CALIFORNIA COASTAL COMMISSION
SOUTH CENTRAL COAST DISTRICT
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W19b

LCP-4-MAL-20-0035-1 (City of Malibu)

August 12, 2020

CORRESPONDENCE

LCP-4-MAL-20-0035-1
CITY OF MALIBU

August 9, 2020

While some of my previous concerns and comments that I had expressed to the City of Malibu Planning Commission on 11-18-2019 and 1-11-2020 have been addressed, codifying fire safety in fireprone wildlands that have often been developed without concerns for public safety such as in Malibu remains a conundrum.

I truly believe that home losses in wildland fires will not be reduced in the future with the City of Malibu's amendment to the Local Implementation Plan (LIP) portion of its certified Local Coastal Program (LCP) unless homeowners maintain their properties in a fire-safe condition year-round and the City of Malibu and the local Fire Department finally gets knowledgeable and dedicated boots on the ground to implement a meaningful fire safety program irrespective of or in addition to these proposed changes.

Past fire history has clearly shown that the minimum distances, as proposed, are still not enough to reduce or eliminate wildfire conflagrations. As proposed, hedges and flammable fences and walls are now prohibited within (still only) five feet of the outermost projections of any building while main buildings on the same lot must (still only) be separated by a minimum of ten feet, and projections are still permitted within six feet of the required ten feet. These projections could possibly consist of heat-, fire- and firebrand-trapping projections inclusive of shade structures which are defined as temporary or permanent roofs or a coverings made of or supporting plants or vines which are designed to provide shelter from the heat or glare of the sunlight.

Where do we go from here?

Sincerely yours,

Klaus W.H. Radtke

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January 11, 2020

To: Malibu City Council

Re: Local Coastal Program Amendment No. 19-002 and Zoning Text Amendment No. 19-004—Amendments to the Local Coastal Program and Malibu "pertaining to fire-resistant landscaping and a safer fire environment."

You are facing the conundrum of new requirements for homes that burned during the 2018 Woolsey Fire or for otherwise new construction without being able to truly address Malibu's almost unique fire-prone environment, as almost all wind-driven wildland fires coming over and down the central Santa Monica Mountains will stop at the beach as they run out of fuel.

While I will not further comment on the specifics of the proposed amendment as you have relied on many sources to come to this conclusion, for further clarification I am providing herewith as **Attachment # 1** the letter I forwarded to the Planning Commission on November 18 on the subject.

Attachment #2 takes a fire-science-based look at fire problems in the Santa Monica Mountains from a more historic perspective such as also quoting the 1973 Stanford Research Institute think tank report *Decisions Analysis of Fire Protection Strategy for the Santa Monica Mountains*[1] that concluded that fire losses in the Santa Monica Mountains could be limited to 7 years if…...

The report was based largely on raw data provided by the City and County of Los Angeles Fire Departments and the U.S. Forest Service. In carrying out a comprehensive economic analysis for protecting the Santa Monica Mountains from wildfire, the report proposed and analyzed the following three alternatives:

1. To reduce the number of wildland conflagrations.
2. Given the number of wildland conflagrations, to reduce their extent.
3. Given the number of wildland conflagrations, to reduce the damage (to structures).

The fire-adapted vegetation in the mountains and the fire weather patterns make wildland fires inevitable. Reducing the number of wildland fires and reducing their size would require lateral fire barriers such as firebreaks of at least 200 feet in width or wider fuel breaks that require a large labor input for maintenance of even greater width. Attempting to stop the frontal advance of wildland fires to the beach would require horizontal (E-W) firebreaks of at least ½ mile in width. But even then, there would be no guarantees that wind-driven wildland fires could be stopped because of spotting of firebrands. As such, alternative 3 was the only one economically feasible with benefits to society overall. It used the fire loss data of the 1961 Bel Air Fire in predicting future fire losses in the Santa Monica Mountains. In using the least-cost plus-loss planning method, the conclusion was that, with then approved (fire-retardant) roofs and "brush" clearance of 100 feet, the average home destruction rate could be limited to 7 homes per year for the whole Santa Monica Mountains stretching from Ventura County to Griffith Park.
To accomplish this, the three final recommendations were:

[1] Stanford Research Institute. *Decisions Analysis of Fire Protection Strategy for the Santa Monica Mountains: An Initial Assessment.* Prepared for Forest Service. US Department of Agriculture. Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. Stanford Research Institute. Menlo Park, CA. Oct. 1973. 159 pp.

1. Public Education - Fire agencies should emphasize that occasional large-scale fires are inevitable in the Santa Monica Mountains and urge that steps be taken to minimize the loss when the conflagrations occur.
2. Insurance Surcharge Rates - The brush surcharge rates should be set to reflect expected losses. If present rates do not meet this criterion, they should be revised.
3. Planning for Fire Protection – Fire protection agencies should use the least-cost plus-loss economic planning methods as illustrated in the report; fire research and planning groups should continue to develop them.

The report also noted that brush clearance is inadequately enforced and only applies to "brush," and that flammable landscape vegetation that often replaces flammable brush is not required to be cleared. The report then suggested that research should also be directed towards the role of ornamental shrubbery in the spread or containment of fires. It also stated that additional steps should be taken to protect individual homes from fires aside from the first step of installing fire-retardant roofs (whose meaning has now been replaced with the more stringent requirement of nonflammable and preferably Class A roofs as well as Class B roofs) and clearing the "brush" should include:

1. Reducing overhanging roofs and closing other openings to the house to prevent flying embers from entering it.
2. Installing fireproof shutters, especially on the sides of the house that get direct fire exposure.
3. Having auxiliary pumps for swimming pools.
4. Eliminating flammable objects from the yard.
5. Improving access driveway standards.
6. Initiating programs to train able-bodied citizens to defend their houses during periods of moderate fire exposure.

If all the above listed items would have been diligently followed up and enforced, the report estimates that fire losses could perhaps have been reduced to that approaching the average of 7 homes per year. However, the Stanford Research Institute report did not foresee the continuous permitting of homes (inclusive of the proliferation of accessory structures and barns, flying decks, wooden balconies and wooden fences) in high fire risk areas. The siting and density of such homes added structural fuel components that increased the spread and reduced the containment of fire. Also, the role of topography was not yet addressed in "brush" clearance requirements, and (as even shown today in most brush clearance publications) most fire department pamphlets still show the house situated on level land with proper ingress and egress that includes the building pad as well as a flat 100-to-200-foot clearance distance with no surrounding homes. The real problems faced by homeowners struggling with living in steep mountainous topography with often limited ingress and egress and with other homes nearby is often an instant disconnect when they are provided with such unrealistic guidelines.

Attachment #3 is an excerpt of the over-100-page report titled *The Homeowner – The Forgotten Firefighter* (firesafetyus.com) and pertains to the Nov. 2-3 Old Topanga Fire in Malibu. It is being updated and finalized with additional information provided by homeowners that largely did not evacuate and stayed behind to fight the fire in order to save their own and neighboring homes. Newly built, highly exposed view homes were often the first to ignite when windows blew out. Storm (fire) shutters were the keys in saving some of these homes. As described and witnessed, vegetation that was not maintained in a fire-safe condition burned readily. As plants mature, their crowns shade out what then becomes an interior crown of largely fine, dead fuel that is instrumental in carrying the fire while the exterior crown may look lush and green.

While some may have called it a mystery or miracle that their vegetation did not burn while the neighbor's vegetation maintained in the same manner readily caught on fire and burned the house

down, it must be remembered that the wind, acting like bellows, makes the final decision as to what will or will not burn.

While the exterior crowns of vegetation may look lush and green, interior shaded crowns often pose an extreme fire hazard if they are not well-maintained, and dead, fine fuels accumulate that are instrumental in quickly spreading wildfires.

Furthermore, the term 'fire-resistant' landscaping is such a confusing misnomer as it is also used in the literature for plants that may burn readily but survive a fire because of prolific regeneration from seed or re-sprouting from epicormic roots or shoots. For example, in the City of Malibu two types of potentially highly flammable pines are primarily planted for privacy screening, namely Aleppo Pine and Canary Island Pine. Occasionally Monterey Pine is also planted. However, the last-named is used only to a limited extent because it is not drought-tolerant and requires more care. As can still be witnessed throughout the Woolsey Fire burn wherever Canary Island pines were planted along roadsides by the County Fire Department's former Forestry Division over the years, they have re-sprouted from the trunks or stems no matter how badly they were burned. On the other hand, most of the Aleppo Pines that faced similar fire exposure conditions are dead. Unbeknown to most, the small Aleppo Pine cones pose an additional fire hazard. The cones are small, have already largely opened and dispersed their seeds by late summer and readily catch fire when exposed to direct flame impingement and then become wind-driven fire bombs. Some years back, a mountain homeowner learned it the hard way. While a beautiful trailer home shaded by and hidden away under a large Aleppo Pine with adequate setback and good clearance on the top of a hill was not impacted by the flames from below, the dying flames did touch the crown of the Aleppo pine. Soon a rain of fire bombs as witnessed by the residents descended onto the trailer home and the rest was history.

Dead pine needles dropping on roofs and raingutters, collecting around structures or within the interior crowns and at the base of the trees, pose almost year-round fire hazards. For example, the October

19, 1991 Oakland Tunnel Fire started on a Saturday afternoon in pine needle litter at the base of a non-maintained Monterey Pine tree. While the local Fire Department quickly 'extinguished' the small burn, the litter, fanned by drying winds, flared up again on Sunday morning. The reignited fire quickly expanded through the grassy hills, brush, pine and eucalyptus trees, also being fed by often closely packed wooden houses with wood roofs. By sunset 25 lives had been lost and over 3,000 single family homes and apartments had largely turned to ashes.

It is very difficult for you to therefore come up with truly meaningful amendments since the keys to a more fire-safe environment are still fire-safe construction in topography where the structure can be safely protected and where vegetation is maintained in such a way that it will not carry a fire. If any of the legs of this basic home fire triangle is broken, unattended homes often have little chance of survival. The basic problem is that homeowners, either for privacy concerns, cost reasons, or perhaps even ignorance, do not maintain their property in a 'fire-safe' manner. Living in a wildland fire environment requires almost year-round vigilance as erosion, slides, and mudflows can be additional concerns.

So, in summary, it takes more than amendments pertaining to "fire-resistant landscaping and a safer fire environment" to make Malibu more "fire-safe." A good start would be to review the1973 Stanford Research Institute think tank report and truly follow through with its recommendations on a year-round basis.

Sincerely yours,

Klaus W.H. Radtke

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Appendix 1

November 18, 2019

To: Chair Jennings and Members of the Planning Commission
Re: Local Coastal Program Amendment No. 19-002 and Zoning Text Amendment No. 19-004—Amendments to the Local Coastal Program and Malibu.

On Page 1, Discussion, it states:
In November 2018, the Woolsey Fire damaged or destroyed over 440 homes in the City and significant amounts of landscaping and other structures, including decks, hardscapes and fences. Although fires have historically been unpredictable, dependent upon factors such as wind speed, wind direction and fuel load, it is possible that standards could be established to decrease a property's likelihood of burning and spreading the fire to neighboring properties. Fuels for fires include, but are not limited to, dead plant material, buildings, decks, fences and other flammable materials such as mulch.

Please note that there are some inaccuracies in this long statement, as underlined, that must first be acknowledged as we have apparently not learned from past mistakes.

Funded under the Forest Service/Los Angeles County cooperative research contract and at the request of County Board of Supervisors, I wrote *A Homeowners Guide to Fire and Watershed Management at the Chaparral/Urban Interface* in 1982 (*HOGFW* Attachment 1). It was updated in 2004 to keep it in public domain, still downloadable from the web as of today (HOGFW Attachment 2). In 1981 the article *Fire History of the Santa Monica Mountains* (FHSMM Attachment 3) was also published. Such information was then spread throughout fire-prone mountain communities. Subsequently, in 1984 the National Foundation for Environmental Safety (NFES), with Judge Baker as moderator, gave an evening seminar at the Malibu Library to a packed audience consisting of fire personnel from throughout the area, public officials, homeowners and news services. The predictability of wildland fires affecting the Santa Monica Mountains and specifically Malibu was demonstrated on wall maps along with handouts. Such information was then further provided throughout the years to the community by NFES and local newspapers (Attachments 4, 5, 6, 7, 8).

Since the lessons learned were not yet implemented during the 1993 Old Topanga Fire, the County of Los Angeles Fire Department was then largely blamed for the "lack of community preparedness and lack of effective firefighting" with many stating that if Malibu would have been an independent city, it would not have happened. Then incoming County Fire Chief Freeman, eager to learn from mistakes, immediately organized along with the upcoming new City of Malibu a large Fire Safety Fair to educate homeowners for the inevitable. He also changed the Fire Department's policy from forced evacuation to voluntary evacuation and closer communication with residents. However, apparently not learning from past mistakes and lessons learned being forgotten with new City employees and changing City management, the City did not follow through with such Fire Safety Fairs but instead took the easy way

out – like most agencies – just publishing a safety brochure instead of boots-on-the-ground education along with the Fire Department and making sure that existing laws are already enforced.

This brings us now to the 2018 Woolsey Fire and the lessons that were already published in the 1980s and known to local elected and fire officials but soon forgotten. According to a *Los Angeles Times* article dated Jan. 6, 2019,[2] Los Angeles City fire officials already predicted the fire-driven path of the Woolsey Fire soon after it started, namely that it would end up in the City of Malibu pointing towards Point Dume and would stop at the beach. This was not based on rocket science but on common sense. I believe that, given the fire prediction information distributed since 1981, almost every high school student in the City of Malibu could have accurately predicted where the fire would end up, given the fire start.

The Woolsey Fire, contrary to what County Fire and City of Malibu officials want the public to believe, was therefore not an unpredictable fire but gave the City of Malibu almost 24 hours notice that it was coming, compared to other past wind-driven fires that started near the top of the mountain and raced to the beach within hours. Given this fact, many home losses could have been prevented and much of the evacuation panic avoided if the City of Malibu – independently, as I believe, was its duty – would have immediately issued a bulletin such as perhaps the following:
A fire has broken out near xxx during extreme fire weather conditions. The fire, fanned by strong Santa Ana winds, can be expected to reach the City of Malibu within the next 24 hours. Assure that your home is prepared for the assault of the fire by removing away from any structures all flammable items that can be ignited by firebrands or flame impingement. Also make sure that all cars, travel trailers, etc., are garaged or are moved out of the area, as firebrands raining from the sky ahead of the fire can readily ignite them.

If you have not prepared your property for a wildland fire, be prepared to evacuate. Note that mobile homes are extremely vulnerable to wildland fires and therefore can virtually not be protected during an onrushing wildfire despite present fire clearance codes. So, if you are living in a mobile home, be prepared to evacuate.

Don't depend on fire hydrants or your water hoses to provide fire protection as the fire overruns your community. Water systems are designed to provide fireflow for fighting individual structural fires and not for simultaneous fire needs during wildland fires.

Now back to the proposed amendments before you today. What is the meaning of adopting a new amendment if you could not even enforce what is presently on the books? Writing and adopting laws is meaningless if the enforcement power and spirit is not behind them.

Some sections of the proposed "fire-resistant plant ordinance" (a misnomer in itself) are well-intended and meaningful as they address many of the reasons why largely unattended homes burned during the

[2] Cosgrove, Jaclyn. *Los Angeles Times.* Firefighters' fateful choices: How the Woolsey fire became an unstoppable monster 1-6-2019.

Woolsey Fire. However, the ordinance as a whole it politicized, as some sections of it will just lead to future predictable designs-for-disaster while largely keeping the status quo. The basic concepts of conduction, convection, and radiation heat sources were explained in *HOGFW* so that, I believe, even high school students could readily comprehend them and therefore assist their parents in preparation of a wildfire. They should be fully understood, acknowledged and incorporated in any amendment and then implemented and enforced.

On Page 12, the proposed amendment states: *An alternative to prohibiting the planting of highly flammable trees completely is to prohibit the planting within 30 feet of structures. The proposed amendment would prohibit the planting of the following trees and shrub species within 30 feet of structures:*
1) Eucalyptus (Eucalyptus, gum tree)
2) Pine (Pinus species)
3) Cypress (Cupressus species)
4) Cedar (Cedrus species)
5) Tree of Heaven (Ailanthus altissima)

So, according to these statements, homeowners could plant a row (a line source of radiation) of what is acknowledged to be highly flammable landscape vegetation such as pines or Bluegum Eucalyptus trees 30 feet from their home (what kind of home and where is it located). Have we not created the recipe for a future urban firestorm?

As the trees mature, their crowns expand and their branches encroach within 15-20 feet of the house to provide it with the required privacy as still allowed by the amendment. If unattended, the houses have a high probability of igniting as the aerial fuels will be instrumental in supporting the firespread, and the fire's radiating heat will make it impossible to protect the homes throughout the burnout period of the trees and can readily blow out windows.

A nearby homeowner, perhaps also foolishly, plants only a single pine tree thirty feet away from his home and also makes sure that it is set back for such a distance from any accessory structures inclusive of nearby neighbors' homes. His home has a chance of surviving a fire, even if unattended, if the tree burns but this all depends on the fire winds. So, what are the differences in heat sources expected if a row of trees, a hedge, a wooden fence (a line source of radiation) catch on fire compared to a single tree (a point source of radiation).

As restated on page 41 of the 2004 *HOGFW*, 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 (1/2) that at 10 feet and one-fourth (1/4) that at 5 feet.

For a point source of radiation such as a tree or bush, the heat intensity already decreases with the square of the distance from the source. Thus, a tree burning within 20 feet of a window transfers only one-fourth (1/4) the heat to the house compared with a tree burning within 10 feet, and only one-sixteenth (1/16) of the heat compared with a tree within 5 feet.

Given these facts, increasing the number of flammable landscape plants around a home and increasing the number of trees, or both, will make a home much more prone to fire, despite legal "brush clearance."

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

The following is also well to remember:
A.) 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. Wind-driven firebrands will also shower the neighborhood during the burnout period.
B.) 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.
C.) 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. If the wind cooperates with an uphill running fire, flames of up to 100 feet long could even be expected that directly impinge on the house. Two-foot-tall mature low fuel plants such as prostrate coyote brush (*Baccharis pilularis*) can already produce 30-foot-long flames on steep slopes during extreme fire weather conditions with a fire burning uphill.

Given all the fire safety conundrums that are neither acknowledged nor addressed in the proposed amendments, I strongly suggest that they be withdrawn and rewritten if so desired so that sections of the City of Malibu do not become an even greater highly flammable urban forest in the years to come.

Sincerely yours,

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Appendix 2

FIRE-SCIENCE-BASED OVERVIEW

1. **Wildland Fire Management in the Santa Monica Mountains**
2. **The Home as Emergency Fire Shelter**
3. **"Optional" Fire Shelters during Possible Worst-Case Scenario Entrapment Situations of Campers within Major Wildland Campsites**

Klaus W-H Radtke

This unpublished "draft" document attempts to provide a fire-science-based basic understanding of past wildland fire management attempts in the Santa Monica Mountains and fire safety related issues inclusive of homes as emergency fire shelters. The knowledge gained is then expanded to evaluating clearance distances that may be necessary for "optional" emergency fire shelters and the type of "optional" shelters required/ recommended during possible worst-case scenario entrapment situations of campers within major campsites in chaparral ecosystems. Such safety zones for survival are largely not feasible, and fire-safe-maintained campground sites with clear escape routes rather than relying only on optional fire shelters of campsites located in fire hazardous areas is still the best option.

For homes to be considered as emergency fire shelters in fire-prone areas, they should be so sited, constructed, and maintained as to become a safe shelter-in-place.

For a well-trained firefighter, a safety zone is defined as providing freedom from danger, risk, or injury. However, these standards cannot be achieved in many situations for campers and hikers as they are not as physically fit as firefighters, generally not properly dressed, and not trained to evaluate, confront or avoid dangerous situations. Therefore they face much greater risks to exposure. Minimum standards for the general public are therefore different from that for well-trained firefighters that are properly prepared and dressed for fighting wildland fires.

Table of Contents

I. Fire and Chaparral in the Santa Monica Mountains[3]

Chaparral is a plant community in California that has adapted over many years to summer drought and frequent fires. In other words, it is fire-dependent and needs fires to sustain and rejuvenate itself. Two distinct sub formations of chaparral called "hard chaparral" and "soft chaparral" are clearly distinguished in ecological literature and are generally referred to as chaparral and coastal sage scrub communities. This distinction is important for fire management, watershed and hillside management, as conservation efforts, as well as escaping safely in a wildland fire scenario.

The coastal sage scrub community or "soft chaparral" is rapidly becoming an "endangered" habitat because it is commonly found in California's coastal zone, where most urban expansion is taking place. It is generally restricted to the most xeric sites at lower elevations because of orographic effects, and at higher elevations because of shallow soils. The dominant species that compose the coastal sage scrub community are of smaller stature than those in the chaparral plant community and provide a more open habitat that encourages more herbaceous species including sages, California sagebrush, and Deerweed. In comparison to hard chaparral species, which tend to start growth in winter, coastal sage species tend to start growth soon after the first significant winter rains.

From the fire management and suppression viewpoints, these are important considerations. Since coastal sage scrub, because of its shorter life span and greater mixture of herbaceous species, can already become highly fire-prone within 7-10 years after a previous fire, the highest fire frequencies are found in the coastal sage scrub communities. This is well-documented in the lower elevations along Pacific Coast Highway (PCH) where fires overlap, specifically in the lower Corral Canyon watershed characterized by coastal sage scrub cover.

Woody chaparral, if not degraded by too frequent fires and human activities that provide an intermix of more highly flammable herbaceous species, does not become highly fire-prone for about 15 to 20 years. Historically, such young chaparral, because of its low dead-to-live fuel ratio, acted as effective fire barriers and helped set boundaries for past fires in the Santa Monica Mountains, as the flanks of the fire were easier to contain then, even under Santa Ana fire weather conditions.

Wildfires in Southern California can occur at almost any time of the year but are most prevalent during the dry season. Extreme fire danger conditions normally exist from September through December or until the winter rains end the dry season. Fires are most likely to occur during strong Santa Ana winds; these winds, also known as Santana, Foehn, Devil, or Fire Winds, blow from the north to northeast out of the Great Basin of Utah, Colorado, and surrounding Northern States. As the air is compressed and forced southwestward to lower elevations, it becomes hot, dry, and gusty. When Santa Ana winds meet the local mountain winds, unpredictable fire patterns are often set up, making erratic fire fronts and spotting ahead of fires a common occurrence. Within the onset of the Santa Ana winds, humidity often drops rapidly while the air temperatures rise quickly. These are called typical "Red Flag" fire weather conditions that lead to greater possibilities of brush fires spreading rapidly, and uncontrollable wildland fires. As, for example, described in the City of Malibu *Residents Handbook for Emergency Survival* (referred to as *Malibu Survival Guide*), these conditions generally exist when the wind exceeds 25 mph and the relative humidity is below 15%. Southern California averages about 15 Red Flag days every year.[4] Public parks, campgrounds, and hiking trails within fire-prone watersheds throughout the mountains are closed to the public during all Red Flag alert days.

Under Santa Ana fire weather conditions, wildfires are extremely difficult to control unless the fuel supply (vegetation and structures) is exhausted or the wind subsides.

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[3] Radtke, Klaus W.H. *Living More Safely in the Chaparral-Urban Interface*. Gen. Tech. Rep. PSW-67, Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1983. 51 pp.

[4] City of Malibu. *Malibu Survival Guide: Residents Handbook for Emergency Survival.*

In the interior mountain ranges of Los Angeles County, fire frequency and numbers of acres burned are high in the summer months because of high summer temperatures and occasional lightning strikes. In the coastal Santa Monica mountain range, fire frequency is lower in the summer, and lightning strikes are almost unknown as causes of fire. The number of acres burned during this time period is also lower than in the interior ranges because the Catalina eddy, a marine breeze characterized by cool, moist air, penetrates the local mountains, primarily during June and July.[5] This cool air is responsible for the abnormal air circulation pattern of upslope instead of downslope winds during the evening and into the night. In both the inland and coastal regions, the great toll of acreage burned from late September through December is the result of the Santa Ana wind, which has its highest frequency from September through February and is almost absent in July and August. As Malibu has experienced time and time again, during drought years, wildland fire starts with homes endangered and quickly lost can even happen in January and February during the supposedly "rainy season," especially within coastal sage scrub. For example, on January 8, 2007, at approximately 5:00 p.m., a fire starting in the vicinity of Malibu Bluffs Park near the ocean, south of Pacific Coast Highway, quickly expanded into the Colony area, burning down four houses on Malibu Road. Los Angeles County Fire Department officials traced the fire start to a discarded cigarette stub.

The amount of fine, dead fuels (generally under 1/4 to 1/2 inch in size) determines the rate of fire spread because such fuels dry rapidly, ignite quickly, and preheat live fuels to the ignition point. So, when a wind-driven fire makes a run through flammable vegetation, it will first be nourished by and consume fine dead fuels. When fine dead fuels are removed through diligent, year-round maintenance, a fire cannot spread through such areas. Direct impacts on fire-safe-built structures such as fire-safe homes are therefore minimal and of very short duration from the heat and flame sources originating beyond the fire-safe zone. Firebrands then become the biggest cause of concern, especially if a structure is unattended.

Live fuel moisture is also an important fire-safe characteristic because plants with high fuel moisture ignite less readily. Within the interior Santa Monica Mountain range (generally characterized by woody chaparral), the late summer and fall Santa Ana fire winds coincide with low live fuel moisture of plants. Within a few hours the dry, hot winds can reduce fuel moisture of fine dead fuels to the critical level of ready ignition and can further decrease live fuel moisture by a few percentage points over several days.

The major flammable native vegetation found in the Santa Monica Mountains, namely grassland, coastal sage scrub, and chaparral, have a direct bearing on fire starts, fire frequency and fire intensity because of their different fuel loads and ease of ignition. For example, the flash fuel annual grasses seldom exceed 5 tons of fuel per acre, whereas mature, woody chaparral can greatly exceed 30 tons per acre. Grassland fires may be more frequent and provide a quick heat release but are also more easily extinguished; however, they often carry the fire into the coastal sage scrub and chaparral. In any event, the fuels dictate the ease of fire starts and spread rates and this has a direct bearing on fire frequency. When the grasslands were grazed by sheep, reducing their fuel loads, the highest fire frequency was found in coastal sage. With reduction in grazing, fire in annual grasslands, especially along roads and rights of way, along with downed power lines, have become the major source of fire starts.

The predictable direction of fire spread in the Santa Monica Mountains during Santa Ana wind conditions is south to southwest. This spread pattern is primarily influenced by the winds and secondarily by topography. Because canyons in the eastern part of the Santa Monica Mountain range run in a south-to-south-westerly direction or parallel with the fire winds, fire is channeled up the canyons, spreads out as it reaches the ridges, contracts initially as it is funneled downhill through the canyons, and may fan out in either direction as it reaches the beaches. The western portion of the Santa Monica Mountains does not have this pronounced linearity of

[5] Radtke, Klaus W. H., Arthur M. Arndt and Ronald H. Wakimoto. *Fire History of the Santa Monica Mountains.* In Gen. Tech. Rep. PSW-58. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; pp. 438-443. 1982.

canyons and fire winds, however. Fires are therefore more influenced by the direction of the wind and are more irregular in shape. One of the most important topographic effects to remember is that fire spreads much faster uphill than downhill.

II. Wildland Fire Heat Sources and the Basics of Fire Behavior [6,7]

Understanding the basics of fire behavior will prove helpful to homeowners, campers, as well as hikers. They will be able to better judge fuels in terms of flammability, heat intensity, heat duration, and fire spread.

A fire can be visualized as 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, sustaining combustion requires a continuous supply of oxygen.

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**.**

Understanding the different heat sources of a wildland fire is critical to siting of fire-safe homes and using them as stand-alone fire shelters, as well as understanding the need for and protection other emergency fire shelters may offer.

Heat transfer is by convection, radiation and conduction. 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.

Convection heat is the transfer of heat by atmospheric currents and is most critical under windy conditions and in steep terrain. It is responsible for most wildland fire-related injuries and fatalities. With light wind and on level terrain, the convection heat column is almost vertical. Reducing the duration of heat and length of flames produced by nearby vegetation can be critical to protecting yourself and 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 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

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[6] Radtke, Klaus W. H. *A Homeowner's Guide to Fire and Watershed Management at the Chaparral/Urban Interface.* Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture and County of Los Angeles. 1982. 33 pp. Reprinted as *A Homeowner's Guide to Watershed and Fire Safety* by Los Angeles County Fire Department (Forester and Fire Warden 1982-1995+. 33 pp.
Radtke, Klaus W. H. *A Homeowner's Guide to Fire and Watershed Management at the Chaparral/Urban Interface.* Revised 2004. City of San Diego Water Department in cooperation with the City of San Diego Fire Recovery Network and the Conservation Action Committee. 2004. 45 pp.

[7]Knowles, Robert. Booklet on blaze protection ordered reprinted (L.A. County Board of Supervisors orders reprinting of 25,000 copies of *A Homeowner's Guide to Fire and Watershed Management* ...after last Saturday's disastrous fires in Malibu). *Los Angeles Herald Examiner*. October 13, 1982.

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 as possible from your house so that it can also act as an emergency fire shelter.

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.

The interaction of the three types of heat transfer with topography can be illustrated by visualizing a burning match. 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. 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. You cannot outrun a rapidly moving uphill fire. So, be prepared, stay calm, and evaluate your situation before this happens.

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 non-maintained yard tree, which may take many minutes to burn, may represent a greater hazard to a home than nearby discontinuous, well-maintained chaparral.

The different major wildland fuels found in the Santa Monica Mountains, such as grasses, coastal sage, scrub, chaparral, and trees, have various ignition requirements. Heat and ignition are greatly influenced by fuel particle size distribution, live-to-dead ratio of these particles, and moisture content of live and dead tissues. The physiological condition of the living tissues greatly affects live fuel moisture. A vigorous growing plant has high living tissue moisture, and a plant under stress or in poor vigor has relatively lower living tissue moisture. For example, growing green grass has a living tissue moisture content greater than 100 to 150 percent of dry weight. Dead tissue moisture content is determined by the ambient air temperature and therefore changes rapidly. Dry grass has the lowest heat requirements for ignition and is therefore easily ignited; it has the longest fire season and also the highest fire frequency. Coastal sage scrub, because of its summer dormancy, its high amount of fine dead fuels, aromatic oils, and the relatively short life cycle of individual species, is next in heat requirements for ignition and in fire frequency. Woody chaparral shrubs in coastal areas have higher fuel moisture than the same vegetation inland and normally do not become dangerously dry until late summer or fall. However, even among these plants, several species, such as Chamise, have greater amounts of fine fuel (such as needles) and tend to have more flammable compounds (such as oils) during the annual dry season.

III. Understanding the Purpose and Effectiveness of (Emergency) Fire Shelters

As the number of civilians moving to the wildland-urban interface and enjoying the outdoors increases, the number of wildland fires associated with disasters and injuries both among civilians and firefighters also increases.

The most common cause of thermal injury is direct contact with flames. Although a significant amount of radiant heat can be created in wildland fires, firefighter clothing is usually enough to offset serious burns. Temperatures may be extreme at the fire front but they are of short duration. The worst burn events typically involve civilians

who are inexperienced with wildland fire behavior or with rapid, unanticipated changes in fire behavior and do not have the proper equipment and clothing to protect themselves from such extreme exposure. Immediate death is primarily due to incineration. Of the 133 firefighter fatalities during 1990-1998 studied by Mangan,[8] the most common cause of death with 29% was burnovers. It occurs when a firestorm burns over the individuals in the path of an advancing fire front. Volunteer firefighters experienced the most fatalities with heart attacks being the most common.

Another type of burn is the inhalation burn. Mostly seen in firefighters, this is when the patient has inhaled superheated air. One good indication that the patient may have a supraglottic (above the glottis) heat injury is swollen lips. In this case, advanced airway interventions may have to be done soon. If the patient has severe shortness of breath, he may have to be treated with high-flow oxygen. Protecting the airway from extremely hot air is always a firefighter's primary concern. Breathing through a wet shroud or bandana exposes the airways to hot, moist air, which can be more harmful than hot, dry air. Avoid breathing through wet cloth but protect your face. A wet bandana or wet cloth can be used to cover the nose and mouth to reduce inhaling smoke after the flame and heat of the fire have passed.

As explained by Robert Frantz in the book *Disaster Medicine,*[9] contact with superheated air brings the risk of respiratory tract injury. Respiratory tract injury should be suspected with burns around the face, neck, and upper body. Physical findings that have a high correlation with upper respiratory burns include facial burns, nasal hair singeing, facial edema, stridor, and early respiratory distress. Serious respiratory burns are most often seen in those casualties whose history includes being trapped in the burning area. These people have no choice but to breathe the smoke and hot air. The level of injury is directly correlated with the amount of time spent in the burning area and the actual temperature of the air being breathed.

Fire tents–As understood by firefighters, an emergency fire shelter is a stand-alone, compact, aluminum foil and fiberglass tent-like structure employed by firefighters as a last resort in a wildfire life-threatening situation to protect them from burning from radiant heat sources. The fire shelter is basically a one-person pup tent, minus the floor, made from fiberglass cloth covered with a reflective aluminum coating. It takes a minimum of 15 to 20 seconds to deploy a shelter under ideal conditions, longer in turbulent winds and when an area has to be cleared. As explained by Anderson, the new post 2003 generation fire shelter protects primarily by reflecting radiant heat and trapping breathable air.[10] It has two layers. The outer layer is aluminum foil bonded to woven silica cloth. The foil reflects radiant heat and the silica material slows the passage of heat to the inside of the shelter. The aluminum can reflect up to 95 percent of the fire's radiant heat but generally does poorly against moving, windborne (convection) heat. Unlike radiant heat, convective heat (from flames and hot gases) is easily absorbed by the fire shelter, allowing the temperature of the material to rise rapidly. At 470° F such fire shelters generally fail as glue holding the outside together melts. People can survive inside temperatures up to 175-190° F. But for how long?

Initially it is difficult to understand how anyone can survive breathing dry hot air in a fire shelter until one understands that air, fortunately, is a poor conductor of heat and the upper airway is very efficient in thermal or heat exchange. As further explained by Robert Frantz, for this reason a person can breathe air at a temperature of 199° F (92° C) for 30 minutes and of 482° F (250° C) for 3 minutes without serious injury. Although most of the injuries to the respiratory tract are therefore generally mild and they involve only the upper airways, anyone with a significant history of exposure should receive a medical evaluation as soon as possible. Thermal injuries to the respiratory tract can be insidious, with a delayed onset of respiratory distress after contact with

[8]Mangan, R. "Wildfire Fatalities in the United States 1990-1998" *United States Department of Agriculture, Forest Service.* 1999. As quoted with permission by Robert Frantz in Chapter 20 "Fire Storms and Wildfires" in the book *Disaster Medicine.*

[9] Frantz, Robert E. "Firestorms and Wildfires" (Chapter 20) in *Disaster Medicine* authored by Hogan, David E. and Jonathan L. Burstein.

[10] Anderson, Leslie. Project leader. "The new generation fire shelter." NWCG PMS 411. Boise, ID: *National Wildfire Coordinating Group, Fire Equipment Working Team, National Interagency Fire Center*. 2003. 30 pp.

superheated air. Significant respiratory distress may be present as late as 24 hours after the exposure. Thermal airway injury is always associated with edema, which can rapidly occlude the airways.

In stark contrast to the higher temperatures generally required for respiratory tract injuries, soft body tissue thermal burns can already occur when the skin is exposed to temperatures above 115° F (46° C). At temperature exposure greater than 120° F for three seconds, a child's skin is burned severely enough to require surgery.[11]

While emergency fire shelters reduce the risk of death and injury for firefighters, they are not fail-safe, and carrying a fire shelter should never be considered an alternative to safe firefighting.

But what about smoke inhalation during wildland fires? While lightweight breathing devices occasionally carried during prescribed burn operations can protect from smoke inhalation, they are not generally carried during wildland fires. In reviewing the literature about smoke exposure among wildland firefighters, Reinhardt and Otmar (1997)[12] found that overexposure to carbon monoxide and respiratory irritants is likely among firefighters when direct control of fires is required and smoke production is intense. Such over-exposures are brief events but sometimes poor atmospheric dispersion or rigorous work schedules cause hours or even days of unhealthy working conditions. During such exposures increased respiratory health problems have been measured in wildland firefighters. Small but statistically significant reductions in lung functions have been observed, across both work shifts and seasons. Specifically, smoke exposure is likely to be the highest during initial attack, during direct attack on fires in high winds (as the smoke lays low on the ground), and large fire situations that suffer from poor atmospheric dispersal. Hazards in smoke seems to be limited to respiratory irritants and carbon monoxide. Ambient wind speed is a key factor in controlling smoke exposure potential, with smoke exposure proportional to wind speed at both wildland fires and prescribed burns. Prescribed burns may increase exposure because of the higher moisture in the fuels.

Fire trucks/vehicles–Since the 1950s mechanized fire equipment such as fire engines have been more widely used in wildland fire suppression, and by necessity often became emergency shelters. Because of firefighter deaths as well as "close-calls" when using fire trucks as emergency fire shelters, research is being conducted continuously to evaluate their effectiveness during a burn over (where a fire escapes beyond the fire lines). Such a vehicle entrapment study was conducted by the Missoula Fire Laboratory in 1996 with the Los Angeles County Fire Department and other fire services throughout the country as collaborators.[13] Some of the research results important for survival in a real-world fire entrapment are listed below:

a. In most fuel types (besides grass and light brush), the temperature and radiant heat flux generally increase with the height above the ground. This is consistent with the principle that heat rises. This observation has special relevance considering the height of an engine cab compared to the height of a fire shelter.

b. Heat from the passage of the fire front appears to be retained in the vehicles longer than in the fire shelter or other items of PPE (Personal Protective Equipment), indicating that the metal in an engine may act as a "heat sink."

c. Moving just a few feet back from the oncoming flaming front—especially on a road cut on steep slopes—appears to significantly reduce the effect of temperature and radiant heat flux on both the individual firefighter and fire engine.

d. During the moderate-intensity, short-duration exposure of the Los Angeles County tests, exterior components of the engines either caught fire or experienced some melting (See Figures 27 and 28 of the Mangan report

[11] http:/emedicine.medscape.com.

[12]Timothy E. Reinhardt and Rogar D. Otmar. "Smoke Exposure Among Wildland Fire Fighters- A Review and Discussion of Current Literature." USDA Forest Service Pacific NW Research Station General Tech Report PNW-GTR-373 Feb. 1997.

[13] Mangan, Richard, Project Leader. "Surviving Fire Entrapments. Comparing conditions inside vehicles and fire shelters." *USDA Forest Service Technology and Development Program.* Missoula, Montana. *Fire.* September 1997.

referred to in the above footnote). Under higher intensity or longer duration exposures, the fire engine could catch fire and continue burning when conditions outside would be harmful to a firefighter attempting to leave the engine.

e. When a fire comes up a steep side slope, it appears to go over and under the engine, creating an eddy on the back side that draws heat and flame. A firefighter taking shelter behind an engine parked on a steep slope would not be protected from heat or flame. This effect was demonstrated in October 1996 when an engine was burned over during the Calabasas Fire in Malibu.

f. When the outside doors of an engine cab are subject to high radiant heat loads, the petroleum-based plastics and sound-deadening materials in the door panels and dashboard volatilize. The smoke generated by this volatilization may cause both short-term and long-term health effects on firefighters without respiratory protection, and will create conditions that force them from the cab into the fire area.

g. Under high heat loads, tempered glass in the cab's windows may break out. This may occur when the difference in temperature inside the cab and the temperature outside is only 4° C. Consideration should be given to using safety glass for greater levels of protection.

h. The temperature difference between the 1-inch (3-cm) and 12-inch (30-cm) levels in the fire shelters reinforces the need to encourage entrapped firefighters to get on the ground and to keep their face and mouth as close to the ground as possible, protecting their respiratory system.

Based on such results, it is prudent for firefighters operating fire trucks to also carry emergency fire shelters that they employ inside their trucks to escape the heat and toxic smoke, or deploy it outside along a road cut or other surrounding areas that protect from convective, radiant, and conductive heat sources.

Open ground fire safety zone–All firefighters that are working on or near a fire line, or hikers and campers suddenly exposed to a wildland fire line, must be able to identify a survival safety zone and need to know how big is "big enough." Such a zone is defined as providing freedom from danger, risk, or injury. Research conducted by Butler and Cohen indicates that an open ground safety zone should be large enough (and therefore cleared of all flammable vegetation) so that the distance between the person and the flames is at least four times the maximum flame height.[14] The research compared the causes of fire fatalities and near fire fatalities of firefighters wearing largely protective Nomex clothing in severe fire conditions even in those cases where crowning in forest fires could produce flames in excess of 200 feet.

The authors further stated that radiant energy travels in the same form as visible light, that is, in the line of sight. Therefore, locating safety zones in areas that minimize firefighters' exposure to flames will reduce the required safety zone size. For example, topographical features that act as radiative shields are the lee side of rocky outcroppings, ridges and the tops of ridges, or peaks containing little or no flammable vegetation. Since safety zone size is proportional to flame height, any feature or action that reduces flame height will have a corresponding effect on the required safety zone size. Some examples are burnout operations that leave large "black" areas, and thinning or fuel-reduction operations that reduce fuel. The authors emphasized that the research results only address the results of radiant heat, and convective heat transfer from gusts, fire whirls or turbulence could increase this required zone.

The Stanford Research Institute's 1973 report, in analyzing fire protection strategies for the Santa Monica Mountains,[15] quotes the yet unpublished report by Green (1973) that lateral firebreaks (those containing the

[14]Butler, Bret W. and Jack D. Cohen. "Fire Fighter Safety Zones: How Big is Big Enough." *Fire Management Notes*. Volume 58. N. 1. Winter 1998. pp. 13-16.

[15]Stanford Research Institute. Decisions Analysis of Fire Protection Strategy for the Santa Monica Mountains: An Initial Assessment. Prepared for Forest Service. US Department of Agriculture. Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. Stanford Research Institute. Menlo Park, CA. Oct. 1973. 159 pp.

flanks of the fire) must be at least 200 feet wide to provide adequate safety for suppression crews (as it provides a 200-foot distance from flames in emergencies).[16] According to the above quoted research by Butler and Cohen, flame length would have to be limited to 50 feet in length to provide adequate protection during extreme fire events. However, fire behavior modeling by many different authors since then has indicated that flame length can greatly exceed this length under extreme fire weather conditions, especially in steep topography with flames being pushed uphill by convection currents.

Wilson,[17] in investigating the common denominators of fire behavior on fatal and near-fatal forest fires in the U.S. from 1926 to 1976 involving firefighters, found unexpected factors. He stated that firefighters were surprised to learn that fatal and near-fatal incidents often occur in fairly light fuels, on small fires or isolated sectors of large fires, and that fire behavior is relatively quiet before the incident. The general belief is that the high intensity crown fire in timber or heavy brush is most likely to trap and kill firefighters. Yet, with rare exceptions, such as the Sundance Fire of 1967 in Idaho, the Blackwater Fire of 1937 in Wyoming, and the King's Canyon Fire of 1967 in Western Nevada, most of the fires in his study were innocent-appearing just before the accidents.

Wilson then asked himself the question. Why, then do such tragedies and near-fatalities occur under so-called "easy" fire behavior conditions? He answered it by stating that fire spread and intensity can change much more quickly in light fuels than in heavier fuels. Fine fuels tend to be more quickly responsive to changes in atmospheric conditions than heavier fuels. Second, hot, dry Santa Ana (or foehn-type) winds dry out the lighter fuels with the result that any change of wind, slope, or other environmental factor may lead to a drastic and unanticipated change in fire behavior. Since dry fuels burn with little or no smoke, the obvious signs of change in fire behavior, such as smoke and crackle of flames, are only noticeable once the situation has become critical. Wilson then concluded that there are four major common denominators of fire behavior in fatal or near-fatal fires. These often occur:

1. On relatively small fires or deceptive quiet sectors of large fires.
2. In relatively light fuels such as grass, herbs, or light brush.
3. When there is an unexpected shift in wind direction or wind speed.
4. When fire responds to topographic conditions and runs uphill.

But Wilson also cautioned that, with a sudden change of wind, the fire may change direction regardless of the topography.

A common-sense approach for hikers when caught in the open without a shelter and with a fire approaching is to look for a road cut or ditch (firefighters have even survived in deep wheel well ditches or deep ruts on dirt roads). Lie face down in the ditch or road cut on its uphill side at the base of the (hopefully tall) bank and cover yourself with anything that will shield you from the heat of the fire. If you do not have protective clothing, cover yourself with dirt as much as you can as it is a good insulator. If there are no road cuts, look for large rock outcroppings and shield yourself from the approaching radiation heat behind these rocks. However, if you have time, remove all fuel from around the rocks. If time is more limited, first remove all finer dead fuels as these will carry the fire and provide a quick heat release that may be fatal. Even hiding in the depression under large fallen logs and covering exposed parts of your body with soil will help protect you. However, be aware that you may share such shelters with rattlesnakes and other critters. Also carry lightweight heat-reflecting blankets with you wherever you go.

[16]Green, Lyle. R. Developing Fuel-Breaks for Wildland Fire Control in California. Review draft of the U.S. Forest Service, Riverside Fire Laboratory. June 1972.

[17]Wilson, Carl C. "Fatal and Near-Fatal Forest Fires. The Common Denominator." In: *The International Fire Chief* 43(9). 6 pp. March 1976 (portions of this paper were first prepared for the National Advanced Fire Behavior Course, Sunriver, Oregon, April 1974 and for the National Fire Behavior Officers Training Course, Marana, Arizona, March 1976).

IV. Wildfire Management Policies and the Home as Emergency Fire Shelter

Every home constructed in fire-prone areas should be so sited, constructed, and maintained that it could be considered a shelter-in-place for natural disasters inclusive of wildland fires. Such was the case with the Spanish haciendas that had fireproof tile roofing and fireproof exterior walls and extensive fire-safe landscape buffers around their structures. However, after WWII when construction expanded rapidly into the wildland-urban interface areas, such lessons were quickly forgotten and homes were often sited in high-risk-fire topography and quickly built with the easiest available material: wood. Quite predictably, wildland fire disasters grew bigger and bigger and burned more and more homes even in seemingly fire-safe areas, as firebrands carried the wildland fire from wood roof to wood roof, burning thousands of homes even within the city, as was the case in the 1991 Oakland Tunnel Fire. When the November 6, 1961, Bel-Air Fire burned or severely damaged over 500 homes, the fire was ranked only second in the Western states to the San Francisco Fire that followed the earthquake of 1906, as the insurance loss was estimated at $24 million. Because of the high risk and exposure to insurers, private fire insurance had pretty well dried up by 1968 and the insurance companies were then forced by the State of California to form a FAIR PLAN umbrella insurance pool that spread the shock losses of brush fires among all insurance companies. Because of its generally low cost relative to the risk insured, it was a key incentive to continue development in high risk fire areas often without meaningful fire-safe changes in land use, planning, and construction, as FAIR PLAN subsidized insurance for homeowners living in such areas. Consider that two-thirds of the homes destroyed by wildfire since state-wide public records were kept in 1923 have been burned since 1980.[18] The new density of hillside housing has shifted from a policy of the home as an emergency fire shelter to wholesale evacuation and with it a greater loss of homes during fires (K. Radtke, unpublished research).

Research was conducted as far back as the early 1980s in the Santa Monica Mountains[19] by UCLA researchers pertaining to residents' beliefs regarding fire hazards, their adjustments to the threat of fire, and the expectations regarding the level of fire services provided to them. Results indicated that they were well aware of the hazards, were uncertain of what technological safeguards are likely to be the most effective, and may have unreasonable expectations regarding their individual protection via fire service organizations.

However, it is not too difficult to build and maintain a fire-safe designed home. First, it must be located in an area where it is not exposed to convection and radiation heat sources. This means that it must be set back from slopes, not located side-slope, not located in fire chimneys such as narrow canyons, not in saddles, and not in or at the confluence of narrow canyons. Given the steep topography of the Santa Monica Mountains and the insistence on their property rights when people want to build on otherwise wildfire-exposed lots, such constraints are often hard to meet. However, building with truly fire-safe construction and designing homes that don't catch convection and radiative heat sources but rather let them slide over the houses where possible can often greatly mitigate some of the siting problems. Add to this the proper clearance of all flammable materials around the house while working with your neighbors to do the same, and you have created a pretty safe fire shelter for yourself and them. But keep your diligence up on a year-round basis.

Many of the even more recent fire losses in the Santa Monica Mountains were still related to causes such as fire-trap constructed homes (wood roofs, wood decks), homes so located and built as to being exposed to convective and radiative heat sources (fire catchers), flammable accessory structures, wood fences, railroad ties, improper clearance of native and ornamental vegetative fuel sources, accumulation of other flammable materials around the homes, and ease of fire entry. When even seemingly fire-safe construction, such as newer homes with stucco siding, enclosed eaves, and fire-safe Class A roofs, catches on fire there must be reasons. Totally overlooked Achilles heels of such homes are wooden decks, the vents required at the base of their stuccoed walls, and the

[18]Davis, Mike. Let Malibu Burn: "A Political History of the Fire." *L.A. Weekly* 1996. Internet Report Oct. 24, 2007.

[19]Loeher, Larry. Fire Hazard: "The Dimension of Resident's Attitude," in *Living in the Chaparral of Southern California-an Integrated Approach to Public Safety*. Proceedings of the Conference and Public Workshop sponsored by the National Foundation for Environmental Safety and the National Park Service. 1985. pp. 51-55.

still-permitted use of wood along the outside of homes, such as wooden railroad ties for steps to reduce the overall cost compared to fireproof steps such as stone or concrete. The vents are soon forgotten or overlooked and soon covered with landscaping. When the railroad ties slowly ignite or such vegetation burns on unattended homes (such as fire-evacuated homes), firebrands or flames have plenty of time to creep into the wooden frame covered by the stucco and slowly ignite the house from the inside. An initial tell-tale sign of this is often a warm or hot exterior or interior wall of the house, soon perhaps a smoky room, and finally often smoke coming from the chimney on a hot day.

This author, as one of the board members of the then National Foundation for Environmental Safety, conducted many homeowner inspections free of charge in Los Angeles County's wildland areas during the 1980s-1990s, often after homeowners had passed their yearly "brush clearance" inspections and thought they were safe. Wildfires and their causes as well as home losses were also investigated when time permitted and fire safety seminars were held throughout California.

To his dismay, the author found that most of the homes inspected were not really fire-safe, as flammable landscape vegetation, flammable household items, or flammable accessory structures were never really addressed during brush inspections. To his knowledge, none of the residences of homeowners that diligently followed his advice were lost in wildfires even when they were located in the center of a firestorm such as in central Las Flores Canyon during the 1993 Old Topanga Fire. The owner of the property wanted to build a home on a lot inherited from his parents where their previous summer home had burned down during the 1943 Las Flores Fire. He attended the Symposium Chaparral—Fire & Man this author had organized with the Los Angeles County Fire Department Forestry Division and other agencies such as U.C. Berkeley extension services at Tapia Park in Malibu in June 1978. Because of potential fire exposure to steep slopes in a fire-funnel canyon, the owner of this particular home built a compact one and a half story overall fire-safe-designed side-slope home with stucco siding, a low pitch Class A tile roof so as not to be exposed much to convective and radiative heat sources, and added a stand-alone garage. Because windows and the code-required vents near the roof and at the base of the stucco walls presented dangerous places of fire entry, he then hand-fabricated 1/2-inch-thick plywood shutters with handles to fit the windows and also constructed small wooden shutters to fit every opening or vent within the stuccoed walls of the home and garage as the house was being completed (see 1982 *Homeowner's Guide*... p. 15; 2004 *Homeowner's Guide*... p. 19). The fire-safety emergency devices were put in place whenever a fire potentially threatened the neighborhood. He then also taught his neighbors the lessons he had learned. During the 1993 Old Topanga Fire, when a firestorm overran the house, small wooden vent covers at the rear of the house facing the slope and upstairs wooden shutters placed from the interior saved the house when one of the windows broke and the vents were charred black during the burnout period of the low-growing coyote brush on the steep and long slope located within 15 feet of the rear of the garage. This was reported by the *Los Angeles Times* on November 5, 1993 and other news media at this time. Others in the neighborhood had installed roll-down metal fire shutters along fire-exposed windows. Being educated to the potential fire danger and knowing what to do and following through paid off in all instances investigated.

Further research has indicated that home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings. Those characteristics of a structure's materials and design and the surrounding flammables that determine the potential for a home to ignite during wildland fires (or any fires outside the home) from direct flame impingement, as well as the ever-present firebrands, are being referred to as home ignitability[20]

The Stanford Research Institute report (1973) quoted earlier, is a think-tank" report based largely on raw data provided by the City and County of Los Angeles Fire Departments and the U.S. Forest Service. In carrying out a

[20]Cohen, Jack D. "Reducing the Wildfire Threat to Homes and How Much?" Paper presented at the Fire Economics Symposium in San Diego, CA. April 12, 1999.

comprehensive economic analysis for protecting the Santa Monica Mountains from wildfire, the report proposed and analyzed the following three alternatives:

1. To reduce the number of wildland conflagrations.
2. Given the number of wildland conflagrations, to reduce their extent.
3. Given the number of wildland conflagrations, to reduce the damage (to structures).

The fire-adapted vegetation in the mountains and the fire weather patterns make wildland fires inevitable. Reducing the number of wildland fires and reducing their size would require lateral fire barriers such as firebreaks of at least 200 feet in width or wider fuel breaks that require a large labor input for maintenance of even greater width. Attempting to stop the frontal advance of wildland fires to the beach would require horizontal (E-W) firebreaks of at least ½ mile in width. But even then, there would be no guarantees that wild-driven wildland fires could be stopped because of spotting of firebrands. As such, alternative 3 was the only one economically feasible with benefits to society overall. It uses the fire loss data of the 1961 Bel Air Fire in predicting future fire losses in the Santa Monica Mountains. In using the least-cost plus-loss planning method, the conclusion was that, with then approved (fire-retardant) roofs and "brush" clearance of 100 feet, the average home destruction rate could be limited to 7 homes per year for the whole Santa Monica Mountains stretching from Ventura County to Griffith Park.

To accomplish this, the three final recommendations were:

1. Public Education - Fire agencies should emphasize that occasional large-scale fires are inevitable in the Santa Monica Mountains and urge that steps be taken to minimize the loss when the conflagrations occur.

2. Insurance Surcharge Rates - The brush surcharge rates should be set to reflect expected losses. If present rates do not meet this criterion, they should be revised.

3. Planning for Fire Protection – Fire protection agencies should use the least-cost plus-loss economic planning methods as illustrated in the report; fire research and planning groups should continue to develop them.

The report also noted that brush clearance is inadequately enforced and only applies to "brush," and that flammable landscape vegetation that often replaces flammable brush is not required to be cleared. The report then suggested that research should also be directed towards the role of ornamental shrubbery in the spread or containment of fires. It also stated that additional steps should be taken to protect individual homes from fires aside from the first step of installing fire-retardant roofs (whose meaning has now been replaced with the more stringent requirement of nonflammable and preferably Class A roofs as well as Class B roofs) and clearing the "brush" should include:

1. Reducing overhanging roofs and closing other openings to the house to prevent flying embers from entering it.
2. Installing fireproof shutters, especially on the sides of the house that get direct fire exposure.
3. Having auxiliary pumps for swimming pools.
4. Eliminating flammable objects from the yard.
5. Improving access driveway standards.
6. Initiating programs to train able-bodied citizens to defend their houses during periods of moderate fire exposure.

If all the above listed items would have been diligently followed up and enforced, the report estimates that fire losses could perhaps have been reduced to that approaching the average of 7 homes per year. However, the Stanford Research Institute report did not foresee the continuous permitting of homes (inclusive of the proliferation of accessory structures and barns, flying decks, wooden balconies and wooden fences) in high fire-risk areas. The siting and density of such homes added structural fuel components that increased the spread and reduced the containment of fire. Also, the role of topography was not yet addressed in "brush" clearance

requirements, and (as even shown today in most brush clearance publications) most fire department pamphlets still show the house situated on level land with proper ingress and egress that includes the building pad as well as a flat 100-to-200-foot clearance distance with no surrounding homes. The real problems faced by homeowners struggling with living in steep mountainous topography with often limited ingress and egress and with other homes nearby is often an instant disconnect when they are provided with such unrealistic guides.

Lee and Bonnicksen,[21] in evaluating brushland watershed management policies in southern California, came to their somewhat surprising findings that increasing monetary losses in wildland fires appear to have resulted from the increases of property values at risk and not from the increases in number of acres burned. This holds also true for wildland fires in the Santa Monica Mountains and indicates that the Stanford Research Institute report (1973) that recommended its alternative 3, reducing the damage (to structures) through fire-safe construction and clearance of flammable vegetation, is still the most cost-effective bio-social consideration.

Further requests for studies on solving the fire problems in the Santa Monica Mountains, often urged by the public, elected officials as well as fire chiefs such as County Fire Chief Houts himself, continued for quite some time and became more urgent with every uncontrollable large-scale fire. One such study by Lowden and Degenkolb (1972)[22] recommended the development of a strong fire research program within the Los Angeles County Forester and Fire Warden Department. One such program was then initiated soon thereafter with cooperative research programs between the County of Los Angeles and the U.S. Forest Service Riverside Fire Laboratory, and expanded in 1976.

The 1976 5-year research and development program called Vegetation Management Alternatives for Chaparral and Related Ecosystems, headquartered at the Riverside Fire Laboratory, was initiated by the U.S. Forest Service Pacific Southwest Forest and Range Experiment Station and the Pacific Southwest Region, Forest Service, U.S. Department of Agriculture. (A comprehensive report of its findings, recommendations and management guides produced was published in 1986).[23] The County of Los Angeles, through the Los Angeles County Forester and Fire Warden, continued to be one of the grant-receiving cooperators with Klaus Radtke continuing as its cooperating scientist. Several then state-of-the art publications were produced by this author and others during the five-year period such as his *Living More Safely at the Chaparral/Urban Interface* and *A Homeowner's Guide to Fire and Watershed Management...*, published at the insistence of the Forest Service. However, many of the recommendations were not seriously addressed and were started to be implemented only reluctantly by local agencies before the wildfires of 1978, 1982 and 1993 that burned 230, 85, and 333 homes respectively, and 202, 11, and 112 structures that included barns, sheds, detached garages, etc.

Research was hampered and then generally shut down within the Fire Department because of concerns raised by a post-tax-cutting-related audit (Proposition 13) that attempted to streamline the department. This audit, among other more items, recommended that up to 25% of fire department rank and file jobs be filled by civilians (with great salary and retirement savings), as they are not directly involved in firefighting but that the wildfire prediction research carried out within the Forestry Bureau (by Radtke) be prioritized.

Since, in response to this audit, the efforts of foresters in fire-related work were further marginalized, cooperative wildfire-related research within the Fire Department was largely continued "under the radar" by this author. Non-published research still focused on assisting firefighters with evaluating potential home losses given a fire start in the area and supporting a then-controversial triage system for predicting home losses in a

[21]Lee, Robert G. and Thomas M. Bonnicksen. "Brushland Watershed Fire Management Policy in Southern California: Biosocial Considerations." California Water Resources Center. University of California. Contribution No. 172. August 1978. 73 pp.

[22]Lowden. Merle S., and John G. Degenkolb. Fire in the Malibu. U.S. National Bureau of Standards. 1972. 16 pp.

[23]Conrad, C. Eugene, George A. Roby, Serena C. Hunter. "Chaparral and Related Ecosystems: a 5-year Research and Development Program." Gen. Tech. Rep. PSW-91, Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1986. 51 pp.

fire, defending defensible homes with limited resources available, and bypassing predictable indefensible homes in a fire conflagration.[24] Some studies focused on predicting a fire's path given a fire start and recommending its containment (largely along flanks in a large-scale fire) based not only on man-made barriers such as firebreaks and roads but also types and age classes of native woody chaparral vegetation.[25] Efforts were also made to disseminate public safety information when feasible.[26]

The summary of one such report, filed away somewhere in County files, reads as follows:[27]

> Six fuel management alternatives were proposed to meet the objectives of reducing large-scale fire conflagrations as well as the damage to property and watershed values. It was shown that the best long-range fuels management alternative for the Santa Monica Mountains may be Alternative F.
>
> Alternative F presupposes that all agencies adhere to a land use plan that incorporates fire-safe zoning ordinances and building codes that are vastly improved. This land use plan must also recognize the interrelationship of fire and watershed management (of vegetation and topography) and must not favor one over the other. Lack of multiple purpose management may be witnessed throughout the mountains when local brush clearance ordinances are strictly enforced by the fire services on steep terrain to which they may not be applicable. Additionally, the land use plan requires that public agencies update their ordinances to assure that they are not in conflict with one another (and public safety).
>
> Alternative F also presupposes that homeowners are made aware of the fire and watershed management problems in fire-prone mountainous areas so that they can effectively manage their land as well as their home.
>
> Prior to the establishment of large-scale mosaics of different vegetation classes in woody chaparral (which could be largely accomplished through effective wildland fire management), intensive research has to be completed throughout the mountain range on fire behavior, fire corridors (fire topography), fire climate, and vegetation. This information must then be assimilated to create an effective fire barrier system for the Santa Monica Mountains which could act as backbone for the mix of fuel management methods that is going to be used by the different agencies. The additional value of such studies is that it provides quantitative data to answer many related questions that arise in effective fuel management.
>
> Fast-moving fires of low to moderate intensity (as measured in environmental terms) in annual or soft chaparral may be a fact of life which public agencies have to accept given the restraint on aggressive firefighting due to past haphazard development. Any management alternative should be careful not to increase these vegetation types at the expense of chaparral so that large-scale fires and their frequency are not changed or increased from one vegetation type to another.

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[24]Radtke, Klaus and Martin Gubrud. "Evaluation of Roof Types from Infrared Aerial Photographs." Unpublished document prepared under Cooperative Research Agreement 21-436 between the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture and the County of Los Angeles and its Department of Forester and Fire Warden. On file, County of Los Angeles, Department of Forester and Fire Warden, Los Angeles. July 11, 1980. 14 pp.

[25]Radtke, Klaus. 1982. The Oat Fire of October 31-November 1, 1981. Unpublished report prepared under Cooperative Research Agreement 21-436 between the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture and the County of Los Angeles and its Department of Forester and Fire Warden. On file, County of Los Angeles, Department of Forester and Fire Warden, Los Angeles; 22 pp. 1 map.

[26]Radtke, Klaus. An Urban Viewpoint of Wildland Fire Problems. In: Proceedings of the 1980 national conference of the Society of American Foresters. Oct. 5-8, 1980. Spokane, Washington. Society of American Foresters; 1981: 117-122.

[27]Radtke, Klaus. "Fuel and Fire Management in the Santa Monica Mountains." Unpublished document prepared under Cooperative Research Agreement 21-436 between the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture and the County of Los Angeles and its Department of Forester and Fire Warden. 1980. 54 pp.

After 1982, Radtke, in private practice, continued to oppose non-fire-safe development in the Santa Monica Mountains[28] and supported fire-safe community standards that must include safe and adequate ingress and egress.[29] In 1984, with Judge Baker of the National Foundation for Environmental Safety as moderator, a professional seminar was held at the Malibu Civic Center's Library attended by Fire Department personnel from Los Angeles County, Los Angeles City, and Ventura County Fire Departments as well as research professionals and interested homeowners. The meeting highlighted unpublished research carried out under the Chaparral Research and Development Agreement. Fire history, vegetation type, and age class maps were displayed on overlays and historic fire corridors were outlined. It was shown how the lessons gained from such research could predict fire patterns given a fire start and where and how fires could be fought effectively under different fire weather regimes because of less resistance to containment. Such knowledge gained by fire chief officers led, for example, to the containment of the eastern flank of the 1993 Old Topanga Fire along Topanga Canyon Road.[30] However, such knowledge gained has to be continuously updated to be applicable to current field conditions.

There are firebreaks within the Coastal Sage Scrub areas of, for example Corral Canyon, that have not been maintained in the recent past and are slowly being revegetated naturally. If not maintained, the lower faces of such firebreaks will become vegetated with a mixture of highly flammable annual weedy species and highly flammable Coastal Sage Scrub components. One may ask when and why were such firebreaks established in the first place and why have they not been vegetated with "nonflammable" or "low fuel" vegetation. The following quote taken from the introduction to a 1938 research publication pertaining to test plots established in the Santa Monica Mountains by the Department of Los Angeles County Department of Forester and Fire Warden for revegetating firebreaks answers these questions:[31]

> "The many miles of firebreaks constructed during the past two decades produced an annual maintenance problem of major proportions. Firebreaks were constructed primarily to assist in rapid influx of firefighters to the conflagration, as a front line of defense from which to set backfires, and to retard the spread of fire if burning against the wind. The firebreaks, in order to be effective, must be free of vegetation in order to rob the area of fuel. Following initial construction, annual weeds and grasses appear as though from nowhere, which had to be removed by hand and on more favorable slopes by motive power. Areas where cleaning may be performed by caterpillars make up a very small percent of the firebreak."

Extensive test plots with more than 30 species of succulents were established in the 1930s throughout the southland in cooperation with the L. A. County Department of Forester and Fire Warden, the U. S. Forest Service, arboretums and nurseries, as well as the University of Berkeley. One such plot was also established after the 1935 Fire adjacent to Latigo Canyon Road about one mile north of the Lechuza Fire Patrol Station. Results indicated that the plants would be eaten by deer and rodents if not fenced, would largely freeze in the higher elevations, would require supplemental watering, and could not compete with the native vegetation as they were more suited for the immediate coastal areas.

As the wildland-urban interface extended more and more into the mountains and mingled often highly flammable structures and flammable landscape vegetation with highly flammable native vegetation, the options for maintaining and using firebreaks for backfiring and effectively fighting wildland fires diminished greatly. While lateral firebreaks have proven effective in the past to contain the flanks of even wind-driven fires, the emphasis is now on mass or forced evacuation during wildland fires. Unfamiliarity with the area by out-of-town firefighters,

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[28]Radtke, Klaus. Re: Rancho Malibu Estates (Vesting Tentative Tract Map No. 46277. Document addressed to Los Angeles County Board of Supervisors raising concerns about this unsafe development. Geo Safety, Inc. 10 pp.

[29]Radtke, Klaus. Public Hearing on the Adoption of a Permanent Community Standard District, Malibou Lake. Document addressed to Los Angeles County Regional planning Commission. Geo Safety, Inc. 3 pp.

[30]Personal communication in 1994 at Fire Camp 2 by the chief in charge of this section.

[31]Gerhardy, Carl O. "Succulent Plantings at Lechuza Plot, Santa Monica Mountains March 1936." *Department of Forester and Fire Warden, Los Angeles County*. December 23, 1938.

structural firefighters exposed to wildland fire fighting in unfamiliar territory, and the lack of effective firefighting due to crowd control and evacuation has already affected fire patterns of recent fires, will undoubtedly increase the acreage burned in the area, and has increased structural losses. The latter has been well documented for the Santa Monica Mountains. Homes unattended by either homeowners, friends or residents, or firefighters have a much greater probability of burning than attended homes as many homes slowly ignite and become fully engulfed after the fire front has passed.

The opening of the coast road and highway from Santa Monica to Oxnard at the close of the Rindge Ranch area by the early 1930s started a real estate boom that also saw development in the riparian areas of lower Corral Canyon. For example, the 1950 Los Angeles County Forester and Fire Warden base map identifies only one structure located along a permanent road leading more than 750 feet along the creek from the highway into the canyon as the Parmalee residence.[32] However, the 1950 Malibu Beach Quad map[33] based on aerial photos, shows 3 structures within the riparian area of lower Corral Canyon with a permanent road extending now to 1,500 feet through and along the creek into the canyon. Dirt roads branching off from it lead west, then east up to and across the Coastal shelf and north along the riparian boundary and up a short distance into the hills towards a relatively flat area.

When the western flank of the 1943 Woodland Hills Fire burned across the Corral Canyon area, it did not reburn a thin strip of riparian vegetation within lower and central Corral Canyon. While this often gives residents the false hope that they can also by luck, divine intervention, preparedness, or firefighter intervention survive the next fire, this is often not the case unless they have a truly fire-safe home built in an area where it can be easily protected or can serve as a stand-alone fire shelter. These lessons were then learned (but generally soon forgotten) when the 1958 Liberty Fire, in burning 74 homes in its path, also burned 17 homes in the Corral Canyon area.

Rebuilding and new construction becomes easier after the vegetation is cleared by fire, and the 1967 Point Dume quad[34] map now shows an additional structure further along the dirt road that leads north into the canyon, as well as at the terminus of the dirt road leading west out of the canyon that is now connected to Corral Canyon Road. The photo-revised 1981 Point Dume Quad map[35] now only shows the original (now uninhabited?) three (rebuilt) structures from the 1950 quad map. The unimproved roads west to Corral Canyon no longer exist, and the access road from the highway is also eliminated. Such roads became overgrown with native as well as weedy, exotic vegetation such as Black Mustard. When walking the area, remnants of Rindge Ranch range fencing were still in evidence along the hillsides.

[32]Los Angeles County Forester and Fire Warden. 1950 base map. Santa Monica Mountains. Scale 1" = 2,000 feet.
[33]USGS (United States Geological Survey). Malibu Beach 7.5 minute quadrangle topographic Map. 1950.
[34]USGS (United States Geological Survey). Malibu Beach 7.5 minute quadrangle topographic Map. 1950 (photo-revised 1967).
[35]USGS (United States Geological Survey). Malibu Beach 7.5 minute quadrangle topographic Map. 1950 (photo-revised 1981).

V. Australian-type Emergency Fire Shelters/Fire Bunkers

After the Australian Victoria Fire of February 6-7, 2009, in which over 170 people were killed largely trying to escape fire infernos by car, private contractors proposed fire-proof "live-in fire bunkers" as stand-alone structures adjacent to homes. Some of these private bunkers were often designed to withstand the extreme heat of over 1,700° F generated by direct flame impingement in a fire inferno characterized by heavy woody fuels with long burnout or fire reburn periods that could extend into hours. Many of the destroyed homes were located in the midst of Eucalyptus forests with minimal fire clearance and minimal fire-safe designs or construction. Eucalyptus forests are known to be some of the most explosive and volatile wildland fire fuels in the world and, once ignited, fires cannot be stopped in them.

Such bunker shelters can be considered an extreme case of a "live-in" fire shelter where all common sense and fire science evidence about living more safely within the wildland urban interface has been thrown out the window, thereby expecting a predictable design for disaster. To this author's knowledge, no freestanding private nor public wildfire emergency shelter bunkers have been designed and/or approved by any public agency in fire-prone wildlands in the U.S. It must be emphasized that fire bunkers are not a safe nor meaningful alternative to proper siting of buildings or campsites, meaningful fuel modification, and construction of fire-safe homes.

However, because of the fire politics of such fire bunkers in Australia, and the life safety concerns about the proliferation of private contractors that advertise fire bunkers that often do not address or evaluate the threat level and occupant load required, the Australian Building Codes Board (ABCD) is preparing to add a new building classification namely Class 10c – Private Bushfire Shelters.

In the preface to the standards, ABCD immediately issued a disclaimer stating "The guidelines do not constitute and must not be relied upon as legal or other professional advice. You should seek legal and other specific professional advice tailored to your needs and circumstances."[36]

In its media release on *National Standards for Private Bush Fire Shelters,* ABCD clearly states and cautions "However, the standards and private bush shelters are not stand alone solutions to protect people in bushfires. As the Board has made clear in the past, building standards need to be part of a wider set of measures to deal with mitigation of bushfire risk, including effective coordination of efforts by authorities and communities, predicting fire spread, better education of homeowners, clarity in community notification procedures and sound planning and fuel management strategies."

The overall Australian emphasis here is on PRIVATE FIRE SHELTERS and NO LIABILITY TO PUBLIC AGENCIES, as no public agency will and can endorse private or public fire shelters.

[36]ABCD -Performance Standards for Private Bush Fire Shelters 2010 (Internet Research).

VI. Camp Sites within Fire-prone Coastal Sage Scrub or Chaparral Watersheds

What about camp sites in fire-prone Coastal Sage Scrub or Chaparral areas? The Butler and Cohen research results described earlier indicate that, in order to prevent injury from largely radiation heat to firefighters caught in the open with protective clothing, an open ground safety zone should be large enough (and therefore cleared of flammable fuels) so that the distance between the person and the flames is at least four times the maximum flame height. Such a zone was defined as providing freedom from danger, risk, or injury.

The above guidelines, not even taking unpredictable wind patterns and convection heat sources in account, would require a total (!) fuel clearance zone of at least 50 to 200 feet with campers huddled in the middle of campsites with protective gear (!). Furthermore, clearance distances must be so shaped as to provide a buffer of at least 50 feet to the closest grassy vegetation and about 200 feet from the drainages or any heavier, continuous fuels. It must be acknowledged that few campers would be wearing proper fire-protective clothing if a wildland fire develops and they could be required to find shelter within a few minutes. Tents must also be considered potential fuel and could further compromise the minimum required safety zone if they catch on fire.

Highly flammable vegetation could have a flame residence time of as little as 5 to 15 seconds for grass, perhaps several minutes for pockets of degraded coastal sage scrub, and perhaps about five minutes or slightly more for the brush in canyons. This, and also the smoke created, depends of course on such factors as fire weather conditions, the fuel itself, live and dead-to-live fuel moisture, and wind patterns.

Direct fire line exposure of campsites to flame and heat is life-threatening, as one can succumb to radiation and convection heat sources before the flames from the fire front overrun the sites. However, as discussed previously, short-term smoke exposure in wildland fires is not life-threatening but can have short-term health effects. With no wind, the fire's smoke column rises straight up in the air while in strong winds it lays down on the landscape and becomes heaviest in canyons and draws. Level plateaus will be exposed to less smoke under such conditions than canyons and draws. However, lower canyon areas, often heavily vegetated with riparian vegetation, may be a smoke sink while burning. Native coyote brush, often found intermixed in disturbed riparian areas, has approximately 10% crude fat or oil content as measured by oven dry weight. This is similar to Chamise, considered the most flammable chaparral species. Plants with a high oil content such as Coyote Brush, Chamise, sages, and landscape plants such as Rosemary, needle-like conifers, and many Eucalyptus species, when burning give off much more smoke than plants with a low crude fat content. These plants often explode when they reach the ignition point, giving off thick, dark smoke in the process. Plants with a low crude fat content but with a high moisture content give off more smoke that is lighter colored than similar plants burning under dry conditions.

Exposure to smoke from poison oak is generally not a concern in grassland or Coastal Scrub communities but could be a concern in nearby canyons and north slope chaparral plant communities.

From personal experience this author knows that camping in the Santa Monica Mountains—as he has occasionally done since 1960—or “hiking through the brush” may expose one not only to an occasional wildfire threat when the fire ignition conditions are high, but also to other natural hazards on a daily basis. While he would not hike or camp in these mountains during days of high fire danger, other dangers he encountered were flash floods in narrow canyons, mudslides, rattlesnakes, and black widow spiders on the ground, grass and brush (was bitten by one once). There was also an abundance of bees largely when the sages were in bloom in the coastal sage scrub in early winter and the woody chaparral species in mid-winter and spring. Encountering ground wasps is normally also an unpleasant experience. Heat exhaustion or heat stress that could include symptoms such as fatigue, dizziness, weakness, nausea, vomiting, headache, muscle cramps, or even impaired

judgment could happen on hot days and could ultimately lead to heat stroke, a life-threatening situation.[37] Earthquakes may also be an occasional rare and unnerving experience.

With the above concerns in mind, no open ground safety zone "fire shelters," even where feasible, would generally be meaningful alternatives for the overall fire safety of camping in well-maintained public campgrounds. Open ground safety zone "fire shelters" have the built-in potential of becoming a design-for-disaster during unpredictable and rare circumstances of sudden, unexpected life-threatening fire behavior within or in close proximity to campsites.

Many fires have and are continuing to provide insight into the potential for loss of life. For example, hazardous conditions were dramatically shown in videos made during the early phases of the October 20, 1991, Oakland Tunnel Fire.[38] The fire had reignited in a small pine needle burn thought to be extinguished the previous day, Saturday, by the local fire department. The next morning the weather changed with gusty winds picking up that quickly reignited the fire hidden in the duff below the pine needles, and carried spot fires onto adjacent slopes covered with flash fuels and then onto highly explosive pine and eucalyptus trees. The exploding trees crowned and the resulting firestorm flames, stretched by high winds, along with the rain of firebrands, engulfed street after street largely lined with wooden homes. Since it was a Sunday morning many people were at home. As the large, seemingly fire-safe Parkwood apartments complex became engulfed with flames, the single exit from it became clogged with cars and fleeing pedestrians. Piles of woodchips had been stored near the exit there as they were being spread out within the landscaping. As the pedestrians were trying to flee, they were showered with blinding wood chip firebrands as well as wood chip debris. Close by at Charing Cross Road, tragedy had already unfolded in an area where the paved sideslope-situated street narrowed to about twelve feet in width with a long and narrow draw vegetated largely with weedy grasses and native coyote brush pointing uphill towards it. Some cars attempting to escape the fire jammed up along this narrow stretch of road and able-bodied residents jumped out of their cars, fleeing along the road. Oakland Police Officer John Grubensky was directing the fleeing residents to hurry along the road to safety until the convection and radiation heat rushed over him and engulfed his body. The last person to escape alive remembered seeing that his pants legs were already on fire as he was encouraging her to run past him. He and five other civilians were found burned to death in this location and others were found nearby. While this tragedy had been unfolding, residents in homes on a nearby street cried out for help as some of them were being incinerated within their homes, with firefighters unable to help because the fire was too intense.

Two years later, on November 2, 1993, during the initial phases of the Malibu-Topanga Fire, another predictable but preventable design for disaster resulted in the incineration of two elderly mountain residents. They lived in a non-permitted temporary makeshift firetrap trailer home without utilities such as water and electricity. It was accessible during the dry season by a narrow dirt road that led through the chaparral and across several small draws. The situation was known to fire personnel of close-by Fire Camp 8, other County Department personnel as well as nearby wildland residents. Some had befriended the couple and assisted them as needed and hoped to be there for them in emergencies. After the fire broke out the wife, working in Santa Monica, heard about it and rushed home in the afternoon through traffic, roadblocks and fire lines to evacuate her invalid husband. She was forced to drive up into the mountains apparently along the longer route across the Las Flores Canyon bridge before it caught on fire because Rambla Pacifico had long been closed by a landslide. After evacuating her husband and attempting to drive back along the dirt road, her truck was overrun by fire close to the safety of stand-alone fire-safe homes at the end of the dirt road and near Fire Camp 8. The most accessible home at the

[37]Frantz, Robert E. "Firestorms and Wildfires" (Chapter 20) in *Disaster Medicine* authored by Hogan, David E., and Jonathan L. Burstein.

[38]Klaus Radtke—the incidents described are based on personal knowledge gained from research conducted, inclusive of site investigations and review of documents, photographs and videos (1991 [Oakland] Tunnel Fire) and personal association with the victims years prior to the fire (Old Topanga Fire).

beginning of the dirt road was empty and locked because the residents were on vacation and others had apparently been evacuated.

In the area where the fatalities occurred, the 1993 fire had burned through an incomplete burnout within the Piuma Fire of October 14, 1985. The burnout was characterized by standing dead fuels characterized by a higher dead-to-live fuel ratio than would normally be found in 8-year-old woody chaparral regrowth. Additionally, because of further disturbance, the degraded woody chaparral had a high herbaceous flash fuel component.

One must also not forget the lessons learned from the tragedy that occurred during the Griffith Park Fire of October 3, 1933 in Los Angeles County. It killed 25 park workers and injured and often severely burned an additional 130 hired by the County to combat unemployment with park work. The *Evening Outlook* newspaper in Santa Monica described the developing tragedy as follows: "Deep in the canyon a small area was in flames. There was little or no wind. The flames and smoke from the burning scrub oak growth at the canyon's floor were shooting straight up."[39] When suddenly strong winds came up and ignited the narrow box canyon, the young men raced up the steep canyon walls after they were trapped by the walls of flames. As described by survivors, the scorching heat first dropped many of the victims before they were overrun by the flames. When the tragedy became known thousands stormed morgues in dread fear loved ones lost their lives in the canyon inferno." The next day the *Evening Outlook* reported that the quickly formed board of inquiry stated that ill-timed backfiring had cut off the workers in the canyon.[40]

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We must keep in mind the proverb "That what can never happen always happens first."

[39]*Evening Outlook*, Santa Monica, California. Wednesday, October 4, 1933.
[40]*Evening Outlook*, Santa Monica, California. Thursday, October 5, 1933.

Appendix 3

Frank Barnaby

In sum a few notes from 20743 Rockpoint Way, Big Rock, Malibu about the 11-2-1993 Old Topanga Fire

- **Re**. **Who stayed to fight the fire in Rockpoint Way area**: I was surprised to hear William Morris stayed at his house. I was completely unaware of him, as he was probably unaware of me at my house right above him. I discovered that Michael Harris, from up on Seaboard, had also stayed when we unexpectedly converged on the road, and put out fires on Jim Kiewit's home at the junction of Rockpoint and Seaboard later in the night. In the future a plan might be good for home owners who stay to fight the fire, for instance setting up communications such as walkie talkies, etc.
- **Regarding when the water stopped down on Rockpoint Way:** I can say with absolute certainty that I had water and water pressure for a short time after the firestorm passed over. If as you say the fire passed over at 17:30 on Rockpoint Way, then I had water till near 18:00. It seemed later to me, but I had no idea what time it was in the darkness of smoke.
- **Firefighting helicopters or water drops:** I never saw any water drops, nor was I aware of any in the Rockpoint Way area. Nor did I ever see a firetruck or fireman in my area, or any evidence that they had been there.
- **Benefit of staying to fight the fire:** I learned a few things in the '93 fire as it was: I witnessed that some homes did not catch fire during the firestorm, but burned later. If firemen had been able to come in pickup trucks down the narrow private roads to our neighborhood, even with a minimal amount of foam or water in a tank, or just some tools like shovels, probably a number of homes might have been saved. Certainly homeowners who stayed were able to save homes. I saved my own house at 20743 Rockpoint Way, Bob Scott's home at 20677 Rockpoint Way, and Jim Kiewits on Seaboard at the top of Rockpoint Way, with the help of Mike Harris and Mark Herron's son. Of course, Mark Herron and his son stayed and saved their home above mine. I am sure there were others.
- **Firehoses: My neighbor and I had a 2.0" fire hose hooked up to a hydrant at the end of Seaboard private road:** That hose was only running maybe 3 minutes before the firestorm passed over and possibly a bit after. But I was not aware of anything except fighting the fire at my house after the fire struck. The fire hose was certainly not wasting water in our case, but helped save at least 2 homes, and possibly more up the hill, including Michael Harris's House. My garden hose saved my house without a doubt, before the water went off.
- **Preparations:** Fire resistant landscape, brush clearance, and limbed up trees were important parts of mitigating fire around my house. Also any amount of water in a tank with a pump or even barrels of water under rain gutters with buckets can be a deal breaker. A few 50-gallon barrels full of water saved Jim Kiewit's house when we found them.
-

To back up a few days before the fire:

I had such a strong feeling the fire was imminent that summer. I had been preparing for it, to stay and protect my home. I had already bought a smoke mask with filters, and hooked up my heaviest construction quality garden hose to mainline pressure, at 150 psi. I did not have a proper fire hose for the fire hydrant above my house up at the end of Seaboard Rd., until just before the fire. I was driving home and jammed my brakes on in front of Jay Dunitz's home on Seaboard as I remembered the more than a hundred foot length of 2" canvas fire hose that he had offered me to take but that did not have a nozzle.

The day of the fire I rushed home from Santa Monica when my wife, Annica, called to tell me the news. She told me a helicopter had flown over broadcasting through a loudspeaker for everyone to evacuate. The fire department had already warned us previously that our private roads were too narrow for their trucks. I helped her pack our pets and all the belongings she could fit into her car. Ash was already falling from the sky, and our horse, Tareana, was whinnying and charging around crazily in her corral. The only thing I could think to do was

possibly bring her into the house to survive the fire. We did not have a horse trailer. That was when a small man came walking up our driveway and told us he was Bill Morris's house guest, and that he knew horses. He said he would ride Tareana to safety. He managed to calm her, and put a bridle and bareback pad on her. Annica handed him a scrap of paper with our phone number on it, and he rode off into the smoke like a pro. Someone told us later that he was an ex jockey.

Soon as Annica drove off with our son, animals and her car packed to the headliners, I rushed to the fire department up the highway at Carbon Canyon to try and get a nozzle for my fire hose. The sky was growing dark with smoke and falling ash. There was mayhem at the fire station with huge diesel trucks idling noisily in a line up the street. The fire I think may have already been raging in Carbon Canyon. All the truck bays were empty in the fire station, and lockers were hanging open. Equipment was strewn everywhere. I told firemen hurrying past that I was trying to save my home, and needed a nozzle for a 2.5" hose. Finally one fireman grabbed my arm and pulled me over to a locker and gave a huge nozzle for the hose.

My neighbor Mark Herron, up on the end of Seaboard, and I had agreed to help one another. We figured that if my house burned, so would his just above me, and maybe others beyond. We hooked the fire hose up to a street hydrant at the end of Seaboard at the top of his driveway. We planned to water down my house and landscape just before the fire arrived to protect our homes. We tested the big hose, and the stream arced far into the sky over my house, but it was much heavier and more powerful than one man could handle. As the fire approached the ridge, Mark's son hurriedly built a framework to secure the hose nozzle to and aim over my house. He could then straddle it and tilt the head this way and that by himself.

Mark and I and his son were up at his house, watching the fire approach. When it appeared to be near to cresting the ridge on the opposite side of our canyon, I ran down to my house. I grabbed my 1" hose hooked up to my mains pressure, and climbed a ladder to my garage roof. In a few moments my roof was literally covered in petals of flame dropping from the sky. Looking upwards they fell as if from inside of a volcano. It was remarkable how well a rock roof held up to such a thick carpet of glowing embers over it. I wielded the hose stream over the glowing roof, blackening large wedges, but there was so much fire falling from the sky that my hose made little difference. I was completely unaware at that point, of any water coming from the fire hose at Mark's house above.

Suddenly all my tall pines burst into flame on the front of my hillside. The fire had just sprung upon us. It could never have had time to burn down into the deep canyon separating us from the opposite ridge. The fire must have jumped across the canyon somehow. Burned right through the air to us. In the instant before I leapt off the roof, the flames had to be well over 100 feet high. It was like an explosion. As I ran off the edge of the roof, I kept repeating to myself, "Don't break your leg… Don't break your leg!" I landed on the upslope of the hillside with my hose, and rolled down behind the garage to avoid the blast of heat. I lay there with the hose in an inexplicable cacophony of crackling or something that sounded like swarms of insects, I don't know how to explain it, but suddenly I knew the firestorm had roared over me.

I got to my feet and rushed out with my hose. Fire raged everywhere around my home. I dragged my hose from the front to the back of my house and back again, putting out flames in plant material and on the wood siding. I loped down the arbor path, dragging my hose over our concrete pavers toward bursts of light. The Juniper bushes at the corner of our bedroom exploded in grey smoke at the end of my stream. Then an explosive crackling spun me around as our Podocarpus trees blazed around our garden deck. Below them in darkness were our avocado and citrus trees, which were finally giving fruit after years of care. I blasted the deck and burning Podocarpus trees as the tall smoky skeletons of our hillside pines sputtered in sparks overhead and dropped flaming limbs.

Embers hurled by the wind stuck to the wood siding and were fanned alive in the firestorm. The underside of my eaves were plastered which surely saved my house, and I would recommend that to anyone. Initially a few shouts from Mark's son were barely audible from the black void above. I don't know if he was still using the big fire hose. I never saw any evidence of water raining down. Maybe that huge stream just evaporated in the heat. I was dousing flames at the corner of our bedroom, when I heard Mark's son shouting for me to run back to the front of my house. I ran back lugging and jerking my hose to find all my Italian Cypressses spewing up flames in crackling bursts like huge roman candles along my driveway. I turned the hose on the ones nearest my garage, and worked my way down the driveway. That was when my water stream began to drop to my feet. The water was finished, probably less than 30 minutes after the firestorm had passed over.

Suddenly, down at the last house at the end of our street, a large eucalyptus tree burst into white flame. Somehow the house and tree had out-survived all the others on our street. In the ghostly pyrotechnics reflecting from the surface of the swimming pool, I spotted puffs of smoke coming from the corner of the wooden pool deck. It was attached to the house like a fuse. So many houses burned in this way. Houses that had miraculously escaped the leading edge of the firestorm, burned down from a few pathetic splinters that had ignited later. I would have gone to put them out, but unpredictable gusts of fire were still torching sections of the road on the way there.

Everything was on fire everywhere. Soot thick black smoke made visibility very strange. Only flames could be seen like an x-ray that only sees bones, I could only see fire, near or far. Everything was fire in the blackness. With my water gone I stood for a moment on my front lawn at the edge of my hillside, looking down at Al Broussard's house below. I had heard explosions, probably acetylene tanks he kept in the garage. I saw the black silhouette of house framing. The house was being completely incinerated. Then I heard a sickening snap and crash in bursts of flame that seemed to be his roof collapsing into the inferno.

I spent quite some time thereafter, patrolling my house and throwing dirt on flames with a shovel. The fire had become less threatening around the immediate vicinity of my house. All my large pines in the back garden and behind my house had miraculously not burned. That seemed an impossibility after witnessing such a conflagration. Mark Herron's house above me stood in darkness, also saved from flame. It seemed I had been working for hours, and I was beginning to suspect I had saved my house. I was completely exhausted standing outside the sliding door of my living room looking down over my hillside when I noticed something very strange. There was a long snake-like glow below me on the hillside, stretching about 100 feet below my house. I stared trying to make sense of it when I realized that the dried stem material underneath the thick dark top layer of green ice plant was on fire. A long burning edge was silently moving up the hill toward my house. I started from the top of the slop hacking it away with a hoe and machete, then raking it down the slope away from the house.

As I'm sure many people discovered, ice plant is a terrible ground cover. It rolls down the hill like a carpet in heavy rain, and it was surely responsible for houses burning in the fire. Later I witnessed homes that had escaped the fire, only to be burned down by slow moving coals travelling under the ice plant up against homes and wooden decks. I think Peter Monge's house burned like this. I saw flames flickering down there before his house burned. I wanted to run down to the end of Rockpoint Way, and put them out but fires in the landscape were still very unpredictable. Dangerous flare ups blow-torched across the road at any time. The winds were changing constantly depending on the fire. It had its own weather system.

After I finished hacking away the ice plant from the top edge of my hillside, I crawled back up the slope. I could barely stand I was so exhausted. For the time being the fire around my house seemed to be non-threatening. I was covered in mud and ash. My hair was like wire and so glued together that it hurt. I walked into my house. It was easy to see inside without electricity because flames were flickering in all the windows surrounded by fires out in the landscape. Reflections danced on my walls and ceiling. I hoisted a 5 gallon jug of

Arrowhead water to my shoulder and walked back to my bathroom. My clothes were stiff as melted plastic. I pulled them off and stood in the shower. As flames danced in the frosted glass, I poured water over myself and soaped myself clean as possible.

The strange thing was that after my shower I really just needed to disconnect. Relax in any way I could. I went through the motions kind of automatically. I put on my good jeans and a nice shirt. I went out to the kitchen feeling kind of refreshed, and poured myself a glass of wine. I know this sounds insane with all the fire around me, but I took a cigarette, and my glass of wine, and walked down my driveway to survey the fire from down on Rockpoint Way.

Just up the road my neighbor Rick Rutkowski's house was burning. To my right down the road, Morris's house had been untouched in a shadow of thick foliage and overhanging trees. At the sharp bend in the road, the skeletal remains of Al and Arlene Broussard's house were smoking furiously. Down at the end of Rockpoint Way, what was left of Peter's house was still blasting embers into the sky.

I turned up to the left and watched Rick's house on fire. It was a big brand new cliffside house and generated an extravaganza of flame. Below was a near 45 degree or steeper slope, maybe 500-600 feet to the highway. Flames bellowed out Rutkowski's shattered windows in a weirdly high-pitched screech. I stared into the flaming belly of the house, when there was another ungodly groan and squealing in the smoke. Suddenly the entire house tilted, as if opening its jaw from the bluff. I saw the steel rebar of its foundations stretching, molten and elastic as rubber bands, snapping and recoiling back in slow motion. Then the house hurdled into the darkness in a giant fireball. It plunged down the mountainside, until flames consumed the last of it far below, and it slowly sank back into the glimmering black landscape.

I had no idea what had happened to my good friend, Andre De Mondesire who lived up the road. His wife Lisa and daughter had left, but he had stayed. He had come down to check on me when I was working with Mark Herron before the firestorm struck. We took a photo of the fire cresting the ridge behind us. I prayed his house had survived. Rockpoint Way up to his house looked passable. Flurries of sparks crackled explosively over sections, but lengths of it remained in darkness. I pulled the elastic strap of my breathing mask back over my head and started walking, ready to spring from crackling bursts that might jump the road. I passed the snaky glow of ice plant burning up toward where the front of Rutkowski's house had once been. The ice plant had missed its chance. When I had rounded the bend in the road, I was amazed to see that Andre and Lisa's house was still standing, safe in a pocket of darkness.

Andre was nowhere to be seen, and I assumed he had left. Then I became aware of a racket of pyrotechnics from over the hill up at Jim Kiewit's house. There was a glow in the darkness that was much bigger than a single burning home, a glow that should not have been there. The fire had already passed but now a new fire was approaching from the opposite direction. Unbeknownst to me and my courageous neighbors, a backfire had either been set, and that was what some people thought, or the wind had turned the fire back into our neighborhood. Hurrying up into the glare of white smoke at the top of the road in Jim Kiewits parking area, I spotted the shape of Mark Herron's son, wearing his face mask with a red bandana around his head. He defiantly raised a shovel in his fist, and gestured toward the Kiewit house. The new fire coming up the hill had ignited Jim's collection of log rounds under his pine trees. We had just begun rolling the flaming rounds to the middle of his parking area when we turned to what sounded like a deflated rubber ball thumping back and forth against a wall. We thought we were alone on our street, but a pair of large oval eyes and a green rubber snout appeared through the smoke. My lawyer neighbor, Michael Harris, wearing an army surplus gas mask, raised his hand into an A-Ok sign.

The three of us finished rolling the last of the flaming rounds away from Kiewit's trees, and then hurried over to bucket water up into his roof eaves which had caught fire. There was no time to figure out how to start the old gas engine pump which Kiewit had apparently left ready and hooked up to his water tank. Instead we

bucketed water from the steel barrels he had positioned under his rain gutter downspouts. The 50-gallon barrels under his rain gutters allowed us to save his house.

The new fire was circling and threatening homes the first fire had missed. I walked back down the road to check on my house as sparks began hurling again through the darkness. I stopped at my neighbor Bob and Mary Scott's house to rip away an arbor smoldering over his front door. The wooden structure twisted easily off the nails loosened in the charcoaled beam ends. That was when I noticed smoke coming from Andre and Lisa's house, across the street.

I rushed over tromping through their garden planters to peer through the windows. Smoke hovered over the large oak plank table where our families had so often had dinner together. I ran into the backyard and saw smoke rising like steam from their cedar shingled roof. I found a ladder and climbed up. Mark's son rushed around the corner to help. He found a small plastic child's beach bucket lying next to their Jacuzzi, and handed up pitifully small amounts of water with it. When my eyes adjusted to the dark on the roof, I realized the smoky shingles under my feet were dangerously full of charred black holes venting smoke. The fire was in the attic. I hurried off the roof and climbed down. The house could not be saved. Mark's son left me to go back home to help his dad.

From what I could see through Andre and Lisa's glass patio door, the house had already been emptied of some things, but there was one of Andre's painting standing alone on an antique easel I knew Andre loved. I grabbed a heavy terracotta pot with strawberries planted in cups around the sides, and heaved it at the patio door. That decision almost made me a casualty of the fire. The pot rebounded off the tempered glass like a wrecking ball right past my shoulder. Had it struck me I would have certainly been badly injured, or knocked unconscious, possibly even burned up with the house.

I walked back down Rockpoint carrying Andre's painting and easel under my arm. In the clayish haze of dawn, the charred skin of the mountains were venting grey smoke. Fine ash had sifted past the window insulation and door sweeps, and had layered the table tops and floors.

Saving Your Home in a Wildfire

Klaus W.H. Radtke[1]

My Golden Rule for My Own Home to Survive a Wildfire (and it did after being overrun)

1. **Don't evacuate.** Never leave your house unattended/never evacuate. Evaluate your location and neighborhood. Know your area as your own safety may depend on your neighbor's preparation.
2. **Be proactive and prepare defensible space**. This not only pertains to removing flammable landscape and wildland fuels but also includes wood fences and other flammable items close to the house. Conduction, convection and radiation heat sources may impact your house directly. The millions of firebrands will also find and ignite anything flammable.
3. **Secure a water supply**. Locate trash cans around the house. Fill them with water, place rags or gunnysacks in at least one trash can and put a stone on the lids. Fill up the bathtubs. If your neighbor has a pool or uphill water tank, work together in protecting your immediate neighborhood. Don't just rely on the fire hydrant in front of your house or at the street corner.
4. **Protect the windows, vents and weep screeds.** Eliminate flammable trees and shrubs near windows and wood fences close to the house (at least five feet distance).
5. **Don't live in a house with a wooden roof** or in a wood roof community.

To my knowledge we have never lost a home in a wildland fire if these golden rules were followed. K.R.

Now let us look more closely at these Golden Rules and evaluate them as documented by eyewitness testimony of homeowners that did not evacuate during fires such as the November 2, 1993 Old Topanga Fire in the Santa Monica Mountains. The fire burned again through a chaparral ecosystem dissected by narrow, slide-triggering roads, interspersed with Pine and Bluegum eucalyptus trees and at times homes bunched too close together with wooden fences along with highly flammable railroad ties as erosion control measures. Many of the lessons learned/relearned and documented by eyewitnesses is also applicable to other wildfire ecosystems. So, let us take time to read, evaluate, learn from each other, work together and be prepared.

1. Don't Evacuate (a Firefighter's Golden Rule); Shelter in Place. Protect the windows and vents.

During the hundreds and hundreds of home inspections I conducted, I always stated "This is what I would do if this would be my property." If these recommendations would be carried out properly, there rarely would have been a reason to evacuate. Remember that most fatalities in wildfires are caused by people caught "in the open." So, don't panic and don't become a statistic. Evaluate your situation and be prepared to stay or evacuate if you must. Again, don't be caught in the open.

Fire winds blow out windows of fire catcher homes (the house blows up). Fire catcher homes are often two story or larger homes found in areas most susceptible to wildland fires such as ridgetops, top of slopes, sideslope or within or on tops of draws. These are not homes to "Shelter in Place." However, many of these can be made much more fire-safe.

Eyewitness Testimony:

*The CDF crew decided to retreat into the unburned house adjacent to the burning garage. The wood fences along the driveway were on fire along with the hedge. The crew foreman said that they were now in the middle of the firestorm and that they had to find some clean air to breathe inside the house and that the firestorm would go over in about fifteen minutes. It would take at least 1 to 1.5 hours for the house to burn down and that they would exit after the fire storm had passed. It was now pitch dark and it felt as if Gil was in his own world. So much smoke was in the house that the alarm was going full blast. The living room and upstairs were full of smoke (unfortunately the upstairs windows had been left open and they had no screens). So the foreman took everyone down to the third and lowest level of the house below the driveway where there was good air to breathe and wait out the firestorm.

*Kurt and brother Brad were instrumental in saving a total of seven homes, including Kurt's own. They had a fire hose hooked to the fire hydrant in front of Kurt's house. According to Kurt's observations, at least 16-18 homes out

[1] **For further information and concepts on fire and watershed management please refer to the 1982 through 2004 publications *"A Homeowner's Guide to Fire and Watershed Management at the Chaparral-Urban Interface"* still available for free downloading from the Web and also from the Web site firesafetyus.com.**

of approximately 48 did not burn until hours after the firefront had passed. Good water pressure was available in the hydrants within an hour at most after the firefront had passed, so these houses could have easily been saved. Firefighters were not willing to come up Rambla Vista as they considered it too dangerous.

*"I ignored Sheriff's Department orders and walked along the beach from Topanga to Big Rock, arriving at my house at about 3:30 p.m. It was my intention to stay and try to save our house. I feel reasonably secure in my understanding of fighting fires due to my training as a Naval Officer. I was involved in preparing my proper clothing and firefighting equipment, constantly avoiding the helicopters and law enforcement officers at the door. At 6:30 p.m. an out-of-town fire company was parked in our driveway. The telephone which was still working summoned me at about 6:45; my wife and children asked me to leave because the media was repeating the command structure's demand for homeowners to evacuate. They were afraid for me. With a fire company on my driveway, I felt reasonably secure in turning over the job to them. I showed the fire company the pool and I opened the gate for them." As witnessed by a neighbor who did not evacuate, the fire engine left soon thereafter and the house caught on fire late at night and burned down unattended.

*The owner had saved his house with his fire pump and had to stand watch all night to be sure another flare-up did not occur. During this time period two other houses in the area burned. Since there was plenty of water in the area (over 10,000 gallons) these house could have been saved if firetrucks were there. If there were really 7000 firefighters in the Malibu-Topanga area it is incomprehensible that at least one truck and crew could not be assigned to this area for the duration of the threat (Note: the site in question was near Fire Camp 8 which was "in chaos" as reported and was crowded with hungry, tired and sleeping fire personnel).

*With the chimney damper closed, the car turned around in the garage for quick evacuation if necessary and no flammable materials anywhere around the house, she was waiting for the fire to arrive. The long and step slope had an excellent 200-foot fuelbreak except for sections of the adjacent slopes where a developer had not cleared the almost 50-year old chaparral despite continuous Fire Department notices. However, they had also done some clearance there beyond the fence. Then the buffeting winds ahead of the firestorm suddenly started to shake and bend the large tempered glass sliding doors facing the slope back and forth with ash entering through the cracks. As the firefront was racing down the opposite canyon through 40-year old chaparral, she evacuated, fearing that the glass plates would blow out of the frames and thought that the house was lost after she left. As witnessed by a neighbor who was safely situated across the 32-wide street, the uphill moving flames totally engulfed the one-story wood siding home with a composition roof but no decks for just a short time before they died down and the house reappeared. Because the slopes had been meticulously cleared of any flammable fine fuels, there was virtually no flammable fuel remaining that could carry the fire further and extend the burnout period. Apparently, none of the windows blew out after all but it was a close call. Black char marks were left on the wood siding facing the slopes and the raingutters were thereafter leaking at the seams.

A reminder: Fire winds blow out windows of fire catcher homes (the house blows up). Fire catcher homes are largely found in areas most susceptible to wildland fires such as ridgetops, top of slopes, sideslope or within or on tops of draws. These are not homes to "Shelter in Place" but can be made more firesafe.

If the fire winds don't blow out the windows, direct flame impingement from downslope flammable fuel sources and largely all around the house landscape fuel sources, especially close to windows, will then follow up to finish the job. The windows of newer homes are now protected with double-pane windows and often tempered glass on large sliding doors. However, the last and best defense for even such windows is fire shutters.

What do hurricanes and firestorms have in common? Both are powerful storms that knock out windows. If the storm fronts don't manage to do it, the many flying objects inclusive of broken tree branches (and even large pine cones) can accomplish this. While all around the world people therefore secure their windows with storm shutters or plywood in preparation of a hurricane, in fire-prone environments people often just vacate like lemmings (or are forced to do so), then watch from nearby roads or on TV in horror or disbelief as their homes turn to ashes.
As already "demonstrated by field research" during the November 2, 1993 Old Topanga Fire, homes that were either protected by the more expensive Roll-away aluminum storm shutters (Cashin - Hume Road) or, along with vent openings, by inexpensive, largely homemade plywood shutters (Hill - Las Flores Heights Road) readily survived in the middle of a firestorm while most surrounding homes burned. For a home to survive a wildlife, it is therefore extremely important to combine fuel modification with protecting the windows. Protecting windows is even more important than protecting vents in largely stucco homes because windows will blow out before firebrands will enter through the vents and perhaps start igniting the interior wood frame. When protected by ¼"wire mesh as required by building and fire code, the home will rarely ignite by firebrands or burning ambers but can more readily ignite from any flammable materials placed next to those vents such as landscape plants, leaves, birds nest, wooden fences, materials "pack-rated nearby" or even a wooden doghouse as documented. Amber-resistant vents are often recommended to retrofit attic, soffit, basement, foundation, and gables.

However, before doing so, consult with a building contractor, architect, or engineer to ensure that adequate ventilation exists when installing ember resistant vents which may restrict airflow. Also, be aware of pet entrance doors. They are best placed near largely nonflammable floors and interiors such as the kitchen and bathroom.

Can a wooden home with a nonflammable roof whose windows and other openings are protected, survive if overrun by a firefront? Of course, as documented by the many charred sides of wooden homes provided the burnout period of the surrounding fuels is greatly shortened.

On the other hand stuccoed homes have Achilles heels that are seldom acknowledged or recognized even by experienced fire personnel evaluation fire losses. These are the "weep screeds" at the base of a stucco house. Homeowners are not aware of them and largely plant ornamental vegetation around the house that, even if watered, collect flammable debris such a leaf litter.

Eyewitness testimony

*Malibu: Using backroad trails, he got around the police lines on his bike. As he approached his new, fire-safe, all stucco house with all-around good clearance, he saw smoke coming from the chimney. He ran into the house which was full of smoke and realized that fire had gotten into the wood frame from the weep screeds located on the outside along the ground. The interior not being completely finished, he was able to expose the affected interior wood frame areas and extinguish the fire.

*Malibu: Seeing the smoke, he realized that the fire had gotten into the wood frame of the one-story stucco home, perhaps from a wood post nailed to the frame near the front door before the house was stuccoed. He immediately grabbed a hammer, felt the stucco with his other hand and started knocking holes into the wall where he felt the heat. Then he took the garden hose and concentrated the water into the holes, extinguishing the smoldering wood frame fire. The horses in the large corral were on their own, moved around, and survived unhurt as the fire front swept through the area.

*The old stone house with its wooden window frames and some of the surrounding flammable vegetation was foamed down by the firetruck just before the firestorm approached, which blew out the many unprotected windows and burned down the house.

*"Suddenly a fireball (it felt like a flamethrower) flew over, incinerating a home directly in its path (windows blew out.) The lower envelope of the fireball also left a black scorch mark on the wood siding along the upper east wall of my house but it did not burn."

*Matt had a newer house with double-pane windows, stucco siding, no flammable landscaping, and a large lawn taking up the downhill area of the property. However, there was a row of large eucalyptus trees on his neighbor's property within 10 feet or less of his house which the neighbor did not want to cut down, probably because of privacy, also claiming that they were a Monarch butterfly habitat. As the neighbor's house and the row of eucalyptus burned along the east side of his house, all outer-pane windows of Matt's house broke as they were exposed to the radiation heat. Two of the top floor windows also fell out and broke in many pieces. Even the stucco surface (the stucco was smooth-finished) peeled off in places. The small 2x4 wood retaining wall burned adjacent to a vent touching the rear, and Matt thinks that he was lucky that the fire did not enter the house through the vents.

*The second floor window at the side of the house facing the long and steep downhill slopes broke but the flames could not enter the house because he had placed a prefabricated plywood shutter against the window from the inside prior to the firestorm approaching.

*"He (the policeman) told me he would arrest me if I tried to go in.," remembered Mayer with obvious bitterness. "I only regret I didn't get his badge number." Mayer stood there, infuriated, watching the windows of his house first break in the fire, then he heard the burglar alarm go off. About 5 p.m. the fire overtook the wood-frame structure, burning it to its foundation and gutting a cement-block garage and office complex below. He could have saved it himself (Laurel Canyon Fire, L.A. City 9-16-1979).

*Stucco homes with Class A fire-safe roofing along with wood roof homes located at the top of a 50% slope not properly cleared yet as per fire department requirements were quickly ignited when they were engulfed by flames and their windows largely blew out (Baldwin Hills Fire, L.A. City 7-2-1985).

2. Provide Your Own Water Source

No water systems in fire-prone mountainous areas are designed to provide water from hydrants (or even garden hoses) as the firefront overruns a community. It is therefore critical that the homeowner provides his own water source.

The least expensive water source are sturdy plastic trash cans filled with water strategically placed around the house (as well as gunnysacks and perhaps a shovel). Of course, if a pool or a gravity-fed water tank is available, you can be your own firefighter with some basic training and also assist your neighbors in saving their homes.

Remember again, if caught in a wildland fire, the safest place is still your home. So, be prepared and provide yourself with defensible space. Most fatalities occur with people caught in the open and overcome by the heat of the fire before the flames even reach them. When caught in the open, most fatalities occur in light fuels such as grasslands because the wind can quickly and unpredictably change direction. One cannot outrun the radiating heat sources from even such a seemingly "non-threatening" fire.

Eyewitness testimony:

*"Any amount of water in a tank with a pump or even barrels of water under rain gutters with buckets can be a deal breaker. A few 50 gallon barrels full of water saved Jim Kiewit's house when we found them.

*After the firestorm had passed, he exited his basement, kicked on the generator, positioned his 2" fire hose and started pumping from the pool."

*The wooden trellis attached to the front of the unattended house had caught on fire and was burning towards the front door and window when the downhill neighbor ran over, knocked down the trellis and doused it with his five- gallon bottles of water, saving the house.

*"I grabbed two fire extinguishers and ran to the house below where a bush adjacent to a window on the uphill side of the slope was fully engulfed in flames and was igniting an adjacent pine tree. I was concerned that if any of the houses below would catch on fire, they could then ignite a neighboring house and of course my house. I saved both houses."

*"The adjacent home had a pool. I had a water pump and used the pool water. When some of the landscape vegetation ignited around my house, my neighbors and I put out the fire."

*"As my house burned I was able to stay alive at my neighbor's home who pumped his pool and was able to save his home."

*The men started the gasoline fire pump to draw water from the pool and started hosing down the structures. All outdoor furniture, etc., as well as firefighting tools, were placed in the garage. As time permitted, all vines were torn from the buildings and trees were cut down.

*The morning of the fire the gardener came as part of his normal route, saw the smoke from the fire, and turned on the automatic landscape watering system (cycles on all stations) and probably also the roof sprinkler. While the wood deck burned and fell against the stucco house, the unattended house did not burn.

*In the evening they tried to find out where fires were still coming from in the neighborhood and found that all of the propane tanks were still turned on (these were normally 500-1,000-gallon tanks). For example, someone had a swimming pool and the water heater was engulfed in 10-foot flames. Bryan found the propane tank and turned the gas off. They did this with about 6-8 tanks. If attended, many of these houses would have been simple to save, as they had big swimming pools and hot tubs.

*One type-3 engine from CDF with four firefighters (three men, one female) tied into the unattended house as it had a large pool as well as a pool pump and saved it.

*Three firetrucks with tired firemen from three surrounding cities moved up to his long, protected driveway to get away from the firefront as they had no water. He offered them pool water from his large pool which was the only water source in the area and also offered them water to save nearby homes. When the studio (round building) caught fire about six times during the night along the north end, firefighters helped him put out the fire with his pool water. The fire had penetrated the one-foot-wide wooden fascia board at the end of the roof along the backside of the house where the slope almost meets the building. From there the fire went into the interior crawl space where the electrical wires were located. The railroad ties also were a problem and burned for days after the fire.

*Homeowner firefighters arrived back about 30 minutes after they had to retreat and the houses were still standing. They used the rags in the trash cans to put out spot fires.

*Dick ran across the hill down Rambla Vista to get the Fire Department, but they would not come uphill. They would not even use the pool. So he ran back up and kicked over the wooden fences, which initially saved the house. Electricity and water were out. It got so hot that first the paint on the wooden garage door of the neighboring house would bubble up, then the garage door would smoke, then it would ignite. He stayed throughout the fire storm, even going into the pool.

*Bill helped the firemen hook up the pool pump. After they left, Bill kept an eye on the house all night as the trees and spot fires around it kept burning. (It had a wooden deck and was very vulnerable to spot fires.)

*The day-laborers used buckets and water from the fish pond to put out spot fires.

*He was bitter that his unattended home had burned down with his dog inside as there was a fire hydrant located along the street in front of his home (He did not know that firefighters had tried to tie into the hydrant but found it "dry.").

3. Provide Defensible Space inclusive of Safe Access. Stay Calm.

A fast-moving firefront is largely fed by fine dead fuels under 1/2" in diameter that can quickly lose their fuel moisture as drying Santa Ana, Foehn or fire winds materialize. As a firefront then flashes through an area, it burns all remaining vegetation that has been preheated to the ignition point. In chaparral ecosystems, consisting largely of small diameter fuels, such burnout period may only last 10 to 15 minutes, and in coastal sage scrub even less. In forested ecosystems or when houses burn down, such burnout periods are often much longer.

Eyewitness testimony:

*The fire department had already warned us previously that our private roads were too narrow for their trucks.

*There were newscasters like ants out of an ant hill. They never did anything to help but were just in the way doing their news. Interviewing her, they wanted her to cry to enhance their news story but she refused. On the other hand, she loved everyone that could help her such as fire people, animal control officers, road crews.

*The cars parked along the narrow road were momentarily engulfed by fire. Darlene watched the paint peel off the newscaster truck and the newscasters looked real nervous. She was never afraid because the firemen were there too, telling her everything was OK. A tree (limb?) fell and first hit the newscaster car before bouncing off the top of her car. The firemen got briefly out of their truck and hosed both cars down. When there was an opening in the flames, the cars moved instinctively forward by a few feet or so. When the flames closed in, they stopped. The cars that were flanked by the fire moved more often. At about 1705 the firemen in the fire truck said that they could leave to Fire Camp 8.

*Suddenly he saw the Blue Gum eucalyptus behind his house catch on fire and rushed over there. Then the tires of the two-wheel utility trailer parked near the eucalyptus trees caught on fire. Now the fire came down the hill from the north. Suddenly, surrounding eucalyptus trees were also on fire.

*2-story wood house at edge of slope without setback with wooden decks facing down-slope and pool. A stone wall adjacent to the street as well as a driveway and parking area between the wall and the house provided added separation from fire exposure of burning uphill vegetation on the slopes. Only a few trees around the house. Lush vegetation. Firetrucks had made a stand at surrounding houses and probably saved the house as there were scorch marks from firebrands on the deck.

*The palm tree behind his house was on fire. He found shelter behind his own 4-foot-tall stone wall and sat out the firefront. The actual heat wave and the total engulfment of the flames was over in about two minutes. The neighbor's automobile was on fire. The leaves in the gutter of the neighbor's house were on fire. Hot spots were everywhere. Some of his trash buckets had water and he used it to douse hot spots on his deck.

*Much of the area to the south and east is fairly level and is disked every year, providing a good fire-break

*8 to10 day-laborers from the labor exchange came to upper Via Costera and effectively fought the fire with chain saws and hoses and helped save the homes. Earlier a young sheriff with a bullhorn had ordered everyone to leave but they ignored him.

How much shall I clean?

This depends on your particular situation. When I documented in my 1982 *Homeowner's Guide to Fire and Watershed Management*... that an uphill moving fire on steep slopes could already produce flames in excess of 30 feet in two-foot-tall low-fuel plants such as coyote brush (Baccharis pilularis) and that the flame length could exceed 100 feet in six-foot-tall chaparral, some fire departments recommended/required fuel modification of up to 200 feet. When an unprotected house is located sideslope or in draws or "fire chimneys," meaningful recommended fuel modification may even exceed these distances, especially if a house is unattended. However, remember, whatever you do, first start clearing all flammable fuels from around your house.

Additionally, remember the following and realize that your home can readily burn down from conduction, radiation and convection heat sources even on level ground. 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 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 home and especially windows.

Eyewitness testimony:

* "I turned up to the left and watched Rick's house on fire. It was a big brand new cliffside house and generated an extravaganza of flame. Below was a near 45 degree or steeper slope, maybe 500-600 feet to the highway. Flames bellowed out of the shattered windows in a weirdly high-pitched screech."

*"Suddenly all my tall pines burst into flame on the front of my hillside. The fire had just sprung upon us. It could never have had time to burn down into the deep canyon separating us from the opposite ridge. The fire must have jumped across the canyon somehow. Burned right through the air to us. In the instant before I leapt off the roof, the flames had to be well over 100 feet high. It was like an explosion. As I ran off the edge of the roof, I kept repeating to myself, "Don't break your leg… Don't break your leg!" I landed on the upslope of the hillside with my hose, and rolled down behind the garage to avoid the blast of heat. I lay there with the hose in an inexplicable cacophony of crackling or something that sounded like swarms of insects, I don't know how to explain it, but suddenly I knew the firestorm had roared over me."

*"I got to my feet and rushed out with my hose. Fire raged everywhere around my home. I dragged my hose from the front to the back of my house and back again, putting out flames in plant material and on the wood siding. I loped down the arbor path, dragging my hose over our concrete pavers toward bursts of light. The Juniper bushes at the corner of our bedroom exploded in grey smoke at the end of my stream. Then an explosive crackling spun me around as our Podocarpus trees blazed around our garden deck. Below them in darkness were our avocado and citrus trees, which were finally giving fruit after years of care. I blasted the deck and burning Podocarpus trees as the tall smoky skeletons of our hillside pines sputtered in sparks overhead and dropped flaming limbs."

*"Along my driveway all my Italian Cypresses spewed up flames in crackling bursts like huge roman candles."

*"Suddenly, down at the last house at the end of our street, a large eucalyptus tree burst into white flame. Somehow the house and tree had out-survived all the others on our street."

*He was a safety minded Vietnam vet and did excellent fire clearance around his mobile home which was one of the few homes that did not burn.

*The heavy brush on the steep slopes below the house was instrumental in starting to ignite it.

*As the fireball passed, it had gotten so hot that all plants on the east side of the house scorched. Most of the leaves were burned off the Blue Gum eucalyptus trees along the slope near the southeast side of the house and the trees were on fire.

*The house had a large pool as well as a pool pump but was surrounded by many trees. Owners evacuated quickly. CDF tried to save it but could not. Too dangerous, too many trees.

*Another house with a wooden deck (at the bottom of a narrow driveway with little brush clearance) overlooking a steep draw about three hundred feet long (chimney effect) ignited quickly.

*As witnessed, a fireball engulfed the house. It must have gotten very hot before the fireball died down quickly because of lack of fuel directly around the house. The seams of the copper rain gutters still show heat discoloration after the fire. A winter woodpile burned which had been placed against the concrete wall near the house. There were no railroad ties near the house.

*The house had no trees around, good clearance, and survived.

*The flames first came from the west (uphill behind his house). They went thirty feet past the hillside but did not reach the house, as they were cut off by the vegetation clearance he had done.

*The 3.5 acres of bare land south of his house had not been cleared prior to the fire. The owner told him that he was legal because he did not have to clear the brush prior to the fire because the Fire Department had given him an extension.

*2-story split level all-exterior wood house with tile roof sideslope along steep slopes with a long, narrow, private driveway leading uphill to the house. Two helicopter drops were made on the house but it could not be saved. The big trellis on the downhill side covered with Bougainvillea ignited with a big bang. Then the house ignited (window blew out?). Many pine and eucalyptus trees below the house and along the sides also started to burn.

*One-story stucco house with tile roof overlooking steep, westerly-facing slopes. Fire-stopped tile roof. They had done excellent weed abatement in excess of 100 feet down the slope about three weeks before the fire which impressed the firemen. Dana had closed all the windows but forgot to fill up trash cans with water. He followed instructions by firemen such as turning on the hydrant at Rambla Pacifico, etc. Two helicopter drops were made on the backside of his house and the house next door. Firemen laid on the ground for cover when the drops were made. House did not burn.

*Large, two-story stucco house with tile roof and extensive down-slope groundcover greenbelt which is regularly watered. Owner did not evacuate and protected the home.

4. What Can or Shall I do if I Own a Lot with Limited Defensible Space?

Remember, while you only have to prepare defensible space up to your property line by removing flammable fuels (wildland, landscape and structural) for about 100-200 feet as per fire code, depending on your situation, your safety also depends on your neighbor's willingness to cooperate. But many homes are lost in situations where there is no such defensible space all around the house because the lots are small and the neighbor's trees, wooden fences, etc., are in close proximity to your house. That is part of the reason why there is so much disconnect and so much frustration with the well-meaning pamphlets prepared by fire agencies on how to prepare defensible space.

This is what you can do immediately to not become a SITTING DUCK. Cut back the neighbor's flammable vegetation encroaching onto your property up to the property line and document it. Tell your neighbors to maintain their vegetation fire-safe. Protect your exposed windows with either fire-safe, remote-controlled roll-down electric or hand-crank shutters or even wooden shutters that you can often fabricate on your own, and also protect your vents.

If at all possible, replace the wooden fences around the home and along a close property boundary with your neighbor with a heat-shielding stone wall. It will not only protect your home from radiation heat sources but may also be your "life-saver" if you choose to remain behind or are caught in a firestorm. It is also critical for firefighters' safety.

If you neighbor has not followed through yet on your request to fire-proof flammable vegetation, and pine trees are still loaded with dead needles during the fire season, hose the trees down to remove the dead pine needles. If the flammable trees are drought-stressed, you may want to lay a hose under them in the interim so that they are deep-watered.

If time permits, become a community organizer and help create a more fire-safe neighborhood.

5. What about Wooden Roofs?

No wooden roof is safe in wildland fire situations. Largely ignited by firebrands, they then create self-feeding fires that can burn hundreds, even thousands of nearby homes. Change your wooden roof or make sure that you are not located in a wood-roof community.

Wooden roofs are not addressed here as the reality is that within a short period of time, the remaining wood roof homes still existing in wildland areas will have burned during wildland fires if not changed to fire-resistant roofing, and that the local communities will then (finally, finally!) overcome the lobbying of the wood shingle industry and pass truly fire-resistant roofing ordinances when rebuilding.

Pre-1990s homes (largely dried-out wooden houses or houses with wood decks whose windows are largely only protected by single pane or non-tempered glass windows) are also at high risk.

Most past "Shelter in Place" fatalities occurred in wood roof homes. A wind-driven fire spreads so quickly from wood roof to wood roof and turns then quickly into a firestorm that escape is not possible or unprotected windows blew out in fire-exposed, largely fire-catcher, older homes. Also, many of the serious burns occurred when people were caught in the open or were running away from the sudden "fire inferno" caused by wood roof homes burning as was already well documented during the Sept. 16, 1985 Baldwin Hills Fire in Los Angeles City.

<u>Eyewitness testimony</u>

*Many older homes in the neighborhood had wood shingle roofs when Big Rock was developed and he had changed his wood roof to asphalt shingles after purchasing it some time ago. It did not burn but the fire burned most of the other wood shingle roofs on his street still remaining there.

*"I ran into the backyard and saw smoke rising like steam from their cedar shingled roof. I found a ladder and climbed up. Mark's son rushed around the corner to help. He found a small plastic child's beach bucket lying next to their Jacuzzi, and handed up pitifully small amounts of water with it. When my eyes adjusted to the dark on the roof, I realized the smoky shingles under my feet were dangerously full of charred black holes venting smoke. The fire was in the attic. I hurried off the roof and climbed down. The house could not be saved."

*Below his house, the neighbor's house had a wood shingle roof overhang. Gerhard and friends took a ladder and ripped the wood shingles off as the wood roof section caught on fire and saved it.

*"I grabbed my 1" hose hooked up to my mains pressure, and climbed a ladder to my garage roof. In a few moments my roof was literally covered in petals of flame dropping from the sky. Looking upwards they fell as if from inside of a volcano. It was remarkable how well a rock roof held up to such a thick carpet of glowing embers over it. I wielded the hose stream

over the glowing roof, blackening large wedges, but there was so much fire falling from the sky that my hose made little difference."

*"With wet cloths tied over our faces because of the smoke and because of lack of water, we used a shovel and dry gunny sacks to beat out the firebrands that were blowing down from the burning uphill house some distance away and landing on our neighbor's wooden roof. The neighbor had evacuated without filling up any trash cans or the bathtub with water. The owner of the house told us later that his insurance company paid for a new roof as he told them that firefighters had damaged the roof, trying to save the house."

*County Supervisor Kenneth Hahn, along with Los Angeles City Fire Commissioner Anne Lane and firefighters, said many of the homes might have been spared if they had not had wood-shingle roofs. The evidence was visible throughout the fire area. Homes with rock roofs stood virtually untouched by the fire while homes on both sides, across the street and in back were burned to the ground. However, the fire was so intense that it exploded windows and consumed some homes with rock roofs (Baldwin Hills Fire L.A. City 9-16-1985).

6. What about Wood Decks?

Many fire losses of unattended homes <u>after</u> the firefront has moved through are caused by wood decks or flammable fuels (rats' nests) accumulated around the house igniting.

<u>Eyewitness testimony:</u>

*One unattended house burned near my house after the firefront had moved through because burning embers had fallen on the wooden deck. It could have been saved with a garden hose.

*"I saw flames on the wood struts of the wood deck which burned for hours and the car on the wood deck caught fire and rolled down the hill. The house itself finally caught on fire and burned full blast about 0200-0230 at night (firefront went by about 1630 or 10 hours before)."

*The house was the easiest to save if the owner had been home and should not have burned. It was all stucco and had practically no flammable siding. Its wood fence and outdoor furniture did not burn. However, it had two small wood balconies and one of them caught fire. If the owner would have been home, he could have stomped out or pissed out the fire. For 10-15 minutes the balcony burned before it started igniting the house. Then it took a couple of hours for the fire to eat through the house.

*Fire trucks at Hellstein's house filled up with water from the pool and were send over and extinguished the fire on the wooden deck and protected the house from burning.

*The house had a pool. As observed by the neighbor, the wooden deck of the overall fire-safe house caught on fire and firemen from the fire truck tried to cut it off with a chainsaw but were not successful. The house subsequently burned.

*Two-story wood house with wood deck, many trees around house. The deck burned, windows broke and firebrands ignited the interior. When the owner returned, he helped save the house by extinguishing the firebrands in the interior while his neighbor aimed water at the house from his water tank. Prior to the firefront hitting the area, both had already cut down the big pine tree between both houses.

*When he returned to the house after his attempt to evacuate (escape route was closed by tall Bluegum eucalyptus trees burning), all decks had caught on fire. Fortunately, they were made of thick 3" wood and burned slowly. A staircase made of 2" wood had already burned down. Firebrands had caught near the wooden deck door and had burned through the bottom of the door into the house and cracked a window. The plastic drain pipe exiting along the east from the interior of the house had caught fire and the fire had followed it right into the house.

*The all-wood 2-to-3-story house with asphalt roof but dried-out wood siding and an upper floor slightly cantilevered slope-side over the lower floor (up to about four feet) ignited as the firefront passed through.

*The houses burned from north to south as the flames got underneath the decks, blew out windows, and rolled into the interior of the houses. It was very hot.

*Stucco, red tile roof. French doors. Wooden fascia. Wood decks. The wooden deck started to ignite, then the wood fascia around the windows, etc., burned.

*One-story house with wood siding and old asphalt roof along a narrow ridge but good clearance. Open wood deck overlooking the slopes from south to west. Many railroad tie walls. Owner did not evacuate. House was saved by professional firefighters with <u>lots</u> of water from fire hydrant.

*One-story Spanish style stuccoed house with tile roof and extensive vineyard greenbelts and pool. Unattended. Based on common sense rules, the house should not have burned but its Achilles Heel may have been the small, wooden deck facing the downhill side of the house. It, as well as the trees below it, caught fire when a large three-story house that was located sideslope below Rambla Pacifico burned down.

*The house next door caught fire and thereafter the wooden deck of their rental house also caught on fire. Fire trucks at Hellstein's house filled up with water from pool and were sent over and extinguished the fire on the wooden deck, saving the house.

7. What about Wood Fences? Railroad Ties? Firewood?

If your house is unattended during a wildfire and there are attached or close-by wooden fences or wooden decks, the chances are great that your house will have turned to ashes when you return.

Just think about it. Would anyone in their right mind remove all flammable vegetative fuels (both native and landscape fuels) from around the house as required by fire code, and then send them through a chipper to refabricate them as highly flammable (but legal) wood fencing, railroad ties close to or even attached to the house? If feasible, replace the wood fences with stone walls.

Eyewitness testimony:

*"I made it back, avoiding the police lines, and saved my friend's house by knocking down the burning wooden fence adjacent to the house."

*After exiting his basement after the firestorm had passed, he restarted his pool pump (fed by the 1,600-gal. gravity fed tank) and doused the ignited railroad ties and wood fence. He continued to knock down the flare-ups of the railroad ties during the night.

*They believe that their clearance and removal of the many pine needles prior to the fire saved their home, but admit that it is a bad idea to have railroad ties or telephone poles for hillside stabilization or retaining walls on slopes, as these kept burning and endangering the house.

*They saved the adjacent motorhome and adjacent house which had only about 15 feet distance to the fully engulfed house. Fortunately, a concrete wall between both houses protected the two off-duty firemen from the radiating heat of the burning home while they aimed a stream of water at it for about twenty minutes from their fire hose connected to the fire hydrant at the street. If it would have been a wooden fence instead of a concrete wall, the adjacent home and motorhome would have also burned.

*The trees and other vegetation seemed to be at once on fire, and fire personnel started hosing down the trees until they ran out of water. The vegetation then caught the wood fences on fire and all these flames caught the houses on fire.

*The house caught fire after 2300—more than five hours after the firefront had passed—as the railroad ties behind the house burned and "lit up some plants."

*Late at night, after the firefront had passed and the onshore winds had put an end to the fire, a firetruck from the nearby station suddenly pulled up, rolling out hoses. He stopped them, asking what is happening and was told that the Fire Department was receiving calls from people below, being concerned about the fire on the hillside, probably from reigniting railroad ties. Tired, but being concerned about the heavy erosion water from a firehose would cause on the hillside and knowing that the railroad ties would just constantly reignite after being watered down, he promised to smother them with soil, putting on his boots, grabbing his shovel and starting to do so before the fire personnel was willing to leave.

*A large pile of firewood within about twenty feet of the older wood house was burning, and a fire captain advised them to scatter the burning firewood as its radiation heat (and convection heat, depending on the winds) could catch the side of the house on fire and blow out its windows.

*"Being off-duty, I made my way down to my home and evacuated my family. I then began recon and structure protection of my neighborhood. As a single resource I was able to extinguish many fires on fences and bushes close to homes."

8. What About Propane Tanks?

Turn off the gas valve before evacuating. Propane tanks are potential designs for disaster. If at all possible, provide a fire-safe zone of at least twenty feet around all tanks or build a concrete wall within five feet of them and keep the surrounding area free of flammable items. This includes all flammable materials inclusive of sheds and homes.

Eyewitness testimony:

*As the mobile home burned, the propane tank line separated, spewing gas and caught the pine tree on fire.

*"After I evacuated and looked back. I saw the hose of a propane tank shooting blue flames everywhere."

*"It was dark in the basement but I could hear the wind howling and propane tanks exploding in the distance."

*All trees (eucalyptus and pines) were blazing. To escape the flames the CDF truck backed into the driveway courtyard in front of the house where it was partially protected by low concrete walls. The heat was very intense and the garage was on fire. The 500-gallon butane tank filled with about 300 gallons of gas suddenly blew its lid (safety seal) with a loud explosion. For the first two hours the tank whistled loudly (still had lots of pressure), sending out flames. For the next two days a flame up to eight feet high lit the area. The flame came in very handy at night when Gil was patrolling for and fighting spot fires.

*The house above was still crackling with flames and sending down firebrands, but the winds had died down. Earlier the water heater from the house had exploded and hurled through the air, landing in front of their house as 15-to-20-foot-high flames from the gas line shot into the air.

9. What About Mobile Homes?

They are potential designs for disaster, as they are largely located on small lots with often not well-maintained, limited defensible space, no garage to protect the cars, no proper clearance from propane tanks or any flammable materials. Largely wooden steps lead to small wooden decks and the front door. They are the first to burn as a firefront goes through so that few are ever saved in a wildland fire, whether it is in a desert, chaparral or a forested environment. If they are on a sturdy enough foundation to withstand the fire winds and escape direct flame impingement or radiating heat sources, the uncountable firebrands raining down on them will ignite any flammable fuels. Once ignited, the "dancing" lines of propane tanks will then spew fires in all directions and other tanks will blow up as the heat intensity of a now self-feeding firefront increases.

Eyewitness testimony

*"You could hear the propane tanks going off. It sounded like bombs and there were big balls of fire in the sky afterwards. You could hear the booms and you know another house (mobile home) was gone."

*After a MH ignited, it quickly spread the fire. The propane tank gas line, up to this point attached to the MH, was now separated and spouting flames for many hours as the gas valve had not been turned off at the tank. With the pressure originating from the tank, the largely flexible gas line whipped around in the air, spreading flames in all directions.

*The side slope situated, unattended mobile homes were protected from direct flame impingement by a well-maintained uphill firebreak in excess of 100 feet and the all-around removal of flammable landscape fuels. However, they had no chance of survival when the firefront, moving downhill from the top of the mountain, showered them with firebrands large and small.

*"Especially during initial attack operations, the fire crew was exposed to heat and smoke from various hazardous sources including but not limited to houses, vehicles, vegetation, sheds containing unknown chemicals, as well as fiberglass boats and recreational vehicles."

10. What about Visibility? Firebrands? Smoke? Other Hazards

Firebrands, carried by the fire winds, can literally rain down on a community ahead of the firefront and ignite any receptive fuels they find. Many homes that could be easily saved, if attended, are often ignited by firebrands and finally burn down many hours after a firefront has passed. Burning structures then produce more firebrands during their burnout time that can last for many hours.

Smoke is a real hazard during wildfires and it is therefore recommended that only able-bodied and properly dressed persons remain behind during a wildfire.

Eyewitness testimony

*Visibility was 0 in most areas of the fire."

*The fire was spreading as a result of flaming embers raining from the sky.

*Firebrands rained all around us. There was no actual firefront.

*The fire burned the woodworking shop north of the house and his antique car that sat adjacent to it and right in front of the propane tank. He watched as the thick rain of flying firebrands was being pushed underneath the car by the strong winds, igniting it.

*Smoke got extremely intense and Gil ran up and down the road to find a place to breathe. Gil jumped into the CDF truck as instructed.

*"At first the wind initially was so strong that it blew out the tree fires. The sound of the firestorm was unbelievable, like out of one of the horror movies but then the wind subsided. There were still red ashes everywhere. But luckily the fire storm was over and the burning embers put themselves out."

*A helicopter dropped a load of red material (phos-chek?) above Lamplighter Lane (below his house). He saw only one drop the whole day. A siren came on when the load was dropped.

*Then they put the pool pump on a cart with wheels and brought the pump up the steep driveway of Bill's house because he had a pool. The large house above it was burning and was sending showers of firebrands downhill to Bill's house. They were afraid that if any of the houses on upper Villa Costera caught on fire, it would cause a chain reaction. They sprayed the back of Bill's house while the firebrands were raining down.

*After the fire storm had passed, Tony was bombarded by firebrands for a long time. Many houses that burned later were ignited by firebrands. His own deck was scorched by them. Three structures were lost south of PCH (along the beach) because of firebrands.

11. How Shall I Be Dressed if I Don't Evacuate in Order To Safe My House?

Wildland firefighters try to wear protective clothing (PPE) that can vary greatly between different fire departments but is generally designed to provide protection against burn injuries that result from direct contact with flames and transfer internally generated heat to minimize heat stress injuries. It must be remembered that most injuries to firefighters are due to heat stress, not burn injuries. On the other hand the worst burn events occur with inexperienced homeowner firefighters as they are generally not properly dressed to fight a fire**.** Sturdy shoes/boots, long pants preferable jeans, a long-sleeve shirt, a bandana/face mask, goggles as well as water are the minimum requirements if a homeowner decides to stay with his or her home in the last minute. Cotton fabrics are preferred to synthetics that may melt on the body.

Besides flame injury another type of burn injury is the inhalation burn. This is mostly seen in firefighters that have inhaled superheated air. One good indication that a person may have a supraglottic (above the glottis) heat injury is swollen lips. In this case, advanced airway interventions may have to be done soon. If the patient has severe shortness of breath he/she may have to be treated with high flow oxygen. Protecting the airway from extremely hot air is always a firefighter's primary concern. Breathing through a wet shroud or bandana exposes the airways to hot, moist air, which can be more harmful than hot, dry air. Avoid breathing through wet cloth but protect your face. A wet bandana or wet cloth can be used to cover the nose and mouth to reduce inhaling smoke after the flame and heat of the fire have passed.

Breezing largely through the nose, firefighters can survive inside temperatures of 175-190^{o} F (92^{o} C) such as in fire shelters for up to 30 minutes without serious injury. How is this possible and for how long? Air, fortunately, is a poor conductor of heat and the upper airway is very efficient in thermal or heat exchange. For this reason a healthy person in a fire shelter can survive breathing such superheated air. Although most of the injuries to the respiratory tract are therefore generally mild and involve only the upper airways, anyone with a significant history of exposure should receive a medical evaluation as soon as possible. Thermal injuries to the respiratory tract can be insidious, with a delayed onset of respiratory distress after contact with superheated air. Significant respiratory distress may be present as late as 24 hours after the exposure. Thermal airway injury is always associated with edema, which can rapidly occlude the airways.

In stark contrast to the higher temperatures generally required for respiratory tract injuries, soft body tissue thermal burns can already occur when the skin is exposed to temperatures above 115^{o} F (46^{o} C). At temperature exposure greater than 120^{o}F for three seconds, a child's skin can be burned severely enough to require surgery.

Eyewitness testimony

*The woman firefighter told her to get out of her dress and put on jeans and boots if she wanted to assist. She then watered down the large wooden deck, changing at the same time into jeans. Because the road is wider at her house than most other parts of Rambla Pacifico, fire equipment was parked there everywhere (which probably helped save her all wood house and wood decks).

12. What about out of Area Firefighters? FIRESCOPE? Local Firefighters?

Homeowner Comments

*There was a command system but no plan. There is a universal problem with FIRESCOPE. They have to work towards effective deployment or it is a waste of men and equipment. We have huge losses because the strategy is not effective. Prevention-Strategy-Tactics. Fire Dept. Risk Analysis: Clearance, Water, Roads, Communication, etc.

*With FIRESCOPE, once an area is assigned in a fire, the local Fire Department (even if it would b prepared), loses control of that area. State legislation is needed for local units to take over control of an area as fire liaison and supervise and direct out-of-area firefighters. The local firemen, if prepared, should input the local knowledge and strategize.

*The first fire engine showed up at about 2300 (the firefront had passed about 1615). It was not local. None of the firemen knew how to get up or down the roads. They did not know where they were and asked for drinking water, as they had none.

*After midnight but by about 0200 hours, water had returned. Someone had found firemen within walking distance sleeping, who said that they could not come to help because of downed power lines. They also did not know that some water pressure had returned to hydrants. Residents cleared the power lines from the road as well as the road and a fire truck came up to mop up.

*At about 1800 after the home was saved, the fire chief and firemen asked the owner how to get to the beach and where the roads went to. Rodger told them that they could not get to the beach anymore and explained the road system.

*At PCH firemen told people they cannot do anything to save the houses in the hills because they have no water.

* Fire Camp 8 was not overall safely maintained and several structures and woodpiles burned.

* Firemen were worn out but saved the house. There were too many fires. Firemen from different jurisdictions could not get together and could not get organized fast enough. The fire was just too overwhelming for them.

*The firefighters that helped save the house were magnificent. They were from Redbluff (CDF?). They "had balls" and knew what they were doing in contrast to other firemen that ran and hid. None of the firemen knew the area. Their (Redbluff) engines kept coming back at night and filling up from the hydrant in front of the house until 0100 when the water failed.

*The L.A. County Fire Incident Investigation Team came a few months after the fire to investigate the burning of the Montebello rig and told Bernie that the assisting agencies are simply not trained to fight these wildfires.

*Firemen had very poor communication and were ill-prepared to fight this kind of fire. Out-of-town firemen had no maps and did not know the area. The big fire trucks were ill-equipped for the area, and it seemed to be like a big McFire (McDonalds) Department, everything the same, not geared to local needs.

*When firebrands started to float down on the neighborhood later at night and threatened to ignite it, he drove around looking for fire trucks and found firemen sleeping. He asked/told them that neighboring houses are endangered and are about to burn and that the house next to him had pool which he already had used. The firefighter crew came down with their truck and saved the neighbor's house using the pool water and prevented the fire from spreading to other homes.

*Having ignored the mandatory evacuation order he immediately went with his jeep looking for firefighters to provide a firetruck for his home as he knew that the fire was coming over the top from Las Flores Canyon. He found three fire chiefs (white shirts, etc.) and urgently demanded a fire truck. One of the chiefs asked him "What roof do you have?" He answered "Rock roof." "What house?" He answered "Stucco." "Clearance?" "Good all-around clearance with ice plant slope." The chief then answered "You will get a truck," and radioed to get a fire truck.

*I still cannot believe that we, as precinct workers in the Carbon Canyon Fire Station, received no warning whatsoever about the fire which consumed all three of our homes."

* "I rushed to the fire department up the highway at Carbon Canyon to try and get a nozzle for my fire hose. The sky was growing dark with smoke and falling ash. There was mayhem at the fire station with huge diesel trucks idling noisily in a line up the street. The fire I think may have already been raging in Carbon Canyon. All the truck bays were empty in the fire station, and lockers were hanging open. Equipment was strewn everywhere. I told firemen hurrying past that I was trying to save my home, and needed a nozzle for a 2.5" hose. Finally one fireman grabbed my arm and pulled me over to a locker and gave a huge nozzle for the hose."

Photo-documentation

1. Protecting a Stucco Home More Effectively From Fire Intrusion

A. Smoke Coming from Chimney of Stucco House after Firefront Had Passed

*Malibu: Using backroad trails, he got around the police lines on his bike. As he approached his new, fire-safe, all stucco house with all-around good clearance, he saw smoke coming from the chimney. He ran into the house which was full of smoke and realized that fire had gotten from the outside into the wood frame from below. The interior not being completely finished, he was able to expose the affected wood frame areas and extinguish the fire.

Left: The low-growing groundcover that was planted at the base of the house adjacent to the weep screeds caught on fire.
Right: Weep screeds and the frame were repaired and the affected side of the house restuccoed.

B. Protecting weep screeds on a new home

Left: A fire-safe designed home with stuccoed decks and weep screeds protected along concrete steps and concrete exterior flooring (red arrows).
Right: However, weep screeds located above a proposed planter at the entrance door (red arrows) may be the Achilles heel in later years as the planter accumulates dead debris. Such weep screeds at the base of stucco foundations are generally only used on walls constructed with wood framing, and are not required on stucco-coated masonry structures or when adhered stone is installed over masonry. Future owners may not be aware that the holes in the weep screeds as indicated by the many red arrows, while allowing moisture to drip from the wood frame covered by the stucco, also provide an entry for flames into the house.

C. Lighting fixtures as possible fire entry in a "fire-safe" stucco home

Any opening in a wood-framed stucco home is a potential entry for flames. This photo shows the lighting fixture pierced roof of the open garage underneath the deck. As an adjacent large tree burned, direct flame impingement melted the lighting fixtures and gained entry into the framing.

2. Protecting Windows from Fire Entry

With the windows protected by home-made wooden fire shutters installed from the outside at ground level and inside on the upper floors, this tile-roofed split-level stucco home overlooking steep slopes survived a 10-15 minute fire storm coming down the canyon and also uphill from the creek. Note the heat-cracked windows on the right.


With roll-down aluminum fire shutters protecting its windows, this ridgetop home survived the firestorm that overran and engulfed it during the November 2, 1993 Old Topanga Fire.


The fire gained entry into the house at the top of a steep slope without any setback by blowing out windows. With the burned "low-fuel plants" removed from the planter in front of the picture windows, roll-down shutters were installed after the fire along with restuccoing the fire-damaged sections of the house. While shading from the sun is desired for the windows facing a southerly slope, be aware that the enlarged overhang is a potential "fire catcher."

3. Eliminating Flammable Roofs

Flammable roofs have been by far the largest causes of fire losses and fire conflagrations in fireprone wildland environments throughout the fire history of this country. One can only be more fire safe by replacing any flammable roofing material as such roofs are the immediate receptors of fire brands and any other flammable objects landing on them.

1978- Three people watering the roofs of their wood-roof community while they still have water pressure. Two people are watching on the ground. Backyards are planted with low-fuel plants, protecting the uphill facing sides of the homes from direct flame impingement. Little good will this do when firebrands start raining down on the roofs as the wind shifts..

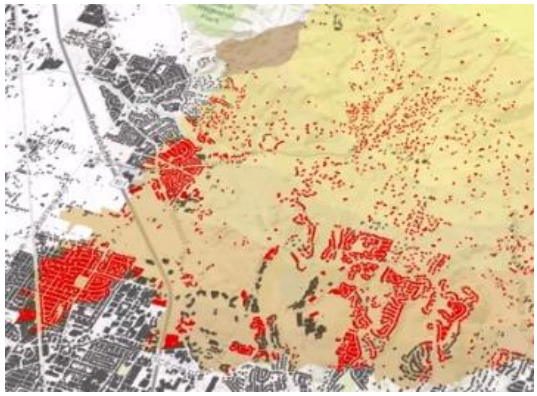
1956 – Destroyed wood frame and wood roof homes.

1978 – A rare sight of a saved wood roof home.

1991 – Oakland Tunnel Fire: Narrow roads, wood houses, wood roofs, wood balconies, many pine and eucalyptus trees.


1999 – Crest De Ville Fire – A small fire quickly destroyed a new wood shingle roof community despite available water.


2007 – Angora Fire at Lake Tahoe – Rebuilding but safely (?) in a high elevation forested environment.

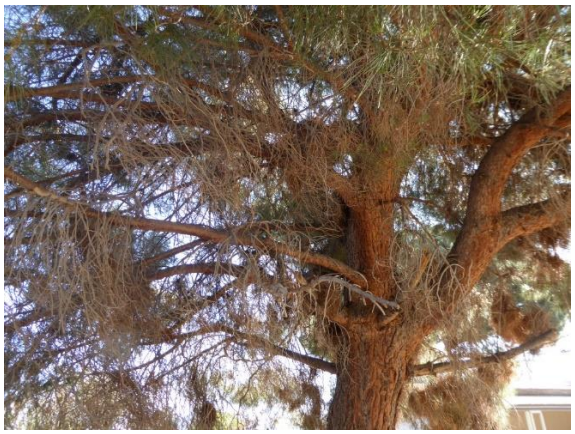
2017 Left: Tubbs Fire (Napa,Sonoma,Lake Counties) spotting across the 101 Freeway in Santa Rosa, N. California.
Right: Red dots indicate destroyed homes along the western front of the fire inclusive of tightly packed red dots in Santa Rosa. – The fire followed a path similar to the 1964 Hanley Fire in which only a few dozen homes were destroyed. Building in fireprone enviroments with little thought about fire safety and past fire history caused a wind-driven spotting conflagration in 2017 which destroyed over 5,600 structures that did not exist in 1964.


2018 Camp Fire in Butte County, Northern California – During predictable high wind and spotting conditions the fire destroyed 18,000 structures which included most of the town of Paradise. Paradise was also expanded in fireprone enviroments with little thought about fire safety and fire history (above photos from the Atlantic). A special fire prevention fee of $470 mil. spent on prefire fire prevention efforts made little difference in reducing the fire losses or assisting in fire containment.

4. Living More Safely in Mobile Homes in Fireprone Environments


This mobile home and propane tank, maintained by an army veteran, survived a mobile home park fire conflagration.

Another mobile home during the height of the fire season.

The large pine adjacent to the above mobile home passed fire inspection as ornamental vegetation while littering its roof with pine needles. Its interior, largely dead crown poses an exteme fire hazard not only to this mobile home but to neighboring homes and the mobile home park itself because it can become instrumental in the spread of the fire and in supporting a fire conflagration.

Photo-documentation will be continued as time permits. Photos and input from readers are appreciated.