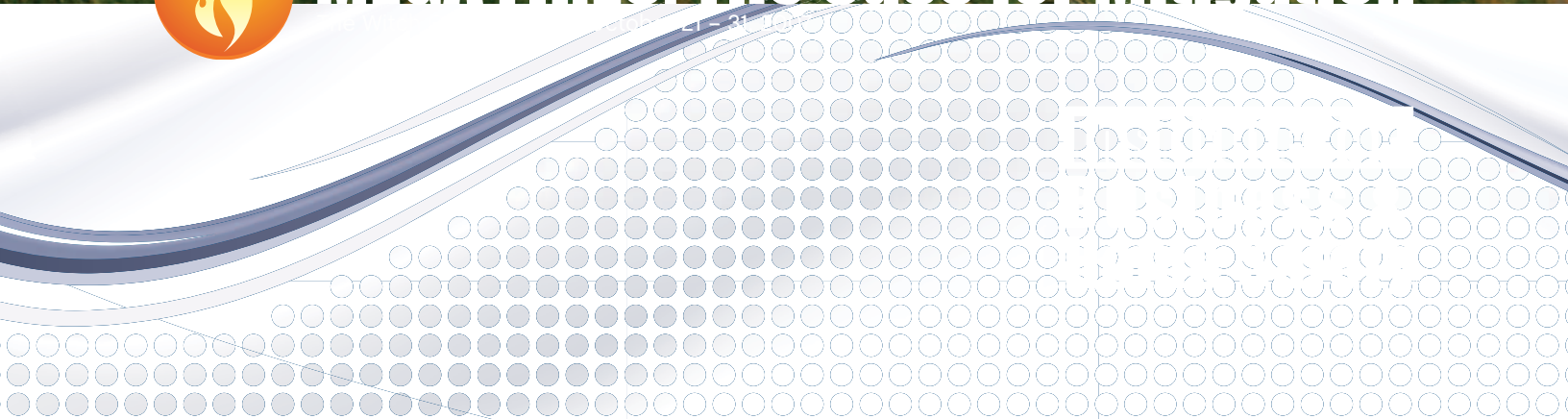




MEGA FIRES: The Case for Mitigation





July 2008

The Institute for Business & Home Safety is dedicated to reducing the social and economic effects of natural disasters and other property losses by conducting scientific research and advocating improved construction, maintenance and preparation practices.

The applied building science research conducted for *Mega Fires: The Case for Mitigation* provides new data and findings that ultimately will help consumers better protect their homes against the ravages of wildfires.

Fully one-third of homes in the U.S. are now located in what fire safety officials call the Wildland Urban Interface. While this study focuses on Southern California, the findings and recommendations can be applied to all wildfire-prone areas across the country.

Mega Fires: The Case for Mitigation is the first research study to be published under the auspices of IBHS' new Insurance Center for Building Safety Research. This state-of-the-art, multi-peril research and training facility will produce real-world findings that will lead to more durable, sustainable communities.

Julie Rochman
President & CEO
IBHS

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MEGA FIRES: The Case for Mitigation





OVERVIEW

Wildfires are called wild for a reason – they are often uncontrollable. What is controllable, however, is the preparation we undertake to protect our homes from damage and loss once wildfires strike. The Institute for Business & Home Safety (IBHS) is an independent, non-profit, scientific and educational organization supported by property insurers and reinsurers. IBHS has undertaken a major research effort to study wildfires with the goal of reducing the social and economic effects of these disasters. This report documents the findings of that research and provides recommendations for improving construction, maintenance and preparation practices that will reduce wildfire-related losses in residential areas.

Increasingly destructive wildfires are ravaging homes and businesses in more than three-fourths of our states. One of the most devastating fires in recent history was the \$1 billion Witch Creek Wildfire that decimated vast parts of San Diego County, California, in October 2007. By the time it was fully contained, the fire had burned an estimated 198,000 acres and damaged or destroyed more than 1,200 homes and 500 outbuildings.

IBHS recognized that the communities affected by this fire would provide ideal field observations regarding the value and efficacy of property protection measures. Some neighborhoods affected by the fire were built as “Shelter-in-Place” (SIP) communities, while others had no requirements for reducing wildfire risk. This research project compares the damage done by the Witch Creek Wildfire in three SIP communities with three conventional communities.

To be considered Shelter-in-Place, an entire community must be designed to withstand heat and flames from an approaching wildfire. This means that every home must share the same fire-resistive design qualities, including a well-maintained fire district-approved vegetation management plan.

“Shelter-in-Place” is a term used in San Diego County; however, the SIP restrictions and

covenants that combine to protect homes community-wide could be referred to as “Wild-fire Resistant Communities” for purposes of exporting the standards to other areas.

For this study, IBHS examined construction features, proximity to the fire, wind speed and direction, slope and the amount and type of vegetation. IBHS also commissioned social research to better understand what motivates people living in wildfire-prone areas to take protective actions and what would make the difference for those who do not.

Recognizing that both building and social sciences play a critical role in helping determine how to deal with our country’s growing wildfire threat, IBHS brought together a variety of experts and resources for this project, including leading academic researchers, federal government fire science authorities, social research professionals and fire safety officials.

Just two weeks prior to the Witch Creek Wildfire, California Insurance Commissioner Steve Poizner and CAL FIRE Director Ruben Grijalva established a partnership to reduce the risk of wildfires. They issued a Memorandum of Understanding October 10, 2007, which cited the following key facts:

- The number and degree of wildfire losses are increasing in California decade by decade.
- Each year, over \$100 million is being spent on suppression efforts and more in the disaster recovery phases of catastrophic, natural and/or human caused hazards, but the losses continue to mount.
- Hundreds of thousands of acres burn within the Wildland Urban Interface (WUI) each year.
- Thousands of homes, businesses and other structures are damaged or destroyed each year by wildfires, resulting on average in more than \$200 million in annual property damage.
- Many of these fires result in injury and/or death to fire department and law enforcement personnel, and members of the public.
- In the 2003-2004 wildfire sieges, CAL FIRE’s fire suppression costs exceeded \$252.3 million; property damage costs exceeded \$974



million; 5,394 structures were destroyed; and more than 23 people lost their lives as a result of California wildfires.

- More than 5 million homes are currently located in California's WUI. As more homes are built within these areas, the danger to life and property will continue to increase, unless significant action takes place to prevent these fires or mitigate the damage and injury caused by fire.

Commissioner Poizner and Director Grijalva's primary goals are to reduce the loss of life and large-scale property damage/losses from wildfire, and to increase awareness of fire officials, the insurance industry and the public on methods and ways to prevent and mitigate wildfire losses.

IBHS is deeply concerned about California's growing wildfire threat, as well as the increasing wildfire threat in dozens of other states. We believe that the research findings in this study and the resulting recommendations will add substantially to the scientific body of knowledge available regarding methods to prevent and mitigate wildfire losses. The goal of this report is to share our research findings as a way to contribute to local and national discussions about ways to reduce vulnerability to wildfires, minimize losses and make our communities safer and more resilient.

MAJOR FINDINGS AND RECOMMENDATIONS

The major findings of the study are:

- **HOMES WITH THE HIGHEST RISK OF BURNING ARE THOSE ADJACENT TO WILDLAND SITUATED ON THE PERIMETER OF HOUSING DEVELOPMENTS.** In this study, properties positioned along the edge of a housing development, which was located on the windward side or along a side that ran parallel to the prevailing direction of the Santa Ana winds, were exposed to a substantially higher risk of being destroyed. While the increased risks varied from community to community, it was generally found that

properties along these edges were nearly twice as likely to burn as properties on the first row back from the edge and three to eight times more likely to burn than homes further back in a housing development.

- **INTERIOR HOMES SITUATED LESS THAN 15 FEET APART ARE AT HIGH RISK FROM WILDFIRE.** While homes adjacent to wildland are most vulnerable to wildfires, homes in the interior areas of housing developments that were located less than 15 feet apart, were much more likely to burn in clusters – in other words, multiple homes right next to each other tended to burn. This finding elevates the importance of a community-wide approach to protecting properties against wildfire where the density of homes is high, and it also emphasizes the potential threat posed by neighboring properties. Cluster-burning was not witnessed in homes located more than 45 feet apart from each other.
- **ALL HOMES, REGARDLESS OF THEIR VALUE, CAN BE BEST PROTECTED FROM WILDFIRE BY IMPLEMENTING APPROPRIATE LOSS REDUCTION MEASURES.** The value of a home was not found to be a major factor in the risk that it would burn. In the study communities, there was a relatively even distribution of the percentage of homes that burned across a wide range of home values. This suggests that any home can be protected by taking the proper steps.
- **THE REQUIREMENTS ESTABLISHED IN THE NEW 2007 CALIFORNIA BUILDING CODE WILL BE EFFECTIVE IN REDUCING LOSSES AND DAMAGE FROM WILDFIRES.** San Diego County, which adopted progressive codes in 2001 and strengthened those codes in 2004, experienced lower burn rates in homes built to these wildfire property protection standards in unincorporated areas, according to an analysis conducted by the county after the 2007 fires. The 2004 San Diego County standards were reflective of the strict requirements of the new state code.
- **THE REQUIREMENTS ESTABLISHED BY SHELTER-IN-PLACE (SIP) COMMUNITIES ARE**



EXTREMELY EFFECTIVE IN REDUCING LOSSES AND DAMAGE FROM WILDFIRES.

Development guidelines utilized in SIP communities and periodic inspections backed up by mandatory fuel control and maintenance of surrounding vegetation provided the best survival rates. No homes were burned in the at-risk SIP communities. However, a couple of documented close calls point to the need for constant vigilance even with the best community-wide approaches.

- **WIND-BLOWN EMBERS, WHICH CAN TRAVEL ONE MILE OR MORE, WERE THE BIGGEST THREAT TO HOMES IN THE WITCH CREEK WILDFIRE.** There were few, if any, reports of homes burned as a result of direct contact with flames.
- **POLICYMAKERS NEED TO TAKE A MORE PROACTIVE, COMMUNITY-BASED APPROACH TO PROPERTY PROTECTION.** Government leaders should critically review the costs associated with the firefighting resources and manpower needed to battle the growing wildfire threat, and implement effective mitigation efforts before wildfires strike.
- **HOMEOWNERS NEED TO RETROFIT THEIR HOMES.** Homeowners must become familiar with the affordable options available to retrofit their existing homes to increase their protection against wildfire, and local and state government leaders should encourage this education.
- **NEW HOME CONSTRUCTION IN WILDFIRE-PRONE AREAS SHOULD BE BUILT USING THE SHELTER-IN PLACE STANDARDS.** These standards must be accompanied by routine inspections and strict, ongoing enforcement to be successful.
- **FINANCIAL AND REAL ESTATE MARKETS MUST ACKNOWLEDGE THE VALUE OF WILDFIRE-RESISTANT CONSTRUCTION AND RETROFITTING.** The financial services industry, along with the real estate industry, must recognize the value of making these improvements to existing homes, and new homes should be marketed for the ability to survive in wildfire-prone areas.

OBJECTIVES OF THE WITCH CREEK WILDFIRE STUDY

The primary objective of the research was to determine the relative merits of property protection measures ranging from individual actions to community-wide actions, such as those undertaken by the SIP communities studied.

In this study, IBHS analyzes the performance of homes affected by the Witch Creek Wildfire with a primary focus on three SIP communities and three more traditional communities for comparison. The comparison communities contained homes with varying ages, where the oldest home was built in 1931 and the newest was constructed in 2007. Any measures undertaken to reduce the risk of wildfire-related property damage in these comparison communities were undertaken voluntarily by individual homeowners or in cooperation with homeowners' associations.

This wildfire provides a useful real world laboratory for field observation of the value of property protection measures. The report provides an analysis of data collected in various communities impacted by the fire. It seeks to create a common basis for evaluating building performance by considering roof type, wall finish, proximity to the edge of the wildland brush fire, wind speed, wind direction, slope of the upwind terrain, and the amount and type of vegetation.

METHODOLOGY AND DATA COLLECTION

A reconnaissance team, including IBHS staff and a representative from the U.S. Forest Service, was dispatched to the area of the Witch Creek Wildfire within one week after the fire was contained. High-resolution aerial photography was commissioned to document the areas where most of the houses were damaged or destroyed. These aerial photos were taken on the first clear day after the fire was extinguished.



IBHS also obtained data from San Diego County's Department of Planning and Land Use regarding building features for the houses burned in the unincorporated areas. Additional data was obtained for specific properties from the files of IBHS members in the property-casualty insurance industry and from databases, including Zillow. IBHS engineers also photographed selected communities from a low-flying helicopter.

A series of focus groups were conducted by IBHS and American EnviroNics to analyze the perceptions and practices of homeowners in the SIP communities and from various more traditionally developed areas throughout San Diego County. A follow-up survey of county residents also was conducted. Results of the social research are summarized in this report.

One of the SIP communities studied is quite similar to one of the comparison communities in terms of the age, spacing, roof covers, wall materials, property values, terrain and vegetation surrounding the homes. It provides the best one-to-one comparison between what is required by the building code and the SIP requirements. The other two SIP communities include a mixture of home sizes and property densities, which renders them somewhat closer to typical housing developments in this geographic area. The final two traditional communities used for comparison are representative of typical non-SIP communities in the area.

As noted above, the main goal of the research was to determine the relative merits of property protection measures ranging from individual to community-wide actions as typified by the SIP communities.

The fact that no homes in the SIP communities were destroyed by the wildfire created the appearance that the community-wide approach provided the best overall outcome. Consequently, one objective of the research was to level the playing field by assuring that these communities were actually exposed to similar wildfire risks, at least at the perimeter of the development, as the comparison communities.

It was not possible to accurately determine what firefighting techniques may have

contributed to the differences in losses seen in these various communities. However, site visits to the communities clearly indicated that the well-planned and executed development of the SIP communities made it much easier for firefighters to protect homes there. It should be noted that based on case histories of damage and loss, including some smoke damage in the SIP communities, there is a clear need for vigilance and attention to details in order to achieve optimal protection from wildfire damage.

THE CASE FOR MITIGATION

The Witch Creek Wildfire began on a ranch east of Ramona, Calif., on October 21, 2007. When it was fully contained 10 days later, property insurers estimate this wildfire resulted in \$1 billion in insured losses. State and local fire officials estimate 197,990 acres were burned, 1,125 homes and 499 outbuildings were destroyed, and another 77 homes and 25 outbuildings were damaged. CAL FIRE ranks the Witch Creek Wildfire as the third largest for the number of buildings destroyed. The most rapid expansion of the burn area occurred between October 22 and October 24, when Santa Ana winds drove the fire to the west, southwest and south through canyons and across wildlands. The 1,624 buildings destroyed in the Witch Creek Wildfire represent nearly 73 percent of the seven-year national average of 2,240 structural losses through 2006, according to the National Interagency Fire Center.

The last 20 years have seen a steady rise in the amount of acreage charred by wildfires in the U.S. On average, 3.4 million acres burned annually between 1990 and 1994. This figure grew to 4.1 million from 1995 to 1996 and to 6 million from 2000 to 2004. In 2007, 85,000 wildfires burned more than 9.3 million acres. Six of the ten worst seasons in terms of acres burned have occurred since 2000.

More recently, in just the last three years, there has been a trend toward larger and more destructive wildfires in the Southeastern and Midwestern portions of the country. Florida, Georgia, Michigan, Minnesota, North Carolina, Oklahoma, the Tennessee Valley and parts of



Texas all have experienced this trend. There is substantial evidence that these states and others are becoming increasingly prone to these events due to widespread drought, insect infestations and uncontrolled fuel sources (vegetation) in the Wildland Urban Interface (WUI).

The mounting risks in the WUI become even more apparent when considering the increased level of development there. In the 1990s, 8.4 million homes – accounting for some 60 percent of new home construction – were built in the WUI. Today, about one-third of the housing units in the contiguous U.S. are located in the WUI, according to Tom Harbour, Director, U.S. Forest Service Fire and Aviation Management.

The Witch Creek Wildfire is representative of the rising number and frequency of large scale wildfires that earn the label “mega fires” from the U.S. Forest Service. While these types of fires represent less than one percent of wildfires annually, the size, complexity and uncontrollable nature of the blazes present mounting challenges to firefighting resources and communities due to the widespread financial fallout. There have been more than ten mega fires since the late 1990s. U.S. Forest Service officials estimate that large fires expend 85 percent of firefighting resources each year.

When a wildfire grows to the level of a mega fire the best hopes firefighters have for gaining control of the blaze are a break in the weather or an interruption of the fuel sources. The Witch Creek Wildfire clearly achieved this level because efforts to attack and contain it were largely ineffective until the Santa Ana winds diminished. Firefighters could do little more than try to minimize losses to the threatened communities. The fire probably would have continued until it reached the Pacific Ocean if weather patterns had not changed on October 24.

The nation’s approach to protecting the properties located in vulnerable areas prone to wildfire has been fragmented. When mega fires occur, they strain firefighting resources and generate mounting public pressure on federal, state and local officials to act. Once the blaze is extinguished, this pressure

typically results in broad procedural and policy changes to improve firefighting responses. In contrast, individual interviews with homeowners conducted by IBHS indicate that little has been done to minimize future wildfire risks to properties built in and near the WUI.

National programs such as Firewise, funded by the U.S. Forest Service, and state programs, including Fire Safe California and Utah Living with Fire, have provided interested homeowners and civic leaders with assistance in reducing their risks. These efforts could be bolstered by the establishment of broad-based partnerships from the grassroots to the upper levels of government.

Positive steps toward a systematic approach to property protection are being taken in states such as California, which recently adopted statewide building code provisions that address wildfire risks. While the code provisions reduce wildfire risks for new homes and some select housing developments reach beyond individual efforts, the majority of Californians remain exposed.

In San Diego County, developers of five SIP communities exceeded what is now required by California’s 2007 Building Code. These communities, which began construction prior to the code’s adoption and are unique to San Diego County, were specifically built with wildfire in mind. The construction was guided by standards created in cooperation with fire officials and enforced through deed restrictions. These guidelines extend to the landscaping, surroundings, and construction materials and techniques of the homes and all outbuildings. Local adoption and enforcement of wildfire-related code provisions are making a difference in a number of areas, but more often the focus remains on enhancing fire suppression capabilities.

THE PERCEPTION AND REALITIES OF RISK

This project utilized a combination of professional opinion research methods, social psychology and cognitive linguistics to gain a



better understanding of the underlying motivations that drive public attitudes toward wildfire and property protection measures.

Through a combination of focus groups and a telephone survey of 400 San Diego County residents, IBHS sought to determine the following:

- The perceived threat of wildfires and the ability to control them;
- What steps people have taken to protect their home and why they have chosen to take those steps;
- The depth of knowledge about property protection measures and the existence of Shelter-in-Place (SIP) communities;
- Why SIP homeowners purchased their homes and how they feel about living in the community; and
- Promising avenues for educating the public about the availability of retrofit and new construction options that can provide for better property protection against wildfires.

This study revealed homeowners in vulnerable areas recognize their risk, but their knowledge about how to reduce that risk is limited and they often question whether their efforts will pay off. Many homeowners felt a lack of control in the face of often uncontrollable wildfires. This is a major stumbling block for many residents and is accompanied by concerns about the costs involved with protecting their properties.

In this report, IBHS offers evidence that it is possible to better protect homes from the threat of wildfire, regardless of the age or value of the homes. The methods for doing so can be cost-effective, but the approach must be comprehensive to be successful. This requires homeowners to move beyond a fatalistic view, which was evident in the opinion research, and take control of their future as it relates to wildfire safety. While wildfires can be uncontrollable, our ability to protect our homes so they can better survive is very much within our control.

Another equally important finding of this research surrounds the perception of homeowners living in interior sections of communities. IBHS data shows there is an increased risk for residents whose homes are located in the interiors of densely populated communities, yet the majority of these homeowners do not recognize this risk.

BASIC FACTORS AFFECTING WILDFIRE RISKS TO BUILDINGS

Wildfire experts point to eight basic factors that affect the risk of a home burning in a wildfire. A weakness in any of these areas can lead to a similar result – a destroyed or severely damaged home.

While it may seem overwhelming to tackle all of these areas at once, IBHS recommends that homeowners take a 360-degree view of their property and establish a systematic approach to address each of the following areas:

- 1. FLAMMABILITY OF THE ROOF:** At a minimum, a home should have a Class A-rated, fire-resistant roof cover or assembly, and preferably one that is self-extinguishing once a falling ember burns out. Self-extinguishing means that the firebrand will not burn through to the roof deck and flames will not spread to other parts of the roof. Without a fire-resistant roof, other approaches toward mitigation will fall short of protecting the home.
- 2. AREAS WHERE FUEL OR FIREBRANDS CAN COLLECT AND ALLOW FLAMES TO MAKE DIRECT CONTACT WITH ANY SURFACE OF THE HOUSE:** These areas include gutters, edges of barrel tile roofs without bird stops, roof valleys, inside corners in an L- or T-shaped house, and the intersection between a deck and an exterior wall of the house.
- 3. ANY PATHWAY THAT WILL ALLOW BURNING EMBERS TO GET INSIDE THE HOUSE:** This can include vents (soffits, attics, crawl spaces or wall vents) or windows prone to breaking when exposed to wildfire conditions (usually unprotected, single-pane windows).



4. ANY FUEL SOURCES THAT WILL BRING FLAMES WITHIN 5 FEET TO 10 FEET OF THE HOUSE:

This can include flammable plants close to a wall, dead foliage that builds up underneath succulents or other normally fire-resistant plants, certain types of mulch, a combustible fence or yard structure that is located close enough to allow flames to come into contact with the wall or the overhanging roof above.

5. ANY WOOD STRUCTURE CONNECTED TO THE HOUSE:

If it is combustible, the structure will support flames or glowing embers and provide a pathway for the fire to penetrate underneath the roof or through walls.

6. FUEL SOURCES WITHIN 30 FEET OF THE HOUSE THAT WILL SUPPORT A HIGH INTENSITY SPOT FIRE:

This can include any trees that can quickly become a fire torch, such as a palm tree with a beard, a wooden trellis made of common lumber sizes, playground equipment made with wooden pieces or a pile or rack of firewood on the ground or in a wheelbarrow.

7. A LARGE FUEL SOURCE SUCH AS A CONTINUOUS TREE CANOPY:

This could potentially support a high intensity wall of flames within 100 feet of the house. Individual trees, even those that could torch, are not a particularly high risk provided they are planted 30 feet to 100 feet from the house and do not intermingle to form a continuous tree canopy.

8. ACCESS TO THE PROPERTY:

If firefighters and their equipment cannot gain access to the property and a water source, there is little chance they can protect the home.

There are several approaches to addressing these risk factors, including modern building code provisions, fuel modification guidance, and the SIP requirements developed by the Rancho Santa Fe Fire Protection District.

Perhaps the most important thing for existing homeowners to know, primarily those in densely populated communities where houses are less than 30 feet apart, is the fact that these

risk factors can be addressed and reduced through cooperative local action.

The risks for homes located in the interior of a densely populated community are real. This study examined one such community, which was developed according to conventional standards. Of 717 homes located in the interior section, 63 were destroyed and there were many others that had significant damage in the Witch Creek Wildfire.

By taking stock of the areas in a 100-foot, 360 degree radius around the home, to include landscaping, yard structures and details of construction – particularly exterior finishes and surfaces – homeowners can significantly impact their wildfire risk. These are decisions within the control of individual homeowner and their adjacent neighbors.

Looking beyond these dense populations, this study clearly found that the homes at greatest risk in typical communities are those located along the perimeters abutting wildlands. These risks dramatically increased when the ground sloped downward and when the edge of the housing development corresponded with the windward face or a parallel side of the predominant wind direction.

Addressing the geographic hazards of building on sloping landscapes also is something within local control. Evidence of this is found in the fact that no homes burned in the SIP communities, which were constructed according to the hazards posed by wildfires. This is not to say that residents living in these communities can forego being vigilant about wildfire protection or that they can expect to be completely immune from damage. Case histories indicate there was limited damage to homes in at least three SIP communities, which is addressed in more detail below.

BUILDING CODES BEGINNING TO ADDRESS RISKS

As early as 1965, California began to apply vegetation modification requirements to the development of government buildings. In 1982, vegetation modification requirements



were added to developments on land located in the State Responsibility Area. These are areas where the state has financial responsibility for preventing and suppressing forest fires. In 1992, following the Oakland Tunnel Fire, the vegetation modification requirements were extended to Local Responsibility Areas, which include areas designated as high risk wild-fire areas and where local governments have responsibility for fire protection.

The 1993 wildfires led to an earnest attempt to change building codes to target the fire resistance of homes. This effort was primarily supported by the Federal Emergency Management Agency when it began providing funding for research and building code development. In 1995, building codes emerged to require the use of tempered glass, Class A-rated roofing materials, nominal one-hour rated walls, boxed eaves, metal gutters and downspouts and fire-resistant doors. These requirements were not adopted by the state or many local jurisdictions.

In 1997, San Diego County began requiring Class A roof coverings to protect against wild-fire damage.

By 2006, three years after the Cedar Fire that destroyed 317 houses in the City of San Diego, the city's building codes had been amended to require a Class A roof assembly for all new buildings and in the event of a roof replacement that exceed 25 percent of the roof area. The amendments also included the prohibition of wood shake or wood shingle roof coverings and the requirement that these be replaced with Class A materials when reroofing or within 25 years of the roof installation.

By 2002, both the city and county of San Diego had adopted the 2001 California Building Code. The county significantly strengthened its requirements in 2004.

An analysis by the San Diego County Department of Planning and Land Use of homes in the unincorporated areas at risk of wildfire, and the numbers of homes burned following the 2003 and 2007 wildfires, provided the following statistics:

October 2003 Wildfires

- Of 15,000 total structures within the fire perimeter, 17 percent were damaged or destroyed.
- Of the 400 structures built using the 2001 building codes, only 4 percent were damaged or destroyed.

October 2007 Wildfires

- Of 8,300 structures within the fire perimeter, 13 percent were damaged or destroyed.
- Of 789 structures built using the 2001 building codes, 3 percent were damaged or destroyed.
- Of the 1,218 structures built using the 2004 building codes, only 2 percent were damaged or destroyed.

These figures provide a solid foundation for the success of building codes, when combined with the vegetation modification requirements, in reducing property losses in wildfires.

Even more promising are new standards that became effective in January 2008, as part of the California Building Code. The standards apply to new buildings located in the State Responsibility Areas and the WUI as of January 1, 2008, and to new buildings in the Local Agency Very-High Hazard Severity Zones as of July 1, 2008.

As homes destroyed by the Witch Creek Wildfire are rebuilt, many will be constructed under the new code provisions. Building codes, however, should be considered minimum standards and wildfire property protection must continue to be an integral part of public policy discussions.

THE SHELTER-IN-PLACE APPROACH TO MITIGATION

As early as 2000, the Rancho Santa Fe Fire Protection District began working with developers to create wildfire-resistant properties, which later became designated as SIP



communities. In addition to the basic mandated vegetation modifications and building code provisions, these communities required the following:

- Residential fire sprinklers;
- A well-maintained, fire-resistive landscape with a minimum 100-foot defensible space surrounding all structures;
- Adequate roadway and driveway widths, designed to accommodate two-way traffic and large firefighting apparatus;
- Adequate water supply and water flow for firefighting efforts; and
- Vegetation-modification zones surrounding the entire community.

A major emphasis is placed on the maintenance of these design qualities through covenants, periodic inspections and mandatory actions based on the inspection reports.

At least three of these communities, The Bridges, Cielo, and The Crosby, were threatened by the Witch Creek Wildfire. One of the three focus groups conducted for this study included homeowners from these communities.

No homes burned in these communities although there were several close calls. In one case, a homeowner left a piece of plywood leaning against the entry door to the garage. The plywood caught on fire and the fire burned through the entry door and into the garage where the sprinkler system extinguished it. A second incident involved a wheel barrow full of firewood that was left next to a wall of a house. The firewood ignited and sent flames against the wall and eave of the roof. The wheel barrow was moved while it was on fire to keep flames away from the house. Both houses survived the fire.

SIP homeowners attending the focus groups lived in a variety of house styles from single-family homes to villas. They were attracted to these communities because of the secluded location in the hills and canyons, which this study found can be a major risk factor in wildfire damage. It was only after the wildfire

threatened their homes that they recognized the value of the SIP building standards.

One of the participants explained that his home received about \$20,000 in damage due to smoke and radiant heat that melted the exterior seals on 13 of the double-pane, tempered glass windows. The man blamed himself for the smoke damage because he left an upstairs window open when the family evacuated. He credited the community's developer and builder with the home's overall survival considering the flames were visible from his house. Other participants also talked about neighbors with smoke damage and clean-up costs due to the accumulation of ash.

Although it wasn't the SIP standards that convinced the focus group participants to buy their homes in these communities, all of the participants said they now place a high value on the safety provided by the development guidelines. (Note: they also agreed they would not promote this factor when selling their homes out of a fear that it might remind buyers that the home is in an area prone to wildfires.)

The costs associated with the SIP homes, many of which are valued in the millions of dollars, comes from the location rather than the property protection measures that were incorporated there. For the homeowners who returned to find their houses largely unscathed by the Witch Creek Wildfire, the true value is evident.

If the financial services sector and real estate industry also begin to recognize this fact, the move could convince homeowners in any financial bracket to incorporate disaster-resistant features through affordable retrofit options.

The reality is the same geographic factors that lead to residential development in these areas put all homes at risk. With one-third of the nation's population now living in the WUI, more properties will be lost to wildfire unless there is a much-needed shift in the way we value construction that will stand up to this natural hazard.



ANALYZING THE WITCH CREEK WILDFIRE

Most of the wildland areas surrounding the studied communities burned October 22-24, when the Santa Ana winds drove the wildfire through the canyons and across the wildlands.

Several parameters were considered, including: meteorological conditions at the time the communities were at risk; proximity of the homes to the edge of the community; and whether that edge was on the windward side, the leeward side, or parallel to the prevailing wind direction during the time when the wildfire posed the greatest risk.

The study focused on global burn rates, in addition to the six communities for comparison. One of the conventional communities was selected because of its similarities to a SIP community in terms of house spacing, terrain, surrounding vegetation, age of homes and value of homes.

The other two conventional communities provided significant variations in home spacing and in terrain features, but, nevertheless were representative of typical older housing developments in the area. While none of the homes in the SIP communities exhibited visible structural damage from the aerial photos, damage was evident for 179 homes in the conventional communities, of which 165 burned to the ground.

A detailed database was created that includes entries for all homes in these six communities and others inside and within two miles of the final fire perimeter. The database contains the following information for nearly 3,000 homes. For the purposes of this report, analysis was limited to 487 homes in the SIP communities and 1,579 homes in the conventional communities:

- County Parcel Number
- Street Address
- City
- Zip Code
- Latitude

- Longitude
- Community Name
- Year Constructed
- Square Footage
- Land Size
- Approximate Value from Zillow
- Number of Stories/Floors
- Roof Material
- Exterior Wall Finish Material
- Presence of Overhanging Vegetation
- Presence of Upwind and Downwind Terrain Prone to Fire-Spread
- Slope of Upwind Terrain
- Minimum Distance to Neighboring House
- Whether the House was Destroyed
- Whether the House was Next to a House that was Destroyed
- Location of the House Near the Edge of the Community (First or Second Row)
- Orientation of House Location Relative to Prevailing Wind Direction

In addition, when available for select homes, more detailed information was collected, including:

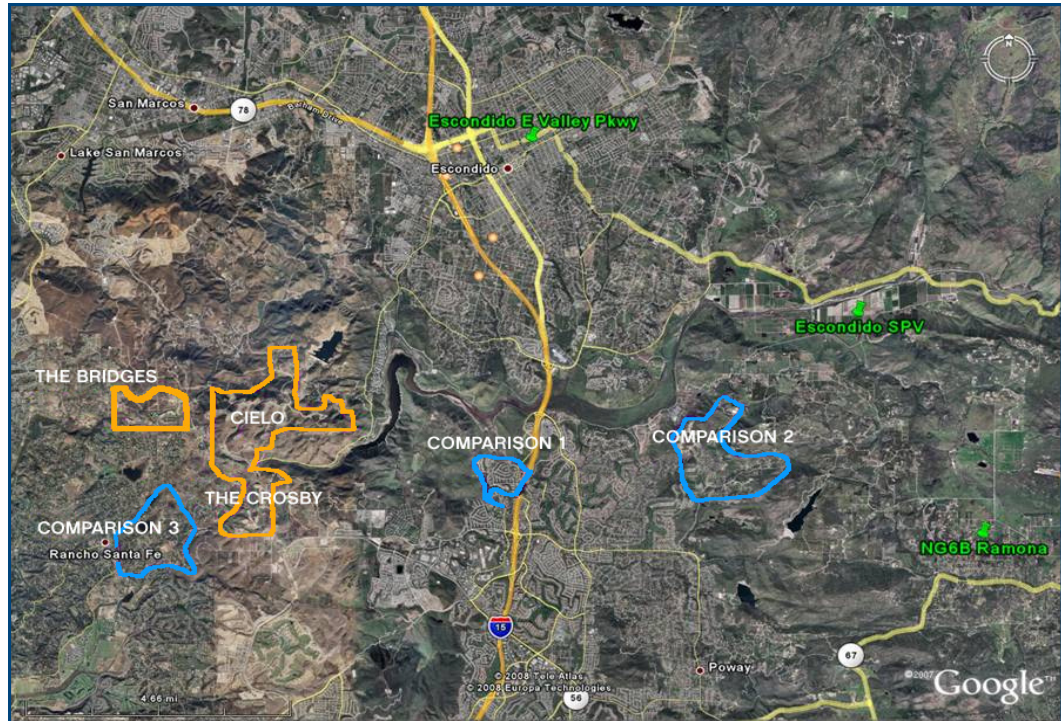
- Boxed Eaves/Soffits/Fascias
- Vent Size of Eaves/Soffits/Fascias
- Window Type (Single- or Double-Paned)
- Presence of Tempered Glass
- Presence of Chimney Spark Arrestors
- Presence of Roof Vents
- Size of Roof Vents

The collection of this additional data has allowed IBHS to investigate the potential influence of various parameters on the risk of a home burning. This portion of the research is ongoing, but many essential conclusions are currently available, and are summarized in the following sections.



Figure MET 1

The locations of the communities studied and the locations of the weather stations (referenced in the following section) are shown in Figure MET-1. The outlines of the SIP communities are shown in orange, the outlines of the conventional study communities are in blue and the locations of the meteorological stations are the green push-pin symbols.



METEOROLOGICAL CONDITIONS

The initiation of the Witch Creek Wildfire at 12:35 p.m. October 21, 2007, coincided with a period of unusually high and consistent Santa Ana wind activity. Two weather stations in the area, the Escondido East Valley Parkway and the Ramona NG6B stations, provided nearly continuous meteorological data throughout the duration of the fire. A third station, the Escondido SVP station, provided data for the first few hours of the wildfire. The locations of the stations, relative to the final fire perimeter, are shown in Figure MET-1.

The wind data show that strong winds from northerly through east-northeasterly directions persisted for the better part of two and a half days, driving the fire through canyons toward the ocean. Most of the area burned by the fire was consumed during that period before the weather conditions changed and significant periods of low winds and calm conditions prevailed.

Figure MET-2 shows the magnitude and direction of the winds at the Ramona NG6B station

starting one day before the wildfire began and extending until the fire was nearly contained October 31. This trace is representative of the general wind conditions throughout the area affected by the fire.

Humidity measurements also indicate that the relative humidity dropped abruptly from about 90 percent to less than 10 percent when the

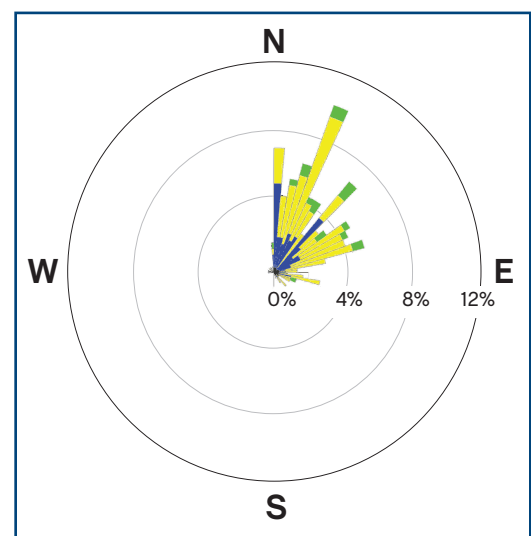


Figure MET 2

Magnitude and direction of the winds at the Ramona NG6B station. Relative frequency of winds shown as a percentage of time.

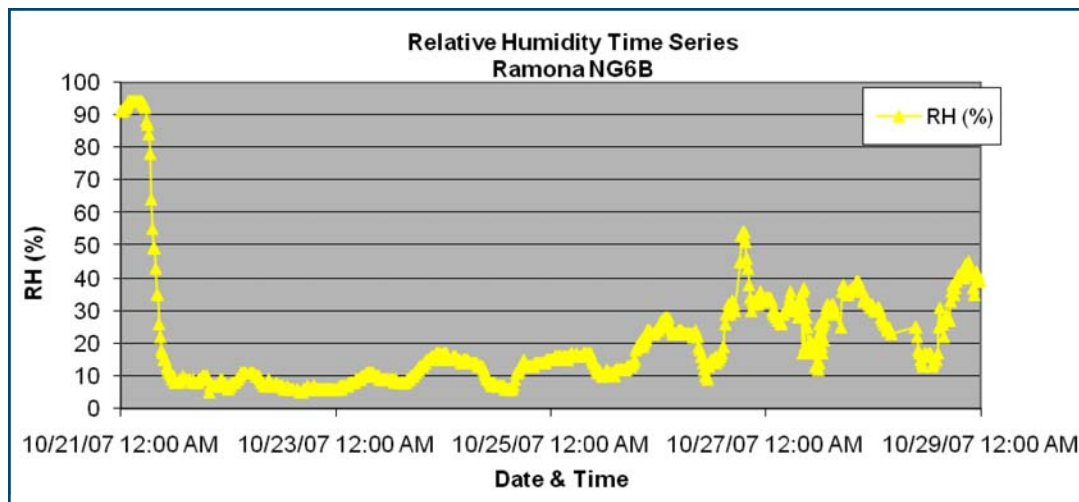


Figure MET 3

A trace of relative humidity measurements.

Santa Ana winds began and remained very low for the next three to four days before rebounding to about 30 percent during the last few days that the fire burned. A trace of the relative humidity measurements is shown in Figure MET-3.

The spread of the fire was closely linked to the meteorological conditions as well as the topography of the area.

For purposes of this analysis, meteorological conditions are considered a constant for all of the communities studied. This is based on analysis of fire spread and meteorological data over the two-and-a-half-day period when the fire was most intense.

VEGETATION AND TOPOGRAPHY

IBHS worked with researchers at the University of Colorado to develop an assessment of the fuel content and rate of burn as a way to gauge relative risk of fire in the wildland areas surrounding the homes.

Maps were produced that rate the surrounding vegetation fuel and rate of burn as low, medium or high. This model relied on vegetation cover information in overlays of the area from the Geographic Information System (GIS). A sample plot of the area around Community 2 is shown in Figure VEG-1. Similarly to the meteorological conditions, the fuel load modeling did not vary significantly around the edges of the various communities. Consequently, the surrounding vegetation is considered a constant in the analysis.

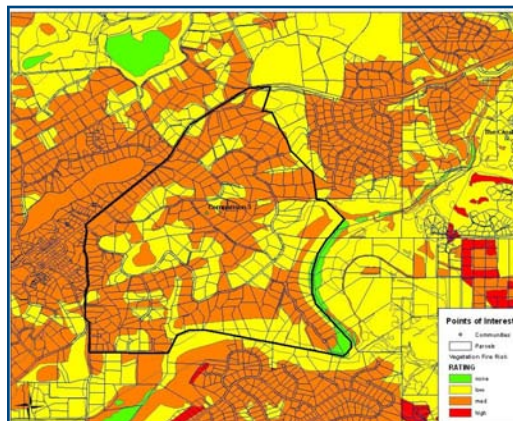


Figure VEG 1

GIS plot of vegetation for Comparison Community 2.



BUILDING AND SITE CHARACTERISTICS

The following provides an overview of the characteristics of the six communities studied in detail during this investigation.

SIP COMMUNITIES

Five developments within the Rancho Santa Fe Fire Protection District have been designated as SIP communities. None of the homes in these communities were destroyed or suffered structural damage from the Witch Creek Wildfire. Three of these communities, The Bridges, The Crosby, and Cielo, were studied in this project. The other two SIP communities were not selected for detailed study because they were either too small (less than 100 homes; Santa Fe Valley) or not covered by the post-fire aerial photography (4S Ranch).

The Rancho Santa Fe Fire Protection District's *Sheltering-in-Place During Wildfires* guidelines list general home and property design and maintenance requirements, as well as community design features. In order for the development to be designated as a SIP community, a home must meet the following criteria:

- Constructed of fire-resistive materials
- Boxed eaves
- Residential fire sprinklers
- Well-maintained, fire-resistive landscape with a minimum 100-foot defensible space surrounding all structures
- Class A-rated, non-combustible roof
- Chimneys with spark arrestors containing a minimum ½-inch screening

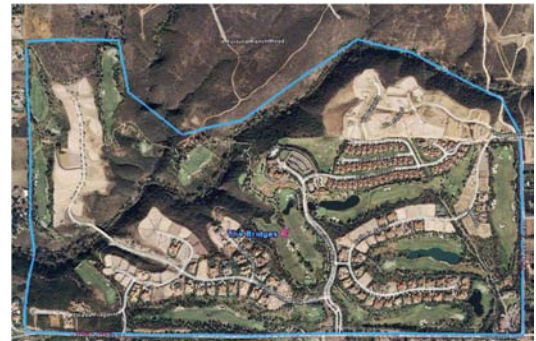
Additional design criteria for the entire community include:

- Adequate roadway and driveway widths, designed to accommodate two-way traffic and large firefighting apparatus
- Adequate water supply and water flow for firefighting efforts
- Vegetation – modification zones surrounding your community

The guidelines also outline steps for maintaining the structure and landscaping, which the homeowners should take to ensure that their house remains a SIP structure.

The three SIP communities selected included 487 structures at the time data was collected. Some ongoing construction is still underway in all of these communities.

THE BRIDGES AND THE CROSBY



Figures SIP-1 and SIP-2 show the layout of The Bridges and The Crosby, respectively, prior to the Witch Creek Wildfire. The communities are relatively new and significant construction took place after the aerial photos were taken in 2003. Nearly all of the empty lots shown in the photos were built out by the time the Witch Creek Wildfire occurred. As of February 29, 2008, there were 164 property records for The Bridges and 180 property records for The Crosby.

A combination of research using aerial photographs, on-site visits and information contained in the Zillow real estate database were

Figures SIP 1-2

1. Image outlining the area of The Bridges community in Rancho Santa Fe. Image Source: Google Earth (2003 photo).

2. Image outlining the area of The Crosby community in Rancho Santa Fe. Image Source: Google Earth (2003 photo).



used to categorize roof and wall materials used in homes in both communities. Information was collected on all but four homes in each community, where a majority of houses have a tile roof covering and stucco walls. However, it is likely that these homes do in fact have a tile roof covering and stucco walls.



Figures SIP-3 and SIP-4 show a section of each community. The amount of green space provided by the golf course is clearly visible. The relative spacing between homes and the general vegetation patterns are representative of each community.

THE BRIDGES

In the northeast corner of The Bridges property is a small valley that continues along the northern edge through to the southwest corner. Homes in most areas of the property occupy a space at an elevation 200 feet higher than in the valley. The potential exists for a wildfire to rapidly spread from the valley to the populated area at the top of the hill.

There are several factors apparent through visual inspection and aerial imagery that influenced the wildfire exposure of homes in this community.

The elevation changes along the western edge of the community as compared to the eastern edge, which would have been the first area to experience wildfire driven by Santa Ana winds. The presence of a golf course, which served as a fire break, separates homes from the vegetation on the slope. Homes are also free of overhanging vegetation on the roofs. Due to these factors, any initiation of wildfire in the community would be caused by flying embers rather than direct flame spread.

There were no structural losses in the community, despite the fact that MODIS (Moderate Resolution Imaging Spectroradiometer) Fire Detection Maps indicate that areas near The Bridges were burning on October 22 and 23 and the weather station data near The Bridges shows conditions conducive to fire spread.

Additionally, the effectiveness of the community's design and its location along the western edge of the fire boundary could have transformed it into a firebreak. This combined with the efforts of firefighters may be credited with helping to slow, if not stop, the fire's spread from east to west and into communities not built to SIP standards.

Without these kinds of fire-breaks, created either by effective land use or by the fire departments, the fire may have burned until it reached the Pacific Ocean.

THE CROSBY

Like The Bridges, there is some elevation difference along the western boundary of The Crosby, with a small valley bordering the western edge. While this valley has lower elevations than the populated areas it is less pronounced than what is observed in The Bridges.

The exception is the area in the southwest corner of The Crosby, where the elevation difference from the valley across the golf course to the future home sites on "Riding High Way"

Figures SIP 3-4

3. Photo of the Calla La Serra street section of The Bridges, taken by IBHS staff during aerial observations via low-flying helicopter.

4. Photo of the Top of the Morning Way and Road to Morocco Street sections in The Crosby taken by IBHS staff during aerial observations in a low-flying helicopter looking toward the north.

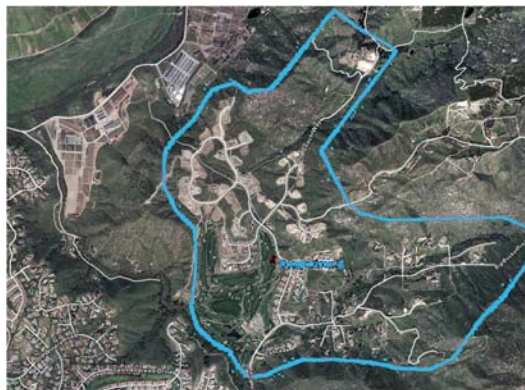


Figures SIP 5-7

5. Image outlining the area of the Cielo community in Rancho Santa Fe. (Image Source: Google Earth 2003 photo)

6. Image outlining the area of comparison Community 2. (Image Source: Google Earth 2003 photo)

7. Photo of the Camino de la Mitra Street section of Cielo taken by IBHS staff during aerial observations from a low-flying helicopter looking toward the northwest.



and “Road to Singapore” is about 250 feet. This heightened elevation could lead to rapid fire spread from the valley to the home.

Much like in The Bridges, the addition of the open and well-maintained space of the golf course separates the vegetation on the slope from the home sites. Upon inspection of the pre- and post-fire aerial imagery, it appears this community also has little dead vegetation and overhanging trees on the property, reducing fire fuel and fire spread.

The MODIS Fire Detection Maps similarly indicate that some areas near The Crosby were burning on October 22nd, 23rd, and during a flare up of the wildfire on the 24th. Weather conditions were favorable throughout this period for fire spread.

There were no structural losses due to the wildfire and any damage was attributed to smoke and radiant heat. Fire spread to areas west of The Crosby was likely caused by flying firebrands or burning brush along the southern edge of the community and toward the dry river valley.

CIELO AND COMMUNITY 2

Figures SIP-5 and SIP-6 show the layout of Cielo and Community 2 prior to the Witch Creek Wildfire. As of February 29, 2008, the Zillow real estate database listed 143 homes in Cielo and 122 homes in comparison Community 2. Sections of both neighborhoods are still being developed and plots are cleared for future development. This resulted in a number of homes being included in the real estate database that were not included in the 2003 pre-fire aerial imagery available from Google Earth.

CIELO

Homes in Cielo were constructed between 2000 and 2007, as with the prior SIP communities. The majority of homes built in comparison Community 2 were built during the same timeframe with the exception of a few older houses. Information about the year of construction was not available for 12 homes in Cielo and eight homes in Community 2.

Visual inspections, information from Zillow and aerial imagery were again used to determine the roof and wall covering material of the homes. This information was not available for six homes in Cielo. Roof materials could not be determined for 24 homes. Wall materials could not be determined for 36 homes in Community 2. All other homes in Cielo have a tile roof covering, and all but one home was built with a stucco exterior finish. This home has both brick and stucco exterior material. Tile



roof coverings were used in all but one home in Community 2, which had asphalt shingles. Stucco was used for all of the wall coverings that could be determined in Community 2.

Figure SIP-7 shows a section of Cielo. The relative spacing between homes and the general vegetation patterns can be seen and are representative of the entire community.

Complex terrain is even more of a factor in Cielo and Community 2 when compared to the other SIP communities studied. The southwest corner of Cielo is 300 feet to 500 feet above sea level. In this area the houses are also somewhat closer together than at other areas within the community. The elevation for the other areas where houses are spread farther apart is 900 feet to 1,200 feet. In these areas the home lots are located on the ridges of steep hills, which increases their vulnerability to fire spread. Unlike the previous two SIP communities, Cielo does not use the open space of a golf course to serve as a fire break. It does, however, closely follow the guidelines concerning removal of dead vegetation and keeping 100 feet of defensible space around the properties.

COMMUNITY 2

No structural damage was reported to homes in Cielo due to the Witch Creek Wildfire. In comparison, 20 homes were destroyed in Community 2. It is not possible to link the burned homes in Community 2 with specific ignition points. However, during site visits IBHS noted a number of homes in Community 2 did not have birdstops in the ends of the roof tiles (see Figure SIP-8) and setbacks were not as large as required in the SIP communities. It is possible that other critical ignition points were also missed because the houses were no longer standing and there were no eyewitness accounts of the fire available. IBHS observations suggest addressing a number of local risk factors, which would have been paid attention to in a SIP community, could have produced a different outcome.

COMMUNITIES 1 AND 3

COMMUNITY 1

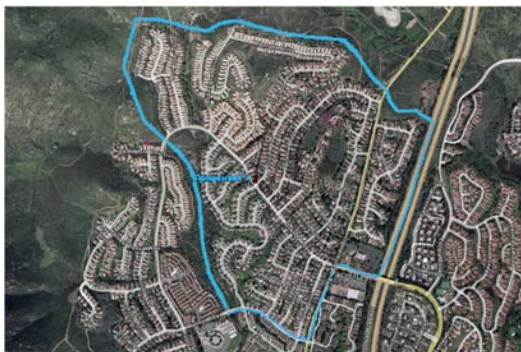
Figure SIP-9 shows the layout of Community 1 where 130 homes were damaged or destroyed by the fire. The Bridges is located about five miles to the west-northwest; The Crosby is located approximately four miles to the west-southwest; Cielo is located about three miles to the west-northwest. Its proximity to these SIP communities was one of several reasons for its inclusion in this study. Other factors include:

- Affordability
- Density
- Terrain
- Proximity to commercial properties

This community is representative of affordable housing available in San Diego County, whereas the SIP communities are occupied by higher income homeowners and the property values are significantly higher. The housing density is also greater than that of the SIP communities.

Figure SIP 8

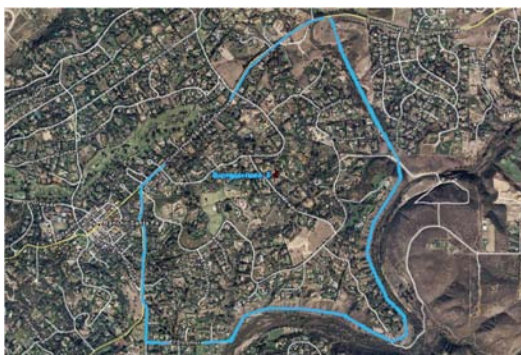
Open-ended tiles without bird stops were seen on roofs throughout Community 2. Source: IBHS photo.



Figures SIP 9-10

9. Image outlining the area of Community 1 in San Diego. (Image Source: Google Earth 2003 photograph)

10. Image outlining the area of Community 3 in Rancho Santa Fe. (Image Source: Google Earth 2003 photo)





Terrain was another consideration. While there are features that make this community vulnerable to fire spread, the terrain is not extreme. The community is also bordered by shopping centers, apartments and townhomes. IBHS will soon be studying the effects of the wildfire on commercial properties in this area.

COMMUNITY 3

Figure SIP-10 shows the layout of Community 3 where 15 homes were damaged or destroyed.

This community was selected for comparison in part because of its proximity to the SIP communities, which in turn created the presence of similar weather conditions. The Bridges is located about a mile to the north; The Crosby is less than a mile to the east-northeast; Cielo is about a mile to the northeast. All four of these communities would have experienced similar weather conditions with minor local differences in wind speed, direction and relative humidity.

This is the western-most community studied in this project and it would have been the last to

see fire conditions. The fire began to the east near Julian and Ramona and traveled west.

Beyond proximity, the main reason this community was selected for the comparison is because of the large escarpment that runs along the eastern and southern edges of the community. There are many homes located along this feature and it was the site of the majority of losses on this community.

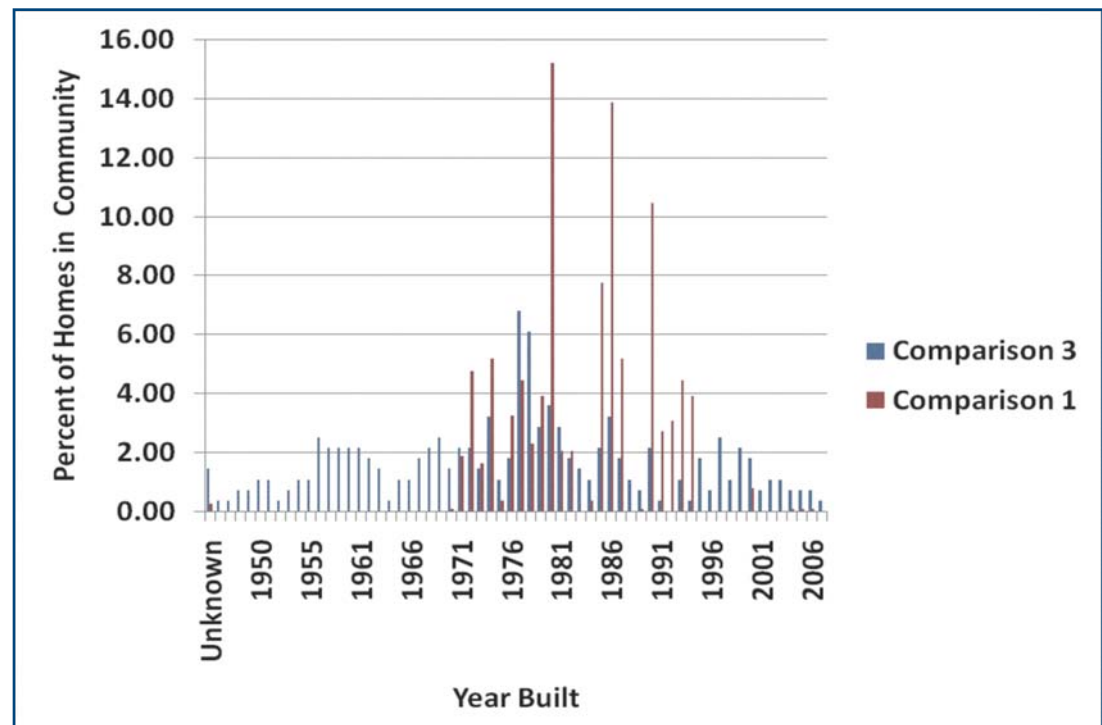
This community also has dense and overhanging vegetation that in some cases obstructs the view of homes from the roadway. The area has the densest vegetation of any of the communities studied.

Figure SIP-11 shows a comparison of the percentage of homes built according to year of construction in Communities 1 and 3.

Homes in Community 3 were built between 1931 and 2007. This information was not available for four of the homes. In comparison, homes built in Community 1 were constructed between 1971 and 2006. Information about the year of construction was not available for three

Figure SIP 11

Comparison of ages of homes built in Communities 1 and 3.





homes. The variations in ages of the homes resulted in a wide array of house styles and construction materials.

DATA ANALYSIS AND RESULTS

High-resolution aerial photos taken on the first clear day following containment of the Witch Creek Wildfire were analyzed to determine the numbers and locations of homes within the fire perimeter, as well as whether or not the homes burned. The fire perimeter used in this analysis was defined by the San Diego Fire Recovery Network (SDFRN). Burned homes located within a two-mile radius outside this boundary were also counted.

The edges of developments were identified, and the edge segments and homes along those boundaries were categorized according to their orientation relative to the prevailing direction of the Santa Ana winds. This was a two-step process, beginning with the review of the photographs to determine whether the wildfire burned up to the edge of the development. The edge segments were then classified as being on the windward side of the development, parallel to the predominant mean

wind direction or on the downwind side of the development.

The windward side included edge segments facing burned wildland to the NNW, N, NNE, NE, ENE, E, and ESE. The segments parallel to the mean wind direction were those facing burned wildland to the NW, WNW, SE and SSE. The downwind segments included those facing burned wildland to the S, SSW, SW, WSW, and W.

Homes located along each of these segments were visually assessed to determine whether they burned or remained intact. Counts were also conducted to determine the number of burned and unburned homes along the first row back from the windward edge segments and in the interior portions of the developments. These included all homes not placed in one of the other categories.

The results of that analysis are provided in Table 1. An additional 23 homes burned that were not located within the fire perimeter defined by SDFRN. Some of these homes were as much as a mile from the fire boundary.

Table 1	Total number of houses	Number of houses burned	Percent of houses burned
All houses	6712	698	10
Houses on upwind edge of developments	1450	378	26
Houses on edge of development that was parallel to prevailing wind	225	57	25
Houses on 1st row back from upwind edge of development	483	89	18
Houses on downwind edge of development	249	25	10
Houses in interior of development	4305	149	3% to 4%

Table 2	Total number of houses	Percent of houses burned
All houses	8,300	13
Houses built under the 2001 building code	789	3
Houses built under the 2004 building code	1,218	2

Table 1

Statistics on homes and burn rates for houses within the fire perimeter and visible in high-resolution aerial photos

Table 2

Summary statistics for loss rates of homes in the unincorporated areas built under various building codes.



Table 3-4

3. Summary of burn rate data for three comparison communities.

4. Summary of burned home cluster data.

Table 3	Community	Total Number of Houses	Number of Houses Burned	Percent of Houses Burned
All Houses	1, 2, & 3	1,757	165	10
	1	1,175	130	11
	2	122	20	16
	3	277	15	5
Houses on Upwind Edge of Developments	1, 2, & 3	334	71	21
	1	191	43	23
	2	115	20	17
	3	28	8	29
Houses on Edge of Development that was Parallel to Prevailing Wind	1, 2, & 3	55	11	20
	1	48	10	21
	2	0	0	0
	3	7	1	14
Houses on 1st Row Back from Upwind Edge of Development	1, 2, & 3	139	17	12
	1	109	14	13
	2	7	0	0
	3	23	3	13
Houses on Downwind Edge of Development	1, 2, & 3	132	0	0
	1	110	0	0
	2	0	0	0
	3	22	0	0
Houses in Interior of Development	1, 2, & 3	914	66	7
	1	717	63	9
	2	0	0	0
	3	197	3	2

Table 4	Number of Clusters		
Number of homes in cluster (burned)	Community 1	Community 2	Community 3
*1	25	15	9
2	14	1	0
3	7	0	0
4	7	0	0
5	1	0	0
6	0	0	0
7	2	0	0
8	1	0	0
Average spacing of homes in feet	10'-15'	>40'	>45'
*Individual homes that burned (not in a cluster)			



TOTAL NUMBER OF HOUSES

The high-resolution aerial photos only covered a portion of the entire fire perimeter. As such these counts only represent part of the total population of homes within the fire perimeter.

The San Diego County Department of Planning and Land Use conducted a full count of properties within the unincorporated area of the fire perimeter. This count identified the total population of homes and determined which of the burned homes were built according to 2001 and 2004 building codes. These findings are represented in Table 2. Although the IBHS sample of homes in the aerial photos is somewhat representative of the total population, the burn rate of 10 percent was slightly lower for all homes as compared to the county's findings of 13 percent for all of the wildfires that affected the unincorporated areas of the county.

Similar statistics have been developed for the three comparison communities. The summary burn rate statistics for combined data from all three communities is shown in Table 3. Table 3 also contains a separate listing of house counts and percent burned for each of the three communities.

This data shows that there can be significant variation in the statistics on a community by community or development by development basis. Clearly, the risk is consistently greatest around the edges of the communities;

but, there were enough homes burned within the interiors of the developments to call for increased vigilance by all homeowners regardless of the location of their property.

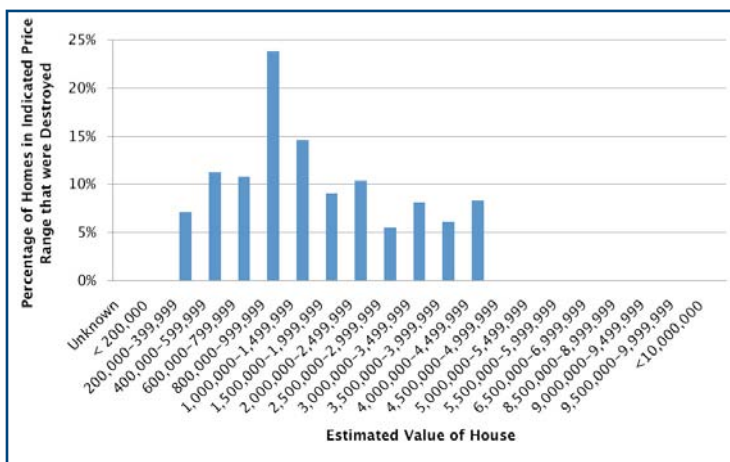
CLUSTER BURNING

Aerial photography was used to explore burn patterns in the study communities and the tendency of houses in certain communities to burn in clusters. The distance between each home and the closest adjacent home was measured for each house. Table 4 provides the results of the pattern analysis and lists the average minimum distance between homes in each of the communities.

Clearly, the minimum distance between homes is a major factor in the tendency for adjacent homes to burn. The general rule of fire science is that efforts should be made to keep high-intensity spot fires, which would include a burning house, from coming within at least 30 feet of a house to prevent damage. Therefore, it is not surprising that there was a tendency for homes in Community 1, where there is very little distance between homes, to affect each other.

At least 32 out of the 130 homes that burned in Community 1 would be considered initiation points for the fire, assuming at least one home in each cluster acted as a point of burn initiation for the destruction of that cluster.

This supports the recommendation that in densely packed developments it is particularly important for neighbors to work together to reduce their risks. IBHS researchers interviewed homeowners in Community 1 with houses that were still standing but located next to each of the burned homes. Without exception, each homeowner of a still-standing house had retrofitted their houses for greater wildfire protection. These actions include, but



VAL 1

Comparison of the percent of homes destroyed by value.



Figures ANA 1-3

1. Percentage of burned homes in Community 1 built during the indicated period.

2. Percentage of burned homes in Community 2 built during the indicated period.

3. Percentage of burned homes in Community 3 built during the indicated period.

were not limited to, replacing their roof with a Class A fire-rated roof covering and replacing single-pane windows with dual-pane windows, and in some cases tempered glass windows.

While these homeowners did report some damage, such as broken outer panes of glass and melting of the metal window frames, these property protection activities appear to have contributed to saving their homes. In most cases, there was evidence that flames came dangerously close to these homes by igniting sections of or entire wooden fences surrounding the houses. Wooden trellises and other yard structures were also burned.

Property value data collected from the Zillow real estate database was used to determine whether the value of a home was a factor in whether it burned. Data for all three comparison communities was combined and the percentages were computed for the number of homes burned in a certain value range. The results are shown in Figure VAL-1 and indicate that there is not much of a relationship between risk of burning and home value. Other than a spike in burn rates for homes in the \$800,000 to \$1.5 million range, the burn rate was fairly constant at about 8 percent.

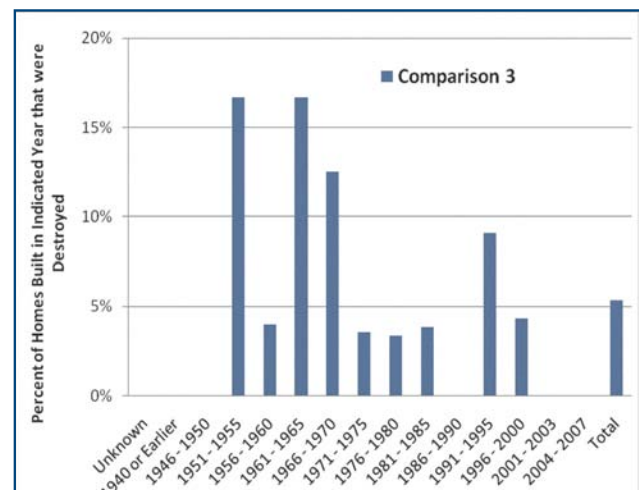
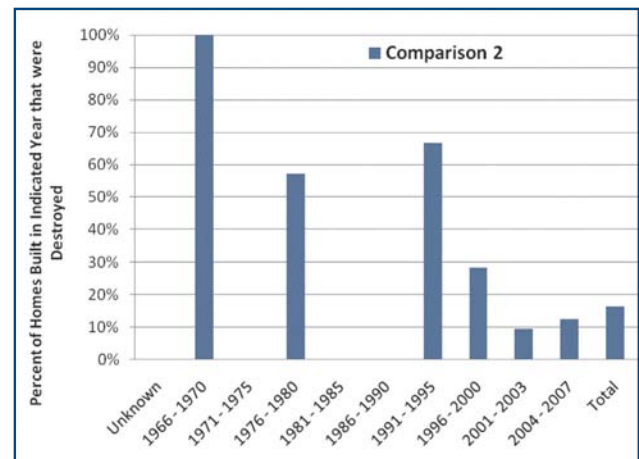
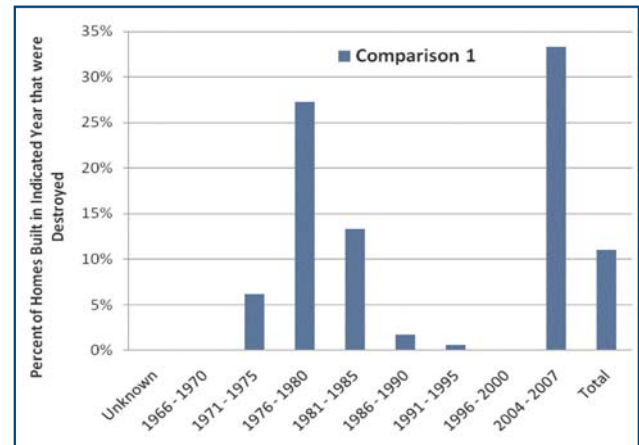
VARIOUS BUILDING CODES

The role of the age of a home in relation to burn rates in the three comparison communities was also investigated. Figures ANA-1, ANA-2 and ANA-3 include the percentages of homes that were destroyed in each community and the corresponding years of construction.

COMMUNITY 1

This densely-populated, traditionally-developed community lies within the city limits of San Diego. Of the 1,177 homes located here, 30 percent were on the edge or one row back from the area burned by the wildfire and the remaining 70 percent are in interior sections.

Figure ANA-1 shows that of the 1,177 homes located here, 130 were destroyed resulting in a burn rate of 11 percent. The majority of destroyed homes were built between 1976 and





1985, which was prior to the adoption of modern building codes.

Only two homes in this community were built after 2001, when the City of San Diego began enforcing the 2001 California Building Code. One of these houses was destroyed by the Witch Creek Wildfire. While there is an apparent increase in the number of destroyed homes built in more recent years, the small sample size of three homes built, one of which burned, makes it impossible to determine the effectiveness of modern codes.

COMMUNITY 2

This is a traditionally developed area located in the City of Poway. The community has widely spaced homes, all of which essentially border or are one row back from the area burned by the wildfire. Table 3 shows the 20 homes that burned in Community 2 were all located on the edge facing the fire.

Figure ANA-2 shows of the 122 homes located here, 20 were destroyed resulting in a burn rate of 16 percent. The majority of destroyed homes were built between 2001 and 2007 when, according to city records, Poway was following the 2001 California Building Code. There were 38 homes built prior to 2001.

COMMUNITY 3

This community, which is in an unincorporated portion of San Diego County, is more densely populated than Community 2, but the homes are more widely spaced than in Community 1. Of the 280 homes located here, 21 percent are on or one row back from the area burned by the wildfire and 79 percent are in interior sections.

Figure ANA-3 shows 15 homes in this community were destroyed resulting in a burn rate of 5 percent. All of the destroyed homes were built prior to 2001, with 16 homes built between 2001 and 2007. The county adopted a WUI standard in 2001 that exceeded the 2001 California Building Code and strengthened that standard in 2004.

The fact that none of the homes built after 2001 were destroyed seems to support the

effectiveness of the improved building codes; however the sample size is too small to make a definitive determination.

GAUGING PUBLIC OPINION

A history of wildfires in San Diego County shows 9,145 homes and other structures have been damaged or destroyed since October 1967. The vast majority (8,264) of those buildings were affected by wildfires in 2003 and 2007. The rate of growth in this county and the potential for fire-related losses is in keeping with an equally growing concern about the safety of properties located in the nation's WUI.

To better understand how the public views and responds to this risk, a telephone survey of 400 San Diego County homeowners was conducted from June 15-22, 2008, using a random digital dial methodology. Participants were screened to include owners of single-family homes, duplexes and mobile homes. The margin of error was 4.9 percent. It should be noted that this survey was conducted during a dry, hot summer when many wildfires were burning in Northern California.

For the past 16 years, California's firefighters and governments have been enforcing brush clearance, known as the creation of defensible space, as a primary means of reducing the risks of wildfires to property. The message appears to be resonating; 51 percent of homeowners surveyed listed brush clearance as the most important thing they have done to protect their properties and 46 percent considered brush clearance as the most effective means of reducing their wildfire risk. Still, 53 percent of people who have already created a defensible space around their home worried about whether it will be safe when fires threaten. Of the 51 percent that have cleared brush, 53 percent agree that they worry about the danger of wildfires.

Of the 60 percent of respondents who said they consider wildfires a very serious threat to San Diego County, 20 percent agreed they do not know how to protect their homes and only 4 percent considered their home safe from



Clearing brush is by far the most commonly taken prevention measure among those at highest risk

Q19 What are the most important things you've done to make your home more protected from wildfire damage, or have you not done anything? (3 responses accepted)

	Overall	High risk	Moderate risk	Low risk	Lowest risk
Cleared area/brush/weeds/shrub control	51%	71%	68%	44%	31%
Have not done anything	20%	10%	8%	28%	28%
Changed roof/have safe roof	20%	17%	23%	22%	11%
Don't need to do anything given locations	7%	0%	2%	%	
Don't believe need to do anything	13%	4%	2%	4%	13%
Planted appropriate plants/ice plants	6%	12%	9%	3%	2%
Added/have sprinklers, water tanks	6%	4%	13%	2%	2%
Keep well watered	6%	4%	8%	5%	4%
Added fire extinguishers/alarms	3%	0%	2%	3%	6%
Be aware/keep informed/have evacuation plan	3%	0%	5%	3%	0%
Wildfire protected home/indoors/siding	3%	3%	4%	2%	2%
Good insurance	2%	3%	3%	2%	0%
Other/Nothing	3%	5%	5%	2%	1%

Almost two-thirds of homeowners have heard something recently about wildfire protection

Q11 Do you recall seeing or hearing anything recently about wildfire protection?

Yes, Heard	65%
No, Not Heard	34%
Don't Know	1%

(asked of people who've heard about the issue, n=279)
What do you remember hearing or seeing?

New equipment—helicopters/fire trucks	31%
Keep brush, shrubbery maintained	16%
City preparing for wildfire season	13%
Methods for fire protecting homes	8%
Consolidating a few fire departments into one/A new fire station	6%
Heard or saw something about wildfires on the television	5%
Need more money to fight wildfires/Not enough funding	4%
Better response times	3%
Plan to get military to help fight wildfires	2%
Not prepared for wildfires	2%
Made it legal to fight fires at night	1%
Other	4%
No/None/Nothing/ DK/Not Sure	7%



wildfire. One-quarter of survey participants said they had been in or displaced by wildfire.

Judging by the survey responses it appears that in San Diego County, as with many other parts of the country where mega fires have caused widespread damage, the message homeowners are getting about wildfire protection primarily relates to the need for new firefighting equipment. Historically, once a mega fire is extinguished the public policy focus often shifts to improving the firefighting capabilities rather than property protection. In this case, 31 percent of respondents recalled hearing about the need for new equipment, compared to 13 percent who heard about the need to get prepared for wildfire season.

When it comes to wildfire, residents do appear to be paying attention. Nine out of 10 rated wildfires as a serious problem for San Diego – more serious than the economy or traffic.

There appears to be a window of opportunity to begin educating homeowners about the affordable retrofit options that can significantly reduce the risk of losing their homes to a

wildfire. This study shows the primary source for this information is fire departments. IBHS will work with the various fire entities in San Diego County to help put the valuable retrofit information contained in this report into the hands of homeowners.

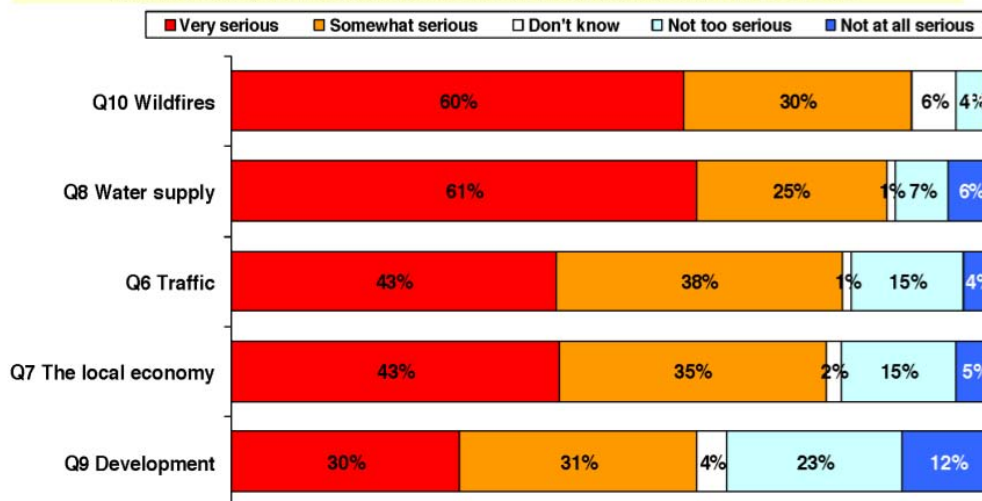
By helping homeowners understand and respond to their risk, they can take steps to increase the chances their house will survive a wildfire.

Homeowners in this survey attached their wildfire risk to obvious geographic features. Residents living in or near a canyon, less than a mile from undeveloped land or who have a lot of trees on their property felt more at risk. Those who live in flat and densely populated areas felt less at risk. Based on self-reported topographical characteristics, almost half of the homes in this survey are at least moderately vulnerable to wildfire.

This study shows topography and location can be a major risk factor, particularly if the home is near the edge of a development and faces the windward direction or is parallel to the

Nine out of ten rate wildfires as a serious problem for San Diego – more serious than the economy or traffic

Please tell me if you feel each of the following is a very serious problem facing the San Diego, a somewhat serious problem, a not too serious problem or not a very serious problem at all in this area





prevailing direction of Santa Ana winds, which can quickly spread a wildfire into populated areas. There are affordable steps that any homeowner can and should take to reduce this risk. These are outlined in the home assessment checklist and retrofit guide that follow.

IBHS wanted to gauge how much San Diego's homeowners know about how to protect their properties beyond creating defensible space. When asked for the most effective things that can be done to reduce the risk of wildfire damage, 19 percent said installing a fire-resistant roof and 11 percent listed installing fire sprinklers.

More specifically, 17 percent of homeowners who are in a high risk fire area based on their topography listed roof replacement as a good option for fire protection. This is compared to 23 percent of homeowners who considered their risk moderate and 22 percent of homeowners who rated their risk as low. Fire science researchers consider a fire-resistant roof as a fundamental requirement for beginning the process of wildfire protection.

Among these same homeowners, 3 percent of those at high risk listed using metal fencing as a protection measure, compared to 2 percent of moderate risk. Fencing was not listed by other homeowners in the survey.

The installation of dual-pane, tempered glass windows did not make the list of survey responses. Yet, IBHS research found they do make a difference in a home's survival.

Living in risky geographic areas is not the only factor that puts a home at risk of being damaged or destroyed by wildfire. Homeowners in the survey indicated that living in a densely populated area or in an area with less vegetation made them feel less at risk. However, this study found the closer together homes are built the greater chance that a wildfire can lead to cluster burning.

Cluster burning occurs when fire spreads from one home to the next. IBHS interviewed homeowners who lived next to and/or across the street from a house that burned. Each of the homeowners reported replacing their roof

with a fire-resistant covering and/or installing windows with dual panes and, in most cases, tempered glass. While many of these residents reported damage to the window frames and/or a broken outer-pane of glass following the Witch Creek Wildfire, their investment paid off in the form of having a home to come back to after the evacuation orders were lifted.

The potential for cluster burning makes the concept of a community-wide approach to fire protection even more important. The majority of survey participants viewed their neighbors as having a higher wildfire risk and only 28 percent ranked their own homes as somewhat unprotected.

Residents living in communities with homeowners associations (HOAs) were more receptive to a community approach to protect their properties. This could present an opportunity for fire agencies to work with HOAs to illustrate the benefits of a 360-degree approach to wildfire protection extending from the landscape to the surroundings and the home.

Homeowners in the focus groups responded negatively to the idea of more government regulation. Most participants preferred the idea of the government helping to educate them about steps they can take to protect their houses, rather than imposing mandatory requirements.

The focus groups and polling reflected the demographic makeup of San Diego County as a mix of retirees and young upwardly mobile families. With an average home price of \$425,000, the potential exists for the property tax rolls to be adversely affected by wildfire. This gives the county a vested interest in property protection.

The willingness of homeowners in this survey to take property protection measures corresponded with higher home values. Older homeowners and those with less education and lower valued homes felt safer overall and were less likely to do anything to protect their houses. This is contrary to the study's findings that age and the value of a home were not factors in its ability to survive a wildfire. This



means that any home can be protected with a comprehensive approach.


Unfortunately, the majority of homeowners in the survey believed the most effective wild-fire property protection measures are also the most expensive. This appears to be the biggest stumbling block for convincing them to take action. Fatalism, a lack of understanding about how to protect their home, and the belief that they have done all they can are also major factors.

It may not be possible to quickly overcome all of these obstacles, but the successful campaign to encourage homeowners to create defensible space is evidence that it is possible to get them to take action.

One way to get homeowners on board is to integrate the benefits of fire protection with cost-saving measures that promote energy efficiency, decrease maintenance and add to the resale value of a house.

The survey showed homeowners feel less safe than they did five years ago when it comes to wildfire. And although some homeowners have taken proactive measures to protect their homes from wildfire, others have done little or nothing at all. This puts the county at a high risk of repeating the catastrophic results of the Witch Creek Wildfire.

This can be avoided by encouraging homeowners to do more now before a wildfire strikes. The survey showed 64 percent of survey respondents were motivated by the possibility of learning more about effective wildfire protection measures that include inexpensive, easy projects. Another 57 percent liked the idea that these measures could better protect their neighborhoods.

IBHS will work with other organizations to harness this potential enthusiasm and demonstrate that it is possible to better protect homes. This will require public motivation, cooperative efforts both at the public and private level, and a long-term commitment to property protection. 



MEGA FIRES: The Case for Mitigation

WILDFIRE HOME ASSESSMENT



HELPING HOMEOWNERS MAXIMIZE THEIR \$\$\$

This checklist will help you assess the vulnerability of your home and its surroundings to wildfire. Each section is listed in order of importance as it relates to wildfire protection. After you assess your risk, use the required action and cost sections to help you prioritize ways to better protect your property.

FREE-\$	<\$500
\$\$	\$501-\$1,000
\$\$\$	\$1,001-\$5,000
\$\$\$\$	>\$5,001

Your house	Required action or retrofit	Relative cost
ROOF COVERING - Your roof, both in terms of the covering and design, is the most vulnerable part of your home when considering vulnerability to wildfire.		
1. Do you have a noncombustible or Class A roof?	If not, replace your roof covering with a Class A fire-rated covering	\$\$\$\$
2. Do you have a tile or metal roof? If yes, are bird stops installed to seal the openings at the edges? Are there other roof openings?	Install bird stops. Plug any roof openings that are not functioning as vents.	\$-\$\$
3. Do you have combustible siding where a lower level roof meets an upper level roof/wall (complex roof)?	Replace siding with a more fire-resistant material.	\$\$-\$\$\$\$
4. Has vegetative debris accumulated on your roof?	Remove debris from your roof.	FREE
VENTS - Vents are vulnerable to wind-blown embers and flames from nearby vegetation and combustible siding.		
1. Are your vents covered with 1/8"-1/4" metal mesh screens?	Install screens, or install new vents with screening.	\$-\$\$
2. If your vents are not covered with metal screens, have you prepared vent covers that can be easily installed when a wildfire is approaching?	Prepare covers. Since the primary purpose is to prevent embers from getting inside your vents, 1/2" plywood could be used. Keep the areas around the vents clear of vegetation and other combustible materials. Install covers before evacuation and remove them upon your return.	\$
GUTTERS - Debris can collect in gutters and become fuel for falling embers during a wildfire. It's then possible for the fire to burn into the attic space.		
1. Has vegetative debris accumulated in your gutters?	Clean out your gutters on a regular basis.	FREE
2. Have you installed gutter covers to help keep your gutters clear?	Install a gutter cover device. There are a number of designs and devices available.	\$\$-\$\$\$\$





Your house	Required action or retrofit	Relative cost
EAVES - Eaves are vulnerable and can provide a way for a wildfire to get into your attic.		
1. Do you have boxed-in or open-eave construction? Open eave construction is more vulnerable in wildfire conditions. If you have open-eave construction, can you see gaps between blocking and sheathing, or rafter tails?	Plug openings in open-eave area with durable caulk, or install a non-combustible covering over blocking to eliminate openings. An alternative method is to enclose or box-in the eaves. This method may require vents to allow for moisture management.	\$-\$\$\$
2. If your eave area is boxed-in, is the soffit material non-combustible?	Replace with non-combustible or other material that is fire resistant. Common soffit materials include those that are non-combustible, such as a fiber-cement product or exterior fire-retardant treated plywood, or combustibles such as plywood or solid wood boards. Vinyl soffit materials are not recommended.	\$\$-\$\$\$
WINDOWS - During a wildfire the most vulnerable window is one that is open. The most vulnerable part of a closed window is the glass.	Close windows to prevent embers and flames from entering the home.	
1. Do you have single-pane windows?	Install dual-pane windows, which will provide more protection from wildfire than a single pane. Dual-panes also will provide greater energy conservation and insulation during warmer and cooler months.	\$\$\$-\$\$\$\$ Costs depend on the number of windows and the location.
2. Does your window have tempered glass?	Tempered glass is more expensive than annealed glass, which is more commonly used, but it also is about four times more resistant to breaking during a fire. When replacing single-pane windows consider dual-pane, tempered glass. While this will increase the cost, it will also provide significant wildfire protection while lowering your energy bill. The cost increases are dependent on the opening size.	





Your house	Required action or retrofit	Relative cost
3. Do your windows have storm shutters?	Shutters and pre-made covers will protect your window from wildfire exposures such as embers, the impacts of other airborne debris and radiant heat exposures.	\$-\$\$\$
4. Have you made covers for your windows that can be easily installed prior to evacuation during a wildfire?	If you choose to make these from 1/2 inch plywood, clear the surrounding area of vegetation and other combustible materials that could ignite the plywood covers.	\$\$
SIDING - Fire can penetrate siding and spread into the stud cavity and up the wall into the eave and soffit area. This also can expose the windows to flames.		
1. Is your siding made of a noncombustible material?	Re-siding your house is an expensive but worthwhile proposition. There are ways to consider the fire performance of common siding materials (see the WUI Product Handbook). Although vulnerable, siding is usually second to more vulnerable features such as the roof, vents and windows under wildfire conditions. Panelized products have fewer lap joints, so can be considered less vulnerable. Wood siding shingles and plain bevel lap joints are the most vulnerable to flames.	\$\$\$\$
2. If you have a combustible siding product (e.g., wood siding), is it a panel or horizontal lap product?		
3. If you have a combustible horizontal lap siding product, does it have a simple lap joint, also called a plain bevel joint?		





Your surroundings	Required action or retrofit	Relative cost
<p>DEFENSIBLE SPACE - This is the area within 100 feet of your home or to your property line.</p> <p>The purpose of defensible space is to modify the landscape through pruning and maintaining it to keep a wildfire from approaching your home.</p>		
VEGETATION / PLANTS (0 to 5 feet around a home)		
Do you have vegetation that is close to, adjacent to or under vents, soffits or windows?	<p>Carefully maintain or remove.</p> <p>All vegetation needs to be maintained, but ground cover or small plants will be less of a problem here.</p> <p>Larger plants, particularly those that tend to generate an abundance of dead material will pose a significant threat to your home.</p>	FREE
TREES		
1. Do trees or branches hang over your home?	Prune back to a minimum of 10 feet from your home.	FREE-\$
2. Are your trees pruned to eliminate ladder fuels?	Prune trees to eliminate ladder fuels.	FREE-\$
Ladder fuels are those that will allow fire to climb up the bark and into the upper portion of the tree		
Has vegetative debris accumulated in the areas that connect the deck and walls, under the deck or at the base of exterior walls or fencing?	Inspect for and clear all vegetative debris on a regular basis.	FREE
DECKS - If ignited, decks will lead a wildfire directly to your home. The flames can burn siding, break the glass in nearby windows or sliding glass doors, and ignite the eaves and vents. All of these scenarios result in fire moving into your home.		
1. Is your deck made using combustible boards?	When it's time to replace the deck, choose a material that complies with the new California Building Code requirements (Chapter 7A). Download a copy of the WUI Product Handbook at http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland.php	\$\$\$-\$\$\$\$
If you deck has boards, chances are good that they are combustible (i.e., solid wood, or one of the wood plastic composite products).		
There are a limited number of metal (non-combustible) deck boards. Exterior fire-retardant treated lumber can also be used.		





MEGA FIRES: The Case for Mitigation

Your surroundings	Required action or retrofit	Relative cost
2. Do you have combustible materials stored under or on top of your deck?	Move this material to an enclosed area away from your home. If you choose to enclose the underside of your deck, be sure to address moisture management issues through drainage and ventilation.	FREE-\$\$
FENCES - A fence that connects directly to your house can act as a wick, bringing the fire to the house and igniting the siding. If ignited, fences will provide a radiant exposure for your siding and windows.		
Does a fence come within 10 feet of your house, or come into direct contact with it?	Replace with a noncombustible fence or use noncombustible components such as heavy wire mesh in a wood frame.	\$\$\$\$
YARD STRUCTURES - Any fuel source, decorative or functional, within 30 feet of your home.		
Do you have any playground equipment, firewood, trellises or other yard features that could bring flames too close to your home?	Combustible structures should be moved 30 feet to 50 feet from the home.	FREE



Your property	Required action or retrofit	Relative cost
PARCEL - Where a home sits on the property can be critical when a slope is involved.		
1. Does your property meet the state's requirement for 100 feet of defensible space? Contact the local fire agency for guidance.	Modify the vegetation around your home to meet the defensible space requirements, including thinning plants and trees within 30 feet of the house or to the property line and maintaining the areas from 30 to 100 feet or to the property line.	\$\$\$
2. Is your home positioned at the top of a slope?	If so, additional vegetation modification and a careful selection of building materials may be required.	FREE-\$\$\$\$





MEGA FIRES: The Case for Mitigation

RETROFIT GUIDE



GETTING READY

The Institute for Business & Home Safety (IBHS) has conducted multi-faceted research to determine what may have caused various types of homes to be damaged or destroyed by wildfires in Southern California in late 2007. The results of that research were used to develop the following important information to help individuals and families protect their homes against wildfires.

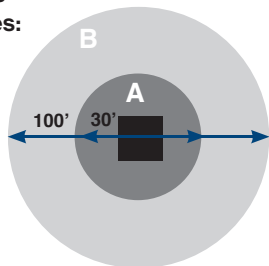
There are three clear areas of vulnerability: landscaping, surroundings and the home itself. Each of these areas can be dealt with through maintenance and structural improvements. Most of these projects are affordable and can be done in a weekend. Some of the projects have an additional financial benefit: they can help improve the energy efficiency of your home.

DEFENSIBLE SPACE: IT'S THE LAW

Since 2006, most Californians have been required by law to create 100 feet of “defensible space” around their properties. The goal is simple: to reduce the amount of potential fuel that can bring a wildfire dangerously close to your home. Defensible space also creates a safer area for firefighters to defend your home.

This 100-foot buffer is divided into two zones:

The first zone (A) extends 30 feet (or to the property line) from your home and requires the most thinning and separation of plants, trees and other vegetation. Once established, careful maintenance is needed to keep the area clear of undergrowth over time.



The second zone (B) extends from 30 feet to 100 feet (or to the property line). Trees, plants and other vegetation here should be maintained and dead plant materials or weak tree branches should be removed. If not, the vegetation will become a fuel source providing a wildfire a direct path to your home.

THREE STEPS EVERY HOMEOWNER SHOULD TAKE

MAINTAINING YOUR LANDSCAPE

1

PLANTS

WHAT YOU SHOULD KNOW: Close to the house, plants can become a major fire hazard. Plants against combustible siding, as well as plants under or next to windows or the inside corners of a house present the greatest hazard. Embers from a wildfire can become trapped in corners, igniting nearby plants and exposing siding and roof overhang to flames.

WHAT YOU SHOULD DO: Remove dead vegetation close to the house, paying attention to material on and underneath plants. Mulch can



Figures 1-2

1. If ignited, flames from this burning bush would impinge on the single pane glass window, and the nearby eave vent.

2. Interior corners are more vulnerable because of the proximity of the corners. If ignited, flames will more rapidly spread up the walls.



help keep the ground moist and reduce the need for watering, but it also can become a fire hazard. Avoid using combustible materials for mulch, particularly small pieces of bark. Consider 1/2 inch "rock" mulch or other non-combustible materials. Prune or use only small plants around siding, windows and at inside corners.

GUTTERS

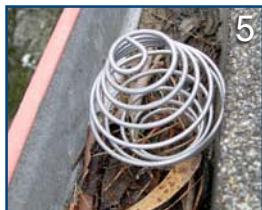
WHAT YOU SHOULD KNOW: Wind-blown vegetative debris and overhanging trees can lead to accumulation of leaves and needles on your roof. Once dry, this debris becomes quick-starting fuel for a wildfire. Gutters and other roof-to-wall intersections are particularly vulnerable to wind-blown embers. Even if you have a Class A fire-resistant roof covering, such as tile or concrete, the edges and underside of the roof and exterior siding can become exposed to flames.

WHAT YOU SHOULD

DO: Prune tree branches that overhang the roof and remove any dead vegetation, including branches, within your defensible space. This should be part of your routine defensible space maintenance. Do this at least once each year, at a time best suited for the health of the tree or plant.

Clean gutters and roof areas where debris collects as needed. Inspect these areas at least twice a year, preferably when seasons change. Remove accumulated leaves, pine needles and any other combustible debris.

Covering your gutters with screens can minimize the build-up of debris. Remember that even gutters with screens should be inspected to make sure covers are still in place and performing properly.



ASSESSING YOUR HOME'S SURROUNDINGS

2

By taking stock of what is in your yard, and looking beyond the plants and trees, you can reduce the risk of otherwise harmless items becoming fuel for a wildfire. This is the second and often overlooked step toward better wildfire protection.

YARD STRUCTURES

WHAT YOU SHOULD KNOW: Trellises, playground equipment, gazebos and other structures located close to your home can increase vulnerability to wildfire. Wind-blown embers can accumulate in or on such structures and start a fire. Depending on how close the items are to vegetation, they might be ignited by direct contact with flames. Trellises are especially susceptible, since they are often made of lightweight wood, covered with vegetation, and attached to, or close to, the house.

WHAT YOU SHOULD DO: Consider removing trellises, unless they are made of exterior-rated, fire retardant wood, heavy timbers or some other type of noncombustible materials. Keep all yard structures free of accumulated debris. Any structures, such as a child's play set, that are built from combustible materials should be relocated at least 30 feet away from the house.

Figures 3-6

3. A number of gutter cover devices are available that can help minimize debris accumulation in gutters.

4. Some of the screen-type gutter covers can become detached. Using a wire to tie the wire mesh to the gutter can help it stay in place.

5. This device helps keep the downspout open, but as you can see, periodic cleaning may still be required.

6. (above) Extensive needle accumulation has occurred in this metal gutter. If ignited by embers, the fire exposure would impinge on the roof sheathing at the edge of the roof, not the roof covering.



Figure 7

This is an example of a 'complex' roof. If ignited, the debris that has accumulated would provide a flaming exposure on the siding and underside of the roof sheathing.

OUTBUILDINGS

WHAT YOU SHOULD KNOW: All buildings on the property face the same types of risks as the home when it comes to wildfire. Once ignited, these buildings can bring flames closer to the house and may cause it to ignite.

WHAT YOU SHOULD DO: Relocate combustible outbuildings at least 30 feet away from your house. Other options would be to create defensible space around the outbuilding, just as you did with your home, or incorporate noncombustible or fire-resistant materials into the building.

FIREWOOD, LEFTOVER MATERIALS AND DRY MULCH

WHAT YOU SHOULD KNOW: It may seem obvious, but firewood, plywood remnants or dry mulch located too close to a home can be factors in spreading wildfires.

WHAT YOU SHOULD DO: Move firewood, dry mulch, leftover building materials and items such as wheelbarrows containing these materials as far away from your house as possible.

IMPROVING YOUR HOME'S FIRE RESISTANCE

3

You probably already have a running list of home improvement projects large and small. As your third and final step, add these structural projects to that list because they can provide vital protection against wildfire – and, in some cases, save money on energy bills.

ROOF

WHAT YOU SHOULD KNOW: Replacing a roof is a major project, but it also yields major benefits. IBHS research shows combustible roof coverings are the greatest threat to a house in wildfire conditions. Roof shape also plays a role. Take a careful look at your roof. If you have a lot of ridges and valleys that intersect with the walls of the house, you have a complex roof. Debris readily accumulates in these areas. Burning embers can, too. So, keep your roof clean of debris.

WHAT YOU SHOULD DO: It can be difficult to tell whether you have a Class A fire-rated roof, unless it's made of an obviously noncombustible material, such as tile. If you are not sure about your roof, schedule a professional roof inspection to find out. If you replace your roof, choose a Class A rated roof covering (your building code may require this upgrade anyway) and completely remove the old covering.



Figures 8-10

8. Finer mesh screen, such as the 1/8" screen shown here, will provide more protection against the entry of burning embers, but it is also easier for finer mesh screens to become plugged with debris, thereby reducing air flow into the enclosed space.

9. This is an example of open eave construction. Note the gaps between the blocking and horizontal members in the joist bays between the blocking that has the vent holes.

10. This is an example of an enclosed, or 'boxed-in' eave. This one also has a strip vent.

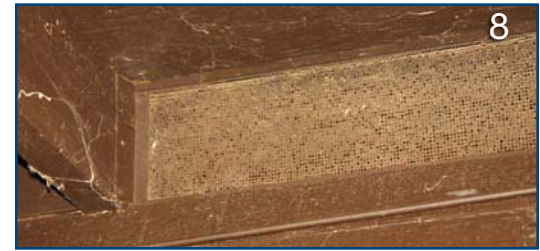
Here are some things to keep in mind when choosing a Class A roof covering:

- Many roof coverings have a Class A rating based only on the top/external part of the roof that you can see. Some examples include asphalt composition shingles, steel roofs, and clay or concrete tiles.
- Other roof coverings obtain their Class A rating because additional materials that enhance fire resistance are used in the roof assembly, underneath the part of the roof that you can see. These coverings are considered Class A by assembly. Examples include wood shakes treated with an exterior fire retardant chemical, aluminum, and some newer composite roofs made from recycled plastic materials.

EAVES, SOFFITS AND OTHER ATTIC OPENINGS

WHAT YOU SHOULD KNOW: IBHS researchers have learned from post-fire surveys of buildings damaged and destroyed by wildfires that attic/roof vents are vulnerable entry points for embers and flames. Among the most vulnerable are vents in the eave and soffit areas, but there are also risks associated with the most common type of eave, known as open eave construction, which does not have vents. You have this type of construction if you can see the rafter tails from your roof framing on the exterior underside edge of your roof. There are gaps where the blocking and rafter tails intersect; as a result, wind-blown embers can become lodged here and ignite the house.

WHAT YOU SHOULD DO: If you have vented openings into your attic or crawl space, check for screening. At a minimum, these vents should be covered with a 1/4 inch metal mesh screen, or better yet, 1/8 inch metal mesh screens. Keep in mind that while a finer mesh screen will offer better protection against embers, it also requires more maintenance to be kept free of debris. It is important to keep air flowing freely to help manage the moisture in your attic.



Screens offer a minimum level of protection from wildfire embers, but there is evidence of embers occasionally passing through screening during large fires. Newer vent styles that have recently been designed appear to offer better protection. These are in the testing phase and should become available to the public in the coming months.

If you have open eaves, you can create a box to help keep embers from lodging there. To do this, fasten sheathing made from a non-combustible or fire-resistant material to the underside of the rafter tails. This will create an enclosure that follows the slope of the roof. This can also be accomplished by extending the material from the roof edge horizontally to the exterior wall.



TILE ROOF

WHAT YOU SHOULD KNOW:

Some roofing materials have a gap at the edge of the roof. The most common example is a clay barrel tile roof covering, but it's also a problem with some standing-seam metal roofs. The gap can allow birds and other rodents to get into the opening and build nests which are highly combustible and easily ignited by wind-blown embers. The flames can then quickly spread to the structural members that support your roof and bypass any protection offered by Class A fire-rated materials.

WHAT YOU SHOULD DO: Use a form of protection called "bird stopping" to seal the open edges of the roof covering. Bird stops are a manufactured shield that can be purchased from roofing supply stores and are typically provided by the manufacturer of the roof covering. The bird stop can be inserted into the opening. You can also use mortar mix to plug the ends. Remember, the idea is to keep fuel sources and embers out from under the edge of the roof.

WINDOWS AND DOORS

WHAT YOU SHOULD KNOW: The doors and windows of your home should be able to resist wind-blown embers and protect against radiant heat and flame exposures. Depending on the type of glass, a window that is exposed to flames may break after only 1 to 3 minutes of exposure to intense heat or flames. When windows break from exposure to heat and/or flames, embers and flames can get inside the house. Testing has shown that single-pane windows are highly vulnerable to breaking when exposed to wildfire conditions. Fortunately, dual-pane windows provide better protection;

this protection is even greater when tempered glass is used. Remember, even dual-pane, tempered glass windows will not protect your home if they are left open. So, close all windows before you leave the house.

The California Building Code now requires that all new buildings in wildfire-prone areas be built with dual-pane windows with at least one pane of tempered glass. Prior building codes have already required tempered glass be used in exterior doors and windows within 18 inches of the floor. The new code extends the tempered glass requirement to the other windows in the home. The new codes also require that exterior doors be made of noncombustible construction or that solid wood doors be at least 1 3/8-inch thick.

Figures 11-12

11. In this case, a bird stop piece is missing. If you have bird stops, inspect them regularly to make sure they are all still in place and functional.

12. Smaller gaps can occur in standing seam metal roofs. As shown here, material is also available to plug the ends of these roof coverings.

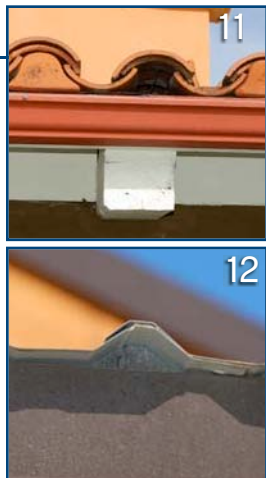


Figure 13-14

13. The outer pane of this dual pane window broke during a 2007 wildfire in Southern California. In this case, the dual pane window was one reason why this home survived.

14. Tempered glass in a window will have a marking etched in one of the corners, similar to that shown here.



WHAT YOU SHOULD DO: Determine what kind of windows are in your home. Single-pane windows are more common in older homes, while dual-pane windows are more frequently found in newer construction. Dual-pane windows have two sheets of glass that are separated by an airspace. To find out if your dual-pane windows contain tempered glass, look for an etching ("bug") in the corner that proves it is tempered.

You should replace your single-pane windows with dual-pane windows that have at least one

**Figure 15-17**

15. The chain link fence enclosure surrounding this deck did not prevent debris from accumulating. It was also high enough off the ground to store things underneath. It was close enough to the ground to make it inconvenient to clean out the debris.

16. A close up photo of Figure 15. The fence probably helped keep rodents and animals out of the open crawl space.

17. This photograph shows two small decks made with two different wood-plastic composite decking products. The one on the left complies with the performance requirements of the California Wildland Urban Interface building code (Chapter 7A). The one on the right does not.

pane of tempered glass. Dual-pane windows without tempered glass don't protect as well in wildfire conditions. Current energy code requirements usually require dual-pane windows, so changing your single-pane window to dual-pane will help you on two fronts: fire-resistance and energy efficiency.

If you cannot afford to replace your windows, provided that you have controlled the fuels close to your house, including vegetation, mulch and yard structures, a less expensive alternative is to create shutters out of ½ inch plywood. Cut them to size and label them for each window so they can be installed quickly when wildfire threatens. Take the time to pre-install the anchorage hardware and prepare your shutter materials in advance. The ½ inch plywood will provide an extra measure of protection from radiant heat or the impact of windblown embers.

DECKS

WHAT YOU SHOULD KNOW: Decks are important because of where they typically are located – attached to the house, next to windows, sliding glass doors and possibly combustible siding. When thinking about your deck consider its construction material and the types of items that are on top and beneath the decking. You also need to consider the defensible space leading up to the deck, which can act as a wick and move the fire through the vegetation and ignite the decking materials.

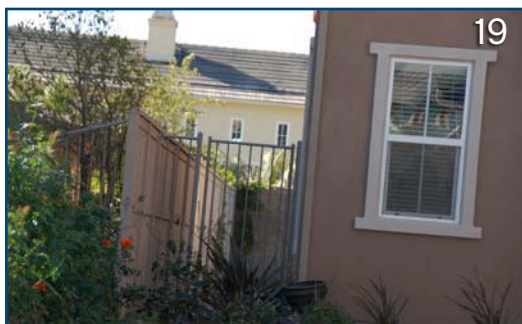
Decking material used in wildfire-prone areas in California now must meet minimum fire performance requirements. Using these materials is recommended regardless of whether codes dictate it. The California Office of the State Fire Marshal publishes the *Wildland Urban Interface Product Handbook*, which lists products that have been reviewed and verified by the state for their compliance with the new 2007 California Building Code. Some of the materials reviewed include exterior siding, windows and deck materials. This document is available online and is regularly updated. Download a free copy at <http://osfm.fire.ca.gov/strucfireengineer/pdf/bml/wuiproducts.pdf>



WHAT YOU SHOULD DO: Enclosing your deck can help reduce the risk of damage from wildfire. Decks can be enclosed vertically by applying an exterior siding product around the deck's edge, or horizontally by applying an exterior panelized product to the bottom of the deck support joists. Wire screening can also be used.

To determine if enclosing your deck is necessary, consider whether you store combustible materials under your deck, or if your defensible space is inadequate, particularly in the 0 to 30-foot zone. If you can avoid storing combustible materials under your deck, and if you maintain your defensible space, enclosure will not significantly increase your wildfire protection.

If you choose to enclose your deck, make sure you provide sufficient ventilation or other means for water to drain out. A minimum of one square foot of venting for 150 square feet of deck area is recommended for proper drainage. If you do not allow for the deck's structural support members and deck boards to dry out, fungal decay will become your deck's biggest threat.



Figures 18-19

18. This is an example of a wood frame fence with a noncombustible (wire mesh) infill. Such a design makes it much more difficult for fencing to act as a wick in bringing fire to your home.

19. In this case, a metal gate provides the connection between a wood fence and home.

Enclosing your deck will not reduce the risk of the top being exposed to embers. For that, the best protection is to keep the deck clear of leaves, pine needles and other vegetative debris.

FENCES

WHAT YOU SHOULD KNOW: Fences can be a wildfire hazard, particularly if they connect directly to the house. The bottom of fences collect debris that, when combined with combustible fencing materials, become a fuel source that can act as a wick to carry fire directly to the house.

WHAT YOU SHOULD DO: New fences should be entirely constructed of noncombustible or fire-resistant materials. A wood frame with steel mesh infill is another option that will provide adequate protection. Existing wood fences that are attached to the house should be retrofitted so the fence ends with a noncombustible material like masonry or heavy timber to keep fire from spreading to the house. A common technique is to use a metal gate that is attached to the fence on one side and to the exterior siding on the other side.

It is also important not to store firewood or other combustible materials up against the fence, and to regularly remove debris and dead vegetation at the bottom of the fence.

TOPOGRAPHY

WHAT YOU SHOULD KNOW: The topography of the land around your home, which includes the slope of the land and the direction the house faces, is a major consideration in assessing your home's exposure to wildfire. Wildfires burn up a slope faster and more intensely than along flat ground. A steeper slope will result in a faster moving fire, with longer flame lengths. Higher wind speeds would have the same effect.

WHAT YOU SHOULD DO: If your home is mid-slope, or at the top of a steep slope but set back less than 15 feet for a single-story and 30 feet for a two-story home, IBHS recommends taking additional precautions. These include being more aggressive in creating defensible space and more aware of the materials used to build the house, deck or any outbuildings. Also pay closer attention to any yard structures that could act as wicks and lead the fire directly to the house.

Consider improving your home's protection by constructing a noncombustible retaining wall to help increase the set back. When making future home improvements incorporate fire-resistant features and materials into the home and surrounding landscape.

CHIMNEYS

WHAT YOU SHOULD KNOW: Spark arrestors for your chimney are required to prevent embers in your fireplace from starting wildfires. Think of it as a community-wide approach to wildfire protection – you protect your neighbors and they protect you by having a chimney spark arrestor.

WHAT YOU SHOULD DO: Install a spark arrestor that has 1/2 inch mesh. These are available at large hardware stores or fireplace specialty stores.

ACKNOWLEDGEMENTS

The Institute for Business & Home Safety gratefully acknowledges the individuals who contributed to this research study. They come from many backgrounds, including fire safety, public policy, engineering, and academia.

In particular, IBHS wishes to express its sincere thanks to:

Ruth Bernstein, EMC Research

Dr. Patrick Bourgeron, Director, Center for the Environment, Plymouth State University

Tanya Brown, Texas Tech University

Jack Cohen, RMRS-Fire Sciences Laboratory

Dr. Bernd J. Haupt, The Pennsylvania State University

Dr. Hope Humphries, Institute for Alpine and Arctic Research, University of Colorado

Cliff Hunter, Rancho Santa Fe Fire Marshal

Dr. Sarah M. McCaffrey, U.S. Forest Service

Dr. Pamela Morgan, American Environics

Steve Quarles, University of California, Cooperative Extension

Clay Westling, County of San Diego

John Whaley, American Environics

Front and back cover image photo credit:

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