

**Wildland** | 2019  
**URBAN Interface**



# Planning for the WUI

*Tools, Tips, and Trends*

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Image Credit: Scott Story

# Rapid growth of the US wildland-urban interface raises wildfire risk

Volker C. Radeloff<sup>a,1</sup>, David P. Helmers<sup>a</sup>, H. Anu Kramer<sup>a</sup>, Miranda H. Mockrin<sup>b</sup>, Patricia M. Alexandre<sup>a,2</sup>, Avi Bar-Massada<sup>a</sup>, Van Butsic<sup>c</sup>, Todd J. Hawbaker<sup>d</sup>, Sebastián Martinuzzi<sup>e</sup>, Alexandra D. Syphard<sup>f</sup>, and Susan I. Stewart<sup>a</sup>

<sup>a</sup>SILVIS Lab, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, WI 53706; <sup>b</sup>Northern Research Station, US Department of Agriculture Forest Service, Baltimore, MD 21228; <sup>c</sup>Department of Biology and Environment, University of Haifa-Oranin, 36008 Kiryat Tivon, Israel; <sup>d</sup>Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720; <sup>e</sup>Geosciences and Environmental Change Science Center, US Geological Survey, Denver, CO 80225; and <sup>f</sup>Conservation Biology Institute, Corvallis, OR 97333

Edited by Janet Franklin, University of California, Riverside, CA, and approved February 6, 2018 (received for review October 28, 2017)

The wildland-urban interface (WUI) is the area where houses and wildland vegetation meet or intermingle, and where wildfire problems are most pronounced. Here we report that the WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km<sup>2</sup>; 33% growth), making it the fastest-growing land use type in the conterminous United States. The vast majority of new WUI areas were the result of new housing (97%), not related to an increase in wildland vegetation. Within the perimeter of recent wildfires (1990–2015), there were 286,000 houses in 2010, compared with 177,000 in 1990. Furthermore, WUI growth often results in more wildfire ignitions, putting more lives and houses at risk. Wildfire problems will not abate if recent housing growth trends continue.

wildfires | housing growth | sprawl | development | fragmentation

The wildland-urban interface (WUI), defined as the area where houses are in or near wildland vegetation, is the area where wildfires pose the greatest risk to people due to the proximity of flammable vegetation (1). Wildfires frequently burn houses in the WUI (2, 3), and are most difficult to fight there. Furthermore, the WUI is where people often ignite wildfires (4), and the vast majority of fires are human-caused (5). While fires are an integral part of many ecosystems and the Earth system as a whole (6), humans have changed fire regimes globally (7) and throughout the United States (8), and climate change will increase fire frequency in the future, including in the WUI (9).

The close proximity of houses and wildland vegetation does more than increase fire risk (9). As houses are built in the WUI, native vegetation is lost and fragmented (10); landscaping introduces nonnative species and soils are disturbed, causing nonnatives to spread (11); pets kill large quantities of wildlife (12); and zoonotic disease, such as Lyme disease, are transmitted (13). Thus, understanding WUI patterns and WUI growth is important with respect to wildfires and many other environmental problems.

The WUI is widespread in the United States (1, 14) and in many other parts of the world (15, 16), including Argentina (17), Australia (18), France (19), and South Africa (20). Furthermore, both the annual area burned (8, 21, 22) and fire suppression costs (23) have rapidly increased in the United States. The area burned annually nearly doubled, from an average of 18,000 km<sup>2</sup>/y in 1985–94 to 33,000 km<sup>2</sup> in 2005–14 (22). Concomitantly, federal wildfire suppression expenditures tripled from \$0.4 billion/y to \$1.4 billion/y (23), and exceeded \$2 billion in 2017.

While there is ample evidence that houses in the WUI pose problems, it is not clear how fast the WUI is growing. Overall, the US population grew by 60 million people and 29.2 million homes from 1990 to 2010, but how much of that growth occurred in the WUI is uncertain. Previous assessments of WUI growth (24, 25) analyzed only housing data up to 2000, and did not account for changes in wildland vegetation. Post-2000 housing data are important, because the United States entered a recession after 2008,

accompanied by a strong downturn in the housing market. Similarly, without data on vegetation change, the major cause of WUI growth is unclear. Areas where forests are regrowing on abandoned farmland, such as in the New England states (26), could see WUI growth without any additional houses. Fundamentally, two processes can create new WUI: construction of new homes in or near existing wildland vegetation, and an increase in wildland vegetation within and near previously developed areas. The prevalence of each process is unclear.

Knowing how the WUI is growing, and evaluating management and policy responses, federal wildfire management policies and the promotion of fire-adapted local jurisdictions use a variety of land use environmental impacts of housing growth on the WUI for the environment, accompanied by the lack of information in the most recent decade, highlight the need to grow and identify its causes. Thus, we ask: (i) how much has the WUI in the United States grown from 1990 to 2010, (ii) whether mainly by housing growth or by vegetation growth, and (iii) whether WUI growth has occurred within or near existing wildland vegetation.

The lack of consistent, fine-resolution data has been the biggest impediment to

**Significance**

When houses are built near wildland vegetation, they increase the risk of wildfire. Here we show that there will be more wildfires due to human activities that occur will pose a greater risk to people if they will be hard to fight, and let us become impossible. We examined the WUI in the United States from 1990 to 2010, and found that a large area has been built since 1990 in the United States. The WUI is the area where houses are in or near wildland vegetation, and where wildfire problems are most pronounced. Within the perimeter of recent wildfires (1990–2015), there were 286,000 houses in 2010, compared with 177,000 in 1990. Furthermore, WUI growth often results in more wildfire ignitions, putting more lives and houses at risk. Wildfire problems will not abate if recent housing growth trends continue.

**Author contributions:** V.C.R., M.H.M., P.M.A., A.B.-M., V.A.S., T.J.H., and S.I.S. analyzed data; V.C.R., H.A.K., S.M., A.D.S., and S.I.S. wrote the paper.

The authors declare no conflict of interest. This article is a PNAS Direct Submission. Published under the PNAS license.

<sup>1</sup>To whom correspondence should be addressed. Email: radeloff@facstaff.wisc.edu

<sup>2</sup>Present address: Forest Research Center, School of Agriculture, University of Lisbon, Portugal.

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# Why Land Use Planning?

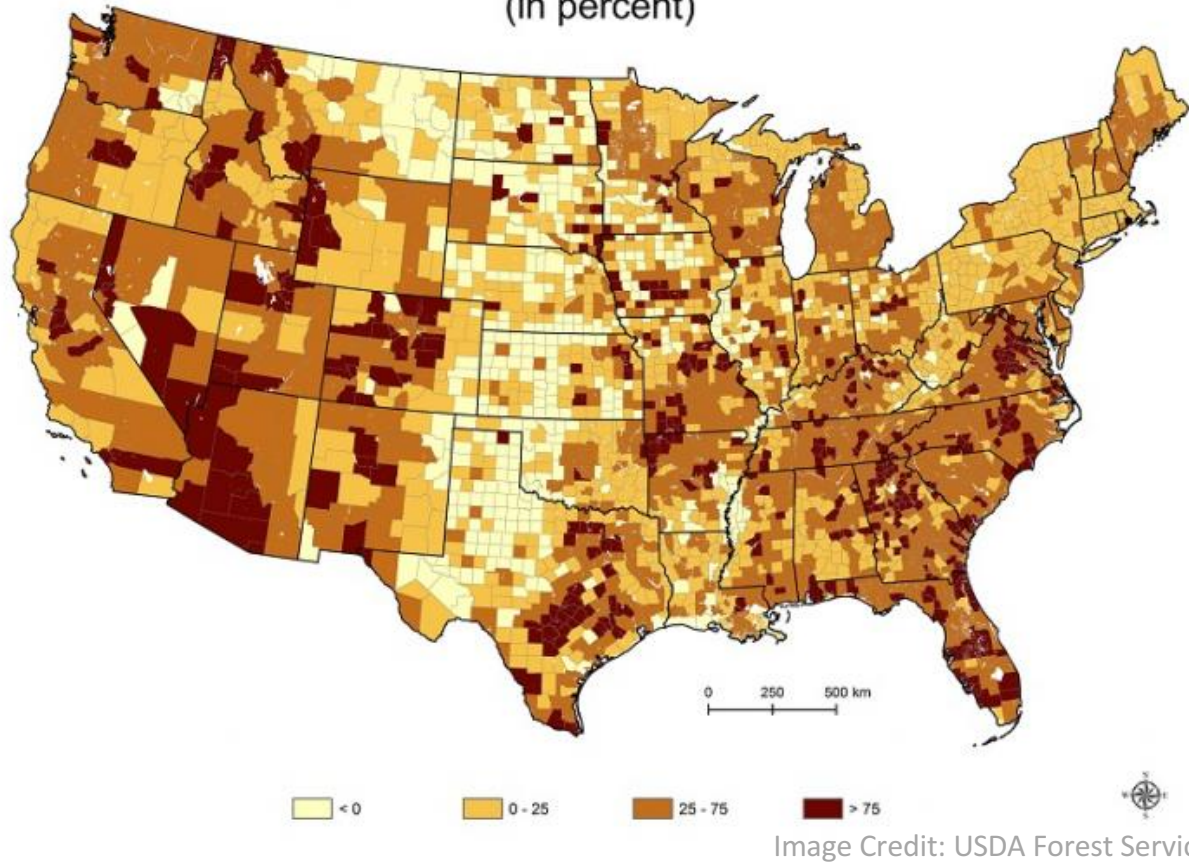
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Growth Rate of Homes in the WUI 1990-2010 by County (in percent)



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# Wildfire Planning Tools!

**FIRE CODE**      *Maintenance Agreements*      **Hazard Mitigation Plan**      **USE-SPECIFIC STANDARDS**  
*Site Design Standards*      *Open Space Plan*      **Community Wildfire Protection Plan**  
**Conservation Easement**      *Land Acquisition*      **Wildland-Urban Interface Regulations**  
**Comprehensive Plan**      **SUBDIVISION REGULATIONS**      **Future Land Use Map**  
*Site-Specific Assessment*      **Building Code**      **Development Fees**  
*Nuisance Ordinance*      *Wildfire Overlay Zone District*      **Post-Disaster Building Moratorium**  
*Landscaping Requirements*      **Wildfire Overlay Zone District**      **Post-Disaster Building Moratorium**



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# Wildfire Planning Tools

- Plans
- Regulations
- Incentives/ Voluntary Programs



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# Community Planning Assistance for Wildfire



- Land Use Planning
- Hazard Assessments
- Capacity Building
- Research



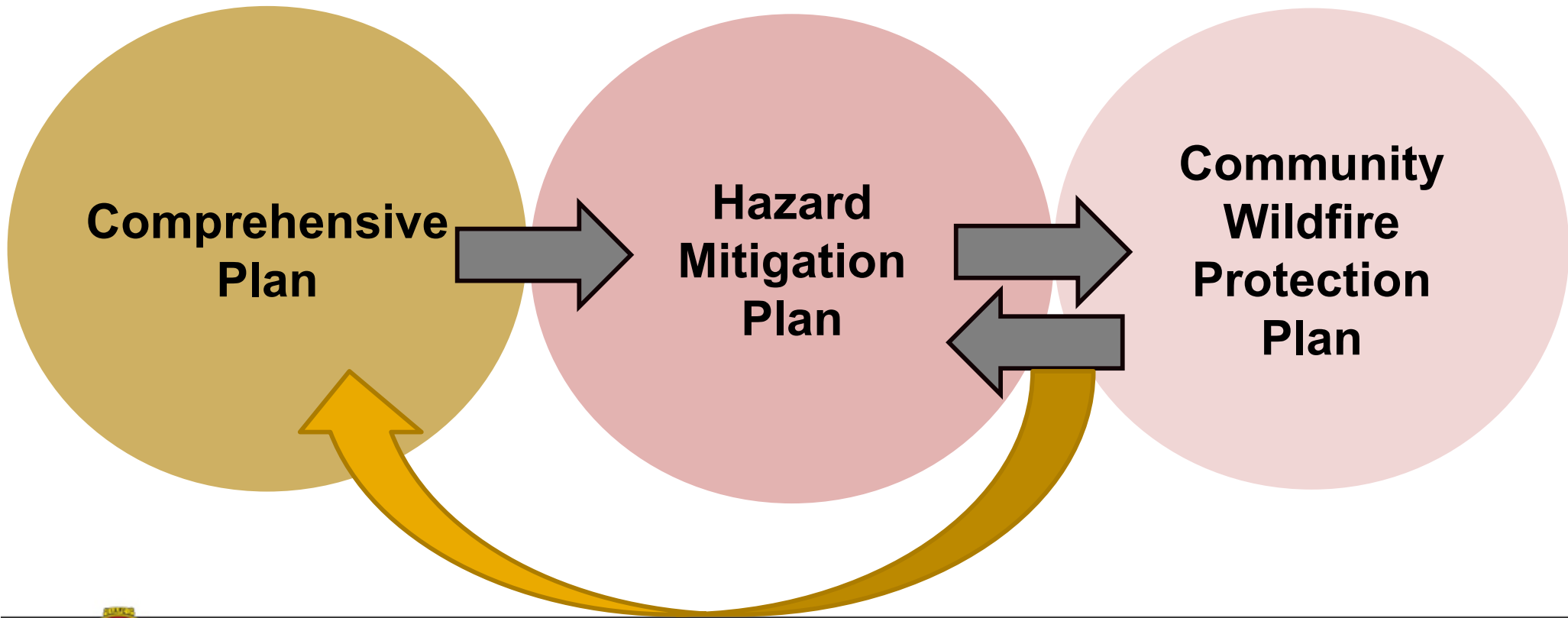
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# Community Plans



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# Wasco County, OR

Image Credit: WPI



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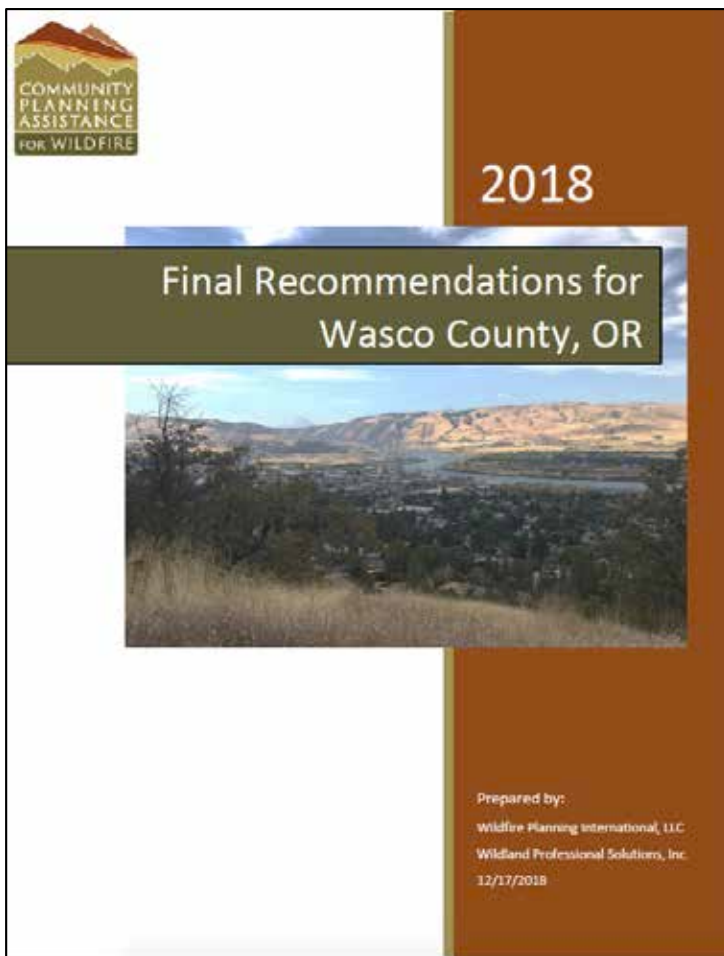


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## RECOMMENDATION 2: Include Wildfire Goals in Wasco County 2040 to Support Hazard Plan Implementation

### ❖ Why This Recommendation Matters

Wasco County is currently updating its Comprehensive Plan, which was first adopted in 1983. Since its initial adoption, the Comprehensive Plan has undergone multiple revisions—most recently in 2010—and is now in need of a full revision. The planning update process, known as Wasco County 2040, began in 2015 and final adoption of the plan will occur by 2020. The purpose of the update is to provide a long-term planning horizon for the next 20 years of anticipated growth and change. It also gives county staff an opportunity to engage the public in shaping the future of Wasco County.

Wasco County 2040 policies will lay the groundwork for an update to the Land Use and Development Ordinance and other local plans, implementation tools, and strategies.<sup>13</sup> Following discussions with Wasco County planning staff, Wasco County 2040 will relate to hazard plans, including the Wasco County Multi-Jurisdictional Natural Hazards Mitigation Plan and the Wasco County Community Wildfire Protection Plan (CWPP), by providing high-level goals and/or policies to support long-term implementation of hazard risk reduction. The most detailed information on wildfire and corresponding mitigation actions will be contained in the Wasco County CWPP. Wasco County 2040 therefore presents an important opportunity to support wildfire risk reduction across the county by providing a solid foundation of resilience-oriented community goals and policies upon which future hazard activities can be built.

### ❖ Implementation Guidance

#### *Background on Current Comprehensive Plan*

Wasco County's current Comprehensive Plan contains information on wildfire topics dispersed throughout the plan. References include:

- Detrimental effects of fire on local habitat and/or communities and other associated impacts (e.g., poor air quality);
- Fire disturbances on the land, including effects on rangeland and vegetation types;
- Detailed information on fire protection capabilities and fire protection districts;

<sup>13</sup> <https://Wasco2040.com/faq/>



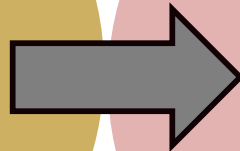
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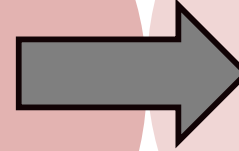


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2040  
Comprehensive  
Plan**



**Wasco County  
Natural  
Hazards  
Mitigation  
Plan**



**Wasco  
County  
Community  
Wildfire  
Protection  
Plan**



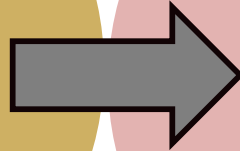
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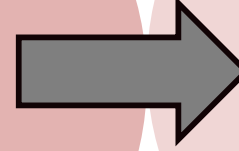
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2040  
Comprehensive  
Plan**



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Natural  
Hazards  
Mitigation  
Plan**



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Wildfire  
Protection  
Plan**

Where and how should growth occur?



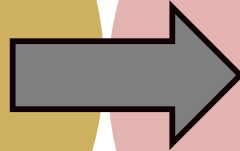
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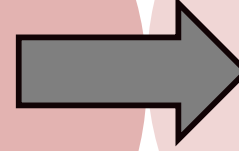
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Comprehensive  
Plan**



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Hazards  
Mitigation  
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Wildfire  
Protection  
Plan**

What kind of fire protection resources are available?



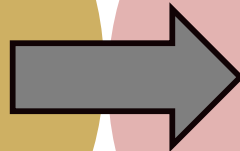
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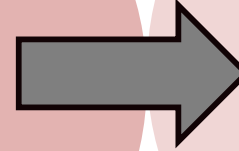
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What kind of mitigation requirements are necessary?



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**Comprehensive  
Plan**

**Hazard  
Mitigation  
Plan**

**Community  
Wildfire  
Protection  
Plan**

**Regulations**



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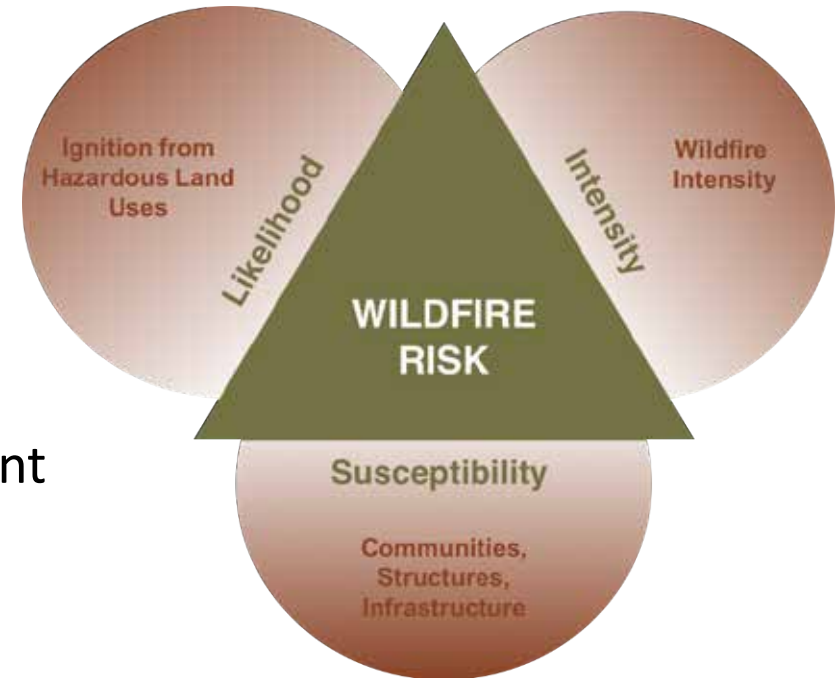
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# WUI Landscape Regulations

- Home Ignition Zone vegetation mitigation
- Based on local wildfire risk
- Locally applicable and consistent approach- community benefit
- Alignment:
  - Between new and existing development mitigation efforts
  - Other regulations and community values



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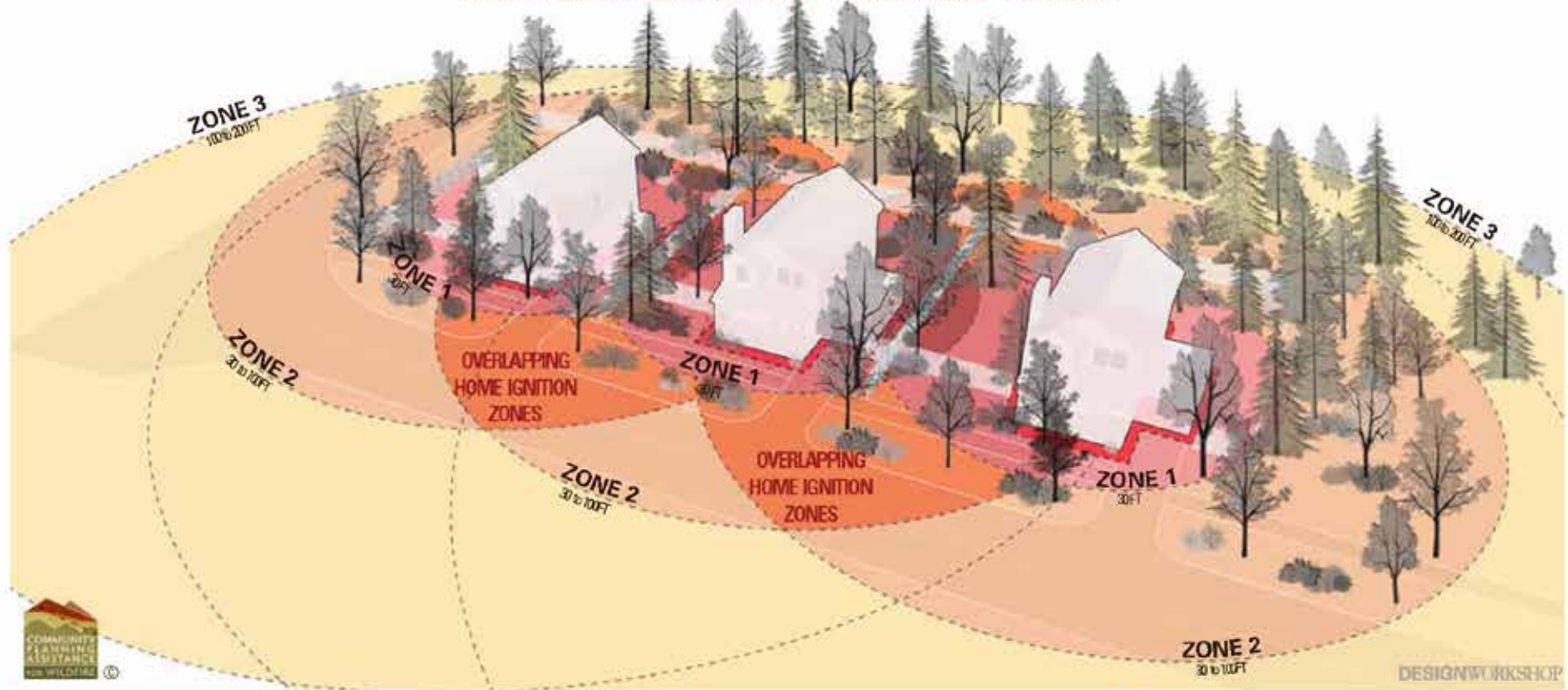
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**UNMITIGATED STANDARD LOT RESIDENTIAL**

**OVERLAPPING HOME IGNITION ZONES**



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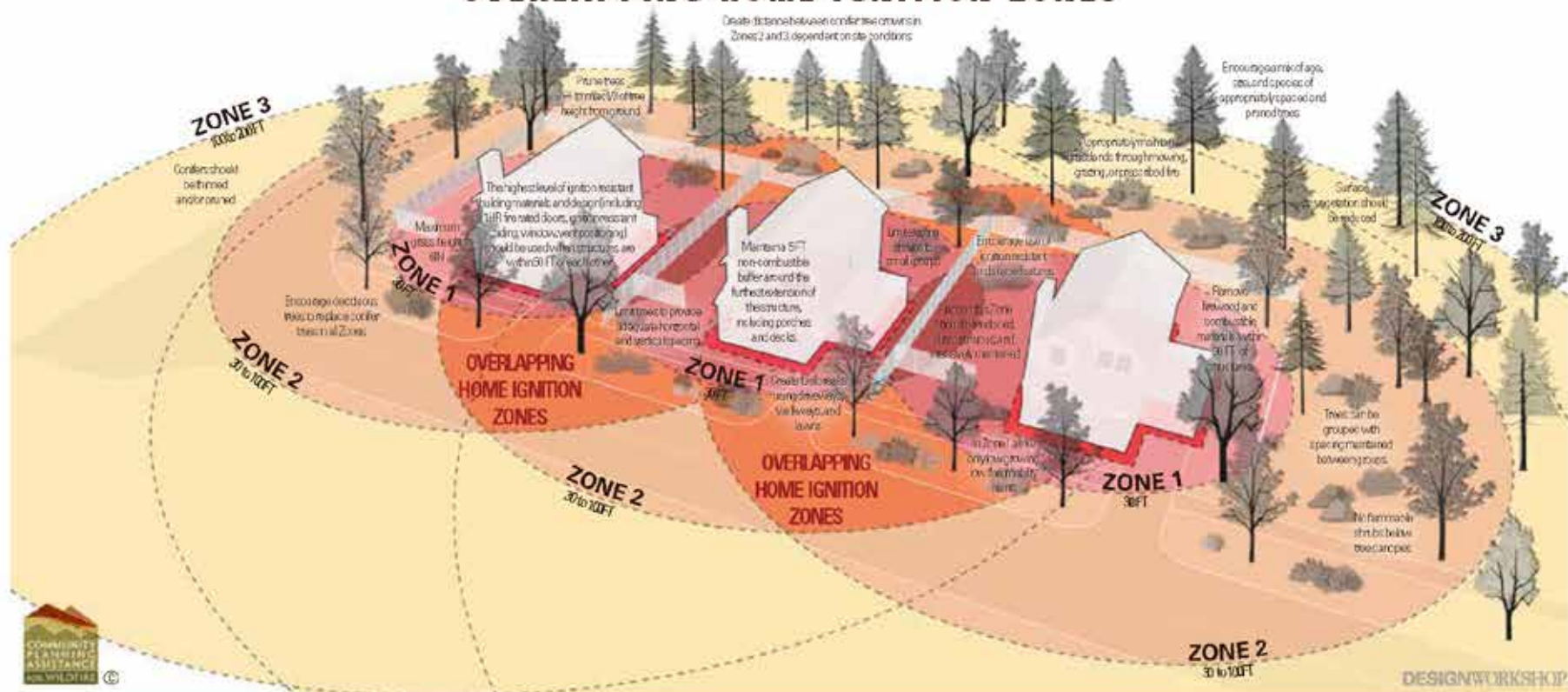
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# MITIGATED STANDARD LOT RESIDENTIAL

## OVERLAPPING HOME IGNITION ZONES



**ZONE 1A** Eliminated Combustible Material

**ZONE 1** Reduced, Discontinuous, and Intensively Maintained Vegetation

**ZONE 2** Spaced, Pruned, and Limited Low-Growing Surface Vegetation

**ZONE 3** Thinned, Pruned Trees, and Reduced Surface Vegetation



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# Common Problems

- Misconceptions of wildfire susceptibility
- No consistent local guidance/requirements
- Conflicting community values
- Conflicting regulations or initiatives
- Limitations to compliance
- Capacity



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# Town of Mammoth Lakes, CA

Image Credit: WPI



2018

## Final Recommendations for the Town of Mammoth Lakes, CA



Prepared by:  
Wildfire Planning International, LLC  
Wildland Professional Solutions, Inc.  
PlaceWorks, Inc.  
10/31/2018



## RECOMMENDATION 1: Adopt a New Wildfire Hazard Assessment

### Why This Recommendation Matters

#### Overview Mammoth Lakes Wildfire Risk Assessment History

Currently, there are two separate wildfire risk/hazard assessments that can potentially influence planning decisions within the Town of Mammoth Lakes. The first is the California Department of Forestry and Fire Protection wildfire hazard severity assessment adopted (with modifications) by the Mammoth Lakes Fire Protection District Board of Commissioners. The second is the community wildfire hazard assessment that was undertaken as part of the 2009 Mono County Community Wildfire Protection Plan (CWPP).

#### The Need for an Updated, Cohesive and Consolidated Risk Assessment

Current WUI research and best practices typically describe the wildland-urban interface as a "set of conditions" in which both vegetation (wildland fuels) and the built environment (built fuels) are influenced by weather and topography to create an environment where fire can ignite and spread through this combined fuel complex (the combination of wildland and built fuels). One cohesive and comprehensive town-wide risk assessment and spatial definition of the WUI is necessary to provide consistent decision support for developing and implementing land use policies and regulations. The Mammoth Lakes Fire Protection District has recently engaged with the Anchor Point Group to produce a wildfire risk assessment in a format and scale that will support land use planning decisions and provide context for individual parcel-level assessments.

#### What is Wildfire Risk?

Wildfire risk can be visualized as a triangle, consisting of three components:

1. Likelihood of a wildfire occurring based on topography, weather, and ignition patterns; this can also include ignition sources from hazardous land uses (e.g., sewmalls or propane storage facilities);
2. Predicted intensity of a wildfire (usually measured in flame length) based on vegetation type and weather conditions;
3. Susceptibility of values, sometimes referred to as Highly Valued Resources and Assets (HRVA's). For land use planning purposes, values typically consist of communities, structures and infrastructure, but other values that may be considered can include:
  - o Recreation, tourism-based activities



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# Challenges and Successes

- Tree preservation “Village in the Trees”
- Town landscape plan requirements
- Town visual screening requirements
- Mammoth Lakes Fire Protection District requirements



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# Improving Administration

- Streamlined permitting process
- Integration of MLFPD into plan review process
- Provide a prescriptive approach with a performance alternative



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# Partnership and Outreach Support

- Recommended plant list
- Partner with landscape industry:
  - Suppliers, nurseries
  - Horticulturists, Landscape architects
  - Landscape contractors
- Collaborative public outreach
  - Town of Mammoth Lakes
  - Mammoth Lake Fire Protection District
  - Mammoth Lakes Fire Safe Council
  - Landscape industry



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# Successful Regulatory Solutions

- Relate to local wildfire risk assessment
- Measurably contribute to wildfire risk reduction
- Involves local landscape industry
- Address conflicts (regulatory, practice, community values)
- Provide prescriptive and/or performance path
- Compel compliance and maintenance
- Account for local administrative capacity



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# BUILDING CODES AS A WILDFIRE MITIGATION TOOL



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# FIRE CODE HISTORY

- Building Codes developed out of tragedy
- Great Chicago Fire
  - 17,000 building
  - 300 lives
- Peshtigo
  - 1,200,000 Acres
  - 2,500 killed
- Current – look around



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# WILDFIRE CODES – The Big 3

- NFPA 1144
- IWUIC (ICC)
- California Building Code
  - Chapter 7
- Consensus Codes
- Local Codes



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# WUI STRUCTURAL CODES

- 3<sup>RD</sup> LEG
- Time to focus on the exterior
- How structures ignite
- Designed to slow fire, not stop fire
- Wildland fire, not urban conflagration



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# WHEN THEY FAIL

- California
- Statistical average
- Weakest link
- No control group



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# OREGON CODES

- Progressive?
- Mini/Maxi
- Roof Ordinance
- SB 360
- Consequences



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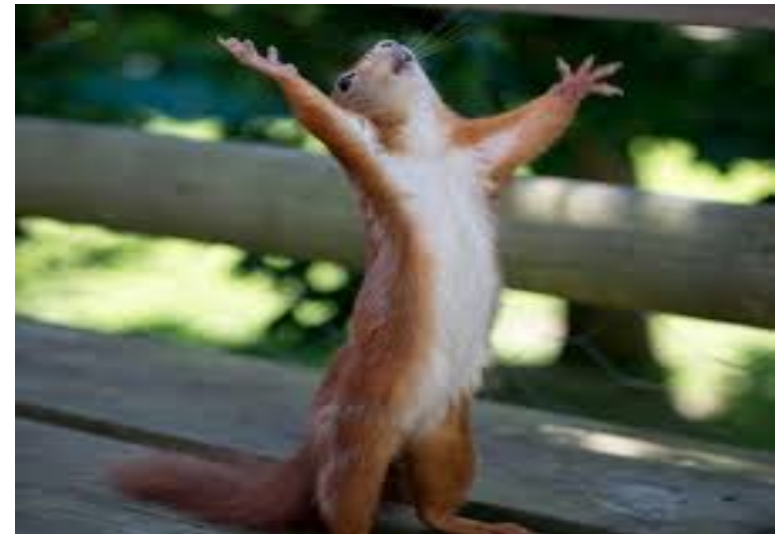




# R327/Appendix W

- Path to adoption
  - Chief Klienburg
  - Chief Sartain
- BCD
- Concessions
- Now in local hands
- Hurdles

**HALLELUJAH!**  
(KIND OF.....)



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# MOVING FORWARD

- Heavy lift begins
- Changing the narrative – cost vs. safety
- Cost? – Headwaters Economics study
- Our responsibility to our community
- Can't extrapolate data from the past



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# LESSONS LEARNED

“Wise men learn many things from their enemies.”

—Aristophanes

- Always something to be learned from the other side
- Understand opponents
- Bridge the divide
- Get support from higher powers early
- What are you willing to accept?
- The best ways to persuade others is by listening to them



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# Design Review Standards and Guidelines

- In 2016 the Town of Vail amended its Design Standards to include use of Ignition Resistant Building Materials and Landscaping
- Inclusions were aimed at changing decades worth of irresponsible building and landscaping practices in the WUI
  - Designed to create a new aesthetic



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# Design Review Standards and Guidelines



Past desired aesthetic



New aesthetic



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# Design Review Standards and Guidelines

- 2016 – Town amended design guidelines to recommend use of ignition resistant building materials and landscaping designs
- Fire Department reviews development applications and provides comments on incorporation of design elements



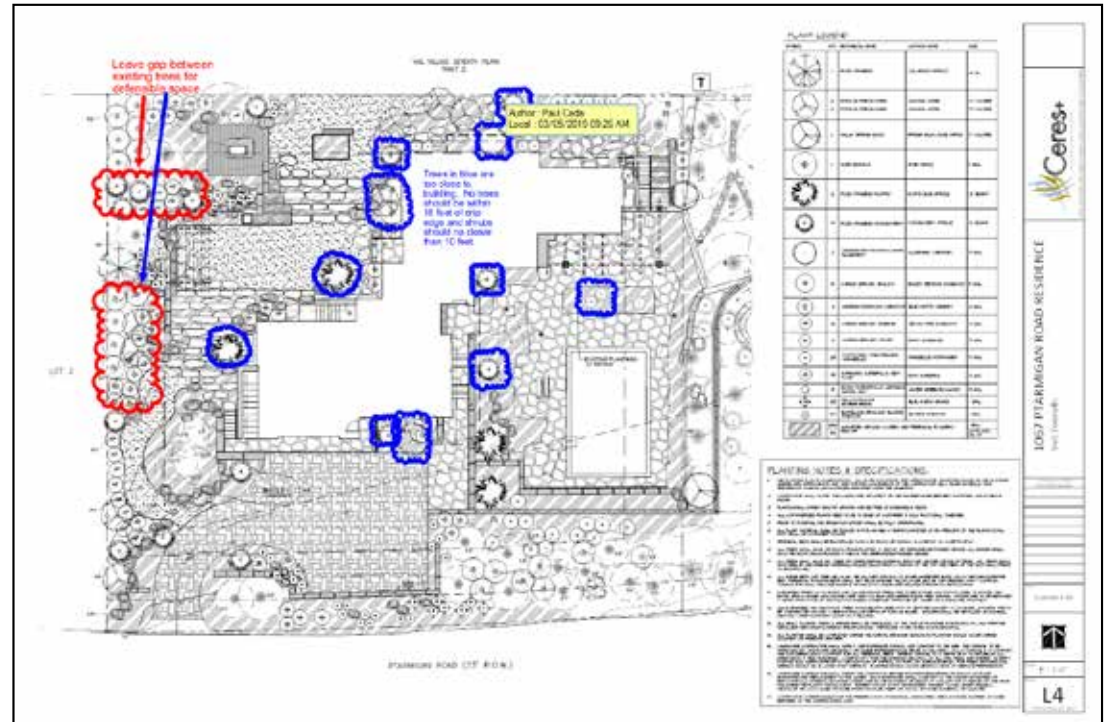
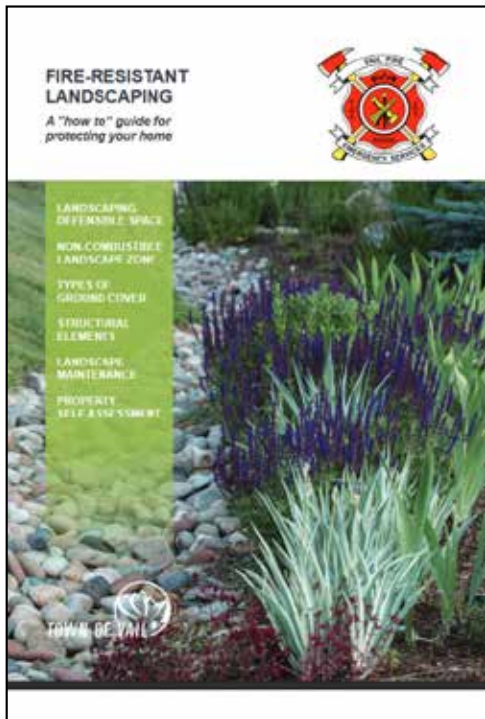
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# Design Review Standards and Guidelines



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# Design Review Standards and Guidelines

- Opportunities
  - “Softer” approach than regulation
  - Educational tool -- Community, Professionals, Boards and Elected Officials
  - Uses non-prescriptive standards
- Challenges
  - Only addresses new construction or substantial remodels
  - Inconsistently applied
  - Requires substantial education for acceptance
- First step in long term changes to the community aesthetic and wildfire adaptation



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# Land Use Planning Tools

- Plans
- Regulations
- Incentives/ Voluntary Programs



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# Planningforwildfire.org



Ashland, Oregon



Austin, Texas



Bemidji, Minnesota



Bend, Oregon



Lewis & Clark County, Montana



Los Alamos County, New Mexico



Mammoth Lakes, California



Mariposa County, California



Boise, Idaho



Boulder County, Colorado



City of Chelan, Washington



Chelan County, Washington



Missoula County, Montana



Park County, Montana



Pigeon Forge, Tennessee



Pinetop-Lakeside, Arizona



Deadwood, South Dakota



Flagstaff, Arizona



Gunnison County, Colorado



Huerfano County, Colorado



Redding, California



San Diego, California



San Luis Valley, Colorado



Santa Fe, New Mexico



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# Contact Information

Molly Mowery

**[molly@wildfireplanning.com](mailto:molly@wildfireplanning.com)**

Kelly Johnston

**[kelly@wildlandprofessional.ca](mailto:kelly@wildlandprofessional.ca)**

Doug Green

**[dgreen@sistersfire.com](mailto:dgreen@sistersfire.com)**

Paul Cada

**[pcada@vailgov.com](mailto:pcada@vailgov.com)**



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