



# Learning to Live with Fire in Forest Communities

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# I Executive Summary

California is a flammable state - fires have always burned here and always will. But due to a century of putting out natural wildfires, combined with hotter, drier summers as our climate changes, megafires regularly threaten people and ecosystems. In 2018 alone, California wildfires killed 106 people and resulted in \$148.5 billion in damages, including capital losses, health costs and indirect losses.<sup>1</sup> Californians need to learn to coexist with fire, especially communities in the forested Wildland-Urban Interface (WUI).

Home hardening, where the homes themselves are made less flammable by using fire-resistant building materials, and defensible space around individual homes remain critical approaches for reducing the potential that a home will burn. These practices also reduce the potential that the fire can spread from home-to-home. However, Fire-Resilient Community Design shows promise as an additional, powerful approach for reducing fire risk to forest communities. This approach takes a popular tool currently used for reducing fire risk—fuel breaks—and reimagines them as an integrated part of a community that reduces risk to homes and neighborhoods while also benefitting nature.

Zoning decisions typically play an important role in shaping the character of a town, by specifying where agricultural, residential, commercial and industrial uses are sited. The novelty here is in the idea of using zoning to configure land uses to proactively achieve fire risk reduction. Intentionally siting land uses with reduced flammability around a community, as a buffer, offers a number of risk-reduction benefits. The buffer itself can give firefighters a safer place to control an unwanted fire. The low flammability land uses along the perimeter can also serve as a staging ground for fire crews and as temporary refuge areas for people evacuating. With housing concentrated in certain zones and no longer dispersed throughout the WUI, a third risk-reduction strategy—controlled burning to reduce fuel loads and minimize risks of future catastrophic fires—can be re-introduced into those wildlands that are adapted to frequent fire. Together, these actions may further support healthier habitat and biodiversity in the buffers and surrounding wildlands, if managed appropriately. Fire-Resilient Community Design is one more tool in the toolbox, and must be done in conjunction with home hardening and defensible space measures since embers can still travel over the buffer zones and reach homes.

In addition to saving lives and saving homes, money spent to enact such measures could result in significant savings overall. Research shows that every \$1 spent to prevent disaster saves \$6 on disaster recovery<sup>2</sup>, which also makes community-scale approaches fiscally smart.

Fire experts agree this systematic approach could inform how communities impacted by fire build back more safely, and help other communities preempt such impacts. And yet, to date, constraining development in the WUI has been politically

## TO USE A FIRE-RESILIENT COMMUNITY DESIGN APPROACH:

1. Enact urban-growth boundaries or similar land use tools and policies to focus development to a defined community core area inside the buffer zone. Establishing wildfire buffers only works by limiting expansion into the Wildland-Urban Interface, where the wildfire hazard risk to human lives, property, and nature greatly increases.
2. Create a fire buffer by siting land-uses with low flammability, such as agriculture or landscaped parks, around the perimeter of developed areas.
3. Manage buffer zones for fire-resilience. This could happen through the creation of a special district with the authority to assess tax and fees; hold and manage land; enter into management agreements with neighboring public and private property owners; purchase and administer insurance for homeowners, including community-based catastrophe insurance.
4. Improve ecosystem health of surrounding wildlands, and reduce fuels, for example through controlled burns in landscapes adapted to frequent fire.



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1 Wang, D., Guan, D., Zhu, S., Kinnon, M. M., Geng, G., Zhang, Q., ... Davis, S. J. (2020). Economic footprint of California wildfires in 2018. *Nature Sustainability*, 1-9. <https://doi.org/10.1038/s41893-020-00646-7>

2 Multihazard Mitigation Council. (2017). *Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study - Summary of Findings*. [https://www.fema.gov/sites/default/files/2020-07/fema\\_ms2\\_interim\\_report\\_2017.pdf](https://www.fema.gov/sites/default/files/2020-07/fema_ms2_interim_report_2017.pdf)

challenging. But as severe fires have become increasingly common, posing ever-greater threats, elected officials and constituents are more willing to consider measures they wouldn't have previously.

In 2019, The Nature Conservancy of California partnered with the Paradise Recreation and Park District (PRPD) and Conservation Biology Institute (CBI) to explore community design elements to test the scientific justification for a “defensible space” zone around a community – one that can provide both a boundary for urban growth to reduce habitat fragmentation and impacts and enable safer communities for people. The researchers were able to develop management scenarios that could reduce urban ignition risks while offering additional benefits, including open space for recreation, emergency refuges and staging areas for fire-fighting, and conservation benefits by decreasing edge effects of human settlements.<sup>3</sup> Based on this research, we developed a model prioritization schema for the Town of Paradise and created guidance for the integration of wildfire buffers in both new and existing forest communities in high-risk wildfire prone areas.

## POLICY INTERVENTIONS:

This initial assessment has already helped identify several policy interventions that could create the required enabling conditions:

- Enhance hazard mitigation and wildfire resilience planning coordination across state agencies, including the development of guidance documents such as the *Wildland-Urban Interface Planning Guide*.<sup>4</sup>
- Significant additional funding is necessary to support management within buffer areas. This funding could come from state or federal disaster mitigation grants, or from local initiatives.
- The state should create incentives (and eliminate disincentives) for local urban growth boundaries that would help implement urban buffer zones.
- Significant additional funding is also required for ecological forest management in wildlands adjacent to buffers and communities.
- Buyout strategies – where residents sell their risk-prone properties to the state or local government and relocate to areas with lower risk – should be considered as severe fires become increasingly common. While buyout strategies can be controversial, post-disaster buyouts are often welcomed by affected communities as providing options for people in a time of great need.

## WHY PARADISE?

The Town of Paradise, California burned almost entirely to the ground in the 2018 Camp Fire. During the fire, residents congregated in parks on the perimeter of the town, using them as refuges from the fire as it swept through the community. Recognizing that the fire burned up to – but not through – the parks, the Paradise Recreation and Park District collaborated with researchers at The Nature Conservancy and Conservation Biology Institute to explore the idea of Fire-Resilient Community Design. The researchers estimated how fire risk in Paradise would change over time if key parcels around the perimeter were used for new parks, instead of as sites for housing. They found that by not building back on parcels in the highest risk areas, there is a potential to reduce future losses and improve community resilience to wildfire.<sup>5</sup>



3 Conservation Biology Institute, The Nature Conservancy, and Paradise Recreation and Park District. (2021). Paradise Nature-Based Fire Resilience Project Final Report. <https://consbio.org/products/reports/paradise-nature-based-fire-resilience-project>

4 California Governor's Office of Planning and Research. (2022). Wildland-Urban Interface Planning Guide: Examples and Best Practices for California Communities. [https://opr.ca.gov/docs/20220817-Complete\\_WUI\\_Planning\\_Guide.pdf](https://opr.ca.gov/docs/20220817-Complete_WUI_Planning_Guide.pdf)

5 Conservation Biology Institute, The Nature Conservancy, and Paradise Recreation and Park District. (2021). Paradise Nature-Based Fire Resilience Project Final Report. <https://consbio.org/products/reports/paradise-nature-based-fire-resilience-project>

## FIRE HAS ALWAYS BEEN AN ESSENTIAL PART OF THE CALIFORNIA LANDSCAPE

In 2020, nearly 10,000 wildfires burned more than four and a half million acres across California, in what has been widely reported as a record-setting year. Economic losses exceeded \$19 billion, and 33 people were killed directly by wildfire.<sup>6</sup> And yet, taking a longer view, fire isn't new; it has always been part of California landscapes. Before European colonization, research estimates that four and a half million acres burned annually.<sup>7</sup> Lightning ignitions were common in much of the state, and many native tribes intentionally used fire to cultivate the land for food, resources, and community safety — a practice now called cultural burning. Natural fire regimes ranged from frequent low-intensity burns in dry forests to infrequent high-intensity burns in chaparral shrublands, which in each case promoted biodiversity and ecological fire resilience.

But a lot has changed over the past 150 years. Native people were forcibly removed from their lands, and cultural burning was prohibited by law. Lightning fires have long been suppressed due to colonists' misunderstanding of the role of fire in California ecosystems. Larger, fire-resistant trees were preferentially logged for economic reasons. More recently, hotter temperatures and drought have also increased the flammability of vegetation across the state.

These changes have led to the emergence of new burning patterns, to which many of California's forested ecosystems, and Californians, are not well-adapted. In ecosystems historically dominated by frequent fire, such as northern California's mixed conifer forests, fire suppression has dramatically increased the build-up of woody debris, or fuel loads. Where wildfires previously burned mainly along the forest floor, this build-up of fuels can push fire into the treetops, resulting in high levels of tree mortality from fire. In these ecosystems, the problem is that when fires do burn, they burn at a higher intensity that causes ecological damage. Forests that experience frequent lower and moderate intensity burns result in a patchwork pattern of succession and diverse habitat that supports greater biodiversity and resilience to future disturbances.

Another key change between pre-colonial settlement and now is the addition of millions of people living in and adjacent to wildland areas, also known as the Wildland-Urban Interface (WUI). The WUI is the fastest-growing land type in the contiguous US. From 1990 to 2010, the number of people living in the WUI in the U.S. roughly doubled, associated with an increase of 32 million homes from 1990–2015.<sup>8</sup> Within this same period, the number of homes lost to wildfires in the WUI increased steadily<sup>9</sup> as the intermixing of human activity with a natural environment resulted in increased risk of loss.

This sprawl of human development into wildlands has contributed to the loss of homes and even lives. It also contributes to the widespread yet misguided idea that wildfire is "bad." Yet we are learning that we can't keep fire out of our ecosystems forever, and that Californians, along with many others living in the American West, will need to learn to live with fire. Indeed, fire, managed appropriately, will help us reduce the incidents of catastrophic fire and make our communities and ecosystems more resilient.

*"Human nature being what it is, this may not be the catastrophe where we learn our lesson. It may be the next fire. But we seem to be getting a lot of support from people to come up with better wildfire solutions than what we've been doing."*

*"There's a very small window where we can change the map a little bit, to help make it protected."*

— DAN EFSEAFF, PRPD



©Lauren Hook/TNC Photo Contest 2019

- 6 Safford, H., Paulson, A., Steel, Z., Young, D., Wayman, R., & Varner, M. (2022). The 2020 California fire season: A year like no other, a return to the past or a harbinger of the future?. *Global Ecology and Biogeography*, 00, 1-21. <https://doi.org/10.1111/geb.13498>
- 7 Safford, H., Paulson, A., Steel, Z., Young, D., Wayman, R., & Varner, M. (2022). The 2020 California fire season: A year like no other, a return to the past or a harbinger of the future?. *Global Ecology and Biogeography*, 00, 1-21. <https://doi.org/10.1111/geb.13498>
- 8 Mietkiewicz, N., Balch, J. K., Schoennagel, T., Leyk, S., St. Denis, L. A., & Bradley, B. A. (2020). In the Line of Fire: Consequences of Human-Ignited Wildfires to Homes in the U.S. (1992–2015). *Fire*, 3(3), 50. <https://doi.org/10.3390/fire3030050>
- 9 Caggiano, M. D., Hawbaker, T. J., Gannon, B. M., & Hoffman, C. M. (2020). Building Loss in WUI Disasters: Evaluating the Core Components of the Wildland-Urban Interface Definition. *Fire*, 3(4), 73. <https://doi.org/10.3390/fire3040073>



## WHAT IS FIRE-RESILIENT COMMUNITY DESIGN?

The Fire-Resilient Community Design approach takes an existing tool – the fuel break – and re-imagines it as a linked system of fire-resistant land uses that serve as a fire buffer surrounding a community. It essentially involves four actions:

1. Designating buffer zones
2. Managing those zones for risk reduction and resilience
3. Improving ecosystem health of surrounding wildlands
4. Limiting growth beyond the buffer

Broadly, to reduce risks to human life and property, people living in fire-prone areas have typically utilized four distinct evidence-based strategies:

### HOME-HARDENING

Using less-flammable, fire-resistant building materials.

### DEFENSIBLE SPACE

Removing flammable material, such as vegetation, from the immediate vicinity of a home.

### FUEL BREAKS

Intensively reducing fuels using mechanical tools, grazing or controlled burning to facilitate control of wildfires.

### LAND MANAGEMENT

Reducing fuel loads in wildlands using mechanical tools or controlled burning for ecosystem health, where appropriate.

These four strategies each play an important role in reducing risk. Their implementation has generally relied on actions by homeowners and public agencies that manage land. Fire-Resilient Community Design is a new approach that relies on land use planning at the community level, but its foundation is built using a fuel break as a buffer around a community. At their most fundamental, buffers are open spaces with reduced flammability between the likely sources of wildfires (e.g. wildlands) and denser communities. Strategically placed fuel breaks are intended to give firefighters a safer place to control a wildfire, and to reduce the adjacency between fuels and critical assets like homes and economic centers. It is important to note that fuel breaks are much less likely to stop a fire without firefighter intervention, because embers can fly over them and ignite vegetation or homes on the other side. For community risk reduction, this emphasizes that home hardening and defensible space remain critical.



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Traditionally, fuel breaks have been comprised of either total vegetation clearance or reductions in the amount of existing vegetation. In many of California's forested ecosystems, reducing fuels can align with ecological restoration. Where forest restoration treatments are installed as fuel breaks, they are a win-win for nature and communities.

Buffers without growth boundaries, however, may not work to reduce community level fire risk, because homes built beyond the buffer are still subject to higher risk from fire. Limiting rural sprawl and designing lower flammability land uses as buffers around communities are linked strategies that can provide benefits to people and ecosystems. Fire-informed land use planning decisions that consider the proximity of homes to lower flammability land uses can also enable greater restoration in nearby forests through the expansion of beneficial management action such as prescribed fire. Buffers can serve multiple purposes- both as a fuel break, but also as parks, open space, and recreational lands.

Actions such as designing communities with these fuel breaks increases opportunities for novel funding strategies. Research shows that every \$1 spent to prevent disaster saves \$6 on disaster recovery<sup>10</sup>, making community-scale approaches an appropriate investment for the Federal Emergency Management Agency (FEMA), and an appealing source of loss reduction for the insurance industry. New investment from these actors broadens the base of support for risk reduction, making new sources of project funding available.



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<sup>10</sup> Multihazard Mitigation Council. (2017). Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study - Summary of Findings. [https://www.fema.gov/sites/default/files/2020-07/fema\\_ms2\\_interim\\_report\\_2017.pdf](https://www.fema.gov/sites/default/files/2020-07/fema_ms2_interim_report_2017.pdf)





# Rebuilding and Learning in Paradise, California

## ADDING FIRE-RESILIENT COMMUNITY DESIGN TO THE FIRE RISK REDUCTION TOOL BOX

Nowhere are the risks of wildfire to communities more apparent than in the town of Paradise, which burned in the 2018 Camp Fire, killing 85 people in this small town in the Sierra Nevada foothills. The fire destroyed over 18,000 structures, including about 90 percent of the town's homes. The emotional toll and mental health impacts are incalculable. Many residents chose not to rebuild. But many did, and now the rebuilding process in Paradise is already underway. As of June 2021, over 1,000 homes of the 14,000 that were burned down have been rebuilt, and hundreds more projects have been permitted. Many people in the local community were interested in exploring ways they could, as they said, "build back better." Right now, before the majority of rebuilding begins in Paradise, is when civic leaders have a chance to reconsider and proactively reconfigure the town's perimeters to keep people out of harm's way.

With the town's future in mind, representatives from Paradise Recreation and Park District collaborated with The Nature Conservancy and the Conservation Biology Institute to examine how well a community-encircling buffer zone around the perimeter of Paradise might reduce fire risk to the town while also promoting recreation and conservation priorities. The buffer would be created through the acquisition of select parcels (or easements for management) deemed at high-risk for ignition in a wildfire. Although the buffer would be created through land protection by a special district, its effectiveness in increasing fire resilience could only be fully realized if integrated with a re-imagined approach to development planning that includes fuels management in the forested areas and use of some parcels as managed recreation areas.

Results of the assessment suggest that Fire-Resilient Community Design could play a critical role in increasing fire resilience and reducing risk as Paradise builds back, but only if fire safety is placed at the forefront of decisions around where development is—and is not—sited.

This study asserts that areas on the town's perimeter, especially those deemed high-risk, could be designated as buffer zones. Any existing structures in these zones that have not burned in previous fires would be removed after a land transaction is completed and new structures would be prohibited.

The study's authors propose that initially, implementation could happen through land acquisition and management where public agencies offer to buy privately-owned lands. Buyout strategies can be controversial—but as severe fires have become increasingly common, posing ever-greater

## WHAT IS MANAGED RETREAT?

Managed retreat is a coordinated effort in which communities get government aid to move away from places threatened by floods, droughts, fires or high temperatures. To date, managed retreat has been mostly focused on coastal flooding events and has been relatively limited, with governments typically buying out single homes or mandating resettlements of whole communities.



©Stuart Palley



threats to communities, elected officials and constituents are becoming more willing to consider measures they wouldn't have previously. In addition, post-disaster buyouts are often welcomed by affected communities as providing options for people in a time of great need. Paradise is unique in that the Camp Fire created a forced de-population and reduced most structures to rubble. Because many residents are hesitant to return and rebuild in the same places, a buyout approach may be easier to implement than in a pre-fire environment, where people are still occupying their homes, and expansion into the WUI is commonplace.

The study's collaborators have not yet designed the specific management scheme for the buffer areas, but because the Paradise Recreation and Park District will ultimately manage the land acquired, they are likely to become parks. The team has applied for FEMA funding to develop specific management plans, as well as an acquisition strategy for turning the idea into a reality.

*“We felt strongly that whatever we did needed to have a strong scientific basis, and we wanted to make sure the science was ready to go. Now, with the science in hand that shows that a buffer zone would reduce risk to the town, the District is already starting to acquire perimeter properties.”*

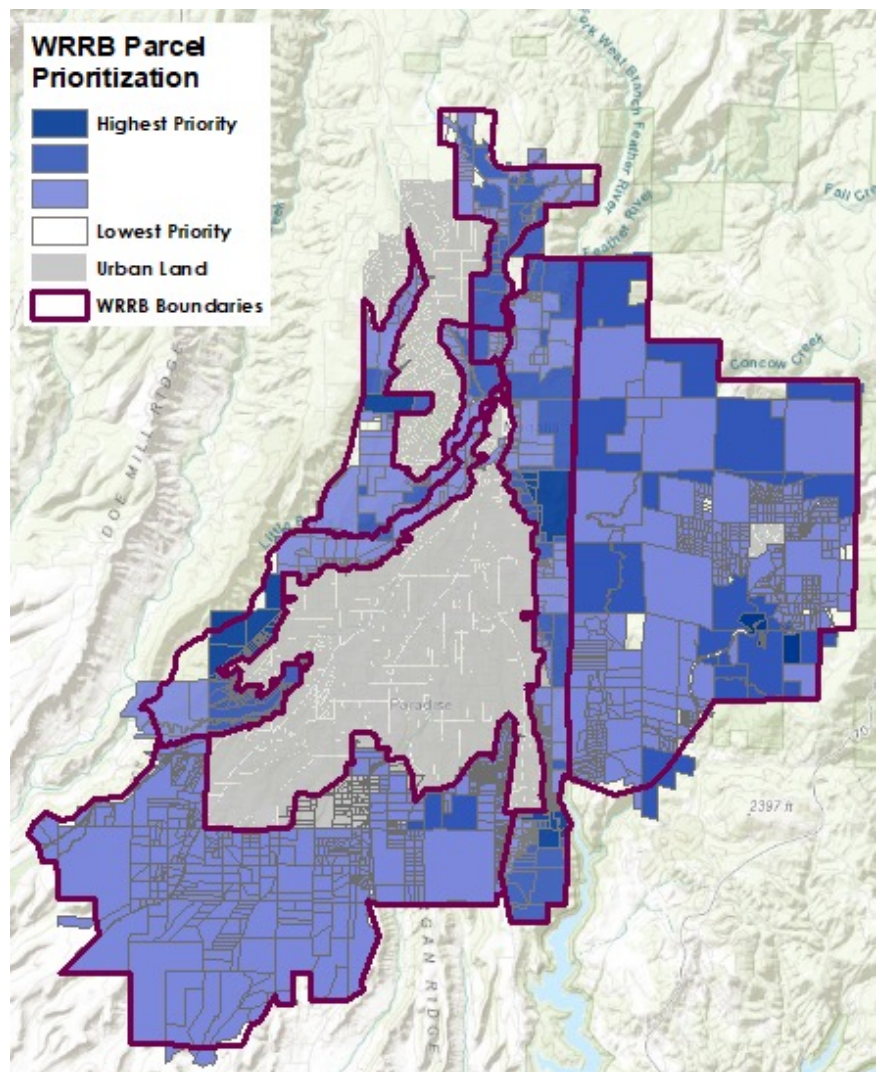
— DAN EFSEAFF, PRPD

## METHODS

The researchers used spatial data on forest fuels surrounding Paradise with wind direction under severe conditions to estimate which areas are most likely to burn in the future. Parcels were ranked by risk, with those at highest risk deemed higher priority for acquisition or management. The study took into account Paradise's unique geography, where deep canyons on two sides can strongly influence fire spread. Using local knowledge and ownership data, the parcels were then also evaluated for conservation value and recreation potential and opportunity for changing land use.

They found that reducing the number of built parcels that are in the path of strong winds and directly adjacent to wildlands would help reduce risk, and they identified specific parcels for conversion to non-residential uses.

Darker colors are a higher priority for actions that can support a Fire-Resilient Community Design. The red outline highlights the analysis area.



## A Model for Fire-Resilient Community Design in Forest Communities



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In Paradise, The Nature Conservancy and partners explored the role that land use planning and fuel reduction could play in community protection. Though Paradise is unique and some of the approach is specific to that community, there are several principles that have the potential to apply more broadly. These takeaways are important considerations for communities and planners that have not suffered such massive fire losses.

It is important to remember that buffer scenarios are not one-size-fits-all. Communities can envision and design buffers that meet their unique needs and circumstances, and use spatial data to qualitatively evaluate their utility. More rigorous fire behavior modeling could be applied to quantitatively evaluate fire losses to a community with and without buffers, allowing for realistic cost-benefit assessment.

The buffer zone's ultimate effectiveness is tied to the ability of local governments to manage growth outside the town and beyond the buffer. This could be accomplished through incentive-based programs or zoning, which would require regulatory action on the part of a town or county.

Zoning decisions typically play an important role in shaping the character of a town, by specifying where agricultural, residential, commercial and industrial uses are sited, but the novelty here is in the idea of using zoning to configure town boundaries and land-uses based, in part, on fire risk.

It is impossible to eliminate all risk in fire-prone regions, but there are several key steps to reducing risk to people and built infrastructure. A fundamental first step is to avoid building new communities in high fire risk areas. Where communities already exist, they can reduce their risk by taking an integrated approach that includes home hardening, defensible space, wildland fuel reduction and Fire-Resilient Community Design.



### INCORPORATING BUFFERS INTO EXISTING COMMUNITIES SCENARIO 1: BUSINESS AS USUAL DESIGN

The schematic below illustrates how unchecked growth can result in the loss of agricultural open space, and also result in increased WUI area where homes are adjacent to hazardous wildland fuels, thereby exposing residents and property to greater losses from wildfire.

In this scenario, building is extending deep into the flammable wildlands, placing more homes at fire risk, fragmenting habitat, and offering no ingress or egress point for firefighters. Instead of building into the wildlands as shown below, existing agricultural land could be integrated into a buffer established between the homes and wildlands, beyond which development is limited. By preventing “leapfrog development,” the community can reduce risk by minimizing homes embedded within the more flammable wildlands, which has the co-benefit of reducing ecosystem fragmentation. It can also help firefighters to manage the inevitable wildfires so that they can play their natural role, reducing fuels and restoring biodiversity on the broader landscape. Limiting growth beyond the buffer can result in more densely built communities, which reiterates the importance of home hardening and defensible space, since fire can spread from home to home

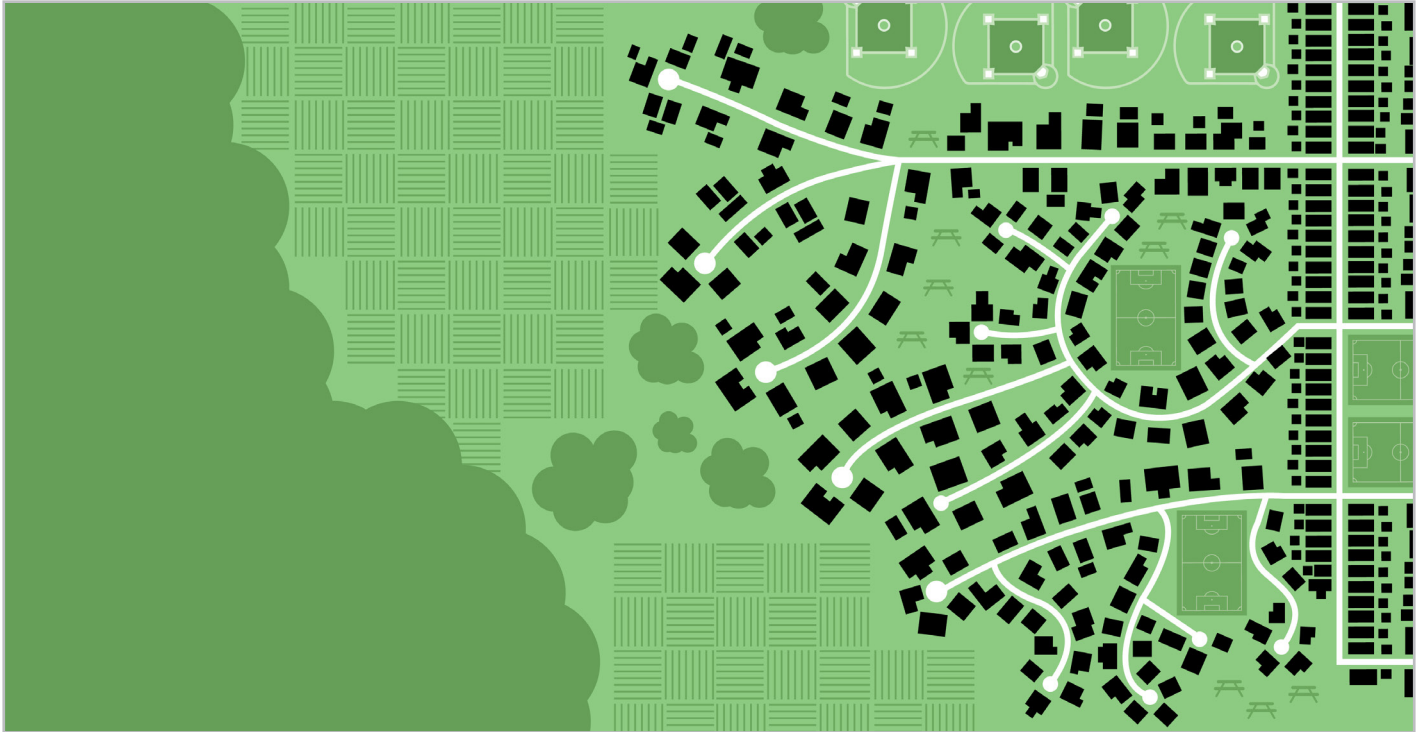


*Allowing development to expand into wildlands puts it at risk and also results in fragmentation of habitat.*

## INCORPORATING BUFFERS INTO EXISTING COMMUNITIES

### SCENARIO 2: ADAPTING EXISTING LAND USES FOR NETWORKED FUEL BREAKS

How a community decides to manage growth can have big impacts on its fire resilience, and on habitat fragmentation. The community below may have some risk reduction benefit from its proximity to agricultural land, depending on the type of crop and how it is managed, particularly in comparison to direct proximity to wildland fuels. The key is that a Fire-Resilient Community Design approach intentionally links different land use types together into a contiguous fuel break. However, for this to be effective, the lands must also be managed to maintain reduced flammability. For example, agricultural land uses are a more effective fuel break if the crops are kept clear of combustible material such as grasses and debris. This requires sustained management by landowners and/or local governments, which is time-consuming and costly, though less costly and disruptive than the process of recovering from catastrophic wildfire.



*Agricultural lands (hashmarks), managed wildlands (dark green), and recreation areas can be stitched together to form a fuel break.*

**One way in which communities could organize buffer management could be through the creation of a special district. Such a district should have the authority to:**

- Assess tax and fees and otherwise raise revenue;
- Hold and manage land;
- Enter into management agreements with neighboring public and private property owners; and
- Purchase and/or administer insurance for homeowners within their boundaries, including but not limited to community-based catastrophe insurance.



## INCORPORATING BUFFERS INTO EXISTING COMMUNITIES

### SCENARIO 3: ZONING FOR WILDFIRE BUFFERS

This same community could instead have made more strategic land use planning decisions to create a more resilient future. This includes leveraging zoning strategies, urban growth boundaries, or other policy measures to limit growth outside of the core community.

Concentrating development also makes it more feasible to restore beneficial planned fire in wildlands with controlled burns or to let wildfires burn as managed wildfires when it is safe to do so. In many forest ecosystems that evolved with frequent fire, regular, low-intensity controlled burns can restore ecosystem health and reduce the possibility of severe fires by clearing out accumulated woody debris. Wildlife will also benefit from reduced habitat fragmentation.



*The hashmarks shows an area that is often developed, perpetuating community adjacency to wildlands. Instead, this buffer area could be zoned for land uses that can also act as a fire break, as shown in Scenario 2. These schematics were adapted from the “Fire Mitigation in the Wildland Urban Interface SmartCode Module” written by Martin Dreiling. The SmartCode was created by the Center for Applied Transect Studies.*

#### What are urban growth boundaries (UGB)?

- UGBs are a policy tool that communities use to separate developed areas from wildlands.
- UGBs are usually created by voter initiative for a specified period. In California, UGBs have been used for decades to meet various goals—to limit air and water pollution, reduce greenhouse gas emissions, protect natural and agricultural lands, and reduce the need for expensive utility extensions.
- Anecdotally, firefighters were able to protect the communities of Windsor and Healdsburg in Sonoma County in part because of their well-defined edges with UGBs by staging fire response teams and equipment in the surrounding parks, open space and agriculture.<sup>11</sup>

<sup>11</sup> Shore, T. (2020, February 18). What Are Urban Growth Boundaries and Why Do We Need Them? Retrieved from Greenbelt Alliance website: <https://www.greenbelt.org/blog/what-are-urban-growth-boundaries-need/>

## APPLYING FIRE-RESILIENT COMMUNITY DESIGN TO NEW COMMUNITIES

It is easier to prevent growth into high fire-risk areas than it is to take it out once it is established. Where new communities are planned, or in a postfire situation, where there is an opportunity to think about how to rebuild in a more fire-resilient way, communities could consider siting lower flammability land uses that are being planned around the outside of a community, rather than in the interior. For example, many communities that end up growing without consideration of fire risk look like the one on the top. However, by using roughly the same footprint but strategically siting lower flammability land uses around the community, rather than embedded throughout it, could offer some risk reduction benefits. In the example schematic below, the top is a “business as usual” development scenario, but the bottom schematic shows how moving the lower flammability land uses, here denoted as sports fields and irrigated recreation parks, could function as a fuel break between wildlands and housing. Again, these buffers must be coupled with growth limitations, and a special management district is likely needed to ensure these areas are managed to maintain reduced fuels.



*Business as Usual Growth*



*Land Uses as a Networked Fuel Break*



At its core, this Fire-Resilient Community Design approach is simply another form of land-use planning. For decades, communities have comprehensively apportioned uses within limited space to keep incompatible activities apart, and to accommodate the needs of the community. Even the specific idea to strategically site fire resistant land near or around vulnerable development is not new.<sup>12</sup> And yet, Fire-Resilient Community Design, such as strategically siting fire-resistant land near or around vulnerable development, has rarely been used to reduce fire risk. To date, constraining development in the WUI has been politically challenging and has generally not been undertaken. These two approaches in tandem have the potential to help create safer communities. This systematic approach could also inform how communities impacted by fire build back more safely, as well as help other communities preempt such impacts.

Defensible space, home hardening, fuels reduction, and controlled burns are all accepted among fire experts as effective tools for reducing fire risk. Anecdotal reports from areas scorched by fires indicate that landscaped recreation areas, farms, orchards and vineyards are often spared, as higher water content in the leaves of irrigated vegetation make the plants resistant to combustion (though not always). Yet few studies have examined how these land uses could be stitched together strategically to reduce community vulnerability.

## WHAT ABOUT NON-FORESTED COMMUNITIES?

Wildfire buffers are site-specific. In other ecosystems, such as the Central and Southern California chaparral and coastal sage scrub communities where intense urbanization has also led to increased pressure on the WUI – the buffer approach should be used to inform how new communities or communities impacted by fire can build more safely. The establishment of irrigated buffers at the expense of existing intact habitat should not be used to justify new development or to retrofit existing developments in hazardous areas. The natural fire regime in these ecosystems differs from the that of the forested ecosystems presented in this report and require further study to determine the best buffer approach.



©Laura Bliss/Bloomberg CityLab. Bille Park with burnt trees visible behind. The park was one of the few areas in Paradise untouched by the Camp Fire.

12 Cohen, J. (1991). A site-specific approach for assessing the fire risk to structures at the wildland/urban interface. In: Nodvin, S & Waldrop, T. (eds), Fire and the Environment: Ecological and Cultural Perspectives: Proceedings of an International Symposium, Knoxville, Tennessee, March 20-24, 1990. (pp. 252-256). <http://www.fs.usda.gov/treesearch/pubs/4685>





# What's Next

The potential benefits and trade-offs, implementation hurdles and needed policy changes associated with this approach are still being analyzed and refined. As part of this analysis, the team will also explore the application of community-based catastrophe insurance in communities—including Paradise—to better understand the applicability of insurance-based approaches to finance Fire-Resilient Community Design.



## DEFINITIONS

<b>Fire Break</b>	Any natural or constructed discontinuity in a fuelbed utilized to segregate, stop, and control the spread of fire or to provide a control line from which to suppress a fire; characterized by complete lack of combustibles down to bare soil. <sup>13</sup>
<b>Fuel Break</b>	A strategically located area where the volume and arrangement of vegetation has been managed to limit fire intensity, fire severity, rate of spread, crown fire potential, and/or ember production. <sup>14</sup>
<b>Greenbelts</b>	Agricultural lands, open space, parks, wildlands, or a combination thereof, as designated by Local Jurisdictions, which surround or are adjacent to a city or urbanized area, and restrict or prohibit Development. <sup>15</sup>
<b>Greenways</b>	Linear open spaces or corridors that link parks and neighborhoods within a community through natural or manmade trails and paths. <sup>16</sup>
<b>Wildfire Risk Reduction Buffer</b>	Greenspaces or open spaces that are managed to reduce the spread of wildfires and are located between the structures and the wildlands to reduce community vulnerability to wildfire risks. Wildfire buffers are designed to provide additional benefits that may include shelter from natural disasters, recreation, habitat, and stormwater capture.

13 Food and Agriculture Organization. (1986). Wildland Fire Management Terminology. Food and Agriculture Organization of the United Nations. FAO Forestry Paper 70, 257 p.  
14, 15, 16 Title 14 of the California Code of Regulations (14 CCR)





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## FOR MORE INFORMATION:

[www.scienceforconservation.org/science-in-action/wildfire-and-communities](http://www.scienceforconservation.org/science-in-action/wildfire-and-communities)

