THE Ember Alliance

2023

LOVELAND FIRE RESCUE AUTHORITY

LARIMER COUNTY, COLORADO

Community Wildfire Protection Plan

Loveland Fire Rescue Authority Community Wildfire Protection Plan 2023 Update

PREPARED FOR LOVELAND FIRE RESCUE AUTHORITY

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Table of Contents

How to use this CWPP Document

This document is designed for everyone that lives, works, and manages land within and around LFRA. Different sections will be most helpful to different people; please use this guide to direct you to the resources most relevant to you.

I want to learn the basics.	•Section 1.a to learn about CWPPs •Section 2.f to learn about wildfire threats in your local Fire Authority •Section 3.a to learn what your next steps can be •Appendix A for an introduction to fire behavior
I want to learn about protecting my home and family.	•Section 3.a to learn about the actions you can take, including detailed recommendations and research-backed guidance for protecting your home and family •Section 3.a to find detailed hazard ratings and recommendations for your neighborhood
I want to learn about community-led action.	•Sections 3.a, 3.b, and 4.c to learn about the actions communities can take together to better protect everyone, including funding opportunities •Section 5.b to find all specific recommended actions for the community.
I want to learn about landscape-scale wildfire mitigation.	•Section 2.e, 2.f and 2.g to learn about fire history and treatment history in the area •Section 4.b to learn about priority fuel treatment projects for this community •Sections 4.c, 4.d, and 4.e for general recommendations for stand-level and roadside fuel treatments
I want to learn about the science behind these recommendations.	•Appendix B to learn about modelling methodology for fire behavior and evacuation modelin, on-the-ground hazard assessments, and treatment prioritization •Appendix C for survey methology and results •Section 7 to see all referenced research and information

Acronyms

LFRA	Loveland Fire Rescue Authority
BTWC	Big Thompson Watershed Coalition
CR	County Road
CSFS	Colorado State Forest Service
CWDG	Community Wildfire Defense Grant
CWPP	Community Wildfire Protection Plan
DFPC	Division of Fire Prevention and Control
FAC	Fire Adapted Community
FEMA	Federal Emergency Management Agency
HIZ	Home Ignition Zone
HOA	Homeowner's Association
IIBHS	Insurance Institute for Business & Home Safety
IRPG	Incident Response Pocket Guide
ISO	Insurance Services Office
LCCC	Larimer County Conservation Corps
LCD	Larimer Conservation District
LCDNR	Larimer County Department of Natural Resources
LCSO-ES	Larimer County Sheriff's Office- Emergency Services
NFPA	National Fire Protection Association
NWCG	National Wildfire Coordinating Group
PODs	Potential Operational Delineations
RAWS	Remote Automatic Weather Stations
TEA	The Ember Alliance
USFS	U.S. Forest Service
WUI	Wildland-Urban Interface

Refer to the **Glossary** on page 163 for definitions of the words and phrases used throughout this document.

1. Introduction

1.a. Purpose and Need for a CWPP

Community Wildfire Protection Plans (CWPPs) help communities assess local hazards and identify strategic investments to mitigate risk and promote preparedness (**Figure 1.a.1**). Assessments and discussions during the planning process assist fire authorities with fire operations in the event of a wildfire and help residents prioritize mitigation actions. These plans also assist with funding gaps for fuel mitigation projects since many grants require an approved CWPP.

> "*Community* Wildfire Protection Plans (CWPPs) represent the best opportunity we have to address the challenges of the wildland-urban interface (WUI) in a way that brings about comprehensive and locally supported solutions." – Colorado State Forest *Service*

The Loveland Fire Rescue Authority (LFRA) oversees 187 square miles in Larimer County. The Authority is located in the foothills of Colorado's Front Range, approximately 60 miles north of Denver (Figure 1.a.2). It covers the City of Loveland as well as the communities of Drake, Waltonia, Storm Mountain, Masonville, Pinewood, and east Pole Hill. This area is the ancestral land of the Arapaho, Ute, Shoshone, Cheyanne, Sioux, and Lipan Apache.

Figure 1.a.1. Elements of a holistic and actionable CWPP.

The 2023 CWPP for LFRA takes advantage of recent advances in fire science and addresses changes to fire risk, home construction, and other characteristics of the community. The CWPP includes a wildfire risk analysis, prioritization of mitigation activities, and implementation recommendations. This document is a tool for the Fire Authority, land managers, residents, communities, and homeowner's associations (HOAs) to prioritize projects that will make LFRA a safer and more resilient community to wildfire. The objectives of this project are to:

- Produce an actionable CWPP based on robust analyses of fuel hazards, burn probability, evacuation routes, and community values across the Fire Authority.
- Provide recommendations, including prioritization, for reducing fire hazards, hardening homes, and increasing evacuation safety.
- Engage community members during the CWPP process to address local needs and concerns.
- Set the stage for planning and implementation by residents, LFRA, HOAs, and agency partners to mitigate hazards and promote community preparedness.

Complex interactions among wildland fuels, weather, and topography determine how wildfires behave and spread. Many aspects of wildfires are predictable based on known scientific research on the physical processes driving fire. Much of the work in this CWPP is based on scientific research and computer models of wildfire behavior. A basic understanding of fire behavior aids in interpreting the findings and recommendations reported herein. See **Appendix A. Introduction to Wildfire Behavior and Terminology** and the **Glossary** on page 163 for key term definitions.

Why is the CWPP relevant to me?

Becoming a fire adapted community that can safely coexist with wildland fire takes a concerted, ongoing effort by everyone who lives, owns property, protects, or manages land in and around this community. Conditions in LFRA share some risk factors common to past catastrophic wildfires across the country. This CWPP provides recommendations for how to prepare your family to safely evacuate during a wildfire, how to mitigate your home ignition zone to give your house a fighting chance at surviving wildfires and protect the lives of firefighters engaged in protecting your community.

Even if you do not have a permanent home on your property, you can take steps to protect your camper and other assets, including the value of your property; areas that are heavily burned have less aesthetic and monetary value. More importantly, work you do to reduce fire risk on your property can amplify the work that your neighbors do on theirs, resulting in greater protection for everyone. Removing trees from along roadways can increase the visibility of your property to firefighters, increase the accessibility of your property for fire engines, and reduce the chance that non-survivable conditions can develop and entrap residents and first responders during wildfires.

This CWPP is a call to action to do your part to continue making LFRA a beautiful and safe community. Land management partners and FLRA are here to support your individual efforts, and they are committed to taking action to reduce wildfire risk and increase emergency preparedness for the benefit of this amazing community.

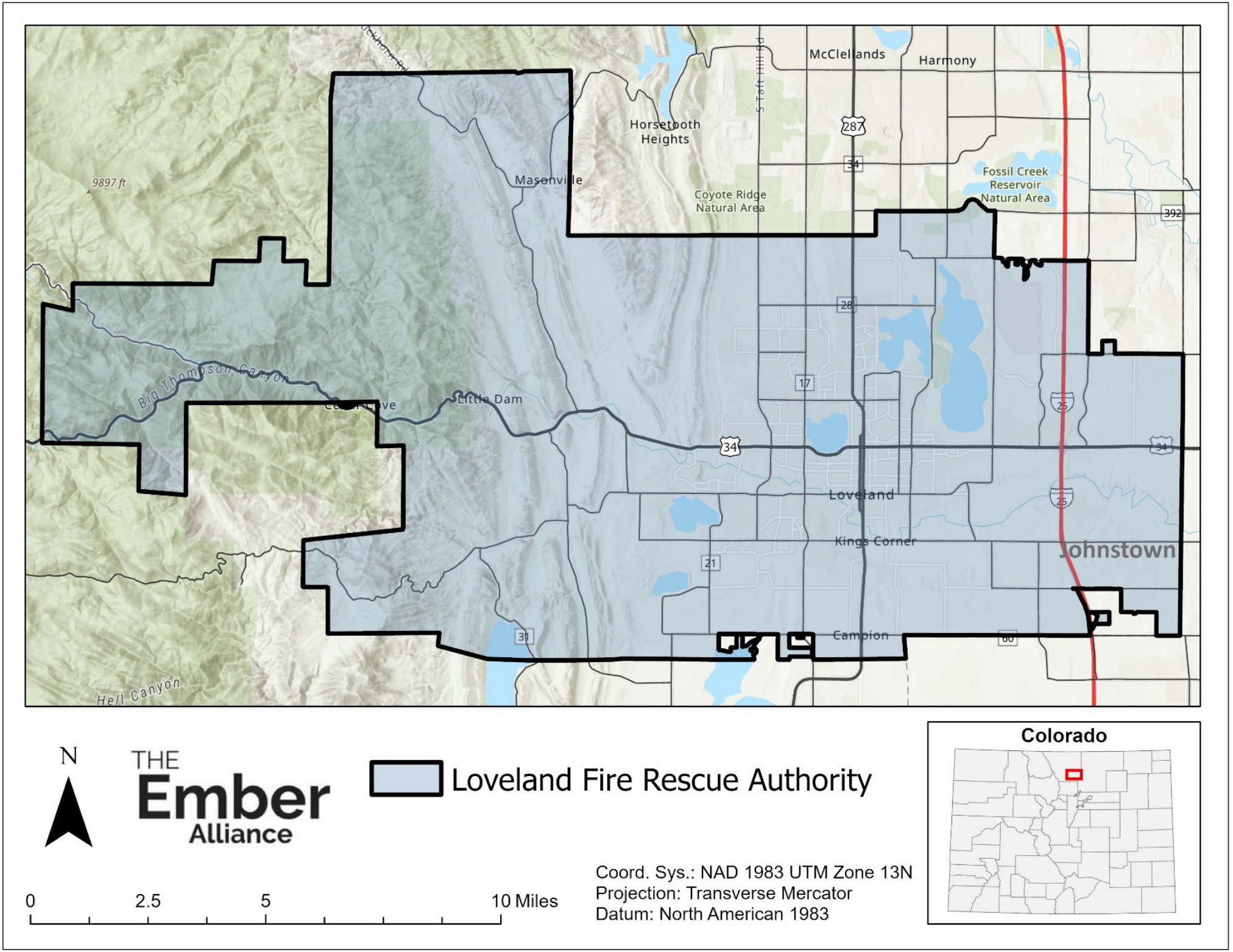


Figure 1.a.2. Boundary of LFRA in Larimer County, Colorado. Source: LFRA and ESRI. View an interactive map online.

1.b. Community and Partner Engagement

Collaboration is an essential part of CWPPs. Community engagement, partner commitment, and follow-through are what make a CWPP successful. The Ember Alliance (TEA)—a Colorado nonprofit dedicated to fire management and community engagement—worked with LFRA to write this CWPP. TEA and representatives from LFRA engaged partners from across the landscape and neighboring districts to develop the recommendations set forth in this CWPP. They incorporated lessons learned from the recent challenging wildfire seasons in Colorado and considered valuable insights shared by community members and other partners.

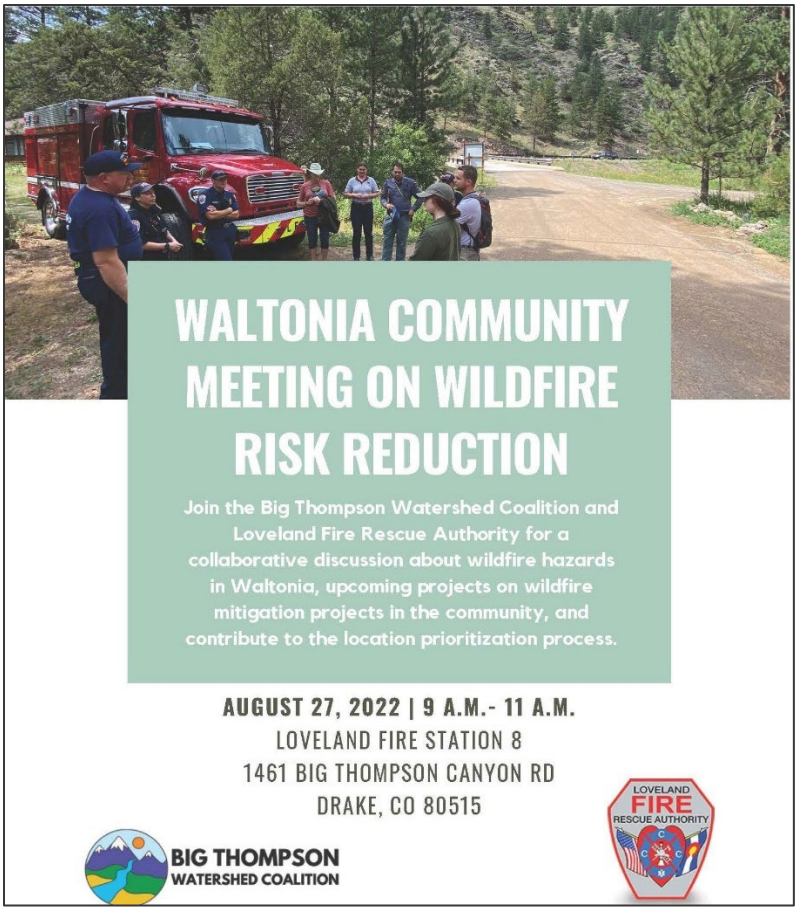
Recommendations in this CWPP also consider overlapping and related plans and prioritization processes in the area, including the 2015 Big Thompson River Restoration Master Plan, 2021 Big Thompson River Envisioning Project, 2023 Big Thompson Forest Health Assessment, and 2022 Northern Colorado Fireshed Wildfire Risk Assessment.

TEA and LFRA would like to thank the following partners for their time and effort in developing, providing data, providing feedback, and planning implementation projects for this CWPP:

- Arapaho-Roosevelt National Forest
- Big Thompson Watershed Coalition
- City of Fort Collins Natural Areas
- City of Loveland Open Lands & Trails
- City of Loveland Parks & Recreation
- City of Loveland Urban Forestry
- City of Loveland Water & Power
- Colorado Department of Fire Prevention and Control
- Colorado Forest Restoration Institute
- Colorado Parks and Wildlife
- Colorado State Forest Service
- Estes Valley Watershed Coalition
- Larimer Conservation District
- Larimer County Department of Natural Resources
- Larimer County Office of Emergency Management
- Larimer County Road and Bridge
- Larimer County Sheriff's Office – Emergency Services Unit
- Larimer County Wildfire Partners
- Northern Water
- The Heart J Center at Sylvan Dale Ranch

TEA and LFRA conducted extensive community and partner engagement to gain a better understanding of the community's current knowledge of wildfires, assess their concerns and needs, and learn about ongoing mitigation work. Engagement included:

- Participation in grass-roots meetings facilitated by the Big Thompson Watershed Coalition in Storm Mountain and Waltonia in August 2023.
- Community survey in winter of 2023 to gather vital community input that we incorporated into recommendations and priorities for the 2023 CWPP.
- Meeting with agencies involved in wildfire response in January 2023 to discuss experiences and concerns with evacuations in LFRA.
- Meetings with agencies that facilitate fuel treatments, wildfire suppression, and prescribed burning in winter and spring of 2023 to discuss the findings of our fire behavior analyses and learn about their organization's fuel treatment priorities. Partners included the City of Loveland Open Lands & Trails, Larimer County Open Space, CSFS, DFPC, Larimer County Sheriff's Office - Emergency Services Unit (LCSO-ES), and U.S. Forest Service (USFS).
- Final community meeting in June 2023 to share findings and recommendations from the CWPP.



Community engagement was a fundamental aspect of this CWPP. Thank you for helping us create a locally relevant and actional CWPP to meet your needs! Top: Flyer for a Waltonia community meeting in August 2022 (source: LFRA). Bottom: Raina Eshleman with LCSO-ES speaks about the new Larimer County Wildfire Partners program during the final CWPP community meeting in June 2023 (source: TEA).

1.c. Accomplishments Since the Previous CWPP

Loveland Fire Rescue Authority

- LFRA built a new station, Station 7, in 2020 following the Home Ignition Zone guidelines as an example for the community.
- In 2023, LFRA hired a Community Engagement Specialist, specializing in connecting with the community and assisting residents with education, mitigation, and building community.
- LFRA worked with other response agencies involved in the two largest wildfires in Colorado history (Cameron Peak and East Troublesome in 2020) to document the lessons learned from evacuations. New evacuation polygons for the Authority were built in coordination with Larimer County.
- LFRA increased their NWCG qualifications across all position levels. In 2018, the highest qualification on staff was a Strike Team Leader and they retained 5-6 Engine Bosses. In 2023, the Authority employs 4-5 Task Force Leaders as their highest qualification and encompasses about a dozen Engine Bosses.
- LFRA staff worked with the City of Loveland to complete some mitigation work in open spaces along the Big Thompson River in town.
- LFRA regularly meets with HOAs about defensible space.
- The Authority is building their own taskforces for longer wildfire assignments.

LFRA Station 7, designed with home hardening and defensible space practices. Photo credit: Loveland Fire Rescue Authority.

Big Thompson Watershed Coalition

- BTWC purchased an air curtain burner to reduce the burden of slash disposal on residents.
- BTWC connected with dozens of homeowners to reduce fuels on their lands via mechanical thinning, hand thinning, and pile burning and collaborated on at least seven projects within the Fire Authority boundary in the past couple years.
- BTWC worked with partners and on their own to increase the social license to talk about and complete mitigation work in the Big Thompson Canyon.

Larimer Conservation District

- LCD connected with dozens of homeowners to reduce fuels on their lands and collaborated on many projects within and around their district.
- LCD participated in significant amounts of community outreach to normalize homeowner action in fuels reduction and mitigation.

US Forest Service

- The Arapaho-Roosevelt National Forest is mitigating in Pierson Park along POD boundaries using mechanical thinning and prescribed fire to create tactical fire features that prevent fires from moving closer to Loveland and the surrounding communities.
- There are over 50,000 piles created on USFS land in or near LFRA's boundary that are ready to burn when weather and social conditions allow.

2. Loveland Fire Rescue Authority: Background

2.a. General Description

Loveland Fire Rescue Authority (LFRA) covers not only the City of Loveland but also the communities nearby including Masonville, Drake, Storm Mountain, Waltonia, and a small part of Johnstown.

LFRA is home to approximately 109,000 residents. Approximately 20% of residents are over the age of 65, and 21% are under the age of 18. 8% of residents live below the poverty line and 70% of residents own their home. (U.S. Census Bureau, 2021).

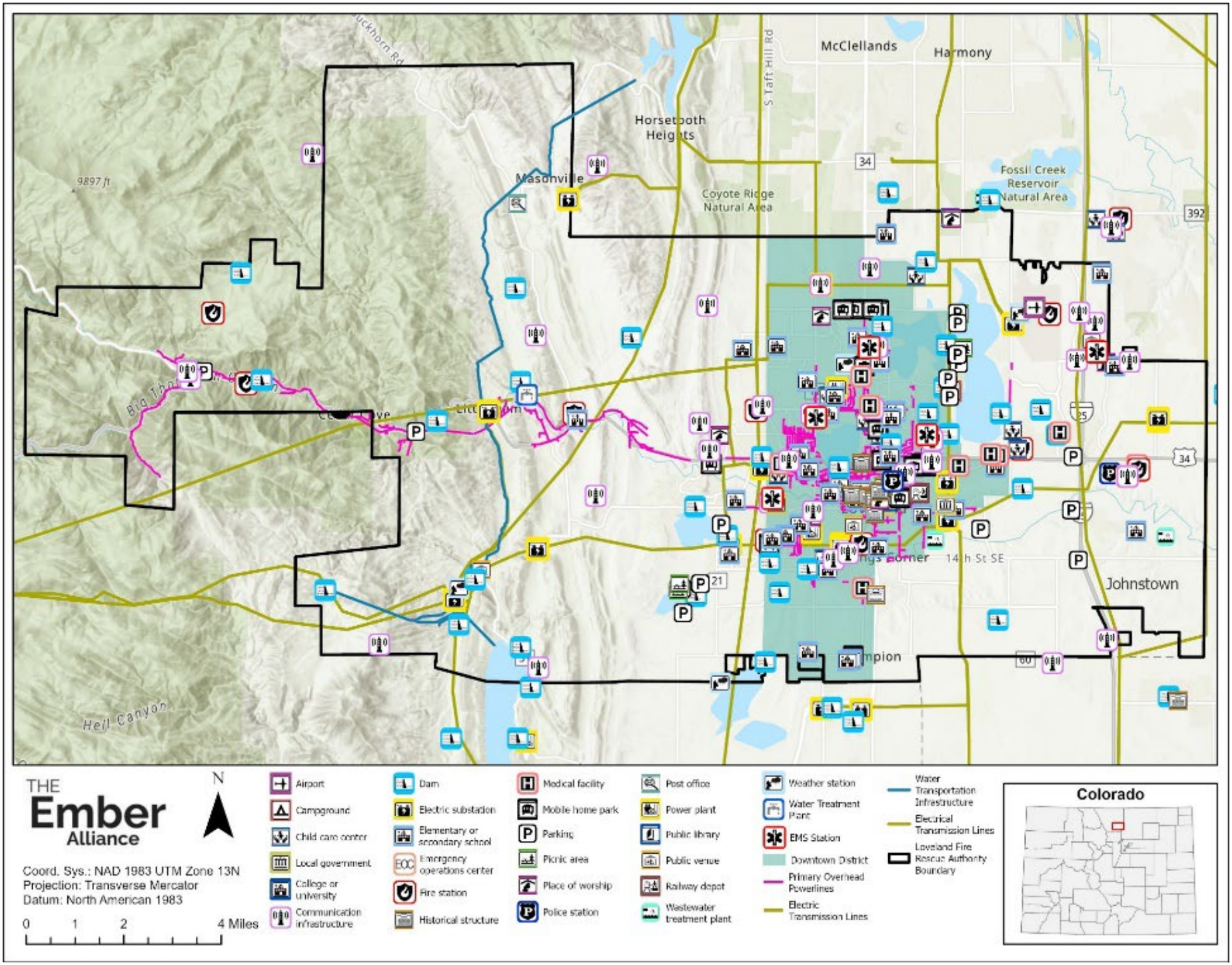
LFRA is bordered by the Poudre Fire Authority to the north, Estes Valley Fire Protection District and Glen Haven Area Volunteer Fire Department to the west, Berthoud Fire Protection District to the south, and Front Range Fire Protection District and Windsor-Severance Fire Protection District to the east. LFRA often coordinates with these districts to provide mutual aid and respond to calls near the borders of the Authority.

Within LFRA there is a significant amount of critical community infrastructure, including an airport, 41 dams, 35 schools, 15 fire and emergency medical services stations, four hospitals, four power plants, a water treatment plant, and three wastewater treatment plants (**Figure 2.a.1**).

Approximately 33,800 acres of land (28%) of LFRA is publicly managed land. The US Forest Service manages large areas of land in the west half, and Larimer County owns many open spaces. The City of Loveland owns 48 parks, and the City of Fort Collins manages five parks. The Colorado Division of Fish and Wildlife manages state wildlife areas, and Colorado State Parks manages Boyd Lake State Park (**Figure 2.a.2**).

Elevations in LFRA range from 4850 to 8500 feet above sea level, gaining elevation to the west. The Authority lies within the Big Thompson watershed, and the Big Thompson River runs east across it. About 25% of the area is developed land, and about 20% is agricultural land. This is mostly in the eastern half of LFRA. In the west half, ponderosa pine and mixed conifer stands cover 25% of the land, with lodgepole pine and aspen stands throughout. There are also large areas of grassland and shrubland (**Figure 2.a.3**). Black bears, elk, mountain lions, and mule deer are some of the large wildlife found in LFRA.

The Big Thompson River is a critical source of drinking water, wildlife habitat, and recreation for communities across LFRA. The Big Thompson River and the Colorado-Big Thompson Project supply water to over 1-million water users. The Big Thompson Canyon has experienced several devastating floods over the past 40 years. Mitigating post-fire conditions across the watershed following the 2020 Cameron Peak Fire is important for reducing the likelihood of severe flooding in the coming years, and to reduce the likelihood of high-intensity wildfires in the future that could trigger post-fire flooding (JW Associates, Inc., 2023).



13 **Figure 2.a.1.** Non-residential values within and around LFRA. Sources: CO Department of Public Health and Environment, CO Division of Oil and Public Safety, Homeland Infrastructure Foundation-Level Data, Federal Deposit Insurance Corporation, U.S. Environmental Protection Agency, U.S. Geological Survey, National Oceanic and Atmospheric Administration.

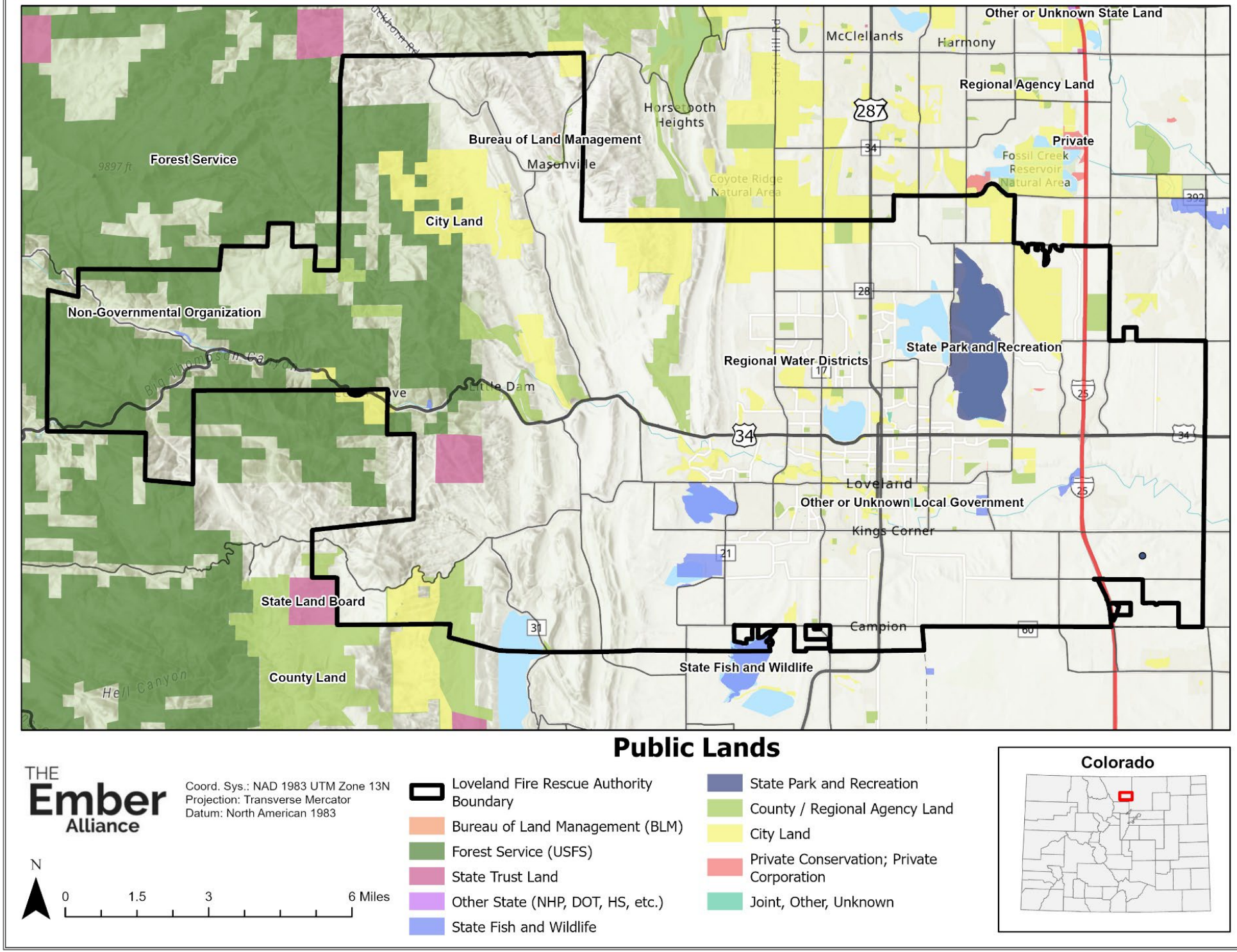


Figure 2.a.2. Publicly owned land across LFRA. Source: U.S. Geological Survey, Protected Areas Database of the United States

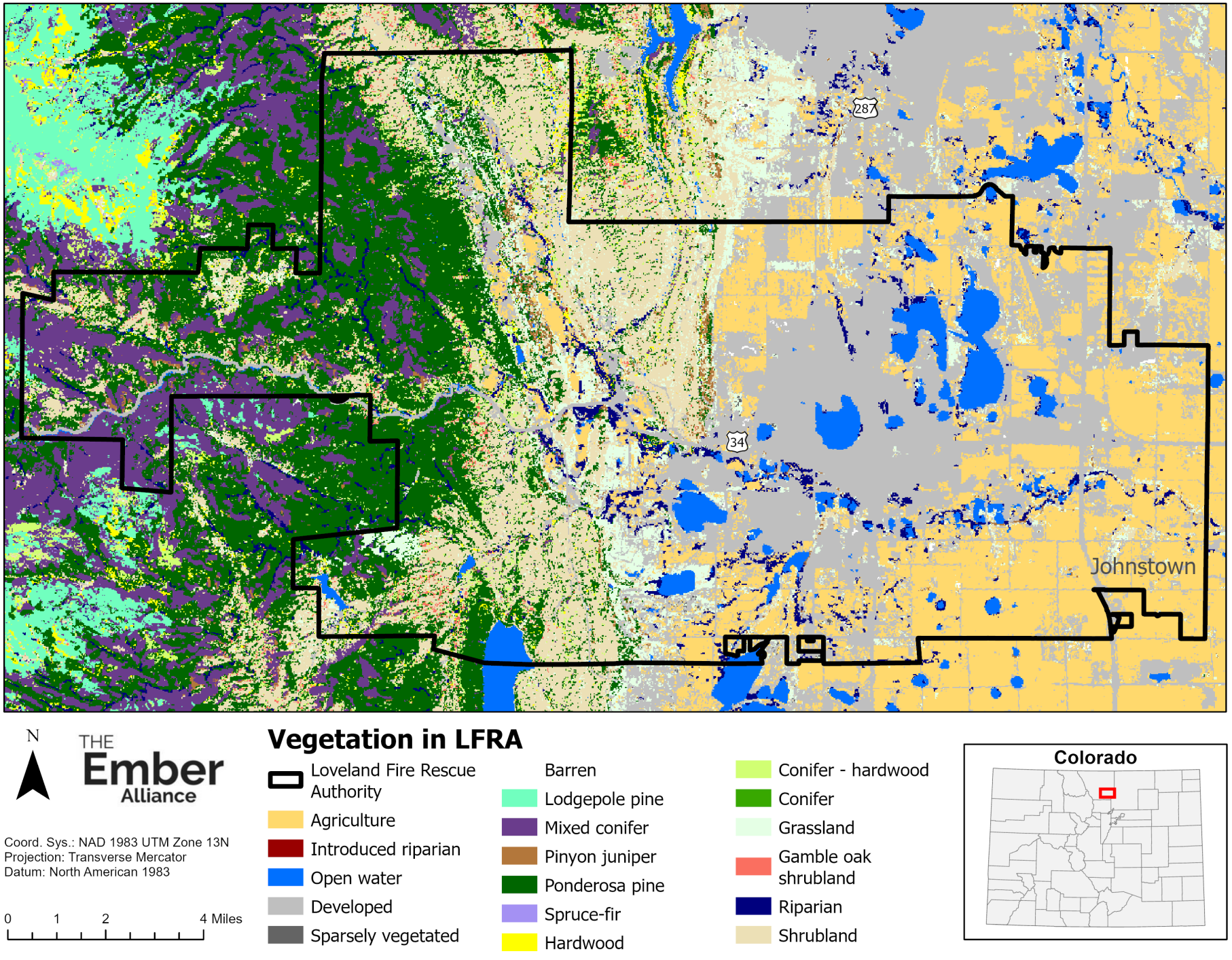


Figure 2.a.3. Map of vegetation across LFRA. It is primarily developed land, agricultural land, ponderosa pine, and shrubland. Source: Colorado State Forest Service, Colorado Forest Atlas

2.b. Fire Authority Capacity

LFRA hosts both paid and volunteer staff. LFRA employs 135 total staff, with a minimum of 27 response employees working daily. There are 14 volunteer firefighters.

LFRA has a fleet of structure and wildland engines with water tenders and support vehicles. These engines are spread out among ten stations, seven of which are staffed 24 hours a day; the station at Northern Colorado Regional Airport is staffed 40 hours a week and as need for airport standbys, and the remaining two (Drake and Storm Mountain Stations) are staffed on a volunteer basis.

All response personnel hold a red card with a minimum Type 2 Wildland Firefighter certification (FFT2, needed to participate in wildland firefighting). All officers in LFRA either hold a higher certification such as FFT1 or IC5, or are actively working to obtain that certification.

LFRA provides and receives mutual aid from each of the neighboring districts. This support means residents on the edges of LFRA's jurisdiction, both inside and outside, may see first responders from both LFRA and the neighboring agencies. This also means that LFRA responds to more calls each year, but the residents on the Fire Authority boundaries are able to get the fastest response, no matter which Authority or district they reside in.

Insurance Services Office (ISO) ratings range from 1 (highest) and 10 (lowest). They are provided to fire departments and insurance companies to reflect how prepared a community is for fires in terms of local fire department capacity, water supply, and other factors. The ISO ratings for LFRA are as follows:

- Class 2 – This rating applies to all structures within five (5) road miles of an LFRA fire station AND within 1,000 feet of a fire hydrant.
- Class 3– This rating applies to all structures within five (5) road miles of an LFRA fire station and are NOT within 1,000 feet of a fire hydrant. LFRA must bring its own water supply, via water tender shuttle operations in these areas.
- Class 10 – Any area that is more than five (5) road miles from an LFRA fire station.

LFRA Station #9. Photo credit: LFRA.

2.c. Wildland-Urban Interface

Every year, wildfires result in billions of dollars in fire suppression costs and destroy thousands of homes across the United States. Some of the most destructive, deadly, and expensive wildfires occurred in the past several years, partly due to construction of additional homes in the wildland-urban interface (WUI). Wildfire risk in the WUI is further exacerbated by severe fire weather perpetuated by climate change (Caton et al., 2016). Some nearby examples include the 2020 Cameron Peak Fire, which destroyed 469 structures; the 2020 East Troublesome Fire, which destroyed at least 366 structures; and the 2021 Marshall Fire, which destroyed over 1,000 structures. See **Appendix A** for a discussion about how wildfires can threaten and destroy homes.

The WUI is any area where the built environment meets wildfire-prone areas—places where wildland fire can move between natural vegetation and the built environment and result in negative impacts on the community (Forge, 2018). People that live and work in the WUI must be aware of the effect that ecosystem processes and disturbances, such as wildland fires, have on their lives. WUI exists along a continuum of wildland to urban densities (**Figure 2.c.1**). Wildland-urban intermix refers to areas where housing and wildland vegetation intermingle, while wildland-urban interface refers to areas where housing is in the vicinity of a large area of dense wildland vegetation (Martinuzzi et al., 2015).

The Grassland-Urban Interface and Intermix (GUI) are new terms utilized by the wildland fire community to illustrate the specific risks to homes and structures near grasslands. It is relevant to this landscape because LFRA has similar locations, vegetation, weather, and structure density to the grasslands and structures in Superior, CO, where the 2021 Marshall Fire burned over 1000 structures in one day by moving rapidly between structures and connecting grasslands. For now, the GUI remains a subset of the WUI, until specific definitions are agreed upon by the wildfire mitigation and response community at large. Strategic wildfire mitigation across the WUI can increase the safety of residents and wildland firefighters and reduce the chances of home loss.

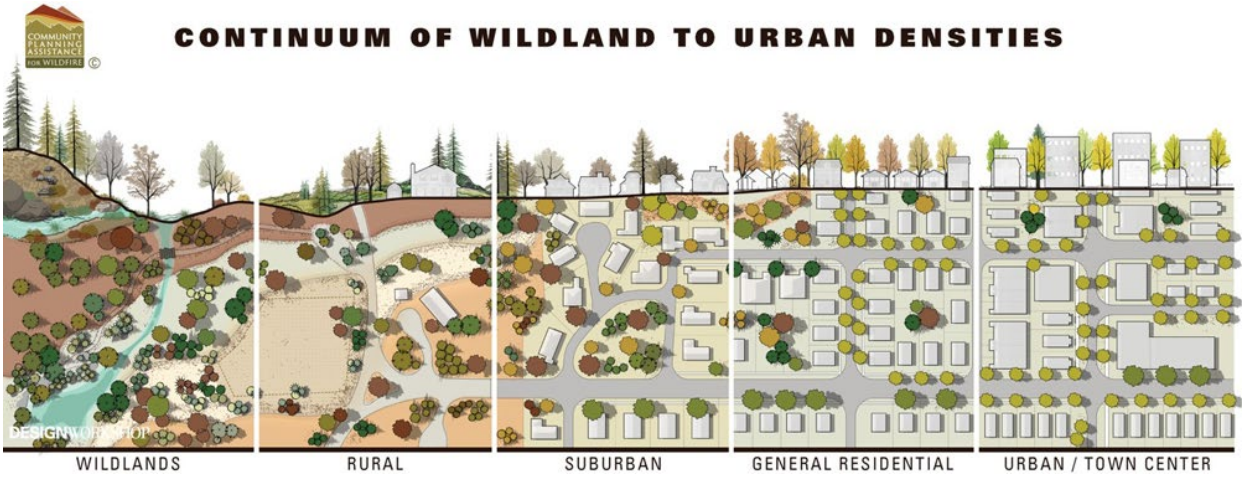


Figure 2.c.1. The wildland-urban interface exists along a continuum of wildland to urban densities. Source: Community Planning Assistance for Wildfire.

All residents of the west half of LFRA live in the WUI and all residents of the east half of the Authority live in the Grassland-Urban Interface (GUI) (**Figure 2.c.2**). For this CWPP, the WUI boundary includes all of LFRA and the surrounding landscape that could transmit wildland fire into LFRA (**Figure 2.c.2**; see methodology in **Appendix B**).

According to the 2020 Wildfire Risk to Communities analysis by the U.S. Forest Service, homes in LFRA and the surrounding areas have a higher risk of fire than 46% of the communities in the state of Colorado (USFS, 2021a). Over the past 50 years, immigration to the mountains west of Denver increased the number of occupied structures within this historically forested landscape. This population change increased not only the density and size of the WUI, but also increased the risk of structure loss from wildfire and the likelihood of fire ignitions.

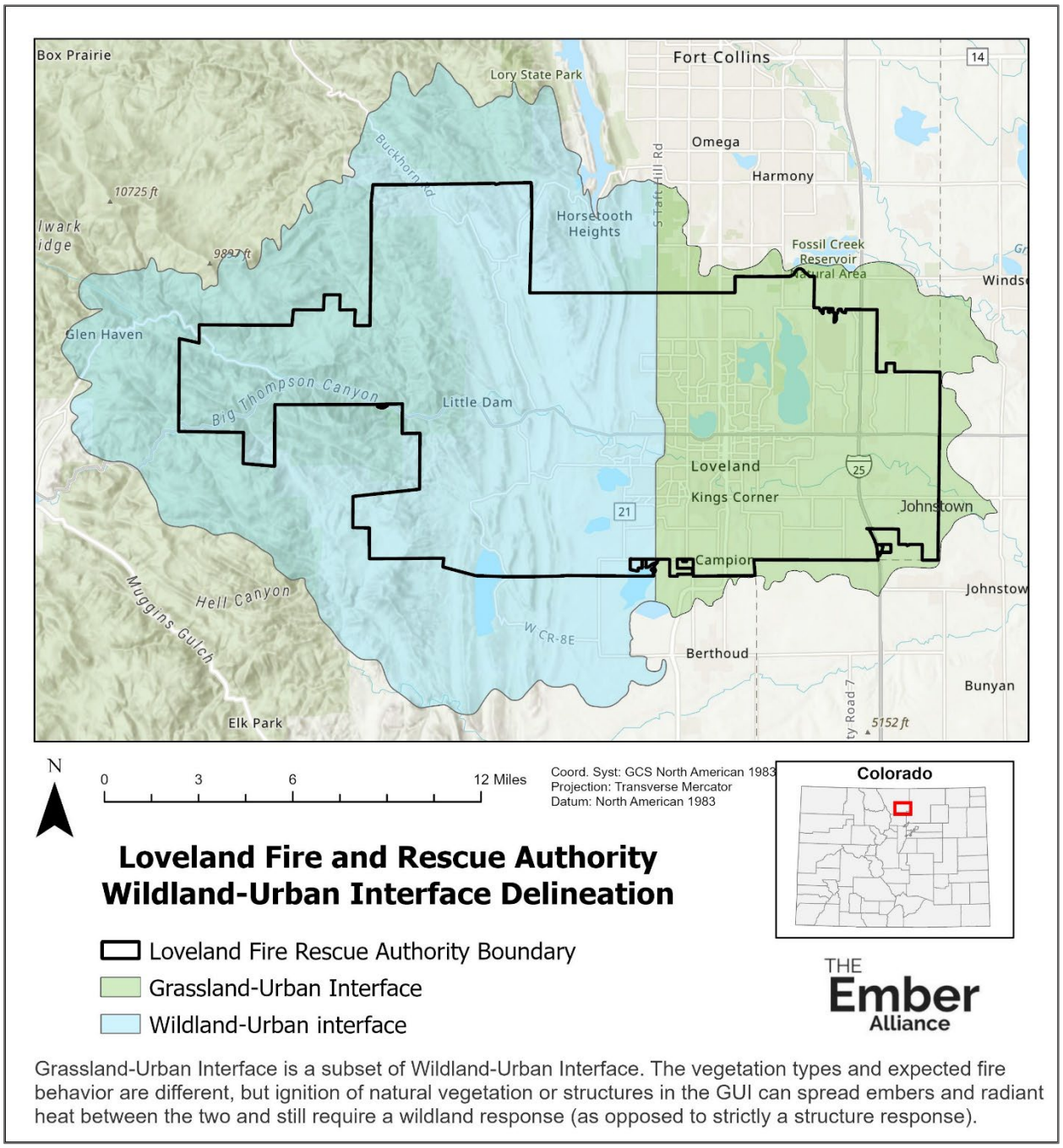


Figure 2.c.2. All residents of LFRA live in the Wildland-Urban Interface and/or Intermix and are exposed to elevated wildfire risk. For this CWPP, the WUI boundary includes all of the lands in and around the LFRA response area that could transmit wildland fire into LFRA (see methodology in **Appendix B**). View an interactive map online.

2.d. Firefighting in the WUI

One of the standard firefighter orders is to "fight fires aggressively, having provided for safety first" (NWCG, 2018a). Firefighters are committed to protecting lives and property, but firefighting is particularly perilous in the WUI. The firefighting community is committed to wildland firefighter safety which can require them to cease structure protection when conditions are exceedingly dangerous, particularly around homes with inadequate defensible space, safety zones, and egress routes.

High-intensity, fast-moving wildfires in the WUI can quickly overwhelm firefighting resources when homes begin igniting each other (Caton and others, 2016). Firefighters are often forced to perform structure triage to effectively allocate limited resources during an incident, and more importantly, to protect the lives of firefighters. The Incident Response Pocket Guide (IRPG), which is carried by all firefighters certified under the National Wildfire Coordinating Group, explicitly states, "**Do not** commit to stay and protect a structure unless a safety zone for firefighters and equipment has been identified at the structure during size-up and triage" (NWCG, 2018a). The IRPG outlines four categories of structure triage:

(1) Defensible – stand alone
(2) Defensible – prep and hold
(3) Non-defensible – prep and leave
(4) Non-defensible – rescue drive-by

Do not count on firefighters staying to defend your home—your home should be able to survive a wildfire on its own. There are never enough firefighters to stay and defend every single home during large incidents. Section **Mitigate** the Home Ignition Zone of this CWPP provides recommendations for how residents can increase the chance of their homes surviving wildfires and enhance the safety of wildland firefighters.

Homes that were defended by firefighters. Photo Credit: Michael Rieger/FEMA.

2.e. Fire History Along the Colorado Front Range

Colorado's Front Range was influenced heavily by fire before the era of fire suppression. This land is the ancestral land of the Arapaho, Ute, Shoshone, Cheyanne, Sioux, and Lipan Apache. Many Indigenous peoples utilized fire as a land management tool. Lightning ignited fires were common in ponderosa pine and dry mixed-conifer forests before European settlement in the 1850s.

Ponderosa pine forests with mixtures of Douglas-fir, Gamble oak, Rocky Mountain juniper, and aspen were fire-adapted ecosystems and very resilient to wildfires. Low- to mixed-severity fires occurred every 7 to 50 years, creating a mosaic of widely spaced trees and small tree clumps interwoven with grasslands and shrublands, particularly on drier south-facing slopes. North-facing slopes often supported denser forest stands (**Figure 2.e.2**) (Addington et al., 2018). Frequent fires killed many tree seedlings and saplings, thereby preventing the accumulation of ladder fuels and reducing the potential for surface fires to transition into crown fires. Fire spread was more rapid through understory grasses but released far less heat, so larger trees survived unscathed. Occasionally, dense clumps of trees experienced mortality from passive crown fire or active crown fires over several hundred acres, further increasing the diversity of habitat in these ecosystems. Ponderosa pine ecosystems with fewer trees support more abundant and species-diverse understories of grasses, forbs, and shrubs and provide habitat for a variety of wildlife that prefer more open forest structure (Kalies et al., 2012; Matonis and Binkley, 2018; Pilliod et al., 2006).

Mixed-conifer forests with an abundance of Douglas-fir and a variable mixture of ponderosa pine, lodgepole pine, Englemann spruce, Colorado blue spruce, subalpine fir, and aspen experienced wildfires every 20 to >100 years (**Figure 2.e.2**). These forests burned less frequently due to cooler, moister conditions at higher elevations, particularly on north-facing slopes, and they had higher tree densities than ponderosa pine ecosystems (Addington et al., 2018). High-severity wildfires could kill patches of trees and create a mosaic landscape with recently burned forests and dense unburned forests.

As the initial ranching and logging activities of Euro-American settlers subsided in the region and government-mandated fire suppression began in the late 1800s, forests filled in with trees (**Figure 2.e.3**) (Addington et al., 2018). Although many residents consider dense forest as "natural," these conditions are vastly different from the fire-resilient ecosystems that existed before. Tree densities in lower-elevation forests along the Colorado Front Range average 4.5 times higher today than they were in the mid-1800s, and tree densities in mid-elevation forests average 2.3 times higher today (Battaglia et al., 2018). Landscapes of continuous, dense forests are more prone to high-severity fires that are difficult to suppress and can result in catastrophic losses to lives and property (Haas et al., 2015), and climate change makes high-severity wildfires more frequent, intense, and larger in extent (Parks et al., 2016).

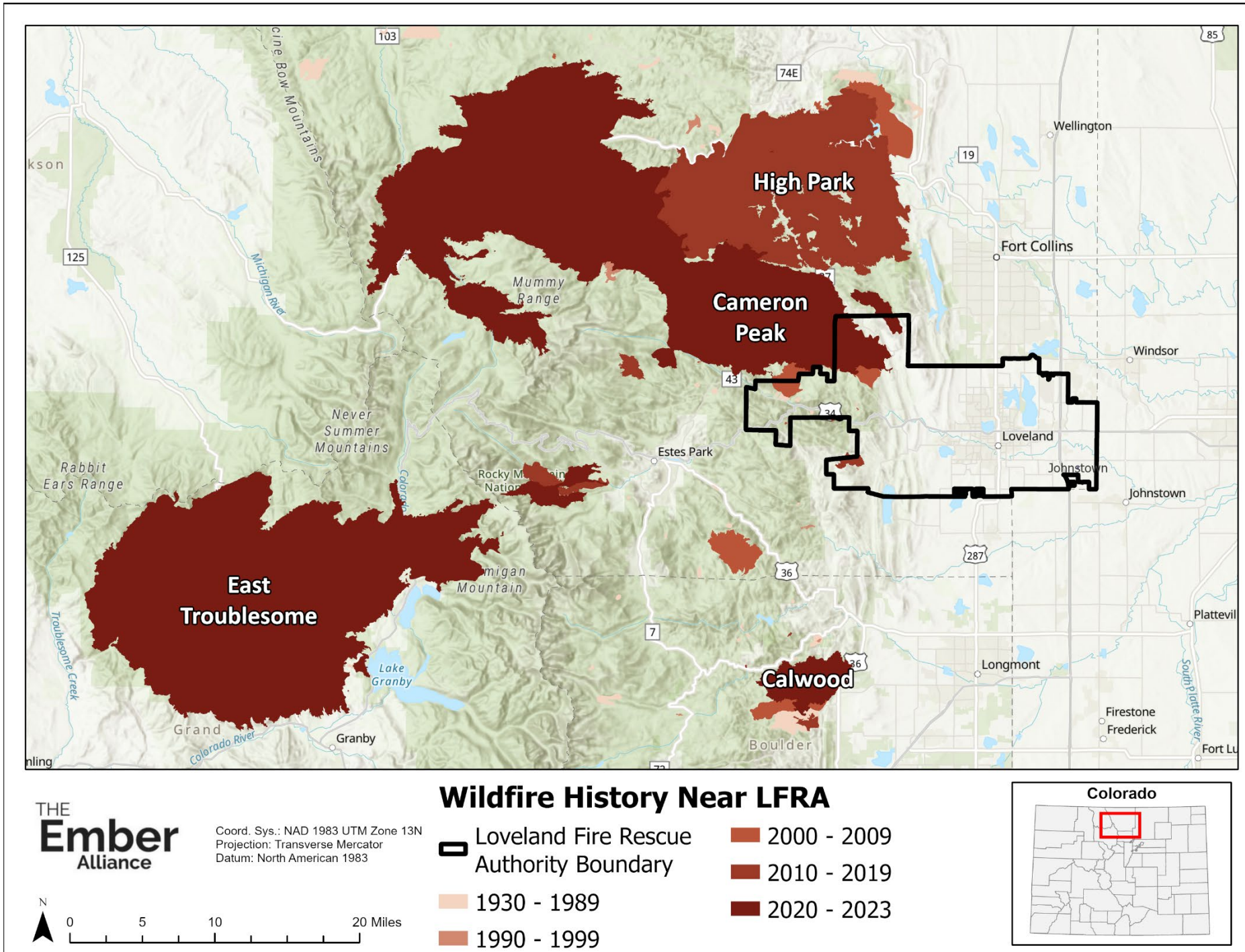


Figure 2.e.1. Recent wildfires along the Colorado Front Range. The 2020 wildfires entered the Authority and LFRA supplied resources for months to defend homes and support evacuations of their communities and nearby communities. Source: National Interagency Fire Center. View an interactive map online.

Lodgepole pine forests are part of resilient fire-adapted ecosystems after infrequent, stand-replacing wildfires. Research on historical conditions in lodgepole pine forests suggests they experienced high-severity wildfires every couple of centuries in northern Colorado and southern Wyoming (Higuera et al., 2021) (**Figure 2.e.2**). Lodgepoles grow dense and tall, which leaves little light that reaches the understory. They have relatively high canopy base height because they drop their lower branches as they grow, and few ladder fuels exist in the understory, meaning they typically burn with high-severity crown fires. They have serotinous cones that open after the heat of a wildfire, creating a dense seedbed that will grow into a new even-aged stand and replace the burned previous stand. Young stands that are in recovery and regeneration stages after wildfires do not have the resources to regenerate after a second wildfire event, so frequent stand-replacing fires are detrimental to this ecosystem (Dennis et al., 2009; Turner et al., 2019). Fires are becoming more common in high elevation lodgepole pine and wet mixed-conifer forests due to climate change (Higuera et al., 2021).

Rocky Mountain lower montane-foothill shrublands are also prevalent in this area, dominated by mountain mahogany. Native grass species present include mountain muhly, blue grama, sideoats grama, Arizona fescue, and various other grasses. Introduced grasses including cheatgrass, smooth brome, and Kentucky bluegrass are often present (Decker et al. 2020). Shrublands provide important forage to ungulates like mule deer and elk. Fire is a naturally occurring process in Rocky Mountain lower montane-foothill shrubland, and this ecosystem historically experienced wildfires every 14-112 years at a variety of fire severities depending on local site factors (Missoula Fire Sciences Laboratory 2012; Decker et al. 2020).

The eastern half of LFRA was historically covered in short-grass prairie. These ecosystems experienced frequent fires ranging from every 1 to 35 years due to dry conditions and an abundance of dead grass. Native Americans lit fires in grasslands to improve conditions for hunting and for other cultural reasons. Fires spread rapidly through dry grass and consumed most of the vegetation, which quickly resprouted. Grazing by large ungulates such as bison and the activity of prairie dogs resulted in patchy vegetation and bare soil in areas, which could slow the rate of spread and reduce flame lengths (Zouhar, 2021).

Except for occasional prescribed burns in grassland, these ecosystems do not experience their historical, frequent fire regime due to the forceful removal of Native Americans and cessation of their cultural burning practices and diligent fire suppression as Euro-American development expanded in grasslands along the Front Range. Non-native species such as smooth brome were introduced to grasslands as forage for cattle. Many grasslands today can carry rapidly spreading fires across continuous grass and dead fuel due to the expansion of non-native grasses such as smooth brome and cheatgrass, the extirpation of bison, and reduction in prairie dog colonies. The 2021 Marshall Fire demonstrates the type of destruction that can occur in the grassland-urban interface on windy days under extremely dry conditions.

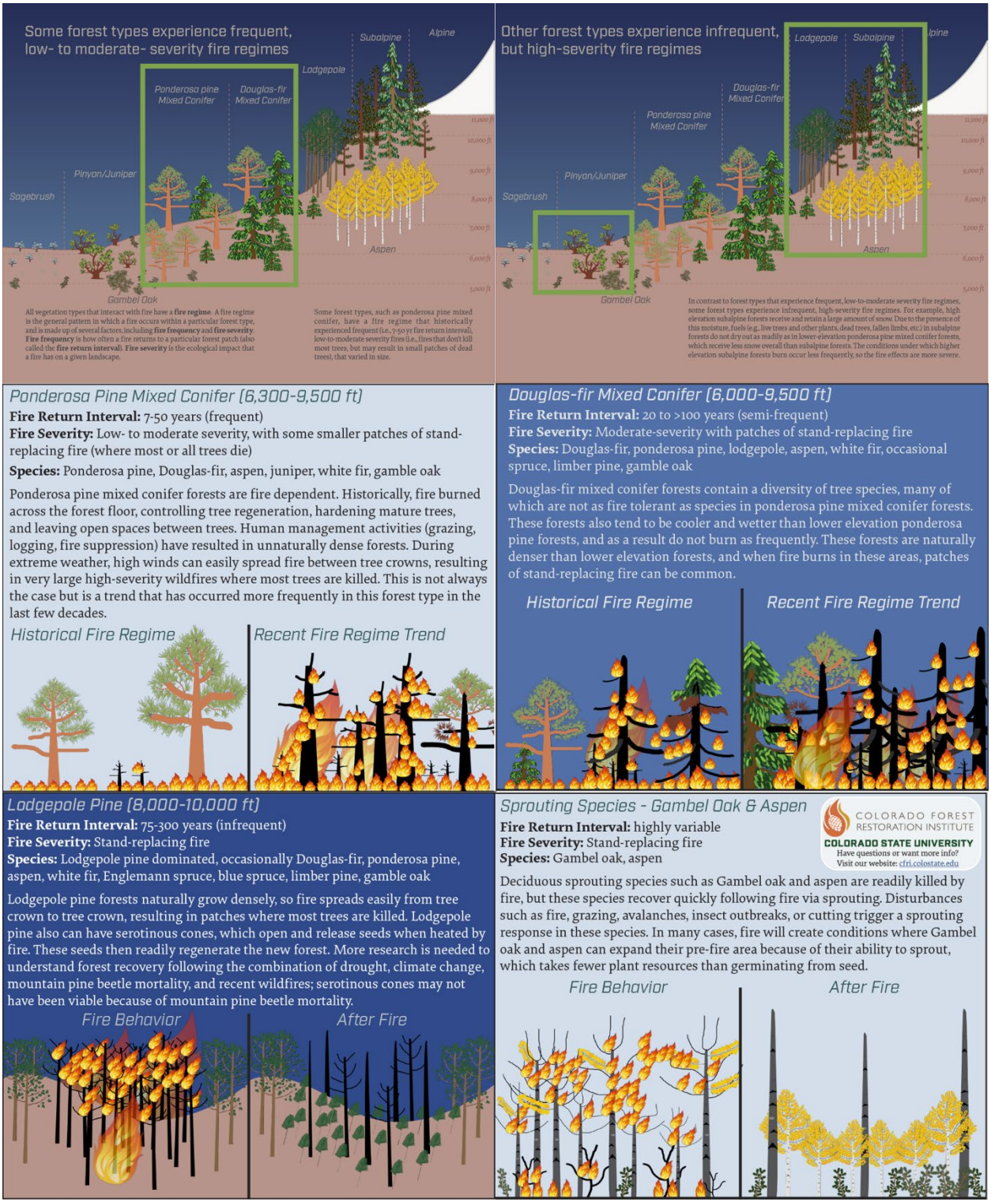
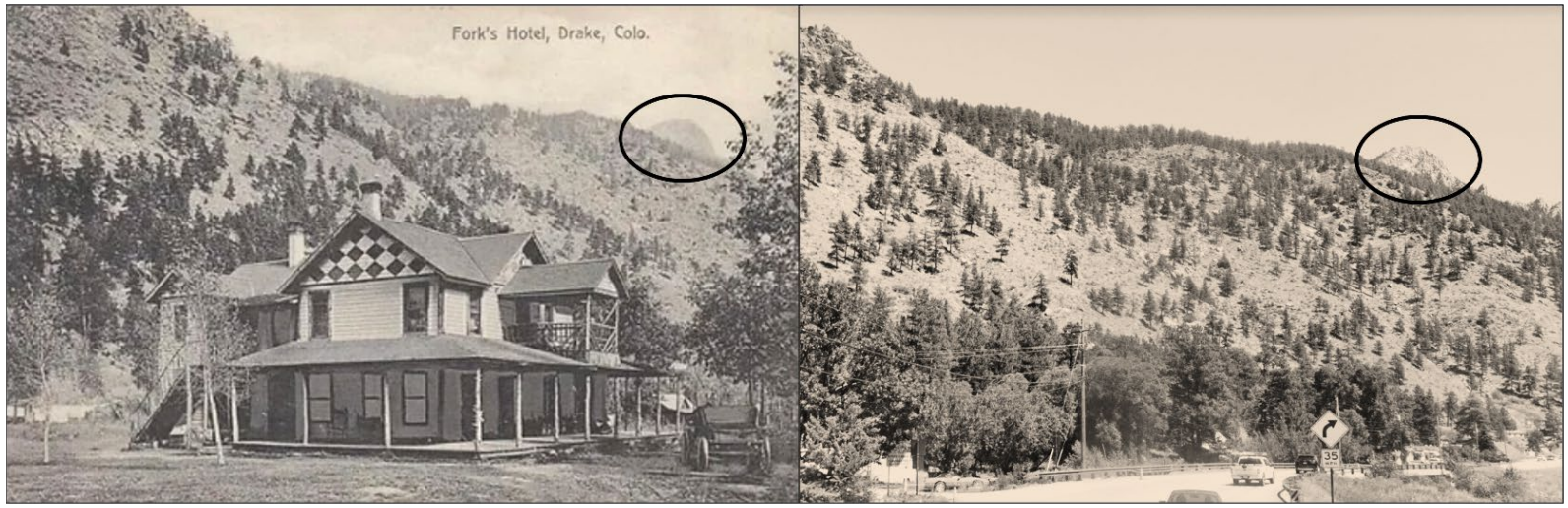


Figure 2.e.2. Ponderosa pine forests along the Colorado Front Range historically experienced frequent fires every 7-50 years and mixed-conifer forests experienced semi-frequent fires every 20 to >100 years, resulting in less dense forest conditions than we see today. Gambel oak experienced variable fire regimes, but likely more frequent that what they see today, resulting in more frequent regrowth. Source: Colorado Forest Restoration Institute.



Circa 1910, Loveland Museum

2022, Google Maps

Between 1902-1917, C.L. McClure
Denver Public Library Special Collections

2022, Google Maps

Figure 2.e.3. Tree densities in many ponderosa pine and mixed-conifer forests are higher today than they were historically in part due to fire suppression, as demonstrated by these paired photographs along Highway 34 near Drake, Colorado. Sentinel Rock pictured in the lower-left photo was demolished in the 1930s for highway improvements. Source: Loveland Museum, Denver Public Library Special Collections, and Google Maps.

Along the Front Range of Colorado, a combination of extreme fire weather conditions (heat and high winds), unplanned ignitions, and dry, unmitigated vegetation can create catastrophic wildfire scenarios in the WUI. Many catastrophic wildfires in Colorado occurred on dry and windy days, resulting in rapid fire spread over short periods of time. On the Front Range, wind can gust over 60 miles/hour, which makes wildfire suppression nearly impossible (Haas et al., 2015). Climate change continues to increase the occurrence of extreme fire weather and lengthen the fire season (Parks et al., 2016).

Days with red flag warnings indicate severe fire weather and require extra vigilance by fire departments and residents (see **Table 2.e.1** for red flag warning criteria). The occurrence of red flag warnings is highly variable from year to year due to regional weather patterns and weather anomalies such as El Niño and La Niña. LFRA experienced up to 45 red flag warnings per year from 2006 to 2022, with 45 red flag warnings in 2012 and 2022 (**Figure 2.e.4**). Red flag conditions are most common in March, April, and October. Climate change is expected to cause 6-8 more red flag warning days each year in the coming fifty years, making fire adaptation even more critical to the community. See **Appendix B** for more information on climate change and wildfire risk.

During red flag warnings, all residents need to be prepared for evacuations in the case of a wildfire, just as the fire department will be preparing for wildfire response.

The most notable wildfires in LFRA were the Cameron Peak Fire of 2020, the Bobcat Fire of 2000, and the Reservoir Ridge Fire of 2010. The potential for another large wildfire that exceeds the suppression capacity of local firefighting resources remains great. In 2020, the three largest wildfires in Colorado history, the Cameron Peak Fire, East Troublesome Fire, and Pine Gulch Fire, collectively burned over half a million acres (**Figure 2.e.1**).

Table 2.e.1. Red flag days are warnings issued by the National Weather Service using criteria specific to a region.

National Weather Service – Denver/Boulder Forecast Office **Red Flag Warning Criteria**	
Option 1	**Option 2**
Relative humidity less than or equal to 15%	Widely scattered dry thunderstorms
Wind gusts greater than or equal to 25 mph	Dry fuels
Dry fuels	

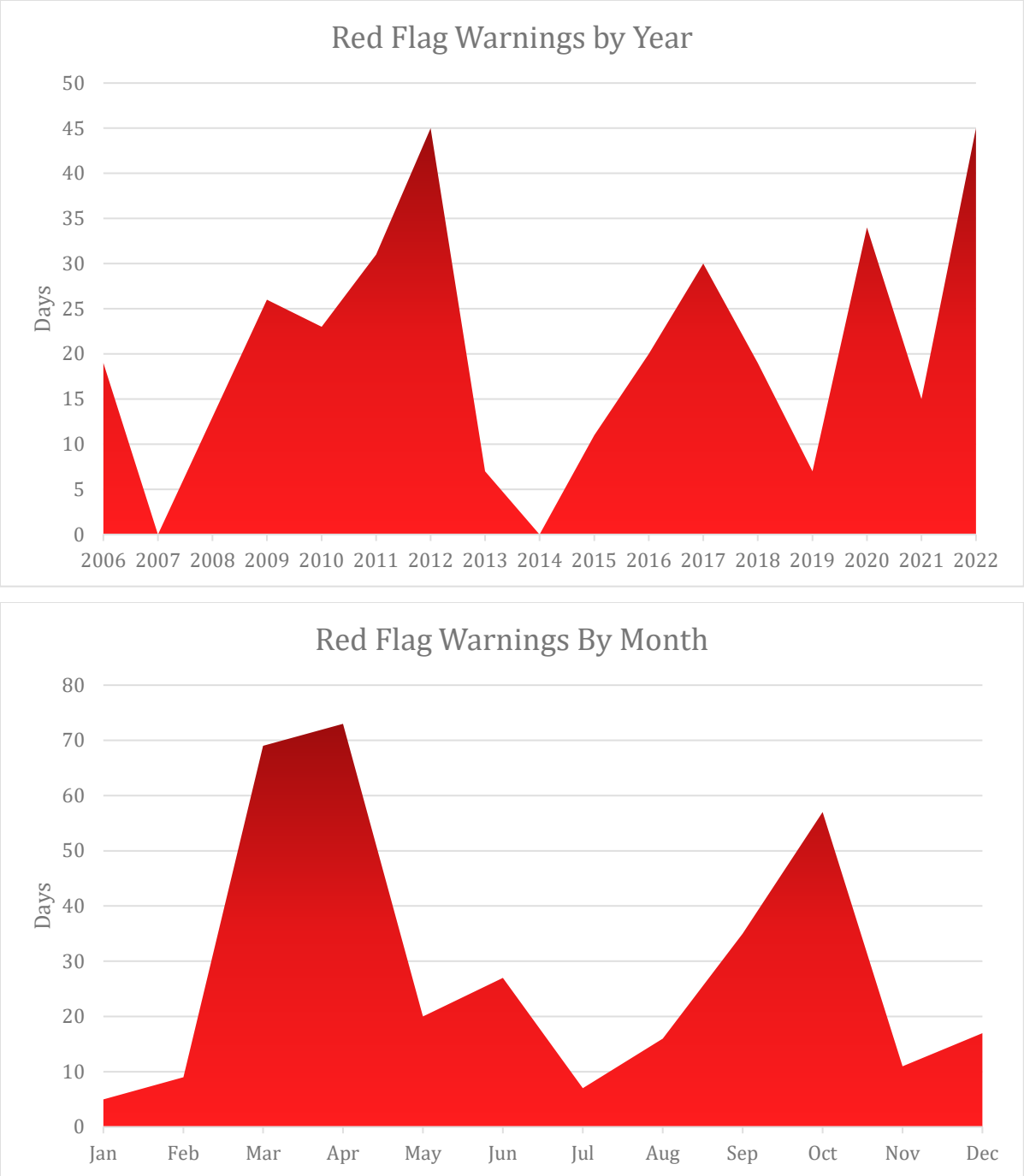


Figure 2.e.4. Total number of red flag days by year and by month from 2006 to 2022. March, April, and October are the most common months for experiencing red flag weather. Source: Iowa State University, Iowa Environmental Mesonet.

2.f. Variable Fire Behavior and Exposure in LFRA

Many neighborhoods in LFRA could experience extreme fire behavior that could put the lives of residents, visitors, and firefighters at risk. Steep slopes, dense forests, limited road access in and out of neighborhoods, and flammable building material contribute to this dangerous situation. **There is an immediate need for this community to undertake proactive measures to mitigate wildfire risk to protect lives and property.**

Topography and fuel conditions are highly variable across LFRA (**Figure 2.f.1**), and patterns in these factors, plus alignment between wind patterns and topography, help explain the patterns in potential fire behavior across LFRA and surrounding landscape. If wind is pushing wildfire up a steep slope, it can result in more extreme fire behavior than if a fire is backing down the leeward side of a slope. Northwest facing slopes are likely to have dense forest conditions and a greater quantity of fuel available to burn if conditions are dry enough. However, south facing slopes are usually drier than north-facing slopes, and grasses present in moderately dense forests and shrublands can dry out very quickly on hot days and support rapidly moving fires with high flame lengths.

Under moderate fire weather conditions—conditions typical of a summer day in the area —24% percent of LFRA could experience high to extreme fire behavior. This percentage increases to 36% under less common but more extreme, hot, dry, and windy conditions (**Figure 2.f.2**).

High to extreme fire behavior includes ember production that ignites additional fires away from the main fire and the movement of high-intensity fire from treetop to treetop. Such fires are extremely challenging if not impossible to control until winds die down and fuel moistures increase. Fire growth could be extensive across western LFRA if wildland firefighters cannot engage due to dangerous conditions from extreme fire behavior (**Figure 2.f.3**). Rapidly moving wildfires in shrublands and grasslands in the eastern part of LFRA could enter neighborhoods and initiate home-to-home ignitions.

High to extreme fire behavior can also create non-survivable conditions along roadways, which is of particular concern in some western neighborhoods in LFRA where there are few points of egress for an evacuation. Under moderate fire weather conditions, 8% of the roads in the western part of LFRA could experience non-survivable conditions, and this percentage rises to 25% under extreme fire weather conditions (**Figure 2.f.4**). Evacuation preparedness is of the utmost importance for residents in neighborhoods with hazardous conditions along roadways (see **Section 3.a. Evacuation Preparedness**).

Important Considerations about Fire Behavior Predictions

Fire behavior models can provide reasonable estimates of relative wildfire behavior across a landscape. However, wildfire behavior is complex, and models are a simplification of reality. Models also struggle to capture impacts of structures on wildfire spread and home-to-home ignitions. It is recommended to use fire behavior analyses at a landscape scale to assess relative risk across the entire LFRA.

Exceptional hot, dry, and windy conditions are increasingly common due to climate change and could result in even more extreme fire behavior across LFRA than predicted by this analysis.

See **Appendix B** for details on fire behavior modeling used for this CWPP.

On days with extreme fire weather conditions, about 30% of homes in the western part of LFRA and 6% in the eastern part could be exposed to embers from burning vegetation, regardless of vegetation in the immediate vicinity of the home (**Figure 2.f.5**). Homes serve as an additional source of fuel that could produce high-intensity flames, emit embers, and initiate home-to-home ignitions. Residents and business owners can complete home hardening practices to reduce the risk of embers penetrating their homes.

Residents in LFRA are highly concerned about wildfire risk. Top concerns to residents are loss of life, loss of insurance coverage, and impacts to water resources. (**Figure 2.f.6**). Fortunately, these concerns can be addressed through concerted effort across the community to mitigate wildfire risk and increase emergency preparedness. **Implementing recommendations in this CWPP will go a long way towards helping LFRA become a fire adapted community.**

While it is always a good idea to invest in defensible space and home hardening for residents in the WUI, it is equally important to understand the limitations these steps have in certain environments. Relying on those actions or expecting the fire department to be able to protect your home and family is naïve in these extreme danger scenarios. Major coordinated action is needed to provide helpful protection against wildfire in these areas. Working with neighbors to create fuel treatments, mosaic landscapes, and protected roadways can make the community safer for everyone.

Take Away Message

Parts of LFRA at high risk for large, high-severity wildfires due to dense forest conditions, dry and hot weather, and strong, gusty winds. Increasing drought and warming temperatures exacerbate wildfire risk in the area. **Proactive work by LFRA, residents, and partners is imperative to protect lives and property .**

Strong, gusty wind contributed to rapid growth of the 2020 East Troublesome Fire in Colorado.

Photo credit: Jessy Ellenberger, Associated Press.

Figure 2.f.1. Fuel loads are variable across LFRA, including dense forests with abundant ladder fuels (top), open forests with widely spaced trees and few ladder fuels (middle), shrublands (bottom left), and riparian corridors (bottom right). Fuel type and fuel loads greatly influence fire behavior, intensity, and rate of spread. Photo credit: The Ember Alliance.

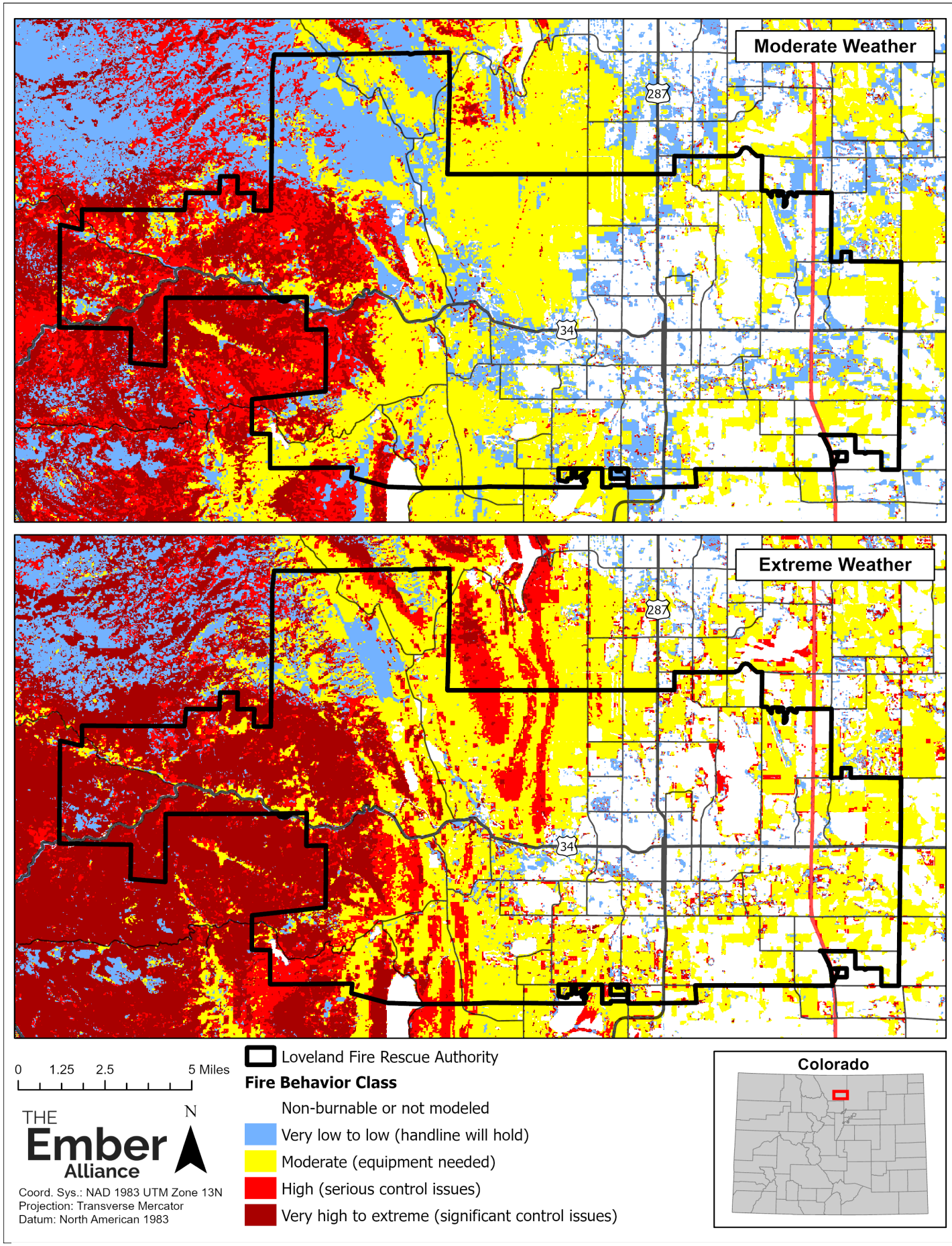


Figure 2.f.2. Under moderate fire weather conditions—conditions typical of a summer day in LFRA —24% percent of LFRA could experience high to extreme fire behavior, and this percentage increases to 36% under less common but more extreme, hot, dry, and windy conditions. High to extreme fire behavior includes ember production that ignites additional fires away from the main fire and the movement of high-intensity fire from treetop to treetop. Such fires are extremely challenging if not impossible to control until winds die down and fuel moistures increase. See **Appendix B** for a description of modeling. View an interactive map online.

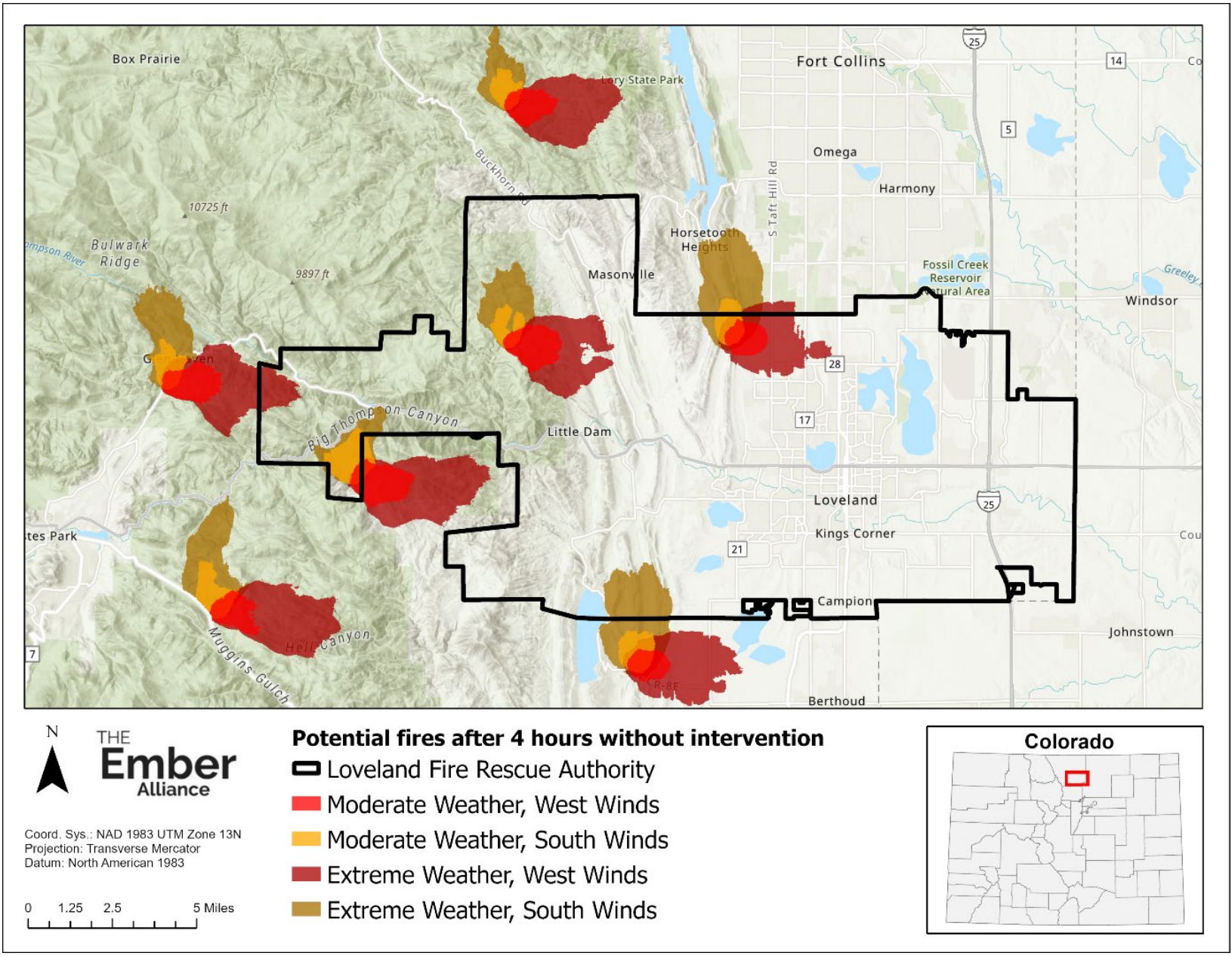


Figure 2.f.3. Fire growth could be extensive across LFRA under extreme fire weather conditions if wildland firefighters cannot engage due to dangerous conditions from extreme fire behavior. Simulated fire perimeters were based on fire behavior predictions after 4-hours of fire growth without suppression activities from hypothetical ignition locations. Multiple fire perimeters are shown to demonstrate the variety of fire sizes, shapes, and travel paths that could happen in and around LFRA under different fire weather conditions and wind directions.

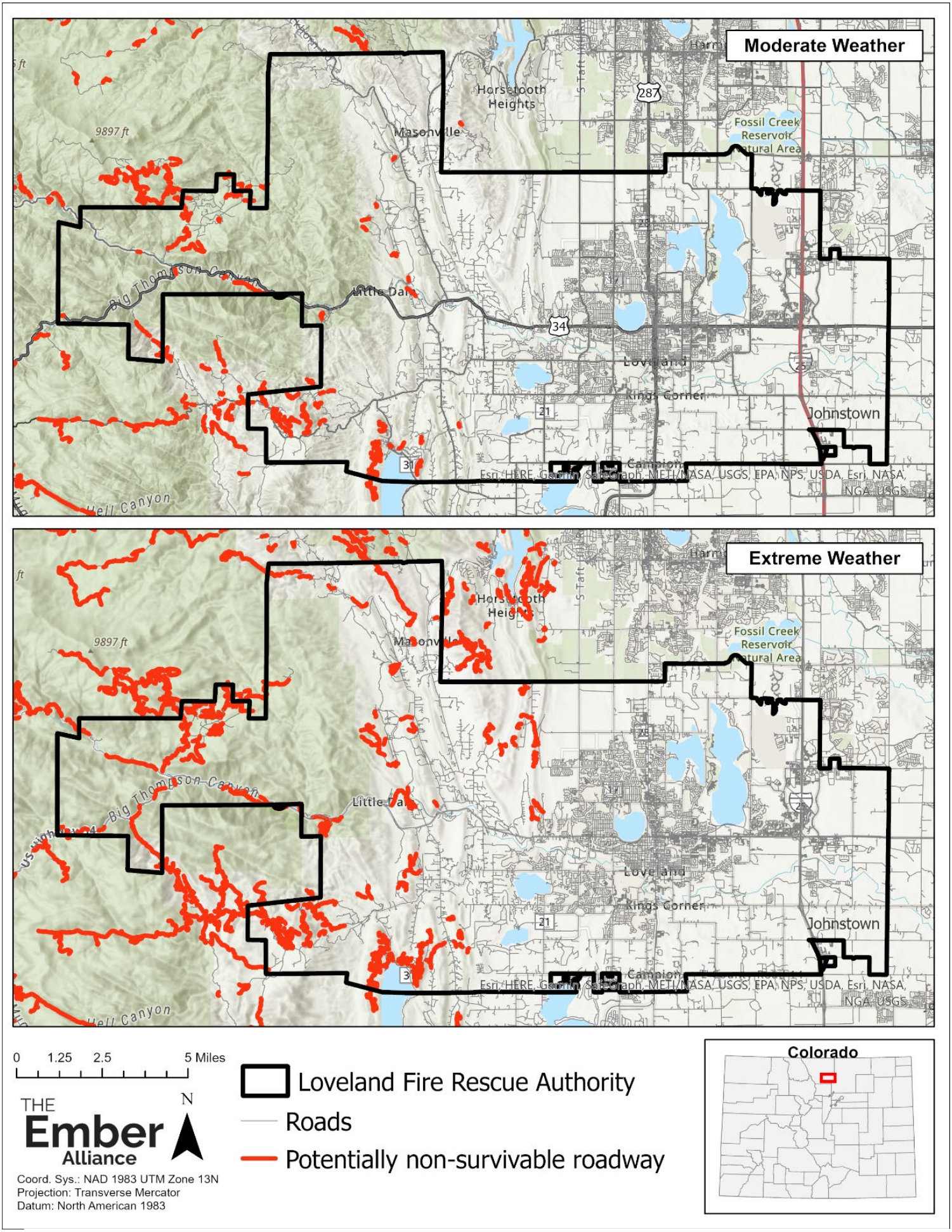


Figure 2.f.4. Under moderate fire weather conditions, 2% of roads and driveways in LFRA could potentially experience non-survivable conditions during wildfires. This percentage rises to 6% under extreme fire weather conditions. In the areas west of Wilson Ave, where the roads are more exposed, 8% of roads are potentially non-survivable under moderate weather and 25% under extreme weather. View an interactive map online.

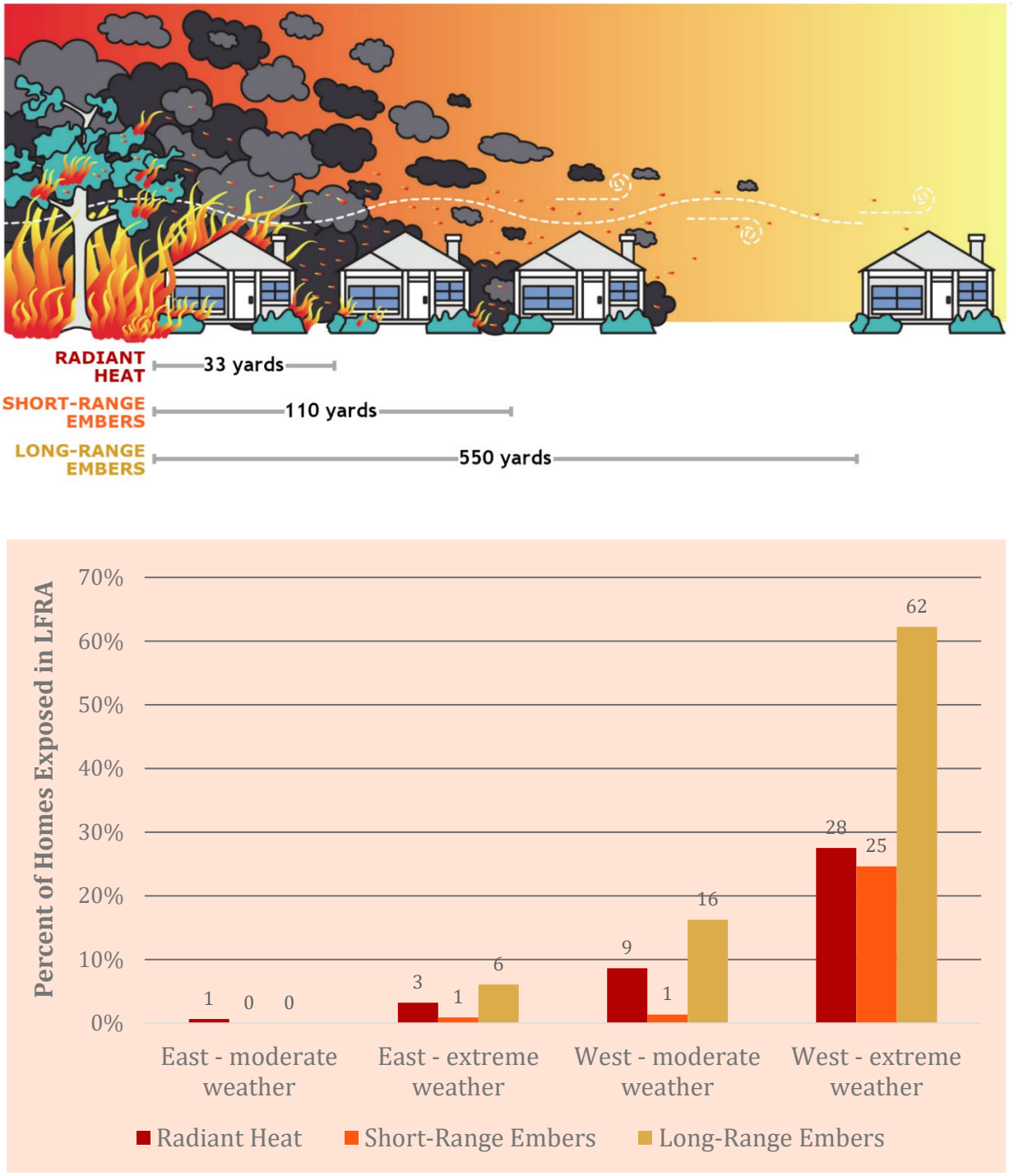


Figure 2.f.5. Percentage of homes in eastern vs. western LFRA with different types of exposure to wildfire under moderate and extreme fire weather conditions. Radiant heat from burning vegetation can ignite nearby homes, and embers emitted from burning vegetation or other homes can travel long distances and ignite vegetation and homes away from the main fire. Analysis based on research by Beverly et al., (2010) (see **Appendix B** for details). Image modified from Reducing Brushfires Risks by the Victorian Auditor-General's Office.

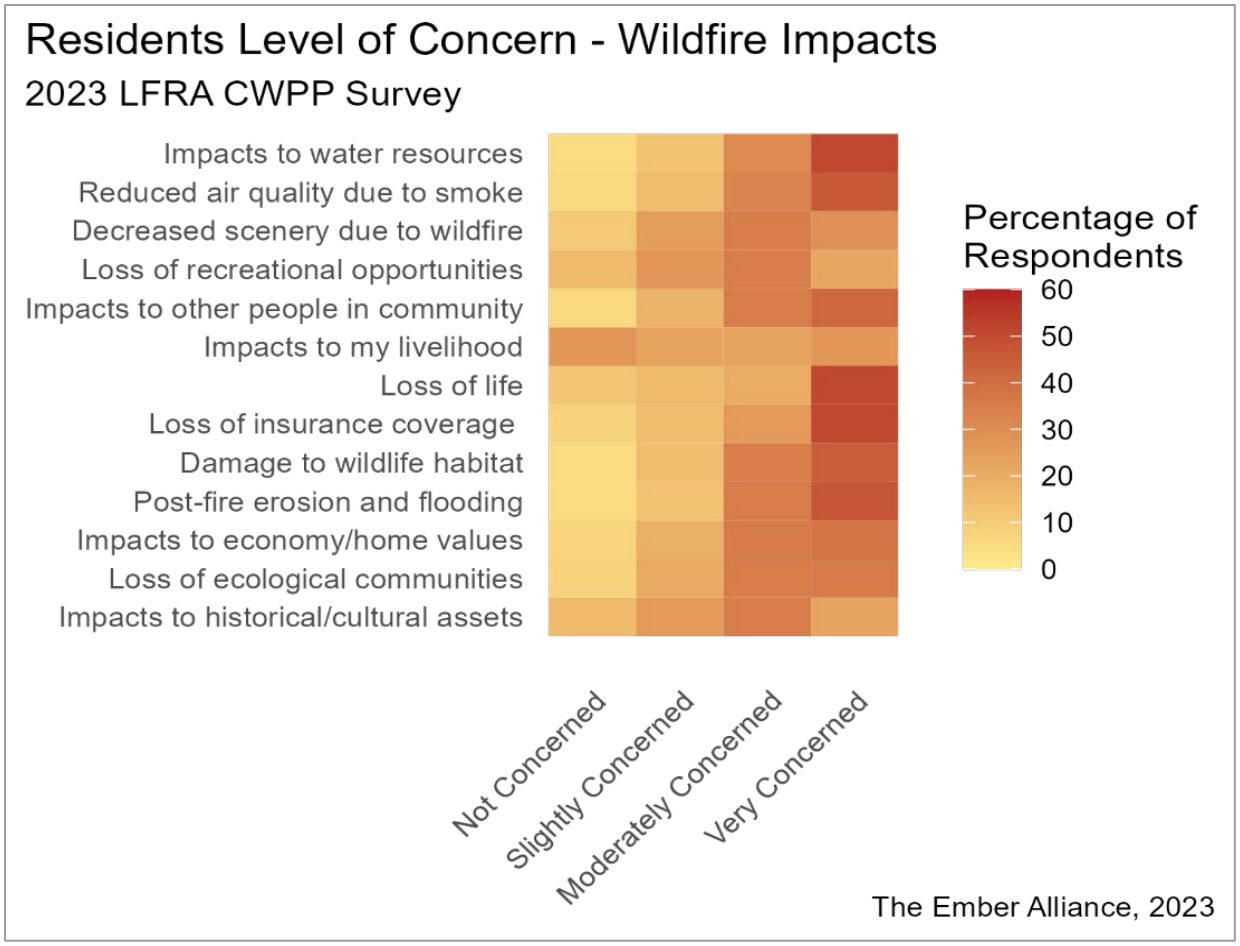


Figure 2.f.6. Level of concern about wildfire impacts expressed by LFRA residents who responded to the CWPP survey. Top concerns were loss of life, loss of insurance coverage, and impacts to water resources. See **Appendix C** for a full summary of survey findings.

2.g. Fuel Treatment History in and Around LFRA

Fuel treatments reduce the amount of fuel in strategic locations, reducing fire risk to nearby communities and creating tactical opportunities for wildland firefighters to engage with wildland fires. Fuel treatments were important tactical features during the Cameron Peak Fire because they reduced the potential for extreme fire behavior in strategic locations (Avitt 2021) (**Figure 2.g.1**).

Many agencies and landowners have completed fuel treatments that include removing ladder fuels, cutting trees, burning slash piles, and broadcast burning. LFRA has participated in this fuels reduction, and other organizations and agencies have also completed a significant amount of work in the area. The Big Thompson Watershed Coalition, Larimer Conservation District, US Forest Service, Colorado State Forest Service, City of Loveland, Fort Collins Natural Areas, Larimer County, and others have been a part of treating hundreds of acres in LFRA.

An essential component of this CWPP was identifying locations for additional fuel treatments to protect the community. **Section 4** outlines these priority locations and the land management agency leading these efforts in the coming years.

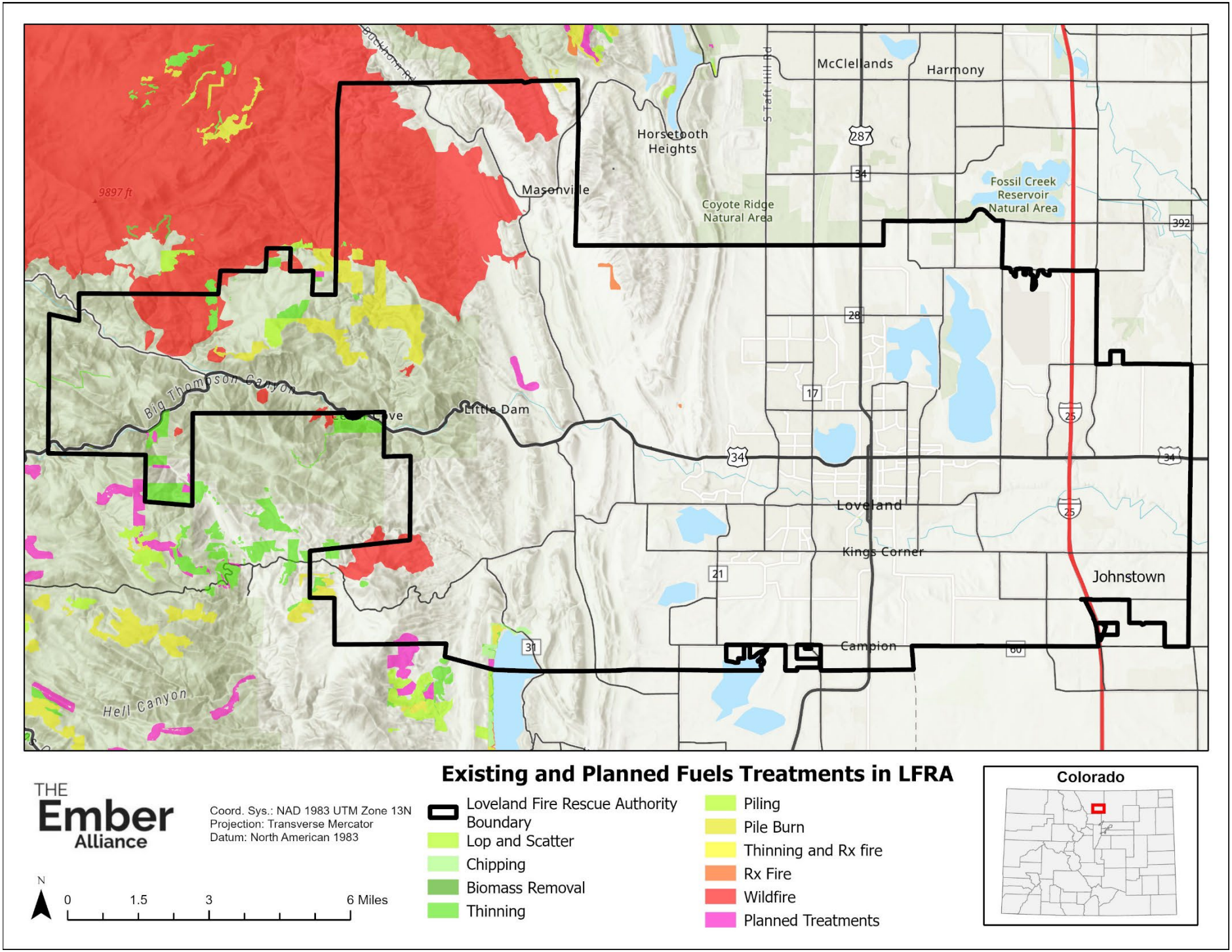


Figure 2.g.1. Locations of forest management treatments and wildfires in and around LFRA from 2000-2023 conducted by, Colorado State Forest Service, Larimer County Natural Resources, US Forest Service, Big Thompson Watershed Coalition, Larimer Conservation District, Loveland Parks and Open Space, and Fort Collins Natural Areas. View an interactive map online.

3. Becoming a Fire Adapted Community

It is recommended that LFRA, HOAs, and residents embrace the concept of Fire Adapted Communities (FAC), which is defined by the National Wildfire Coordinating Group as "a human community consisting of informed and prepared citizens collaboratively planning and taking action to safely coexist with wildland fire". This concept can guide residents, fire practitioners, and communities through a holistic approach to become more resilient to fire (**Figure 3.1**).

Your community's CWPP sets the stage for fire adaptation, and the next step is on-the-ground action and an ongoing commitment to risk mitigation at all levels of the community, from individuals to neighborhoods and HOAs, to LFRA, land managers and other partners. This section of the CWPP includes recommendations and resources for mitigating wildfire risk and enhancing emergency preparedness. LFRA and public land managers have an important role to play in implementing the recommendations in this CWPP, and they have made commitments to take on-the-ground action as outlined in **Section 4.**

Individual homeowners, neighborhoods, and HOAs also have a vital role to play in addressing shared wildfire risk. Action and community-building centered around mitigation have reduced wildfire risk and increased community resilience across the mountain west. Mitigation work by residents can spur mitigation by their neighbors (Brenkert-Smith et al., 2013). The cumulative impact of linked defensible space across private properties can improve the likelihood of home survival and protect firefighters during wildfire events (Jolley, 2018; Knapp et al., 2021).

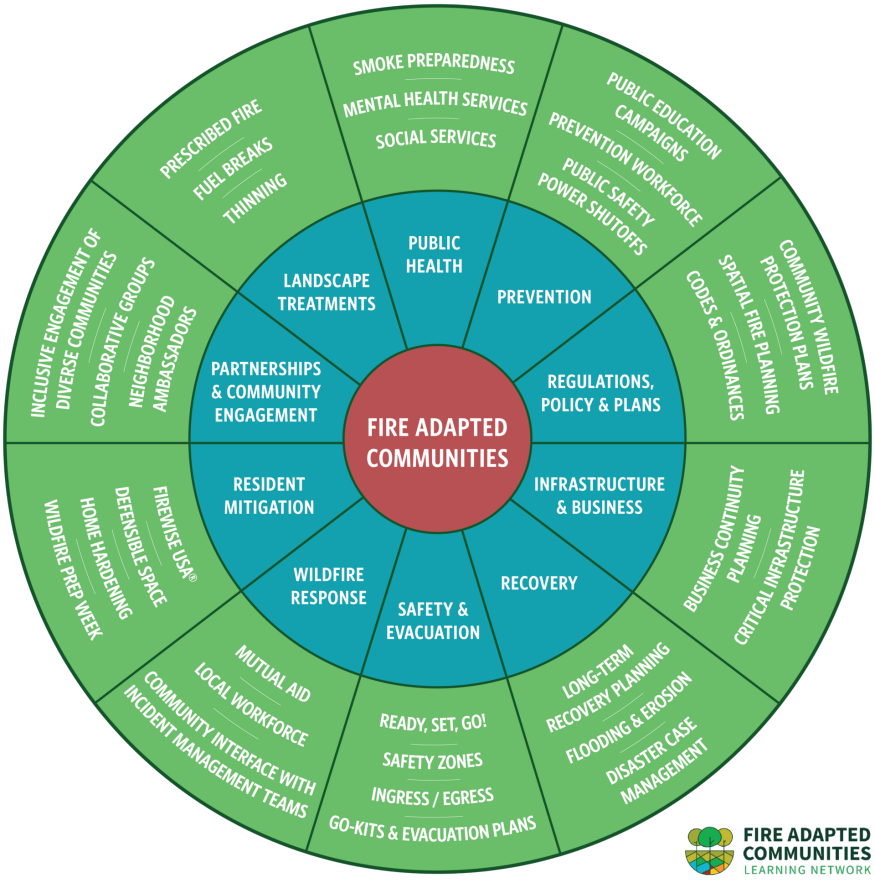


Figure 3.1. The Fire Adapted Communities graphic provides specific programs and activities that communities can take to reduce their wildfire risk and increase their resilience Source: [Fire Adapted Community Learning Network](#).

3.a. Recommendations for Residents

Mitigate the Home Ignition Zone

During catastrophic wildfires, property loss happens mostly due to conditions in the **home ignition zone** (HIZ). The home ignition zone includes your home and other structures (e.g., sheds and garages) and the area within 100 feet of each structure. Firefighter intervention, adequate defensible space, and home hardening measures are common factors for homes that survive major wildfires (IIBHS, 2019; Maranghides et al., 2022). Research following the 2018 Camp Fire showed that homes were more likely to burn down when they were close to other structures that had also burned, when they had vegetation within 100 meters of the home, and when they had combustible materials (firewood or propane tanks) near the home (Knapp et al., 2021).

You can increase the likelihood that your home will survive a wildfire and help protect the safety of firefighters by creating defensible space, replacing or altering building materials to make your home less susceptible to ignition, and taking steps to increase firefighter access along your driveway.

It is important for residents to work together as a community to mitigate shared wildfire risk in the HIZ. Structure-to-structure ignition is a major concern in WUI communities and can cause substantial property loss. Neighbors can increase their homes' chances of survival during a wildfire if they work together to reduce hazards in their overlapping defensible space.

Defensible space is the area around a building where vegetation, debris, and other types of combustible fuels have been treated, cleared, or reduced to slow the spread of fire and reduce exposure to radiant heat and direct flame. It is encouraged that residents develop defensible space so that, during a wildfire, their home can stand alone without relying upon limited firefighter resources.

Defensible space allowed firefighters to protect this home during the 2016 Cold Springs Fire near Nederland, CO. Photo credit: Wildfire Partners.

Home hardening is the practice of making a home less likely to ignite from the heat or direct contact with flames or embers. It is important to remember that embers can ignite homes even when the flaming front of a wildfire is far away. Home hardening involves reducing this risk by changing building materials, installation techniques, and structural characteristics of a home. Home hardening measures are particularly important for WUI homes; 50 to 90% of homes ignite due to embers rather than radiant heat during wildfires (Babrauskas, 2018; Gropp, 2019; Holstrom et al., 2023).

Fortunately, some residents in LFRA have already started taking actions to mitigate their home ignition zone (**Figure 3.a.1**). At least 22% of respondents annually remove debris from their home, and nearly 20% have cut or limbed trees near their home.

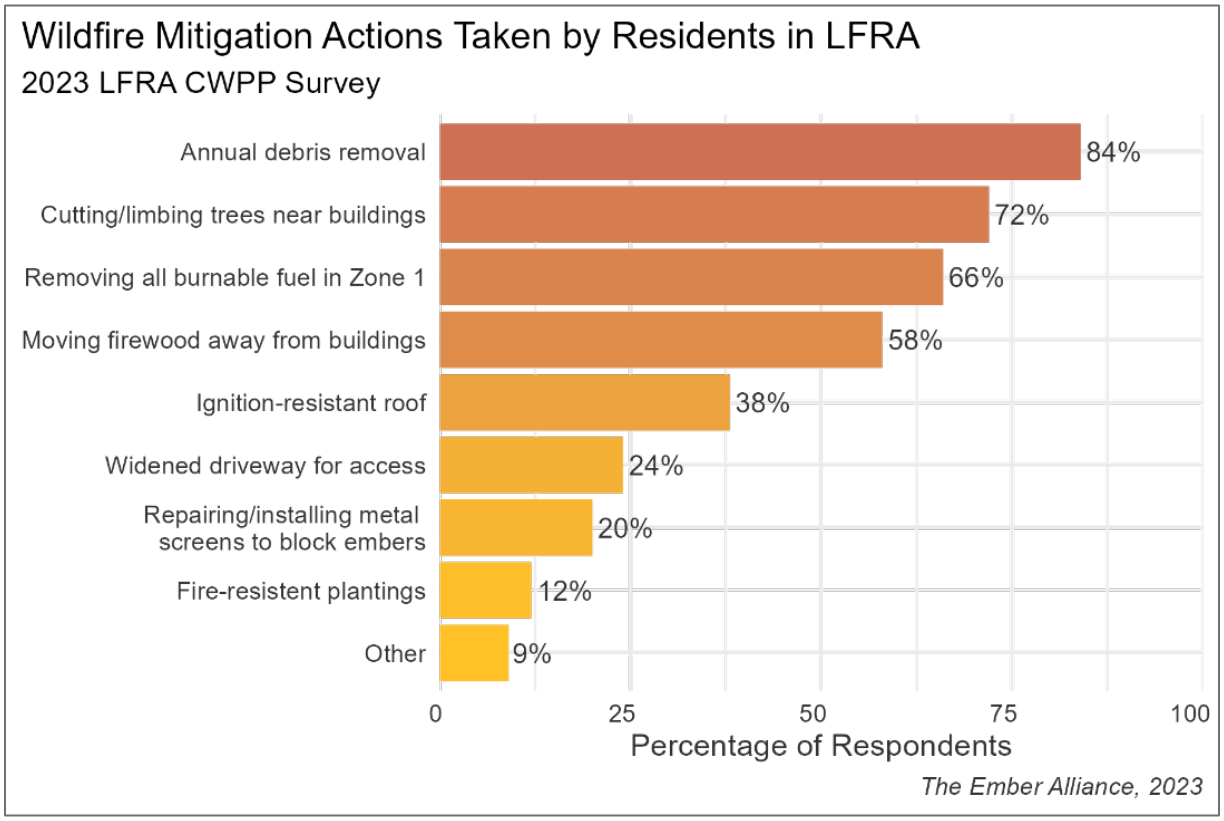


Figure 3.a.1. Percentage of LFRA residents who responded to the CWPP survey and have completed different actions to mitigate risk in their home ignition zone. See **Appendix C** for a full summary of survey findings.

New Wildfire Risk Reduction Requirements in LFRA

On June 30, 2023, LFRA and the City of Loveland adopted the new Wildfire Risk Reduction Requirements, which focus on construction hardening, fuels management and fences. Wildfire risk reduction requirements are in accordance with the City Unified Development Code (UDC) and all other applicable requirements of the locally adopted 2021 International Fire Code, 2021 International Building Code, and 2021 International Residential Code. Requirements apply to new construction, additions, and repairs in the WUI. See Appendix O of the International Fire Code for a map where the requirements apply, details of the requirements, and limited exceptions to the policy in LFRA.

Defensible Space

Defensible space creates a buffer between your home and grass, trees, and shrubs that could ignite during a wildland fire. Defensible space can slow the spread of wildfire, prevent direct flame contact, and reduce the chance that embers will ignite material on or near your home (Hakes et al., 2017). Substantially reducing vegetation within the HIZ and removing vegetation that overhangs decks and roofs can reduce structure loss, especially for homes on slopes (Syphard et al., 2014).

> **!** **Do not count on firefighters staying to defend your home—your home should be able to survive a wildfire on its own. There are never enough firefighters to stay and defend every single home during large incidents.** Properties that are not defensible will often not receive firefighter resources due to unsafe conditions and the higher likelihood of home loss.

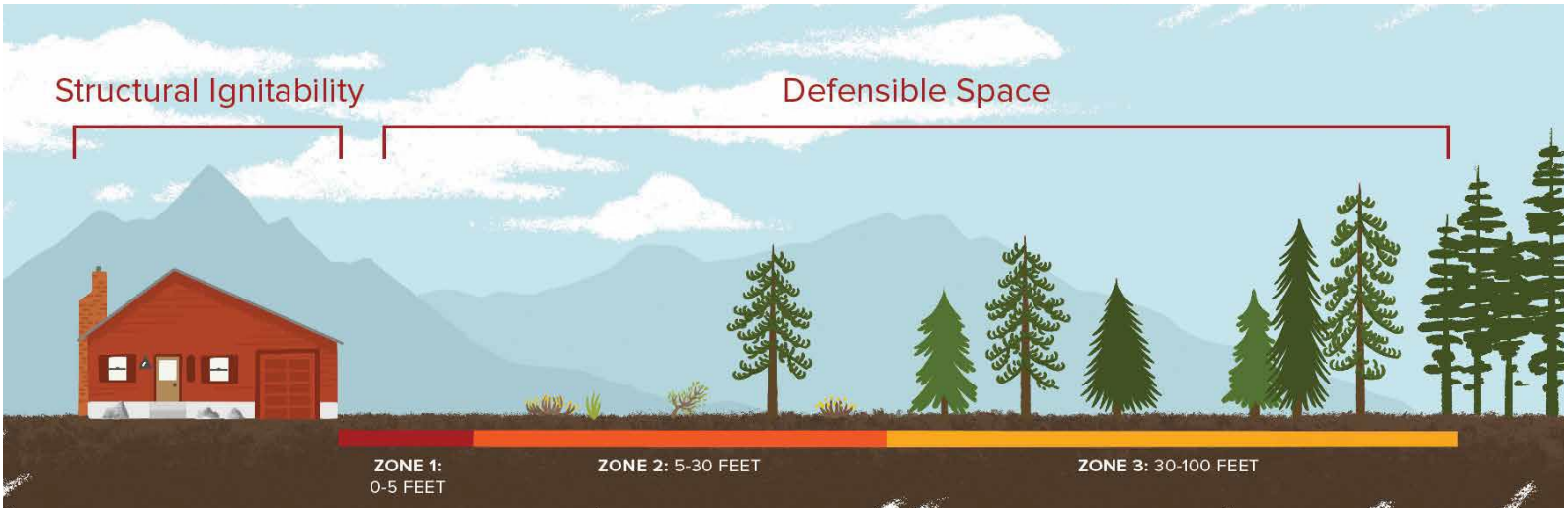
Defensible space is divided into multiple zones around a home, and recommended practices vary among zones. The Colorado State Forest Service (CSFS) defines zone one as 0 to 5 feet from the home, zone two as 5 to 30 feet from the home, and zone three as 30 to about 100 feet from the home (**Figure 3.a.2**). Some organizations call zone one the "noncombustible zone" (0 to 5 feet from the home) and zone two the "lean, clean, and green zone" (5 to 30 feet from the home).

Structure-to-structure ignition is a serious concern in high-density neighborhoods. The 2021 Marshall Fire burned neighborhoods similar to the urban parts of LFRA. Of the 848 structures that were exposed to direct flame contact, 99% were within 100 feet of another structure, and 78% were within 30 feet (Holstrom et al., 2023).

Property owners should establish defensible space around each building on their property, including campers / RVs, detached garages, storage buildings, barns, and other structures. RVs are highly flammable and can emit embers that might ignite nearby homes and vegetation. Removing all vegetation under and around campers in HIZ 1 is crucial. Campers / RVs, boats, detached garages, storage buildings, barns, and other large structures should be placed at least 50 feet away from primary structures to prevent structure-to-structure fire spread (Maranghides et al., 2022).

A 2021 study from the University of Colorado-Boulder showed that homeowners living in the WUI in Bailey, CO typically underestimated the level of risk their home is at due to wildfire, and tended to overestimate the amount of work they have done to protect their property (Simpkins, 2021). Make sure you are informed about best practices for protecting your home. See **Table 3.a.1** and the CSFS publication The Home Ignition Zone for recommendations. **Section 4.c.** includes specific defensible space recommendations by forest type for HIZ 3.

Some homes in LFRA have exemplary defensible space with mowed grass near structures, trees limbed and not overhanging roofs, and non-flammable barriers within home ignition zone 1. Photo credit: LFRA.



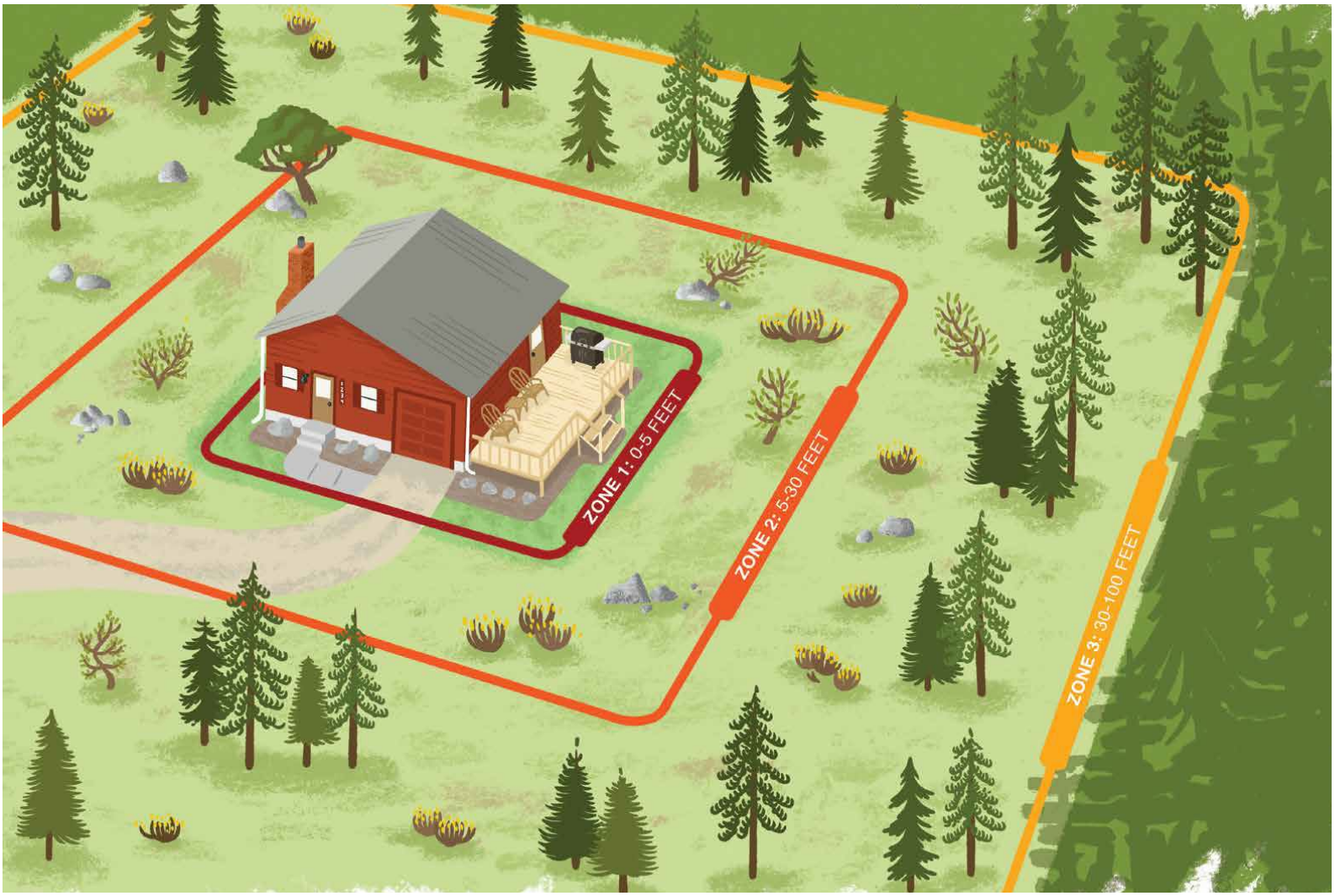


Figure 3.a.2. Home ignition zones recommended by the Colorado State Forest Service. Using ignition-resistant building materials and removing burnable fuel around primary structures, outbuildings such as sheds, and campers / RVs is crucial for increasing your home's chance of surviving a wildfire and creating safe conditions for wildland firefighters. Source: Colorado State Forest Service 2021, The Home Ignition Zone.

Table 3.a.1. Home ignition zone recommendations based on the CSFS publication The Home Ignition Zone. Specific measures will depend on the placement and condition of your property. Requirements from the LFRA Wildfire Risk Reduction Requirements for the WUI are highlighted in **green**. See Appendix O of the International Fire Code for more information.

Zone 1: 0 to 5 feet from your home – the noncombustible zone.
Goal: Prevent flames from coming into direct contact with your home.
• **Create a noncombustible border 5 feet around your home. Remove all vegetation and replace flammable wood chips or mulch with alternatives like dirt, stone, flagstone, concrete, or gravel.** Research shows that the worst materials to use in zone 1 are shredded rubber, pine needles, and shredded western red cedar due to their high flammability **(Quarles and Smith, 2011)**. • Remove branches that hang over your roof and drop needles onto your roof and remove all fuels within 10 feet of the chimney. • Remove combustible materials (dry vegetation, wooden picnic tables, juniper shrubs, etc.) from underneath, on top of, or within 5 feet of decks, overhangs, windows, and doors. • Annually remove dead or dry leaves, pine needles, and dead plants within 5 feet of your home and off your deck, roof, and gutters. Raking material farther than 5 feet from structures will not significantly reduce the likelihood of ignition. • Move firewood or other combustible materials to Zone 3. • Do not use space under decks for storage.

Zone 2: 5 to 30 feet from your home – the lean, clean, and green zone.
Goal: Slow the movement of flames approaching your home and lower the fire intensity.
• Irrigate and mow grasses to 4 inches tall or less. • Remove any accumulated surface fuels such as logs, branches, slash, and mulch. • **Use only Firewise Plant Materials plants for landscaping.** Firewise plants have more fire-resistant attributes, like short-statures, deciduous leaves, and higher moisture content. They also tend to be more drought tolerant and require less water. • **In the LFRA WUI, no highly combustible brush, trees, or shrubs shall be placed within 15 feet or a home or accessory structure. Exceptions can be made for deciduous trees within 10 feet of the home with approval by the fire code official.** • Remove enough trees to create at least 10 feet* of space between crowns. Measure from the outermost branch of one tree to the nearest branch on the next tree. Create even more space between trees if your home is on a slope (Table 3.a.2). See Figure 3.a.3 for how to measure crown spacing. • Favor the retention of aspen trees because this species naturally has high fuel moisture, no low branches, and smooth bark, making them less likely to ignite than conifer trees. • Remove ladder fuels under remaining trees. This is any vegetation that can bring fire from the ground up into taller fuels. • **Remove limbs so branches do not hang below 10 feet above the ground.** See Figure 3.a.3 for a depiction of how to measure limb height. • Keep spacing between shrubs at least 2-3 times their height. • Relocate wood piles and propane tanks to Zone 3. • Remove stressed, diseased, dead, or dying trees and shrubs. This reduces the amount of vegetation available to burn and improves forest health. • Keep shrubs at least 10 feet* away from the edge of tree branches.

Aspen trees naturally have high fuel moisture, no low branches, and smooth bark, making them less likely to ignite than conifer trees. Retaining small groups of aspen trees is acceptable in HIZ 2—just remember to rake up dry leaves that fall onto your roof or on the ground within 5 feet of your home. Photo credit: Fire Adapted Colorado.

Zone 3: 30 to 100 feet from your home

If you live on a slope, this zone should be larger due to the greater potential for extreme fire behavior. Section 4.c. includes recommendations for zone 3 by forest type.

Goal: Slow movement of flames, move fire to the ground, and reduce ember production.

- Store firewood and propane tanks at least 30 feet away and uphill from your home and away from flammable vegetation. Store even farther away if your home is on a slope.
- Move campers / RVs, boats, detached garages, storage buildings, barns, and other large structures at least 50 feet away from your home.
- Mow or trim grasses to a maximum height of 6 inches. Grasses can be taller in zone 3 than zone 2 because of the greater distance from your home, but shorter grass is always better for reducing potential flame lengths and therefore radiant heat exposure.
- Remove enough trees to create at least 6- to 10-foot spacing* between the outermost branches of remaining trees. Create even more space between trees if your home is on a slope (Table 3.a.2). See Figure 3.a.3 for a depiction of how to measure crown spacing.
- Favor the retention of aspen trees because this species naturally has high fuel moisture, no low branches, and smooth bark, making them less likely to ignite than conifer trees.
- **Remove limbs so branches do not hang below 10 feet above the ground.** See Figure 3.a.3 for a depiction of how to measure limb height.
- Remove shrubs and saplings that can serve as ladder fuels.
- Remove heavy accumulations of dead trees, branches, and piles of fallen leaves, needles, twigs, pinecones, and small branches. Thin trees to increase spacing and remove ladder fuels to reduce the likelihood of torching, crown fires, and ember production.
- Consult with a qualified forester to develop a plan to manage your property to achieve fuel reduction and other goals, such as creating wildlife habitat. Follow principles of ecological restoration as outlined in Section 4.c.

*Spacing recommendations are a general guideline and should be increased for properties on steeper slopes. Reach out to LFRA or forestry professionals to develop a plan for your property.

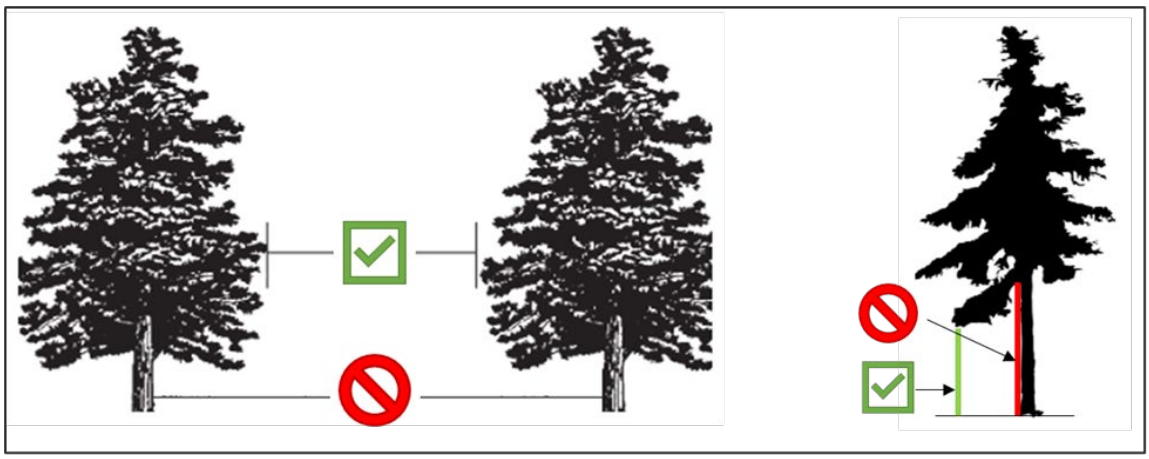


Figure 3.a.3. Spacing between tree crowns is measured from the edge of tree crown to tree crown, NOT from tree stem to tree stem (left). Height of limbs above the ground is measured from the ground to the lowest point of the limb, NOT from where the limb attaches to the tree (right). Per requirements from the LFRA Wildfire Risk Reduction Requirements, limbs must be pruned to a height of 10 feet above the ground.

Table 3.a.2. Minimum recommended spacing between tree crowns and shrubs is greater for properties on steeper slopes due to the exacerbating impact on fire behavior (Dennis, 2003).

Percent slope	Minimum spacing between tree crowns	Minimum spacing between shrubs / small clumps of shrubs
0 to 10 %	10 feet	2.5 x shrub height
11 to 20%	15 feet	3 x shrub height
21 to 40%	20 feet	4 x shrub height
>40%	30 feet	6 x shrub height

Some homeowners in the WUI are concerned that removing trees will destroy the forest and reduce the aesthetic and monetary value of their property. In fact, many dense ponderosa pine forests are unhealthy and greatly diverged from historical conditions that were maintained by frequent wildfires (**Figure 2.e.2**). The reality is that nothing will decrease the aesthetic and monetary value of your home as much as a high-severity wildfire burning all the vegetation in the community, even if your home survives the fire. Forest management can look messy and destructive in the first years following treatment; however, grasses, shrubs, and wildflowers will respond to increased light availability after tree removal and create beautiful ecosystems with lower fire risk (**Figure 3.a.4**). It might even be said that the more trees you cut, the more trees you save from wildfire.

Many property owners enjoy their land even more after conducting effective fuel treatments. Removing trees can open incredible views of mountains, rivers, and rock formations, and wildlife are often attracted to forests with lower tree densities and a greater abundance of understory plants. Reducing fuel loads and increasing the spacing between trees increases the chance that your home and your neighbors' homes will survive a wildfire, and most importantly, it increases the safety of wildland firefighters working to protect your community.

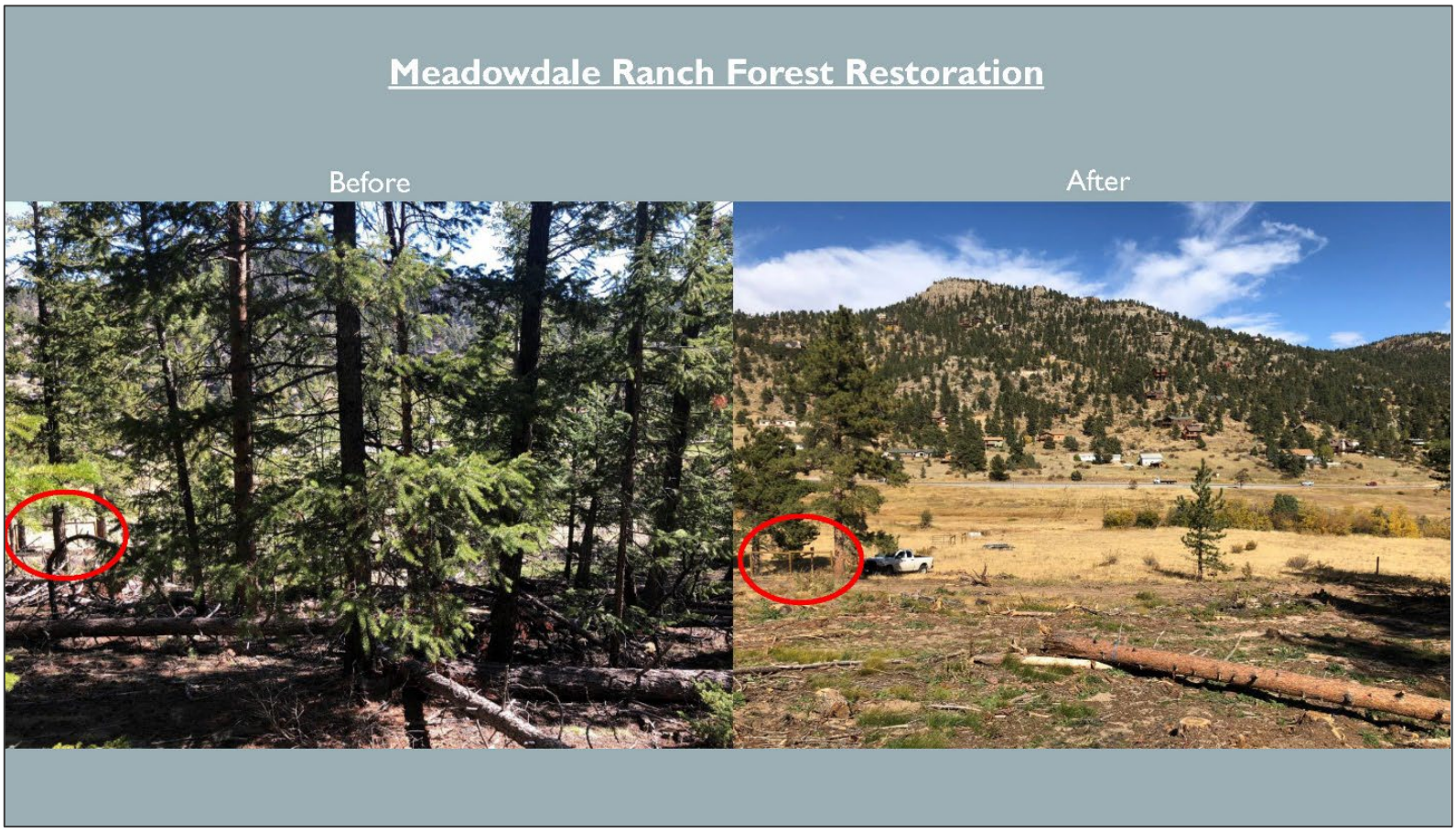


Figure 3.a.4. Grasses, shrubs, and wildflowers quickly respond to increased light availability after tree removal, resulting in beautiful ecosystems with lower fire risk and more high-quality wildlife habitat. The red circle in each photo indicates the same tree. Photo credit: Larimer Conservation District.

Linked Defensible Space

The home ignition zone of individual homes can overlap with that of their neighbors, so wildfire hazards on one property can threaten adjacent properties. Structures that are on fire can emit significant radiant heat and embers and endanger homes and structures near them**.** Nearly all homes in LFRA (99%) could be exposed to short-range ember cast from at least one neighboring home (**Figure 3.a.5**).

Neighbors can increase their homes' chances of survival during a wildfire if they work together to create linked defensible space. Linked defensible space also creates safer conditions and better tactical opportunities for wildland firefighters. According to James White, the Rocky Mountain Region Cooperative Fire Specialist, "Broadcast burning, mechanical thinning, and other treatments are proven to mitigate wildfire risk, but they are even more effective when we work together to integrate treatments across the landscape, across borders and ownerships" (Avitt, 2021). Defensible space projects that span ownership boundaries are better candidates for grant funding due to their strategic value.

How can you help inspire your neighbors to act? Start by creating defensible space and hardening your own home. Then try the ideas below:

- Invite your neighbors over for a friendly conversation about the risk assessment in this CWPP. Review resources about defensible space together, discuss each other's concerns and values, and develop joint solutions to address shared risk.
- Help organize walking tours in your neighborhood to visit the property of residents with exemplary defensible space. Witnessing the type of work that can be done and seeing that a mitigated property can still be aesthetically pleasing can encourage others to follow suit.

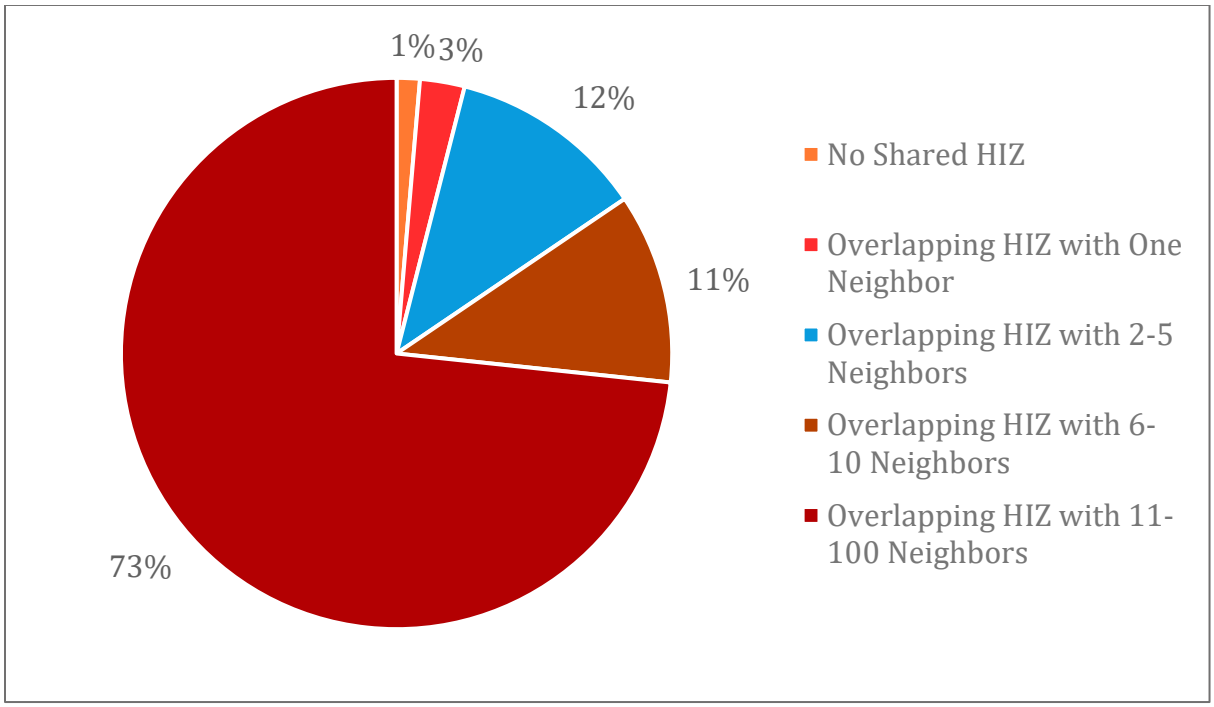


Figure 3.a.5. Percent of homes in LFRA that have shared HIZs with other structures. 99% of structures within LFRA have overlapping HIZs with at least one other structure, opening them up to higher risk of short-range embers from other structures.

Mosaic Landscapes

Varied fuel types are known to slow the spread of fire, and heterogeneous landscapes (landscapes with multiple fuel types and trees of different sizes and ages) are more typical of historical forest conditions (Duncan et al., 2015). Creating a mosaic landscape in neighborhoods can help slow fire spread by changing the fuel types as it moves across a hill or valley. A mosaic landscape can be created in many ways. For example, a neighborhood could have a few acres of old growth conifer trees next to a couple acres of aspen stands, and a few acres of young regenerating conifer trees by a large grassy meadow. This can be arranged in many ways for aesthetic and tactical purposes, and will resemble a patchwork quilt or mosaic art (**Figure 3.a.6**).

The homes in these patches still need to have adequate defensible space, but this would create a more diverse landscape where fire may move slower as it transitions between forest types and unforested locations like shrublands or meadows. Slower fire movement means firefighters have time to defend more homes in the neighborhood. It also creates a diversity of biomes that both residents and wildlife enjoy.

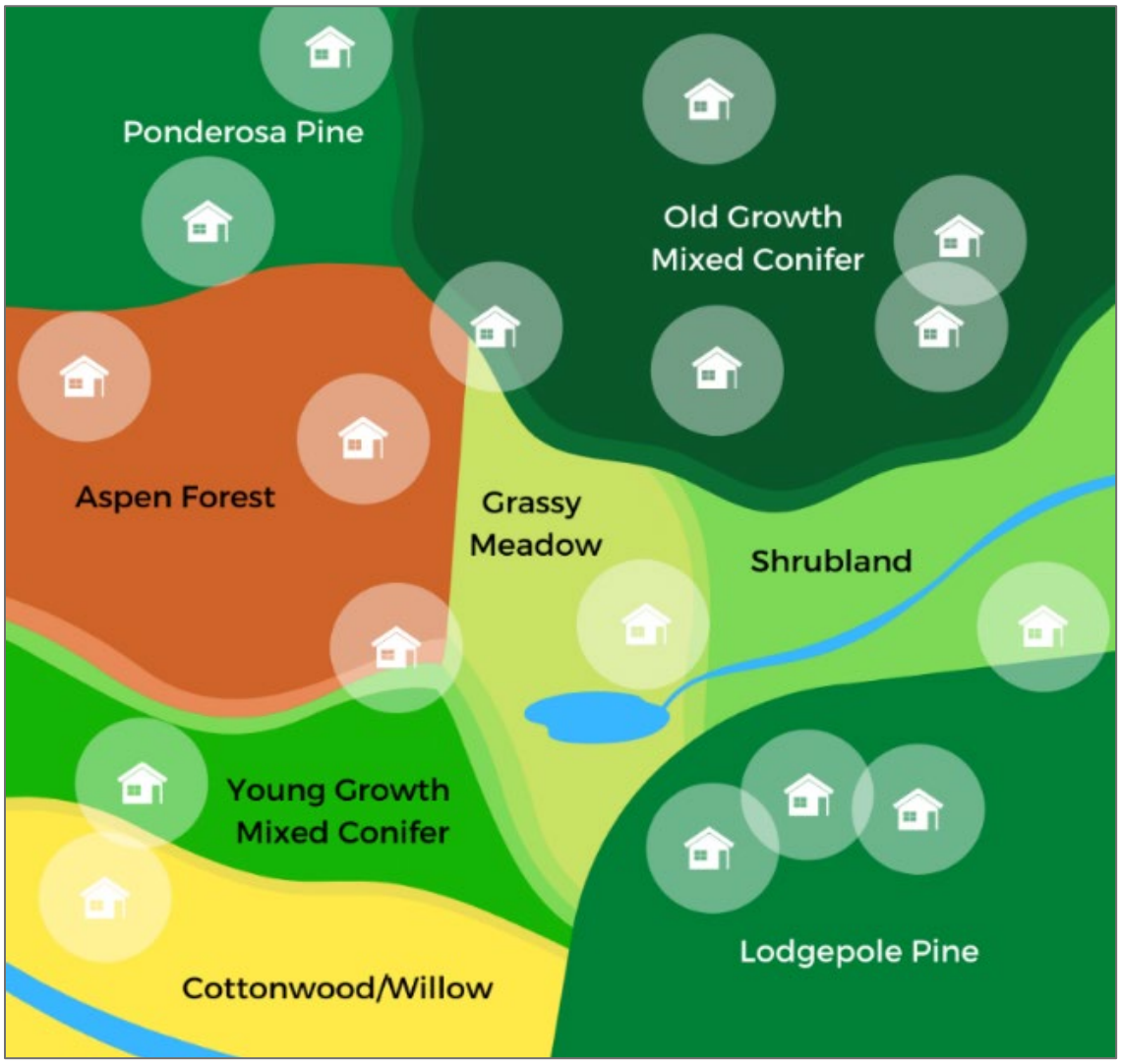


Figure 3.a.6. Example of a mosaic landscape in a neighborhood. Each home has defensible space around it, and the landscape is varied throughout, providing tactical opportunities for firefighters working to defend homes. Source: The Ember Alliance.

Home Hardening

Home hardening involves modifying your home to reduce the likelihood of structural ignition. 11% of homes in LFRA are at risk of long-range embers, and 6% are at risk of radiant heat from burning vegetation under severe fire weather conditions (**Figure 2.f.5**). Home ignition risk is likely higher than that estimated by this analysis; the high density of structures in LFRA creates increased risk for home-to-home ignition from radiant heat and embers.

Buildings cannot be made fireproof, but the chance of your home surviving wildfires increases when you reduce structural ignitability through home hardening in tandem with the creation and maintenance of defensible space. Research from the Insurance Institute for Business & Home Safety (IIBHS) clearly illustrates the benefits of home hardening for reducing the chance of home ignition from embers (watch a video of the research here). Figure 3.a.5 depicts important home hardening measures.

Lessons learned from the 2021 Marshall Fire are applicable to residents of LFRA due to their similar geography, fuels, and weather. During the event, embers were responsible for 70% of recorded structure damage – the other 30% were damaged from direct flame contact (Holstrom et al., 2023). Home hardening is the only defense against embers. Reducing the ability of embers to penetrate and ignite your home is recommended for everyone in LFRA, including those in urban areas.

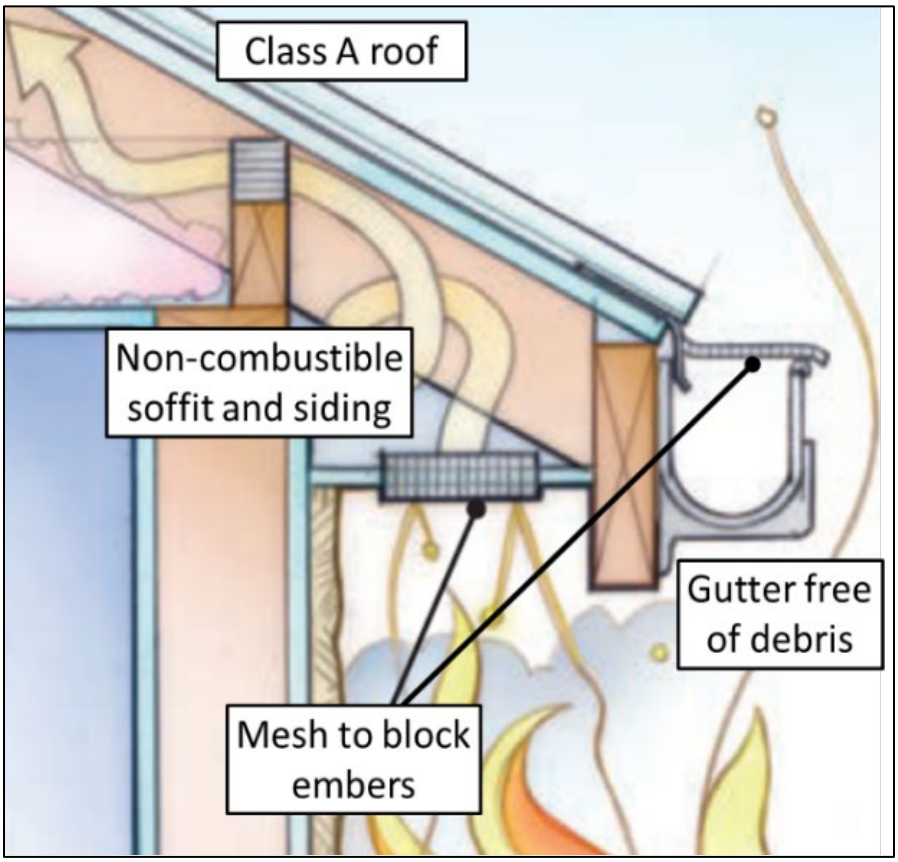


Figure 3.a.7. Residents can increase their homes' chance of survival by making it harder for embers to enter and ignite their homes (image from *Healthy Building Science*).

Roofs, vents, windows, exterior siding, decks, and gutters are particularly vulnerable to wildfires. Research on home survival during wildfires demonstrates that enclosed eaves and vent screens can reduce the penetration of wind-born embers into structures (Hakes et al., 2017; Syphard and Keeley, 2019). According to the CWPP survey, **very few residents in LFRA have installed screens to reduce ember penetration into their home (Figure 3.a.1. This is a low-cost action that all residents should consider.**

Multi-pane windows have greater resistance to radiant heat. Windows often fail before a home ignites, providing a direct path for flames and airborne embers to enter a home (CSFS, 2021).

It is important to replace wood or wood shingle roofs with noncombustible materials[1] such as composite, metal, or tile. Ignition-resistant or noncombustible siding and decking further reduce the risk of home ignition, particularly when homes also have a 5-foot noncombustible border of dirt, stone, or gravel around them. Additionally, non-wood siding and decking are often more durable and require less routine maintenance.

Residents should also consider replacing wooden fences with noncombustible materials and keeping fences at least 8 feet away from the home. Keep double combustible fences at least 20 feet away from the home. Fences can serve as pathways for wildfire to travel between vegetation and structures and from structure to structure (Maranghides et al., 2022). Wooden fences attached to homes served as one of the leading causes of home loss during the Marshall Fire (Marshall Fire FLA, 2023).

There are many low-cost actions you can start with to harden your home (see **Table 3.a.3**). Keep home-hardening practices in mind and use ignition-resistant materials if you replace a hail-damaged roof or remodel your home. Effective as of July 1, 2023, many home hardening practices are required for homes in the WUI per LFRA's Wildfire Risk Reduction Requirements. See Appendix O of the International Fire Code for a map where the requirements apply, details of the requirements, and limited exceptions to the policy in LFRA.

Wildfire Risk Reduction Requirements in LFRA

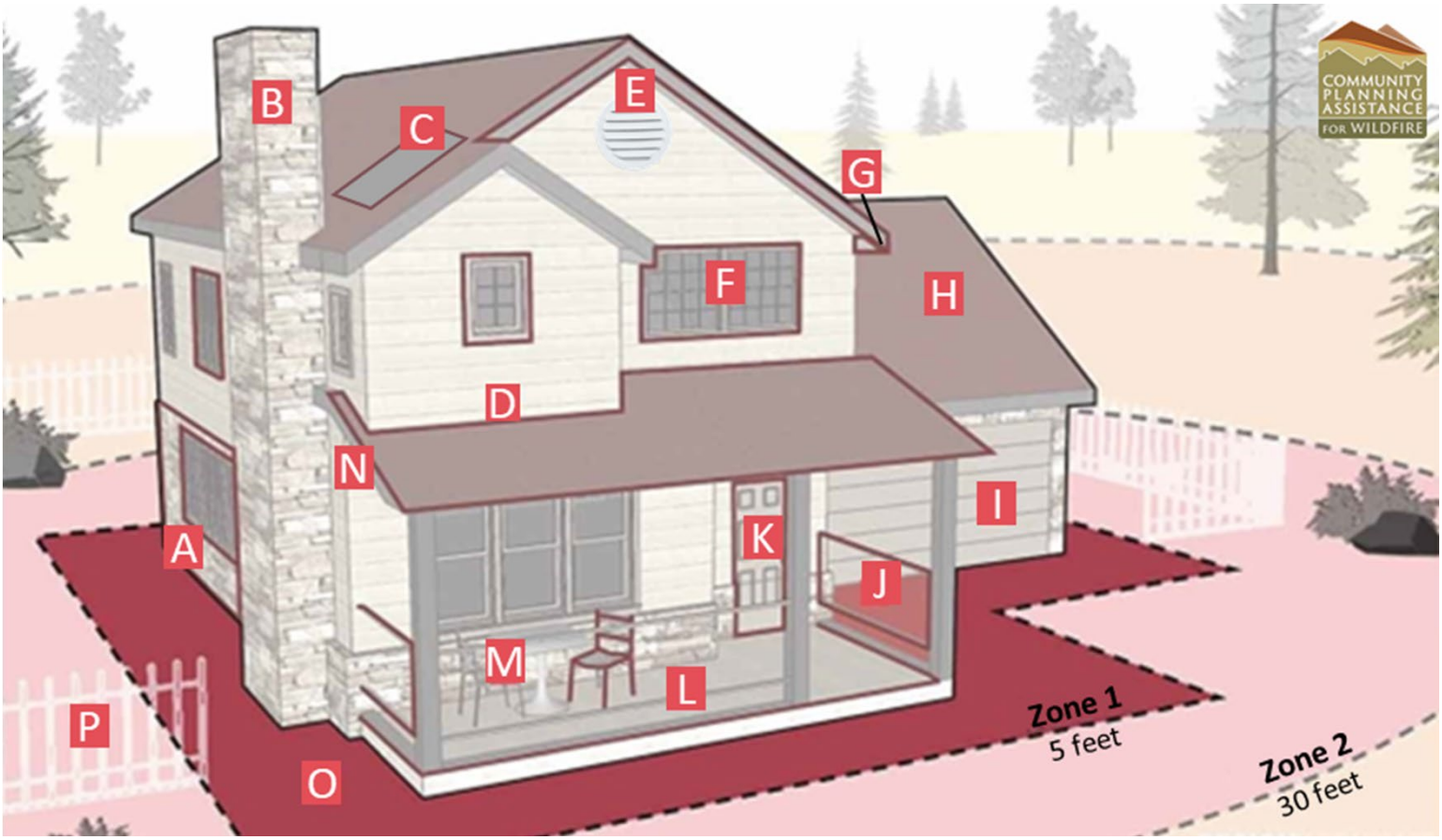
New construction, additions, and repairs in the WUI must comply with LFRA's Wildfire Risk Reduction Requirements, which includes requirements for roofs, overhangs and projections, windows, spark arrestors, gutters and downspouts, exterior doors, vents, decks, base of walls, posts, and columns, exterior siding, and fencing. See Appendix O of the International Fire Code for a map where the requirements apply, details of the requirements, and limited exceptions to the policy in LFRA.

Urban residents and the Grassland-Urban Interface

Residents that are not surrounded by forests are still part of the wildland-urban interface. Grasslands can spread fires to neighborhoods and initiate home-to-home spread, as seen in the 2021 Marshall Fire. Homeowners in the grassland-urban interface can take action to harden their homes and create defensible space to reduce the risk of ignition from wind-driving wildfires in grasslands and suburban and urban neighborhoods.

Home hardening is the highest priority action for residents in urban and eastern portions of LFRA (see **Figure 3.a.7**, **Figure 3.a.8**). Defensible space in Zone 1 (within 5 feet of the home) is the second highest priority here. This work will reduce the chances that flames and embers from nearby homes and grasses can ignite your home.

[1] See the **Glossary** on page 106 for the definition of terms used the describe the performance of building materials when exposed to fire (e.g., wildfire-resistant, ignition-resistant, and noncombustible).



Low-cost actions:

- **B.** Cover chimneys and stovepipe outlets with 3/8th to ½ inch corrosion-resistant metal mesh.
- **C.** Minimize debris accumulation under and next to solar panels.
- **E.** Cover vent openings with 1/16th to 1/8th inch corrosion-resistant metal mesh. Install dryer vents with metal flappers and keep closed unless in use.
- **H.** Clear debris from roof and gutters regularly.
- **I.** Install metal flashing around and under garage doors that goes up at least 6 inches inside and outside the door.
- **J.** Use noncombustible lattice, trellis, or other decorative features.
- **K.** Install weather stripping around and under doors.
- **L.** Remove combustible materials from underneath, on top of, or within 5 feet of deck.
- **M.** Use noncombustible patio future.
- **N.** Cover all eaves with screened vents.
- **O.** Establish and maintain a 5-foot noncombustible buffer around the home.

Actions to plan and save for:

- **B.** Use noncombustible or ignition-resistant siding and trim (e.g., stucco, fiber cement, fire-retardant treated wood) at least 2 feet up around the base of your home.
- **E.** Use multipaned glass for skylights, not materials that can melt (e.g., plexiglass), and use metal flashing.
- **F.** Install a 6-inch vertical noncombustible surface on all gables above roofs.
- **G.** Install multi-pane windows with at least one tempered-glass pane and metal mesh screens. Use noncombustible materials for window frames.
- **H.** Install noncombustible gutters, gutter covers, and downspouts.
- **I.** Install ignition-resistant or noncombustible roofs (composite, metal, or tile).
- **J.** Install 1-hour fire rated garage doors.
- **A.** Install 1-hour fire rated doors.
- **B.** Use ignition-resistant or noncombustible decking. Enclose crawl spaces.
- **C.** Use noncombustible eaves.
- **P.** Replace wooden fences with noncombustible materials and keep at least 8 feet away from the home (at least 20 feet away for double combustible fences.

Figure 3.a.8. A home can never be made fireproof, but home hardening practices decrease the chance that flames, radiant heat, and embers will ignite your home. Infographic by Community Planning Assistance for Wildfire with modifications by The Ember Alliance to include information from CALFIRE 2019 and Maranghides et al. 2022.

Annual Safety Measures and Home Maintenance

Reviewing safety protocols, creating defensible space, and hardening your home are not one-time actions, but part of *annual* home maintenance when living in the WUI. During a wildland fire, homes that have clear defensible space are identified as sites for wildland firefighters to engage in structure protection, and homes that are not safely defensible will not usually receive firefighter resources. See Home Ignition Zone checklists from the CSFS for annual safety and maintenance activities.

Pile Burn Cooperatives

Building and burning slash piles is an effective way to remove slash from HIZ 3, and thus, reduce wildfire risk to your home. Pile Burn Cooperatives are groups of neighbors that get together to help each other burn slash piles, with support from their local fire authority and local organizations. Pile burning is an appropriate method for slash management in the western, more rural parts of LFRA's response area, where homes have at least 100 feet of forested fuels surrounding them. We recommend that communities such as Cedar Park and Storm Mountain form Pile Burn Cooperatives (PBCs) with support from LFRA, The Ember Alliance, and the Big Thompson Watershed Coalition, to safely and effectively burn slash piles to mitigate wildfire risk in these communities. The Colorado Division of Fire Prevention and Control offers a pile burn certification program to landowners who are interested in learning how to safely and effectively burn piles on their property. This is highly recommended for residents who are interested in burning their own slash piles and working with their neighbors to form Pile Burn Cooperatives.

The Ember Alliance hosts pile build and burn workshops to assist communities who are interested in forming Pile Burn Cooperatives. In June of 2022, the organization hosted a pile burn workshop at a private property in Storm Mountain with support from LFRA and Big Thompson Watershed Coalition. Visit The Ember Alliance's website to learn more about Pile Burn Cooperatives in Colorado.

A pile build workshop that The Ember Alliance hosted in Coal Creek Canyon, Boulder County (left) and near Red Feather Lakes, Larimer County (right). Photo credit: The Ember Alliance (left), Evan Barrientos Photography (right).

Mitigation Barriers and Opportunities

Homeowners and residents in the WUI share concerns about mitigating risk and maintaining safe conditions in their home ignition zone (**Figure 3.a.9**). **Table 3.a.3** proposes several opportunities to address these challenges.

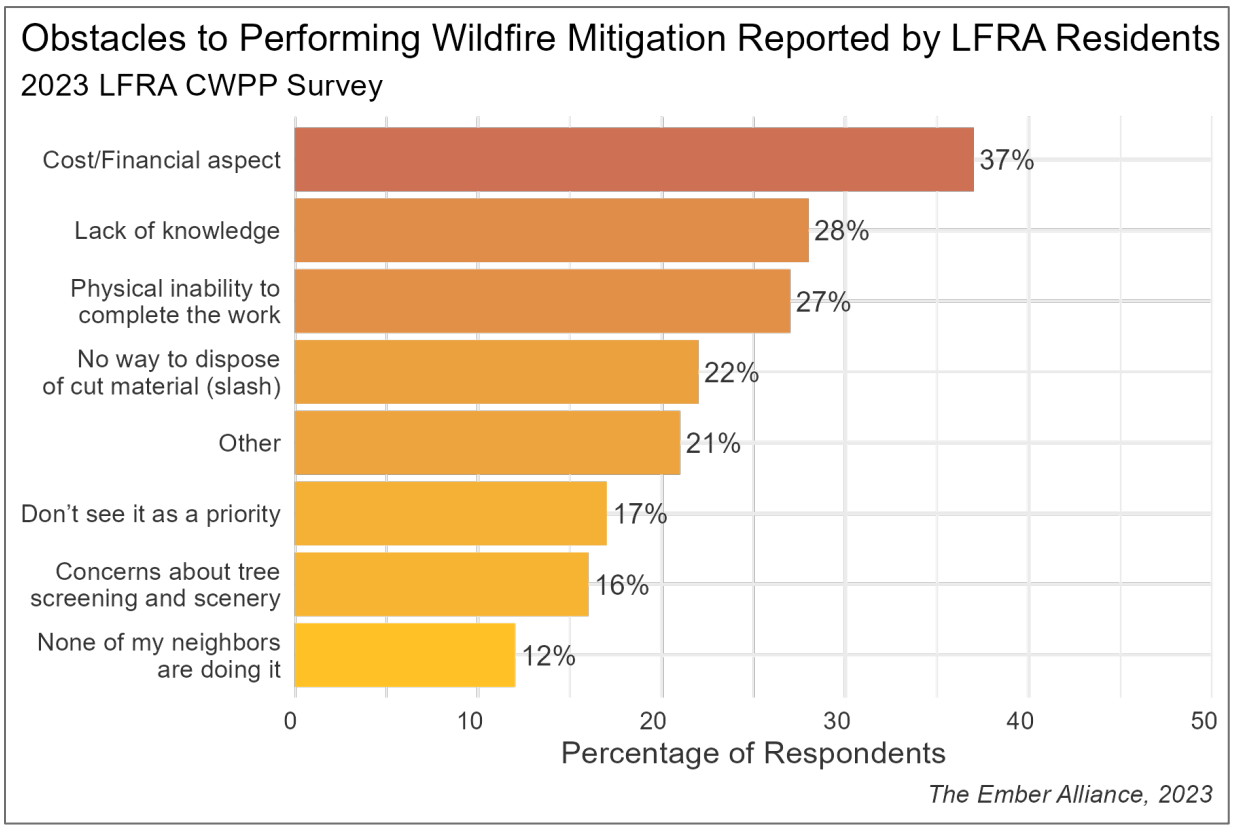


Figure 3.a.9. Percentage of LFRA residents who responded to the CWPP survey and their barriers to completing further mitigation on their home/land. See **Appendix C** for a full summary of survey findings.

Table 3.a.3. Common concerns from residents in the WUI, and potential solutions to encourage mitigation measures in the home ignition zone.

Concern	Potential solutions
I don't know where to start with creating defensible space.	Review **Figure 3.a.2**, **Table 3.a.1**, and read the CSFS publication *Protecting your home from wildfire: Creating wildfire-defensible zones* for mitigation recommendations. Reach out to Loveland Fire Rescue Authority, Larimer County Wildfire Partners, Colorado State Forest Service, Big Thompson Watershed Coalition, or Larimer Conservation District to learn about defensible space and home hardening tactics from their qualified specialists.
I do not have a permanent structure on my property, so I don't know how HIZ applies to me.	Even if you do not have a permanent home on your property, you can take steps to protect your camper and other assets, including the value of your property; areas that are heavily burned have less aesthetic and monetary value. Removing all vegetation from under and within 0-5 feet of your camper / RV and keeping grass mowed in HIZ 2 are crucial to reduce your camper's potential exposure to radiant heat. Limbing and thinning out trees in HIZ 2 and 3 can also reduce your camper's potential exposure to radiant heat and embers, thereby reducing the risk of your camper burning and generating embers that can ignite nearby homes and vegetation. Work you do to reduce fire risk on your property can amplify the work that your neighbors do on theirs, resulting in greater protection for everyone. Removing trees from along roadways can increase the visibility of your property to firefighters, increase the accessibility of your property for fire engines, and reduce the chance that non-survivable conditions can develop and entrap residents and first responders during wildfires.
I don't have the resources to invest in defensible space.	Creating adequate defensible space can take years and a significant financial investment. Fortunately, there are **effective, low-cost measures** that residents can start with: ✓ Annually remove leaves, needles, and other vegetation from roofs, gutters, decks, and around the base of homes. ✓ Use hand tools like a pole saw to remove tree branches that hang less than 10 feet above the ground. ✓ Remove combustible materials (dry vegetation, wooden picnic tables, juniper shrubs, etc.) from underneath, on top of, or within 5 feet of decks. ✓ Remove vegetation and combustible materials within 5 feet of windows and doors. ✓ Replace wood mulch within 5 feet of all structures with dirt, stone, or gravel. ✓ Remove downed logs and branches within 30 feet of all structures. ✓ Apply for cost-sharing grants with your neighbors to subsidize the creation of defensible space (see **Section 3.f.** for potential funding sources).

	✓ Research tax credits that will offset the costs or the work you want to do from the Colorado Department of Revenue.
I don't have the resources to invest in home hardening.	Retrofitting an existing home to be ignition-resistant can be expensive, particularly actions like replacing flammable roofs and siding. Some of these costs can be divided and prioritized into smaller projects. If you are building a new home, the cost of using ignition-resistant materials is roughly the same as using traditional building materials (Quarles and Pohl, 2018). Ignition-resistant features often come with additional benefits, such as greater durability and reduced maintenance. Many home hardening practices are required in Larimer County per building construction regulations for homes within the Wildfire Hazard Area. New construction and expansions adding 50% or more area must comply with the new building standards. Fortunately, there are **effective, low-cost measures** that residents can start with to harden their homes: ✓ Install noncombustible metal gutter covers. ✓ Cover vent openings with 1/16th- to 1/8th-inch corrosion-resistant metal mesh. ✓ Cover chimney and stovepipe outlets with 3/8th- to ½-inch corrosion-resistant metal mesh to prevent embers from escaping and igniting a fire. ✓ Caulk and plug gaps greater than 1/16th-inch in siding or around exposed rafters. ✓ Install weather stripping around and under garage doors to reduce gaps to less than 1/16th-inch. ✓ Remove combustible materials from underneath, on top of, and within 5 feet of a deck. ✓ Replace wood mulch within 5 feet of all structures with noncombustible products like dirt, stone, or gravel. ✓ Store all combustible and flammable liquids away from potential ignition sources. ✓ Keep a fire extinguisher and tools such as a shovel, rake, bucket, and hose available in your garage for fire emergencies. Suggestions from CAL FIRE's 2020 Low Cost Retrofit List.
I am afraid that removing trees will destroy the forest and reduce the aesthetic and monetary value of my property.	The reality is that nothing will decrease the value of your home as much as a high-severity wildfire burning all the vegetation in the community, even if your home survives the fire. Drive around the community and look for homes that have followed the guidelines in **Figure 3.a.2** and **Table 3.a.1**. Some properties in LFRA have exemplary defensible space and beautiful landscaping at the same time. Read Firewise Plant Materials from Colorado State University Cooperative Extension and Firescaping from Fire Safe Marin for suggestions on beautiful, fire-resistant landscaping. As an added benefit, fire-resistant landscaping is often more drought tolerant.

	Learn about the ecology of frequent-fire forests along the Colorado Front Range by reading *Back to the future: Building resilience in Colorado Front Range forests using research findings and a new guide for restoration of ponderosa and dry-mixed conifer landscapes* (Miller, 2018). Restored ecosystems can be aesthetically pleasing, benefit wildlife and light-loving wildflowers and grasses, and protect your home from high-severity wildfires.
My neighbors haven't mitigated risk on their property.	Some residents in LFRA are rightfully concerned about high hazards on their neighbors' properties and public land. Your home ignition zone might overlap with your neighbor's property. Given the high fire risk in the area, it is important that residents across LFRA create defensible space and harden their homes. Ideas to inspire action by your neighbors include: ✓ Organizing walking tours to visit the property of residents with exemplary defensible space. Witnessing the type of work that can be done and seeing that a mitigated property can still be aesthetically pleasing can encourage others to follow suit. ✓ Inviting your neighbors over for a friendly conversation about the risk assessment in this CWPP. Review resources about defensible space together, discuss each other's concerns and values, and develop joint solutions to address shared risk.

Fire-resistant landscaping in zone 1 can be aesthetically pleasing and more drought tolerant, requiring less watering during the summer. Limbed and thinned trees in zone 2 (as seen in the background of this photo) can create beautiful, open conditions that allow understory vegetation to flourish under higher light conditions and provide habitat for wildlife. Photo credit: Washington State University Master Gardener Program.

Evacuation Preparedness

Evacuation can weigh heavily on the minds of residents in LFRA. The death of 86 people in Paradise, California during the 2018 Camp Fire, many of whom were stranded on roadways during evacuation, underscores the importance of evacuation preparedness and fuel mitigation along evacuation routes. Roads with vegetation that is dense, tall, and/or near the edge of the road can create flame lengths and heat that are dangerous to evacuees. Roads that may be unpassable during a wildfire event are called potentially non-survivable. Larimer County Sheriff's Office calls evacuations early to get residents out of danger before roads may become potentially non-survivable.

The best way to get out quickly and safely during an evacuation is to be prepared. Prepare a go-bag and have a family emergency plan **before** the threat of wildfire is in your area. Talk to your children and elderly family members about what they would be expected to do. Visit the Larimer County Emergency Preparedness page to learn about go-bags and evacuation planning, including tips for preparing your pets and livestock for evacuation. Signing up for local emergency notifications can also help you leave quickly. Residents should register their cell phones and email addresses through NOCO Alert—the official emergency notification system for Larimer County[2]. Residential landlines are automatically registered unless their phone uses VoIP (voice-over internet protocol), and phones registered through the previous notification system were automatically transferred to Lookout Alert. See the Larimer County Sheriff's Office website on emergency notifications for more information.

Evacuation preparedness is the responsibility of each resident in LFRA. 75% of respondents to the CWPP survey have evacuation plans for their family but only 31% have plans for their pets and livestock. Just 33% have a go-bag ready. These are simple and crucial actions that can save lives.

Understand the differences between voluntary and mandatory evacuations. The following definitions are provided by the Larimer County Sheriff's Office:

Table 3.a.4. Evacuation types used in Larimer County.

Voluntary Evacuation	Mandatory Evacuation
When to leave: Leave if you are concerned for your safety, you need additional time to exit the area, or you have health conditions that may be aggravated by the incident.	**When to leave**: Immediately! You are ordered to leave due to an imminent or immediate threat to your safety.
What to do: Gather essential items to add to an Emergency go-bag such as medications and items you may need if away for an extended period.	**What to do:** Grab your go-bag and leave the area immediately.
Other considerations: Create a plan for transporting animals out of the area if needed.	**Other considerations:** You may not be allowed to return until the emergency is resolved.

[2] NOCO Alert is the official emergency notification system for Larimer County as of the writing of the LFRA CWPP in 2023.

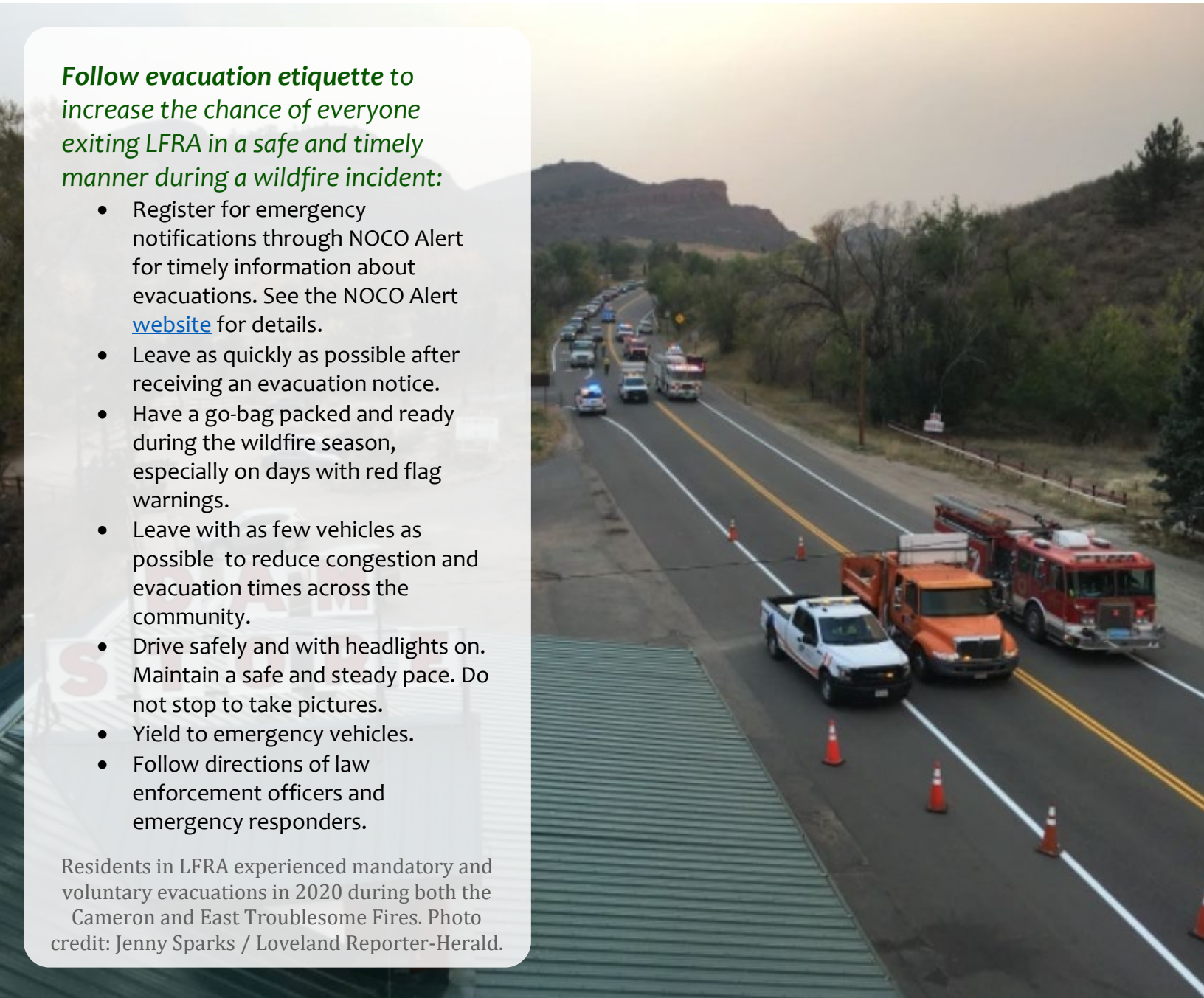
Some residents have family members or neighbors with physical limitations who might struggle to evacuate in a timely manner. Family members or individuals living alone also need to address the unique needs and vulnerabilities that arise from mobility or hearing impairments during an evacuation. Other residents are concerned about school-aged children who might be home alone during an evacuation. Families with these concerns should put extra time into having go bags ready and using the earliest evacuation warnings to leave in the event of a wildfire, rather than waiting for mandatory evacuation orders. Parents should work with their neighbors to develop a plan for how their children would evacuate if they are home alone. Having a plan in place ahead of time can ensure prompt evacuations and save lives during wildfires.

Residents with livestock trailers or large camper vehicles should plan to leave during voluntary evacuation notices to allow time for their preparations and create more space on the roads for other residents during a mandatory evacuation. It is important to have a plan for where to take livestock to reduce some of the chaos and uncertainty created by wildfire evacuations.

NOCO ALERT
EMERGENCY ALERTS IN LARIMER COUNTY, COLORADO

Follow evacuation etiquette *to increase the chance of everyone exiting LFRA in a safe and timely manner during a wildfire incident:*

- Register for emergency notifications through NOCO Alert for timely information about evacuations. See the NOCO Alert website for details.
- Leave as quickly as possible after receiving an evacuation notice.
- Have a go-bag packed and ready during the wildfire season, especially on days with red flag warnings.
- Leave with as few vehicles as possible to reduce congestion and evacuation times across the community.
- Drive safely and with headlights on. Maintain a safe and steady pace. Do not stop to take pictures.
- Yield to emergency vehicles.
- Follow directions of law enforcement officers and emergency responders.



Residents in LFRA experienced mandatory and voluntary evacuations in 2020 during both the Cameron and East Troublesome Fires. Photo credit: Jenny Sparks / Loveland Reporter-Herald.

Accessibility and Navigability for Firefighters

Address signs

Installing reflective address numbers can save lives by making it easier for firefighters to navigate to your home at night and under smokey conditions. Reflective signs are available for purchase from LFRA, making is an easy and inexpensive action you can accomplish to protect firefighters and your family. Mount reflective address signs on noncombustible posts, not on stumps, trees, wooden posts, or chains across driveways. Chains across driveways might be removed during wildfire suppression to permit access to your property. Make sure the numbers are clearly visible from both directions on the roadway.

Driveways

It is important to ensure emergency responders can locate and access your home. Narrow driveways without turnarounds, tree limbs hanging over the road, and lots of dead and down trees by the road may make firefighters choose to not defend your home during a wildfire event (Brown, 1994).

Some roads in LFRA have accessibility and navigability issues, such as narrow widths, inadequate vertical clearance for engines, and heavy fuel loading on the sides of the road. These unsafe road and driveway conditions could turn firefighters away from attempting to defend homes. According to the National Fire Protection Association, driveways and roads should have a minimum of 20 feet of horizontal clearance and 13.5 feet of vertical clearance to allow engines to safely access the roads (O'Connor, 2021). Residents should remove trees and low-hanging limbs along driveways to facilitate firefighter access, as well as removing all dead trees that could fall across the driveway and block access.

Where possible, residents should improve roadway access, and where this is not feasible, it is vital that homeowners take measures to harden their home and create defensible space. Some actions to increase access to your home are simple, such as installing reflective address numbers, and others take time and investment, such as widening driveways to accommodate fire engines.

LFRA utilizes KnoxBox tools to permit emergency access to gates and buildings. Ensure that yours is set up with LFRA and of the correct model numbers so that LFRA can use them. Contact LFRA or visit their FAQ page to learn more. If you have other gate codes, share them with LFRA so they can non-destructively access your property in an emergency.

If you or your neighborhood has a private bridge, post the bridge weight limits. Not all firefighting equipment will cross unmarked bridges, so knowing and posting weight limits may help firefighters access and defend your home.

Many driveways within LFRA do not meet current access requirements and pose safety issues that are difficult to mitigate. Long, narrow, steep driveways lacking turnarounds, and dense trees on the sides of the road can create challenges for emergency response vehicles during wildfires. Photo credit: LFRA.

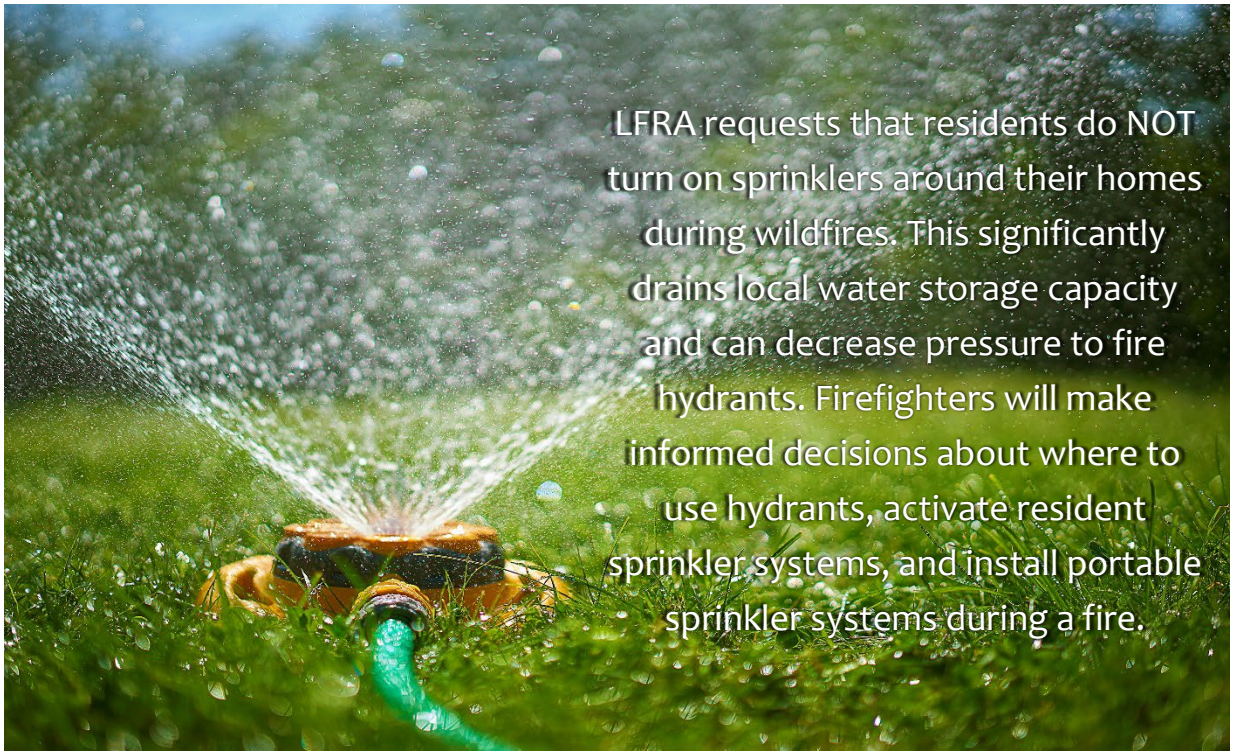
Private Water Resources

Water resources to fight fires in the foothills can be scarce, especially during the fire season in late summer and fall. Firefighters are skilled at determining the most beneficial ways to use water to protect structures from an approaching fire. Providing clear access to suitable water resources around your home or neighborhood can help them defend your home.

Do not turn sprinklers on around your home as you evacuate. This is counterproductive to protecting your home because continuous use of water far in advance of the fire can drain local wells and cisterns long before the fire reaches your neighborhood. This leaves firefighters with less resources to defend your home, putting their lives and your property at higher risk. Leave sprinklers visible but **turned off** so firefighters can determine whether they will be useful or not. Read this post by Fire Safe Marin about why it is unwise to leave water running when you evacuate during a wildfire.

Before you evacuate, prepare personal water resources by making them easily accessible and clearly labelling how to access them. Unlock pump house doors and remove vegetation or other obstructions. If you have a generator, leave it in an accessible location in case the power is turned off. Notify the fire department of community cisterns or tanks so they can be identified prior to the emergency. LFRA can use unpressurized water sources, static water sources as well as pressurized water sources available in the area while working to protect homes from wildfire. Contact LFRA when planning a new cistern to ensure it is compatible with their equipment.

Most importantly, create defensible space around your home and buildings so that water resources can be used effectively. Water is not a reliable resource in the Colorado foothills and mountains. Maintaining a property that requires less water and resources to defend is more likely to survive a fire. See **Table 3.a.1** and **Figure 3.a.8** for guides on defensible space and home hardening recommendations.



Steps to enhance firefighter safety and access BEFORE a fire:

- Install reflective address numbers on the street to make it easier for firefighters to navigate to your home under smoky conditions and at night. **Installing reflective address numbers can save lives and is inexpensive and easy to accomplish.**
    - Make sure the numbers are clearly visible from both directions on the roadway.
    - Use noncombustible materials for your address sign and sign supports.
- Improve roadway accessibility for fire engines. Long, narrow, steep, and curving private drives and driveways without turnarounds significantly decrease firefighter access to your property, depending on fire behavior.
    - Fill potholes and eroded surfaces on private drives and driveways.
    - Remove trees along narrow private drives and driveways so the horizontal clearance is 20 feet wide, and prune low-hanging branches of remaining trees so the unobstructed vertical clearance is at least 13.5 feet per National Fire Protection Association recommendations.
- Post the load limit at any private bridges or culverts on your property.

Steps to enhance firefighter safety and access DURING a fire:

- Park cars in your driveway or garage, not along narrow roads, to make it easier for fire engines to access your home and your neighbors' homes.
- Clearly mark septic systems with signs or fences. Heavy fire equipment can damage septic systems.
- Clearly mark wells and water systems. Leave hoses accessible for firefighters to use when defending your home, but **DO NOT** leave the water running. This can reduce water pressure to hydrants across the community and reduce the ability of firefighters to defend your home.
- Leave gates unlocked during evacuations for firefighters and law enforcement.
- Leave exterior lights on to increase visibility.
- Leave a note on your front door confirming that all parties have evacuated and providing your contact name and phone number.

Relative Risk Ratings by CWPP Plan Unit

This CWPP is a useful planning document, but it will only affect real change if residents, neighbors, LFRA, HOAs, and agency partners come together to address shared risk and implement strategic projects. This section of the CWPP provides relative hazard ratings and specific recommendations for CWPP plan units in LFRA.

CWPP plan units are areas with shared fire risk where residents can organize and support each other to effectively reduce wildfire risk and enhance emergency preparedness. We delineated 18 plan units in LFRA by considering similarities in social groupings, clusters of addresses, evacuation routes, topographic features, and vegetation (**Figure 3.a.10**). No plan unit splits a land parcel, ensuring that fuel treatment recommendations within each plan unit can be realistically implemented by landowners. Amendments were made to boundaries based on local knowledge from LFRA.

LFRA firefighters conducted on-the-ground observations to assess fire risk, fire suppression challenges, evacuation hazards, and home ignition zone hazards between November 2022 and March 2023, and we combined these on-the-ground observations with output from the fire behavior and evacuation modeling to produce relative risk ratings. See **Appendix B** for a description of hazard rating methodology. Plan unit hazard ratings are specific to LFRA and not suitable for comparing this fire authority to other communities in Colorado or the country.

The potential for wildfires to pose a threat to lives and property is high across LFRA, but risk is relatively higher in the western parts (**Figure 3.a.11**). Plan units with higher relative risk are strong candidates for immediate action to mitigate hazardous conditions. However, plan units with moderate relative risk still possess conditions that are concerning for the protection of life and property in the case of a wildfire.

Across LFRA, wildfire hazards vary significantly. In the western part of LFRA, trees are dense and mostly coniferous, the slopes are steep, and elevations are higher; the east has more grasslands, developed land, and flat terrain. Areas in the west tend to have more evacuation and fire suppression challenges, namely due to the terrain and road access. Hazards around structures tend to follow the river through Loveland which may correlate to the original building and therefore older construction on homes. (**Figure 3.a.11**).

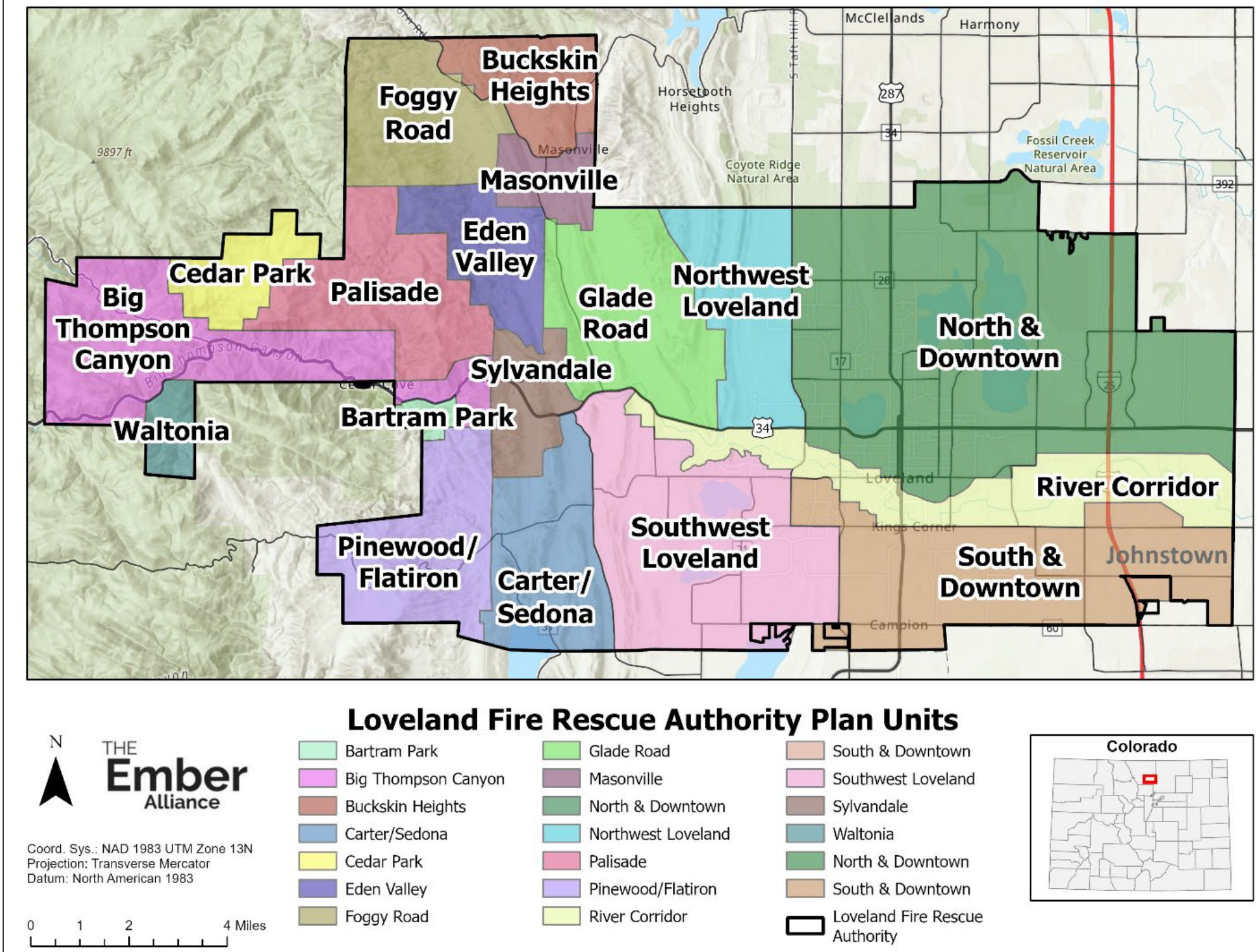
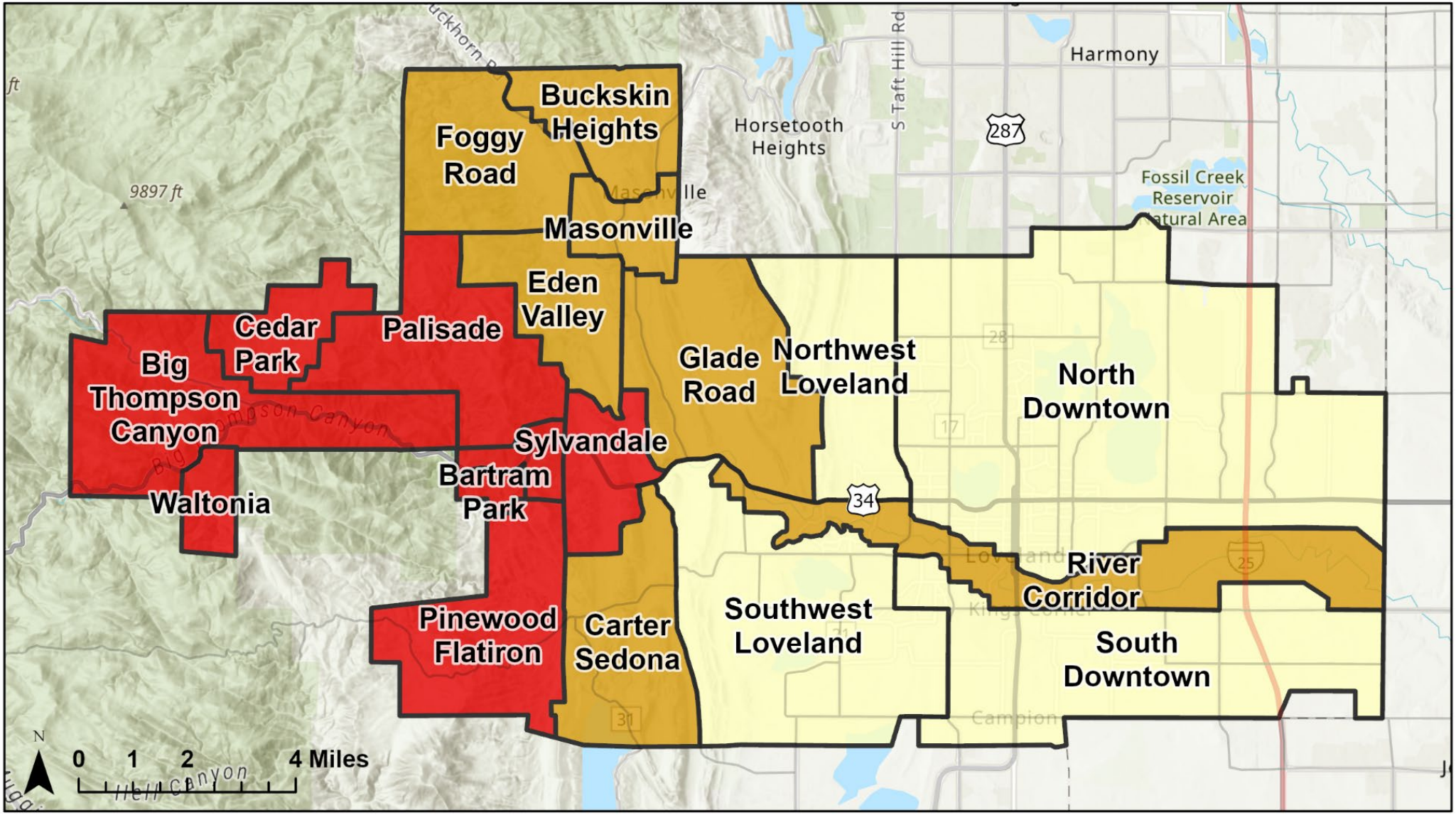


Figure 3.a.10. CWPP plan units in LFRA. [View an interactive map online](#).

Overall Relative Risk among CWPP Plan Units



Relative Risk Rating for LFRA

Extreme | High | Moderate

Coord. Sys.: NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Datum: North American 1983

THE Ember Alliance

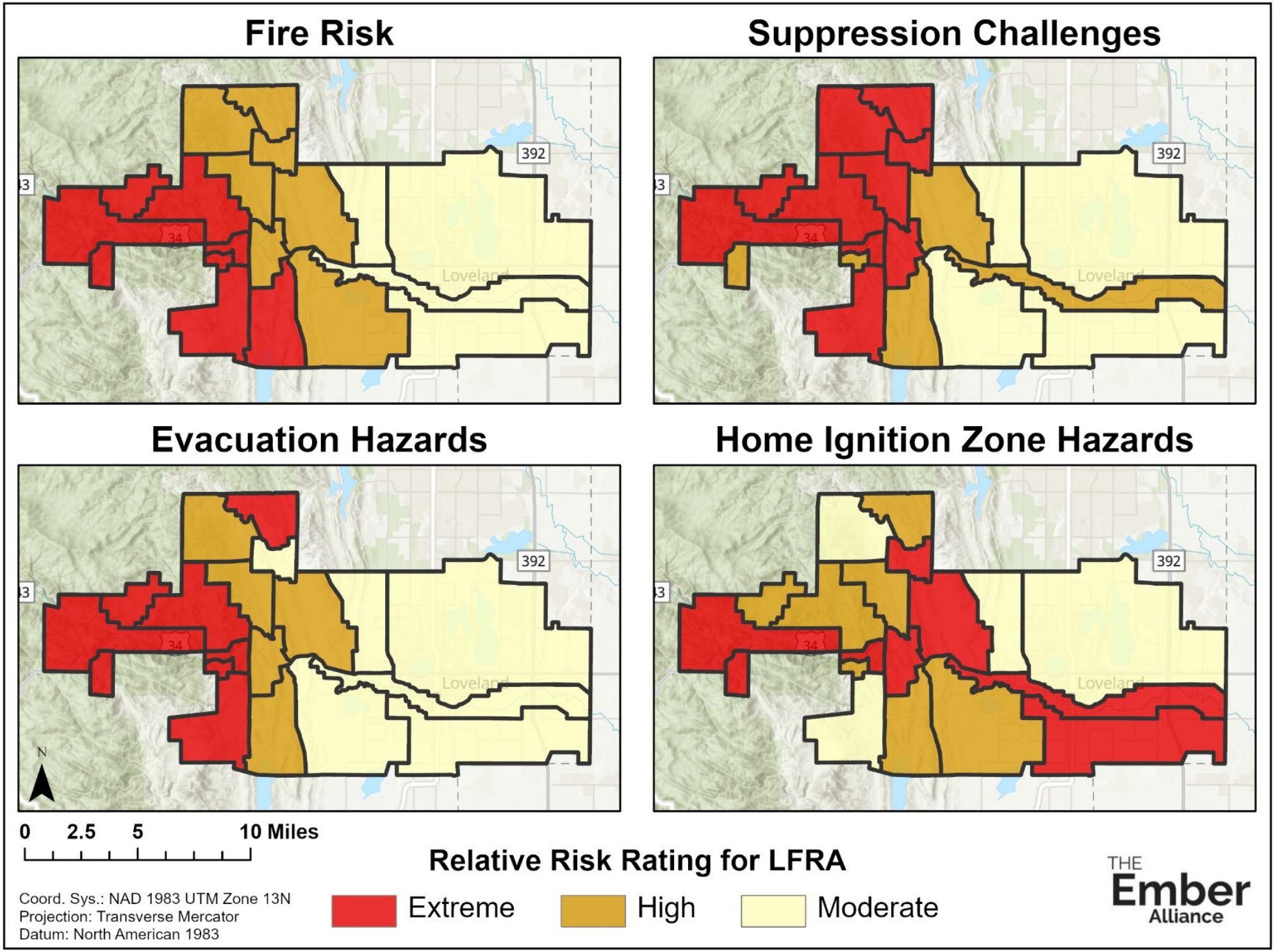


Figure 3.a.11. Relative risk rating for plan units across LFRA. "Moderate" risk is a relative term – all residents within LFRA are exposed to elevated fire danger due to topography and fuels in this part of Colorado and should take recommended actions in this CWPP seriously. View an interactive map online.

Priority Action for CWPP Plan Units

Here we describe conditions in each CWPP Plan Unit from our on-the-ground relative risk rating assessment and include a summary of predicted fire behavior, roadway survivability, and home exposure to radiant heat and short- and long-range embers from burning vegetation (see **Appendix B** for methodology). We also provide priority recommendations for collective action by homeowners to address shared risk and magnify the impact of individual mitigation actions. Guidelines for priority action could be spearheaded by neighborhood ambassadors in each filing with support from fellow residents (see **Section 3.d.** for a description of a neighborhood ambassador program recommended for LFRA). Photos of representative vegetation in each filing were taken during the LFRA community assessment.

Bartram Park

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **63%** of the area could experience very high to extreme fire behavior.
- **22%** of homes are exposed to radiant heat from burning vegetation.
- **100%** of homes are exposed to embers from burning vegetation.
- **66%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Bartram Park is mostly covered by grasses and shrubs, with ponderosa pine scattered on the north and east hillsides. The drainages have cottonwood and other riparian species.

There are some steep slopes, with many narrow valleys and ridges that could increase unpredictable fire behavior.

The Bartram Park plan unit has had many small fires over the last 30 years. Most of these were caused by lightning strikes and were quickly put out by local firefighters.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it. The homes located west of Bartram Park Road are built on hillsides and ridge tops and are at higher fire risk. Firefighters may not be able to protect these homes in an extreme wildfire event due to the steep slopes and limited road access with no escape routes.

Many homes in the unit are older and were not built with ignition-resistant materials. For example, wood siding and decking can easily ignite when exposed to direct flames or embers from a wildfire. Some homes have older asphalt roofs that are vulnerable to embers. Many of the homes have fire hazards in home ignition zones 1, 2, and 3. Some have branches near or over the roof, pine needles and leaves in the gutters, and other flammable items near the home.

Roadway accessibility and evacuation capacity: There is only one way in and out of this community. Many of the roads are one-lane roads which will make it difficult for residents to evacuate and for firefighters to access and protect homes during a wildfire. There are steep roads, switchbacks, and limited turnarounds that can cause traffic to get backed up or move slowly. Residents evacuating livestock can make evacuation times even longer.

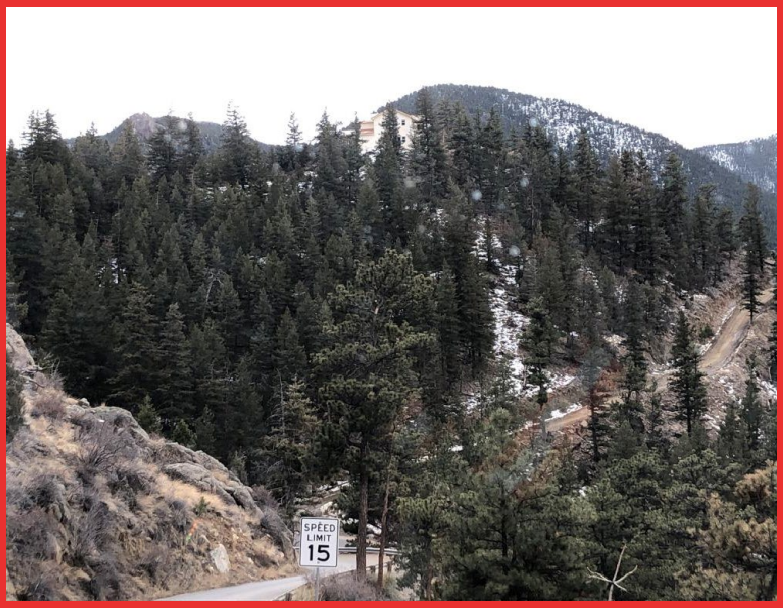
Fire suppression considerations: Bartram Park does not have any pressurized fire hydrants, and there is very limited access to water for firefighters along the Big Thompson River. There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents. Many of the homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

Recommendations for residents in Bartram Park:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Bartram Park Road, Keko Drive, Okeepa Trail, and Tracy Trail (see **Figure 3.b.4**).
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Work with LFRA and Larimer County Wildfire Partners to identify a feasible secondary egress route out of the community.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install community cisterns in coordination with LFRA.

Big Thompson Canyon

Extreme relative risk rating



Under extreme fire weather and during a fire:

- **70%** of the area could experience very high to extreme fire behavior.
- **43%** of homes are exposed to radiant heat from burning vegetation.
- **100%** of homes are exposed to embers from burning vegetation.
- **33%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Big Thompson Canyon is mostly covered by grasses, shrubs, and ponderosa pine overstory growing more densely upslope. The river and drainages have some riparian species like cottonwood, aspen, and willow.

There are steep slopes with many narrow valleys and ridges that could increase unpredictable fire behavior. Fortunately, due to the steepness, there are not many homes built mid-slope or on ridge tops.

This plan unit has seen many fires in the past decades, including some that were locally significant like the 75-acre Round Mountain Fire in 2010. Most fires that have started in this area were put out quickly by local firefighters.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it. Firefighters may not be able to protect homes here in an extreme wildfire event due to the steep slopes and limited road access off the highway with no escape routes.

Buildable areas are limited within the canyon, so most homes are surrounded with thick vegetation including grasses, shrubs, and large trees. Most of the homes here are older and were not built with ignition-resistant materials. Homes that were rebuilt following the 2013 floods tend to have ignition-resistant siding and roofs. The majority of homes here have fire hazards in home ignition zones 1, 2, and 3. Some have branches near or on the roof, pine needles and leaves in the gutters, and other flammable items near the home.

Roadway accessibility and evacuation capacity: There are many one-lane roads and bridges in this plan unit that will make it difficult for residents to evacuate and for firefighters to access and protect homes during a wildfire. Many side roads may be non-survivable during a wildfire as well. Fortunately, Highway 34 is built to handle evacuations and has been used for major evacuations successfully. There may be residents evacuating livestock which can make evacuation times longer.

Fire suppression considerations: Big Thompson Canyon has just one dry hydrant located in Viestenz-Smith Mountain Park, and there is very limited access to water for firefighters along the Big Thompson River.

There are major overhead powerlines through the canyon that cross Highway 34 many times. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the homes do not have consistent and legible address signs, which makes them difficult for firefighters to find.

Recommendations for residents in Big Thompson Canyon:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along, particularly along parts of Big Thompson Canyon Road, County Road 43, Idlewild Lane, Sly Fox Road, and Storm Mountain Drive (see **Figure 3.b.4**).
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- If you do not have a Class A roof, begin planning or saving for replacing your roof with noncombustible materials.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Widen private and neighborhood roads and bridges and create pullouts to facilitate two-way traffic during emergencies.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install large community cisterns in coordination with LFRA where there are no hydrants and homes are concentrated.
- Contact your local utilities companies and ask them to reduce the risk of powerlines falling during wildfires.

Buckskin Heights
High relative risk rating

Under extreme fire weather and during a fire:

- **13%** of the area could experience very high to extreme fire behavior.
- **4%** of homes are exposed to radiant heat from burning vegetation.
- **21%** of homes are exposed to embers from burning vegetation.
- **17%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Buckskin Heights is covered by grasses and shrubs, with ponderosa pine scattered at higher elevations, and drainages have cottonwood trees.

The slopes are steep and wide, with many narrow valleys and ridges that could increase unpredictable fire behavior.

This area sees either natural or human caused fire most years. Fires in this area tend to be in late summer, fall and dry winter months. The Cameron Peak fire created a large spot fire 3 miles north of the community in 2020. This fire consumed some homes and triggered mandatory evacuations in the area.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it. Quite a few homes are built mid-slope or on ridge tops and are at high risk of ignition if a fire were to start below them.

Most homes here are over 20 years old and were not built with ignition-resistant materials. In Buckhorn Estates off CR27, more modern Class A roofs and some newer Class B roofs were noted.

The Buckhorn Estates homes near CR27 generally have well-mitigated home ignition zones. The older homes adjacent to CR27, 38E, Milner Mountain Road, and Redstone Canyon (25E) do not have defensible space or home hardening work done. A few homes have hazards including wooden sheds, wood piles, propane tanks, and other flammable materials near the home. Firefighters may not be able to protect some of the homes here in an extreme wildfire event due to a buildup of many different fuels near the homes.

Roadway accessibility and evacuation capacity: Many roads in this plan unit could be potentially non-survivable during wildfires, which is a concern for evacuation and fire suppression. There are some one-lane roads in this plan unit that will make it difficult for residents to evacuate and for firefighters to access and protect homes during a wildfire. There are many areas that would need to evacuate livestock, which could make evacuation times longer.

Fire suppression considerations: Buckskin Heights has a few fire hydrants and one cistern, but not enough to adequately and reliably defend the homes in the area.

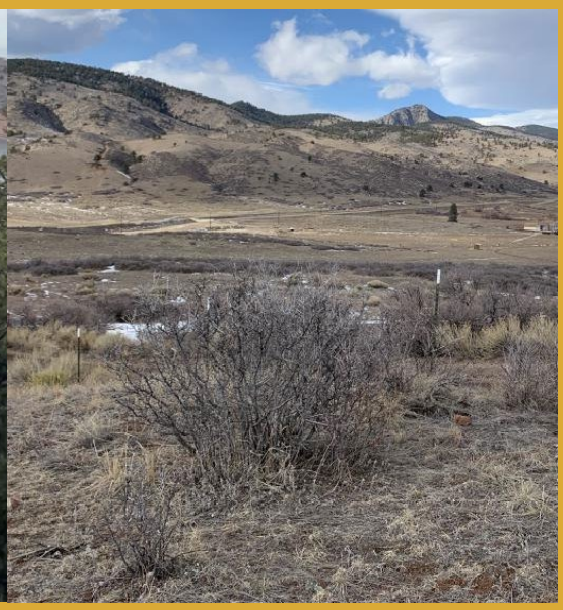
There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the homes do not have consistent and legible address signs, which makes them difficult for firefighters to find.

Recommendations for residents in Buckskin Heights:

- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along North County Road 27, Otter Road, and Woodchuck Drive (see **Figure 3.b.4**).
- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Prepare your home for wildfire. Mowing grass, trimming vegetation, use of wildfire resistant landscaping, and fuel removal could help homes survive a fast-moving wildfire event in this unit (see **Recommendations for Residents**).
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Homeowners in subdivisions with limited roadways should develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install community cisterns in coordination with LFRA where there are no hydrants.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.

Carter / Sedona
High relative risk rating



Under extreme fire weather and during a fire:

- **19%** of the area could experience very high to extreme fire behavior.
- **36%** of homes are exposed to radiant heat from burning vegetation.
- **64%** of homes are exposed to embers from burning vegetation.
- **27%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Carter Lake and Sedona area is mostly covered by grasses and shrubs, with ponderosa pine overstory in the south.

There are some steep slopes, with narrow valleys and ridges that could increase unpredictable fire behavior.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it. The homes built mid-slope or on ridge tops are at higher risk of ignition if a fire were to start below them.

Homes in the northern part of the unit are newer and tend to have ignition-resistant materials, but the homes in the southern part are older and were built with less ignition-resistant siding and roofs. High-density subdivisions have an elevated risk of home-to-home ignitions because homes are so close together.

Roadway accessibility and evacuation capacity: Many roads in this plan unit could be potentially non-survivable during wildfires. The main roads are well maintained and functional for evacuation traffic, though the subdivision roads that are one lane can cause traffic to get backed up or move slowly. Some private driveways may be inaccessible to engines, preventing firefighters from defending those homes. The area is rural, with lots of livestock evacuation to be expected which will make evacuation times longer.

Fire suppression considerations: Carter / Sedona has some fire hydrants, and there are a few lakes and ditches that can be used as draft sites.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

Recommendations for residents in Carter / Sedona:

- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Cottontail Road, Fawn Trail, Indian Blind Trail, King Ranch Road, Lakefront Drive, Mule Deer Drive, Prairie Way, Rainbow Lane, Rock Hill Road, Sedona Hills Drive, and Sunflower Road (see **Figure 3.b.4**).
- Prepare your home for wildfire. Mowing grass, trimming vegetation, use of wildfire resistant landscaping, and fuel removal could help homes survive a fast-moving wildfire event here (see **Recommendations for Residents**).
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install large community cisterns in coordination with LFRA.

Cedar Park

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **60%** of the area could experience very high to extreme fire behavior.
- **67%** of homes are exposed to radiant heat from burning vegetation.
- **100%** of homes are exposed to embers from burning vegetation.
- **74%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Cedar Park is mostly covered with grasses and shrubs where homes are concentrated, with dense mixed conifer stands surrounding the area.

The slopes are steep as you move out from the main basin, with many narrow valleys and ridges that could increase unpredictable fire behavior.

Historically, Cedar Park see fires every year either from natural or human causes. Large fires have been significant over the last 30 years when drought conditions were prevalent. In 2000, the Bobcat Fire consumed some homes in Cedar Park. In 2020, the Cameron Peak fire burned north of Cedar Park and triggered mandatory evacuations in most of the unit.

Hazards in the home ignition zone: The main threat to the homes here is embers igniting in home ignition zones 1 and 2. At least half of the homes here are built mid-slope or on ridge tops and are at high risk of ignition if a fire were to start below them.

Many homes are older and were not built with ignition-resistant materials. They may have wood siding or decks. Some homes have older asphalt roofs that are not ignition-resistant. Many of the homes have fire hazards in home ignition zones 1, 2, and 3. Some have branches near or hanging over the roof, pine needles and leaves in the gutters, and other flammable items near the home.

Firefighters may not be able to protect these homes in an extreme wildfire event due to the steep slopes and limited road access with no escape routes.

Roadway accessibility and evacuation capacity: Many roads in this plan unit could be potentially non-survivable during wildfires. There are many one-lane roads that will make it difficult for residents to evacuate and for firefighters to access and protect homes during a wildfire. Storm Mountain Drive is the only way in and out of this plan unit, and it is steep with switchbacks and limited turnarounds that can cause traffic to get backed up or move slowly. Residents evacuating livestock can make evacuation times even longer.

Fire suppression considerations: Cedar Park does not have any pressurized fire hydrants, and there is access to just one draft site by the small lake at the bottom of the plan unit, which is at risk of being drained if the dam is not repaired by 2025. There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents. Many of the residences have consistent and legible address signs. This will make it easier for firefighters to navigate the area at night and under heavy smoke.

Recommendations for residents in Cedar Park:

- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Badger Court, Berg Ranch, Bobcat Drive, Chipmunk Place, Green Ridge Road, Lakeview Drive, Palisade Mountain Drive, Possum Court, Skyline Drive, Snowtop Drive, Spruce Mountain Drive, Storm Mountain Drive, and Wren Place (see **Figure 3.b.4**).
- Prepare your home for wildfire. Mowing grass, trimming vegetation, use of wildfire resistant landscaping, and fuel removal could help homes survive a fast-moving wildfire event here. Home hardening is the top priority for homeowners in Cedar Park (see **Recommendations for Residents**).
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Work with LFRA and Larimer County Wildfire Partners to identify a feasible secondary egress route out of the community.
- Install community cisterns in coordination with LFRA where there are no hydrants.
- Work together as a community to address the dam repair so firefighters can continue to use the lake as a water source during wildfires.
- The Storm Mountain Wildfire Action Group (SWAG) has started initiating mitigation efforts throughout the community. This group should continue to coordinate with LFRA, Larimer County Wildfire Partners, BTWC, LCD, and fellow residents within Cedar Park to implement the above recommendations.

Eden Valley
High relative risk rating

Under extreme fire weather and during a fire:

- **32%** of the area could experience very high to extreme fire behavior.
- **17%** of homes are exposed to radiant heat from burning vegetation.
- **30%** of homes are exposed to embers from burning vegetation.
- **26%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Eden Valley is mostly covered by grasses and shrubs, with sparse ponderosa pine and mixed conifer overstory growing thick closer to the hilltops. The low-lying areas have cottonwood and other riparian species.

The slopes in the western part of the plan unit are steep, with many narrow valleys and ridges that could increase unpredictable fire behavior.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it. Only some homes are built mid-slope and are at high risk of ignition if a fire were to start below them.

Firefighters may not be able to protect some homes off Lone Acres Lane in an extreme wildfire event due to the steep slopes and roads with no escape route. Most homes throughout Eden Valley are older and were not built with ignition-resistant materials. Most of the homes here have fire hazards in home ignition zones 1, 2, and 3. Some have branches near or hanging over the roof, pine needles and leaves in the gutters, and other flammable items near the home.

Roadway accessibility and evacuation capacity: The lower section of Lone Acres Lane is the most restrictive road in the plan unit, with several switchbacks on moderately steep slopes and no alternative ways in or out. The long road remains narrow throughout with limited opportunities to pass. The rest of the roadways are accessible. Residents evacuating livestock can make evacuation times even longer.

Fire suppression considerations: Eden Valley does not have any pressurized fire hydrants, but there is good water access in the valley.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Most of the homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

Recommendations for residents in Eden Valley:

- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Lone Acres and North County Road 29 (see **Figure 3.b.4**).
- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Homeowners that use Lone Acres Lane should develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.

Foggy Road

High relative risk rating

Under extreme fire weather and during a fire:

- **16%** of the area could experience very high to extreme fire behavior.
- **7%** of homes are exposed to radiant heat from burning vegetation.
- **53%** of homes are exposed to embers from burning vegetation.
- **15%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Foggy Road plan unit is mostly covered by grasses and shrubs, with some pine trees mixed in.

The slopes are moderately steep, with a couple narrow valleys and ridges that could increase unpredictable fire behavior.

Hazards in the home ignition zone: Most homes in this plan unit are newer and built with fire-resistant materials. Residents in this plan unit have generally done a good job implementing defensible space in home ignitions zone 1 and 2, but many homes still have hazards in zone 3. Many homes have propane tanks within 30 feet of the home. The main threat to homes in this plan unit is embers igniting vegetation and other hazards in home ignition zone 3.

Roadway accessibility and evacuation capacity: The roads can handle two-way traffic, and there are two egress routes that can be used in emergencies such as wildfires. However, there are some roads that have dense vegetation growing alongside them, which could create non-survivable conditions during an evacuation.

Fire suppression considerations: The Foggy Road plan unit has some hydrants near roads, but not enough for suppression efforts, and there are no additional water sources for firefighters.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the homes do not have consistent and legible address signs which make them difficult for firefighters to find.

The Foggy Road plan unit was burned in the 2020 Cameron Peak Fire, and some was burned in the 2000 Bobcat Fire.

Recommendations for residents in Foggy Road:

- Remove vegetation along roadways to reduce the risk of non-survivable conditions during wildfires, particularly along Big Bear Road and North County Road 27 (see **Figure 3.b.4**).
- Prepare your home for wildfire. Home hardening and mitigation in home ignition zone 3 is the highest priority here (see **Recommendations for Residents**).
- Move propane tanks to home ignition zone 3 (at least 30 feet away from the home) or clear vegetation within 10 feet of propane tanks.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop evacuation plans for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install large community cisterns where hydrants are not present or reliable, in coordination with LFRA.

Glade Road

High relative risk rating

Under extreme fire weather and during a fire:

- **7%** of the area could experience very high to extreme fire behavior.
- **11%** of homes are exposed to radiant heat from burning vegetation.
- **49%** of homes are exposed to embers from burning vegetation.
- **4%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Glade Road plan unit is mostly covered by native grasses and shrubs, with some ponderosa pine forests throughout. The drainages have cottonwood and other riparian species.

The slopes are gentle but frequent, with topographic features that could increase fire behavior. Some homes are built on hillsides and ridge tops and are therefore at higher fire risk.

Hazards in the home ignition zone: Homes throughout this plan unit have mixed construction materials. About half of the homes are older and were not built with fire-resistant materials, while the other half of homes are built with fire-resistant materials such as metal roofs. Some homes have hazards in home ignition zones 1, 2, and 3 such as branches overhanging roofs, pine needles accumulated in gutters, and vegetation within the first 5 feet of homes. The main threat to homes in this plan unit is embers igniting in home ignition zones 1 and 2.

Roadway accessibility and evacuation capacity: Roads in this plan unit are well maintained and accessible for firefighters, with some exceptions on narrow gravel roads that are the only way in and out of some neighborhoods. The area is rural, with lots of livestock evacuation to be expected, which can slow down evacuation time.

Fire suppression considerations: Glade Road has fire hydrants in the newer developments, but the water still needs to be transported from there to homes further away.

Many of the homes do not have consistent and legible address signs which make them difficult for firefighters to find.

The Glade Road plan unit sees natural or human-caused fires nearly every year, and many of the fires in past years occurred in the dry, grassy areas of the unit. The Bobcat and Cameron Peak fires both burned within 5 miles of this unit and triggered mandatory evacuations in the north and west sections.

Recommendations for residents in Glade Road:

- Remove vegetation along roadways to reduce the risk of non-survivable conditions during wildfires, particularly along secondary roads leading into subdivisions and long driveways (see **Figure 3.b.4**).
- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Target outreach and education campaigns to share the importance of replacing flammable roofs with noncombustible materials and removing all flammable material within 5 feet of the home and other structures.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop evacuation plans for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Widen roads and create turnarounds in the neighborhoods with narrow, gravel roads that may be inaccessible for firefighters during a wildfire.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Expand the hydrant system where needed, especially into the older neighborhoods within the Glade Road plan unit.

Masonville
High relative risk rating

Under extreme fire weather and during a fire:

- **5%** of the area could experience very high to extreme fire behavior.
- **7%** of homes are exposed to radiant heat from burning vegetation.
- **36%** of homes are exposed to embers from burning vegetation.
- **4%** of roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Masonville plan unit is primarily covered by grasses and sagebrush with dense cottonwood growth along Buckhorn Creek and ponderosa pine forests higher up on hillsides.

The slopes are moderately steep, with many narrow valleys and ridges that could increase unpredictable fire behavior. A few homes are built on hillsides and ridge tops, making them vulnerable to ignite if a wildfire were to start below them.

Hazards in the home ignition zone: Most homes in this plan unit are older and were not built with fire-resistant materials. Most of the homes have an abundance of hazards in home ignition zones 1 and 2. Many homes have branches near or hanging over the roof, large trees directly adjacent to the home, pine needle debris in the gutters, and other flammable hazards next to the home. Propane tanks are frequently stored withing 30 feet of homes. The main threat to the homes here is embers igniting the house or in home ignition zones 1 and 2.

Roadway accessibility and evacuation capacity: Most roads are well maintained and accessible for firefighters during a wildfire. There are many egress routes out of the plan unit, which can be helpful during an evacuation. However, many residents in this plan unit have livestock, which could slow down evacuation time. A few roads are narrow and could be challenging for livestock evacuation.

Fire suppression considerations: Masonville has limited fire hydrants near the main roads, and the pressure is unreliable.

Many of the homes located on the main roads in Masonville have consistent and legible address signs. Firethorn Drive was noted as having exemplary signage that would be visible even under smokey conditions. However, homes on the side roads do not have consistent and legible address signs which makes them difficult for firefighters to find.

Masonville residents are no strangers to fire and have been evacuated many times over the past few decades.

Recommendations for residents in Masonville:

- Remove vegetation along roadways to reduce the risk of non-survivable conditions during wildfires, particularly along County Road 32C (see **Figure 3.b.4**).
- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Target outreach and education campaigns to share the importance of replacing flammable roofs with noncombustible materials and removing all flammable material within 5 feet of the home and other structures.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop evacuation plans for your family and livestock, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Install consistent, legible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Expand the hydrant system or install large community cisterns where homes are further away from water sources.

North & Downtown
Moderate relative risk rating

Under extreme fire weather and during a fire:

- **1%** of the area could experience very high to extreme fire behavior.
- **1%** of homes are exposed to radiant heat from burning vegetation.
- **2%** of homes are exposed to embers from burning vegetation.
- **0%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The North & Downtown plan unit is mostly covered by grasses and shrubs, with ornamental vegetation near homes and structures. Vegetation is dense in many of the open spaces (both public and private).

The area here is generally flat, and most utilities are underground, except in the subdivisions on the outskirts of the plan unit.

Hazards in the home ignition zone: Homes here are varied in their construction materials; some homes are built with fire-resistant materials while others are not. Since this plan unit is in a more urban part of LFRA, many homes are built close together and only have home ignition zones 1 and 2. Some homes on the outskirts of the plan unit have more land around them and therefore have a third home ignition zone. Regardless of how many home ignition zones are around your home, all residents need to focus on home hardening and creating defensible space. The main threat to homes in this plan unit is embers landing on or within 30 feet of the home and igniting it.

Roadway accessibility and evacuation capacity: Roads in the North & Downtown plan unit are accessible for firefighters, have good signage, and can handle heavy traffic. The most limiting factor for evacuation is the railroad tracks, where cars can be stopped and backed up for significant periods of time.

Fire suppression considerations: North & Downtown is well covered with pressurized fire hydrants and has additional water sources such as lakes and ditches.

There is a lot of infrastructure in the North & Downtown plan unit. Boyd Lake State Park is Loveland's most active park in the summer.

Recommendations for residents in North & Downtown:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**).
- Keep roofs clear of overhanging branches and debris, keep gutters cleaned out, and clear vegetation within the first 5 feet of the house.
- Target outreach and education campaigns to share the importance of replacing flammable roofs with noncombustible materials and removing all flammable material within 5 feet of the home and other structures.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop evacuation plans for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.

Northwest Loveland
Moderate relative risk rating

Under extreme fire weather and during a fire:

- **2%** of the area could experience very high to extreme fire behavior.
- **3%** of homes are exposed to radiant heat from burning vegetation.
- **13%** of homes are exposed to embers from burning vegetation.
- **9%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Northwest Loveland consists of open spaces and developed land. The open spaces are covered by native grasses and shrubs with ponderosa pine dotted throughout. The developed areas have various ornamental species and are typically irrigated. The drainages have cottonwood, willow, and other riparian species. The area is flat with some valleys and ridges in the west.

This area has seen some fires, both natural and human caused, in the past 30 years. Many of these fires occurred in the drier areas of the unit where there is an accumulation of brush and grass.

Hazards in the home ignition zone: Homes are densely clustered, so the main threat to homes during a wildfire would be home-to-home ignitions from embers landing on roofs or flammable material in home ignition zones 1 and 2. Just a few homes are built mid-slope or on ridge tops and are at high risk of ignition if a fire were to start below them.

Most homes here are newer construction and have ignition-resistant siding and roofing, but the residences off Morning Drive are older and were not built with ignition-resistant materials. They are also in a location where fire suppression could be difficult. Most homes are typical suburban houses with a few flammable hazards close to the buildings where embers could catch. There are a lot of wooden fences in this area.

Roadway accessibility and evacuation capacity: Roads here are well maintained and accessible, with a few exceptions in the small subdivisions. Where the roads are less well maintained or are narrower, evacuations will need to be complete before emergency responders can enter the area.

Fire suppression considerations: Northwest Loveland has pressurized fire hydrants within Loveland city limits, but not outside. Springer Valley has no water resources.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the homes have legible and reflective address signs. This will make it easier for firefighters to navigate the area at night and under heavy smoke.

Recommendations for residents in Northwest Loveland:

- Prepare your home for wildfire. Mowing grass, trimming vegetation, use of wildfire resistant landscaping, and fuel removal are high priority here (see **Recommendations for Residents**).
- Remove wooden fences that can serve as fuel pathways.
- Replace your flammable roof with noncombustible materials and remove all flammable material within 5 feet of the home and other structures. Encourage your neighbors to do the same.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Ridge Parkway (see **Figure 3.b.4**).
- If you live in a denser, urban subdivisions, continue to keep your roof clear of overhanging branches and buildup of small fine fuels, clean out your gutters regularly, and remove all combustible fuels within the first 5 feet of your house.
- If your home is on a small acreage lot with detached outbuildings, make sure to remove combustible fuels within 5 feet of your home and outbuildings and follow the recommendations in **Figure 3.a.2** further from your structures. If home ignition zone 2 or 3 overlaps with your neighbors, coordinate mitigation actions with them. Be mindful of natural grasses in the open areas, ladder fuels and the accumulation of dry and dead vegetation.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and see if your neighbors need additional support during evacuations.

Palisade

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **60%** of the area could experience very high to extreme fire behavior.
- **75%** of homes are exposed to radiant heat from burning vegetation.
- **100%** of homes are exposed to embers from burning vegetation.
- **43%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Palisade is mostly covered by dense evergreen forest with grasses and shrubs growing underneath. There are some steep slopes, with many narrow valleys and ridges that could increase unpredictable fire behavior. Fires that get established in this plan unit have the potential to threaten the Cedar Park community.

The northern portion of the Palisade plan unit burned in the 2000 Bobcat Fire and 2020 Cameron Peak Fire. The 2003 Palisade Fire burned about 10 acres in the southeastern part of the plan unit.

Hazards in the home ignition zone: There are very few homes in the plan unit, and none are located on ridge tops or mid-slope. However, most homes could be threatened by radiant heat and embers from burning vegetation. Some homes in the area are newer and are built with ignition-resistant roofs and siding while others are older and are built with highly flammable materials. About half of homes have flammable materials within 30 feet of the structure including branches over the roof, pine needle debris in the gutters, wood piles and other hazards.

Steep slopes make stand-scale fuel treatments difficult in this area even though it is a priority treatment location, so it is important for homeowners to mitigate their property.

Roadway accessibility and evacuation capacity: The most concerning factor for evacuation is limited access along Storm Mountain Road, which is the only way in and out and in some places only accommodates one-way traffic. The narrow roadway is unpaved and has several tight switchbacks. This will make it difficult for residents to evacuate and for firefighters to access and protect homes during wildfire. Residents evacuating livestock can make evacuation times even longer.

Fire suppression considerations: Palisade Mountain does not have any pressurized fire hydrants, and there are not good draft sites for fire engines. Many of the homes have reflective, legible address signs. This will make it easier for firefighters to navigate the area at night and under heavy smoke.

Recommendations for residents in Palisade:

- Prepare your home for wildfire. Home hardening and mitigation within 30 feet of your home are the highest priority for homeowners here (see **Recommendations for Residents**).
- Replace your flammable roof with noncombustible materials and remove all flammable material within 5 feet of your home and other structures. Encourage your neighbors to do the same.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with your neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Work with LFRA and Larimer County Wildfire Partners to identify a feasible secondary egress route out of the community.
- Widen private and neighborhood roads and create pullouts to facilitate two-way traffic during emergencies.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install community cisterns in coordination with LFRA where there are no hydrants.

Pinewood / Flatiron

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **50%** of the area could experience very high to extreme fire behavior.
- **55%** of homes are exposed to radiant heat from burning vegetation.
- **69%** of homes are exposed to embers from burning vegetation.
- **48%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The eastern and lower-elevation portions of Pinewood / Flatiron are primarily covered in grasses and shrubs. In the higher elevations there are dense forests with abundant ladder fuels.

The terrain is rugged and there are steep slopes, with many narrow valleys and ridges that could increase unpredictable fire behavior. Fire could rapidly spread upslope through grasses and shrubs, particularly when wind blows upslope, and extreme fire behavior could occur in forested areas.

The central portion of the Pinewood / Flatiron plan unit was burned by the 2010 Reservoir Road Fire. Two homes burned and 300 residents were evacuated during this 778-acre fire.

Hazards in the home ignition zone: The main threat to the homes here is embers igniting within 30 feet of structures. Several homes are located mid-slope and on ridge tops, and over half of homes could be exposed to radiant heat and embers from burning vegetation.

Most homes in this plan unit have non-flammable roofs, and many have non-flammable siding and decking. Most homes do not have hazards within 5 feet of the structure and about 75% are clear of hazards within 30 feet. However, ladder fuels and closely spaced trees are present within 30 feet of some homes and within 100 feet of many homes. Some homes have additional hazards within 30 feet, such as wood piles, propane tanks, and other flammable materials.

Steep slopes make stand-scale fuel treatments difficult in this area even though it is a priority treatment location, making it even more important for homeowners to mitigate their property.

Roadway accessibility and evacuation capacity: Many roads in this plan unit could be potentially non-survivable during wildfires. Some roads also have narrow roadways with switchbacks, few turnarounds, and only one lane, so residents must be done evacuating before first responders can access those areas. More than half of roads are accessible to Type 3 engines, but dead ends and few turnarounds could endanger firefighters. Residents evacuating livestock can make evacuation times even longer.

Fire suppression considerations: Some neighborhoods in Pinewood / Flatiron have fire hydrants, but they may not be pressurized. Nearby reservoirs could serve as alternative water sources for firefighters. There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents. Many of the homes do not have consistent and legible address signs, which makes them difficult for firefighters to find.

Recommendations for residents in Pinewood / Flatiron:

- There is an abundance of roadways in Pinewood / Flatiron that could experience non-survivable conditions during wildfires. Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Green Mountain Drive, Greenwood Drive, James Park Road, Newell Drive, Over Road, Turkey Walk Road, and West County Road 18E (see **Figure 3.b.4**).
- Prepare your home for wildfire. Home hardening and mitigation within 30 feet of your home are the highest priority for homeowners here (see **Recommendations for Residents**).
- Replace your flammable roof with a class A roof and remove all flammable materials within 5 feet of your home and other structures. Encourage your neighbors to do the same.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with your neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Widen private and neighborhood roads and create pullouts to facilitate two-way traffic during emergencies.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Work with LFRA to test fire hydrants for water pressure and improve those with inadequate pressure.

River Corridor
High relative risk rating

Under extreme fire weather and during a fire:

- **3%** of the area could experience very high to extreme fire behavior.
- **7%** of homes are exposed to radiant heat from burning vegetation.
- **2%** of homes are exposed to embers from burning vegetation.
- **0%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: Vegetation in the River Corridor is diverse, including dense developments with manicured lawns, irrigated pastures, grasslands on flat terrain, grasslands and shrublands on rolling hills and hogbacks, and cottonwood trees and other riparian vegetation along rivers. The eastern part of the plan unit is mostly flat. In the west there are some narrow valleys and ridges that could increase unpredictable fire behavior. Fires with rapid rates of spread and moderate flame lengths are possible in areas with tall grasses and shrubs. Fires in riparian areas are more likely in winter months when fuels are dry.

The River Corridor plan unit has experienced several small wildfires, but all of these fires were quickly controlled by local emergency responders.

Hazards in the home ignition zone: The main threat to the homes in the River Corridor is embers igniting vegetation or other flammable materials within 30 feet of structures. Home-to-home ignition is highly likely in the suburbs where homes are tightly packed and fences create fuel pathways.

Some buildings in the area are newer and are built with non-flammable roofs and siding while others are older and are built with highly flammable materials. Many of the homes and buildings with flammable building materials are found in the western portion of the plan unit. About half of homes have flammable landscaping, lawn furniture, and other materials within 30 feet of structures. Many homes have wooden fences that can serve as a fuel pathway from burning vegetation to homes or from burning home to home.

Roadway accessibility and evacuation capacity: Road conditions are variable across the plan unit. Some roads are paved and well-maintained, but others are narrow and blocked by locked gates, which decreases access for firefighters. There are numerous ways for residents to evacuate, but congestion is likely due to the high density of homes.

Fire suppression considerations: The River Corridor has a well-developed hydrant system for water delivery. Some hydrants in the western part of the plan unit are smaller and have lower water pressure.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Practically all homes have reflective and legible address signs. This will make it easier for firefighters to navigate the area at night and under heavy smoke. However, access into some areas of the river corridor is difficult as the river divides the unit in addition to multiple irrigation ditches.

Recommendations for residents in River Corridor:

- Prepare your home for wildfire. Mowing grass, trimming vegetation, use of wildfire resistant landscaping, and fuel removal could help homes survive a fast-moving wildfire event in this unit (see **Recommendations for Residents**).
- If you live in a denser, urban subdivisions, continue to keep your roof clear of overhanging branches and buildup of small fine fuels, clean out your gutters regularly, and remove all combustible fuels within the first 5 feet of your house.
- If your home is on a small acreage lot with detached outbuildings, make sure to remove combustible fuels within 5 feet of your home and outbuildings and follow the recommendations in **Figure 3.a.2** further from your structures. If home ignition zone 2 or 3 overlaps with your neighbors, coordinate mitigation actions with them. Be mindful of natural grasses in the open areas, ladder fuels and the accumulation of dry and dead vegetation.
- Remove wooden fences that can serve as fuel pathways.
- Replace flammable roofs with noncombustible materials.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Connect with homeless neighbors and collaborate on effective warming solutions that don't require open flames.

South & Downtown
Moderate relative risk rating

Under extreme fire weather and during a fire:

- **2%** of the area could experience very high to extreme fire behavior.
- **5%** of homes are exposed to radiant heat from burning vegetation.
- **1%** of homes are exposed to embers from burning vegetation.
- **0%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The South & Downtown plan unit is primarily flat and covered by irrigated lawns and landscaped yards with various plants and ornamental shrubs and trees. There are some agricultural fields in the east.

Hazards in the home ignition zone: Homes are densely clustered, so the main threat to homes during a wildfire would be home-to-home ignitions from embers landing on roofs or in flammable material in home ignition zones 1 and 2.

Homes in this plan unit are generally newer construction and have ignition-resistant building material. Several homes have older roofs and flammable siding and decking. Between 25-50% of homes have fire hazards in home ignition zones 1, 2, and 3. Of particular concern are mulch and landscaping immediately adjacent to structures.

Roadway accessibility and evacuation capacity: Roads in this area are generally paved and well maintained, and accessible by fire engines. Roads in dense subdivisions may become congested during evacuations. Narrow, dirt roads in the eastern part of the plan unit could also experience congestion, particularly if multiple emergency vehicles respond to an incident.

Fire suppression considerations: There are many pressurized fire hydrants across neighborhoods in the western part of this plan unit. There are fewer hydrants in the less-populated, eastern part of this plan unit so firefighters would have to rely on cisterns and draft sites for water supply.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Many of the residences have consistent and legible address signs. This will make it easier for firefighters to navigate the area at night and under heavy smoke.

Recommendations for residents in South & Downtown:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority in this plan unit (see **Recommendations for Residents**). If home ignition zone 2 overlaps with your neighbors, coordinate mitigation actions with them.
- Houses in the denser, urban subdivisions should continue to keep their roof clear of overhanging branches and buildup of small fine fuels on the roof, continue to keep gutters cleaned out, and remove all combustible fuels within 5 feet of the house.
- The small acreage lots with homes, detached garages and/or outbuildings should complete the same HIZ 1 recommendations and address HIZ 2 and 3. If HIZ 2 and 3 overlap with your neighbors, coordinate mitigation actions with them. Residents here should be mindful of natural grasses in the open areas, ladder fuels and the accumulation of combustible fuels on these properties and next to outbuildings.
- Remove wooden fences that can serve as fuel pathways.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.

Southwest Loveland
Moderate relative risk rating

Under extreme fire weather and during a fire:

- **4%** of the area could experience very high to extreme fire behavior.
- **8%** of homes are exposed to radiant heat from burning vegetation.
- **30%** of homes are exposed to embers from burning vegetation.
- **1%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Southwest Loveland plan unit is primarily flat. The eastern part of this plan unit is dominated by mowed grassland that transitions to shrubs in the west. Drainages have cottonwood and other riparian species. There is low chance of wildfires spreading from treetop to treetop, but wildfires can spread rapidly through tall grasses and shrublands and emit enough heat to ignite homes.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it.

Some homes in this plan unit are newer construction and have ignition-resistant building material. Other homes are older and not built with ignition-resistant materials. About half of the homes have minimal hazards in home ignition zones 1 and 2 with landscaping primarily consisting of watered, mowed lawns. Some homes have flammable material in home ignition zones 1 and 2. Of particular concern are mulch and landscaping immediately adjacent to structures and wood piles and other flammable material within 30 feet of the home.

Roadway accessibility and evacuation capacity: There are several egress routes from this plan unit, and most roads are wide enough to accommodate two-way traffic. Roads are wide and have pullovers or turnarounds that make access easier for fire engines.

Many properties in the area have livestock that could require multiple trips to evacuate. This might create congestion and increase the amount of time it would take to evacuate the area.

Fire suppression considerations: Pressurized hydrants are available within subdivisions but are scarce around more isolated properties. Cisterns and draft sites are available in most parts of the plan unit.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Gated communities and bridges with unknown weight limits would make access for firefighters difficult. Many of the homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

Recommendations for residents in Southwest Loveland:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1 and 2 are the highest priority here (see **Recommendations for Residents**). If home ignition zone 2 overlaps with your neighbors, coordinate mitigation actions with them.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Develop an evacuation plan for your family and livestock, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Post weight limits on private bridges.

Sylvandale

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **28%** of the area could experience very high to extreme fire behavior.
- **29%** of homes are exposed to radiant heat from burning vegetation.
- **82%** of homes are exposed to embers from burning vegetation.
- **15%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Sylvandale plan unit is primarily covered by grasses and scattered brush, with Ponderosa pine overstory in the higher elevations on the north and east aspects. The drainages have cottonwood, willow, and other riparian species.

There are numerous topographic features such as saddles, ravines, and chimneys. With the addition of strong winds, fire will spread dramatically during hot, dry, and warm winter weather conditions. Most of the steep slopes located in this plan unit are made up more of rock than vegetation.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 30 feet of the home and igniting it.

Many homes in the plan unit are older and not built with ignition-resistant materials. Many homes have older, flammable roofs, siding, and decking. There are some modular and single-family homes built close together with the potential for home-to-home ignitions. Many homes have branches near or hanging over the roof, debris in gutters, and vegetation or other flammable material immediately adjacent to structures.

Roadway accessibility and evacuation capacity: The main concern for evacuation in the Sylvandale area is the large number of livestock that could require multiple trips to evacuate. This might create congestion and increase the amount of time it would take to evacuate the area. Most roads can accommodate two-way traffic and are accessible to fire engines. One exception is West County Road 22H, which can only accommodate one-way traffic and is inaccessible to large fire engines.

Fire suppression considerations: Pressurized hydrants are limited across the Sylvandale area, and many have unreliable pressure. Many of the homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Other considerations: The City of Loveland's Water Treatment Facility lies within this plan unit and is critical infrastructure for LFRA and the City of Loveland.

Recommendations for residents in Sylvandale:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1, 2, and 3 are important in this plan unit (see **Recommendations for Residents**).
- Remove trees, shrubs and tall grasses along private roads and driveways to improve evacuation safety and firefighter access during a wildfire.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Waterdale Drive, North County Road 29, West County Road 22H, and Ellis Ranch Lane (see **Figure 3.b.4**).
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Work with neighbors and LFRA to form Pile Burn Cooperatives. Working collectively to build and burn slash piles is safer, more efficient, and provides a valuable opportunity to share knowledge and resources.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family and livestock, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Work with LFRA to test fire hydrants for water pressure and improve those with inadequate pressure.

Waltonia

Extreme relative risk rating

Under extreme fire weather and during a fire:

- **86%** of the area could experience very high to extreme fire behavior.
- **75%** of homes are exposed to radiant heat from burning vegetation.
- **100%** of homes are exposed to embers from burning vegetation.
- **74%** of the roads have potentially non-survivable conditions.

Vegetation, topography, and potential fire behavior: The Waltonia plan unit is primarily covered by grasses, shrubs, and mixed pine, with stands of ponderosa pine overstory on the north and east aspects. The area is a deep, narrow canyon with steep slopes that could escalate fire behavior. Extreme fire behavior is likely in much of the plan unit.

Over the last 30 years, Waltonia has experienced numerous fires primarily caused by lightning. The fires were quickly controlled by local emergency responders. The 2020 Cameron Peak fire burned north of Waltonia. This fire consumed some homes and triggered mandatory evacuations in the greater Big Thompson Canyon.

Hazards in the home ignition zone: The main threat to the homes in this plan unit is embers landing on roofs or within 100 feet of the home and igniting it. Most residences and homes in the unit are older with little to no ignition-resistant construction, such as wooden decks and siding. Many homes have older asphalt roofs that are not susceptible to embers. Most homes have hazards in home ignition zones 1, 2, and 3, including tree branches overhanging roofs, pine needles accumulated in gutters, and old wooden sheds, wood piles, propane tanks, and other flammable materials within 30 feet of the home.

Roadway accessibility and evacuation capacity: The primary road in this plan unit—Waltonia Road—could experience potentially non-survivable conditions during a wildfire. Roads are narrow, steep, and have limited turnarounds, which would create significant challenges during evacuations and limit accessibility to fire engines. Properties in some parts of the plan unit have livestock that

could require multiple trips to evacuate. This might create congestion and increase the amount of time it would take to evacuate the area.

Fire suppression considerations: Waltonia does not have any pressurized fire hydrants. There is very limited access to water for firefighters along the Big Thompson River.

There are overhead powerlines throughout the plan unit. Downed powerlines can be an ignition source and hazard to firefighters and residents.

Some homes do not have consistent and legible address signs, which make them difficult for firefighters to find.

Recommendations for residents in Waltonia:

- Prepare your home for wildfire. Home hardening and mitigation in home ignition zones 1, 2, and 3 are high priority in this plan unit (see **Recommendations for Residents**).
- Work with neighbors to create linked defensible space. Projects that span multiple properties are more effective at reducing wildfire risk and more attractive to grant funders. Contractor costs can sometimes be shared among homeowners, reducing the cost for everyone involved. See **Recommendations by Vegetation Type** for implementation recommendations and pictures of effective stand-scale treatments to protect communities and restore ecosystems.
- Steep slopes make fuel treatments difficult in this area, making it even more important for homeowners to mitigate their property.
- Contact your local HOA, road association, or the county to remove vegetation along shared roads in the community, particularly along Waltonia Road and Waltonia River Court (see **Figure 3.b.4**)
- Contact your local HOA, road association, or the county to widen roads and create pullouts to facilitate two-way traffic during emergencies.
- Contact Larimer County Wildfire Partners about becoming Wildfire Partners Certified.
- Organize community-wide home hardening and defensible tours to demonstrate effective mitigation practices.
- Develop an evacuation plan for your family, sign up for emergency notifications from Larimer County, and coordinate with neighbors who might need additional support during evacuations.
- Develop a rapid neighborhood evacuation plan and conduct evacuation drills.
- Install visible, reflective address and street signs. These can be purchased inexpensively from LFRA.
- Install community cisterns in coordination with LFRA where there are no hydrants.
- The Waltonia Road Association has started initiating mitigation efforts throughout the community. This group should continue to coordinate with LFRA, Larimer County Wildfire Partners, BTWC, LCD, and fellow residents to implement the above recommendations.
- Learn about and support the mitigation work that is happening in Waltonia. See the **Quillan Gulch** project area for more information.
- Work with CDOT to install an emergency call box near the Waltonia Road and US Hwy 34 intersection.

3.b. Recommendations for LFRA and Partner Organizations

Wildfire Risk Reduction Requirements

Responsible Parties: LFRA, City of Loveland, Town of Johnstown

On June 30, 2023, LFRA and the City of Loveland adopted the new Wildfire Risk Reduction Requirements, which focus on construction hardening, fuels management and fences. See Appendix O of the International Fire Code for a map where the requirements apply, details of the requirements, and limited exceptions to the policy in LFRA.

It is the intent of LFRA and the City of Loveland to reduce wildfire risk in a cost-effective manner, while maintaining the aesthetic qualities of the WUI. Wildfire risk reduction requirements are in accordance with the City Unified Development Code (UDC) and all other applicable requirements of the locally adopted 2021 International Fire Code, 2021 International Building Code, and 2021 International Residential Code.

In addition to the wildfire risk reduction requirements in the WUI, we also recommend that LFRA, the City of Loveland, and the Town of Johnstown implement building requirements in the grassland urban interface (GUI) (see **Figure 3.b.1.**). It is recommended that the GUI requirements focus primarily on home hardening and HIZ 1.

Consider applying requirements in the GUI that match current research recommendations (Maranghides et al., 2022):

- Home and structure building setbacks should be structure-centric, not parcel-centric. Cross-boundary structure separation should always be a consideration.
- Existing high-density housing areas should prioritize home hardening as opposed to defensible space.
- New high-density developments should have complete defensible space and buildings that are extremely resistant to ignition. They should have HOAs, or other forms of financial and regulatory collaboration set up to maintain community wildfire protection.
- Replace wooden fences with noncombustible materials and keep at least 8 feet away from the home. Keep double combustible fences at least 20 feet away from the home. Wood fences can serve as pathways for wildfire to travel between vegetation and structures and from structure to structure.

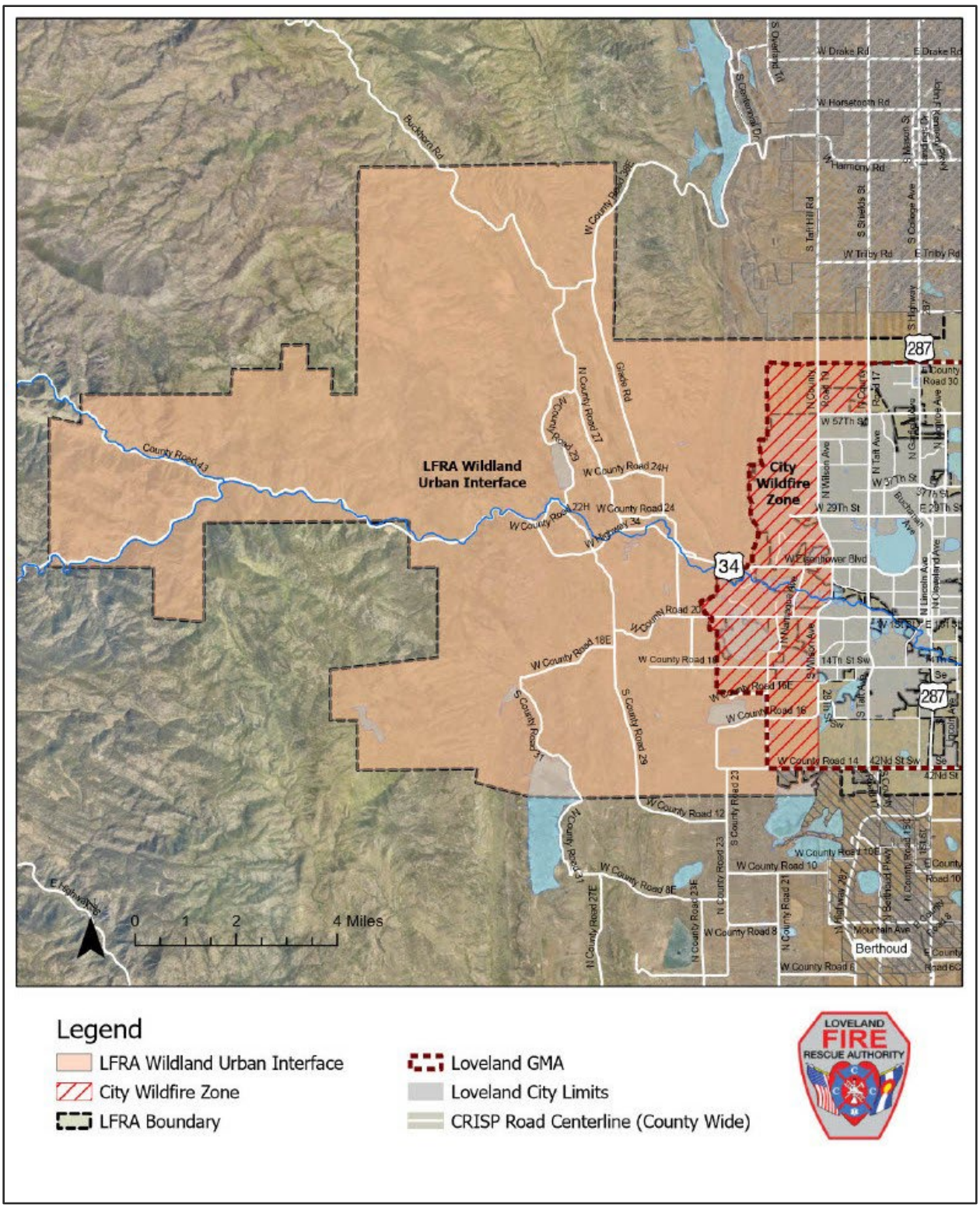


Figure 3.b.1. The new Wildfire Risk Reduction Requirements to residents that live in LFRA's wildland urban interface. Visit LFRA's website to learn more about the requirements.

Evacuation Planning and Capacity

Responsible Parties: LFRA, Larimer County Sheriff's Office

There is a high likelihood of evacuation congestion and long evacuation times during a wildfire. Some neighborhoods have only one ingress/egress route, and some have roads that are narrow, winding, or difficult to navigate, especially through heavy smoke from a wildfire.

LFRA has been involved with many evacuations, from small fires that only threaten a couple homes to massive evacuations during 2020's Cameron Peak and East Troublesome Fires. LFRA, Larimer County Sheriff's Office, and other partners discussed lessons learned from their evacuation experience and discussed what improvements could be made during future evacuations in LFRA.

Many roads throughout the community are narrow and lined with dense vegetation that could create non-survivable conditions during wildfires (**Figure 3.b.3**). Under extreme fire weather conditions, 8% of roadways in LFRA could experience non-survivable conditions, concentrated in the west half of their response area (**Figure 2.f.4**). **Mitigation actions along sections of road with high risk for non-survivable conditions during a wildfire can increase the chances of survival for residents stranded in their vehicles during and decrease the chance that roadways become impassable due to flames.**

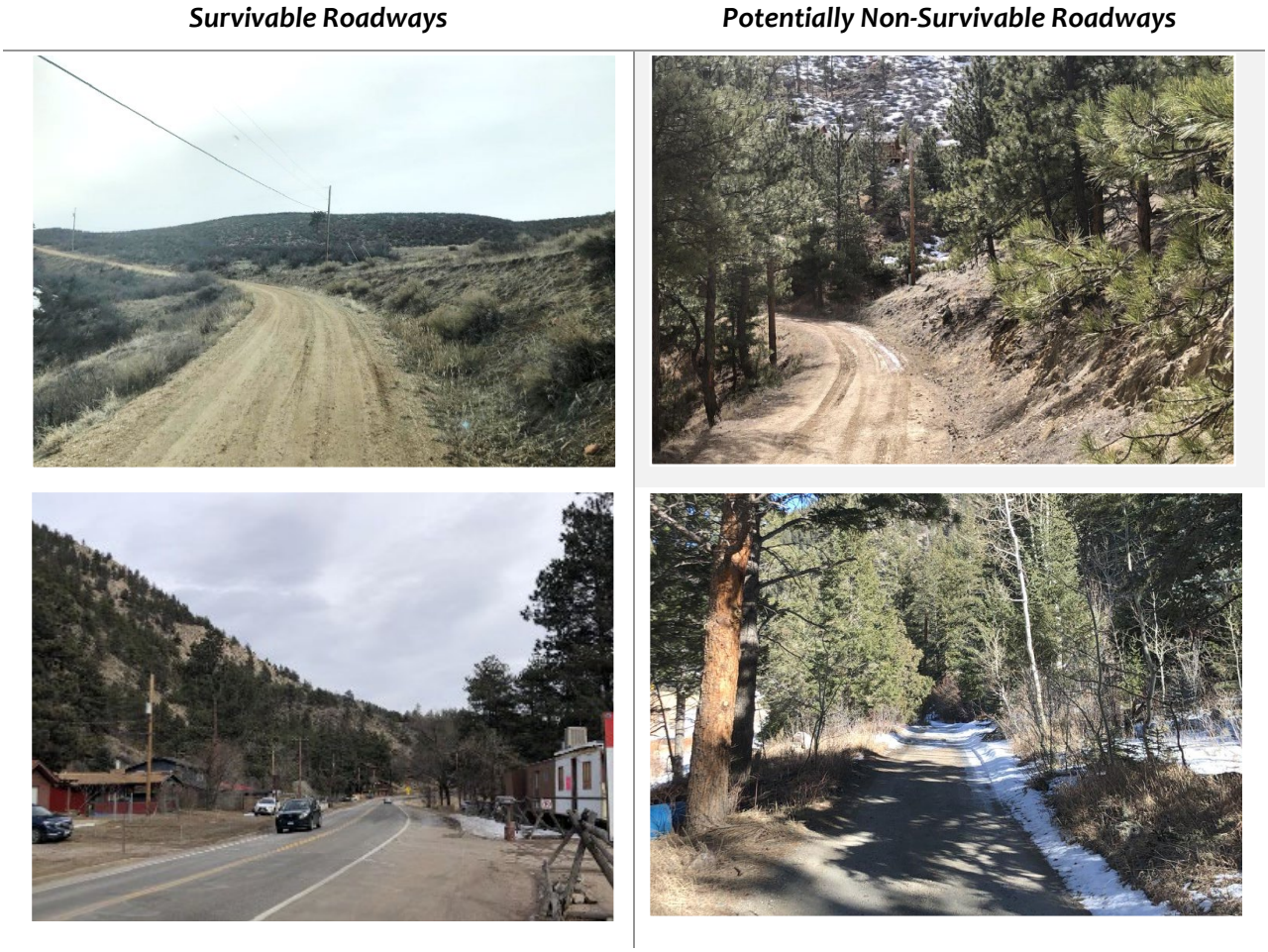


Figure 3.b.2. Some roads in LFRA have been well mitigated by removing tall trees and saplings, removing limbs on the remaining trees, and keeping grass mowed (left images). Other roads could experience potentially non-survivable conditions because they are lined by thick forests that have an abundance of ladder fuels (right images). Photo credit: The Ember Alliance.

Reliable technology to provide warnings and information about evacuations can help residents feel confident in their ability to evacuate during a wildfire. The Larimer Emergency Telephone Authority, LETA-911 uses NoCo Alert, also known as reverse 911, to communicate evacuation orders to residents. HOAs, and residents should actively extend awareness about NoCo Alert to neighbors that are unaware of the program.

NoCo Alert is the reverse 911 system used by LETA-911 to contact residents during emergencies, including during wildfire evacuations. Residential landlines are automatically registered unless their phone uses VoIP (voice-over internet protocol). Residents can register their cell phones and email addresses on the NoCo Alert website.

We recommend the following steps for residents, HOAs, community groups, LFRA, and the Larimer County Sheriff's Office to address evacuation concerns in LFRA:

- Conduct tree removal, cut low limbs, and mow grass along roadways to increase the likelihood of survivable conditions during a wildfire. Prioritize the roads with the most traffic and congestion and work out to the less congested roads (**Figure 3.b.4**). See **Section 4.d.** for recommended approaches to reduce wildfire risk along roadways.
- Coordinate with the Larimer County Sheriff's Office to conduct evacuation drills to practice safe and effective evacuation for the entire LFRA.
- Coordinate with LETA-911 to increase participation in NoCo Alert across LFRA. Unfortunately, only 58% of respondents to the CWPP survey indicated that they have signed up for NoCo Alert, but this number should ideally be 100%.
- Regularly test the NoCo Alert system to ensure timely and accurate communication could occur during an evacuation.
- Educate residents about warning systems, protocols for evacuation orders, and evacuation etiquette prior to the need to evacuate the community. Communicate the importance of following evacuation orders; **failing to leave the community in a timely manner during a wildfire emergency can put first responders at risk.**
- Encourage residents to leave with only one vehicle per household to reduce congestion.
- Encourage all households to develop family evacuation plans and to pack go-bags that are ready. Currently, only 75% of respondents to the CWPP survey have evacuation plans for their family and only 33% have go-bags at the ready. Ready, Set, Go! is a helpful resource to help with evacuation planning.
- Encourage residents to work with their neighbors to develop a plan for helping each other with evacuation if a resident is not at home, school-aged children or pets might be home alone, or residents have mobility impairments and need special assistance.
- Encourage residents to evacuate whenever they feel unsafe, even before receiving mandatory evacuation orders. All residents should leave promptly when they receive a mandatory evacuation order. This means having a family emergency plan in place and go-bags prepacked.
- Evaluate the efficacy of alternate methods of warnings and alerts, such as warning sirens. Research suggests that individuals trust and are more likely to respond to sirens than other warning systems like social media (National Academies of Sciences, Engineering, and Medicine, 2018).
- Make sure warnings and alerts can be understood by all residents, including those with English as a second language and with hearing impairments.

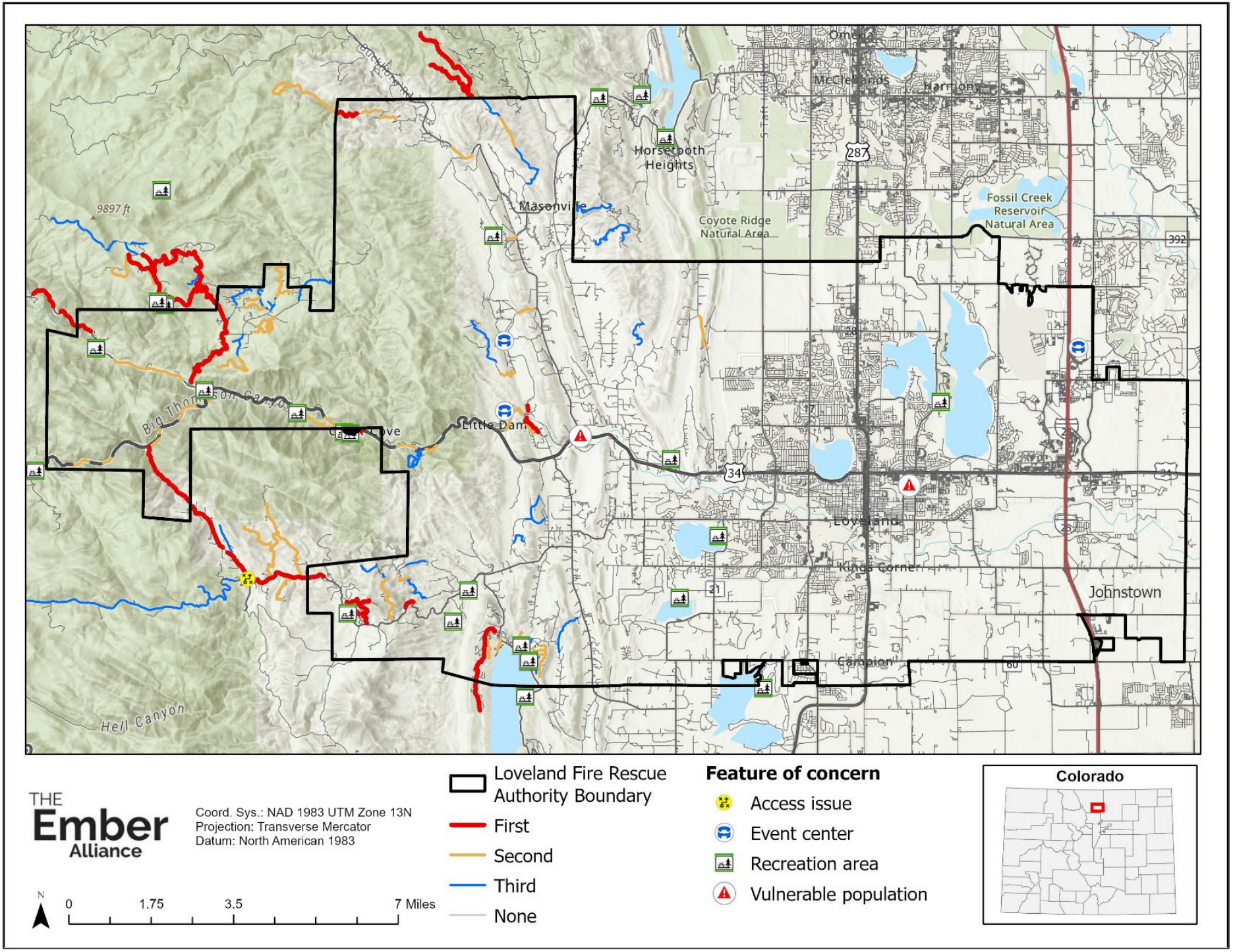


Figure 3.b.3. Potential need for roadside fuel treatments based on the potential for wildfire to create non-survivable conditions along roadways and the potential for congestion during evacuations (methodology provided in **Appendix B**). See **Section 4.d.** for recommended approaches to reduce wildfire risk along roadways. View an interactive map online.

Accessibility and Navigability for Firefighters

Responsible Parties: LFRA, Larimer County Road and Bridge, City of Loveland Road and Bridge

Residents, LFRA, HOAs, and Larimer County can work together to ensure emergency responders can locate and access everyone's home. Narrow roads without turnarounds, tree limbs hanging over the road, and lots of dead and down trees by the road may make firefighters choose to not defend your home during a wildfire event (Brown, 1994).

Where feasible, LFRA and HOAs should improve roadway access by widening road networks in neighborhoods with narrow roads and creating turnarounds and pullovers to accommodate fire engines and two-way traffic during evacuation. The community can apply for grants and work with the Larimer County Sheriff's Office to remove trees from along roads to reduce the chance of non-survivable conditions occurring during wildfires. Residents can remove trees along driveways and prune low-hanging branches to increase horizontal and vertical clearance. According to the National Fire Protection Association, driveways and roads should have a minimum of 20 feet of horizontal clearance and 13.5 feet of vertical clearance to allow engines to safely access the roads (O'Connor, 2021).

Widening roads and removing fuels along roadways can be time-consuming and expensive, but this work is vital for the safety of residents and first responders. Residents, community leaders, LFRA, and county agencies can work together to share costs and apply for grants to facilitate this important work.

A one-lane dirt road in LFRA. It would not be possible for a firefighting engine to enter here if residents were also evacuating. Photo: LFRA.

Outreach and Education

Responsible Parties: LFRA, Larimer County Wildfire Partners, Community Leaders

LFRA should continue to engage with community members using a variety of methods, including community ambassadors, social media, and education materials for visitors of short-term rentals. The following priority recommendations may fall to different entities or partners within and around LFRA.

As your community makes progress on the top-priority actions outlined below, refer to the fire adapted communities' "wheel" (**Figure 3.1**) and seek additional ideas and resources from the Fire Adapted Community Learning Network and Fire Adapted Colorado (FACO). Visit their websites for more information on their programs and upcoming events.

Neighborhood Ambassador Program

Creating a **Neighborhood Ambassador Program** could help residents better understand wildfire risks and spark coordinated action that effects positive change in LFRA. The neighborhood ambassador approach requires engaged volunteer ambassadors and a dedicated lead coordinator. See **Table 3.b.1** from the guide *Fire adapted communities neighborhood ambassador approach: Increasing preparedness through volunteers* for effective activities that neighborhood ambassadors can undertake (Wildfire Adapated Partnership, 2018).

Table 3.b.1. Potential activities for the neighborhood ambassador program. Table adapted from (Wildfire Adapated Partnership, 2018).

Example activity	Ambassador responsibility	Coordinator responsibility
Educational programs about defensible space and home hardening	Gauge interest of neighbors and select topics. Find meeting location. Encourage neighbors to attend.	Arrange for specialists to make presentations. Advertise program through HOA newsletters, social media, etc.
Emergency planning	Organize an event for people to ask firefighters and law enforcement personnel about emergency planning and evacuation. Encourage residents to work with their neighbors to develop a plan for evacuation if a resident is not at home, school-aged children or pets might be home alone, or residents have mobility impairments and need special assistance.	Provide information to residents about emergency planning and go-bags. Arrange for specialists to make presentations. Advertise program through HOA newsletters, social media, etc.
Pile Burn Cooperative involvement	Work with LFRA to determine if slash pile burning is an appropriate method of slash management in your neighborhood or community. Gauge interest level among residents around pile burning.	Work with LFRA and partner organizations to plan pile build and burn workshops. Facilitate pile burn days among residents within your neighborhood or community.

Community chipping day	Secure HOA buy-in and request financial support. Select a date and organize event logistics. Encourage neighbors to attend.	Secure fuels module availability and grants or other financial support. Address liability and safety concerns. Advertise program through HOA newsletters, social media, etc.
Defensible-space walking tour	Identify homeowners with exemplary defensible space. Select a date and organize event logistics. Encourage neighbors to attend.	Arrange for fuel treatment specialists to attend and make presentations. Provide handouts and other educational material about defensible space. Advertise program through HOA newsletters, social media, etc.
Defensible space projects	Work with neighbors to identify high-priority project locations using insights from this CWPP. Secure HOA buy-in and request financial support. Select contractors and solicit bids. Oversee project completion.	Work with a certified forester for insights about effective treatment location and prescriptions, following guidelines in this CWPP. Identify potential contractors. Write scope of work for contract. Inspect project upon completion. Celebrate success through social media posts and newspaper articles.
Roadside fuel treatment projects	Work with neighbors to identify roads and driveways with potentially non-survivable conditions using insights from this CWPP. Secure HOA buy-in and request financial support. Select contractors and solicit bids. Oversee project completion.	Work with a certified forester for insights about effective treatment location and prescriptions, following guidelines in this CWPP. Identify potential contractors. Write scope of work for contract. Inspect project upon completion. Celebrate success through social media posts and newspaper articles.
Firewise designation	Attain Firewise designation. Plan volunteer mitigation events Account for money, time, and resources spent on mitigation	Guide ambassadors in updating 3-year action plans. Support annual community-wide education program

Social Media

Social media is a powerful tool when used properly to connect with audiences. FEMA has a Wildfire and Outdoor Fire Safety Social Media Toolkit that is a great starting place for fire authorities to begin gaining an audience with their constituents and sharing important fire safety information. Put Fire to Work highlights programs and organizations that successfully engage audiences around wildland fire and prescribed burning. CalFire's Ready for Wildfire campaign is active and collaboratively created to engage and encourage people to take action on wildfire preparedness.

Considerations for Vulnerable Populations

Social factors influence how impacted an individual or a community may be in the event of wildfire. This so-called social vulnerability is due to a lack of access to resources. The resources that are lacking can include infrastructure, social support, health, and financial means (Cutter et al., 2003). While LFRA at large may be well prepared for wildfire after engaging in this CWPP planning process, there is potential for some to fall through the cracks or struggle to engage in necessary mitigation and preparation work which makes them more at risk in the event of a fire.

Poverty, racial and ethnic discrimination, age, and physical ability are frequently factors that are associated with social stratification and result in resource inequity (Crowley, 2020; Cutter et al., 2003; Davies et al., 2018; Emrich et al., 2020; Hewitt, 2013; Ojerio et al., 2008). Thus, it is important to consider how to ensure that all community members can participate in the wildfire preparedness actions outlined in this CWPP. Vulnerable populations in LFRA tend to be concentrated near the urban core (**Figure 3.b.5**, **Figure 3.b.6**). LFRA has worked with the homeless population and has connected with local outreach organizations. Continuing this work and building relationships with the homeless community can build trust and give LFRA the opportunity to educate and share safe warming tools.

Pre-fire

Before a fire, it is important to ensure that preparation and potential evacuation communication materials are available in other languages spoken in LFRA. Sole use of English in materials makes it difficult for people with lower proficiency in English to understand. This includes children, people with low literacy, and people who primarily speak other languages. Materials that use images and diagrams rather than words can make sure the broadest audience can understand any materials that LFRA distribute about wildfire. The Colorado State Forest Service recently made their Home Ignition Zone Guide available in Spanish. This resource should be made available to Spanish-speaking residents within LFRA.

Another major barrier is the ability to do the work recommended in this plan. Populations that may be impacted by this include those in lower income brackets who don't have the resources to harden their homes (i.e., by replacing their roofs, siding, and decks with ignition-resistant construction materials), those who rent their homes and cannot make modifications, and those with physical disabilities or impairments that keep them from doing the physical labor often involved in preparation and mitigation actions themselves. A CWPP is a great way to begin addressing economic disparity because it can provide a basis for LFRA to apply for grant funding to support mitigation work on behalf of the community.

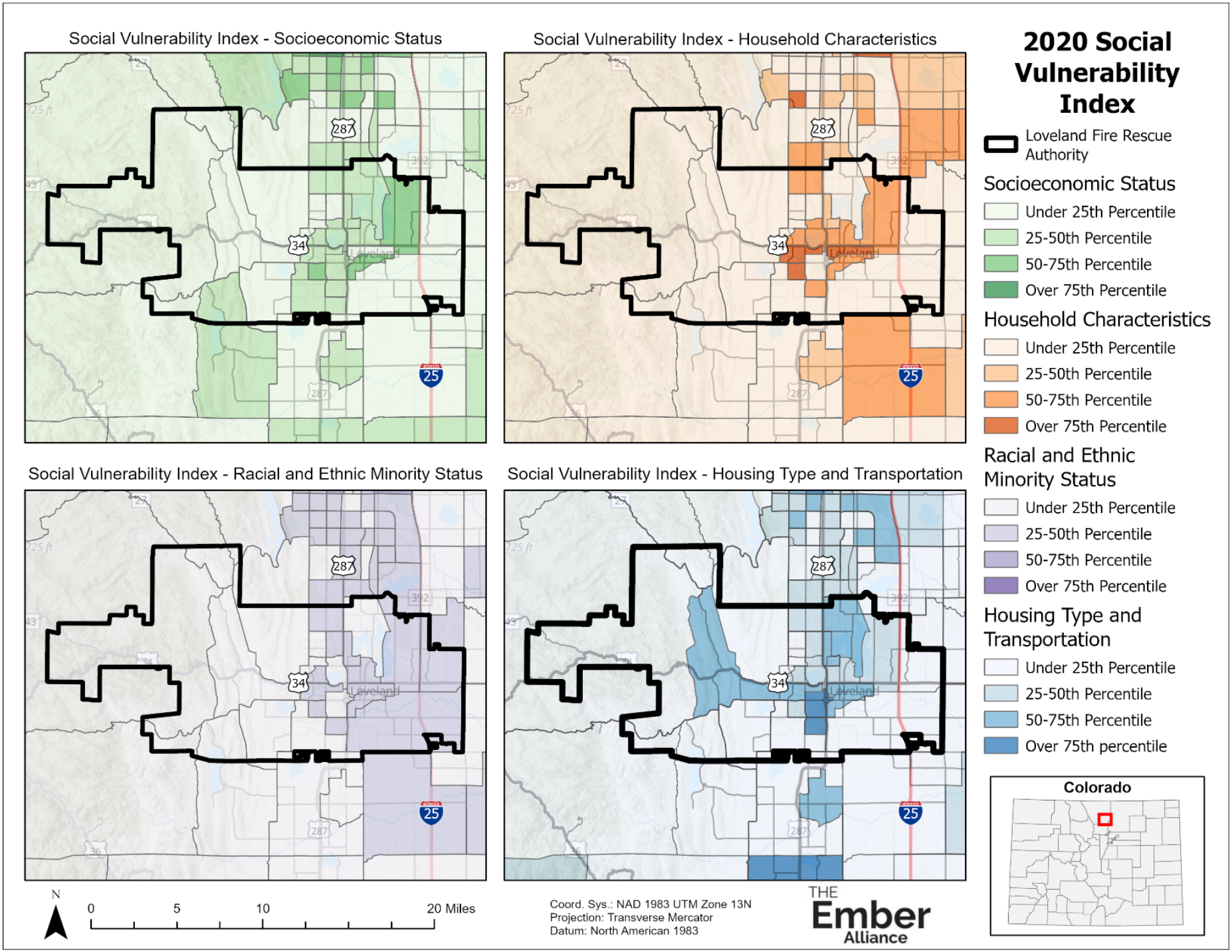
To truly reduce the economic barrier at a community level, community leaders must design programs that are accessible for all income brackets. For example, providing mitigation services such as a community chipping program that is free for residents who fall within lower income brackets can encourage those residents to mitigate their properties when they may have otherwise found it inaccessible. Similarly, volunteer days can help those who are not physically able to engage

in pre-fire protection of their home by connecting physically able community members with them to help do home hardening work.

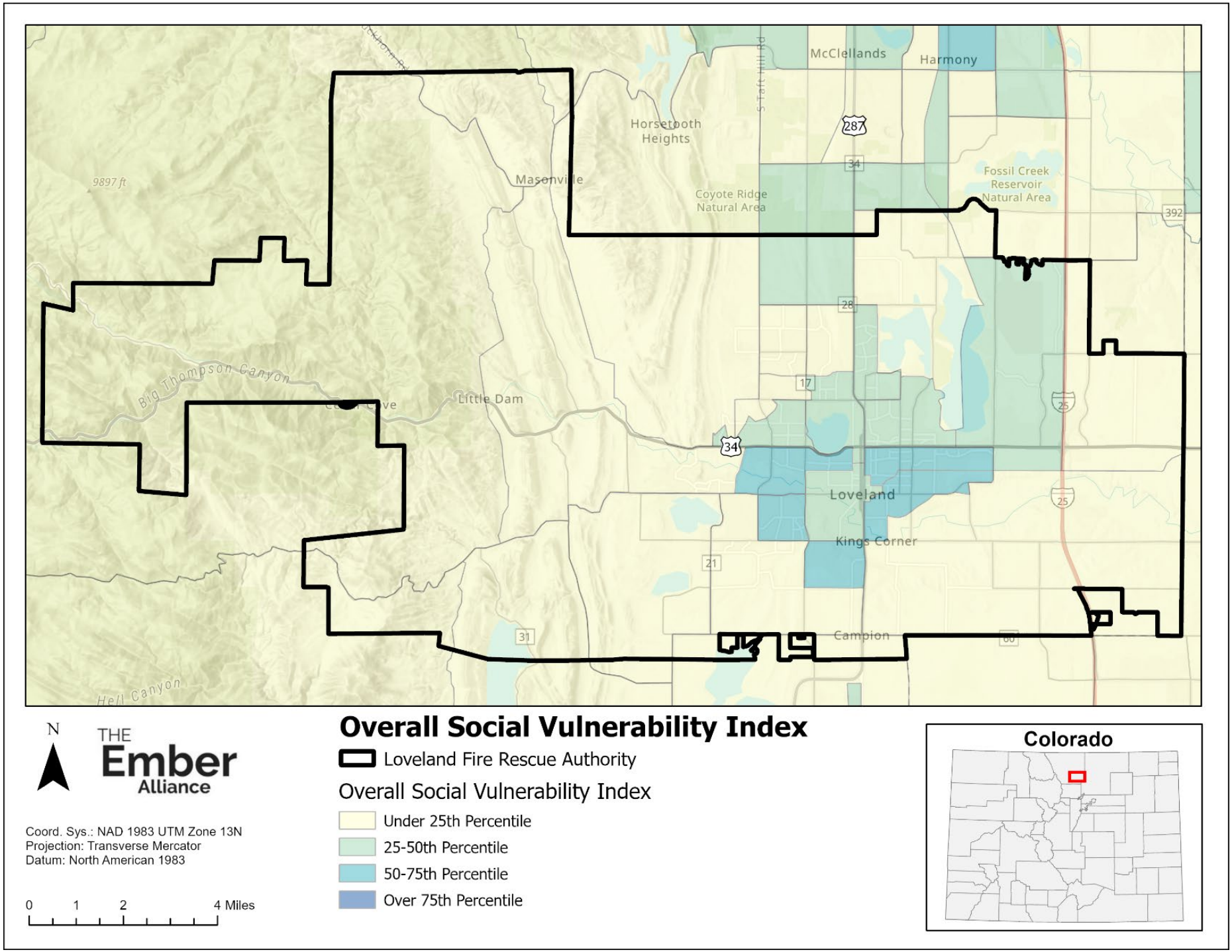
Post-fire

Following a fire, households are often solely responsible for their own recovery. While challenging for everyone, this is a particular issue for those without equal access to the social aid that is available like FEMA recovery funds, information on the internet, and claims for insurance (Laska and Morrow, 2006; Méndez et al., 2020). Groups impacted by this can include older adults, undocumented folks, and those who speak English as a second language or not at all.

While planning for post-fire is less of a focus of this CWPP, it is worth mentioning that community ties are as important after a fire as they are in trying to reduce the impact of potential fire. Communities that consider who will need the most assistance after a fire ahead of time are better able to get those folks the help they need quickly.



110 **Figure 3.b.4.** Social vulnerability index for LFRA. Categories are broken down by socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. Maps show that the most vulnerable populations are located near downtown Loveland. Being higher on a percentile means that there are more vulnerable populations in that area compared to the rest of the state of Colorado. Source: Centers for Disease Control and Prevention, 2020 CDC/ATSDR Social Vulnerability Index.



111 **Figure 3.b.5.** Overall social vulnerability index for LFRA. This map shows that the most vulnerable populations are located near downtown Loveland. Source: Centers for Disease Control and Prevention, 2020 CDC/ATSDR Social Vulnerability Index.

Homeowner and Short-Term Rental Certification

Residents in the WUI can benefit from a program clearly describing successful HIZ and staff who are able to help them identify where work needs to occur. Boulder County created a program called Wildfire Partners that does just this and uses it to license short-term rentals as well. Larimer County recently hired a Wildfire Partners Coordinator to implement this program in Larimer County.

Short-term rentals are home or apartment rentals that are leased for 30 days or less at a time, usually called vacation rentals, Airbnb's, or VRBOs. Local governments have struggled to regulate short-term rentals, and a study published in 2018 found that 20% of short-term rentals in the U.S. did not have smoke detectors and 58% didn't have fire extinguishers. Visitors are often unaware of the risks that come with their vacation location. Short term rentals without defensible space, clearly defined escape routes, or basic fire safety measures put visitors and neighbors at high risk in the event of a wildfire.

Larimer County is creating a program similar to Boulder's, and we recommend that LFRA staff collaborate with them to implement more rigorous short-term rental guidelines to protect the life safety of visitors as well as the properties of the homeowners in their jurisdiction. **Table 3.b.2** and **Figure 3.b.7** contain recommendations that were adapted from Boulder's Wildfire Partners program.

Table 3.b.2. Recommended mitigation goals for obtaining Short Term Rental Licenses in LFRA. Goals are adapted from Firewise USA.

Action	Goals
Home Ignition Zones	Create defensible space around homes and outbuildings according to the CSFS Guidelines. See **Figure 3.a.2** and **Table 3.a.1** for specifics.
Landscaping	Maintain Zone 1 (0-5 feet from the home) to clean, unburnable conditions with litter and duff removed regularly.
Roofing and Vents	Install and maintain a Class-A roof with mesh covers on vents.
Decks and Porches	Keep decks free of flammable materials such as propane tanks or firewood piles. Use non-combustible deck materials when possible.
Siding and Windows	Clean and maintain windows and siding. Use ignition-resistant siding and tempered multi-paned windows when building or remodeling.
Emergency Responder Access	Maintain a 20-foot-wide driveway with 13.5 feet of overhead clearance for emergency vehicles. Ensure that street and house numbers are clearly marked from the road, and there is enough turnaround space for fire trucks in front of your house.
Informed Renters	Provide evacuation maps to renters with multiple ways out of the neighborhood. Require renters to sign up for emergency alerts while they are visiting. Share current fire ban information with renters before they visit, and close off outdoor fire pits when they are not allowed to be used.

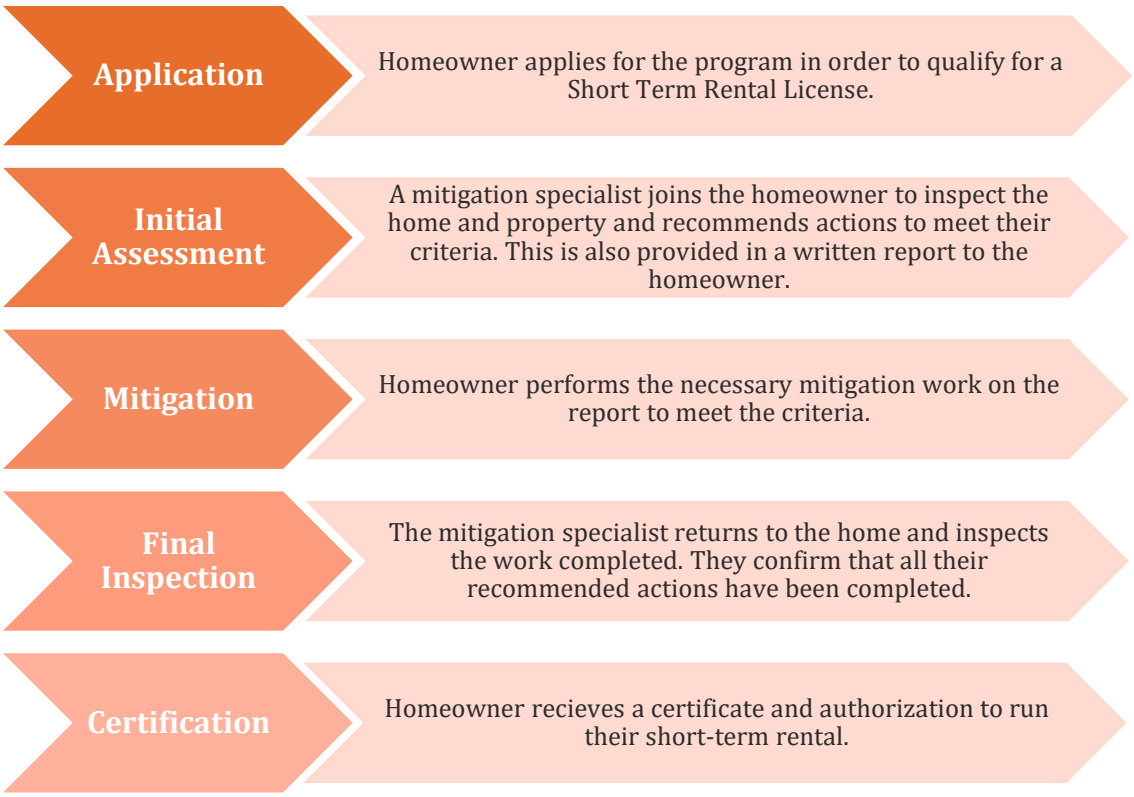


Figure 3.b.6. Proposed short-term rental licensing process. Homes that are currently operating as short-term rentals could be giving a grace period to complete the mitigation to maintain their business as they complete required mitigation. Process adapted from Wildfire Partners.

Collaboration

Collaboration with landowners, community members, local governments, business owners, and other partners is the best way to ensure recommendations from this plan translate to on-the-ground action. Some organizations may be able to offer incentives to homeowners, others have expertise and capacity to mitigate wildfire risk, and others have authority to enforce changes. A holistic approach to fire adaptation is only possible through compromise, mutual respect, and collaboration around shared goals.

Numerous partners were engaged in the development of this CWPP and offered input on the recommendations and priorities for LFRA. It is recommended that LFRA continue meetings with land management partners to provide accountability on projects, continue to participate in cross-boundary mitigation programs such as the Northern Colorado Fireshed Collaborative (NCFC), and support the community ambassador program's growth and maintenance.

3.c. Funding Opportunities

There are many funding opportunities from federal, state, and local agencies as well as non-profits to assist in forest health and wildfire mitigation projects. These funds can increase capacity but cannot cover all the costs of fire mitigation needed within the valley. Residents and partners must put forth funds and time to complete this work.

Opportunities from Local and State Agencies in Colorado

- The Colorado State Forest Service (CSFS) **Forest Restoration and Wildfire Risk Mitigation (FRWRM)** is a competitive grant program designed to assist with funding community-level actions across the entire state to: reduce the risk to people, property and infrastructure from wildfire in the wildland-urban interface; promote forest health and the utilization of woody material including for traditional forest products and biomass energy; and encourage forest restoration projects. Eligible applicants include local community groups, local government entities such as fire authorities, public and private utilities, state agencies, and non-profit groups.
- The State of Colorado developed the **Colorado Strategic Wildfire Action Program (COSWAP)** grant program in 2021 to distribute over $17 million to fuels reduction, mitigation, education, and capacity building in the state.
- **Colorado Water Plan Grants** from the Colorado Water Conservation Board includes a category for watershed health & recreation that can support planning and action to protect critical drinking water, infrastructure, and overall watershed health from post-fire impacts.
- CSFS administers programs for landowner and community assistance, including the **Colorado Forest Ag Program** and **Colorado Tree Farm Program**.
- CSFS regularly updates their **Natural Resources Grants & Assistance Database** to help residents, agencies, and other partners find funding for natural resource projects.
- The Colorado Department of Revenue provides a **Wildfire Mitigation Measures Subtraction** and **State income tax credit for wildfire mitigation (HB22-1007)** whereby individuals, estates, and trusts may claim a subtraction on their Colorado income tax return or receive a state income tax credit for certain costs incurred in performing wildfire mitigation measures on property in the WUI.
- The **Larimer County Office of Emergency Management** offers community mitigation grants to increase a community's long-term resilience to natural hazards.

Funding from Federal Agencies

- **Community Wildfire Assistance Program** from the Bureau of Land Management supports activities such as hazardous fuels reduction, thinning, chipping, outreach, and education on non-federal lands.
- **Community Wildfire Defense Grants** (CWDG) are funded annually through the National Forest Service and help communities take action on implementation projects in CWPPs.
- **Building Resilient Infrastructure and Communities (BRIC) grant program** supports states, local communities, Tribes, and territories as they undertake large-sale projects to reduce or eliminate risk and damage from future natural hazards. Homeowners, business operators, and non-profit organizations cannot apply directly to FEMA, but they can be included in sub-applications submitted by an eligible sub-applicant (local governments, Tribal governments, and state agencies).
- **Hazard Mitigation Assistance Grants Program (HMGP)** provides funding to state, local, Tribal, and territorial governments so they can rebuild in a way that reduces, or mitigates,

future disaster losses in their communities. This grant funding is available after a presidentially declared disaster.

- **Environmental Quality Incentives Program (EQIP)** from the Natural Resources Conservation Service can support private landowners and Tribes conduct forest management, prescribed burning, or prescribed grazing to reduce fire risk.
- **Assistance to Firefighters Grants (AFG)** help firefighters and other first responders obtain critical resources necessary for protecting the public and emergency personnel from fire and related hazards.
- **Fire Prevention & Safety (FP&S) Grants** support projects that enhance the safety of the public and firefighters from fire and related hazards.
- **Staffing for Adequate Fire and Emergency Response (SAFER)** grants directly fund fire departments and volunteer firefighter organizations to help increase their capacity.

Opportunities from Non-Governmental Organizations

- Coalitions and Collaboratives, Inc. manages the **Action, Implementation, and Mitigation Program (AIM)** to increase local capacity and support wildfire risk reduction activities in high-risk communities. AIM provides direct support to place-based wildfire mitigation organization with pass-through grant funding, on-site engagement, technical expertise, mentoring, and training on mitigation practices to help high-risk communities achieve their wildfire adaptation goals.
- **Stewardship Impact Grants** from Great Outdoors Colorado fund local agencies, tax districts, political subdivisions, and non-profit organizations for wildfire mitigation work that aligns with resource conservation or outdoor stewardship objectives.
- **Conservation Service Corps Grants** from Great Outdoors Colorado fund chainsaw crews to support local agencies, tax districts, subdivisions, and non-profits with mitigation projects.
- Fire Adapted Colorado (FACO) manages the **FACO Opportunity Fund**, which is a matching mini-grant program to support projects, build capacity, and address local needs with funding from the National Fire Adapted Communities Learning Network.

Supporting the Fire Authority

LFRA strives to be supportive of forestry projects that improve forest health and wildfire safety. Creating, managing, and implementing fuels mitigation projects takes time and effort that is often unfunded. Education and outreach are incredibly important to LFRA – connecting with their constituents is a vital part of building relationships and providing the highest quality services.

- The **Staffing for Adequate Fire and Emergency Response (SAFER)** grants can help fund staff capacity for fire departments.
- The **Assistance to Firefighters Grants (AFG)** can provide critical response resources for firefighters and emergency responders.
- Community support is also vital to the success of the fire stations:
  - LFRA is supported by volunteer responders who respond to fires, medical emergencies, and rescues every day of the year. Consider volunteering at Station 8 or 9!
  - Financial support in the form of monetary donations or support of local ballot measures that provide tax revenue for the FPD is vital to their success in responding to residents in their time of need.
  - Attend events hosted by LFRA. Seeking out information to protect your home from fire danger can also help protect your local firefighters. Sharing this information within your community can build community resilience and can help lower implementation costs for individual homeowners for many projects.

4. Implementation Recommendations for Fuel Treatments and Ecological Restoration

4.a. Objectives

Fuel Treatments

> *"Given the right conditions, wildlands will inevitably burn. It is a misconception to think that treating fuels can 'fire-proof' important areas… Fuel treatments in wildlands should focus on creating conditions in which fire can occur without devastating consequences, rather than on creating conditions conducive to fire suppression" (Reinhardt et al. 2008).*

Fuel treatments are a land management tool for reducing wildfire hazard by decreasing the amount and altering the distribution of wildland fuels. Common goals of stand-scale fuel treatments are to reduce the risk of active or passive crown fires and to reduce fire intensity. This is achieved by removing trees, increasing the distance between tree crowns, removing small trees, shrubs, and low branches to increase the distance between surface fuels and tree crowns, and removing downed trees and other dead vegetation (Agee and Skinner, 2005). Fuel treatment methods include tree thinning, pruning, pile burning, broadcast prescribed burning, and fuel mastication.

Strategically located, high-quality fuel treatments can create tactical options for fire suppression (Jolley, 2018; Plucinski, 2019; Reinhardt et al., 2008). Fuel treatments along trails, ridgelines, and other features can allow firefighters opportunities to use direct or indirect suppression techniques to contain fire spread. Firefighters used fuel treatments north and west of LFRA as tactical features when fighting the Cameron Peak fire in 2020. The most useful treatments were previous wildfires (namely the High Park fire burn area and the Bobcat Fire burn area), fuel treatments from the previous five years, and fuel treatments along roadways (Griener, 2023).

Strategic fuel treatments, in tandem with work by individual residents to mitigate hazards in their home ignition zone, can help protect life and property. Based on responses to the CWPP survey:

- 88% of residents understand the risk of fire in LFRA.
- 75% of residents support removing trees as a fuel treatment on private and/or public land.
- 70% of residents have already cut trees or removed low limbs within their home ignition zone (**Appendix C**).

Many local agencies that manage land within and around LFRA are actively reducing wildland fuels. Additional strategic work is required to mitigate wildfire risks across LFRA.

Ecological Restoration

Ecological restoration is the process of assisting the recovery of an ecosystem that has been damaged, degraded, or destroyed (SER, 2004). Many forests in the western United States have been damaged, degraded, or destroyed because of changes to their historical fire regimes following Euro-American colonization.

Ecological restoration in ponderosa pine and dry mixed-conifer forests seeks to transform dense forests into ecosystems that are more resilient to wildfire. Tree densities in ponderosa pine forests along the Colorado Front Range average 4.5 times higher today than they were in the mid-1800s

(Battaglia et al., 2018). Landscapes of continuous, dense forests, such as in western LFRA, are more prone to high-severity fires that are difficult to suppress and can result in catastrophic losses to lives and property (Haas et al., 2015). Restoration treatments in dry-mixed conifer and ponderosa pine forests seek to reduce tree density and create patterns with single trees, clumps of trees, and meadows—conditions that are more like historical ecosystems along the Front Range of Colorado. Such restoration treatments can reduce crown-fire hazard, increase the abundance and diversity of grasses, shrubs, and wildflowers, and improve habitat for many wildlife species, including deer and elk (Addington et al., 2018).

Lodgepole pine forests are part of fire-adapted ecosystems that are resilient after infrequent, stand-replacing wildfires. Research on historical conditions in lodgepole pine forests suggest they experienced high-severity wildfires every couple of centuries in northern Colorado and southern Wyoming (Higuera et al., 2021). Forest health treatments that focus on fire prevention and restoring historic conditions to lodgepole pines focus on patch cuts to mimic stand-replacing fire events and create mosaic landscapes of forests with different ages, compositions, and fuel loads. Patch cuts remove every overstory tree in a stand to create opportunities for regeneration of aspen and understory plants. They do not return nutrients to the soil or create a rich seed bed the way that fire does, but there will need to be significant amounts of outreach and education with the community before there is social license to conduct prescribed fire in lodgepole stands.

Ecological restoration in grasslands includes converting degraded ecosystems into short-grass prairie with a variety of native plants and frequent-fire regimes. This is accomplished through regular prescribed burns, judicious use of herbicide to control non-native grasses, seeding with native species, careful grazing with cattle, and maintenance of existing prairie dog colonies (Miller, 2006; Phillips-Mao, 2017; USFS Southwest Region, 2014).

In some cases, fuel treatments can achieve both ecological objectives and wildfire risk reduction. Restoration treatments in dry-mixed conifer and ponderosa pine forests tend to achieve both fuel treatment and ecological restoration objectives. In contrast, a treatment that creates a forest with widely, evenly spaced trees could serve as an effective fuel treatment but would not achieve ecological objectives in most forest types. Mowing grasslands to reduce fuel load might reduce potential flame lengths but will not restore short-grass prairie ecosystems without also conducting regular prescribed burns and seeding with native species.

Methods Used to Conduct Fuel Treatments and Restore Ecosystems

Mechanical Treatments

Trees can be removed manually or mechanically, providing for considerations of safety, slope, road access, cost, and potential damage to soil. Use of mechanical equipment is often infeasible on slopes greater than 35% (Hunter et al., 2007). Handcrews with chainsaws can operate on steeper slopes, but handcrews usually cover less ground each day than mechanical thinning. Sometimes the only option for tree removal on steep, inaccessible slopes is expensive helicopter logging.

Thinning operations often increase surface fuel loads and can fail to achieve fire mitigation objectives if fuels created by the harvest activities (also known as slash) are not addressed (Agee and Skinner, 2005). See below for options to mitigate surface fuel loads created by fuel management.

A feller-buncher removes trees in a dense stand of pine trees. This is a common piece of equipment used in mechanical treatment. Photo credit: Oregon Department of Forestry

Broadcast Prescribed Burning

Broadcast prescribed burning is the most effective method to mitigate wildfire risk and create healthy conditions in a variety of grassland, shrubland, and forest ecosystems (Paysen et al., 2000; Stephens et al., 2009). This method has unique impacts on vegetation, soils, and wildlife habitat that cannot be replicated by mechanical treatments alone (McIver et al., 2013). Prescribed burning mimics naturally occurring wildfire, can treat hundreds of acres at a time, removes surface fuel, and is relatively cost-effective (Hartsough et al., 2008; Hunter et al., 2007). Prescribed burns can reduce property damage during wildfires because they are so effective at reducing fuel loads (Loomis et al., 2019).

Prescribed burning can remove surface and ladder fuels and restore ecological processes to frequent-fire ecosystems. Firefighters who plan and implement burns must hold rigorous certifications set by the National Wildfire Coordinating Group. Photo credit: The Ember Alliance.

Broadcast prescribed burning can be used following mechanical treatments to magnify treatment impacts. Thinning and burning treatments tend to achieve fuel reduction objectives and modify fire behavior to a greater extent than thinning alone (Fulé et al., 2012; Prichard et al., 2020). Regular spring burning can also help restore short-grass prairie ecosystems by controlling non-native grasses such as smooth brome (Willson and Stubbendieck, 1997). Many native grass species stay green into the summer, unlike cheatgrass and smooth brome, making them less receptive to wildfire (Miller, 2006).

Broadcast prescribed burning is challenging in the WUI due to diverse fuel types, proximity to homes, risk of visibility impairments on roads from smoke, health impacts of smoke, and political and social concerns. However, with proper planning and implementation, qualified firefighters can safely conduct prescribed burns, even in the WUI (Hunter et al., 2007). Life safety is always a top consideration when developing and conducting prescribed burns.

Broadcast burning is carefully regulated in Colorado by the Division of Fire Prevention and Control (DFPC), the Colorado Department of Public Health and Environment, local sheriff's offices, and fire departments as outlined in the *Colorado Prescribed Burning Act of 2013* and *2019 Colorado Prescribed Fire Planning and Implementation Policy Guide*. Firefighters who plan and conduct prescribed burns are highly qualified under national standards set forth by the National Wildfire Coordinating Group.

Less than 1% of prescribed burns escape containment lines, and most of these are rapidly suppressed (Weir et al., 2019). The wildland fire community soberly reviews prescribed burn escapes to produce lessons learned and make improvements (Dether, 2005).

Mowing / Grazing

Mowing involves using equipment or grazing animals to trim the height of grasses and forbs. Some equipment can mow down shrubs and small saplings. Mowing is primarily used to reduce flashy fuels in home ignition zones 1 and 2 and along roadways, railways, and powerlines.

Mowing and grazing can decrease flame length by reducing the height and volume of fine flashy fuels (Harper, 2011). Mowing grasslands along the border of the grassland-urban interface can reduce the exposure of adjacent homes to long flame lengths and create opportunities for fire suppression. In some cases, it can stimulate the regeneration and growth of native plants, but it can also promote the spread and growth of non-native grasses. Mowing requires regular maintenance several times a year and removal of dead grass clippings. The creation of "rangeland greenstrips" through mowing, burning, grazing, and seeding with native plants can reduce the chance of wildfires damaging properties while also restoring ecological conditions in grassland ecosystems (Miller, 2006). Open Space managers in the City of Loveland, Larimer County, City of Fort Collins, City of Louisville, Superior, Highlands Ranch, and other Front Range Communities have begun using mowed fuel breaks in the grassland-urban interface.

Cows grazing in Colorado. Photo credit: Gates Frontiers Fund Colorado Collection within the Carol M. Highsmith Archive, Library of Congress.

Treatment Types Covered in the CWPP

This CWPP covers fuel treatments in the home ignition zone 3, stand-level fuel treatments, and roadside fuel treatments, each with their own objectives and benefits:

Fuel Treatment Category	**Primary Objectives and Benefits**
Defensible space in home ignition zone 3 (30-100 feet away from the home)	Reduce surface fuels, reduce tree density, and increase the distance between surface and canopy fuels. Moderate fire behavior near structures and increase their chance of surviving a wildfire. Increase safety and access for wildland firefighters. Increase the visibility of structures from roadways to assist wildland firefighters with locating and accessing your home. Coordinate with partners when home ignition zone 3 overlaps neighboring properties to address shared wildfire risk. Linked defensible space creates safer conditions and better tactical opportunities for wildland firefighters. Defensible space projects that span ownership boundaries are better candidates for grant funding due to their strategic value.
Stand-level ecological restoration / fuel treatments	Reduce surface fuels, reduce tree density, and increase the distance between surface and canopy fuels. Restore ecological conditions to create more fire-resilient ecosystems. Reduce the likelihood of high-severity wildfires near communities. Create tactical opportunities for fire suppression.
Roadside fuel treatments	Dramatically reduce or eliminate surface and canopy fuels. Reduce the likelihood of non-survivable conditions along roadways during wildfires. Create tactical opportunities for fire suppression. Increase the visibility of structures from roadways to assist wildland firefighters.

4.b. Priority Project Areas for Land Managers

Altering potential wildfire behavior and restoring ecological conditions requires a landscape-scale approach to treatments across ownership boundaries. We located and prioritized project areas for roadside fuel treatments, ecological restoration, and/or stand-level fuel treatments within and around LFRA to be implemented in the next 5 years (**Figure 4.b.1**). These project areas cross ownership boundaries and require community-wide commitment, coordination, and collaboration among private landowners, public land managers, and forestry professionals to create successful outcomes.

Project areas were identified by assessing potential need for treatment based on fire behavior, home exposure, infrastructure and values, evacuation hazard, previous fuel treatments and planned work, potential funding sources, the location of strategic boundaries for wildfire management and suppression (aka, potential operational delineations [PODs]), connection with community members, and other feasibility considerations. PODs are topographic areas bounded by features suitable for fire control (e.g., ridgetops and roads) that can be used for proactive wildfire decision making and tactical operations during wildfire events. PODs can serve as management units for proactive ecological restoration and wildfire risk mitigation, as well as for cross-boundary and collaborative land and fire management planning (Thompson et al., 2022). The Arapaho Roosevelt National Forest and other partners with the Northern Colorado Fireshed use PODs to plan landscape-scale projects to protect communities and restore ecosystems.

In winter and spring of 2023, TEA, LFRA, and representatives from land management agencies and other partner groups met to refine project areas and assign project leads. Partners included representatives from the U.S. Forest Service, Larimer County Conservation Corps, Larimer County OEM, Larimer County Sherriff's Office, Larimer Conservation District, Big Thompson Watershed Coalition, Estes Valley Watershed Coalition, City of Loveland Parks and Recreation, and City of Loveland Water and Power.

The section below describes the current conditions in each CWPP project area, treatment objectives and benefits, potential treatment types, project leads, and relative importance. The relative importance and feasibility of treatments is reflected in their timeline—partners aim to conduct treatments for immediate action in the next 1-2 years, short-term treatments are targeted for the next 3-4 years, and mid-term projects for the for the next 5-10 years. Mid-term projects will require more coordination, funding, and other enabling conditions before implementation can begin.

The CWPP implementation plan for stand-level and roadside treatments focuses on high-priority locations, but this does not discourage ecological restoration and fuel mitigation in other areas. If multiple neighbors work together to mitigate fire risk across ownership boundaries, it could attract funding and increase the priority and effectiveness of treating those areas. LFRA, local organizations, residents, and land managers should reevaluate fire risks and reprioritize treatment units as conditions change over time.

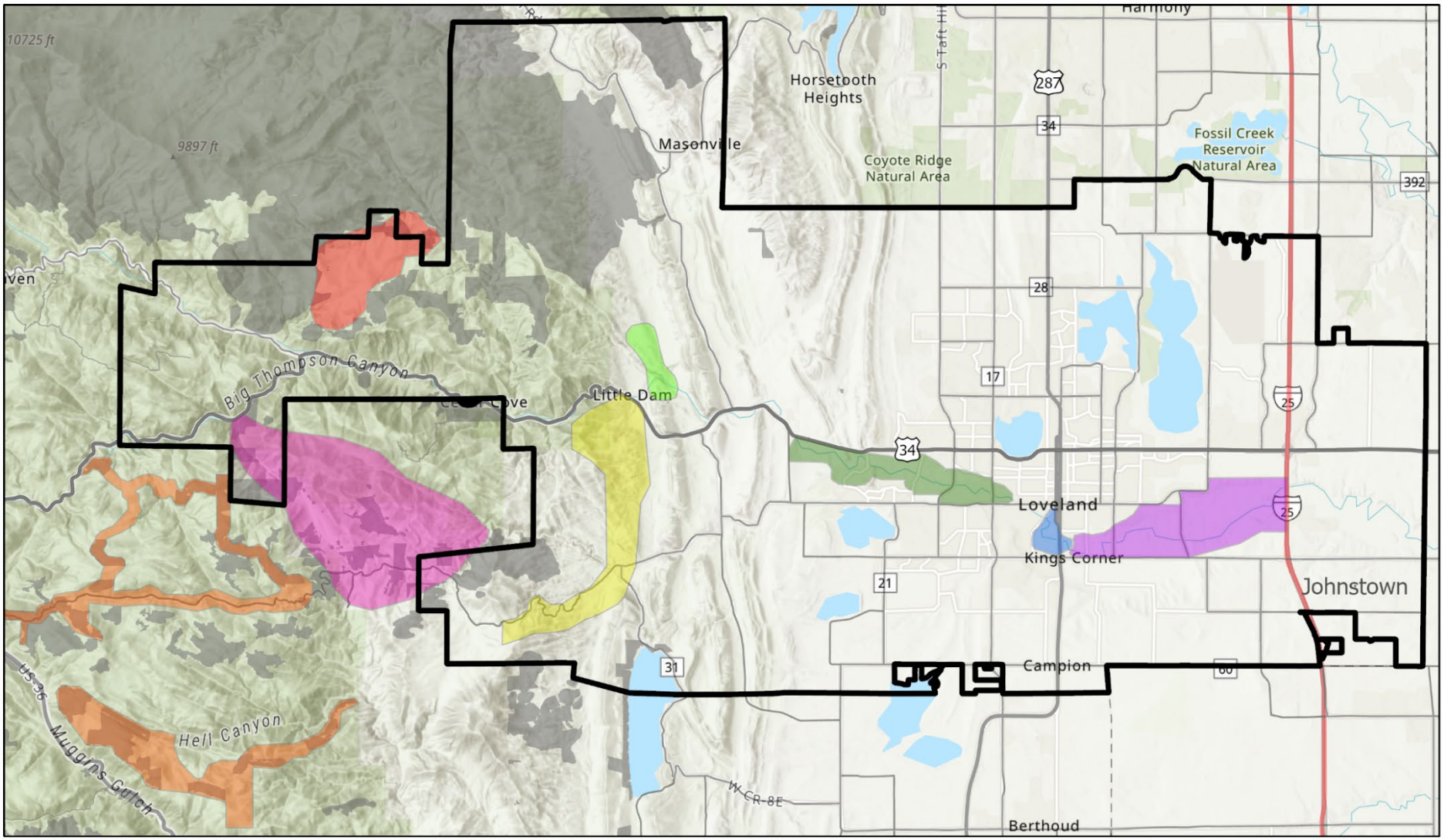


Figure 4.b.1. Priority project areas for implementation in the next 5 years to reduce the impact of wildfire in LFRA, create strategic opportunities for wildland firefighters, create safe conditions for evacuations, and restore ecological conditions. View an interactive map online.

Storm Mountain

The Storm Mountain project area encompasses 1800 acres of mostly private land ownership in the northwest part of LFRA (**Figure 4.b.2**). This area is the community core of Storm Mountain, where homes are the densest. The Cameron Peak and Bobcat Fires burned very close to this community, and there has been significant work around the community, but little work on private land to protect residents and structures. Watersheds in this area are classified as having moderate to high hazards associated with watershed health and high to highest hazards associated with forest health (JW Associates, Inc., 2023).

Storm Mountain is covered with montane shrublands and grasslands with mixed conifer forests around them. Even under moderate weather conditions this area has the potential to see very high to extreme fire behavior and crown fire. The Arapaho-Roosevelt National Forest has approximately 37,000 slash piles in this area that will be burned over the next several winters under appropriate conditions. Until they are burned, they remain a fuel loading hazard adjacent to the Storm Mountain and Cedar Park communities.

Treatment objectives:

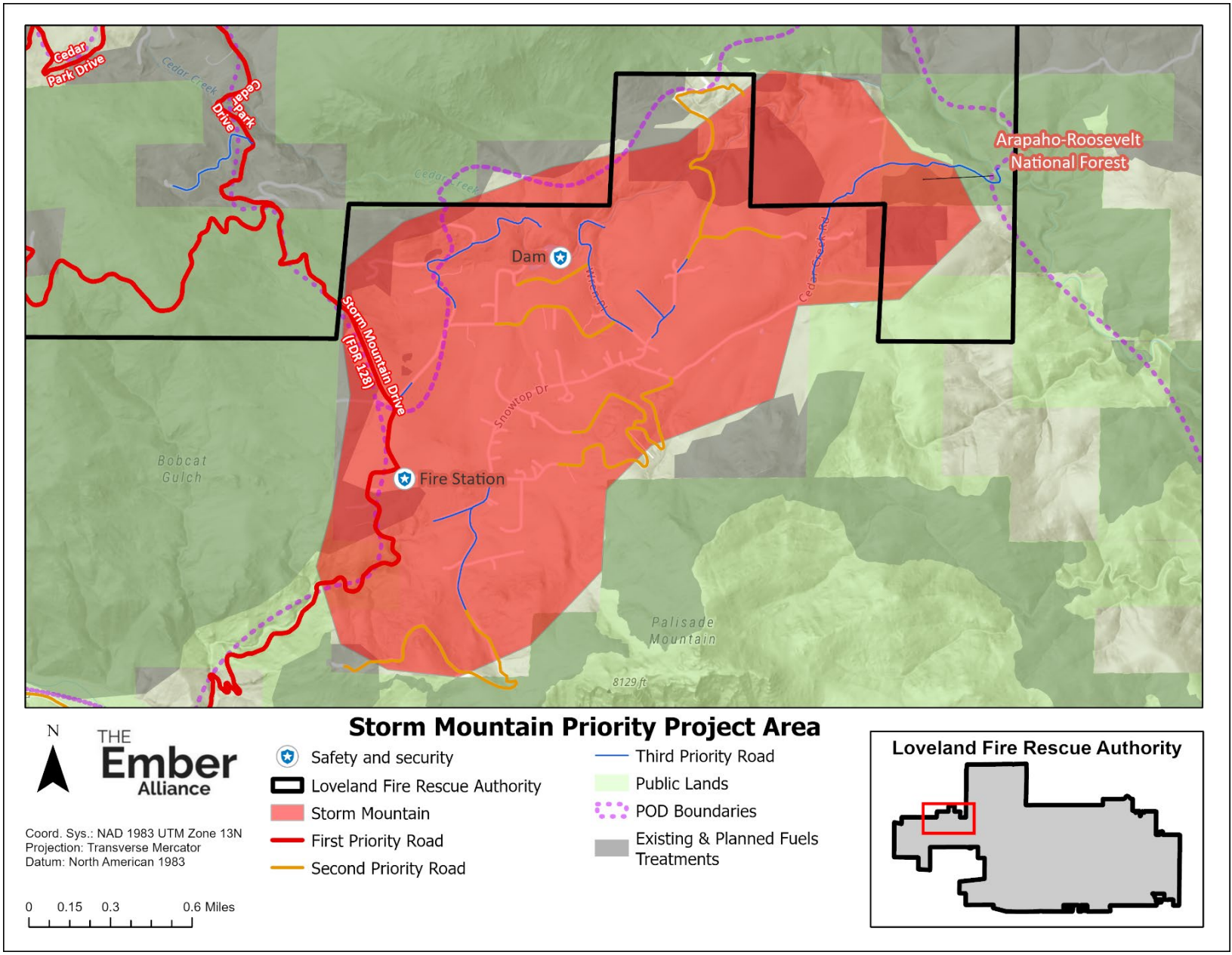
- The primary objective of the Storm Mountain Project is to decrease the amount of hazardous fuels across the community for the protection of resident lives and homes.
- The second objective is increasing safety along the main evacuation route, Storm Mountain Drive, as well as other priority roadways in the area.
- The third objective of this project is to protect LFRA Station 9 and the Cedar Springs Dam.
- Another goal of this project is increasing community outreach and education within the Storm Mountain community on the purpose and safety of landscape fuel treatments and prescribed fire on private and public land.

Treatment type:

- Mechanical thinning followed by slash management including pile burning, chipping, hauling, and use of the air curtain burner.
- If feasible, consider prescribed burning in parts of this project area. An assessment for the Northern Colorado Fireshed suggest that values at risk, including forest health and the WUI, could experience benefits from the judicious use of prescribed burning (Rhea et al., 2022).
- Any use of prescribed fire in this project area should be accompanied by notifications to residents of Cedar Park and Storm Mountain to make them aware of when and where burning will be conducted.
- Along roadways, vegetation should be removed on either side of the road to increase public safety in an evacuation. See Section 4.d. for more information on roadside fuel treatments.
- Treatments should reference best practices for working within sensitive or threatened species. This area covers habitat for the Preble's meadow jumping mouse and mountain mahogany/needle-and-thread plants.

Priority: Immediate action, work starting within 1-2 years.

Lead and support organizations: The Big Thompson Watershed Coalition is the lead organization on the project with support from Loveland Fire Rescue Authority, Larimer Conservation District, Arapaho-Roosevelt National Forest, and the Colorado State Forest Service.



Pierson Park

Pierson Park project area encompasses 160 acres of US Forest Service and private land just southwest of LFRA (**Figure 4.b.3**). Watersheds in this area are classified as having moderate to highest hazards associated with watershed health and high to highest hazards associated with forest health (JW Associates, Inc., 2023).

The USFS is planning to treat up to 3000 acres of land along POD boundaries in this location and it would be critical for firefighting tactical operations for the private lands between these USFS parcels to have similar treatments. The Arapaho-Roosevelt National Forest has approximately 15,000 slash piles in this area that will be burned over the next several winters under appropriate conditions. Until they are burned, they remain a fuel loading hazard adjacent to the nearby residents.

Treatment objectives:

- The primary objective is to connect fuel treatments along POD boundaries across public and private lands. The USFS is planning to complete 3,000 acres of POD boundary treatment in this area on public land, and this project goal is to engage private landowners adjacent to USFS lands that lie along POD boundaries and complete fuel treatments on their lands.
- The second objective is to increase safety for evacuations and firefighter access along Pole Hill Road.

Treatment type:

- Shaded fuel breaks up to 1,000 feet around the POD boundary line via mechanical thinning, hazard tree removal, and pile burning. An assessment for the Northern Colorado Fireshed suggest that values at risk, including forest health and the WUI, could experience positive benefits from the judicious use of prescribed burning (Rhea et al., 2022).
- Along Pole Hill Road, vegetation should be removed on either side of the road to increase public safety in the event of an evacuation. See Section 4.d. for more information on roadside fuel treatments.
- Treatments in this area should reference best practices for working within sensitive or threatened species habitat. This area includes habitat for mountain mahogany/needle-and-thread plants.

Priority: Immediate action for USFS land, work starting within 1-2 years. Long-term action for private land, starting in 4-5 years.

Lead and support organizations: The Arapaho-Roosevelt National Forest is the lead organization on the project with support from Loveland Fire Rescue Authority, Larimer Conservation District, Big Thompson Watershed Coalition, and the Colorado State Forest Service.

Photo credit above: USFS

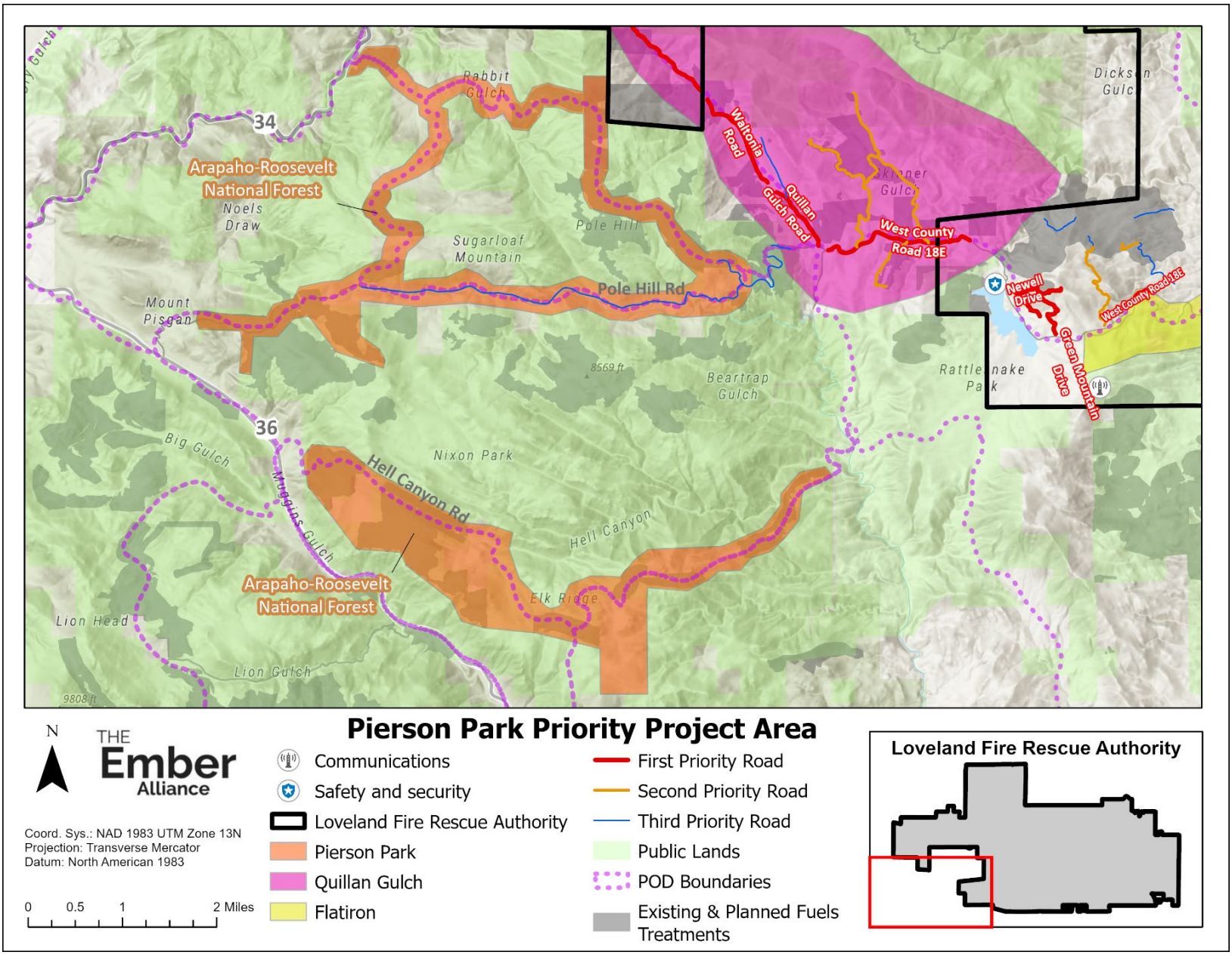


Figure 4.b.3. Pierson Park project area in LFRA.

Quillan Gulch

Quillan Gulch project area encompasses 5700 acres of primarily private land with some USFS land in southwest LFRA (**Figure 4.b.4**). This project area includes planned fuel treatments in Waltonia and along Pole Hill Road. Waltonia is a known hazardous residential location, and this project covers their secondary evacuation route out of the community which is a first priority road and connects many existing fuel treatments across this landscape). Watersheds in this area are classified as having moderate to highest hazards associated with watershed health and high to highest hazards associated with forest health (JW Associates, Inc., 2023).

Treatment Objectives:

- The primary objective is roadside fuel treatments along Waltonia Road, Quillan Gulch Road, and Pole Hill Road to increase the safety of evacuation routes for residents. These roads are also POD boundaries and mitigation along them can be used as a defense line during a wildfire event.
- The secondary objective is landscape scale fuel treatments in the area to protect resident lives and residences, as well as reduce the severity of wildfires.
- The third objective is increasing community outreach and education within the Waltonia community on the importance of home hardening and defensible space.

Treatment Type:

- Mechanical treatment followed by entire tree removal and hauling slash offsite.
- Along roadways, vegetation should be removed on either side of the road to increase public safety in the event of an evacuation. See **Section 4.d.** for more information on roadside fuel treatments.

- Treatments in this area should reference best practices for working within sensitive or threatened species habitat. This area includes habitat for the Preble's meadow jumping mouse and mountain mahogany/needle-and-thread plants.

Priority: Immediate action, work starting within 1-2 years.

Lead and Support Organizations: Larimer Conservation District is the lead organization on the project with support from Loveland Fire Rescue Authority, Big Thompson Watershed Coalition, Arapaho-Roosevelt National Forest, Colorado State Forest Service, and Larimer County Department of Natural Resources.

Photo credit: LFRA

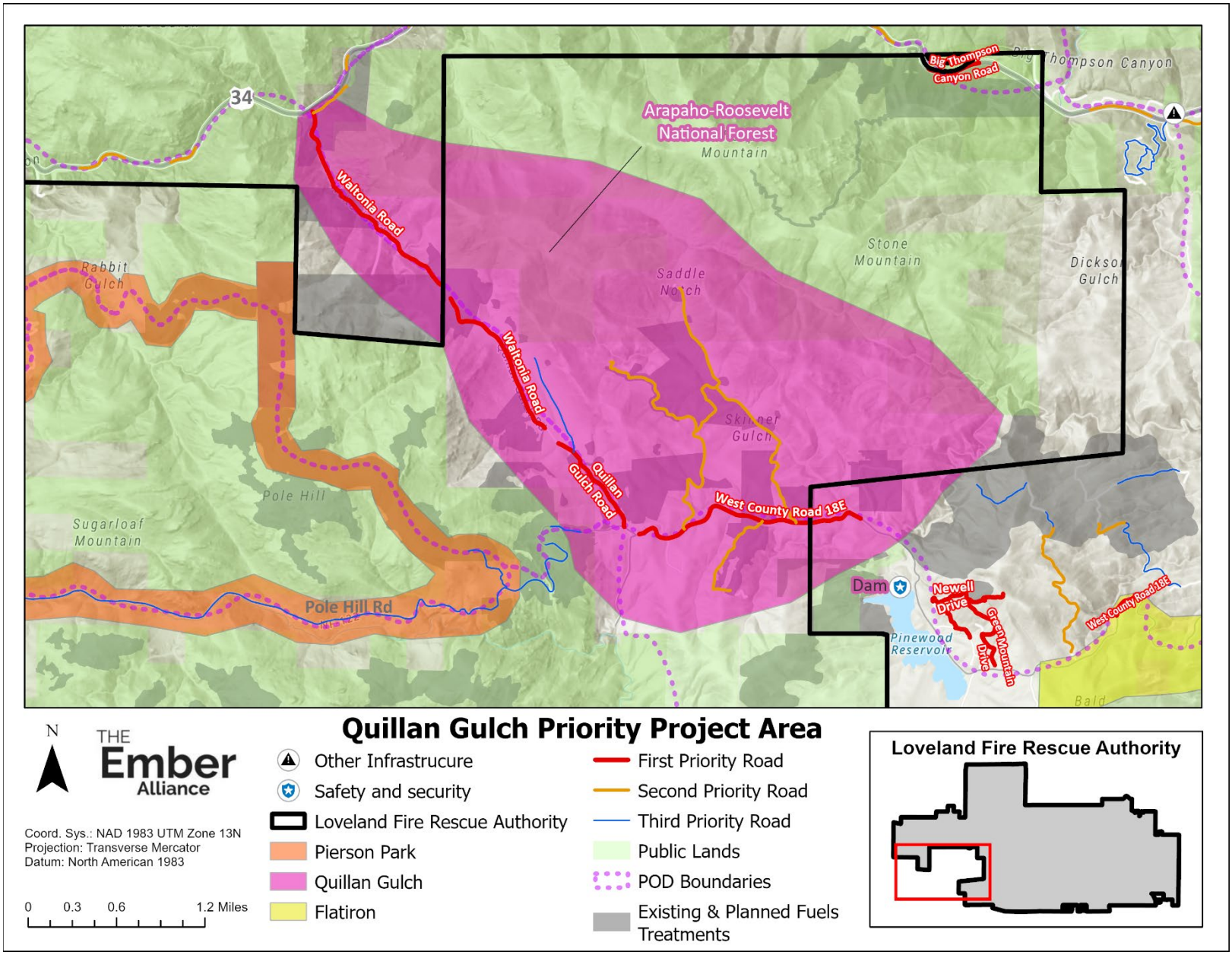


Figure 4.b.4. Quillan Gulch project area.

Flatiron

Flatiron project area encompasses 2600 acres of county land that is connected by Bureau of Reclamation and Norther Water land and some private land parcels (**Figure 4.b.5**). This project lies along the last POD boundary before the City of Loveland and has a section of first priority roadway to treat along W CR 18E. Larimer County Department of Natural Resources owns two recreation sites in this landscape and has completed sone fuel treatments adjacent to this project area. Watersheds in this area are classified as having moderate to high hazards associated with watershed health (JW Associates, Inc., 2023).

Treatment objectives:

- The primary objective is to protect values at risk including the power plant, substation, dam at Flatiron Reservoir, the visitor center, and weather station from severe wildfire.
- The secondary objective is to reduce hazardous fuel loads in this area and along the POD boundary to mitigate the risk of severe wildfires, restore forest health, and protect residents' lives and property.
- The third goal is to engage private landowners within the project area to provide them with the tools and resources to complete fuel treatments on their lands.

Treatment type:

- Mechanical thinning and slash removal with pile and/or broadcast burning. An assessment for the Northern Colorado Fireshed suggest that values at risk, including forest health and the WUI, could experience positive benefits from the judicious use of prescribed burning (Rhea et al., 2022).
- Any use of prescribed fire in this project area should be accompanied by notifications to nearby residents to make them aware of when and where burning will be conducted.

- Along roadways, vegetation should be removed on either side of the road to increase public safety in the event of an evacuation. See Section 4.d. for more information on roadside fuel treatments.
- Treatments in this area should reference best practices for working within sensitive or threatened species habitat. This area includes habitat for the Preble's meadow jumping mouse and mountain mahogany/needle-and-thread plants.

Priority: Mid-term action, work starting within 2-4 years.

Lead and support organizations: Public land projects will be led by Larimer County Department of Natural Resources and supported by Northern Water. Loveland Fire Rescue Authority will lead private lands outreach, supported by the Larimer County Wildfire Partners Program. Colorado State Forest Service will support both public and private land projects as needed.

Photo credit above: LFRA

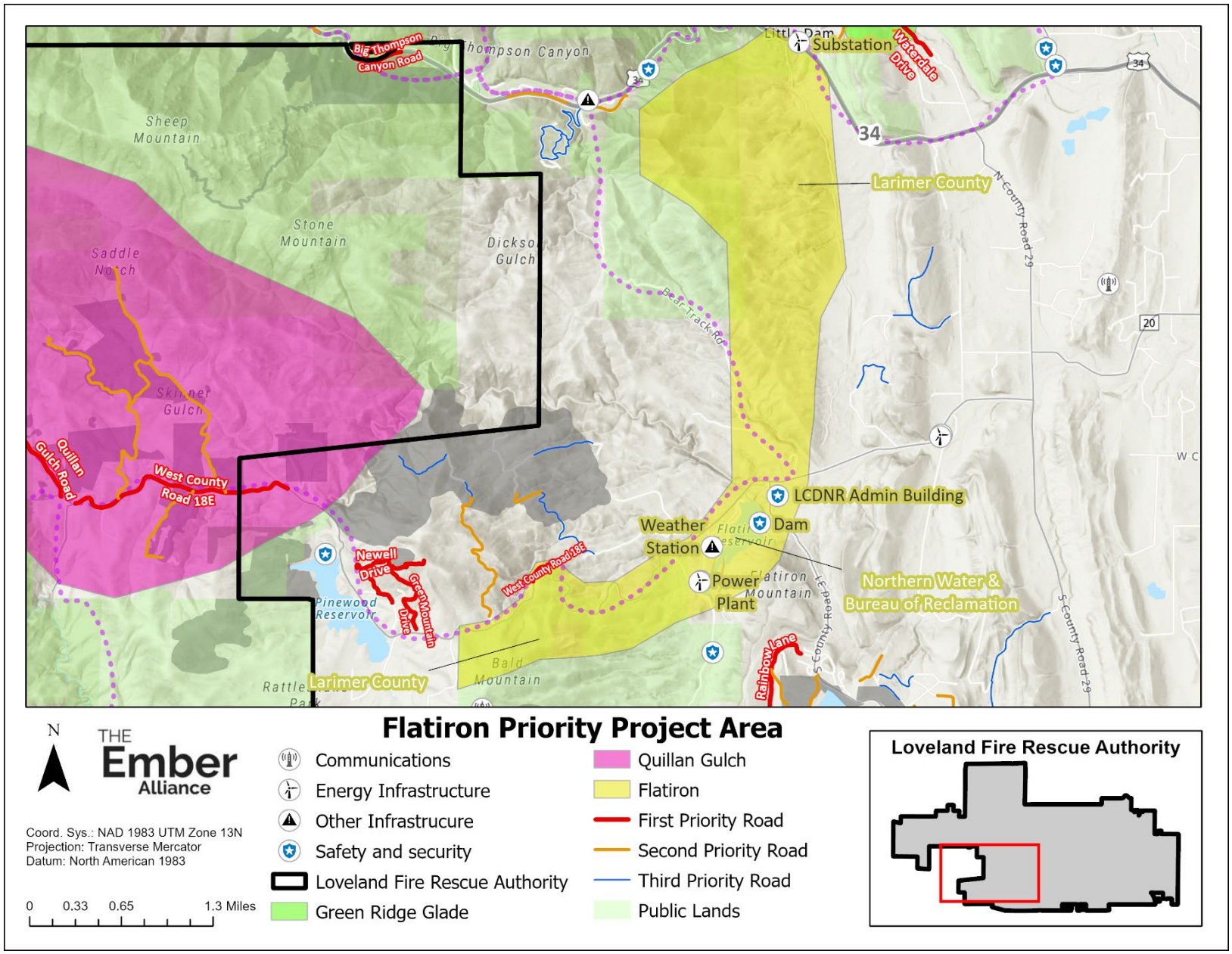


Figure 4.b.5. Flatiron project area.

Green Ridge Glade

Green Ridge Glade project area encompasses 440 acres of City of Loveland and private land in west central LFRA (**Figure 4.b.6**). This reservoir is right next to the City of Loveland Water Treatment Plant, which is critical infrastructure for over 75,000 people. Watersheds in this area are classified as having moderate hazards associated with watershed health and forest health (JW Associates, Inc., 2023).

Treatment objectives:

- The primary objective is to protect the water treatment plant and dam from wildfire.
- The secondary objective is to reduce the amount of hazardous fuels to the west of the reservoir to protect watershed health and resident lives and property.

Treatment type:

- Defensible space and hazard tree removal around the above identified values at risk.
- Mechanical thinning and slash removal via chipping, pile burning, and hauling.
- Any use of prescribed fire in this project area should be accompanied by notifications to nearby residents to make them aware of when and where burning will be conducted.
- Treatments in this area should reference best practices for working within sensitive or threatened species habitat. This area includes habitat for the Preble's meadow jumping mouse and mountain mahogany/needle-and-thread plants.

Priority: Immediate action, work starting within 1-2 years.

Lead and support organizations: City of Loveland Water and Power is the lead organization on this project area with support from Loveland Fire Rescue Authority, Sylvan Dale Ranch, and the Colorado State Forest Service.

Photo credit above: Google.

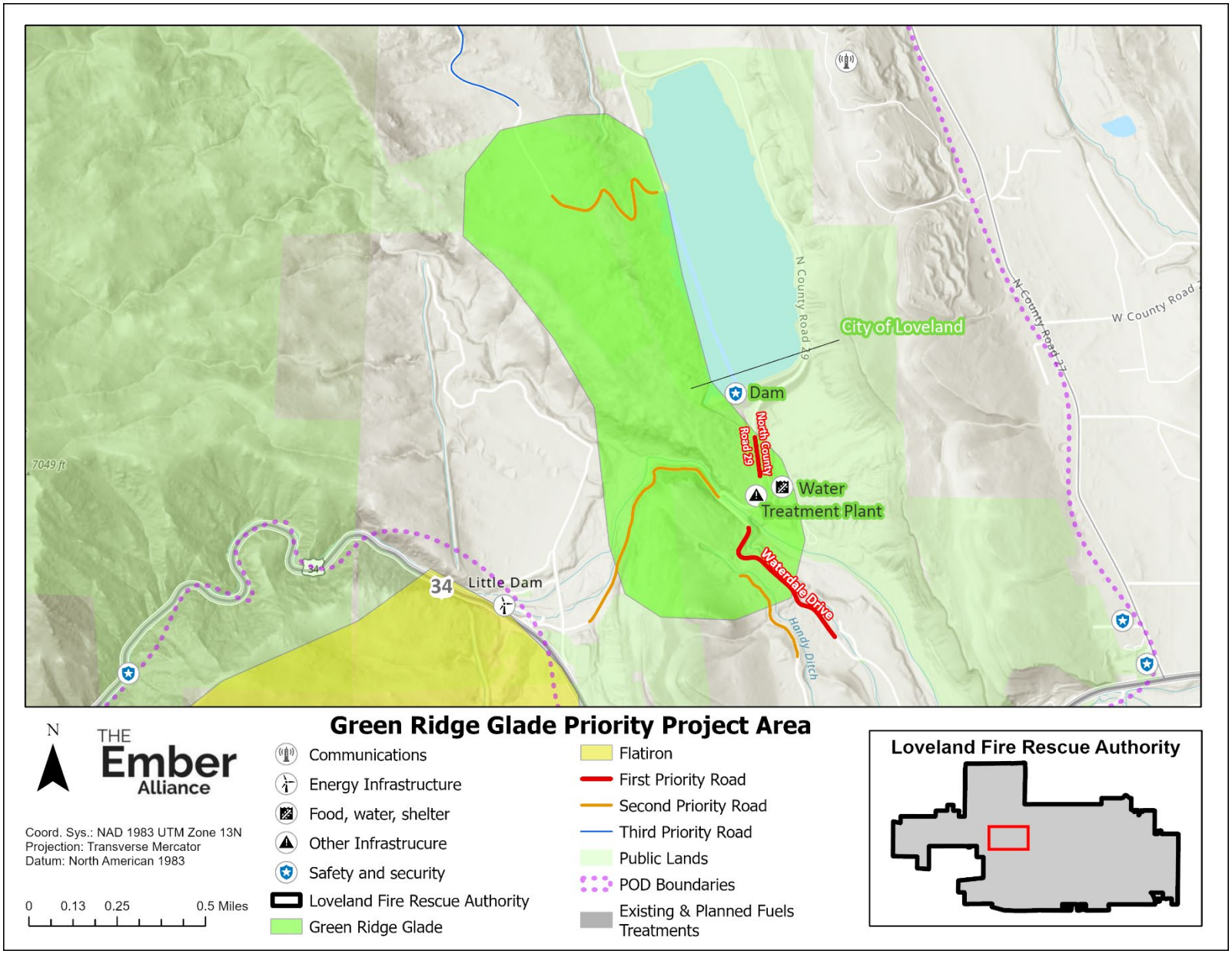


Figure 4.b.6. Green Ridge Glade project area.

River Corridor West

River Corridor West project area encompasses 1400 acres of City and private land in central LFRA (**Figure 4.b.7**). This area covers the Big Thompson River as it travels east through Loveland, as well as ditches and ponds. The vegetation here can grow rapidly and could spread flames rapidly in an urban corridor, especially with invasive species such as cheatgrass. Treatments in this area will be tied to and expand upon the 2015 Big Thompson River Restoration Master Plan and 2021 Big Thompson River Envisioning Project.

Treatment objectives:

- The primary objective is to reduce the amount of hazardous fuels along the river corridor through town, primarily along city-owned open spaces.
- The secondary objective is to protect the EMS station, City of Loveland government building, electric substation, and mobile home park.
- The third objective is to connect with private landowners along this area and connect mitigation work between public and private lands.

Treatment type:

- Regular mechanical thinning and slash removal of shrubs and trees, particularly junipers and non-native species like Russian olive.
- Defensible space and hazard tree removal around the above identified values-at-risk
- Removal of dead fuels that can accumulate in riparian areas after floods.
- Grazing and prescribed burning in ditches to reduce their opportunity to act as fuel pathways onto adjacent properties.
- Any use of prescribed fire in this project area should be accompanied by notifications to nearby residents to make them aware of when and where burning will be conducted.

- Restoration of short-grass prairie ecosystems through a combination of herbicide to remove flammable, non-native grasses such as cheatgrass and smooth brome, grazing with cattle or goats, late-spring or early-summer prescribed burning, and seeding with native species.
- Mowing tall grasses or creating "rangeland greenstrips" by restoring short-grass prairie at distances of 10-30 feet from private property fence lines into open space.

Priority: Long-term action, work starting within 3-5 years.

Lead and support organizations: City of Loveland Open Lands and Trails is the lead organization on this project area with support from Loveland Fire Rescue Authority, Greeley-Loveland Irrigation Company, and Larimer County Wildfire Partners Program.

Photo credit: LFRA

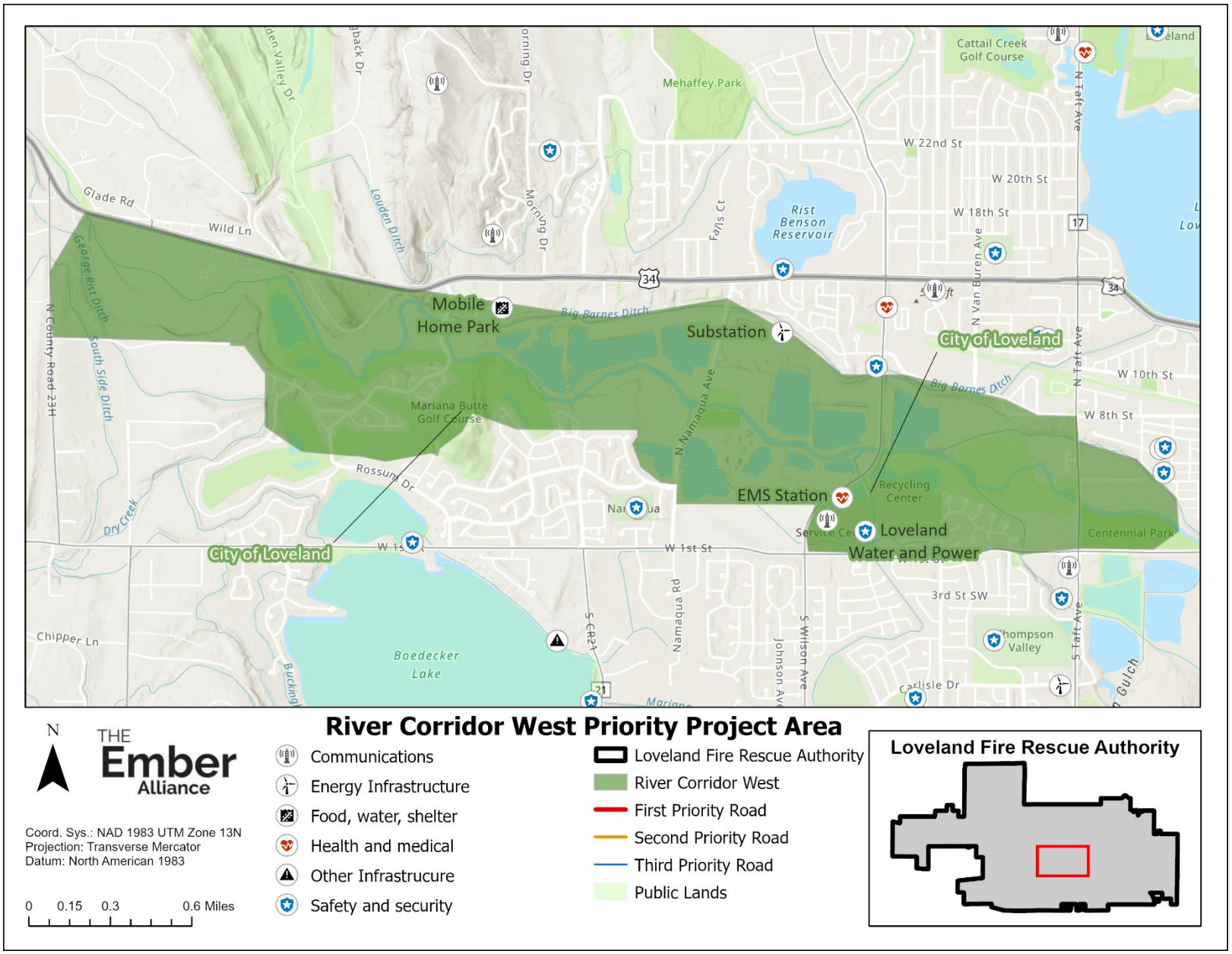


Figure 4.b.7. River Corridor West project area

South Railroad Facility

South Railroad Facility project area encompasses 230 acres of mostly City of Loveland land in downtown Loveland (**Figure 4.b.8**). This area is home to the new South Railroad Facility which is an overnight safe location for transient residents. It also houses the LFRA training facility. There are dense riparian fuels in the river corridor in this area.

Treatment objectives:

- The primary objective is to reduce fuels along rivers, drainages, and open spaces in this project area to protect residents, recreationalists, and transient populations that use the South Railroad Facility.
- The secondary objective is to protect the LFRA Training Facility and the Reflections for Youth Academy.
- The third objective is to connect with private landowners along this area and connect mitigation work between public and private lands and connect with transient populations on safe warming practices and resources.

Treatment type:

- Regular mechanical thinning and slash removal of shrubs and trees, particularly junipers and non-native species like Russian olive.
- Defensible space and hazard tree removal surrounding the above identified values-at-risk.
- Regular maintenance of park facilities including irrigation and mowing.
- Grazing and prescribed burning in ditches to reduce their opportunity to act as fuel pathways onto adjacent properties.
- Any use of prescribed fire in this project area should be accompanied by notifications to nearby residents to make them aware of when and where burning will be conducted.
- Restoration of short-grass prairie ecosystems through a combination of herbicide to remove flammable, non-native grasses such as cheatgrass and smooth brome, grazing with cattle or goats, late-spring or early-summer prescribed burning, and seeding with native species.

- Mowing tall grasses or creating “rangeland greenstrips” by restoring short-grass prairie at distances of 10-30 feet from private property fence lines into open space.

Priority: Immediate action, work starting within 1-2 years.

Lead and support organizations: City of Loveland Open Lands and Trails and City of Loveland Parks and Recreation are the lead organizations on this project area, with support from Loveland Fire Rescue Authority, Loveland Water and Power, and Larimer County Wildfire Partners Program.

Photo credit above: LFRA

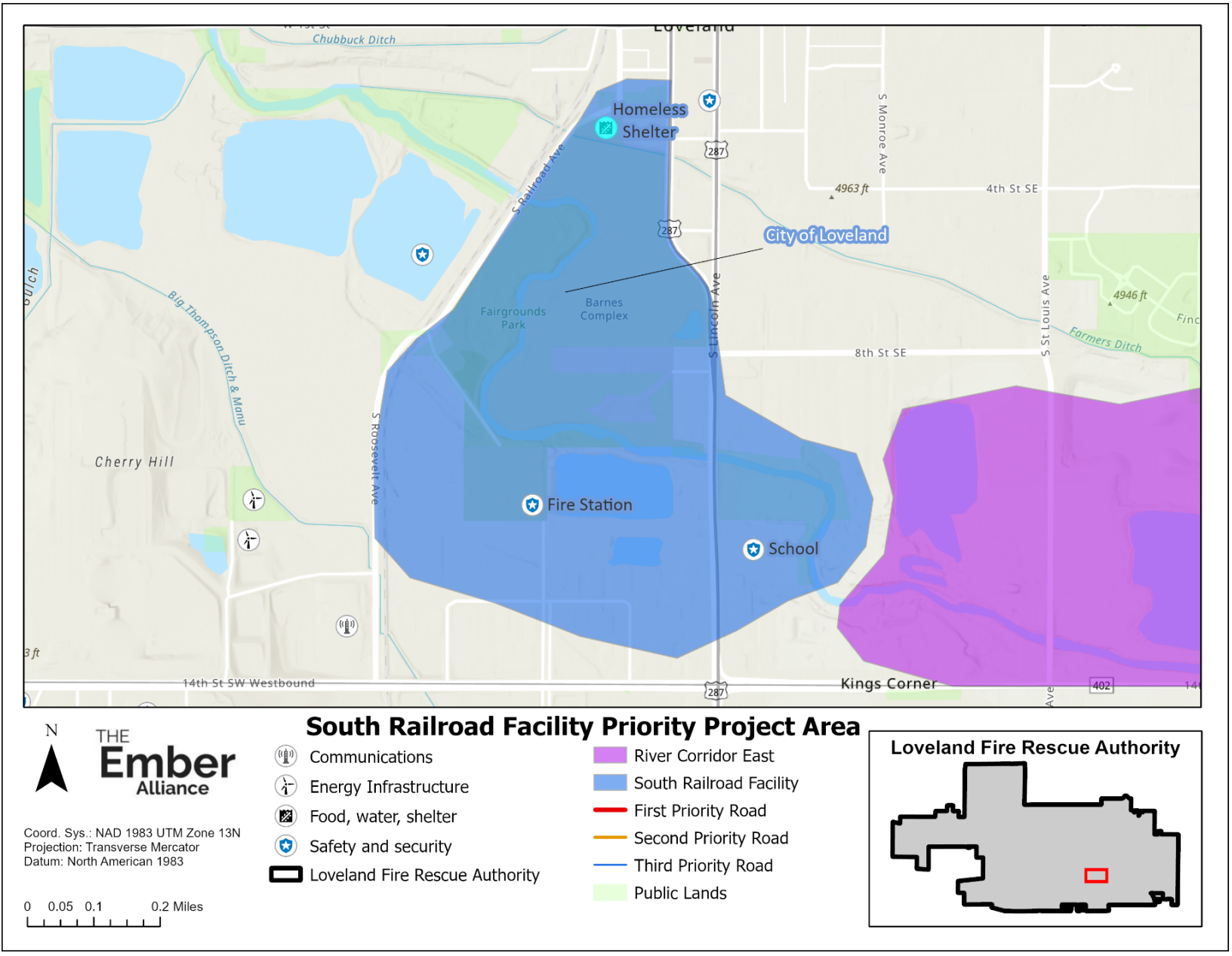


Figure 4.b.8. South Railroad Facility project area.

River Corridor East

River Corridor East project area encompasses 2400 acres of City of Loveland, Colorado State Fish and Wildlife, and private land (**Figure 4.b.9**). This area covers the Big Thompson River as it travels east out of Loveland, as well as irrigation ditches and ponds. The vegetation here can grow quickly and could spread flames rapidly in an urban corridor. Treatments in this area will be tied to and expand upon the 2015 Big Thompson River Restoration Master Plan and 2021 Big Thompson River Envisioning Project.

Treatment objectives:

- The primary objective is to reduce the amount of hazardous fuels along the river corridor through town, primarily along city-owned open spaces.
- The secondary objective is to protect the wastewater treatment plant, New Vision Charter School, electric substation, Koppes dam, and the Colorado Parks and Wildlife recreation facilities.
- The third objective is to connect with private landowners along this area and connect mitigation work between public and private lands.

Treatment type:

- Regular mechanical thinning and slash removal of shrubs and trees, particularly junipers and non-native species like Russian olive and Siberian elm.
- Defensible space and hazard tree removal surrounding the above identified values-at-risk.
- Removal of dead fuels that can accumulate in riparian areas after floods.
- Grazing and prescribed burning in ditches to reduce their opportunity to act as fuel pathways onto adjacent properties.

- Any use of prescribed fire in this project area should be accompanied by notifications to nearby residents to make them aware of when and where burning will be conducted.
- Restoration of short-grass prairie ecosystems through a combination of herbicide to remove flammable, non-native grasses such as cheatgrass and smooth brome, grazing with cattle or goats, late-spring or early-summer prescribed burning, and seeding with native species.
- Mowing tall grasses or creating "rangeland greenstrips" by restoring short-grass prairie at distances of 10-30 feet from private property fence lines into open space.

Priority: Mid-term action, work starting within 2-3 years.

Lead and support organizations: City of Loveland Open Lands and Trails is the lead organization on this project area with support from Loveland Fire Rescue Authority, City of Loveland Parks and Recreation, City of Loveland Water and Power, Colorado Parks and Wildlife, and Larimer County Wildfire Partners Program.

Photo credit above: LFRA

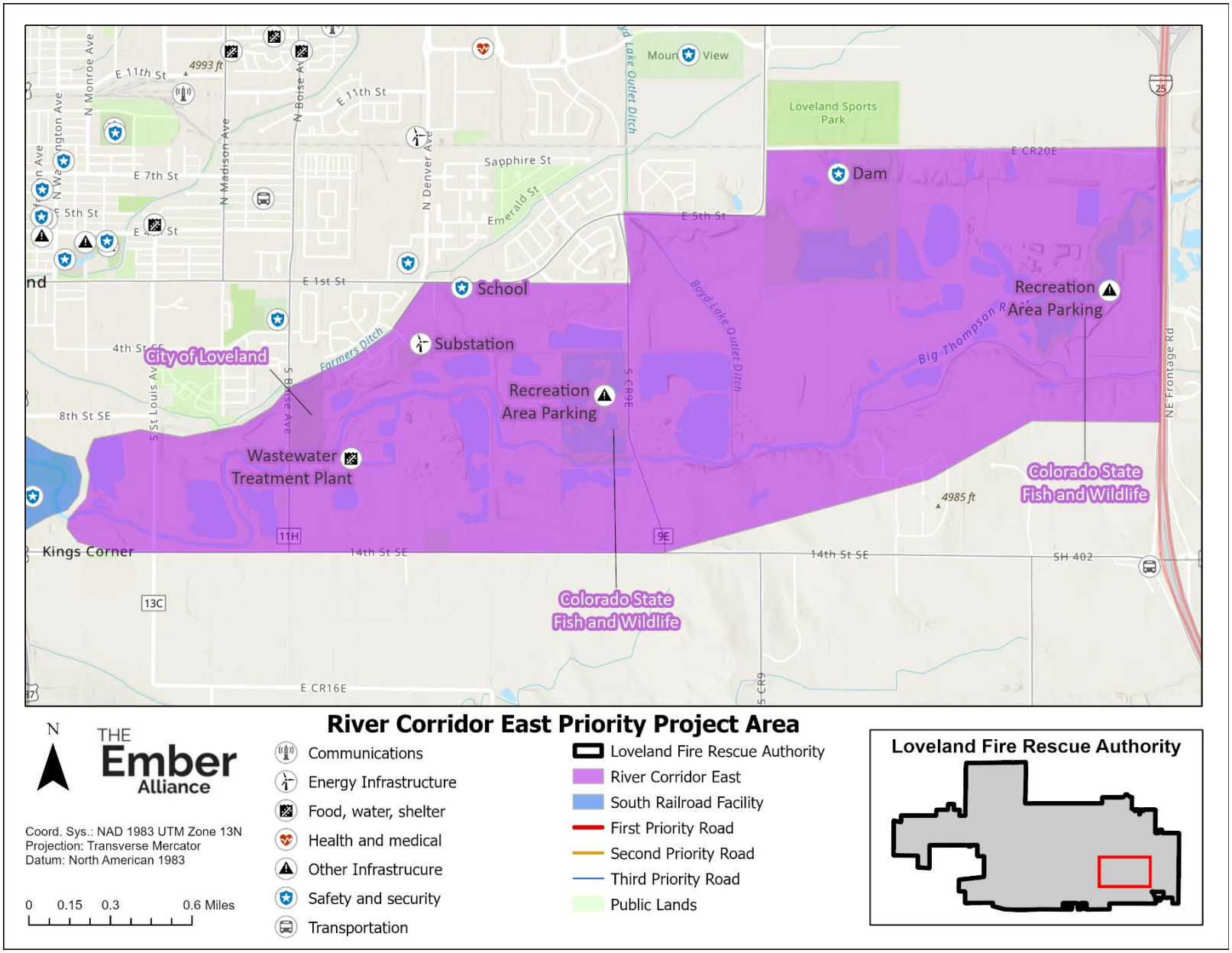


Figure 4.b.9. River Corridor East project area.

4.c. Recommendations by Vegetation Type

Local knowledge and professional expertise are needed to design effective, site-specific fuel treatments based on the best available science. Specific fuel treatment recommendations are dependent on forest type, tree density, fuel loads, terrain, land use, and management objectives. The location and purpose of treatments also matter. Treatments in large, forested areas can include the retention of individual trees and groups of trees. Evenly and widely spacing trees might be reasonable in the home ignition zone 3, but this tree arrangement would not be appropriate for restoration-style fuel treatments.

Treatments in home ignition zone 3 (30-100 feet away from the home) can restore historical forest structure, but it is most important to focus on reducing wildfire risk to the home, creating safe conditions for fire fighters, and increasing the visibility of your home from the road for firefighters. Homeowners often enjoy the more open forest around their home because it lets in more light which encourages understory grasses and shrubs to grow and, in turn, can increase wildlife sightings near their home. Home ignition zone 3 often overlaps neighboring properties and requires residents to work together to address shared wildfire risk.

For all fuel treatments, it is important to address surface fuels. Forest management operations often increase surface fuel loads and can fail to achieve fire mitigation objectives if fuels created by the harvest activities (also known as slash) are not addressed (Agee and Skinner, 2005). Slash can include small trees, limbs, bark, and treetops. See **Section 4.e. Approaches to Slash Management** for pros and cons of different slash management options.

Mitigating the impacts of tree removal on soil compaction and erosion is also important when treatments occur near streams and riparian ecosystems. The Colorado State Forest Service recommends streamside management zones of at least 50 feet (CSFS, 2010). Treatments should be monitored for colonization of invasive, weedy plants that might require control through integrated weed management. It's always a good idea to take pictures of treatments before and after to help evaluate effectiveness and monitor changes over time.

Here we provide general recommendations for treatments in home ignition zone 3 and stand-scale fuel treatments and ecological restoration by vegetation types. Guidance for defensible space is summarized from the CSFS publication The Home Ignition Zone. It is important to work with a forester that has experience creating defensible space so they can help you design an effective treatment specific to vegetation type, slope, and other conditions around your home.

Grasslands

Grasslands cover about 6 percent of land in LFRA, including pasturelands, native short-grass prairie, and highly degraded prairie covered by invasive grasses such as smooth brome and cheatgrass. Wildfires can spread rapidly across grasslands on dry, windy days. Many homes in LFRA occur along the grassland-urban interface, which makes management of grasslands important for both fire resilience and ecological restoration.

Recommendations for home ignition zone 3:

- Mowing grass is not required in HIZ 3, unless mowing is conducted in conjunction with other management techniques to restore short-grass prairie.
- Removal of cheatgrass and smooth brome with herbicide, grazing, and prescribed burns, and seeding with native species can restore short-grass prairie ecosystems. Many native grass species stay green into the summer, unlike cheatgrass and smooth brome, making them less receptive to wildfire.

- Homeowners adjacent to grasslands should focus their efforts in HIZ 1 and 2. It is particularly important to create non-burnable barriers around your home and other structures to reduce the chance of flames contacting structures.
- Replacement of wooden fences with non-flammable materials can reduce the chance of fire spreading from grasses to fences to homes.

Recommendations for large-scale fuel treatments and ecological restoration:

Removal of cheatgrass and smooth brome with herbicide, grazing, and prescribed burns, and seeding with native species can restore short-grass prairie ecosystems (Phillips-Mao, 2017). Many native grass species stay green into the summer, unlike cheatgrass and smooth brome, making them less receptive to wildfire (Miller, 2006). Prescribed burns in late spring and early summer are most effective for controlling cheatgrass and smooth brome because it prevents these grasses from seeding (USFS Southwest Region, 2014; Willson and Stubbendieck, 1997).

Agricultural Lands

Agriculture covers about 20% of the land area in LFRA, mostly in the east side of LFRA. There are many crops here, and most are irrigated at some point through the year.

Recommendations for home ignition zone 3:

- Irrigate vegetation through the dry seasons.
- Remove flammable dead plant material via mowing, grazing, or prescribed burning.

Rocky Mountain Lower Montane-Foothill Shrublands

Rocky Mountain lower montane-foothill shrublands include a mixture of grass and shrub species such as mountain mahogany and big sagebrush. Shrublands provide important forage to ungulates like mule deer and elk. Shrublands are found in LFRA.

Wildfires in shrublands have high rates of spread, particularly when there are continuous grasses, and burning shrubs can emit significant radiant heat. Fire is a naturally occurring process in Rocky Mountain lower montane-foothill shrubland, and this ecosystem historically experienced wildfires every 14-112 years at a variety of fire severities depending on local site factors (Decker et al., 2020; Missoula Fire Sciences Laboratory, 2012).

Recommendations for home ignition zone 3:

- Unlike home ignition zones 1 and 2, shrubs do not need to be removed in home ignition zone 3 unless they occur in continuous dense stands, occur under trees and can serve as ladder fuels, or abut sheds or other outbuildings.
- Remove slash from the site. Avoid lop-and-scatter and mulching treatments that only rearrange fuels without removing them.

Recommendations for stand-scale fuel treatments and ecological restoration:

Management in Rocky Mountain lower montane-foothill shrublands usually involves careful management of livestock grazing and integrated weed management where appropriate. Conditions in these ecosystems can be improved by infrequent prescribed burning and allowing wildfires to burn where they can be controlled to prevent damage to homes.

Mixed Foothills Shrublands

Shrublands can include many species, including Gambel oak, mountain mahogany, serviceberry, sagebrush, chokecherry, and antelope bitterbrush. They grow with grasses and forbs and occasionally with juniper, piñon pine, or ponderosa pine.

Recommendations for home ignition zone 3:

- Remove continuous stands of juniper bushes and trees.
- Thin Gamble oak if they occur in continuous, dense stands. Remove Gamble oak that occur under trees and can serve as ladder fuels or abut sheds or other outbuildings. Eradication of Gambel oak is not recommended because it is an important species for wildlife. Use mastication, mowing, and herbicide to remove Gambel oak and control the regrowth every three to five years, or more frequently depending on growing conditions. Triclopyr is recommended as the most effective herbicide when applied to the stump directly after cutting the stem (Jester et al., 2012).
- Favor leaving large, old, Gamble oaks to maintain diversity in the ecosystem.
- Remove slash from the site. Avoid lop-and-scatter and mulching treatments that only rearrange fuels without removing them.

Recommendations for stand-scale fuel treatments and ecological restoration:

No management is required in areas where wildfires would not threaten homes. In shrublands near human habitation, mastication, well-managed livestock grazing, and prescribed burning can reduce fuel loads. Prescribed burning during the growing season – particularly later growing season, when the stored sugar levels in the roots are lowest – can reduce the volume of resprouting (Harrington, 1989). Eradication of Gambel oak is not recommended because it is an important species for wildlife. Favor leaving large, old, Gamble oaks to maintain diversity in the ecosystem.

Monitor juniper encroachment into grasslands and other shrublands. Junipers that are encroaching onto sagebrush or other shrublands should be thinned and monitored for regrowth.

Ponderosa Pine and Dry Mixed-Conifer Forests

Ponderosa pine and dry-mixed conifer forests occur on south-facing aspects in western and west central LFRA. Some ponderosa pine forests in LFRA have low to moderate tree densities and understories with grasses, forbs, and shrubs. Dry mixed conifer forests often occur on warm, dry south-facing slopes and contain ponderosa pine, Douglas-fir, and Rocky Mountain juniper, with occasional blue spruce.

Gamble oak and Rocky Mountain juniper are highly flammable components of ponderosa pine ecosystems. Gambel oak demonstrate vigorous growth after disturbance because they can sprout new trunks from their extensive root system (Abella and Fulé, 2008; Jester et al., 2012). Rocky Mountain juniper does not resprout after the aboveground vegetation is burned by wildfire. These species add diversity to the landscape and provide food and shelter to wildlife species, but they can be dangerous sources of fuel in the home ignition zone.

Ponderosa pine and mixed-conifer forests were fire-adapted ecosystems and very resilient to wildfires. Low- to mixed-severity fires occurred every 7 to 50 years and resulted in a mosaic of widely spaced trees and small tree clumps interwoven with grasslands and shrublands, particularly on drier south-facing slopes (**Figure 2.e.2**) (Addington et al., 2018). Frequent fires would kill many tree seedlings and saplings, thereby preventing the accumulation of ladder fuels and reducing the potential for surface fires to transition into crown fires.

Recommendations for home ignition zone 3:

- Remove large trees so that the crown spacing of remaining trees is 6 to 10 feet. If desired, retain scattered, small clumps of trees (about 6-10 trees) with interlocking crowns. Ensure these clumps are at least 10 feet away from single trees and other tree clumps. See **Figure 3.a.3** for a depiction of how to measure crown spacing.

- Favor leaving large, older trees that have naturally lost their lower branches and have thick bark that confers resistance to wildfires.
- Favor leaving aspen on site to create beautiful post-treatment conditions with greater resistance to wildfire.
- Remove shrubs and small trees that can serve as ladder fuels or abut sheds and other outbuildings.
- Remove limbs of all remaining trees so branches do not hang below 6 feet above the ground**,** ideally not below 10 feet above the ground, to reduce the risk of wildfire transitioning from the surface into treetops. **Per requirements from the LFRA Wildfire Risk Reduction Requirements for the WUI, limbs must be pruned to a height of 10 feet above the ground.** See **Figure 3.a.3** for a depiction of how to measure limb height.
- Remove slash from the site. Avoid lop-and-scatter and mulching treatments that only rearrange fuels without removing them.

Recommendations for stand-scale fuel treatments and ecological restoration:

Follow the principles of ecological restoration as outlined in Addington et al., 2018 to help achieve fuel reduction and ecosystem restoration objectives. In frequent-fire forests, such as ponderosa pine and dry mixed-conifer forests along the Colorado Front Range, restoration treatments involve converting dense forests into a mosaic of single trees, clumps of trees, and meadows. These conditions are similar to historical forests that were maintained by wildfires and very resilient to them.

Thinning combined with broadcast burning is the most effective treatment for ponderosa and dry mixed conifer forests (Addington et al., 2018; Fulé et al., 2012; Prichard et al., 2020). Older trees can withstand the fire while small trees, shrubs, downed logs, and fine fuels are consumed.

Aspen and Other Riparian Hardwood Species

Aspen is found scattered throughout forests and riparian areas in western LFRA, and there are dense stands of cottonwood, willow, birch, and other riparian species along the Big Thompson River and near reservoirs.

Aspen groves are important food and habitat for mountain fauna. They tend to have higher moisture contents and can slow the spread of wildfire. Fires often kill mature aspen but initiate rapid resprouting, and the death of conifer trees from wildfire can increase light availability for aspen. Cottonwood and willow trees are excellent at stabilizing riverbanks and wetland habitat. They grow quickly and provide habitat and forage for many species.

Recommendations for home ignition zone 3:

- There is no need to remove aspen, cottonwood, or willows in home ignition zone 3 unless they are within 5 feet of sheds or other outbuildings.
- Remove shrubs and small conifer trees that can serve as ladder fuels.
- Remove large conifer trees so that the crown spacing of remaining trees is 6-10 feet. Remove limbs of all remaining trees so branches do not hang below 6 feet above the ground**,** ideally not below 10 feet above the ground, to reduce the risk of wildfire transitioning from the surface into treetops. **Per requirements from the LFRA Wildfire Risk Reduction Requirements for the WUI, limbs must be pruned to a height of 10 feet above the ground.** See **Figure 3.a.3** for a depiction of how to measure crown spacing and limb height.
- Mitigate the impacts of tree removal on soil compaction and erosion by maintaining streamside management zones of at least 50 feet (CSFS, 2010).

- More information can be found in the Cottonwood Management publication from the Colorado State Forest Service.
- Remove slash from the site. Avoid lop-and-scatter and mulching treatments that only rearrange fuels without removing them.

Wet Mixed-Conifer and Lodgepole Pine Forests

Wet mixed conifer forests occur on north-facing slopes in western LFRA, such as the south side of Highway 34 as it travels through the Big Thompson Canyon, and on flatter or north facing slopes south of County Road 43 and on Palisade Mountain. Wet mixed-conifer forests consist of any of the following species: lodgepole pine, subalpine fir, Engelmann spruce, Douglas-fir, limber pine, and bristlecone pine. Lodgepole pine forests typically grow in dense, even-age stands and with understories nearly devoid of grasses and forbs due to limited light availability.

Lodgepole pine trees rely on stand-replacing fire every 75-300 years to regenerate the next generation of trees. Many lodgepole pine trees have serotinous cones that are sealed shut with resin and only open under high heat caused by wildfire. The death of overstory trees increases the availability of sunlight to regenerating trees, including sun-loving aspen. Most species in wet-mixed conifer forests are not resistant to fire and will burn easily.

Recommendations for home ignition zone 3:

There are two main options for treatments in home ignition zone 3 in wet mixed-conifer forests:

- Thin trees to create 6- to 10-foot crown spacing. In general, you should not remove more than 30% of overstory trees because lodgepole pine are susceptible to windthrow. Retreatment to further reducing tree density and remove regenerating trees is imperative. See **Figure 3.a.3** for a depiction of how to measure crown spacing.
- Create a mosaic of open areas and groups of trees through patch cutting. Groups can include 30-50 trees and must be separated from other groups by at least 30-50 feet. Patch cutting is recommended because it reduces the chance of windthrow, and it increases the likelihood that wildfire will be unable to spread from tree clump to tree clump.

For all treatments in wet mixed-conifer forests:

- Remove small trees and shrubs that serve as ladder fuels.
- Remove limbs of all remaining trees so branches do not hang below 6 feet above the ground**,** ideally not below 10 feet above the ground, to reduce the risk of wildfire transitioning from the surface into treetops. **Per requirements from the LFRA Wildfire Risk Reduction Requirements for the WUI, limbs must be pruned to a height of 10 feet above the ground.** See **Figure 3.a.3** for a depiction of how to measure limb height.
- Favor leaving aspen on site to create beautiful post-treatment conditions with greater resistance to wildfire.
- Remove slash from the site. Avoid lop-and-scatter and mulching treatments that only rearrange fuels without removing them.

See additional guidance in the CSFS publication *Lodgepole Pine Management Guidelines for Land Managers in the Wildland-Urban Interface.* See ___ for an example of exemplary defensible space in lodgepole pine forests in your community.

Recommendations for stand-scale fuel treatments and ecological restoration:

In infrequent-fire forests, removing all trees can imitate high-severity wildfires that these systems are adapted to. Creating heterogeneous (mosaic) landscapes with patch cuts, decreasing the density of trees, and increasing diversity in age, size, and species in lodgepole and wet mixed-conifer forests

can also be effective at altering the intensity of fire (Dennis et al., 2009). Broadcast burning is rarely feasible in lodgepole stands because they are susceptible to active crown fire that is not easily managed in prescribed burning scenarios.

4.d. Recommendations for Roadside Fuel Treatments

Treatments along roadways require a dramatic reduction of fuels to create safe and survivable conditions. This includes removing most trees adjacent to the roadway, limbing remaining trees, and regularly mowing grass and shrubs (**Figure 4.d.1**). Treatments along roadways are often described as shaded fuelbreaks (Dennis, 2005). See **Table 4.d.2** for some example recommendations for roadside fuel treatments in LFRA.

The width of an effective roadside fuel treatment (distance to the left and right of a road) is dependent on slope. CSFS recommends that treatments extend 150 to 240 feet off the downhill side of the road and 100 to 150 feet off the uphill side. Wider treatments are necessary on the downhill side on steeper slopes due to the exacerbating effect of slope on fire intensity when fires travel uphill (**Table 4.d.1**) (Dennis, 2005). Important aspects of all roadside fuel treatments include:

- Removing limbs overhanging the road to create ***at least*** 13.5-feet of vertical clearance. See **Figure 3.a.3** for a depiction of how to measure limb height.
- Removing trees alongside the road to create ***at least*** 20-feet of horizontal clearance.
- Removing trees to create ***at least*** 10-feet crown spacing between remaining trees within the roadside treatment zone specified in **Table 4.d.1**. See **Figure 3.a.3** for a depiction of how to measure crown spacing.
- Removing all dead trees that could fall across the road and block traffic.
- Removing shrubs and regeneration that can serve as ladder fuels.
- Mowing grasses adjacent to the road.

Along important evacuation routes that could experience extreme congestion, roadside treatments should be more aggressive and consist of near removal of all trees within at least 30 feet of roadways. Clearcutting along roads when surrounding forests remain dense can cause problems with snow drifting, so shaded fuelbreaks might be more appropriate in areas where drifting is more likely, or snow fences might need to be installed.

Some residents find roadside fuel treatments aesthetically displeasing because of the removal of so many trees, but these treatments are vital for increasing the safety of residents and firefighters in this community. Roadside treatments must dramatically reduce fuel loads to effectively reduce the risk of non-survivable conditions developing during wildfires.

Table 4.d.1. Minimum fuel treatment width uphill and downhill from roads depends on the slope along the roadway. Recommendations from the Colorado State Forest Service (Dennis, 2005).

Percent slope (%)	Downhill distance (feet)	Uphill distance (feet)	Total fuel treatment width (feet)
0	150	150	300
10	165	140	305
20	180	130	310
30	195	120	315
40	210	110	320

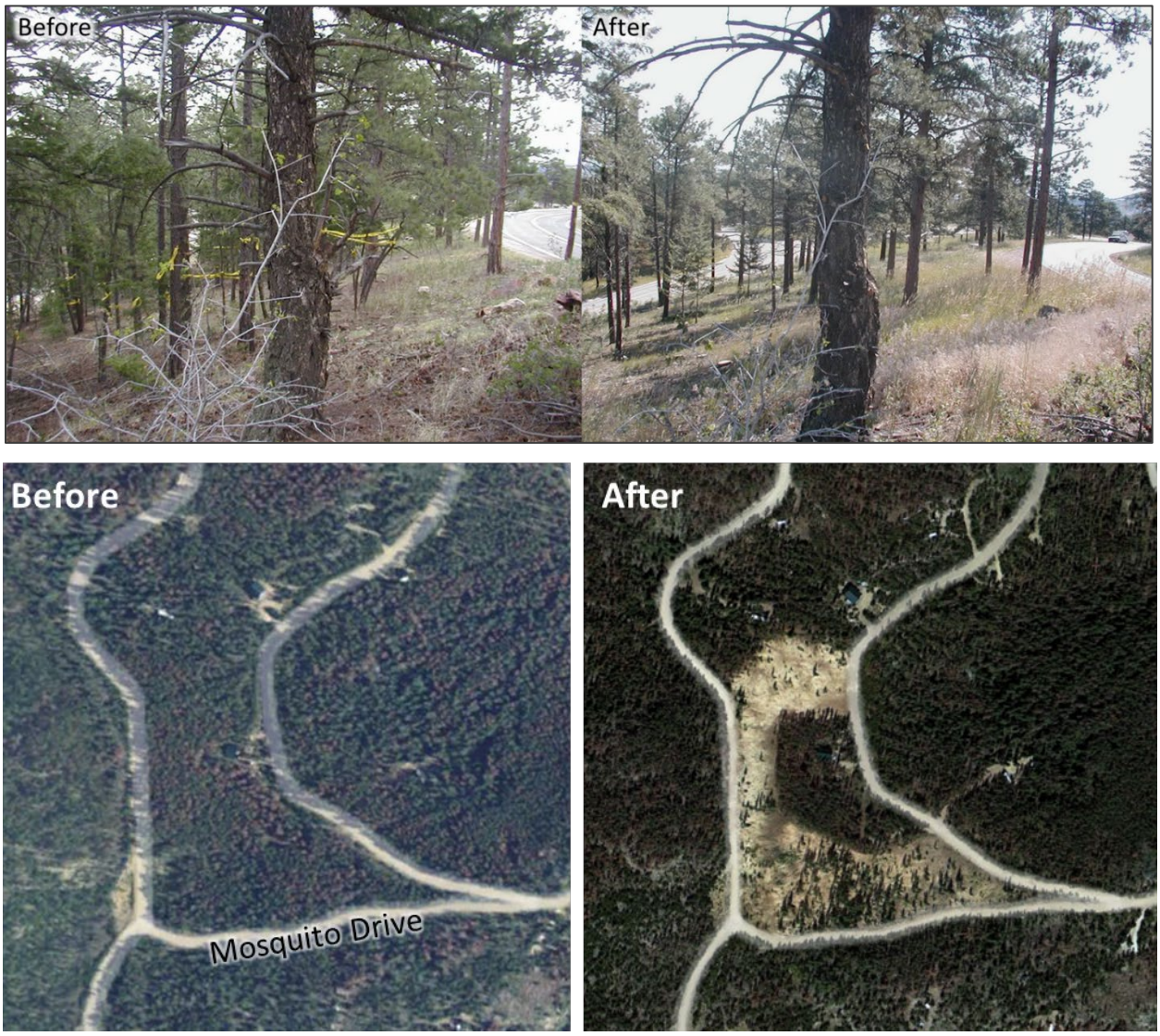
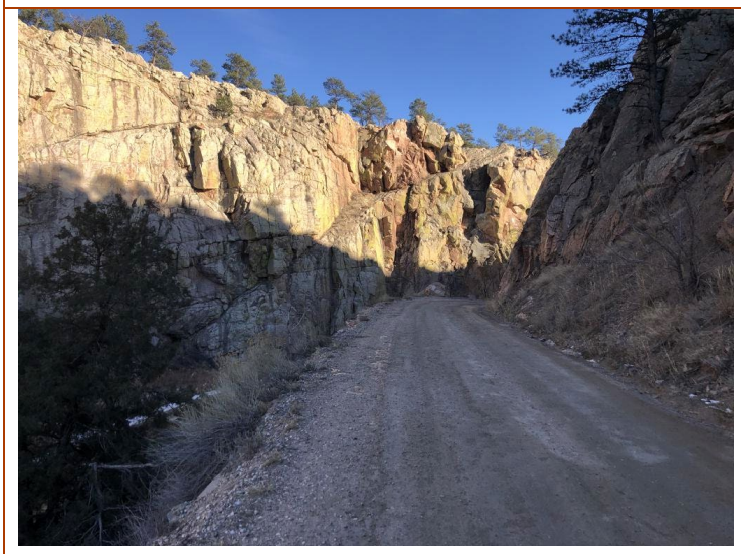


Figure 4.d.1. Effective roadside fuel treatments remove enough trees to result in widely space crowns, remove ladder fuels (seedlings, saplings, shrubs, and low limbs), and reduce surface fuels. More dramatic tree removal along roadways can create even safer roadside conditions where appropriate. Photo credits: Genesee Foundation (top) and USDA/FPAC/GEO/Google Earth (bottom).

Table 4.d.2. Examples of conditions occurring along roadways in LFRA and suggestions for improvement.

Roadway example	Suggestions for improvement
	• Clear all trees away from roadway. • Clear extra space on the downhill side of the road. • Create regular pullouts and turnaround locations for engines.
	• Clear trees and tall shrubs from below the road. • Create regular pullouts and turnaround locations for engines where possible.

	• Occasional mowing along the side of the road for the tall grasses and shrubs could be applied. This is generally a good roadway.
	• Clear conifer trees away from the roadway. • Create pullout and turnaround locations along the road to facilitate two-way traffic and enable fire engine access.
	• Remove trees that are leaning over the roadway because they could fall and trap residents during an evacuation. • In the urban areas of LFRA, roadways are generally considered survivable without additional treatment.

4.e. Logistics of Fuel Treatments

Roles and Responsibilities

Landowners are responsible for fuel mitigation on their own lands, including along their private driveways. Residents must initiate and follow through on this work, but that does not mean they must do it alone. For assistance in planning and implementing fuel treatments, contact the Larimer Conservation District, Larimer Conservation Corps, LCSO-ES, Big Thompson Watershed Coalition, Colorado State Forest Service, or other wildfire mitigation specialists. LFRA can also reach out to volunteer organizations like Team Rubicon for support implementing hazardous fuel reduction.

Tree cutting with a chainsaw and other forestry equipment should be done by experienced and certified individuals. The Colorado State Forest Service provides guidance for how to select a contractor for forest management, and they provide a list of local contractors (see CSFS Fort Collins Field Office website for a list current as of 2022).

The Arapaho-Roosevelt National Forest is conducting fuel treatments on USFS land within and around LFRA, including stand-scale treatments, roadside treatments along POD boundaries, and creating slash pile for burning. There are tens of thousands of piles within and around LFRA that are ready to be burnt, but the agency needs more public support before conducting the pile burns.

The responsibility for conducting roadside fuel treatments depends on the location of the road. Landowners are responsible for treatments along their private driveways. Treatments along country roads need to be coordinated with the Larimer County Road and Bridge Department. **Cooperation from private property owners is necessary for effective roadside fuel treatments; roadside easements are rarely wide enough to satisfy the minimum of 150 feet treatment depth on each side of roads.**

Treatment Costs

The cost of fuel treatment depends on management objectives, treatment specifications, slope, accessibility, and treatment method (e.g., mechanical thinning, hand thinning, or prescribed burning). Costs of $2,500 to $10,000 per acre are not uncommon along the Colorado Front Range where there is little biomass or timber industry to provide financial return (Gannon et al., 2019). Follow-up treatments are generally less expensive than the initial entry and help maintain the efficacy of the original treatment investment.

Since fuel treatments are expensive, it is important to conduct strategic, well-designed, landscape-scale treatments to increase the likelihood that fuel treatments modify fire behavior, save lives, and restore ecosystems. Fuel treatments can reduce property damages by making wildfires less damaging and easier to control; this is especially true for prescribed burning which is often cheaper and more effective at altering forest fuel loads than mechanical thinning alone (Fulé et al., 2012; Loomis et al., 2019; Prichard et al., 2020). Proactive management of forests can also reduce the cost of rehabilitating water sources when wildfires are followed by large storms and result in massive erosion (Jones et al., 2017). Fuel treatments can also reduce suppression costs due to the increased efficiency of firefighting (Loomis et al., 2019).

Longevity of Fuel Treatment Benefits

Benefits of fuel treatments are not permanent and decrease overtime, with treatment "lifespan" depending on forest type, topography, rates of seedling regeneration (which is often influenced by precipitation), and the number of trees removed during treatments. Many forests require more than one treatment to reduce fuels and restore ecosystem structure. Some areas might require mechanical tree removal followed by prescribed burning, and then a maintenance treatment with

tree removal and/or prescribed burning 10 to 20 years later. With a single pulse of tree regeneration, the risk of torching returns to near pre-treatment levels within 10 to 35 years in ponderosa pine forests in Colorado (Tinkham et al., 2016). Gamble oak shrublands can require retreatment every 3-5 years due to vigorous sprouting after treatment (CSFS, 2021).

Approaches to Slash Management

Forest management operations often increase surface fuel loads and can fail to achieve fire mitigation objectives if fuels created by the harvest activities (also known as slash) are not addressed (Agee and Skinner, 2005). Slash can include small trees, limbs, bark, and treetops. Slash management is a critical step in the forest management process. It is unwise, ineffective, and even dangerous to conduct poor-quality fuel treatments that fail to reduce canopy fuels, result in increased surface fuel loads, and do not receive maintenance treatments. Such treatments can lead to a false sense of security among residents and fire suppression personnel (Dennis, 2005), and they divert limited funds away from more effective, strategic projects.

Leaving untreated slash within roadside fuel treatments is particularly counterproductive. The risk of active crown fire might be lower after a thinning operation, but untreated slash in fuel treatments can burn at high intensities and endanger the lives of residents stuck on roadways during a wildfire. Slash is easier and cheaper to manage along roadways due to access, and roads can serve as highly effective holding features for controlled burning of grass in the spring and fall and pile burning in the winter.

Methods for managing slash come with different benefits and challenges (**Table 4.e.1**). For example, lop-and-scatter and mastication do not remove surface fuels from the site, they only rearrange them. It can take a decade or more for slash to decompose to a point where it no longer poses a significant fire hazard. Broadcast prescribed burning and pile burning are more effective at removing surface fuels, but they require extensive planning and expertise to conduct properly.

LFRA, HOAs, BTWC, LCD, and Larimer County should work together to develop a slash management strategy for the area. This can and should include a combination of the following slash management techniques.

Prescribed burning is a common tool used to restore ecosystem processes and reduce fuel loads. Photo credit: The Ember Alliance.

Broadcast Prescribed Burning

Broadcast prescribed burning is generally the most effective method to reduce surface, ladder, and canopy fuel loads. Prescribed burning mimics naturally occurring wildfire, can treat hundreds of acres at a time, consumes surface fuel, and is relatively cost-effective (Addington et al., 2018; Fulé et al., 2012; McIver et al., 2013; Prichard et al., 2020). Strategically-located prescribed burns can reduce property damage during wildfires by effectively reducing fuel loads (Loomis et al., 2019).

Broadcast burning can be safely and successfully conducted with proper planning

and implementation by qualified firefighters. Broadcast burning requires careful planning and tactical decisions to prevent smoke from impacting sensitive populations and roadways. Broadcast burning is regulated in Colorado by the Division of Fire Prevention and Control, Department of Public Health and Environment, local sheriff's offices, and fire departments as outlined in the *2019 Colorado Prescribed Fire Planning and Implementation Policy Guide.*

Challenges with broadcast burning can include public concerns about risk from flames, embers, and smoke. There are often limited opportunities to conduct burns under appropriate fire weather conditions, and firefighters are often on wildfire assignments and unavailable to conduct burns.

Pile Burning

Pile burning can be the best and sometimes only option for slash removal in steep, inaccessible areas, and incomplete slash management can leave an area just as at risk as an unmitigated area. Pile burning is different from broadcast burning; the overall complexity of pile burn operations is lower because fire activity is limited to discrete piles, and piles can be burned when snow covers the ground. Burning piles can produce embers, but the risk of these embers igniting spot fires or structures is low. Piles are typically burned on days with snowpack, high fuel moistures, and low to moderate wind speeds. Embers from burn piles travel shorter distances than embers from passive and active crown fires because the burning material is closer to the ground (Evans and Wright, 2017). In the rare occurrence that a wildfire encounters unburned piles, unintended ignition of the pile can exacerbate fire behavior, as was observed during the 2010 Fourmile Canyon Fire in Colorado (Evans and Wright, 2017).

Challenges with pile burning can include public concerns about risk from flames, embers, and smoke. There are often limited opportunities to conduct pile burns because of requirements for snowpack and atmospheric ventilation. Intense heat from pile burning can sterilize soils and result in slow recovery of plants. Mitigation measures, such as raking the burnt soil and seeding with native plants, are sometimes warranted after pile burning if the soil was completely sterilized by extreme heat or if invasive species are prevalent in the area (Miller, 2015).

Pile burning can be a safe and effective method to consume slash created by thinning operations
Photo credit: The Ember Alliance.

It is critical to properly construct piles either by hand or with machines and to burn them as soon as conditions allow (see the 2015 *Colorado pile construction guide* from the DFPC and CSFS for guidance). Unburnt slash piles can become a hazard during wildfires, especially if loose logs catch fire and roll down slopes. Burning older piles is less effective and does not consume as much material because piles become compact and lose fine fuels over time (Wright et al., 2019).

Individuals must apply for smoke permits from the Colorado Department of Public Health and Environment to burn piles and apply for open burn permits from the Larimer County Department

of Health and Environment. In Larimer County, pile burning above 6,000 feet in elevation can only occur between October 1st and May 1st, when winds are less than 10 mph, and there are at least 3 inches of snow on the ground. Pursuant to Colorado House Bill 22-1132 (Darcy's Last Call Act), individuals must contact their local fire department before burning.

DFPC administers a certified burner program that provides civil liability protection to individuals planning and leading burns if smoke or flames cause damage. The burn must have been properly planned, approved, and executed to receive liability protection. The rigorous certification program requires individuals to complete 32-hours of training, pass an exam, lead at least three pile burns, complete a task book, and comply with all legal requirements for pile burning in Colorado.

Air Curtain Burners

BTWC and LFRA collaborated to purchase an air curtain burner that is used and managed by LFRA, BTWC, and their partners. Air curtain burners are machines that burn woody material cleanly in contained space. They typically consist of a box or trench into which slash is loaded and ignited. A strong fan blows a curtain of air down and over the burning material in a way that keeps oxygen flowing through the fire and keeps smoke from escaping out the top. Carbon from the smoke is filtered out of the air and kept inside the box.

Air curtain burners can be used under a much wider range of conditions and locations than pile burning or broadcast burning. Air curtain burners can burn more kinds of slash than pile burning, including green wood, lumber, and general yard waste. Burning material is contained and can be extinguished with relative ease.

LFRA co-owns and operates this air curtain burner in their jurisdiction, along with partners. Photo: The Ember Alliance.

Air curtain burners can be an acceptable form of slash removal where there is no social license for pile or broadcast burning. They produce significantly less smoke than open burns and can be placed in accessible locations in the WUI.

Challenges with air curtain burners include their substantial upfront cost and the need for professional operators. They also come with effort to haul slash from treatment areas to the site of the air curtain burner. Nutrients are permanently removed from the treatment site, but they can be returned to the ground in the location of the burner if ash is removed and spread out.

Community Slash Piles

Community slash piles allow residents to immediately reduce fuel loads on their property, and it eliminates the need for residents to burn or chip their own material. However, it can be challenging for residents to haul material from their properties to the slash pile.

The success of community slash piles is dependent on consistent management of the pile. If large slash piles are left in the community, they can pose a fire risk. Community slash piles also come with a cost for management and maintenance, but the cost is spread across all residents and therefore lower than if individual residents were to create and burn their own slash piles.

38% of survey respondents reported that access to inexpensive/easy means of slash disposal would encourage and enable them to reduce the risk of wildfire on their property. That was the most supported action that the community could take to enable residents to do more work, so LFRA and Larimer County should consider making the slash disposal site free to residents and nearby neighbors (**Figure 4.e.1**). Providing a program that will pick up the slash material and bring it to the slash disposal site will also reduce barriers for residents to complete mitigation work thoroughly.

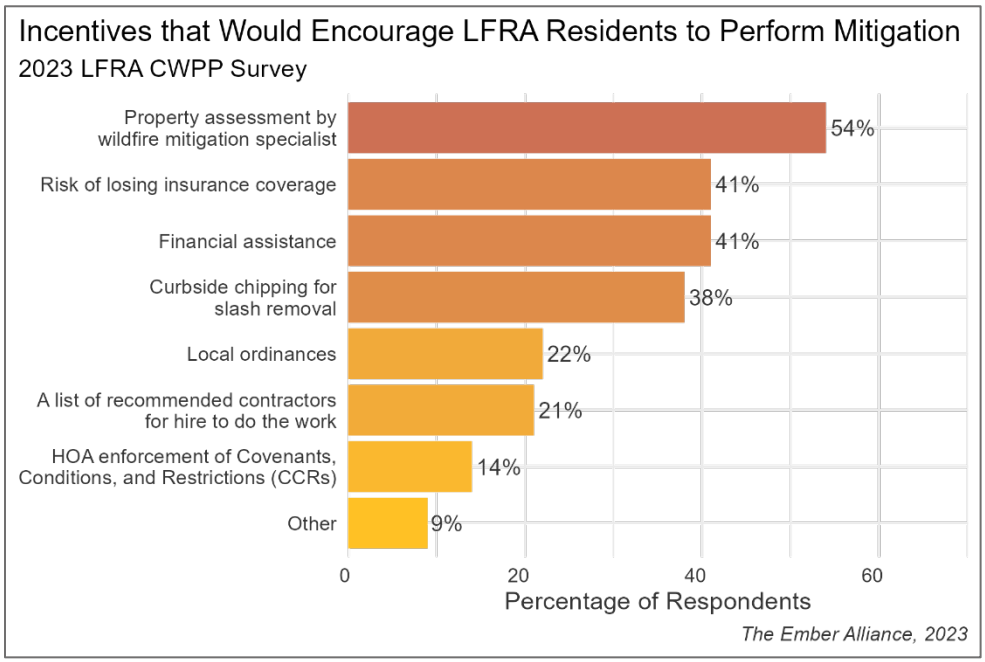


Figure 4.e.1. Resident responses to the survey question "Which of the following would encourage and enable you to reduce the wildfire risk on your property?" 38% of respondents requested slash disposal support.

Lop-and-Scatter

Lopping involves cutting limbs, branches, treetops, smaller-diameter trees, or other woody plant residue into shorter lengths. Scattering involves spreading lopped slash so it lies evenly and close to the ground. The lop-and-scatter approach reduces the height of slash relative to untreated slash, therefore increasing the distance between surface and canopy fuels (but not as effectively as broadcast prescribed burning or pile burning).

Lop-and-scatter can contribute to more intense fire behavior by not addressing increased surface fuel loads created by thinning (Agee and Skinner, 2005; Hunter et al., 2007). **Lop-and-scatter should not be utilized in HIZ 1, 2, or 3 or along roadways** because this method does not remove surface fuels from the site, it just rearranges them. Lop-and-scatter is better suited to areas with low slash accumulations and for stand-scale fuel treatment areas far away from homes.

Mastication or Chipping

Mastication involves using specialized machines like a tow-behind chipper or a hydro-ax to grind up standing saplings and shrubs and cut slash into medium-sized chips. Chipping involves processing slash through a mechanical chipper to break material into small chips or shreds. Mastication and chipping can reduce fire intensity and rates of spread by increasing the distance between surface and canopy fuels and suppressing the regrowth of grasses (Kreye et al., 2014).

However, unless material is hauled away after treatment, fuels are just rearranged, not reduced. Smoldering fires in masticated and chipped fuels can be difficult to suppress, produce abundant smoke, kill tree roots, and lead to spot fires if high winds reignite masticated fuels and blow them across containment lines (Kreye et al., 2014). Additionally, fuels left behind in mastication and chipping treatments are deeper and more compact than natural fuels (Kreye et al., 2014). Thus, they can impede plant regeneration, particularly when the depth of masticated and chipped fuels exceeds 4 inches (Jain et al., 2018). For detailed information on chipping and mastication, refer to CFRI's Mulching Knowledge Summary.

Neighborhood chipping programs are cost-effective ways for communities to gain access to chippers without individuals paying for the unit and service each time they need it. Many communities create chipping programs where a chipper can be brought to anyone's property and chip the material there for them to spread across their land again. LFRA, BTWC, or LCD could host a chipping program for residents as another cost-effective slash management option.

Hauling Material Offsite

Cut trees can be loaded on trucks and removed completely from the site, thereby immediately reducing fuel loads on the site. The destinations of removed trees are mills to be turned into boards, yard waste disposal sites to be composted and turned into garden soil or mulch, or the landfill.

Hauling material offsite can be expensive and labor intensive. There is a limited biomass and timber industry in Colorado, so material often costs more to transport than it is worth. Needles, bark, and small branches are often left behind, which means surface fuel loads can be greater after treatment than before. Hauling material outside the community can also spread insects like mountain pine beetles and emerald ash borer.

Utilizing Material for Firewood

Wood leftover from thinning operations can be used as firewood. Firewood needs to be "seasoned" before use, which involves splitting the wood into usable logs and drying it for 6-18 months. Homeowners can often manage preparing firewood themselves, so it can be an inexpensive way to manage slash. Utilizing material for firewood can relocate surface fuels from one site to another, but it increases fuel loads near a home until burned. **Firewood must be stored at least 30 feet and uphill of structures; otherwise, it can create hazardous conditions during a wildfire.**

If firewood is used locally, it reduces the chances of introducing non-native insects and diseases to the ecosystem that cause outbreaks and damage forest health. Transporting firewood outside the community is not recommended if there are insects like mountain pine beetles and emerald ash borer in the area.

Table 4.e.1. Many methods are available to remove slash created by forest thinning, each with their own benefits and challenges.

Method	Removes surface fuel from site	Restores ecosystem functions	Retains nutrients on the site	Expertise required to conduct	Effort to conduct	Relative cost / acre	Total time to plan and conduct
Broadcast prescribed burning	✓	✓	✓	Very high	Very high	$$$	Months to years
Pile burning on site	✓		✓	Moderate	Moderate to high	$$	Weeks to months
Air curtain burner	✓			High	Moderate	$$$$	Weeks to months
Community slash pile	✓			Low to moderate	Moderate	$$	Ongoing
Lop-and-scatter			✓	Low to moderate	Moderate	$ - $$	Weeks to months
Mastication or chipping	(✓)		✓	High	Moderate to high	$$$	Weeks to months
Hauling material away	✓			Low to moderate	High	$$ - $$$	Weeks to months
Utilizing material for firewood	(✓)			Low	Low to moderate	$	Days to weeks

Note: Mastication and chipping only remove surface fuel from the site if material is hauled away after treatment. Utilizing material for firewood can relocate surface fuels from one site to another but increase fuel loads near a home until burned.

5. Implementation Plan and the Future of the CWPP

Below are strategic actions for LFRA, residents, HOAs and other community groups, public land managers, county, state, and federal agencies, and non-profit conservation groups to accomplish immediately or in the mid- or long-term (see definitions below). Some activities have low financial cost but require a fundamental shift in attitudes and behavior to prioritize wildfire risk mitigation. Other actions are more substantial and require commitment and collaboration across the community to pool resources, apply for grants, and make incremental steps towards meaningful change. Many of these recommendations are aspirational and will require expanded capacity and funding, as well as patience and hard work from community members and leaders to make lasting changes.

5.a. Implementation Phases

Immediate Action	Mid-Term Action	Long-Term Action
• Has the highest potential for immediate return-on-investment • Can be funded within the current capacity of LFRA and partner organizations with some supplemental funding from grants available in the next 18 – 24 months (such as CWDG) • Can occur with modest expansion of the current LFRA staff and partner organizations • Can capitalize on current relationships with emergency response partners, land management agencies, and non-profit organizations	• Requires moderate expansion of financial and implementation capacity of LFRA and partner organizations • Requires new cooperative relationships with emergency response partners, land management agencies, and non-profit organizations • Requires greater level of coordination among partners • Requires greater level of community discussion and decision making	• Requires multi-year planning and funding • Requires extensive grant funding • Requires substantial expansion of financial and implementation capacity of LFRA and partner organizations • Requires substantial coordination among partners • Requires substantial community discussion and decision making

5.b. Implementation Activities and Responsibilities

Recommendation	Responsibility	Priority
Category: Fire Adapted Communities		
Adopt the Fire Adapted Communities as the overarching vision and strategy for CWPP implementation.	LFRA, residents	Immediate
Refer to the FAC framework when making updates to the WUI code and building new developments within LFRA's response area.	LFRA, City of Loveland, Larimer County	Immediate
Take advantage of resources and services provided by the new Larimer County Wildfire Partners Program to become more fire adapted.	Residents, LFRA	Immediate
Strive to become a Firewise community.	Residents, community organizations	Mid-term
Category: Fire Authority Capacity		
Become a volunteer with LFRA Stations 8 or 9 to become more informed about wildfire mitigation practices in your community and to inspire fellow residents to engage in wildfire and emergency preparedness.	Residents	Immediate
Continue developing mutual aid relationships with neighboring districts.	LFRA	Immediate
Hire a wildfire coordinator and 4 seasonal employees to staff LFRA Station 8 to implement the CWPP in the western part of their response area (based on LFRA's 2023 strategic plan)	LFRA	Mid-term
Install cisterns in communities that don't have fire hydrants or other water sources for firefighters to use during a wildfire. When you do so, ensure that connections are compatible with LFRA's equipment.	HOAs or other community groups in collaboration with LFRA	Mid-term
Category: Outreach		
Host all CWPP information on LFRA's website, along with other resources about wildfire risk and preparedness.	LFRA	Immediate
Host an annual wildfire education day that is open to all residents within LFRA. Due to the diversity across Loveland and the canyon, it may make sense to host an urban wildfire education day geared towards residents in the grassland urban interface and a rural wildfire education day geared towards residents in the more forested part of LFRA, i.e., the wildland urban interface.	LFRA and other partners	Immediate

Recommendation	Responsibility	Priority
Form a volunteer group called the CWPP Implementation Committee, or other mutually agreeable name to continue momentum developed by the CWPP.	LFRA, HOAs or other community groups, residents	Immediate
Inform residents about ecological benefits of restoration-style fuel treatments.	LFRA, BTWC, LCD, other partners	Immediate
Conduct targeted outreach efforts to residents in each plan unit based on their relative risk rating, with special emphasis on home hardening and defensible space. See **Section 3.b** for specific recommendations in each plan unit.	LFRA	Immediate
Conduct field tours with residents to demonstrate exemplary home hardening, defensible space, and landscape-scale fuel treatments.	HOAs and community groups, with support from LFRA	Immediate
Share successes from completed fuel treatments, community mitigation projects, and outreach events on social media to spotlight these efforts.	LFRA, HOAs and community groups (sharing through avenues like next door)	Immediate
Provide welcome packets to new residents with information on wildfire preparedness.	LFRA, HOAs, Realtors	Immediate
Create a neighborhood ambassador program to connect residents with available tools and to coordinate mitigation efforts across LFRA, among both public and private landowners.	Residents, with support from LFRA	Mid-term
Educate transient and unhoused populations about safe warming practices and wildfire safety.	City of Loveland, in coordination with LFRA	Immediate
Create targeted outreach campaigns for part-time residents and short-term rentals about the importance of creating defensible space to mitigate risk to the community at large.	LFRA	Immediate
Build social license around prescribed fire, and specifically pile burning in WUI communities. Bolster notifications system for planned prescribed fire implementation.	USFS, local non-profit organizations such as BTWC, local community groups	Immediate
Develop community notification platform (non-imminent to life and health) similar to NOCO Alert that wouldn't be specific to evacuation but would communicate general information such as planned prescribed fire, fuel treatments, power outages, etc. across LFRA.	LFRA	Immediate

Recommendation	Responsibility	Priority
Create informational video summarizing wildfire risk and preparedness within LFRA's response area and make it available on LFRA's website.	LFRA	Mid-term
Category: Home Ignition Zone		
Engage in annual maintenance of your HIZ.	Residents	Immediate
Establish defensible space around homes, detached garages, storage buildings, barns, and other structures so that the home can stand alone without relying on limited firefighting resources. Follow recommendations in the CSFS The Home Ignition Zone and this CWPP.	Residents	Immediate
If you live in an HOA, advocate for regulations that align with the CSFS The Home Ignition Zone.	Residents	Immediate
Coordinate with Larimer County Wildfire Partners Program to conduct home assessments and provide specific recommendations to individual homeowners to improve their HIZ.	LFRA, Larimer County Wildfire Partners	Mid-term
Host HIZ training for local contractors so they can be familiar with best practices for defensible space creation. Provide a list of "HIZ trained contractors" on LFRA's website where residents can easily find it.	LFRA, Larimer County Wildfire Partners	Mid-term
Introduce a program similar to the Vail Fire Protection District's Fire Free Five, which provides financial incentive to residents who remove all flammable materials and vegetation from home ignition zone 1.	LFRA, City of Loveland, Larimer County	Long-term
Category: Homes in the Grasslands		
Focus on hardening your home by using fire-resistant building materials such as a metal roof and noncombustible siding.	Residents	Immediate
Remove vegetation and other flammable materials within the first five feet of your home.	Residents	Immediate
Eliminate fuel pathways that could cause your house to ignite from a wildfire by removing wooden fences, or making sure they are not directly attached to your home. For example, replace the first 5 feet of wooden fencing between your home and the fence with metal fencing or chicken wire.	Residents	Immediate
Category: Linked Defensible Space and Fuel Treatments		
Work together to pool financial and other resources and pursue grants to mitigate wildfire risk across the community.	Residents, HOAs, and other community groups	Immediate

Recommendation	Responsibility	Priority
Connect with your neighbors to link your defensible space. Islands of treatments are not nearly as effective as community-level treatments that are connected.	Residents	Immediate
Form Pile Burn Cooperatives with your neighbors to help each other build and burn slash piles.	Residents	Immediate
Maintain your defensible space and community-level treatments that have been completed in the past by re-treating every few years.	Residents, HOAs, local, state and federal land managers	Immediate
Focus initial efforts on mitigating fire risk in CWPP priority project areas, with a focus on treatment methods to restore ecological conditions.	Project leads, residents that live within project areas	Mid-term
Build off the CWPP to identify projects that improve linked defensible space and create mosaic landscapes.	Residents, HOAs, and other community groups	Mid-term
Conduct landscape-scale fuel treatments across public and private property lines in priority project areas and beyond.	Residents, local, state and federal agencies, local non-profit organizations	Mid-term
Category: Slash Management		
Provide support and resources to residents who want to use pile burning as a slash management method. Pile burning is appropriate on larger acreage parcels where piles can be burned at least 50 ft away from the nearest structure. In subdivisions made up of small parcels, or in more urban areas where homes are densely packed together, alternative slash management methods should be pursued.	LFRA and other fire professionals	Immediate
Form Pile Burn Cooperatives with your neighbors to help each other build and burn slash piles.	Residents	Immediate
Create a slash disposal site for residents who are unable to burn their slash.	LFRA and community groups	Mid-term
Implement a slash pick up program for residents (to pick up and transport slash to the disposal site).	LFRA and community groups	Mid-term
Develop an Air Curtain Burner program collaboratively with local partners and host community burn days.	LFRA and local partners such as BTWC	Mid-term
Implement a community chipping program so residents who are unable to burn slash can chip material on their property.	LFRA and community groups	Long-term
Category: Evacuation Preparedness		

Recommendation	Responsibility	Priority
Develop a family evacuation plan and go-bags. Plans should include considerations of pets and livestock if applicable.	Residents	Immediate
Cooperate with neighbors to develop plans for evacuating children who may be home alone or residents with mobility impairments or other special needs.	Residents	Immediate
Increase resident awareness of evacuation planning, processes, and NOCO Alert.	LFRA, and LETA	Immediate
Sign up for emergency notification through NOCO Alert.	Residents	Immediate
If you have livestock, a camper, or anything else that may slow down your evacuation time consider leaving during a voluntary evacuation rather than waiting until the evacuation is mandatory.	Residents	Immediate
Provide access to water supplies when evacuating for firefighters to use if they choose. Do NOT turn on sprinklers during evacuation.	Residents	Immediate
Cooperate with emergency response partners to conduct plan unit-wide evacuation drills.	LFRA, emergency response partners	Immediate
Continue conversations about evacuation planning for the community, including alternative evacuation routes.	LFRA, emergency response partners	Immediate
Develop a plan to evacuate socially vulnerable populations including the elderly, unhoused, and low-income families who may not have access to a vehicle.	LFRA, and LCOEM	Immediate
Category: Firefighter Access and Evacuation Safety		
Replace burnable, non-reflective address numbers with reflective signs available from LFRA.	Residents	Immediate
Mount address numbers on non-burnable posts or on rocks, not on stumps, and not on chains across driveways that might be taken down by firefighters during structure protection actions.	Residents	Immediate
Develop standards for cistern and pipe compatibility to ensure that private water resources are compatible with LFRA's equipment.	LFRA	Immediate
Improve driveway access for firefighters (e.g., widen driveways, fill potholes, remove and limb trees along driveways, create turnarounds at end of driveways).	Residents	Mid-term
Create pullouts and turnarounds on narrow roads throughout LFRA for emergency vehicles.	Local road associations, HOAs, other groups who	Mid-term

Recommendation	Responsibility	Priority
	own and manage roadside land	
Coordinate efforts to mitigate hazardous conditions along roadways.	LFRA, project area leads and supports	Mid-term

5.c. CWPP as a Living Document

CWPPs are a guide and a plan for action. They should be revisited and reviewed annually, at minimum, by LFRA and the CWPP Implementation Committee. Check off goals as they are accomplished and celebrate treatments, outreach events, new partnerships, and other accomplishments. Keep track of the work that happens between updates, take pictures, and collect implementation ideas for the next update.

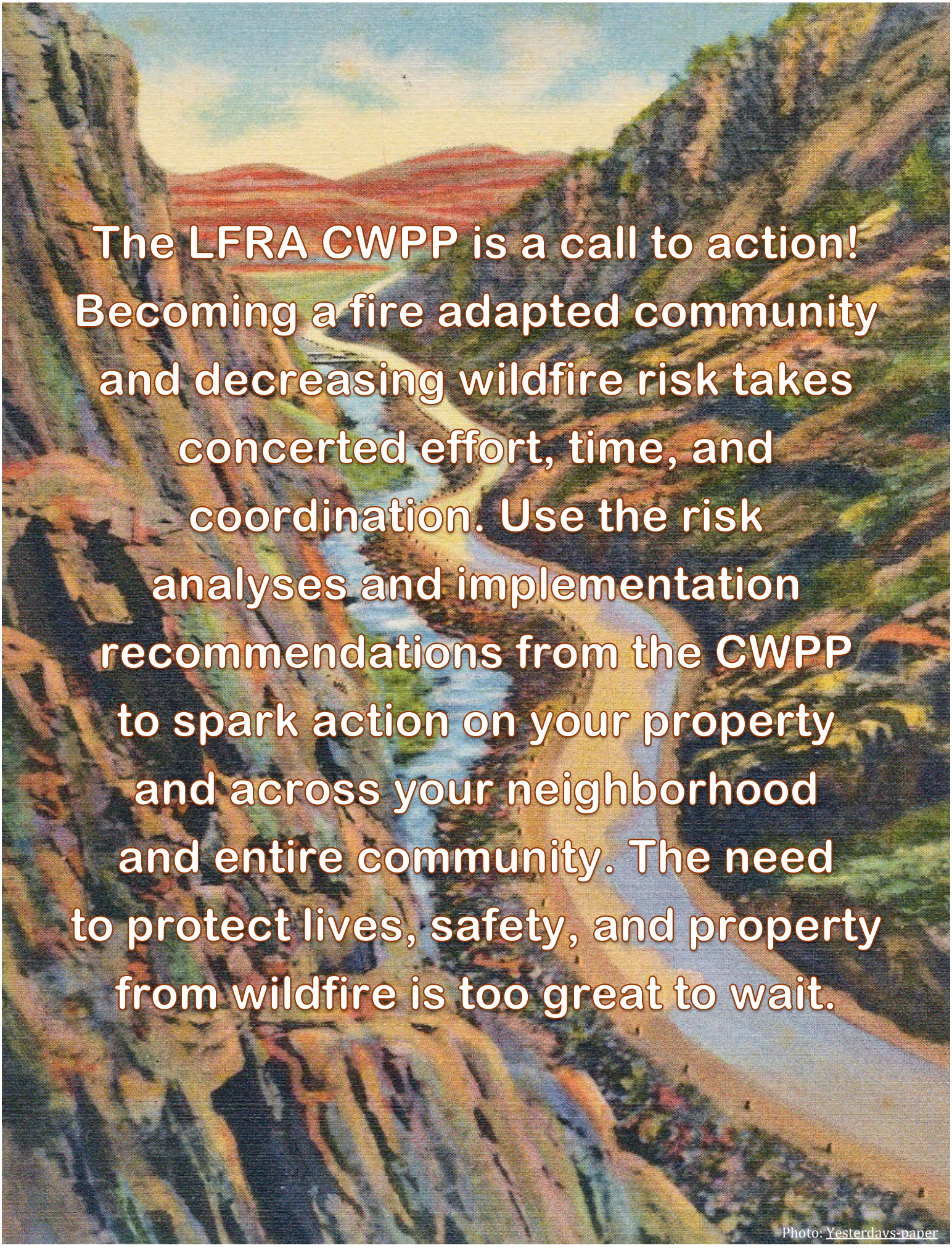
The CSFS requires CWPPs to be updated on a regular basis. It is recommended to update them every 5 years, at minimum. CWPPs greater than 10 years old are outdated and can exclude communities from successfully applying for competitive funding opportunities.

The update to this plan can either be a preface to this document or a new document that integrates with this one. The update to this plan must include:

- A description of progress made since the CWPP was created.
- A description of demographic changes in the community and other important infrastructure changes.
- Identification of new risks in the community.
- Updated risk analysis if major changes have happened between revisions.
- Updated and prioritized projects for the community with maps and descriptions

The suggested review process by CSFS involves:

- Reviewing the existing CWPP
- Engaging partners that have a vested interest in the plan
- Hosting collaborative meetings
- Documenting completed projects and demographic and landscape changes
- Developing updated wildfire risk reduction priorities
- Updating maps
- Distributing updated drafts to key partners for review and input prior to final approval
- Finalizing with core team signatures and submit to CSFS State Office


The LFRA CWPP is a call to action! Becoming a fire adapted community and decreasing wildfire risk takes concerted effort, time, and coordination. Use the risk analyses and implementation recommendations from the CWPP to spark action on your property and across your neighborhood and entire community. The need to protect lives, safety, and property from wildfire is too great to wait.
Photo: Yesterdays-paper

6. Glossary

20-foot wind speed: The rate of sustained wind over a 10-minute period at 20 feet above the dominant vegetation. The wind adjustment factor to convert surface winds to 20-foot wind speeds depends on the type and density of surface fuels slowing down windspeeds closer to the ground (NWCG, 2021).
Active crown fire: Fire in which a solid flame develops in the crowns of trees and advances from tree crown to tree crown independently of surface fire spread (NWCG, 2018b).
ArcCASPER: An intelligent capacity-aware evacuation routing algorithm used in the geospatial information system mapping program ArcMap to model evacuation times and congestion based on roadway capacity, road speed, number of cars evacuating per address, and the relationship between roadways congestion and reduction in travel speed (Shahabi and Wilson, 2014).

Basal area: Cross sectional area of a tree measured at breast height (4.5 feet above the ground). Used as a method of measuring the density of a forest stand in units such as ft^2/acre (USFS, 2021b).

Broadcast prescribed burning (aka, prescribed burn, controlled burn): A wildland fire originating from a planned ignition in accordance with applicable laws, policies, and regulations to meet specific objectives (NWCG, 2018b).

Canopy base height (CBH): The average height from the ground to a forest stand's canopy bottom. CBH is the lowest height in a stand at which there is sufficient forest canopy fuel to propagate fire vertically into the canopy. Ladder fuels such as lichen, dead branches, and small trees are incorporated into measurements of CBH. Forests with lower canopy base heights have a higher risk of torching (NWCG, 2019).

Canopy bulk density (CBD): The density of available canopy fuels in a stand (the mass of available canopy fuel per canopy volume unit). Typical units are either kg/m^3 or lb/ft^3. Stands with higher CBD have a higher likelihood of active crown fire (NWCG, 2019).

Canopy cover: The ground area covered by the crowns of all trees in an area as delimited by the vertical projection of their outermost crown perimeters (NWCG, 2019).

Canopy fuels: The stratum of fuels containing the crowns of the tallest vegetation (living or dead), usually above 20 feet (NWCG, 2018b).

Canopy height: The average height of the top of the vegetated canopy (NWCG, 2019).

Canopy: The more or less continuous cover of branches and foliage formed collectively by adjacent tree crowns (USFS, 2021b).

Canyon: A long, deep, very steep-sided topographic feature primarily cut into bedrock and often with a perennial stream at the bottom (NRCS, 2017).

Chain: Chains are commonly used in forestry and fire management as a measure of distance. 1 chain is equivalent to 66 feet. Chains were used for measurements in the initial public land survey of the U.S. in the mid-1800s.

Chute: A steep V-shaped drainage that is not as deep as a canyon but is steeper than a draw. Normal upslope air flow is funneled through a chute and increases in speed, causing upslope preheating from convective heat, thereby exacerbating fire behavior (NWCG, 2008).

Community Wildfire Protection Plan (CWPP): A plan developed in the collaborative framework established by the Wildland Fire Leadership Council and agreed to by state, Tribal, and local governments, local fire departments, other partners, and federal land management agencies in the vicinity of the planning area. CWPPs identify and prioritize areas for hazardous fuel reduction treatments, recommend the types and methods of treatment on Federal and non-Federal land that

will protect one or more at-risk communities and essential infrastructure, and recommend measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, and structure protection (NWCG, 2018b).

Convection: A type of heat transfer that occurs when a fluid, such as air or a liquid, is heated and travels away from the source, carrying heat along with it. Air around and above a wildfire expands as it is heated, causing it to become less dense and rise into a hot convection column. Cooler air flows in to replace the rising gases, and in some cases, this inflow of air creates local winds that further fan the flames. Hot convective gases move up slope and dry out fuels ahead of the flaming front, lowering their ignition temperature and increasing their susceptibility to ignition and fire spread. Homes located at the top of a slope can become preheated by convective heat transfer. Convection columns from wildfires carry sparks and embers aloft.

Crown (aka, tree crown): Upper part of a tree, including the branches and foliage (USFS, 2021b).

Defensible space: The area around a building where vegetation, debris, and other types of combustible fuels have been treated, cleared, or reduced to slow the spread of fire and reduce exposure to radiant heat and direct flame. It is encouraged that residents develop defensible space so that during a wildfire their home can stand alone without relying upon limited firefighter resources due to the great reduction in hazards they have undertaken. The Colorado State Forest Service defines three zones of defensible space: zone 1 (HIZ 1) as 0 to 5 feet from the home, zone 2 (HIZ 2) as 5 to 30 feet from the home, and zone 3 (HIZ 3) as 30 to about 100 feet from the home (CSFS, 2021).

Direct attack: Any treatment applied directly to burning fuel such as wetting, smothering, or chemically quenching the fire or by physically separating the burning from unburned fuel (NWCG, 2018b).

Draws: Topographic features created by a small, natural watercourse cutting into unconsolidated materials. Draws generally have a broader floor and more gently sloping sides than a ravine or gulch (NRCS, 2017).

Ecological restoration: The process of assisting the recovery of an ecosystem that has been damaged, degraded, or destroyed (SER, 2004). In ponderosa pine and dry mixed-conifer forests of the Colorado Front Range, ecological restoration involves transforming dense forests into a mosaic of single trees, clumps of trees, and meadows similar to historic forests that were maintained by wildfires and very resilient to them (Addington et al., 2018).

Ember: Small, hot, and carbonaceous particles. The term "firebrand" is also used to connote a small, hot, and carbonaceous particle that is airborne and carried for some distance in an airstream (Babrauskas, 2018).

Ember cast: The process of embers/firebrands/flaming sparks being transported downwind beyond the main fire and starting new spot fires and/or igniting structures. Short-range ember cast is when embers are carried by surface winds and long-range ember cast is when embers are carried high into the convection column and fall out downwind beyond the main fire. The number of embers reaching an area decreases exponentially with distance traveled, and the likelihood of structure ignition increases with the number of embers landing on receptive fuels (Caton et al., 2016). The distance used to differentiate short-range and long-range ember cast varies among sources. NWCG (2018b) classifies short-range ember cast as embers that travel less than 0.25 miles and long-range ember cast as embers that travel more than 0.25 miles, whereas Beverly et al., (2010) use a threshold of 0.06 miles. We use the Beverly et al., (2010) definition in this CWPP.

Fire adapted community (FAC): A human community consisting of informed and prepared citizens collaboratively planning and taking action to safely coexist with wildland fire (NWCG,

2018b). There is not a checklist or one silver bullet to become a FAC; there are many strategic actions and tools that should be used together to reduce shared risk. Risk mitigation is the responsibility of everyone who lives and works in the community—residents, community groups, fire authorities, agency partners, non-governmental organizations, etc. Fire adaptation is an ongoing process of collaborative action to identify risk, mitigate it, and maintain the work overtime.

Fire behavior: The manner in which a fire reacts to the influences of fuel, weather, and topography. Characteristics of fire behavior include rate of spread, fire intensity, fire severity, and fire behavior category (NWCG, 2018b).

Fire history: A general term referring to the historic fire occurrence in a specific geographic area (NWCG, 2018b).

Fire intensity (aka, fireline intensity): (1) The product of the available heat of combustion per unit of ground and the rate of spread of the fire, interpreted as the heat released per unit of time for each unit length of fire edge, or (2) the rate of heat release per unit time per unit length of fire front (NWCG, 2018b).

Fire regime: Description of the patterns of fire occurrences, frequency, size, and severity in a specific geographic area or ecosystem. A fire regime is a generalization based on fire histories at individual sites. Fire regimes can often be described as cycles because some parts of the histories usually get repeated, and the repetitions can be counted and measured, such as fire return interval (NWCG, 2018b).

Fire severity. Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time (NWCG, 2018b). Fire severity is determined by visually inspecting or measuring the effects that wildfire has on soil, plants, fuel, and watersheds. Fire severity is often classified as low-severity (less than 20% of overstory trees killed) and high severity (more than 70% of overstory trees kills). Moderate-severity or intermediate fire severity falls between these two extremes (Agee, 1996). Specific cutoffs for fire severity classifications differ among researchers. For example, Sherriff et al. (2014) define high-severity fires as those killing more than 80% of overstory trees.

Fire weather conditions: Weather conditions that influence fire ignition, behavior, and suppression, for example, wind speed, wind direction, temperature, relative humidity, and fuel moisture (NWCG, 2018b).

Firebreak: A natural or constructed barrier where all vegetation and organic matter have been removed down to bare mineral soil. Firebreaks are used to stop or slow wildfires or to provide a control line from which to work (Bennett et al., 2010; NWCG, 2018b).

FireFamilyPlus: A software application that provides summaries of fire weather, fire danger, and climatology for one or more weather stations extracted from the National Interagency Fire Management Integrated Database (NWCG, 2018b).

Fireline: (1) The part of a containment or control line that is scraped or dug to mineral soil, or (2) the area within or adjacent to the perimeter of an uncontrolled wildfire of any size in which action is being taken to control fire (NWCG, 2018b).

Flame length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface). Flame length is measured on an angle when the flames are tilted due to effects of wind and slope. Flame length is an indicator of fire intensity (NWCG, 2018b).

FlamMap: A fire analysis desktop application that can simulate potential fire behavior and spread under constant environmental conditions (weather and fuel moisture) (Finney, 2006). FlamMap is

one of the most common models used by land managers to assist with fuel treatment prioritization, and it is often used by fire behavior analysts during wildfire incidents.

Fuel model: A stylized set of fuel bed characteristics used as input for a variety of wildfire modeling applications to predict fire behavior (Scott and Burgan, 2005).

Fuel reduction: Manipulation, combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage from wildfires and resistance to control (NWCG, 2018b).

Fuelbreak: A natural or manmade change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled. Fuelbreaks differ from firebreaks due to the continued presence of vegetation and organic soil. Trees in shaded fuelbreaks are thinned and pruned to reduce the fire potential but enough trees are retained to make a less favorable microclimate for surface fires (NWCG, 2018b).

Fuels mitigation / management: The act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire, in support of land management objectives (NWCG, 2018b).

Fuels: Any combustible material, most notably vegetation in the context of wildfires, but also including petroleum-based products, homes, and other man-made materials that might combust during a wildfire in the wildland-urban interface. Wildland fuels are described as 1-, 10-, 100-, and 1000-hour fuels. One-hour fuels are dead vegetation less than 0.25 inch in diameter (e.g., dead grass), ten-hour fuels are dead vegetation 0.25 inch to 1 inch in diameter (e.g., leaf litter and pine needles), one hundred-hour fuels are dead vegetation 1 inch to 3 inches in diameter (e.g., fine branches), and one thousand-hour fuels are dead vegetation 3 inches to 8 inches in diameter (e.g., large branches). Fuels with larger diameters have a smaller surface area to volume ratio and take more time to dry out or become wetter as relative humidity in the air changes (NWCG, 2018b).

Handcrews: A number of individuals that have been organized and trained and are supervised principally for operational assignments on an incident (NWCG, 2018b).

Handline: Fireline constructed with hand tools (NWCG, 2018b).

Hazards: Any real or potential condition that can cause injury, illness, or death of personnel, or damage to, or loss of equipment or property (NWCG, 2018b).

Home hardening: Steps taken to improve the chance of a home and other structures withstanding ignition by radiant and convective heat and direct contact with flames or embers. Home hardening involves reducing structure ignitability by changing building materials, installation techniques, and structural characteristics of a home (California Fire Safe Council, 2020). A home can never be made fireproof, but home hardening practices in conjunction with creating defensible space increases the chance that a home will survive a wildfire.

Home ignition zone (HIZ): The characteristics of a home and its immediate surroundings within 100 feet of structures. Conditions in the HIZ principally determine home ignition potential from radiant heat, convective heat, and ember cast (NWCG, 2018b).

Ignition-resistant building materials: Materials that resist ignition or sustained flaming combustion. Materials designated ignition-resistant have passed a standard test that evaluates flame spread on the material (Quarles, 2019; Quarles and Pohl, 2018).

Incident Response Pocket Guide (IRPG): Document that establishes standards for wildland fire incident response. The guide provides critical information on operational engagement, risk management, all hazard response, and aviation management. It provides a collection of best practices that have evolved over time within the wildland fire service (NWCG, 2018a).

Indirect attack A method of suppression in which the control line is located some considerable distance away from the fire's active edge. Generally done in the case of a fast-spreading or high-intensity fire and to utilize natural or constructed firebreaks or fuelbreaks and favorable breaks in the topography. The intervening fuel is usually backfired; but occasionally the main fire is allowed to burn to the line, depending on conditions (NWCG, 2018b).

Insurance Services Office (ISO) rating: ISO ratings are provided to fire departments and insurance companies to reflect how prepared a community is for fires in terms of local fire department capacity, water supply, and other factors (see more information online at https://www.isomitigation.com/ppc/fsrs/).

Ladder fuels: Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees with relative ease. Ladder fuels help initiate torching and crowning and assure the continuation of crowning. Ladder fuels can include small trees, brush, and lower limbs of large trees (NWCG, 2018b).

LANDFIRE: A national program spearheaded by the U.S. Department of the Interior and the U.S. Department of Agriculture to provide spatial products characterizing vegetation, fuels, fire regimes, and disturbances across the entire United States. LANDFIRE products serve as standardized inputs for fire behavior modeling. More information about the program is available online at https://www.landfire.gov/.

Lop-and-scatter: Cutting (lopping) branches, tops, and unwanted boles into shorter lengths and spreading that debris evenly over the ground such that resultant logging debris will lie close to the ground (NWCG, 2018b).

Mastication: A slash management technique that involves using a machine to grind, chop, or shred vegetation into small pieces that then become surface fuel (Jain et al., 2018).

Mitigation actions: Actions that are implemented to reduce or eliminate (mitigate) risks to persons, property, or natural resources. These actions can be undertaken before and during a wildfire. Actions before a fire include fuel treatments, vegetation modification in the home ignition zone, and structural changes to increase the chance a structure will survive a wildfire (aka, home hardening). Mitigation actions during a wildfire include mechanical and physical tasks, specific fire applications, and limited suppression actions, such as constructing firelines and creating "black lines" through the use of controlled burnouts to limit fire spread and behavior (NWCG, 2018b).

Mosaic landscape: A heterogeneous area composed of different communities or a cluster of different ecosystems that are similar in function and origin in the landscape. It consists of 'patches' arranged in a 'matrix', where the patches are the different ecosystems and the matrix is how they are arranged over the land (Hansson et al., 1995).

National Wildfire Coordinating Group (NWCG): An operational group established in 1976 through a Memorandum of Understanding between the U.S. Department of Agriculture and Department of the Interior to coordinate programs of the participating agencies to avoid wasteful duplication and to provide a means of constructively working together. NWCG provides a formalized system and agreed upon standards of training, equipment, aircraft, suppression priorities, and other operational areas. More information about NWCG is available online at https://www.nwcg.gov/.

Noncombustible building materials: Material of which no part will ignite or burn when subjected to fire or heat, even after exposure to moisture or the effects of age. Materials designated noncombustible have passed a standard test (Quarles, 2019; Quarles and Pohl, 2018).

Non-survivable road: Portions of roads adjacent to areas with predicted flame lengths greater than 8 feet under severe fire weather conditions. Potentially non-survivable flame lengths start at 8 feet according to the Haul Chart, which is a standard tool used by firefighters to relate flame lengths to tactical decisions (NWCG, 2019). Drivers stopped or trapped on these roadways would have a low chance of surviving radiant heat from fires of this intensity. Non-survivable conditions are more common along roads that are lined with thick forests, particularly with trees that have limbs all the way to the ground and/or abundant saplings and seedlings.

Overstory: Layer of foliage in a forest canopy, particularly tall mature trees that rise above the shorter immature understory trees (USFS, 2021b).

Passive crown fire: Fire that arises when surface fire ignites the crowns of trees or groups of trees (aka, torching). Torching trees reinforce the rate of spread, but passive crown fires travel along with surface fires (NWCG, 2018b).

Pile burning: Piling slash resulting from logging or fuel management activities into manageable piles that are subsequently burned during safe and approved burning conditions (NWCG, 2018b).

Potential operational delineations (PODs): PODs are topographic areas bounded by features suitable for fire control (e.g., ridgetops and roads) that can be used for proactive wildfire decision making and tactical operations during wildfire events. PODs can serve as management units for proactive ecological restoration and wildfire risk mitigation, as well as for cross-boundary and collaborative land and fire management planning (Thompson et al., 2022).

Radiation: A method of heat transfer by short-wavelength energy through air (aka, infrared radiation). Surfaces that absorb radiant heat warm up and radiate additional short-wavelength energy themselves. Radiant heat is what you feel when sitting in front of a fireplace. Radiant heat preheats and dries fuels adjacent to the fire, which initiates combustion by lowering the fuel's ignition temperature. The amount of radiant heat received by fuels increases as the fire front approaches. Radiant heat is a major concern for the safety of wildland firefighters and can ignite homes without direct flame contact.

Rate of spread: The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Rate of spread is usually expressed in chains or acres per hour for a specific period in the fire's history (NWCG, 2018b).

Ravine: Topographic feature created by streams cutting into unconsolidated materials. They are narrow, steep-sided, and commonly V-shaped. Ravines are steeper than draws (NRCS, 2017).

Remote Automatic Weather Stations (RAWS): A weather station that transmits weather observations via satellite to the Wildland Fire Management Information system (NWCG, 2018b).

Risk: (1) The chance of fires starting as determined by the presence and activity of causative agents (e.g., lightning), (2) a chance of suffering harm or loss, or (3) a causative agent (NWCG, 2018b).

Roadside fuel treatment: A natural or manmade change in fuel characteristics along a roadway which affects fire behavior so that fires burning into them can be more readily controlled, survivable conditions with shorter flame lengths are more likely during a wildfire, and firefighter access is enhanced (NWCG, 2018b).

Saddle: A low point on a ridge or interfluve, generally a divide or pass between the heads of streams flowing in opposite directions. The presence of a saddle funnels airflow and increases windspeed, thereby exacerbating fire behavior (NRCS, 2017).

Safety zones: An area cleared of flammable materials used by firefighters for escape in the event the line is outflanked or spot fires outside the control line render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand, allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks; they are greatly enlarged areas which can be used with relative safety by firefighters without the use of a fire shelter (NWCG, 2018b).

Shaded fuelbreak: Fuel treatments in timbered areas where the trees on the break are thinned and pruned to reduce fire potential yet enough trees are retained to make a less favorable microclimate for surface fires (NWCG, 2018b).

Slash: Debris resulting from natural events such as wind, fire, or snow breakage or from human activities such as road construction, logging, pruning, thinning, or brush cutting. Slash includes logs, bark, branches, stumps, treetops, and broken understory trees or brush (NWCG, 2018b).

Smoldering combustion: The combined processes of dehydration, pyrolysis, solid oxidation, and scattered flaming combustion and glowing combustion, which occur after the flaming combustion phase of a fire; often characterized by large amounts of smoke consisting mainly of tars (NWCG, 2018b).

Spot fire: Fire ignited outside the perimeter of the main fire by an ember (NWCG, 2018b). Spot fires are particularly concerning because they can form a new flaming front, move in unanticipated directions, trap firefighters between two fires, and require additional firefighting resources to control.

Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire (NWCG, 2018b).

Stand: An area of forest that possesses sufficient uniformity in species composition, age, size, structural configuration, and spatial arrangement to be distinguishable from adjacent areas (USFS, 2021b).

Structure protection: The protection of homes or other structures from an active wildland fire (NWCG, 2018b).

Structure triage: The process of inspecting and classifying structures according to their defensibility or non-defensibility, based on fire behavior, location, construction, and adjacent fuels. Structure triage involves a rapid assessment of a dwelling and its immediate surroundings to determine its potential to escape damage by an approaching wildland fire. Triage factors include the fuels and vegetation in the yard and adjacent to the structure, roof environment, decking and siding materials, prevailing winds, topography, etc. (NWCG, 2018b). There are four categories used during structure triage: (1) defensible – prep and hold, (2) defensible – stand alone, (3) non-defensible – prep and leave, and (4) non-defensible – rescue drive-by. The most important feature differentiating defensible and non-defensible structures is the presence of an adequate safety zone for firefighters (NWCG 2018a). Firefighters conduct structure triage and identify defensible homes during wildfire incidents. Categorization of homes is not pre-determined; triage decisions depend on fire behavior and wind speed due to their influence on the size of safety zones needed to keep firefighters safe.

Suppression: The work and activity used to extinguish or limit wildland fire spread (NWCG, 2018b).

Surface fire: Fire that burns fuels on the ground, which include dead branches, leaves, and low vegetation (NWCG, 2018b).

Surface fuels: Fuels lying on or near the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants (NWCG, 2018b).

Task book: A document listing the performance requirements (competencies and behaviors) for a position in a format that allows for the evaluation of individual (trainee) performance to determine if an individual is qualified in the position. Successful performance of tasks, as observed and recorded by a qualified evaluator, will result in a recommendation to the trainee's home unit that the individual be certified in the position (NWCG, 2018b).

Torching: The burning of the foliage of a single tree or a small group of trees from the bottom up. Torching is the type of fire behavior that occurs during passive crown fires and can initiate active crown fires if tree canopies are close to each other (NWCG, 2018b).

Values at risk: Aspects of a community or natural area considered valuable by an individual or community that could be negatively impacted by a wildfire or wildfire operations. These values can vary by community and include diverse characteristics such as homes, specific structures, water supply, power grids, natural and cultural resources, community infrastructure, and other economic, environmental, and social values (NWCG, 2018b).

Watershed (aka, drainage basin or catchment): An area of land where all precipitation falling in that area drains to the same location in a creek, stream, or river. Smaller watersheds come together to create basins that drain into bays and oceans (NOAA, 2021).

Wildfire-resistant building materials: A general term used to describe a material and design feature that can reduce the vulnerability of a building to ignition from wind-blown embers or other wildfire exposures (Quarles, 2019; Quarles and Pohl, 2018).

Wildland-urban interface (WUI): Any area where the built environment meets wildfire-prone areas—places where wildland fire can move between natural vegetation and the built environment and result in negative impacts on the community (Forge, 2018). For the purpose of this CWPP, the WUI boundary includes all of LFRA and the surrounding landscape that could transmit wildland fire into LFRA and the area along important evacuation routes (**Figure 2.c.2**). Strategic wildfire mitigation across the WUI can increase the safety of residents and wildland firefighters and reduce the chances of home loss.

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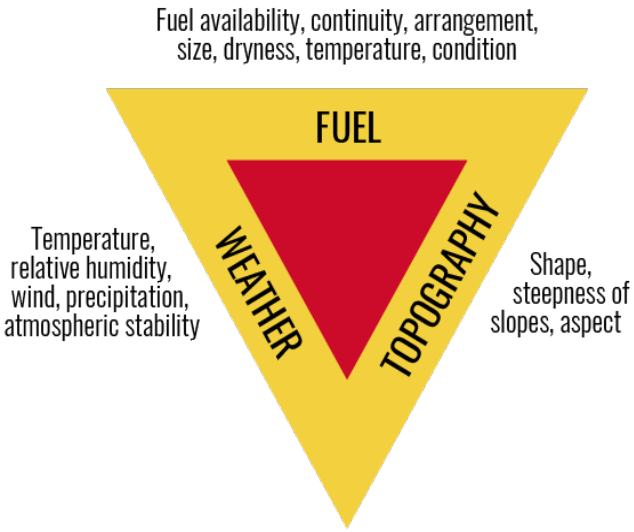
Appendix A. Introduction to Wildfire Behavior and Terminology

Fire Behavior Triangle

Complex interactions among wildland fuels, weather, and topography determine how wildfires behave and spread. These three factors make up the sides of the fire behavior triangle, and they are the variables that wildland firefighters pay attention to when assessing potential wildfire behavior during an incident (NWCG, 2019).



Interactions between fuels, weather, and topography dictate fire behavior. Source: California State University.

Fuels

Fuels include live vegetation such as trees and grasses, dead vegetation like pine needles and cured grass, and materials like houses, sheds, fences, trash piles, and combustible chemicals.

Grasses and pine needles are known as "flashy" fuels because they easily combust and burn the fastest of all fuel types. If you think of a campfire, flashy fuels are the kindling that you use to start the fire. Flashy fuels dry out faster than other fuel types when relative humidity drops or when exposed to radiant and convective heat[3]. Fires in grassy fuel types can spread quickly across large areas, and fire behavior can change rapidly with changes in weather conditions.

Dead branches on the surface dry out slower than flashy fuels, release more radiant heat when they burn, and take longer to completely combust. The rate of spread is fast to moderate through shrublands depending on their moisture content, and long flame lengths can preclude direct attack by firefighters. Shrubs and small trees can also act as ladder fuels that carry fire from the ground up into the tree canopy.

Dead trees (aka, snags) and large downed logs are called "heavy fuels," and they take the longest to dry out when relative humidity drops and when exposed to radiant and convective heat. Heavy fuels release tremendous radiant heat when they burn, and they take longer to completely combust,

[3] Radiant heat transfer occurs by short-wavelength energy traveling through air. Radiant heat is what you feel when sitting in front of a fire. Radiant heat preheats and dries fuels adjacent to a wildfire, which initiates combustion by lowering the fuel's ignition temperature. Convective heat transfer occurs when air is heated, travels away from the source, and carries heat along with it. Convective heat is what you would feel if you put your hand in the air above an open flame. Air around and above a wildfire expands as it is heated, causing it to become less dense and rise into a hot convection column. Cooler air flows in to replace the rising gases, and in some cases, this inflow of air creates local winds that further fan the flames. Hot convective gases move up slope and dry out fuels ahead of the flaming front, lowering their ignition temperature and increasing their susceptibility to ignition and fire spread.

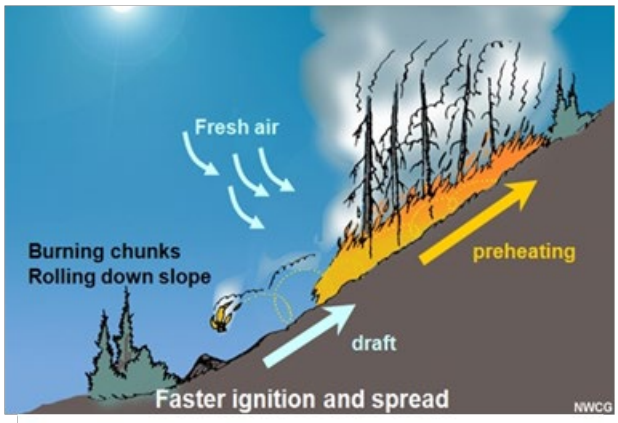
just like a log on a campfire. Fire spread through a forest is slower than in a grassland or shrubland, but forest fires release more heat and can be extremely difficult and unsafe for firefighters to suppress. An abundance of dead trees killed by drought, insects, or disease can exacerbate fire behavior, particularly when dead trees still have dry, red needles (Moriarty et al., 2019; Parsons et al., 2014).

Topography

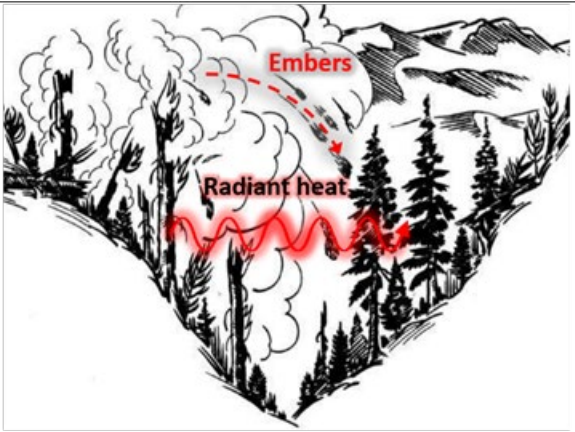
Topography (slope and aspect) influences fire intensity, speed, and spread. In the northern hemisphere, north-facing slopes experience less sun exposure during the day, resulting in higher fuel moistures. Tree density is often higher on north-facing slopes due to higher soil moisture. South-facing slopes experience more sun exposure and higher temperatures and are often covered in grasses and shrubs. The hotter and drier conditions on south-facing slopes mean fuels are drier and more susceptible to combustion, and the prevalence of flashy fuels results in fast rates of fire spread.

Fires burn more quickly up steep slopes due to radiant and convective heating. Fuels are brought into closer proximity with the progressing fire, causing them to dry out, preheat, and become more receptive to ignition, thereby increasing rates of spread. Steep slopes also increase the risk of burning material rolling and igniting unburnt fuels below.

Narrow canyons can experience increased combustion because radiant heat from a fire burning on one side of the canyon can heat fuel on the other side of the canyon. Embers can easily travel from one side of a canyon to the other. Topography also influences wind behavior and can make fire spread unpredictable. Wildfires burning through steep and rugged topography are harder to control due to reduced access for firefighters and more unpredictable and extreme fire behavior.



Slope increases fire spread through radiant and convective heating (source: NWCG).



Fires can easily cross narrow canyons (source: U.S. Forest Service).

Steep slopes and topographic features such as narrow canyons exacerbate fire behavior.

Weather

Weather conditions impacting fire behavior include temperature, relative humidity, precipitation, wind speed, and direction. The National Weather Service uses a system called a red flag warning to indicate local weather conditions that can combine to produce an increased risk of fire danger and behavior. Red flag warning days indicate an increased risk of extreme fire behavior due to a combination of hot temperatures, very low humidity, dry fuels, strong winds, and the presence of thunderstorms (**Table A.0.1**).

Direct sunlight and hot temperatures impact how ready fuels are to ignite. Warm air preheats fuels and brings them closer to their ignition point. When relative humidity is low, the dry air can absorb moisture from fuels, especially flashy fuels, making them more susceptible to ignition. Long periods of dry weather can dehydrate heavier fuels, including downed logs, increasing the risk of wildfires in areas with heavy fuel loads.

Wind influences fire behavior by drying out fuels (think how quickly your lips dry out in windy weather), increasing the amount of oxygen feeding the fuel, preheating vegetation through convective heat, and carrying embers more than a mile ahead of an active fire. Complex topography, such as chutes, saddles, and draws, can funnel winds in unpredictable directions, increasing wind speeds and resulting in erratic fire behavior.

Table A.0.1. Red flag days are warnings issued by the National Weather Service using criteria specific to a region.

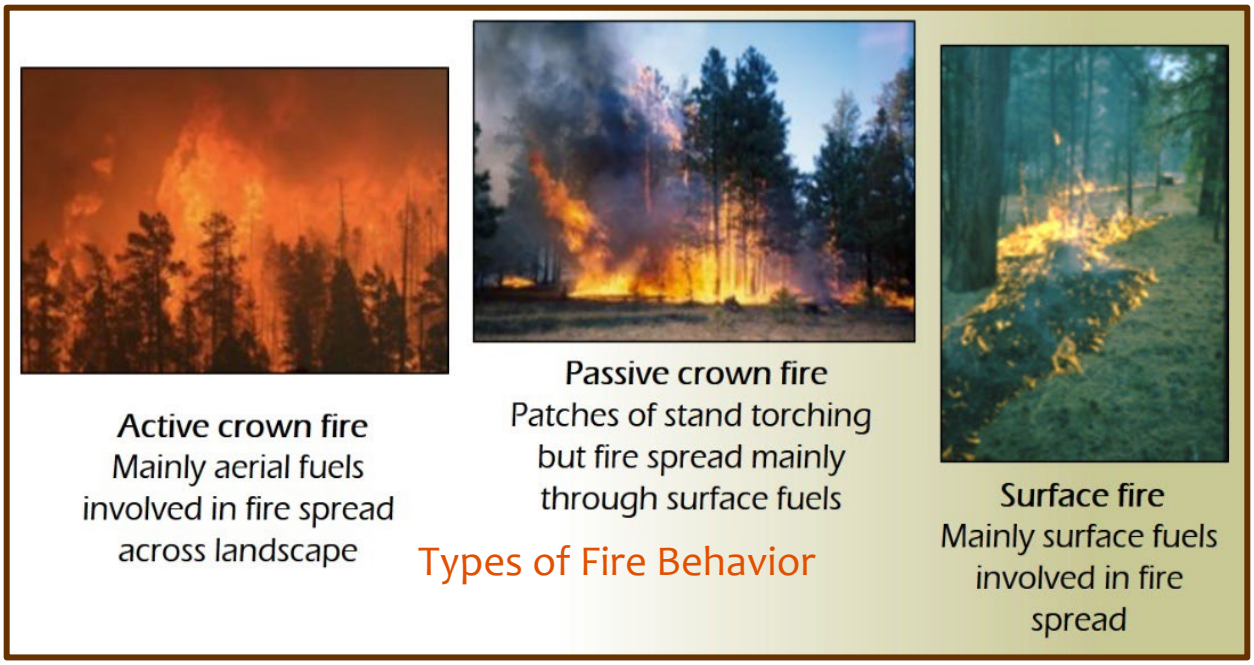
National Weather Service – Denver/Boulder Forecast Office **Red Flag Warning Criteria**	
Option 1	Option 2
Relative humidity less than or equal to 15%	Widely scattered dry thunderstorms
Wind gusts greater than or equal to 25 mph	Dry fuels
Dry fuels	

Categories of Fire Behavior

Weather, topography, and fuels influence fire behavior, and fire behavior in turn influences the tactical options available for wildland firefighters and the risks posed to lives and property. Three general categories of fire behavior are described throughout this CWPP: surface fire, passive crown fire, and active crown fire.

- **Surface fire –** Fire that burns fuels on the ground, which include dead branches, leaves, and low vegetation. Surface fires can be addressed with direct attack using handcrews when flame lengths are less than four feet and with equipment when flame lengths are less than eight feet. Surface fires can emit significant radiant heat, which can ignite nearby vegetation and homes.
- **Passive crown fire –** Fire that arises when a surface fire ignites the crowns of trees or groups of trees (aka, torching). Torching trees reinforce the rate of spread, but passive crown fires travel along with surface fires. Firefighters can sometimes address passive crown fires with an indirect attack, such as dropping water or retardant out of aircraft or digging fireline at a safe distance from the flaming front. The likelihood of passive crown fire increases when trees have low limbs and when smaller trees and shrubs grow below tall trees and act as ladder fuels. Radiant heat and ember production from passive crown fires can threaten homes during wildfires.
- **Active crown fire –** Fire in which a solid flame develops in the crowns of trees and advances from tree crown to tree crown independently of surface fire spread. Crown fires are very difficult to contain, even with the use of aircraft dropping fire retardant, due to long flame lengths and the tremendous release of radiant energy. The likelihood of active crown fires increases when trees have interlocking canopies. Radiant heat and ember production from active crown fires can threaten homes during wildfires.

Passive and active crown fires can result in short- and long-range ember production that can create spot fires and ignite homes. Spot fires are particularly concerning because they can form a new flaming front, move in unanticipated directions, trap firefighters between two fires, and require additional firefighting resources to control. Crown fires are generally undesirable in the wildland-urban interface (WUI) because of the risk to lives and property; however, passive and active crown fires are part of the natural fire regime for some forest types and result in habitat for plant and animal species that require recently disturbed conditions (Keane et al., 2008; Pausas and Parr, 2018). Historically, passive and active crown fires occurred in some lodgepole pine forests and higher-elevation ponderosa pine and mixed-conifer forests on north-facing slopes (Addington et al., 2018; Romme, 1982).



Wildfire Threats to Homes

Wildfires can ignite homes through several pathways: radiant heat, convective heat, and direct contact with flames or embers. The ability for radiant heat to ignite a home is based on the properties of the structure (i.e., wood, metal, or brick siding), the temperature of the flame, the ambient air temperature, and the distance from the flame (Caton et al., 2016). Ignition from convective heat is more likely for homes built along steep slopes and in ravines and draws. For flames to ignite a structure, they must directly contact the building long enough to cause ignition. Flames from a stack of firewood near a home could cause ignition to the home, but flames that quickly burn through grassy fuels are less likely to ignite the home (although the potential still exists). Fires can also travel between structures along fuel pathways, such as a fence or row of shrubs connecting a shed and a home (Maranghides et al., 2022). Some housing materials can burn hotter than the surrounding vegetation, thereby exacerbating wildfire intensity and initiating home-to-home ignition (Mell et al., 2010).

Homes built mid-slope and at the top of steep slopes and within ravines and draws are at greater risk of convective heat from wildfires. A wildfire could rapidly spread up this steep slope and threaten the home above. Photo credit: LFRA.

Homes can be destroyed during wildfires even if surrounding vegetation has not burned. During many wildland fires, 50 to 90% of homes ignite due to embers rather than radiant heat or direct flame (Babrauskas, 2018; Gropp, 2019). Embers can ignite structures when they land on roofs, enter homes through exposed eaves, or get under wooden decks. Embers can also ignite nearby vegetation and other combustible fuels, which can subsequently ignite a home via radiant heating or direct flame contact. Burning homes can release embers that land on and ignite nearby structures, causing destructive home-to-home ignitions, as evidenced by the destructive 2021 Marshall Fire in Boulder County. Structural characteristics of a home can increase its exposure to embers and risk of combustion, such as wood shingle roofs and unenclosed eaves and vents (Hakes et al., 2017; Syphard and Keeley, 2019). Embers can also penetrate homes if windows are destroyed by radiant or convective heat. See your community's CWPP for specific recommendations to harden your home against wildfires.

Resources for More Information on Fire Behavior

- Introduction to Fire Behavior from the National Wildfire Coordinating Group (9:57 minute video)
- The Fire Triangle from the National Wildfire Coordinating Group (7:26 minute video)
- Understanding Fire Behavior in the Wildland/Urban Interface from the National Fire Protection Association (20:51 minute video)
- Understanding Fire from California State University (website)
- S-190 Introduction to Wildland Fire Behavior Course Materials from the NWCG (PowerPoints, handouts, and videos)

Appendix B. Community Risk Assessment and Modeling Methodology

WUI Delineation

Delineating the wildland-urban interface is a critical component of CWPPs in compliance with the Healthy Forest Restoration Act (HFRA) of 2003. Communities can extend the WUI boundary into adjacent areas that pose a wildfire threat to their community, that can serve as a strategic location for wildland firefighting, and that are adjacent to evacuation routes for the community (HFRA 4 U.S.C. §101.16). Strategic wildfire mitigation across the WUI can increase the safety of residents and wildland firefighters and reduce the chances of home loss.

Fire behavior models can provide reasonable estimates of relative wildfire behavior across a landscape. However, wildfire behavior is complex, and models are a simplification of reality. It is recommended to use fire behavior analyses at a landscape scale to assess relative risk across the entire LFRA. Models cannot produce specific and precise predictions of what will occur in the vicinity of an individual home during a wildfire.

We delineated the WUI for LFRA to include any area that could transmit wildland fire into the community during a 4-hour period in the absence of firefighter suppression and control measures under extreme fire weather conditions with 25 mph winds out of the west based on wildfire modeling with FlamMap (see below). In light of the Marshall Fire but in absence of enough research and collaborative guidance on grasslands along the Colorado Front Range as a form of WUI, the Core Team agreed to define the grassland-urban interface (GUI) as a subset of WUI that encompasses everywhere within and around LFRA that could burn based on the same criteria as above. It is delineated separately due to the difference in the way the vegetation burns, the treatments necessary to reduce wildfire risk, and the lack of guidance on how to address fires that are both wildfires and urban conflagrations.

Fire Behavior Analysis

Interpretations and Limitations

Fire behavior models have been rigorously developed and tested based on over 40 years of experimental and observational research (Sullivan, 2009). Fire behavior models allow us to identify areas that could experience high-severity wildfires and pose a risk to lives, property, and other values at risk.

We used the fire behavior model FlamMap, which is a fire analysis desktop application that simulates potential fire behavior and spread under constant weather and fuel moisture (Finney, 2006). FlamMap is one of the most common models used by land managers to assist with fuel treatment prioritization, and it is often used by fire behavior analysts during wildfire incidents.

Fire behavior analyses are useful for assessing relative risk across the entirety of LFRA and are not intended to assess specific fire behavior in the vicinity of individual homes. It is not feasible to predict every combination of fire weather conditions, ignition locations, and suppression activities that might occur during a wildfire. Uncertainty will always remain about where and how a wildfire

might behave until a fire is actually occurring, and even then, fire behavior can be erratic and unpredictable.

Fire behavior models like FlamMap do not include structures as a fuel type. Structures like homes, sheds, fences, and other buildings are absolutely a source of fuel during wildland fires and can produce massive amounts of embers that contribute to home-to-home ignitions (Maranghides et al., 2022). However, FlamMap cannot account for fine-scale variation in surface fuel loads, defensible space created by individual homeowners, and the ignitability of building materials, nor are these data available at the scale of individual homes across an entire fire authority. In the absence of this information and a deeper quantitative understanding of interactions between structures and wildland vegetation during a wildfire, fire behavior cannot be modeled for areas dominated by homes in the same fashion as areas dominated by grassland, shrubland, or forest vegetation. For this reason, we conducted a separate analysis to predict potential exposure of homes to radiant heat and ember cast (see section below).

Model Specifications and Inputs

We used FlamMap to model flame length, crown fire activity, potential fire sizes, and conditional burn probability. FlamMap requires information on topography and fuel loads across the area of interest (**Figure B.1**). See **Table B.1** and **Table B.2** for details on model inputs and specifications.

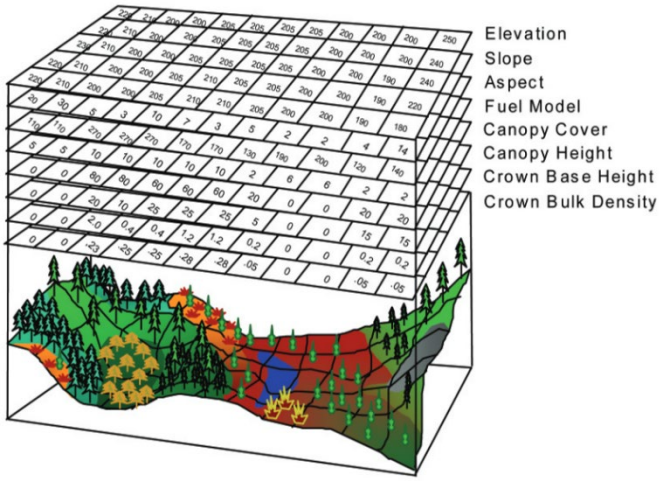


Figure B.1. FlamMap requires a variety of information about topography and fuels. Image from Finney (2006).

We used 2015 LANDFIRE data modified by the Colorado Forest Restoration Institute in 2021 as the basis for our modeling. LANDFIRE is a national program spearheaded by the U.S. Department of the Interior and the U.S. Department of Agriculture to provide spatial products characterizing vegetation, fuels, fire regimes, and disturbances across the entire United States. LANDFIRE products serve as standardized inputs for fire behavior modeling. CFRI modified 2015 LANDFIRE data by assigning TL5 fire behavior fuel model to lodgepole pine forests and reducing canopy base height by 30% to more closely replicate observed crown fire activity in this forest type. They also modified surface and canopy fuels in areas that experienced fuel treatments and/or wildfires since 2016. We thoroughly quality controlled fuel data and worked with LFRA to assess the reasonableness of model predictions.

Figure B.2 depicts the fire behavior fuel models present across LFRA. Fuel models are a stylized set of fuel bed characteristics used as input for a variety of wildfire modeling applications to predict fire behavior (Scott and Burgan, 2005). Our maps of fire behavior predictions include areas indicated as "unburnable / not modeled"—parking lots, roadways, bodies of water, and barren areas are considered unburnable; areas dominated by homes and buildings were classified as "not modeled" because fire behavior models do not include structures as a fuel type (Scott and Burgan, 2005).

Fire behavior models require estimates of fire weather conditions, and a common practice is to model fire behavior under hot, dry, and windy conditions for an area—not the average conditions,

but extreme conditions. Wildfires that grow to large sizes, exhibit high-severity behavior, and overwhelm suppression capabilities tend to occur under extreme fire weather conditions (Williams, 2013).

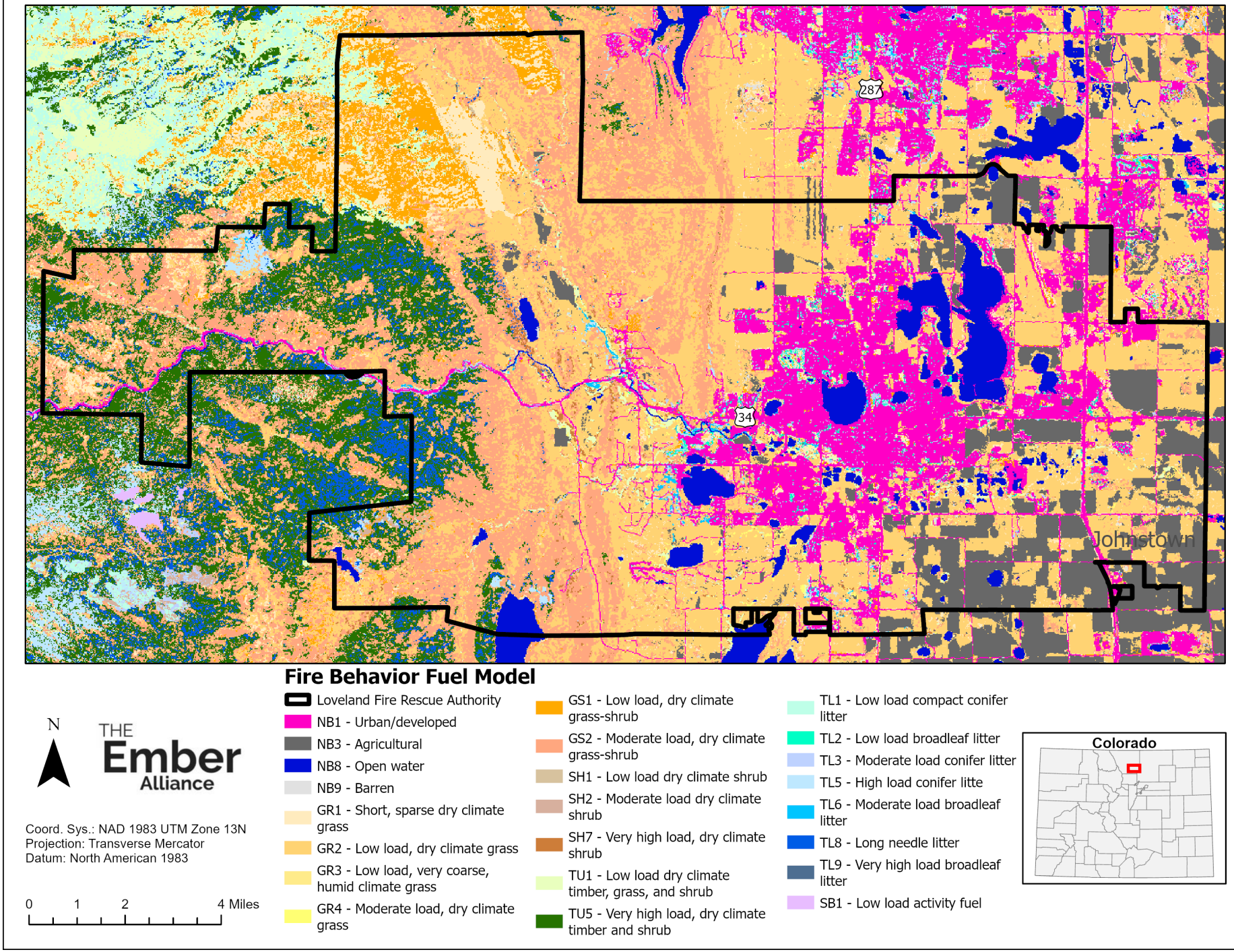
We modeled potential wildfire behavior under moderate (60th percentile) and extreme (90th percentile) fire weather conditions (**Table B.2**). Weather parameters for this analysis came from data collected at the Estes Park RAWS with additional data pulled and fuel moisture conditions from FireFamilyPlus. 60th percentile conditions are like a normal summer day, whereas 90th percentile conditions are extremely hot, dry days—days that would qualify for red flag warnings and result in large-fire growth, such as conditions in early September 2020 during the Cameron Peak fire. These two benchmarks allow us to analyze where an average fire in LFRA may burn so LFRA can prioritize outreach and treatment under regular circumstances, as well as what can be expected under more extreme circumstances, as was seen in 2020.

Winds across the Front Range of Colorado are unpredictable and can be extremely gusty in mountainous areas. We modeled 20-foot windspeeds of 15 mph for moderate fire weather conditions and 25 mph for extreme fire weather conditions. Wind speeds of 25 mph qualify as red flag warnings when occurring with low relative humidity and dry fuels (**Table A.1**). We modeled potential fire spread under winds blowing out of the west (270°) and blowing out of the south (180°) based on observations from the Estes Park RAWS and a temporary RAWS set up on Storm Mountain, as well as observations of local firefighters. We modeled flame length and crown fire activity based on west winds, and we modeled burn probability based on both these prevailing winds.

Windspeeds from personal weather stations are measured a few feet above the ground, but fire behavior models require 20-foot windspeeds, which are defined as sustained wind over a 10-minute period at 20 feet above the dominant vegetation. The wind adjustment factor to convert 20-foot windspeeds to midflame windspeeds is 0.2 for fully sheltered fuels in open stands (NWCG, 2021). Vegetation and friction slow down windspeeds closer to ground level. The adjustment factor to convert ground-level winds to 20-foot windspeeds is 5, the inverse of 0.2.

Fire spread was modeled with FlamMap's "minimum travel time" algorithm to predict fire growth between cells and account for fire spread through spotting. We modeled fire growth under 6,000 random ignitions across the landscape, and we allowed fires to grow for 4 hours in the absence of firefighter suppression and control measures. We modeled fire behavior in an area five and a half times larger than LFRA and centered on LFRA to capture the landscape-scale movement of fire.

FlamMap offers two methods for calculating crown fire initiation and spread: the Scott and Reinhardt method and the Finney method. We used the Scott and Reinhardt method as this method resulted in predictions of crown fire occurrence more consistent with expectations and has been found more reliable than the Finney method (Scott, 2006). Conditional burn probability is calculated as the percentage of simulated fires that burn each 30-meter by 30-meter (0.2 acre) area under specified fire weather conditions, wind directions, and wind speeds.



187 **Figure B.2.** 20% of LFRA's response area is urban or agricultural land in the east, and the west side is where the very high timber litter fuels are. The rest of LFRA is primarily low to moderate load dry climate grass, shrub, timber, and litter fuels. Fire behavior fuel models are an important input for making fire behavior predictions. See Scott and Burgan (2005) for a description of each fuel model. Source: 2016 LANDFIRE.

Table B.1. Model specifications used for fire behavior analyses with FlamMap for the 2023 LFRA CWPP.

Model specification	Value
Crown fire calculation method	Scott/Reinhardt (2001)
Wind options	Gridded winds
Wind grid resolution	60 meters
Number of random ignitions	6,000*
Resolution of calculations	30 meters
Maximum simulation time	240 minutes
Minimum travel paths	500 meters
Spot probability	0.7
Spotting delay	15 minutes
Lateral search depth	6 meters
Vertical search depth	4 meters

*We used the same random ignition locations for fire spread analysis under moderate and extreme fire weather conditions.

Table B.2. Fire weather conditions utilized for fire behavior modeling are based on weather observations from the Estes Park Remote Automatic Weather Station between June 15 to October 15, 2014-2021 and fuel moisture predictions from FireFamilyPlus. Weather conditions on October 21, 2020 during the East Troublesome Fire are presented for comparison.

Variable	Moderate fire weather (60th percentile)	Extreme fire weather (90th percentile)	East Troublesome Fire (for comparison)
Temperature	74° Fahrenheit	82° Fahrenheit	67° Fahrenheit
Relative humidity	25%	13%	14%
Wind direction	Scenario 1: South (180°) Scenario 2: West (270°)	Scenario 1: South (180°) Scenario 2: West (270°)	South-southwest (235°)
20-foot wind speed[1]	15 mph	25 mph	6 mph, gusting to 30 mph
Fuel moisture[2]			
1-hour	5%	3%	3.2%
10-hour	6%	4%	4.5%
100-hour	9%	7%	9.7%
1000-hour[3]	12%	10%	
Live woody	84%	71%	60%
Live herbaceous	49%	35%	3.2%
Crown foliage	100%	80%	

[1]20-foot wind speeds are approximately 5 times faster than winds at ground level in fully sheltered fuels; vegetation and friction slow down windspeeds closer to ground level (NWCG, 2021).

[2]One-hour fuels are dead vegetation less than 0.25 inch in diameter (e.g., dead grass), ten-hour fuels are dead vegetation 0.25 inch to 1 inch in diameter (e.g., leaf litter and pine needles), one hundred-hour fuels are dead vegetation 1 inch to 3 inches in diameter (e.g., fine branches), and one thousand-hour fuels are dead vegetation 3 inches to 8 inches in diameter (e.g., large branches). Fuels with larger diameters have a smaller surface area to volume ratio and take more time to dry out or to become wetter as relative humidity in the air changes.

[3]1000-hour fuel is moisture not used by FlamMap for predicting fire behavior but is included here to provide additional context.

Predicted Fire Behavior

Wildland firefighters pay attention to current and expected fire behavior when making tactical decisions. Fire behavior classes are based on flame length, rate of spread, and crown fire activity and are utilized by firefighters to guide tactical decisions following the Haul Chart (**Table B.3**).

Flame length is the distance measured from the average flame tip to the middle of the flaming zone at the base of the fire. Flame length is measured at an angle when the flames are tilted due to effects of wind and slope (see image at right). Flame length is an indicator of fireline intensity—the amount of energy released by a fire. **Figure B.3** depicts predicted flame lengths across LFRA.

The occurrence of torching (aka, passive crown fire), spotting, and active crown fire are notable fire behaviors that must inform tactical decisions on the fireline. Both passive and active crown fires pose a significant risk to the safety of firefighters and residents and can destroy homes through radiant and convective heating and ember production. See **Appendix A** for a description of different types of fire behavior. **Figure B.4** depicts crown fire occurrence across LFRA.

Fire behavior class was determined for LFRA by combining predictions of flame length and crown fire activity following the Haul Chart. Under moderate fire weather conditions—conditions typical of a summer day in LFRA—24% percent of LFRA could experience high to extreme fire behavior, and this percentage increases to 36% under less common but more extreme, hot, dry, and windy conditions (**Figure B.5**). High to extreme fire behavior includes ember production that ignites additional fires away from the main fire and the movement of high-intensity fire from treetop to treetop. Such fires are extremely challenging if not impossible to control until winds die down and fuel moistures increase.

The northwestern side of LFRA could experience fast-moving fires with moderate flame lengths because they were previously burned and have tall grasses. The Big Thompson Canyon and surrounding area has steep, north-facing slopes with dense forests and abundant ladder fuels and could experience extreme and erratic fire behavior. Each of the plan units in this area – Big Thompson Canyon, Waltonia, Bartram Park, Palisade, Pinewood/Flatiron, and Cedar Park – are expected to have more than half their land area burning with very high to extreme fire behavior on extreme weather days, similar to the conditions during the Cameron Peak blowups or Marshall Fire days. Bartram Park, Cedar Park, and Waltonia also have more than half of the roads in that unit potentially non-survivable under the same conditions, creating a potentially disastrous situation.

Firefighters would struggle to suppress fires across LFRA under hot, dry, and windy conditions due to extreme flame lengths and radiant heat emissions. Exceptional hot, dry, and windy conditions are increasingly common due to climate change and could result in even more extreme fire behavior across LFRA than predicted by this analysis.

Table B.3. Description of fire behavior and tactical interpretations for firefighters from the Haul Chart (NWCG, 2019).

Fire behavior class	Flame length (feet)	Rate of spread (chains/hr)*	Tactical interpretation
Very low, smoldering	<1	0-2	Fire is not spreading and has limited flaming. Fire can be attacked at the head or flanks by persons using handtools. Handline will hold the fire.
Low, creeping, spreading	1-4	2-5	Fire can be attacked at the head or flanks by persons using handtools. Handline should hold the fire.
Moderate, running	4-8	5-20	Fires are too intense for direct attack on the head of the fire by persons using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft may be effective.
High, torching and spotting	8-11	20-50	Fires present serious control problems with torching, crowning, and spotting. Control efforts at the head of the fire are probably ineffective.
Very high, active crown fire	11-25	50-150	Crowning, spotting, and major fire runs are expected. Control efforts at the head of the fire are ineffective.
Extreme and erratic	>25	>150	Extreme intensity, turbulent fire, and chaotic spread. Escape to safety should be considered.

*__Note:__ 1 chain = 66 feet. Chains are commonly used in forestry and fire management as a measure of distance. 1 chain / hour = 1.1 feet / minute.

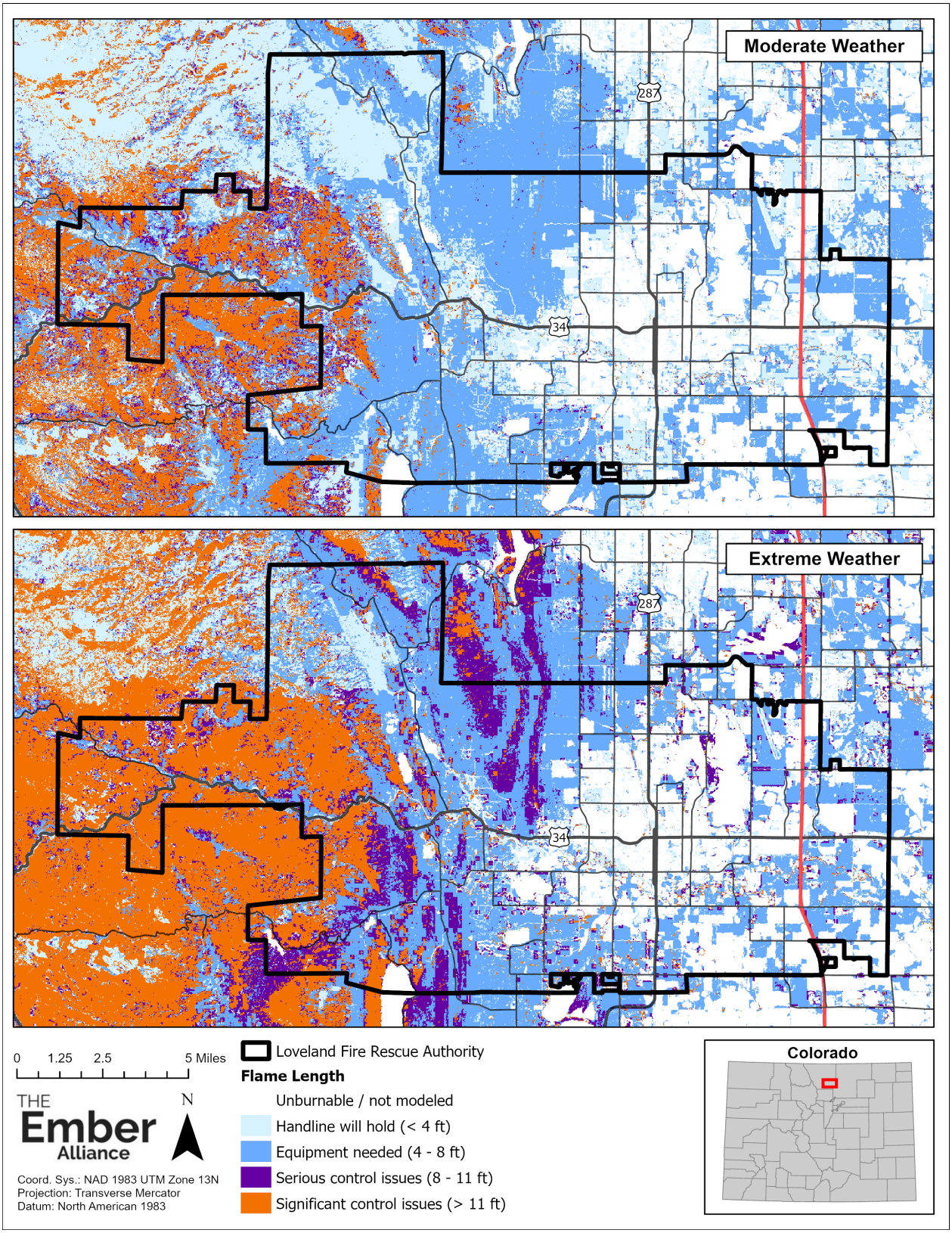


Figure B.3. Flame lengths in LFRA under moderate and extreme fire weather conditions, categorized by the Haul Chart (**Table B.3**).

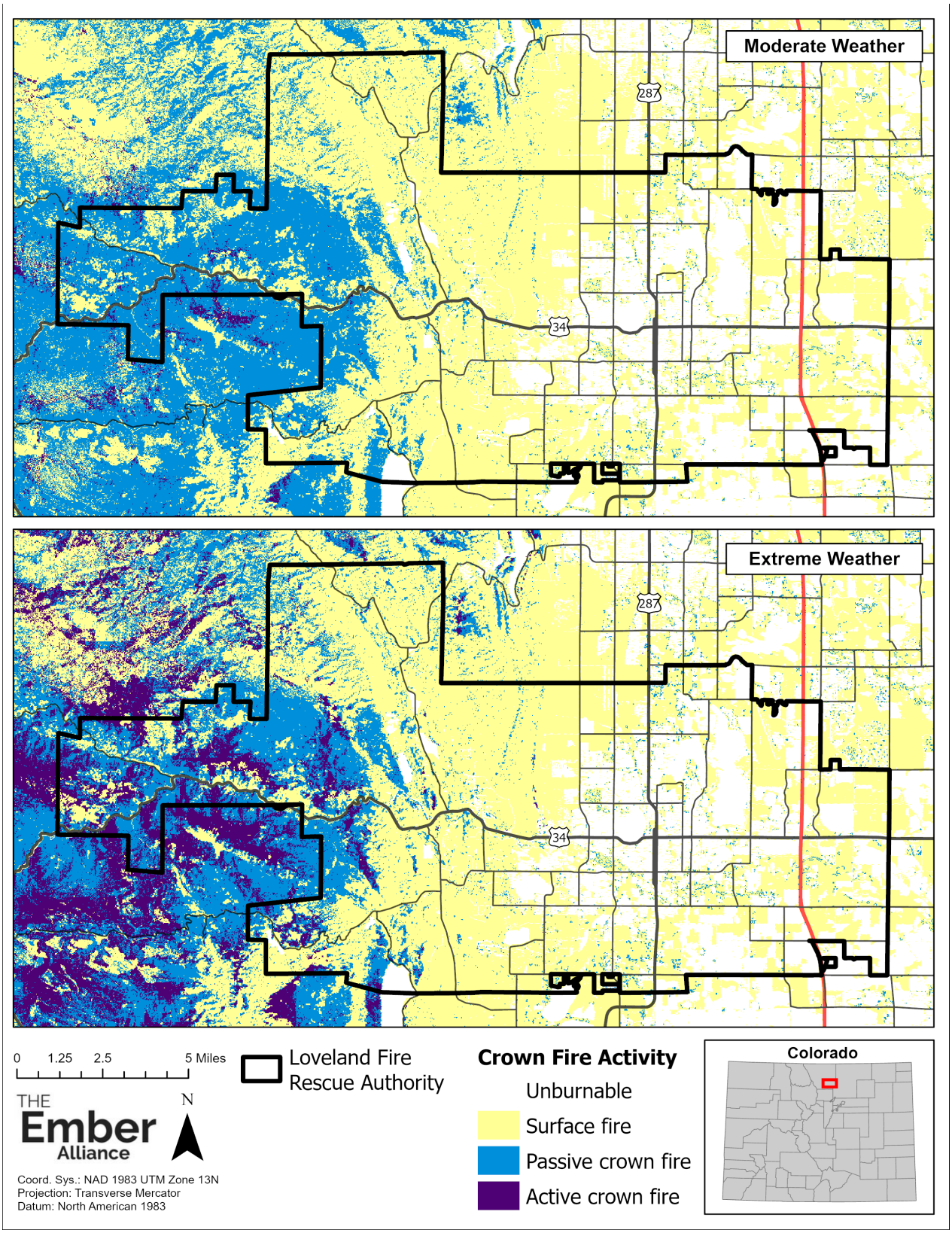


Figure B.4. Crown fire activity in LFRA under moderate and extreme fire weather conditions.

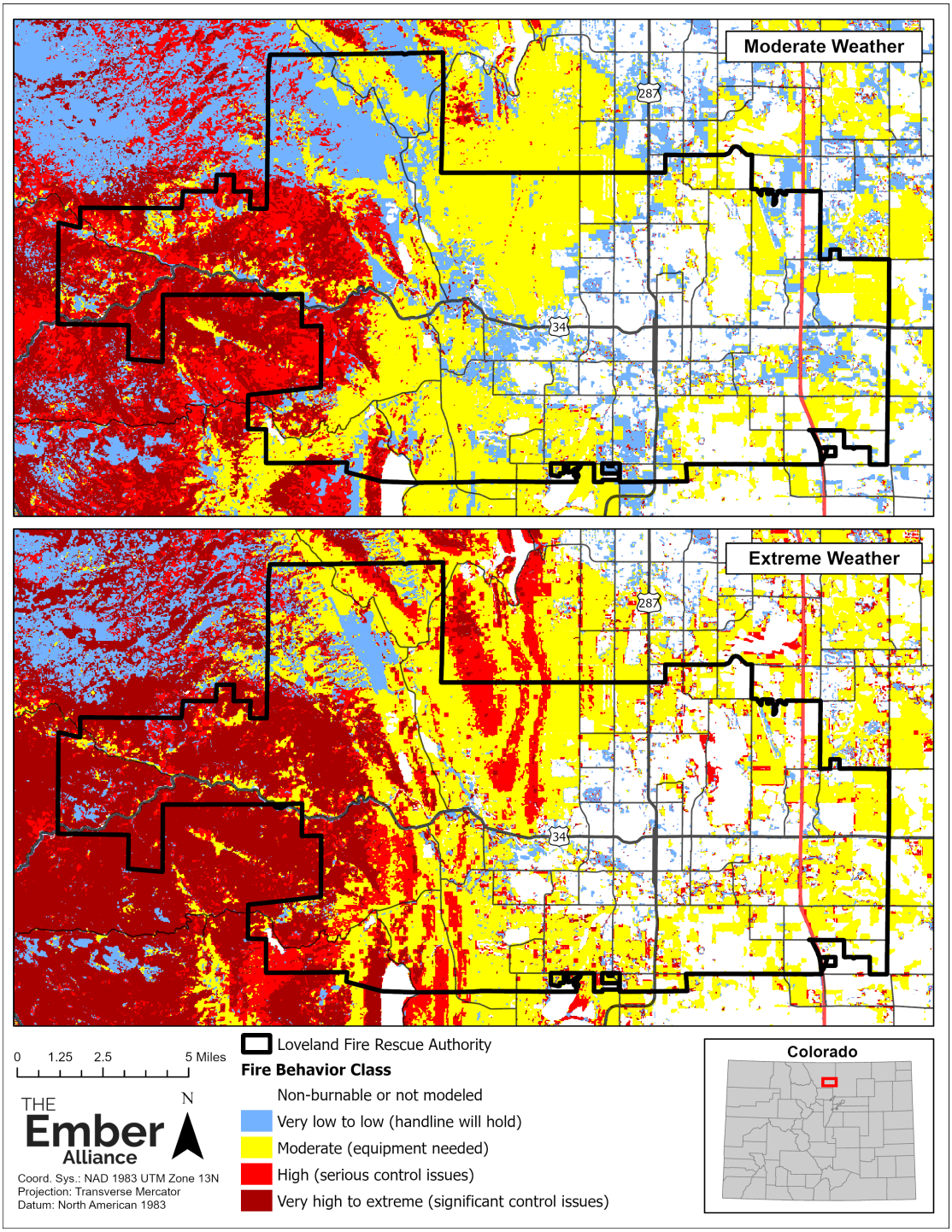


Figure B.5. Under moderate fire weather conditions—a typical summer day —24% percent of LFRA could experience high to extreme fire behavior, and this percentage increases to 36% under less common but more extreme, hot, dry, windy conditions. High to extreme fire behavior includes ember production that ignites additional fires away from the main fire and the movement of high-intensity fire across treetops. Such fires are extremely challenging if not impossible to control until winds die down and fuel moistures increase. View an interactive map online.

Predicted Conditional Burn Probability

Conditional burn probability indicates how likely an area is to burn during a wildfire. Wind direction strongly affects burn probability, carrying fires quickly up slopes facing toward the incoming winds. Topography, non-burnable barriers such as wide rivers, interstates, and highways, and fuel loads also influence conditional burn probability by dictating how fire spreads across the landscape.

Short-range transport of embers can cause spot fires to ignite even across unburnable barriers such as US Highway 34. Rapid fire growth and spotting across roadways is more likely under higher windspeeds and with drier fuel conditions. **Unpredictable wind conditions along the Colorado Front Range make it difficult to predict potential fire spread, making it imperative for residents across LFRA to take measures to mitigate their home ignition zone.**

The relative burn probability is distinctly higher west of Wilson Rd. To the east, there is a lot of developed lands and irrigated agriculture, meaning a lower likelihood of vegetation catching on fire. However, the west side of LFRA has higher fuels loads and is more likely to have large fires and fire behavior that encourages spotting and rapid fire growth (**Figure B.6**). Glade Road, Northwest Loveland, Masonville, Buckskin Heights, Southwest Loveland, Eden Valley, Waltonia, Carter/Sedona, and Pinewood/Flatiron are most likely to burn and the Downtown plan units as well as the River Corridor are least likely to see fire.

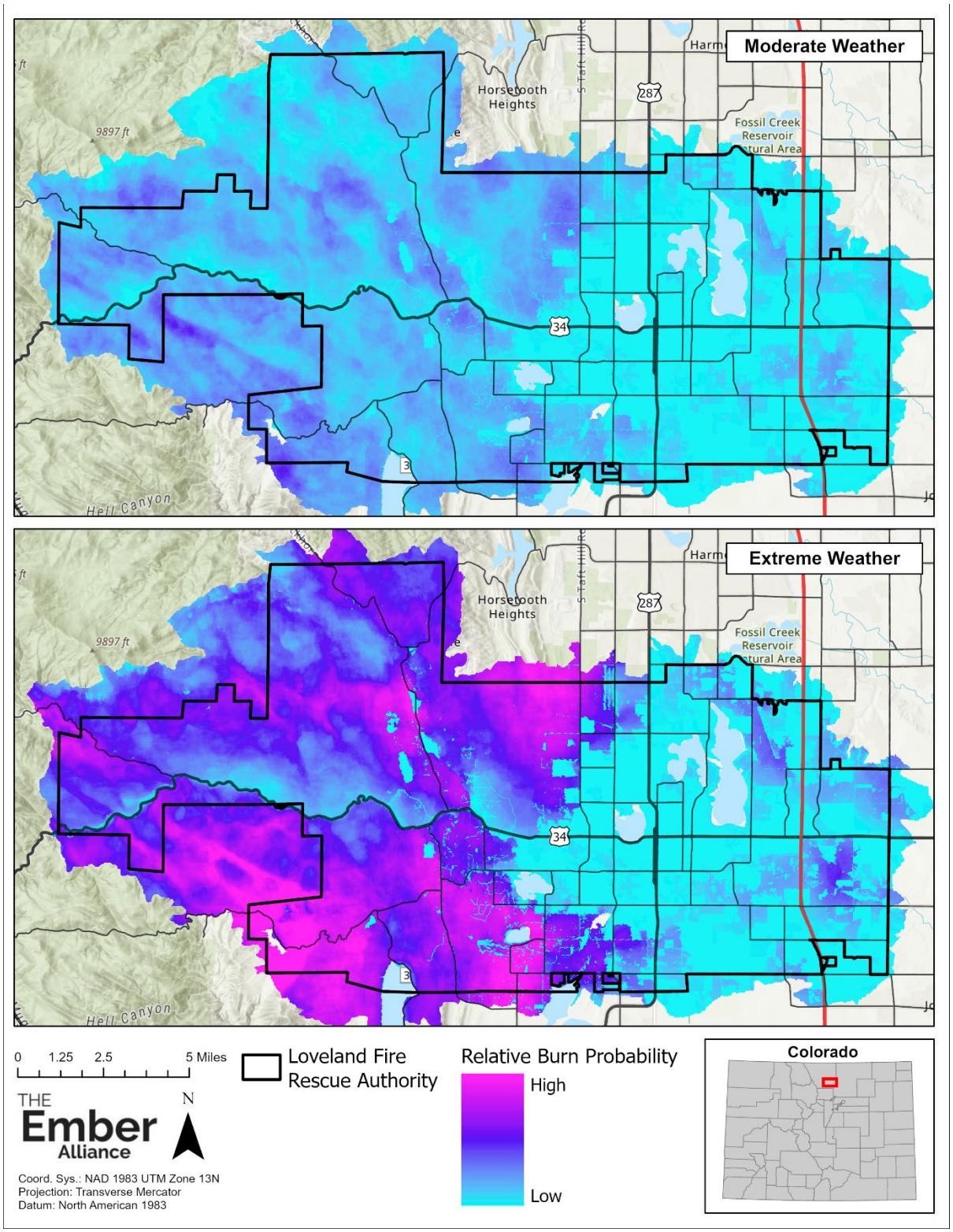


Figure B.6. Conditional burn probability under moderate and extreme fire weather conditions with winds from the west and the south. Wildfire spread was simulated for 4-hours without suppression activities from 6,000 random ignition locations across an area 5.5 times larger than and centered on LFRA. View an interactive map online.

Predicted Radiant Heat and Ember Cast Exposure

We assessed the risk that radiant heat and short-range and long-range ember cast pose to structures[4]. See **Appendix A** for a description of how wildfires can ignite homes. Ember production and transport and their ability to ignite recipient fuels are guided by complex processes, so we utilized the simplified approach of Beverly et al., (2010) to assess home exposure to radiant heating and short- and long-range ember cast. Exposure is based on distance from long flame lengths and potential active crown fire assuming:

- Radiant heat can ignite homes when extreme fire behavior (flame lengths > 16 feet) occurs within 33 yards (30 meters) of structures.
- Short-range embers can reach homes within about 110 yards (100 meters) of active crown fires.
- Long-range embers can reach homes within about 550 yards (500 meters) of active crown fires.

Embers can ignite homes even when the flaming front of a wildfire is far away. See Section 3.a. Mitigate the Home Ignition Zone for tangible and relatively simple steps you can take to harden your home against embers. Mitigation practices, such as removing pine needles from gutters and installing covers over vents, can make ignition less likely and make it easier for firefighters to defend your property.

Distance thresholds used by Beverly et al., (2010) are based on observations from actual wildfires, but their estimates are lower than those from some researchers. Studies on wildfires burning eucalyptus forests in Australia and wildfires burning chaparral in California demonstrated that embers can travel 12 to 15 miles from the flaming front and ignite spot fires (Caton et al., 2016), but these fuel types are very different from conifer forests in Colorado. Embers from ponderosa pine trees tend to ignite fuels at a much lower rate than embers from other tree species (Hudson et al., 2020). In addition, the number of embers reaching an area decreases exponentially with distance traveled, and the likelihood of structure ignition increases with the number of embers landing on the structure (Caton et al., 2016). Therefore, using conservative estimates of distance allows us to identify areas with the greatest risk of ignition from short- and long-range embers.

Potential exposure to radiant heating and long- and short-range ember cast is widespread across LFRA, and this awareness should encourage residents and business owners to complete home hardening practices to reduce the risk of ignition. Potential exposure to radiant heat, short-range ember cast, and long-range ember cast is focused on the western edge of LFRA (**Figure B.8**). Under moderate fire weather, less than 1% of homes in the eastern portion of LFRA are at risk of exposure to radiant heat and less than 1% to long-range ember cast, and these percentages increase to 3% of homes potentially exposed to radiant heat and 6% potentially exposed to long-range ember cast under extreme fire weather. In the western half of LFRA, 9% of homes are at risk of exposure to radiant heat and 16% to long-range ember cast, and these percentages increase to 28% of homes potentially exposed to radiant heat and 62% potentially exposed to long-range ember cast under extreme fire weather (**Figure B.7**, **Figure B.8**). Under moderate fire weather, nearly half of the

[4] It is recommended to use this analysis to assess relative risk across the entire Fire Authority and not to evaluate absolute risk to individual homes. FlamMap and the approach of Beverly et al. (2010) cannot account for defensible space, the fire resistance of materials used in home construction, and other fine-scale variation in fuel loads that contribute to the ignition potential of individual homes.

structures in Waltonia are at risk of radiant heat exposure, and more than half the homes in Palisade, Cedar Park, Pinewood/Flatiron, Waltonia, and Big Thompson are at risk of long-range ember cast. Under extreme fire weather, **every single home (100%)** in Palisade, Cedar Park, Waltonia, Big Thompson, and Bartram Park are at extreme risk of embers and radiant heat.

99% of structures in LFRA could be exposed to short-range ember cast from at least one other home, which puts all those homes at risk of home-to-home ignition, especially if they are not mitigated or hardened (Syphard et al., 2012). On average, homes could be exposed to short-range ember cast from more than 11 other homes, with some homes exposed to as many as 88 other homes. Fuel treatments within HIZs and surrounding undeveloped areas could help reduce the exposure of homes to radiant heat and short-range spotting for homes in the rural parts of LFRA (**Figure B.9**). All homes should be built and upgraded with ignition-resistant materials to reduce the effects of short-range ember cast.

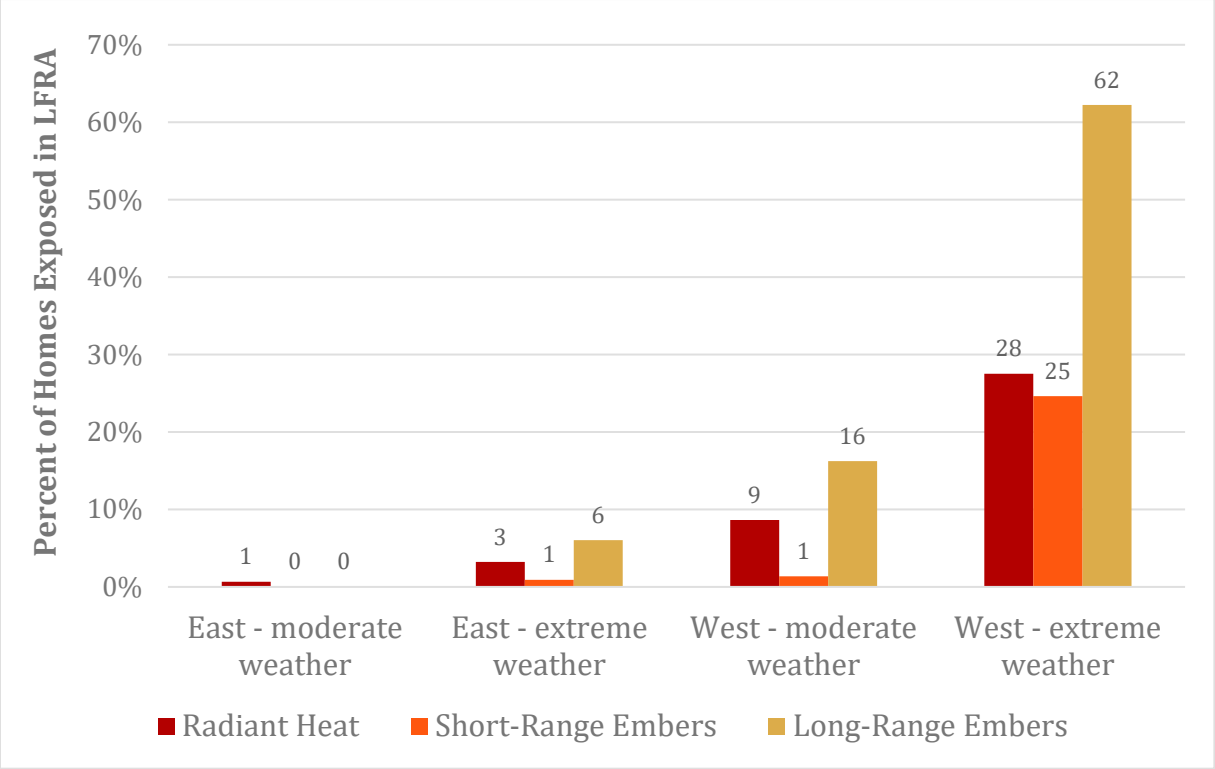


Figure B.7. Percentage of homes in east vs west LFRA (divided at Wilson Ave) with different types of exposure to wildfire under moderate and extreme fire weather conditions. Radiant heat from burning vegetation can ignite nearby homes, and embers emitted from burning vegetation or other homes can travel long distances and ignite vegetation and homes away from the main fire.

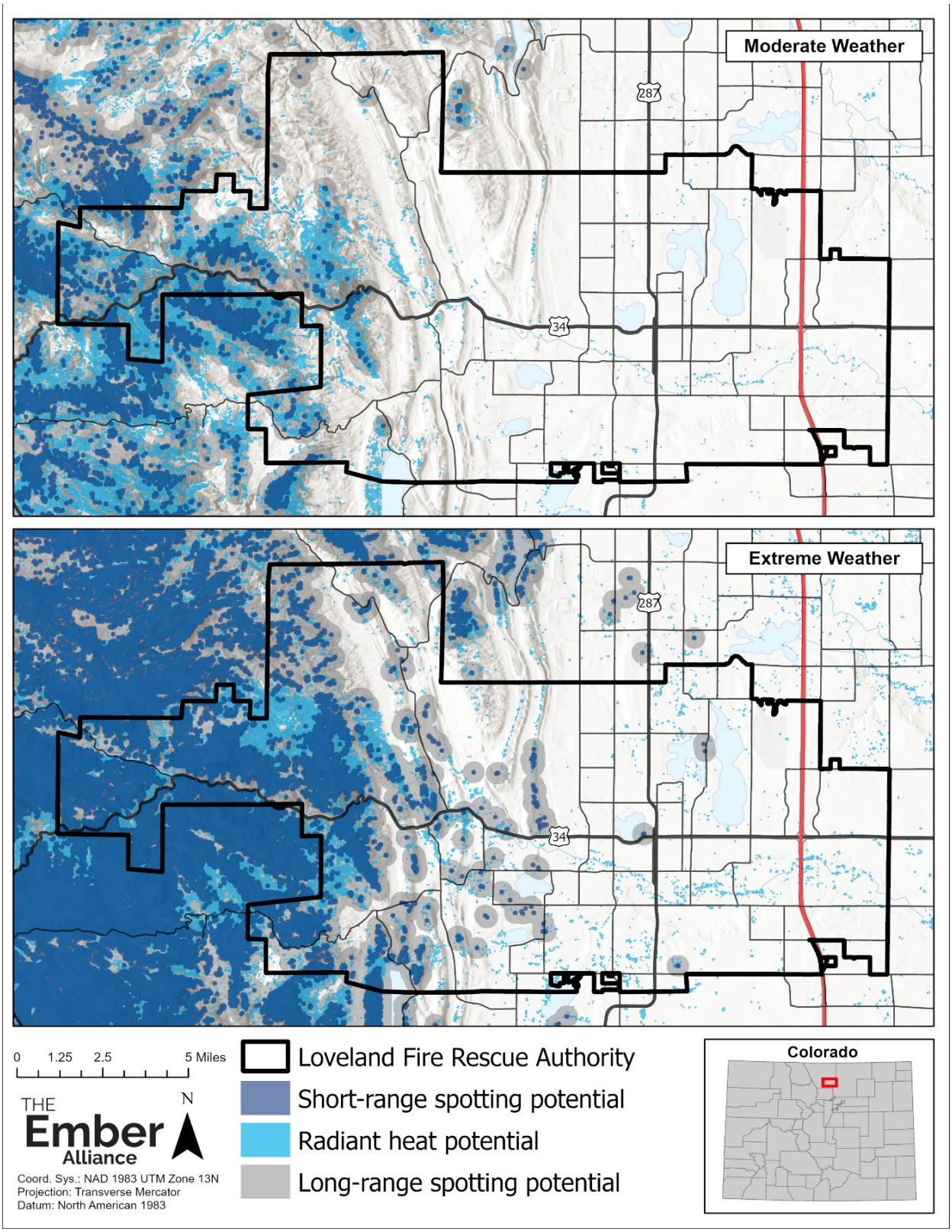


Figure B.8. Predicted exposure to short-and long-range ember cast and radiant heat under moderate and extreme fire weather conditions in LFRA.

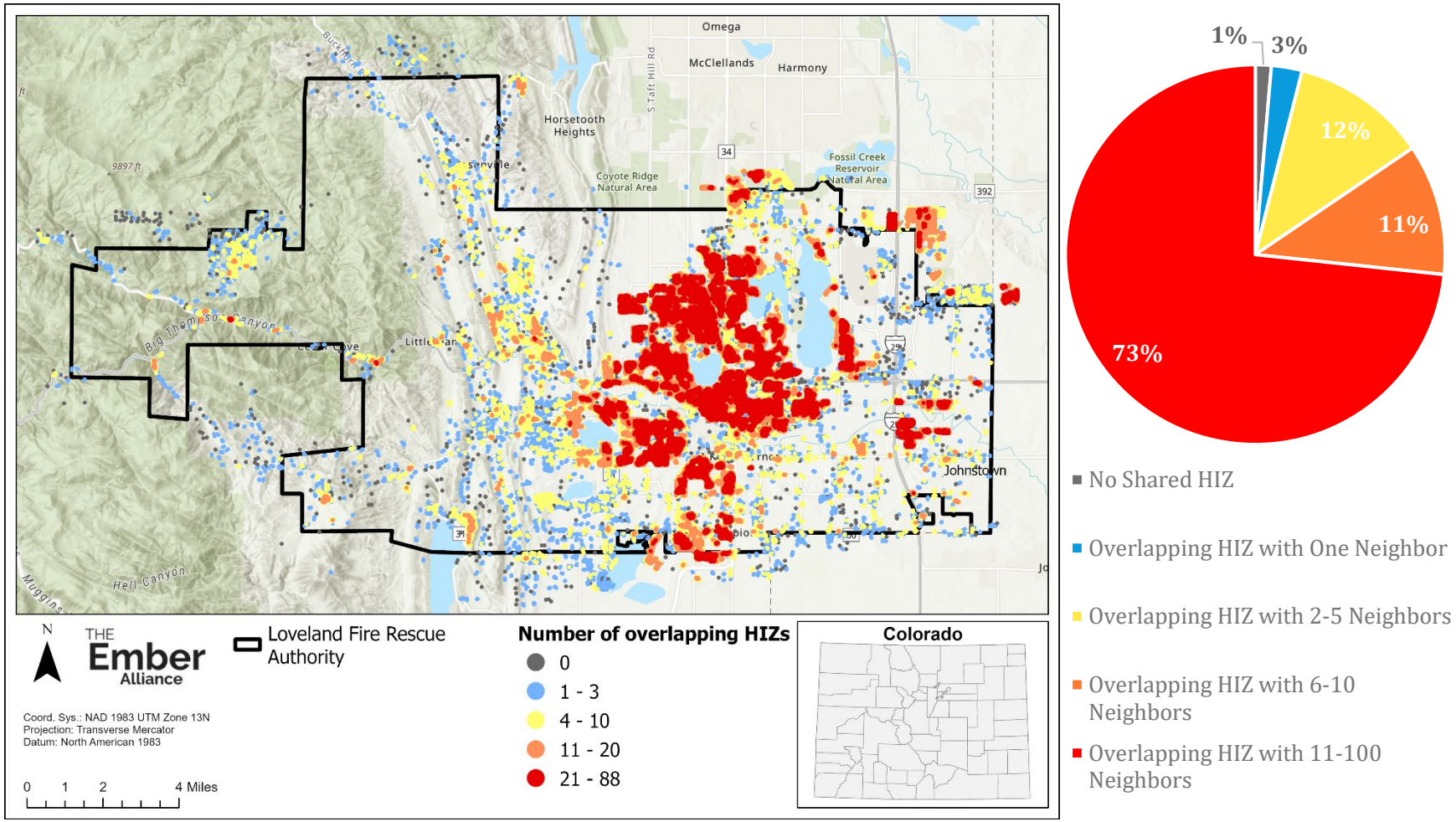


Figure B.9. 99% of homes could be exposed to short-range ember cast from at least one neighboring home, with the average home in LFRA potentially exposed to short-range ember cast from 11 or more other homes. Homes within 100-meters of other homes are at greater risk of home-to-home ignitions from short-range ember cast (Syphard et al., 2012).

Roadway Analysis

Evacuation concerns can weigh heavily on the minds of many residents in LFRA. The death of 86 people in Paradise, California during the 2018 Camp Fire, many of whom were stranded on roadways during evacuation, underscores the importance of evacuation preparedness and fuel mitigation along evacuation routes. **Mitigation actions along sections of road with high risk for non-survivable conditions during a wildfire can increase the chances of survival for residents stranded in their vehicles during a wildfire and decrease the chance that roadways become impassable due to flames.**

It is important for law enforcement personnel to plan for areas of high congestion when making decisions about how to conduct actual evacuations in LFRA. Roads were categorized by how much congestion may occur during evacuations based on knowledge of prior evacuations and professional expertise from firefighters and law enforcement (**Figure B.10**). Roads with extreme congestion include Highway 34 west of Wilson Ave and Highway 34 and County Road 43 west of their junction in the canyon. Wilson Ave and Buckhorn Rd/ County Road 27 both can back up to about a mile north of their intersection with Highway 34, and Buckhorn Rd is known to be congested to the northwest of its intersection with County Road 38E. The intersection of Pole Hill Rd and County Road 29 going north is also a location for potential major congestion. Some of these roads are one-lane in each direction and, in the event of a crash or other roadway blockage, be inaccessible to emergency responders if the congestion were especially bad. For example, Highway 34 doesn't have regular shoulders for pulling off or moving accidents out of traffic.

We utilized fire behavior predictions to identify road segments that could experience non-survivable conditions during a wildfire. We used roadway data from OpenStreetMap and the Colorado Department of Transportation, with modifications to the road network based on local expertise. We identified "non-survivable roadways" as portions of roads adjacent to areas with predicted flame lengths greater than 8 feet. Drivers stopped or trapped on these roadways could have a low chance of survival due to radiant heat emitted from fires of this intensity. This assumption is based on the Haul Chart, which is a standard tool used by firefighters to relate flame lengths to tactical decisions (**Table B.3**) (NWCG, 2019). Direct attack of a flaming front is no longer feasible once flame lengths exceed about 8 feet due to the intensity of heat output. Flames greater than 8 feet could also make roads impassable and cut residents off from egress routes. Non-survivable conditions are more common along roads lined by thick forests with abundant ladder fuels, such as trees with low limbs and saplings and tall shrubs beneath overstory trees.

Under moderate fire weather conditions, 8% of the roads in west LFRA could experience non-survivable conditions, and this percentage rises to 25% under extreme fire weather conditions (**Figure B.11**). Non-survivable roads east of Wilson Ave are negligible. In three of the planning units, at least 20% of the roads are potentially non-survivable under moderate fire weather conditions (Waltonia, Cedar Park, and Pinewood/Flatiron), and under extreme weather conditions more than half of the roads in Cedar Park, Waltonia, and Bartram Park planning units are potentially non-survivable, with Waltonia and Cedar Park facing nearly 75% of the roadways being potentially non-survivable at some point during a fire. Some non-survivable road segments are part of key evacuation routes and a high priority for mitigation to reduce fuels and potential flame lengths, including portions of Highway 34 and County Road 43, and many of the roads that connect to them such as Waltonia Road, Storm Mountain Drive, Pole Hill Rd, and County Road 29. We identified these areas as evacuation pinch points and incorporated them into recommendations for roadside fuel treatments across LFRA.

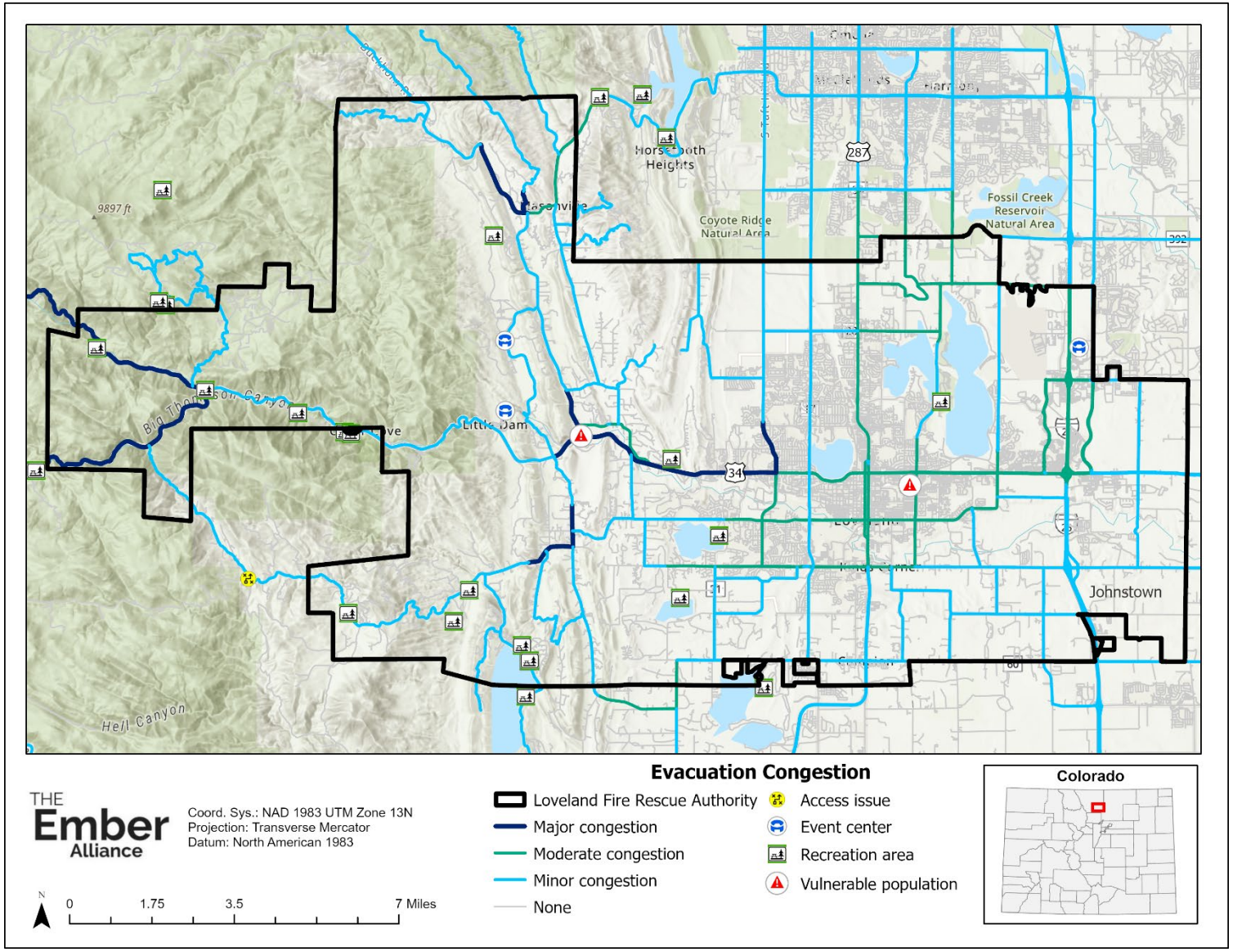


Figure B.10. Predicted congestion across LFRA. This map was created through discussions with the Fire Authority, local sheriff's office, and other stakeholders that have experience with evacuations and local roadway conditions.

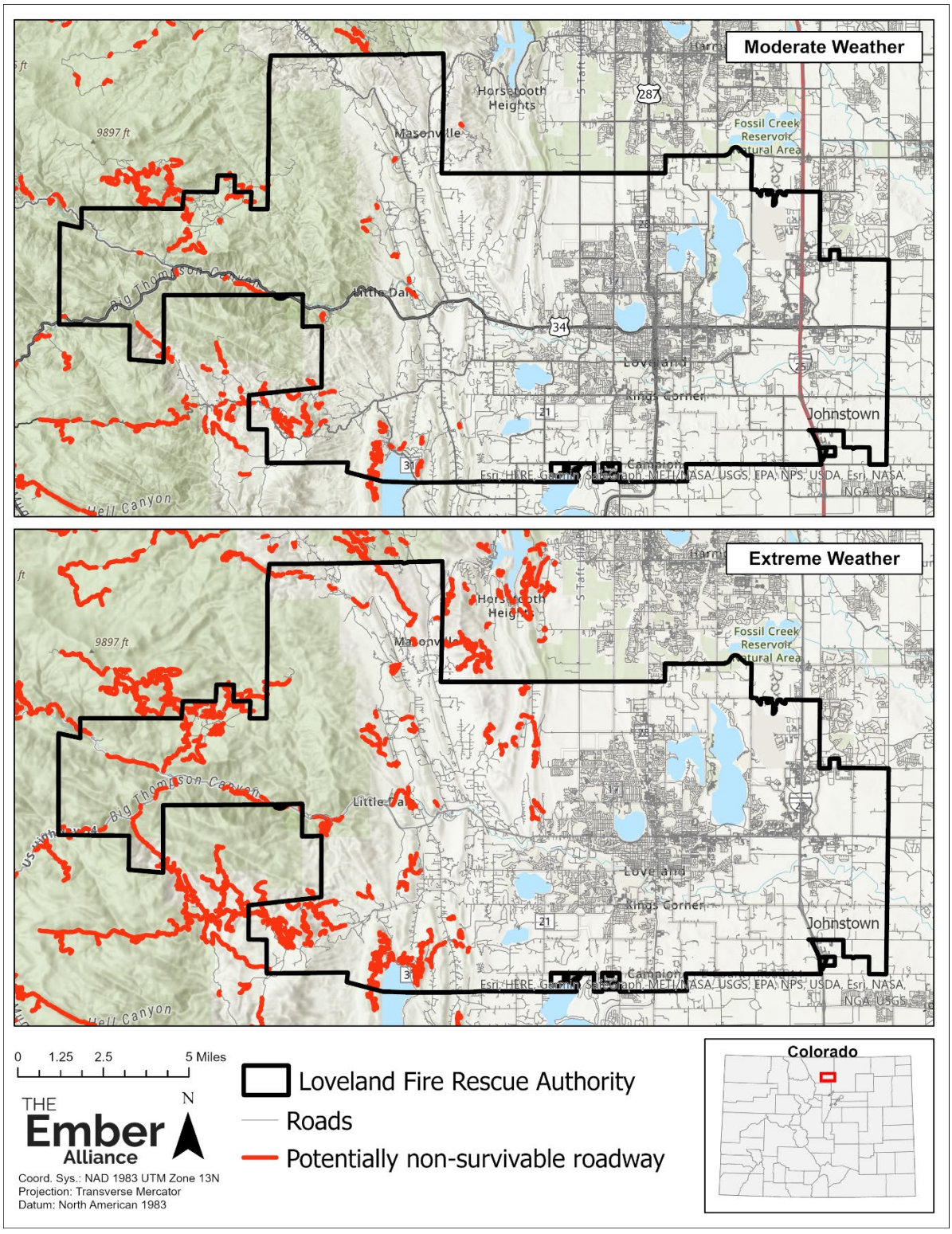


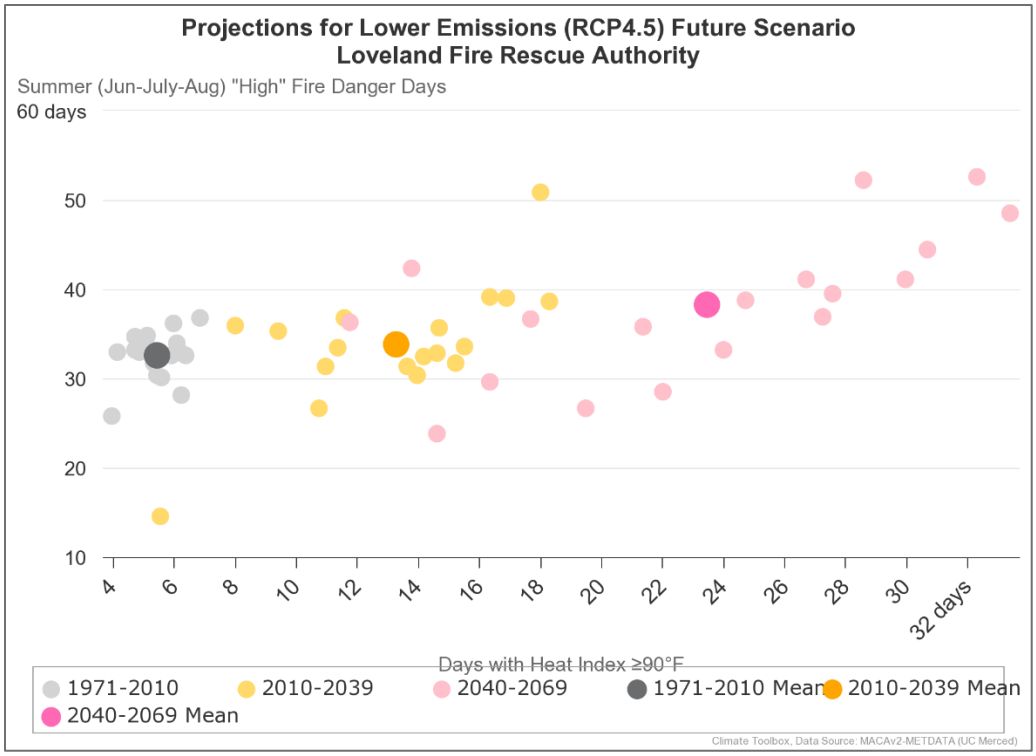
Figure B.11. Under moderate fire weather conditions, 2% of roads and driveways in LFRA could potentially experience non-survivable conditions during wildfires (i.e., flame lengths over 8 feet). This percentage rises to 6% under extreme fire weather conditions. In the areas west of Wilson Ave, where the roads are more exposed, 8% of roads are potentially non-survivable under moderate weather and 25% under extreme weather. View an interactive map online.

Climate Change Assessment

Climate change has a measurable impact on fire intensity and frequency, and this is likely to continue given current trajectories. Fire behavior modeling for this CWPP utilizes weather data from 2002-2022 and does not include future weather predictions. Therefore, we used the Climate Toolbox's Future Climate Scatter to explore the potential for exacerbated fire weather conditions in the future for this area. This tool models climate scenarios for the next fifty years using the Representative Concentration Pathways 4.5 and 8.5. These two models forecast future climate scenarios based on different levels of global greenhouse gas emissions. We analyzed six variables: the number of days expected to be "high fire danger" days, days with a heat index over 90°F, 100-hour fuel moisture levels, the number of days with temperatures over 86° Fahrenheit, vapor pressure deficit, and the length of growing season.

The models predict that under moderate or intense greenhouse gas concentrations, LFRA will experience hotter summer temperatures and an increased number of days considered to be high fire danger. In the next 50 years, it would be reasonable to expect maximum summer temperatures to increase by 5-7° Fahrenheit, and **the number of days with high fire danger is likely to increase by 6-8 more days per year (Figure B.12).** Fuel moistures will continue to drop on average, and the number of days each year that hit over 86° F will likely double **(Figure B.13)**. Vapor pressure deficits (VPD) could increase on average from 1.6 to 2.4, and the growing season will increase by 25-35 days, meaning more time for fuels to grow (**Figure B. 14.**).. Vapor pressure deficit is a meaningful measurement of moisture stress experienced by plants, more so than relative humidity because vapor pressure deficit is independent of temperature. High values of VPD indicate that the air can draw more moisture out of leaves while they photosynthesize, resulting in drier fuels. Higher vapor pressure deficits in the future due to climate change, coupled with longer growing seasons, means that fuels will be even drier and more ready to burn for a longer period of time during hot summer months.

Fire behavior has the potential to be extreme based on the weather from the past twenty years, and it may be even more extreme and frequent under the future conditions presented here. This behavior could include longer flame lengths, faster rates of spread, higher fire severity, and more crown fire activity. More extreme fire behavior increases danger to the life safety of residents, as well as to their homes, businesses, and community resiliency.



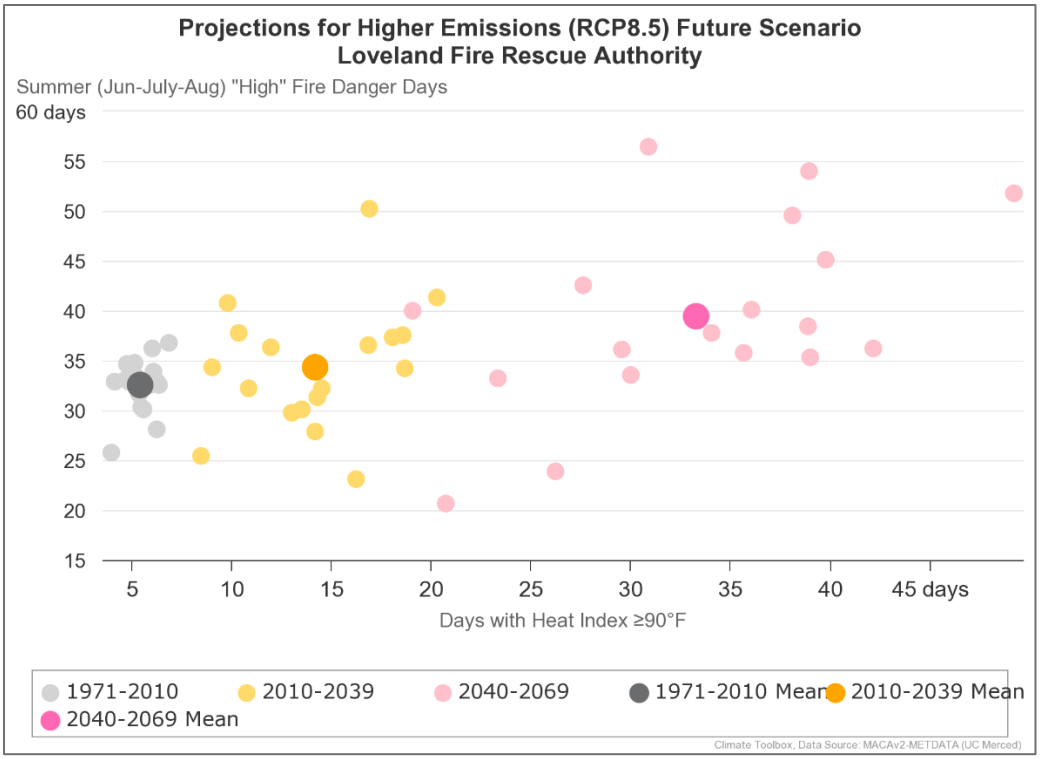
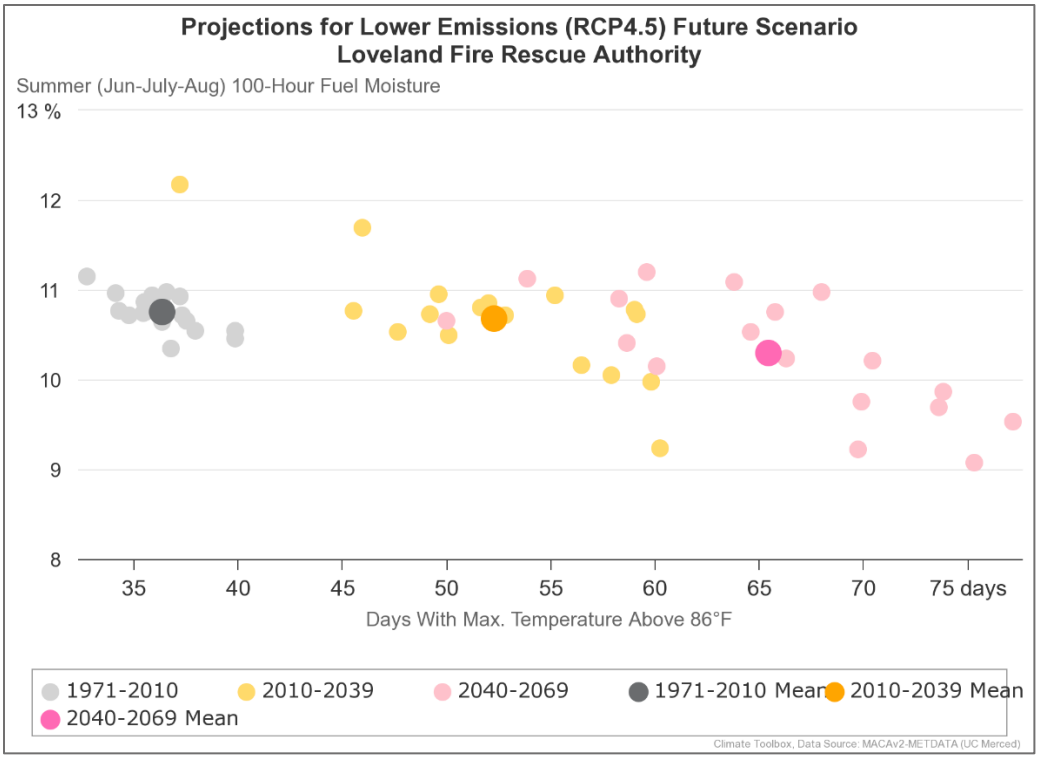


Figure B.12. Potential number of days with a heat index of 90° F or greater and number of days per year with high fire danger in LFRA modelled with the Climate Toolbox Future Climate Scatter (Hegewisch et al., 2021). The top graph is modelled under the RCP 4.5 scenario, where greenhouse gas emissions stabilize before the year 2100, peaking around 2040. The bottom graph is modelled under the RCP 8.5 scenario, where greenhouse gas emissions are not curtailed by 2100.



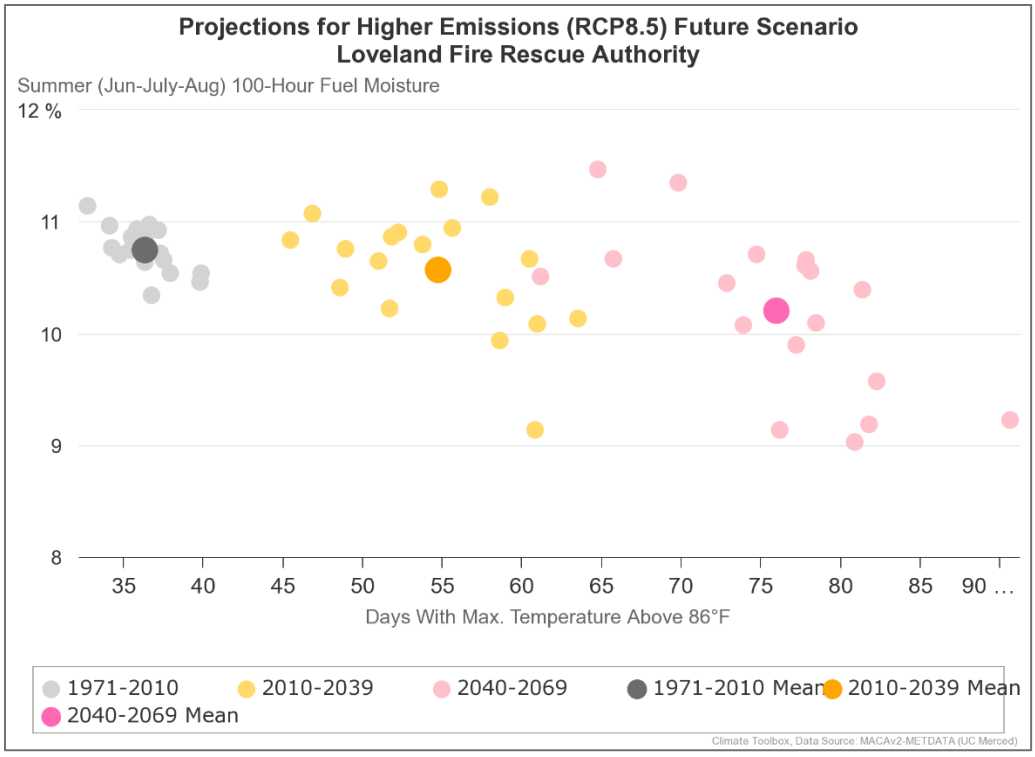


Figure B.13. Potential summer 100-hour fuel moisture and days with a max temp of over 86° F in LFRA modelled with the Climate Toolbox Future Climate Scatter (Hegewisch et al., 2021). The top graph is modelled under the RCP 4.5 scenario, where greenhouse gas emissions stabilize before the year 2100, peaking around 2040. The bottom graph is modelled under the RCP 8.5 scenario, where greenhouse gas emissions are not curtailed by 2100.

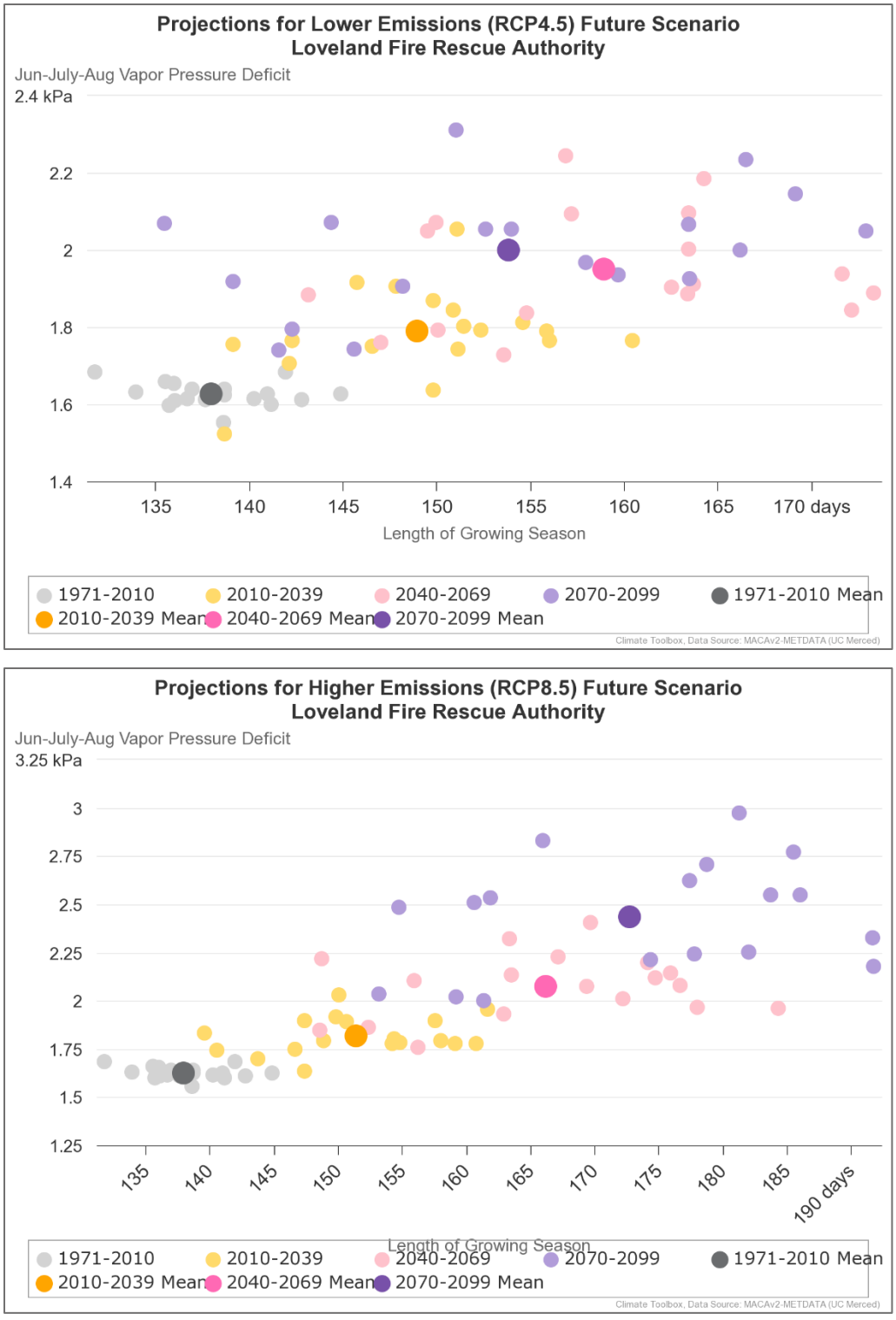


Figure B. 14. Potential future vapor pressure deficit and predicted length of the growing season in LFRA modelled with the Climate Toolbox Future Climate Scatter (Hegewisch et al., 2021). The top graph is modelled under the RCP 4.5 scenario, where greenhouse gas emissions stabilize before the year 2100, peaking around 2040. The bottom graph is modelled under the RCP 8.5 scenario, where greenhouse gas emissions are not curtailed by 2100.

Plan Unit Relative Risk Assessment

CWPP Plan Units

We compared the ***relative*** risk that wildfires pose to life and property in 18 plan units across LFRA (**Figure B.15**). Plan units are areas with shared fire risk where residents can organize and support each other to effectively mitigate hazardous fuels across the plan unit. To delineate plan units in LFRA, we considered clusters of addresses, evacuation routes, vegetation, and local knowledge of community organization. Topographic features were considered by utilizing sub-watershed boundaries to guide plan unit boundaries. We included topographic features into the delineation process to ensure that different units encompass areas with similar fire behavior. Land ownership also played a role in establishing unit boundaries. No plan unit splits a land parcel, ensuring that fuel treatment recommendations within each plan unit can be realistically implemented by landowners. Amendments were made to boundaries based on local knowledge from LFRA.

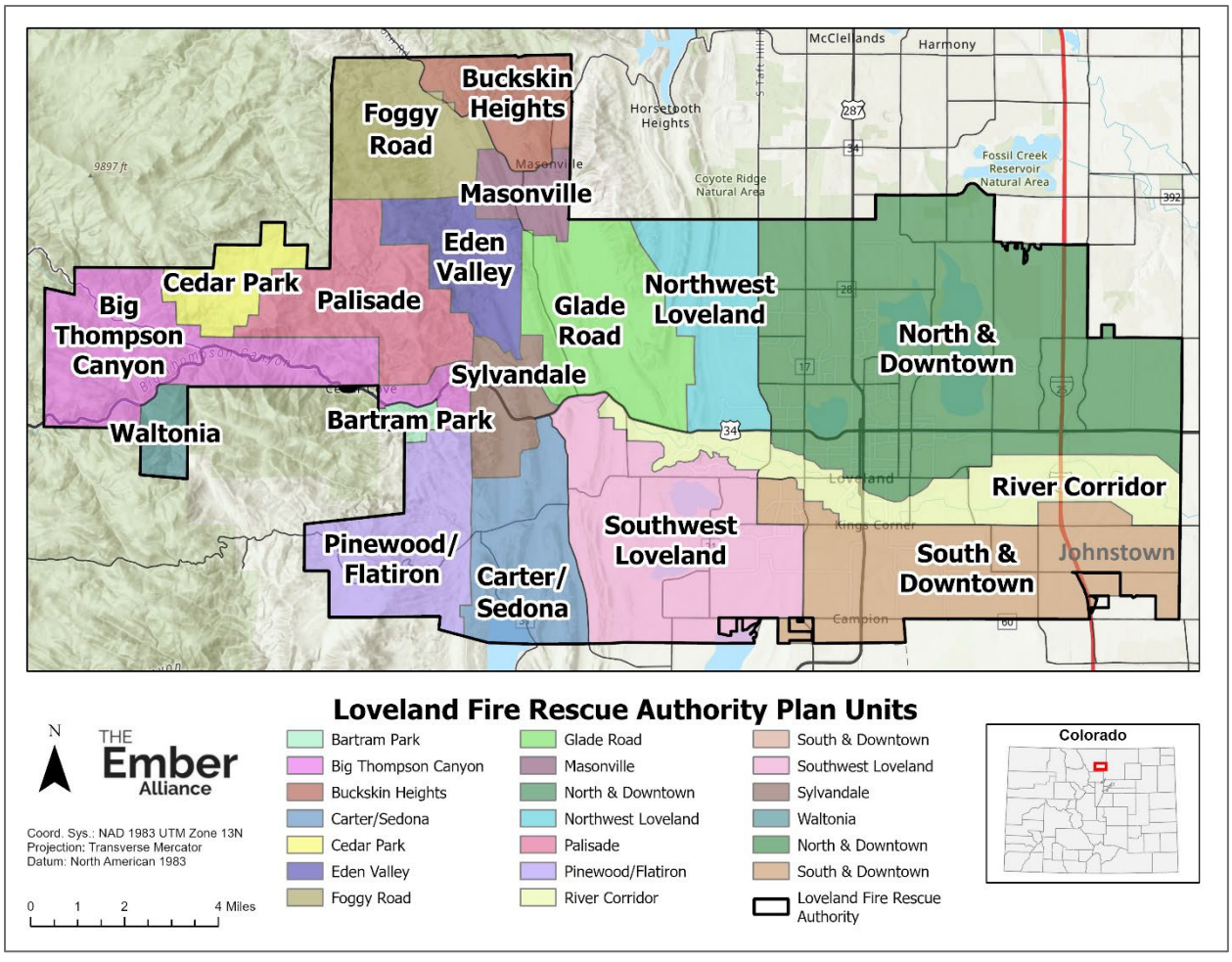


Figure B.15. CWPP plan units in LFRA. View an interactive map online.

Risk Rating Approach

Some plan units in LFRA have high risk from wildfire damage, and to help prioritize hazard mitigation, we developed a rating of relative risk. A plan unit receiving a relative rating of "moderate risk" has risk factors that are lower than risk factors in other plan units, but it is still an area with wildfire hazards. We assessed hazards in four categories: fire risk, fire suppression challenges (e.g., limited hydrant availability and engine access), evacuation hazards, and home ignition zone hazards. We developed the ratings of relative risk specifically for LFRA, so the assessment is not suitable for comparing this fire authority to other communities in Colorado or the United States.

Our assessment was based on predictions of fire behavior, radiant heat and ember cast exposure, roadway survivability, and evacuation time, as well as an on-the-ground assessment of each plan unit. Between November 2022 and March 2023, LFRA firefighters drove around LFRA and used a modified version of the NFPA Wildfire Hazard Severity Form Checklist (NFPA 299 / 1144) to rate home ignition zone hazards within each plan unit.

A rating scale was developed specifically for LFRA based on the range of values observed across the community (**Table B.4**). The purpose of the assessment is to compare relative hazards within the community and is not suitable for comparing LFRA to other communities.

Table B.4. Relative risk rating values for LFRA.

	Points		Relative hazard rating		
Hazard category	Max. possible	Range of values observed in LFRA plan units	Moderate	High	Extreme
A. Fire risk	55	3 – 54	<20	20 – 40	>40
B. Fire suppression challenges	40	3 – 27	<15	15 – 20	>20
C. Evacuation hazards	55	13 – 50	≤20	21 – 35	>35
D. Home ignition zone hazards	58	12 – 54	<25	25 – 35	>35
Overall risk	208	42 – 172	<100	100 – 125	>125

Relative Risk Rating Form

A. Fire Risk	Points
1. Average flame length[1]	
<4 feet	0
4-<8 feet	5
≥8 feet	10
2. Percent area predicted for active crown fire[2]	
<10%	0
10-<50%	5
≥50%	10
3. Percent of homes exposed to extreme radiant heat[2]	
<10%	0
10-<33%	6
≥33%	12
4. Average conditional burn probability[2]	
<0.5%	0
0.5-<0.95%	5
≥0.95%	10
5. Additional risk factors	
Mid-slope homes	2
Homes on ridge tops	2
Saddles / ravines / chimneys	4
Utilities (gas / electric) placement	
All underground	0
Infrequent overhead powerlines	3
Frequent overhead powerlines	5
A. Total points possible	55

[1]Predictions from FlamMap under 60th percentile fire weather conditions for plan unit and adjacent watersheds.

[2]Predictions from FlamMap under 90th percentile fire weather conditions for plan unit and adjacent watersheds.

*Different percentile fire weather conditions were used for flame length than other metrics of fire behavior to capture a greater variation in potential fire behavior among plan units.

B. Fire Suppression Challenges	Points
1. Percentage of homes near hydrants	
>75%	0
25-75%	5
<25%	10
2. Presence of dip / draft sites	
At least one dip / draft site present OR unnecessary due to hydrants	0
No dip / draft site	5
3. Road/driveway accessibility for Type 3 engines (percent of roads/driveways)	
>90%	0
75-90%	5
50-75%	10
<50%	15
4. Presence of legible and reflective signs (percent of roads and homes)	
>90%	0
75-90%	3
<75%	5
5. Presence / absence of HazMat	
Absent	0
Present	5
B. Total points possible	40

C. Evacuation Hazards	Points
1. Number of lanes in each direction	
At least 1 lane on >75% of roads	0
At least 1 lane on >50-75% of roads	5
Less than 1 lane on >50% of roads	10
2. Number of primary egress routes	
3 or more routes	0
Only 2 routes	5
Only 1 route	10
3. Potential for moderate to major congestion on primary egress routes[3]	
No	0
Yes	10
4. Percentage of road with non-survivable conditions under 90th percentile fire weather	
<10%	0
10-<33%	10
≥33%	20
5. Presence of livestock that could create evacuation challenges	
0-1 properties with livestock	0
2-5 properties with livestock	3
>5 properties with livestock	5
C. Total points possible	55

[3]Potential for congestion assessed by LFRA and partner agencies with experience in evacuations during the East Troublesome and Cameron Peak Fires in 2020.

D. Home Ignition Zone Hazards	Points
1. Roof construction material	
Class B or C on <10% of homes	0
Class B or C on 10-15% of homes	5
Class B or C on >25% of homes	10
Class C on >50% of homes	15
2. Percent of homes with combustible or non-ignition-resistant siding	
<10%	0
10-50%	3
>50%	5

3. Percent of homes with combustible or non-ignition-resistant decking	
<10%	0
10-25%	3
>25%	5
4. Percent of homes with wooden fences	
<10%	0
10-25%	1
>25%	2
5. Percent of homes with adequate mitigation in home ignition zone 1	
>90%	0
75-90%	3
50-75%	6
<50%	10
6. Percent of homes with adequate mitigation in home ignition zone 2	
>90%	0
75-90%	3
50-75%	6
<50%	10
7. Percent of homes with additional hazards in zones 1 and 2 (e.g., wood piles, propane tanks, wooden sheds)	
<10%	0
10-25%	1
25-50%	3
>50%	5
8. Average number of homes potentially exposed to short-range ember cast from other homes	
<5 homes	0
5-10 homes	3
≥10 homes	6
D. Total points possible	58

Fuel Treatment Prioritization

Roadside Fuel Treatments

We assessed the potential need for roadside fuel treatments based on the potential for non-survivable conditions (predicted flame lengths >8 feet) to arise under moderate (60th percentile) and extreme (90th percentile) fire weather conditions, congestion potential, the number of homes dependent on road segments for evacuation, and the potential for roads to serve as tactical features during wildfire suppression. Areas with non-survivable conditions under moderate fire weather are at greater risk than those with conditions that only become non-survivable under extreme percentile weather. Keep in mind that our fire behavior analyses occurred at the scale of 0.2 acres (30 x 30 meters), so locations of potential treatment areas are approximate. The potential for congestion was determined by LFRA and partner agencies with experience in evacuations during the East Troublesome and Cameron Peak Fires in 2020 (**Figure B.10**). Roads in need of fuel treatment in LFRA are focused on the west side of the Authority. County Road 43, Storm Mountain Road, and Waltonia Road are the longest stretches of roads that need treatment. Pole Hill, Rainbow Lane, Otter Road, and Raccoon Drive are in need of roadside fuel treatment as well, but need shorter sections worked on (**Figure B.16**; **Table B.5**).

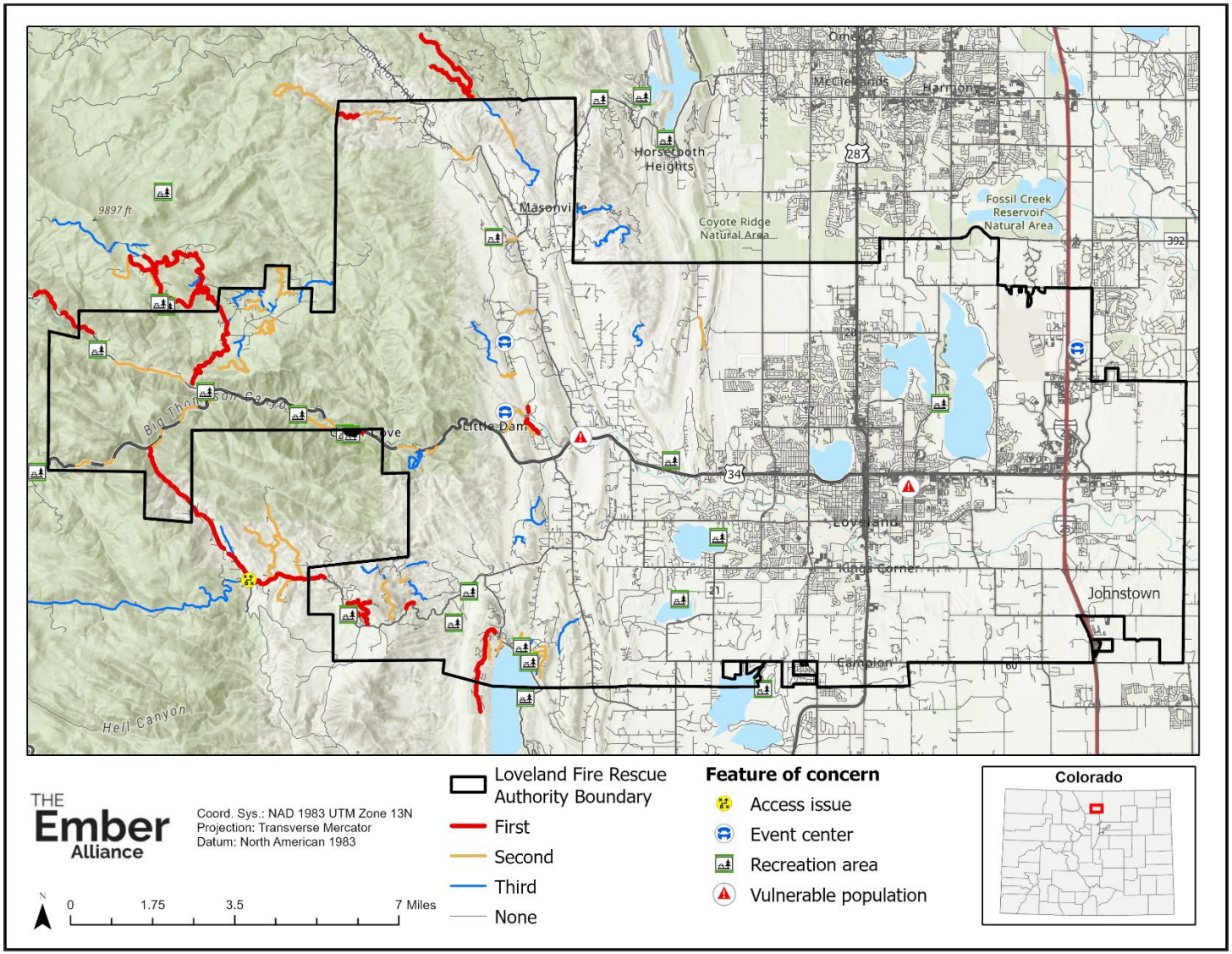


Figure B.16. Potential need for roadside fuel treatments based on potential fire behavior and evacuation congestion in and around LFRA. Our fire behavior analyses occurred at the scale of 0.2 acres (30 x 30 meters), so locations of potential treatment areas are approximate. View an interactive map online.

Table B.5. Total length and names of road segments potentially in need of roadside fuel treatments in LFRA.

Potential Need for Treatment	First	Second	Third
Total length of road segments	25 miles	29 miles	27 miles
Road names	Rainbow Lane, Big Bear Road, Quillan Gulch Road, Big Thompson Canyon Road, Greenwood Drive, Newell Drive, Cedar Park Drive, Storm Mountain Drive (FDR 128), Waterdale Drive, Waltonia Road, County Road 43, North County Road 29, West County Road 18E, Otter Road, Galuchie Drive, Woodchuck Drive, Green Mountain Drive	Idlewild Lane, Chipmunk Place, North County Road 27, County Road 32C, West County Road 22H, Palisade Mountain Drive, Rainbow View Lane, James Park Rd, Tracy Trail, Ellis Ranch Lane, Storm Mountain Drive, Sunflower Road, Rock Hill Road, Cottontail Road, Turkey Walk Rd, Ridge Parkway, Spruce Mountain Drive, Elk Way, Lonely Hectares, Green Ridge Road, Palisades Mount Drive, Sly Fox Rd, Idlewild Ln, Palisade Mountain Road, Bobcat Drive, Snowtop Drive, Snow Top Drive, Fawn Trail, Saddle Notch Drive, Indian Blind Trail, Waltonia River Court	Fourwheel Drive, Mule Deer Drive, Sedona Hills Drive, O'Keepa Trail, Soaring Eagle Pass, Spring Canyon Ranch Road, Lakefront Drive, Wren Place, Jug Court, Okeepa Trail, Over Road, King Ranch Road, Bartram Park, Eagle View Road, Badger Court, Skyline Drive, Prairie Way, Forest Road 128, Stag Hollow Road, Berg Ranch, Possum Court, Keko Drive, Lakeview Drive, FDR 153B, FDR 153C, FDR 122 Pole Hill Road, Foggy Park Road (FDR 153)

Stand-Scale Fuel Treatments

We created topographic units for assessing the potential need for stand-scale fuel treatments by delineating small watersheds (i.e., an area of land where all precipitation falling in that area drains to the same location) and subdividing these into three hillslopes—one on each side of a stream or river and one above the headwaters of the watershed (**Figure B.17**). We delineated hillslopes in ArcGIS using a modified version of the WEPP Hillslope Toolbox, which is based on TOPAZ (Topographic Parameterization Software) from the USDA Agricultural Research Service.

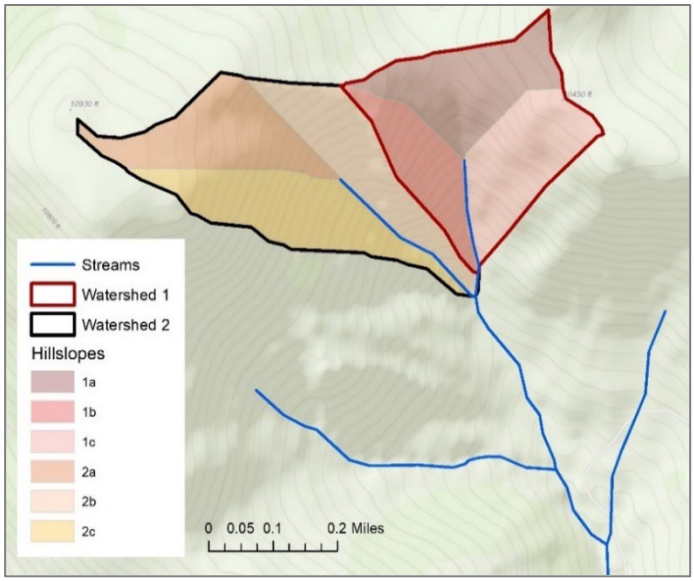


Figure B.17. Depiction of small watersheds and their subdivided hillslopes.

We used 30 m resolution digital elevation models from the U.S. Geological Service, and delineated hillslopes with a critical source area of 75 acres (30 hectares) and a minimum source channel length of 330 feet (100 meters). Critical source area is the minimum allowable area above the head of a first-order channel, and minimum source channel length is the minimum length of a channel used to delineate watersheds. Hillslopes were also split by major roads like Highway 34 and county roads because stand-scale fuel treatments often occur on one side of a major road at a time. Hillslopes east of Wilson were removed and not analyzed in this process because the area was too flat to create meaningful hillslopes. Treatment recommendations and priorities in the east half of LFRA were made based on fire models, values at risk, and local professional knowledge. Areas that were less than 20 acres in size were combined with adjacent hillslopes to result in potential treatment areas in size from 20 to 400 acres—reasonable sizes for forest management projects in the WUI.

We assessed the potential need for fuel treatments in each hillslope based on predicted fire behavior, homes potentially exposed to short-range ember cast from the unit, presence of priority roadway treatments, occurrence of previous treatments, POD boundary locations, and percent slope within the unit (**Table B.6**). PODs are topographic areas bounded by features suitable for fire control (e.g., ridgetops and roads) that can be used for proactive wildfire decision making and tactical operations during wildfire events. PODs can serve as management units for proactive ecological restoration and wildfire risk mitigation, as well as for cross-boundary and collaborative land and fire management planning (Thompson et al., 2022). Land managers, wildland fire / fuel planners, and researchers have worked together to define POD boundaries across all of Larimer County.

Fuel treatments are primarily wanted and needed in the west half of LFRA, around Storm Mountain, Drake, Waltonia, and near the reservoirs in the southwest. More treatments to the west of LFRA's response area will help protect residents and create reduced fire behavior coming into the area (**Figure B.18**). There are approximately 10,000 acres in the first priority treatment areas, 15,000 in the second priority, and 23,000 in the third priority. Not all these acres are expected to be treated, these are just the priority locations. After creating an initial draft priority locations map, partners including LFRA, CSFS, USFS, LCD, BTWC, Northern Water, LCDNR, the City of Loveland, and others worked together to provide feedback on what inputs should be weighted higher and where in the priority locations would not be treatable.

Table B.6. Methodology for ranking potential need for stand-scale fuel treatments to mitigate fire hazards within and adjacent to LFRA.

Potential need for fuel treatments	Maximum weight		Highest	High	Moderate
Number of homes exposed to short-range ember cast (33 yards) and/or radiant heat from the hillslope (moderate fire weather)	30%	Cutoff	≥4 homes	1-3 homes	0 homes
		Points	30	15	0
Presence of priority roadways (non-survivable evacuation pinch points)	25%	Cutoff	At least one priority roadway	---	No priority roadways
		Points	25	---	0
Percent active crown fire (moderate fire weather)	15%	Cutoff	≥10%	2 - <10%	<2%
		Points	15	8	0
Percent area as grass/shrub or shrub fuel types with flame lengths > 11 feet (moderate fire weather)	15%	Cutoff	≥66%	33- <66%	<33%
		Points	15	8	0
Average conditional burn probability (moderate fire weather)	15%	Cutoff	≥0.166%	0.10 - <0.166%	<0.10%
		Points	15	8	0
Overall ranking (sum of values)		Cutoff	≥50	40-49	20-39

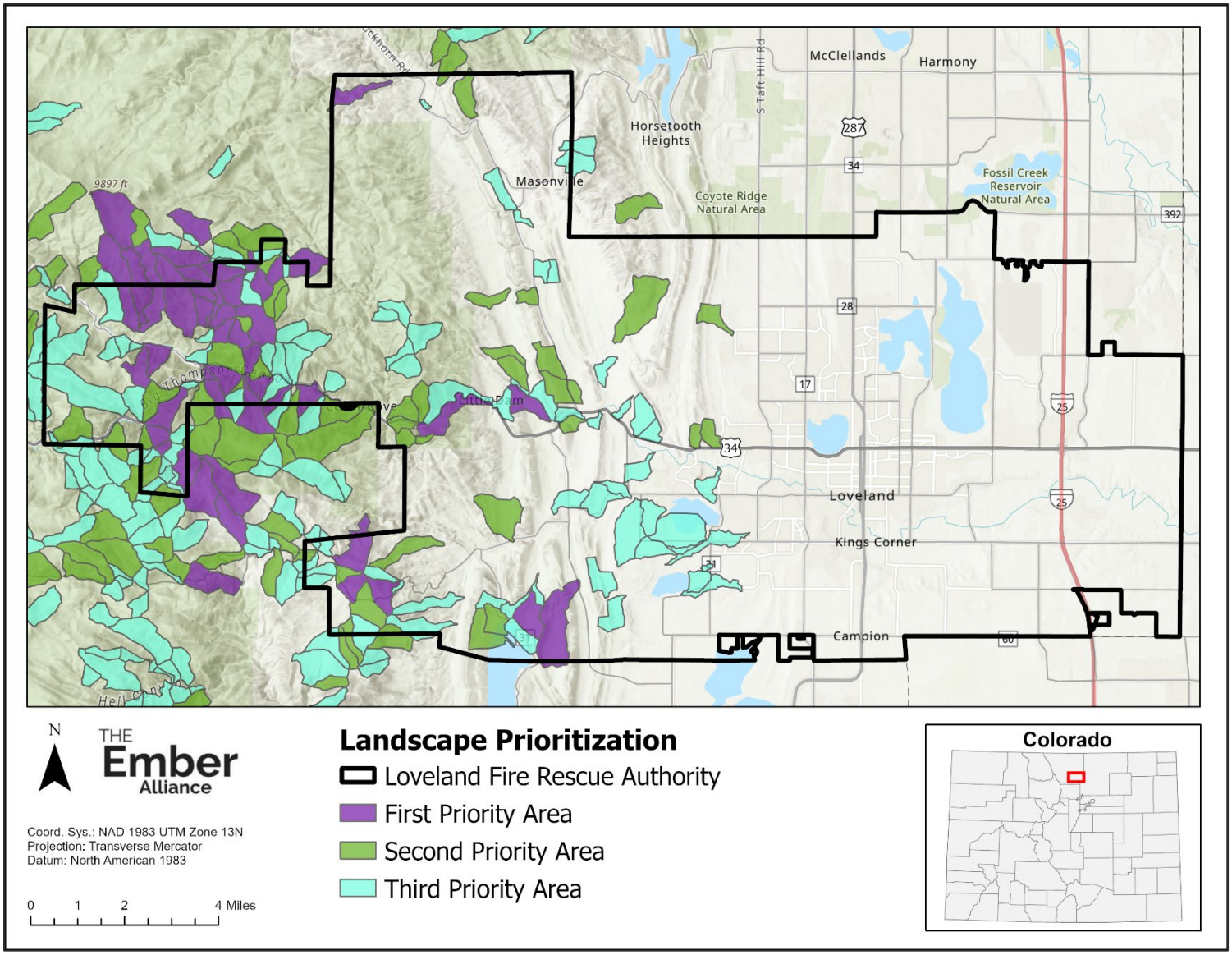


Figure B.18. Potential need for stand-scale fuel treatments in and around LFRA based on predicted fire behavior, burn probability, threatened structures, operability, previous fuel treatments, and roadway conditions.

Appendix C. Community Survey Methodology and Results

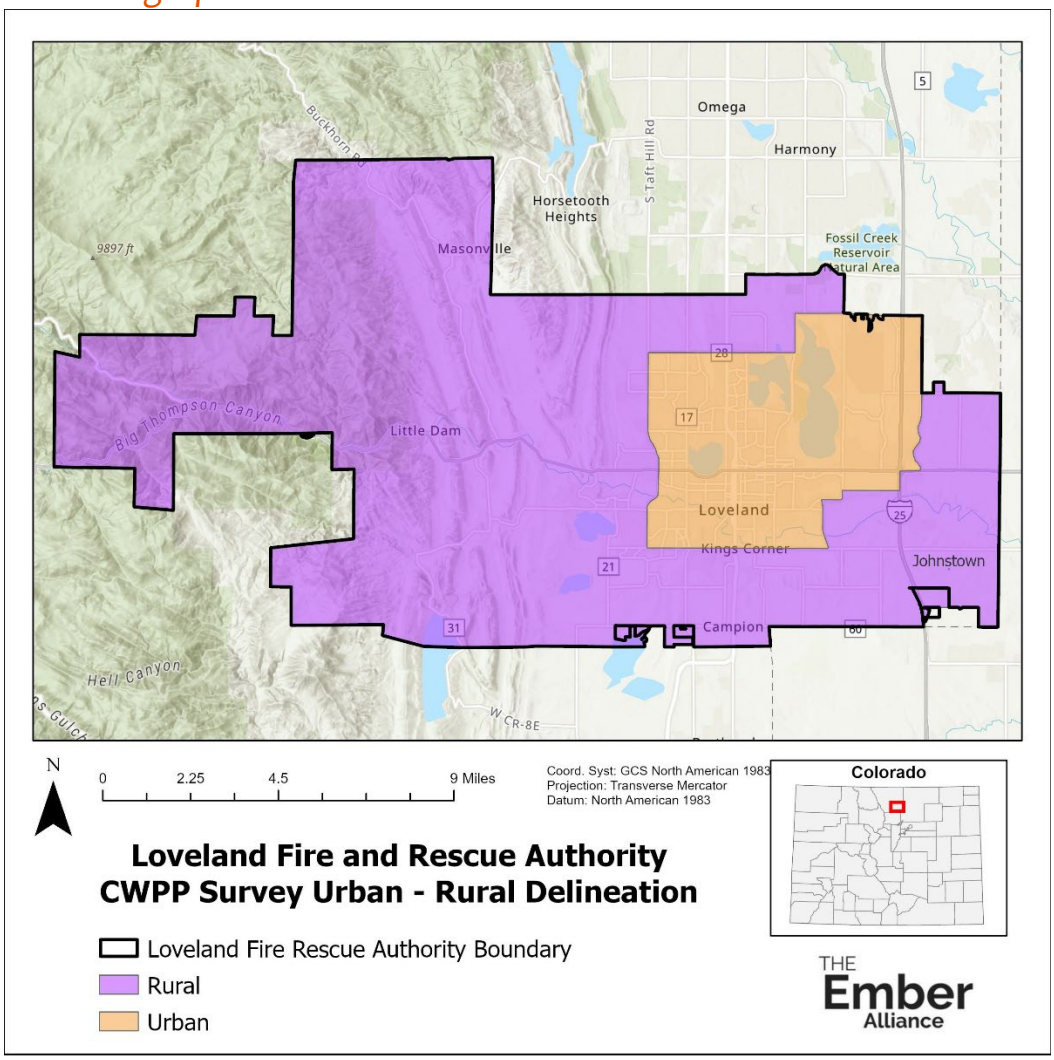
Community Survey Distribution

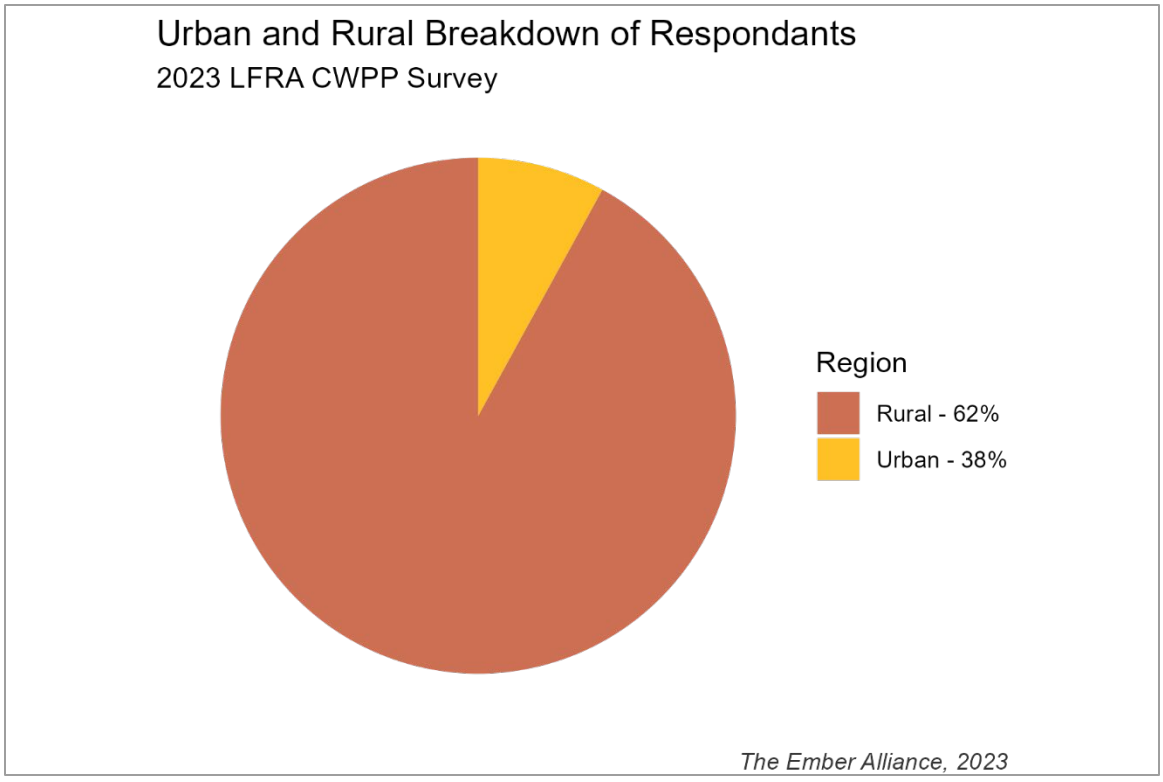
In December of 2022, LFRA and TEA distributed a survey to residents of LFRA. The survey was available online, and residents in rural parts of LFRA were mailed paper copies of the survey or a postcard with a QR code link to the survey online. More outreach was done to rural residents because they have been historically harder to reach. The survey was open for two months and then the data was analyzed. Survey results informed the CWPP recommendations throughout this document.

Questions and Responses

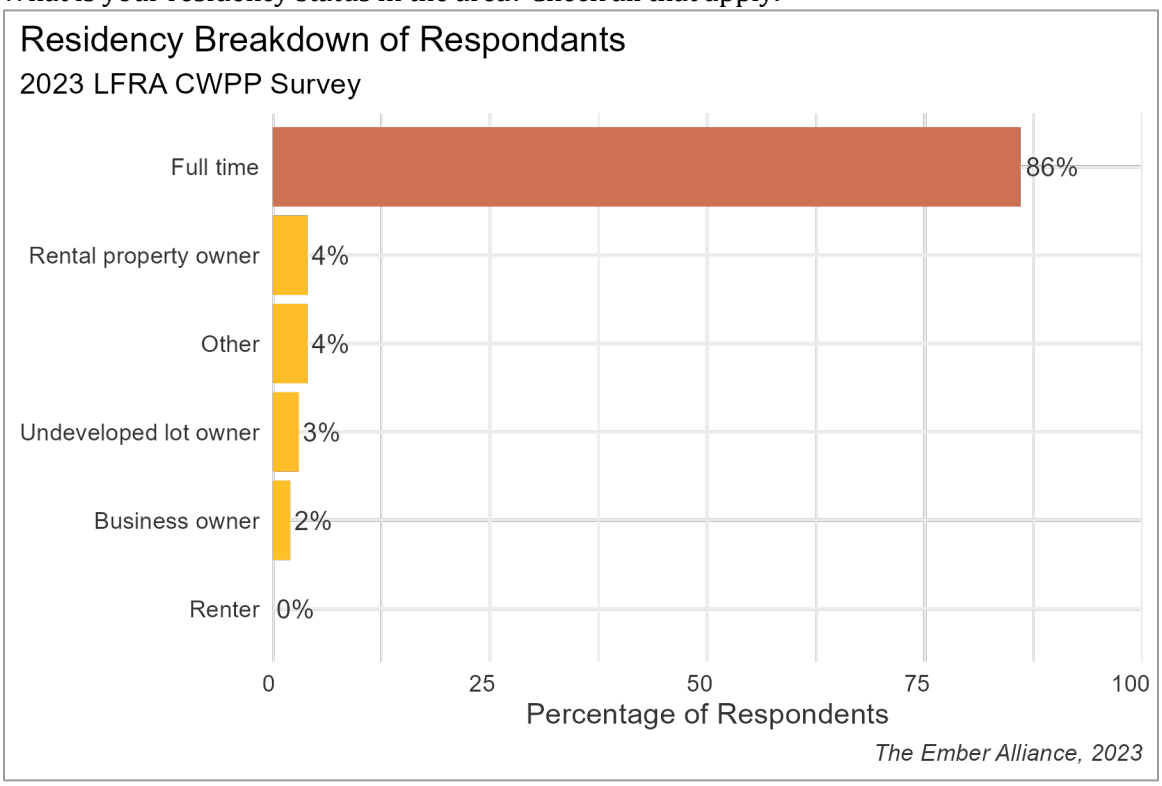
The following charts show all the questions asked in the survey in the order they were presented, and the responses received.

Section 1: Demographics

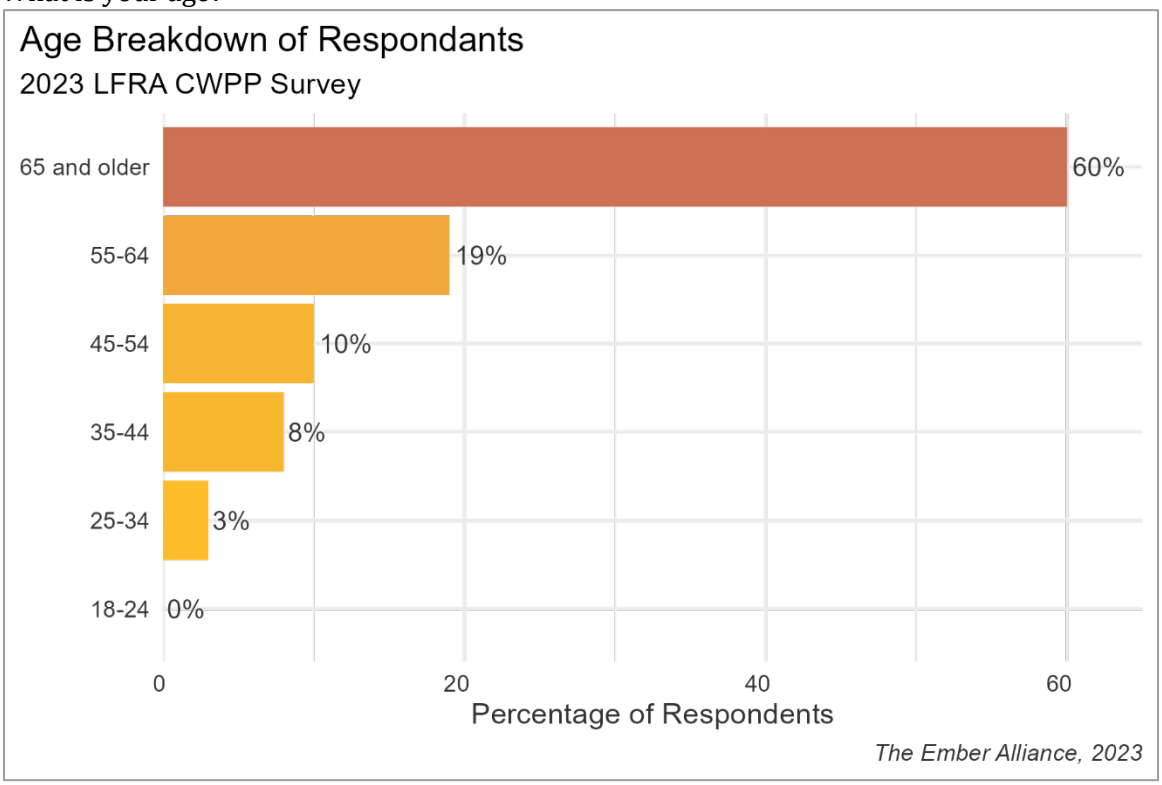



Urban and Rural Breakdown of Respondants
2023 LFRA CWPP Survey
Region
Rural - 62%
Urban - 38%
The Ember Alliance, 2023

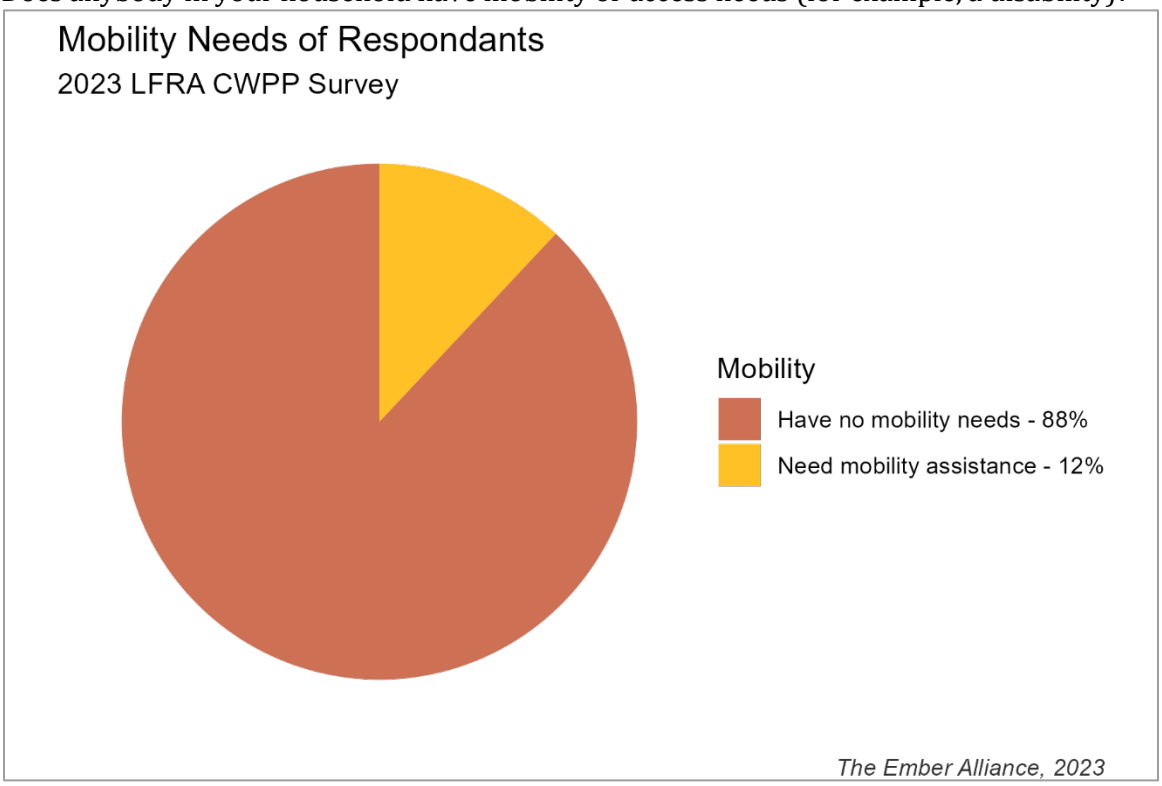
1. What is your residency status in the area? Check all that apply.



2. What is your age?

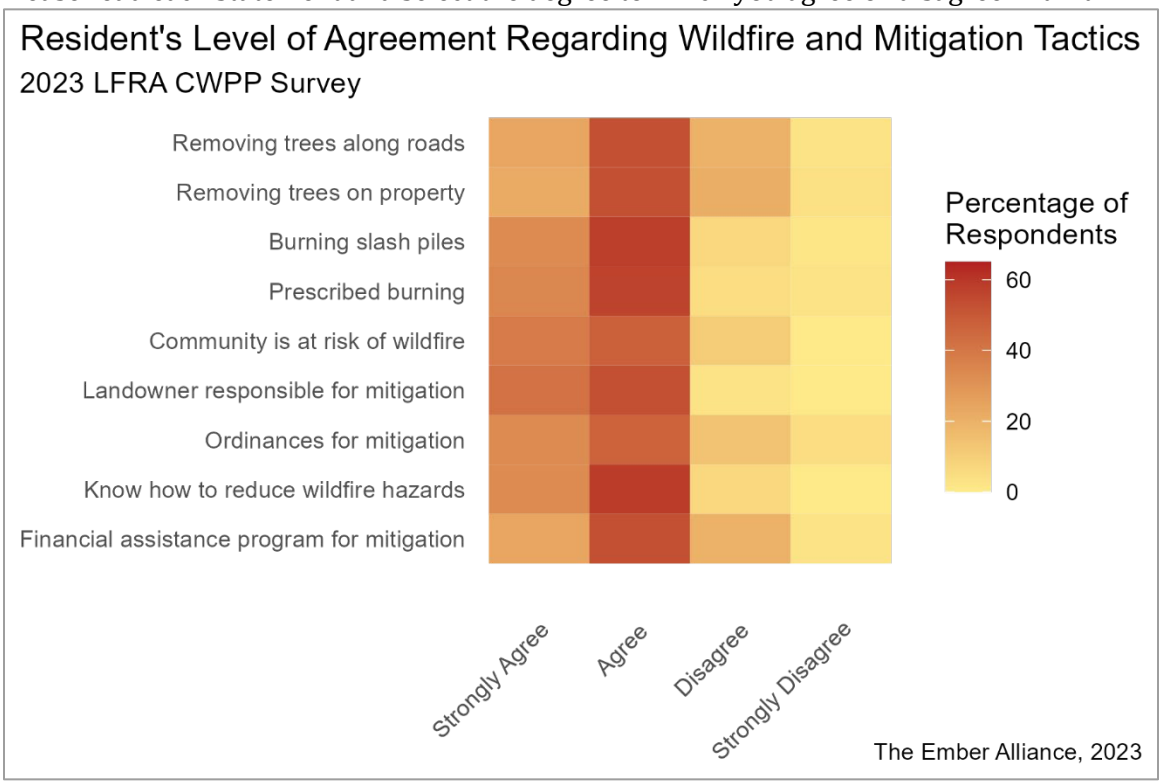


3. Does anybody in your household have mobility or access needs (for example, a disability)?

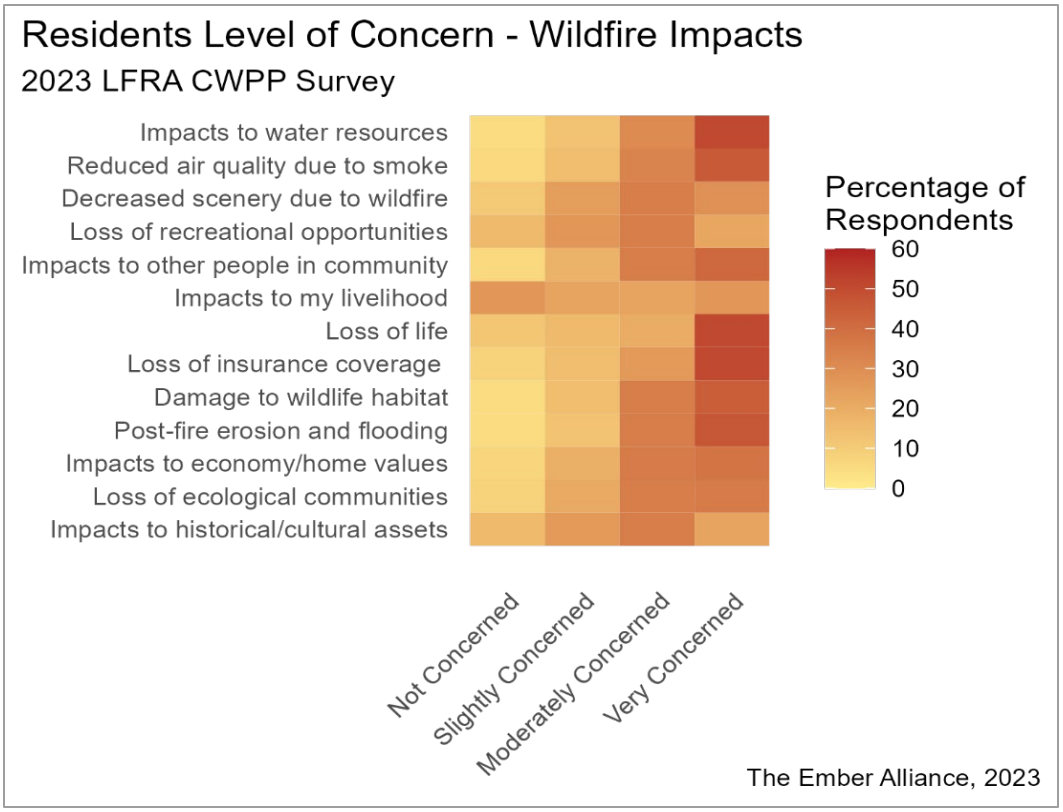


Section 2: Wildfire Knowledge and concerns

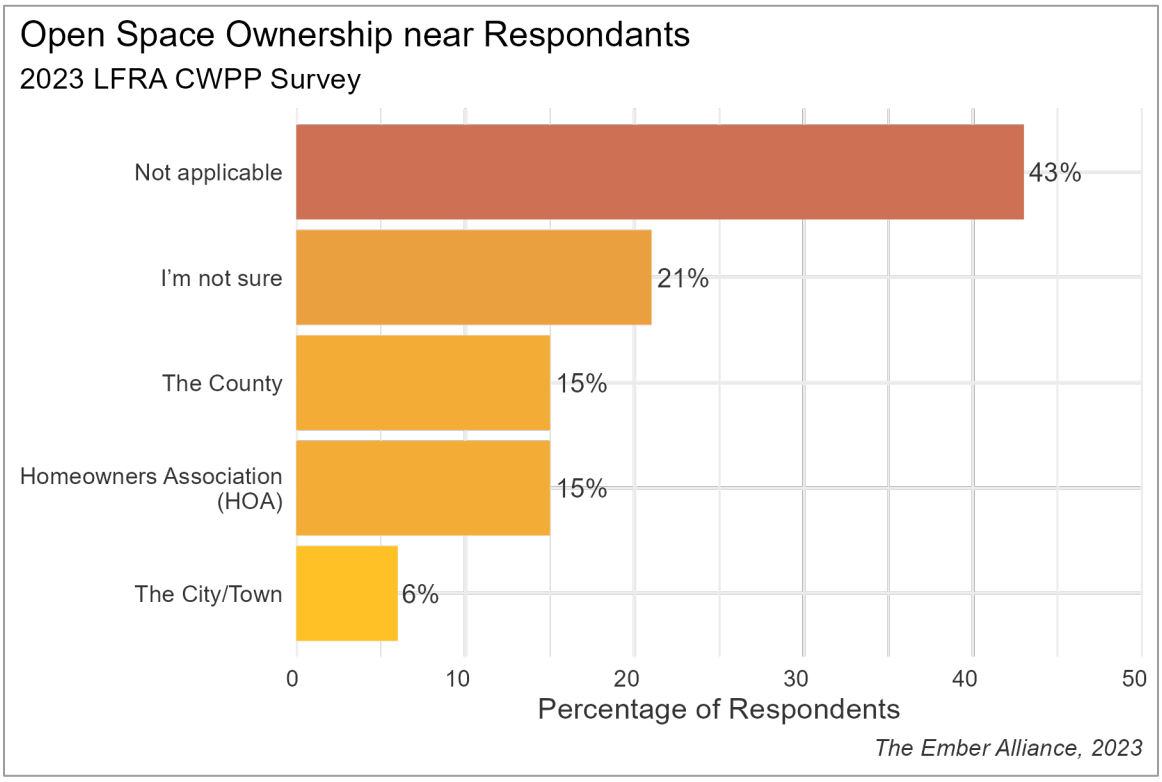
4. Please read each statement and select the degree to which you agree or disagree with it.



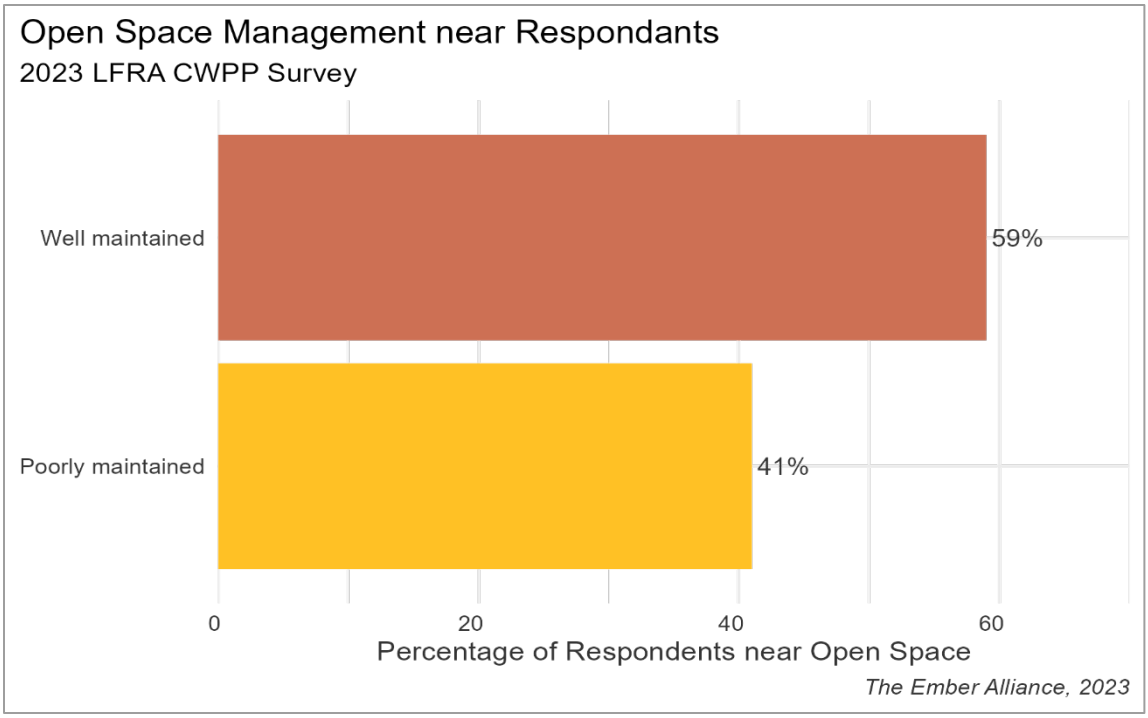
5. How concerned are you about the following wildfire related issues?



6. Is there an Open Space/Natural Area adjacent to your property? If so, do you know who maintains it?

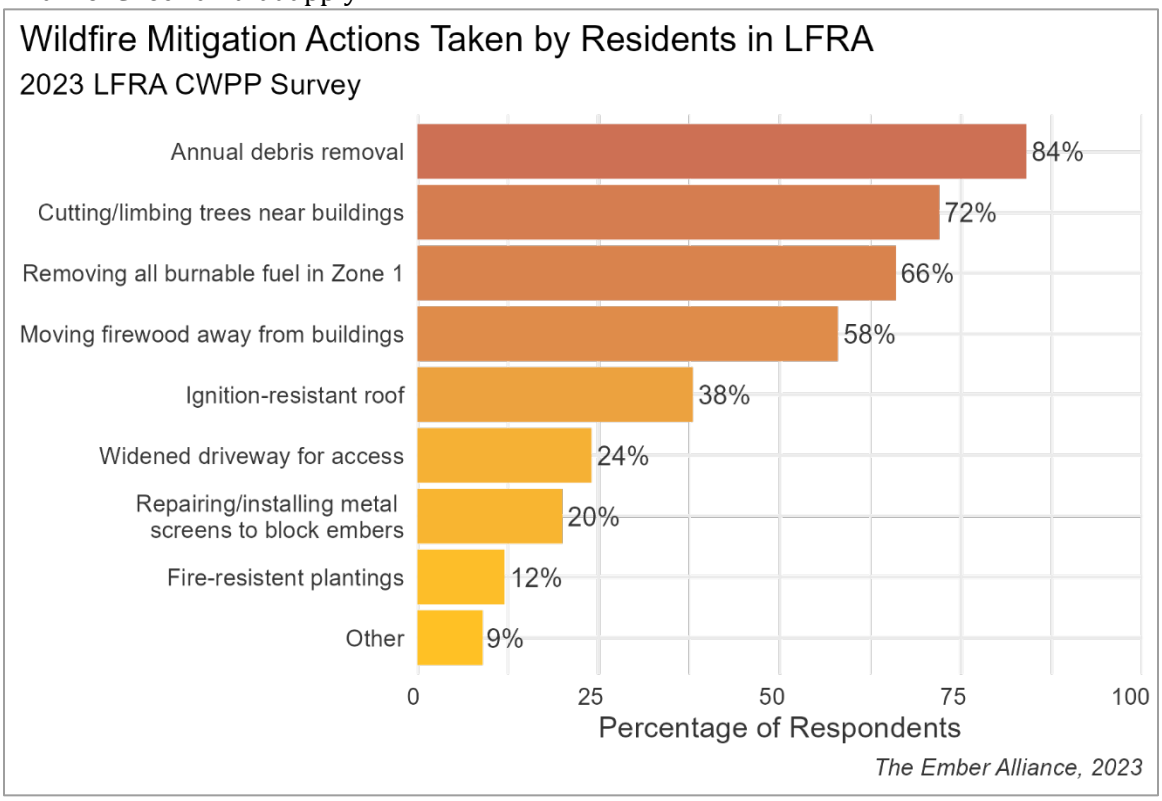


7. Do you feel the Open Space/Natural Area is maintained appropriately?

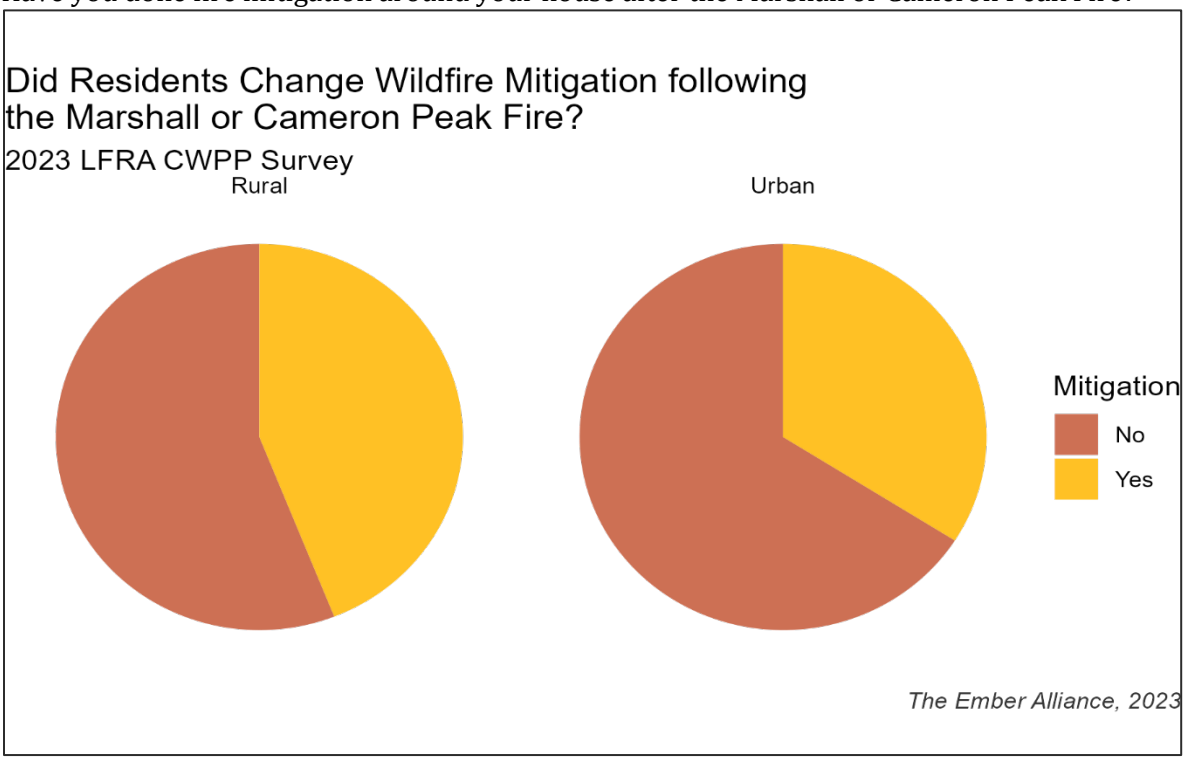


Section 3: Reducing wildfire hazards

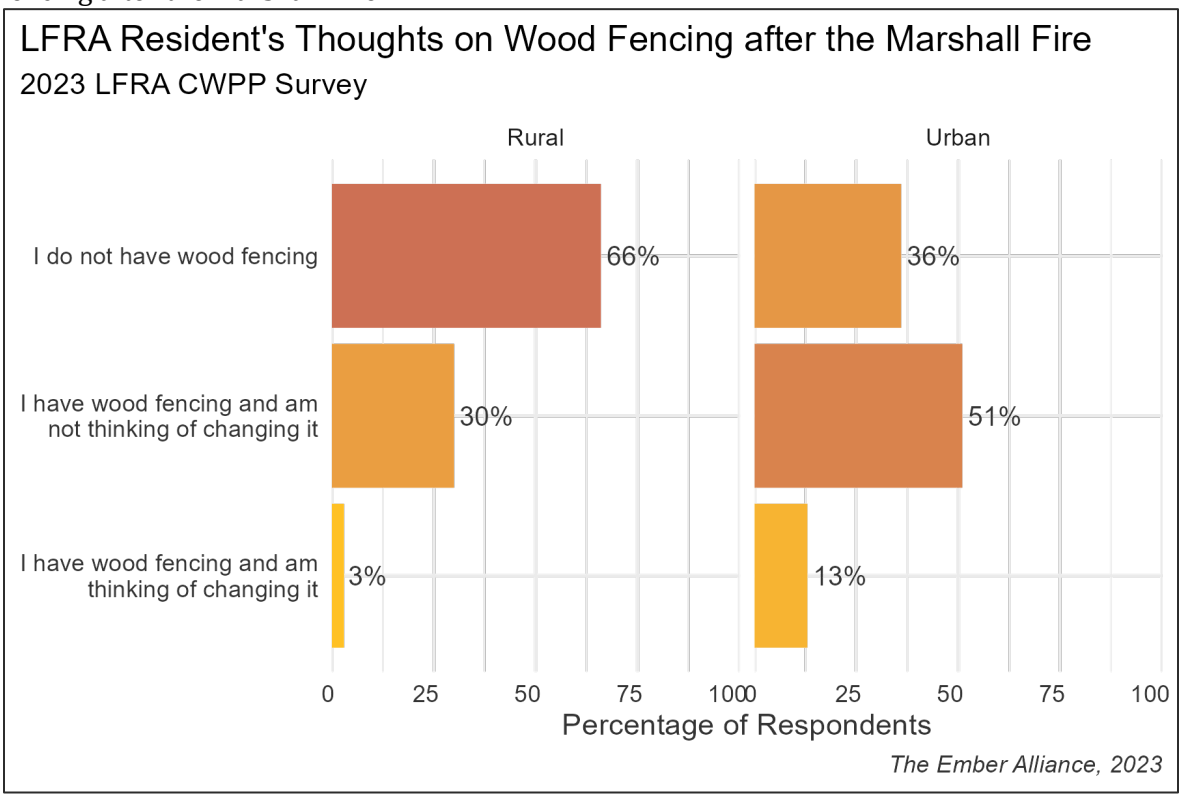
8. I have completed the following work to my home/business/property to lessen the risk of wildfire: Check all that apply.



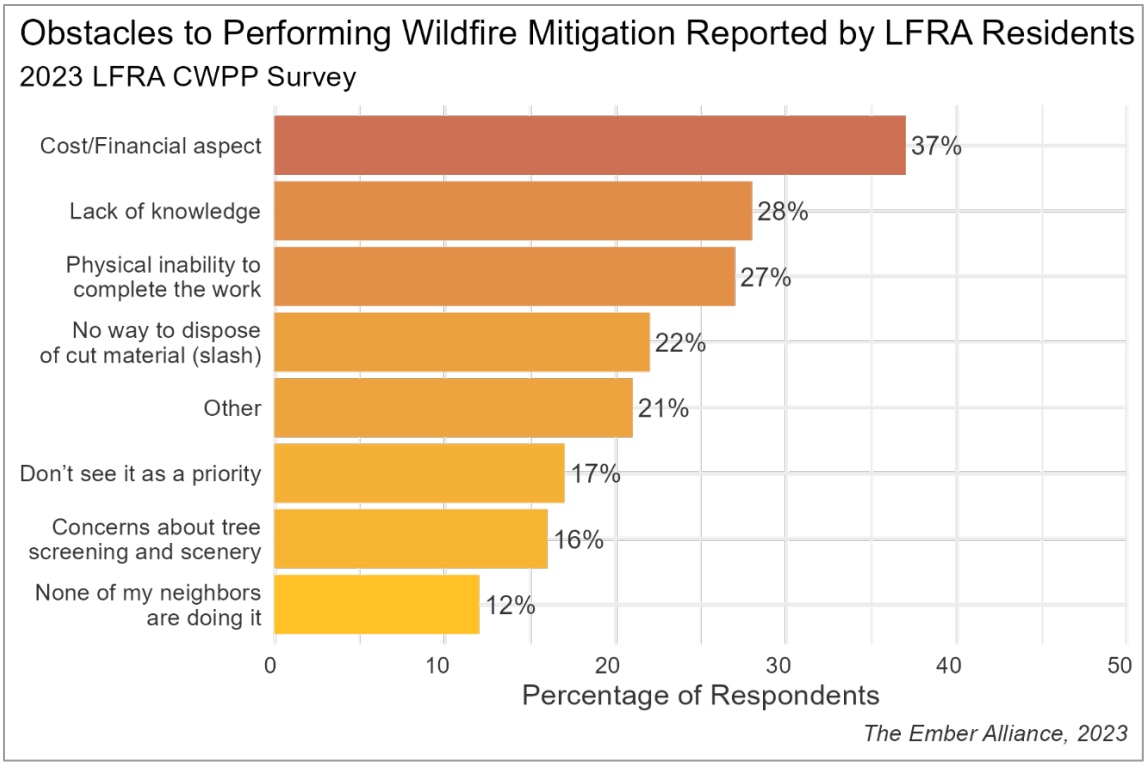
9. Have you done fire mitigation around your house after the Marshall or Cameron Peak Fire?



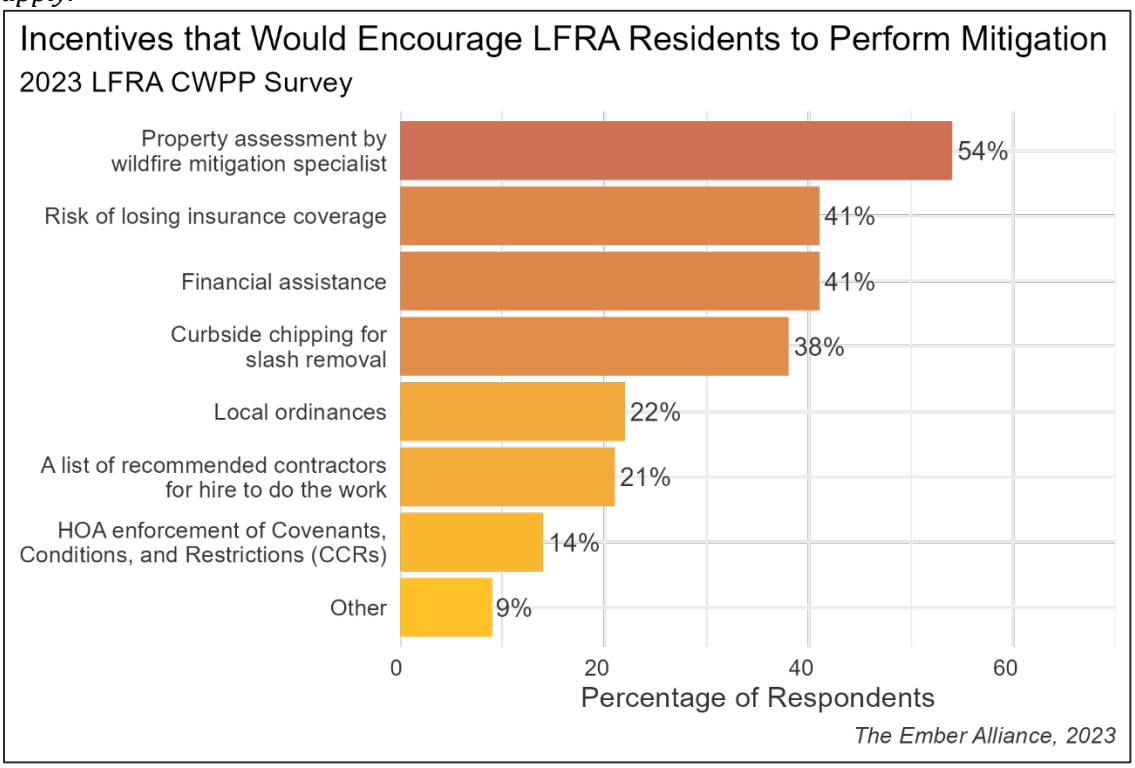
10. Do you have wood fencing around your home? If so, have you thought about changing the fencing after the Marshall Fire?



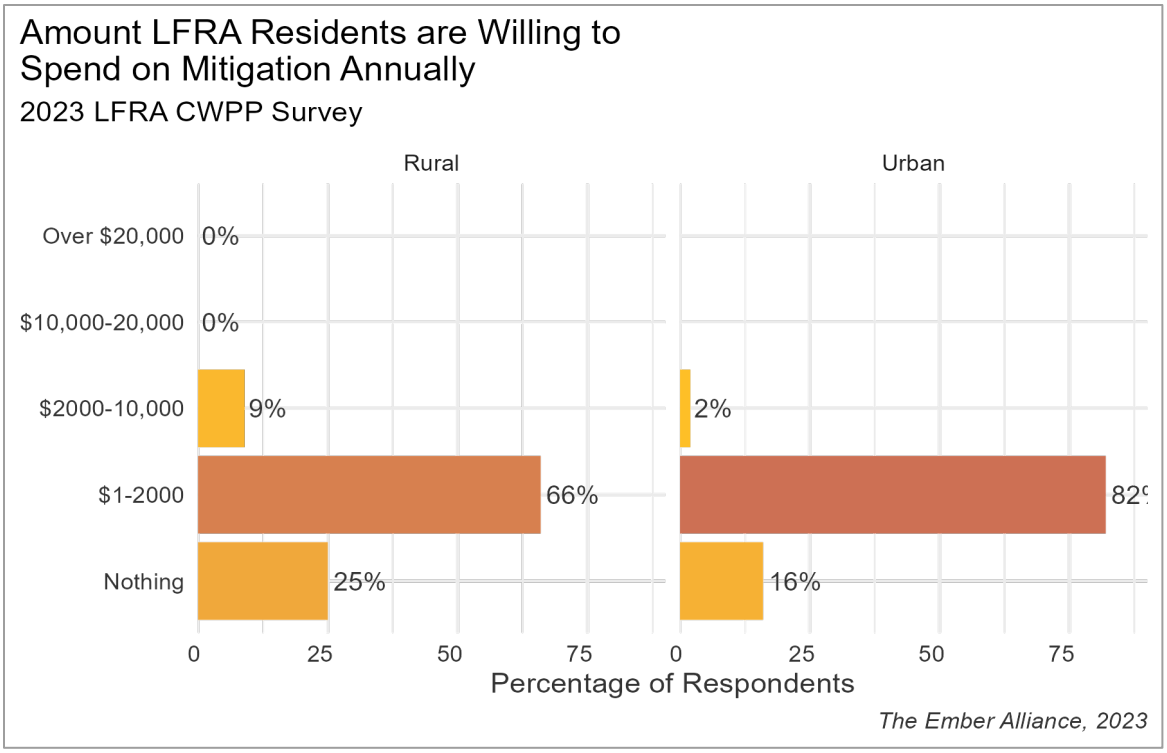
11. What are the obstacles that have stopped you from doing wildfire mitigation? Check all that apply.



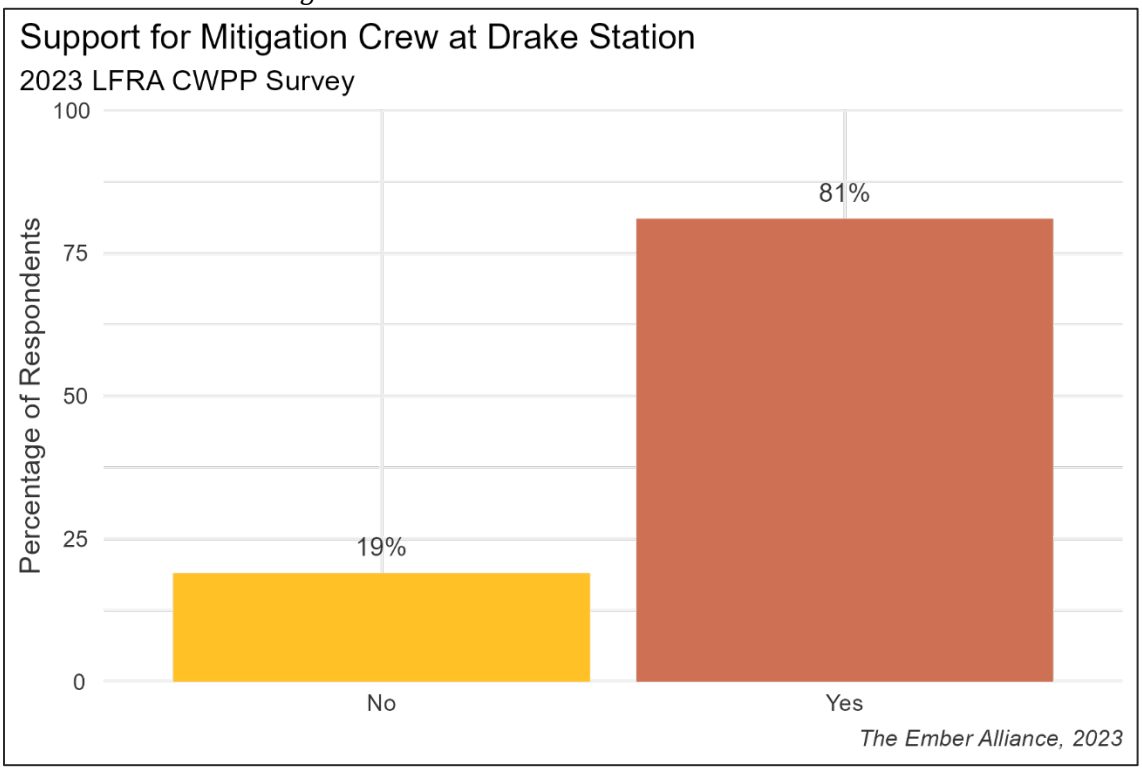
12. *Which of the following would encourage you to perform wildfire mitigation? Check all that apply.*



13. *How much are you willing to spend annually on wildfire mitigation on your property or home?*

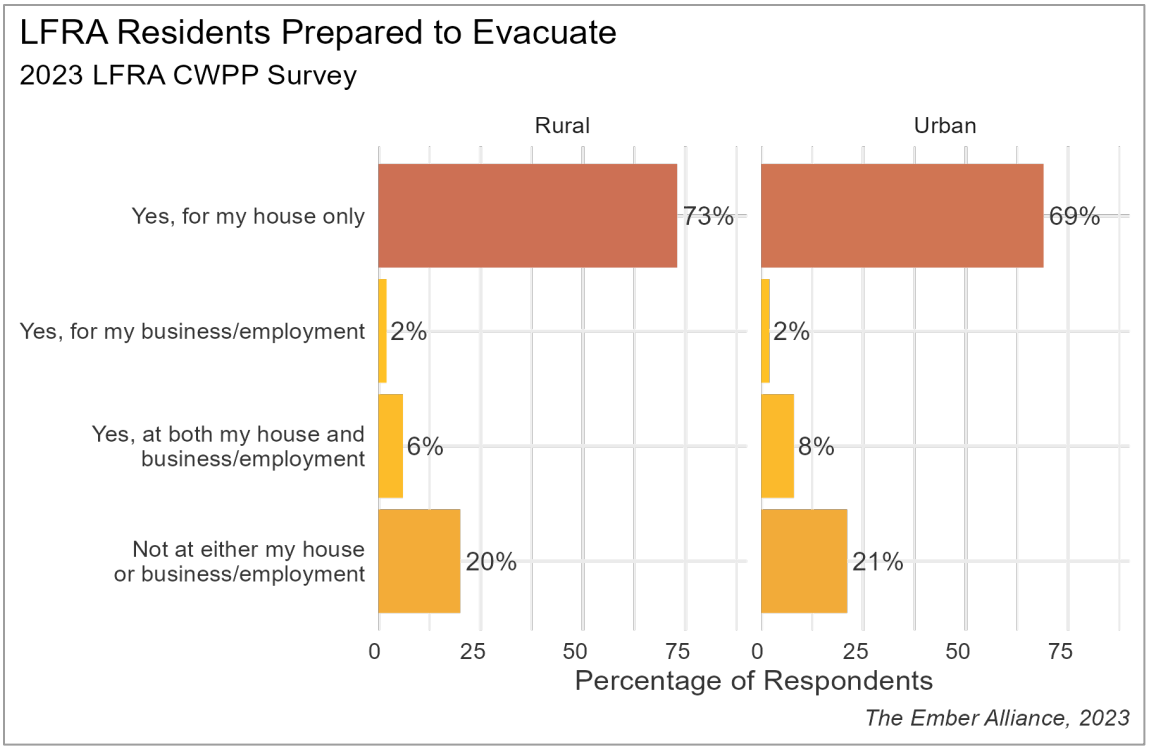


14. *Would you be supportive of LFRA adding a seasonal crew to Station 8 (Drake Fire Station) to assist residents with mitigation work?*

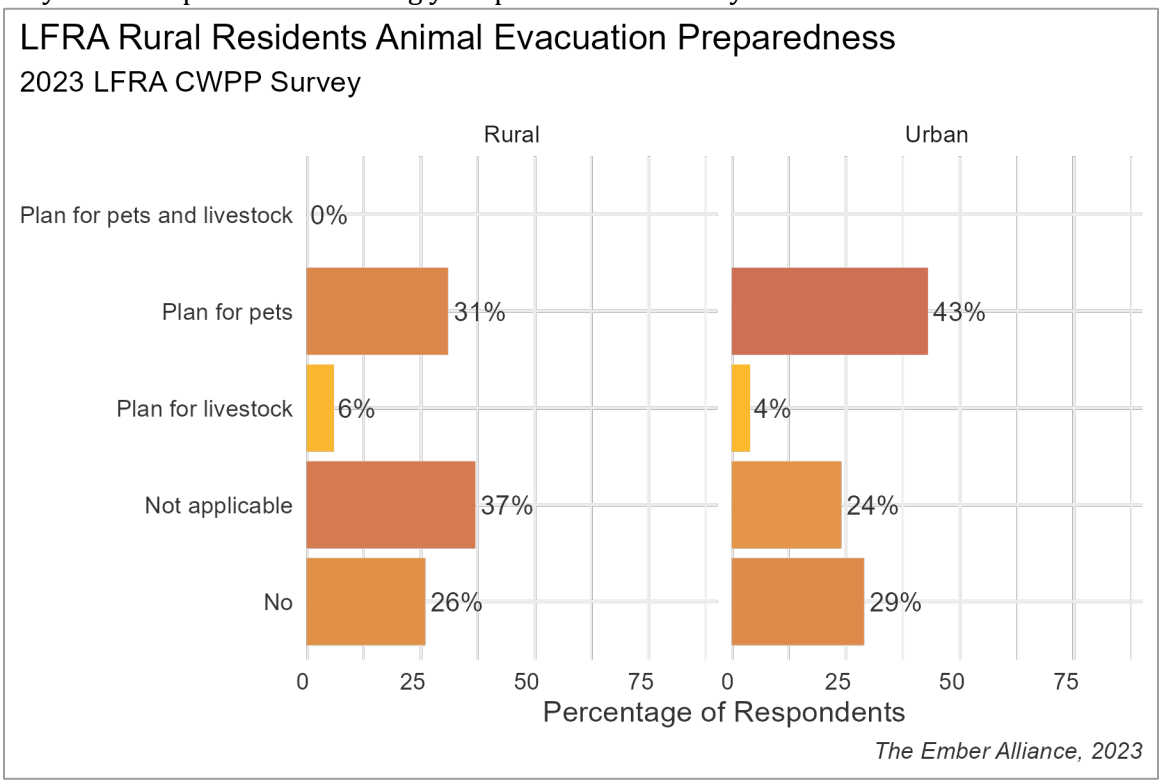


Section 4: Evacuation preparedness

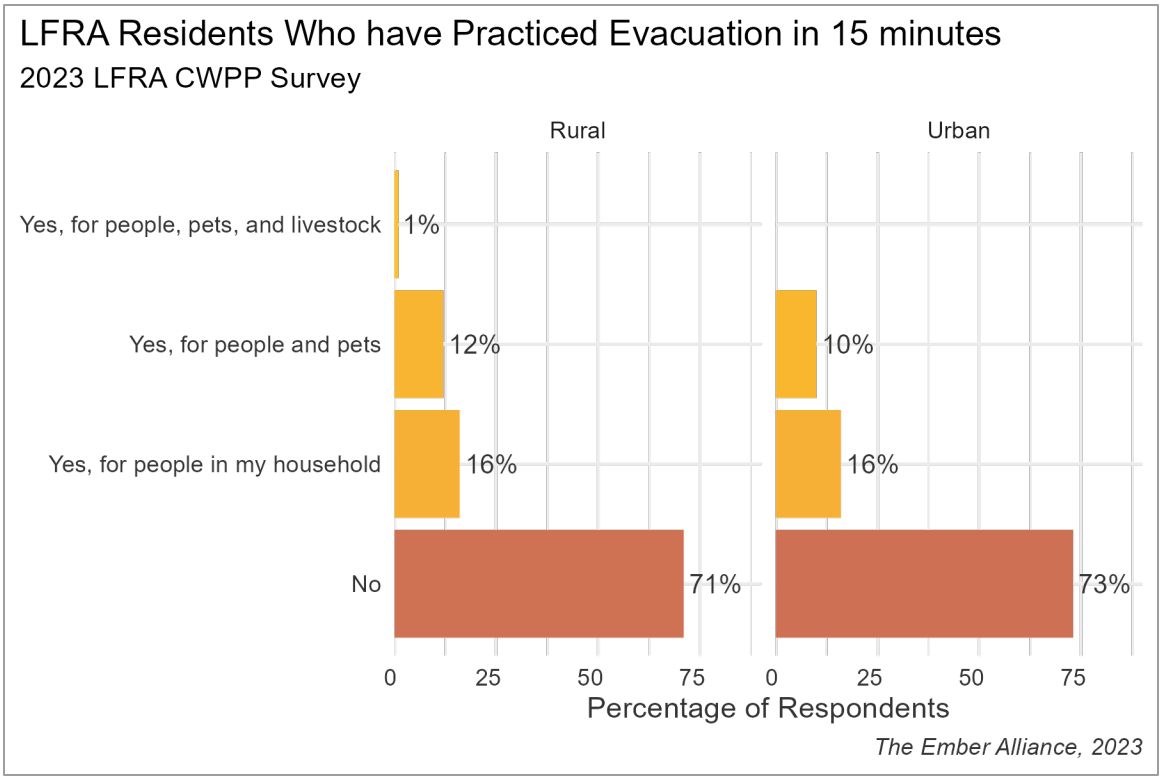
15. Do you have an evacuation plan?



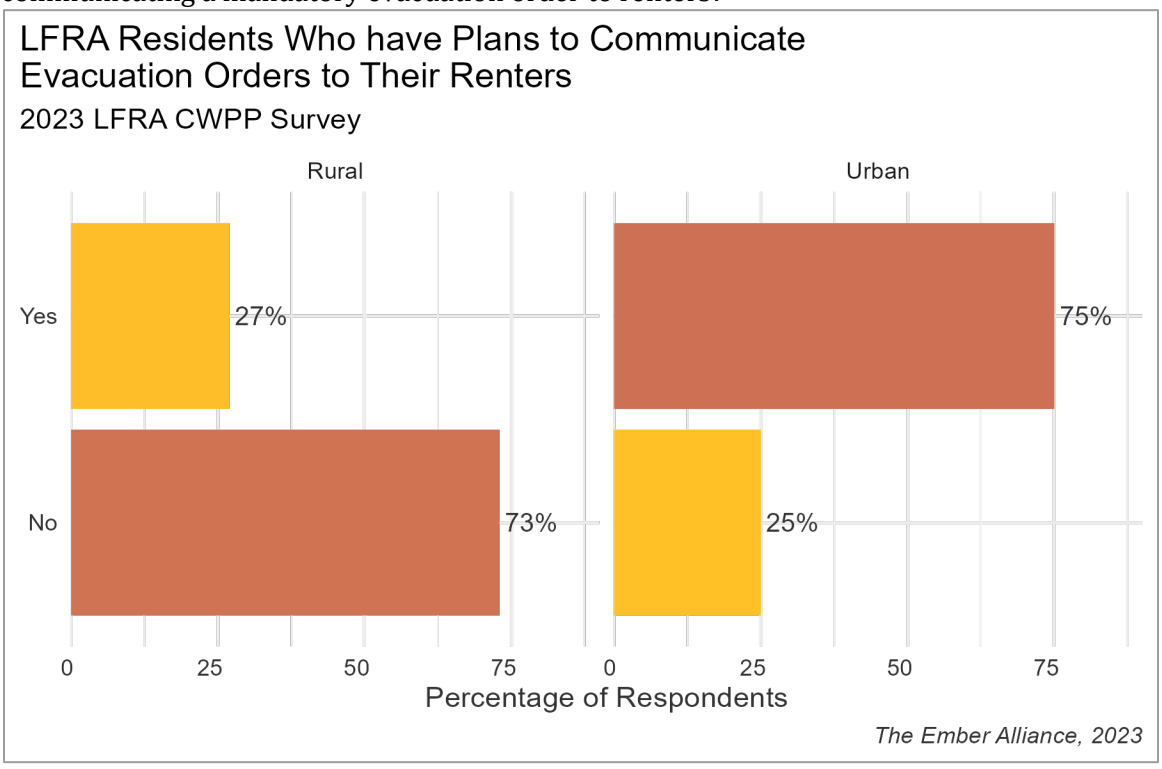
16. Do you have a plan for evacuating your pets or livestock if you are not at home?



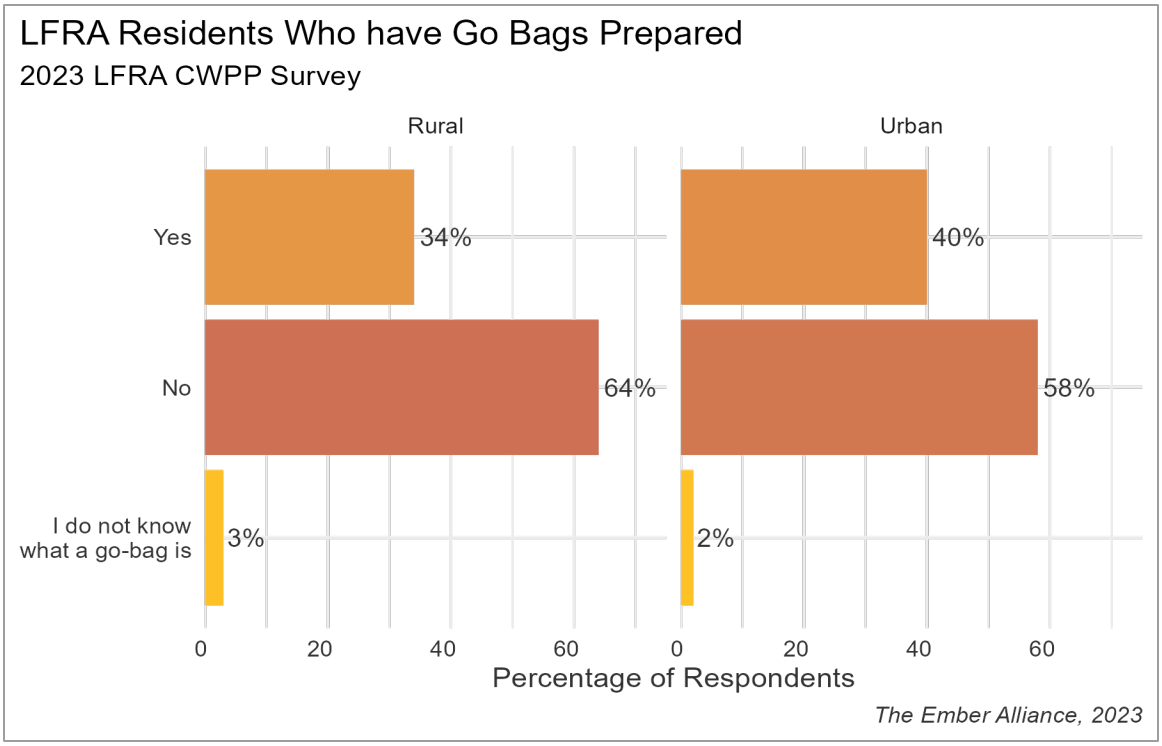
17. Have you and your family practiced evacuating your home within 15 minutes or less?



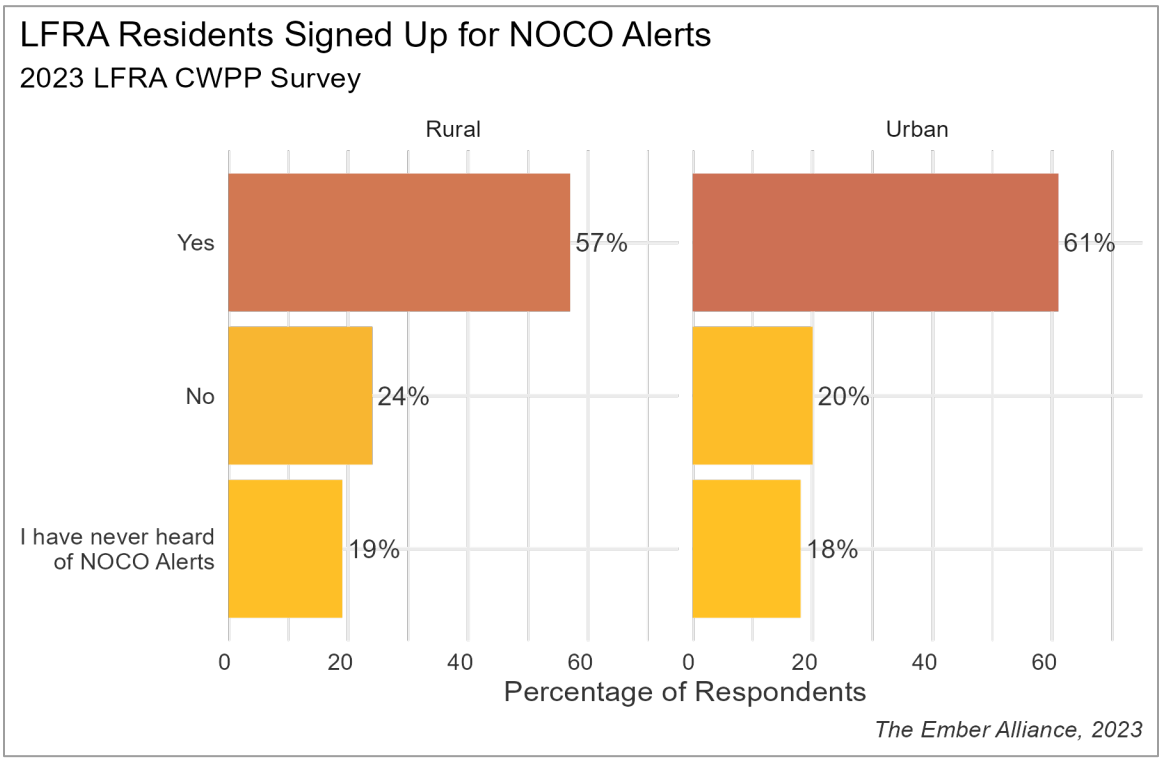
18. If you are renting out your house (short-term or long-term) do you have a method of communicating a mandatory evacuation order to renters?



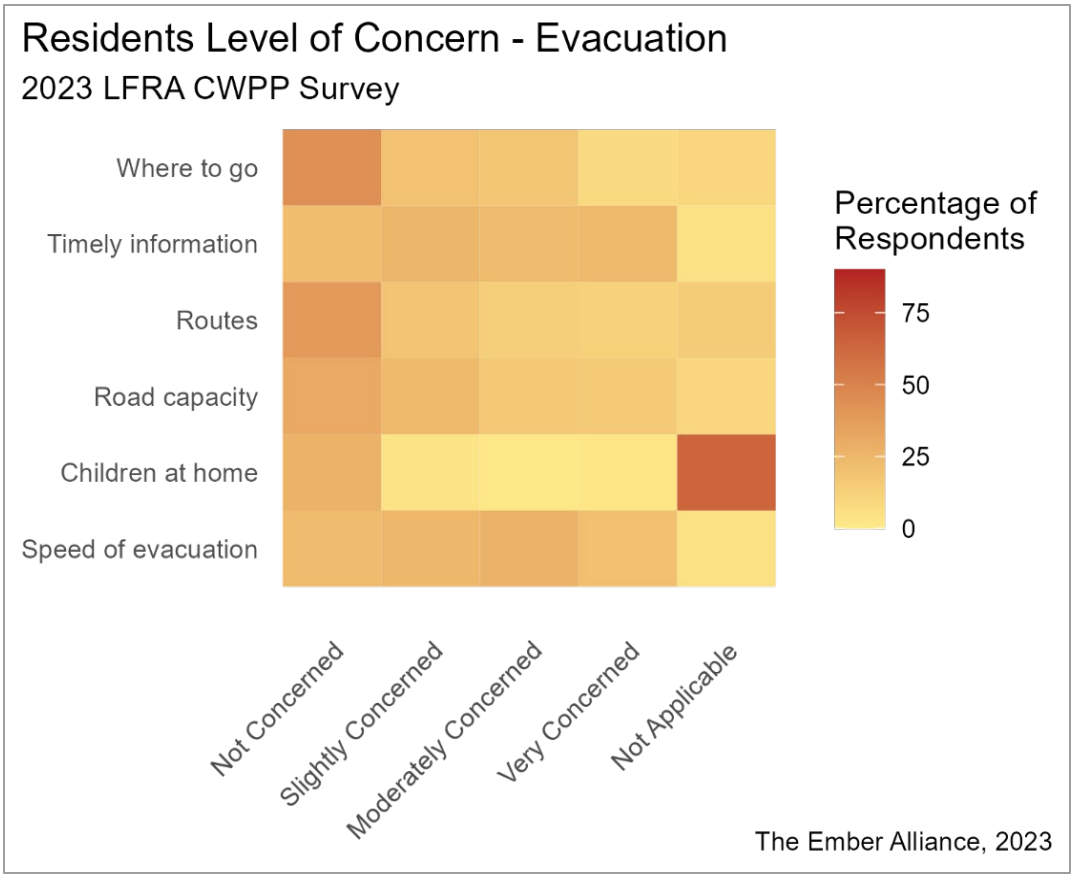
19. Have you prepared a written list of items to take and a "go-bag"?



20. Have you signed up for emergency alerts via NOCO Alerts to receive notifications during wildfire incidents?

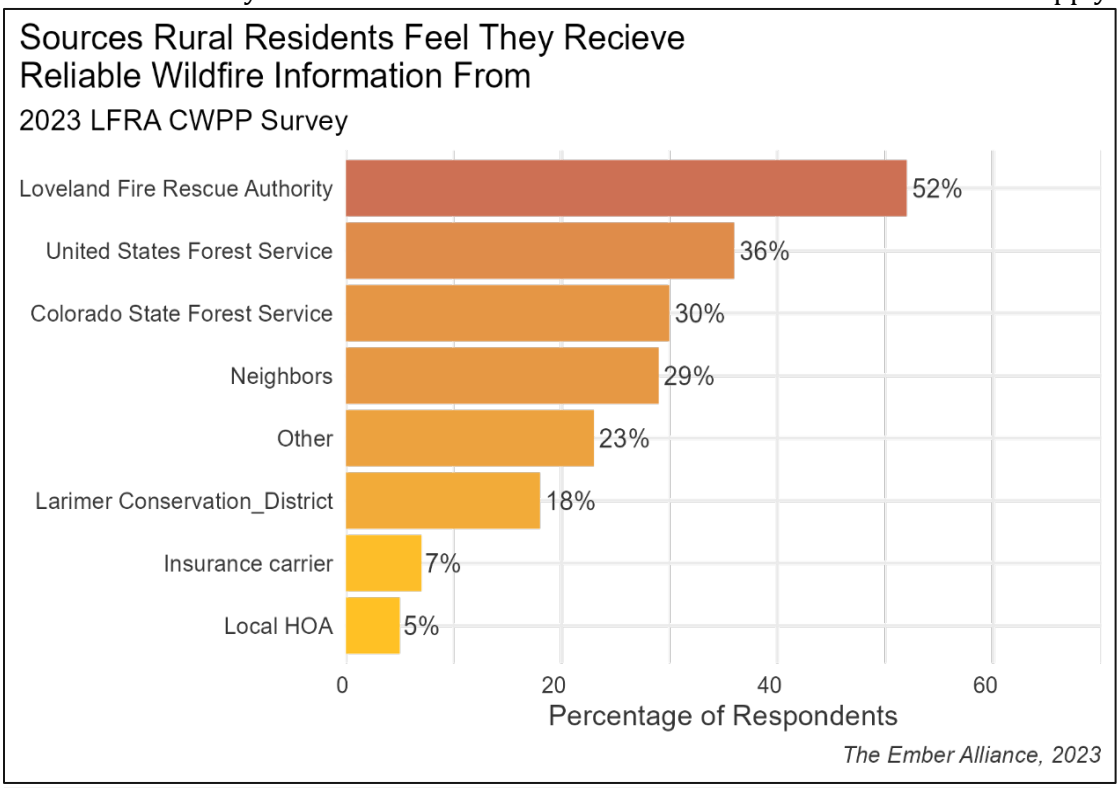


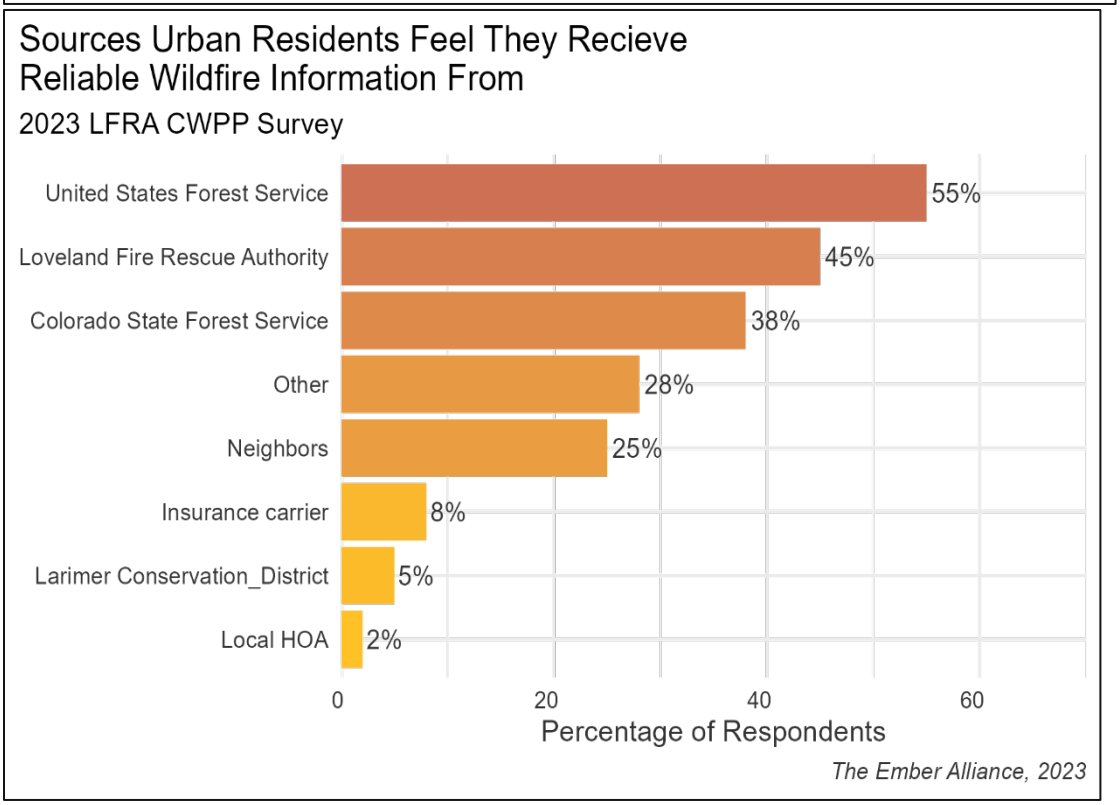
21. If there were an evacuation in the community because of wildfire, how concerned are you about the following issues?


Residents Level of Concern - Evacuation
2023 LFRA CWPP Survey
Where to go
Timely information
Routes
Road capacity
Children at home
Speed of evacuation
Not Concerned
Slightly Concerned
Moderately Concerned
Very Concerned
Not Applicable
Percentage of Respondents
75
50
25
0
The Ember Alliance, 2023

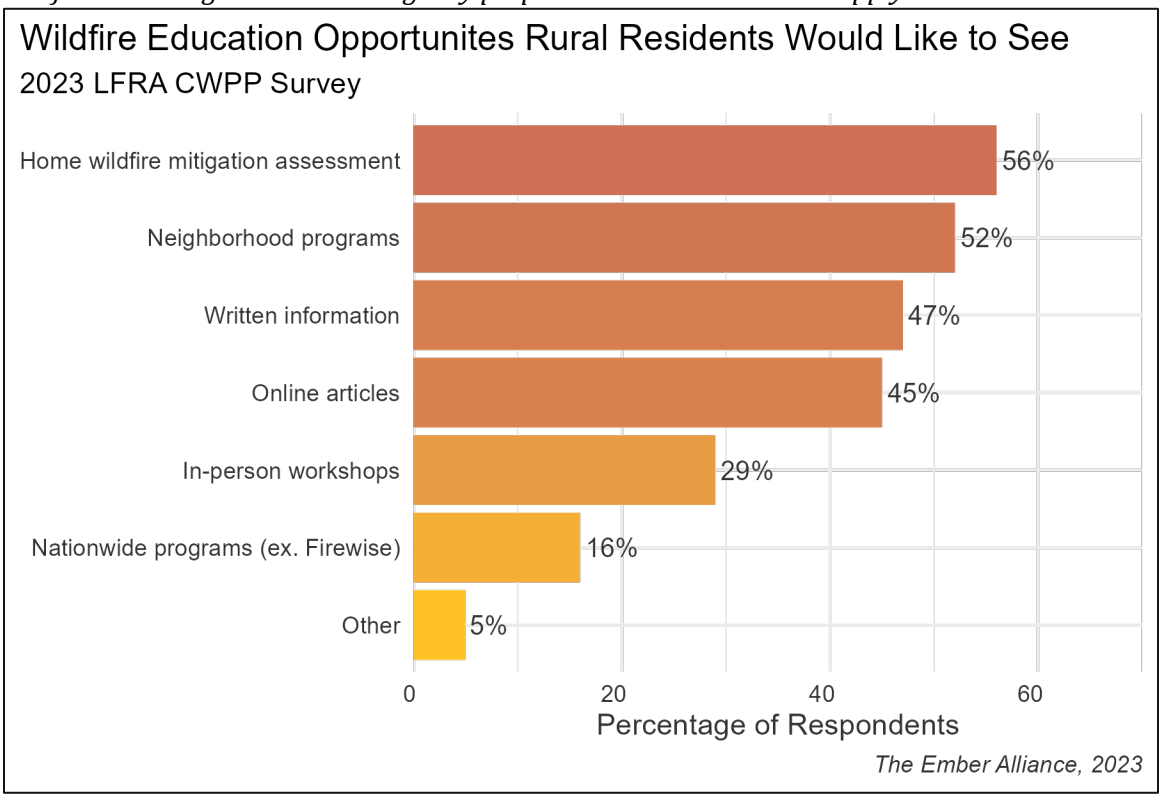
Section 5: Resources and educational opportunities

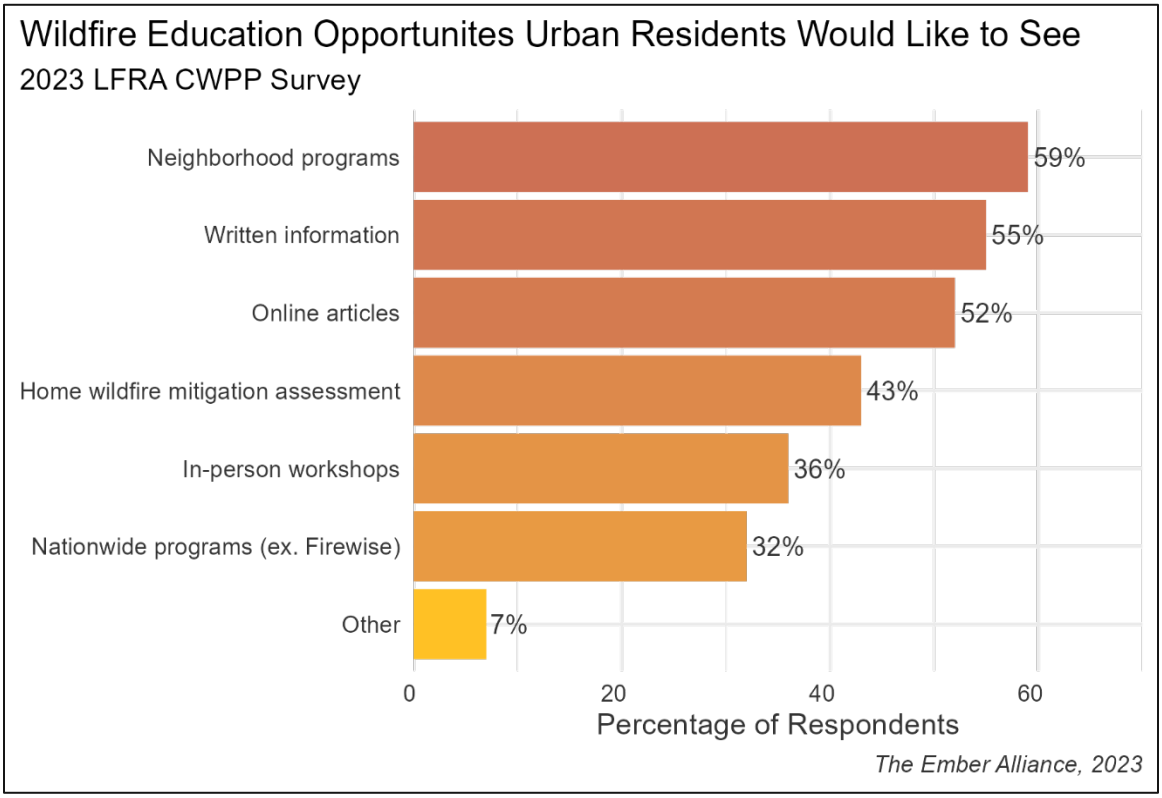
22. What sources have you found most reliable for wildfire information? Check all that apply.



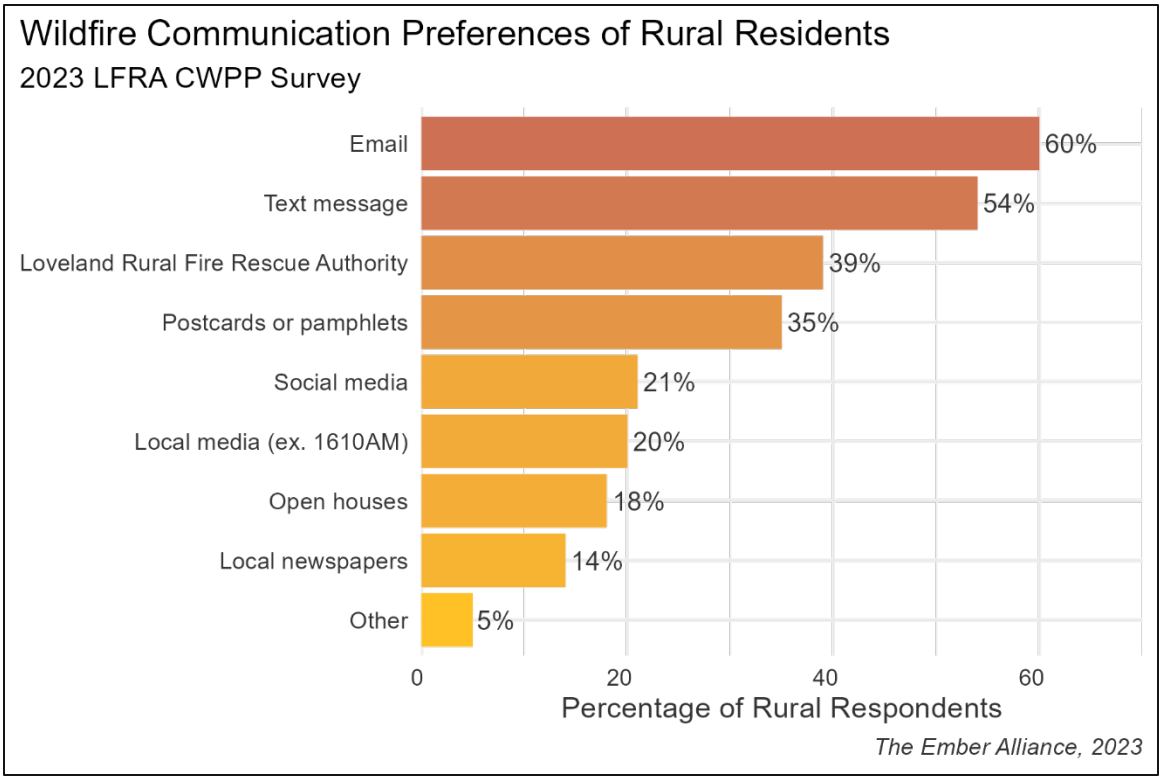


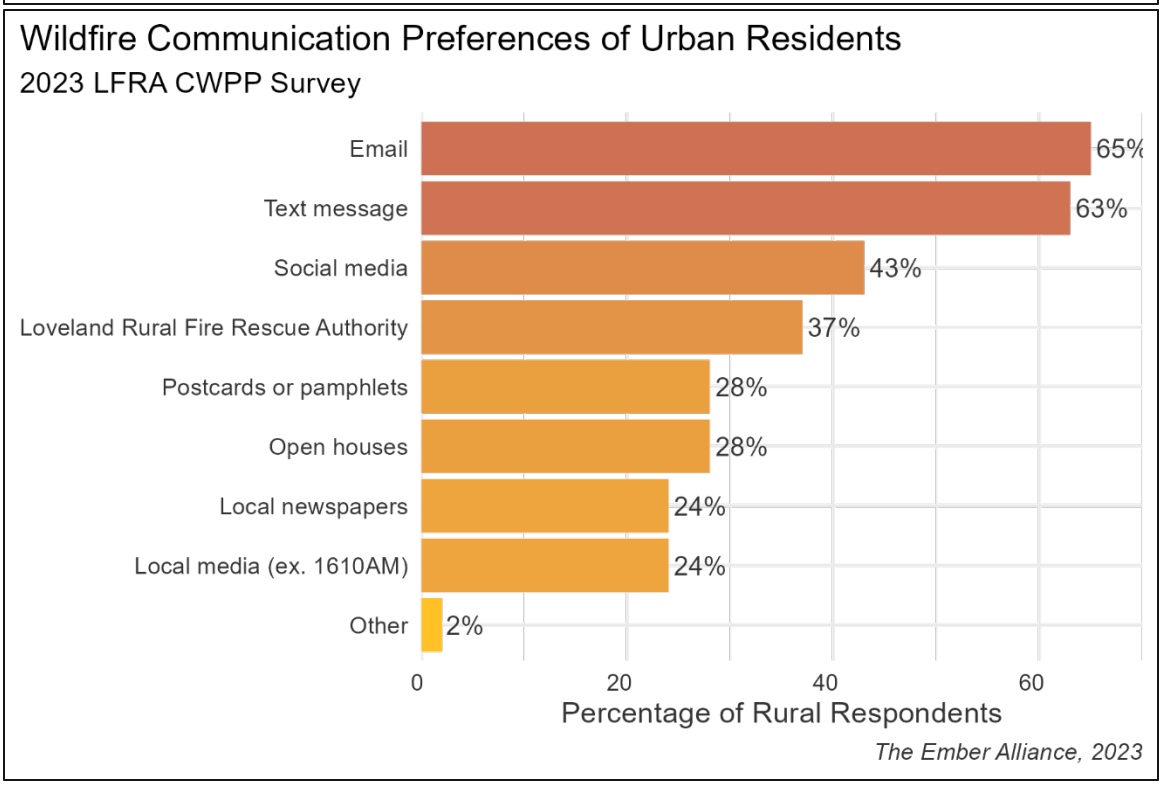
23. *Which of the following educational opportunities would you participate in to learn about wildfire risk mitigation and emergency preparedness? Check all that apply.*





24. *How would you like to be informed about wildfire information? Check all that apply.*


Wildfire Communication Preferences of Rural Residents
2023 LFRA CWPP Survey
Email
Text message
Loveland Rural Fire Rescue Authority
Postcards or pamphlets
Social media
Local media (ex. 1610AM)
Open houses
Local newspapers
Other
60%
54%
39%
35%
21%
20%
18%
14%
5%
0
20
40
60
Percentage of Rural Respondents
The Ember Alliance, 2023


Wildfire Communication Preferences of Urban Residents
2023 LFRA CWPP Survey
Email
Text message
Social media
Loveland Rural Fire Rescue Authority
Postcards or pamphlets
Open houses
Local newspapers
Local media (ex. 1610AM)
Other
65%
63%
43%
37%
28%
28%
24%
24%
2%
0
20
40
60
Percentage of Rural Respondents
The Ember Alliance, 2023

LFRA Survey Comments

During the survey, residents were given the option to add comments for each section. The comments revealed perspectives on wildfire that weren't shown through responses to multiple-choice or ranked questions. Multiple points of view were represented throughout the comments ranging from strong support for fire mitigation to questioning any type of risk of wildfire in the area.

"Most folks living in this area feel that wildfires are not a problem they have to worry about."

"The Marshall Fire was alarming and eye opening. It could happen to any of us. Time to act."

Evacuation Issues – Residents have significant concerns about there being only one way in and one way out of a community, especially in Storm Mountain, the road to Carter Lake, and other limited access roads. Some residents need more information regarding evacuation safety and preparedness in their neighborhoods.

"We only have one road in or out - so evacuation is always scary to ponder. When we were evacuated for the Cameron Peak Fire - it was a bit of a traffic jam - which is terrifying."

"Larimer County owes Storm Mountain a secondary evacuation route - it's way overdue. We have over 500 full-time people on the mountain and only 1 road in/out. If there is a fire on the access road or along any of our roads heading off the mountain, where are residents to go????????"

Open Space/Natural Areas – Several respondents indicated concern with open spaces or natural areas either behind or adjacent to their property not being maintained, with tall grasses and many dead and overgrown trees. Residents feel it is the responsibility of the County or City to maintain the property and do so on a regular basis.

"Don't know who to get in touch with at Larimer County to mitigate county property next to my property. Needs tree thinning and branch clearing and cutting. Don't know my legal rights to do it."

"The City of Loveland needs to develop and implement a wildfire mitigation plan for the natural areas."

Education Resources – Respondents indicated they want to improve their knowledge so they can take meaningful action. They noted a series of educational seminars on fire risk and mitigation would be helpful for all the public, wildfire mitigation home assessments, having access to more resources for chipping/disposal, and establishing Firewise communities in Loveland. There is also a need to educate part-time residents and short-term renters on the risk of fire. Several noted the inaction of neighbors is discouraging as it feels like their mitigation efforts are for nothing.

"Would like to see more neighbors take action to clear their properties more. Some have done a good job, and some don't do anything at all. Need more education. Need resources that could pick up piles of slash or trees. Some of us are all about mitigation but right next door can be a completely unmitigated property so - what do our efforts matter?"

"It is hard to spend a lot on mitigation if others in the neighborhood don't. I think folks are worried about aesthetics- would be nice to have some examples we could drive by and look at as **good mitigation**. How to inspire my non-resident neighbor to do mitigation?"

"Would like to have my property checked for additional things I can do to prevent damage to property."

Clear and Concise Information/Guidance from LFRA – Several comments noted support for LFRA mitigation requirements/guidance, and the availability of information from LFRA and county services. Other comments noted the fire department needs better outreach on different social media platforms that are user friendly, especially in terms of the emergency notification system.

"Lack of county enforcement enables neighbors to be negligent, which impacts us. City and county ordinances would not be effective unless adequately enforced."

"I think the fire department needs a better social media outlet where up to date information is shared."

"We need more education and outreach regarding the emergency alert systems. They can be confusing."