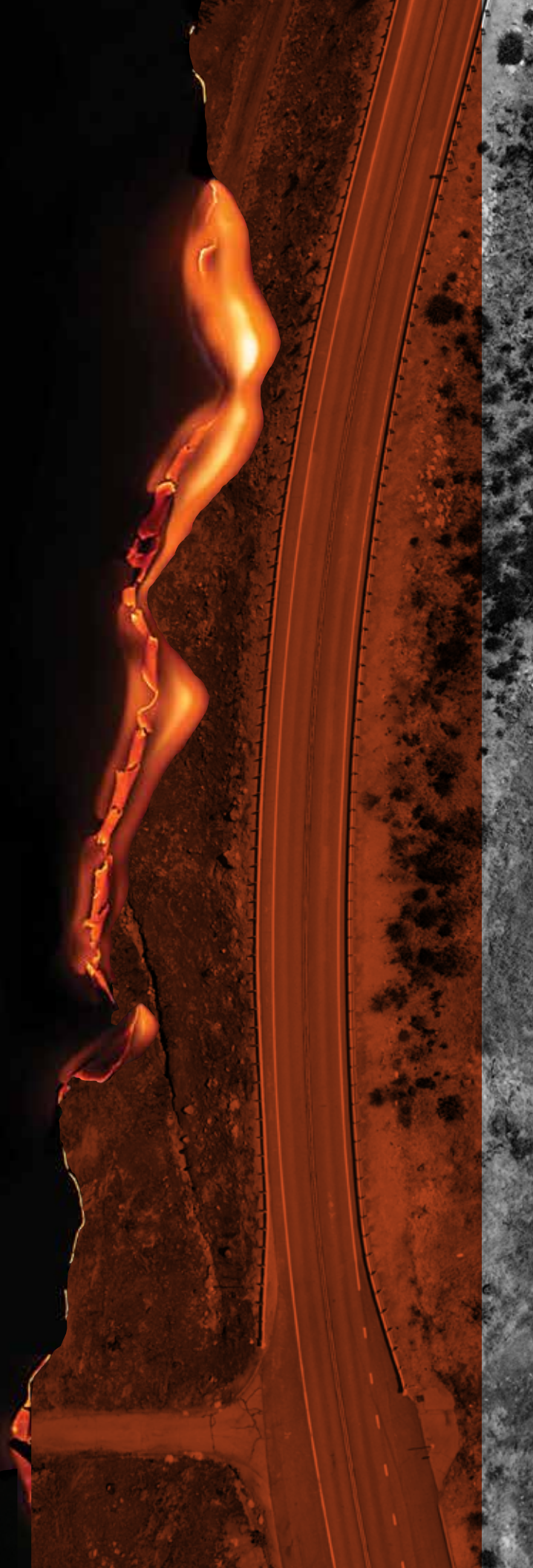




MITIGATING WILDFIRE RISK IN RIGHTS-OF-WAY

WITH AN INTEGRATED VEGETATION MANAGEMENT APPROACH





TABLE OF CONTENTS

01

INTRODUCTION

03

SECTION ONE | WILDFIRES : A NATIONWIDE PROBLEM

05

SECTION TWO | INFLUENCING THE FIRE TRIANGLE

06

SECTION THREE | USING A ZONE DEFENSE AGAINST WILDFIRE FUELS

09

SECTION FOUR | MANAGING ROW ZONES AND FUEL BREAKS WITH IVM

13

SECTION FIVE | CASE STUDY : PARK FIRE

18

CONCLUSION



Photo courtesy of Caltrans.



IN 2025, THERE WERE ALMOST 78,000 WILDFIRES IN THE U.S., 10,000 MORE THAN A DECADE AGO.¹

But it's not just the number of fires that poses a threat, it's the intensity. Since the turn of the millennium, wildfires have become up to four times larger and three times more frequent than in the 1980s and 1990s.² The amount of U.S. forest area burned doubled from 1984–2015.³ Today's wildfires are faster moving, harder to contain and more destructive than our country has ever seen. Trend data suggests that extreme fire events around the world will grow by 30% by 2050, and by 50% by the end of this century.⁴

HOW ARE WILDFIRES CHANGING?

THERE WERE 10,000 MORE WILDFIRES IN 2025 VS. 2015¹

FIRES TODAY ARE:



4X BIGGER



3X MORE FREQUENT SINCE THE 1980s & 1990s²

FROM 1984–2015, THE AMOUNT OF U.S. FOREST AREA BURNED DOUBLED.³

BY 2100: EXTREME FIRE EVENTS EXPECTED TO GROW BY 50%.⁴



At the intersection of natural areas and human activity are millions of acres of right-of-way (ROW) that must be managed to protect public safety and critical infrastructure. As the stewards of these acres, vegetation managers can play a vital role in mitigating wildfire risks. With the right approach, ROWs can be pivotal in holding the line against wildfire fuels.



The practice of integrated vegetation management (IVM) is proving to be perhaps the most valuable tool vegetation managers can deploy in this fight. Using a combination of mechanical, biological and chemical control methods, vegetation managers can reduce not only overall fuel load but specific types of fuel that contribute to hotter, faster fires.

This paper examines the growing wildfire risk across the U.S. and looks at practical examples of effective IVM approaches that are leading to fire mitigation success.





HOTTER, DRIER AREAS OF THE WESTERN U.S. HAVE ALWAYS EXPERIENCED MORE FREQUENT WILDFIRES.

In recent years, however, wildfires have become more common in geographies we don't traditionally associate with them — places like New Jersey, Maine, Wisconsin and Louisiana. That's because the climate is changing across the country.

CLIMATE FACTORS AFFECTING FIRE RISK AND INTENSITY



Warmer temperatures expedite evaporation of moisture that otherwise saturates the ground, soil and developing vegetation. Incompatible vegetation in ROWs can become increasingly flammable as it dries out.



Hotter nighttime temperatures reduce the natural cooling-off period and humidity that help tamp down fires.



Earlier snow melts leave forests drier for longer periods of time.



High winds contribute to fire spread, driving embers ahead of flames. In recent fires, embers have crossed mountain divides and miles of inflammable terrain.



"Whiplash weather," such as an unusually wet winter followed by a very hot summer, results in drier vegetation.

MANAGING RIGHTS-OF-WAY AND WILDFIRE RISK

“The fact is that we are having droughts in places that don’t normally have droughts,” explains Lawrence Kahn, Director of the Utility Vegetation Management Institute and an Adjunct Professor at Tulane University Law School. “As a result, vegetation that has grown accustomed to having lots of water becomes dry and brittle, and that’s fuel in the event of a fire.”



As fire threat migrates, it’s also coming into contact with more people and structures. Approximately 80% of the U.S. population lives in the East, where woody cover has increased by more 36% in the last 30 years — a factor directly correlated to an increase in large wildfires.⁵ In the South, forests are now denser with fuels, while droughts are becoming more frequent. A recent USDA Forest Service mapping project identified areas of significant fire risk in Florida, the Atlantic and Gulf coasts, and southeastern Texas.⁶ Just about everywhere, more people are building near forests and grasslands, creating areas of wildland-urban interface (WUI). And getting closer to nature isn’t just about aesthetics, urban sprawl or property values. Human beings are drawn to trees and plants. Kahn notes that numerous studies have found links between having trees nearby and positive effects on physical health, mental health and even rates of employment. Where people move, so does infrastructure. Power lines, pipelines, roads and more become part of the WUI, crossing through areas of increasing wildfire risk. By controlling the fuel load in these areas, vegetation managers can play a crucial role in helping to slow and even prevent wildfires.



Photo courtesy of Caltrans.



FIRE CAN ONLY HAPPEN WHEN THREE FACTORS ARE PRESENT: OXYGEN, HEAT AND FUEL.

Remove any one of these and the fire is extinguished.



Oxygen reacts with burning fuels to release heat and generate combustion products that strengthen flames.



Heat represents the source of ignition. In utility areas, downed lines are always a fire concern. In roadside ROWs, sources of ignition can be as big as a car fire or as small as a cigarette flicked from a window. Lightning, however, remains a major cause of wildfires, and researchers predict an increase in cloud-to-ground lightning strikes in coming years as a result of our changing climate.⁷



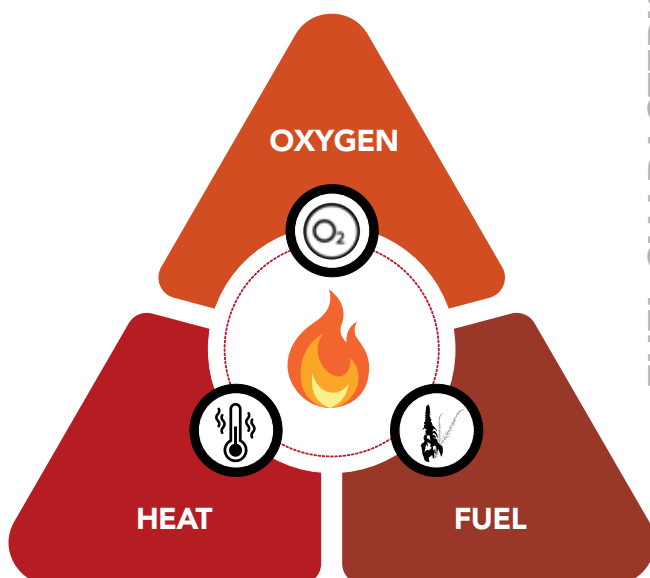
Fuel is the substance that burns. In ROWs, this can include grasses and broadleaf weeds, brush and trees. Of the three sides of the fire triangle, fuel is the one that humans can most reliably and predictably control.

THE FIRE TRIANGLE

Fire needs three things to ignite and continue burning: oxygen, heat and fuel. This is known as the fire triangle.



FUEL CHARACTERISTICS



GRASSES AND BROADLEAF WEEDS

- Ignite easily due to small size and thin, flat leaves
- Grow in dense arrangements, creating more fuel load
- Dry quickly
- Grow upright, allowing for easy spread

TREES

- Become stressed in high stem-density settings
- Under stress are vulnerable to drought/disease and insects — all can contribute to drying and flammability
- Contribute to long-distance fire spread when embers blow from tree crowns

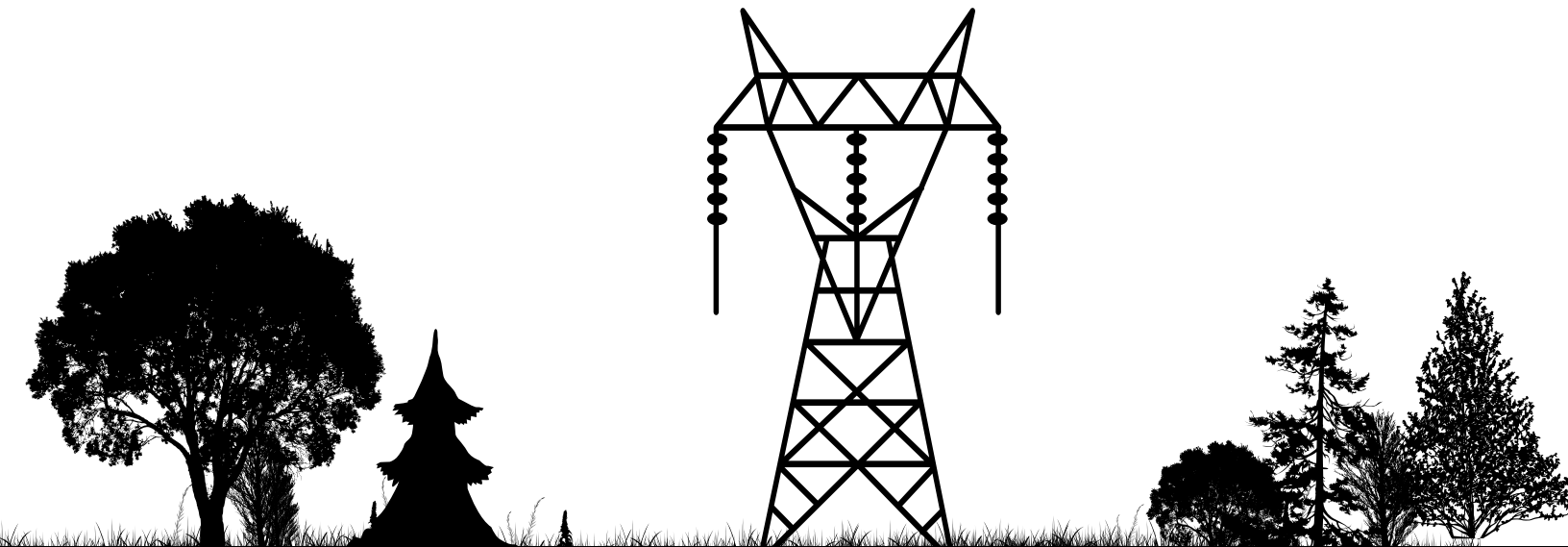
BRUSH

- Crowds out lower-growing vegetation
- May consume large volumes of water, contributing to drying out other vegetation
- Acts as ladder fuel, enabling fire to climb into tree crowns where it can spread rapidly

A ZONE APPROACH to vegetation management has traditionally been about avoiding service interruptions and safety issues. But when this concept widens to look at incompatible species that are fire prone or add to fuel loads, it can also be very useful in mitigating wildfire risks. In this way, a zone approach can accomplish multiple goals.



WIRE ZONE — BORDER ZONE METHOD



BORDER ZONE

Areas adjacent to natural forests

- Managed for low to medium-sized shrubs

WIRE ZONE

Managed for grass, forbs and low shrubs compatible with power lines

BORDER ZONE

Areas adjacent to natural forests

- Managed for low to medium-sized shrubs

FIRE MITIGATING BENEFITS OF IVM

Control weeds that can ignite easily

- Reduce brush that can serve as ladder fuel

- Encourage growth of fire-resistant native vegetation

Control fast-burning grasses

- Remove ladder fuels

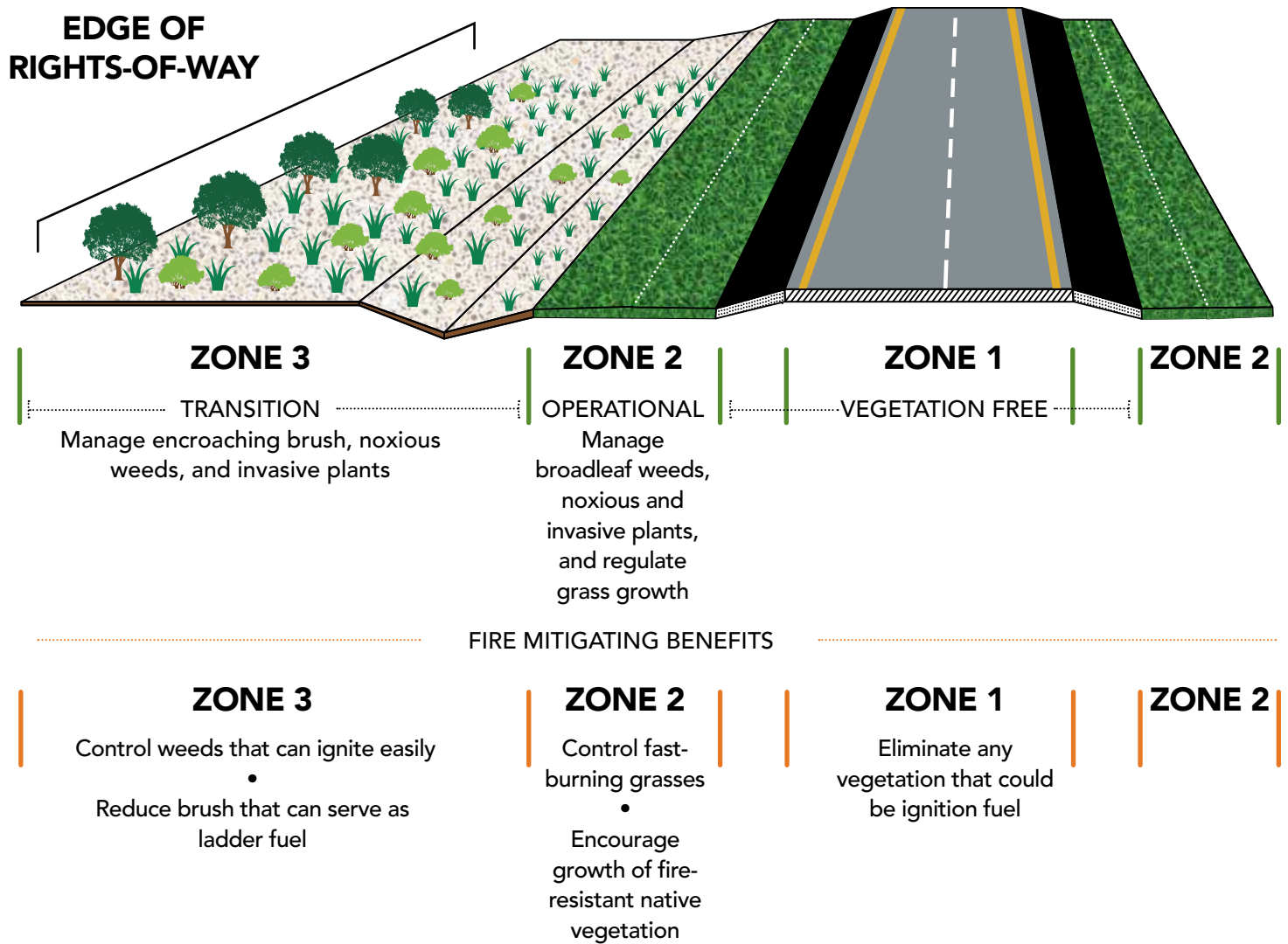
Control weeds that can ignite easily

- Reduce brush that can serve as ladder fuel

- Encourage growth of fire-resistant native vegetation



ROADSIDE ROW VEGETATION MANAGEMENT BY



BEYOND THE ZONE: SHADED FUEL BREAKS

At the edges of ROW zone areas, there is still more opportunity to influence wildfire fuel load. Located in forested areas, shaded fuel breaks can also be critical to slowing down wildfires. In shaded fuel breaks, the focus is on removing ladder fuels and thinning trees to create lower stem density. Ladder fuel removal also helps encourage growth of lower-growing native vegetation. Although no vegetation is fireproof, native, low-growing vegetation tends to burn less quickly than invasive grasses or brush.

**FIRE-RESISTANT VEGETATION**

- * Native ground cover plants
- * Wildflowers
- * Shrubs with wide branch spacing
- * Deciduous trees
- * Look for vegetation with leaves that are supple or hold water



**SCOTCH
BROOM**



BLACKBERRY



**DEER
BRUSH**



MANZANITA



**OAK
RESPROUTS**



CHEATGRASS

The fire mitigation effects of native vegetation can be enormous. Fire-resistant vegetation can help keep heat down, preventing nearby trees from catching fire. It can also lower the overall fire intensity and keep it in a more defined space, making it easier for firefighters to control.



ONCE THE VEGETATION MANAGEMENT NEEDS

of various zones and shaded fuel breaks are identified, the question becomes how best to control the unwanted vegetation in each area.

Traditionally, mechanical or manual methods have been the go-to for maintaining ROWs, but these techniques can have varying results.

Mowing provides a neat appearance and helps with managing low-growing weeds, but it can also encourage the spread of weed seeds. Because it isn't selective, mowing cuts down both desirable and unwanted vegetation. Cutting and removal is often used to tackle brush and thin trees. This process is labor intensive, and if cuttings are not removed, they add to wildfire fuels. All of these mechanical methods must also be performed regularly to stay on top of regrowth.

IVM provides a more flexible option that lets vegetation managers use multiple methods of control to achieve lasting results that contribute to operational and fire mitigation goals.

PUTTING IVM TO WORK IN ROW

IVM uses a combination of practices to help control unwanted vegetation.

These methods include:

-  **MECHANICAL / MANUAL** — MOWING, LOPPING, CUTTING, MASTICATION
-  **CULTURAL** — INTRODUCING DESIRABLE NATIVE VEGETATION, MULCHING
-  **BIOLOGICAL** — GRAZING ANIMALS, PLANTING DESIRABLE VEGETATION
-  **PRESCRIBED BURNS** — STRATEGICALLY PLANNED FOR FUEL REMOVAL
-  **CHEMICAL** — USE OF SELECTIVE HERBICIDES

Selective herbicides can be used on their own or as effective partners with any of the other methods, helping to extend control and reduce maintenance labor. Here are some of the ways an IVM approach that incorporates selective herbicides can be used to manage various ROW vegetation needs.

IVM FOR TOTAL VEGETATION CONTROL*ROW USE CASE EXAMPLES: UTILITY SUBSTATIONS, ROADSIDES ZONE 1*

For bare ground areas, IVM may involve cultural methods, such as placement of weed mats or gravel, along with applying a mix of herbicides that provide fast knock-down and lasting residual control. Carefully consider herbicide selectivity and safety profiles to protect waterways and nearby trees — including roots that may run underneath treatment areas.

IVM FOR GRASS AND BROADLEAF CONTROL*ROW USE CASE EXAMPLES: UTILITY WIRE ZONES, ROADSIDES ZONE 2*

Selective herbicides may be used solely in these areas or as a follow up to maintain a mowed landscape and reduce re-sprouts from weed seed spreading. Preemergent herbicides can be particularly useful in these zones, where they can usually be applied at lower use rates to prevent weeds from germinating.

Once weeds are under control, cultural methods might be used to encourage growth of native grasses and forbs. In these cases, look for a herbicide that works on targeted weed species and with proven safety on beneficial low-growing vegetation. Ideally, over time, the area will require less and less maintenance as native plants — which are also more fire-resistant — move into the area. When prescribed burns are used to control invasive grasses, selective herbicides can be used after a burn to keep unwanted vegetation from re-sprouting.



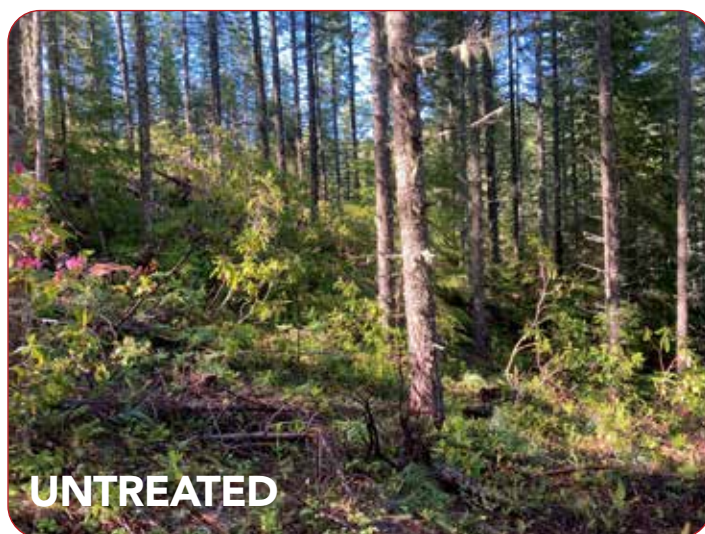
Photo courtesy of Caltrans.



IVM FOR BRUSH CONTROL

ROW USE CASE EXAMPLES: UTILITY BORDER ZONES, ROADSIDES ZONE 3

Brush control often requires initial mechanical removal, which can be supplemented with selective herbicide treatment. Cut-stump treatments and basal bark applications help keep brush from re-growing. Long-residual herbicides can provide a year or more of activity, reducing maintenance labor and providing peace of mind that ladder fuels are under control. Look for herbicides that won't damage trees or other desirable vegetation in the area and check the riparian profile of any products if the application is near water.



These comparison views of a shaded fuel break trial area near Sweet Home, Oregon, show how selective herbicide treatment helps control brush while maintaining low-growing, native vegetation.

IVM FOR SHADED FUEL BREAKS

ROW USE CASE EXAMPLES: FOREST BORDERING ROWS, FIRE ACCESS ROAD BORDERS

In shaded fuel breaks, it may be necessary to control multiple types of vegetation, including trees, brush, invasive weeds and grasses. IVM has proven successful in controlling unwanted vegetation in these areas while encouraging development of more fire-resistant species, such as wildflowers, ground cover and low-growing shrubs that hold moisture. A recent Oregon State University study of a shaded fuel break in the Cascade Mountains found all of the IVM techniques tested “were effective in reducing fuels associated with live vegetation while allowing for low lying, native vegetation to develop.”⁸



This section of the study area utilized a combination of lopping and selective herbicide treatment for brush control. This approach provided 88% control at 12 months post treatment.⁹ (Photo courtesy of Dr. Scott Oneto.)

COMPARING IVM APPROACHES FOR MAINTAINING SHADED FUEL BREAKS⁹

A recent study conducted by the University of California Cooperative Extension shows how IVM can be helpful in maintaining fuel breaks. The Mitchell Mine fuel break was created in 2018 using a combination of mastication, hand thinning and pile burning. By 2023, this 10-mile break had substantial vegetation regrowth. The researchers tested numerous treatment methods on a portion of this fuel break to determine “which were the most economical, efficient and effective at controlling plant regrowth.” The study looked at the use of lopping, flaming, grazing by sheep and goats, and use of herbicides. Areas were reexamined 12–16 months after treatment. The researchers reported that each method had its pros and cons. Grazing, for example, was highly effective but requires access to livestock. Flaming was relatively inexpensive per acre but demonstrated poor long-term control. Herbicide-only strategies, tested using a variety of application techniques (spot spraying, broadcast, etc.), were effective and economical. However, **IVM approaches combining mechanical removal and herbicides proved successful** across multiple study criteria. One test area that used both lopping and herbicide application provided 88% control one-year post-treatment.



On a stretch of highway in northern California, a coordinated approach to ROW vegetation management and shaded fuel breaks virtually stopped a fire in its tracks, protecting infrastructure and homes.

California leads the nation in wildfires, so it's no wonder they are also on the leading edge of approaches to help reduce them.

However, even here, looking at vegetation management as a fire mitigation strategy is relatively new. Kris Mitchell, Caltrans Vegetation Manager for District 3, learned first-hand how IVM-managed fire breaks can be a game-changer when wildfires strike.

In District 3, Mitchell oversees vegetation management for roadsides across 11 counties in the northern part of the state. Like most maintenance teams, Caltrans crews traditionally focus on the most typical hazards in ROWs. “Our spraying crew would manage a 10-foot bare ground swath for things like dragging chains and cigarette butts that could start fires, and our tree crew focused on trees that could fall onto the roadway,” Mitchell explains. “Our main approaches to IVM are mechanical, manual and chemical.”

In 2021, Caltrans started a fuels reduction effort, initiating projects to create shaded fuel breaks near roadways. By 2023, District 3 had completed a fuels removal project along a 15-mile stretch of Highway 32 in Butte County. The project created a bare ground fire prevention strip as well as a shaded fuel break.



HIGHWAY 32 FUEL REDUCTION PROJECT AREA

Map showing the fuel reduction work along Highway 32 between Chico and Forest Ranch in Northern California. The insert highlights where the project corridor was located in the Sierra Nevada foothills.

(Map courtesy of Caltrans.)

That winter, heavy snows damaged a number of pine trees in the project area. Caltrans crews came in the following spring to remove downed trees that could be roadway safety hazards and/or wildfire fuel. As part of their IVM approach, they employed both masticators and herbicides. “We tend to use a combination of Vastlan and glyphosate,” Mitchell explains. This maintenance work would turn out to be timely.

In July of 2024, a man rolled a burning car into a ditch off Upper Park Road in the town of Chico. This careless act ignited the Park Fire, which stretched across Butte and Tehama Counties. The Park Fire scorched more than 400,000 acres — but not the area that had been maintained as a shaded fuel break in District 3.

As seen in post-fire photos and videos, the shaded fuel break stopped the spread of flames, sparing residences on the other side of the road. “There were some homes lost in the fire,” Mitchell says, “but it was significantly less damage than we could have had.” The shaded fuel break also protected Caltrans infrastructure. Mitchell notes, “Our guardrails, signage — all of it made it through the fire.”

View of Highway 32 in Butte County, California, following the Park Fire in 2024. The fire stopped at the shaded fuel break (left side of image). (Photo courtesy of Caltrans.)



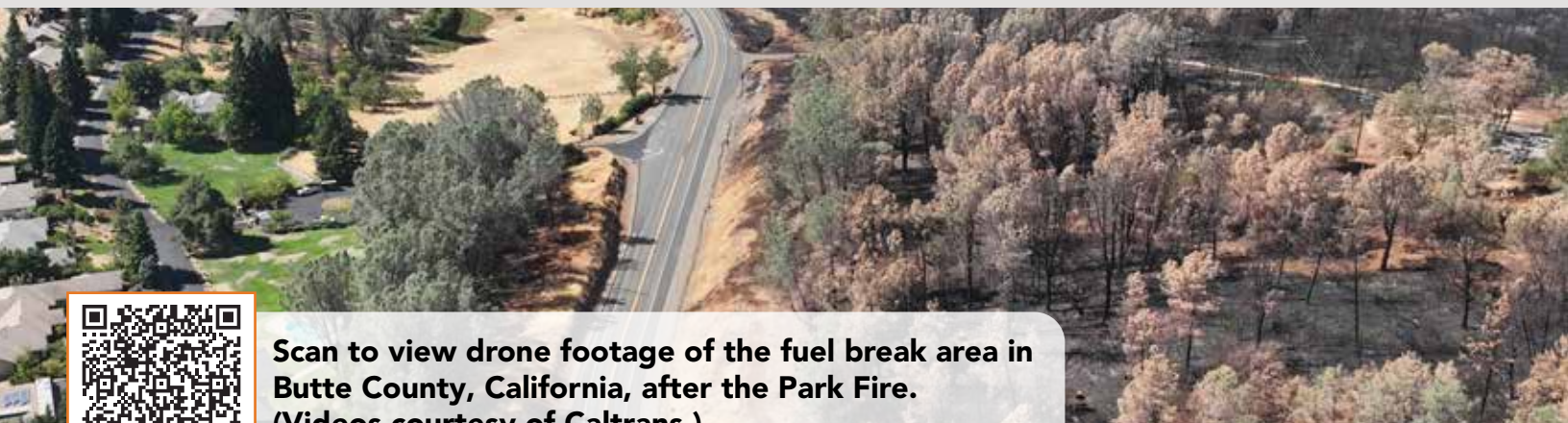


WHILE THE VISUALS ARE DRAMATIC, Mitchell says they simply demonstrate how well a properly maintained fuel break can work. “I wasn’t surprised that it worked, but I was awestruck by seeing the benefits of doing this work,” Mitchell says. “It was almost a textbook example of why we do what we do.”

Caltrans has since expanded its shaded fuel break efforts. Using data from CalFire, California Community Wildfire Protection Programs (CWPP) and other agencies, they have created overlay maps that identify ROWs that rate “very high” for fire risk as well as evacuation routes that must be protected. These areas are prioritized for using IVM to create and maintain fire prevention strips and shaded fuel breaks. Their success with shaded fuel breaks is changing the way Mitchell and her colleagues look at their vegetation management work in every ROW.

“We’re looking past the initial 20 feet or so of invasive weeds, bare ground and hazard trees,” she says. “If there’s a dead tree all the way at our right-of-way line, we’re thinking about it differently. It may or may not strike the roadway, but we are asking ourselves: Can we thin these areas out? Can we remove the deadwood? Can we lift the ladder fuel? We’re looking at the whole area now.”

Park Fire damage along Highway 32, viewed from the opposite direction. Thanks to the shaded fuel break, the fire did not jump the road, protecting the houses seen on the left. (Photo courtesy of Eric Cummings.)



Scan to view drone footage of the fuel break area in Butte County, California, after the Park Fire. (Videos courtesy of Caltrans.)

“I was awestruck by seeing the benefits of doing this work. It was almost a textbook example of why we do what we do.”

— Kris Mitchell, Caltrans Vegetation Manager for District 3

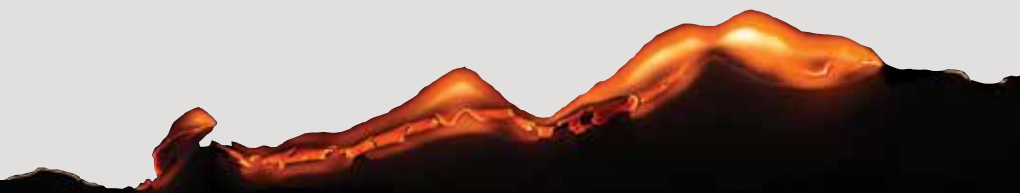
EXPANDING PARTNERSHIPS

Other organizations are taking notice and looking to change their fuel management practices, too. “More and more people are getting on board with the work that needs to be done and then connecting with us,” Mitchell says. This includes businesses like Sierra Pacific Industries, government agencies such as the Bureau of Land Management and U.S. Forest Service, and various conservancy groups. “They are reaching out to partner with us, asking us to increase the footprint of the work we’re doing and even asking permission to come on our rights-of-way to do fuels reduction,” she says. “We’re looking at this and saying, ‘Yes! Where do we sign up?’”

Even partners that are typically reluctant to allow herbicide use are becoming more convinced by the results of IVM in fuel break projects. For example, use of herbicides on U.S. Forestry Service land requires a special pesticide use proposal (PUP). “I recently got a PUP for the first time ever up on [Highway] 49, an area where we’ve never been able to spray,” Mitchell says. “We’ve got permission to spray about a six-mile stretch for fuels reduction and brush control.”

Homeowners are also becoming more agreeable to the idea of shaded fuel breaks. Mitchell acknowledges that the aesthetics of shaded fuel breaks aren’t always appealing to residents who like the look of a dense forest. But the practical benefits are hard to argue against. Having more defensible area around your home helps improve safety and can lower insurance rates.

“We’ve had times when we’re working on an area that backs up to someone’s property and they’ll come out and say, ‘Hey can you come on down to my area too?’” Mitchell says. “Each year it’s getting a little bit easier to convince people to let us do the work.”



TIPS FOR CREATING A SUCCESSFUL ROW FUEL BREAKS INITIATIVE



Kris Mitchell, Caltrans District 3 Vegetation Manager, shares a few best practices for creating and sustaining a program that combines ROW maintenance and fire mitigation.



HELP YOUR TEAM BECOME INTEGRATED VEGETATION MANAGEMENT EXPERTS.

Recognize that not everyone working on your ROW team has a background in vegetation management. Some may have backgrounds in maintenance, landscape architecture, environmental science or other disciplines. Make sure everyone understands the goals of vegetation management and how IVM helps. In California, there's even an initiative underway to create a vegetation management course in cooperation with a community college.



CREATE TEAMS WITH VEGETATION MANAGEMENT PLAN LEADERS.

While maintenance crews are in the weeds (quite literally), plan leaders keep the big picture in mind, balancing the many needs of ROW maintenance for operational, safety, aesthetic and fire prevention goals.



TALK TO FORESTERS IN YOUR AREA.

These experts will have a different perspective on fuel management. Visit with them in the field. Ask what your crews should be watching for in fuels management. Ask for their tips on techniques for thinning and maintenance.



SEEK OUT PARTNERSHIPS.

Fires don't obey property lines. Shaded fuel breaks may need to overlap areas managed by other stakeholders. Help them understand the benefits of shaded fuel breaks and encourage working together to improve fire mitigation.



SHARE KNOWLEDGE.

A private company may be employing a new technique you can learn from. A government entity may benefit from learning more about your experience with selective herbicides. Look for opportunities to work with researchers who can help quantify best practices.

FROM THE CASCADES AND SIERRAS to Appalachia and the Atlantic coast, wildfires are a growing threat. In every region, wildfire incidence is less a question of “if” than “when.”

For busy vegetation managers, adding fire mitigation to the list of ROW maintenance tasks may feel daunting. The good news is that IVM techniques — many of which are already widely deployed for ROW vegetation management — are also highly useful for reducing wildfire risks.

When combined with a zone approach tailored to the vegetation management needs of each area, IVM techniques, including use of selective herbicides, can help reduce fuel loads and maintain landscapes where fire stays closer to the ground and remains less intense. Where ROWs border forests, shaded fuel breaks that are maintained to control ladder fuels provide defensible space where firefighters have a chance to get ahead of spreading flames and prevent further destruction.

Just as vegetation managers have come to see ROWs as an inherent part of the landscape for pollinators and wildlife, it’s also time to consider the vital role ROW management can play in wildfire mitigation. IVM with selective herbicides can be an economical and effective route to operational, aesthetic, ecological and fire mitigation goals for ROWs, wherever they are managed.



Photo courtesy of Caltrans.



¹ “Wildfires and Acres,” National Interagency Fire Center, accessed March 26, 2026, <https://www.nifc.gov/fire-information/statistics/wildfires>.

² Virginia Iglesias, “LA fires: Why fast wildfires and those started by human activities are more destructive and harder to contain,” PreventionWeb, January 13, 2025, <https://www.preventionweb.net/quick/92047>.

³ National Oceanic and Atmospheric Administration. “Wildfire Climate Connection,” Last modified July 24, 2023, <https://www.noaa.gov/noaa-wildfire/wildfire-climate-connection>.

⁴ “Are Wildfires Increasing or Decreasing in the U.S.?” Western Fire Chiefs Association, Edited September 17, 2024, <https://wfca.com/wildfire-articles/are-wildfires-increasing-or-decreasing-in-the-us>.

⁵ M.A. Ivey et al., “Woody Cover Fuels Large Wildfire Risk in the Eastern U.S.” *Geophysical Research Letters*, 51 (2024), <https://doi.org/10.1029/2024GL110586>.

⁶ Kalen Breland, “A new ‘geography of fire’ defines southern wildfire risk,” USDA Forest Service, May 13, 2025, <https://research.fs.usda.gov/srs/articles/new-geography-fire-defines-southern-wildfire-risk>.

⁷ Dmitri A. Kalashnikov et al., “Projections of lightning-ignited wildfire risk in the western United States,” *Earth’s Future*, 13 (2025), <https://doi.org/10.1029/2025EF006108>.

⁸ “Research Report: Fuel Load Evaluations for Shaded Fuel Break Treatments—Corteva and Cascade Timber Consulting Fuel Reduction Trial 2023–2024,” Oregon State University Department of Forest Engineering, Resources and Management, February 2026.

⁹ Scott Oneto and Brian Allen, “Techniques for Controlling Brush After Mastication,” University of California Cooperative Extension, May 2025.



@CortevaVegMgmt



@Corteva U.S. Vegetation Management

To find your local Land Management Specialist
visit vegetationmgmt.com/specialist

Visit us at vegetationmgmt.com

™® Trademarks of Corteva Agriscience and its affiliated companies. Vastlan® is not registered for sale or use in all states. Contact your state pesticide regulatory agency to determine if a product is registered for sale or use in your state. Always read and follow label directions. © 2026 Corteva. VM - 37224 COR (05/26)

