



## **Lake Christine Fire:**

***A Post-Fire Study on the Effectiveness of  
Wildfire Mitigation Activities in Identified Neighborhoods***

**August 2019**

## Acknowledgments

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Any errors or omissions are solely the responsibility of the authors.

## Report Information



This report was developed by the Community Wildfire Planner Center (CWPC), a 501(c)3 dedicated to helping communities prepare for, adapt to, and recover from wildfires. CWPC was formed in 2017 and works with communities across Colorado and elsewhere. CWPC collaborates with Eagle County and the Vail Board of REALTORS to administer the REALFire program.

Authors for this report were Kelly Johnston, RPF, FBAN and Molly Mowery, AICP. Kelly Johnston and Molly Mowery currently serve on CWPC's Board of Directors.

More information about CWPC is available at [www.communitywildfire.org](http://www.communitywildfire.org)

### Cover photo

Overview of the Lake Christine Fire and overlook of the Town of Basalt, CO. Image taken by Molly Mowery. 2018.

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## ACRONYMS

AAR	After action review
BAER	Burned Area Emergency Response
BLM	Bureau of Land Management
CPW	Colorado Parks and Wildlife
EOC	Emergency operations center
HOA	Homeowner association
IC	Incident command
NWCG	National Wildfire Coordinating Group
USDA	United States Department of Agriculture
WUI	Wildland-urban interface

# EXECUTIVE SUMMARY

Shortly after the Lake Christine Fire ignited on July 3, 2018, the fire directly affected or threatened several wildland-urban interface (WUI) areas in Eagle County. Several of the most notable fire impacts over the course of the next 72 hours were the destruction of three homes. Many homes, however, survived after being directly threatened by the Lake Christine Fire. These different outcomes provided an opportunity to further analyze and determine the extent to which structure loss or survivability could be attributed to suppression efforts, mitigation activities, or a combination of both.

The purpose of this study was to conduct a formal analysis on two specific areas, homes in or near the El Jebel Mobile Home Park and Missouri Heights, to determine the role of mitigation. This study provides additional findings which can further inform the potential role and effectiveness of wildfire mitigation, which includes regulatory or voluntary measures, such as: home hardening (i.e., using ignition-resistant construction materials and techniques), managing vegetation near structures and decks, and clearing combustible debris away from structures.

This study determined that homes which survived the Lake Christine Fire can be attributed to a combination of suppression and mitigation actions. In some cases, such as the El Jebel Mobile Home Park, it is highly unlikely that many structures in this area would have survived without the level of structure protection resources that were in place. This conclusion is based on the lack of visible mitigation, prevalent examples of combustible materials in and around structures, and compact development patterns. In other cases, such as several properties in the Missouri Heights neighborhood, it is more likely that structures in this area could have survived with limited to no structure protection resources due to the varying degrees of mitigation and separation of structures from vegetation or other structures.

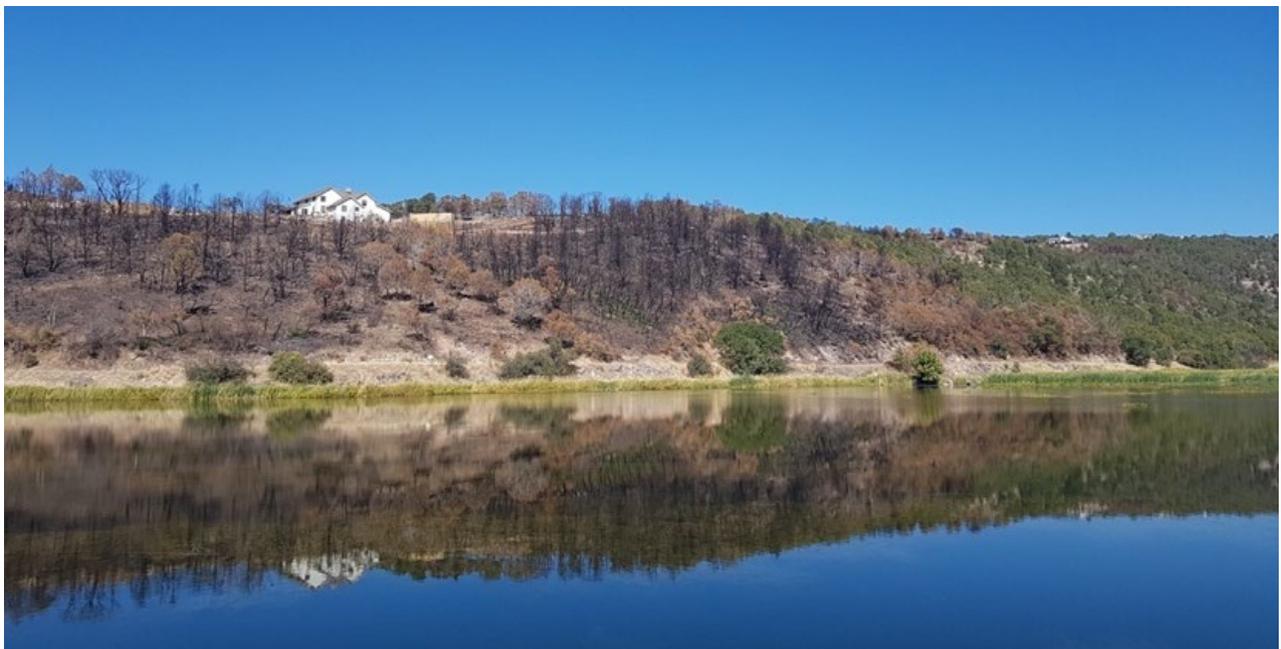
Finally, for structures that did not survive, evidence of home destruction aligns with science and research on structure ignition zone factors and the extreme fire behavior conditions that occurred on the evening of July 4.

These conclusions provide several key takeaways that can also help inform current and future mitigation activities in Eagle County and elsewhere:

- Property mitigation, where it was in place, supported firefighters in their response and suppression efforts by enabling them to make safer decisions and created a more efficient response.

- Voluntary and mandatory mitigation efforts were both necessary to address current and future development. These strategies complement one another during different aspects of the development process and lifecycle of structures.
- Where mitigation was absent, residential areas were 100% reliant on the availability of fire protection resources. During the start of the Lake Christine Fire, residents were fortunate to have those resources available but that may not always be the case. This leaves communities who have not taken any proactive steps in a vulnerable position.
- Other factors, such as access, played a role in the decision-making process as to whether firefighters could provide a safe and efficient response. Ensuring adequate and consistent road and driveway standards would further support response efforts, especially in circumstances that were experienced during the Lake Christine Fire.

Many areas throughout Eagle County, including those that were part of this study, are in the WUI. In addition, the county anticipates future development to continue, which may result in an expanded WUI footprint. Based on the results of this study, wildfire regulations and proactive voluntary measures must continue to be actively supported and integrated into the planning process to prepare for future wildfire incidents. Mitigation activities support the ability for firefighters to safely respond to residential areas threatened by fire, and in most typical WUI disaster situations may be the only available strategy that enables homes to survive when suppression resources are overwhelmed, or simply not available.



*Figure 1. Home survival was a result of both firefighter suppression and mitigation actions.  
Credit: Kelly Johnston*

# PART 1: OVERVIEW

The Lake Christine Fire began at the Basalt State Wildlife Area shooting range on Tuesday, July 3, 2018 (CPW 2018). The shooting range is located one mile northwest of Basalt, Colorado. The start time was recorded at 6:15 pm (NWCG 2018). The ignition was a result of two people allegedly using incendiary tracer rounds at the site, which were prohibited at that time due to Stage 2 fire restrictions in place in Eagle County (CPW 2018; Condon 2018). The fire burned a total of 12,588 acres, destroyed three homes, and caused multiple evacuations with shelter operations; no lives were lost (EOC 2018). The fire was declared 100% contained on August 12, 2018 (NWCG 2018).

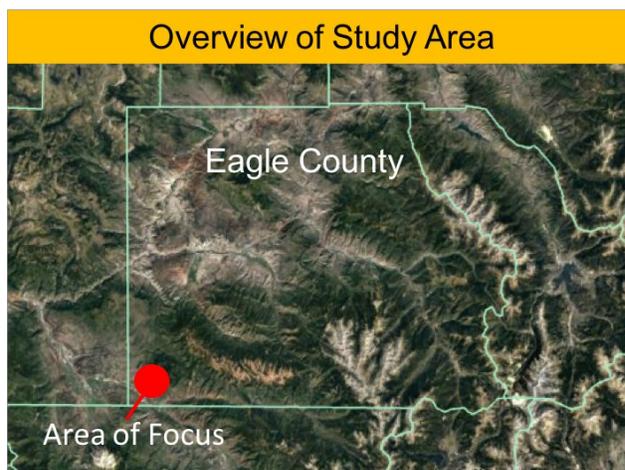


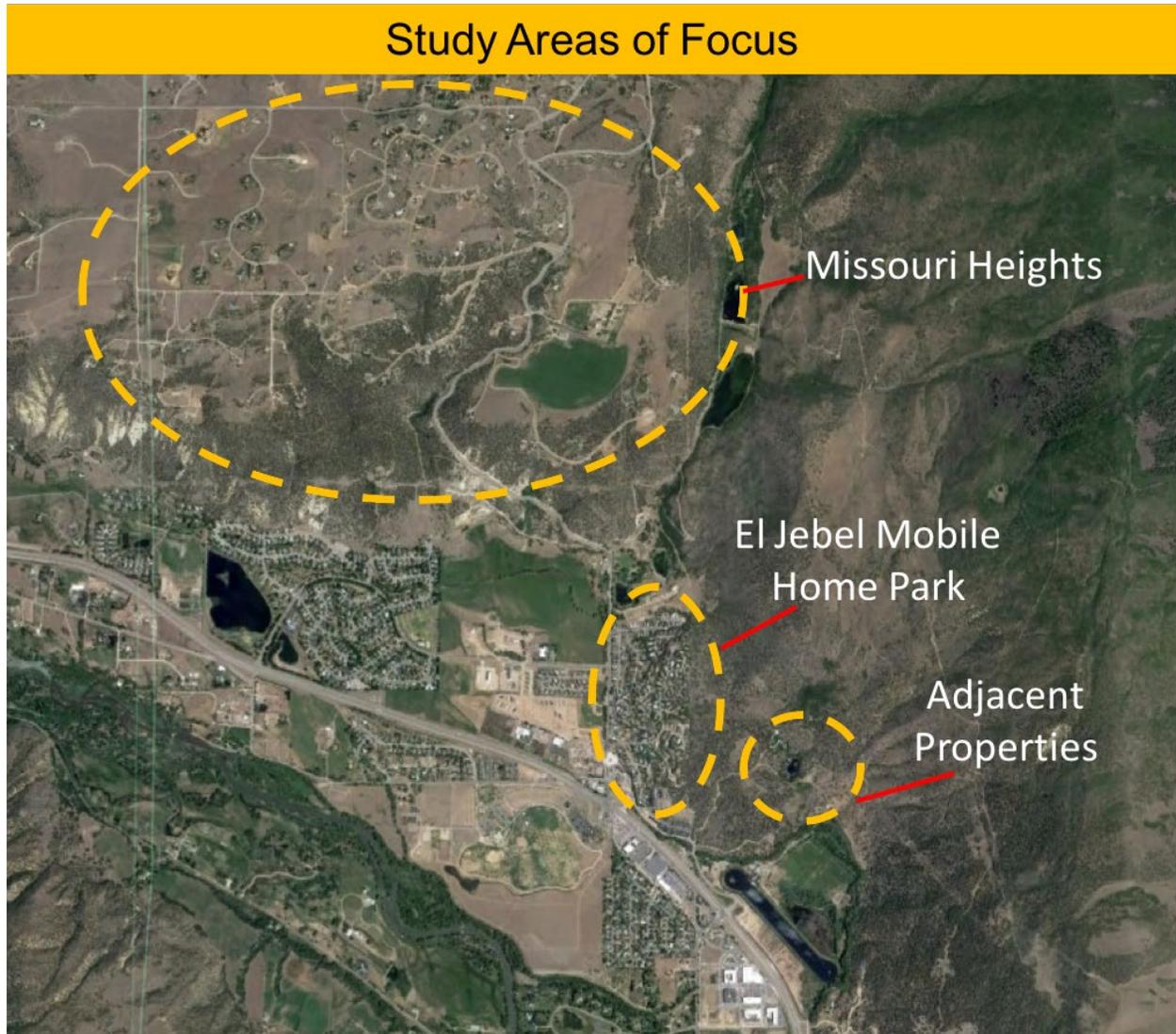
Figure 2. Location of post-fire mitigation study area in Eagle County (displayed by red dot).

## Purpose of Study

The purpose of this study is to analyze wildland-urban interface (WUI) areas in Eagle County that were directly affected or threatened by the Lake Christine Fire to determine which factors played a role in structure loss or survivability.

The wildland-urban interface (WUI) is defined as any developed area where conditions affecting the combustibility of natural and cultivated vegetation (wildland fuels) and structures or infrastructure (built fuels) allow for the ignition and spread of fire through these combined fuels (Mowery et al. 2019). This definition provides for areas that may be subject to ember transport, even if further away from the traditional “line” or “zone” directly adjacent to a wildland area.

Specifically, the study area focuses on two WUI areas that experienced structure losses during the Lake Christine Fire: El Jebel Mobile Home Park and several adjacent properties affected by the fire, and a collection of properties and neighborhoods referred to as Missouri Heights (Figure 3).



*Figure 3. This study is focused on two areas that were directly affected or threatened by the Lake Christine Fire: El Jebel Mobile Home Park and adjacent properties, and several neighborhoods in Missouri Heights.*

This study is limited to a discussion on property and structure mitigation, wildfire ignition, and suppression actions to protect structures. There are additional facets to any wildfire event, such as landscape-scale fuel treatments and post-fire effects on soil and vegetation, that were considered outside the scope of this study's purpose. Where relevant, however, this information has been added for context.

## **Methodology**

Research conducted for this study by the report authors was gathered from the following sources:

- Post-fire field tour on September 21, 2018, lead by Chief Scott Thompson (Roaring Fork Fire & Rescue, formerly known as Basalt & Rural Fire Protection District). The field tour

focused on areas directly affected by the Lake Christine Fire related to this study's purpose (Figure 4).

- In-person and telephone interviews with firefighters and county officials who were engaged in response and/or post-fire damage assessments. Interviews provided firsthand accounts of the incident and observations regarding which factors played a role in the outcome.
- Official incident information and reports available from national and county sources, including Incident Status Summary reports (ICS-209), Incident Action Plans, Burned Area Emergency Response (BAER) Summary, After Action Review/Improvement Plan, fire progression maps and additional spatial data.
- Local radio stories, newspaper articles, and social media posts. This also included videos or images.

## Timeline

The duration of the Lake Christine Fire occurred over several weeks. This study covers the date range of July 3–July 5, the time period when the study focus areas were most acutely threatened or affected by the fire. See Figure 5 for a timeline of key dates relevant to this study.



Figure 4. Chief Scott Thompson (middle) discusses wind patterns and fire behavior with Kelly Johnston (left) during a post-fire field tour. Credit: Molly Mowery.

### Focus of Events Relevant to Study

#### Tuesday, July 3 (evening):

- Lake Christine Fire reported
- Initial evacuations ordered

#### Wednesday, July 4 (day):

- Fire begins to grow significantly due to erratic winds and dry fuels
- Zero percent containment

#### Wednesday, July 4 (night)/ Thursday, July 5 (morning):

- Additional evacuations ordered
- Three structures reported lost, others damaged
- Loss of power to some areas

#### Thursday, July 5:

- Post-fire damage assessments begin

#### Friday, July 13:

- All mandatory evacuations lifted and residents return home

#### Sunday, July 29:

- All pre-evacuation notices lifted

#### Sunday, August 12:

- 100% containment of Lake Christine Fire

Figure 5. Timeline of key events relevant to post-fire mitigation study.

## Lake Christine Fire Impacts

Impacts from the Lake Christine Fire reflect the widespread nature of wildfire impacts on the local environment and community, as broadly discussed below.

### *Acres Burned*

The fire burned a total of 12,588 acres (NWCG 2018), which affected both public and privately-owned land. Public lands within the fire perimeter included areas managed by the USDA Forest Service (White River National Forest), Colorado Parks and Wildfire (Basalt State Wildlife Area), and the Bureau of Land Management.

### *Property Loss*

Eagle County conducted post-fire damage assessments on three residential structures that were destroyed by the Lake Christine Fire. Additional outbuildings (sheds, barns, greenhouses) were reported as destroyed based on field observations shared during post-fire interviews. Additional properties may have been damaged by smoke but no official reports are available.

### *Safety and Evacuations*

There was no loss of life as a result of the Lake Christine Fire. Several firefighter injuries/illnesses were reported due to heat exhaustion, dehydration, and one incident of a dozer rolling over.

Based on Incident Status Summary reports (ICS-209), the total number of civilians evacuated was 2,100. The number of homes evacuated was estimated at 925 (Abraham 2019). Mandatory evacuations occurred primarily within the first week of the fire. On July 13, all mandatory evacuations were lifted. Several areas remained on pre-evacuation notice until July 29 when all pre-evacuation notices were lifted (Aspen Public Radio 2018).

### *Economic Impacts*

A court filing from April 2019 indicates that costs from the Lake Christine Fire may exceed \$25 million. Agencies/companies and costs included in the filing were as follows:

- U.S. Forest Service, estimated costs to fight the fire of \$20 million;
- Xcel Energy, an estimated \$3.4 million in damages and labor to repair and replace power lines;
- Bureau of Land Management, estimated costs of fire suppression, including labor, aviation and supplies, of over \$1.7 million;
- Holy Cross Energy, estimated costs of \$320,000 spent on repairs and labor to re-establish service to affected areas;
- Black Hills Energy, estimated costs of \$149,000;

- Comcast, with estimated restoration costs of nearly \$20,000.

A recent analysis by Headwaters Economics suggests that suppression costs comprise only nine percent of total wildfire costs (Barrett 2018). For example, additional economic impacts that were unaccounted for could include lost revenues from tourists or other visitors who cancelled plans.

## **Additional Impacts**

Other known impacts resulting from the fire include:

- Air quality and public health impacts from smoke (Aspen Public Radio 2018);
- Soil burn severity, potential for floods and debris slides (Schnackenberg and Anderson 2018);
- Trail and road closures, including access to public lands and recreational areas.

## **Study Area**

The WUI is influenced by features in both the natural and built environments, including natural and cultivated vegetation, topography, and development patterns. These influences within or near the study area are described below.

### **Natural Environment**

A major land feature near the study area is Basalt Mountain, an ancient shield volcano with geology consisting of basalt flows, landslide deposits, and sedimentary layers of Mancos shale, evaporites, and Dakota sandstones (Schnackenberg and Anderson 2018). Terrain ranges from flat valleys, watershed drainages, hillsides, and steep basalt-rock cliffs.

Vegetation varies within the study area, and includes grasses, sagebrush, Gambel oak brush, and Pinyon-Juniper at the lower and middle elevations; higher elevations is predominantly comprised of aspen and spruce/fir (Schnackenberg and Anderson 2018). There are several surface water sources within the lower Blue Creek drainage between Missouri Heights and the El Jebel Mobile Home Park (Figure 6).



*Figure 6. Water features in the study area are ditch-fed reservoirs that run along an irrigation network.  
Credit: Molly Mowery*

## Built Environment

The WUI is typically spatially delineated into the intermix and the interface, dependent upon development patterns and proximity to vegetation. An intermix WUI is where development is interspersed or scattered throughout wildland vegetation; an interface WUI is where development is grouped near areas with wildland fuel (Mowery et al. 2019). An intermix WUI is often found in rural, exurban, or large-lot suburban development patterns; an interface WUI is distinguished by a clear line of demarcation between development and vegetation, which may appear as an abrupt edge between a highly-urbanized area and a wildland area. Each WUI development pattern is represented in the two areas of focus for this study, as described below.

### El Jebel Mobile Home Park

The El Jebel Mobile Home Park, owned by Crawford Properties LLC, has 289 mobile home lots, some of which are double wide or triple wide. Development began in the 1970s. Today's population represents a broad range of demographics, including working families and immigrants.

El Jebel Road runs along the Mobile Home Park's western edge. To the north is a rural development and to the south is a new development and urbanized area. The eastern edge of the Mobile Home Park is bordered by a wooden fence that abuts a wildland area managed by the Bureau of Land Management (BLM) and the USDA Forest Service<sup>1</sup>.

Roads are a combination of paved and well-maintained, non-paved crushed gravel surfaces. Driveways and parking pads are typically non-paved and adjacent to or short distances to structures. Vehicles are parked in driveways and along roadsides. The network of roads is a looped pattern, with the exception of a single access point on a dirt road that leads up to six single-family parcels

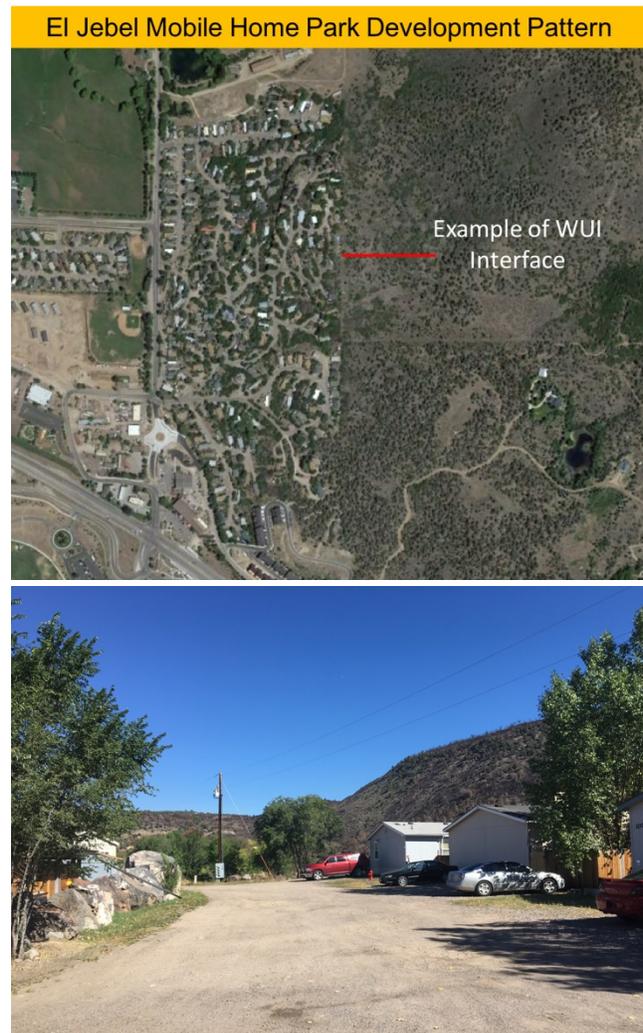


Figure 7. Development patterns in the El Jebel Mobile Home Park represents a WUI interface. Credit: Molly Mowery

<sup>1</sup> Information based on Eagle County assessor records and Upper Colorado River (UCR) Interagency Fire Management Unit)

(1.2 acre lots). Two of those single-family structures were destroyed by the Lake Christine Fire, as further discussed in Part 2.

Topography within the El Jebel Mobile Home Park is relatively flat. Property setbacks vary significantly—some distances between structures are less than 30 feet, while other distances are greater than 100 feet. Vegetation (trees, shrubs, grasses) is interspersed throughout the community, but generally the area represents an interface WUI due to the linear shape and defined edge in proximity to a wildland area (Figure 7).

Homes have either asphalt or metal roofs. Approximately 70% of the homes have lap siding (MHVillage n.d.). Foundations are typically covered/closed with metal, plastic or wooden trellis features. The presence of attachments (decks, wooden fences) and other materials (lawn chairs, bicycles) is readily observed throughout the neighborhood. Utilities are above ground.

## Missouri Heights

Missouri Heights broadly refers to a geographic area in Eagle County that is north of El Jebel, and directly bordered by Garfield County on its western edge.

The community has different neighborhoods organized by an estimated 12 Homeowner Associations (HOAs). Two of the neighborhoods, Vista Hi and Blue Creek Overlook, were directly affected or threatened by the Lake Christine Fire, as discussed in Part 2.

Neighborhood development patterns across Missouri Heights vary. Traditionally, the area was dominated by ranching and agricultural land uses. Over the last several decades, these land uses have been converting to residential subdivisions with lot sizes ranging from 1-2 acres to five or more. Home sizes can range from 3,000-5,000 square feet, in some cases they are 5,000 – 10,000 square feet, and structure age spans decades.

Many neighborhoods within Missouri Heights are developed along rolling hillsides. In other neighborhoods, there are relatively flat areas, with land features such as irrigated



Figure 8. Development patterns in Missouri Heights represents a WUI intermix. Credit: Molly Mowery

fields or horse pastures. Structures are interspersed with vegetation, resulting in a WUI intermix (Figure 8).

Many of the main roads, such as Upper Cattle Creek Road, and some secondary roads and driveways are paved. However, there are also secondary roads and driveways with varying surface conditions, including crushed gravel or dirt. Driveways can also be long and steep. Road and address signage varies, and in limited instances there are locked entrance gates to communities or individual properties.

## **Mitigation Activities**

### **El Jebel Mobile Home Park**

The county has not had any traction with establishing wildfire mitigation activities or programs within the El Jebel Mobile Home Park. Field observations also confirmed the absence of mitigation efforts in this neighborhood. This is likely a result of some or all of the following factors, including: limited interest from residents; ownership/renter patterns, and; restricted opportunities for regulatory intervention.

The State of Colorado is responsible for performing building inspections; the county does not have regulatory authority to address wildfire through structure requirements, with the exception of building permits issued for decks, carports, or similar attachments. In these instances, the county can make a materials requirement (e.g., such as the use of noncombustible or ignition-resistant materials) but cannot make any requirements for vegetation changes to improve defensible space.

Further, the lack of mitigation actions in the El Jebel Mobile Home Park is further complicated by the fact that most residents are either renters; or, in cases where residents own their trailer, they still do not own the land, which is owned by Crawford Properties LLC. These factors also limit the ability to modify existing vegetation for wildfire.

### **Missouri Heights**

In contrast, any structures within Missouri Heights that were built on or after 2003 were subject to Eagle County's wildfire regulations (adopted January 2003). Depending on the hazard rating of an individual parcel at the time of its permit application, county wildfire regulations can require vegetation management of hazardous fuels and specific building construction materials to reduce wildfire hazard. For those properties subject to the county's regulations, the hazard rating was either extreme or high due to the presence of long cul-de-sacs or one-way-in/one-way-out access, slopes, and mature pinyon/juniper. The county will perform on-site assessments to verify these ratings.

However, many structures in Missouri Heights pre-date this regulatory review process. In some cases, several properties have undergone renovations or additions that triggered a review for

wildfire mitigation as part of the permit process. Where applicable, these properties incorporated ignition-resistant construction features or defensible space.

Some homeowners in Missouri Heights have also participated in the REALFire program, a voluntary assessment program that provides mitigation advice to homeowners<sup>2</sup>. However, the fire did not reach any of the properties participating in the REALFire program. Field observations and interviews confirm the spectrum of mitigation that was apparent on properties. No other formal community mitigation program, such as Firewise USA, has been implemented. In sum, Missouri Heights is comprised of a variety of properties, some of which incorporated mitigation into their lots and/or structures—either voluntarily or as a regulatory requirement—prior to the Lake Christine Fire.

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<sup>2</sup> REALFire is a program developed through a collaboration by Eagle County and the Vail Board of REALTORS. It is currently administered by the Community Wildfire Planning Center. The program offers professional home assessments with property-specific recommendations. Participating homeowners who successfully complete all recommendations received a signed certificate of recognition from the Eagle County. More information about the program is available at [realfire.net](http://realfire.net).

## PART 2: ANALYSIS

The Lake Christine Fire was reported on the evening of Tuesday July 3, 2018. Structure impingement in El Jebel and Missouri Heights occurred through the late evening of July 4 and early morning of July 5. This analysis focuses on the period of July 4 to July 5, 2018, when fire progression impinged on the area of El Jebel Mobile Home Park and Missouri Heights.

### Fire Behavior

Overall, fire suppression resources that were interviewed for this study indicated that the fire exhibited aggressive fire behavior, producing flame lengths of 20 to 30 feet and prolific short and medium distance ember impacts during fire spread in the Pinyon-Juniper fuel type until late evening on July 4. The generation of a significant spot fire into the Blue Creek Overlook neighborhood (in Missouri Heights) suggests that embers extended up to 800 feet ahead of the main fire. Information from interviewed firefighter resources report that embers extended up to 60 feet into the El Jebel Mobile Home Park (Lava Drive) from the flanking fire. As wind activity decreased late on July 4 and into the early morning hours of July 5, fire behavior activity decreased significantly in the Vista Hi and Blue Creek Overlook neighborhoods, which was partially credited by firefighter resources for suppression success in this area.

### *Fuels*

Fuels in the fire perimeter that were involved during the July 4 to 5 growth period were dominated by closed conifer timber, litter and Gambel oak brush (NWCG 2018) with some open agriculture (hay) fields, and landscaped residential properties (grass) in extremely dry conditions. In 2005, fuel mitigation work had been undertaken immediately east of the El Jebel Mobile Home Park. However, fire suppression resources reported that the Pinyon-Juniper fuel type was consistent to immediately adjacent of homes within the El Jebel Mobile Home Park area at the time of the fire. Conversely, fire suppression resources in the Vista Hi and Blue Creek Overlook neighborhoods reported minor to significant fuel breaks between structures and the Pinyon-Juniper fuel type, with separation by either agricultural fields, landscaping (typically grass), driveways or both. They also reported that some of the properties where fuel modification within the Pinyon-Juniper fuel type significantly altered fire behavior.

### *Weather*

Relative humidity of less than 10 % and thunderstorms with strong outflow winds contributed to significant fire growth on July 4 (NWCG 2018).

## Topography

The fire started on the southwest slopes of Basalt Mountain, progressing west along the south slope and finally north along the Blue Creek drainage and the southwest slope of the mountain. The south slopes of Basalt Mountain are characterized by generally moderate “benched” slopes transected by the north/south oriented Blue Creek drainage. The southwest slope of Basalt mountain becomes progressively steep moving north. The topography characteristic of the El Jebel Mobile Home park is generally flat; while the eastern flank of the Missouri Heights neighborhood is characterized by the relatively steep slope of the Blue Creek drainage.

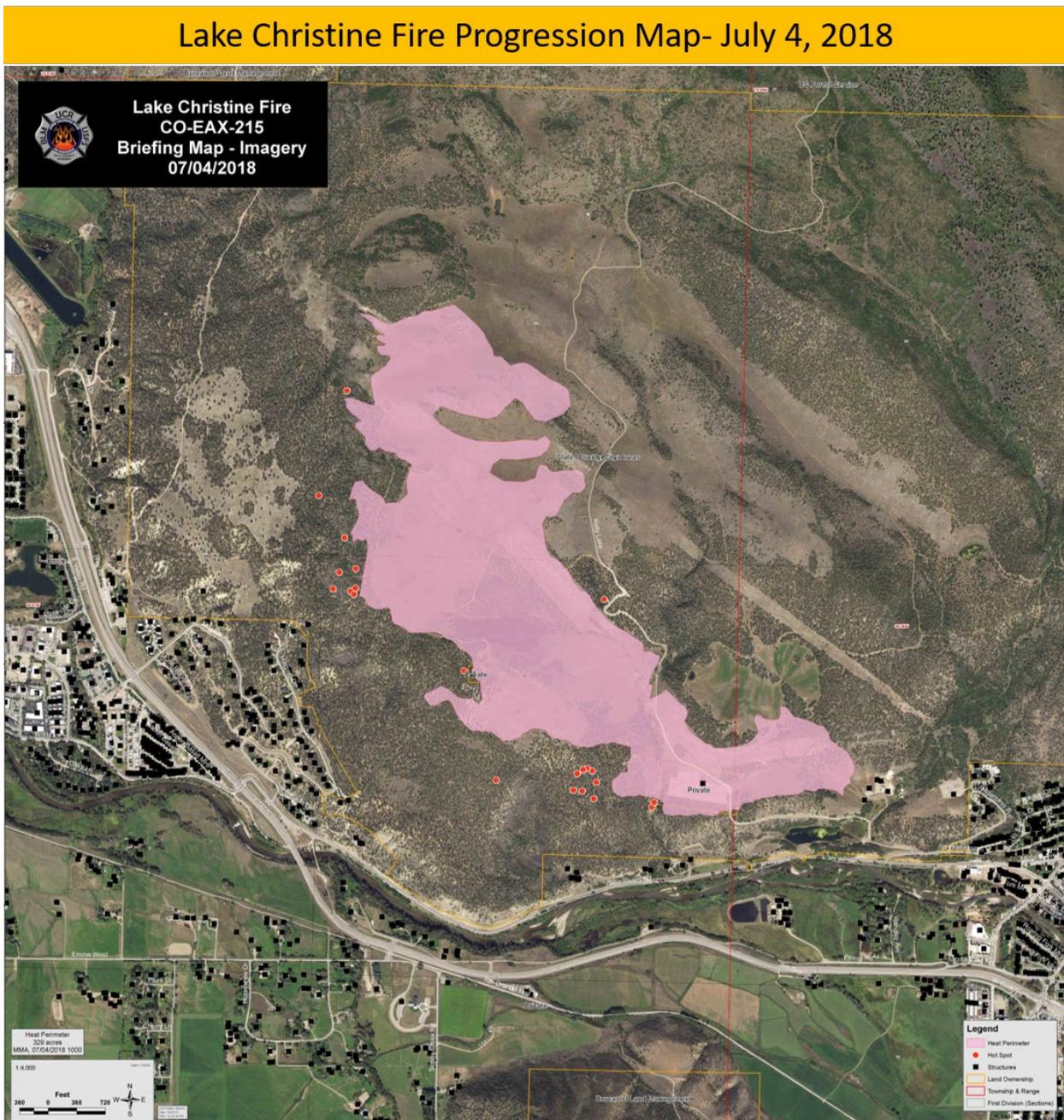


Figure 9. July 4, 2018 Lake Christine Fire Progression Map

### Fire Spread Direction

According to the fire progression map (Figure 9), and interviews with fire suppression resources, initial fire spread was downhill, transitioning to following topography and upslope winds to the north and northwest and west through the late evening of July 4 and into the early hours of July 5. The fire continued to burn to the northeast and up the southwest facing slope of Basalt Mountain for the remainder of the incident.

## Structure Protection Actions Summary

Structure protection actions were undertaken by fire suppression resources in three primary neighborhoods: the El Jebel Mobile Home Park, the Vista Hi neighborhood and the Blue Creek Overlook neighborhood. In all cases, fire suppression resources reported that limited area knowledge, absent or poorly visible street signs and address signage, as well as unknown road and driveway standards (e.g., surface type, length, accessibility) significantly limited suppression capabilities.

### El Jebel Mobile Home Park

The El Jebel Mobile Home Park was the first neighborhood to be challenged by the flank of the fire as it progressed north and northeast. This area saw significant structure protection efforts.

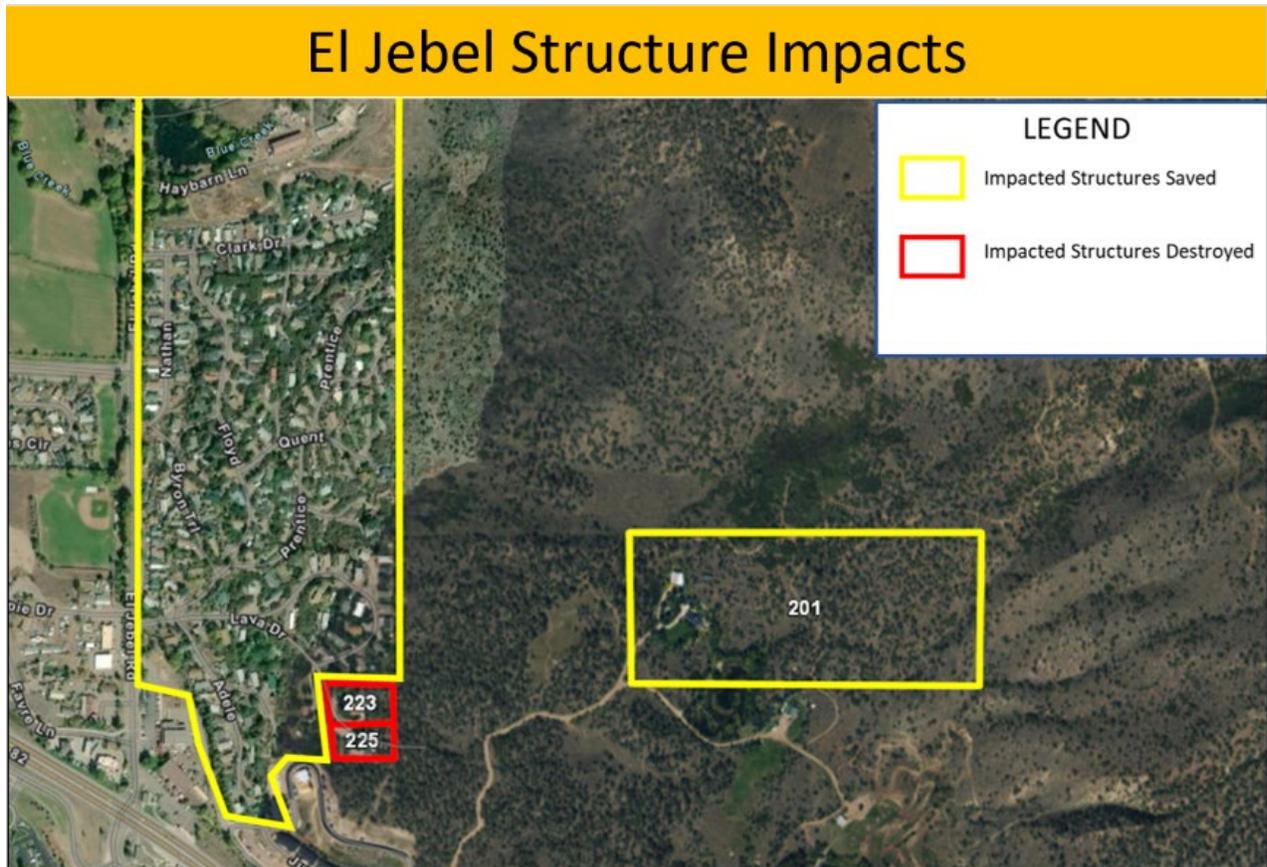


Figure 10. El Jebel Mobile Home Park and Tree Farm Drive impacted structures (saved and destroyed)

Suppression crews in this area reported initiating a burn-out operation to minimize the radiant heat potential of the flank and backing fire, as well as minimize the extent of ember exposure. The burning operations progressed from north to south along the eastern perimeter of the mobile home park. In addition to the burning operations, engine crews also patrolled and suppressed spot fires where embers landed and ignited within the neighborhood. The structure protection operations were successful in protecting all the structures within the mobile home park. Fire behavior at the south end of the neighborhood prevented the completion of the operation, and two structures on Lava Drive, immediately outside the park, were destroyed (Figure 10). Suppression resources who witnessed the ignition of these structures described the cause as a significant ember storm that ignited accessory buildings and decks, which in turn ignited the primary structures.

Fire suppression resources credited the prevalence of metal skirting, or at a minimum enclosed mobile home foundation in the area for resisting ignition from fire and increasing suppression opportunities. However, during a post-fire site visit, study authors noted several conditions that typically lead to structure ignition, such as combustible accessory structures, vegetation, and stored materials immediately adjacent to primary structures. The success of structure protection in this area is largely attributed to the ability of significant suppression resources to arrive from other jurisdictions and be able to engage prior to fire impingement.

### ***Vista Hi Neighborhood (Missouri Heights)***

Subsequent to fire impingement on the El Jebel Mobile Home Park, the Vista Hi neighborhood was challenged by head fire radiant heat and ember impacts approaching from downslope of the 850 Vista Hi property from the Blue Creek drainage. Fire suppression resources reported that the structure was destroyed through ember ignition of accessory structures immediately adjacent and downhill of the primary residence, which, in turn ignited the primary residence. Suppression resources also reported significant ember showers produced by the burning structures that ignited spot fires in hay fields, grass, and Pinyon-Juniper stands over five hundred feet down wind (to the west and northwest). A large, irrigated field located directly west of Vista Hi was attributed to halting fire spread to the west (Figure 11).

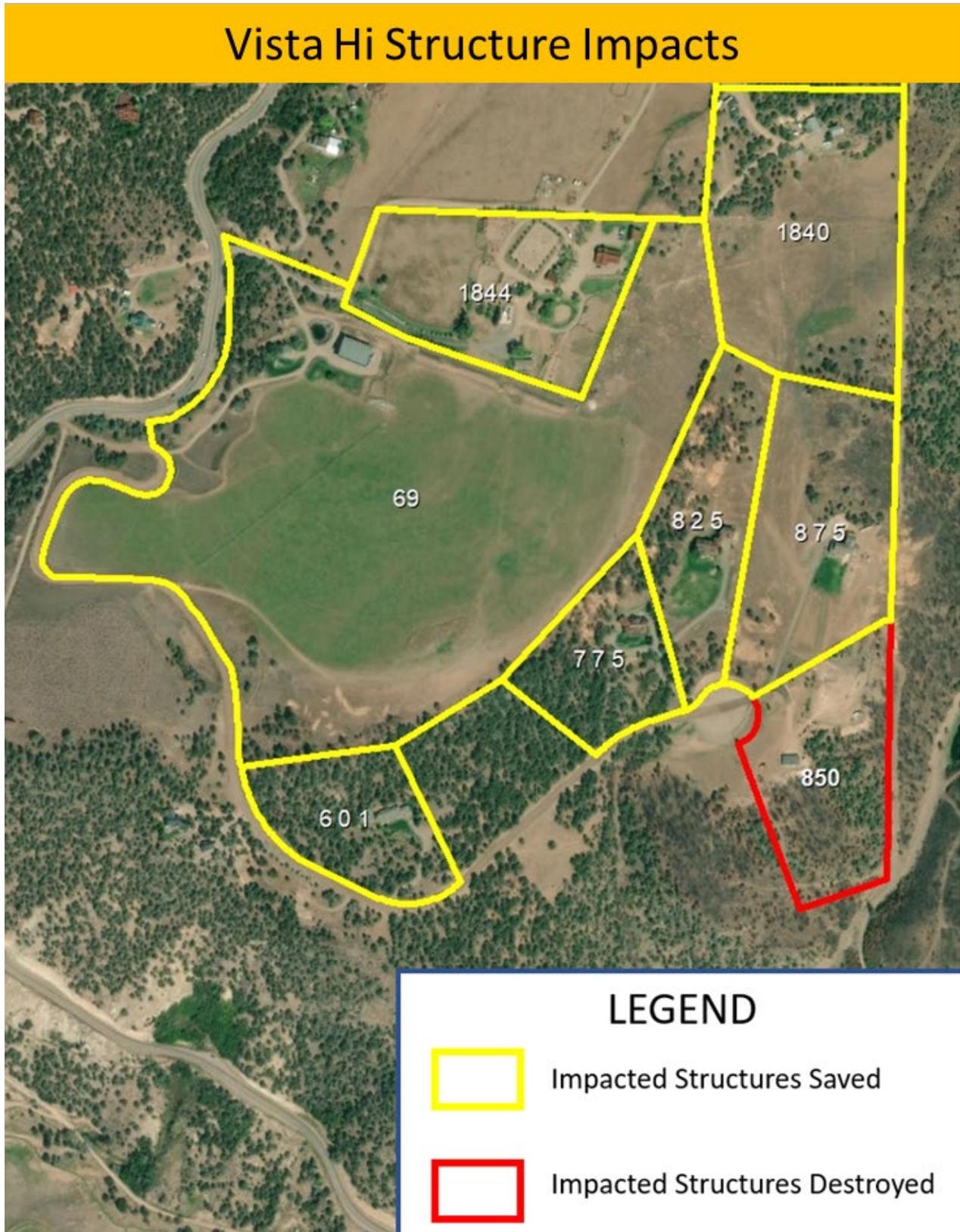


Figure 11. Vista Hi neighborhood impacted structures (saved and destroyed)

## Blue Creek Overlook Neighborhood (Missouri Heights)

As the fire spread to the north, up the Blue Creek drainage and along the southwest aspect of Basalt Mountain, a significant spot fire was generated by embers approximately 800 feet ahead of the fire front. The spot fire quickly grew, impinging upon two properties in the Blue Creek Overlook neighborhood. Due to the fire activity, limited area knowledge, and inability to adequately assess the situation in the dark, fire suppression resources staged outside the properties to wait for a decrease in fire activity. Upon entry to the properties, firefighters found no structure damage. Therefore, both properties survived without fire suppression intervention (Figure 12).

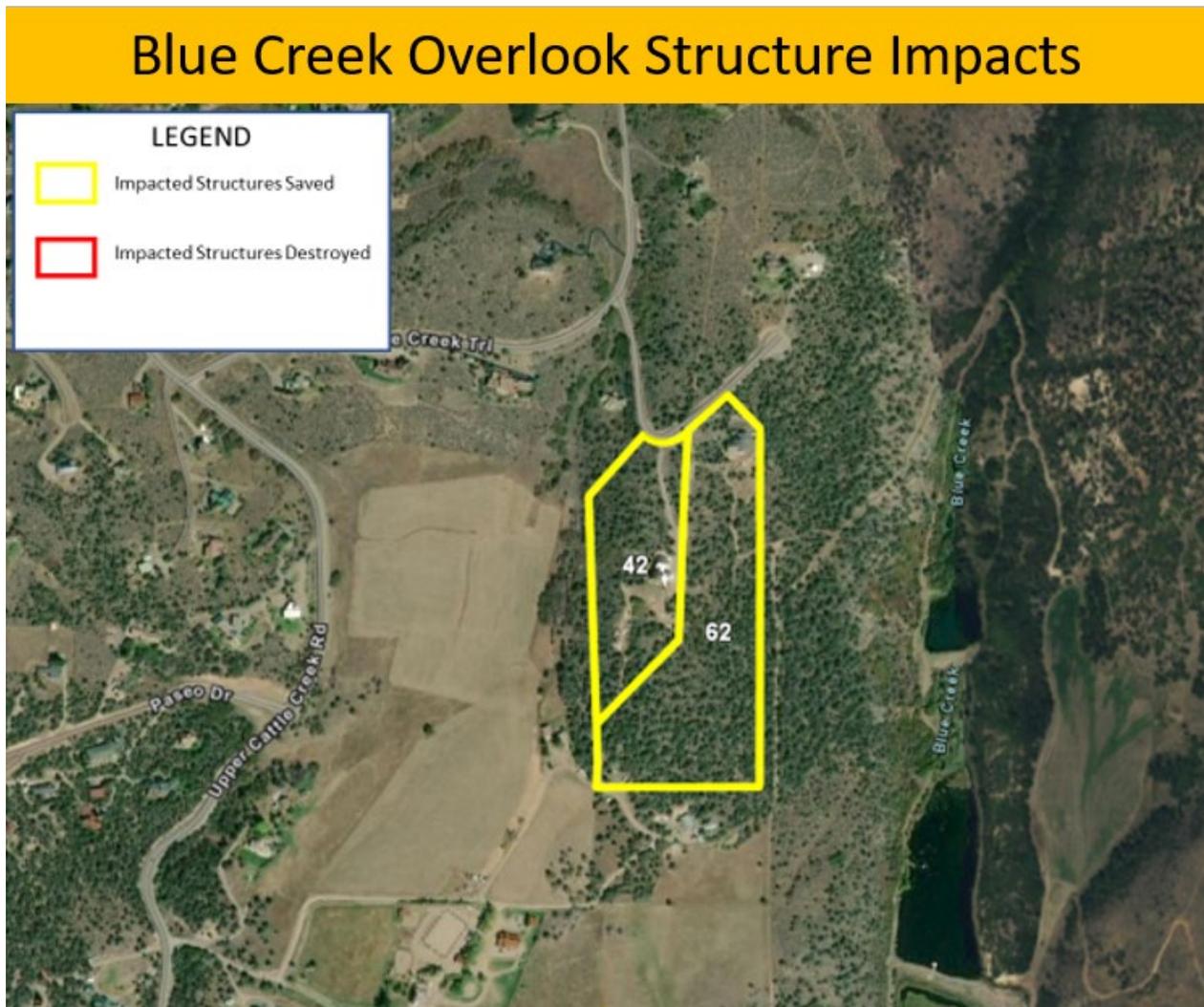


Figure 12. Blue Creek Overlook impacted structures (saved and destroyed)

## Structure Impacts Summary

On July 5, 2018, post-fire damage assessments were conducted for these properties by the Eagle County Wildfire Mitigation Specialist and the County Assessor. This information is not currently accessible, and therefore these structure impact observations are based on the interviews with key fire suppression and mitigation personnel present on the fire ground during the event.

Based on information from the Eagle County Mitigation Specialist and responders, a total of fourteen individual properties were recorded as directly impinged by the fire, either via embers or radiant heat (Table 1). The primary structures on three of these properties were destroyed. Six of the fourteen properties recorded as impacted were built subject to the Eagle County's wildfire regulations (i.e., mitigated properties). All of the properties subject to the regulations survived, as well as six properties not subject to the regulations. Two of the properties subject to regulation did not receive, nor require, fire suppression intervention; the other four received, and required, fire suppression intervention. Suppression resources reported that one of the properties subject to regulation would have been significantly impinged upon if winds had sustained. All of the properties that were not subject to regulation required fire suppression intervention, with the exception of one. Fire suppression resources reported that all properties that survived had some level of mitigation which supported fire suppression intervention.

<b>Table 1. Recorded/ Observed Structure Impacts</b>			
<b>Address</b>	<b>Wildfire Regulations</b>	<b>Outcome</b>	<b>Remarks</b>
225 Lava Drive	No	Destroyed	Embers/outbuildings and attachments; no firefighter intervention.
223 Lava Drive	No	Destroyed	Embers/outbuildings and attachments; no firefighter intervention.
850 Vista Hi	No	Destroyed	Embers/outbuildings and attachments; no firefighter intervention.
201 Tree Farm Drive	Yes	Saved	Homeowner irrigation sprinkler operated.
201 Tree Farm	No	Saved	Homeowner sprinklers operated prior to and throughout fire passage.
42 Blue Creek Overlook	Yes	Saved	Significant ember storm; no firefighter intervention required.
62 Blue Creek Overlook	Yes	Saved	Significant ember storm; no firefighter intervention required.
825 Vista Hi	No	Saved	Firefighter intervention required, but defensible space mitigation provided for minimal suppression effort.
875 Vista Hi	No	Saved	Firefighter intervention required, but defensible space mitigation provided for minimal suppression effort.

<b>Table 1. Recorded/ Observed Structure Impacts</b>			
<b>Address</b>	<b>Wildfire Regulations</b>	<b>Outcome</b>	<b>Remarks</b>
775 Vista Hi	Yes	Saved	Firefighter intervention required. If winds would have sustained, intervention would have been significantly challenged.
601 Vista Hi	No	Saved	No firefighter intervention required. Surface fuels unlikely to carry fire.
69 Vista Hi	Yes	Saved	Spot from ember storm; firefighter intervention required directly adjacent to building.
1844a Upper Cattle Creek	Yes	Saved	Spot ignition; firefighter intervention required.
1840 Upper Cattle Creek	No	Saved	Significant ember storm; firefighter intervention required.

# PART 3: CONCLUSION

## Role of Mitigation

This study was focused on WUI areas in Eagle County that were directly affected or threatened by the Lake Christine Fire to determine whether mitigation factors played a role in structure loss or survivability. Structure survival was dependent upon different conditions and factors in the two focus areas of El Jebel Mobile Home Park and Missouri Heights:

- The El Jebel Mobile Home Park represents a compact residential WUI interface area. This neighborhood had not participated in any organized mitigation programs or implemented any known mitigation activities prior to the Lake Christine Fire, nor were properties subject to Eagle County's wildfire regulations. There were many observed structure and neighborhood vulnerabilities that typically contribute to structure loss. The success of structure protection in the mobile home park is largely attributed to the ability of significant suppression resources to arrive from other jurisdictions in a timely manner and engage prior to fire impingement. The progression and spread direction of the fire, as also provided opportunities for progressive and effective resource allocation and deployment, which was a critical factor in preventing further losses. This scenario should not be considered typical. In the majority of wildland-urban interface events comparable to the Lake Christine event, suppression resources are quickly overwhelmed with multiple simultaneous structure ignitions (Cohen 2010). Based on study evidence and the larger body of structure ignition zone science and research conducted by the Insurance Institute for Business and Home Safety, National Fire Protection Association, and USDA Forest Service, it is highly likely that potentially many structures in this area would not have survived without the level of structure protection resources that were placed. In other words, this area's survival was likely entirely reliant on external suppression resources.
- The neighborhoods of Vista Hi and Blue Creek Overlook within Missouri Heights represent a dispersed residential WUI intermix area. Properties within these neighborhoods reflect a combination of homes that were subject to Eagle County's wildfire regulations or voluntarily participated in mitigation activities, while others did not have any mitigation in place. The success of structure protection in these neighborhoods is attributed to multiple factors, including the availability of resources, low to moderate fire behavior, and varying degrees of structure and property mitigation. In some cases, home survival without structure protection was, or may have been likely

based on the degree to which the property was mitigated; in most cases, home survival may have been less likely without structure protection resources.

In the three instances of home loss, field observations of each individual property also align with national research and science that attributes structure loss to: the presence of combustible materials (e.g., outbuildings, attached fences or decks, vegetation) within 30 feet of the primary dwelling that ignite by embers or direct flame contact; convective or radiant heat from sources within 100 feet, or; a combination of ignition sources.

## Additional Findings

This study also revealed important points related to the relationship between wildfire response planning, land use, mitigation, and suppression activities. Further understanding those factors that influence wildfire outcomes in the WUI can help inform future community planning development and response decisions. The following key takeaways were synthesized from post-fire interviews and field observations:

- **Wind patterns.** Wind patterns resulted in unexpected fire spread direction. This is a reminder to account for all types of scenarios when planning mitigation activities, not only those fire behavior factors (wind patterns, slope) that are most typically observed under “normal weather, or topographic conditions”.
- **Access.** Many firefighters did not have familiarity with the area, and the conditions on the night of July 4 were reported as “pitch dark” due to night time and loss of overhead utility lighting following burned transmission lines. There was often limited to no awareness of the number of structures, length of driveways, micro changes in topography and vegetation, and other situational factors. In some cases, accurate pre-planning response maps were not available, and road signage was poor. As a result, it was difficult for responders to know how safe it was to enter certain areas. If fire behavior conditions were more extreme, these factors may have changed decisions to provide structure protection in order to ensure firefighter safety. Conversely, paved or other roads with improved surface conditions safely allowed the movement of fire apparatus and contributed to a more successful response (particularly in the El Jebel Mobile Home Park). These factors underscore the need for consistent and uniform access standards, such as road and signage, for developments in the WUI.
- **Mitigation.** Properties that were mitigated (as a result of either required county wildfire regulations or voluntary actions) positively influenced suppression and response decisions. That is, firefighters reported that they were able to either quickly protect or move on from these properties, increasing efficiency to their overall response efforts. Existing development should therefore utilize parcel level property assessment programs such as REALFire to continue promoting a systematic approach to risk reduction in the structure ignition zone. Future development subject to wildfire regulations will also

continue to complement other mitigation efforts employed by the county and fire protection districts. Both of these approaches can also offer pre-planning information to fire suppression resources which may be used to increase response effectiveness.

- **Firefighter response.** It cannot be emphasized enough that actions taken by firefighters in both study focus areas were the primary reason why so many structures survived. These actions included both experienced response tactics (Figure 13) and additional mitigation activities taken by crews (e.g., cutting down trees, moving firewood piles away from homes). The community was fortunate to have both a number of trained firefighters and equipment available to respond; between local resources and mutual aid firefighters available from other fire districts. This circumstance, however, cannot be relied on for future wildfire incidents, especially when other active fires across the state or country pull local resources away. Property owners should therefore proactively take all mitigation measures well in advance of a wildfire threat.



*Figure 13. Firefighter taking suppression actions on Lava Drive. Credit: Chief Doug Cupp*

- **Pre-suppression planning.** As noted, many fire suppression resources interviewed indicated that they were not familiar with the local neighborhoods in which they were providing response. They also did not have adequate spatial tools (maps) to show the location or number of structures, which meant they could not always understand where to prioritize patrolling or other placement of resources. There is an existing map book for the I-70 county corridor (see Figure 14); expanding the map book across the county to develop a comprehensive pre-planning spatial analysis would increase the ability for outside resources to efficiently and safely respond in the future to all areas.

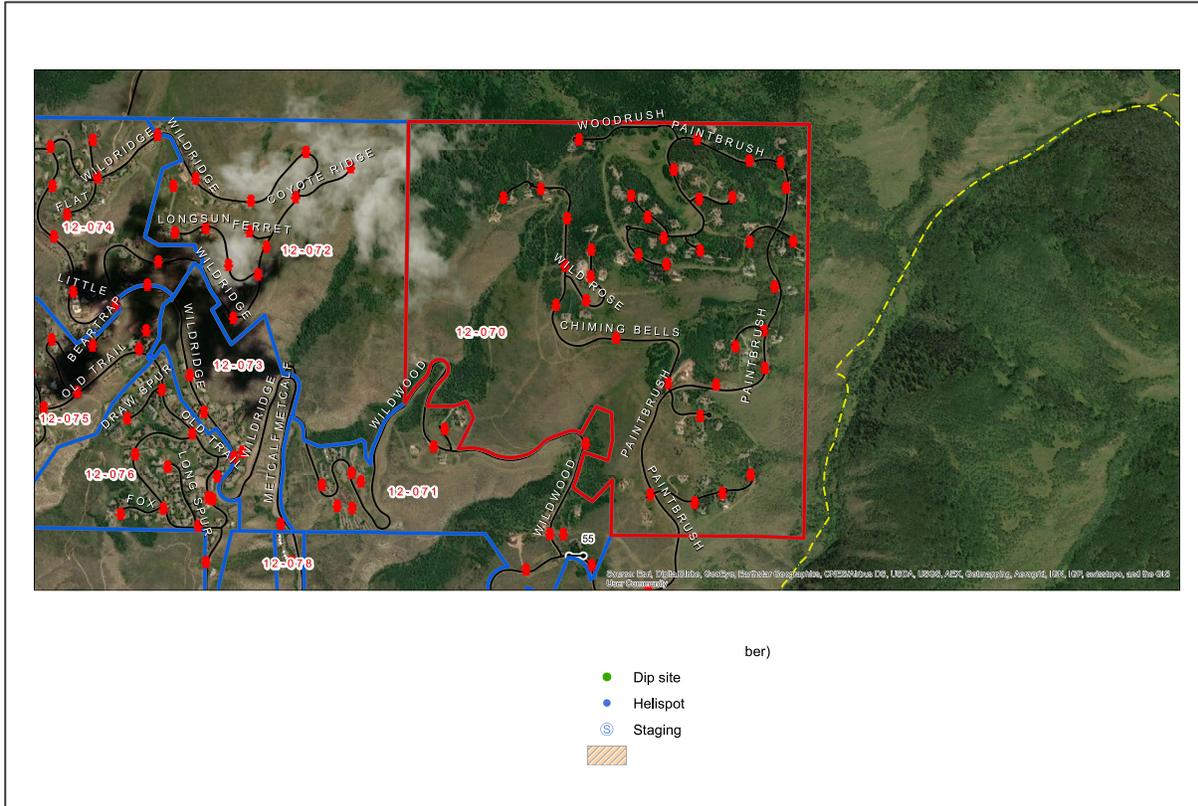


Figure 14. An example from the Lake Christine map book

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Image Credit: Eric Lovgren, Eagle County, CO

## Lake Christine Post-Fire Mitigation Study