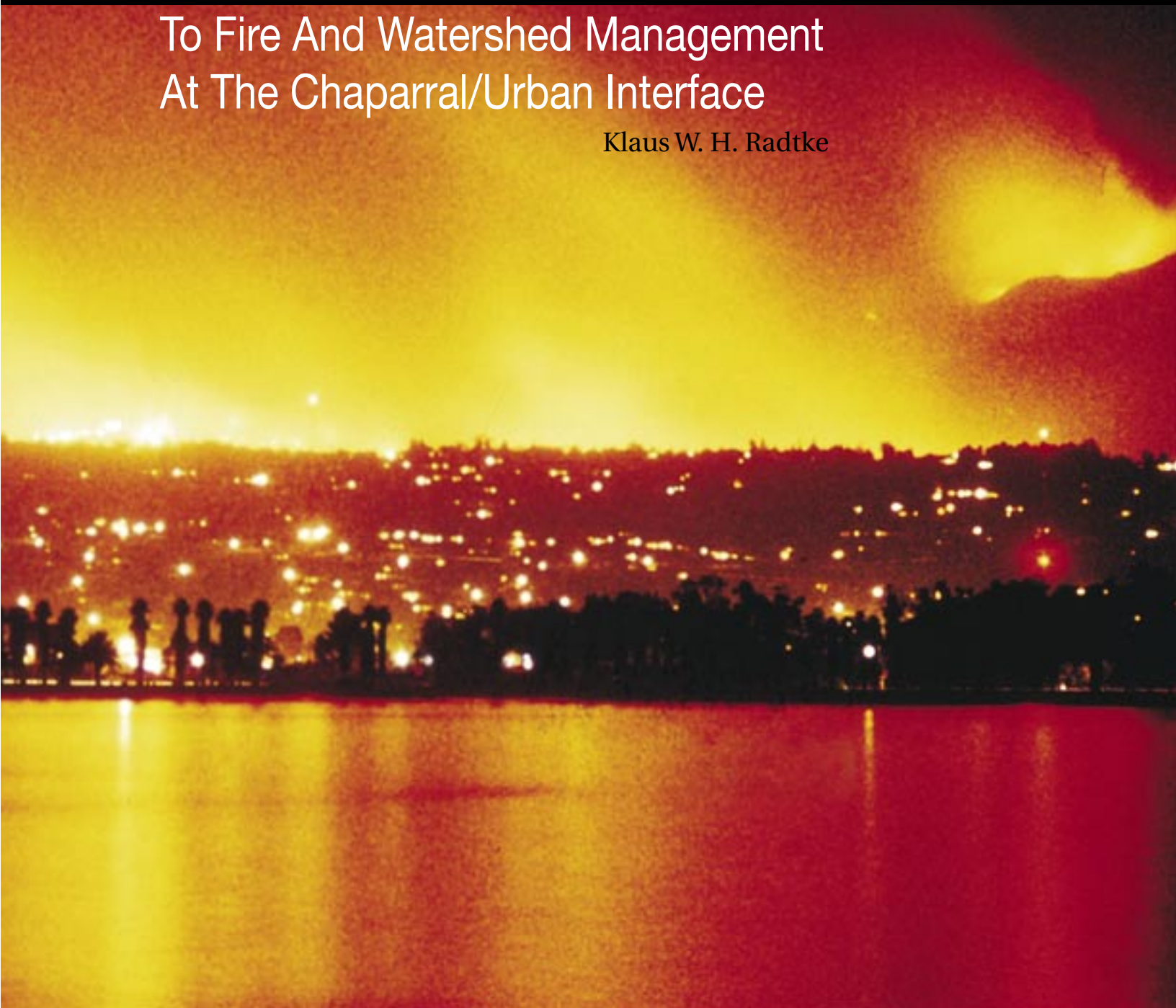


# *A Homeowner's Guide*

To Fire And Watershed Management  
At The Chaparral/Urban Interface

Klaus W. H. Radtke





## Background

From the early 1970s to the early 1980s, I supported, conducted, and spearheaded research projects on urban-wildland interface fire and watershed management problems under Cooperative Chaparral Research and Development Agreement 21-436 and related research programs carried out by scientists of the Riverside Forest Fire Laboratory of the Pacific Southwest Forest and Range Experiment Station, Forest Service, with the County of Los Angeles as a cooperator. The research was geared towards producing practical guides for homeowners as well as resource professionals. By the late 1970s I had completed the wildland fire prediction mapping for the Santa Monica Mountains of Los Angeles County. Working closely with Riverside Fire Laboratory and University of California, Berkeley scientists, I applied the wildland fire behavior and prediction research spearheaded by the U.S. Forest Service Missoula Fire Laboratory to watersheds in urban interface areas in an attempt to balance effective watershed management and fire protection. By 1980 a draft publication had been completed titled *Living More Safely in the Chaparral/Urban Interface*. It had received peer reviews by over 20 scientists and resource professionals and was presented as a prepublication information copy by the Forest Service at the international conference and symposium, Dynamics and Management of Mediterranean-Type Ecosystems, held in June 1981 in San Diego.

While this unabridged version was being prepared for publication (Forest Service General Technical Report PSW-67), representatives of the Los Angeles County Board of Supervisors requested that a publication on watershed and fire safety be made available to the general public by the beginning of the 1982 fire season. In close cooperation with Forest Service scientists, I therefore produced an abridged version of PSW-67 titled *A Homeowner's Guide to Fire and Watershed Management at the Chaparral/Urban Interface*. It was almost immediately republished by the Santa Monica Mountains Residents Association under its original title and distributed to this date, and also republished separately many more times by the County of Los Angeles as *Homeowner's Guide to Fire and Watershed Safety at the Chaparral/Urban Interface* with minor changes to fit their needs. Being in the public domain as it was intended to be, excerpts of it have been widely used over the years by many authors and agencies as part of their own books or

pamphlets. This practice should continue with this updated publication by making it available for downloading on the Internet. It is based on and updates the original June 1982 homeowner's guide at the request of and with the cooperation of the San Diego Fire Recovery Network formed in San Diego after the 2003 wildland fires. For additional information and literature references, please also refer to PSW-67.

A more technical publication, *Living in the Chaparral of Southern California: An Integrated Approach to Public Safety*, was published in 1985 by the National Foundation for Environmental Safety in cooperation with the National Park Service, Santa Monica Mountains National Recreation Area. It is a natural extension of the two publications *Living More Safely...* and *A Homeowner's Guide...* and summarizes the proceedings of the conference and workshop held at the Los Angeles County Museum of Natural History on October 20, 1984. As program organizer, I coordinated the presentations of experienced professionals in their fields that included such wide-ranging subjects as Land Use and Planning, Development and Public Safety, Wildland Fire and Watershed Management, Flood and Erosion Control, Geology, Fire Ecology, Insurance Coverage & Cost, Disaster Preparation & Assistance, and Disaster Psychology.

Klaus Radtke, Ph.D.  
Wildland Resource Scientist  
October 15, 2004

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# Introduction

Several guides and booklets have been written to help the homeowner deal with particular aspects of living in the fire-prone wildlands of the Pacific Southwest. Until the 1982 publication ***A Homeowner's Guide to Fire and Watershed Management at the Chaparral/Urban Interface***, none had given homeowners comprehensive advice on managing their properties effectively so as to reduce the chances of wildfire and mudflow disasters and the hardships, both personal and financial, they bring. The 1982 publication was subsequently identified by the Wildfire Safety Panel investigating the disastrous November 2, 1993 Malibu/Topanga Fire as the basis for developing definite guidelines for vegetation management plans in Los Angeles County. This panel and other post-fire disaster panels such as the San Diego Fire Recovery Network have also time and again acknowledged that continuous education programs are necessary to mitigate hazardous situations.

This revised and updated book attempts to further such an ongoing education process by providing advice in a practical, nonscientific, yet professional manner, through basic principles and guidelines. It is also based on and contains excerpts from the 1983 PSW General Technical Report *Living More Safely in the Chaparral-Urban Interface*, a guide to hillside property management for

fire and watershed protection. Both publications were written by the same author under cooperative contracts between the Pacific Southwest Forest and Range Experiment Station (Forest Service, U. S.

Department of Agriculture) and the County of Los Angeles, with funding provided by the Forest Service. They also incorporated state-of-the-art knowledge in various wildland disciplines, and the experience gained by the author in dealing with fire and floods in his work and as a homeowner at the chaparral boundary.

This book first provides a brief description of the chaparral plant community, followed by sections describing some basic considerations of watershed and fire management. Later sections deal with improving safety around the home through home design, landscaping, and maintenance; evacuation and road closure, protecting oneself and one's property during a wildfire; providing emergency treatment of hillsides after a fire; and, finally, applying the lessons learned.

**For more comprehensive and area-specific fuel modification and public safety code requirements applicable to your community, please also consult planning departments, and fire protection and flood control agencies having jurisdiction there.**







# The Chaparral Plant Community

California's chaparral plant communities consist of many different woody shrubs and herbaceous species that have adapted over millions of years to frequent fires and extended periods of drought. The mixture of plant species in the chaparral communities varies with such factors as aspect and steepness of slope, soils, elevation, fire frequency, and local climate. Although California's climate causes chaparral vegetation to be especially subject to large devastating wildfires, similar plant communities and associated fire and watershed problems occur in other western states and other countries.

Chaparral communities are characterized by a rich diversity of plant species. Although no single characteristic is present in all chaparral species, several adaptations to the hot, dry climate commonly occur. For example, some species have thick leathery leaves that are small or even needle-like. This design helps the plants to tolerate severe summer drought. Other drought tolerance characteristics include waxy and hairy leaf surfaces and leaves that have a high aromatic oil content. Some plants become dormant and shed some or all of their leaves during prolonged drought. A deep, extensive root system, which increases drought tolerance and plant survival on steep slopes, is another characteristic common to many chaparral species.

Chaparral plants survive periodic fire by sprouting and by germination of seeds stimulated by the fire. Soon after burning, new sprouts grow from the roots and root crowns of many plants. Then, fall and winter rains trigger prolific germination of herbaceous species, often resulting in a colorful array of wildflowers in spring. Seeds of woody plants also germinate prolifically.



*After fire, chaparral recovers by means of seeds, sprouts, and bulbs.*

Plant species differ in their susceptibility to fire. Their age and physiological state (whether flowering or dormant, for example) also influence how well they burn. For chaparral-type vegetation in general, the most important factors influencing flammability and fire behavior are fuel moisture (the moisture content of living and dead plant material), fuel loading (the amount of plant material per unit area), and the ratio of fine dead fuel to living fuel.

Fuel moisture is high in winter and spring, but gradually decreases during the hot, dry summer months. The dead-to-live ratio, as well as the fuel loading increase, causing greater fire danger as plants mature and become old.





*Periodic fires rejuvenate the chaparral plant community.*

Fire history records indicate that plant succession patterns influence fire frequency in chaparral communities. Chances of having a second fire within the first few years after an area burns are high because of the large amount of herbaceous fuels such as grasses and flowering annual plants that follow the first burn. These plants readily become dry and carry a low-intensity fire. As the woody plants begin to dominate an area again, germination of the shorter-lived herbaceous species is inhibited. This greatly reduces fire danger for about the next 10 years because of the high proportion of live, succulent plant parts and the low proportion of fine dead plant material on the shrubs.

Fire frequency tends to be greatest in a subunit of chaparral called coastal sage vegetation. This specialized chaparral type is dominated by plants that tend to grow more herbaceous material each year than do woody chaparral shrubs. Plants and soil on south-facing slopes are drier than on north-facing slopes because they are exposed to more



*Five years later young woody plants have replaced the herbaceous species; at this stage they do not carry fire readily.*

direct heat from the sun. Species on these sites burn more readily than vegetation on cooler, wetter sites.

### ***Summary***

- 🔥 *Chaparral communities have adapted to summer drought, frequent fires, and steep unstable slopes.*
- 🔥 *Chaparral plants are able to recover after fire by sprouting and by fire-stimulated germination of seeds.*
- 🔥 *The flammability of chaparral vegetation depends on its moisture content, the ratio of dead-to-living fuel, and the amount of vegetation per unit area.*
- 🔥 *The stage of plant succession, as may be reflected by fuel loading and the severity of a site, affects the likelihood and intensity of a fire.*

# Watershed Management Considerations

A watershed can be defined as all the land and water within the confines of a drainage area. Its depth extends from the top of the vegetation through the soil to the underlying geologic strata that restrict water movement.

Chaparral soils and their underlying soil mantle can store great quantities of water. Rainfall intensities rarely exceed the soil infiltration rate of well-vegetated chaparral watersheds. Watershed problems occur when protective vegetation is removed, as by wildfire or land development.

The main objective in watershed management of chaparral lands is to maintain vigorous, multi-aged stands of vegetation, which can respond favorably to periodic disturbance (by fire). The main objective in homeowner watershed management is to maintain a dense cover of deep-rooted, healthy vegetation that will stabilize the watershed and control the flow of water from it. Soils engineering techniques, which are discussed in detail in *Living More Safely at the Chaparral-Urban Interface*, may also be necessary to control runoff and drainage.

In order to meet the various objectives, a watershed has to be managed as a unit and the erosional processes must be well understood. The first requirement means cooperation among property owners, the second is outlined below.



*A landslide in a residential area endangers homes.*

## Erosional Processes

Chaparral vegetation is commonly found on steep hillsides, even on slopes that exceed the angle of maximum slope. This angle, often called the angle of repose, is the steepest angle that bare soil will maintain. For most natural slopes and most soils, the angle of repose is about  $34^{\circ}$  (67%). Beyond this angle, soil and rocks are totally under the influence of gravity and may slide downhill unless anchored by plants. Vegetative cover, root depth, and root strength affect the extent to which landslides occur. Slope failures are much less common with deep-rooted vegetation than with grasses, and with dry soils than with soils that have been saturated by winter storms or overwatering.

Slopes of varying steepness are illustrated in Figure 1. The relationship between slope ratio, degree of slope, and percent slope is also presented.

Soil failures are most common on slopes ranging from 25° to 45° (49% to 100% or approximately 2:1 to 1:1), making proper management of such steep hillsides extremely critical. Beyond 45°, rockslides are the most common erosional processes. Dry creep, the downhill movement of dry soil and debris, is common on steep slopes with little vegetative cover. It often exceeds wet erosion during low rainfall years and is especially important after fire. The dry creep settles at the base of slopes where it waits to be flushed downstream and perhaps into homes by occasional storms of high intensity.

Soil slips and landslides account for almost 50% of the total erosion on a watershed. Unlike dry creep, these soil movements normally occur when the soil is saturated. They are readily visible and directly translate into financial losses to downstream as well as upstream homeowners. When heavy rains fall on hillsides left bare by fire or improper fuel management, the water cannot infiltrate rapidly enough into the soil, running instead over the soil surface and causing excessive erosion and swollen streams. The soil from the bare hillsides and the dry creep that has collected in the canyons then combine to create mudflow disasters.



*Steep slopes undercut by roads are especially susceptible to slips and slides.*

## Water-repellent Soil

Damaging fires not only burn the vegetative cover, but can also cause the soil to become hydrophobic (water repellent). Normally, slight water repellency of soils is caused by the breakdown of organic material and certain chemicals in plant litter. Hot fires accentuate this by concentrating these water-repellent chemicals. Some of the chemicals are volatilized by heat from the fire, resulting in gases that penetrate deeper into the soil. There the gases cool and condense, coating the soil particles with the water-repellent substances. Since rains cannot readily penetrate this layer of coated soil particles, water quickly saturates the shallow wettable surface layer. Sheet or rill erosion occurs after the surface layer is saturated. More information on hydrophobic soils is presented in the watershed management chapter of *Living More Safely at the Chaparral-Urban Interface*.



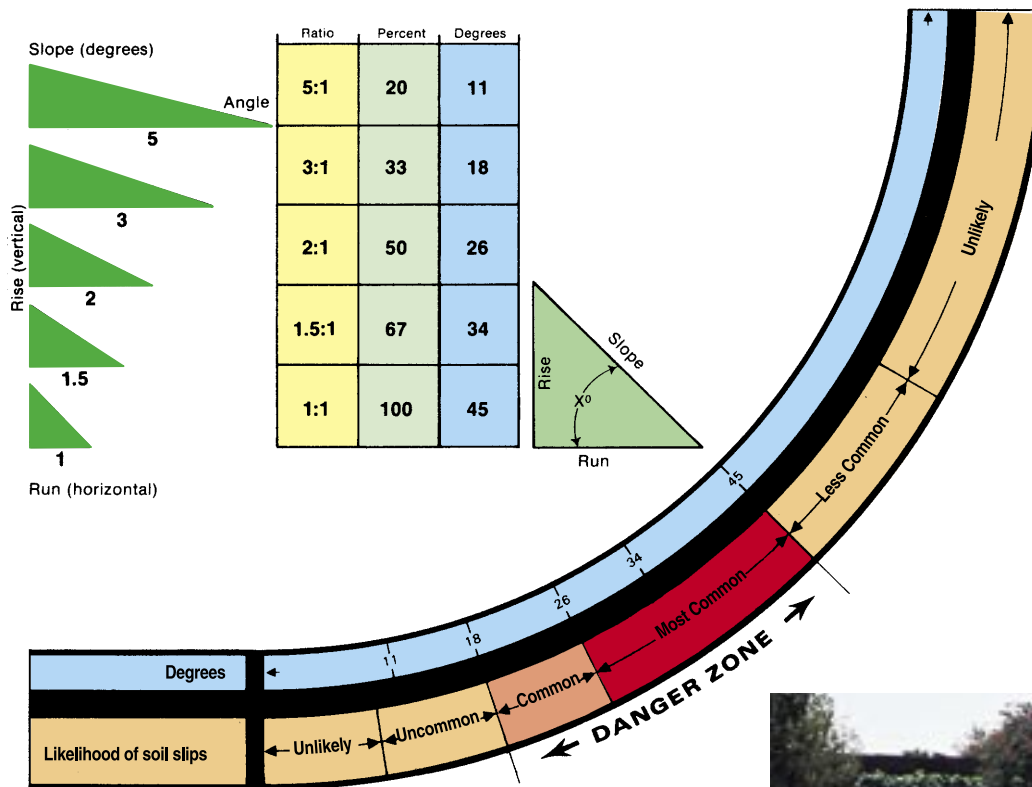


Figure 1. Slope ratio, percent slope, and degree of slope are shown for some hillsides of varying steepness. On natural slopes, the danger of soil slip failures is related to slope angles. The angle may be expressed as the ratio of run to rise, either as a percent (rise/run) or in degrees (angle between run and slope) (Campbell 1975).

## Summary

- Watershed management aims at maintaining a deep-rooted, dense cover of healthy plants.
- Such a plant cover controls surface erosion and reduces slippage by anchoring the soil.
- Deep-rooted plants pump water out of the soil, leaving it free to absorb winter rains.
- Most post-fire mudflow originates from debris accumulated in canyons by previous surface erosion, soil slips, and landslides.
- Fire can accentuate the water repellency of soil.



A steep backyard fill slope has failed, creating great financial hardship for the affected homeowner.





# Fire Management Considerations

Wildland fire management attempts to predict and control fire behavior by managing vegetative fuels to control flame length, rate of spread, heat intensity, and the potential for spot fires.

## Fire Factors

Wind is an important element affecting fire behavior. Wind not only controls the direction, spread, and size of a fire, but also greatly affects the flammability of plants by reducing fuel moisture, preheating the plants, and bending the flames ahead of the fire. Wind is also responsible for spreading firebrands (burning embers) even thousands of feet ahead of a fire front and starting new fires whenever these firebrands land on receptive vegetative or structural fuels. Dry grasses and wood shingle roofs are often the most likely fuel sources to almost immediately start new spot fires.

Most major wildfires occur during extreme fire weather brought on by the warm Santa Ana or foehn winds. With the onset of these winds, which blow from the north or east, temperatures increase rapidly, even into the night, and relative humidity declines drastically. Under such conditions, fires in mature chaparral cannot be controlled unless the fuels are exhausted.



*Even in light fuels, convection currents in steep terrain can create long flames that can ignite a house.*

Topography is also a critical factor in fire safety. It affects windspeed and direction, and is responsible for differences in heat radiation and fire spread. The most important topographic effect to remember is that fire spreads much faster uphill than downhill.

## Ignition

A fire is the flame, heat, and light caused by burning (oxidation) after an object has reached ignition temperatures and has been ignited. Ignition temperatures are influenced by the rate of airflow (supply

of oxygen), rate of heating, and size and shape of the object. Once ignition has occurred, sustained combustion requires a continuous supply of oxygen and fuel.

Wildland fuels, such as grasses, coastal sage scrub, chaparral, and trees, have various ignition requirements, which depend largely on their moisture content and size. For example, dry grass has the lowest heat requirement for ignition, and grassy areas therefore have the highest fire frequency. Woody chaparral shrubs in coastal areas normally do not become dangerously dry until late summer or fall except under severe drought conditions.

## Heat Sources

Heat transfer is by conduction, convection, and radiation. The flame is the visible burning gas and vapor produced by the fire and provides (along with airborne sparks) a direct ignition source for fuels that have reached ignition temperatures.

Conduction is the direct transfer of heat by objects touching each other. An example would be the transfer of heat from a stack of burning firewood to the side of the garage against which it is stacked.

Convection heat is the transfer of heat by atmospheric currents and is most critical under windy conditions and in steep terrain. With light wind and on level terrain, the



*This burning mountain shows that houses situated on ridges and sideslopes are extremely vulnerable to fire.*



convection heat column is almost vertical. Reducing the duration of heat and length of flames produced by nearby vegetation can be critical to protecting your home from fire. Flame length in chaparral fuels can be reduced by maintaining low growing, widely spaced plants. For example, on steep slopes, 30-foot-long convection heat flames can occur in 6-foot-tall mature chaparral at wind speeds of less than 10 miles per hour. Reducing the vegetation to 2 feet in height would reduce the flames to 10 feet. When wind speed increases to 50 mph, as it often does during extreme Santa Ana weather conditions, the flame length for 2-foot-tall non-maintained continuous woody fuels with a high dead-to-live fuel ratio increases to 35 feet and for 6-foot-tall fuels to more than 100 feet.

Radiation heat is the transfer of heat by electromagnetic waves and can, therefore, travel against the wind. For example, it can preheat the opposite side of a burning slope in a steep canyon or a neighboring home to the ignition



*Fine dead fuels in the interior crown make many broad-leaved trees flammable.*

point. Again, it can be predictably managed if you are in control of your situation as the following landscape examples illustrate. For a point source of radiation, the heat intensity decreases with the square of the distance. This means that a burning tree 40 feet from a roof or picture window transfers only one-fourth of the heat to the house compared with a tree burning within 20 feet, and one-sixteenth the heat compared with a tree burning within 10 feet. A line source of radiation such as a burning hedge of junipers or cypresses is even more critical than a single point source because the house receives a broad expanse of heat from all points along the line. In this case, heat intensity varies with the distance instead of the square of the distance, so that the heat intensity at a home located within 40 feet of the burning hedge is still one-half that at 20 feet. This is a powerful incentive not to plant potentially flammable hedges or hedge-like “groundcovers” near structures, as well as keeping flammable shrubs and trees as far away from your house as possible.



*Conifers generally are also highly flammable and produce long flames.*

The interaction of the three types of heat transfer with topography can be illustrated by visualizing a burning match as shown in Figure 2. When the match is held head up, heat transfer is by conduction only, and the match burns slowly. The situation is comparable to a wildfire burning downhill. If the match is held horizontally, heat transfer is by conduction and radiation, and the match burns a little faster. When the match is held head down, it is consumed rapidly because conduction, convection, and radiation heating are occurring together. The situation is comparable to a wildfire burning uphill.

The duration of heat transfer can also be a critical factor. For example, the time period for heavy chaparral fuels to be consumed may be more than 10 minutes, but if the continuity and height of such fuels are reduced and the fine dead fuels removed, the duration of the flame and its associated heat can often be shortened to seconds. Thus, a yard tree, which may take many minutes to burn, may represent a greater hazard to a home than nearby discontinuous, well-maintained chaparral.

### Summary

- 🔥 *Wildland fire management includes modification of the size, arrangement, and kinds of vegetative fuels.*
- 🔥 *Vegetation modifications reduce the ignition potential, flame length, and heat output of a fire.*
- 🔥 *Heat transfer methods (conduction, convection, and radiation) vary in their contributions to a fire depending on wind and topography.*

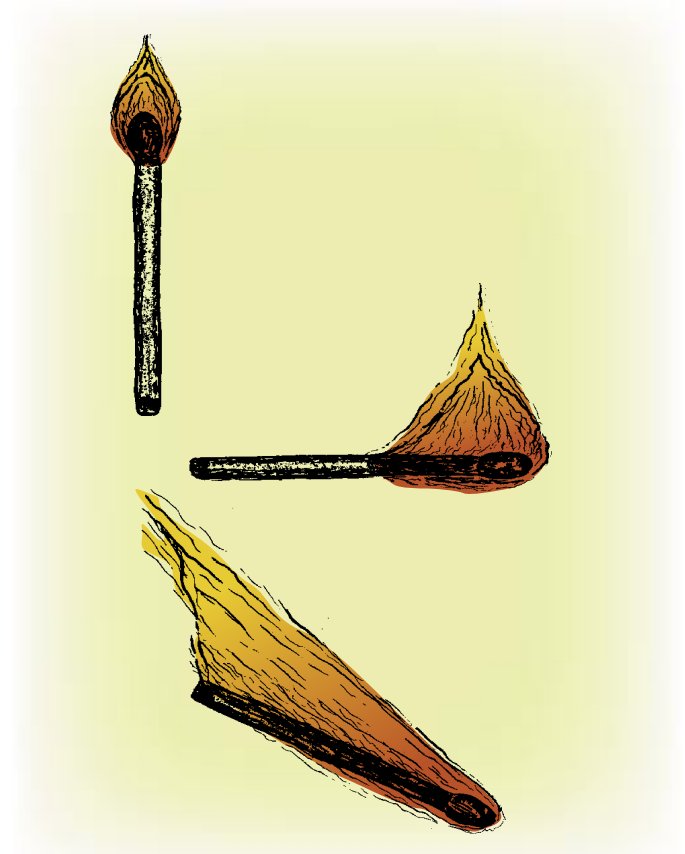


Figure 2. These matches show the interaction of the three types of heat transfer.



# Owning a Fire-safe Home

The fire safety of a home depends on the continuity and loading of the fuels around it, the location of the home with respect to topography, and also on home design and building materials.

## Legal Fuel Modification Requirements

California Resource Code 4219 requires maintaining an effective firebreak around structures in fire hazardous areas for a minimum distance of 30 feet, and fuel modification of flammable vegetation for another 70 feet, for a total minimum fuel modification distance of 100 feet. These, however, are minimum code requirements and do not necessarily insure a fire-safe environment. Therefore, fuel modification distances enforced by local fire authorities may extend beyond 200 feet, so be sure to check with local fire authorities about minimum applicable fire hazard requirements in your community.

Realize, however, that during a large wildland fire, burning embers (firebrands) may be deposited onto your house even thousands of feet ahead of the fire front, ready to ignite it if they find receptive fuels irrespective of fuel modification carried out around the home. Fire loss statistics have clearly indicated—and it is common knowledge among fire personnel—that homes that are attended (either by fire personnel or knowledgeable homeowners



*Wood shingle roofs require an inappropriate amount of manpower and water during a wildfire because they are easily ignited by flying sparks.*

or their support team) have a much higher chance of surviving a fire than unattended homes.

Also realize that there is no true safety net for protecting your home in a large-scale wildland fire or even several smaller wildland fires burning simultaneously in your area, as fire personnel and support equipment may be spread thin and you may be prevented from returning to your home to help protect it. To have a truly fire-safe home environment, you must therefore ask yourself the compound question, “Could (and under what conditions) my home survive unattended in a wildland fire?” Few homes can make it on their own unless “luck” such as a wind shift is on their side!

Do not expect that the Fire Department will and/or must protect your home at any cost or that the codes are adequate to safeguard it. You have the final responsibility of protecting your home and can best do it through (hopefully) effective preplanning and continuous maintenance. An added incentive for creating and maintaining a fire-safe environment should be the realization that in high fire danger areas, insurance coverage generally limits replacement costs (as the actual rates would be generally prohibitive, as one cannot require the general public to take on the extra burden of such costs or subsidize living in such areas) and that you will be required to rebuild to current code requirements. Therefore, people are generally under insured for fire damage. Worse yet, there is generally no insurance coverage available for hillside slip and slide damage that can be very expensive to repair.

The chapter towards the end of the book titled *Firebreak/Fuel Modification Information (for Structures in Fire-hazardous Areas)* provides more detailed information about fuel modification requirements. However, it cannot be emphasized enough that the intent of the fire code is readily defeated if basic fire safety principles are not

already initiated during the land use planning process and carried over into home site selection, home design, and use of fire-safe exterior building materials.

## Fire Topography

The relationship between topography and fire behavior is a factor over which the homeowner has little control. He should, however, be aware of the relationship as it relates specifically to his property. Figure 3 points out that homes located in natural chimneys, such as narrow canyons and saddles, are especially fire-prone because winds are funneled into these canyons and eddies are created. Studies on homes burned along ridges have shown that those located where a canyon meets a ridge are more likely to burn than other ridge-top homes. In very steep and narrow canyons, radiating heat may also be a major factor in fire spread and home losses.

Figure 4 illustrates how homes without adequate setbacks on narrow ridges are often lost because flames and convection heat hit the home directly. Homes located

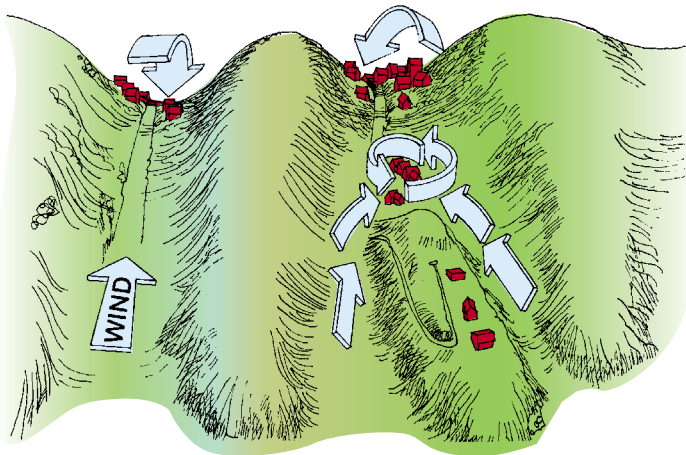


Figure 3. Winds tend to channel through natural chimneys, making narrow canyons and saddles particularly fire-prone.



Figure 4. On narrow ridges, homes without adequate setbacks, such as those on the left, are particularly vulnerable to fire.



on the slope, especially stilt and cantilevered homes, are particularly vulnerable in this respect.

## Building Materials and Design

Building density, design, and building materials are important safety considerations because a burning home can ignite adjacent homes.

The roof is the most vulnerable part of a home because it is exposed to airborne sparks. The wood shingle roof has been the single most important element in home losses during wildland fires. It is also a major source of airborne firebrands capable of igniting nearby structures. Studies of structural losses during wildfires in southern California have shown that with 100 feet of brush clearance, a home with a wooden roof has a 21 times greater chance of burning than a home with a nonwood roof. Although most fire insurance rates are higher for wood roofs than for nonwood roofs, this rate increase does not compensate for the true difference in risk.

Exterior materials used on wildland homes should have a fire-resistance rating of 1 to 2 hours, meaning that they should consist of materials such as stucco, metal siding, brick, concrete block, and rock. This is especially critical for parts of a home exposed to winds from the north or east, or that are positioned at the top of a slope. Figures 5 and 6 graphically summarize the principles of topography, vegetation, and architectural design that can improve the fire safety of a planned or an existing home. Many positive features of home design are shown in figure 5. Note that reduced overhangs or boxed eaves protect the house from ignition and heat or flame entrapment. Undereave vents should be located near the roofline rather than near the wall so that firebrands and heat sources are not trapped and funneled into the vents. Exterior attic and underfloor vents should not face possible fire corridors and should be covered with wire screen (not to exceed



*The burned roof demonstrates that nonflammable roofs are a key to fire safety.*

1/4 inch mesh). Picture windows and sliding glass doors should be made only of thick, tempered safety glass, with other windows made of double-pane glass. Where facing fire winds or possible convection heat sources, windows should be protected with nonflammable shutters. This is especially important if there is only limited slope setback. Stone walls, where effectively used, can reduce the length of fill and cut slopes, can increase the pad size for the home, can act as heat shields, and can also deflect the flames. Swimming pools, decks, and patios can also be used to create a setback safety zone as well as provide safety accessories.

Properly placed rooftop sprinklers or misters under the eaves can be quite helpful in preventing ignition from all sources. Note, however, that sprinklers placed on a wooden roof generally provide only limited fire safety even if you have your own water supply pumped by an independent power source unless you use foam or gel water mixtures. But don't depend on these factors; change the roof!

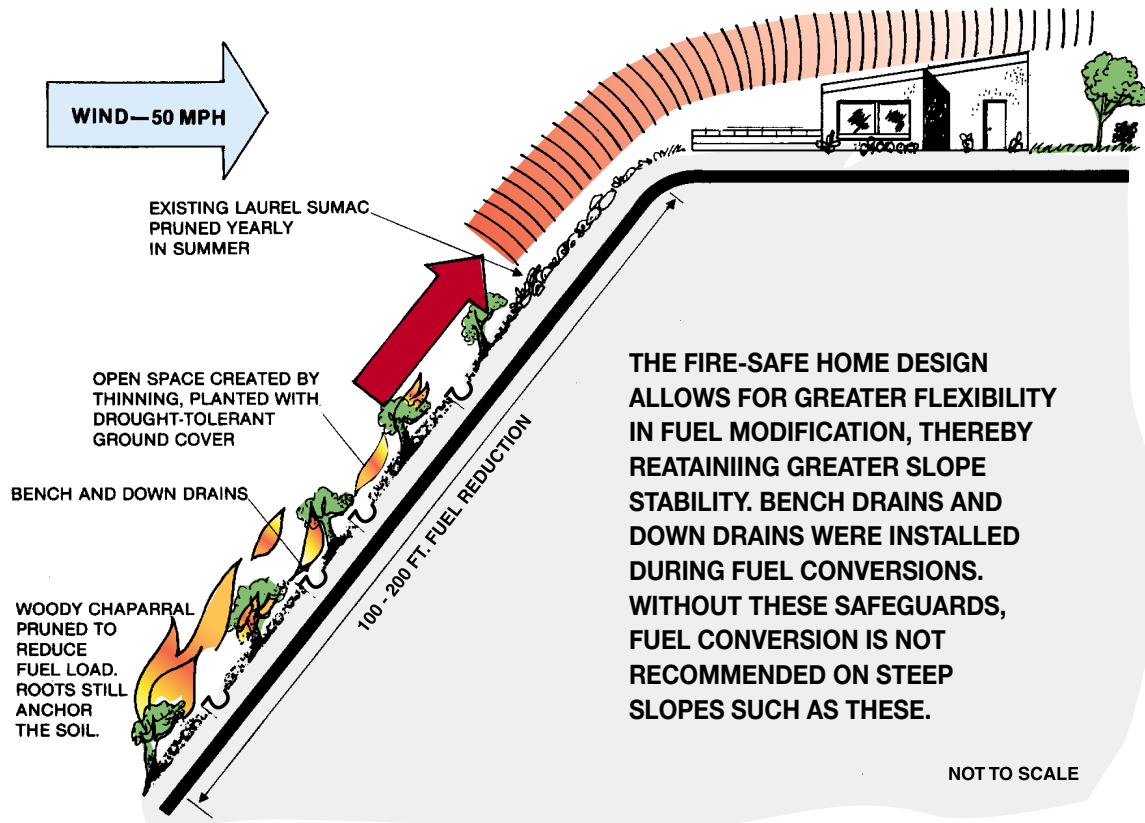


Figure 5. Reducing Fire Risk Through Preplanning.

Class A fire-resistant roof such as tile with seams and joints between tiles sealed.

No exposed wood surfaces but stucco or other nonflammable siding of 1 to 2 hours fire-resistant rating.

Reduced overhang preferably with closed eaves.

Roof slanted to accommodate convection heat.

Safety zone and slope setback of approximately 30 feet for a single story home and vegetation properly thinned within the next 70 feet.

Pool or other low fuel hardscapes used to create buffer zone between house and slope or potential flame sources.

Shrubs and trees not directly adjacent to home nor overhanging the roof.

Decks enclosed (skirted) and constructed of materials of 1 to 2 hours fire-resistant rating.

Adequate screening of vents to prevent entrance of embers. Preferably no vents on north to east side of house (side facing fire winds) or downslope side of house and no flammable vegetation planted near vents or flammable materials stored nearby.

Double-pane and tempered safety glass used as appropriate. Protection of windows with fire-proof shutters.

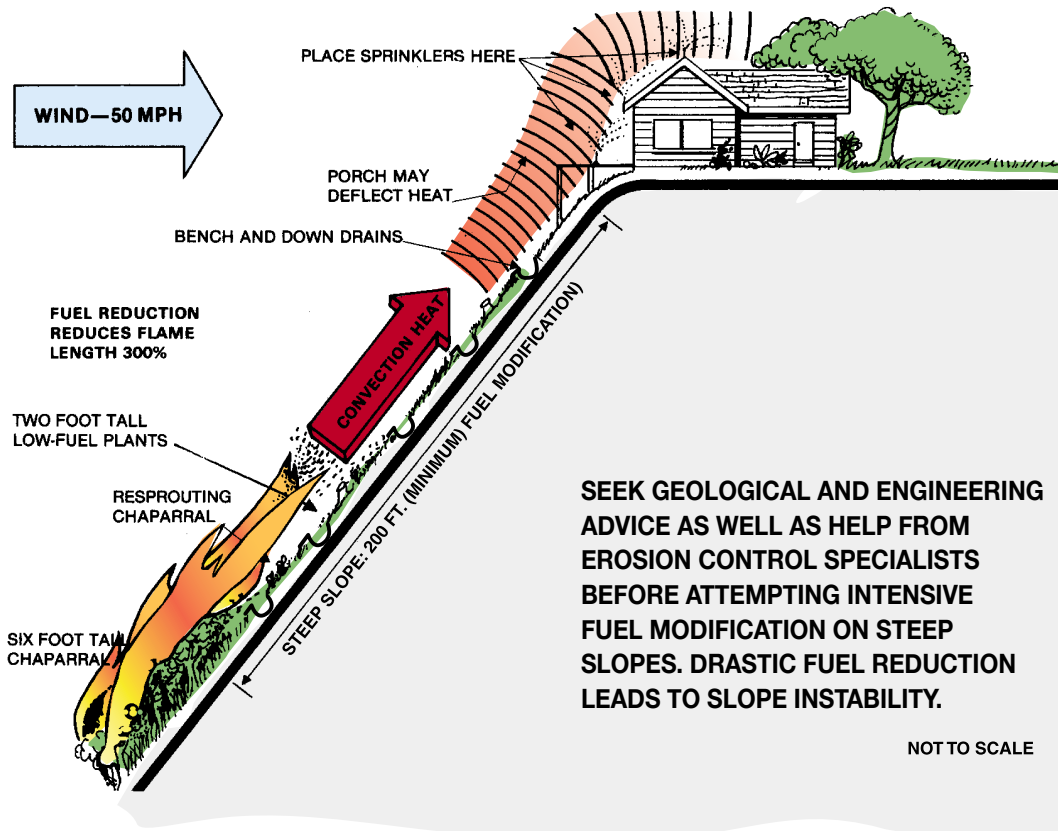


Figure 6. Some ways to modify an existing property to reduce fire risks.

#### Negative Features

1. Wood shingle roof
2. Wood siding
3. Large overhang (open eaves)
4. High gable roof
5. No safety zone (no slope setback)
6. Large picture window
7. Tree crown overhanging the roof
8. Steep slope

#### Positive Features

1. Fire-resistant roof (non-wood)
2. Non-flammable siding
3. Reduced overhang (closed eaves)
4. Redesigning may be too expensive. Review design with your architect.
5. Create slope setbacks with retaining walls (stone walls) to provide level yard extensions and raise stone wall above ground to create heat shields in critical areas; or build totally fire-safe, enclosed deck of 1 to 2 hours fire-resistance (such as stucco siding and stone decking).
6. Install non-flammable shutters
7. Prune or remove tree
8. Increase length of fuel modification zone. Maintain continuously. Also see #5 above.

On steep slopes in high fire danger areas, fire safety can be further increased by the removal of the most flammable plant materials to twice (200 ft.) the legal minimum clearance distance. However, retaining thinned, deep-rooted native, woody plants as well as native bunchgrasses and herbaceous subshrubs is critical for maintaining slope stability and assisting in controlling the invasion of flash-fuel weedy annuals. Maintenance of thinned shrubbery is important because dead, woody vegetation can quickly accumulate in non-watered zones.



## Your Pool as a Water Source

Pools can provide a convenient as well as home-saving water source for use before or during a fire. Fire engines should be able to get within 10 feet horizontally of the pool. If this is not possible, the pool should be equipped with a bottom drain and pipe system that terminates horizontally or below pool level in a 2 1/2-inch valved standpipe equipped with a fire hydrant with national standard thread. A floating pool pump or portable gasoline pump with a suction hose that can reach the bottom of the pool can assure a usable water source even when water pressure and electricity fail. You will also need a fire hose and nozzle.

Fabric fire hoses are suitable for use with pool pumps that are designed for firefighting, but should not be used on home faucets because they readily kink as water pressure drops. All outdoor faucets should be equipped with strong 5/8-inch rubber hoses that will not burst when the nozzle is turned off. A ladder should be available to reach the roof.

For more information on how to enhance the fire safety of a home, see *Living More Safely at the Chaparral-Urban Interface*.



*Design for disaster? You be the judge.*

### Summary

- 🔥 *The fire safety of a home depends on the continuity and loading of the fuels around it, the location of the home with respect to topography, and also home design and building materials.*
- 🔥 *California Resource Code 4219 requires clearance of flammable vegetation and fuel modification for a minimum distance of 100 feet from any structure in a fire hazardous area. Local ordinances may require greater clearance distances and may be more restrictive.*
- 🔥 *Location of a home with respect to topography affects its likelihood of burning.*
- 🔥 *The design of a home should reflect fire safety considerations. The wood shingle roof is the largest single cause of structural fire losses.*
- 🔥 *Burning embers (firebrands) may be a serious threat to the safety of a home irrespective of fuel modification carried out around it, especially if the home is unattended.*
- 🔥 *With some planning, the water in your pool can be an important water source for fighting a fire.*

**The following safety features may save your home during a wildfire:**



*Gasoline pool pumps and accessories.*



*Shutters, even emergency plywood shutters, that protect windows.*



*Vents located near the roofline rather than the wall.*



*Boxed eaves that prevent heat entrapment even if the wood siding catches on fire.*







# Landscaping for Fire and Watershed Safety

**The key to landscaping in fire-prone watershed areas is to selectively replace highly flammable plants with lower growing, less flammable plants of equal root depth and root strength.** In reality, optimum rooting depth and fuel volume generally work at odds with one another. That is, low-growing plants usually have relatively shallow root systems and tall plants have relatively deep and broad lateral root systems. Landscaping requires a compromise between minimizing fuel volume and maximizing root depth.

The key to effective low maintenance landscaping is to use the right plant in the right place. Native plants should generally be planted only on the slope aspects they occupy naturally or areas that are not subject to over-watering. More water-demanding ornamental plants should generally be planted only in more shaded locations, not on harsher southern exposures with thin soils.

## Rooting Depth and Fuel Volume

As a rule, nonwoody ground covers have an effective root depth of less than 3 feet and can be labeled “shallow rooted” for use in steep terrain. Grasses also belong in this category. Shallow-rooted plants should not be used as permanent cover on steep slopes unless they are interplanted



*Planting the right plant in the right place is as important on manufactured slopes (foreground) as on natural slopes (right background).*

at approximately 10-foot centers with spreading shrubs and approximately 20-foot centers with hillside-anchoring, taller shrubs, or small trees. Interplanting is also required in stabilization of fill slopes.

Woody ground cover shrubs generally are moderately deep-rooted, with roots ranging from 3 to 6 feet in depth, and can be effectively used on slopes in conjunction with taller shrubs and trees. Most plant species found in the coastal sage community fall into this root depth category. Plants with roots ranging from 6 to 15 feet or more in depth include most woody shrubs in the chaparral community as well as small, drought-tolerant landscape trees. Very few commercially available woody ground covers, with the exception perhaps of prostrate coyote brush and prostrate acacia, have an

effective root depth greater than 6 feet. Plants with roots much in excess of 15 feet include some native shrubs such as scrub oak and laurel sumac, and trees of larger stature.

Laurel sumac and scrub oak are two of the most watershed-effective, deep-rooted hillside anchoring plant species within the chaparral plant community, and their systematic removal often leads to soil slippage and slides on steeper slopes. Additionally, Laurel sumac has been misrepresented as being highly flammable because of its generally high oil content (which is not much different from that of coyote brush) and the lack of maintenance it often receives. However, in the critical summer time period, Laurel sumac has one of the highest fuel moisture contents of any tall-growing woody chaparral plant tested; does not contain or readily accumulate fine, dead fuels when compared to sages and ceanothus species; and can be easily maintained. It takes much heat energy to drive the moisture out of Laurel sumac leaves and dry them to the ignition point, thereby making the plants quite 'fire-retardant' if they are occasionally pruned and flammable fuels regularly removed around them.

## Drought Tolerance and Sprouting Ability

Drought tolerance and sprouting ability are also important considerations when selecting plants. Water will be an increasingly sparse and expensive resource in the future. The plant's ability to survive on little water, as well as to resprout after a fire or when neglected (neglect could be a result of water shortage), can mean savings over the years on water bills, maintenance costs, replanting costs, and hillside repairs.

Herbaceous or semiwoody ground covers like capeweed, lippia, or prostrate myoporum; woody ground covers such as coyote brush, prostrate ceanothus, and manzanita species (where applicable); hedges such as oleander and myoporum; and even some coniferous trees like Canary Island



*This native plant (center) is dying because of root rot caused by over-watering of the young coyote brush around it.*

pine and Chir pine do not need to be replanted because they generally resprout readily, depending on the severity of the fire and post-fire drought conditions.

Most native plants also resprout, and some native shrubs such as sugarbush, scrub oak, ceanothus species, and chokecherries can be nurtured into short-stemmed trees. At spacings of about 25 feet, these plants can be kept relatively fire retardant through occasional pruning. Resprouting native broadleaved trees such as oaks, sycamores, California bay laurel, Catalina ironwood, and California black walnut, and ornamental trees such as California pepper, and black locust, to name just a few, can be effectively blended into the landscape setting. However, the named ornamental trees may become invasive within native habitats close to the home. Also, since leaves of California bay laurel are highly flammable, the tree should not be planted close to structures. The hardy southern California black walnut offers an excellent deciduous alternative that can be planted even close to homes. For fire safety, trees must be pruned and should be limited to the number necessary to provide shade and slope stability.





*Landscaping with native plants protects this slope.*



*Native Dicentra is blooming the second season after a fire.*



*This home, designed to be fire-safe, also has a 30-foot setback safety zone.*



The use of herbicides and pre-emergent chemicals must be closely monitored in hillside landscaping. Overuse can kill landscape plants and sterilize soils. Fortunately, the deepest-rooted chaparral shrubs are also the hardest to kill with herbicides. Since these shrubs serve the dual function of anchoring the soil to the bedrock and pumping water out of the ground, soil slippage is almost never observed where they are present. Mortality of such plants often results in slippage 5 to 10 years later after the roots have rotted away. The original cause of such delayed slippage is seldom recognized.

## Hillside Landscaping

Some ground covers and low-fuel shrubs commonly used for hillside landscaping in southern California are listed in Table 1 along with their characteristics and some suggestions about where they should be used. The plant species listed, except where indicated, are able to form a solid ground cover for the slopes recommended. However, there is no guarantee that the species prevent slippage when the soil becomes saturated. Interplanting ground covers with shrubs and trees, as discussed earlier, will maximize slope stability. Plants that require high maintenance or that are readily browsed, such as most ceanothus species, are not included in Table 1.

The columns in Table 1 headed “aspect,” “soil depth,” and “irrigation” must be read as a unit. Soil depth figures apply to medium-textured, loamy soils. The irrigation figures apply to coastal regions of southern California and attempt to show relative watering needs of the plants listed. The figures assume that soil moisture is recharged to a 12-inch depth during watering. In reality, this goal is rarely achieved through overhead watering because of sprinkler design and the time period necessary for irrigation. The effective rooting depths indicated in Table 1 are based on moisture withdrawal by roots after soil moisture has been depleted in the upper soil layers.



*Concrete bench and down drain systems need to be maintained year-round.*

The term “fire retardance” as used in Table 1 reflects differences in fuel volume, inherent flammability characteristics of the plant, and ease of fire spread. For example, under extreme autumn fire conditions, on steep slopes with nongusting winds of 30 mph, a 2-foot-tall solid ground cover with “high” fire retardance is expected to produce a flame less than 10 feet long and to reduce the rate of fire spread. Under similar conditions, a plant with “low” fire retardance may ignite readily, will carry the fire, and can produce flames approaching 25 feet in length.

The following example will illustrate the use of Table 1. Capeweed is listed in row 2 of the table. Column 1 shows that the species is most effective for planting on slopes

not exceeding 25°, but may be used on a limited scale on slightly steeper slopes if interplanted with deeper-rooted vegetation. The shallow root system of capeweed may trigger soil slippage. The next three columns are to be read as a unit and show the relationship between aspect, soil depth, and irrigation requirements. For example, the first line shows that on a north-to-east aspect with less than 1 foot of soil depth, established plants require summer irrigation once to twice a month. The remaining columns are self-explanatory.

Ice plants, listed in row 6, have been used extensively for hillside planting because they are low-growing, drought-tolerant, fire-retardant, and aesthetically pleasing; they are easily established on harsh sites, and require minimal maintenance and watering. However, during high intensity storms, by far the greatest slope failures are found on hill-sides planted with ice plants. A wise homeowner will acquire the written opinion of a geologist regarding slope stability before planting ice plants extensively on slopes in excess of 15°. Most species of ice plants are best suited for rock garden situations or for harsher sites with relatively stable geology and thin soils.

## Slope Engineering

Slope engineering techniques such as concrete bench and down drains, designed to slow and direct excess water flow, are necessary on most steep slopes around homes. Their use becomes critical when modification of native vegetation is attempted in geologically unstable areas or areas with past soil slip problems. The homeowner is responsible for the maintenance of any drainage devices on his land and the devices should be listed in the deed for the property. Any modification of vegetation on the hillside where the layering (dip) of the bedrock parallels the slope, as shown in Figure 7, should be undertaken with extreme caution because of the natural instability of the slope. Increasing the infiltration rate of water into the soil and reducing the root strength and

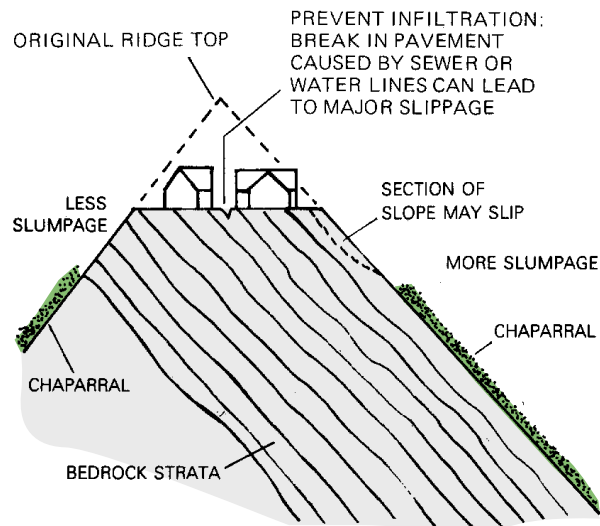


Figure 7. Rock strata may determine hillside problems.

root depth per unit area can result in almost immediate soil failures during winter rains.

More information on various aspects of hillside landscaping including slope engineering techniques, proper watering methods, plant selection, and selective brush conversion is available in *Living More Safely in the Chaparral-Urban Interface*. No book, however, should be a substitute for onsite expert advice from specialists familiar with hillside landscaping and hillside problems.

### Summary

- 🔥 *Slope stabilization may be achieved by the use of deep-rooted plants in conjunction with slope engineering.*
- 🔥 *Fire management requires low-fuel or low-growing plants to reduce flame length and heat output.*
- 🔥 *As a compromise between watershed and fire safety, a combination of taller, deeper-rooted plants should be interplanted with ground covers.*

Table 1. Evaluation of some popular low-growing plants used in hillside landscaping (*check with your local nursery for plants adapted to your site conditions and climate*).

SPECIES	EFFECTIVE. . .									
	On slopes (degrees)			On aspects		At soil depths (feet)			If irrigated summer to fall	At elevations (feet)
	to 25	25 to 35	35+	N to E	S to W	to 1'	1'-3'	3'+		
<b><i>Acacia ongerup</i></b>	▲	▲	■	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	<1M <1M None >1M 2M 1S	Up to 2,000
<b><i>Arctotheca calendula</i></b> (Capeweed)	▲	■		▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	1-2M 1M 2S 2M 1M <1M	Up to 2,000
<b><i>Baccharis pilularis</i></b> dwarf varieties Coyote brush	▲	▲	■	▲ ▲ ▲	▲ ■ ▲ ▲	▲ ■ ■ ▲	▲ ▲ ▲ ▲	▲ ▲ ▲ ▲	<1M 1S 'None' >1M 2S 1S	Up to 4,000
<b><i>Ceanothus griseus,</i></b> <b><i>horizontalis</i></b> Carmel creeper	▲	▲		▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	1M 2S 'None' <2M <1M	Up to 3,000
<b><i>Cistus crispus</i></b> Descanso rockrose	▲	▲		▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	<1M 2S 'None' <2M <1M 1-2S	Up to 4,000
<b><i>Delosperma,</i></b> <b><i>Drosanthemum</i></b> Iceplants (See text)	▲	See text		▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	■ ▲ ■	▲ ▲ ■	<1M 2-3S 'None' 1M <1M '1-2 S'	Up to 2,000
<b><i>Hedera canariensis</i></b> Algerian ivy (Freeway ivy)	▲	▲	■	▲ ▲ ▲	■ ▲ ▲	■ ■ ▲	▲ ▲ ▲	■ ▲ ▲	1W 1M 2S 1W 2M 1M	Up to 2,000
<b><i>Osteospermum fruticosum</i></b> African daisy	▲	■		▲ ▲ ▲	■ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	■ ▲ ▲	2M 1M <1M 1W 2M 1-2M	Up to 2,000
<b><i>Vinca major</i></b> Periwinkle	▲	▲		▲ ▲ ▲	■ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	▲ ▲ ▲	>2M 1M <1M 2M 1-2M	Up to 2,000



Abbreviations: ▲ = Suitable for this category      ■ = Plant not totally suitable for this category  
W = Week      M = Month      S = Summer

### CHARACTERIZED BY...

Spread	Fire retardance	Resprouting ability	Rooting depth (effective)	COMMENTS
Spreading shrub 12 to 30 inches tall	Low; decreases with increase in fuel	Poor	Greater than 6 feet	Low maintenance. No foot traffic. Showy yellow flowers. Draws bees. Most drought-tolerant and quickest-spreading woody plant tested. Full sun.
Spreading ground cover 6 to 8 inches tall	High	If watered	1 to 3 feet	Very low maintenance. Takes occasional foot traffic. Showy yellow flowers. Weedy in manicured setting. Frost sensitive. Draws bees. Spreads by runners. Full sun to partial shade. Use non-seed producing varieties only.
Spreading shrub 12 to 24 inches tall	Low	Vigorous	Approximately 6 feet	Prune back every five years or less often. No foot traffic. Inconspicuous flowers. Hard to establish from flats in midsummer. Healthy green color. Full sun.
Semi-upright shrub 18 to 30 inches tall	Low to medium	If watered after light fire	3 to 6 feet	Low maintenance. No foot traffic. Showy light blue flowers. Draws bees. Ground cover for easily accessible drysite areas in soils with good drainage. Little or no water in the summer. Deep watering only when needed. Full sun to partial shade. Short lived.
Semi-upright shrub 12 to 24 inches tall	Low to medium	Poor	3 to 4 feet	Medium to low maintenance. No foot traffic. Showy pink flowers. Draws bees. Ground cover for easily accessible drysite areas. Attractive if watered; unattractive if not maintained. Full sun.
Trailing ground cover 4 to 18 inches tall	Generally high	Depends on severity of fire	Mostly 1 to 2 feet	Low maintenance. No foot traffic. Showy multi-colored flowers. High foliage moisture and weak root system causes slippage on steeper slopes, especially fills. Full sun to partial shade. May become invasive. Do not plant within a native plant environment.
Trailing ground cover 8 to 12 inches tall	Medium	If watered	3 to 4 feet	Low maintenance. Tolerates foot traffic. excellent for minimizing erosion on long steep cuts. Leaves will burn if watering is neglected. Excellent understory to a variety of trees if maintained and cut back so that it does not climb. No flowers. Full sun to shade. May become invasive.
Trailing ground cover less than 12 inches tall	Medium to high	If watered	3 feet +	Moderate to high maintenance. Tolerates some foot traffic. Showy white flowers and other hybrid colors. Freezes at 25°F. Fertilize and water regularly. Full sun to partial shade.
Trailing ground cover less than 18 inches tall	Medium	If watered	3 feet	Low maintenance. Occasional foot traffic. Showy blue flowers. Does well under partial overstory where somewhat neglected. Sun to shade. May become invasive. Do not plant within a native plant environment.

Design for Disaster: You Decide





# Maintenance for Fire and Watershed Safety

Landscape maintenance is necessary to keep man-made structures separated from surrounding vegetative fuels; to keep the amount of vegetative fuels at a safe level; to create a safety zone for residents, firefighters, and fire equipment; and to assure that water flow from the property is channeled properly. Giving correct priorities to maintenance needs and carrying out maintenance and safety inspections on a regular basis is the key to minimizing the effects of “natural” disasters.

For fire and watershed maintenance, the area around the home should be divided into three perimeters of defense:

- 1. 0-to-30-foot setback zone:**  
**year-round maintenance (regular watering)**
- 2. 30-to-100-foot greenbelt zone:**  
**seasonal maintenance (watering as needed)**
- 3. 100-to-200-foot thinning zone:**  
**yearly inspections, periodic maintenance (dry zone).**

## 0-to-30-Foot Setback Zone- Maintenance Adjacent to the Home

The area within approximately 30 feet of the home is most critical for fire and watershed safety. Maintenance of non-

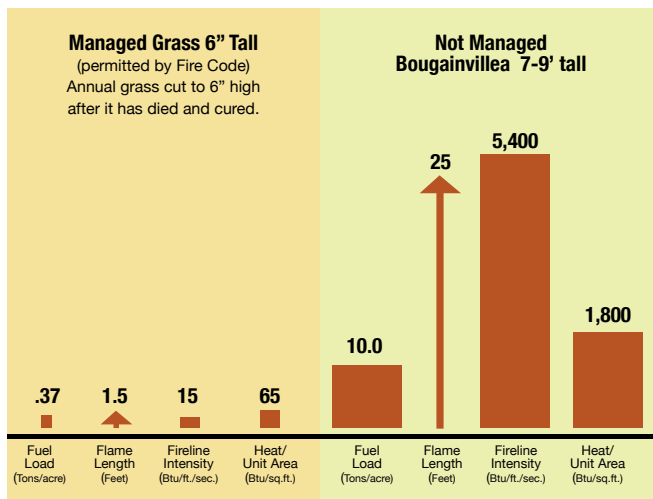


*Native plants can be thinned out to form an effective greenbelt zone that is easily maintained. Concrete bench drains should be cleaned as required.*

flammable landscaping such as lawns, border plantings, flower gardens and vegetable beds, and structures such as pools, concrete decks, and recreation areas help to reduce fire hazards close to the home. This area, for the most part, is level and all water from it should drain toward the street. Rain gutters, pipes, and drainage devices should be cleaned out on a regular basis. Additionally, all debris such as leaves, pine needles, twigs, and overhanging branches should be removed from the roof before the fire season begins.

Foundation shrubs and trees are a necessary part of the landscaping. However, these plants often grow into “urban forest” fuel problems, so that landscape plants, rather than surrounding native plants, become the primary cause of fire losses. Year-round maintenance should consist





*The interior crown of bougainvillea contains much fine dead fuels such as twigs less than 1/2" in diameter. Papery leaf and flower litter also readily accumulate at its base. Such fuels make the plant highly flammable and, once ignited, the fine fuels respond in even light winds with quick heat release.*

*Compared to 6 inch tall dead and cured grass, a seven to nine foot tall and eight to ten foot wide bougainvillea plant can increase the flame length by as much as 1,700% or 17 times, fireline intensity by 36,000% or 360 times, and heat per unit area released as the fire passes through by 2,800% or 28 times.*

*Do not plant bougainvillea near your home in fire-prone areas.*

of pruning and regular watering of individual plants. Together, these measures decrease plant volume, increase plant moisture content, and reduce or eliminate dead fuels. (Caution: Unnecessary watering of drought-tolerant landscape plants may cause root rot of a native plant nearby.)

Trees must receive the same regular maintenance as foundation shrubs, and potentially flammable trees should therefore not be planted in this zone (think about the expanding tree crown and future maintenance). Non-maintained shaded interior crowns of trees such as coast live oaks usually accumulate a high amount of fine dead fuels such as twigs and branchlets, and are exposed to higher wind speeds than exist at ground level. These conditions can produce long flames that are readily bent onto the roofs of nearby structures. Other trees such as eucalyptus, pines, junipers,

cypress, and palms (e.g., Washingtonia) are also notorious for their tendency to spread fire and should not be used in this zone unless they are specimen trees and well-maintained.

## 30-to-100-Foot Greenbelt Area

Seasonal fire maintenance in the 30-to-100-foot greenbelt zone around the home should consist of removing dead woody plants, regular pruning of trees and shrubs to eliminate fine dead fuels and to reduce fuel volume, and eradication of weedy species. Native plants can be thinned out to form an effective greenbelt zone that can be easily maintained. However, selectively removing native plants and pruning up the remaining plants opens up the canopy, creating a much harsher microclimate (climate near the ground), especially on southeastern to southwestern aspects, by exposing the soil surface to the sun. The much higher soil temperatures are detrimental to the native plants and will weaken them, especially during extended drought conditions. Cut plants and plant parts should therefore not be removed from the slopes but chipped on site and retained as mulch and spread evenly to about 3–4 inches in depth as permitted by fire code. Retaining a mulch layer on exposed soil surfaces is also critical in reducing the invasion of weedy, annual flash fuels such as non-native grasses as these can become a major fire hazard and maintenance problem.

To maintain healthy plants and strong root systems, pruning of most native woody plants should be done during the summer after sugars have been recycled from the leaves into the roots. Ground cover shrubs may also need to be thinned periodically. In thinning and pruning, care must be taken not to expose the soil surface to a greater degree than can be safely covered by surrounding plants before the rainy season. If this is not possible, bare ground should be covered with jute netting. Well-pruned, healthy shrubs require several years to build up an excess of flammable live

and dead fuel. Therefore, a complete maintenance job can last a long time.

Erosion during fuel modification can be severe on even moderately steep slopes of about 15° (27 percent). First-year erosion rates can exceed 1 inch of topsoil loss. On an acre basis this would amount to as much as 100 cubic yards of soil (enough to fill about 25 dump trucks) that would find its way into properties at the base of the slope or natural or man-made drainages located there. The loss of topsoil is very critical because topsoil contains more nutrients, has better structure, greater infiltration rates, and greater water storage capacity than subsoil and is therefore more capable of producing vigorous, healthy plants.

Watershed problems in this greenbelt zone are often critical. Yearly, before the winter rainy season, all drainage devices must be inspected to assure that they are functional and not clogged with debris. After major storms, all rain gutters, pipes, concrete bench and down drains, and other such devices must be reinspected. Bench drains are easily blocked by minor soil slips. This forces uncontrolled water flow over the slope and results in supersaturated soils and mudflow.

The automatic irrigation system is the primary cause for soil slips and slides on steeper slopes in urban areas. Failure to properly maintain or adjust such a system to the minimum watering requirements of plants and their changing watering needs during the seasons often leaves sections of slopes overwatered, even saturated, prior to the onset of the winter rains.

Rodents such as gophers and ground squirrels can also be a major cause of soil slips because they weaken root systems and build underground tunnels where water can concentrate. For further discussion of animals detrimental to hillside stability, see the Watershed Management chapter in *Living More Safely in the Chaparral-Urban Interface*.

## 100-to-200-Foot Thinning Zone

The intensity of fire maintenance beyond 100 feet from the home is dictated by topography, design, and exterior building materials of the structure. Minimum maintenance for a home designed with fire safety in mind should consist of reducing the amount and continuity of the vegetation as well as thinning out the most flammable species. Selective maintenance can be done in areas where topography is favorable and geology stable (gentle slopes, rock outcroppings, etc.) every 5 years or less without causing any accelerated soil erosion. Such “feathering out” of older vegetation on portions of a watershed while favoring younger plants reduces the possibility and effect of major wildfires.

### Summary

- 🔥 *Maintenance of landscaping and structural additions around the home is essential for fire safety and watershed protection.*
- 🔥 *Maintenance needs are most critical within 30 feet of the home, but periodic fuel reduction and maintenance of drainage devices are required at greater distances from the home.*
- 🔥 *Covering exposed soil surfaces with a mulch layer reduces erosion, retains soil moisture, and controls the invasion of weedy annual flash fuels.*

# What To Do When Caught in a Wildfire

If your home is threatened by wildfire, you may be contacted by fire or law enforcement officials and advised to evacuate. If you are not contacted in time to evacuate, or if you decide to stay with your home, the following suggestions will increase your chances of safely and successfully defending your property. **(For further information, contact your local fire protection agency.)**

## Before the fire approaches your house:

1. If you plan to stay, evacuate your pets and all family members who are not essential to protecting the home, but do not jeopardize your life.
2. Be properly dressed to survive the fire. Cotton fabrics are preferable to synthetics. Wear long pants and boots and carry with you for protection a long-sleeved shirt or jacket, gloves, a handkerchief to shield the face, water to wet it, and goggles.
3. Remove combustible items from around the house. This includes lawn and poolside furniture, umbrellas, and tarp coverings. If they catch fire, the added heat could ignite your house.
4. Close or cover outside attic, eave, and basement vents. This will eliminate the possibility of sparks blowing into hidden areas within the house. Close window shutters.
5. Place large plastic trash cans or buckets around the outside of the house and fill them with water. Soak burlap sacks, small rugs, and large rags. They can be helpful in beating out burning embers or small fires. Inside the house, fill bathtubs, sinks, and other containers

with water. Toilet tanks and water heaters are important water reservoirs.

6. Locate garden hoses so they will reach any place on the house. Use the spray-gun type nozzle, adjusted to a spray.
7. If you have portable gasoline-powered pumps to take water from a swimming pool or tank, make sure they are operating and in place.
8. Place a ladder against the roof of the house opposite the side of the approaching fire. If you have a combustible roof, wet it down or turn on any roof sprinklers. Turn on any special fire sprinklers installed to add protection. Do not waste water. Waste can drain the entire water system quickly.
9. Back your car into the garage and roll up the car windows. Disconnect the automatic garage door opener (in case of power failure, you may not be able to remove the car). Close all garage doors.
10. Place valuable papers and mementos inside the car in the garage for quick departure, if necessary. Any pets still with you should also be put in the car. In this case, open the car windows partially as the garage may become very hot.
11. Close windows and doors to the house to prevent sparks from blowing inside. Close all doors inside the house to prevent draft. Open the damper on your fireplace to help stabilize outside-inside pressure, but close the fireplace screen so sparks will not ignite the room. Turn on a light in each room to make the house more visible in heavy smoke.



12. Turn off pilot lights.

13. If you have time, take down your drapes and curtains. Close all venetian blinds or noncombustible window coverings to reduce the amount of heat radiating into your home. This gives added safety in case the windows give way because of heat or wind.

## When the fire approaches:

As the firefront approaches, go inside the house. Stay calm; you are in control of the situation.

## After the fire passes:

After the fire passes, check the roof immediately. Extinguish any sparks or embers. Then, check under the eaves and inside the attic for hidden burning sparks. If you have a fire, get your neighbors to help fight it. The water in your pool and the water in your garbage cans, sinks, toilet tanks, etc., will come in handy now. For several hours after the fire, recheck for smoke and sparks throughout the house.

## Remember:

In a major conflagration, fire protection agencies will probably not have enough equipment and manpower to be at every home. You cannot depend totally on their help. One of the firefighters' principal responsibilities is to stop the spread of fire from house to house. Therefore, if one home is on fire, firefighters might have to pass it by to save another in the path of the fire. Your careful planning and action during a fire can save your home. Be prepared. Talk with your neighbors to see what resources you have. Ask your fire or forestry personnel for professional advice and assistance.

## When caught in the open:

When you are caught in the open, the best temporary shelter will be found where fuel is sparse and flame and heat exposure is hopefully reduced. These places could include road cuts and banks, large boulders, rock outcroppings, large logs, and depressions in the ground. Here are comments on some good and bad places to go:

### Automobile

Move the car to bare ground or sparse fuel areas, close all windows and doors, lie on the floor, and cover yourself with a jacket or blanket. The fuel tank of the car will normally not explode until the car is well on fire or may not explode at all. So, keep calm and let the fire pass.

### Road Cut

If caught without shelter along a road, lie face down along the road cut or the ditch on the uphill side (less fuel and less convection heat). Cover yourself with anything that will shield you from the heat of the fire.

### Topographic Chimneys

Never be caught by fire in natural chimneys. These are narrow, steep, dead-end canyons that concentrate heat, explosive gases, and updrafts. Temperatures may exceed several thousand degrees Fahrenheit during a fire.

### Topographic Saddles

While hiking out of an area where fire is in progress, avoid topographic saddles if possible. Saddles are wide natural paths for fire winds, and vegetation here will normally ignite first.

## In the Open

Look for areas with sparse fuel (for example, soft chaparral such as black sage or grassland rather than chamise chaparral), if possible, within a depression. Clear as much fuel as you can while the fire is approaching and then lie face down in the depression and cover yourself with anything that will shield you from the heat. Smoke may create as great a survival problem as the flames. If you are caught on a steep mountaintop or sharp ridge, the backside (or fire leeward side) will provide more safety. Be aware, however, that fire eddies often curl over ridges. Before hiking in fire-prone areas, seek additional advice from wildland firefighting and park service personnel. They may supply pamphlets and can give you specific tips for wildland fire survival.

Remember, even a seemingly non-threatening grass fire is a potential threat to your life if you are caught in the open and exposed to its quick heat release. Breathing very hot air can scorch your lungs and kill you.

## Summary

- 🔥 *Stay calm--you are in control of the situation.*
- 🔥 *If you decide to stay with your home during a wildfire, evacuate all family members who are not essential to protecting the home.*
- 🔥 *Dress properly to shield yourself from the heat and flames.*
- 🔥 *Take steps to prepare your home for the approaching fire.*
- 🔥 *As the fire approaches, move inside and stay until it has passed.*
- 🔥 *Move outside, survey the situation, take action, and help neighbors.*
- 🔥 *If caught in the open, seek shelter where fuel is sparse.*
- 🔥 *Remember that wildfires are erratic, unpredictable, and often underestimated. Life safety should be the most important consideration.*

# Evacuation and Road Closure

**Fire suppression agencies are responsible for determining when the need for evacuation exists and the jurisdictional law enforcement agency is responsible for carrying out an ordered evacuation.** The purpose is to protect people from life-threatening situations. Under Section 409.5 of the California Penal Code, the jurisdictional law enforcement agency is responsible for carrying out an ordered evacuation and closing and restricting access to disaster areas. The news media is legally exempt from this provision.

Persons have the right to stay on their property if they so desire, if in doing so, they do not hinder the efforts of fire personnel or do not contribute to the danger of the disaster situation. In fires or floods, able-bodied persons who wish to remain may be able to aid public safety personnel in saving their property or may even save their own home unassisted.

If at all possible, there should be several phases of road closures within an impending disaster area:

- (1) In an area that could potentially be involved in the disaster, but presently is not, people without purpose (such as people not living in the area) would be restricted from entry to reduce traffic problems or the potential for looting.
- (2) In areas of imminent danger with limited access or egress, people would be discouraged from entry even though they live in the area. Those who are adamant after being informed of the dangers would probably be permitted entry.
- (3) In areas presently involved in an emergency where extreme danger to life exists and where traffic must

be restricted due to movement of emergency vehicles, people, including residents, would be refused entry.

## Summary

- 🔥 *During evacuations persons have the right to stay on their property if they so desire.*
- 🔥 *Depending on the level of emergency, you may not be able to return to your property during road closures.*





# Post-fire Emergency Measures

**The steps to take in emergency rehabilitation of an area after a fire depend on the location of the property, the time of year, the intensity of the fire, the erosion potential, and the kinds of plants present. Figure 8 illustrates some post-fire emergency rehabilitation measures.**

If the fire occurs in midsummer and the burned watershed cover consists primarily of landscape plants with a large proportion of resprouting ground covers and shrubs, all that may be necessary for rehabilitation is to periodically irrigate and perhaps fertilize. Adequate moisture, heat, and nutrients will encourage rapid resprouting so that a good foundation plant cover can be established before the heavy winter rains return.

Postfire management of native plants is similar to the procedure outlined above. Plants should be allowed to resprout and establish themselves from seeds. Thinning of seedlings, as well as removal of dead stems and branches, can begin the following spring after the rainy season is over. The first year's thinning of native plants should be very light, followed by heavier thinning the second and third years after clear species patterns and densities have emerged. Timing becomes critical when a hot fire occurs in late fall. In neighborhoods where steep, long slopes overlook canyons and endanger the lives and property of canyon residents, neighbors should work together to quickly establish an emergency vegetation cover before heavy winter rains begin.

## Vegetative Measures

Aerial emergency seeding efforts by public agencies primarily employ ryegrass which can be viewed as a "band-aid" measure meant to duplicate or complement nature's

own "band-aid" of post-fire herbaceous plants. However, in 1980 the biological group of resource professionals and scientists of an interagency task assembled to produce an Interagency Field Guide for Vegetative Emergency Burn Rehabilitation for California recommended against broadcast-seeding burns in chaparral and coastal sage scrub ecosystems. They stated that seeding is primarily done in response to perceived political and social needs, and as far as the natural system is concerned the introduction of exotic species, in most cases, is not necessary. Nevertheless, when home-owners face excessive erosion on steep, burned slopes previously largely covered with landscaping where little or no post-fire herbaceous regeneration of native vegetation can be expected, a quick vegetative emergency erosion control cover is often required that could include hand-seeding with grains. This is especially important if downslope values to be protected are homes.

Seeds of annual grasses present before the fire will germinate quickly with any moisture because most seeds are incorporated into the soil layer. On the other hand seeds exposed at the soil surface will not germinate and root unless encouraged by 4 to 5 days of moist, overcast weather. The least time- and labor-consuming emergency measure for homeowners is therefore to broadcast annual ryegrass or other quickly germinating species at the rate of 15 to 30 lb./acre, rake the seeds about 1/2 inch deep into the soil where feasible, and then water lightly and regularly. Watering may be necessary two or more times a day during hot weather.

Grasses have fibrous root systems that are very effective in competing for soil moisture. When replanting of shrubs or ground covers is planned for the spring or begins immediately after the fire, annual grasses must be separated from



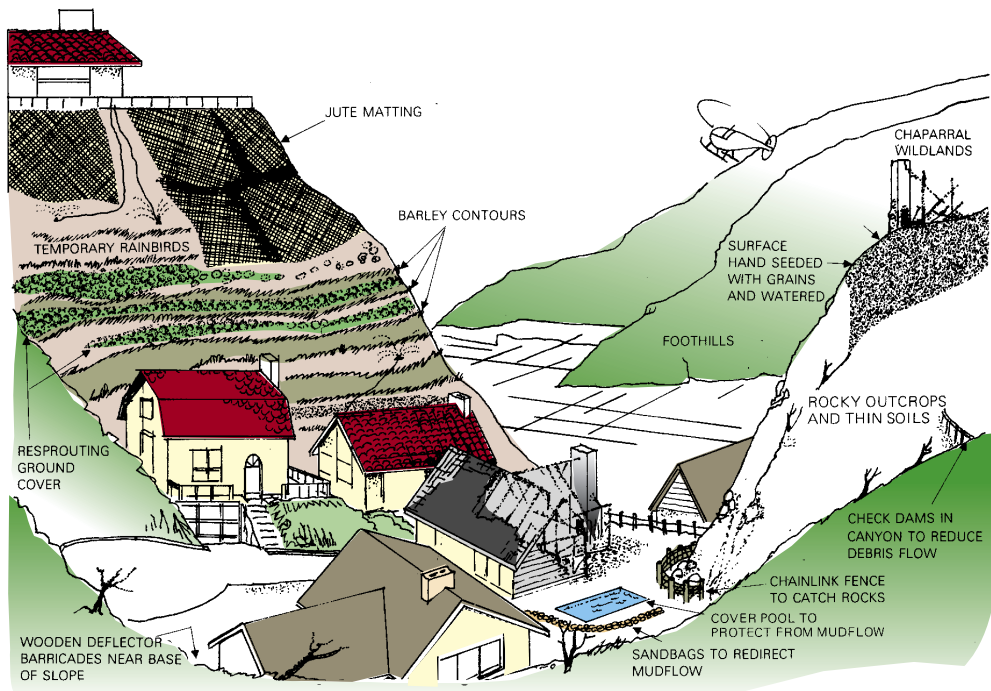


Figure 8. Immediately after a fire, emergency measures should be taken to rehabilitate the watershed.

such plants and should be seeded in contour rows. Such rows should parallel the slope and are easily established with a hoe. They should be spaced about 3 feet apart but could be closer in steeper terrain and on fine-textured soils with low infiltration rates. The ground covers are planted between the contour rows. Contours are very effective in reducing erosion because the ridges and trenches form a series of mini-terraces allowing water to infiltrate into the soil. This increases plant growth, reduces runoff, conserves soil moisture, and prevents soil losses. Do not use contour rows in active landslide areas. Cover these areas with plastic using the guidelines discussed in the next section.

Barley is an effective species for contour row planting. Seeds should be soaked overnight in gunnysacks (cloth bags) in leaky trashcans. The recommended seeding rate is 150 lb./acre with about an equal amount of ammonium phosphate fertilizer. Seeds should be buried about 1/2 to 1 inch deep and the soil tamped. Where possible, the site

should be lightly watered to promote rapid germination. Rapid germination also reduces excessive depredation of seeds by birds and rodents. Barley is readily available from feed stores, but buy only recleaned barley; rolled barley (used for feed) will not germinate. Annual grasses, such as ryegrass and barley, die with the return of hot weather and then present a fire hazard and also continued competition with landscape plants if allowed to go to seed. Plants should therefore be cut down to stubble in spring before this happens and the stubble used as mulch.

## Mechanical Measures

Flood control offices in many jurisdictions provide excellent advice and pamphlets on mechanical measures for use in emergency situations. The most effective methods for homeowner use are wooden deflector barriers (usually plywood) and sandbags that rechannel



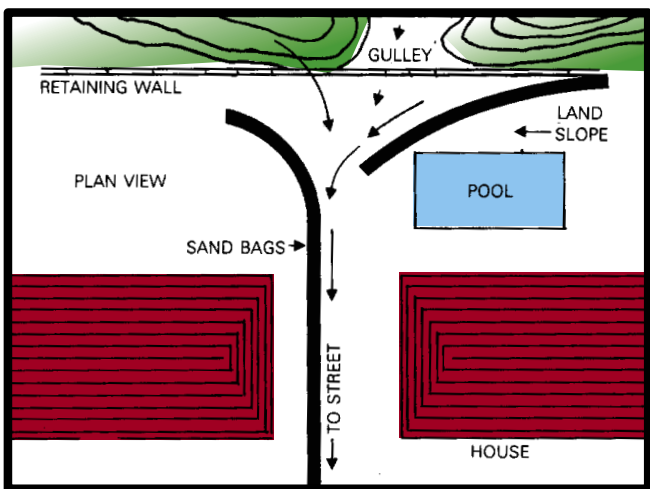
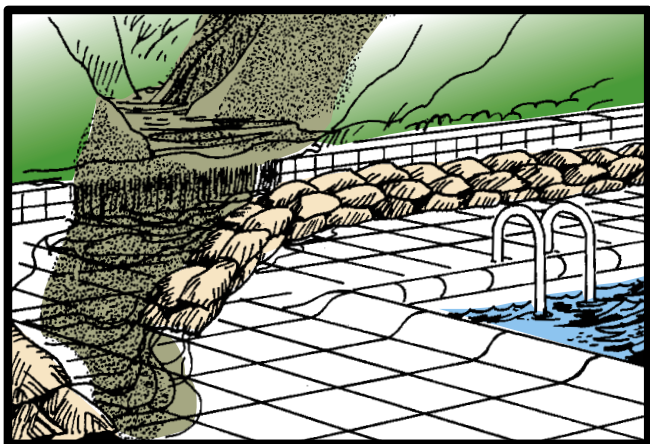


Figure 9. Sandbags divert flowing mud.

mudflow safely around structures. Figure 9 shows that the placement of such structures is critical in achieving the desired results. Sandbags should be filled half-full with sand or soil and the flaps tied under and pointed in the direction of the water source. Bags should be tamped and tightly fitted and each layer staggered, as when building a brick wall. Rows should not be more than three layers high unless they are pyramidal or supported by a building.



Post-fire emergency control measures are effectively used to protect the foundations/building sites of burned homes.



Barley contours effectively reduce soil erosion.

Some other effective measures are check dams to reduce gully erosion, chain link fences to control rock fall, and guniting of steep slopes and spreading of plastic to eliminate water infiltration. Plastic sheets should be 6 mil (0.006-inch-thick) because they are sturdier than 4 mil. The slope should be covered completely and the plastic should be anchored by partially filled sandbags. On steep slopes, the sandbags should be connected using ropes. Plastic sheets that cover only a small section of a slope (as when some sheets have blown away) concentrate the rainwater and are responsible for localized saturated soils and slippage.



*The plastic is well anchored and covers the whole slope.*

## ***Summary***

- 🔥 *Survey fire damage in relation to topography (the whole watershed) and structures.*
- 🔥 *Obtain expert advice immediately and coordinate quick action with other residents.*
- 🔥 *Use vegetative as well as mechanical emergency measures effectively, taking care to avoid possible damage to other properties.*

# *Applying The Lessons Learned*

## **Basic Wildland-Urban Interface Fire Safety Concepts**

### **(Re) building**

1. A wood shingle roof has a generally higher probability of igniting from burning firebrands than native chaparral vegetation.
2. Even with 100 feet of 'brush clearance,' a house with a wooden roof has a 21 times greater probability of burning than a house with a non-wood roof.
3. Even a small two-story structure on level ground can create enough radiant heat during its burnout period to ignite wood siding, etc., on homes within an approximately 60-foot radius.
4. While the burnout period for chaparral fuels in a wind-driven fire is generally less than 15 minutes, the burnout period for structural fuels (houses) may last hours. During this time period your home may be subjected not only to invisible radiation heat from a neighboring burning house that raises surrounding vegetation and structural fuels to the ignition point, but also to visible firebrands that may invade your home unnoticed.

### **(Re) landscaping**

5. For a point source of radiation such as a tree or bush, the heat intensity decreases with the square of the distance from the source. Thus, a tree burning within 20 feet of a window transfers only one-fourth the heat to the house compared with a tree burning within 10 feet and only one-sixteenth of the heat compared with a tree within 5 feet.

6. For a line source of radiation, such as a hedge or row of trees, the heat intensity only decreases with the distance instead of the square of the distance and a house receives this heat from all points along the line. Thus the heat intensity received 20 feet from a burning hedge is still one-half that at 10 feet and one-fourth that at 5 feet.

7. Increasing the number of flammable landscape plants around a home and increasing the number of trees, or both, will make a home more prone to fire, despite legal brush clearance.

8. The term 'fire resistant' is a misnomer in relation to flammability of plants and gives the homeowner a false sense of security, as all plants will burn under the proper fire weather conditions. In fire ecology the term 'fire-resistant' denotes that a plant is adapted to fire such as having thick bark (e.g., mature Ponderosa Pine) or will readily resprout from epicormic roots or shoots (e.g., Coast Live Oak) or will regenerate through prolific seeding (e.g., *Cistus* spp.). The species named can burn under the proper conditions if not maintained in a fire-safe manner.

9. Landscape fuels that burn adjacent to a house create enough conductive and radiant heat to ignite wood siding, wooden decks, trellises, and to break windows. Unprotected windows are often the 'Achilles heel' for fire entry even on a 'fire-safe' designed home.

10. A six-foot-tall mature, continuous chaparral fuel mass burning on steep slopes can create enough radiant and convective heat during its burnout period to ignite upslope homes more than 100 feet away (in other



words the flames and heat produced can reach across a 100-foot-wide fire safety zone (inclusive of the 30-to-100-foot irrigated zone) to ignite flammable components on the house, especially if the house is unattended.

## Lessons from the Ashes

*Major factors of home losses during the 1961 Bel Air/Brentwood Fire*

### Home construction

1. 75% of buildings destroyed had wooden shingle roofs.
2. 66% of dwellings, which sustained any damage, were first ignited on the roof.
3. 12% of dwellings destroyed had unprotected eaves as their point of fire entry.
4. 3% of dwellings destroyed had underflooring as their point of fire entry.
5. 1.5% of dwellings destroyed had windows as their point of fire entry.

### Home Location

6. 70% of dwellings destroyed were located within 50 feet of chaparral.
7. 45% of dwellings destroyed had minimal or no slope setback.
8. 45% of all stilted or cantilevered homes were destroyed (mostly side slope).
9. The burning of homes along ridge tops was not random but was directly correlated with the intersection of main and tributary canyons.

10. Homes situated in steep canyons, at the top of canyons, draws, saddles, along narrow ridges, without adequate slope setback, etc., were especially vulnerable to fire.

## A Few More Things to Keep In Mind In Protecting your Home

During the critical time period when a fire front moves through an area, there are only limited resources such as firefighters and water available, with the latter being generally the most critical factor. Adequate hydrant water pressure and flow is dependent on limited hydrant use. When homes burn simultaneously or need to be protected from multiple hydrants by fire personnel, water pressure and flow drop quickly. It is the same as when your family attempts to take simultaneous showers throughout the house.

Wood homes often require a huge amount of water to be saved, compromising the safety and protection of other houses. In excess of 50,000 gallons of water have been documented as used by homeowners in protecting their large wooden homes as the fire front moved into an area and then did not actually move on as surrounding houses burned and showered the neighborhood with firebrands. Wood homes, even wood shingle homes and wood accessory structures such as decks, are nevertheless still permitted (even sideslope on steep hillsides or in fire funnels) in many highly fire-prone mountain communities, even after disastrous wildland fires. Permitting the placing of wood shingles over 1-hour fire resistive materials in high to extreme fire danger areas or buffer zones, and not developing standards for siting of homes, is still a socially and politically acceptable compromise that largely ignores sound wildland fire safety principles and leads to cyclical recurrences of fire disasters. The ready availability of prefabricated homes that are comparatively quick, easy, and cheap to build (unless fire-safe upgrades are required

or voluntarily incorporated) makes it feasible to develop even low-value lots in high-risk areas that often provide only limited infrastructure protection.

Water is generally now, and probably will always be, the most limited factor in effective fire protection. For that reason innovative ways are constantly being developed to improve the effectiveness of water.

Where fire is imminent a safety zone can be established in the vegetation around homes with long-term “indirect” fire retardants that last weeks to months to limit the spread of fire. These retardants generally remain effective until removed by rain or erosion and are usually applied by fire protection agencies. Since they are based on ammonium phosphate, a fertilizer, they should be hosed off trees and shrubbery after the fire danger has passed. A “fertilizer” burn can be expected on some vegetation.

Foam and gel water mixtures as well as pool and pond pumps are probably the most innovative/effective approaches to house-to-house wildland fire protection to become established practices in the last 20 years and can be readily adapted for homeowner use. It has been documented time and time again that homes burned because of lack of water from primary sources such as storage tank systems and public hydrants, while perhaps in excess of 500,000 gallons of auxiliary water supplies in private pools were not used. But water alone may not do the job.

Foam and gel water mixtures are short-term direct attack methods that can be effectively applied by the homeowner. Foams are quite effective in extinguishing fires but lose their effectiveness within a short period of time (generally less than one-half hour after application) since water drains from the foam, air bubbles burst, and the foam collapses.

Gels, the basis for home fire protection systems, can be readily applied by the homeowner prior to a fire even with a sprayer attached to a garden hose. They stick to and coat

structures for many hours even under Santa Ana drying wind conditions, and can be rejuvenated by applying a fine mist. When coating a house, windows as well as accessory structures such as fences and propane tanks should also be coated. But, remember, you have to be at home to do the job. Since fires may start when you are not at home, be prepared and first create a fire-safe home environment as your first line of defense. Use of homeowner applied gel systems is an effective secondary line of defense.

The Internet should also not be overlooked as a source for up-to-date information on these state-of-the art home fire-saving devices.

Mutual firefighting aid (the pooling of fire personnel and equipment resources during emergencies) has been fine-tuned for over twenty years but has generally been overrated in effective house-to-house fire protection. It may be of limited use during the critical early hours because of lack of proper equipment adapted to steep terrain in areas of limited ingress and egress, limited wildland fire training of urban firefighting personnel, and lack of familiarity with the local terrain by out-of-town firefighting agencies. U.S. Forest Service and California Department of Forestry and Fire personnel are outfitted with small vehicles more adapted to hit-and-run tactics. If circumstances and terrain permit, they can also stay put in safe or hunker-down areas as the fire front passes and carry foam and pool/pond pumps as standard equipment.

Where feasible, such hit-and-run tactics by a limited segment of the firefighting force, being properly equipped and familiar with mountainous terrain, can effectively protect homes during the initial phase as the fire front passes. But they will not protect homes during a longer burnout period if such firefighting forces try to keep ahead of an erratic fire front. While the burnout period of a stand of mature chaparral may last up to fifteen minutes as a fire front moves through, a mixture of trees and flammable structures and erratic winds that often result in incomplete burnout

and a return of the fire as the wind shifts can extend this burnout period to many hours. Homes must therefore be attended throughout the burnout period of surrounding fuels.

## Fire Exposure (Risk)

Wildland fire exposure or risk can be defined as the probability that a given home, subdivision, or community will experience wildland fires within a given time period. So, be prepared, understand, and work to minimize the risks. Fire becomes a way of life and it is highly likely that your community will encounter fire on an average of about every ten years if situated adjacent to or within watersheds covered by native chaparral.

The degree of exposure (risk) an individual home, community, or section of a community faces is a function of the fire history (frequency and severity) in the surrounding vegetation or probability of fire within a certain vegetation type, increase in fire frequency brought on by encroachment of the community into flammable watershed areas and nearby human activity, and site-specific exposure factors such as the proximity to flammable vegetation, siting of structures, construction materials, construction style, etc. (see: Fire Hazard).

Remember that effective fire protection starts in the planning process. Homeowners and homeowner associations, as responsible partners, should get involved in this process as well as in preparing pre-fire plans in cooperation with fire protection agencies. Allowing homes to be rebuilt after a fire on an even larger scale and with greater density, not significantly improving the infrastructure to enhance ingress and egress, not widening streets and driveways, not improving water supply and water flow, and not strictly enforcing fuel modification and maintenance that eliminate

flammable fuels leads to man-made fire disasters on a cyclical basis.

To account for site-specific risk and hazard factors often not addressed by public agencies, fire insurance carriers generally require “brush clearance” much in excess of 200 feet. Satellite imagery to assess risk factors such as proximity to “brush” will be an ever-increasing first low-cost step in the future in assessing insurability in fire-prone environments. Where the risk cannot be spread, insurers are unlikely to insure or will raise their rates.

## Fire Hazard

You, as a homeowner or homebuyer, can affect fire hazard much more than fire risk. By remembering and understanding the basic principles, you can turn the odds in your favor and make your home and community safer. So, again, be prepared, understand where you can be effective, and work to minimize the risks.

Wildland fire hazard can be defined as the potential severity of a fire in a given area due to the availability of:

### 1. Natural vegetative fuels

Type and size of fuels, age, fuel continuity, fuel loading (amount of fuel), litter production (amount and type of litter produced by the plant during its seasonal growing cycle).

### 2. Landscaping/ornamental fuels

Type and size of fuels, age, fuel continuity, fuel loading (amount of fuel), litter production (amount and type of litter produced by the plant during its seasonal growing cycle), maintenance of flammable landscape vegetation (or lack thereof) to make it less flammable or ‘nonflammable.’



### **3. Man-made structural fuels and their design/location**

Size and type of flammable structural components such as wood roofs, wood decks, wood siding, exposed windows, wood window frames, open/non-enclosed eaves, non-protected exterior attic and underfloor vents (permitting fire entry into the interior of the structure), flammable fencing and railing, non-skirted underflooring of houses or decks (unprotected from fire entry from underneath or the sides), flammable outdoor furniture, etc.

### **4. Topography (terrain)**

Topography and the siting of a structure are very critical factors in fire exposure or risk. For example, fire can travel uphill 16 times faster than downhill. A fire spreading uphill resembles a fire spreading before a strong wind. Other factors being equal, a fire burning on level ground will spread twice as fast when it reaches 30% slopes. The rate of spread will again double as the slope reaches 55%. Heat energy release rates will be correspondingly faster and greater as indicated by greater flame length per foot of fire line.

### **5. Typical fire weather conditions**

Low humidity, strong drying winds, and high temperatures.

### **6. The overall development pattern of the area**

Location and siting of homes within mountain topography (side-slope homes, homes located along ridges with minimum setback, homes located in saddles or draws, etc., are at greater risk and are often considered 'a design for disaster'). Construction of homes, exposure of construction materials, exposure distance to flammable vegetation and flammable structural fuels (such as closeness of homes to each other).

# *Firebreak/Fuel Modification Information (for Structures in Fire-hazardous Areas)*

**You are required to clear flammable vegetation only on your own property. Clearance on adjacent properties is the responsibility of the owner. Contact your local forestry or fire personnel if such clearance is needed.** However, be aware that if private homes abut public property or their siting was chosen to take advantage of views irrespective of natural resource protection, required fuel modification may often have devastating impacts on budgets of public park agencies. This is especially true in situations where required fuel modification distances were increased beyond 100 feet without a focused EIR and without assessment of impacts on the environment and the ability of public agencies to fund such protection for private individuals. If benefiting homeowners or homeowner associations are not willing to take on the cost of required fuel modification maintenance of public land directly adjacent to their homes, it discourages the further dedication of pocket parks and open space.

Firefighters who must protect your home from a brush fire would like every advantage they can get. Ideally, they would like to see every bit of hazardous vegetation cleared away, right down to mineral soil.

Homeowners, on the other hand, want the beauty of native vegetation and the seclusion it offers. They also realize that during a major fire conflagration, firefighting personnel are 'spread thin' and homeowners may become the key to saving their own homes. Are you prepared? Can you save your home or can it save itself?

Both natural resource professionals and homeowners realize the danger from soil erosion that will result from a barren hillside; nevertheless, the native brush must be cleared or

modified by law to a point where a home will stand a good chance of being saved in the event of a fire.

## **California law requires you to:**

1. Maintain an effective firebreak by removing and clearing away flammable vegetation and combustible growth from areas within (a minimum of) thirty feet of buildings or structures (Exception: Single specimens of trees, ornamental shrubbery, or similar plants used as ground covers, provided they do not form a means of rapidly transmitting fire from the native growth to any structure);
2. Maintain additional fire protection or firebreaks by removing brush, flammable vegetation and combustible growth located within one hundred feet of such buildings or structures, when such buildings or structures are located within very high fire hazard zones, and are designated by the California Fire Department of Forestry and Fire Protection's Fire Hazard Severity Zone Classification system (Exception: Grass and other vegetation located more than thirty feet from buildings or structures and less than eighteen inches in height above the ground need not be removed where necessary to stabilize the soil and prevent erosion);
3. Remove portions of trees which extend within ten feet of the outlet of a chimney;
4. Maintain trees adjacent to or overhanging a building free of deadwood; and
5. Maintain the roof of a structure free of leaves, needles, or other dead vegetative growth.

## **To Provide Added Fire Protection in and Around Your Home and Garage:**

Remove any combustible structural fuels within the 100-foot minimum safety zone. Realize that wooden fences can act as fire fuses that lead fire directly to a structure.

As required by code, screen the chimney to prevent sparks from igniting the roof or flammable vegetation. Use half-inch wire mesh.

Not only keep all trees, shrubs, or other vegetation adjacent to or overhanging any structure free of dead limbs, branches, and other combustible matter, but also ideally, do not even allow tree limbs to encroach within ten feet of your house. Also keep trellises away from any structures.

Keep the roof and rain gutters free of dead leaves, twigs, and other combustible matter.

Keep all combustible rubbish in non-combustible rubbish containers with tight-fitting lids.

Stack woodpiles neatly and compactly in a location remote from buildings, wood fences, and other combustible materials.

Clear all flammable fuels for a minimum of twenty feet from liquefied petroleum gas storage tanks.

Provide effective fuel breaks in excess of twenty feet wide on either side of roads leading to your house by clearing all flammable fuels. Greatly increase this distance in steeper terrain.



*This Handbook was brought to you by:*  
The City of San Diego Water Department in cooperation with  
The San Diego Fire Recovery Network and The Conservation Action Committee.

For water conservation information call (619) 235-1984  
or visit [www.sandiego.gov/water](http://www.sandiego.gov/water).

