Lake Wildwood will result in flame lengths of 70 to 200+ feet and ember cast that will resist fire control efforts.

5.3.5.2 Ladris Evacuation Modeling Results

Access and egress are available through two staffed security gates: the Lake Wildwood entrance is 1.4 miles north of Highway 20 off Pleasant Valley Road, and the Wildflower Drive access is 3 miles north of Highway 20 off Pleasant Valley Road. At the north end of Lake Wildwood Drive, an emergency gate leads to Pleasant Valley Road just south of the William Ranch Elementary School. If clearly posted, Beitler Road to the east and a utility services gate at the end of Buckeye Circle on the west side of the development may be used as alternative egress roads.

It is assumed that an evacuation order for Lake Wildwood would necessitate the evacuation of the surrounding zones; therefore, zones outside Lake Wildwood were included in the travel time study (see Table 12). A factor of 0.1 was used for heavy vehicles to consider stock trailers or travel trailers being pulled by vehicles evacuating from the zones outside the Lake of Wildwood study area.

Figure 21: Southwesterly Wind Fire Behavior Scenario

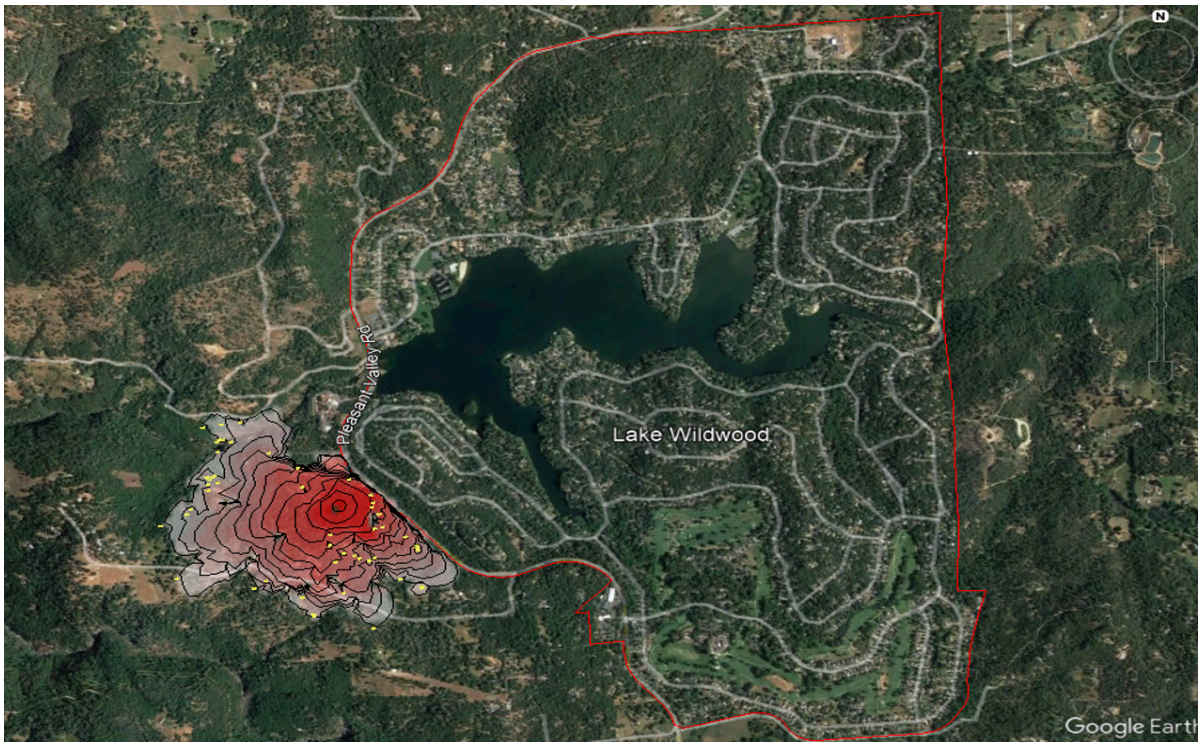
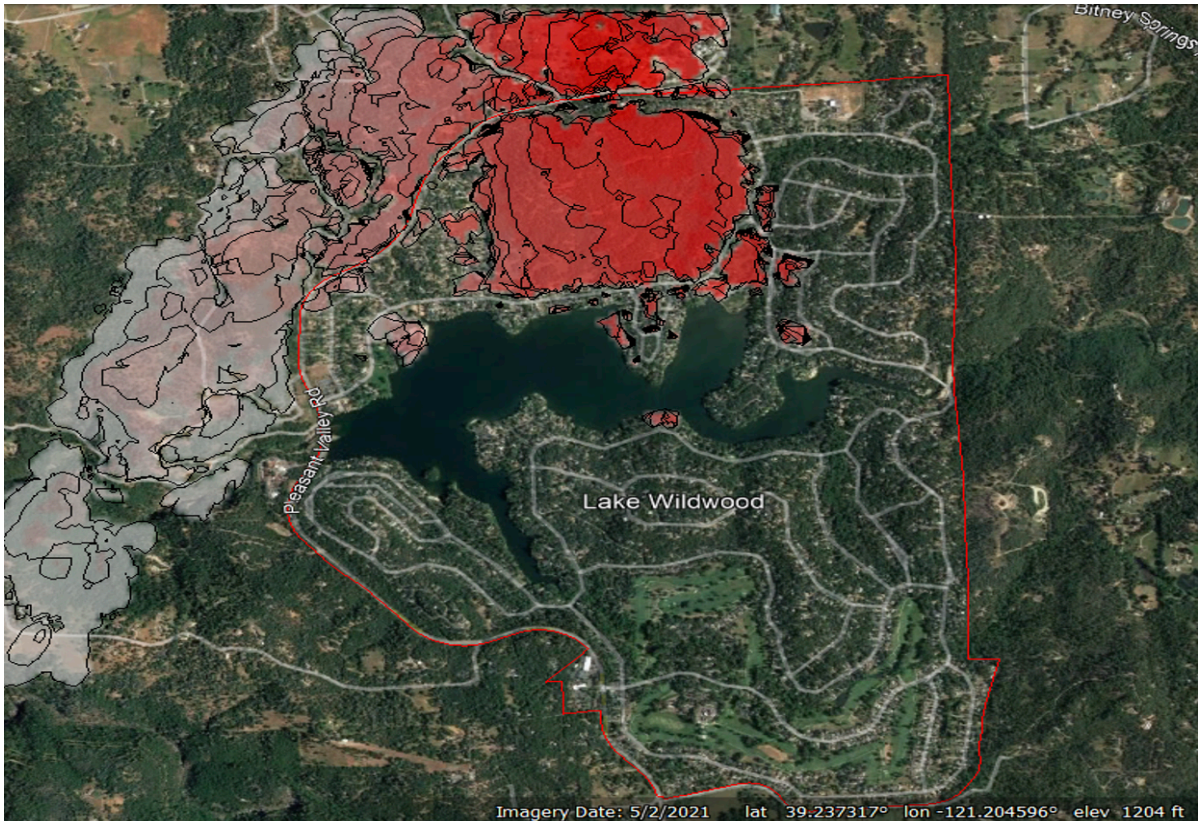


Figure 22: Northeasterly Wind Fire Behavior Scenario



Ladris modeling estimated the average travel time during an evacuation from Lake of the Pines to the Nevada County Fairgrounds to be approximately 4 hours and 21 minutes, making the ECT 4.7 to 5 hours or more.

The following road segments, shown in Figure 23, were the most severely congested in the simulation:

- Lake Wildwood Drive to Pleasant Valley Road (main entrance)
- Highway 20 eastbound to Nevada City Fairgrounds
- Pleasant Valley Road eastbound to Bitney Springs Road to Newtown Road and to Highway 49
- Mooney Flat Road to Smartsville

Note: Bitney Springs Road is shown but not recommended as an evacuation route due to the narrow roadway and heavy accumulation of roadside fuels.

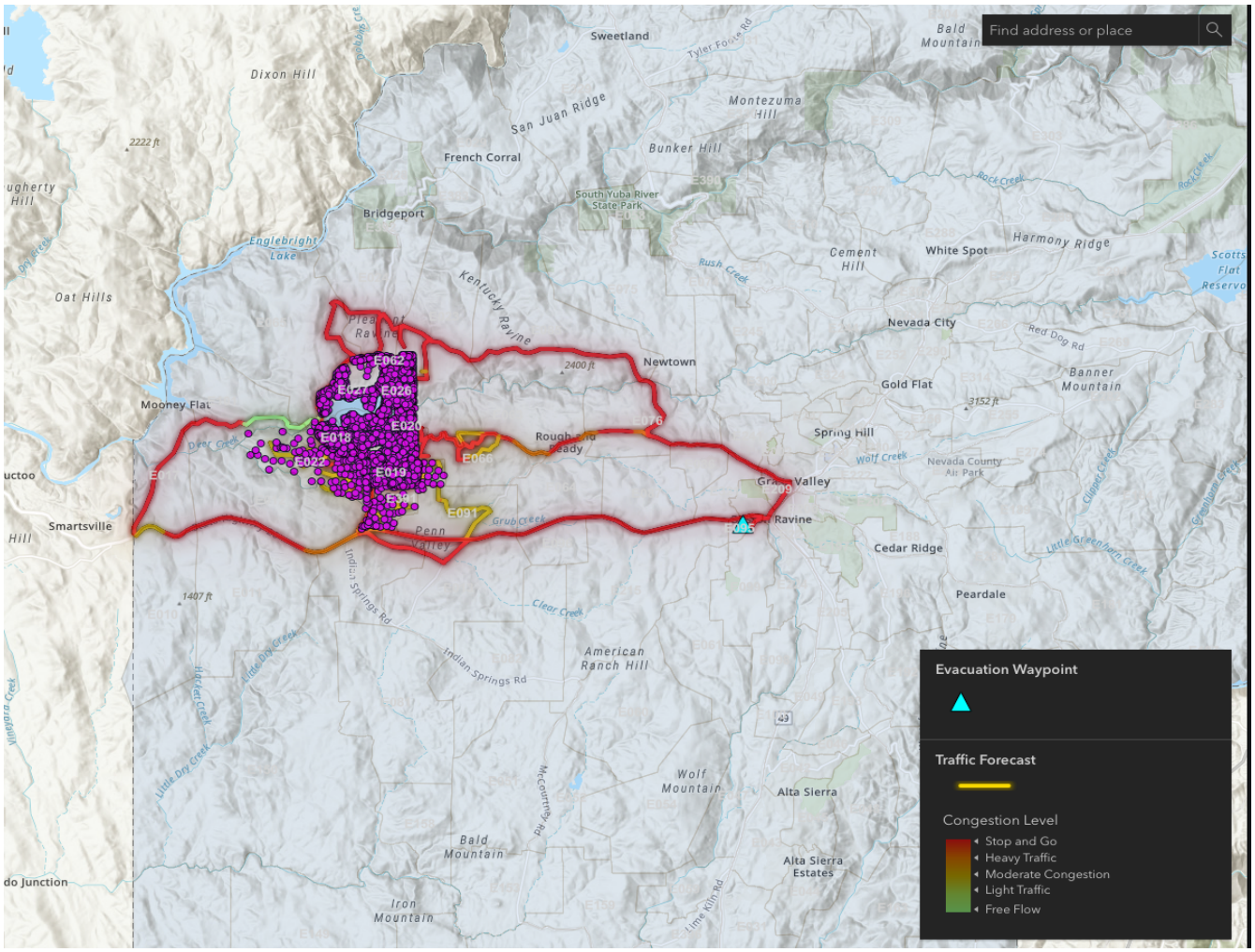
Table 12: Zones Used to Calculate Evacuation Travel Time

Zone ID	Population
NCO-E062	306
NCO-E027	908
NCO-E026	972
NCO-E020	392
NCO-E021	1,642
NCO-E018	494
NCO-E022	341
NCO-E019	919
NCO-E391	98
NCO-E065	629
NCO-E024	339

Table 13: Estimated Evacuation Travel Times

Metric	Value
Worst-Case Single Vehicle	4 hours 21 minutes
Average Single Vehicle	2 hours 50 minutes
Passenger Cars	6,345
Heavy Vehicles	705

Figure 23: Ladris Modeling



5.3.5.3 Evacuation Assessment Observations and Recommendations

During field visits to Lake Wildwood, it was apparent that efforts are being made to replace flammable landscaping with Firewise landscapes and reduce the fuel load along roadways. These projects are, without a doubt, reducing the fire hazard within the community. Nonetheless, there is a real probability that a wildfire burning under the conditions experienced during the 2017 Lobo Fire would become a running fire in the thickly growing live oak, gray pines, and other native conifer stands within the community. In such a scenario, ember production and crown runs could generate house-to-house fire spread. Once established, an urban conflagration of this kind will likely entrap residents, resulting in firefighting tactics shifting from fire control to civilian rescue. It is not the intention of this report to cause alarm but to emphasize that **without the aggressive removal of the intense fuel loading available in the form of healthy, live trees**—not a stated goal of the fuel-reduction program—**the risk for a deadly and destructive urban conflagration resulting from a fire burning in extreme fire weather conditions remains a real and present danger**.[55]

[55] Whitlock, p. 25

Evacuating the entire community and surrounding zones when threatened by an approaching wildfire will result in vehicles queuing for miles along Pleasant Valley Road, Lake Wildwood Drive, and the associated road networks. Anecdotal reports from Lake Wildwood security staff estimated that during the Lobo Fire evacuation, vehicles took two hours or more to exit the Lake Wildwood community. While waiting in these long lines of vehicles, evacuees may be overrun by the firefront. For this reason, it is essential that the shaded fuel breaks developed along the roadways, both inside the Lake Wildwood community and on the egress routes leading out of the community, are of sufficient depth—100 feet or more as measured from the centerline of the roadway—to provide for life safety. Doing this will require an aggressive fuel-reduction program that includes the removal of large trees as needed to provide sufficient gaps in the tree canopy to prevent crown fire and reduce fire intensity.

5.3.5.3.1 Roadway Improvement Recommendations

- Work with Caltrans to continue improvements and wildfire mitigation efforts to increase capacity and to enhance evacuee safety.
  - Consider adding turnouts, expanding the shaded fuel breaks, and widening roadway shoulders.
  - Add traffic lanes on Highway 20 in both directions from Pleasant Valley Road.
- Straighten, add shoulders, and create shaded fuel breaks along the roadway on Bitney Springs Road to Newtown Road.
- Remove and replace padlocked emergency egress gates with cellular-/radio-controlled mechanical gates that can be opened remotely by security staff if an evacuation is ordered.
- Replace the emergency egress gate leading from Lake Wildwood Drive to Pleasant Valley Road just south of William Ranch Elementary School with a 20-foot gate to allow for two egress lanes.
- Straighten and/or widen Mooney Flat Road, add shoulders, and create shaded fuel breaks along the roadway between Pleasant Valley Road and Marina Drive.
- Remove roadside fuels and create shaded fuel breaks of 100 feet on both sides of the road as measured from the centerline of the roadway on the following sections of Pleasant Valley Road:
  - Wildwood Heights Drive northbound to John Born Road
  - Lake Wildwood Dam southbound to Black Forest Road

  Note: A fuel modification of this scope requires the County and private landowners to work collaboratively to develop a safe egress corridor.

5.3.5.3.1 Wildfire Mitigation Projects and Initiatives

Within Lake Wildwood valuable fuel-reduction programs are underway, and much has been done to educate the community and plan for future evacuations. What must be considered is how much more is needed to prepare the community for a fire that starts near or in the development under extreme burning conditions, as experienced during the 49er and Lobo Fires. Without the aggressive removal of the flammable vegetation within the community and along the egress corridors, the community remains at risk from a destructive wildfire.

Vegetation Management

- Reduce fuel loading in the riparian drainages along Lake Wildwood Road.
- Expand fuel-reduction programs within the community to remove the heavy fire loading presented by the accumulation of large live oaks, gray pines, and other highly flammable tree species.
- Continue enforcing the CCRs and state regulations to ensure defensible space standards are met or exceeded.
- Remove large trees as needed to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb trees to a height of 12 or more feet based on the tree species.
- Ensure an ember-resistant zone of 0–5 feet from the house is provided.

Home Hardening

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.
- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

Initiatives

- Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners working with regulatory agencies and to navigate the regulatory impediments to successfully complete wildfire mitigation activities on private property.

6 Findings and Recommendations

As Nevada County faces increasing wildfire risks, the comprehensive evacuation study conducted by PyroAnalysis, LLC, in collaboration with Ladris and various local and state agencies, offers critical insights and actionable strategies to enhance community resilience. The study's multifaceted approach, combining scientific analysis with real-world applicability, has yielded an in-depth understanding of the unique challenges posed by the region's topography, fuel accumulation, and climate conditions.

Key Findings and Implications

1. **Fire Behavior and Traffic Patterns**: The study highlights the severe wildfire risks in Nevada County, exacerbated by the buildup of fuels and expanding wildland-urban interface. The fire behavior and traffic pattern analyses across the five study areas clearly show potential fire trajectories and evacuation challenges, underscoring the need for strategic planning and roadway improvements.

2. **Collaborative Insights**: The involvement of various departments and agencies has enriched the study with ground-level perspectives, making the recommendations scientifically sound and pragmatically viable. This collaboration has ensured that the study's outcomes are rooted in local realities and are more likely to be effectively implemented.
3. **Strategic Recommendations**: Based on the findings, the study recommends targeted actions to improve evacuation routes, enhance public awareness and preparedness, and mitigate fire risks through fuel-reduction and land-management strategies.

6.1 Next Steps and Future Research

The Nevada County Evacuation Study is a crucial step toward safeguarding the community against the ever-present threat of wildfires. To be successful in this monumental task, much more must be done to reduce the hazardous fuels growing along evacuation corridors and within the communities. As identified in this study, shaded fuel breaks that extend a minimum of 100 feet (as measured from the centerline of the roadway) on each side of egress roadways and ongoing improvements to the road networks are required to provide a reasonable degree of safety for evacuees.

In embracing these recommendations, Nevada County can enhance its preparedness and response capabilities, ultimately protecting lives, property, and the natural beauty that defines the region.

This study is a call to action for local authorities, residents, and stakeholders to pursue additional grant funding to do the following:

- Implement the recommended roadway improvement and wildfire mitigation strategies.
- Engage in continuous community education and preparedness programs.
- Conduct further research to ensure educational programs incentivize appropriate human behavior and response before and during an evacuation.
- Analyze the community archetypes for each study area to better understand how the population will react during an evacuation.
- Study the impacts of a multi-jurisdictional evacuation on the road networks.

Prioritize grant funding for the following projects:

- Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners working with regulatory agencies and to navigate the regulatory impediment to successfully implementing wildfire mitigation actions on private property.
- Expand fuel hazard reduction to include the removal of large-diameter trees on evacuation routes leading into Grass Valley, to include Greenhorn, Brunswick, and East Bennett Roads.
- Improve Lost Lake Road to the standards required for a secondary egress.
- Drastically reduce the heavy fuel loading along Red Dog and Banner Quaker Hill Roads.

- Improve and widen Magnolia Road from Sunset Ridge Drive westbound to Combie Road. It is recommended that the culvert running down the north side of the roadway be covered and paved as a pedestrian walking and bike path that can be used as a driving lane during emergencies to increase the capacity of Magnolia Road.

- Create a shaded fuel break on the south side of Combie Road from Magnolia Road to Highway 49. Fuel modification should remove large trees as needed to open the tree canopy and remove all brush and ladder fuels to a minimum depth of 100 feet from the centerline of the roadway.

- Remove roadside fuels and create shaded fuel breaks of 100 feet on both sides of the road as measured from the centerline of the roadway on the following sections of Pleasant Valley Road:
  - Wildwood Heights Drive northbound to John Born Road
  - Lake Wildwood Dam southbound to Black Forest Road

- Support added capacity for defensible space inspectors across all jurisdictions.
  - Increase the frequency of defensible space inspections.
  - Aggressively enforce the existing ordinance(s).

6.2 Summary of Recommended Roadway Improvements and Wildfire Mitigation Projects and Initiatives

6.2.1 Alta Sierra

Roadway Improvement Recommendations

Continue to work with Caltrans to support improvements and wildfire mitigation efforts that increase roadway capacity and enhance evacuee safety.

  - Consider adding turnouts, expanding the shaded fuel breaks, and widening roadway shoulders.
  - Add traffic lanes on Highway 49 north of Alta Sierra Drive, south of Lime Kiln Road, and at the merge point south of McKnight Way[56]

- Improve Brewer Road south of Cane Lane to provide an alternative emergency egress to Highway 49.

- Improve Mt. Olive Road from Dog Bar Road to Highway 174 in conjunction with the Woodpecker Ravine wildfire mitigation project.

- Connect Round Valley Road to provide emergency egress to Highway 49 from Norlene Way.

[56] Nevada County Transportation Commission, READY Nevada County, p. 58-59

Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.
- Masticate or remove dense pockets of vegetation in drainages and along mid-slope roads.
- Remove and replace highly flammable decorative plantings with fire-resistant plant species.
- Remove conifers to create an open tree canopy, thereby reducing the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb remaining conifer trees to a height of 12 or more feet.
- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of zero to five feet from the house, in accordance with Assembly Bill 3074.[57] Where intervening property lines make this difficult, the ASPOA can assist with neighborhood education and information-sharing campaigns.
- Support added capacity for defensible space inspectors across all jurisdictions.
  - Increase the frequency of defensible space inspections.
  - Aggressively enforce the existing ordinance(s).

Home Hardening and Construction Standards

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.
- Add signs throughout the community to identify the egress routes to Highway 49 and Dog Bar Road.
- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

Initiatives

- Encourage the ASPOA to actively engage the community in HOA standards to address properties that are not compliant with defensible space regulations.
- Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners working with regulatory agencies and to navigate the regulatory impediment to successfully implementing wildfire mitigation actions on private property.

[57] CAL FIRE

6.2.2 Greenhorn Road

Roadway Improvement Recommendations

- Expand fuel hazard reduction to include the removal of large-diameter trees on evacuation routes leading into Grass Valley, to include Greenhorn, Brunswick, and East Bennett Roads.
- Improve Lost Lake Road to the standards required for a secondary egress.
- Add an alternative evacuation route by connecting Greenhorn Road to Lava Cap Mine Road.
- Evaluate the viability of Jones Ridge Road as an alternative evacuation route.
- Add road signs that provide clear egress directions to main arterial roads: Signs labeled with "Evacuation Route" are not recommended, as the direction of evacuation must be provided once the fire location is known.

Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.
- Masticate or remove dense pockets of vegetation in drainages and along roads.
- Remove and replace highly flammable decorative plantings with fire-resistant plant species.
- Remove conifers to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb remaining conifer trees to a height of 12 feet or more.[58]
- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of zero to five feet from the house, in accordance with Assembly Bill 3074.[59]
- Support added capacity for defensible space inspectors across all jurisdictions.
  - Increase the frequency of defensible space inspections.
  - Aggressively enforce the existing ordinance(s).
  –

Home Hardening and Construction Standards

- Require any new residential homes and developments to provide a minimum 20-foot fire department access/egress road of an all-weather surface and a fire apparatus turnaround for dead-end roads of 150 feet or more in length.[60]

[58] Nevada County General Code
[59] CAL FIRE
[60] International Code Council, IFC 503.1

- Harden homes by replacing wood decks and lattice work, flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.

- Enforce building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

6.2.3 Cascade Shores/Banner Mountain

Roadway Improvement Recommendation

- Drastically reduce the heavy fuel loading along Red Dog and Banner Quaker Hill Roads.

- Develop safe evacuation corridors with shaded fuel breaks of 100 feet or more in width along evacuation routes.

Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Remove all vegetation along roadways to a distance of 10 feet or more off each shoulder.

- Masticate or remove dense pockets of vegetation in drainages and along roads.

- Remove and replace highly flammable decorative plantings with fire-resistant plant species.

- Remove conifers to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.

- Limb remaining conifer trees to a height of 12 feet or more.[61]

- Ensure that all homes provide 100 feet of defensible space to include an ember-resistant zone of 0–5 feet from the house, in accordance with Assembly Bill 3074.[62]

- Support added capacity for defensible space inspectors across all jurisdictions.

  - Increase the frequency of defensible space inspections.

  - Aggressively enforce the existing ordinance(s).

Home Hardening and Construction Standards

- Require any new residential homes and developments to provide a minimum 20-foot fire department access/egress road of an all-weather surface and a fire apparatus turnaround for dead-end roads of 150 feet or more in length.

[61] Nevada County General Code
[62] CAL FIRE

- Harden homes by replacing wood decks and lattice work and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.

- Enforce building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

6.2.4 Lake of the Pines

Roadway Improvement Recommendations

- Work with Caltrans to continue highway improvements and wildfire mitigation efforts to increase capacity and to enhance evacuee safety.
  - Consider adding turnouts, expanding the shaded fuel breaks along the highway, and widening roadway shoulders.
  - Add additional traffic lanes to Highway 49 northbound from Cameo Drive.
- Improve and widen Magnolia Road from Sunset Ridge Drive westbound to Combie Road. It is recommended that the culvert running down the north side of the roadway be covered and paved as a pedestrian walking and bike path that can be used as a driving lane during emergencies to increase the capacity of Magnolia Road.
- Remove and replace padlocked emergency egress gates with cellular-/radio-controlled mechanical gates that can be opened remotely by security staff if an evacuation is ordered.
- Continue roadway improvements with shaded fuel breaks northbound to Grass Valley along Magnolia Road and Dog Bar Road.

Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Proactively remove and replace highly flammable landscaping with Firewise plant species.
- Remove large trees as needed to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb trees to a height of 10 or more feet based on the tree species.
- Ensure an ember-resistant zone of 0–5 feet from the house is provided.
- Create a shaded fuel break on the south side of Combie Road from Magnolia Road to Highway 49. Fuel modification should remove large trees as needed to open the tree canopy and remove all brush and ladder fuels to a minimum depth of 100 feet from the centerline of the roadway.

Home Hardening

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.

- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

6.2.5 Lake Wildwood

Roadway Improvement Recommendations

- Work with Caltrans to continue improvements and wildfire mitigation efforts to increase capacity and to enhance evacuee safety.

  - Consider adding turnouts, expanding the shaded fuel breaks, and widening roadway shoulders.

  - Add traffic lanes on Highway 20 in both directions from Pleasant Valley Road.

- Straighten, add shoulders, and create shaded fuel breaks along the roadway on Bitney Springs Road to Newtown Road.

- Remove and replace padlocked emergency egress gates with cellular-/radio-controlled mechanical gates that can be opened remotely by security staff if an evacuation is ordered.

- Replace the emergency egress gate leading from Lake Wildwood Drive to Pleasant Valley Road just south of Williams Ranch Elementary School with a 20-foot gate to allow for two egress lanes.

- Straighten and/or widen Mooney Flat Road, add shoulders, and create shaded fuel breaks along the roadway between Pleasant Valley Road and Marina Drive.

- Remove roadside fuels and create shaded fuel breaks of 100 feet on both sides of the road as measured from the centerline of the roadway on the following sections of Pleasant Valley Road:

  - Wildwood Heights Drive northbound to John Born Road

  - Lake Wildwood Dam southbound to Black Forest Road

  Note: A fuel modification of this scope requires the County and private landowners to work collaboratively to develop a safe egress corridor.

Wildfire Mitigation Projects and Initiatives

Vegetation Management

- Reduce fuel loading in the riparian drainages along Lake Wildwood Road.

- Expand fuel-reduction programs within the community to remove the heavy fire loading presented by the accumulation of large live oaks, gray pines, and other highly flammable tree species.
- Continue enforcing the CCRs and state regulations to ensure defensible space standards are met or exceeded.
- Remove large trees as needed to create an open tree canopy to reduce the probability of crown fire; maintain a minimum of 10 to 30 feet of separation in the tree canopy.
- Limb trees to a height of 10 or more feet based on the tree species.
- Ensure an ember-resistant zone of 0–5 feet from the house is provided.

Home Hardening

- Harden homes by replacing wood decks and latticework and flammable roofing materials and fences with limited or noncombustible construction materials and replacing vents with ember and flame-resistant vents.
- Review building regulations and adopt enhanced regulations as needed to ensure that new construction, remodels, and additions meet or exceed the building standards required in Very High Fire Hazard Severity Zones (VHFHSZ).

Initiatives

- Add a grant-funded Nevada County Wildfire Mitigation ombudsman to assist property owners working with regulatory agencies and to navigate the regulatory impediments to successfully complete wildfire mitigation activities on private property.

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Glossary

Term	Definition	Source(s)
Chain	Unit of measure in land survey, equal to 66 feet (20 M) (80 chains equal 1 mile). Commonly used to report fire perimeters and other fireline distances, this unit is popular in fire management because of its convenience in calculating acreage (e.g., 10 square chains equal one acre).	NWCG
Contra Flow	A method designed to increase the capacity of transportation roads toward a certain direction by reversing the opposite direction of road segments.	Evacuation Planning Technical Advisory
Crown Fire	A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.	NWCG
Evacuation	The organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas and their reception and care in safe areas.	Evacuation Planning Technical Advisory
Evacuation Clearance Time	The estimated time to evacuate people from the time an evacuation order is given until the time when the last evacuee can either leave the evacuation zone or the remaining population must shelter –in place. The calculation is based on various factors such as the type of hazard or threat, level of notice of the incident, population characteristics of the area at the time, and public behavior.	Evacuation Planning Technical Advisory
Evacuation Endpoints	For the purposes of this guidance, evacuation endpoints are locations that provide a safe place for evacuees to shelter in the days and/or weeks following an emergency scenario. Endpoints may differ based on evacuee needs. Examples may include hospitals, public shelters, hotels, or second homes.	Evacuation Planning Technical Advisory

Glossary

Term	Definition	Source(s)
Evacuation Route Viability	For the purposes of this guidance, evacuation route viability refers to the ability of transportation infrastructure and services to reasonably enable populations to leave an area at-risk and/or reach temporary areas of refuge under a range of emergency scenarios, given the respective time constraints.	Evacuation Planning Technical Advisory
Fuel (Fire) Break	Strategically engineered strip of land or area with reduced vegetation intended to slow advancing wildfire.	NCTC
Fuel Loading	The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.	NWCG
Hazard	An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss. Please note, there is a difference between hazard and risk. OPR recommends that planners be sensitive to how hazard and risk are used within planning documents and refrain from using these terms interchangeably.	Evacuation Planning Technical Advisory
Interface	A condition where structures about the wildland.	Firescope Glossary of Terms 2019
Intermix	A condition where structures are scattered throughout a wildland area.	Firescope Glossary of Terms 2019
Ladder fuels	Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.	NWCG

Glossary

Term	Definition	Source(s)
Risk	Risk for the purpose of hazard mitigation planning, is the potential for damage or loss created by the interaction of hazards with assets such as buildings, infrastructure, or natural and cultural resources. For natural hazards, risk tends to be calculated based on evaluation of the probability (likelihood) of a hazard event occurring, vulnerability, and the event's potential consequences. This method uses data from the past to establish the probability and, in the case of climate change, includes future projections of probability. Please note, there is a difference between risk and hazard. OPR recommends that planners be sensitive to how hazard and risk are used within planning documents and refrain from using these terms interchangeably.	Evacuation Planning Technical Advisory
Shaded Fuel Break	Fuel breaks built in timbered areas where the trees on the break are thinned and pruned to reduce the fire potential yet retain enough crown canopy to make a less favorable microclimate for surface fires.	NWCG
Spot Fire	Fire ignited outside the perimeter of the main fire by a firebrand.	NWCG
Temporary Refuge Areas	Locations that are used by individuals when a hazard is imminent or occurs with no warning…and are meant to provide temporary and limited protection as an incident occurs.	Evacuation Planning Technical Advisory
Wildland Urban Interface (WUI)	The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.	NWCG
Wildland Urban Intermix	Those areas where structures intermingle with wildlands. To be considered intermix, a development OR structure must be surrounded on 2 or more sides by wildlands. INTERMIX is often found between the INTERFACE and the WILDLANDS.	ARC GIS Story Map

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Appendix A
Community-Identified Evacuation Concerns

APPENDIX A

Community-Identified Evacuation Concerns

Nevada County Office of Emergency Services

Contents

Figures

Introduction

Evacuation opportunities and constraints are a key concern for the over 100,000 residents that call the 974 square miles of Nevada County home. In 2022 the County of Nevada Office of Emergency Services (OES) was awarded funding from the California Department of Forestry and Fire Protection (CAL FIRE) to conduct a countywide Evacuation Study. The intent of the study was to analyze evacuation constraints at the county scale and identify ingress and egress actions that could be used to guide priorities. The desired outcome was that County of Nevada, OES, and regional stakeholders would have a project list that could be leveraged as grants and other opportunities to fund this important work become available in the future.

Recognizing the opportunity to gather valuable data from the community, OES opted to divide the study into three parts so that the relatively limited funds from the grant (#5GG21105) could be stretched as far as possible. The components of the Nevada County Evacuation Study are: (1) the "Study," a fire behavior and traffic analysis of highest priority areas and scenarios led by PyroAnalysis; (2) Appendix A, a catalogue of "Community-Identified Evacuation Concerns"; and (3) Appendix B, a countywide modeling analysis led by Ladris.

The following information comprises Appendix A of the Nevada County Evacuation Study. Appendix A is essentially a glossary of opportunities and constraints voiced by communities across the county. The information offers valuable place-based insight into neighborhoods, Firewise Communities, and HOAs that can be integrated into multi-benefit projects moving forward, and potentially expanded upon with more robust technical analysis at a later date. This information is organized by Forecast Zone as delineated in the Community Wildfire Protection Plan Update and by individual communities within each Forecast Zone.

Methods

In the conceptualization of Appendix A the goal was to provide a platform for communities to articulate, in their own words, their evacuation concerns and constraints. To ensure consistency around the type and amount of information collected, several tools and templates were developed to support communities in conveying this information. However, beyond provision of these resources, no efforts were made to influence/alter the information provided by communities. As such, the community concerns are presented "as is" with minimal editing beyond consistent organization, provision of contextual details, and inclusion of photographs from field visits with communities. No claims surrounding the accuracy of this information are

made, nor has any level of priority to specific communities and the opportunities and actions they identify been assigned. To the extent possible, Appendix A and the information contained within has been developed to facilitate ease of use by diverse stakeholders seeking to secure the resources necessary to make this work actionable.

Concurrent with the Evacuation Study, OES is in the process of conducting a Community Wildfire Protection Plan (CWPP) Update. The CWPP Update process provided a synergistic opportunity to collect additional data from individuals who live, work, or own property in Nevada County that provided further insight into evacuation as a specific facet of wildfire risk and mitigation. In sum, the information presented in this Appendix was derived from community engagement with three tools and templates: (1) a Community Wildfire Protection Plan Survey; (2) an Evacuation Study Community Priority Form; and (3) a Community Evacuation Study Tool. The specifics of each of these and the methods of deployment are described below.

Community Wildfire Protection Plan Survey

The Nevada County Community Wildfire Protection Plan (CWPP) Update is currently underway and is anticipated to be completed December of 2024. This five-phase effort is led by OES and is funded by a grant award (23-DG-1052012-415) from the Community Wildfire Defense Grant Program via the USDA, Forest Service Pacific Southwest Region Fire and Aviation Management. Among the components of the CWPP update are a Wildfire Hazard Assessment (WHA) and Wildfire Risk Assessment (WRA). The Wildfire Hazard Assessment is focused on understanding the fire environment in Nevada County based on three factors: climate, topography, and fuel. The Wildfire Risk Assessment looks at the intersection of the WHA with vulnerability and susceptibility. To determine what is vulnerable and what is susceptible to wildfire, it is necessary to introduce anthropogenic variables and identify what is important to a community to protect known as “High Value Resources and Assets” (HVRAs) at risk. Wildfire risk is determined by intersecting these with where the hazards lie.

To support this analysis, Nevada County was divided into four Forecast Zones. Forecast Zones were necessary due the diversity of climate, topography, and fuel characteristics inherent in a county that encompasses 1,000-foot elevation oak woodlands on the west slope, up over 9,000-foot Sierra Nevada summits, to eastern Sierra Nevada “rain shadow” ecosystems. It was important for the modeling effort utilized (the Interagency Fuel Treatment Decision Support System) that the hazard analysis inputs be calibrated to reflect the unique and diverse ecological conditions across the county as these differences directly affect potential fire behavior.

Of equal importance for the CWPP was mindfulness of the fact that community identity across the county is diverse, and social dynamics typically drive what communities consider to be important, or the HVRAs. Care was made to ensure that boundaries identified for the hazard analysis did not inadvertently bisect communities, so that community HVRAs could be logically analyzed against areas with similar hazard. The result of considering both the best-available science for hazard inputs and over a year of community engagement efforts to identify community boundaries was that Nevada County was divided into four Forecast Zones for the CWPP. See Figure 1.

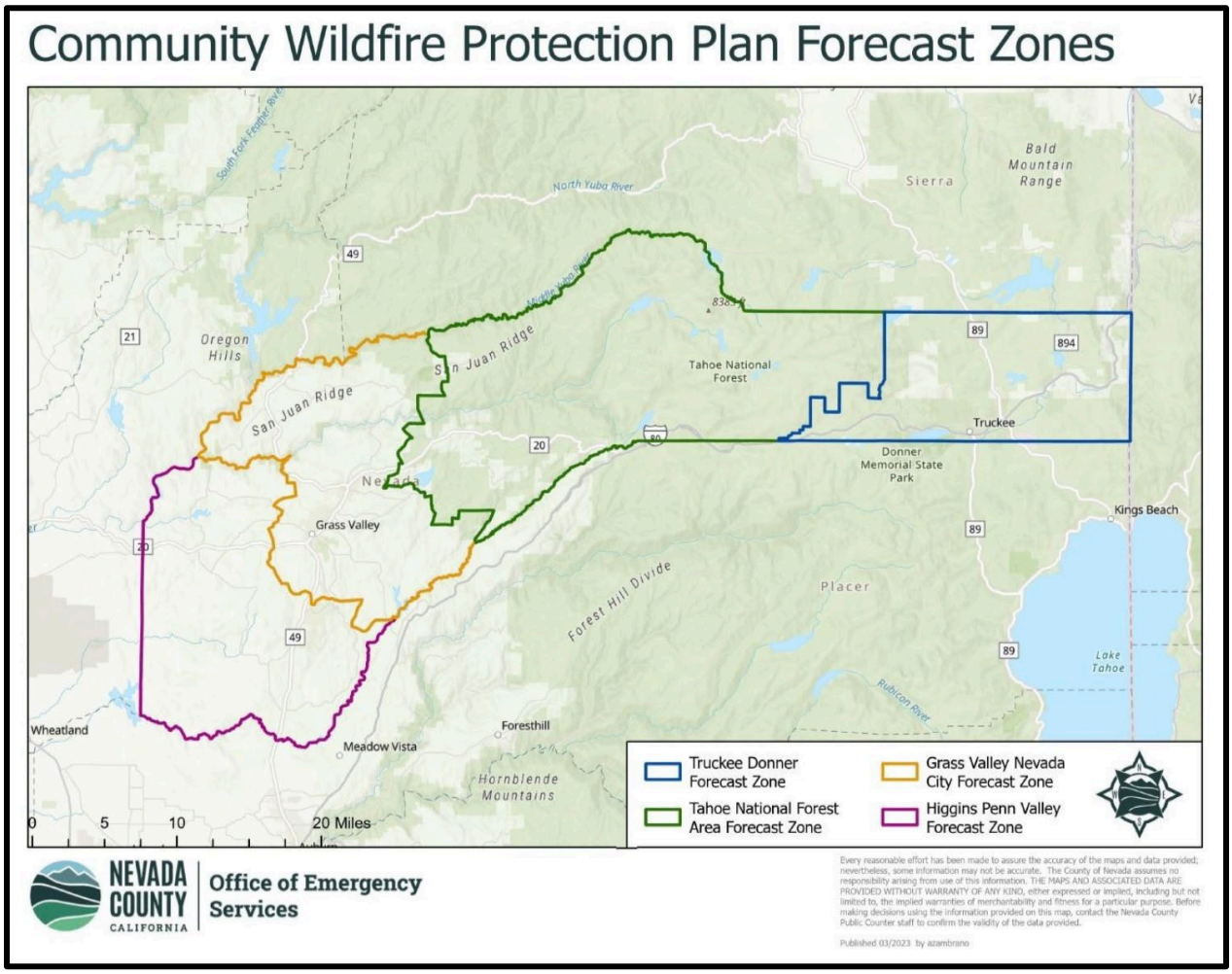


Figure 1: Nevada County Forecast Zones

The wildfire risk modeling element of the CWPP Update necessitated deployment of a countywide survey to better understand the high value resources and assets (HVRAs) that community members feel are at risk from wildfire and thereby important to protect. OES deployed a CWPP survey on June 1, 2023; the survey ran for three months through

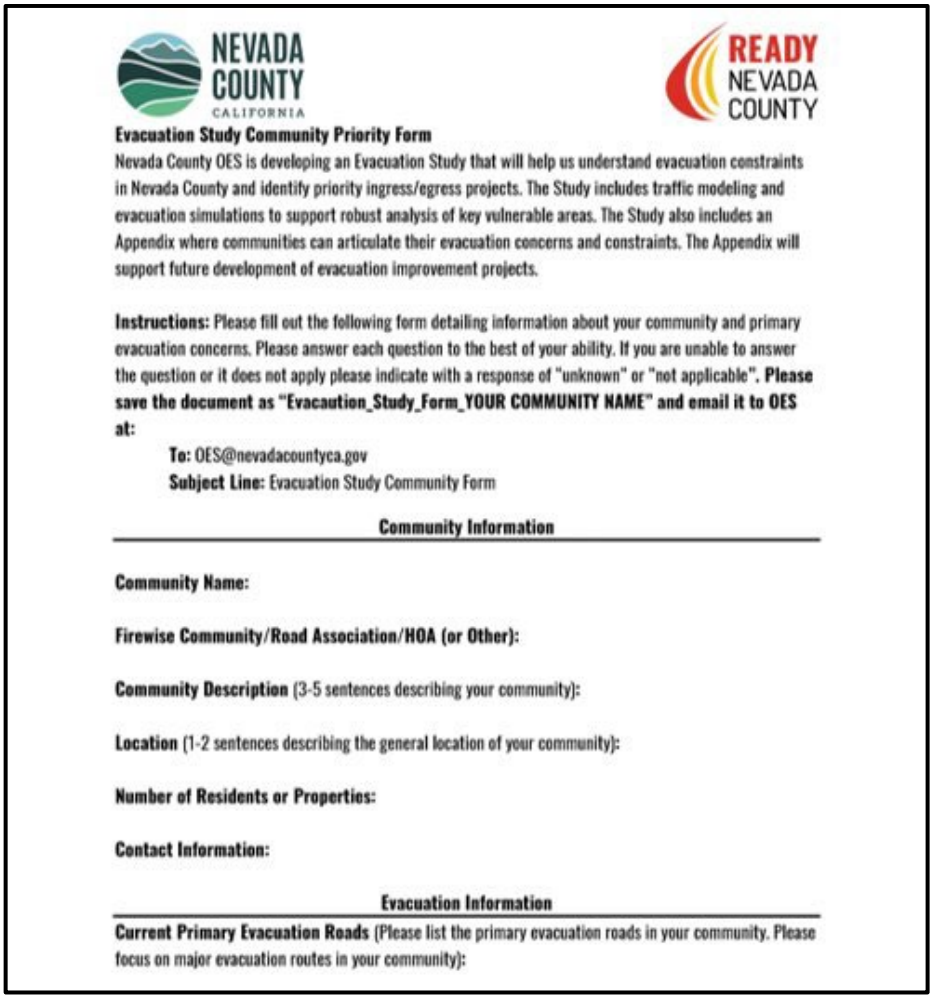
August 31, 2023. In addition to asking community members to answer questions related to identifying priorities around HVRAs, OES elected to include a set of questions related to evacuation experience(s), attitude(s), and behavior(s). Though not specifically necessary for the CWPP modeling effort, community response on these variables as well as response to open-ended survey questions has provided valuable insight into where resources can be best directed to increase community resilience in the face of wildfire. Over 2,260 responses were gathered through the survey effort, representing 2% of the county population. The survey was offered in both English and Spanish and in virtual and printed formats reflective of the OES mission to "meet community members where they are at." The visibility of the survey was amplified through traditional media, including press releases, Facebook posts, and earned radio time. In addition, OES staff facilitated access to the survey at over 70 community events, ranging from HOA meetings to green waste drop offs, to community "Color Runs." See Figure 2.

Figure 2: CWPP Outreach Effort

Data from the survey as it pertains to evacuation is presented as a summary at the beginning of each section in Appendix A (by Forecast Zone). Relevant community quotes pulled from the open-ended questions of the survey are also presented by Forecast Zone. Additional information and data derived from the community survey will be available in the Nevada County Community Wildfire Protection Plan Update (anticipated completion date: December 2024).

Evacuation Study Community Priority Form

To gather consistent information about evacuation opportunities and constraints at a meaningful scale the “Evacuation Study Community Priority Form” was developed and deployed. See Figure 3.



Evacuation Study Community Priority Form

Nevada County OES is developing an Evacuation Study that will help us understand evacuation constraints in Nevada County and identify priority ingress/egress projects. The Study includes traffic modeling and evacuation simulations to support robust analysis of key vulnerable areas. The Study also includes an Appendix where communities can articulate their evacuation concerns and constraints. The Appendix will support future development of evacuation improvement projects.

Instructions: Please fill out the following form detailing information about your community and primary evacuation concerns. Please answer each question to the best of your ability. If you are unable to answer the question or it does not apply please indicate with a response of “unknown” or “not applicable”. **Please save the document as “Evacuation_Study_Form_YOUR COMMUNITY NAME” and email it to OES at:**

To: OES@nevadacountyca.gov
Subject Line: Evacuation Study Community Form

Community Information

Community Name:

Firewise Community/Road Association/HOA (or Other):

Community Description (3-5 sentences describing your community):

Location (1-2 sentences describing the general location of your community):

Number of Residents or Properties:

Contact Information:

Evacuation Information

Current Primary Evacuation Roads (Please list the primary evacuation roads in your community. Please focus on major evacuation routes in your community):

Figure 3: Evacuation Study Community Priority Form

It was specifically requested that priorities be developed, and the form be filled out, at the “community” not “individual” scale – either by an HOA, Firewise Community, Road Association, neighborhood or comparable.

The rationale was not to obscure individual needs, especially as these relate to disabilities or other extenuating circumstances, but rather to position needs at a

community scale so that potential solutions might have both individual and community benefit. Extensive outreach about this priority form template via social media, stakeholder meetings, and through the OES "Virtual Office Hours" platform was conducted. See Figure 4.

The template was made available for download on the Ready Nevada County website with the following instructions:

"Please fill out the following form detailing information about your community and primary evacuation concerns. Please answer each question to the best of your ability. If you are unable to answer the question or it does not apply, please indicate with a response of "unknown" or "not applicable". Please save the document as "Evacuation_Study_Form_YOUR COMMUNITY NAME" and email it to OES at:

To: OES@nevadacountyca.gov
Subject Line: Evacuation Study Community Form"

Figure 4: Template Deployment

Community Evacuation Study Tool

In addition to deploying the Evacuation Study Community Priority Form, a Community Evacuation Study Tool was developed for the purpose of supporting communities in geospatially communicating their opportunities and constraints. This tool allowed communities to identify specific road segments, addresses, evacuation zones, and Firewise Communities and to produce maps to be included as part of their Evacuation Study Community Form. The tool furthermore served as a resource for communities to open dialogue with their neighbors about geospatially specific concerns and provided a standardized way for communities to convey the location of the place-based issues they face. See Figure 5.

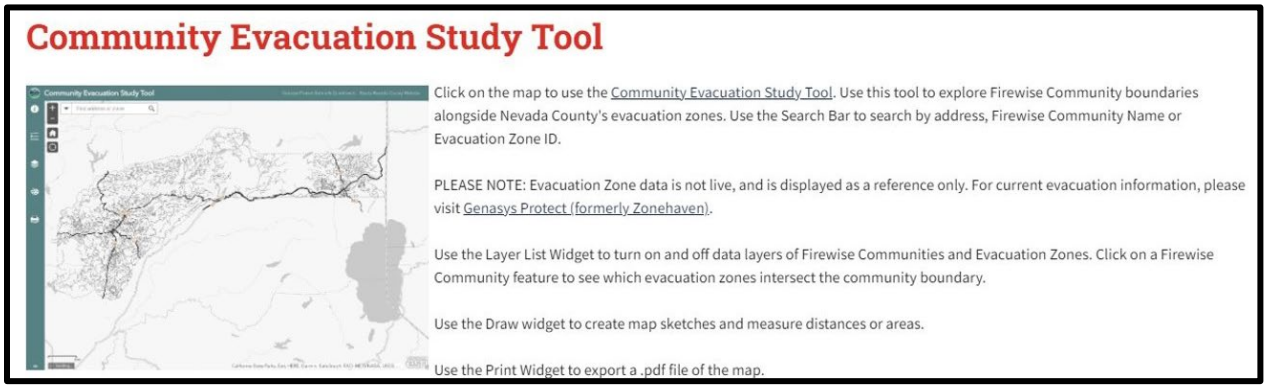


Figure 5: Community Evacuation Study Tool

Appendix A: Community-Identified Evacuation Concerns

The remainder of this document is dedicated to the articulation and conveyance of the opportunities and constraints related to evacuation as voiced by community members of the County of Nevada. This Evacuation Study is a vital component of County of Nevada's multi-disciplinary "Roadmap to Resilience" which aims to articulate a holistic long-range vision that can be deployed at the individual, community, and landscape scale, to promote the well-being and sustainability of our County, its residents, and the resources, values, and assets that make this place home.

Forecast Zone 1: Higgins/Penn Valley

"We would like to see a cultural shift towards more chipping, composting, and free green waste disposal so that citizens can be working on reducing fuel year-round."

"The biggest concern is evacuation in Higgins Corner area. In the event of a big wildfire near Lake of the Pines, thousands of people would all be trying to evacuate onto Combie/Magnolia and Highway 49 creating a potentially deadly traffic jam."

"I get concerned that my disability will make it hard to get out in an evacuation, especially if it is at night, and if I don't have the strength to open the garage door."

"We need shaded fuel breaks up the Deer Creek canyon."

CWPP Survey Results

In the Higgins/Penn Valley Forecast Zone over 600 people completed the Community Wildfire Protection Plan (CWPP) survey. The top three wildfire mitigation priorities identified were roadside vegetation removal, evacuation route improvement, and defensible space assistance. Respondents feel that their personal risk is moderate and that the biggest challenge is fuel on neighboring properties followed by cost factors. Most people had never been evacuated or had only evacuated one time. Most people in this Forecast Zone leave early and the biggest evacuation concern was getting trapped on the road.

Summary of Forecast Zone Concerns

All community concerns articulated by the Higgins/Penn Valley Forecast Zone have been plotted geospatially on a single map. See Figure 6. Descriptions of specific community concerns follow.

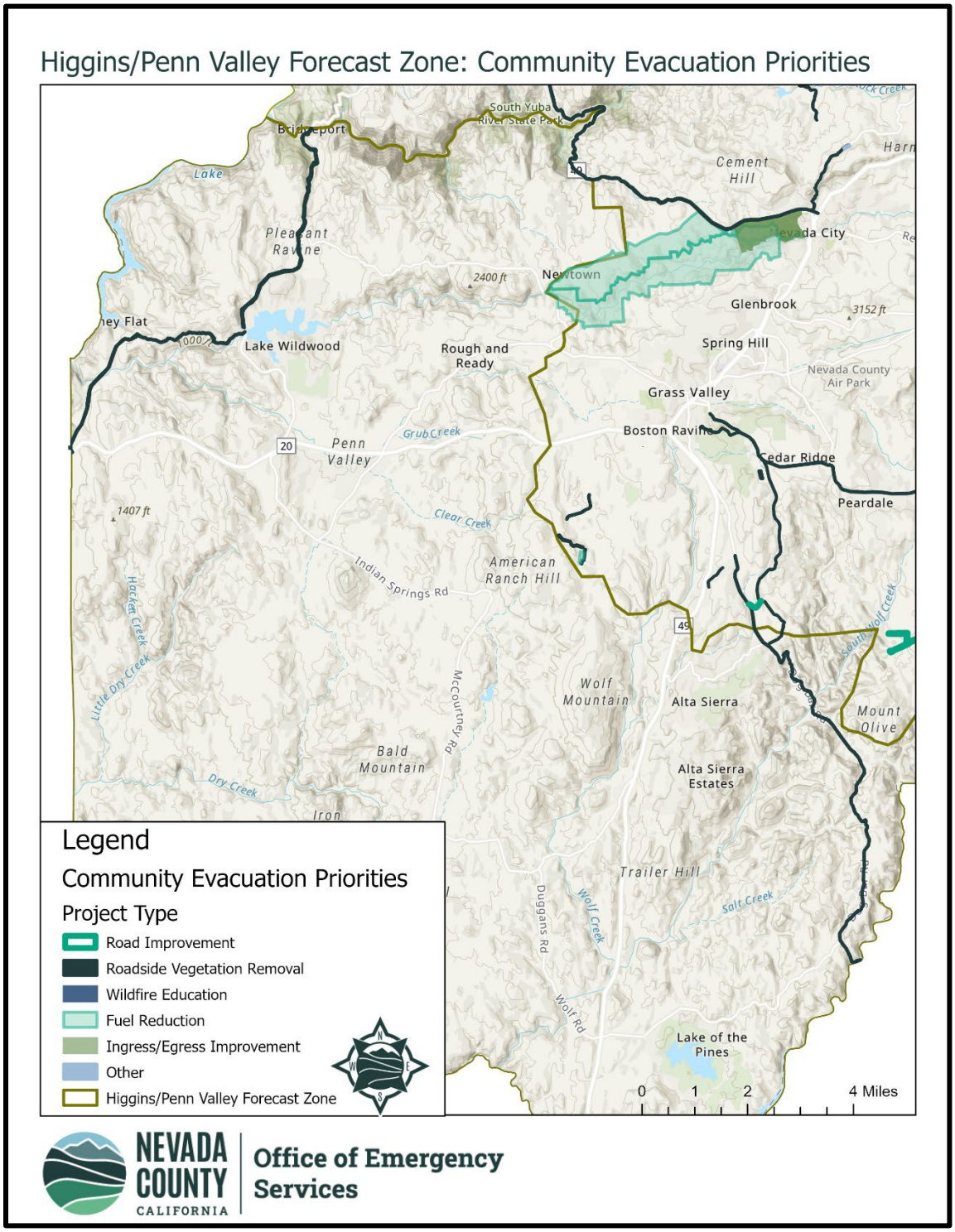


Figure 6: Higgins/Penn Valley Community Evacuation Priorities

Community Concerns

COMMUNITY: Lake Wildwood Association

Community Summary

Lake Wildwood is located within Penn Valley approximately 10 miles West of Grass Valley, with elevations between 1,200 and 1,580 feet above sea level. Due to its size and density, Lake Wildwood consists of two Firewise Communities: Lake Wildwood North and Lake Wildwood South. Lake Wildwood North also includes the Wildwood Ridge community, which is an ungated, 90-home HOA, adjacent to and north of the Lake Wildwood gated community. These communities have had place-based experience with wildfire, including from the 49er Fire in 1988 and the Lobo Fire 2017, both of which necessitated evacuations.

Lake Wildwood is a gated Homeowners Association (HOA) on 2,240 acres. Approximately 5,000 residents reside within the boundaries of Lake Wildwood in single family homes. There are 2,845 residential lots, of which 2,770 have homes and 75 are unbuilt. The private community employs 24-hour on-site security. It includes a 285-acre lake, an 18-hole championship golf course, 32 linear miles of roadway, a clubhouse, community center, swimming pool, pickle ball and tennis courts, boat marina, above-ground boat storage, campground RV and boat storage, public works building, five lake-front community parks, two gate access points and approximately 180 acres of green belt open space. A sewer treatment plant is located directly across Pleasant Valley Road, servicing Lake Wildwood and much of Penn Valley. Within Lake Wildwood, Nevada County maintains several lift stations to transport waste to the facility.

Lake Wildwood is a varied community. Although many community members benefit from incomes ranging from comfortable to moderately affluent, with some who own property in Lake Wildwood as a vacation home, it includes a subset of owners and renters in the lower income range, and some with access and functional needs. The average age of its residents is 67.2 years.

Evacuation Situation

Lake Wildwood Drive and Wildflower Drive are the primary evacuation roads from Lake Wildwood which both go through the ingress/egress gates onto Pleasant Valley Road. Secondary feeder roads are Chaparral Drive, Chaparral Circle, Lake Forest Drive and Sun Forest Drive. Wildwood Ridge has only one ingress/egress road, Gold Country Drive, which connects to Pleasant Valley Road. There are currently 3 locked emergency exits,

which will only be used under the control of incident command. Two of them access Pleasant Valley Road, and one accesses Bitney Springs Road. See Figure 7.

Figure 7: Gates within Lake Wildwood

Pleasant Valley Road is the primary route to Highway 20 to the South, or to Highway 49 to the North (via a winding mountain road.) Mooney Flat Road, which can be accessed directly across from the North gate also accesses Highway 20. See Figure 8.

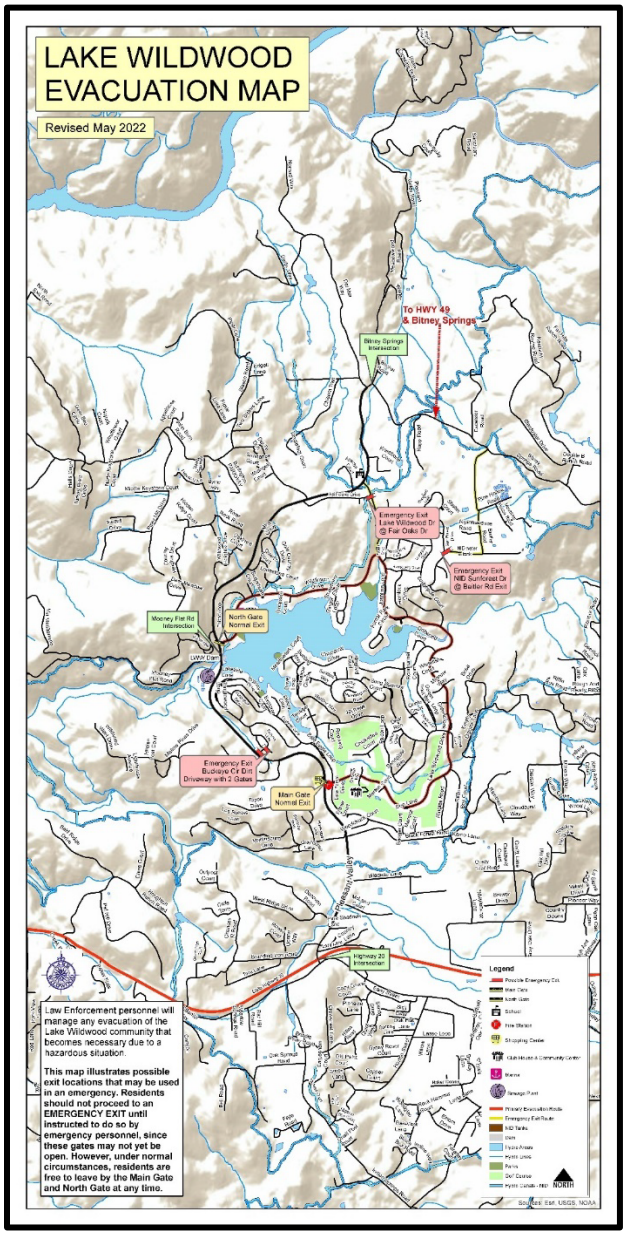


Figure 8: Lake Wildwood Evacuation Map

Primary Challenges

Evacuation from Lake Wildwood is predicted to take approximately 4-5 hours based on the previous evacuations.

The first challenges to evacuation are the limited egress points located at the access gates going out to Pleasant Valley Road. Especially on the South side, traffic to and

through the main gate is a significant bottleneck, with traffic coming from three directions at a three-way stop. Traffic control is required if everyone leaves at once. Also of note is that the primary evacuation roads; Lake Wildwood Drive and Wildflower Drive, are two-lane roads with little or no shoulder/easement to go around hazards. With the incoming lane left open for emergency vehicles, the residents of 2,770 homes are funneled through on one lane to reach gate exits.

Once out of Lake Wildwood, the main road out of the area is Pleasant Valley Road, which is a two-lane road with a four-way stop at the main gate exit of the community and a traffic light at the intersection of Pleasant Valley Road and Highway 20. Although a center lane was added to the section of Pleasant Valley Road between the Main gate and Highway 20 after the 49er Fire, specifically to facilitate evacuation, law enforcement will need to clearly indicate that lane is designated for evacuation if necessary. Should the evacuation lane be used, the choke point at the Highway 20 intersection will still be an issue. On the North side, where Lake Wildwood exits through the North gate onto Pleasant Valley Road, through traffic going both North and South is not restricted by a stop sign.

Should conditions suggest exiting to the North, Pleasant Valley is a winding two-lane road toward Highway 49, or to Bitney Springs Road, which is also a winding two-lane road to Grass Valley. Another option is Mooney Flat Road, also a winding two-lane road which goes past Lake Englebright to Highway 20. Although Lake Wildwood has made a focused effort to clear and maintain evacuation routes within the community, and to reduce fuel in wooded areas, many of the properties outside of the perimeter are still heavily wooded with dense brush fuels which are, in some cases, near the roads.

Impacts and Opportunities

Approximately 5,000 Lake Wildwood residents would be impacted during an evacuation, as well as 4,000 more from rural properties in surrounding locations who will use the same exit road, Pleasant Valley Road. It's possible that a situation could develop with additional cars coming from further north, like San Juan Ridge, adding additional traffic onto Pleasant Valley Road.

Vegetation clearance is needed on some parts of Pleasant Valley Road, including the section between the North and Main gates and the section between the North gate and Wildwood Ridge. The latter is part of a heavily wooded and fuel-laden 350-acre parcel that is unmaintained by current owners. See Figure 9. Much of the area surrounding Mooney Flat Road is a densely vegetated corridor.

Figure 9: Dense Vegetation Outside Lake Wildwood

Lake Wildwood currently expenses approximately $450,000 annually on Firewise efforts, fuel removal and community programs. These funds could function as match to vegetation mitigation projects. See Figure 10.

Figure 10: Vegetation Management in Lake Wildwood

This would result in increased community safety, would assist in managing ever increasing insurance costs, and would contribute to improved mental health of the residents.

The primary benefit of solution deployment is increased safety for the community. Additional benefits included improved value of the homes and community. Economic benefits include increased property values, decreased cost of homeowners' insurance, survival during wildfire without injury, and protecting vehicles during evacuation. Partners in solution deployment may include the Penn Valley Fire Department.

COMMUNITY: Rattlesnake Neighborhood Association Firewise Community

Community Summary

Rattlesnake Neighborhood Association Firewise Community (RNAFWC) consists of 160 residential properties with an average of two to three people per residence for a sum of 240-400 residents that rely on mostly public roads. The community is mixed with many residents over 65 years old. In the past three years RNAFWC has been adjacent to evacuated zones.

The topography is sloping terrain, and the vegetation is mixed tree coverage. The area of concern is approximately bounded by North Rattlesnake Road from Highway 174, south to Red Duster Road including surrounding streets.

Evacuation Situation

Primary evacuation routes used by the community include Highway 174, Empire Mine Road, Rattlesnake Road, Wheeler Cross Road, Dog Bar Road, and La Barr Meadows Road. These roads are mostly two-lane roads with dry vegetation next to and overhanging, presenting a deadly situation if wildfire conditions exist.

Primary Challenges

Primary challenges related to evacuation include Upper Rattlesnake Road at Dray Court. There is excessive dead tree build up on property next to Rattlesnake Road. Rattlesnake Road at 174 (in front of a church) needs a larger buffer of clearance near Highway 174. In addition, La Barr Meadows Road has numerous trees leaning over the road. See Figure 11.

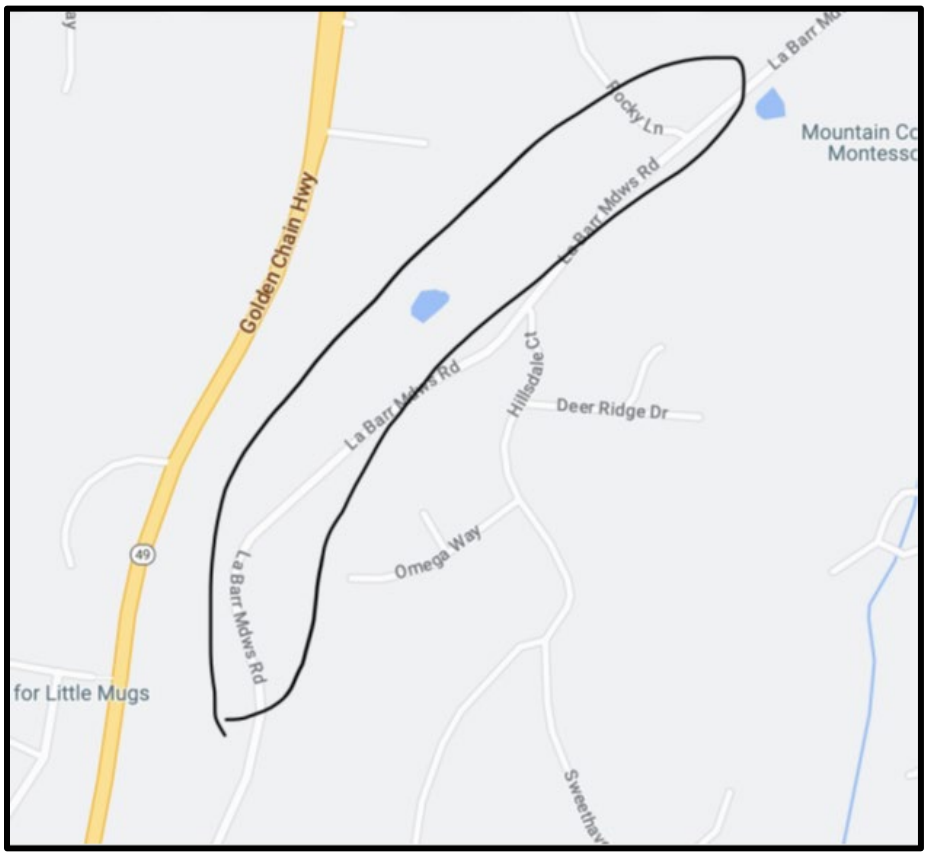


Figure 11: La Barr Meadows Road, Rattlesnake Neighborhood Association

Impacts and Opportunities

Having safe evacuation routes will help with homeowners' insurance issues and would benefit property values. Furthermore, reduced vegetation along roadways would make any evacuation scenario safer for residents.

Opportunities to improve evacuation include vegetation removal along all roads with taller and wider clearances on evacuation routes. Widening is needed on Wheeler Cross Road as it is small and connects many people to evacuating on Dog Bar Road. See Figure 12. In addition, Bradford Road has a significant amount of Scotch Broom.

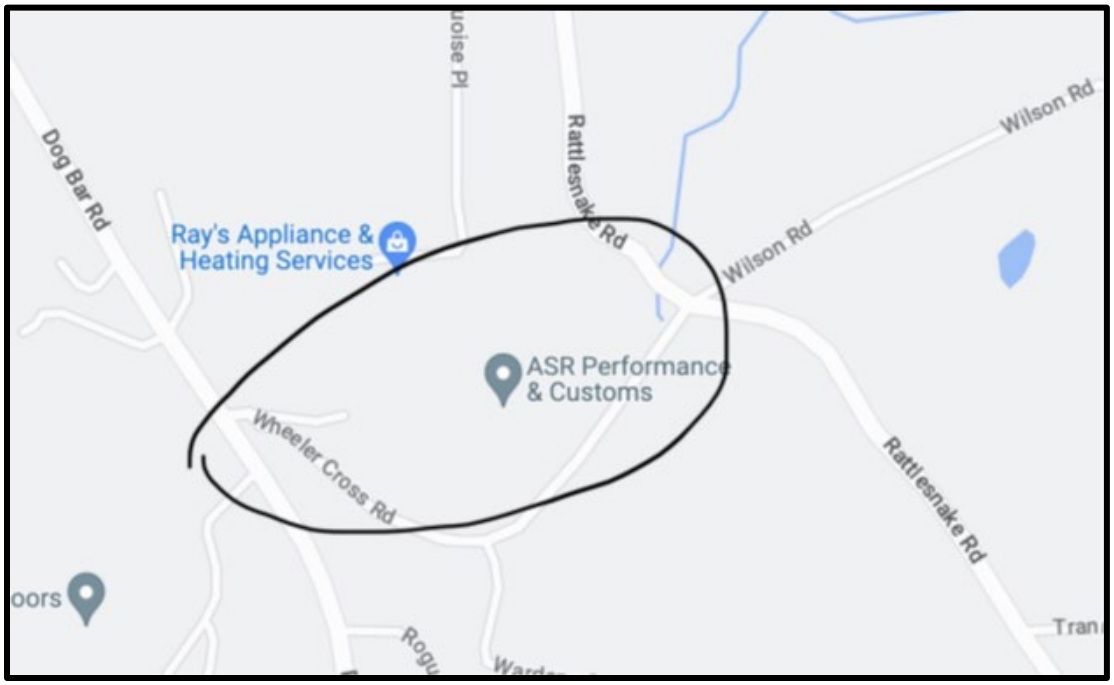


Figure 12: Wheeler Crossing Road, Rattlesnake Neighborhood Association

The Rattlesnake Neighborhood Association and Firewise Community have annual workdays that provide an opportunity to leverage community sweat equity toward evacuation improvement. The community has assisted elderly neighbors with vegetation removal and have also had group scotch broom pulls on Rattlesnake Road and Bradford Road.

COMMUNITY: Sherwood Forest Firewise Community

Community Summary

Sherwood Forest Firewise Community (SFFC) is located is 1.5 miles from the County Fairgrounds off Auburn Road. This community consists of 60 single-family dwellings on one-acre parcels comprising 135 residents. Adjacent residential areas include Hidden Valley and Auburn Road, with approximately 100 residents, and 6B Ranch and Wolf Mountain Road with approximately 200-300 residents. Residents in this area have evacuated in the recent past during the 2017 McCourtney Fire.

The SFFC has county-maintained roads and three fire hydrants. There are two entrances, both of which exit onto Auburn Road. SFFC has successfully completed a 200-foot shaded fuel break around the entire community. See Figure 13.

Figure 13: Sherwood Forest Shaded Fuel Break

Evacuation Situation

The only evacuation route available to Sherwood Forest Firewise Community is onto Auburn Road. Traveling south on Auburn Road, it is four miles to Highway 49 on a narrow shoulder two lane road, which does not have 10 feet of defensible space on either side. Traveling north on Auburn Road it is 1.5 miles to McCourtney Road by the California Highway Patrol (CHP) Office. The choice then is west (left) on McCourtney Road, which leads eventually to Highway 49 and Combie Road on two lane wooded roads. The other option is to head east (right) to a class F intersection, which merges onto Highway 20 and Highway 49.

Primary Challenges

Sherwood Forest Firewise Community's primary challenge related to evacuation is the new RV Park on the corner of McCourtney and Auburn Road. The expected average occupancy of 150 RVs would be added to the average 50 RVs at the Fairgrounds. The only viable exit for the 200 RVs is the intersection onto Highway 20 and then merging onto Highway 49 (class F intersection).

Impacts and Opportunities

The concern of SFFC is that no evacuation plan was presented by the developers when the City of Grass Valley approved the RV park project. In fact, the permit documents indicated that there was no traffic management or fire evacuation mitigation issues. This traffic would be added to the residents along Auburn Road and McCourtney Road who are also attempting to evacuate.

In the short term the community cannot envision any physical work which could be completed to improve the intersection of McCourtney Road and Highway 20. However, two other viable actions exist:

1. Modify now, while they are building the RV park, a larger exit and entrance to the RV Park. Currently there are no modifications to Auburn Road (i.e. no turn lanes or passing lanes, no accommodations to allow cars and RVs to merge).

2. Require the developers to create a wildfire action plan and training document. This should include addressing how evacuation will be managed, how staff will be trained in fire safety and evacuations, how occupants of the RV Park will be notified of evacuation, and consideration of whether they would attempt to shelter in place.

When a plan is developed residents have a chance of a trouble-free evacuation onto Highway 49. These improvements would improve safety concerns of tourists using the RV Park, encourage tourism, and potentially increase the property value in surrounding homes.

Forecast Zone 2: Grass Valley / Nevada City

"I am most concerned about evacuation routes being clogged in the event of a mandatory evacuation order."

"Throughout Nevada County we have policies or ordinances in place for required vegetation removal or management to reduce wildfire risk and to protect roads for ingress and egress. These policies need to be enforced, as well as vegetation maintenance requirements on private lands."

"We live in a very wood area. 100 feet of defensible space is impossible. I'm hoping Woodpecker Ravine can get the funding to get the vegetation cleared to have a good fire break."

"I am particularly concerned about the completion and maintenance of evacuation routes."

"Please improve evacuation routes on the San Juan Ridge. River goers block the road at Edwards Crossing every weekend. Parking tickets don't solve the problem. Small signs do not solve the problem."

CWPP Survey Results

In the Grass Valley/Nevada City Forecast Zone over 800 people completed the Community Wildfire Protection Plan (CWPP) survey. The top wildfire mitigation priorities identified were defensible space assistance, evacuation route improvement, home hardening incentives/rebate programs, and roadside vegetation removal. Respondents expressed high personal risk and identified that the biggest challenge was fuel on neighboring properties followed by cost factors. Most people had never been evacuated or had only evacuated one time. Most people in this Forecast Zone leave early or only when an order is issued. The biggest evacuation concern was getting trapped on the road.

Summary of Forecast Zone Concerns

All community concerns articulated by the Grass Valley/Nevada City Forecast Zone have been plotted geospatially on a single map. See Figure 14. Descriptions of specific community concerns follow.

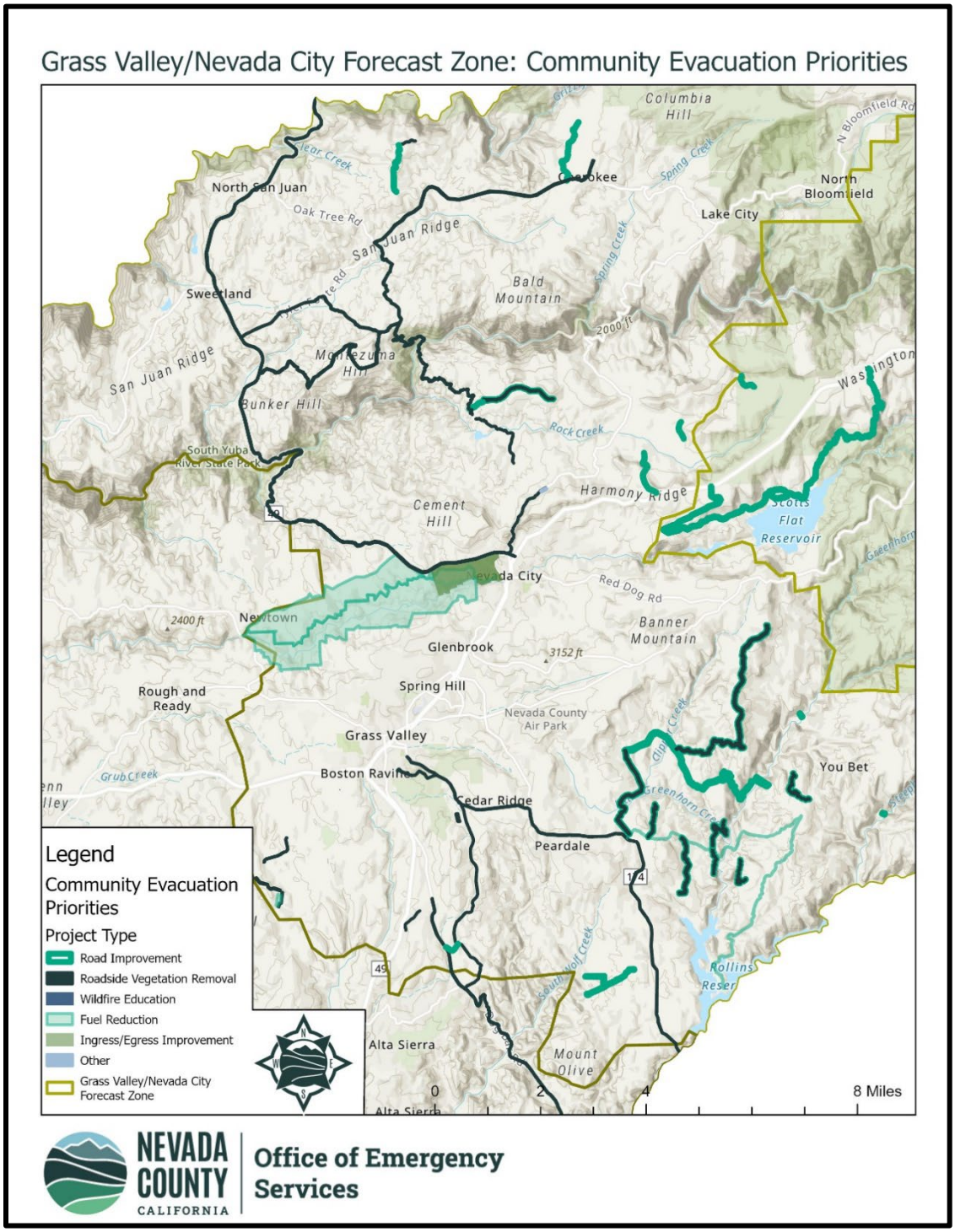


Figure 14: Grass Valley/Nevada City Community Evacuation Priorities

Community Concerns

COMMUNITY: You Bet Firewise Community

Community Summary

You Bet Road is about halfway between downtown Grass Valley and Colfax off Highway 174. The You Bet Firewise Community encompasses 12,655 acres and includes 656 developed parcels and 142 undeveloped parcels. This comprises all parcels that access You Bet Road, beginning at California State Highway 174 in the west and spreading east and northeast roughly between the Bear River, Steephollow Creek, and Greenhorn Creek. Based on its size, You Bet is divided up into 20 areas ranging from 27 parcels to 87 parcels and has Firewise neighborhood leaders in all areas. Overall land ownership includes small private land, federal land (TNF and BLM), private timber company land (SPI), Hanson Brothers, and private utility lands (Nevada Irrigation District [NID]). You Bet Road culminates in Peninsula Campground at Rollins Lake, which is owned and operated by NID. This campground sees up to 600 guests per weekend during peak weekends, and thus traffic explodes seasonally.

The You Bet Firewise Community is a classic “rural” on the Fire Adapted Community (FAC) archetypes. As such, there is a mix of long-term residents (30+ years) and newer, mostly Bay Area residents. The make-up includes individuals, retirees, cannabis growers, and families.

Evacuation Situation

You Bet Road is a 9-mile one way in / out, windy road that traverses steep hills and is bordered by extremely overgrown, mostly unmanaged, forests. There are no other exit routes navigable by 2WD vehicles. About half of the road meets the 10’x15’ accessibility standards. Approximately 5% meets 30’-75’ defensible space standards for evacuation safety. Due to topography, 150’ of vegetation clearance per side is needed.

Within the You Bet Firewise Community, there are approximately 65 side roads off You Bet Road. These private roads all have unique evacuation constraints and are generally overgrown and narrow with a lack of turnouts.

Primary Challenges

Primary challenges related to evacuation for the You Bet Firewise community include vegetation clearing and thinning to 150’ on each side of You Bet Road to attenuate the

risk given the steep topography. A second issue is linked to Chalk Bluff Road, which provides egress to Highway 20. About ¼ mile of Chalk Bluff Road is extremely rough and requires road widening and grading to serve as a functional evacuation route. See Figure 15.

Figure 15: Chalk Bluff Road, You Bet Firewise Community

A third constraint is the need for replacement of the bridge over Steephollow Creek on Lowell Hill Road. This would create egress up Haul Road to I-80. See Figure 16.

Figure 16: Steephollow Creek Bridge, You Bet Firewise Community

Another waterway requiring passage improvement is Greenhorn Creek where the crossing needs to be improved to (a) Greenhorn Road and (b) Red Dog Road. A final consideration is the need for a functional way for residents to pass between Sontag and Louis Roads such as a fire gate. See Figure 17. Overarching challenges on all private roads are the need for widening, vegetation clearing, and turn-outs and turn-arounds.

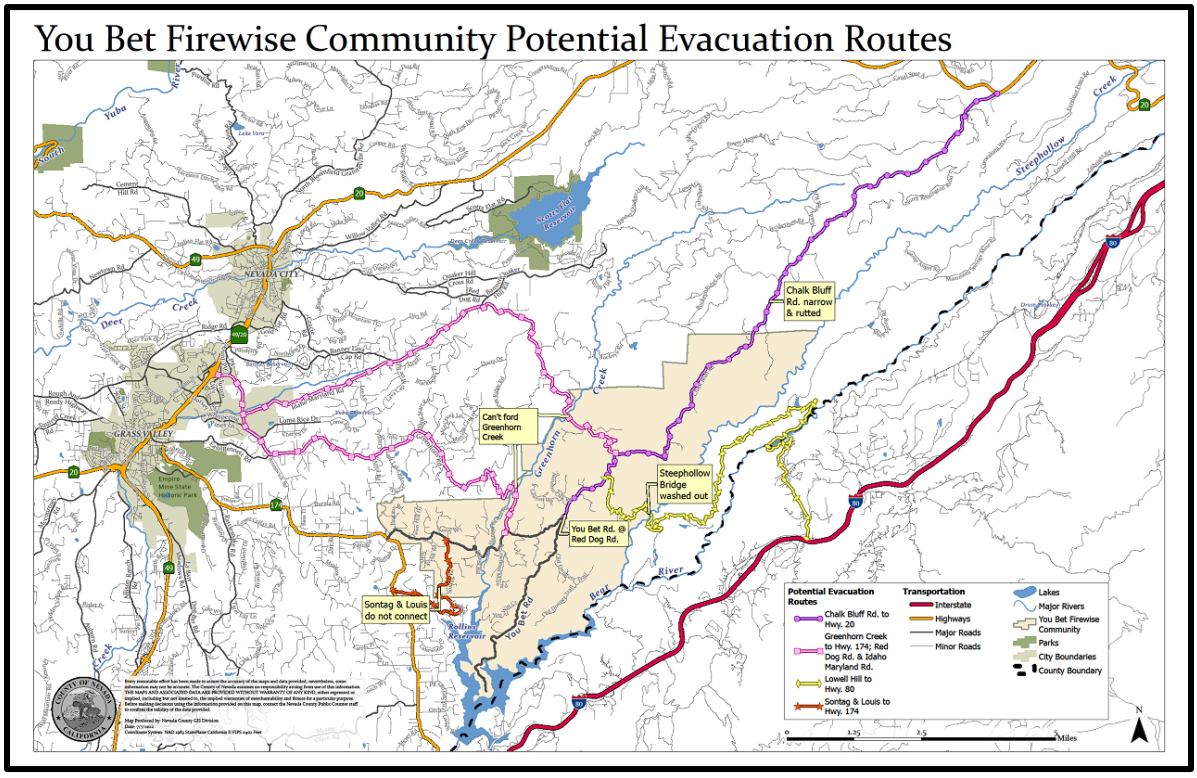


Figure 17: You Bet Firewise Community Evacuation Opportunities and Constraints

Impacts and Opportunities

Rough estimates by the You Bet Firewise Community show that during an evacuation event a 2.5-mile back-up on You Bet Road will occur if most residents attempt to leave at the same time. If neighboring communities (Greenhorn, Banner, Cascade Shores) list You Bet Road as an alternate evacuation route and attempt egress at the same time an already challenging situation would be compounded during an emergency. Community members are concerned that there are no designated “zones of last resort” despite the very real scenario that residents could be unable to use You Bet Road. It is worth noting that some long-term residents clearly state they will shelter in place versus risk the road being unavailable/impassible due to congestion.

Opportunities to improve evacuation for the You Bet Firewise Community include vegetation abatement and other road improvements along priority county-maintained roads, notably You Bet Road, Chalk Bluff Road, and Lowell Hill Road. Treatment of key private roads including Fawn Hill, Sontag Road, Fifield, Mulberry, Arrowhead Mine, Autumn Oak and their "sub" roads is also an opportunity to improve outcomes. The You Bet Firewise Community has developed a "road rating system" that can be leveraged to identify current and future priorities for improvement(s). Improved roads could lead to decreased fire intensity, providing access for first responders and improving lives.

Many residents in the You Bet Firewise Community own heavy equipment and have expressed willingness to participate in larger scale projects. You Bet has an established history of organizing successful "work parties" and could easily deploy these, which represents a grassroots opportunity to leverage community sweat equity to get work done at cost. Wildfire mitigation activities support the protection of several assets including the watershed, power lines, and access to Dutch Flat Powerhouse.

On the emergency communications front You Bet is one of the communities that launched an emergency GMRS radio system in 2022. It has already become the communications backbone for nearly 100 residents. The primary use is for wildfires and road status for evacuation which is necessary because cell service in the community needs improvement as there are currently many dead spots.

COMMUNITY: Montezuma Ridge

Community Summary

Montezuma Ridge is located on the San Juan Ridge in northern Nevada County. The Montezuma Ridge Firewise Community spans the western portion of Montezuma Ridge which runs along the southern bounds of the San Juan Ridge. See Figure 18.

Figure 18: Montezuma Ridge, North San Juan

The community is comprised of 42 properties, home to 100+ full time residents and the Milhouse Boys Ranch. Approximately 30% of the community is over the age of 65, and the community is considered economically disadvantaged based on state agency metrics.

Montezuma Ridge is an active Firewise Community (FWC) holding workdays twice a month, for 8 months of the year. The FWC has a phone tree for emergency and logistical communications and holds potlucks regularly to encourage participation and disseminate important firesafe information.

Residents of the community have experienced wildfire in the past, including the 49er Fire and multiple fires which predate the current county evacuation program. The recent Reader Incident resulted in temporary evacuation orders as well.

Evacuation Situation

Montezuma Ridge relies on several evacuation routes comprising one or multiple roads and highways for safe ingress/egress. These include (1) Purdon Road from Tyler Foote Crossing to Nevada City; (2) Highway 49 from Nevada City to Yuba County; (3) Tyler Foote Crossing Road from Purdon Road to Highway 49; (4) Murphy Road in its entirety.;

and (5) Tyler Foote Crossing Road east toward Graniteville in case of blocked Highway 49 and Purdon Road. See Figure 19.

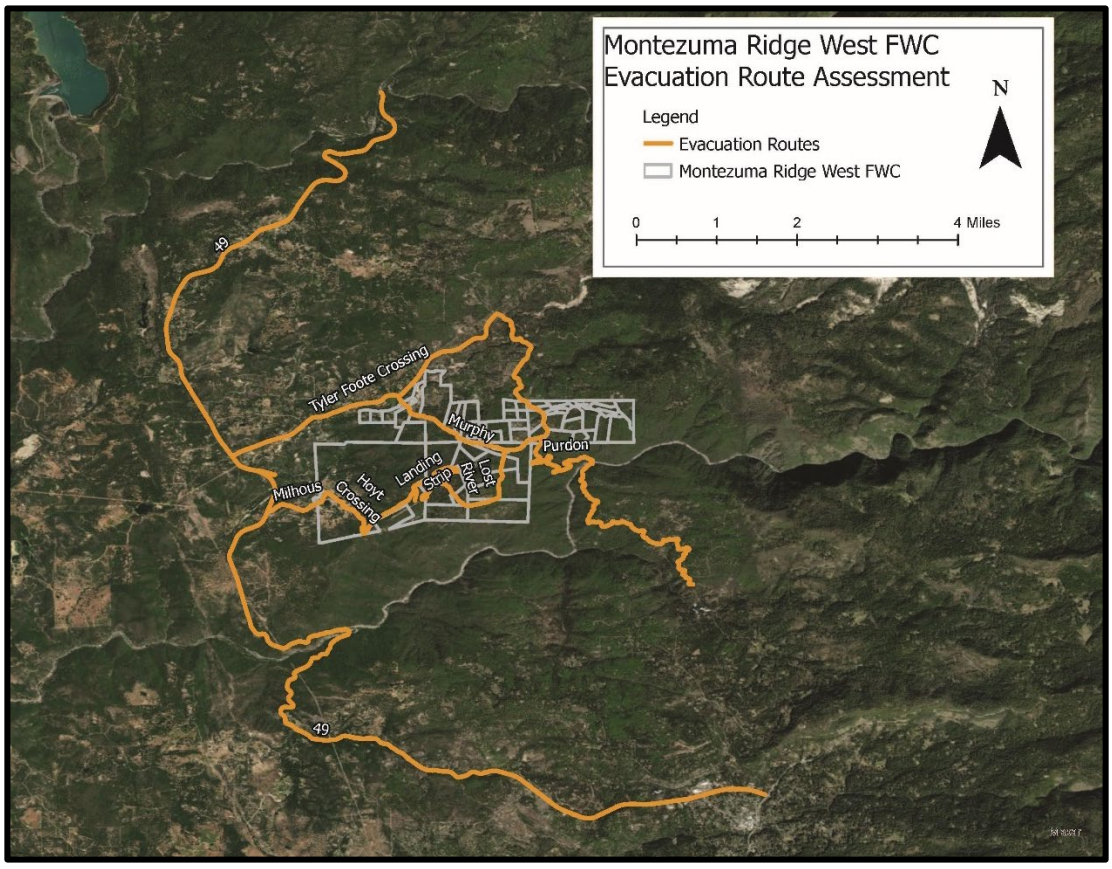


Figure 19: Montezuma Ridge Firewise Community Evacuation Routes

Primary Challenges

The major challenges identified by the Montezuma Ridge Firewise Community are related to road conditions – both pre-existing issues and situations likely to present during an evacuation scenario. These include:

1. Heavy roadside vegetation making the routes unsafe if on fire.
2. Recreation/road blockage at Purdon Road and Highway 49 Crossing.
3. Anticipated road overload during an evacuation event.
4. Limited width on Murphy Road for emergency vehicles.
5. Road conditions on Murphy Road and Purdon Road needing regular maintenance for passenger vehicle passage.

6. Uncertainty in best evacuation route relative to potential road closures.

Impacts and Opportunities

The primary concern of Montezuma Ridge is roadside vegetation clearance of 30' starting with the community's immediate evacuation route arteries (Purdon Road, Lost River Road-Millhouse-Hoyt Crossing, and Murphy Roads) followed by main arteries (Highway 49, Tyler Foote). Murphy Road and Purdon Road need regular maintenance for passenger vehicles to evacuate safely and efficiently. See Figure 20.

Figure 20: Murphy Road, Montezuma Firewise Community

A key goal would be to continue clearing Murphy Road and upper Purdon Road/ (Murphy to Vista Knolls), to 30' from road centerline, starting 2023/2024 on a biannual rotation.

A secondary goal is to clear access along Lost River Road-Hoyts-Milhouse Road 30' from road centerline, starting 2024/2025 on a biannual rotation for maintenance.

A third goal is to support countywide efforts to improve evacuation routes, specifically Purdon Crossing, Tyler Foote Road, and Highway 49.

In addition, enhancement of the historic Montezuma Fuel Break for fire suppression would benefit the FWC and furthermore serve to protect Nevada City. See Figure 21.

Figure 21: Montezuma Ridge Fuel Break

The Montezuma Ridge FWC already focuses two workdays a month conducting vegetation management along relevant evacuation routes, and recently completed a fundraiser to augment a county micro-grant to conduct clearing along Murphy Road. The community has almost eradicated Scotch broom along their evacuation corridor and are continuing to clear roadside vegetation for all roads in the FWC.

The benefit of pursuing these opportunities to improve evacuation outcomes not only serves Montezuma Ridge, but the wider community, including residents along Highway 49, Purdon Road, and Tyler Foote Road. This work would benefit approximately 5,000 Nevada County residents, if not more.

COMMUNITY: Old Mill

Community Summary

Old Mill Firewise Community (OMFWC) is located one block before North Columbia School House and Cultural Center off Tyler Foote Road in North San Juan. The OMFWC is comprised of 1,362 acres across 26 properties with approximately 129 residents.

OMFWC has a road crew to manage brush to keep evacuation routes clear and a Board of Directors for oversight of all activities. See Figure 22.

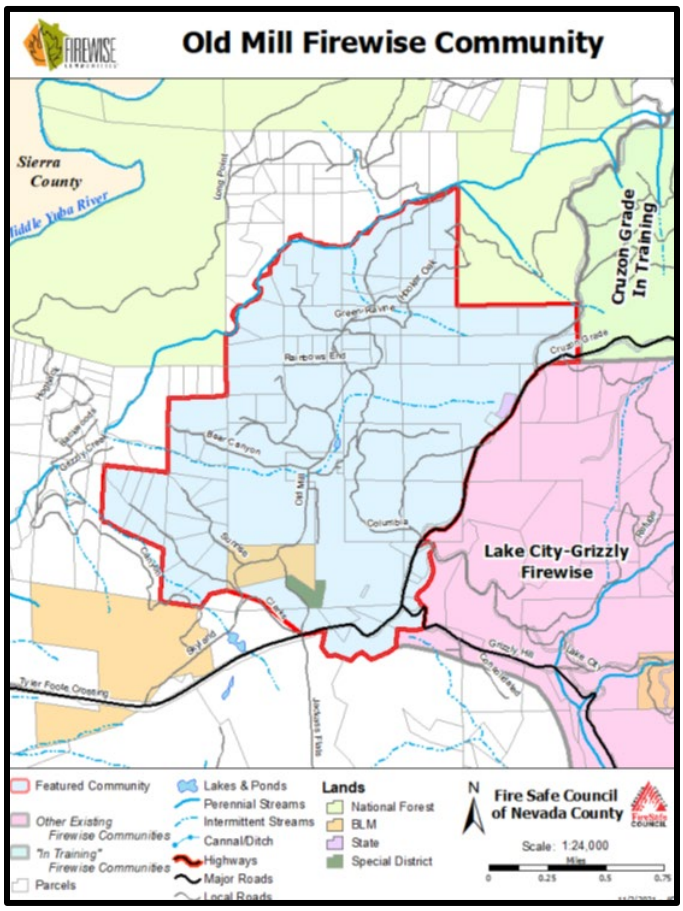


Figure 22: Old Mill Firewise Community

Evacuation Situation

Old Mill Road comprises the ingress/egress for this community. Old Mill Road is 1.7 miles in from Tyler Foote Road. The road has one bottle neck where the road narrows to one lane for approximately 300 feet where only one car can pass at a time. See Figure 23.

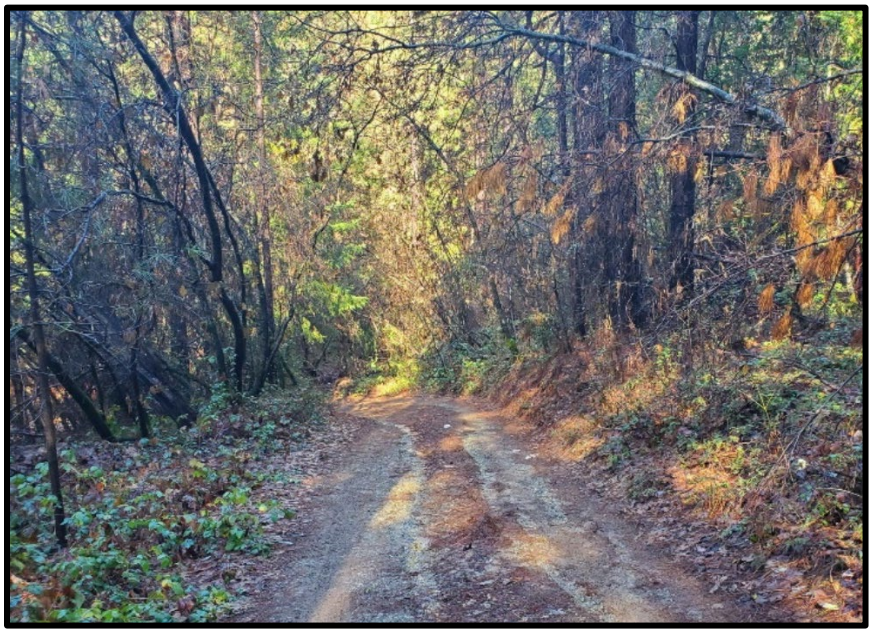


Figure 23: Old Mill Road, Old Mill Firewise Community

Primary Challenges

The primary challenge for Old Mill Road is the ongoing maintenance of the road to keep the evacuation route clear.

Impacts and Opportunities

The outcome of maintaining hazardous vegetation along Old Mill Road is that it will make the community more saleable when real estate changes hands.

COMMUNITY: Toller Ridge

Community Summary

The Toller Ridge Firewise Community/Toller Ridge Road Association is located 5 miles from the Nevada County Government Center, travelling north on Highway 49, between Nevada City and the South Yuba River State Park, with the entrance to Toller Ridge Court on the left-hand side of the highway.

The community consists of 11 (10-20 acre) parcels that are home to 23 residents who are predominately over 65. These residents all access their parcels directly off the North Highway 49 corridor. See Figure 24.

The PG&E High Voltage Line (Colgate Line) runs through several properties, beginning at Highway 49 travelling up to Monte Vista Road. PG&E workers access this line via the private road (Toller Ridge Court). Two of the 11 properties in the community are situated at the lower portion of the community (elevation 1,900 feet), while the other nine properties are located at the top portion of the community, (elevation 2,220 feet). The communities most recent experience with wildfire was the 2020 Jones Fire.

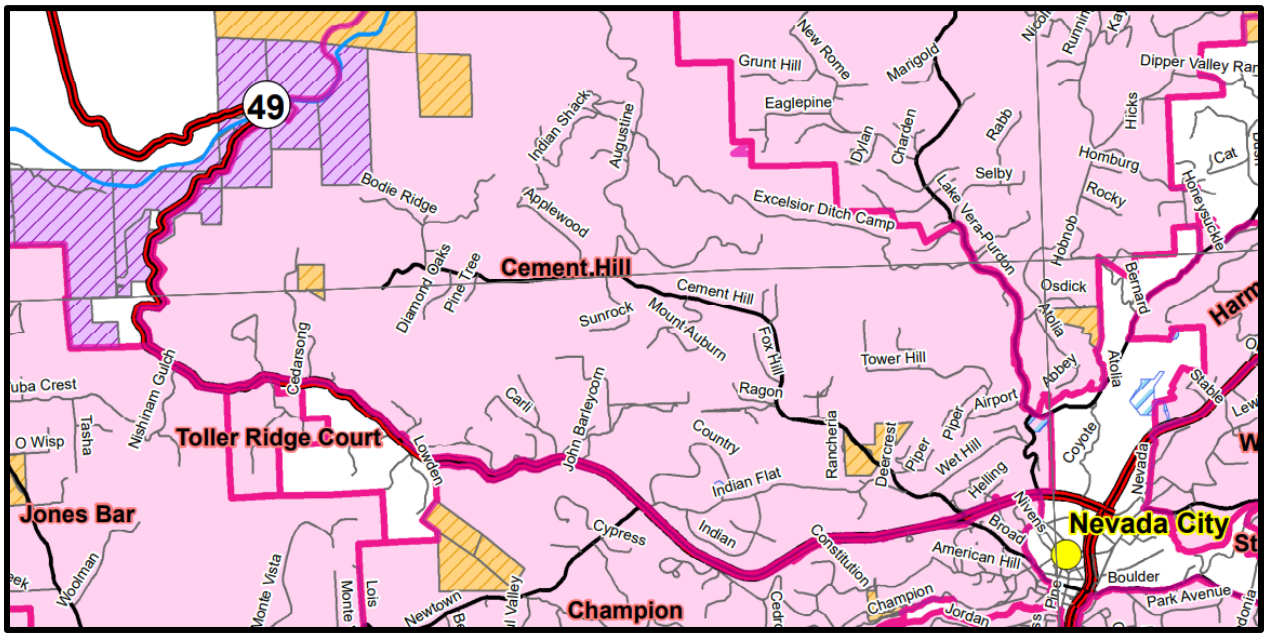


Figure 24: Toller Ridge Firewise Community

Evacuation Situation

The entrance to Toller Ridge Court off Highway 49 represents the only truly viable ingress/egress access road for the community. See Figure 25. In the event of an emergency, the Toller Ridge Firewise Community has identified an alternate way out - travelling up the Colgate High Voltage line that comes out on Monte Vista - however, the terrain is steep and might be difficult for some vehicles to traverse.

Figure 25: Toller Ridge Firewise Community Entrance

Once on Highway 49, evacuation options for the community (dependent on fire location and conditions) include: Newtown Road, American Hill Road, Old Downieville Highway, Champion Mine Road, and West Broad Street.

Primary Challenges

The Toller Ridge Firewise Community has identified three major challenges associated with evacuation:

1. Highway 49 from the South Yuba River to Highway 20: This section of Highway 49 is a major ingress/egress route for communities in this area and the San Juan Ridge. It has large areas of overgrown vegetation. Should a fire start in this area, it could race uphill closing one or two lanes of the highway. There are many ponderosa pines close to the highway. They tend to fall over in high winds. If one fell across the highway, it would block this evacuation route. A wildfire in this area would put Nevada City at risk.

2. Western historical Nevada City: Nevada City is notorious for narrow winding streets. Egress onto Highways 49 and 20 is a major concern. Even in normal circumstances many drivers have difficulty finding their way; the situation would be exacerbated in an emergency. Visitors to the Tribute Trail, parked near the Champion/Old Downieville junction, are present on any given day. Should a special event such as Summer Nights or Victorian Christmas be underway, congestion would be much worse. Potential trouble spots are West Broad at Highway 49, Bennett, Monroe, and Spring Streets – all are areas which become congested during special events. See Figure 26.

Figure 26: Historical Downtown Nevada City, Fourth of July

3. Old Downieville Highway: Depending on the location of a fire, Old Downieville Highway may be the best evacuation route for western historical Nevada City. See Figure 27. Unfortunately, there are 21 dead trees within falling distance on the road outside of the county right of way. They may fall into the road during high winds. The intersection of Old Downieville Highway with Highway 49 is also of concern.

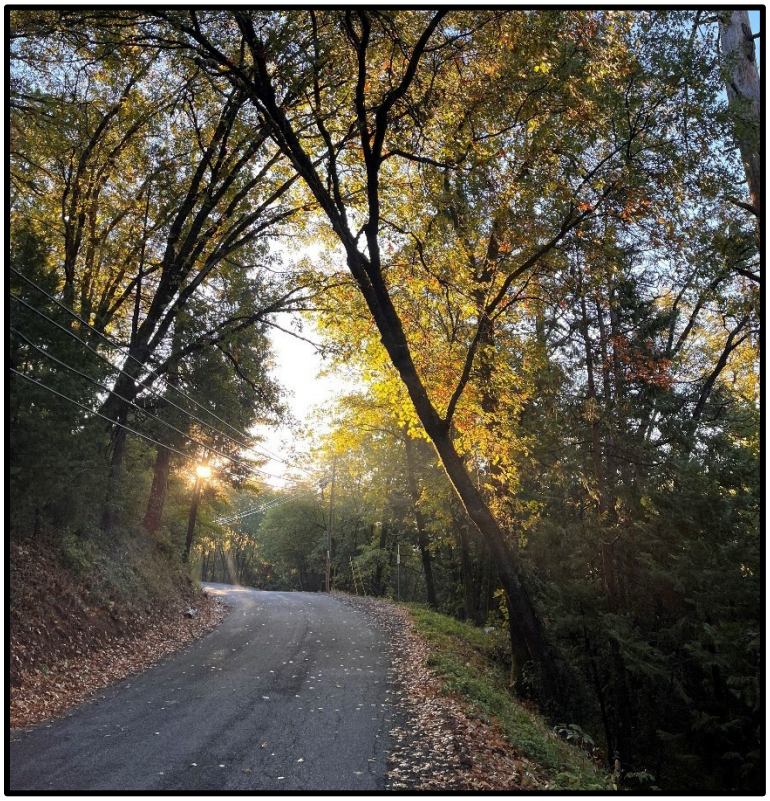


Figure 27: Old Downieville Highway, Nevada City

Impacts and Opportunities

Opportunities to address the challenges that are observed include:

1. Highway 49 from South Yuba River to Highway 20: Implementation of a shaded fuel break on both sides of Highway 49 is recommended. It is also recommended that an arborist evaluate the ponderosa pines along Highway 49 and then have high risk trees removed. Treating this section of Highway 49 would allow for critical ingress/egress. Shaded fuel breaks slow down the intensity and the speed of a fire allowing firefighters a better opportunity to fight the fire. This

could result in saved lives and homes. It also reduces the risk of a fire spreading to Nevada City.

2. Western historical Nevada City (within the Greater Champion footprint): Improving ingress/egress for Nevada City will require systems to assist unfamiliar drivers to find their way, such as improved street signage and traffic directors at key locations. Restricting street parking during special events in fire season should also be considered. Nevada City currently plans to change street signs to reflective metal within the next three years. Downtown Nevada City contains a concentration of infrastructure, property value, and resources. Its protection should be paramount. Providing better ingress and egress will help support firefighters to protect the town, and better egress could save many lives.

3. Old Downieville Highway: Ingress/egress along this key evacuation route would be improved by the removal of dead trees that pose a hazard not just during wildfire but during winter storm events.

The impact of taking the above actions would greatly improve wildfire outcomes not just for Toller Ridge Firewise Community, but for 2,000 to 3,000 residents in the vicinity and potentially visitors to Nevada City as well. Nevada City is the hub of our community. It relies on local and tourist spending. If Toller Ridge Community burned, it could threaten the town of Nevada City, and there would be fewer locals' spending money in Nevada City. If part of Nevada City burned, especially the historic section, there would be a huge economic impact on the businesses and residents of Nevada City.

COMMUNITY: West Sages

Community Summary

West Sages Firewise Community (WSFWC) is located off Tyler Foote Road in North San Juan, with access through Ananda Village. Sages Road and Maidu Way intersect along the ridge line with many properties overlooking the Middle Fork of the Yuba River. WSFWC is comprised of approximately 37 parcels, most in the range of 5-20 acres. Many parcels have multiple dwellings that house property owners and renters. Many of the residents are not known by name given the somewhat transient nature of some of the rental spaces. Approximately 64 individuals are known by name. There are numerous folks who are low income, well over the age of 65, and in need of assistance if evacuation should be necessary.

Evacuation Situation

The primary evacuation roads for the West Sages Firewise Community include Sages Road to Ayodha to Tyler Foote Road.

Primary Challenges

The major evacuation challenges for this community are associated with hazardous vegetation. There is considerable woody debris and fallen trees from PG&E related tree removal in 2021-22 along Sages Road and Maidu Road. In addition, several parcels have not removed grasses and woody growth along the road.

Impacts and Opportunities

There is considerable opportunity to improve evacuation outcomes for the WSFWC if vegetation were cleared from along the roadways. The addition of more clearly delineated turnouts would also be of great value, especially along Maidu Road as this is a one-vehicle lane in most areas.

A workable and useable road is essential for evacuation of people and animals. Several sites in WSFWC have horses, cattle, and other livestock and almost all residents have dogs. There are many elderly who no longer drive or do so sparingly. Access to Oak Tree Road heading West on Sages Road has been recently made passable, however it is gated, locked, and the actual condition is unknown.

If improvements were made, there are 200+ community members that would benefit as the road serves as an evacuation route not just for residents but for Ananda members as well.

COMMUNITY: Lake Vera Round Mountain Ranch Road/Hudson/Round Mountain

Community Summary

The Lake Vera Round Mountain Ranch Road/Hudson/Round Mountain community is comprised of the Lake Vera Round Mountain Firewise Community and the Round Mountain Ranch Road Association (RMRR). Located approximately four miles north of Nevada City near Purdon Crossing, the RMRR Association has 27 parcels holding easements. An additional 16 parcels on Deerhaven and Bear Run frequently use Round Mountain Ranch Road. The area is characterized by a rural residential setting with

pockets of agriculture, bordering recreation areas including the South Yuba River and Bureau of Land Management (BLM) land. See Figure 28.

Figure 28: Recreation, South Yuba River Canyon

Evacuation Situation

The community features poorly maintained, narrow gravel roads with heavy vegetation and trees on shoulders. In one direction Round Mountain Ranch Road, Purdon Road, Rector Road, Rock Creek Road, and Lake Vera Road offer ingress/egress. In the opposite direction Round Mountain Ranch Road, Hudson Way, Rock Creek Road, and North Bloomfield Road service residents. Even where roads are paved and county-maintained (such as North Bloomfield and Purdon Roads) the roadside vegetation is dense.

Round Mountain Ranch Road has been substantially damaged by PG&E tree removal and pole replacement, as well as by the vast increase in recreation use, despite being a private road. Many hikers, bicyclists, and even kayakers use it to access public lands because it is in better condition than upper Hudson Way, which travels through BLM property. During an evacuation not only would recreationists need to get out, but livestock needing trailer evacuation and some disabled and elderly residents would need assistance as well.

Primary Challenges

Every time there is a fire in the South Yuba Canyon, the Lake Vera Round Mountain Ranch Road/Hudson/Round Mountain Community is at risk. The community has also had some major house fires in recent years that could have spread to the wildland easily. In this context of elevated hazard, several challenges exist related to evacuation. Road surfaces need grading, turnouts are not present on Round Mountain Ranch Road, vegetation and trees are dense on lower and upper Hudson Way, with additional hazards posed by trees on Purdon Road and Rector Road. Beyond this, support is needed to incentivize BLM to routinely grade upper Hudson Way to Rock Creek Road.

Impacts and Opportunities

The most significant impact to residents is safety. The highest priorities for the community outside of their immediate neighborhood are in increasing safety along Rector and Lake Vera/Purdon Road with vegetation and tree removal and by creating more turnouts. Within the immediate neighborhood the provision of matching grant opportunities would allow for small projects like vegetation and tree removal and creation of more turnouts on RMRR, and lower Hudson Way to be implemented. Benefits would include increased property values and better homeowner's insurance rates. Surviving evacuation without injury and protecting vehicles during evacuation are also important outcomes for residents.

COMMUNITY: 6B and Friends Firewise Community

Community Summary

6B and Friends Firewise Community contains all parcels southeast of McCourtney Road accessed from Thoroughbred Loop, as well as South Ponderosa Way south from McCourtney Road, and side roads along Hidden Valley Road to near the second small stream crossing on Hidden Valley Road. See Figure 29. A few parcels on Marin Road and Brass Circle are included, which enter McCourtney Road from Polaris Drive.

Figure 29: 6B Firewise Community

In sum, this area comprises 635 acres of mostly gently rolling hills and small valleys with grasslands, chaparral, black oak forests, ponderosa pine forests and riparian vegetation. The community includes the 6B Ranch Estates development (created in 1980) plus adjacent parcels. Most properties are between five and ten acres. All but a few are developed. There are a total of 93 properties and approximately 167 residents. The majority of the 6B and Friends Firewise Community population is over 65 years old. The most recent wildfire this community experienced was the McCourtney Fire in October 2017.

Evacuation Situation

The primary evacuation pathway for the 6B and Friends Firewise Community is McCourtney Road; the secondary route is Hidden Valley Road.

Primary Challenges

The primary challenge to evacuation is getting residents to clear along roadsides to make evacuation routes safe to evacuate. In a recent survey 6B and Friends Firewise Community neighbors cited these fire-related issues as their top three concerns: (1) receiving an alert in time to get out, (2) neighbors with thick brush, and (3) identifying evacuation routes.

Impacts and Opportunities

An impact to consider beyond the aforementioned challenges is the 147-space RV park (in construction) at the corner of McCourtney Road and Old Auburn Road. This park will affect all traffic during any emergency because the Nevada County Fairgrounds (staging area for CAL FIRE and other fire resources, animal evacuation facilities, human evacuation space), CHP headquarters (first responder site) and the entrance to Highway 49 and Highway 20 all intersect at this small section of road. The local entity which approved the RV park project must be held responsible for mitigating this evacuation bottleneck immediately by widening the road to at least two lanes per direction (plus sidewalks) between the freeway interchange and the last (southwest-most) entrance/exit to the fairgrounds. In the event of an emergency this segment of road will be used by hundreds of residents and first responders trying to reach the 49/20 interchange or exit from it. It is a traffic bottleneck as evidenced by traffic congestion every year during the Fair (a non-emergency event).

Major opportunities for the 6B and Friends Firewise Community include:

1. Weed whack dry grass to the fence lines.

2. Clear or thin manzanita along the road at least 15’ from the edge of both sides of the road.

3. Clear brush, dead grass, and small trees along the road at least 15’ from the edge of the road.

4. Burn or remove one hundred plus burn piles along the west side Hidden Valley Road (county land).

Besides increasing fire preparedness and access for medical and law enforcement vehicles, benefits include generally safer (wider) roads and better sightlines for drivers even in non-emergency situations. Road improvement would also improve non-emergency traffic flow and increase safety for pedestrians and bicyclists. Improving roads will increase the value of all the 6B and Friends Firewise Community properties and potentially help residents acquire and maintain home insurance and decrease home insurance premiums.

COMMUNITY: Harmony Firewise Community

Community Summary

Harmony Firewise Community is a geographically diverse community straddling Harmony Ridge, dropping steeply to North Bloomfield-Graniteville Road on the north, and steeply to Highway 20 to the south. The community totals 390 acres, ranging from 0.5 to 92-acre parcels, with the average size of just over 5 acres. In sum there are approximately 75 properties, including 10 undeveloped parcels and about 150 residents. It is estimated that 25-50% of residents are age 65+.

Evacuation Situation

The main evacuation route for this community is North Bloomfield Road or Coyote Street to Highway 49 or Highway 20. Highway 20 toward Truckee/Tahoe is viewed as a better exit route from the area than Highway 49 toward Auburn because fewer vehicles are likely to use it. Approximately half of Harmony Firewise Community residents have addresses on private roads leading directly to Highway 20 (Manzanita Diggins, Stable Lane, Stonehill Road, Rim Rock Lane, and Highway 20); their evacuation concerns are not as great as those on North Bloomfield Road, Harmony Estates Road, Cedar View Road, or Vee Court.

Primary Challenges

The primary challenges for the Harmony Firewise Community are associated with North Bloomfield Road and Coyote Street. Both roads are narrow with encroaching vegetation, presenting a hazard to evacuees and firefighters:

"*North Bloomfield-Graniteville Road currently has encroaching vegetation on both sides and could be a danger to evacuees or fire service personnel. Much of the encroaching vegetation consists of small trees and brush that would easily burn in a wildfire, making the route impassible. Highway 20 is wider and has better vegetation clearing along both sides"* (Source: Dario Davidson, Harmony Firewise Community Assessment, 2020).

Specific concerns include the following:

1. North Bloomfield is the primary exit route to Highway 49/20 for hundreds of residents from the Lake Vera Purdon/Round Mountain area, as well as all along North Bloomfield to the South Yuba River.

2. The intersections at North Bloomfield/Lake Vera Purdon and North Bloomfield/Coyote Street will quickly become jammed in an emergency, especially if emergency vehicles are heading in the opposite direction as evacuating residents.

3. Coyote Street, a paved county road, has no center line, and is steep, winding, with sharp drop-offs. See Figure 30. Nevada County Consolidated Fire is located at the bottom.

4. North Bloomfield Road and Coyote Street will be impassable if there is an accident, or if a car (or worse, an RV) breaks down as there are very few turnouts.

Figure 30: Coyote Street, Harmony Firewise Community

Additional hazards for the community are related to two adjacent and heavily overgrown parcels. To the southeast, is 10+ acres of property owned by Nevada Irrigation District that has water tanks and is bisected by a steep gravel maintenance road and protected by locked gates. To the south is 100+ acres of undeveloped private property with a history of homeless encampments.

Impacts and Opportunities

A high-impact opportunity to improve evacuation outcomes for the Harmony Firewise Community exists by improving North Bloomfield Road to Cooper Road to Harmony Ridge Road to Highway 20. This is the highest priority alternative evacuation route for this community. It is accessible to the greatest number of residents along North Bloomfield Road and has the potential to become a viable alternate route with the least number of resources. Evacuees coming from North and South directions on North Bloomfield could use this route to reach Highway 20. The following improvements would need to be made:

1. North Bloomfield Road to Cooper Road needs vegetation clearance.

2. The first section of Harmony Ridge Road is passable, but difficult for vehicles with low clearance; its condition varies from year to year. The rest of the road towards Highway 20 is in reasonable shape. The first section of the road runs through private property so an agreement with the property owner/s would be required.

Other alternative evacuation routes are not as viable. These include:

1. The NID road maintenance road from Cedar View to Manzanita Diggins/Highway 20. This road is very steep, graveled, with steep drop-offs on the side, and can only be accessed through three locked gates (bolt cutters can be used).

2. Rim Rock Lane off Harmony Estates. This road is steep and winding and can only be accessed through private property. It would require grading and paving. These exits would be very hazardous with reduced nighttime/smoke visibility.

3. Madrone Springs via Blue Tent School Road and Cooper Road are also possible evacuation routes from North Bloomfield Road that lead eventually to Highway 20. However, these are less direct routes to Highway 20 and Madrone Springs has overgrown areas.

NOTE: The Master Plan* for development of Harmony Ridge, the housing development off Hwy 20 and Harmony Ridge Rd., by Ridge Top Holdings, LLC, includes a requirement for secondary egress. The preferred option in the development plan would extend Hoge Road to North Bloomfield Road. However, this secondary egress route is to be constructed in the final phase of the development; the timeline is unknown, but likely several years out.

*See Nevada County Planning Commission Staff Report, April 22, 2023. https://www.nevadacountyca.gov/DocumentCenter/View/49446/-Harmony-Ridge-Subdivision-Development-Agreement-Annual-Review-Staff-Report-PLN23-0057-MIS23-0006-b

An improved secondary egress route leading to Highway 20 would improve public safety by taking the evacuation pressure off North Bloomfield Road/Coyote Street and would provide an alternative route if North Bloomfield egress is blocked or leads into the path of a fire.

COMMUNITY: Greater Champion Neighborhood Association

Community Summary

The Greater Champion Firewise Committee, part of Greater Champion Neighborhood Association (GCNA), starts at the west end of Nevada City and extends west for about 3.5 miles. The borders of GCNA are roughly Highway 49 to the north, Deer Creek to the south, Spring Street in Nevada City on the east and just past Newtown Road to the west.

The GCNA community is in the WUI with 2,000 acres overall. A third of the 505 parcels are in Western Nevada City with an average parcel size of ½ acre. Two third of the parcels are in unincorporated Nevada County with an average parcel size of 5 acres. There are several property owners in the community with 80 to 100+ acres. There are also 150 acres of heavily overgrown public property owned by the Bureau of Land Management (BLM), as well as approximately 15 acres owned by Nevada City and 34 acres owned by Nevada County.

GCNA residents are predominately over 65 years old. This communities most recent experience with wildfire is the Jones Fire of August 2020.

Evacuation Situation

The main ingress/egress routes for GCNA include Highway 49, Newtown Road, American Hill Road, Old Downieville Highway, Champion Mine Road, and West Broad Street.

Primary Challenges

GCNA has identified four primary evacuation challenges as follows:

1. Highway 49 from the South Yuba River to Highway 20: This section of Highway 49 is a major ingress/egress route for communities in this area and the San Juan Ridge. It has large areas of overgrown vegetation. Should a fire start in this area, it could race uphill closing one or two lanes of the highway. The highway south of Newtown Road was closed during the Jones Fire. There are many ponderosa pines close to the highway. They tend to fall over in high winds. If one fell across the highway, it would block this evacuation route. A wildfire in this area would put Nevada City at risk.

2. Western Nevada City: Nevada City is notorious for narrow winding streets. Egress onto Highways 49 and 20 is a major concern. Even in normal circumstances many drivers have difficulty finding their way; the situation would be exacerbated in an emergency. Visitors to the Tribute Trail, parked near the Champion-Old Downieville junction, are present on any given day. Should a special event such as Summer Nights or Victorian Christmas be underway, congestion would be much worse. Depending on the location of a fire, Old Downieville Highway may be the best evacuation route for western Nevada City. Unfortunately, there are 21 dead trees within falling distance on the road outside of the county right of way. They may fall into the road during high winds.

3. Deer Creek Canyon: The canyon is heavily forested with many narrow one lane streets. There is an almost constant breeze blowing up the canyon toward Nevada City. Access to the creek by firefighters is very difficult. CAL FIRE described Champion Mine Road as a little better than a jeep trail. CAL FIRE has also said they have to wait for residents to evacuate before they can use a road to access the creek area. During the Jones Fire, firefighters were able to stop the fire at Newtown Road. They were concerned that once the fire jumped Newtown Road, they might not be able to stop it before it reached Grass Valley due to poor access and heavy fuels.

4. Western Nevada City and Old Downieville Highway: Potential trouble spots include West Broad Street at Highway 49 where congestion can exist to get on the Highway and along Bennett, Monroe and Spring Streets which become congested by parking during special events. See Figure 31. In addition Old Downieville Highway with its 21 dead trees is of concern. Of secondary concern is the intersection of Old Downieville Highway with Highway 49.

Figure 31: Special Event Congestion, Greater Champion Firewise Community

Impacts and Opportunities

Impactful opportunities exist to address each the primary challenges identified by GCNA. These include:

1. Highway 49 from the South Yuba River to Highway 20: GCNA recommends a shaded fuel break on both sides of Highway 49. GCNA would like an arborist to evaluate the ponderosa pine along Highway 49 and then have high risk trees removed. Treating this section of Highway 49 would allow for critical ingress/egress. Shaded fuel breaks slow down the intensity and the speed of a fire allowing firefighters a better opportunity to fight the fire. This could result in saved lives and homes. It also reduces the risk of a fire spreading to Nevada City.

1. Western Nevada City (within the GCNA footprint): Improving ingress/egress for Nevada City will require systems to assist unfamiliar drivers to find their way, such as improved street signage and traffic directors at key locations. Restricting street parking during special events in fire season should also be considered. Nevada City currently plans to change street signs to reflective metal within the next three years. It would also be prudent to remove dead trees on Old Downieville Highway.

2. Deer Creek Canyon: Implement the Deer Creek Canyon Shaded Fuel Break. This will slow down the speed and intensity of a fire allowing residents more time to evacuate and more time and access for fire fighters. CAL FIRE NEU has identified this as a strategic project and has stated it is the single most effective intervention for protecting this area from wildfire. CAL FIRE recently

recommended the Deer Creek Canyon Shaded Fuel Break be expanded to Newtown Road to connect it with the Ponderosa West and Ponderosa Phase 2 shaded fuel breaks. The Fire Safe Council of Nevada County has said the shaded fuel break will provide additional protection for property within 2 miles. This shaded fuel break is supported by Deer Creek South Side (DCSS), Foxwood-Slate Creek, Echo Ridge, Kentucky Flat and Mountain Lake Estates Firewise Communities. It is also supported by the Nevada City Fire Safety Advisory Committee.

The benefit of implementing these actions has the potential to improve evacuation outcomes for 2,000 to 3,000 residents. Downtown Nevada City contains a concentration of infrastructure, property value, and resources. Its protection should be paramount. Providing better ingress and egress will help support firefighters to protect the town, and better egress could save many lives.

Historic downtown Nevada City is the hub of our community. See Figure 32. It relies on local and tourist spending. If Greater Champion burned, there would be fewer locals spending money in Nevada City. If part of Nevada City burned, especially the historic section, there would be a huge economic impact on the businesses and residents of Nevada City. The same is true for Grass Valley.

Figure 32: Historic Downtown Nevada City

COMMUNITY: Jackass Flats

Community Summary

The Outer Jackass Flats Firewise Community/Fire Access (Jackass Flats) Road Association is located on the San Juan Ridge in western Nevada County. Specifically, Jackass Flats Road begins near North Columbia at Tyler Foote Road and runs south about 3.5 miles to the South Yuba River canyon. It is fed into by 10 (mostly dead-end) shorter roads and serves as the primary ingress/egress for the community of at least 60 households, a Zen Buddhist Zendo, the Ananda Meditation Retreat and several home-based businesses. There are approximately 50 identified households and possibly 20-30 others. Among these there are at least 15 and likely more community members over the age of 65. Whether any community members meet the definition of low-income is unknown but likely.

The community is completely off-grid; residents get electricity via solar with back-up generators and water is supplied by wells. All roads are graveled and maintained by residents. Approximately three miles of Jackass Flats Road is part of the Montezuma Fuel Break, which continues on other parcels of the Firewise Community to meet the Montezuma Ridge Firewise Community on the west side of Montezuma Ridge. See Figure 33.

Figure 33: Montezuma Fuel Break, Jackass Flats Firewise Community

In nearly 50 years the community has never been under mandatory evacuation, though several fires have posed a threat, such as the 49er Fire in 1988 and the Jones Fire in 2020. Along the South Yuba Rim from the bridge at Highway 49 and up-river for many miles, there is virtually no recent fire history on the north side where the Jackass Flats community lies.

Evacuation Situation

The primary ingress/egress options available to the Jackass Flats community include:

1. Jackass Flats Road to Tyler Foote Crossing Road.
    a. Tyler Foote west to Highway 49, or to Oak Tree Road to Highway 49.
    b. Tyler Foote east to Highway 89, via Cruzon Grade, Graniteville, and Jackson Meadows.
2. Highway 49 south to Nevada City/Grass Valley.
3. Highway 49 north to Pleasant Valley Road/Highway 20 or to Marysville Road/Highway 70 or Highway 49 north to the high country/Sierra Valley/Highway 89.

Primary Challenges

The primary evacuation challenges identified by the Jackass Flats community include:

1. Tyler Foote Road: From approximately the Sierra Family Health Center up Tyler Foote to the North Columbia Diggings (near Jackass Flats) the road is badly in need of fuel clearance and tree thinning, including removal of clusters of dead pine trees. See Figure 34.

2. Purdon and Murphy Roads: These roads need fuel clearance.

3. Signage for Alternate Evacuation Routes: One of the best ways to get off the Ridge in the event of a fire would be to go up Tyler Foote/Cruzon Grade, through Graniteville to Meadow Lake Road, turning left before Bowman Lake onto Forest Road 41/Pinoli Ridge Road, and on to Jackson Meadows Reservoir and Highway 89. At that point, it is possible to go to I-80/Truckee in one direction or to the Sierra Valley in the other. This route needs some signage (possibly with arrows indicating Jackson Meadows or Highway 89) because there are several

intersections, including the turn-off from Meadow Lake Road that are not signed with road identification or destination.

4. Montezuma Fuel Break: Renewal/completion of fuel clearance along the Montezuma Fuel Break would be a major improvement for the Jackass Flats community, both in terms of ingress/egress and for fire-fighting purposes. Currently, it provides the community an emergency exit to the west, and to Purdon Road.

Figure 34: Dead Trees, Tyler Foote Road

Impacts and Opportunities

Vegetation clearance and tree-thinning along several primary roads serving the Jackass Flat Firewise Community represents an impactful opportunity to significantly improve evacuation outcomes. Focal roads include Tyler Foote Road (from Oak Tree Road to North Columbia, but especially from the Sierra Family Health Center), up Tyler Foote Road to the North Columbia Diggings (near Jackass Flats), Purdon Road (from Tyler

Foote Road to Murphy Road), and Murphy Road (from Purdon Road to Shady Creek Road).

Roads provide fuel breaks, and if a fire can be stopped at a road, it could prevent a fire from burning property, homes and other structures, businesses, forests, and watersheds, all of which are economically beneficial. If making an evacuation route safer prevents injury or death, that is also an economic benefit.

Fuel clearance and fire road improvement on the Montezuma Fuel Break would also be beneficial. Adequate fuel clearance along the Montezuma Fuel Break could make evacuation by residents and ingress by first responders/firefighters safer. Fuel breaks with good fuel clearance provide a potential line of defense from a fire. Montezuma Ridge Firewise Community adjoins the Jackass Flats Firewise Community and could help with restoring the evacuation route on the Montezuma Fuel Break.

Along Jackass Flats Road the partnership between the Bureau of Land Management (BLM) and Yuba Watershed Institute (YWI) presents an opportunity. Work includes over a mile of a BLM parcel that has been and is still in the process of undergoing fuel clearance administered by YWI; BLM has planned a 120-acre prescribed burn that will improve conditions along a portion of Jackass Flats and Macnab Cypress Road, that leads to the Zendo and the Ananda Meditation Retreat, and there are other BLM parcels along roads in the Jackass Flats community.

In sum, pursuing these proposed activities would both benefit the Jackass Flats community of approximately 100-130 people and furthermore, the San Juan Ridge community of over 3,000 people.

COMMUNITY: Lower Colfax Firewise Community

Community Summary

The Lower Colfax Road Firewise Community is in the Peardale-Chicago Park area and includes Lower Colfax Road between Brooks Road and Old Coach Way and most side roads, Meadow Drive and all side roads, Orzalli Road, Edgewood Drive, and Gopher Hill Court. It is a rural residential wildland-urban interface (WUI) with an average parcel size over 5 acres. See Figure 35. Vegetation is mixed conifer-hardwood, meadow/pasture, and evergreen hardwood forest.

Most of the residents are retired or semi-retired and many are recently arrived from urban areas. It is primarily composed of owner-occupied homes (approximately 1,000 residents) spread across 464 developed parcels. There are 94 undeveloped parcels and approximately 20% non-resident ownership. Greater than 50% of the residents are over 65 years old and many are long-time Nevada County residents with low incomes and scant economic resources. The most recent fire residents experienced was the River Fire in 2021. Some residents were under evacuation orders and others received evacuation warnings, but most residents preemptively evacuated.

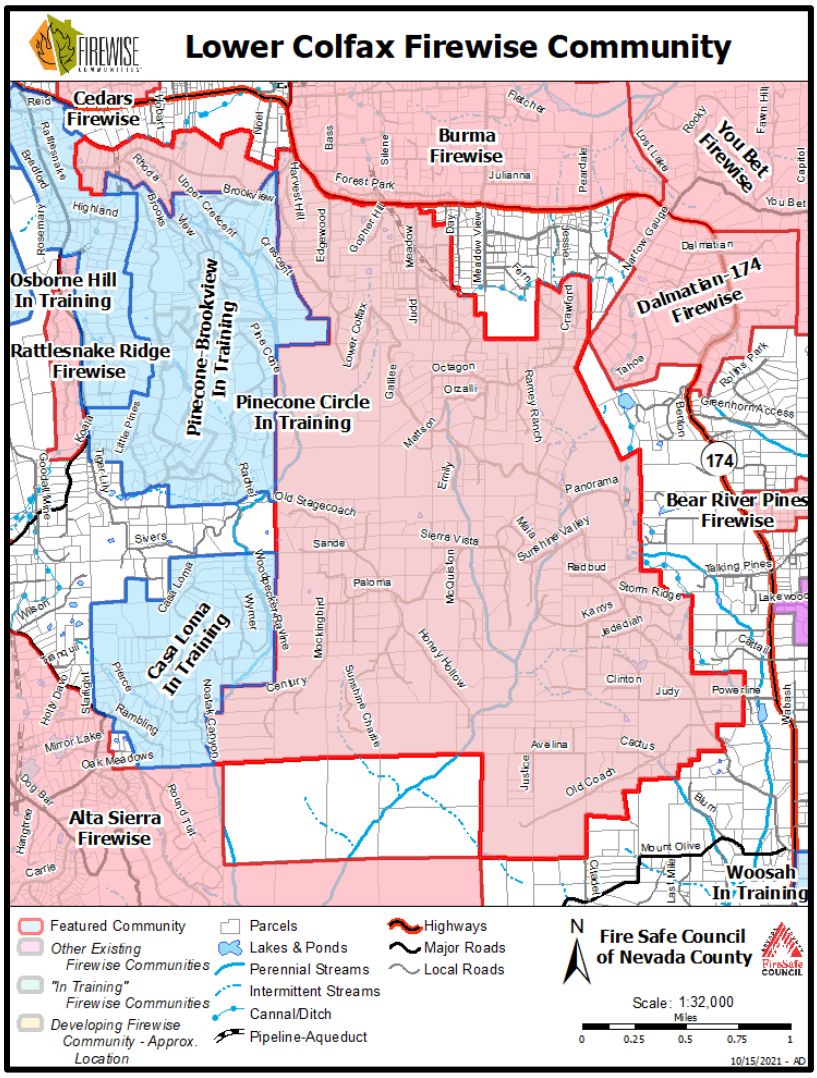


Figure 35: Lower Colfax Firewise Community

Evacuation Situation

In the Lower Colfax Firewise Community multiple tertiary and private single lane roads provide residential access. See Figure 36. Specifically:

1. Old Coach Way is a private road serving 35 residences (about 90 people), who have only one road to reach Lower Colfax.

2. Sunshine Valley Road serves 100 developed parcels and is the single route out to Lower Colfax for these residents.

3. Orzalli Road is a major connector road from Lower Colfax Road to Meadow View Drive.

4. Laws Ranch Cross Road connects Lower Colfax Road to Highway 174 but is very narrow.

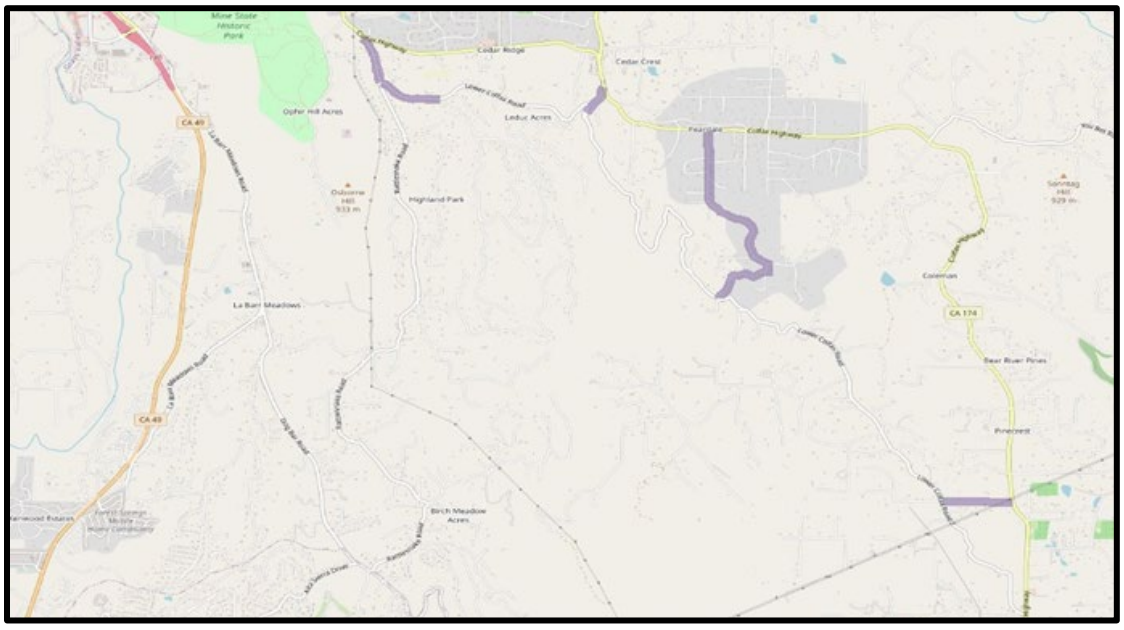


Figure 36: Access Roads, Lower Colfax Firewise Community

Primary Challenges

The most significant concern for the Lower Colfax Firewise Community is a rapid evacuation from a fire in Woodpecker Ravine, when hundreds of vehicles will be exiting

at once, possibly combining on Highway 174 with evacuees from other neighborhoods. See Figure 37. Lower Colfax Road is narrow and winding in most locations, single unmarked lane in many sections. and barely two lanes. The northern half is directly above Woodpecker Ravine. Congestion with emergency vehicles and towed trailers will make prompt evacuation problematic.

Figure 37: Woodpecker Ravine

There are no suitable Temporary Refuge Areas (TRAs) in the community due to terrain and vegetation, although a few could be added or improved in the south half of the community.

Impacts and Opportunities

The Lower Colfax Firewise Community opinion is that the public roads would be difficult to widen and improve due to terrain constraints and existing infrastructure. Vegetation

treatments, specifically bordering roads and ridgetops, to reduce fire intensity and rate of spread would be the most effective treatments. Increasing the roadside clearance from the required minimum of 10 feet to at least 50 feet would make evacuations safer and affect fire behavior.

Old Coach Way could be improved with more serviceable turnouts. It is a well-maintained road with an active road association but is a one lane gravel road lacking sufficient turnouts for simultaneous ingress and egress. Some of the smaller private roads could be slightly widened and improved with vegetation treatments. In addition, a detailed traffic control plan or evacuation zone planning for all traffic utilizing Highway 174 could be helpful. Real time notification of traffic congestion and alternative routes should be considered.

Improved evacuation might have a positive impact on property values. Facilitating access by fire crews could reduce loss of homes during a fire. Old Coach Way, Jarvis-Gann, and Avelina, which together form the main road through the Old Coach Way neighborhood would benefit from mitigation actions. For Old Coach Way - this work would speed up access of fire crews where needed in the neighborhood, because there would be adequate places for departing resident vehicles (including trailers with animals) to allow fire trucks to pass. The back of this neighborhood is at the top of Woodpecker Ravine, so facilitating fire-crew entry would benefit not only residents of this neighborhood but, potentially, residents of the entire Lower Colfax Firewise community.

People would feel safer knowing that evacuation would be more reliable. Elderly and disabled residents might have an easier time getting out with less assistance. Knowing that their evacuation route would not become blocked by fire trucks and vehicles unable to pass on the road would help people react in the most efficient and beneficial way by minimizing panic, and it could save lives. Mitigation actions would benefit at least 1,000 people.

COMMUNITY: Greenhorn Firewise Community

Community Summary

The Greenhorn Firewise Community is located east of the towns of Grass Valley and Nevada City and encompasses primarily evacuation zones 189, 184 and 281. There 829 households with a diversity of income levels in the community and 38% of the residents are age 60 or older. Greenhorn Road, You Bet Road and Banner Lava Cap Road are the primary county-maintained roads and evacuation routes leading out of the community to Highway 174 and Highway 49. Zone 281 was placed under an evacuation warning

during the River Fire. Both the recent River and Bennett wildfires would have threatened all zones if they had spread much more.

In sum, over 9,000 residents live in the Greenhorn Firewise Community and surrounding Firewise communities (You Bet, Banner Mountain, Burma, and Brunswick Manor). See Figure 38.

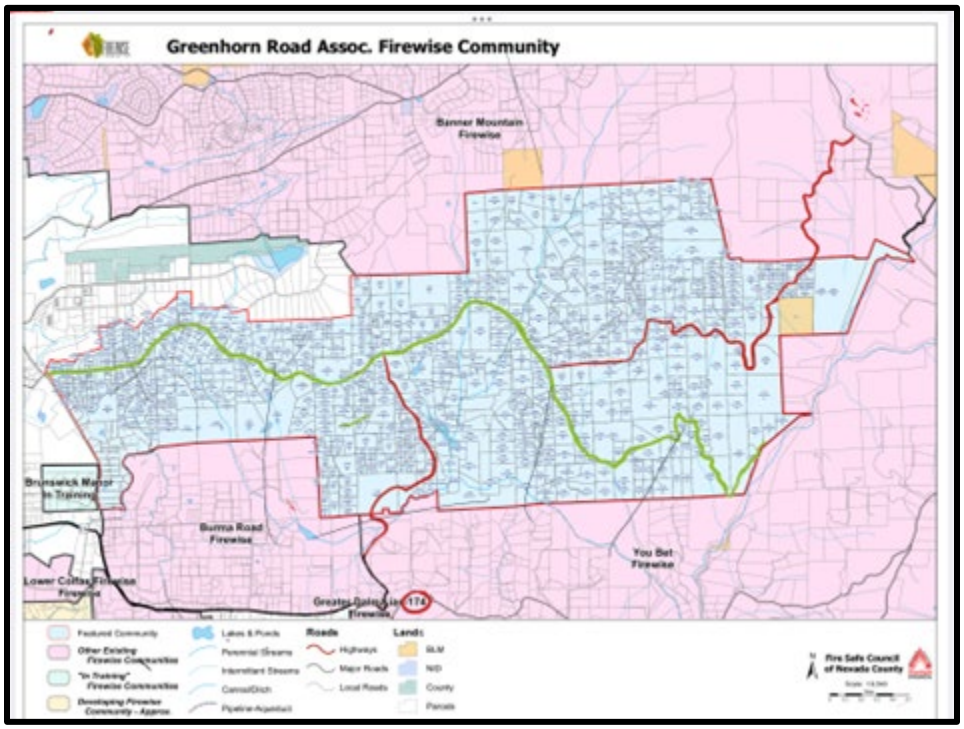


Figure 38: Greenhorn Firewise Community

Evacuation Situation

The Greenhorn Firewise Community has one primary and two secondary evacuation routes. The secondary routes are private roads - narrow, with few turnouts, and mostly unpaved. Evacuation routes are as follows:

1. Greenhorn Road: Greenhorn Road is the community's primary evacuation route and a county-maintained road for most of its length. It has only one outlet to Brunswick Road to Highway 174 or Highway 49. It's easternmost section dead ends on the west side of Little Greenhorn Creek near Missouri Canyon. The eastern section past the 4.25-mile mark is not maintained by the County and is a poorly paved or unpaved one lane road. Four-wheel drive vehicles with experienced drivers can cross the Little Greenhorn Creek stream bed near the

Hansen Brother's Quarry but the Greenhorn Firewise Community does not identify this route as an alternate evacuation route like the following alternate secondary routes.

2. Lost Lake Road: Lost Lake Road is a one-lane, mostly unpaved private road, with few pull outs, which connects from Greenhorn Road south to You Bet Road to Highway 174. The southern section of the Lost Lake Road route is in the You Bet Firewise Community.

3. Jones Ridge Road: Jones Ridge Road from Greenhorn Road to Meadow Way to Tumbling Creek to Red Dog Road to Banner Lava Cap Road is an option, albeit challenging. This one lane route is a series of private roads mostly rough and unpaved dirt and gravel surface. The Red Dog Road section to Banner Lava Cap Road is in the Banner Mountain Firewise Community.

Both the Lost Lake Road and Jones Ridge Road evacuation routes are unsuitable for low clearance vehicles, RVs, and trailers. See Figure 39.

Figure 39: Roads Unsuitable for Low-Clearance Vehicles, Greenhorn Firewise Community

Primary Challenges

The primary evacuation challenge for the Greenhorn Firewise Community is that the Greenhorn area does not have two county-maintained evacuation routes, per the definitions in SB-99. The primary county-maintained route, Greenhorn Road has only one outlet at Brunswick Road. If a wildfire, like the Bennett Fire spreads and threatens the Brunswick Road intersection and blocks egress through Brunswick Road, the community would have to rely on the Lost Lake Road and the Jones Ridge Road secondary evacuation routes to reach county and state routes. These secondary routes are mostly unpaved, poorly graded single lane private roads. On Lost Lake Road, a bridge near Oak Knoll Lane would likely not be crossed by heavy fire equipment because its condition cannot be certified as safe. See Figure 40.

Figure 40: Unsafe Bridge, Greenhorn Firewise Community

One stalled vehicle would trap residents attempting to egress out one of these secondary routes and inhibit access by emergency vehicles. Greenhorn Firewise Community depends on Greenhorn Road for evacuation and sits between two larger Firewise communities - You Bet and Banner Mountain - which would also rely on Greenhorn Road for evacuation depending on the location and direction of a wildfire. If a fire comes from the north, Banner Mountain residents would evacuate down toward Greenhorn and if the fire comes from the south, You Bet residents would evacuate toward Greenhorn Road. The potential for excessive and dangerous congestion is high and would threaten lives and property. As a result, the Greenhorn Firewise Community is focusing on identifying additional secondary private roads for evacuation purposes. See Figure 41.

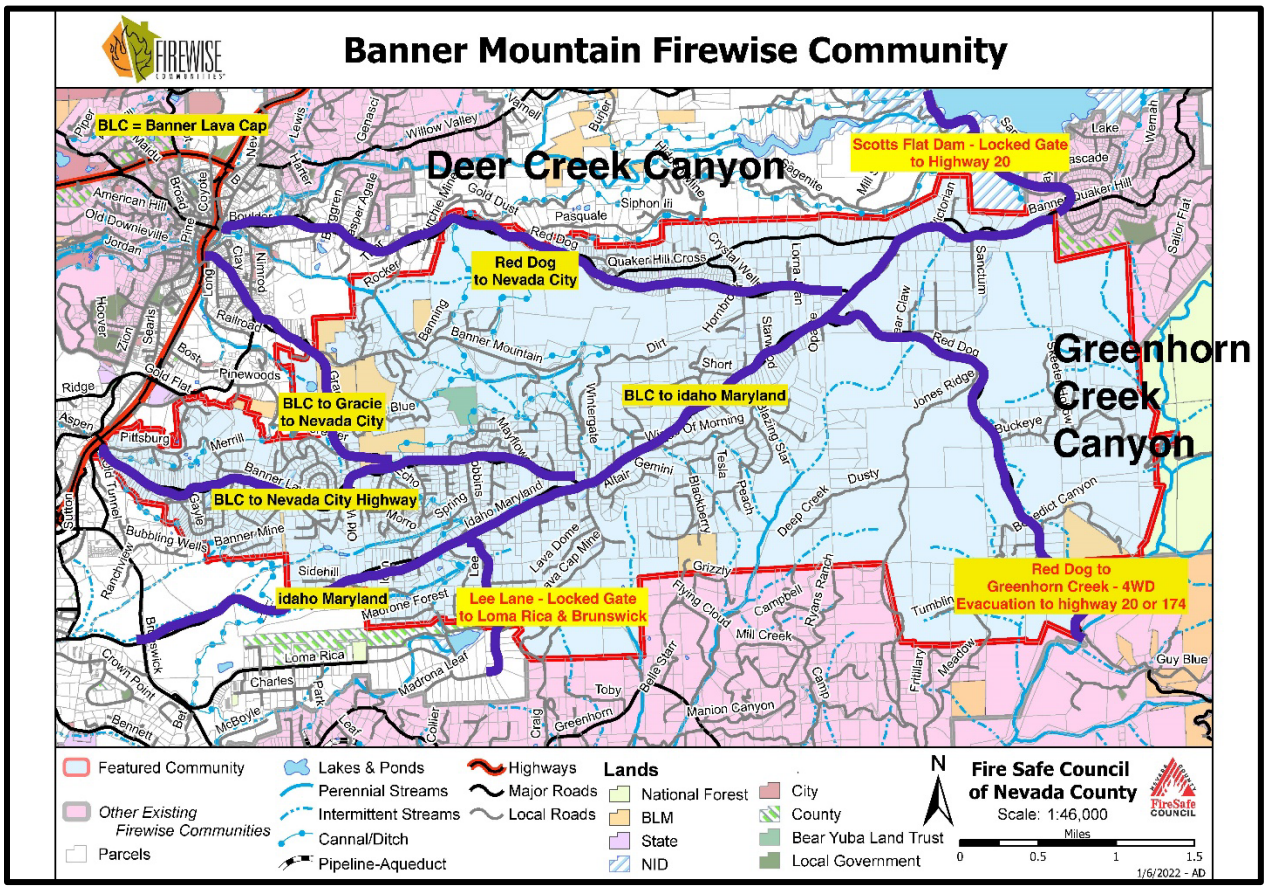


Figure 41: Evacuation Options, Banner Mountain Firewise Community

Impacts and Opportunities

There is an opportunity to improve evacuation outcomes for the Greenhorn Firewise Community by improving ingress/egress. These improvements include:

1. Greenhorn Road can be improved with extended paving at its eastern section and a one lane certified bridge at Little Greenhorn Creek near the Hansen Brothers Quarry to allow a second major egress route to You Bet Road, connecting to Highway 174.

2. Lost Lake Road secondary evacuation route can be improved through vegetation management, paving, road surface regrading, turnout construction, and bridge replacement/upgrading over Little Greenhorn Creek near Oak Knoll Lane.

3. Jones Ridge Road secondary evacuation route can be improved through vegetation management, paving, road surface regrading, and turnout construction.

Improvements to primary and secondary evacuation routes would involve substantial construction and vegetation management services resulting in employment and secondary benefits to the surrounding community. Improved evacuation routes should reduce human and property losses.

COMMUNITY: Foxwood/Slate Creek Firewise Community

Community Summary

The Foxwood Slate Creek Firewise Community (FSCFWC) is in unincorporated Nevada County commencing on Slate Creek Road just below Douglas Drive and continuing on Slate Creek Road to Deer Park Drive. It also includes All's Well Place, the entire length of Little Deer Creek Lane, Logans Run Court and Starlite Lane. The FSCFWC is under the purview of Grass Valley Fire District and Nevada County Consolidated Fire District with addresses assigned to both Grass Valley and Nevada City.

Within the community there are 84 parcels, five of which are Bureau of Land Management (BLM) or other local government. Several residents are well over the age of 65 and many are over 65 years old with varying mobility abilities.

The community is mostly woods and brush with narrow steep and curvy roads. There are four "No Outlet" roads within the Foxwood Slate Creek Firewise Community. The community corresponds regularly, through email, with over 60% of residents and meets annually to stay informed of the latest guidance on keeping the community resilient to wildfire. Many property owners have invested time, materials, and money into their properties to clear dense vegetation, dead trees and implement home hardening measures.

Depending on fire location, 150 - 400+ residents have the potential to evacuate through the community – such as if Mountain Lakes Estates and Champion Road areas are evacuating through the Little Deer Creek/Discovery Way fire road as occurred during the Jones Fire.

Evacuation Situation

For residents of the Foxwood Slate Creek Firewise Community, Slate Creek Road to the intersection with Ridge Road is the most direct exit route. A fire road into Morgan Ranch is accessible from Slate Creek Road and is a secondary route. Slate Creek Road intersects with Deer Park Drive which also leads to Ridge Road and would be a secondary route.

Little Deer Creek Lane commences off Slate Creek Road about one mile from Ridge Road and is a “No Outlet” Road. This road terminates down the canyon and across Deer Creek at 13050 Little Deer Creek Lane.

A locked fire gate located just north of Deer Creek and about halfway down Little Deer Creek Lane leads to Discovery Way in Mountain Lakes Estates, eventually leading to Newtown Road and is a primary evacuation route if Ridge Road is not accessible from Slate Creek Road.

Feeder roads within the community include: (1) Starlite Lane and Logans Run Court, which both feed into Little Deer Creek Lane and are both “No Outlet” Roads; and (2) All’s Well Place feeds into Slate Creek Road and is a “No Outlet” Road.

Primary Challenges

The primary challenge for the Foxwood Slate Creek Firewise Community is that for many residents only one evacuation route exists and if this route is not passable, they would need to flee on foot or shelter in place. Also, the primary evacuation route becomes congested quickly due to the number of residents relying on the same evacuation route.

Main priorities are clearing the brush between 13050 Little Deer Creek Lane and 11142 Peaceful Valley Road, clearing the dirt road between Little Deer Creek Lane and Deer Park Drive, and addressing the overgrowth of the BLM parcels on Slate Creek.

Impacts and Opportunities

A high impact opportunity for the Foxwood Slate Creek Firewise Community is vegetation clearing. The installation of portable stop signs on Ridge Road at Slate Creek Road during an evacuation event and replacing the existing gate and bollards at two fire road locations is also desired.

Providing an alternate evacuation route for residents on Little Deer Creek Lane who do not currently have a second or alternative evacuation route would be beneficial. Evacuees from Mountain Lakes Estates and Peaceful Valley Road could also benefit from this action.

Should the BLM parcels on Slate Creek Road ignite, a major evacuation route would not be passable and could also involve homes on Morgan Ranch Road adjacent to Slate Creek Road causing more homes to be lost. Also Morgan Ranch Road could become unpassable as an evacuation route. Clearing the BLM parcels of the overgrown brush would mitigate this hazard. As the BLM parcels on Slate Creek Road house a large solar array and Lift Station that are owned by the city of Grass Valley and provide key infrastructure support to the community, these assets are at risk should the parcels ignite. See Figure 42.

Figure 42: BLM Parcel, Slate Creek Road

Forecast Zone 3: Tahoe National Forest

"Please cut tree limbs that hang over the road. Especially Highway 49 from North San Juan to Nevada City. These will burn first, drop on the road burning and create a massive traffic jam."

"Our dirt road of 27 residents has identified our evacuation routes and many homeowners clear the vegetation on their property. Our concern is the owners who don't clear their land."

"Reducing fuel loads must be the top priority!"

"Washington Road is very dangerous, as there are downed trees, damaged guardrails, and a lot of thick vegetation on both sides of the road. Our other three evacuation routes are not accessible to most vehicles."

CWPP Survey Results

In the Tahoe National Forecast Zone the top wildfire mitigation priorities identified through the Community Wildfire Protection Plan (CWPP) survey were defensible space assistance, evacuation route improvement, home hardening incentives/rebate programs, and roadside vegetation removal. Respondents expressed high personal risk and identified that the biggest challenge was fuel on their own property followed by cost factors. Most people had never been evacuated or had only evacuated one time. Most people in this Forecast Zone leave early or only when an order is issued. The biggest evacuation concerns were getting trapped on the road, losing home or property, and getting out early.

Summary of Forecast Zone Concerns

All community concerns articulated by the Tahoe National Forecast Zone have been plotted geospatially on a single map. See Figure 43. Descriptions of specific community concerns follow.

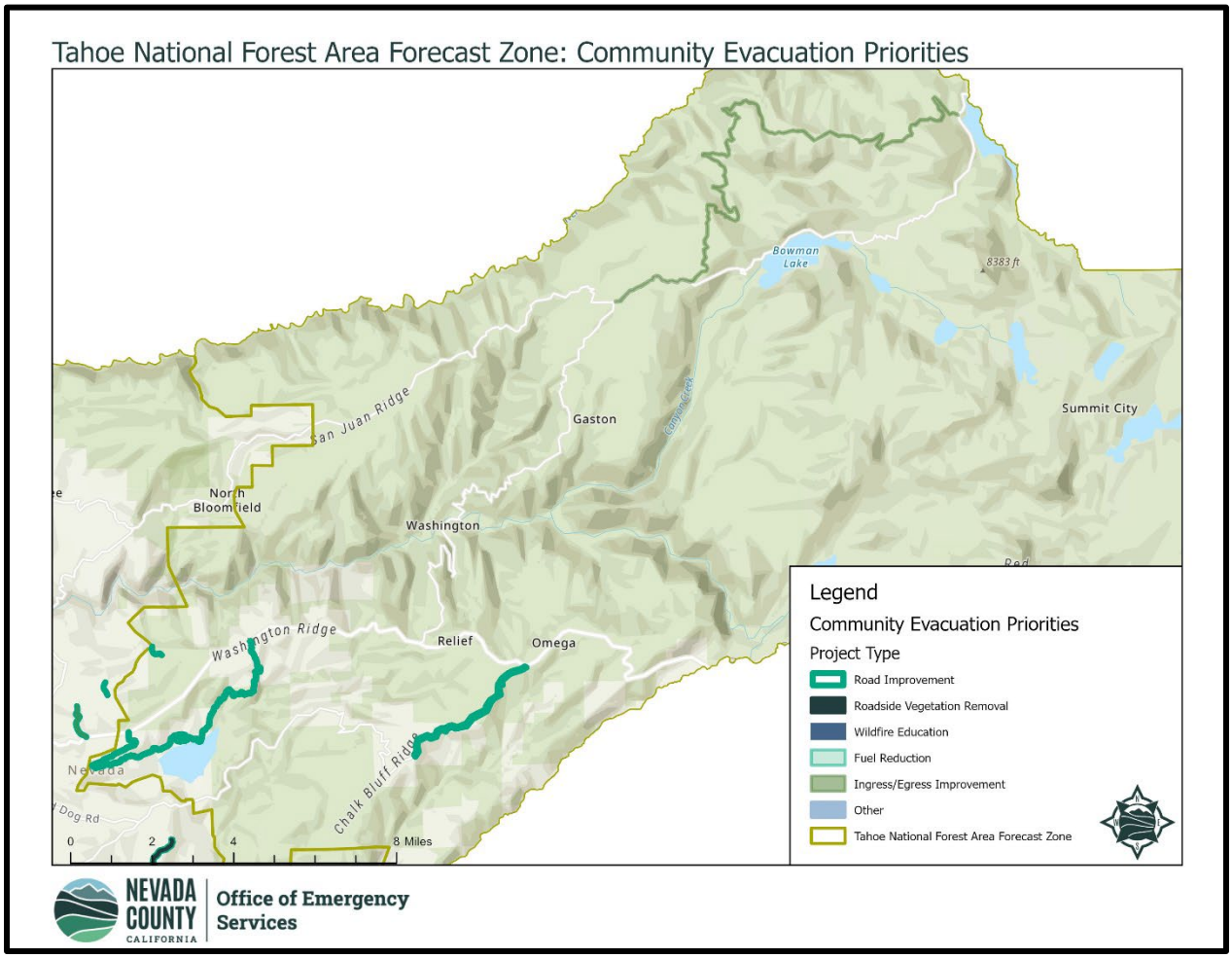


Figure 43: Tahoe National Forest Community Evacuation Priorities

Community Concerns

COMMUNITY: North Cooper Radio

Community Summary

The North Cooper area contains one Firewise Community and a greater surrounding neighborhood. North Cooper Radio represents a radio system and includes the geographic area of Washington Ridge knoll, Blue Ridge Southside and Little Rock Creek Canyon, where north Cooper Road traverses. The side streets that are included off Cooper Road are Lightning Tree, High Rise, Barn Hollow, Royal Plum, Burning Bush, Blue

Ridge, and Calcite Court. This area comprises approximately 66 parcels, of which 22 are undeveloped. The approximate population is 75.

There are two ways to get to this greater neighborhood: (1) drive East on Highway 20, exit at Conservation Road, turn left at Madrone Springs-Cooper Road, and then turn left on Cooper Road; or (2) take North Bloomfield Road off Highway 49, exit left on Cooper Road, take Cooper Road past Blue Tent School Road, and go through a narrow, unpaved section. When the road becomes paved again, that is the start of the North Cooper neighborhood. The neighborhood ends at Madrone Springs Road.

This community gets younger all the time as newer residents often tend to be younger. The neighborhood still has some retired people considered to be seniors. Many are capable people and some need assistance. There are a few financially disadvantaged in the tight knit community – “people with disadvantages are covered by close by neighbors.”

North Cooper Radio has had fires that have been arrested quickly. The community averages one to two wildfires per decade. In the past, fires have been arrested by CAL FIRE, Nevada County Consolidated, the Washington Ridge Conservation Camp, and the neighbors responding quickly with water and equipment.

Evacuation Situation

The primary evacuation road for this community is Cooper Road, to Madrone Springs-Cooper, to Conservation Road out to Highway 20. From this canyon the passage is in excellent condition except for Madrone Springs-Cooper, a Forest Service Road which is dirt with little gravel and often in questionable condition. See Figure 44. Once at Highway 20, it is desirable to head east to Highway 80.

Figure 44: Madrone Springs-Cooper Road

A secondary evacuation route is south on Cooper Road through a narrow, vegetation dense passage to either Harmony Ridge Road to Highway 20 or to North Bloomfield out to Highway 49. This is a less desirable route for the North Cooper Radio Community since the population of those areas will be using those exits and it could be a traffic concern.

Lightning Tree Road does have a gateway to the back gate of the Washington Ridge Conservation Camp. This is a quick way to get to Conservation Road. This is the only way to get the horses out quickly. See Figure 45.

Figure 45: Lightning Tree Road

There is also High Rise Drive, off of Lightning Tree Road, that goes downhill to Arbogast Ranch. Since the fire behavior is most likely to be in the reverse direction, this exit is not likely to be used. This route is more likely to be used by residents of High Rise Drive, Legacy Lane, and Arbogast Ranch Road.

Primary Challenges

People on North Cooper can get out quickly to Highway 20. The only other traffic that would be in play would come up from Madrone Springs. However, evacuees from South Cooper and even North Bloomfield may also choose to come this way. It is important for the North Cooper Radio Community to get out early to create the open path for those coming in from the south.

Paving Madrone Springs-Cooper would be of great value to an evacuation, not only for North Cooper but for South Cooper and part of North Bloomfield. For those coming into the Cooper canyon to evacuate, improvement to the narrow passage that divides North and South Cooper would be expedient. See Figure 46.

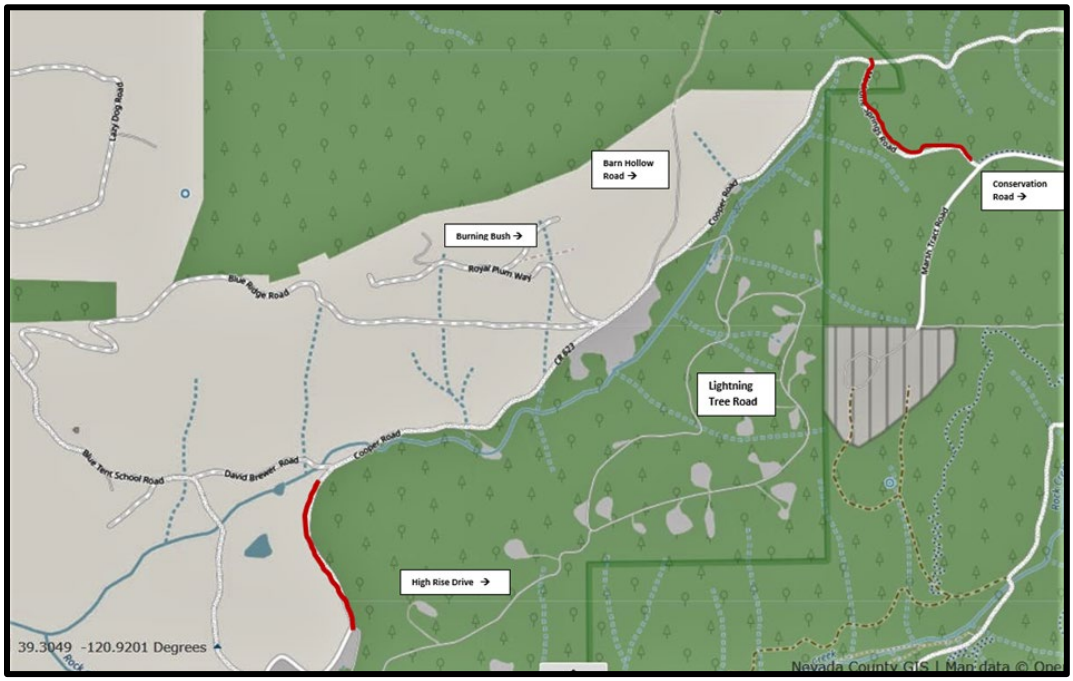


Figure 46: Evacuation Priorities, Lightning Tree Firewise Community

The passage that divides North and South Cooper is narrow and unlike the road segments on either side it is unpaved. For the most part it is one lane. There are some

turnouts, but they would require improvements to be functional. Passage from cars from both directions takes negotiation – for instance, the Waste Management truck requires everyone to back up for dual passage to be possible. See Figure 47.

Figure 47: North/South Cooper Passage, Lightning Tree Firewise Community

Impacts and Opportunities

Relatively simple improvements to the road infrastructure along the Cooper-Madrone Springs to Conservation Camp Road segment and in the passage that divides North and South Cooper represent a significant opportunity to improve evacuation outcomes for the North Cooper Radio Community and surrounding neighborhoods.

Not only would this facilitate evacuations inside and outside this community, paving or improving the road sections cited would have the added benefit of reducing wear and tear on resident vehicles. As those sections are now, they have the potential to damage vehicles over time.

COMMUNITY: Scott's Flat Pines

Community Summary

Scott's Flat Pines Road Neighborhood Firewise Community is located adjacent to the Scott's Flat Reservoir campground off Casci Road, approximately five miles east of Nevada City. See Figure 48.

Figure 48: Scott's Flat Reservoir

Scott's Flat Pines is a fairly rural, densely wooded neighborhood, made up of approximately 18, 10-acre parcels. Fourteen of the 18 parcels have residences on them. The remaining four parcels are either land only or have some sort of structure. It is estimated that there are 40 residents in the neighborhood, the majority of whom are over 65 years of age. There is one point of ingress/egress from this neighborhood which is Scott's Flat Pines Road. See Figure 49.

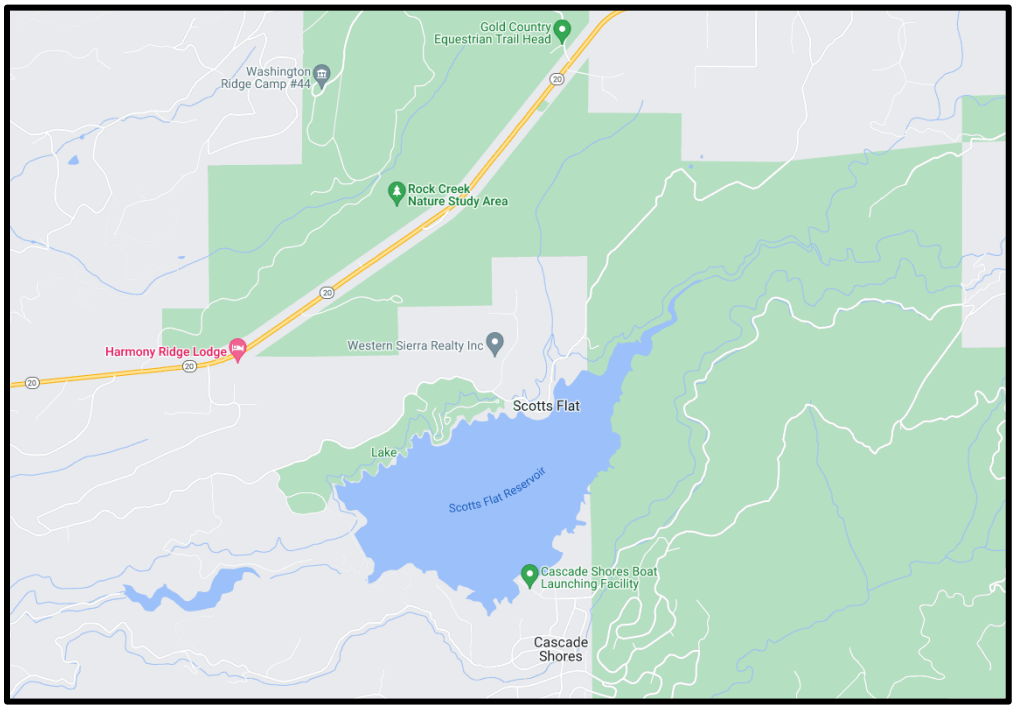


Figure 49: Scott's Flat Pines Firewise Community

Evacuation Situation

The only ingress/egress for this community is Scott's Flat Pines Road to Casci to Scott's Flat Road to Hwy 20. Due to the proximity to the campground on Scott's Flat Lake and the adjacent mountain bike trail system an evacuation situation during the summer would likely necessitate the evacuation of 100+ people beyond the 40 residents including campers and bikers – potentially towing trailers with boats, bikes, and/or recreational vehicles. In this context work is needed to improve evacuation outcomes including road widening, off pavement parking and vegetation clearance.

Primary Challenges

The primary challenges for this community are associated with Scott's Flat Road. Scott's Flat Road is a county road shared with the Scott's Flat Reservoir campground. It is widely used as a parking area for bike riders. At any given time, primarily during the summer/fall months which are also fire season, the road is barely passable due to the off-pavement parking and traffic from the campground. Scott's Flat Road is a very narrow road, with a sheer drop-off on the lake side for a good portion of the road. The road does not have the county mandated 10-foot clearance of vegetation on either side of the road. There is not enough clearance on either side of the road to allow for wide vehicles to pass coming and going. Campers, trailers, and boat trailers are impacted by

the narrow road. An alternative to evacuation via Scott's Flat Road would be Casci Road to Hwy 20, but Casci Road is impassable and private. See Figure 50.

Figure 50: Casci Road, Scott's Flat Pines

Impacts and Opportunities

The main opportunity for this community is to improve conditions along Scott's Flat Road as this is the primary ingress/egress route for this community. The benefit would be people could evacuate if there was a fire or other emergency. The issue of evacuation is bigger than just the Scott's Flat Pines neighborhood. It's imperative that the county take responsibility and address all evacuation routes in the county so that people can reasonably and safely evacuate when they need to.

Scott's Flat Pines neighborhood has been involved with being a Firewise community for four years. As a neighborhood the community continues to work on clearing vegetation,

maintaining 100’ defensible space, home hardening, clearing ladder fuel, zone zero clearance, basically everything that an informed, responsible community needs to do to be as Firewise as possible. Addressing the evacuation constraints would leverage and extend the work that this Firewise Community is already doing.

Forecast Zone 4: Truckee / Donner

“I am mainly worried about lack of road access due to overcrowding of tourists and their lack of knowledge while visiting and not practicing safe fire rules.”

“We are in Kingvale where we need to improve street signage and egress signs. Some of our houses are across a bridge crossing the Yuba and our crossing to safety depends on that bridge. I am concerned to find alternative exits and our community needs help working with nearby communities PlaVada and Towle Mountain to ensure we all have alternative exits in the event of wildfire.”

“Top priority: third exit from Tahoe Donner!!!!!!!”

CWPP Survey Results

In the Truckee/Donner Forecast Zone over 230 people completed the Community Wildfire Protection Plan (CWPP) survey. The top wildfire mitigation priorities identified were defensible space assistance, evacuation route improvement, home hardening incentives/rebate programs, and landscape level shaded fuel breaks. Respondents expressed moderate personal risk and identified that the biggest challenge was the cost of home hardening, fuel on neighboring properties, and removing dead trees. Most people in this Forecast Zone had never been evacuated and most people leave as early as possible. The biggest evacuation concerns were getting trapped on the road, losing home or property, and traffic accidents.

Summary of Forecast Zone Concerns

All community concerns articulated by the Truckee/Donner Forecast Zone have been plotted geospatially on a single map. See Figure 51. Descriptions of specific community concerns follow.

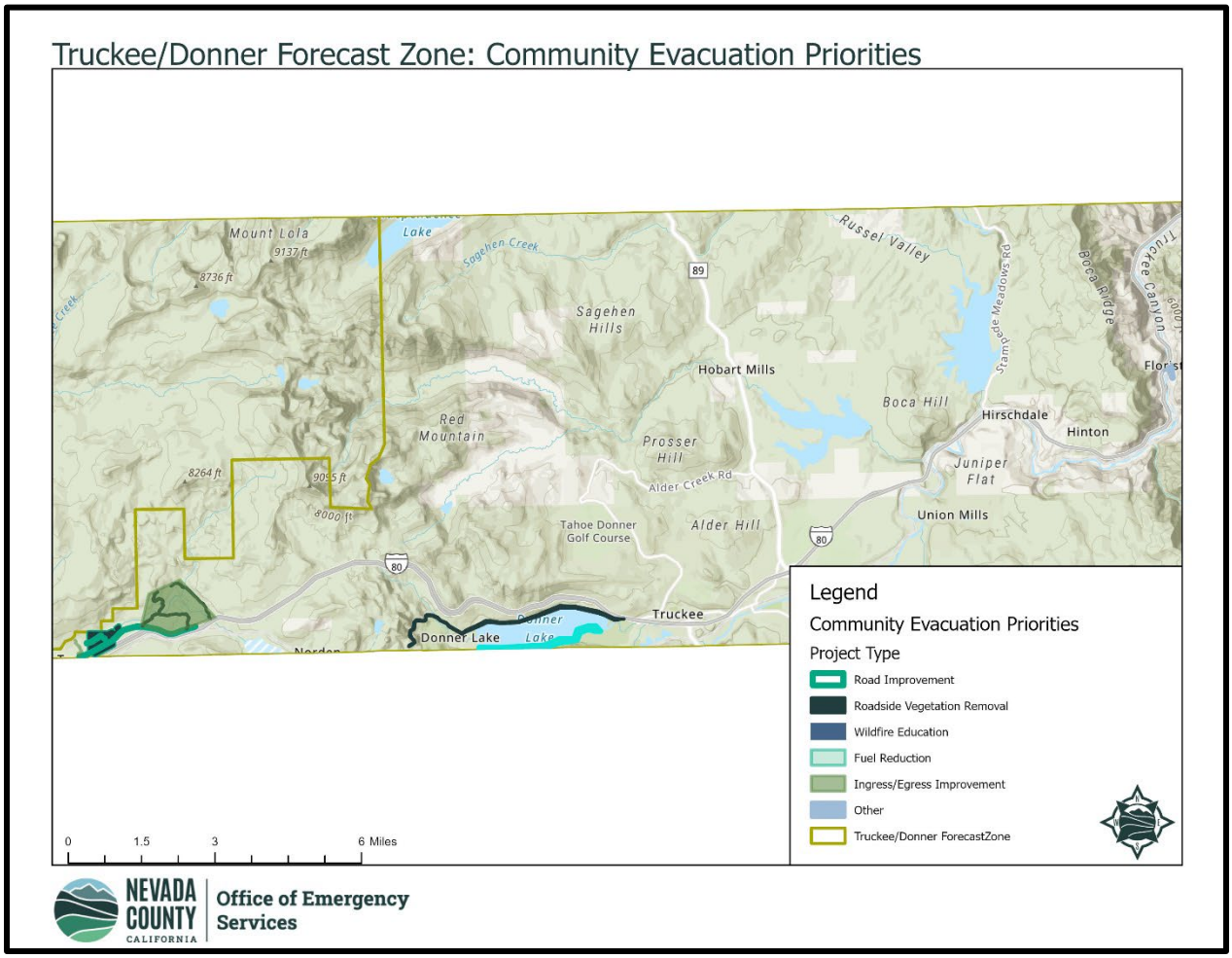


Figure 51: Truckee/Donner Community Evacuation Priorities

Community Concerns

COMMUNITY: Kingvale Property Owners and Water Users, Inc.

Community Summary

Kingvale is located along Donner Pass Road between the Soda Springs and Kingvale exits of Highway 80. It is a historic community with as many of 50% of cabins dating back to the 1930s. Its private roads give access to PG&E staff to reach lines on a major power grid north of Kingvale. See Figure 52. Sierra Pacific Industries (SPI) also uses Kingvale roads to reach their lands.

Figure 52: PG&E Lines, Kingvale Firewise Community

Kingvale Property Owners & Water Users (KPOWU) provides water to the two Kingvale subdivisions, often referred to as “Old Kingvale” between Towle Mountain and PlaVada Woodlands. The Kingvale cabins are on both sides of the North Fork of the South Yuba River with no cabin being further away than one mile from an exit to Donner Pass Road. There are 85 cabins plus around 30 undeveloped lots. Currently there are fewer than 10 full time residents. Most are summer cabins only where many residents spend the summer. Over 50% of cabin owners are over the age of 65. One full time resident has disabilities.

Kingvale roads are privately owned by the water company with public right-of-way access to roads in Kingvale Subdivision 1. Kingvale does not plow the roads in

winter. Regarding wildfire mitigation, this area comprises the Kingvale Firewise Community.

Evacuation Situation

Two key roads exist within Kingvale. Brennan runs through Subdivision 1 and connects to Donner Pass Road at both the west and east ends. Red Fir meets Brennan and heads across two bridges and eventually connects to a PG&E right-of-way and via an informal road to PlaVada Woodlands, exiting at Aspen Drive.

All roads are unpaved. Many roads are named but have never been created or improved. Road signage currently is limited to wood signs on trees, but this will all be corrected with a Measure T grant from Truckee Fire Protection District to upgrade evacuation route signage, street address signs on cabins, and road signs at most major intersections.

At holidays like July 4th when the organization has its annual meeting as many as 175 people could be at Kingvale. During a typical summer weekend 25% of cabins may be occupied (about 50 people present).

Primary Challenges

Challenges related to evacuation include poor signage and inadequate roads. Unpaved roads are not wide enough for cars to pass and traffic must pull into a drive to let another car pass. There is extensive vegetation overhanging the roads. It could be unsafe to exit in a fire given the narrow roads, vegetation, and surrounding forest land. Once a car reaches Donner Pass Road, there are areas where vegetation is problematically close to the paved road.

Road widening is needed but requires the permission of KPOWU who owns the roads. Turnouts could be created, but permission of landowners would need to be secured. Trees could be cleared 10 feet on either side, again with permission from landowners, however, it would be difficult to clear 20 feet in some areas because homes would be impacted.

The bridges in and out of the community could be upgraded from their current 20-ton capacity and widened to make it safe for fire engines to cross. See Figure 53. Currently Truckee Fire Protection District (TFPD) will not cross the bridges leaving the many

cabins north of the river limited to firefighting by hoses from hydrants. The cost of improving the bridges is prohibitive unless KPOWU were to receive funding.

Figure 53: Bridge over South Yuba River, Kingvale Firewise Community

KPOWU has four work parties each year where shareholders work on roads, water lines, green waste removal and other projects in support of the community and these events could potentially be leveraged to support wildfire mitigation activities.

Impacts and Opportunities

As a result of the evacuation constraints in Kingvale, currently some residents would have to choose between staying in place at a cabin versus driving along smokey, dangerous roads in the event of a major fire sweeping through. Even if a fire were on the ground, road evacuation might not be safe. Evacuation route improvements would make it possible for first responders like TFPD to get in and residents to get out safely.

COMMUNITY: PlaVada Woodlands

Community Summary

PlaVada Woodlands is a community located in eastern Nevada County on the west slope of the Sierra Nevada, near Kingvale, at about 6,000 feet of elevation. The PlaVada Woodlands community includes 251 developed parcels and 100 undeveloped parcels, totaling 115 acres. Approximately 15% of the community is full time residents with the remainder being second homes. It is estimated that 50% of the PlaVada and adjacent Kingvale community is over the age of 65.

PlaVada Community Association is a California Mutual Nonprofit Corporation formed primarily for the purposes of providing water and sewer utilities, and road maintenance for the PlaVada Woodlands community. In addition, the Association provides water and sewer services for several non-member neighbors of the community, including the Caltrans Kingvale Maintenance Station located south of the community, which is responsible for keeping I-80 clear for interstate commerce.

Evacuation Situation

The PlaVada Woodlands community has one ingress/egress route – PlaVada Drive, which includes a bridge to cross the Yuba River to Donner Pass Road. With 251 cabins, it is estimated that there may be up to 500 people in residence during the busiest times.

Primary Challenges

The primary challenge related to evacuation is that the community currently has only one evacuation route. If the bridge across the Yuba River (PlaVada Drive) is damaged or blocked during an emergency, there is currently no alternate evacuation route. PlaVada is working with the neighboring community of Kingvale on an agreement to allow PlaVada residents to use the Kingvale roads and bridges as an alternate evacuation route in case of emergency (and vice-versa).

Another challenge is the condition of Donner Pass Road, which is the only path from the Community (accessed either through PlaVada Drive or from the proposed Kingvale secondary evacuation route) to I-80, which provides ingress/egress from the area. See Figure 54. In the area from the Donner Trail Elementary School (West of the Kingvale exit on I-80) to the Soda Springs exit on I-80, Donner Pass Road should be improved for

safety, including removal of vegetation and potentially road widening. To provide safe evacuation in the winter, because of the heavy snow received in the Donner Summit area, wider roads are required so that the roads are sufficiently wide when there are high snow berms to allow all traffic to pass. Additionally, the County relies on Caltrans to plow Donner Pass Road, but there have been many instances in recent years where it was not plowed in a timely manner, resulting in residents being unable to exit the PlaVada community for several days.

The County should work with Caltrans to ensure Donner Pass Road remains accessible throughout the winter. Finally, signage (i.e. signs at community exits along Donner Pass Road) that directs traffic to the nearest I-80 entrance would assist visitors in the area to navigate in case of evacuation.

Within the proposed Kingvale secondary evacuation route, which is along private roads, road widening and turnouts, which would require vegetation clearance and grading, would improve the route so that residents and visitors, especially those without 4WD can easily pass in case of emergency.

Figure 54: Donner Pass Road

Impacts and Opportunities

The Kingvale and PlaVada communities have recently been awarded a grant from the Truckee Fire Protection District's Measure T Community Wildfire Prevention Grant Program, which will be used to fund evacuation route signage within the respective communities. Additionally, PlaVada Community Association owns ~5 acres of land along Donner Pass Road for which grant funding for forest fuels reduction work is actively being pursued.

Members of the Kingvale community have advised that they routinely perform their own maintenance work on their roads, and it is possible that some community members of one or both communities could assist with vegetation clearance and road work along the proposed secondary evacuation route.

Work improving the safety along Donner Pass Road benefits multiple communities including PlaVada, Kingvale, and Towle Mountain, along with Donner Trail Elementary School, the Kingvale Caltrans Station, which has 82 dorms for employees, and the Truckee Fire Protection District Station 97. Improving the Kingvale evacuation route would benefit all PlaVada community members by providing them with a safe secondary evacuation route.

The Kingvale Caltrans station is responsible for keeping I-80 open from the Nevada border through Donner Summit. According to a 2017 CA DOT publication, "Busy I-80 [is] also an important freight route, carrying some $4.7 million of goods and commerce every hour." (https://dot.ca.gov/-/media/dot-media/programs/risk-strategic-management/documents/mile-marker/mm-2017-q1-winter-operations-a11y.pdf) Improvements along Donner Pass Road directly improve the ability for the Kingvale Station to maintain I-80.

Improvement to evacuation routes from PlaVada will, more importantly, provide non-economic benefits in increased public safety for all residents.

COMMUNITY: Towle Mountain

Community Summary

Towle Mountain Association (TMA), 1,651 acres, is located north of Highway 80 between the Kingvale and Soda Springs exits. The southern boundary follows Old

Highway 40 from near the Soda Springs/Highway 80 turnoff to approximately 1.7 miles west. The remaining boundaries are adjacent to Sierra Pacific Industries and/or United States Forest Service timberlands. Three gated roads off Old Highway 40 access the parcels within the subdivision. In sum, Towle Mountain has 50 lots; of these, 24 have structures. There are 2-3 full time residents. See Figure 55.

Infrastructure of significance in the vicinity includes the Caltrans yard and Donner Trail Elementary School to the west in Kingvale. The Tahoe PUD Sewage Treatment Plant, TFPD Fire Station, and Soda Springs are to the east on Donner Pass Road.

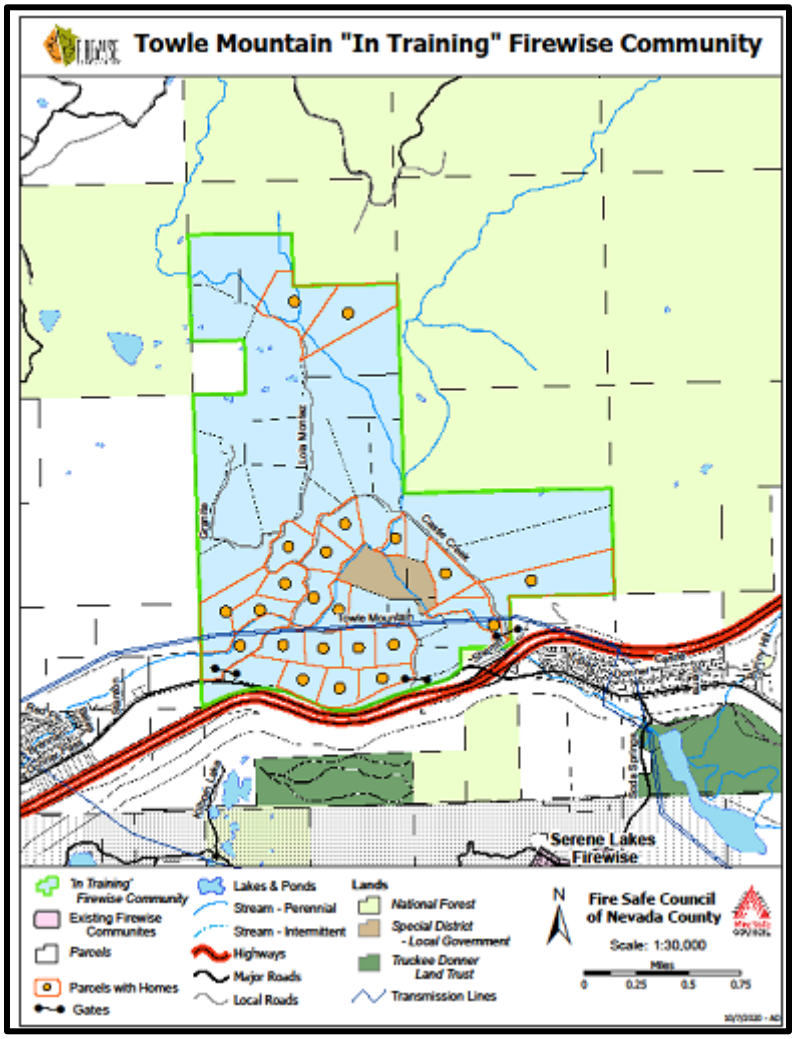


Figure 55: Towle Mountain Firewise Community

Evacuation Situation

Two key roads exist within Towle Mountain. All roads are single lane native surface with varying degrees of improvement including surface rock and improved drainage to divert water runoff during rain or snowmelt events. Two main watercourse crossings of Castle Creek (rock ford) and South Fork Yuba River (one lane bridge) exist within the subdivision. Donner Pass Road with the Kingvale exit to the west and Soda Springs to the east (including continuation of Donner Pass Road into Soda Springs and access to Donner Lake) provide the public road evacuation routes.

Primary Challenges

Many of the challenges related to evacuation are associated with the condition of the roads used by Towle Mountain. Two miles of single lane HOA roads exist for lots in the northern section of the property. The Towle Mountain Firewise Community continues to improve HOA evacuation routes. In 2022 Towle Mountain was able to clear back over five feet along about four miles of road. See Figure 56. The community plans to continue road improvements in the future.

Figure 56: Roadside Vegetation, Towle Mountain Firewise Community

Additional challenges are related to use. Guest users are likely to use several properties during the summer – fire season.

Donner Pass Road between the Kingvale and Soda Springs I-80 exits has some areas of dense vegetation along sections presenting an evacuation route risk for our community. See Figure 57.

Figure 57: Donner Pass Road Between Kingvale and Soda Springs

Impacts and Opportunities

The benefit of implementing wildfire mitigation actions is increased safety during an evacuation event for HOA owners and their guests. In addition, safety for firefighters and emergency service personnel is improved. Improved HOA evacuation routes can

impact overall property values. It also can contribute to reducing wildfire intensity impacting the South Yuba Watershed and local forest health.

A goal for the Towle Mountain community is to develop a one-page handout of evacuation information that can be laminated for each property to post, targeted for guests or infrequent users. Other actions with positive impact for residents include clearing of additional vegetation along key HOA roads (to achieve 10+ fee of clearance) along approximately three to four miles and the improvement of existing turnouts (i.e. add two to three additional turnouts on key evacuation routes). Finally, adding key signage to aid evacuation from the HOA to Donner Pass Road especially for guest users would have a major positive impact.

COMMUNITY: West End and South Side, Donner Lake

Community Summary

The West End of Donner Lake consists of over 500 parcels including around 50 parcels in Wolfe Estates. The South side of Donner Lake consists of another 300 parcels for a combined total of over 800 parcels and 500 homes. The relevant communities include West End Donner Lake Firewise Community, Donner Lake Woods HOA, Creekside Woods HOA, and Wolfe Estates POA. It is estimated that 50 to 100 residences (approximately 100 to 200 occupants) consist of full-time retired homeowners over 65.

Evacuation Situation

The primary evacuation route for West End and South Side Donner Lake is South Shore Drive onto Donner Pass Road. South Shore Drive has an overgrown pine forest along the evacuation route next to the Truckee Park District; West End Park, and the Donner Lake West End Park (DLPOA). The West End Donner Lake Firewise Community has a Micro-Grant and is trying to use the grant to provide forest fuel reduction with DLPOA.

The primary evacuation route has been blocked by events on the West End during 4th of July and summer events, and by downed trees in the winter. The alternate secondary evacuation route through the State Park, (Fire Road), is a single lane of paved road 8 feet wide with two gates. The Town of Truckee Police Department has stated that this route only be used at their direction. Using the Evacuation Route Pre-Planning tool available on the Ready Nevada County website the community evaluated the evacuation of the West end. Based on “usual” summer occupancy of one car per home, the time to reach Donner Pass Road from adjacent blocks was 19 minutes. When the primary

evacuation route was blocked using the tool, the model directed the evacuation to be through the State Park.

Primary Challenges

A primary concern around evacuation centers around when the occupancy exceeds normal occupancy such as on holidays. There could be as many as two cars per residence or 1,000 vehicles plus the additional holiday crowd bussed into the West End Park. These conditions have major implications for evacuation safety. As such, community priorities include (1) vegetation clearance on Donner Pass Road, (2) widening of the Fire Road through the State Park, and (3) signage to direct renters etc. to major arteries and out of the vicinity. See Figure 58.

Figure 58: Dense Roadside Vegetation, Donner Lake

Impacts and Opportunities

85 people perished in the Paradise Fire. Greenville was destroyed in 30 minutes. A wildfire would overwhelm the single evacuation route at Donner Pass Road. A secondary evacuation route through the State Park would save lives with lasting beneficial impacts to community members and visitors alike.

COMMUNITY: Floriston

Community Summary

Floriston is located on the Truckee River 10 miles east-northeast of Truckee off Highway 80 between Truckee and Reno. The Floriston Property Owners Association provides water, sewer, and road services to the 43 parcels which are home to approximately 70 people. See Figure 59.

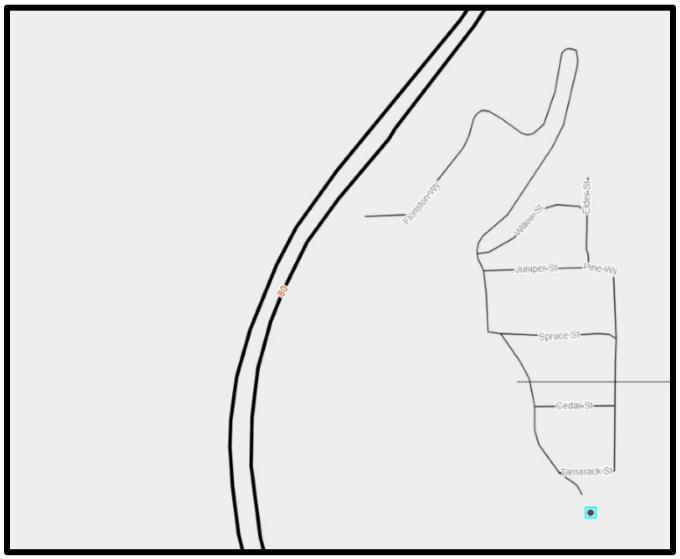


Figure 59: Floriston Firewise Community

Evacuation Situation

Floriston is challenged by infrastructural and topographic constraints. Residents entering and leaving the community must pass through “Mouse Hole,” a large one-way culvert that provides passage under the train tracks. The community itself is comprised of residences built on a steep slope and accessed by narrow and steep roads.

Primary Challenges

Topography, narrow roads, and an access “pinch point” present major evacuation challenges for Floriston. Vegetation on the steep slope behind the community is also a concern for wildfire. See Figure 60.

Figure 60: Vegetation Behind Floriston Firewise Community

Impacts and Opportunities

Several residents of Floriston are committed to pursuing opportunities to address the heavy fuel loading on the slope behind the community to create a zone of wildfire protection. Given the challenges associated with the road infrastructure, the creation of a shaded fuel break, reducing roadside vegetation, and increasing defensible space around homes, including in “zone zero” all represent viable options that will have a positive impact for residents.

Appendix B
Evacuation Study Documents

Section 1
Ladris Software Assessment

Ladris Software Assessment

Considering the destructive and deadly wildfires experienced around the globe already in this 21st century, community planning for wildfire evacuations is a vital component of emergency planning. Traditional planning methods, based largely on the experiences of first responders, do not provide the spatiotemporal insights required to effectively prepare entire communities to flee an approaching wildfire. Nationally adopted standards for wildfire evacuation assessment are not yet available. But emerging technologies and methods for modeling human behavior and traffic operations during a wildfire are improving our ability to anticipate wildland fire behavior and the population's vulnerability to the threat. Using these tools, several potential wildfire and evacuation scenarios can be modeled to identify and prioritize fuel-reduction projects and roadway improvements needed to reduce the community's wildfire risk.

Calculating evacuee travel time continues to be one of the most costly and challenging aspects of emergency planning, especially in the rural and semi-rural communities served by hundreds of miles of roads. Ladris Technologies' dynamic traffic-modeling solution offers a cost-effective alternative to conventional traffic-engineering studies. Until WUI evacuation simulation platforms currently being developed[63] are fully vetted and validated, evacuation planning tools like Ladris are essential in guiding our community evacuation planning efforts.

It is important to understand that human behavior during a wildfire evacuation, coupled with the dynamic nature of wildfire, presents an immense number of variables and complexities that are the subject of ongoing academic studies. None of the available methods used to analyze WUI fire evacuations can predict, with absolute accuracy, the fire conditions or evacuee travel times that will be experienced during a wildfire event. For this reason, evacuation evaluation methods and tools are used to inform planners through a macro-level analysis, from which they can develop strategies to mitigate fire risk, improve evacuation travel routes, and educate the public. It is with this perspective that PyroAnalysis assessed the validity of the Ladris platform for modeling evacuation travel times by comparing Ladris's results to travel time estimates derived from traditional traffic engineering practices.

Estimating evacuee travel times is typically done using common traffic engineering methods. One approach is by assessing roadway capacity and the level of service (LOS) of road segments by referring to road department data. These data are then used to estimate the evacuation time by dividing the total number of vehicles evacuating an area by the roadway capacity. This is the method used in the Lake Wildwood *Firewise Action Plan*.[64] Another method is by collecting floating car data by driving the evacuation road segments being studied and recording the travel time along each segment using a stopwatch. These data are then used to estimate the total time for all vehicles to evacuate the subject area.[65] Yet another method is the use of complex traffic operation modeling platforms employed by traffic engineering firms.[66]

Ladris Technologies Modeling Assessment

To assess the reliability of the Ladris modeling in evacuation planning, a comparison study was performed using the Cedars Ridge subdivision on Highway 174 in Grass Valley. The gated community was selected because the layout of the development, with a single egress point, allowed for consistent evacuation variables that were easily evaluated. Traffic Patterns, a traffic engineering firm, used a

[63] Ronchi et al. (2021) p.2
[64] Whitlock, p. 35
[65] Rodriguez
[66] Fehr & Peers

floating car study to estimate that the total travel time for an evacuee to exit the subdivision was 28 minutes.[67] Ladris's modeling estimated 23 minutes to exit the subdivision.[68]

The travel times for the evacuation of Lake Wildwood were estimated in the *Firewise Action Plan*[69] at 3 hours 30 minutes to 4 hours 42 minutes; Ladris estimated 4 hours 21 minutes.[70] In these comparisons, the travel time estimates provided by Ladris are reasonably aligned with those produced by the floating car study conducted at the Cedars Ridge subdivision and the estimates provided in the Lake Wildwood *Firewise Action Plan*.

Other agencies have conducted similar validation exercises with similar outcomes. Portola Valley in San Mateo County, California, commissioned an evacuation study using a highly regarded traffic engineering firm to evaluate evacuation routes and recommend roadway improvements. After completing this study, the Woodside Fire Protection District proposed using Ladris software for evacuation planning in the communities they protect, including Portola Valley. Before contracting with Ladris, they conducted an extensive evaluation of the platform. The evaluation was performed by the fire marshal and a community volunteer who is a licensed engineer. When interviewed for this report, they provided the following summary of their findings:

- Ladris software is able to analyze the entire road network.
- The software has an intuitive user interface.
- It can be used to model the evacuation impacts from adjoining communities.
- Town planners and public safety officials can use the software to evaluate new developments.
- Public safety departments can use the platform for tabletop evacuation exercises.
- In the evaluators' opinion, the Ladris software evacuation travel time estimates were conservative.

Conclusion

The logistics of how Ladris software models travel times is proprietary information. What is known is that a team of highly skilled software developers collaborated to design robust traffic modeling software that can quickly generate evacuation travel time estimates that are consistent with those provided by traffic engineers. The development team was advised by industry experts in wildfire science, evacuation research, climate risk, and emergency management.

It is understood that Ladris uses free-flow roadway network speed values derived from crowd-sourced data to reflect the actual speeds that vehicles drive on the segments of road modeled. The models allow for these speed values to be modified to refine the results. Ladris' software can use live and historic data sets to allow an analyst to run scenarios for peak traffic hours and weekday, weekend, and holiday traffic fluctuations; these data are generated by a third-party vendor and were not used in Nevada County evacuation simulation modeling.

Keeping in mind that no currently available evacuation modeling software can accurately predict the influences of a wildfire or human behavior on evacuation clearance times, PyroAnalysis' team of experts thoroughly assessed the Ladris evacuation travel time modeling results. They found that, unlike extremely expensive and time-intensive traffic engineering studies, Ladris is a cost-effective tool for first responders and community planners to quickly run customizable evacuation traffic modeling scenarios to identify areas within their communities with constrained and congested evacuation routes, to evaluate

[67] Rodriguez
[68] Ladris Technologies, Inc.1/2/24
[69] Whitlock p. 36
[70] Ladris Technologies, Inc. 1/26/2024

a planned road expansion or the addition of a subdivision, model regional evacuations, or to conduct tabletop exercises with real-time traffic analysis.

November 1, 2023

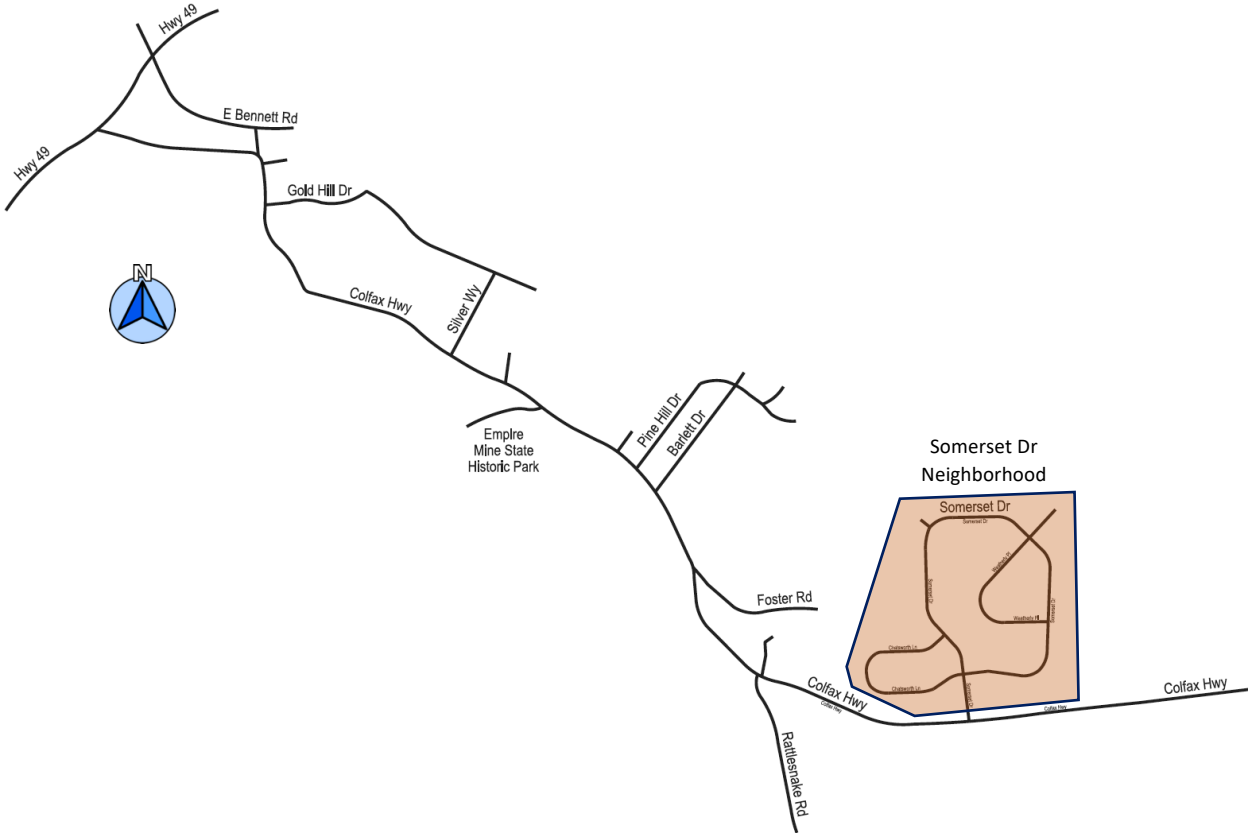
Shane Lauderdale
Pyro Analysis

Subject: Somerset Drive Neighborhood Evacuation Study
Grass Valley, Nevada County, CA

Introduction

Traffic Patterns prepared this traffic operations analysis to estimate the neighborhood evacuation time of the Somerset Drive neighborhood in Grass Valley, CA. This report uses a "Manual Method" analysis estimate travel times of the Somerset Drive neighborhood that focuses to provide a validation of travel time estimates conducted as part of a Computer Model analysis prepared by a separate consultant team for Nevada County. This analysis also includes a travel time impact of a neighborhood evacuation compared to travel times out of the neighborhood during normal traffic conditions.

Figure 1
Somerset Drive Neighborhood – Grass Valley, CA



The Somerset Dr neighborhood, shown in Figure 1, is located approximately 2.4 miles east of the Hwy 49 in Grass Valley, CA. Somerset Dr serves approximately 86 households that rely on the Somerset Dr & Colfax Hwy intersection for neighborhood access.

The Somerset Dr & Colfax Hwy intersection operates as a STOP control for the Somerset Dr approach while Colfax Hwy is controlled. All intersections within the Somerset Dr neighborhood are uncontrolled intersections.

Analysis:

Table 1
Normal vs Evacuation Travel Times in the Somerset Drive Neighborhood

Route No.	Route Description	Estimated No. of Households	Estimated No. of Vehicles	Normal Egress Travel Time (Min:Sec)	Estimated Travel Time in Emergency (Min:Sec)
1	**Somerset Drive** Single Road Serving Neighborhood	86	215	2:10	28:00 Delta: 25 Min. 50 Sec.

Figure 2
Somerset Drive Neighborhood – Normal Egress Travel Times and Routes

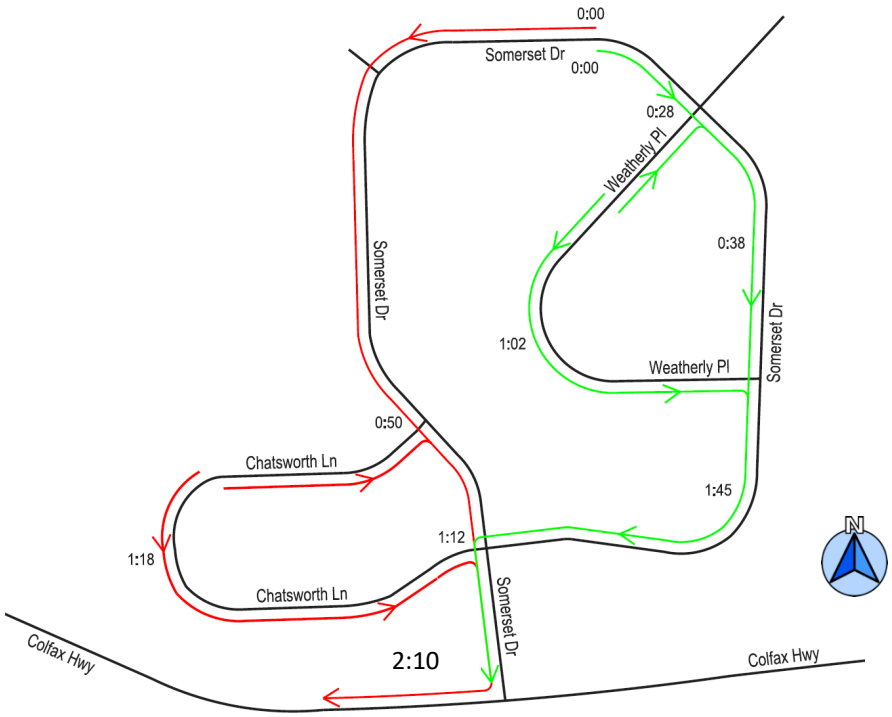


Table 1 shows the estimated evacuation time of the Somerset Dr neighborhood in the event of a fire or major evacuation event where all residents left their households at the same time. Figure 2 shows assumed travel routes of the neighborhood along with the normal egress travel time conditions exiting the neighborhood from the northmost point of the neighborhood. During normal conditions exiting the neighborhood from the north can take up to 2 minutes – 10 seconds. During a major evacuation event it is estimated that same travel path can take up to 28 minutes. The delta in evacuation time leaving the neighborhood is over 25 minutes – 50 seconds.

Methodology

The existing condition travel times exiting the neighborhood were conducted using a Floating Car study method where a vehicle drives through the neighborhood and records the travel time using a stopwatch noting the time duration along segments of the route. Figure 2 shows the Floating Car study travel times within the Somerset Dr neighborhood.

To estimate the emergency evacuation route travel time to exit the neighborhood a manual calculation method was used with the following key assumptions:

- 2.5 Vehicles Per Household
  It is assumed that each household would exit with an average of 2.5 vehicles per household. Some residents may exit with 3 or 4 vehicles and some with 1 or 2 so an average of 2.5 vehicles was assumed for this study.
- 6 Seconds Per Vehicle to Travel through Somerset Dr & Colfax Hwy Intersection
  All vehicle exiting the neighborhood must travel through the Somerset Dr & Colfax Hwy intersection. Somerset Dr operates with a STOP control while Colfax Hwy is uncontrolled through the intersection. Assuming other residents from adjacent neighborhoods are also exiting the area in a disaster event it was assumed that one vehicle every six seconds from Somerset Dr can move through the intersection (10 vehicles per minute). While the Somerset Dr intersection can accommodate up to 2 vehicles at a time (one turning right and one turning left), the six seconds per vehicle with one vehicle at a time metering rate was used as a conservative methodology.

Residents in the Somerset Dr neighborhood must exit using Somerset Dr at Colfax Highway. Somerset Drive operates as a loop road so residents on any of the neighborhood streets must proceed south towards Colfax Hwy making the intersection operate as a “metering” point. The flow rate of the metering is impacted by the existing STOP on Somerset Dr at the intersection and the volume of vehicles on Colfax Hwy. This analysis does not attempt to calculate the overall volumes of vehicles on Colfax Hwy during an evacuation incident so the 6 seconds per vehicle metering rate to exit the neighborhood is used as the primary calculation method to calculate the travel time to exit the neighborhood and is calculated at 22 minutes. A Friction Factor of 1.3 is added on top of the 22-minute estimate to account for unforeseen issues such as movements through intersections within the neighborhood or delays on Colfax Hwy from the evacuation of other neighborhoods in the area. The Friction Factor increases the Somerset Dr evacuation time to 28 minutes, see Exhibit A from calculations. The 28-minute evacuation travel time represents a 25-minute – 50 second increase in travel time compared to non-emergency, normal operations in the neighborhood.

The queue of vehicle extending into the Somerset Dr neighborhood as motorists attempt to exit can be upwards of one mile into the neighborhood which would impact operates at the Somerset Dr &

Chatsworth Dr intersections and the Somerset Dr & Weatherly Place intersections turning those intersections into the equivalent of All Way STOP controls.

Colfax Highway Operations

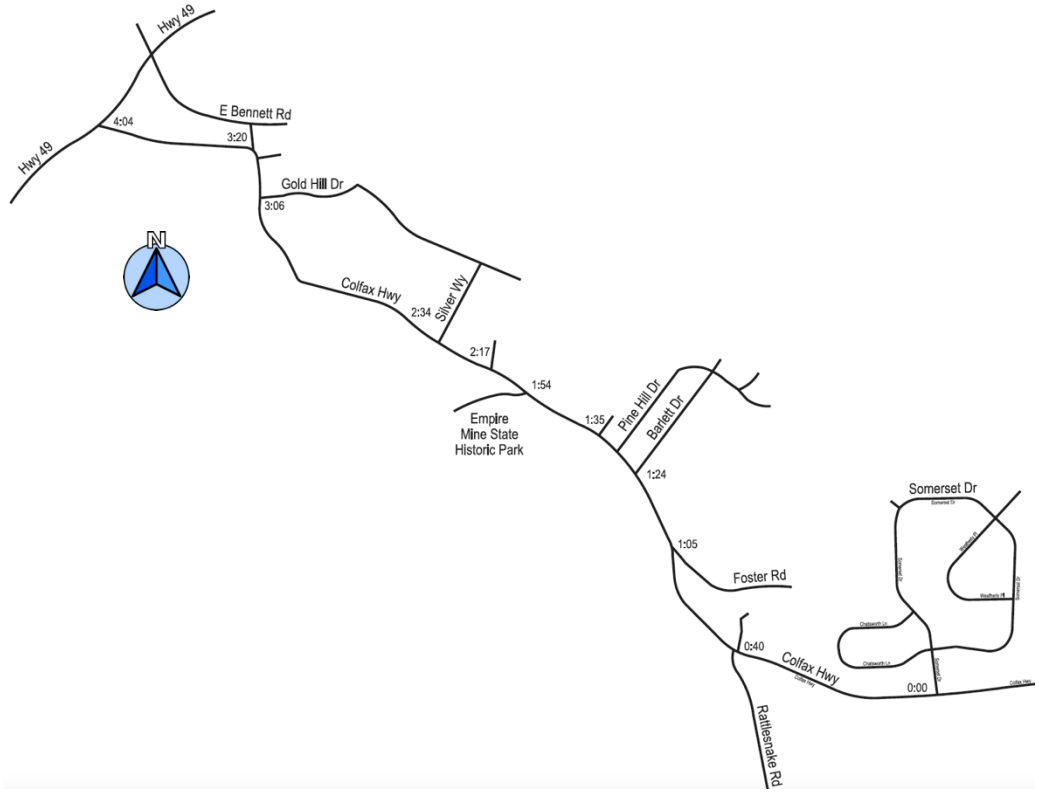
This analysis does not attempt to estimate queue impacts along Colfax Hwy in the event of an evacuation incident but Traffic Patterns does make the following additional notes.

- 2-Lane Road Operations
  The majority of Colfax Hwy operates as a 2-lane roadway. Traffic Patterns used Google Satellite imagery to estimate that each lane is 11-FT wide making it impossible to accommodate additional roadway capacity for additional travel lanes. Managing Colfax Hwy operations with training to residents on traffic operations in the event of an evacuation incident.

- Travel Time on Colfax Hwy
  As part of this analysis a floating car study of Colfax Hwy was also conducted to document current operations for the reader. Figure 3 shows the travel time along westbound Colfax Hwy from the Somerset Dr neighborhood towards Grass Valley, CA at 4 minutes – 4 seconds.

  The exact travel time for the section of Colfax Hwy from Somerset Dr to Hwy 49 cannot be accurately estimated without calculating the total traffic on Colfax Hwy resulting from an evacuation event.

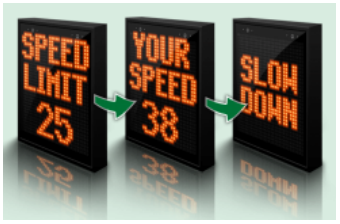
Figure 3
Colfax Hwy – Normal Travel Time Operations

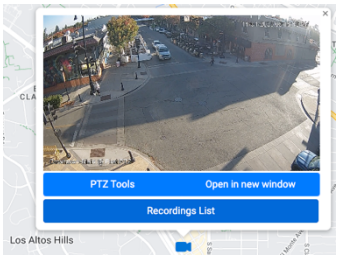


Recommendations:

Managing traffic during an evacuation incident is key to ensuring residents can evacuate safely and that emergency operations staff can travel through the roadway network to aid in evacuation and response. Traffic Patterns recommends the use of training and outreach to advise residents on recommended travel routes in the event of an incident. In addition, Traffic Patterns also recommends the use of Intelligent Transportation Systems (ITS) elements to both guide and monitor traffic operations, including:

1) Communication Message Boards (CMS)
CMS signs can serve multiple applications including aiding in the dissemination of information during an incident. Small scale CMS signs along Colfax Hwy can be used to manage traffic through Vehicle Speed Feedback messaging but the signs are full matrix allowing them to provide information during incident traffic such as "KEEP RIGHT - FIRE TRUCK ACCESS". Signs in the image shown are from Fortel Traffic.





2) Pan Tilt Zoom (PTZ) Traffic Cameras
The use of traffic cameras to monitor roadway operations are key during incident traffic to aid in guiding emergency vehicles to incidents. PTZ cameras in the image shown are from Smart City Signals.

3) Cellular or Satellite Communications
Both equipment options discussed above operate on AC or DC Battery power making remote installations feasible for quick, low-cost deployment. Each operation can also operate on cellular or satellite communications, with satellite likely being the preferred operation along remote highways and to limit impacts from failing cellular repeaters impacted during incidents.

If you have any questions, please feel free to contact me at (408) 916-8141.

Jaime O. Rodriguez, T.E.
Principal

EXHIBIT A

Somerset Dr Evacuation Calculations

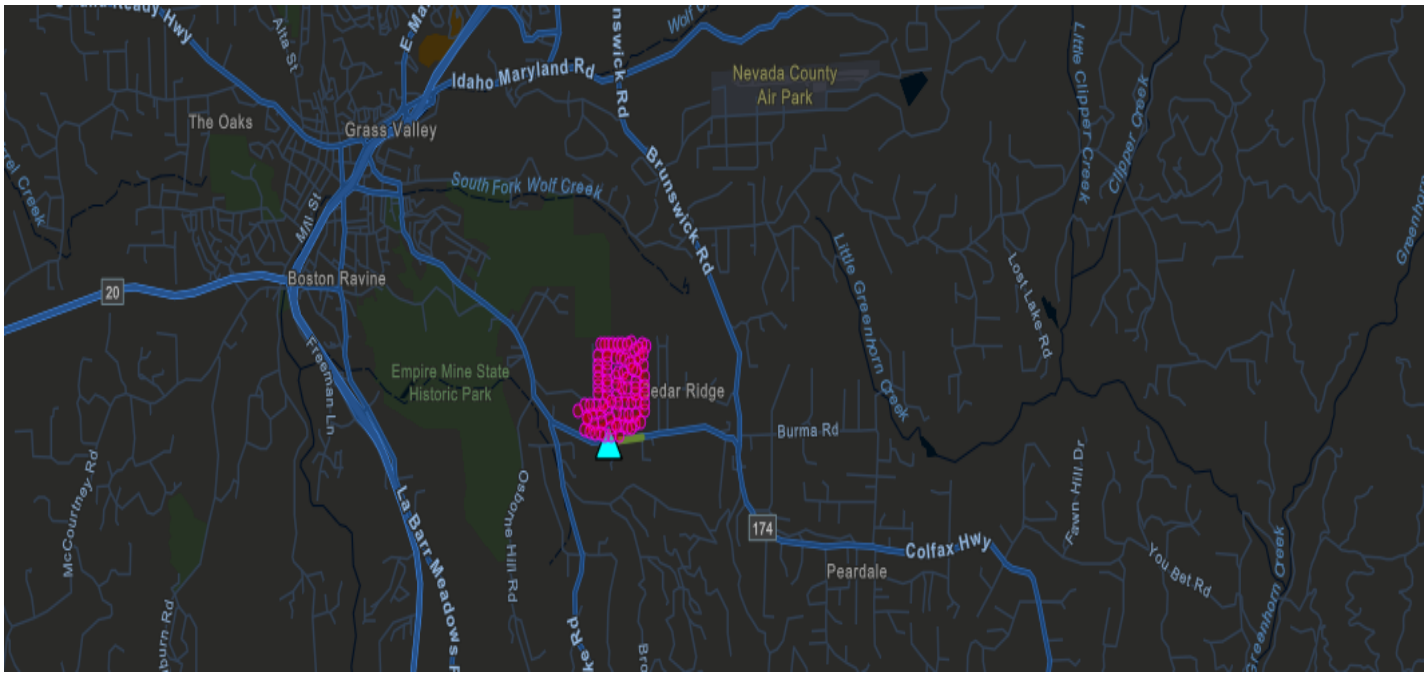
Somerset Dr Evacuation			
Intersecting Street	No. Households	No. Vehicles Exiting	Queue Length (ft)
Somerset Dr (13036 to Chatsworth Ln S) W	41	103	2,460
Somerset Dr (13036 to Chatsworth Ln S) E	42	105	2,520
Somerset Dr - Chatsworth Ln to Colfax Hwy	3	8	180
	86	215	5,160

Somerset Dr Evacuation Time:		
No. of Vehicles Approaching Somerset & Colfax:	215	
Metering Rate at Somerset STOP:	10	Vehicles per Minute
Time Travel through Somerset & Colfax Intersection:	22	Minutes
Friction Factor:	1.3	
Total Time Estimate to Evacuate Neighborhood:	28	Minutes

Evacuation Simulation | Nevada County Office of Emergency Services

2024-01-02 04:54:01.974574

Operator: Support Ladris



Map powered by Esri.

Title: Untitled Simulation

Projections

Metric	Projection
Median	0H 10M
Mean	0H 11M
Standard Deviation	0H 6M
Maximum	0H 23M
Minimum	0H 0M
Addresses Evacuated	92 addresses
Passenger Cars Evacuated	172 passenger cars
Heavy Vehicles Evacuated	57 heavy vehicles
Simulation Type	Polygon

Notice: This report is generated by a modeling algorithm that identifies patterns in disaster response. It is dependent upon the assumptions used by the operator in generating the report and the accuracy of third-party data. It is unlikely to fully reflect all of the complexity inherent in chaotic environments. Any assessment of future outcomes carries inherent risk, and Ladris does not assume responsibility for decisions made as a result of projections. End users should possess expertise in understanding the real-world implications of forecasts, and should always exercise sound judgement and expert discretion when interpreting results.

Evacuation Simulation | Nevada County Office of Emergency Services

2024-01-02 04:54:01.974574

Operator: Support Ladris

Assumptions

The following assumptions were configured by the operator prior to running the simulation:

Variable	Assumption
Regional Occupancy Percentage	100%
Departure Timeframe	1 minutes
Passenger Cars per Address	2.5 per address
Heavy Vehicle Percentage	25%
Freeway Free-Flow Speeds	65 miles per hour
Highway Free-Flow Speeds	50 miles per hour
Arterial Free-Flow Speeds	40 miles per hour
Residential Free-Flow Speeds	28 miles per hour
Service Free-Flow Speeds	15 miles per hour
Road Dataset	PyroAnalysis Validation (A7438AA6A790062ECE528FD5E6A20CB5)
Intersections Dataset	Default (F5F0405E85094D41B102C6408CFFCF5D)
Addresses Dataset	Default (52D6E9B7FAD8F51BFEF5DCC6D8D62CFC)
Zones Dataset	Name Unavailable
Waypoints Dataset	Name Unavailable
Live Traffic Timestamp	N/A

Evacuation Scenarios

Update 1/25/2024

Evacuation Simulations & Data Analysis

Ladris Technologies, Inc.

CAUTION: This report pertains to a modeling algorithm that identifies patterns in disaster response. It is dependent upon the assumptions used by the operator in generating the report and the accuracy of third-party data. It is unlikely to fully reflect all of the complexity inherent in chaotic environments. Any assessment of future outcomes carries inherent risk, and Ladris does not assume responsibility for decisions made as a result of projections. End users should possess expertise in understanding the real-world implications of forecasts, and should always exercise sound judgment and expert discretion when interpreting results.

LADRIS AI

Summary

Scenario	Max Trip Time	Average Trip Time	Passenger Cars	Heavy Vehicles
Alta Sierra	3 hours 47 minutes	3 hours 25 minutes	5625	1406
Lake Wildwood	4 hours 21 minutes	2 hours 50 minutes	6345	705
Lake of the Pines	4 hours 50 minutes	3 hours 39 minutes	5302	589
Greenhorn	1 hour 10 minutes	1 hour 5 minutes	1036	259
Cascade Shores / Banner	2 hours 4 minutes	1 hour 36 minutes	2496	624

Scenarios

For scenarios with contraflow, two simulations are run: one with, and one without contraflow.

NOTICE TO READER

Evacuations are a hazardous and chaotic activity, and these reports may not fully represent all of the variables affecting traffic flow at the time of use.

LADRIS AI

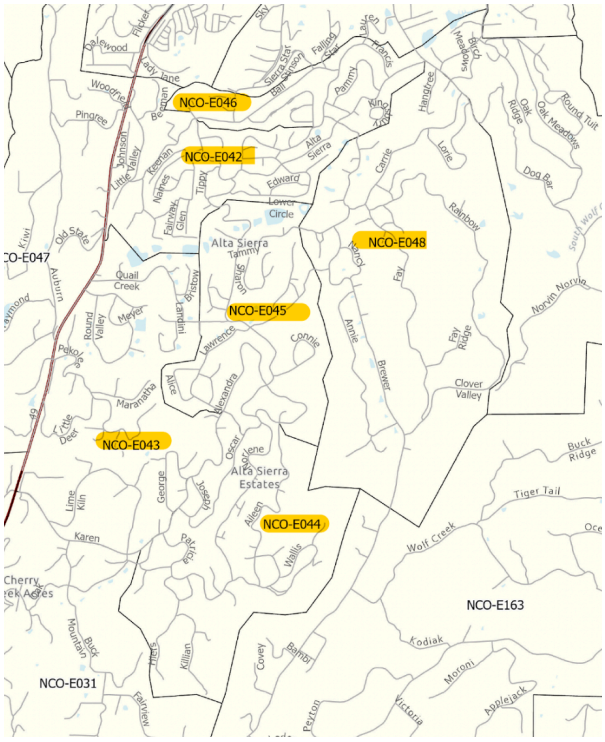
Alta Sierra

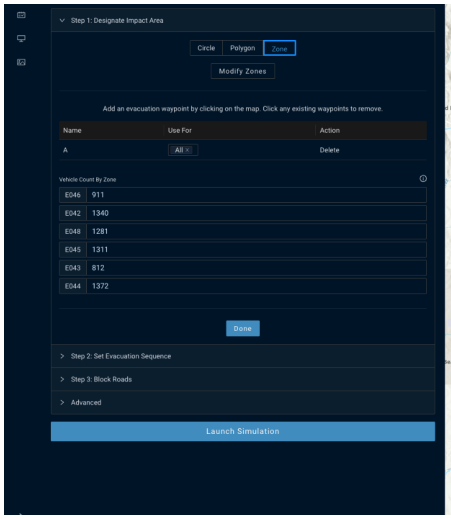
Input Parameters

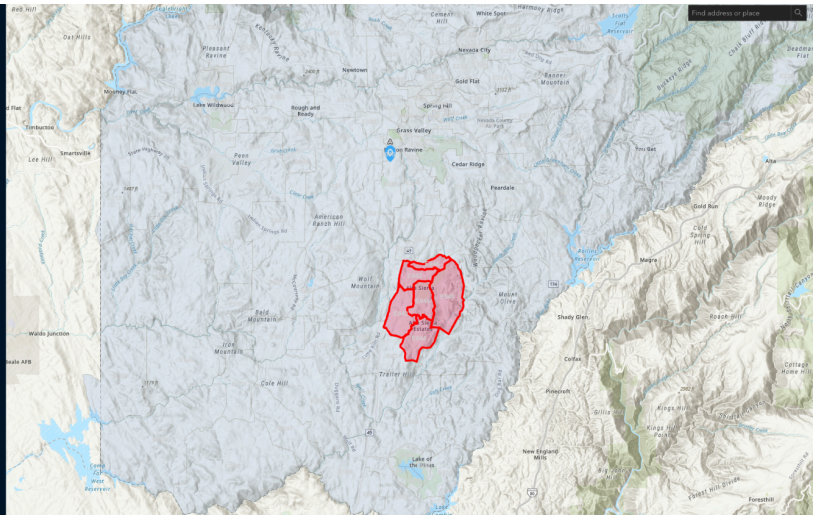
Name	Value	Notes
Heavy Vehicle %	0.2	Percentage of vehicles which are ‘heavy’ (larger than a pickup truck)
Occupancy %	100	Percentage of address in the area which are occupied
Departure Time Frame	5 minutes	Timeframe (in minutes) in which vehicle departures are distributed
Waypoints	11228 McCourtney Rd, Grass Valley, CA 95949 (39.208237, -121.076387)	Evacuation endpoints. All numbers in the results portion are reflective of travel time to this point(s)

Evacuated Zones

Zone ID	Vehicle Count
NCO-E046	911
NCO-E042	1340
NCO-E048	1281
NCO-E045	1311
NCO-E043	812
NCO-E044	1372

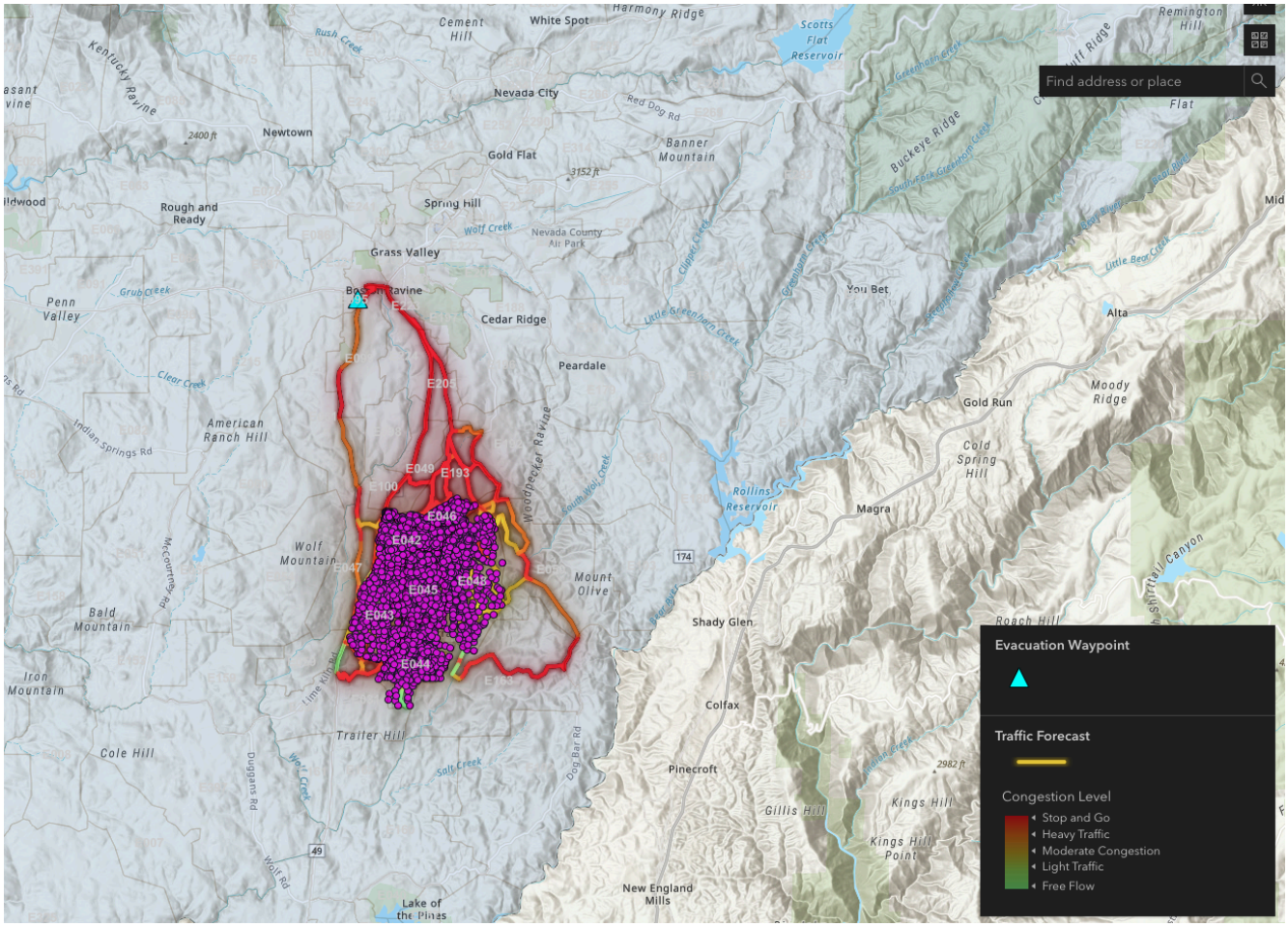






Alta Sierra - Simulation Results

Metric	Value
Worst Case Single Vehicle	3 hours 47 minutes
Average Single Vehicle	3 hours 25 minutes
Passenger Cars	5625
Heavy Vehicles	1406


Find address or place
Evacuation Waypoint
Traffic Forecast
Congestion Level
Stop and Go
Heavy Traffic
Moderate Congestion
Light Traffic
Free Flow
Nevada City
Grass Valley
Penn Valley
Rough and Ready
Newtown
Gold Flat
Spring Hill
Cedar Ridge
Peardale
American Ranch Hill
Wolf Mountain
Bald Mountain
Iron Mountain
Cole Hill
Trailer Hill
Banner Mountain
Buckeye Ridge
You Bet
Alta
Gold Run
Moody Ridge
Cold Spring Hill
Magra
Rollins Reservoir
Mount Olive
Shady Glen
Colfax
Pinecroft
Gillis Hill
Kings Hill
Kings Hill Point
New England Mills
Lake of the Pines
Scotts Flat Reservoir
Remington Hill
Harmony Ridge
White Spot
Cement Hill
Red Dog Rd
Wolf Creek
Clipper Creek
Little Greenhorn Creek
Greenhorn Creek
Little Beer Creek
Woodpecker Ravine
South Wolf Creek
Clear Creek
Grub Creek
Rush Creek
Kentucky Ravine
Indian Springs Rd
Dog Bar Rd
Salt Creek
Lime Kiln Gulch
Dutch Flat
Roach Hill
Shirttail Canyon
E049
E193
E046
E042
E045
E048
E043
E044
E047
E100
E205
174
49

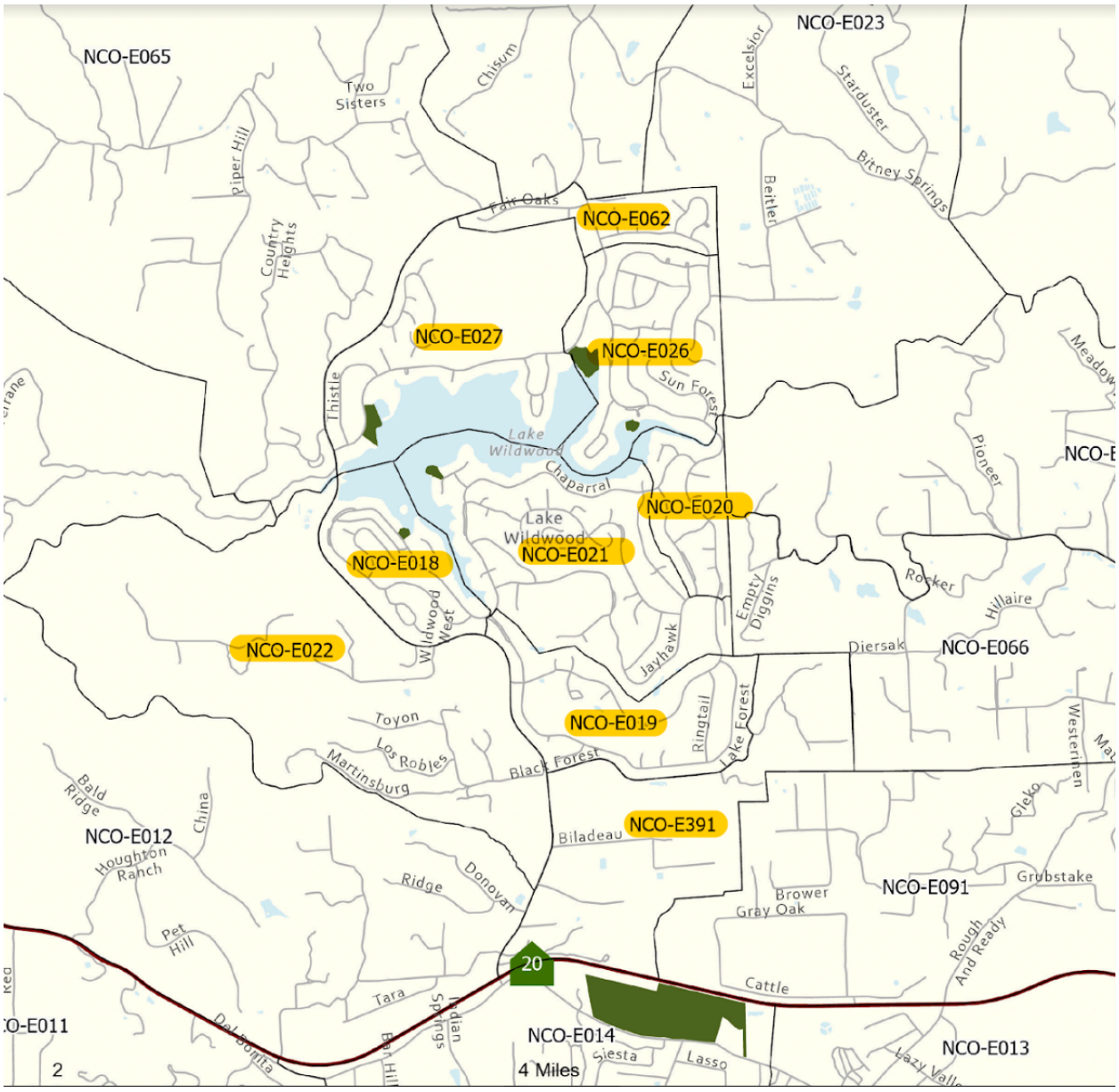
Lake Wildwood

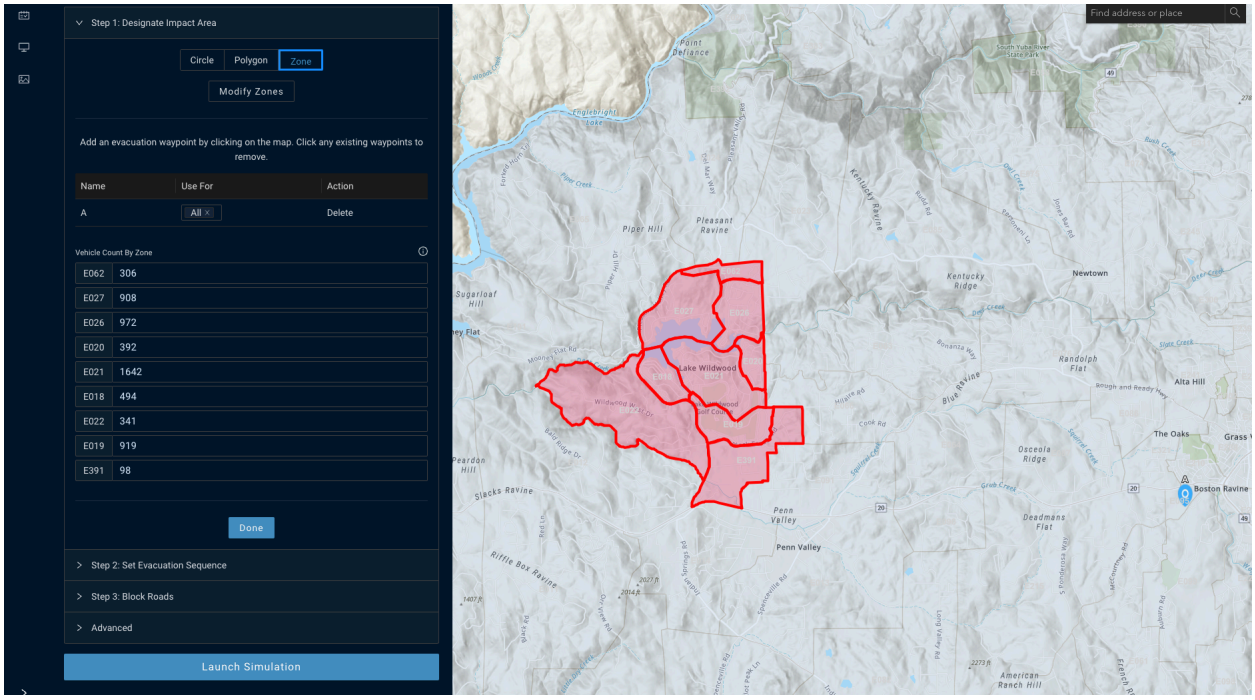
Input Parameters

Name	Value	Notes
Heavy Vehicle %	0.1	Percentage of vehicles which are ‘heavy’ (larger than a pickup truck)
Occupancy %	100	Percentage of address in the area which are occupied
Departure Timeframe	5 minutes	Timeframe (in minutes) in which vehicle departures are distributed
Waypoints	11228 McCourtney Rd, Grass Valley, CA 95949 (39.208237, -121.076387)	Evacuation endpoints. All numbers in the results portion are reflective of travel time to this point(s)

Evacuated Zones

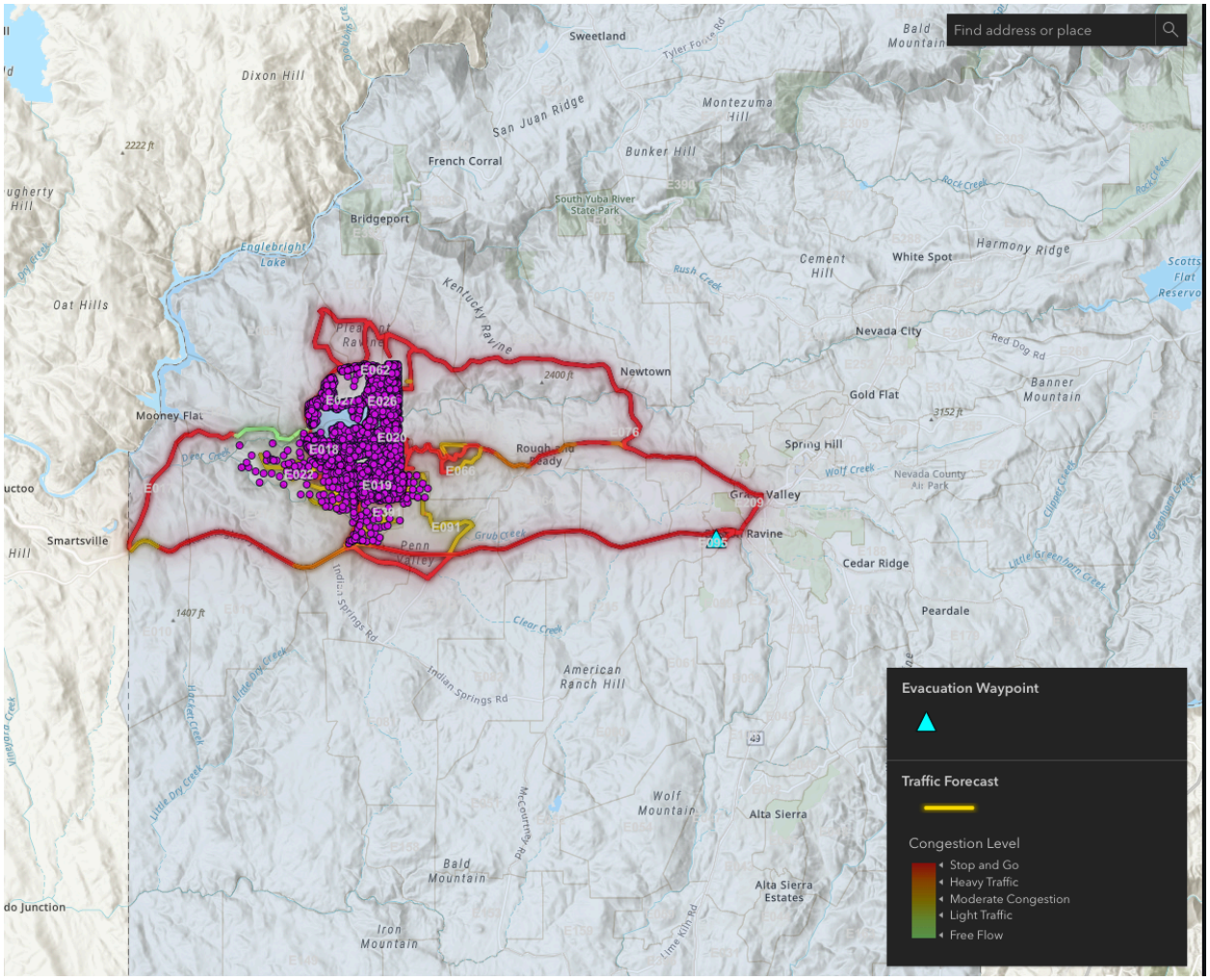
Zone ID	Vehicle Count
NCO-E062	306
NCO-E027	908
NCO-E026	972
NCO-E020	392
NCO-E021	1642
NCO-E018	494
NCO-E022	341
NCO-E019	919
NCO-E391	98
NCO-E065	629
NCO-E024	339



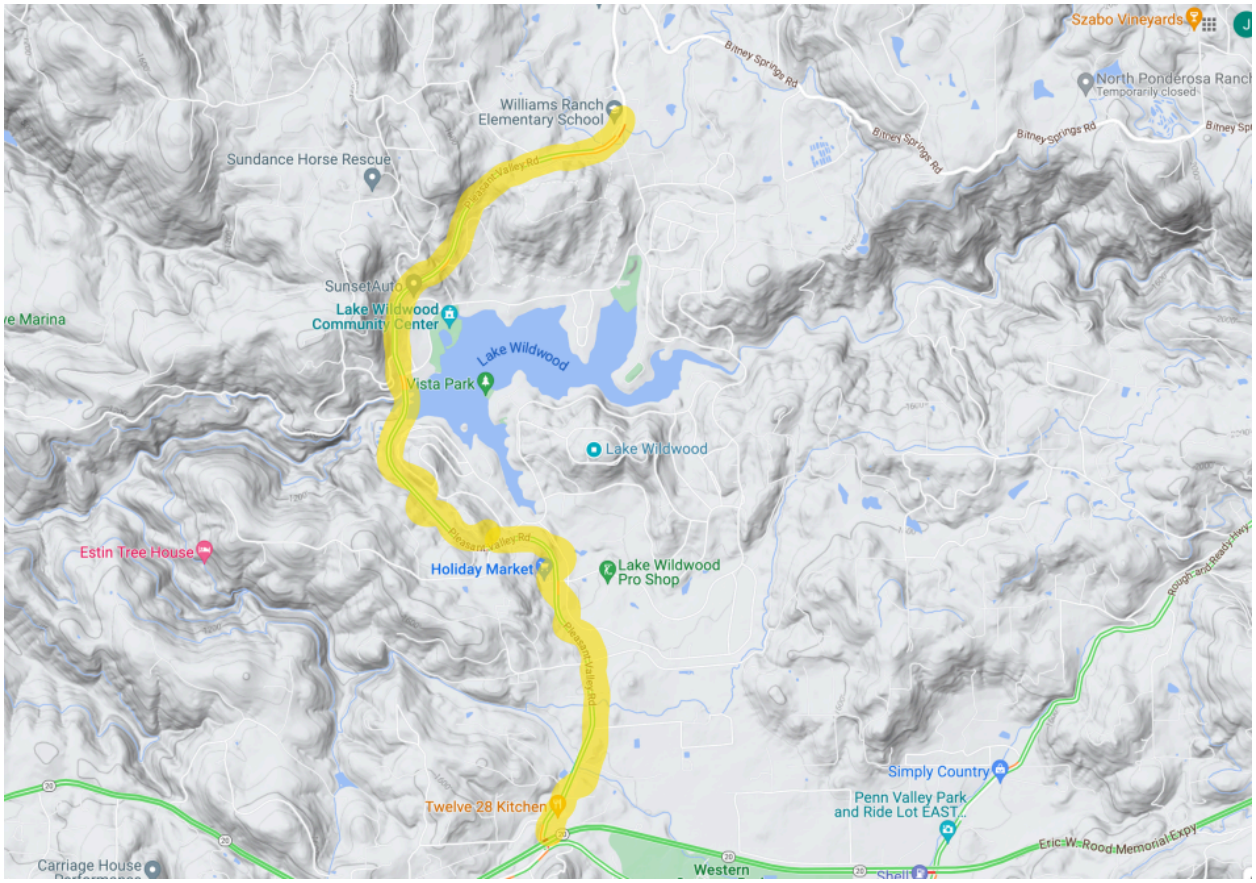


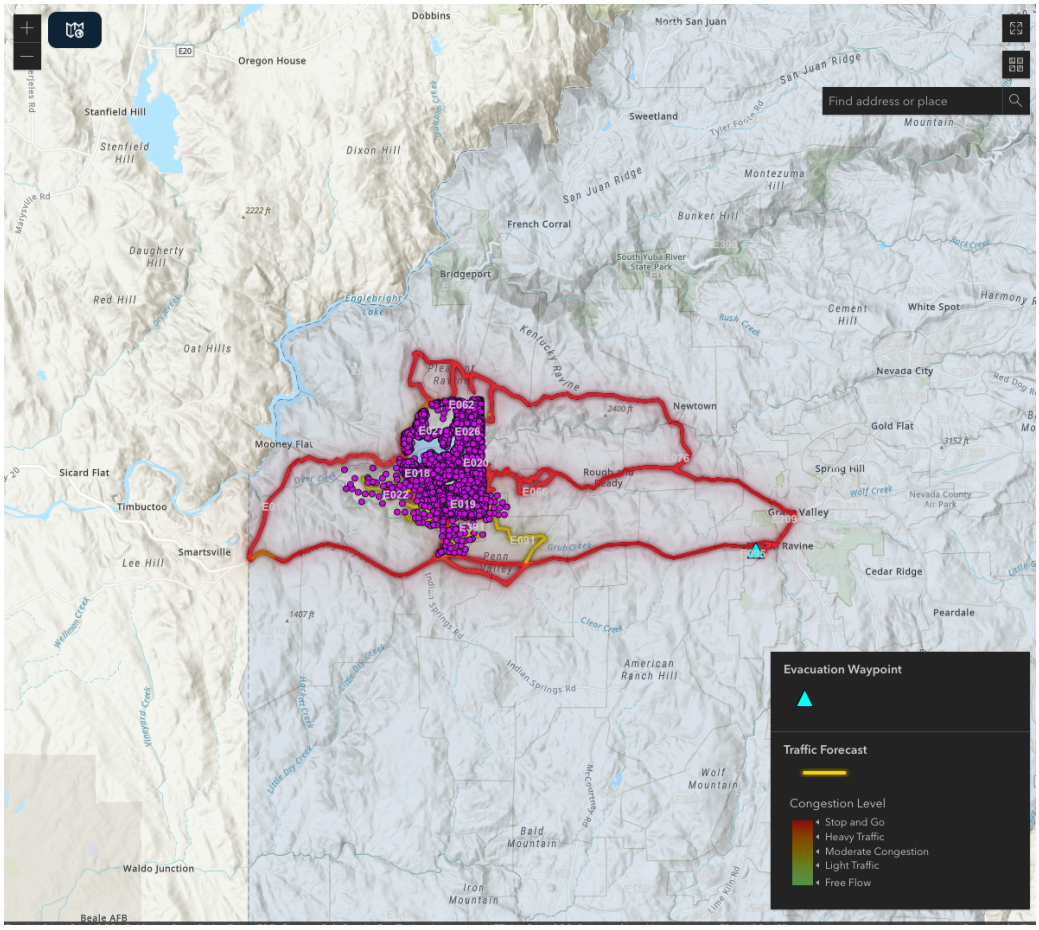
Lake Wildwood - Simulation Results

Metric	Value
Worst Case Single Vehicle	4 hours 21 minutes
Average Single Vehicle	2 hours 50 minutes
Passenger Cars	6345
Heavy Vehicles	705



Lake Wildwood - Contraflow Results





Metric	Value
Worst Case Single Vehicle	5 hours 0 minutes
Average Single Vehicle	2 hours 39 minutes
Passenger Cars	6345
Heavy Vehicles	705

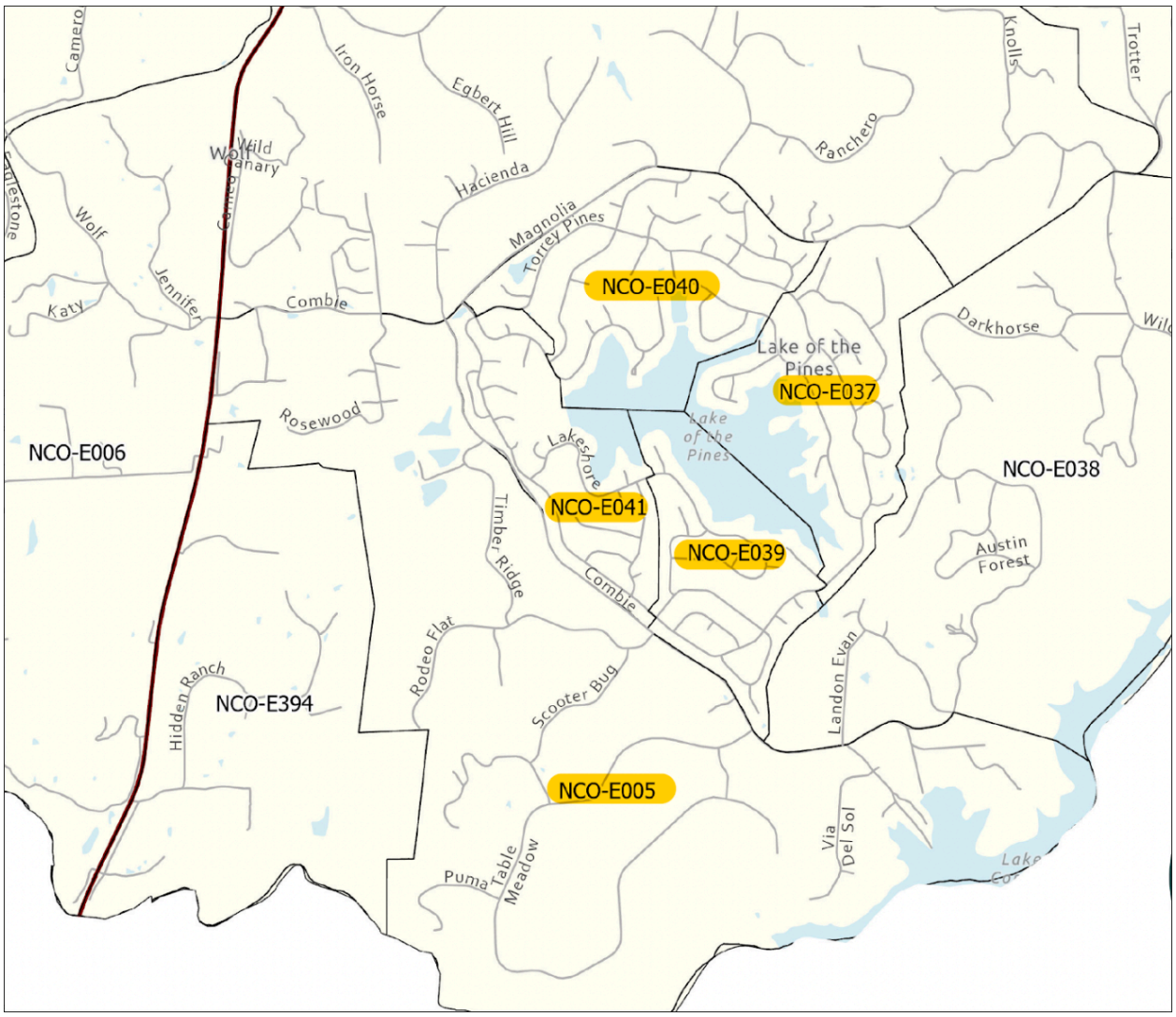
Lake of the Pines

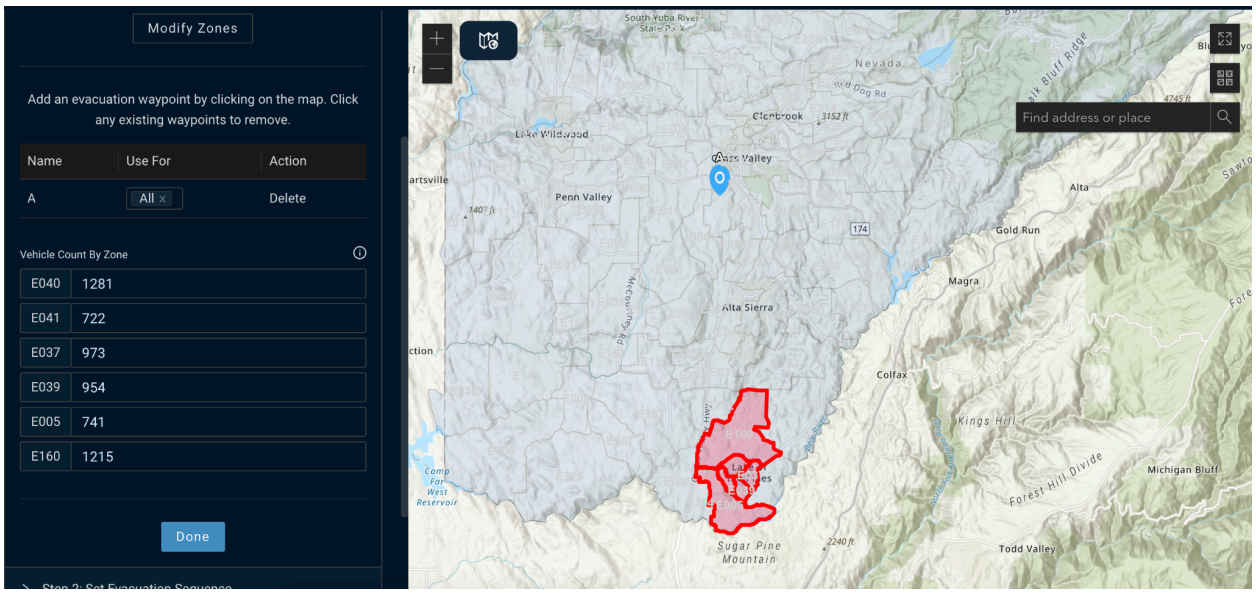
Input Parameters

Name	Value	Notes
Heavy Vehicle %	.1	Percentage of vehicles which are ‘heavy’ (larger than a pickup truck)
Occupancy %	100	Percentage of address in the area which are occupied
Departure Timeframe	5 minutes	Timeframe (in minutes) in which vehicle departures are distributed
Waypoints	11228 McCourtney Rd, Grass Valley, CA 95949 (39.208237, -121.076387)	Evacuation endpoints. All numbers in the results portion are reflective of travel time to this point(s)

Evacuated Zones

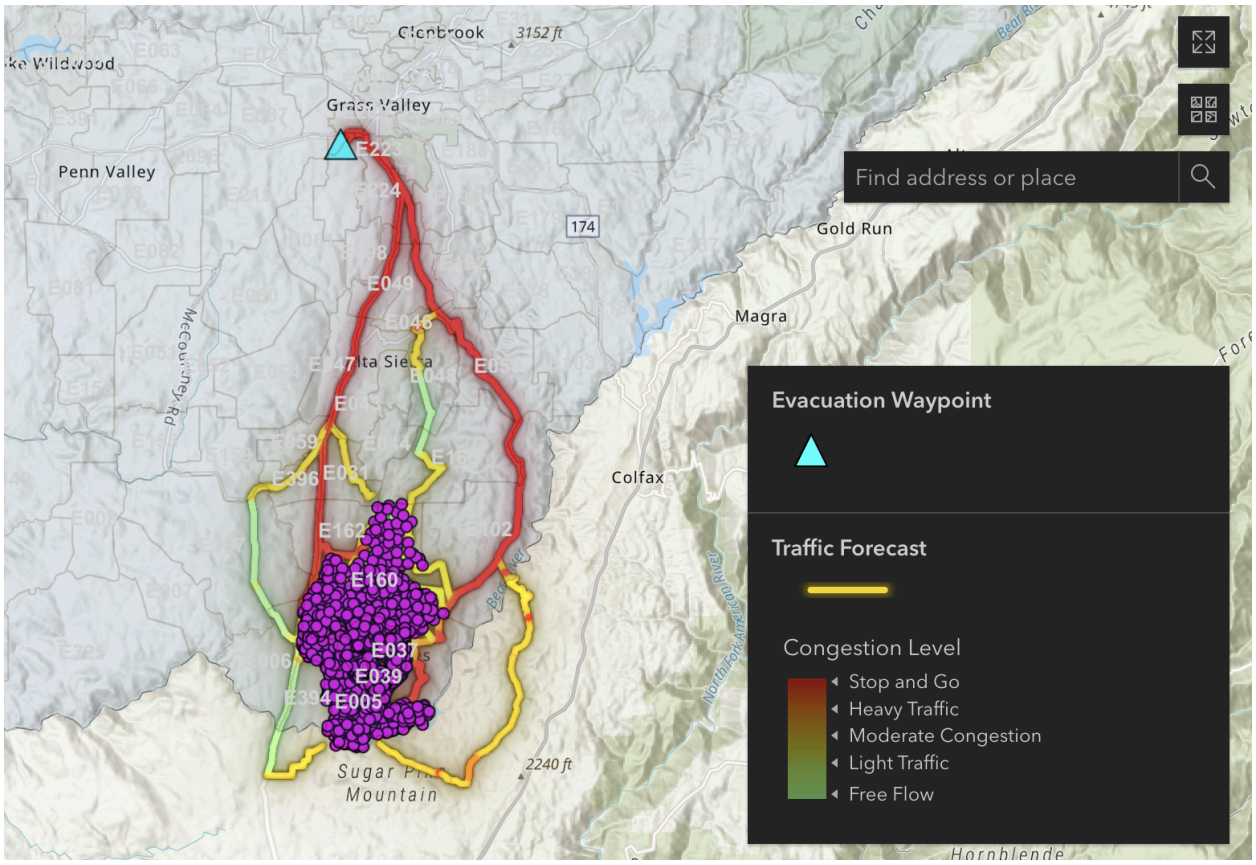
Zone ID	Vehicle Count
NCO-E040	1281
NCO-E041	722
NCO-E037	973
NCO-E039	954
NCO-E005	741
NCO-E160	1215





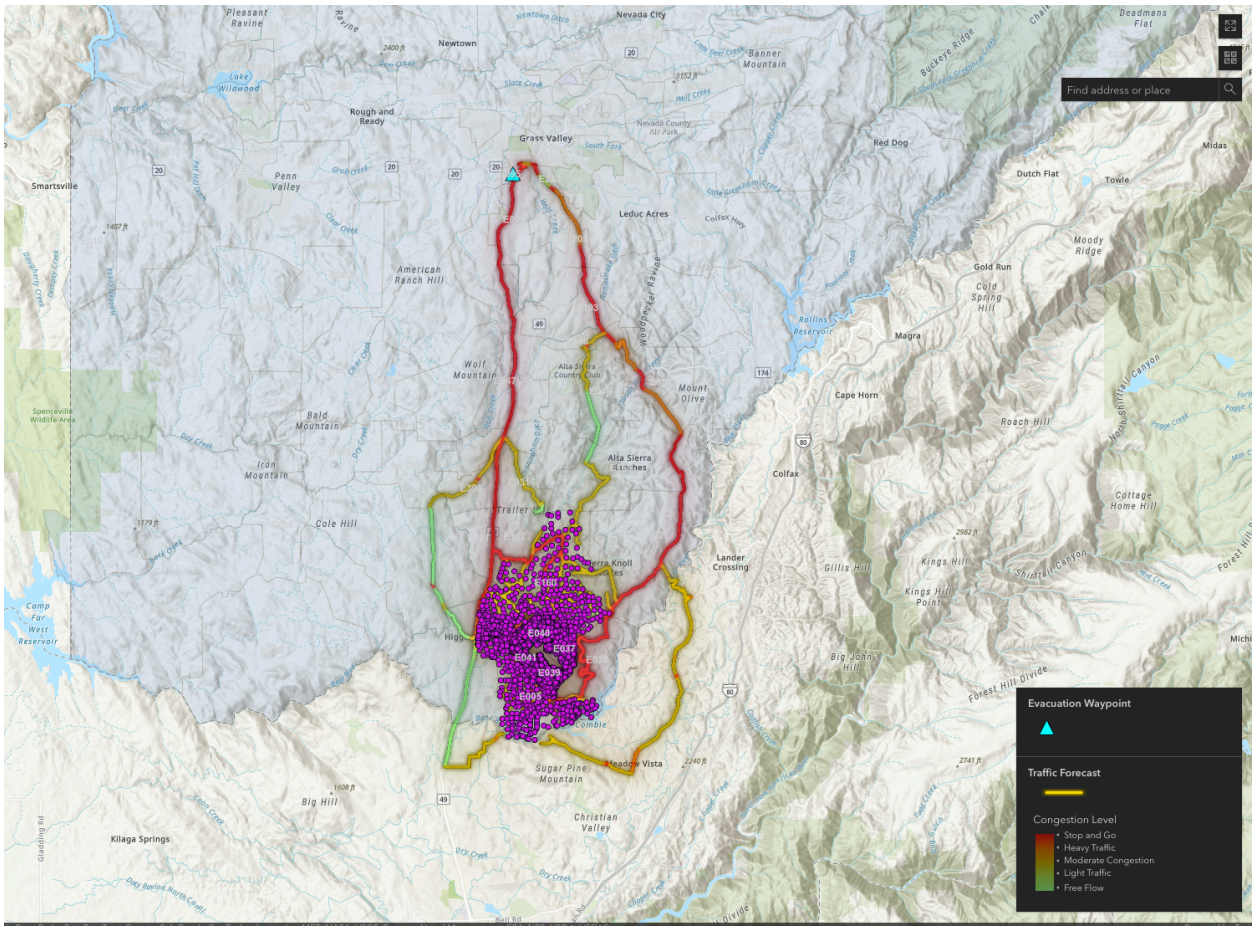
Lake of the Pines - Simulation Results

Metric	Value
Worst Case Single Vehicle	4 hours 29 minutes
Average Single Vehicle	4 hours 4 minutes
Passenger Cars	5302
Heavy Vehicles	589

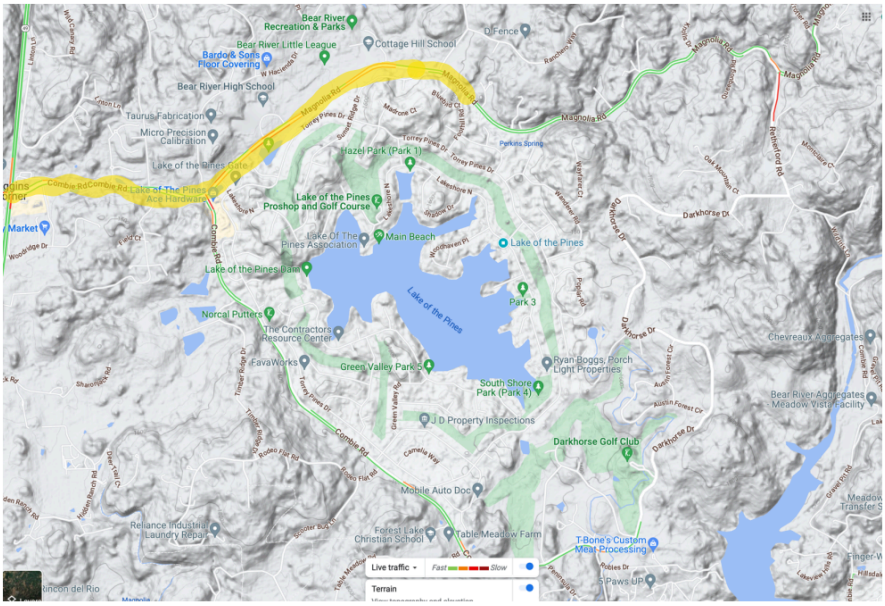


Lake of the Pines with Gates Open - Simulation Results

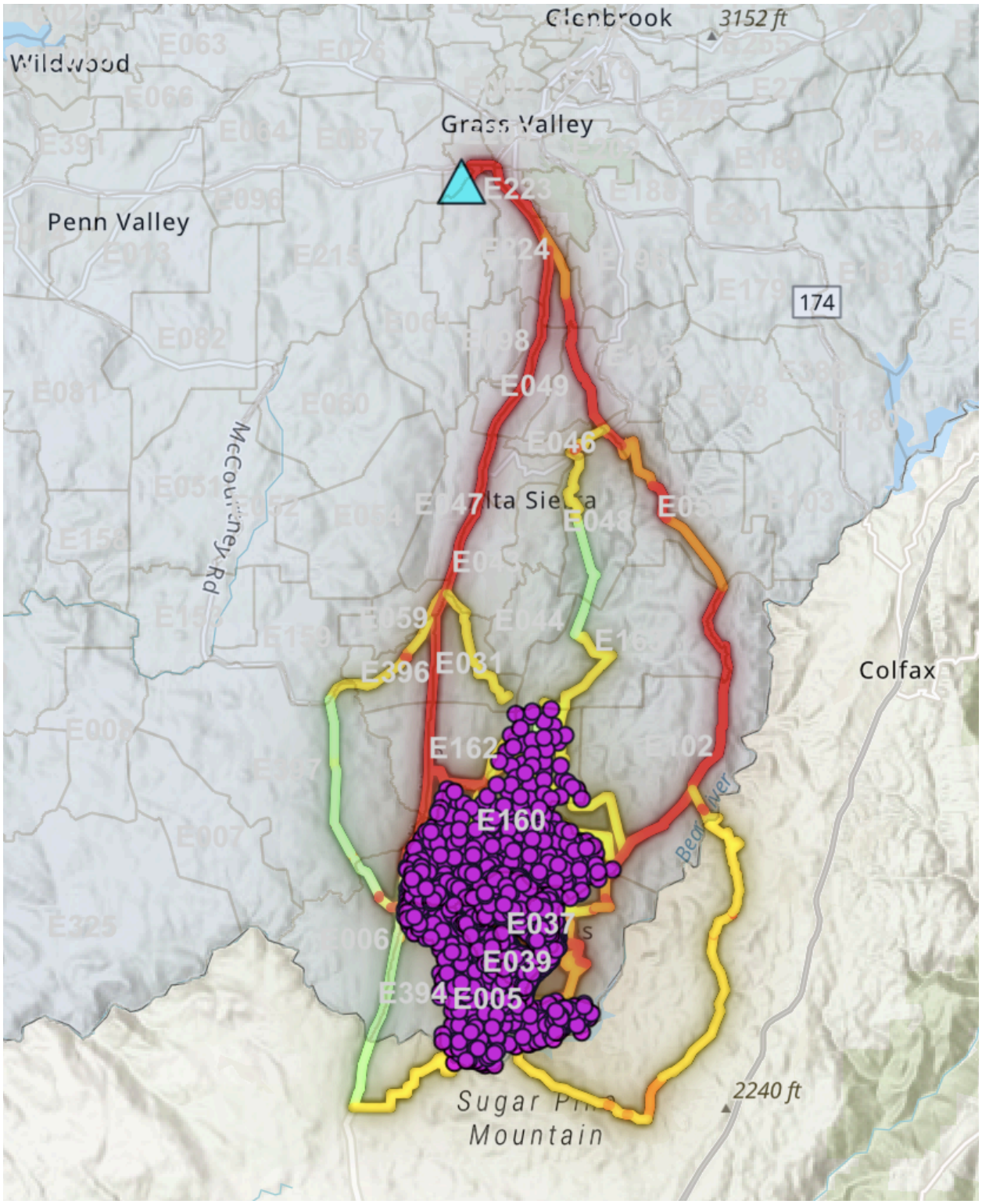
Metric	Value
Worst Case Single Vehicle	4 hours 50 minutes
Average Single Vehicle	3 hours 39 minutes
Passenger Cars	5302
Heavy Vehicles	589



Lake of the Pines - Contraflow Results



Metric	Value
Worst Case Single Vehicle	4 hours 59 minutes
Average Single Vehicle	4 hours 34 minutes
Passenger Cars	5302
Heavy Vehicles	589



Greenhorn

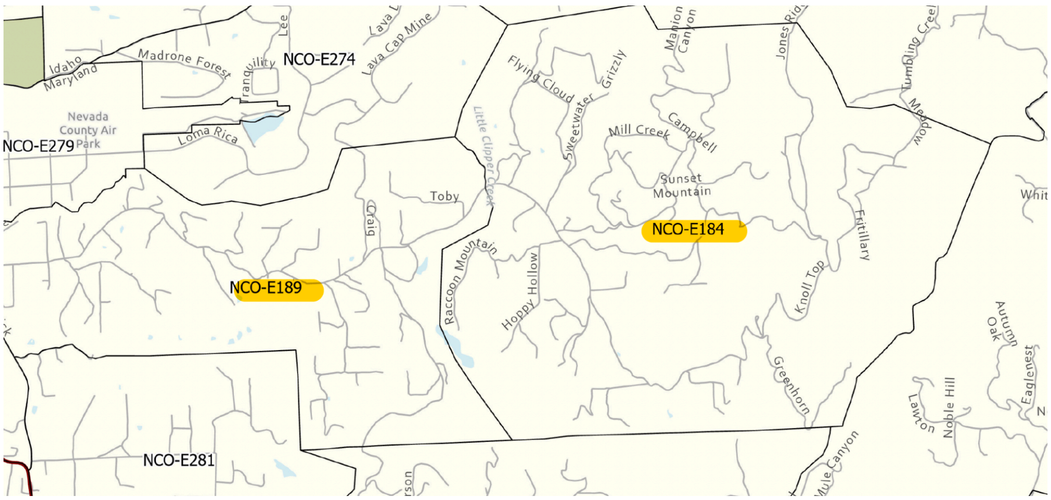
Input Parameters

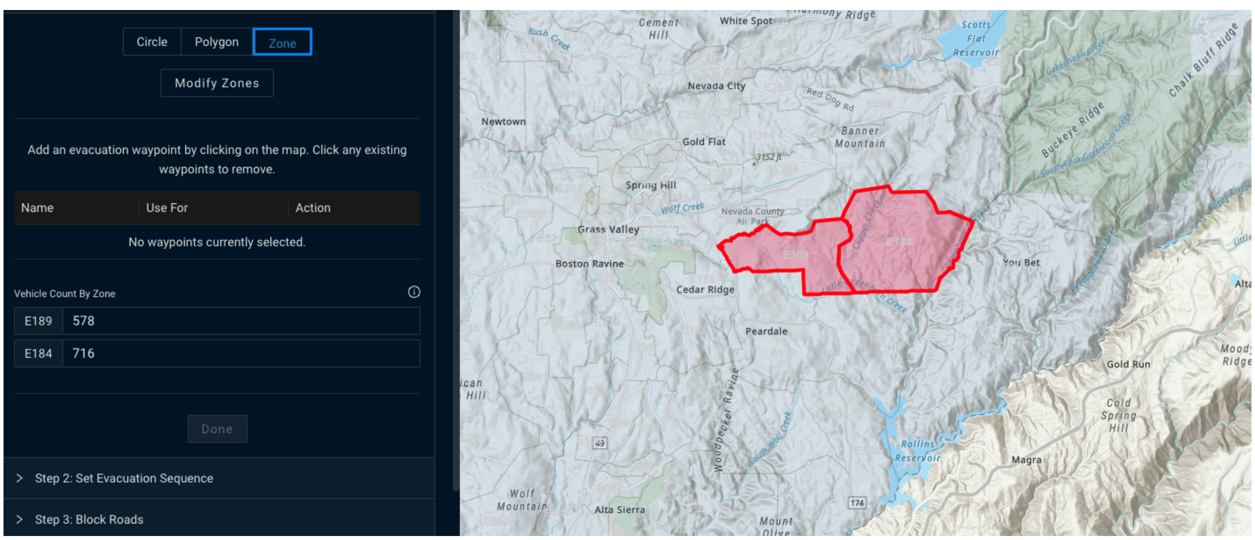
Name	Value	Notes
Heavy Vehicle %	0.2	Percentage of vehicles which are ‘heavy’ (larger than a pickup truck)
Occupancy %	100	Percentage of address in the area which are occupied
Departure Timeframe	5 minutes	Timeframe (in minutes) in which vehicle departures are distributed
Waypoints	11228 McCourtney Rd, Grass Valley, CA 95949 (39.208237, -121.076387)	Evacuation endpoints. All numbers in the results portion are reflective of travel time to this point(s)

Evacuated Zones

Zone ID	Vehicle Count
NCO-E189	578
NCO-E184	716

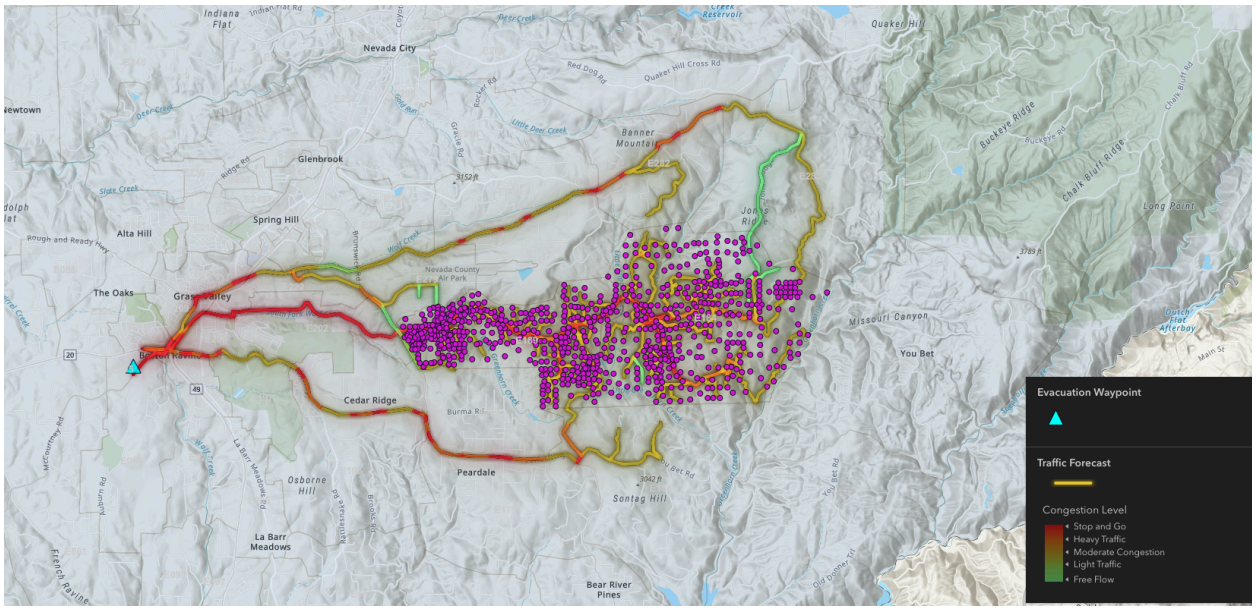
LADRIS AI


NCO-E274
NCO-E279
NCO-E189
NCO-E184
NCO-E281
Madrone Forest
Nevada County Air Park
Loma Rica
Toby
Sunset Mountain
Mill Creek
Raccoon Mountain
Hoppy Hollow
Knoll Top
Greenhorn
Noble Hill


Circle
Polygon
Zone
Modify Zones
Add an evacuation waypoint by clicking on the map. Click any existing waypoints to remove.
Name
Use For
Action
No waypoints currently selected.
Vehicle Count By Zone
E189 578
E184 716
Done
Step 2: Set Evacuation Sequence
Step 3: Block Roads
Nevada City
Grass Valley
Gold Flat
Spring Hill
Boston Ravine
Cedar Ridge
Peardale
Banner Mountain
You Bet
Gold Run
Newtown
White Spot
Cement Hill
Alta Sierra
Magra
Rollins Reservoir

Greenhorn - Simulation Results

Metric	Value
Worst Case Single Vehicle	1 hour 10 minutes
Average Single Vehicle	1 hour 5 minutes
Passenger Cars	1036
Heavy Vehicles	259



Cascade Shores / Banner

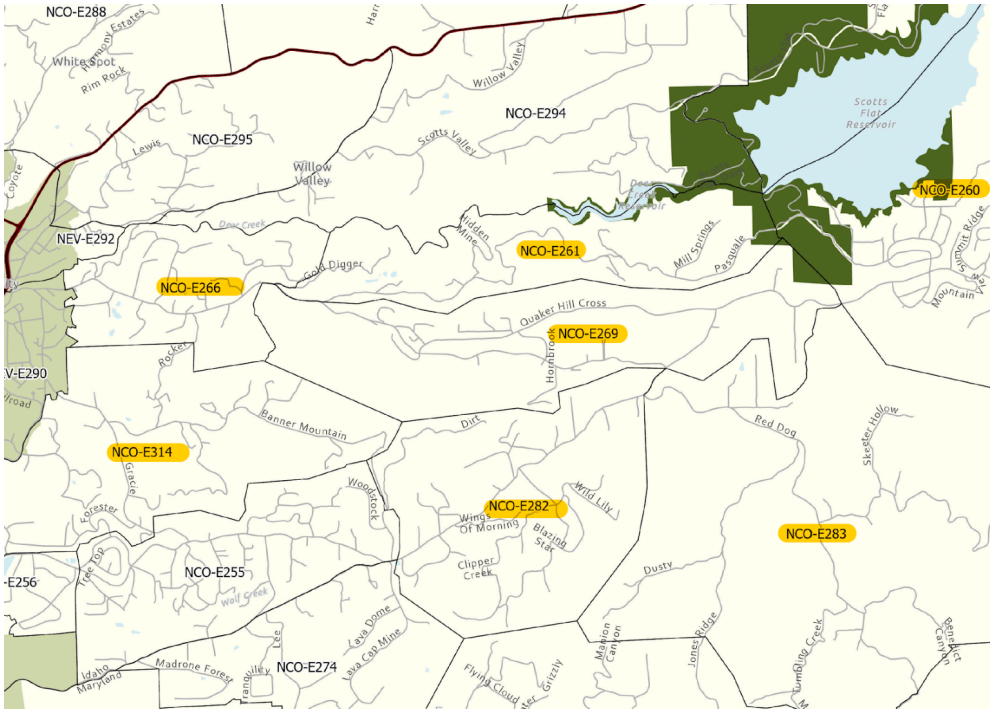
Input Parameters

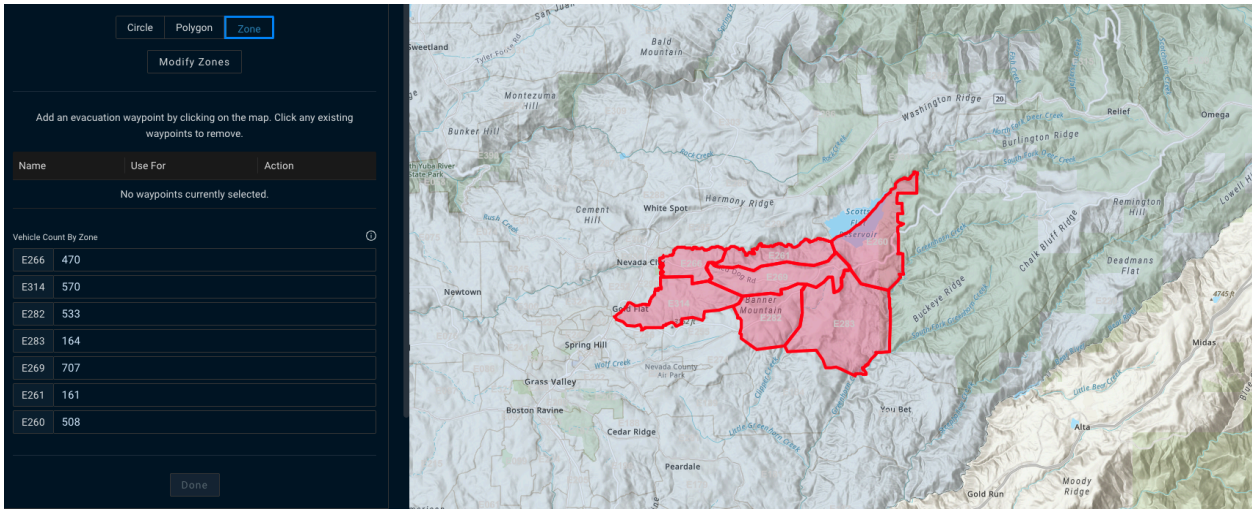
Name	Value	Notes

Heavy Vehicle %	0.2	Percentage of vehicles which are ‘heavy’ (larger than a pickup truck)
Occupancy %	100	Percentage of address in the area which are occupied
Departure Timeframe	5 minutes	Timeframe (in minutes) in which vehicle departures are distributed
Waypoints	11228 McCourtney Rd, Grass Valley, CA 95949 (39.208237, -121.076387)	Evacuation endpoints. All numbers in the results portion are reflective of travel time to this point(s)

Evacuated Zones

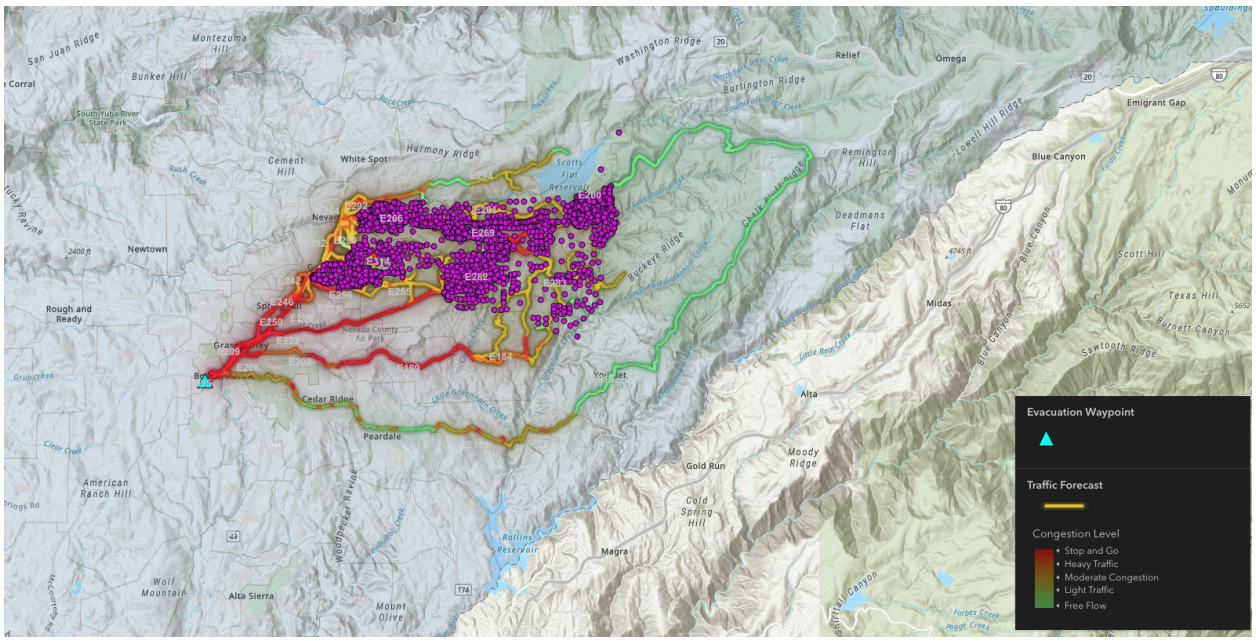
Zone ID	**Vehicle Count**
NCO-E266	470
NCO-E314	570
NCO-E282	533
NCO-E283	164
NCO-E269	707
NCO-E261	161
NCO-E260	508





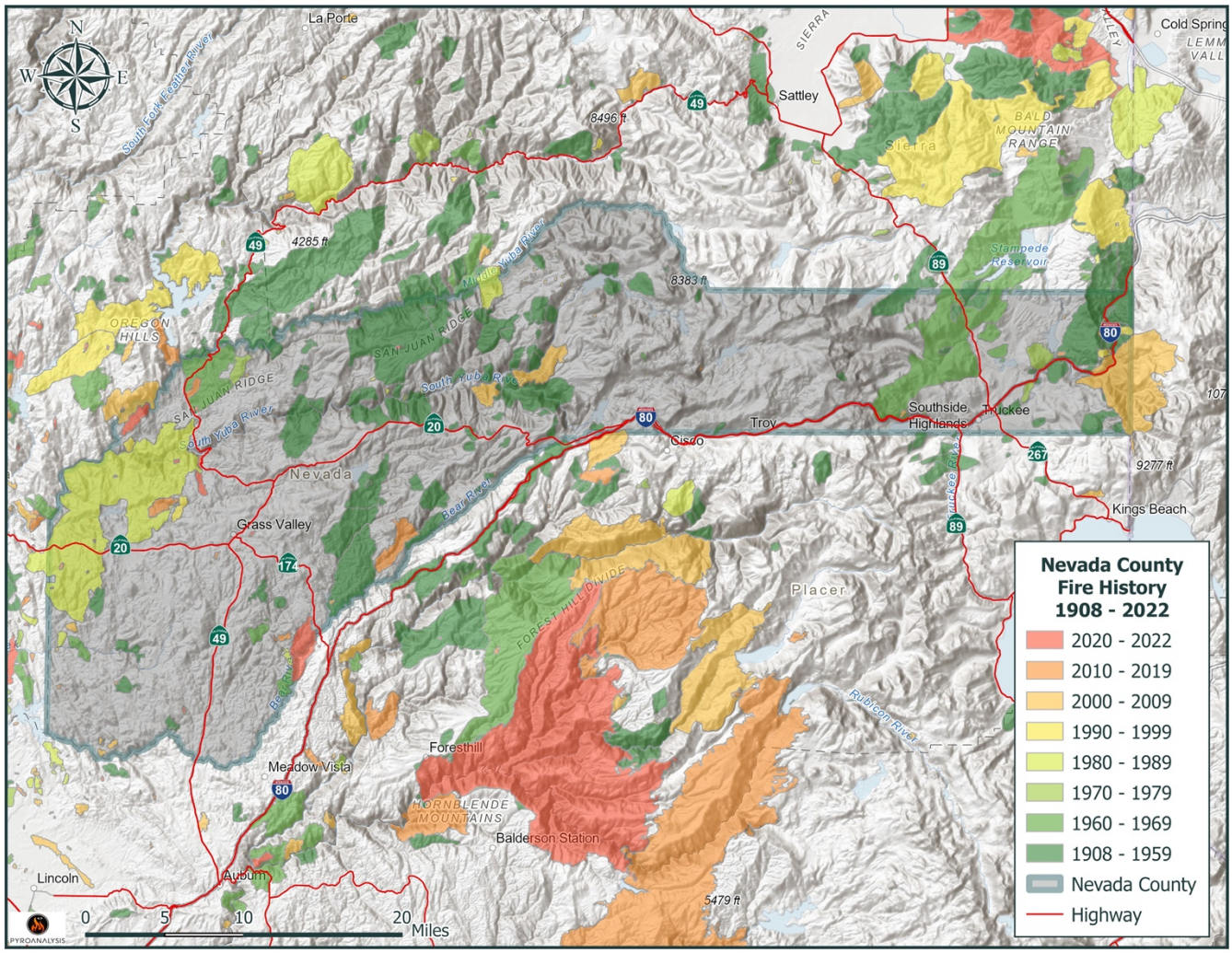
Cascade Shores / Banner - Simulation Results

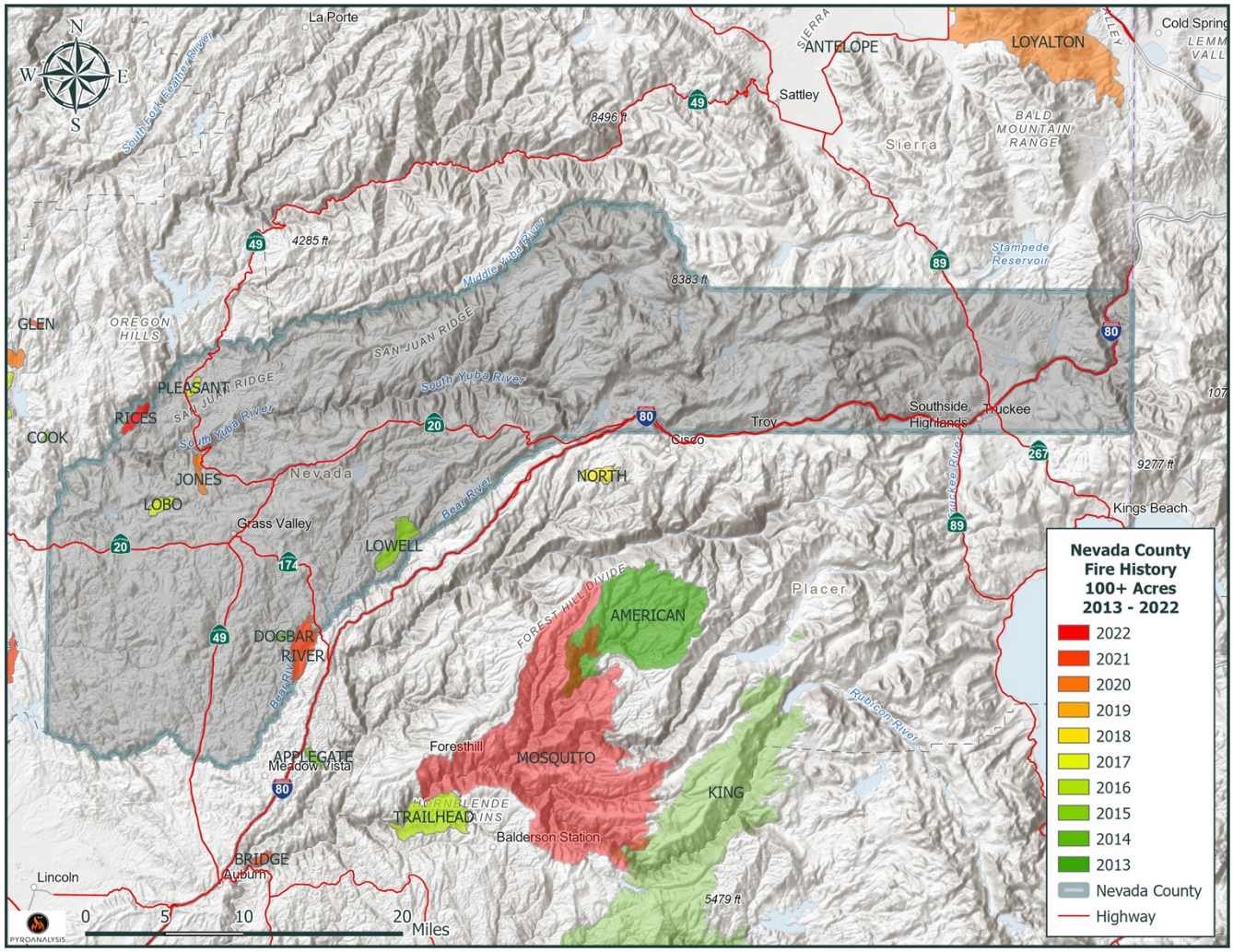
Metric	Value
Worst Case Single Vehicle	2 hours 4 minutes
Average Single Vehicle	1 hour 36 minutes
Passenger Cars	2496
Heavy Vehicles	624

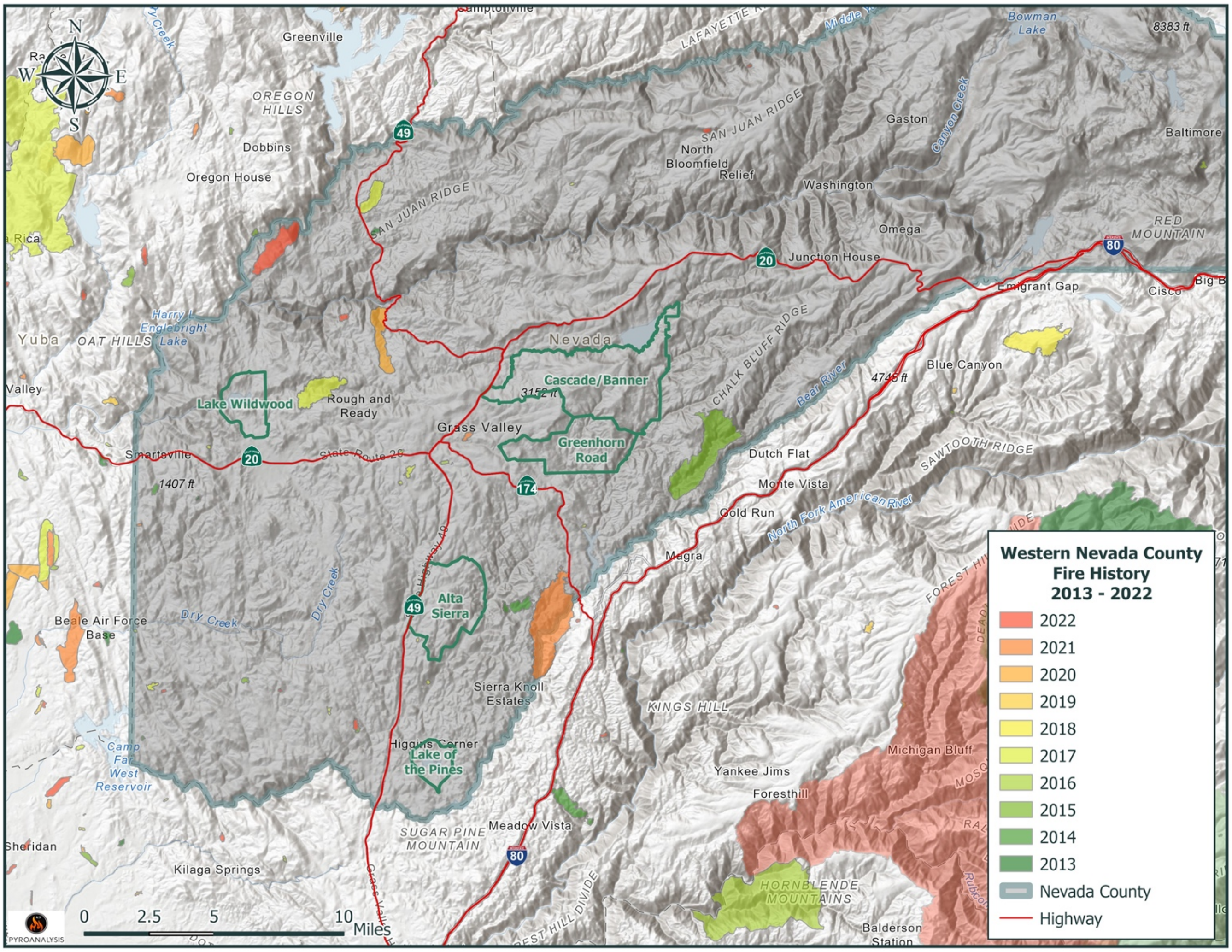


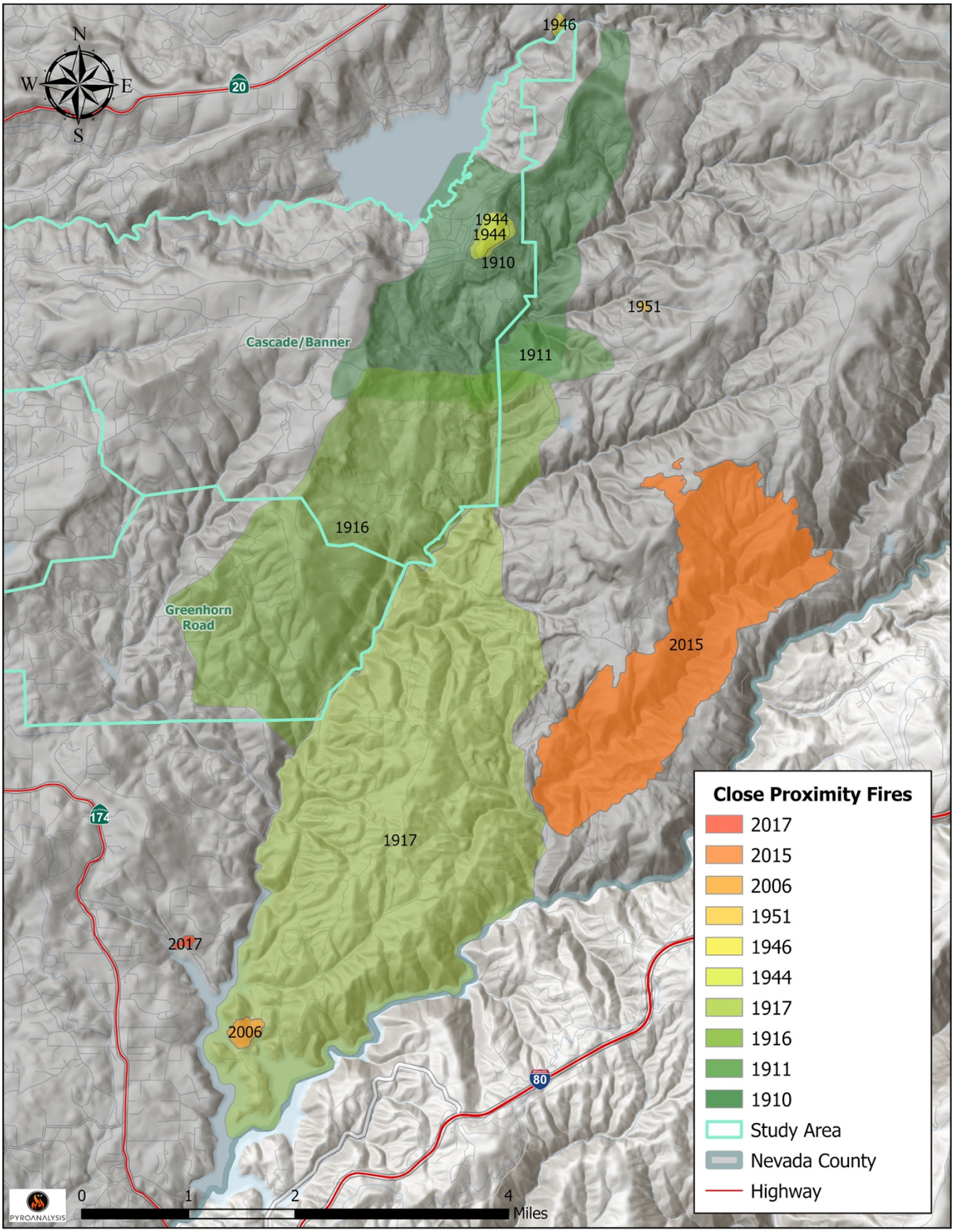
Section 2
Maps

Fire History Maps

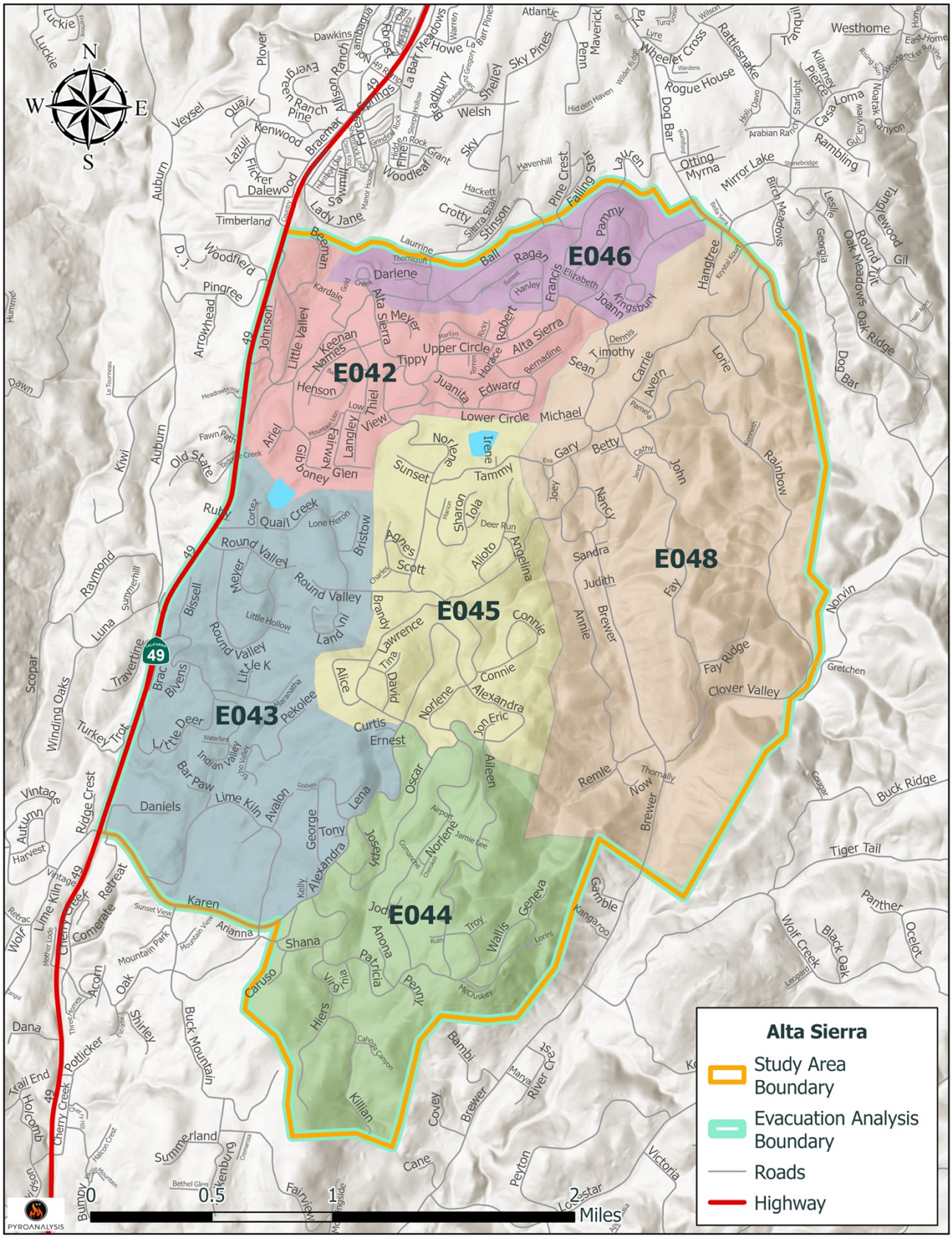


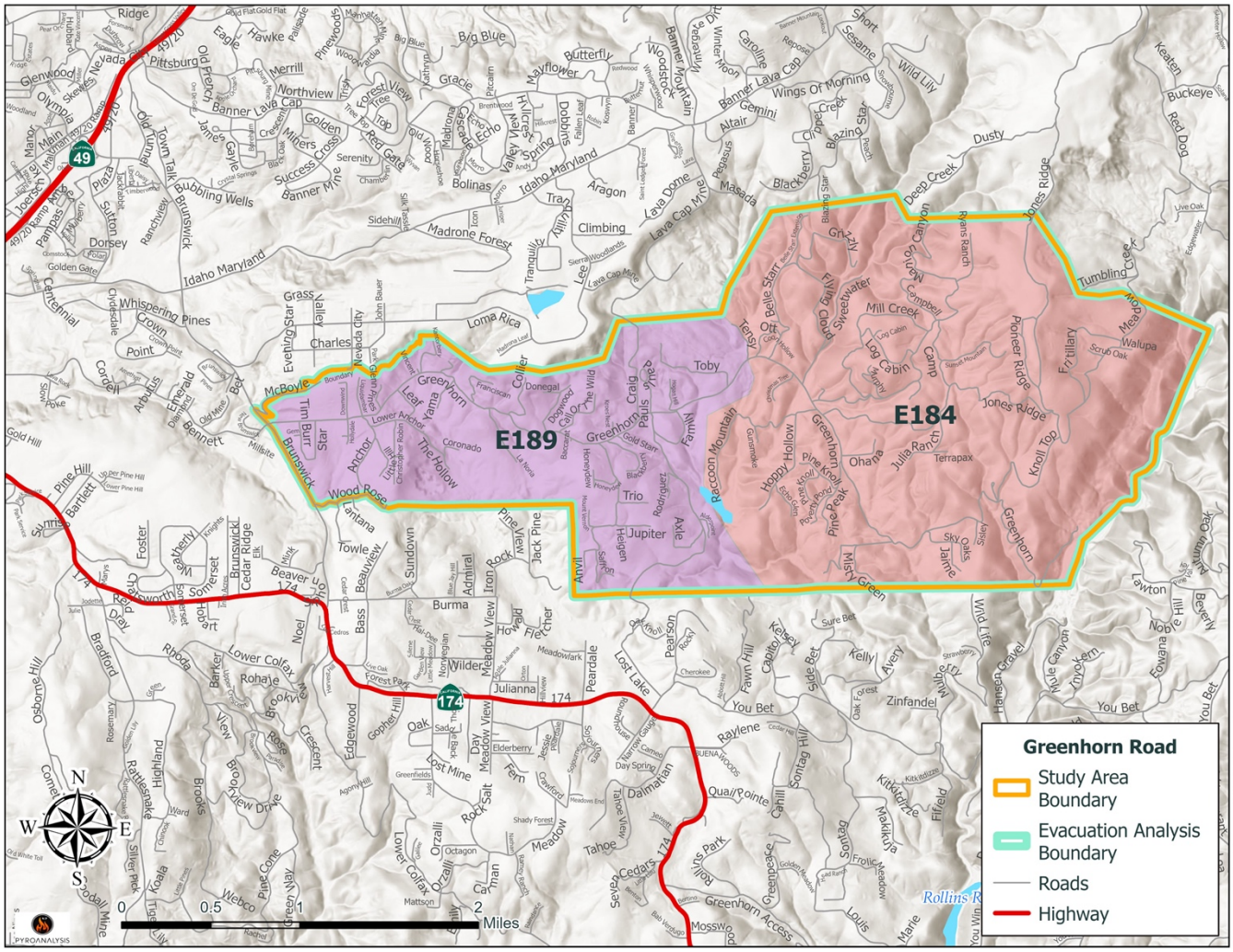

N
W
E
S
La Porte
South Fork Feather River
ANTELOPE
LOYALTON
Cold Spring
Sattley
8496 ft
Sierra
BALD MOUNTAIN RANGE
4285 ft
Middle Yuba River
Stampede Reservoir
8383 ft
GLEN
OREGON HILLS
SAN JUAN RIDGE
PLEASANT
South Yuba River
RICES
COOK
JONES
Nevada
Troy
Cisco
Southside Highlands
Truckee
9277 ft
NORTH
LOBO
Grass Valley
Bear River
LOWELL
Kings Beach
Truckee River
Placer
FOREST HILL DIVIDE
AMERICAN
DOGBAR
RIVER
Rubicon River
Foresthill
MOSQUITO
APPLEGATE
Meadow Vista
KING
TRAILHEAD
Balderson Station
BRIDGE
Auburn
Lincoln
5479 ft
0
5
10
20
Miles
PYROANALYSIS
Nevada County Fire History 100+ Acres 2013 - 2022
2022
2021
2020
2019
2018
2017
2016
2015
2014
2013
Nevada County
Highway

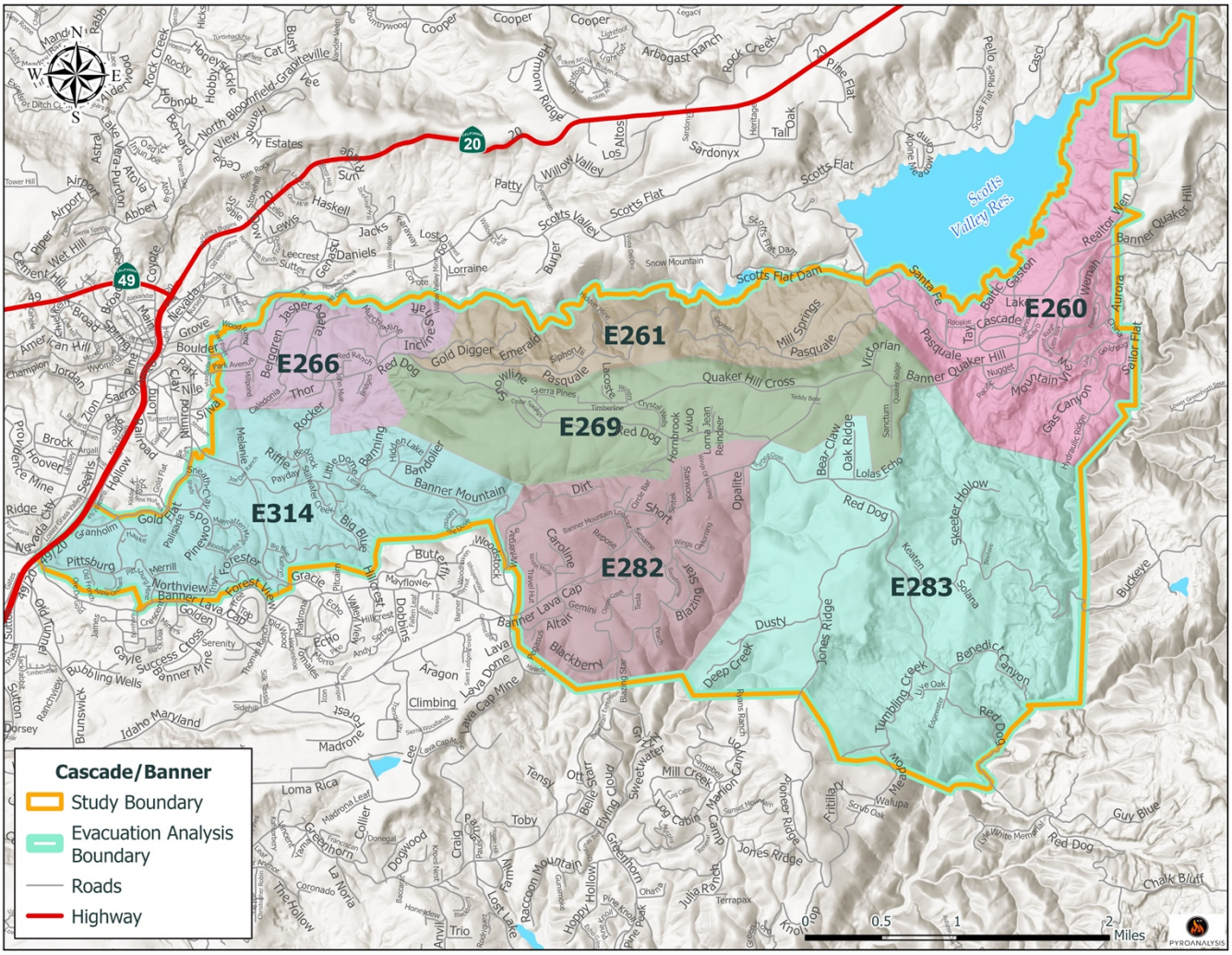

Western Nevada County Fire History 2013 - 2022
2022
2021
2020
2019
2018
2017
2016
2015
2014
2013
Nevada County
Highway
Lake Wildwood
Cascade/Banner
Greenhorn Road
Alta Sierra
Lake of the Pines
Grass Valley
Rough and Ready
Smartsville
Dutch Flat
Monte Vista
Gold Run
Magra
Sierra Knoll Estates
Higgins Corner
Meadow Vista
Emigrant Gap
Blue Canyon
Junction House
North Bloomfield
Washington
Omega
Gaston
Dobbins
Oregon House
Greenville
Beale Air Force Base
Sheridan
Kilaga Springs
Yankee Jims
Foresthill
Michigan Bluff
0 2.5 5 10 Miles

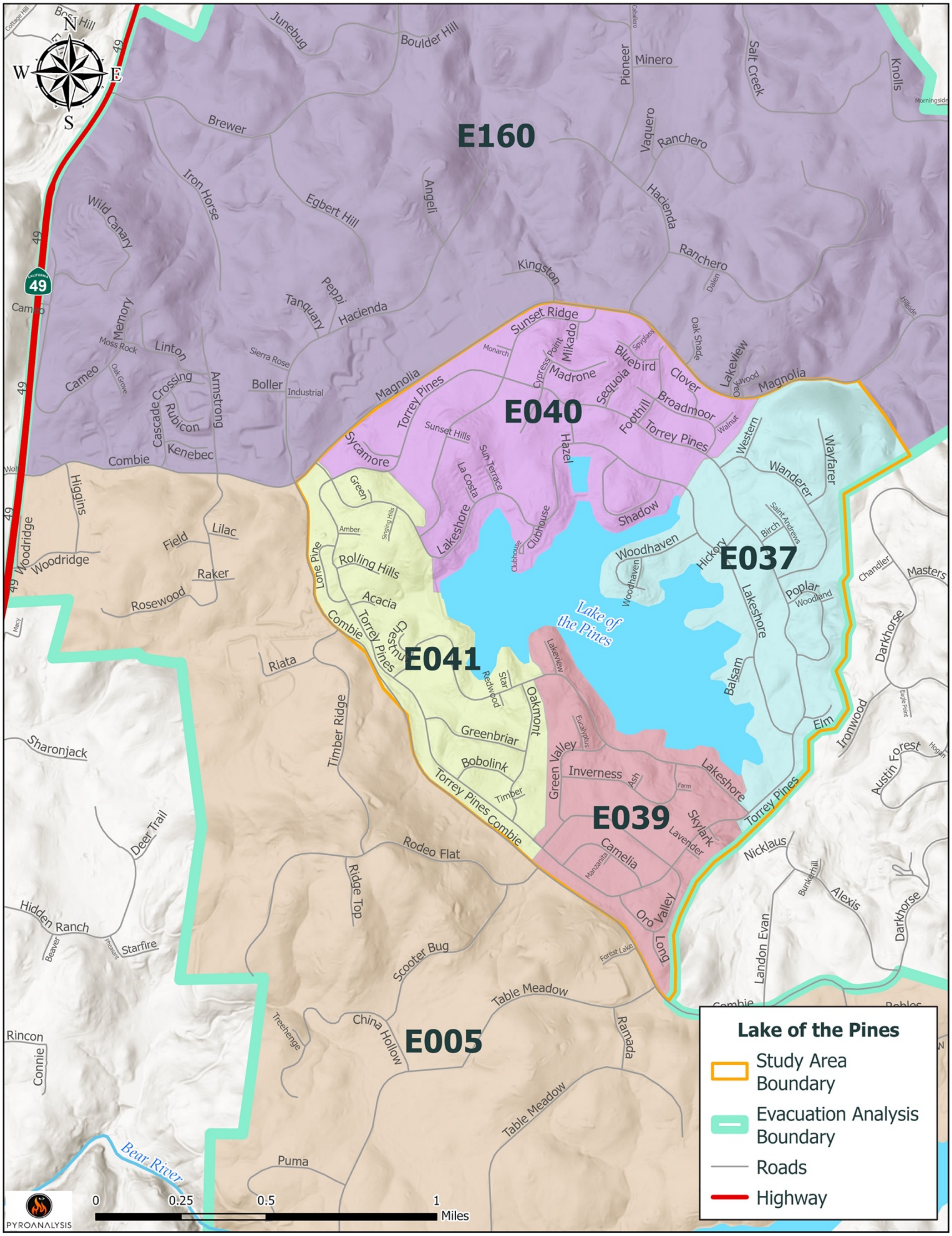

N
W
E
S
20
1946
1944
1944
1910
1951
Cascade/Banner
1911
1916
Greenhorn
Road
2015
174
1917
2017
2006
80
Close Proximity Fires
2017
2015
2006
1951
1946
1944
1917
1916
1911
1910
Study Area
Nevada County
Highway
PYROANALYSIS
0
1
2
4
Miles

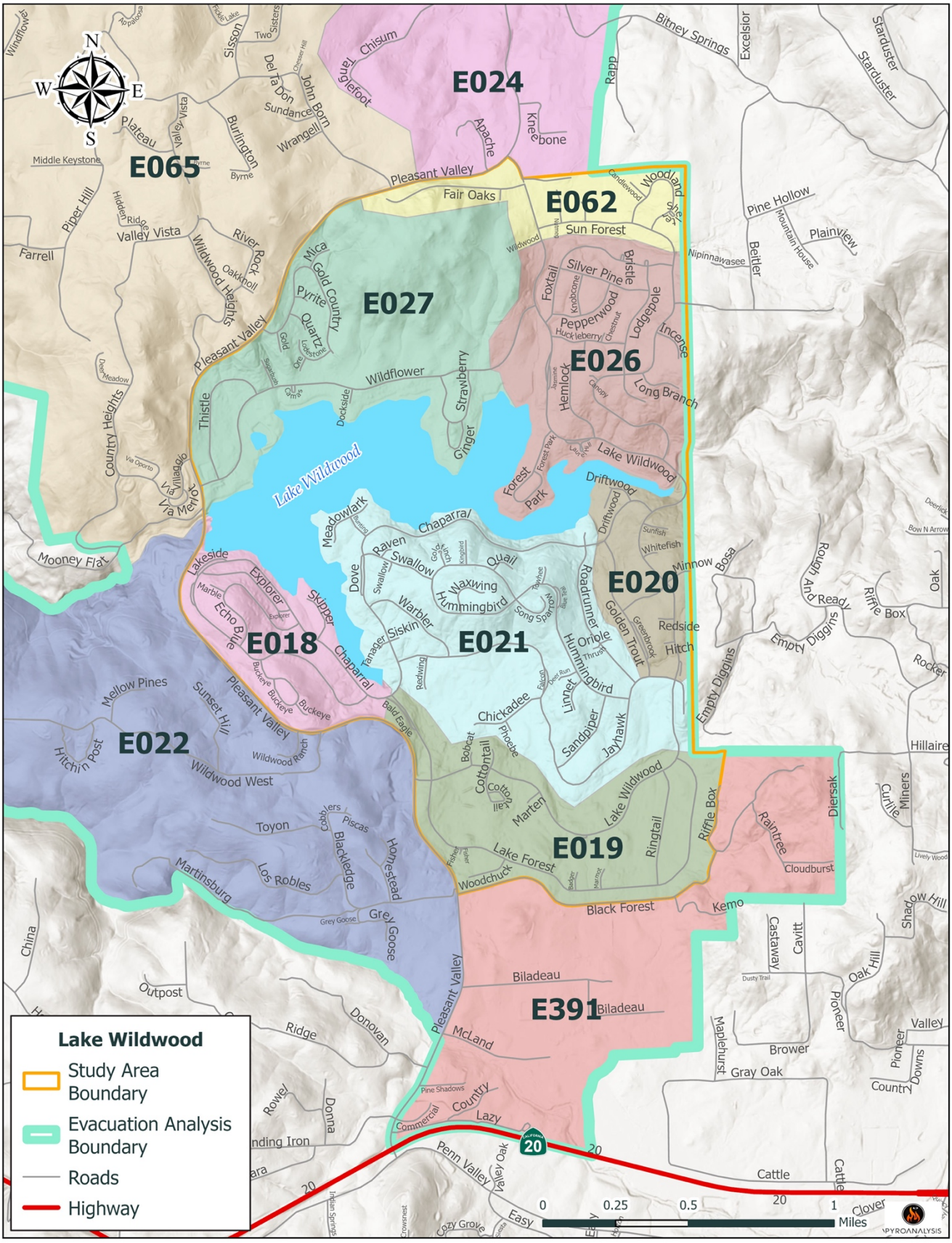
Study Area Maps

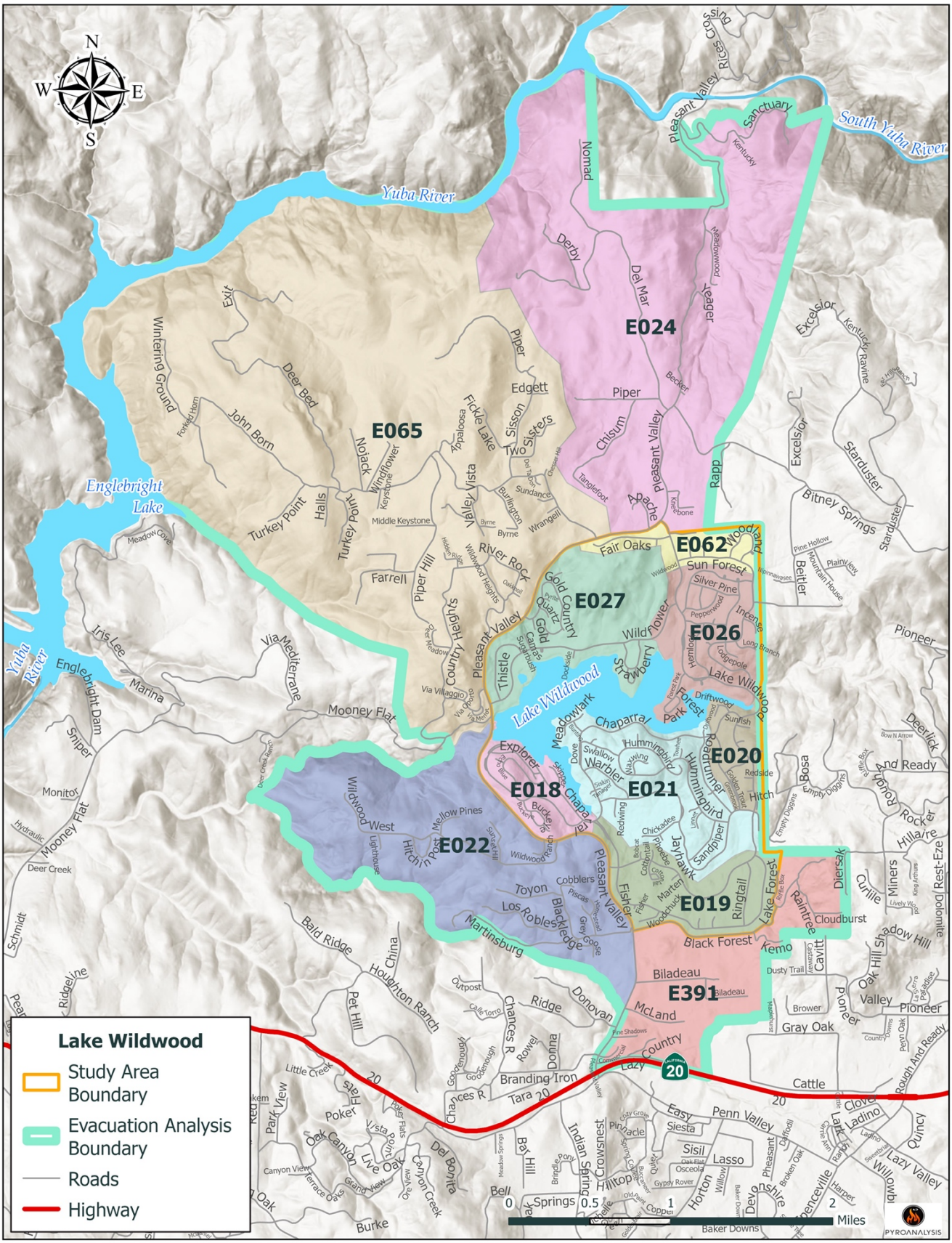



E189
E184
Greenhorn Road
Study Area Boundary
Evacuation Analysis Boundary
Roads
Highway
N
S
E
W
0
0.5
1
2
Miles
PYROANALYSIS

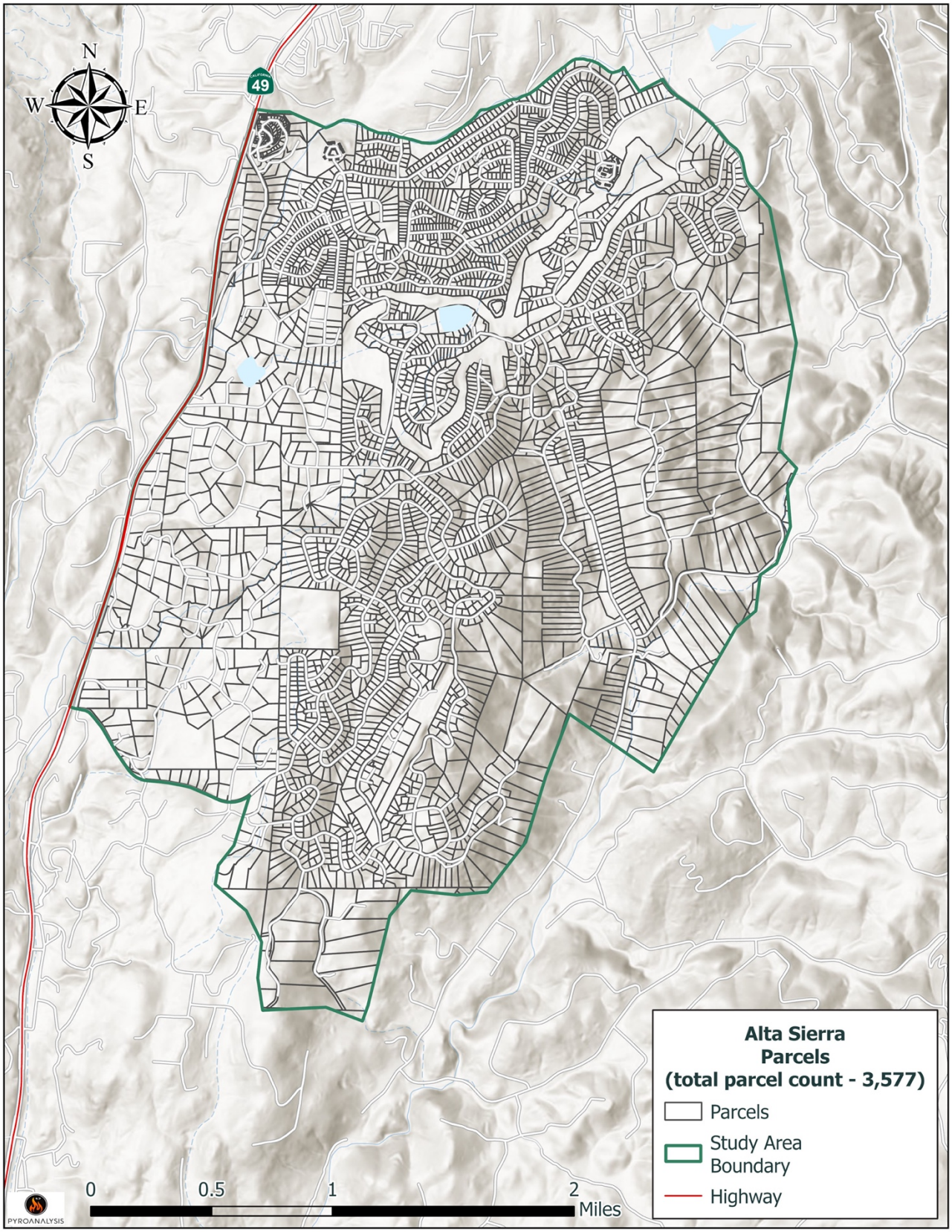

E260
E261
E266
E269
E314
E282
E283
Scotts Valley Res.
Cascade/Banner
Study Boundary
Evacuation Analysis Boundary
Roads
Highway
0.5
1
2
Miles
PYROANALYSIS

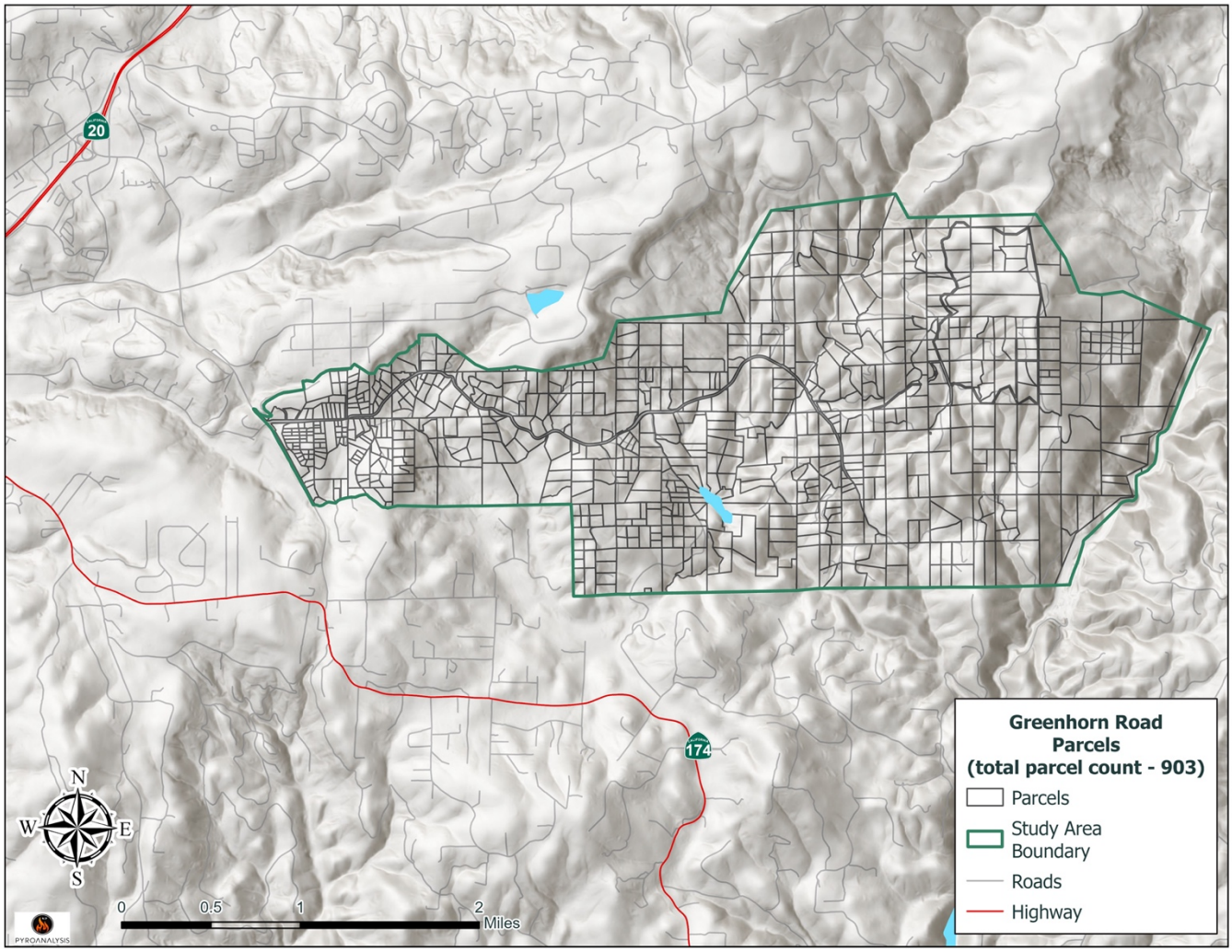

E160
E040
E037
E041
E039
E005
Lake of the Pines
Bear River
Lake of the Pines
Study Area Boundary
Evacuation Analysis Boundary
Roads
Highway
0
0.25
0.5
1
Miles
PYROANALYSIS
N
E
S
W
49
Junebug
Boulder Hill
Pioneer
Minero
Salt Creek
Knolls
Brewer
Vaquero
Ranchero
Iron Horse
Egbert Hill
Angeli
Hacienda
Wild Canary
Kingston
Peppi
Tanquary
Memory
Moss Rock
Linton
Sierra Rose
Boller
Industrial
Magnolia
Sunset Ridge
Mikado
Madrone
Bluebird
Clover
Lakeview
Sequoia
Broadmoor
Foothill
Torrey Pines
Cameo
Crossing
Cascade
Rubicon
Kenebec
Armstrong
Combie
Sunset Hills
Sycamore
La Costa
Sun Terrace
Hazel
Western
Wanderer
Wayfarer
Higgins
Field
Lilac
Woodridge
Raker
Rosewood
Green
Amber
Lakeshore
Clubhouse
Shadow
Woodhaven
Hickory
Birch
Saint Andrews
Lone Pine
Rolling Hills
Acacia
Chestnut
Poplar
Woodland
Chandler
Masters
Darkhorse
Riata
Star
Redwood
Oakmont
Balsam
Timber Ridge
Greenbriar
Green Valley
Inverness
Ash
Farm
Elm
Ironwood
Sharonjack
Bobolink
Timber
Torrey Pines Combie
Skylark
Lavender
Camelia
Manzanita
Forest
Austin
Deer Trail
Rodeo Flat
Ridge Top
Nicklaus
Bunkerhill
Alexis
Hidden Ranch
Starfire
Beaver
Oro Valley
Long
Landon Evan
Scooter Bug
Forest Lake
Table Meadow
Treehenge
China Hollow
Ramada
Rincon
Connie
Puma

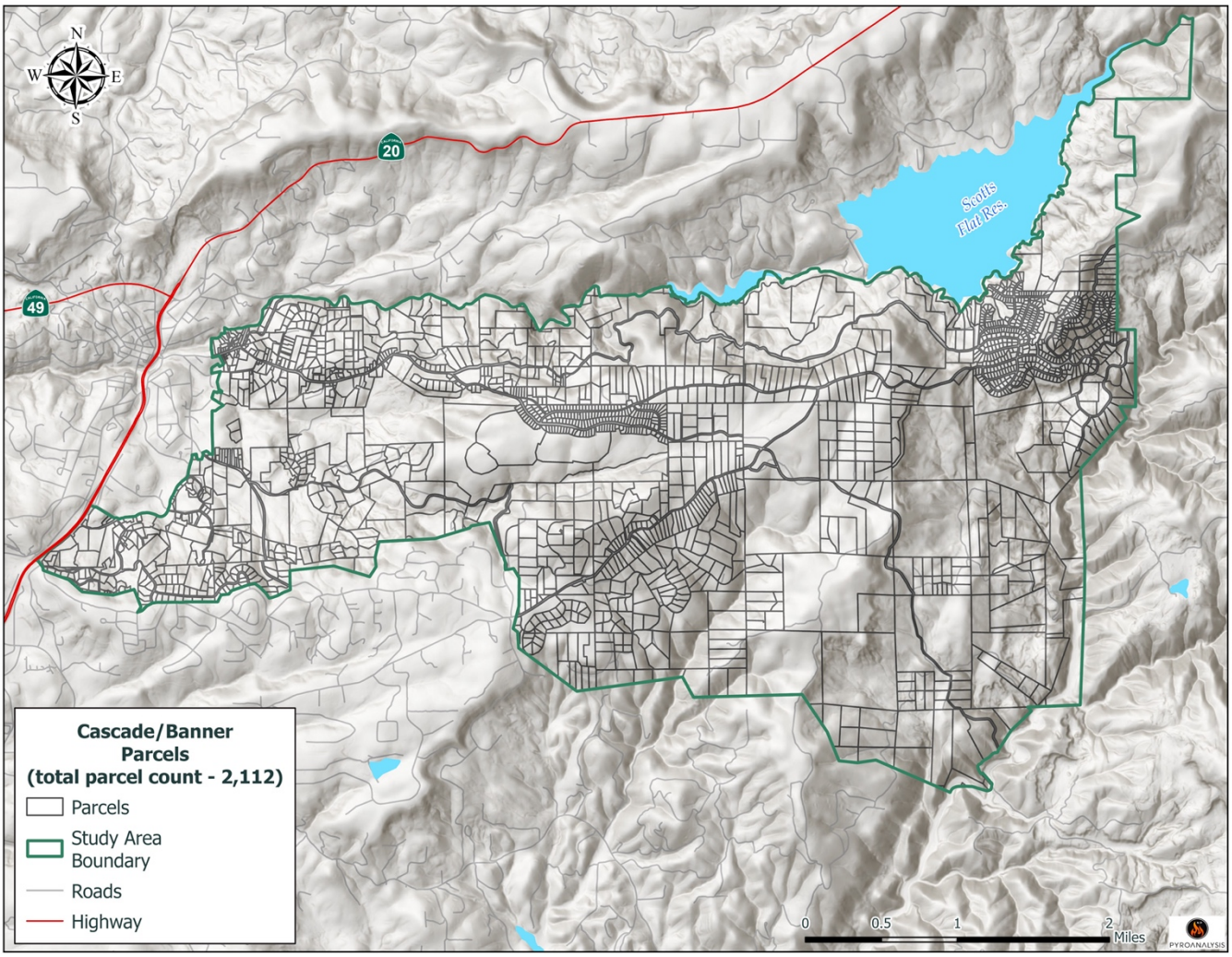

E065
E024
E062
E027
E026
E018
E020
E021
E022
E019
E391
Lake Wildwood
Study Area Boundary
Evacuation Analysis Boundary
Roads
Highway
0 0.25 0.5 1 Miles
PYROANALYSIS

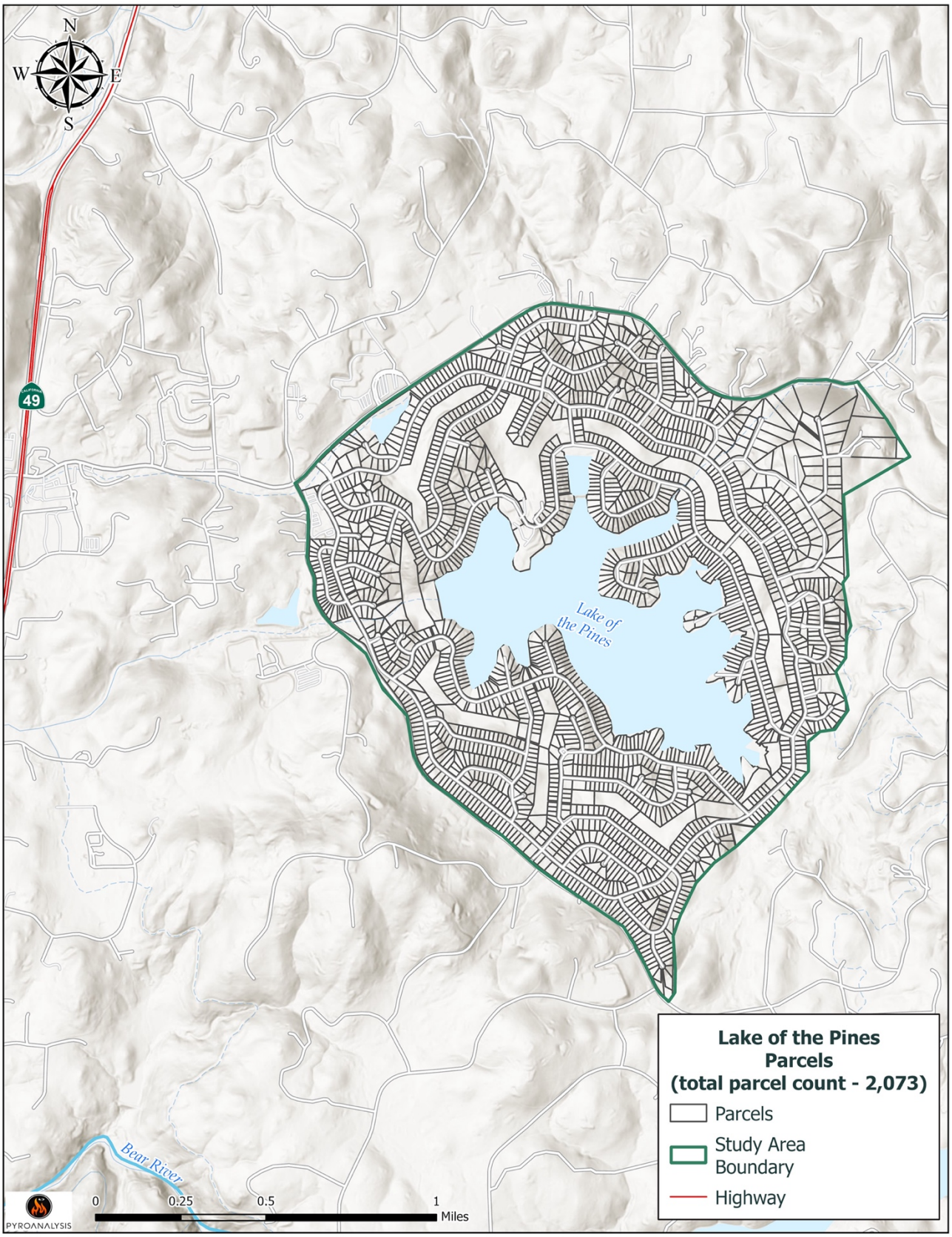

N
W
E
S
E024
E065
E062
E027
E026
E020
E018
E021
E022
E019
E391
Lake Wildwood
Study Area Boundary
Evacuation Analysis Boundary
Roads
Highway
0
0.5
1
2
Miles
PYROANALYSIS

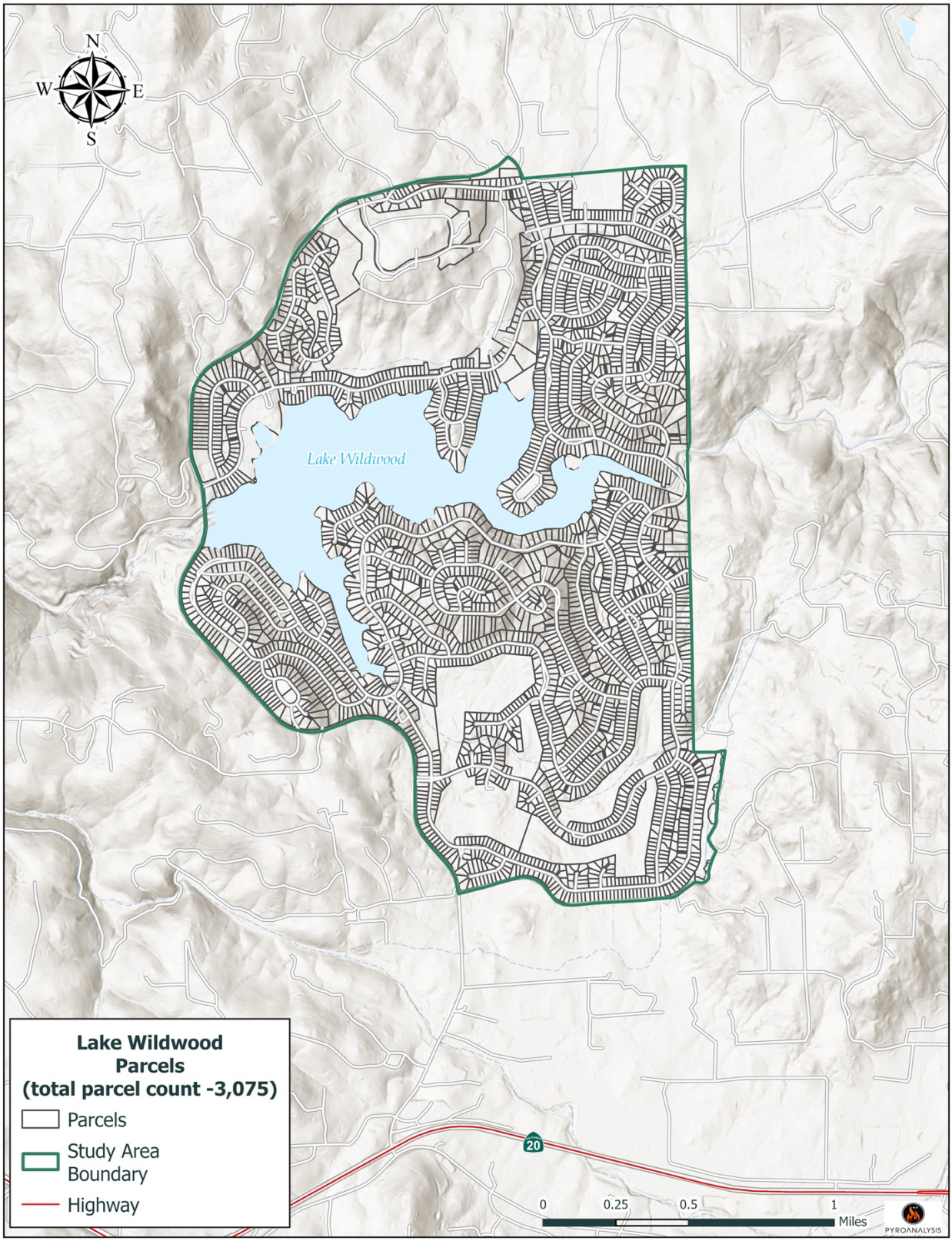
Study Area Parcel Maps




20
174
N
W
E
S
0
0.5
1
2
Miles
PYROANALYSIS
Greenhorn Road Parcels
(total parcel count - 903)
Parcels
Study Area Boundary
Roads
Highway

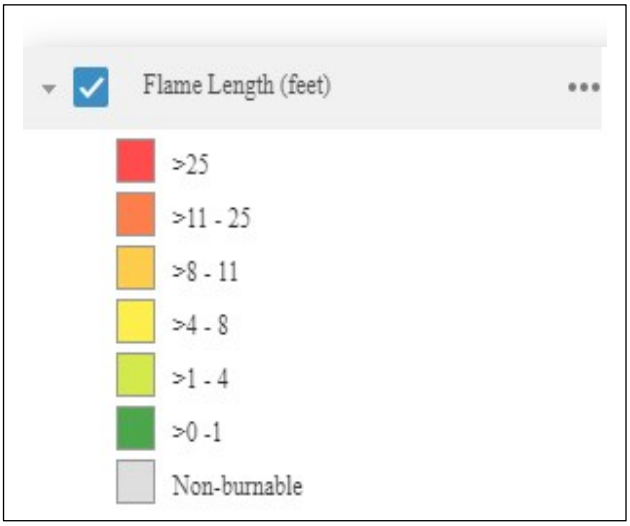

N
W
E
S
20
49
Scotts Flat Res.
Cascade/Banner Parcels
(total parcel count - 2,112)
Parcels
Study Area Boundary
Roads
Highway
0
0.5
1
2
Miles
PYROANALYSIS

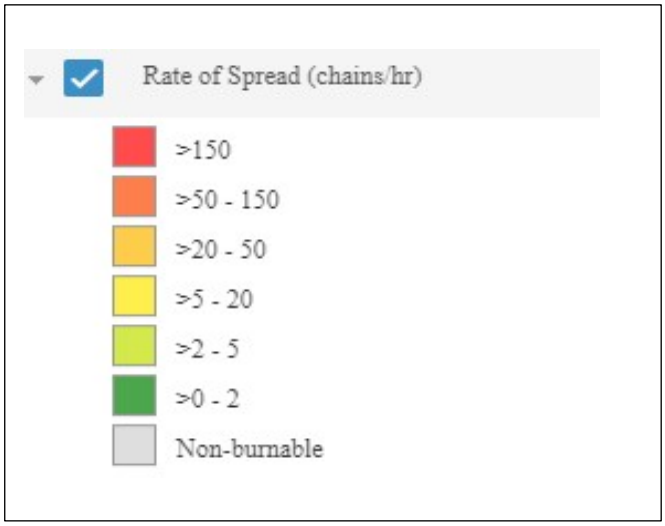

N
W
E
S
49
Lake of the Pines
Bear River
0
0.25
0.5
1
Miles
PYROANALYSIS
Lake of the Pines Parcels
(total parcel count - 2,073)
Parcels
Study Area Boundary
Highway


N
W
E
S
Lake Wildwood
Lake Wildwood
Parcels
(total parcel count -3,075)
Parcels
Study Area
Boundary
Highway
20
0
0.25
0.5
1
Miles
PYROANALYSIS

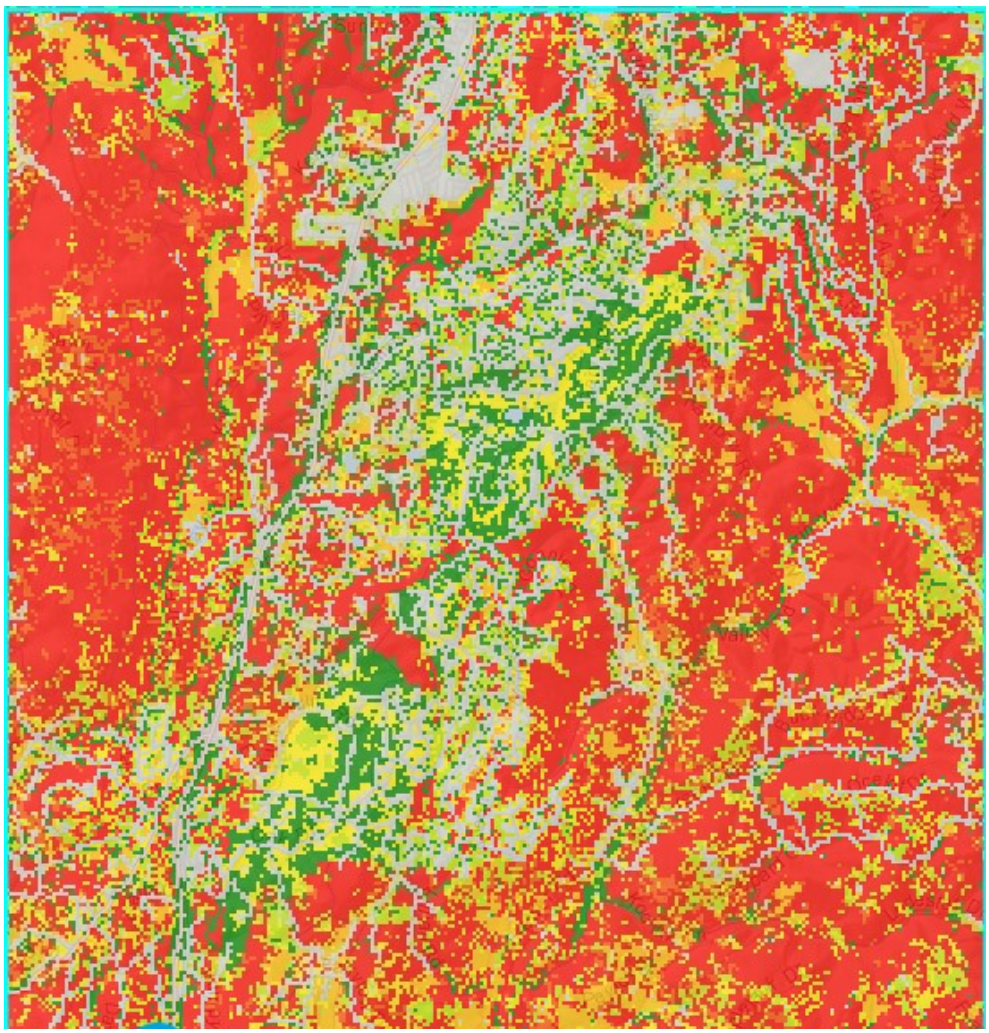
Section 3
Fire Behavior Modeling

Fire Behavior Modeling Legends

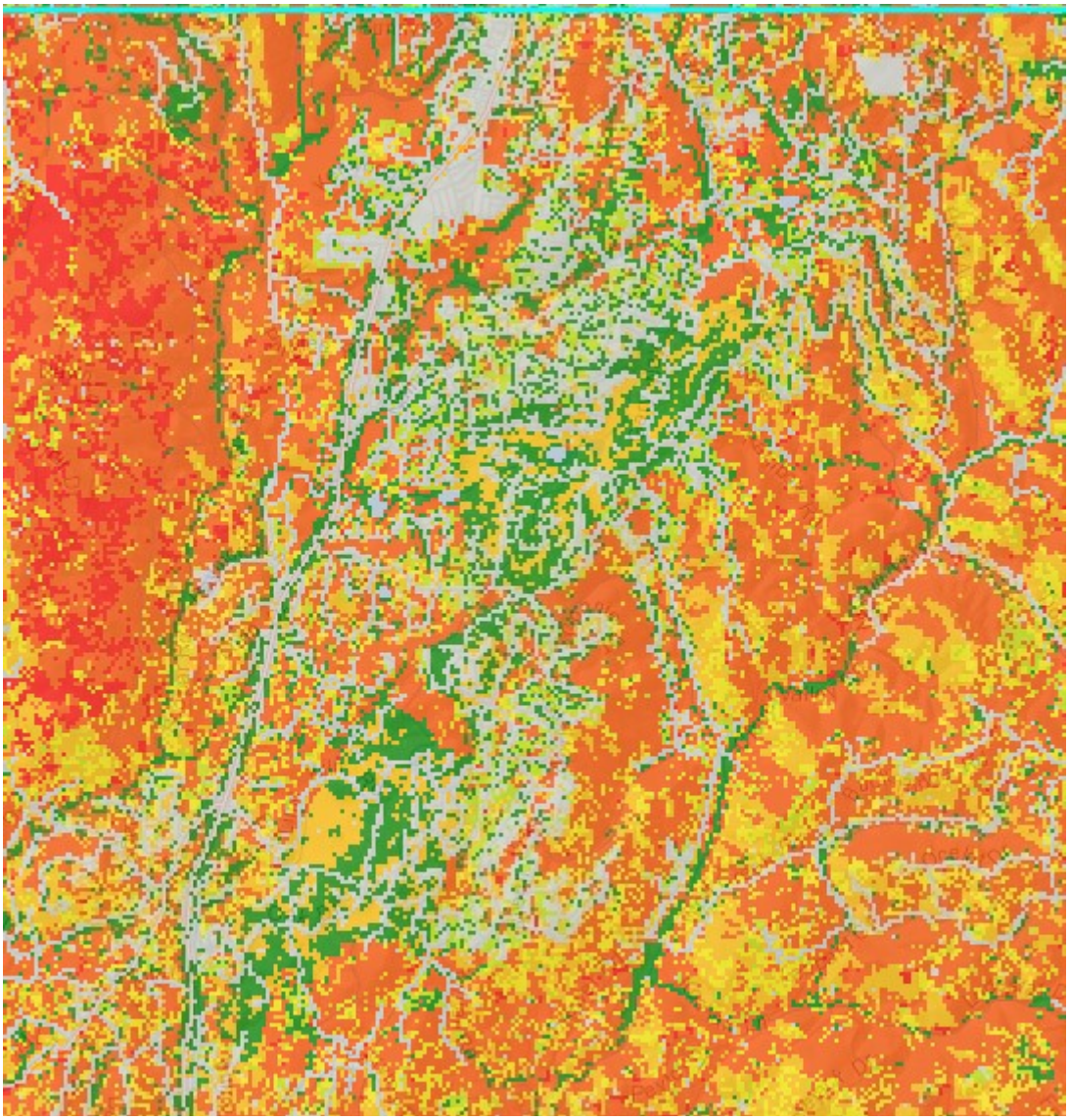




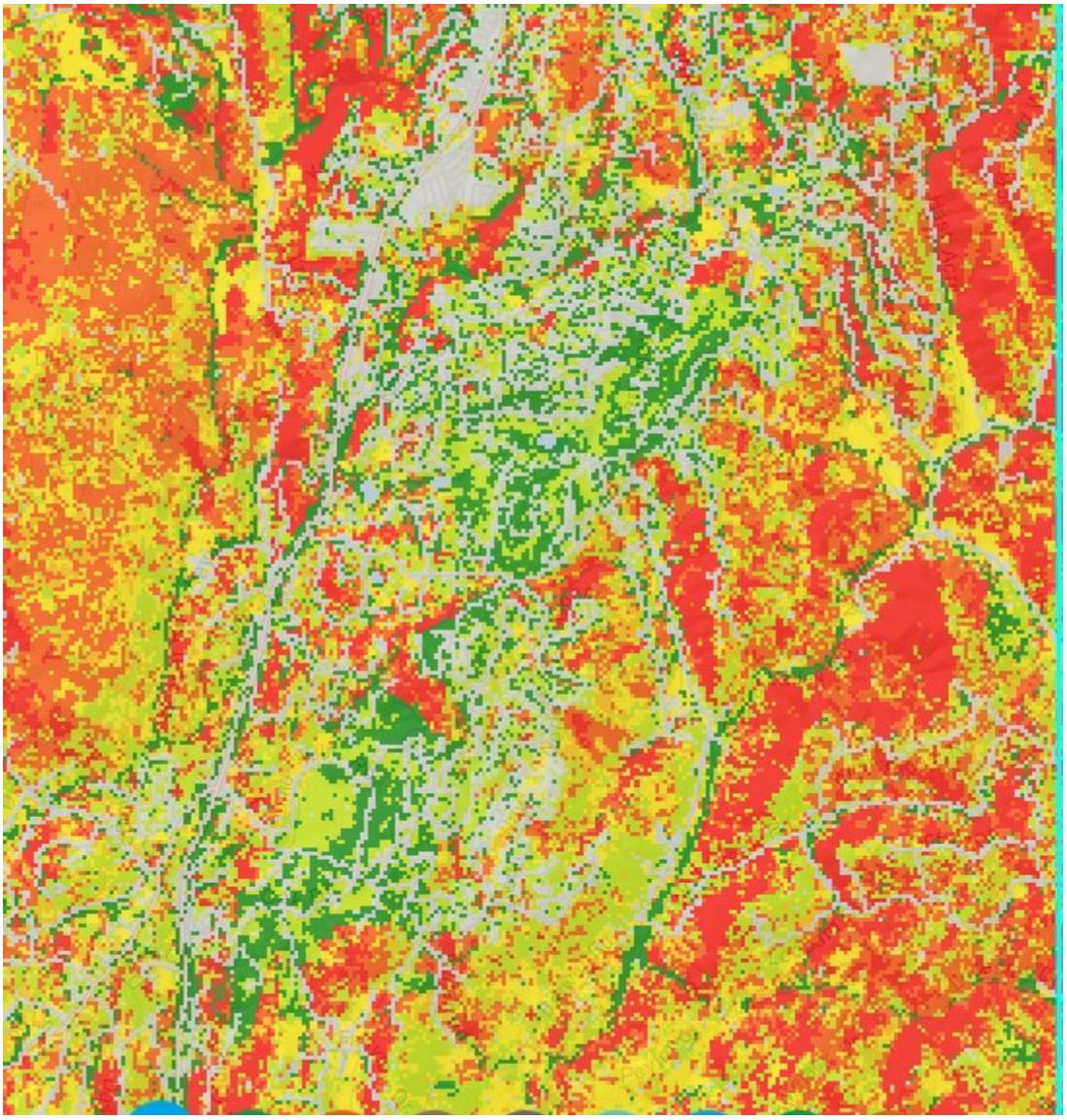
Alta Sierra NE Wind Flame Length



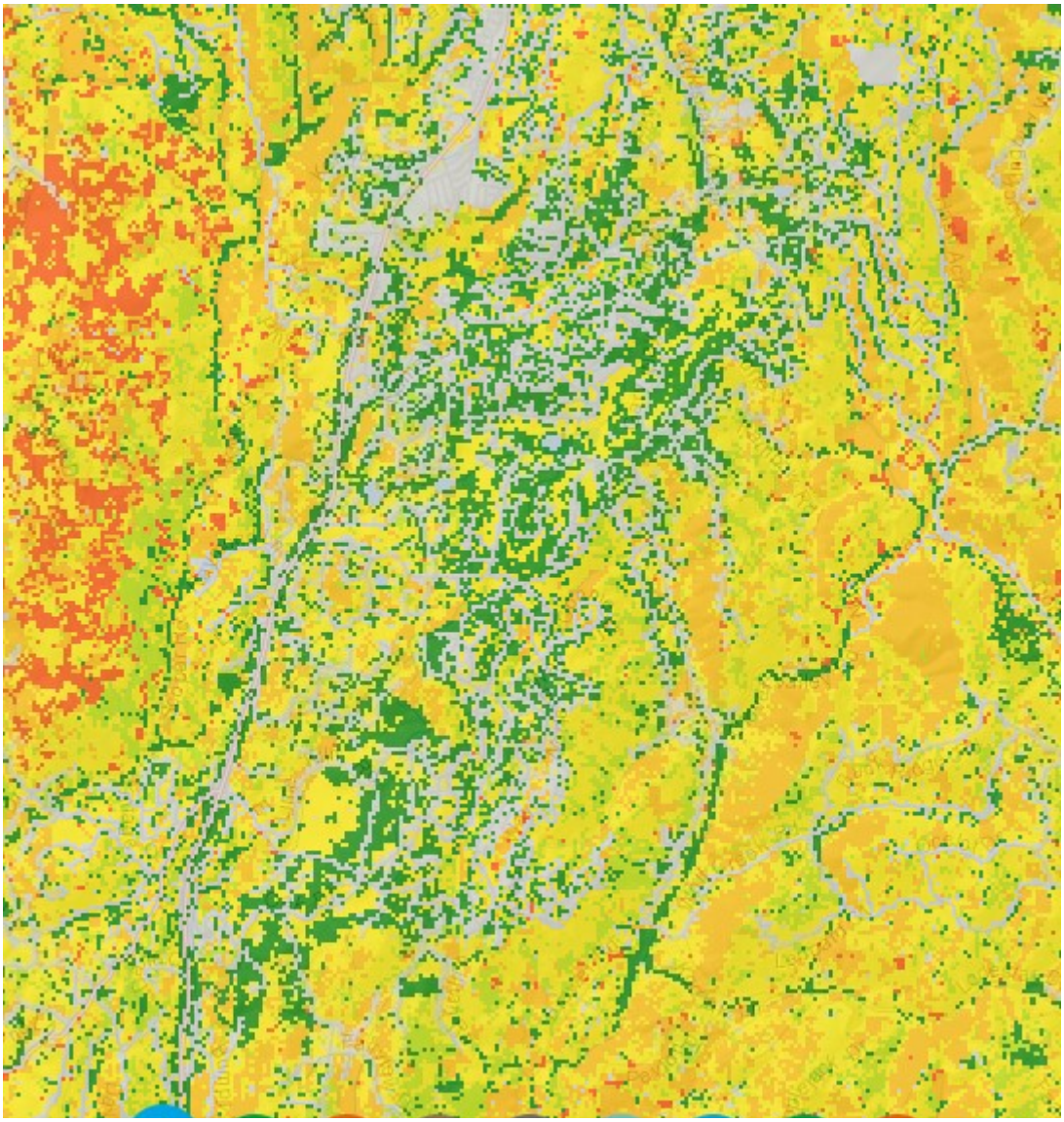
Alta Sierra NE Wind Rate of Spread



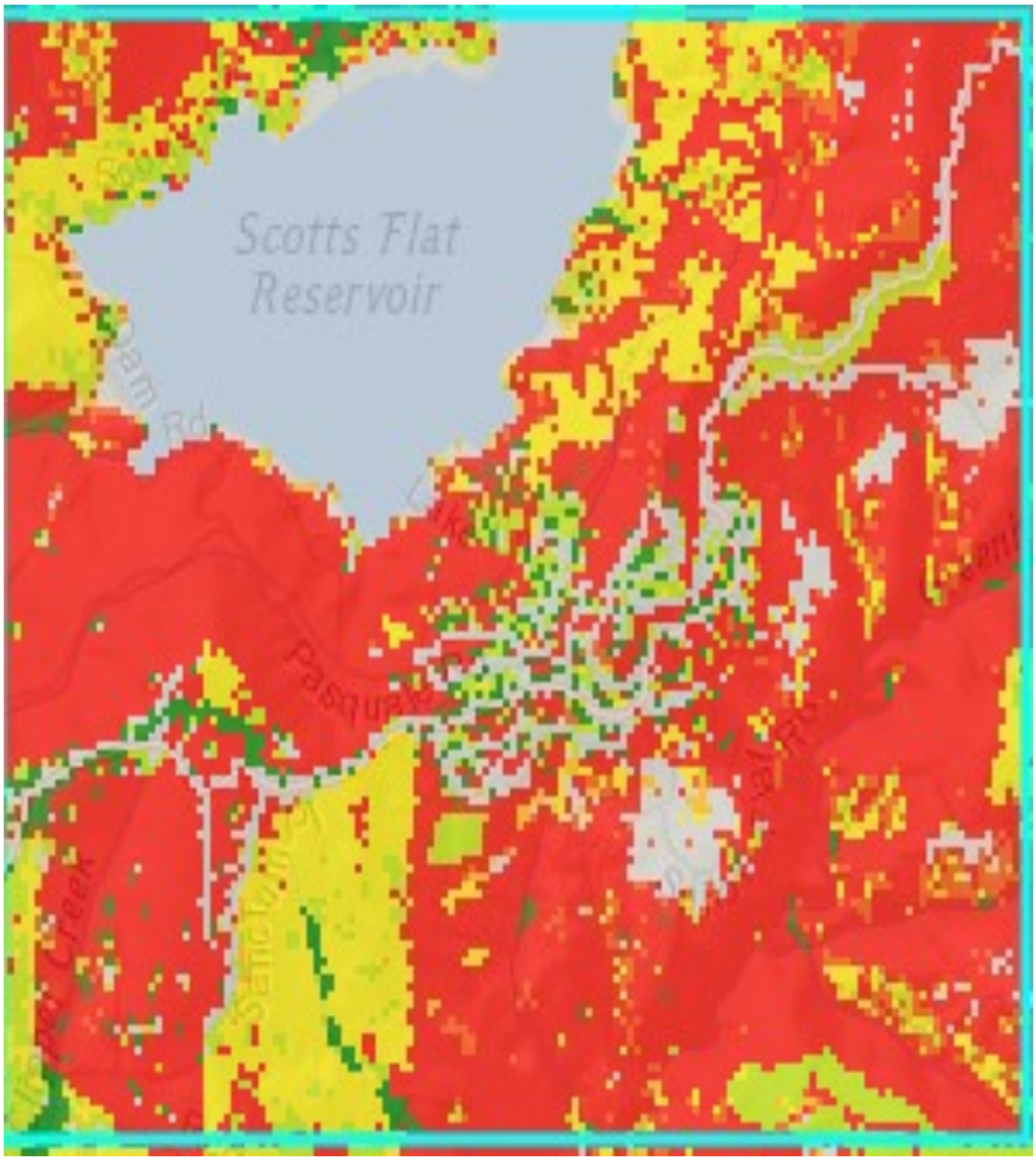
Alta Sierra SW Wind Flame Length



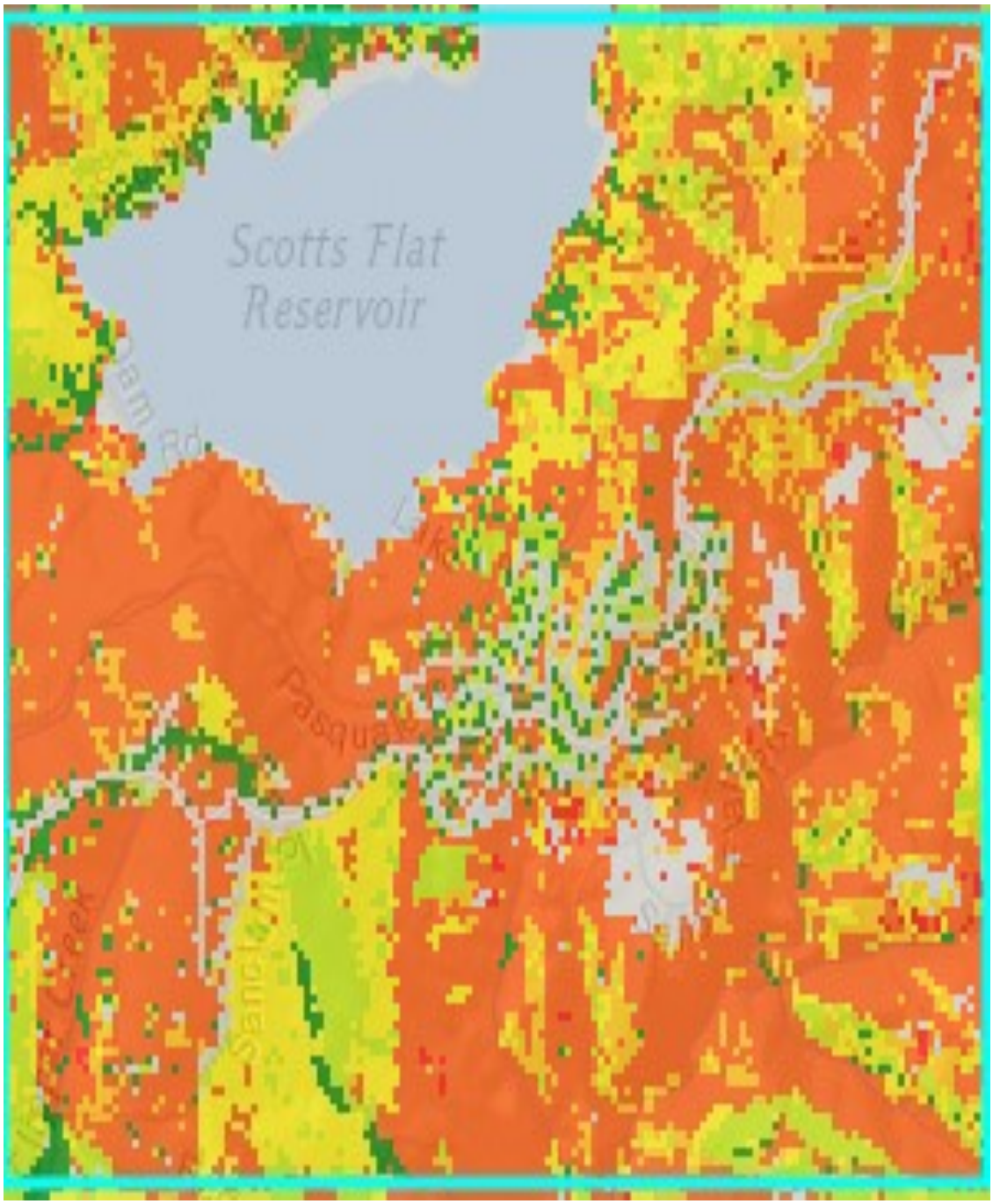
Alta Sierra SW Wind Rate of Spread



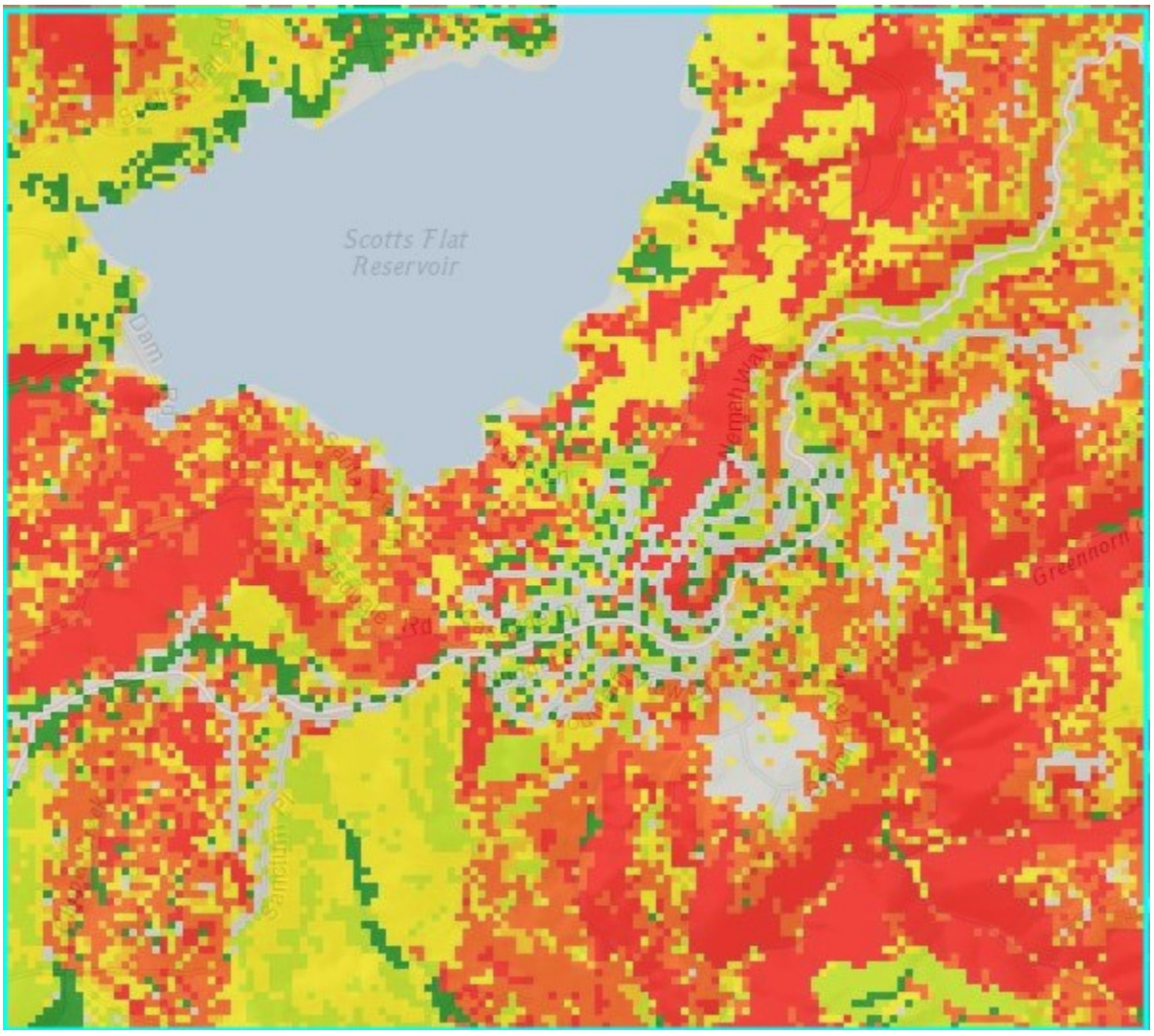
Cascade Shores/Banner Mountain NE Wind Flame Length



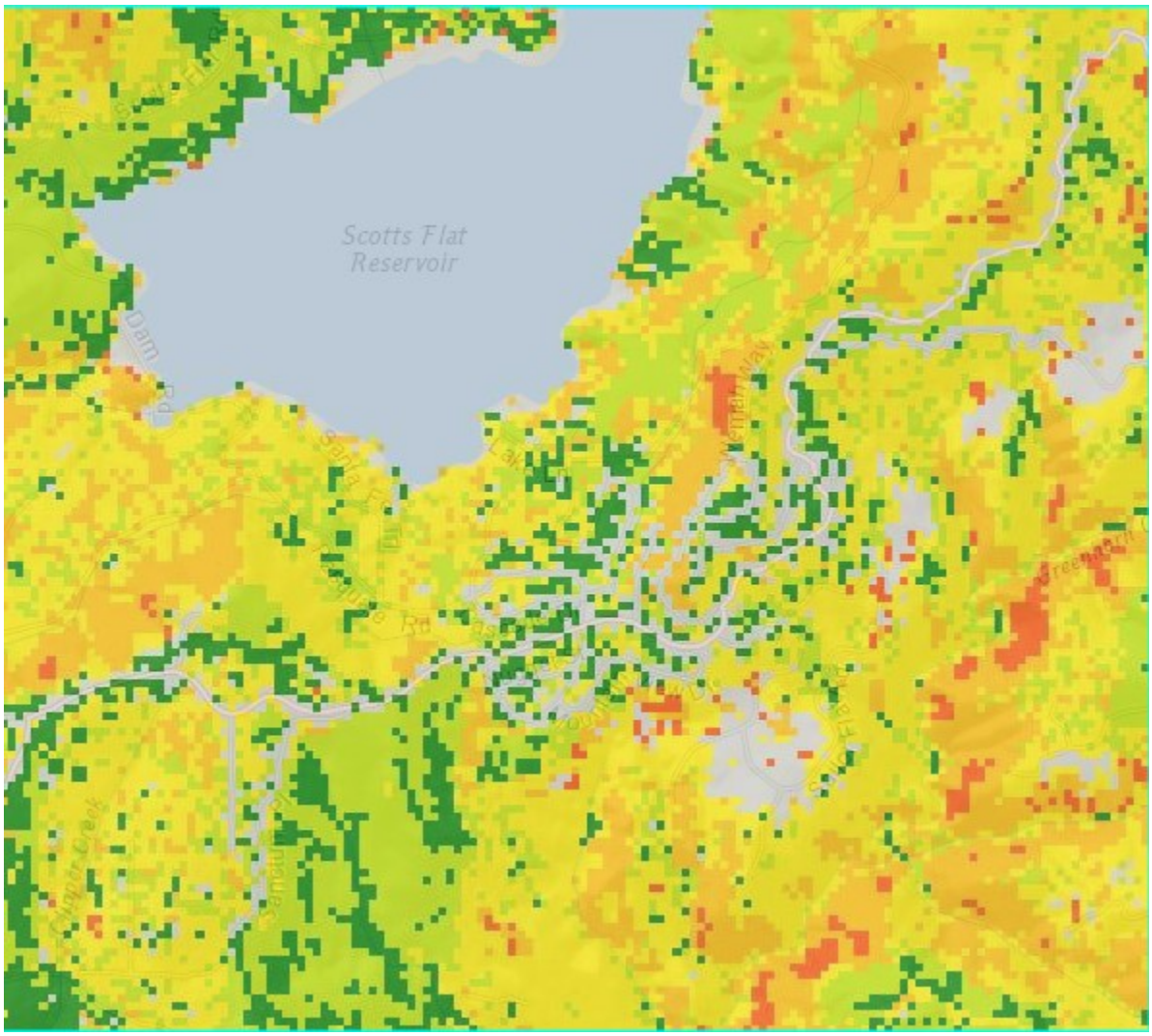
Cascade Shores/Banner Mountain NE Wind Rate of Spread



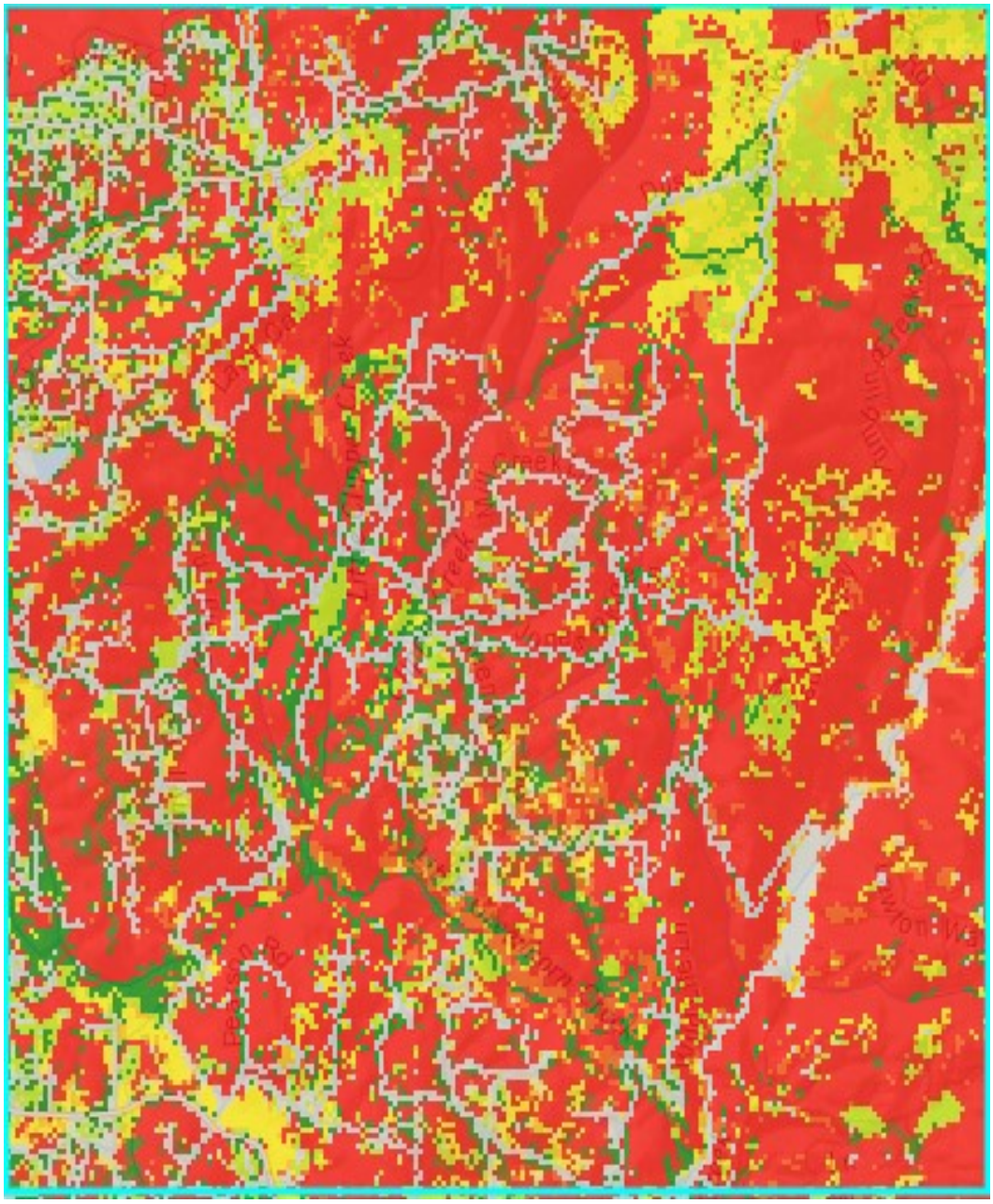
Cascade Shores/Banner Mountain SW Wind Flame Length



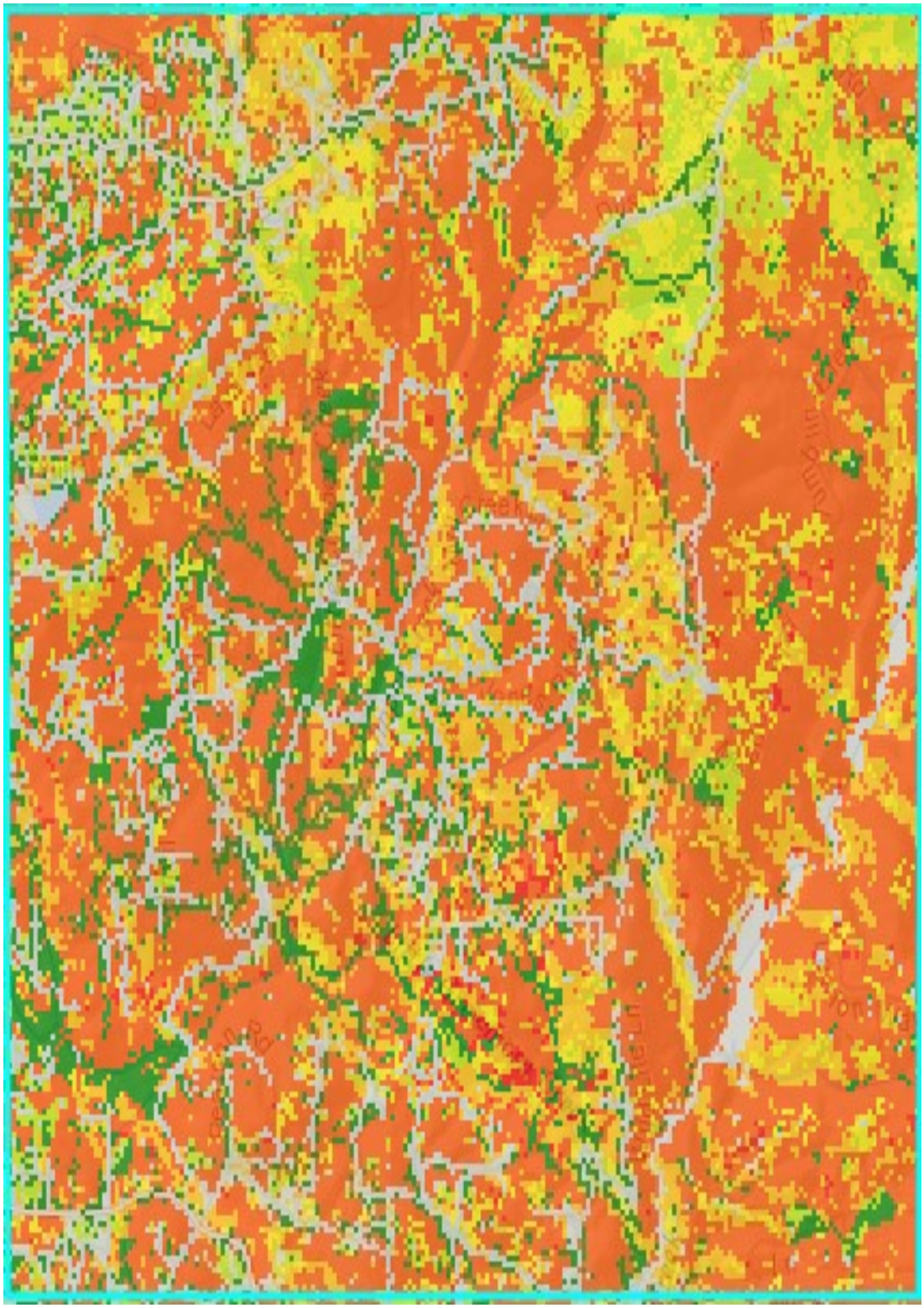
Cascade Shores/Banner Mountain SW Wind Rate of Spread



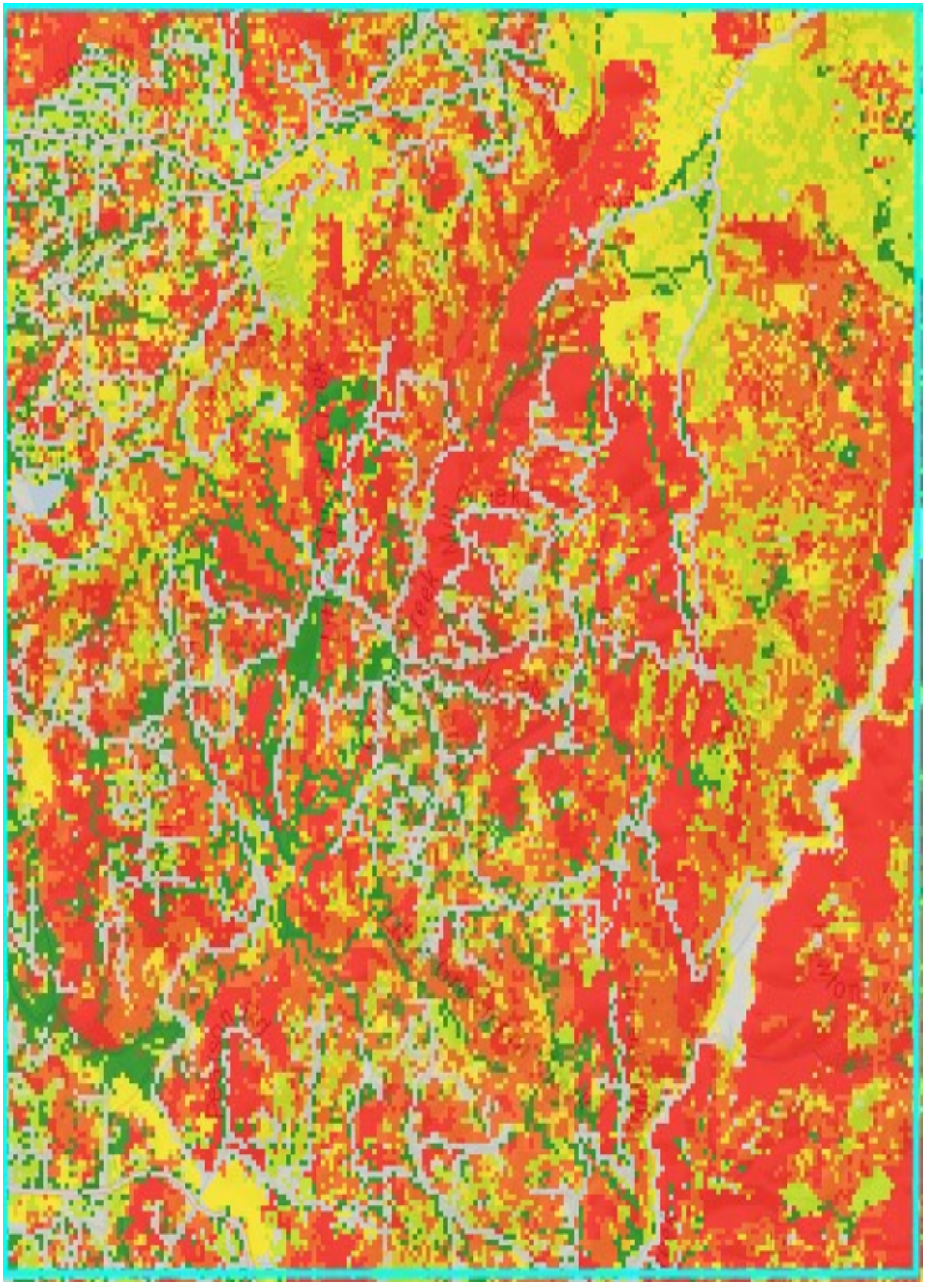
Greenhorn NE Wind Flame Length



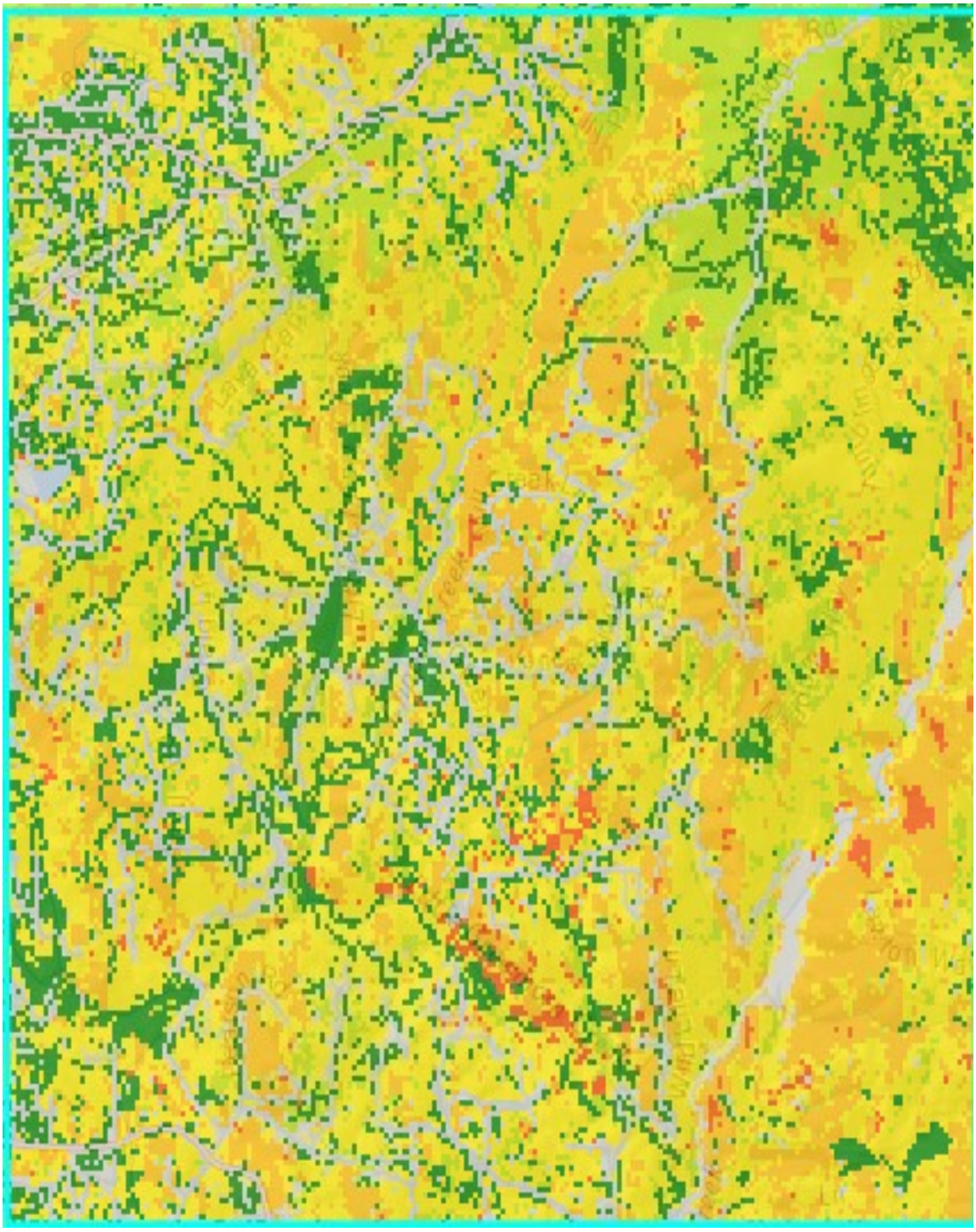
Greenhorn NE Wind Rate of Spread



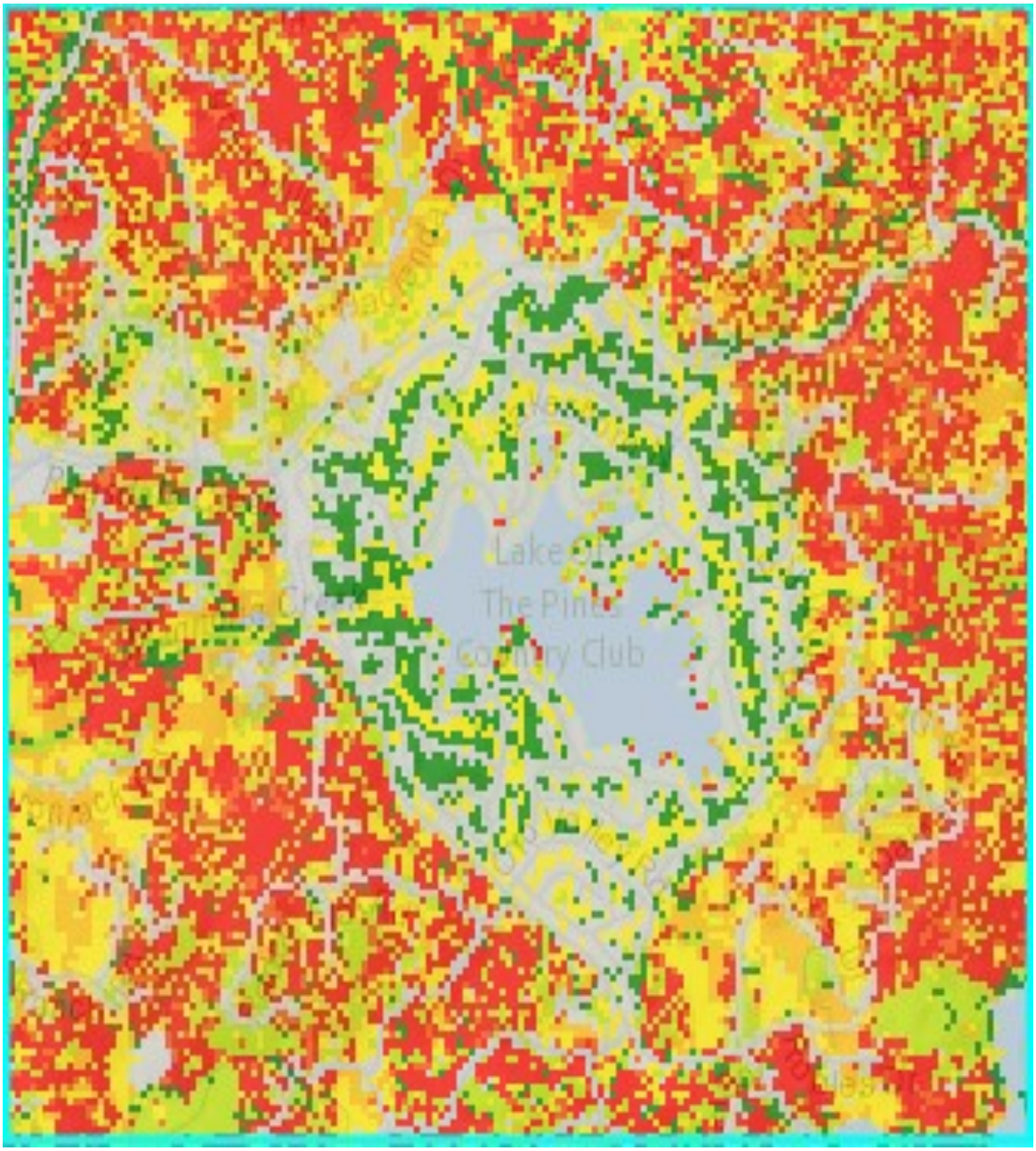
Greenhorn SW Wind Flame Length



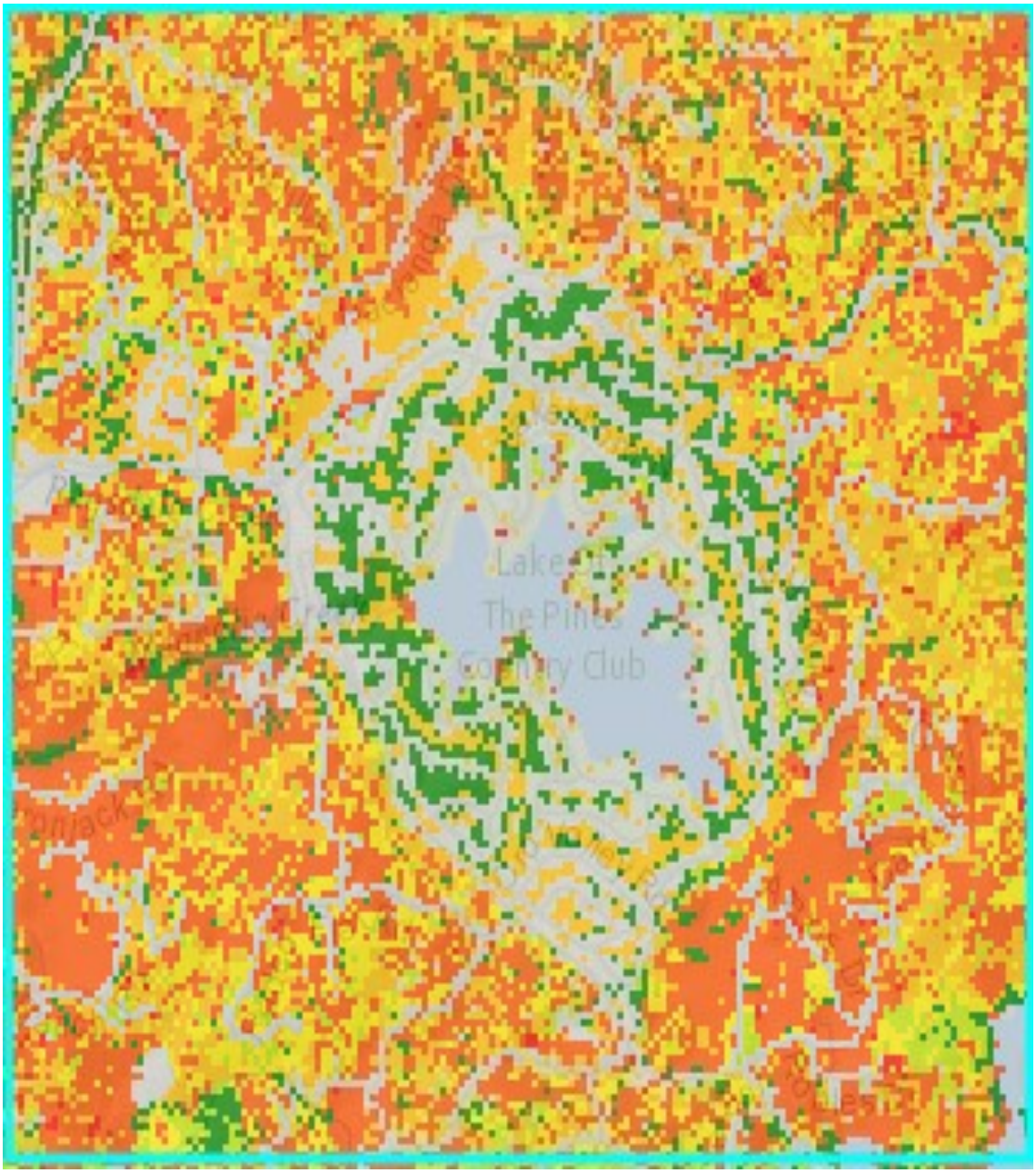
Greenhorn SW Wind Rate of Spread



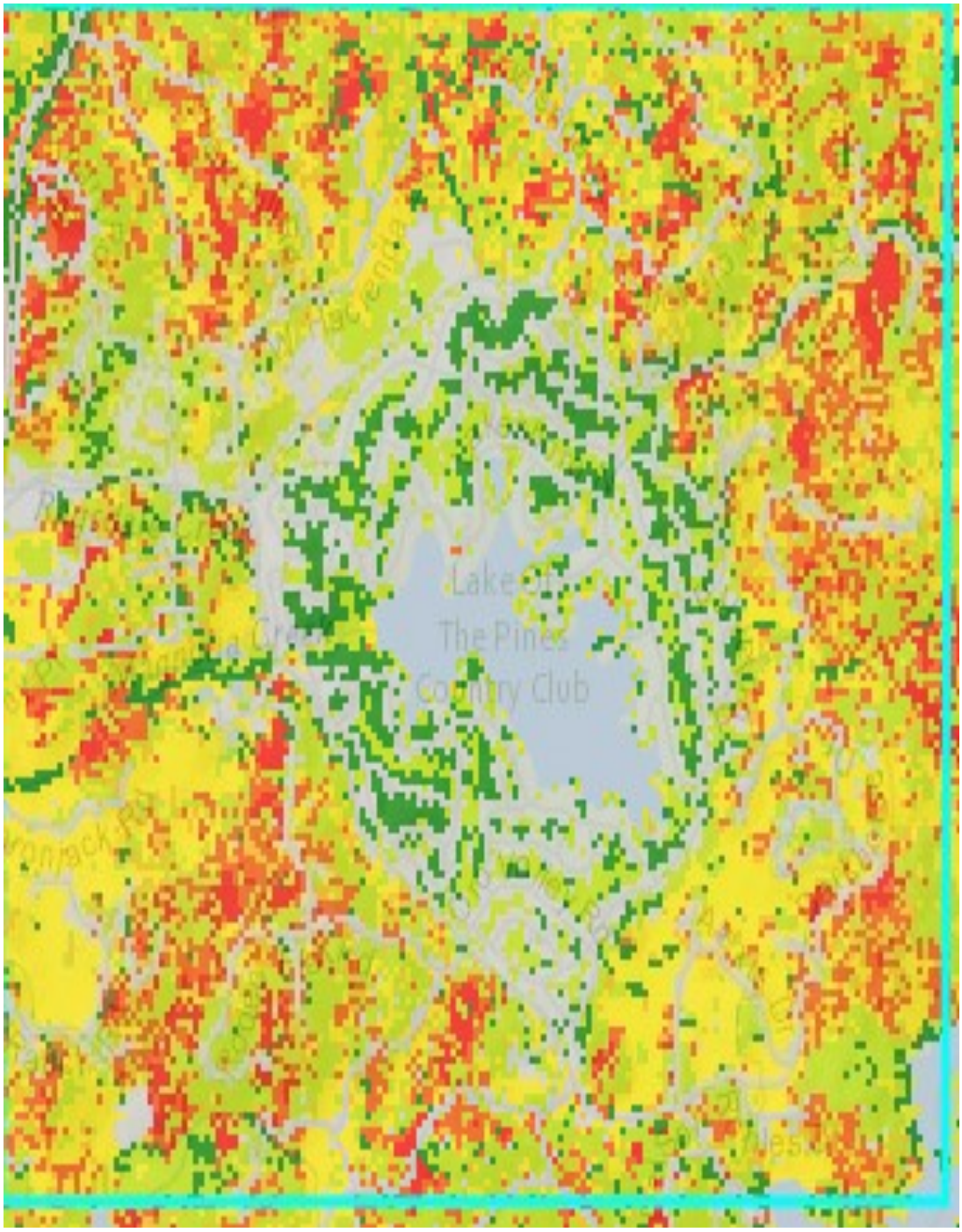
Lake of the Pines NE Wind Flame Length



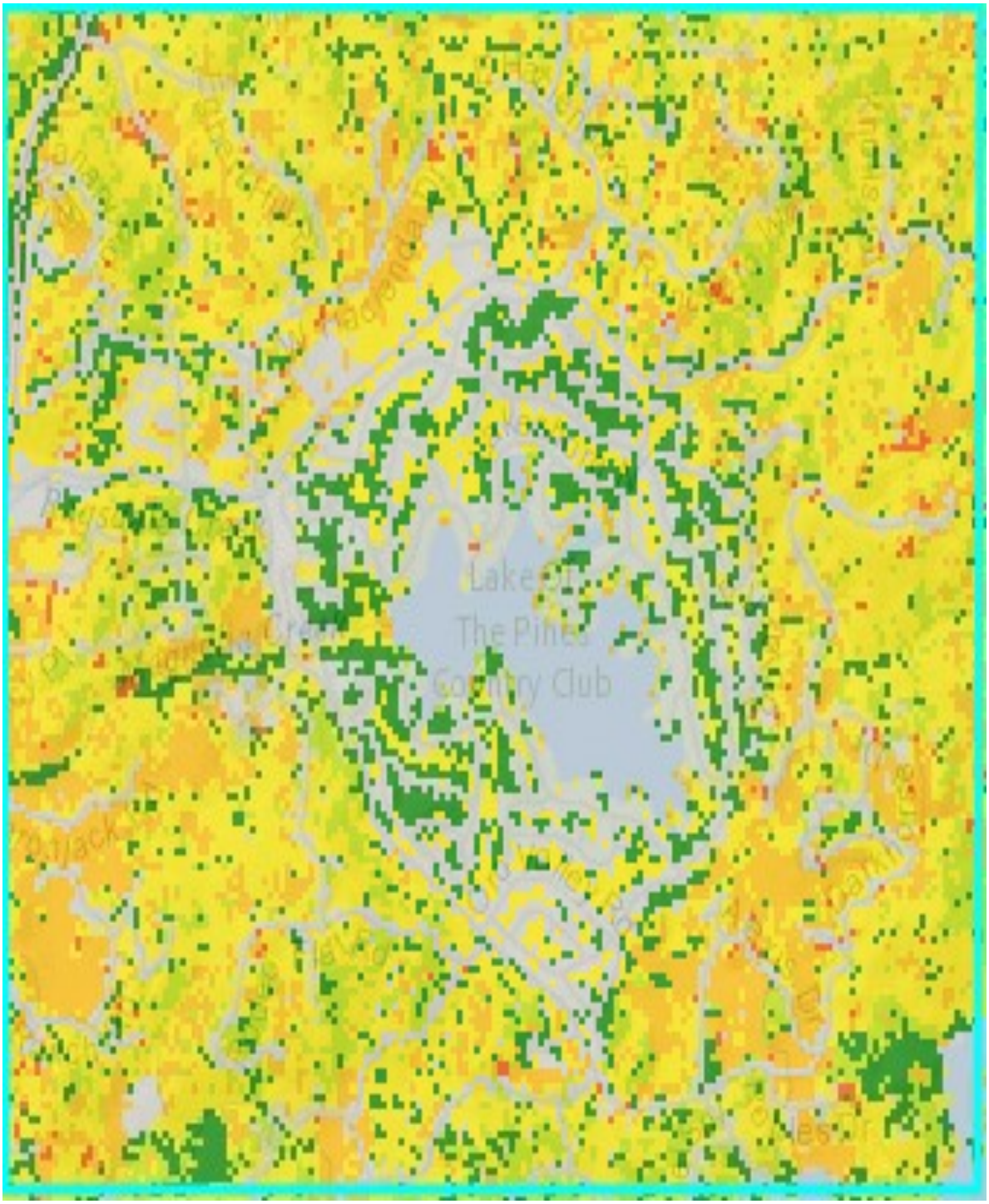
Lake of the Pines NE Wind Rate of Spread



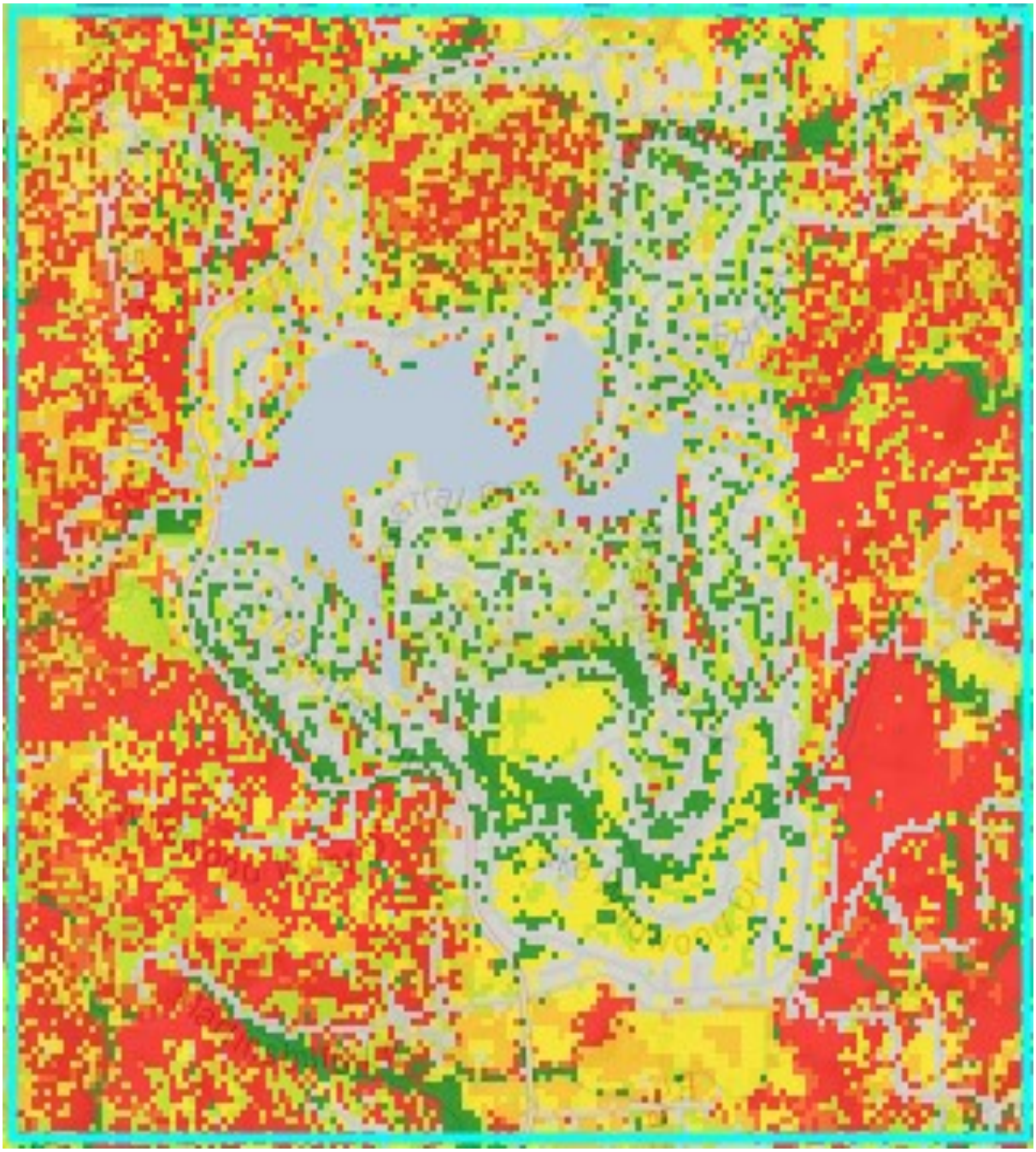
Lake of the Pines SW Wind Flame Length



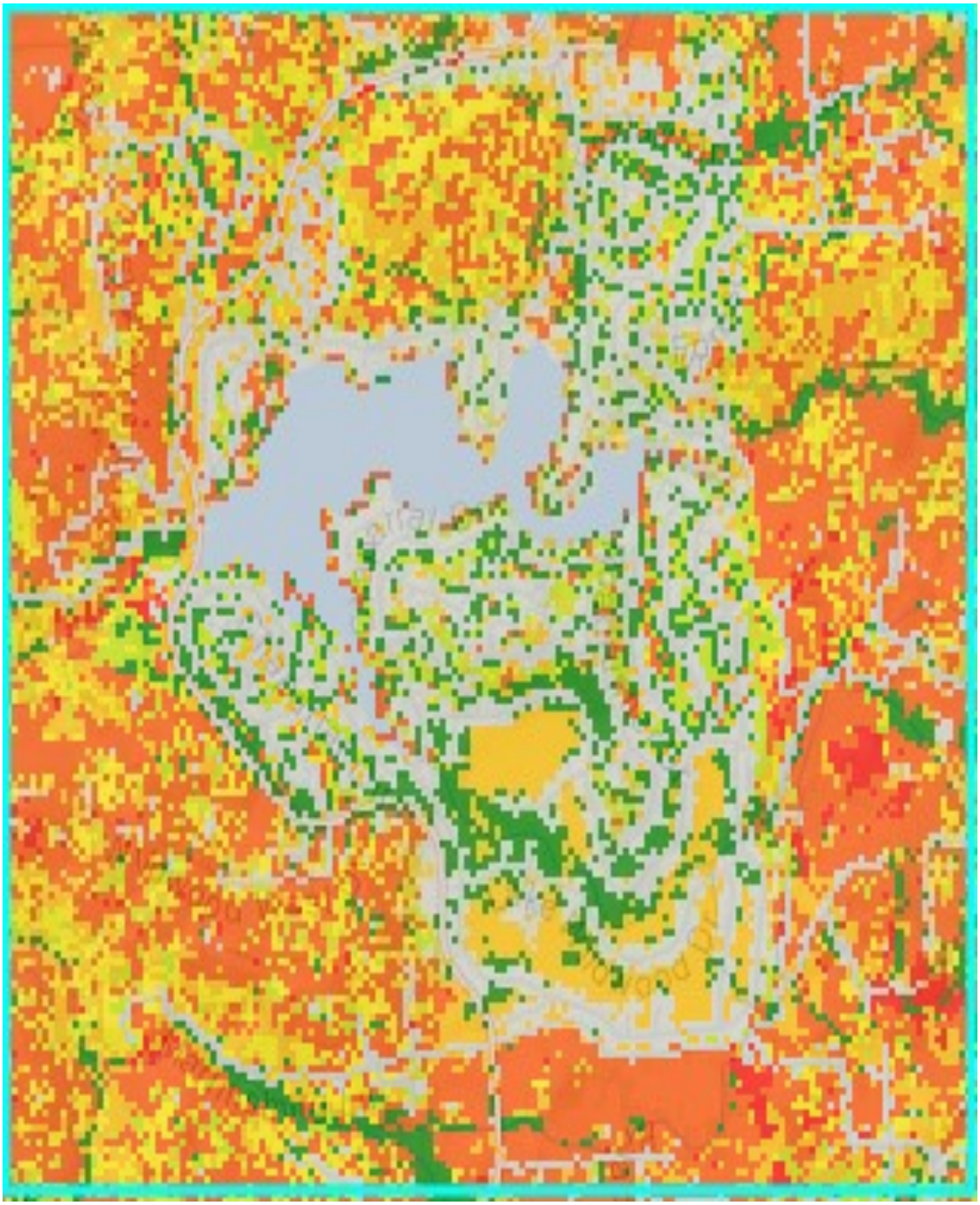
Lake of the Pines SW Wind Rate of Spread



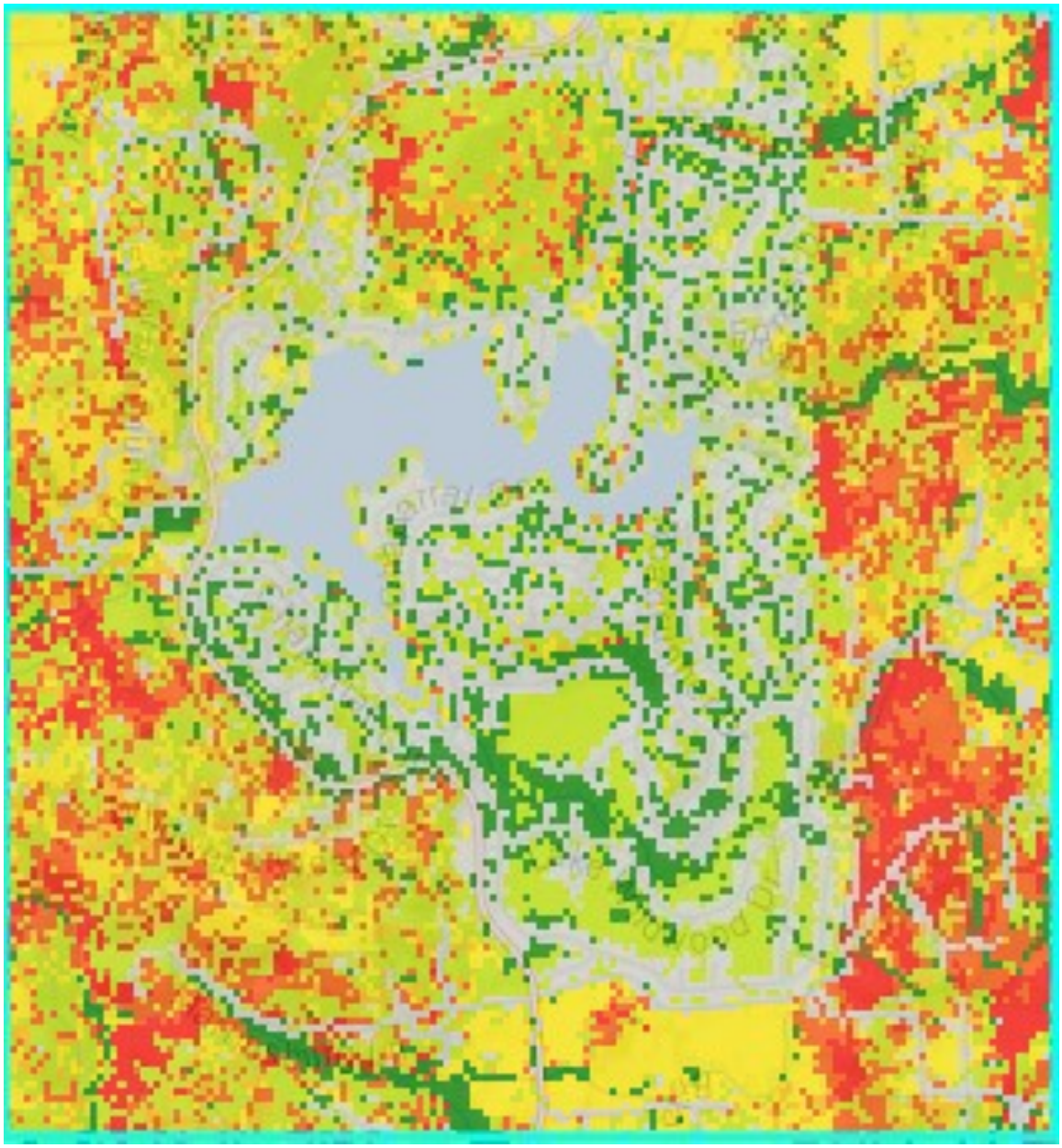
Lake Wildwood NE Wind Flame Length



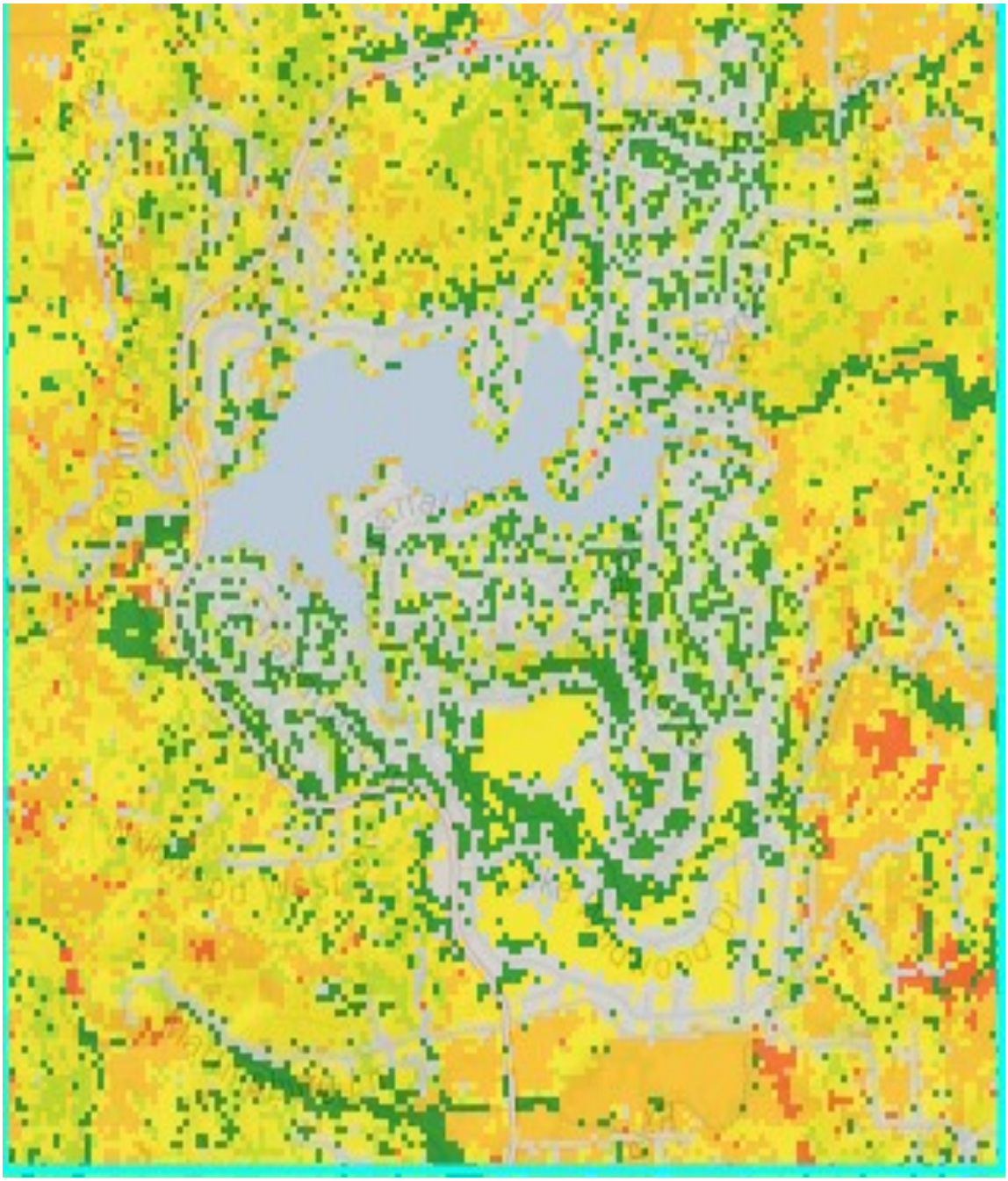
Lake Wildwood NE Wind Rate of Spread



Lake Wildwood SW Wind Flame Length

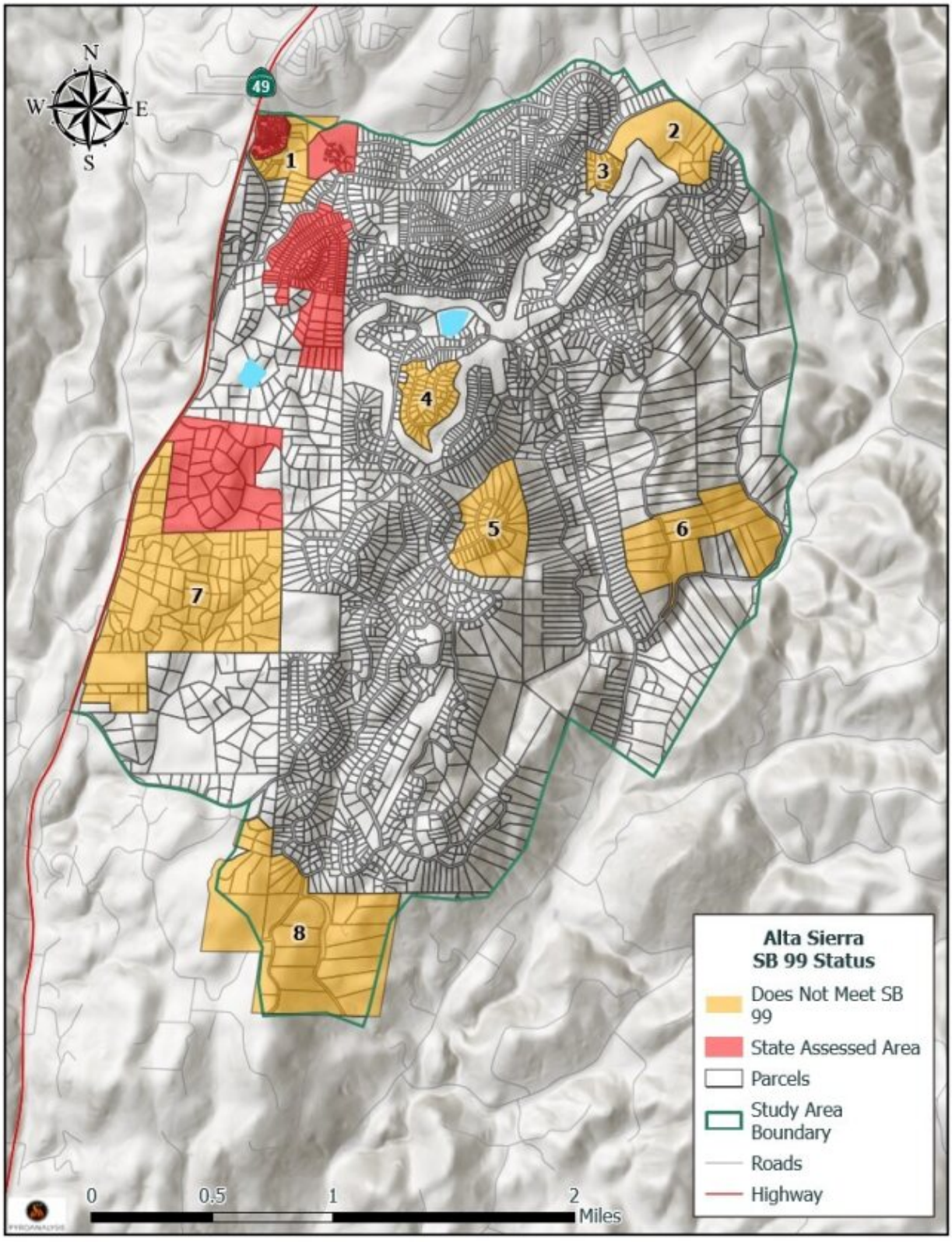


Lake Wildwood SW Wind Rate of Spread



Section 4
SB 99

Alta Sierra


N
W
E
S
49
1
2
3
4
5
6
7
8
Alta Sierra
SB 99 Status
Does Not Meet SB 99
State Assessed Area
Parcels
Study Area Boundary
Roads
Highway
0
0.5
1
2
Miles

Areas identified on the map stated as Does Not Meet SB 99 (Items 1–8)

These areas do not have a secondary ingress or egress route. In light of enhancing safety and ensuring efficient evacuation routes in these subdivisions, we recommend the following measures.

- Create a Secondary Access: Establish an additional access route for subdivisions to improve emergency ingress and egress.
- Install Reflective Addressing Signs: Implement reflective signs for structures and roads, conforming to 14 CCR § 1274.01, 1274.02, 1274.03, and 1274.04, along with the California Fire Code (California Code of Regulations, title 24, part 9).
- Install Reflective Evacuation Route Signs: Place signs that direct residents from local roads to the nearest collector roads and/or arterial highways, based on the California Highway Design Manual. These signs should adhere to the standards in the California Manual on Uniform Traffic Control Devices for emergency management.
- Limit Street Parking During High Fire Danger: When side street parking reduces road width below the standards in 14 CCR § 1273.01, especially during red flag warnings or high fire danger periods, restrict street parking to maintain a wider pathway for rapid evacuation.
- Conduct Community-Wide Evacuation Drills: Organize regular evacuation drills to prepare the community for emergency situations.
- Install Reflective Markers for Road Edges: Place reflective markers to indicate road edges or other areas of potential danger, particularly useful in periods of low visibility.

Areas previously assessed by CAL FIRE.

- Little Valley Rd 21-NEU-BC0A

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2252/attachments/2364

- Gold Creek Court 21-NEU-C0E1

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2331/attachments/2343

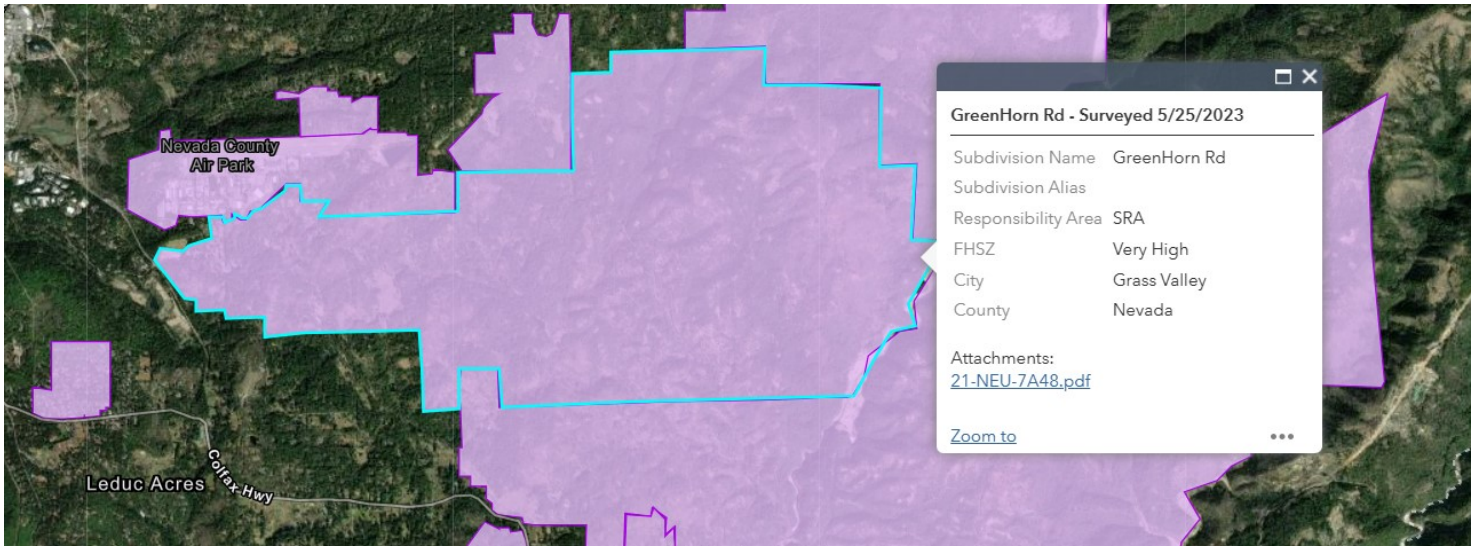
- Names Drive 21-NEU-B962

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2332/attachments/2375

- Round Valley 21-NEU-771D

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2330/attachments/2395

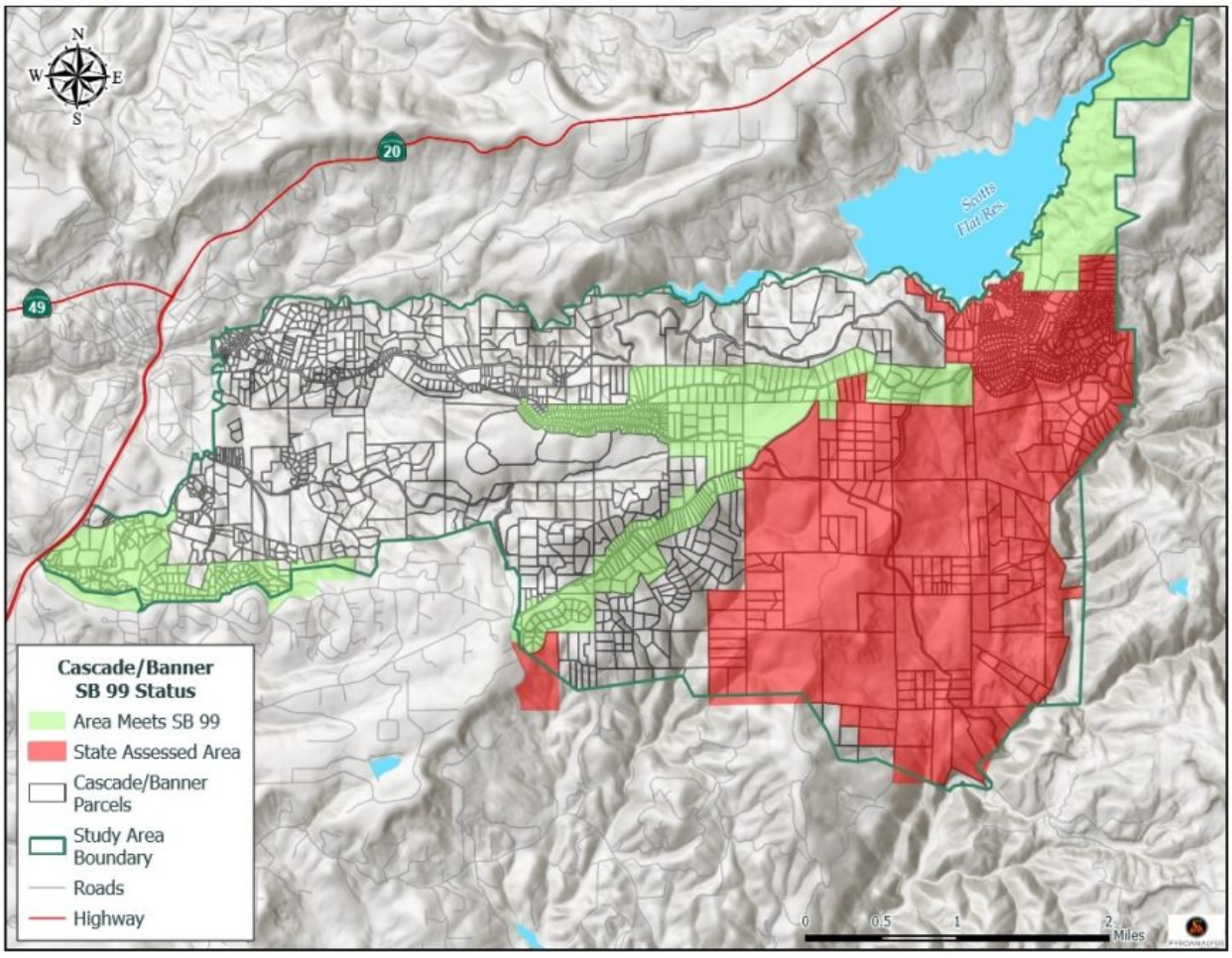
Greenhorn



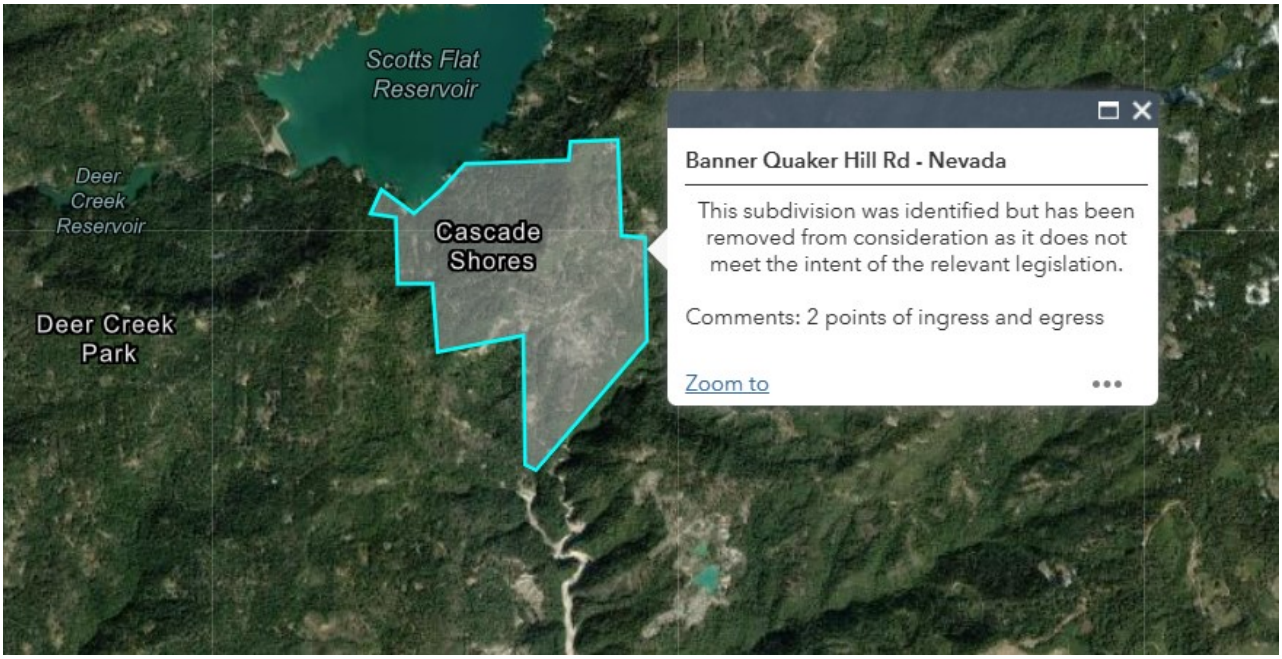
Area previously assessed by CAL FIRE
1. Greenhorn Rd 21-NEU-7A48

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2217/attachments/2345

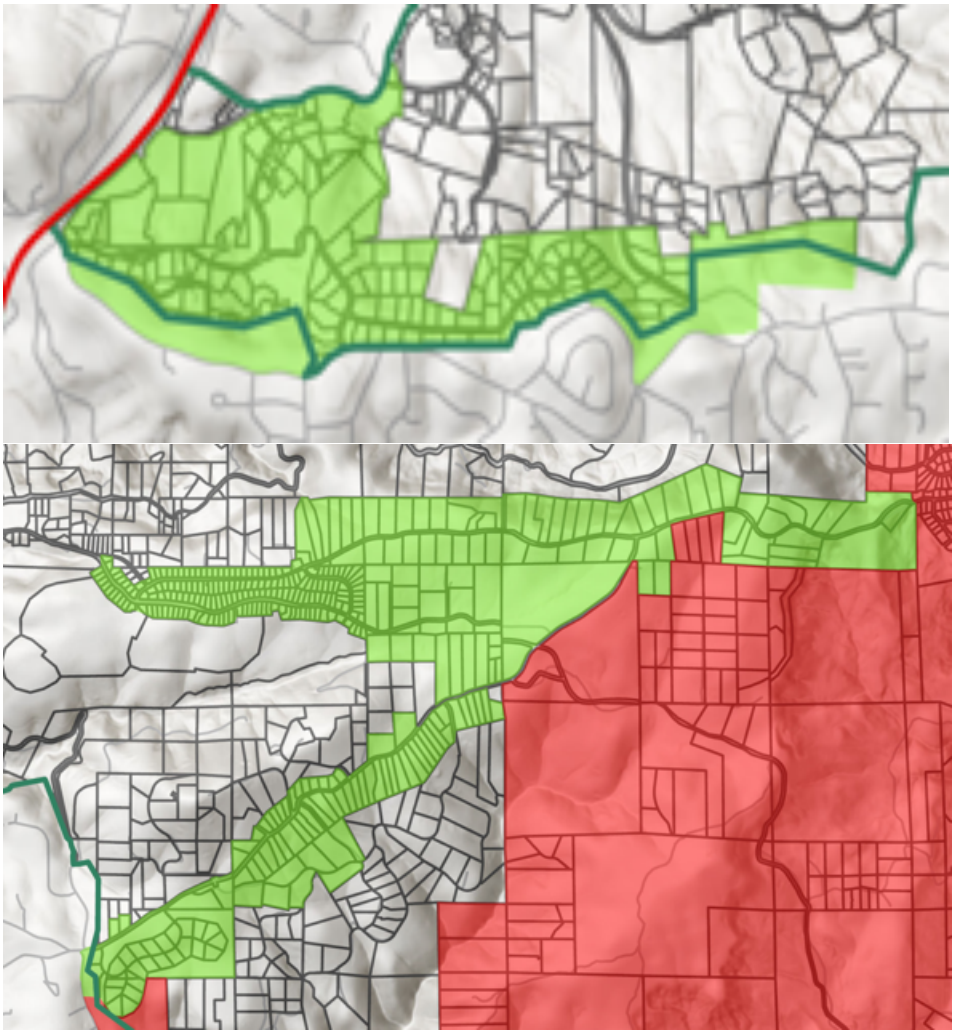
Cascade Shores/Banner Mountain

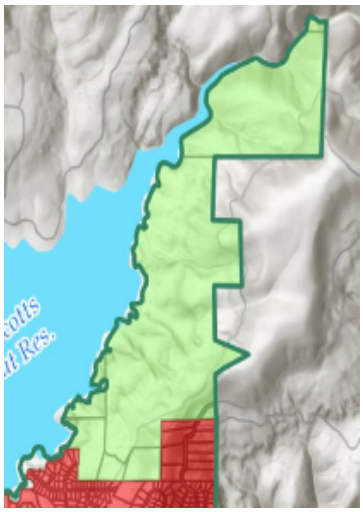


1. Areas previously assessed by CAL FIRE

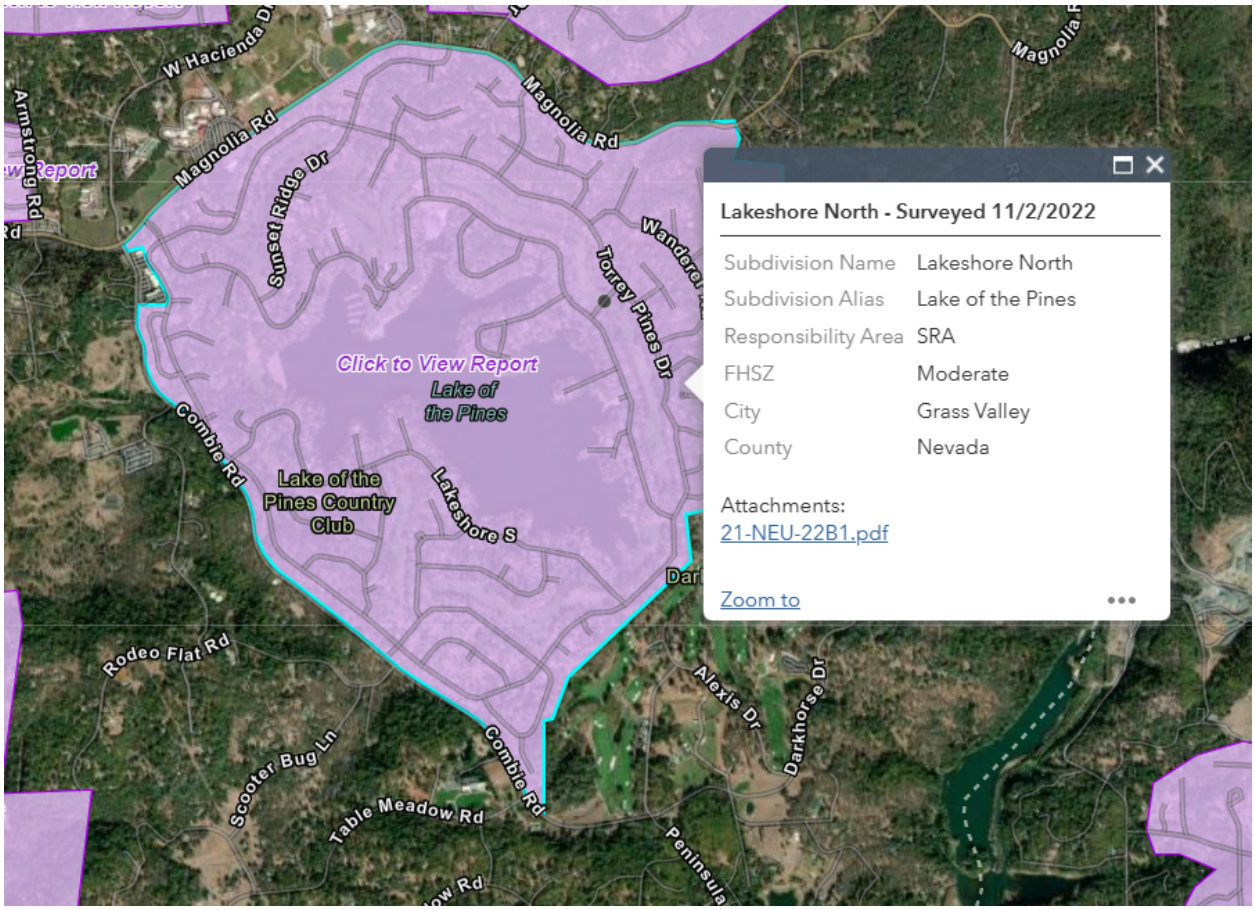


2. Red Dog Rd 21-NEU-2CA6
https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2241/attachments/2387
3, 4, and 5. The Pittsburg Road area and Quaker Hill Cross Road area maps (areas in Light Green)
These two subdivisions were identified by PyroAnalysis, LLC, but were removed from consideration as they do not meet the intent of the relevant legislation. These three areas have two points of ingress and egress.





Lake of the Pines

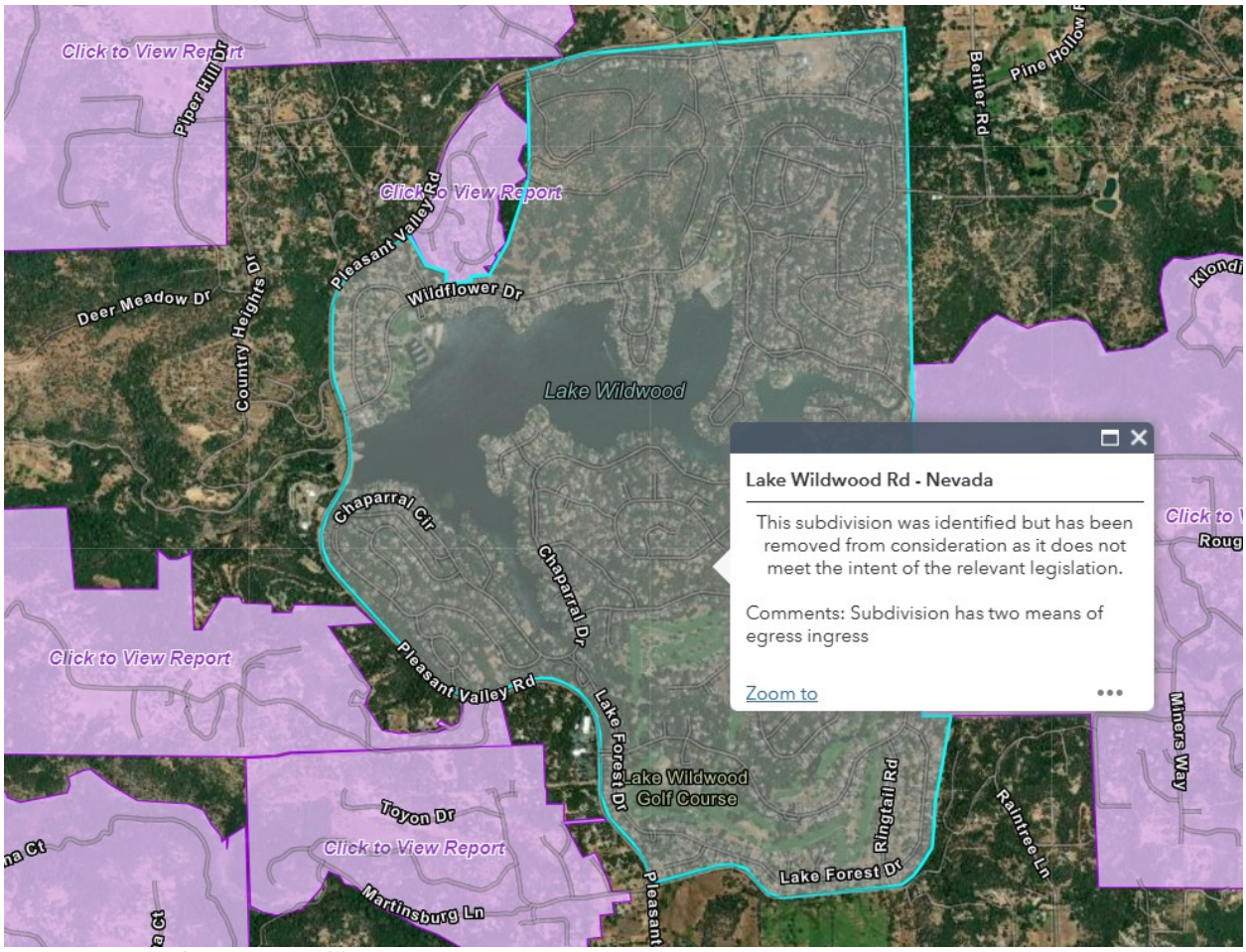


Area previously assessed by CAL FIRE

Lakeshore North 21-NEU-22B1

https://services1.arcgis.com/jUJYIo9tSA7EHvfZ/arcgis/rest/services/Subdivisions_Public_VIEW/FeatureServer/0/2355/attachments/2360

Lake Wildwood



Area previously assessed by CAL FIRE

Section 5
Temporary Refuge Areas

Temporary Refuge Areas

Government Code 65302.15 requires counties to include evacuation locations in the safety element of the general plan. Locations include temporary refuge areas (TRAs), evacuation centers, and evacuation endpoints.

TRAs are locations where evacuees can temporarily take shelter for a limited period if the evacuation route is compromised by fire and smoke, or the roadway becomes so congested that fleeing residents may become entrapped in their vehicles. **TRAs are not intended to provide an alternative to evacuation.** Rather, TRAs may, under extenuating circumstances comprise part of the evacuation scenario for evacuees as they travel to safety.

For TRAs to be viable option(s) for any given community, locations must be identified, permissions obtained, mitigation actions taken (such as vegetation abatement), and agreement reached around responsibilities that include but are not limited to liability and maintenance.

For each of the five areas studied a potentially viable TRA location has been identified based on public accessibility and overarching site feasibility. Additional sites may exist within the focus communities; however, these would require more significant analysis and landowner engagement to vet as being potential option(s). In all instances, additional study would be needed to solidify locations that have the potential serve as TRAs.

Alta Sierra TRA

Of the five areas studied, Alta Sierra has the most significant possibility for a catastrophic wildfire event. For this community, Alta Sierra Elementary School has the potential to serve as a TRA with further analysis, community engagement, and strategic planning.

Greenhorn Road TRA

In the Greenhorn Road community few of the homes have adequate defensible space and large portions of Greenhorn Road are lined with heavy vegetation lending to the prospect of a crown fire in the dense timber stands. For this community, the Nevada County Airport has the potential to serve as a TRA with further analysis, community engagement, and strategic planning.

Cascade Shores/Banner Mountain TRA

Cascade Shores is challenged by dense fuel loading along primary ingress/egress routes and the Scotts Flat Reservoir has little break in the continuity of the trees along the shoreline. For this community, Pioneer Park has the potential to serve as a TRA with further analysis, community engagement, and strategic planning.

Lake of the Pines TRA

The Lake of the Pines area is subject to north winds which can precipitate the potential for extreme fire spread. For this community, Bear River High School has the potential to serve as a TRA with further analysis, community engagement, and strategic planning.

Lake Wildwood TRA

Fires in the Lake Wildwood area can include extremely intense mixed-chapparal-and-oak-woodland fires. For this community, Williams Ranch Elementary School has the potential to serve as a TRA with further analysis, community engagement, and strategic planning.

Section 6
Study Consultants

Shane Lauderdale

Early in his career, Shane developed a passion for community risk reduction, earning a Bachelor of Science in Fire Prevention Technology from Cogswell Polytechnical College and an Associate Degree in Fire Technology from Shasta Community College. He founded PyroAnalysis in 1998 to assist communities, developers, and attorneys in interpreting and applying fire and emergency management principles. As a certified instructor, he has inspired thousands of fire service professionals to create innovative strategies to combat hostile fire and other disasters and was a contributor to the California State Fire Marshal Fire Officer and Fire Investigator certification curriculum.

As a leader in fire and emergency management, Shane has guided communities and institutions through the challenges related to the COVID-19 pandemic, developing and evaluating emergency and evacuation plans, and adopting fire codes and standards specifically tailored to the unique needs of the community.

Shane started his career as a firefighter in the summer of 1985 and served with the City of Redding Fire Department from 1986 to 2012. During his more than 25 years in Redding, he worked as a firefighter, fire apparatus engineer, arson investigator/inspector, fire captain, operations battalion chief, and deputy chief of administration. In January 2012, he became the operations chief at Chico Fire-Rescue. He served as fire chief in Chico, from April 2014 to 2016, where he created the Division of Community Risk Reduction, prioritizing emergency preparedness and risk reduction over the traditional reactive fire service response model.

Shane has served on a Type 1 Incident Management Team since 2001. As an operations section chief and branch director, he has assisted dozens of communities impacted by catastrophic fires and other disasters in California. Incidents include the Thomas Fire of 2017, where he led the evacuation of Ojai and the firefight in Montecito; the Oroville Dam failure; the Camp Fire in 2018; the Kincade Fire of 2019; and the Butte Complex of 2020. He is a member of the Advanced All-Hazard Incident Management (AAIM) training cadre that provides intensive disaster management training and evaluation for All-Hazard Incident Management Teams.

His certifications include NFPA Certified Fire Protection Specialist, Type 1 Operations Section Chief, Type 3 Incident Commander, Certified Chief Fire Officer, Certified Fire Officer, Certified Fire Prevention Officer, Certified Fire Service Instructor, and IAAI/NAFI Certified Fire Investigator.

Mike Bradley

Mike started his professional career in 1991 in the timber industry of Northern California. He worked for a private consulting firm and a large timber company before moving to state service in 2001. As an employee of CAL FIRE, Mike held many positions, including forester, fire captain, battalion chief, division chief, deputy chief, northern assistant region chief, and northern region chief. He retired from state service at the end of 2021. In 2022, Mike began consulting as an emergency management specialist for the US Forest Service International Program. Internationally, he has taught emergency management to Civil Protection employees in the national Emergency Operations Center for Albania. He has also instructed firefighters and Department of Defense and Civil Protection employees in both Albania and Armenia in emergency management and fire protection operations.

Mike has a Bachelor of Science degree in forestry from Humboldt State University and is a Registered Professional Forester #2612. His fireline qualifications range from agency administrator to division supervisor. During his five years at the northern region office, he had responsibility for some of the largest deployments of firefighting resources ever assembled in California. Mike is an experienced professional with a successful career in fire protection, forest, watershed, and administration. He excels at interfacing with others at all levels to ensure formulation, administration, and continuing evaluation of programs and products are developed with the larger picture in mind.

Ron Bravo

Ron began his fire service career in 1985 as a firefighter with the California Department of Forestry and Fire Protection in Butte County. After completing his bachelor's degree from California State University, Chico, he accepted a position as a fire apparatus engineer. Over the course of his career with CAL FIRE, Ron has held the positions of firefighter, engineer, fire captain, battalion chief, division chief, and interim unit chief. Ron has a wide breadth of experience ranging from all-risk firefighting, emergency dispatch operations, hand crew supervision, prevention, and being a sworn peace oOfficer.

He has over 20 years of incident management team experience. Ron was a qualified Type I Incident Commander; held qualifications in operations, plans, liaison, and logistics; and was an information officer and agency representative. He was the incident commander of CAL FIRE Incident Management Team 5 until he retired from CAL FIRE in 2018. Ron has been a member of the national Complex Incident Management Course cadre for over a decade.

After retiring from CAL FIRE, Ron accepted a position as deputy chief with North County Fire Authority (NCFA) in San Mateo County. NCFA provides fire service to the cities of Pacifica, Daly City, and Brisbane. Ron was responsible for the supervision of the operations bureau, which consisted of eight fire companies, training, and special operations.

In the fall of 2020, Ron retired from the fire service. With over 30 years of public safety experience and leadership, Ron has demonstrated the ability to work collaboratively with community, city, state, and federal organizations on emergency incidents as well as nonemergency projects. With experience working through complex community dynamics, applying fire behavior analysis, and investigating arson, Ron possesses a diverse background of knowledge and experience he looks to share and apply.

Dennis Burns

Dennis began his career in 1977 with the California Division of Forestry and Fire Protection. In 1980, he transferred to the Stanislaus County Fire Department, and in 1985, he took a position with the Pleasanton Fire Department, which merged with Livermore in 1987. Dennis retired from the Livermore/Pleasanton Fire Department in 2018.

Dennis earned an Associate of Science in fire science from Modesto Junior College and a Bachelor of Science in fire management from California State University, Sacramento.

Dennis has served on national Type 1 Incident Management Teams as a fire behavior analyst (FBAN) since 2000. He chairs the S-590 (Advanced Fire Behavior Interpretation) Steering Committee and is a member of the National Wildfire Coordinating Group (NWCG) Fire Weather Sub Committee and the NWCG Fire Behavior Curriculum Unit.

Eric Scovel

In 1983, Eric became a volunteer firefighter at the Lakeshore Fire Department in Lake County, California. He became a full-time fire engineer with the Marin County Fire Department in 1994. His GIS interests began when he was selected to serve on a CAL FIRE incident management team in 2007. He served with the team until he retired in 2019. He earned a GIS Certificate from Chico State University in 2018.