



# **Marshall Fire Mitigation Assessment Team: Homeowner's Guide to Reducing Wildfire Risk Through Defensible Space**

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**FEMA**

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# 1. Introduction

On December 30, 2021, a wind-driven wildfire affected over 2,000 residential structures and several commercial facilities in unincorporated Boulder County, the City of Louisville, and the Town of Superior, Colorado. Data gathered after the fire highlighted several vulnerabilities in the Home Ignition Zone (HIZ), particularly with respect to defensible space principles, that likely played a significant role in spreading fire from the wildland and open spaces to the built environment.

Because of the unique nature of the incident, where extreme winds coupled with long term drought, high temperatures, and limited wildfire regulatory adoption, a fast-moving low-intensity grass fire became a highly destructive urban fire directly and indirectly impacting several communities and greater Boulder County area. The Federal Emergency Management Agency (FEMA) deployed its first-ever wildfire Mitigation Assessment Team (MAT) to evaluate building performance during the fire. The MAT was deployed to Louisville, Superior, and unincorporated areas in Boulder County, Colorado, to evaluate damaged homes and commercial structures. MAT members evaluated components and systems of primarily residential structures to determine the effectiveness of various building materials, design, and construction practices for wildfire resiliency. The MAT used the information gathered to evaluate how wildfire-urban interface (WUI) building codes and standards, as well as design, construction, and defensible space practices can be improved to increase community wildfire resilience. This is important as the landscape is continuously evolving due to changing weather patterns and putting more communities at risk.

## 1.1. Purpose

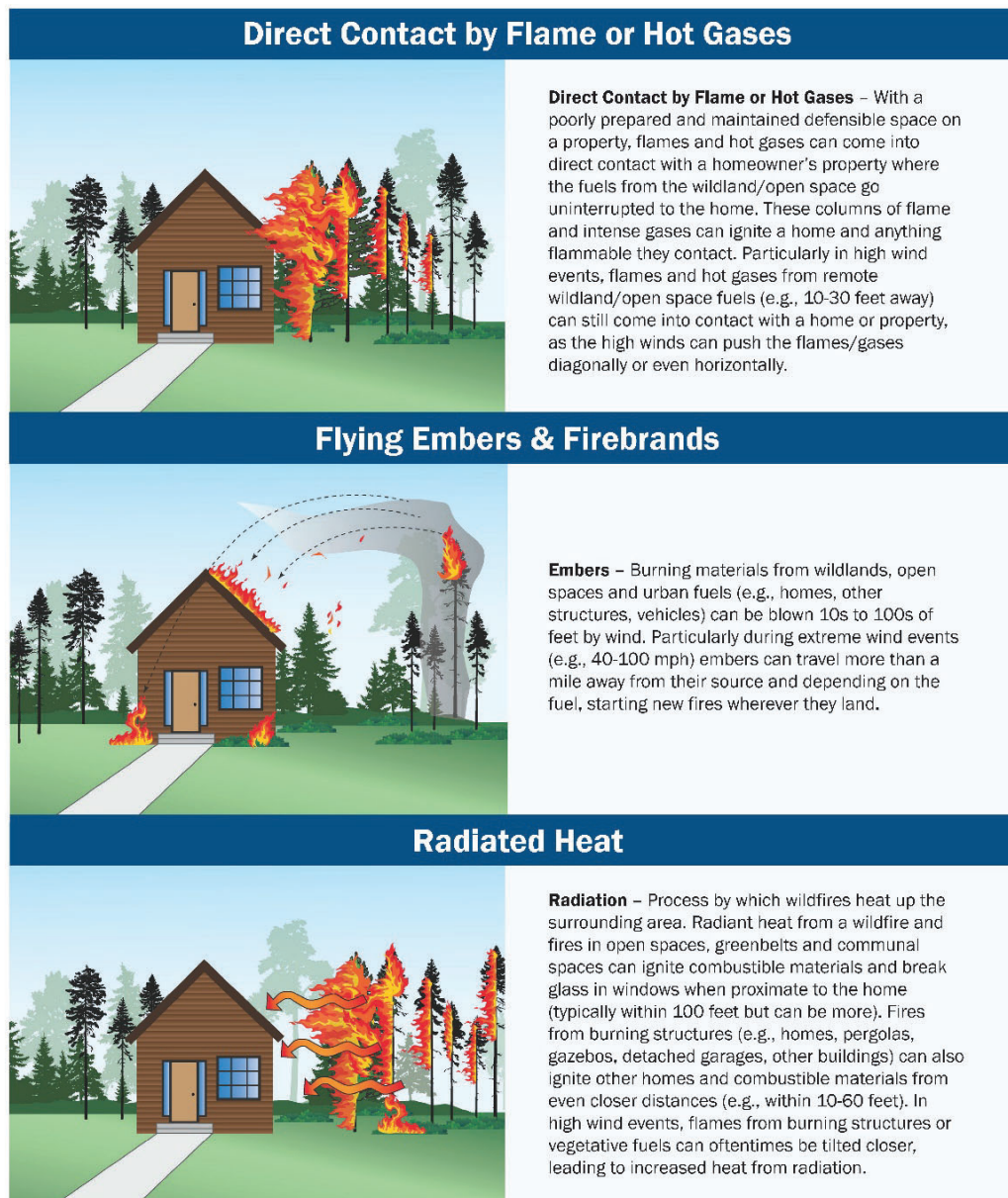
This document provides homeowners with steps they can take now to protect their homes from loss or damage from wildfires due to vulnerabilities introduced by surrounding landscaping and other exterior features (e.g., outbuildings, sheds, furniture, and trash bins) within the homeowner's property. The goal is to increase homeowner's awareness of the key mechanisms and characteristics of WUI fires that can result in home ignition, and to provide homeowners with guidance and various options to assist in the following:

1. Limit the ability of a fire to spread uninterrupted from adjacent wildlands and open spaces directly to the home (via direct contact from flames, exposure to hot gases or heat from radiation)
2. Limit the likelihood of embers igniting receptive fuel beds and other combustible items within the homeowner's property leading to home ignition (via heat from radiation, direct contact from flames, exposure to hot gases or additional embers created by vegetative and non-vegetative features (fuel))

These mechanisms, summarized in Figure 1, not only spread fire from wildlands, open spaces, greenbelts, and communal spaces to structures, but can also lead to the spread of fire from structure-to-structure and other items in the built environment. This is known as an urban conflagration.

This document provides homeowners with practical information, resources, and methods to better reduce or mitigate key vulnerabilities within their property from the home outward. This includes:

1. Creating and maintaining fire-adapted landscaping in terms of selection, location, and management of vegetation on the property
2. Increasing the home's chance to survive a fire whether firefighting resources are available or not available
3. Implementing additional wildfire-resiliency measures when property-line setbacks or defensible space are insufficient or unavailable which includes suggestions for how a homeowner can routinely check and evaluate the vulnerability of their home



**Figure 1. Key Mechanisms for Wildfires Leading to Property Damage and Loss.**

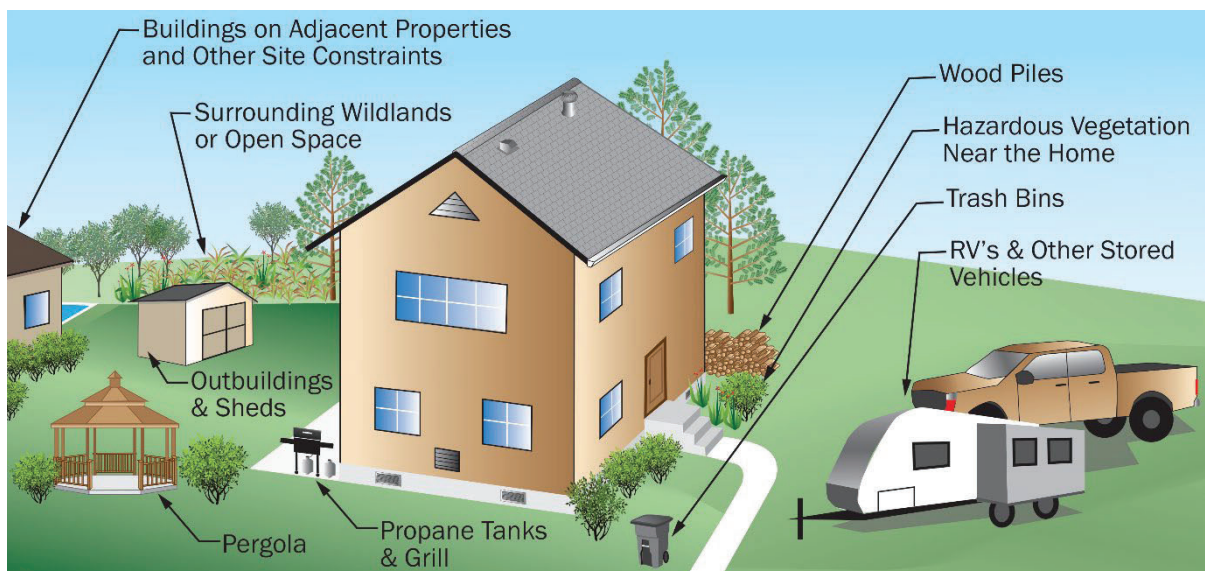


Note: This document focuses on increasing wildfire resiliency in the defensible space around a home. Marshall Fire MAT document *Homeowner's Guide to Reducing Risk of Structure Ignition from Wildfire* provides actionable items for increasing wildfire resiliency for the home itself such as the building materials, components, assemblies, and attachments throughout the exterior envelope (i.e., structural hardening) from the top of the roof down to the foundation.

## 1.2. Key Issues

Defensible space is intended to provide a buffer between the building and the wildland or open spaces that surround it. It should be developed and maintained so that if vegetative or non-vegetative components ignite, they will not threaten the home from generated embers, radiant heat, or direct flames. During a major wildfire event, first responders will likely be unable to actively defend individual homes, so it is essential for homeowners to take proactive measures, so their homes and yards survive with or without defensive actions by first responders (i.e., "survivability"). That said, properly developed and maintained defensible space will also create a place of relative safety that may increase the likelihood of first responders to defend a property. Ultimately, the responsibility of developing and maintaining defensible space, fire-resilient landscapes, and monitoring parcel-level wildfire vulnerabilities lies with homeowners. Information in this report highlights key opportunities for homeowners to reduce their wildfire risk.

Fires rapidly spread via various flow paths that can lead to ignition of structures throughout communities. Structure ignitions can be caused by one or multiple mechanisms, building materials and features, site conditions, or adjacent environmental settings (Figure 2), including:



**Figure 2. Key Wildfire Vulnerabilities Near a Home.**

- **Wildland and Open Space Vegetation (e.g., grasses, shrubs, and trees)** – Fires in these spaces, whether intermixed or next to a community or home, can present a significant risk due to the intensity and rate-of-spread they are often characterized by (particularly in severe fire weather conditions). Large and uninterrupted open spaces or wildlands that border or mix with communities and neighborhoods, if not managed or considered in city or community land-use planning, can easily ignite homes and community assets through elevated radiative exposures, convective heat, and embers.
- **Landscape Vegetation** – Landscaping can consist of a wide range of managed vegetation types (e.g., trees, shrubs, flowers, grasses), plant characteristics and arrangements (e.g., height, growth type and extent, native vs. non-native, tendency for dead material accumulation), landscape purposes (e.g., food, shade, recreation), fire ecology attributes, and quality of ongoing maintenance. These ‘man-made’ landscape environments can be just as combustible as wildland vegetation and can provide a pathway for fire to spread from wildlands, open spaces, and greenbelts to the home both horizontally through surface fuels or vertically as ladder fuels from grasses and other low-lying vegetation and accumulated debris.

While some plants are marketed and described as “firesafe” or “fire resistant”, all plants will burn under the right conditions. The environment plants grow in and how they are maintained will generally have more influence on the flammability of the plant than its inherent characteristics.  
(CAL FIRE, 2022)
- **“Approved” and “Prohibited” Plants** – Many areas have compiled lists of both “approved” and “prohibited” plants to guide homeowners in landscaping design. The ability or inability to resist ignition is based on the physical characteristics of the plant. While these lists are beneficial to homeowners, they can be incomplete or misleading and can provide a false sense of security. These lists are highly dependent on a variety of local factors that may not be relevant to other locations. Numerous factors (e.g., plant species, plant structure, plant products such as resins, setting, surface mass, branching patterns, foliage size, density, litter production and retention, maintenance practices, placement, weather, weather history, etc.) influence whether a plant should be considered “hazardous” or “approved”. Of these factors, maintenance is crucial, and any plant can become a hazard if not maintained properly. Homeowners are encouraged to consult with local fire departments or plant ecologists to evaluate plant “safety” due to the variety and nuances of plant flammability. Even “approved” plants will burn.
- **Embers** – Embers are responsible for the majority of wildfire structure ignitions (estimated to be at least 2/3 of ignitions, Maranghides 2009). Embers can be produced from burning vegetative fuels; other combustible materials such as buildings and contents; and other fuels such as vehicles, and waste bins in the area surrounding the built environment. Embers can be carried by high winds in front of the wildfire at varying distances (e.g., 1/2–2 miles). This creates a wind-driven fire hazard that is unique to wildfire incidents. See Figure 3.



**Figure 3. Embers are the primary driver for rapid spread of wildfires into communities. (Valachovic, et al. 2021).**

- **Site Constraints and Limited Setbacks** –Site constraints and limited setbacks to adjacent properties restrict a homeowner's ability to achieve 30–100 feet of defensible space. These constraints can oftentimes mean that homeowners must contend with additional hazards e.g., adjacent unmanaged vegetation, vacant lots, structure-to-structure fire spread, that are mostly outside of their control. Alternative methods, such as common defensible space with neighbors and other structural hardening measures, are needed to address these increased risks.
- **Other Fuels in the Built Environment** – There are a wide range of other types of combustible fuels that homeowners may have stored adjacent to the primary structure, which may ignite due to a wildfire and present an additional fire hazard to homes. This can include firewood piles, sheds, outdoor grills, propane tanks, outdoor furnishings, lawnmowers, trash bins, vehicles, and decorative landscaping (e.g., artificial grass/turf). The type, quantity, and characteristics of these other fuels range dramatically and can present additional challenges in predicting fire behavior (e.g., fire severity, rate of spread, burning characteristics) and damage loss potential in the WUI (Society of Fire Protection Engineers WUI Handbook, 2023).

### 1.3. Definitions

- **Approved or Recommended plants** – “Recommended” or “approved” plants are generally based on characteristics that allow for a more fire-resistant landscape. Common characteristics include drought-resistance, high moisture content, low levels of volatile oils and other readily flammable chemicals, noninvasive, slow, and low growing, low litter production and bark shedding, and able to grow and thrive without supplemental fertilization.

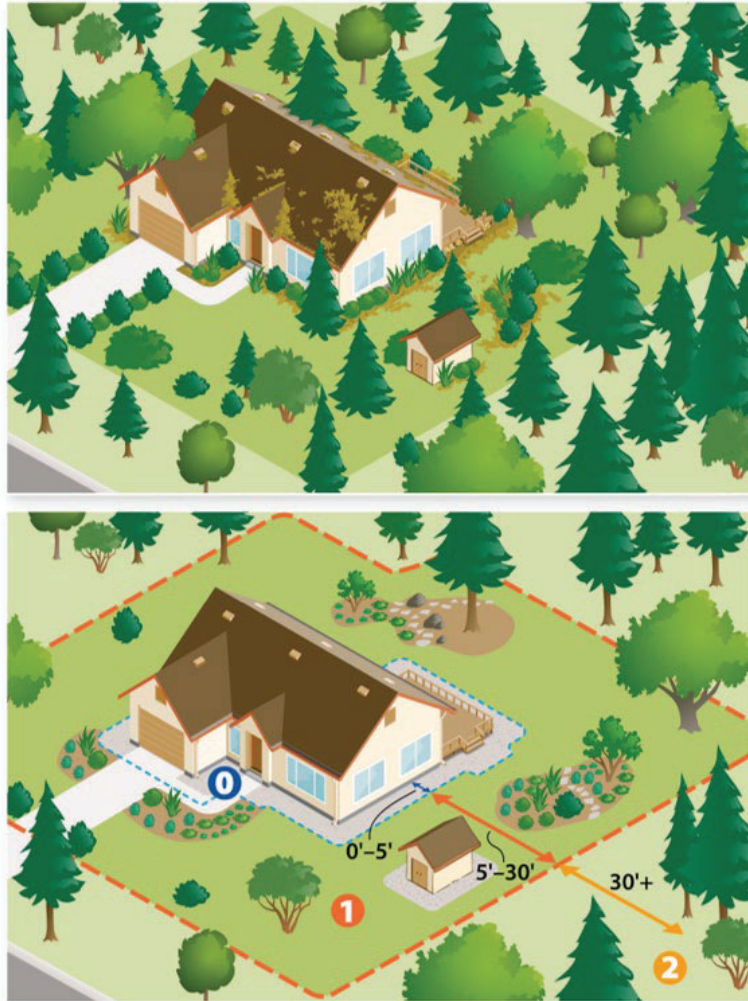


- **Defensible space** – The area around a home where the location, selection, and maintenance of vegetation and other combustible materials are managed such that a fire or wind-blown embers are less likely to ignite the structure. This managed area provides a “defense” against the fire to reduce the structure’s exposure to radiation (heat), direct flame contact and ignition from embers, which are considered the three principal factors of ignition in a wildfire. (Bell et al. 2007).
- **Defensibility** – The level and degree of wildfire mitigation measures that are provided for a structure such that it can be safely defended by firefighting resources in a wildfire but may not survive if firefighting is unavailable.
- **Embers (a.k.a. firebrands)** – Smoldering or flaming particles of vegetation from tree branches, leaves, shrubs, grass, chaparral, or other urban combustibles (such as building components, fences, sheds) that ignite and burn during a wildfire and are carried by winds in front of the wildfire at varying distances. Embers are sometimes also referred to as firebrands.
- **Fire-Adapted Plants** – Plants that have adapted to survive and live in environments with fire. Plant species can typically be classified into five different categories based on their adaptations, although some fit into more than one category. These categories include resisters (i.e., survive moderate to low-intensity fires), sprouters (i.e., endure fire and resprout from their roots), seeders (i.e., evade fire by shedding lots of seeds that sprout after a fire such as serotinous cones of lodge pole pine), invaders (i.e., take over recently burned areas) and avoiders (i.e., grow in areas where fire does not normally occur) (BLM, 2010).
- **Fire-Resistant Landscapes** – This type of landscape uses fire-resistant plants that are strategically planted and maintained to resist the spread of fire to your home. (CAL FIRE, 2019)
- **Hazardous or “Prohibited” Plants** – “Hazardous” or “prohibited” plants are generally based on characteristics that increase ignitability and introduce fire hazards in the landscape. Common characteristics include blade-leaf or needle-leaf evergreens; stiff, woody, small or fine, lacy leaves; leaves and wood containing volatile waxes, fats, terpenes, or oils. Other traits include gummy or resinous sap; plentiful fine, twiggy, dry, or dead materials, loose or papery bark, or produce a large amount of vegetative debris or duff. These types of “hazardous” plants typically flame when preheated and ignited (Fire Safe Marin, 2022).
- **Home Ignition Zone (HIZ)** – The HIZ consists of three zones around a structure including the immediate or ember-resistant zone, the intermediate zone, and the extended or reduced fuel zone (Figure 4). Different names and numbering may be given to these zones by different agencies and organizations.
- **Survivability** – The level to which a structure has the potential to withstand wildfire without being defended.

## 2. What is Defensible Space?

Defensible space, coupled with home hardening, is essential to increasing your home's likelihood of surviving a wildfire. It is the space that provides a buffer between your home and potential fires in adjacent open spaces or wildland areas comprised of grasses, shrubs, and trees. This buffer is needed to slow or stop the progression of wildfire, and it helps protect your home from damage or loss. Maintaining defensible space includes specific actions for vegetative and non-vegetative objects (e.g., trash cans, fencing and sheds) around a home generally up to 100 feet from the structure (IWUIC, 2021). Defensible space is generally subdivided into three zones, whereby the highest priorities and most restrictive measures are required for the area closest to the structure. The National Fire Protection Association® (NFPA) defines the three zones as follows (see Figure 4):

- **Zone 0**, “Immediate Zone”, “Ember-Resistance Zone”, or “Noncombustible Zone” (0–5 feet). Zone 0 is considered the most important and includes areas immediately surrounding a structure, as well as areas under any attached decks or overhangs.
- **Zone 1**, “Intermediate Zone”, or “Lean, Clean and Green” (5–30 feet). Zone 1 adds a defensible zone that extends from Zone 0 to Zone 2. The goal of this area is to reduce the connectivity between garden beds, shrubs, and trees; removing lower branches of trees and shrubs; and creating areas of irrigated and mowed grass or hardscape between lush vegetation islands so that wildfire does not burn to the house or into the crown of trees. Plants should be properly irrigated and maintained to remove dead/dry material (Valachovic, et al., 2021). This designation also applies to the area within 10 feet of driveways, access roads, or public roads adjacent to the property.
- **Zone 2**, “Extended Zone” or “Reduce Fuel Zone” (30–100 feet+). The goal of Zone 2 is to create a fuel break that interrupts the continuous vegetative fuel path of a wildfire, minimize flame length, and keep fires on the ground by reducing ladder fuels and crown clustering.



**Figure 4. Before (upper) and after (lower) implementation of the three-zone defensible space strategy. While this figure shows a forested setting, the same concepts apply to other vegetation types (e.g., grass- and shrub-lands) and residential settings (Valachovic, et al. 2021).**

Many federal, state, and local resources provide a range of information, guidance, and recommendations specific to each zone. See the Reference section for details. Note: Homeowners are encouraged to refer to their local fire department, other local government agencies (e.g., planning department), and other community groups (e.g., HOAs, Firewise communities, fire safe councils, and non-profits) for additional requirements and/or guidance specific to their area. Local ordinances and guidance documents can often provide more tailored and nuanced information for the region or area, and in some cases more stringent requirements.

### 3. Fire-Resistant Landscapes

Reducing or eliminating hazardous fuels (vegetative or non-vegetative) and maintaining the landscape within the HIZ of a structure can greatly increase its survivability. This helps not only reduce potential sources of embers, but also reduces the likelihood of wildland fuels, landscaping

and other materials directly surrounding the structure or below the structure to serve as ember receptors.

### 3.1. “Recommended” or “Approved” Plant Lists

Jurisdictions often provide “approved” or “recommended” plant lists with recommendations on vegetation that has more fire-resistant characteristics given the specific climate, topography, and ecological systems in the local area. Some general characteristics of plants included on “approved” lists are (Kuhns, 2019):

- Drought-resistant
- Contain more moisture
- Contain low amounts of volatile oils and other readily flammable chemicals
- Noninvasive
- Slow growing
- Produce less litter and dead material
- Low growing
- Able to grow and thrive without supplemental fertilization

While these “approved” or “recommended” plant lists provide a starting point for creating a fire-resistant landscape, it is critical that homeowners know how to properly locate, care, and maintain their landscape. All plants, even recommended plants, shrubs, and trees, will burn given the right conditions and have the potential to become fuel during a wildfire. Also, some plants are difficult to maintain because of the amount of maintenance they require. Homeowners should understand the amount of care and maintenance required for their landscape and verify that this aligns with their available resources. Refer to best management practices below for more details.

Colorado State University Cooperative Extension Service has developed a comprehensive list of fire-resistant plant, shrub, and tree species list. These plants are available at many nurseries which, when combined with defensible space landscaping management practices, can reduce fire risk. The list includes many species attractive in suburban settings like iris, penstemon, beebalm, maples, plum, river birch, mountain ash, and lilac. (Colorado Extension Service, 1999).

Additionally, the Colorado State University Cooperative Extension Service and the Colorado Forest Service have developed plant, shrub, and tree recommendations for Colorado’s wildfire environments through the Firewise program which are appropriate to Boulder County’s wildfire risk and Wildland Urban Interface (WUI) conditions (Colorado State University Extension. Fire-Resistant Landscaping Fact Sheet 6.303 06303.pdf (colostate.edu)).

See a sample list of references provided in the box below.



## Federal, State, And County Best Management Practices of Defensible Space

### National Non-Government

- International Wildland-Urban Interface Code (IWUIC). (2021).
- National Fire Protection Association (2022). Firewise USA®. <https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA>
- NFPA 1140, 2022 Edition: Standard for Wildland Fire Protection
- NIST. (2022). WUI Structure/Parcel/Community Fire Hazard Mitigation Methodology. <https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.2205.pdf>

### Federal

- USDA Forest Service. (2022). Urban and Community Forestry Program: Tree Pruning Guide. <https://www.arborday.org/trees/tips/>

### State

- Colorado State University (CSU). (2010): Front Range Tree Recommendation List. <https://extension.colostate.edu/docs/pubs/garden/treereclist.pdf>
- Colorado State Forest Service. (2021). The Home Ignition Zone: A guide to preparing your home for wildfire and creating defensible space. [https://coloradoforestatlas.org/customers/colorado/information/2021\\_CSFS\\_HIZGuide\\_Web.pdf](https://coloradoforestatlas.org/customers/colorado/information/2021_CSFS_HIZGuide_Web.pdf)
- Colorado State Forest Service. (2012). Protecting Your Home from Wildfire: Creating wildfire-defensible zones. [https://static.colostate.edu/client-files/csfs/pdfs/FIRE2012\\_1\\_DspaceQuickGuide.pdf](https://static.colostate.edu/client-files/csfs/pdfs/FIRE2012_1_DspaceQuickGuide.pdf)
- CALFIRE. (2022). Prepare for Wildfire: Defensible Space. <https://www.fire.ca.gov/programs/communications/defensible-space-prc-4291/>

### County

- Boulder County. (2011). Boulder County Community Wildfire Protection Plan: Defensible Space. <https://assets.bouldercounty.gov/wp-content/uploads/2017/02/community-wildfire-protection-plan-book-low-resolution.pdf>
- Boulder County. (2017). Your Defensible Space Slideshow. <https://assets.bouldercounty.gov/wp-content/uploads/2017/02/defensible-space-slideshow.pdf>



### 3.2. Hazardous or “Prohibited” Plant Lists

Many communities within high wildfire-prone areas have a list of common plants that are considered “hazardous” or “prohibited” for use. Specific guidance has not been developed for Boulder County, Colorado. However, observed highly-flammable tree types common to eastern Boulder County include species in arborvitae (cedars), *Juniperus* (junipers), *Pinus* (pines), Douglas fir, spruce, cypress, and yew. Flammable shrubs include Tamarisk, Russian Olive, sagebrush, rosemary, bitterbush and scotch broom. Ground covers such as pampas grass are also extremely flammable in dry conditions. Plants like junipers, Italian cypress, feather and fountain grasses, and ice plant are often considered hazardous due to the amount of maintenance required to manage dead thatch inside or under a green surface layer (Figure 5). Other plants like eucalyptus, palms and some manzanitas are also typically not recommended in medium- to high-wildfire risk areas due to the shedding of dry bark, leaves, fronds, and other duff that can readily ignite and spread fire (UCANR, 2022).

Common characteristics of wildfire vulnerable vegetation include:

- Low moisture content
- Volatile resins and oils, generally aromatic when crushed
- Narrow leaves or long, thin needles
- Waxy or fuzzy leaves
- Accumulates dead leaves and twigs on and/or under the plant
- Loose or papery bark
- Invasive species



**Figure 5. Junipers (left) are among the least fire-resistant plants commonly used in landscaping. Their leaf structure and the volatile oils they contain make them highly flammable. Cheatgrass (right), a non-native species, is a flashy fuel meaning that it is highly flammable and can burn rapidly to spread fire and ignite other fuels.**

The following publications provide general guidance and considerations for identifying hazardous or “prohibited” plants. For more site and neighborhood-specific guidance, homeowners are encouraged to reach out to their local fire department, their county forester, landscape architects, nurseries, cooperative extension agents, or other fire ecology/fire safety professionals to evaluate their landscaping design.



### References for Restricted Invasive Plants (Boulder County, Colorado)

- Boulder County. (2021). Boulder County Invasive Plants 2021 Yearly Report.
- Boulder County, Colorado. <https://assets.bouldercounty.gov/wp-content/uploads/2020/05/weeds-annual-report.pdf>
- Typical invasive trees within Boulder County include: Trees of Heaven, Russian Olive, and Tamarix.
- Other plants that are on Boulder County's List A Watch list include: Mediterranean Sage, Rush Skeletonweed, Myrtle Spurge, Purple Loosestrife, Hairy Willow-herb, Orange Hawkweed, Spotted Snapweed, Yellow Flag Iris, Garden Loosestrife, Yellow Toadflax, Leafy Spurge, and Japanese Knotweed (Boulder County, 2021).

### 3.3. Landscape Design and Layout – Make Wildfire Resiliency Attractive

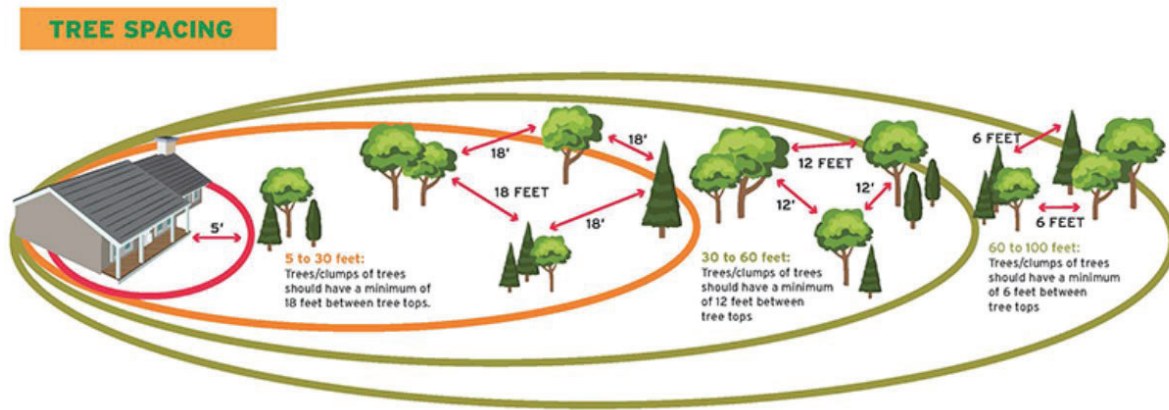
A homeowner's landscape can be tailored to reduce the likelihood of ember ignition, fire intensity, and spread of fire to a home. Methods such as mosaic planting and fuel breaks can greatly reduce radiative exposures, high-severity fires proximate to the home, and ultimately increase the probability that a structure will survive a wildfire. When done well, landscaping around a home can be both fire-resistant and achieve a variety of other goals (e.g., aesthetics, soil retention, healthy and native ecosystems, temperature control, flood control). See Figure 6.



**Figure 6. Examples of Fire-Resistant Landscapes, including Mosaic Design Features. (Left Photo Credit: CALFIRE, 2022b)**

From a fire-prevention perspective, reducing connectivity or continuity of vegetation by creating islands of vegetation or mosaic patterns by increasing spacing between trees and shrubs can limit the spread of fire (Valachovic et al. 2021). Clustered trees and shrubs that are continuous over large areas provide an uninterrupted path, which enables wildfire to gain intensity and spread rapidly. In a WUI setting, this can potentially increase wildfire exposure to homes in intermix zones, and into the developed parts of a community. Landscape designs can also incorporate fuel breaks using pavers and other noncombustible materials. In addition to general spacing, homeowners should reduce the amount of ladder fuels in their landscaping. Ladder fuels are low-growing vegetation such as tall grasses, shrubs, and tree branches, both living and dead that can more readily ignite in a wildfire and lead to ignition of taller vegetation.

Figure 7 illustrates some of the concepts used in successful defensible space development. See the References section for more information. Additional site-specific landscape design guidance is available from the local fire department, county forester, landscape architects, cooperative extension agents or other fire ecology/fire safety professionals.

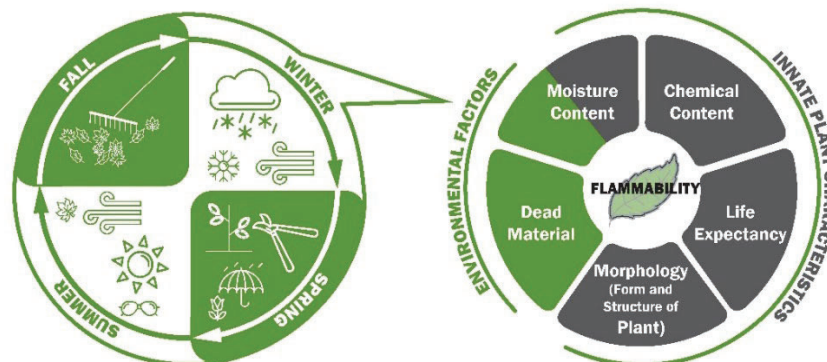


**Figure 7. Prescriptive Tree Spacing Guidance (Reproduced from NFPA's website, ©NFPA 2022).**

### 3.4. Best Management Practices – Any Plant Can Burn!

Choosing appropriate plants for landscaping will still require maintenance throughout the HIZ. Plants require water, trimming, and sometimes removal to reduce the hazard that vegetative fuels pose during a wildfire. Best management practices, even for the same species of plant, can vary depending on site topography and local weather and climate conditions (Figure 8). Strategies used by residents and landscapers to alter influences on flammability (e.g., pruning and plant establishment methods), impacts to plant vigor versus flammability, and other landscaping objectives still need development and industry standardization.

Due to the large variety and detailed nuances of plant flammability, homeowners are encouraged to reach out to local experts (e.g., fire departments, local universities, landscape architects and local fire ecologists) to evaluate their vegetative landscape and how best to manage the vegetation surrounding their home.



**Figure 8. Factors to consider throughout seasons in the year for maintaining defensible space (Sustainable Defensible Space, 2022).**



## 4. How to Increase Home Survivability Without Firefighters

During a major wildfire incident, firefighters and other first responders will likely be unable to “defend” most residential properties. As seen during and after the Marshall Fire (and most major wildfires in the U.S.), the severity and scale of the incident limited the opportunity and safety of first responders to contain or suppress the wildfire let alone defend threatened structures and neighborhoods. Therefore, homeowners are encouraged to develop and maintain appropriate defensible space and structural hardening provisions to ensure that their home and property have a greater chance of survival without relying on the presence of firefighting interventions.

Remember to implement the following methods to protect your home from wildfire:

- Develop and maintain defensible space or alternative risk mitigations where site restrictions exist
- Work with adjacent property owners to develop and maintain “communal defensible space”
- Select, locate, and maintain recommended fire-resistant plants, shrubs, and trees throughout your property
- Develop and maintain a fire-resistant landscape (e.g., tree/shrub spacing, mosaic design), and where necessary, consult a local wildfire specialist, fire department personnel, fire ecologist or fire landscape architect
- Monitor and evaluate your home ignition zone annually and prior to core fire season(s)
- Ask your local fire department, fire safe council or other local wildfire resiliency organization such as Wildfire Partners (<https://wildfirepartners.org/>) to inspect your home and property
- Develop and maintain structural hardening provisions (see Marshall Fire MAT document *Homeowner's Guide to Reducing Risk of Structure Ignition from Wildfire*)

## 5. What if Your Property Has No Space?

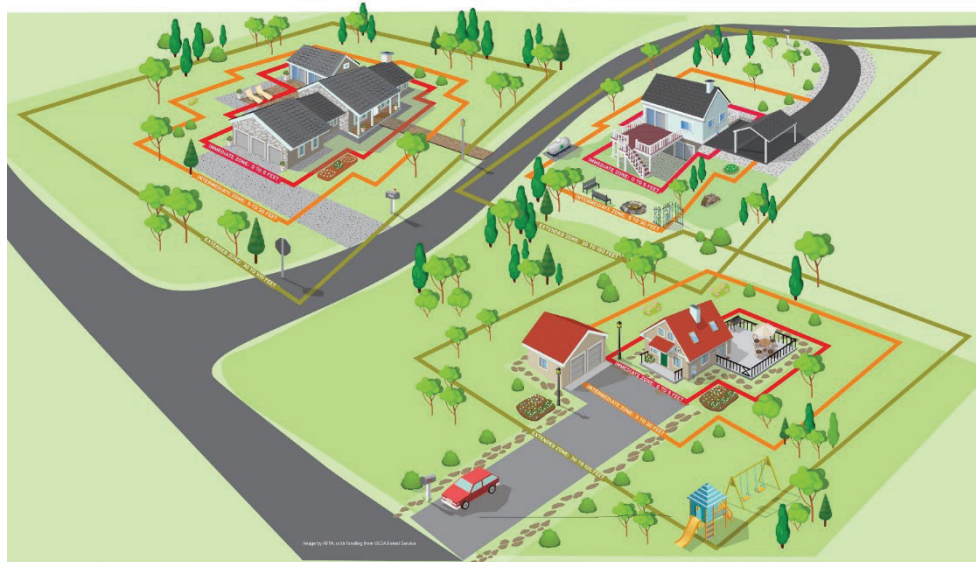
As was observed in the Marshall Fire and numerous WUI fires in recent years, significant damage and loss of property can result from fire spreading from structure-to-structure and not necessarily from the wildlands or open space to the structure. Structure-to-structure fire spread (or urban conflagration) increases in likelihood when homes are closely spaced (e.g., within 60 feet of another structure). This is already recognized in building codes and standards in fire separation requirements. However, most existing codes provide exceptions that allow residential homes to be within 5 feet from a property line (or roughly 10 feet to another home). In some high wildfire jurisdictions, local wildland/WUI fire ordinances have been adopted that require 20 or 30 feet of separation from the primary home to the property line to limit structure-to-structure fire spread, in

addition to the typical defensible space requirements described earlier. While this may be possible for new construction, for most existing properties achieving 30 feet of separation let alone the 100 feet of defensible space is not possible, leaving homeowners unable to achieve prescriptive defensible space measures or optimum wildfire resiliency. The following provides homeowners with guidance on approaches to take to where building setbacks, property line constraints or other practical challenges limit the ability to achieve 100 feet of defensible space or 20–30-foot setbacks to the property line.

### 5.1. Where 100 Feet of Defensible Space is Limited

Where 100 feet of defensible space next to wildlands, open space, or adjacent properties is not available, homeowners are encouraged to consider the following strategies:

1. Work with neighbors and other adjacent property owners to ensure that common defensible space considerations are implemented between and adjacent to structures on both properties within Zones 0–2 within their own property lines (Figure 9).



**Figure 9. Communal defensible space boundaries.  
(Reproduced from NFPA's website, ©NFPA 2022)**

2. Prioritize localized structural hardening measures on the sides of the home with insufficient separation to adjacent properties, such as:
  - Replace existing vent covers with 1/16-inch wire mesh or an approved ember and flame-resistant vent. Some jurisdictions have “pre-approved” products such as CALFIRE’s Building Materials Listing Program (<https://osfm.fire.ca.gov/divisions/fire-engineering-and-investigations/building-materials-listing/bml-search-building-materials-listing/>). Local building and/or fire officials have discretion to approve products.
  - Replace combustible siding with non-combustible or ignition resistant materials (e.g., fiber cement, stucco).



- Replace combustible decking with non-combustible decking.
  - Remove all combustible non-vegetative features (e.g., ornamental grass, trash bins, sheds, pergolas, gazebos, wood piles, vehicles).
  - Replace single-pane window with double-paned or tempered-laminated glazing.
  - Replace combustible fences with non-combustible materials (e.g., concrete, masonry, metal), particularly for fences that attach to a neighbor's combustible fence.
3. Provide structural hardening measures for the entire home (e.g., upgrading to a Class A roof). Refer to Marshall Fire MAT document *Homeowner's Guide to Reducing Risk of Structure Ignition from Wildfire*.
  4. Prioritize the reduction of receptive fuel beds around the entire home from ember attack. Refer to Fire Resistant Landscapes section above.

Hardening structures and parcels to reduce risk of ember exposure and mitigating the major fire pathways that lead wildfire toward residences can be the most important way to protect high-density communities (Maranghides et al, 2022). See *Marshall Fire Mitigation Assessment Team: Mitigation Strategies to Address Multi-Hazard Events*. Refer also to other federal, state, and local references for more details.

## **5.2. Where 30 Feet of Property Line Setback is Limited**

Where 30 feet of setback to the property line is not possible for practical reasons (e.g., parcel dimension or size, topographic limitations, or other easements), homeowners are encouraged to provide additional fire-safety enhancements to their home to reduce the likelihood of structure-to-structure fire spread. The following are potential options (Figure 10):

- Install a six-foot, solid, noncombustible property line wall or fence (e.g., brick, masonry, or concrete masonry unit walls) to minimize ember transmission, radiation, and other forms of heat transfer from adjacent properties. Note: This is more effective for grass and shrubland landscapes.
- Install five to ten feet of noncombustible material (e.g., pavers, gravel) horizontally around the home. Where there is significant hardscaping around the home, additional measures may be needed to limit potential drainage or flooding issues.
- Prioritize localized structural-hardening measures on the side of the structure with less than 30 feet of setback (e.g., replace combustible siding with non-combustible siding). Refer to bullet point 2 in the above section.
- Provide additional structure hardening such as installing or upgrading exterior walls, windows, vents, and under-eaves areas of the home to be fire-resistance rated (e.g., 1-hour rated).

Homeowners may need to contact a licensed contractor or design professional for assistance. Refer to Marshall Fire MAT document *Decreasing Risk of Structure-to-Structure Fire Spread in a Wildfire* for details.



**Figure 10. Examples of additional structural hardening and defensible space features where 30 feet of setback to the property line is not feasible.**

## 6. Monitor and Evaluate Your HIZ

In addition to the measures described above, it is critical that homeowners periodically monitor and evaluate the defensible space and structural hardening provisions in their property's HIZ. A thorough HIZ assessment identifies potential wildfire vulnerabilities that could result in damage or total loss of a structure. These assessments should be performed by the property owner in consultation with wildfire/fire safety professionals (e.g., fire engineers, fire department prevention officers) or other trained individuals (e.g., Firewise USA®), members of the local fire safe council, Wildfire Partners (<https://wildfirepartners.org/>) or those who have taken a recognized HIZ assessment course, such as NFPA®: Assessing Structure Ignition Potential from Fire). The reference section highlights resources which outline best practices for conducting HIZ assessments for defensible space, including the Colorado State Forest Service's Home Ignition Zone Checklist.

There are numerous best management practices (BMPs) for parcel and community-level vegetation management available at the Federal, State, and County levels. For example, the Colorado State

Forest Service has published recommendations for homeowners to prepare the HIZ of their property for wildfire.



### Best Practices for Conducting HIZ Assessments for Defensible Space

- NIST WUI Structure/Parcel/Community Fire Hazard Mitigation Methodology. <https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.2205.pdf>
- NFPA 1140, 2022 Edition: Standard for Wildland Fire Protection
- NFPA® "Assessing Structure Ignition Potential from Wildfire" training.
- Fire Adapted Communities Learning Network. <https://fireadaptednetwork.org/>
- Colorado State Forest Service Home Ignition Zone Checklists. <https://csfs.colostate.edu/wildfire-mitigation/home-ignition-zone-checklists/>
- IBHS, How to Maintain Your Home's Defensible Space. <https://wildfireprepared.org/article/how-to-maintain-your-homes-defensible-space/>
- Society of Fire Protection Engineers: Virtual WUI Handbook. <https://www.sfpe.org/wuihandbook/home#about-handbook>



### FEMA Fact Sheets for Defensible Space in The Home Ignition Zone

FEMA Technical Fact Sheet Series FEMA P-737: *Home Builder's Guide to Construction in Wildfire Zones*. [https://defensiblespace.org/wp-content/uploads/2021/01/FEMA\\_2008\\_P-737-Home-Builders-Guide-to-Construction-in-Wildfire-Zones.pdf](https://defensiblespace.org/wp-content/uploads/2021/01/FEMA_2008_P-737-Home-Builders-Guide-to-Construction-in-Wildfire-Zones.pdf)

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