

# Protecting Communities from Forest Fires

## Effectively Treating the Wildland Urban Interface



Written by Brian Nowicki, May 21, 2001  
Produced by Southwest Forest Alliance  
P.O. Box 1948, Flagstaff, AZ 86002  
(520) 774-6514, Fax (520) 774-6846, Email [swfa@swfa.org](mailto:swfa@swfa.org)

# Protecting Communities from Forest Fires

## Effectively Treating the Wildland Urban Interface

### Southwest Forest Alliance

Forest management over the past century has drastically changed the physical conditions of the forests in the Southwest. Widespread logging has removed primarily the largest and most fire-resistant trees. Livestock grazing and fire suppression have encouraged the growth of a dense forest of relatively small trees. At the same time, population and development booms have extended houses and communities ever further into forest lands.

In May, 2000, the Cerro Grande fire captured national attention as it burned 40,000 acres near Los Alamos, New Mexico, destroying 200 homes. In the fall of 2000, Congress appropriated funding to treat public lands to protect communities at risk from wildfire. National Fire Plan funding has provided an opportunity to thin non-commercial, small-diameter trees, which cause the greatest fire risk. Unfortunately, many projects seeking to use this funding will not provide community protection from wildfire.

The only efforts that will protect communities from the threat of wildfire are those that seek to treat houses and the surrounding properties, and the forest directly adjacent to houses. However, current proposed federal projects to protect communities from wildfire now include everything from fuels reduction treatments within private properties to forest restoration experiments miles into the wildland forest.

A definition of the wildland-urban interface (WUI) is needed in order to identify the goals of treating the interface and determine the appropriate methods to achieve those goals. Clear distinctions must be drawn between fuels reduction and forest restoration, as well as between fuels reduction in the WUI and at the landscape level.

### Defining the Wildland-Urban Interface

The term "wildland-urban interface" refers specifically to areas where forests meet urban development, particularly houses. This definition has been supported by the U.S. Department of Agriculture and the Department of the Interior in various reports in late 2000 and early 2001. Furthermore, the joint USDA/USDI report (January 4, 2001) explains that only houses and other buildings qualify for protection in Federal WUI projects. Therefore, fences, power lines, trails, roads, and properties with no buildings do not on their own constitute WUI areas.

A focused and effective definition of the WUI provides the basis for prioritizing WUI projects. Projects around *interface communities* (defined by the USDA/USDI as areas where urban development abuts or extends into the surrounding wildland, with a population density of greater than 250 people per square mile) would protect the greatest number of people in the greatest number of communities. Therefore, WUI projects protecting interface communities should hold highest priority, before more dispersed WUI areas. Furthermore, WUI projects that directly protect communities should hold higher priority than forest restoration projects and other projects in the wildland forests.

The WUI refers to areas where urban fuels directly meet forest fuels. This is primarily within 20-60 meters (66-200 feet) of houses, where fires most directly threaten houses, and where a defensible zone can be developed. In addition, public agencies (including the U.S. Fish and Wildlife Service and USDA) have proposed to analyze the forest 1/2 mile from the houses on the edge of town for possible WUI treatments.

## Treating the Wildland-Urban Interface

Jack Cohen, a U.S. Forest Service researcher, stated (2000) that "home ignitions are not likely unless flames and firebrand ignitions occur within 40 meters [131 feet] of the structure... The W-UI fire loss problem primarily depends on the home and its immediate site." Another U.S. Forest Service researcher, James Davis (1990) found a precipitous drop in structural loss at even 20 meters (66 feet) distance between the house and the wildland vegetation..."The most effective step is to assure adequate clearance between structures and flammable vegetation." Davis further found that roof flammability greatly influenced home loss.

Multiple researchers and agencies have identified the most important precautions that individual landowners and homeowners must take to protect their homes and properties (Rains 2000, Flagstaff Fire Department 2000, Firewise 2000). The recommendations generally apply to the house and adjacent vegetation, and the area within 20-60 meter (66-200 feet) of the house:

- Use fire-resistant materials in the construction of houses, especially roofs;
- Move firewood away from the house, and remove flammable woody debris;
- Prune lower limbs of trees adjacent to the house;
- Thin dense groups of trees within 60 meters (200 feet) of the house;
- Mow grasses, rake needle litter, and prune ornamental shrubs; and
- Clean roofs and gutters of dead branches, leaves and needles.

These precautions increase the chance that the house can withstand fire if the fire department can not reach the house during a fire, as well as increasing the success of the fire department in protecting the house if they do reach it.

Dan Bailey, a U.S. Forest Service zone fire manager, wrote (1991), "There is one general protection strategy that has proved its effectiveness in every locality-'defensible space'. Creating defensible space involves providing an area between a structure and the surrounding flammable vegetation that is sufficient to allow fire agencies to battle an oncoming wildfire before it reaches structures or to stop a structural fire before it ignites the wildland vegetation... Defensible space can be as simple as a minimum 30-foot (9.14 m) clearing between homes and flammable vegetation or as complex as a greenbelt (or series of fuel breaks) surrounding a planned community."

The concept of defensible space can be incorporated into the WUI treatment similar to the way that the U.S. Forest Service has approached fuel reduction treatments adjacent to communities for decades in the "intensive zone". The intensive zone involves a heavy thinning within the 200 meters (660 feet or one-eighth mile) adjacent to houses, to thin the canopy, remove ladder fuels, and reduce the fuel level. This area can serve as a fuelbreak, a defensible space, and a potential fire line for firefighters.

In high-risk areas and the "fire-prone" side of town there may be a need for a more extensive defensible space. The "extensive zone" involves a light thinning within half a mile of the community. The treatment of the extensive zone, as it has been implemented in the past by the U.S. Forest Service, removes slash and surface fuels, and facilitates the reintroduction of prescribed fire, which could then be used to maintain lowered fire potential in the area. The goal of the extensive zone treatment is to reduce the ability of the forest within the WUI to sustain or initiate a crown fire.

One of the primary concerns in WUI communities is the fear that wildland fires have the potential to enter the WUI as high-intensity crown fires. For this reason, communities and federal agencies have shown great interest in treating land beyond the individual properties and houses and into the surrounding forest. However, in a report on the Cerro Grande fire that burned through Los Alamos, New Mexico in 2000, Cohen reported that the Cerro Grande fire burning to the community was a surface fire. Cohen found, "In several cases, a scratch line that removed pine needles from the base of a wood wall

kept the house from igniting." Cohen and other Forest service researchers have provided evidence that the most efficient and effective strategy for community protection is to treat the areas directly surrounding houses.

A secondary concern in protecting communities from forest fires is that the heat rising off a forest fire can carry burning ash and even leaves and branches called firebrands that can ignite fires far from the fire front. These "lead fires" can start miles ahead of the advancing flames, but usually start within a half-mile of the flame front. Undoubtedly, this is a danger for houses in the WUI, but projects beyond the WUI can only alleviate this concern if they completely eliminate the risk of wildfire for several miles into the wildland forest. However, the complete elimination of forest fire is neither possible nor desirable, and is not economically or ecological viable. Therefore, the only effective way to protect communities from fires started by firebrands is not to treat into the wildland forest, but to treat the houses and surrounding properties so that they are protected from such fire starts.

As the WUI extends further from the houses and the edge of the community, the treatment will need to balance other objectives, such as ecosystem health and wildlife habitat. These projects need to limit their impact on forest-dependent species such as squirrels, northern goshawk, and the Mexican spotted owl. This can be done by providing appropriate fire protection in the areas directly adjacent to communities, so that thinning in the extensive zone can be as light as necessary to protect habitat. Even in the forest directly adjacent to communities, deference will need to be given to rare and threatened species and their habitat.

Further ecosystem protection within the WUI projects could be provided by implementing a 12-inch diameter cutting cap, as proposed by Forest Service Chief Michael Dombeck (2000). With such a cap, no tree with a diameter larger than 12-inches should be cut in the treatment of the WUI. This is especially appropriate within the ponderosa pine ecosystem where larger trees have shown a greater resistance to fire. A 12-inch cap also provides some protection for the forest ecosystems, including protection of forest structure that is critical to wildlife habitat.

It is important to note that a severely thinned forest can itself be more fire-prone, due to large amounts of logging slash and raised soil temperatures. There may be extreme levels of soil compaction due to logging operations, leading to an explosion of exotic species and reduced understory vegetation. There may be serious impacts on wildlife habitat, due to the extreme change in forest structure.

The restoration of natural ecosystem processes, such as frequent fire, hydrologic cycles, nutrient cycles, and competition, is an important part of managing the forests. However, the majority of the forest is not directly adjacent to communities, and restoration projects throughout the wildland forest do not protect houses and communities. While projects that directly protect houses and communities have a relative urgency, restoration work in the wildland forest should proceed cautiously, taking care to cause the minimum of damage while restoring the forest.

## **Community Protection**

Homeowners need to be responsible for their own property. Since the only effective home protection is treatment in, on, and around the house, homeowners must be responsible for protecting that property. At the same time, local communities must take responsibility for managing growth and development that extends into the surrounding forest. Local governments need to require developers to protect the new houses and require landowners to treat their own properties. On the other hand, the federal government is primarily responsible for WUI projects that involve federal land directly adjacent to private residences. In such projects, the federal agencies should be able to supply funding and land management, and encourage cooperative efforts among federal and local agencies, and private landowners.

James Agee, a fire researcher at the University of Washington wrote (1996), "Fire-safe" forests are not fireproof, but will have: Surface fuel conditions that limit surface fireline intensity; Forest stands that are comprised of fire-tolerant trees, described in terms of species, sizes, and structures; A low probability that crown fires will either initiate or spread through the forest." One important caveat must be emphasized here: not every parcel of landscape can or need be treated to make it "fire-safe".

Community protection from wildfire should not be used as a justification for restoration projects in the wildland forest. Restoration of the wildland forest should be strictly based on ecological needs. The wildland forest does not need to be restored to protect communities from fire. Furthermore, restoration projects should not rely on WUI appropriations for support and funding.

With a clear idea of what the WUI is and how to treat it, the U.S. Forest Service and Bureau of Land Management projects can directly address the protection of WUI communities. The only projects that protect houses and communities treat the houses themselves and their immediate surroundings, and involve fuels reductions directly adjacent to communities. In providing community protection it is important to preserve the ecological values that make these communities desirable places to live.

# Protecting Communities from Forest Fires

## Effectively Treating the Wildland Urban Interface

Southwest Forest Alliance  
Brian Nowicki, March 2001

### Abstract

Defining the wildland-urban interface (WUI) is critical to the management of wildland forests and the protection of communities from forest fire. The WUI refers to areas directly adjacent to houses and communities, particularly within forested ecosystems at high risk of wildfire. Communities are most effectively and efficiently protected by treating a narrow strip of forest directly adjacent to the communities, and by treating individual houses and the surrounding properties. Community forest fire protection is little benefited by thinning the surrounding wildland forest distant from houses. In fact, there are clear distinctions between fuels reduction and forest restoration, as well as between fuels reduction in the WUI and in the wildland forest.

### Contents

Introduction.....	2-1
Defining the Wildland-Urban Interface.....	2-2
Current Forest Service Treatments.....	2-3
Protecting Houses and Properties.....	2-4
Protecting Communities.....	2-5
Differentiating Between WUI and Wildland Forests.....	2-6
Responsibility.....	2-8
Conclusions.....	2-9
Literature Cited.....	2-10

### Introduction

Wildfires destroyed 9925 houses between 1985 and 1994, and burned six million acres of public lands nationwide in 1999; and more than 6.5 million acres burned nationwide in 2000 (National Fire Protection Association 2000). In May, 2000, the Cerro Grande fire captured national attention when it burned 40,000 acres near Los Alamos, New Mexico, destroying 200 houses.

Responses of the media, federal agencies, and elected officials to the recent forest fires in the West have added to the confusion surrounding the concept of the wildland-urban interface. Many of these officials are confusing the risk of forest fire with the threat of wildfire to a community, and that confusion is being manifested within the various projects that are proposing to utilize the appropriated funds.

In fall of 2000, Congress appropriated \$120 million each to the Department of Interior and the Department of the Agriculture for the removal of hazardous fuels to alleviate immediate emergency threats to wildland-urban interface areas. The bill required the Secretaries of Agriculture and the Interior to identify all wildland-urban interface communities within the vicinity of federal lands that are at high risk from wildfire, and determine what protective steps are being taken in those communities.

Current proposed federal projects to protect communities from wildfire now include everything from fuels reduction treatments on private properties to forest restoration experiments miles into the wildland forest. A definition of the wildland-urban interface is needed in order to identify the goals of treating the wildland-urban interface and determine the appropriate methods to achieve those goals.

## Defining the Wildland-Urban Interface

The term "urban-wildland interface" was first used in 1974 by C.P. Butler, a physicist at the Stanford Research Institute. He said, "In its simplest terms, the fire interface is any point where the fuel feeding a wildfire changes from natural (wildland) fuel to man-made (urban) fuel... For this to happen, wildland fire must be close enough for its flying brands or flames to contact the flammable parts of the structure." Since then, the urban-wildland interface has also been called the urban interface, the interface, and the wildland-urban interface (WUI).

In 1990, James Davis, Forest Service researcher in the Pacific Northwest region, described the interface as "an artificial environment where structures and introduced vegetation...are placed in a wildland setting." On the same subject, South Dakota State University professor John Ball (1997) wrote, "The urban forest interface is not a boundary between two systems but instead a continuum where urban and forested areas intermingle to various degrees...The interface is also fluid, rippling out from the core as new transportation corridors are created." That is, the WUI is not simply an area in which wildfire threatens communities. Urban development itself is a component of the WUI; the houses and landscaping change and contribute to the fire potential of the area.

The U.S. Forest Service officially defined the WUI for the first time in its September 18, 2000, "Report to the Council of Western State Foresters—The Wildland/Urban Interface Problem". The report defined the WUI very generally, "the urban wildland interface community exists where humans and their development meet or intermix with wildland fuel." A month later, in the October 13, 2000, "Cohesive Strategy for Protecting People and Sustaining Resources in Fire-Adapted Ecosystems" the Forest Service provided a much more specific definition, "Wildland-urban interface areas include those areas where flammable fuels are adjacent to homes and communities."

The Secretaries of the Interior and Agriculture defined the WUI in the January 4, 2001 Federal Register publication "Urban Wildland Interface Communities Within the Vicinity of Federal Lands that are at High Risk from Wildfire". This report identifies three types of WUI communities. The intermix community refers to single houses or medium-sized subdivisions spread throughout wildland areas. The occluded community refers to isolated areas of wildland surrounded by urban areas, such as remnant parks or forests among expanding communities. The type of interface that involves the greatest number of people is the interface community. The interface community refers to areas where urban development abuts or extends into the surrounding wildland.

The USDA/USDI "Urban Wildland Interface Communities" notice further defined the interface community as having a population density of 250 or more people per square mile, the intermix community as having 28 to 250 people per square mile, and the occluded interface as an area usually less than 1000 acres in size. This provides some scale for differentiating WUI areas and prioritizing projects according to the number of people affected.

The USDA/USDI "Urban Wildland Interface Communities" notice included a clarification of the word "structure" that is commonly used in fire literature to refer to buildings. The Departments of Agriculture and the Interior defined a structure as "either a residence or business facility, including Federal, State, and local government facilities... structures do not include small improvements such as fences and wildlife watering devices." This clarifies that houses and business buildings warrant protection in WUI projects, and sets these apart from lower priorities such as private property (without buildings) and infrastructure (roads, fences, utility lines). The report presented infrastructure only as a factor affecting the ability of firefighters to access houses, not as a priority in protection from wildfire.

The Wildland Fire report of the Kaibab National Forest (2000) defined the WUI as "lands within one mile of private in-holdings". The Flagstaff Fire Department (2000) stated "The boundary of this assessment area [the WUI] is generally within 1/2 - 1 mile of major

developments...or city lands." The U.S. Fish and Wildlife Service has also issued a report in which 1/2 mile is proposed as the extent of the WUI. The preponderance of land management agencies have set the range of assessment for the WUI at no more than 1/2 to one mile from houses or private property.

In summary, the WUI is generally defined as an area at risk from wildfire directly adjacent to houses and communities. Only houses and commercial buildings are designated as the part of the community that warrants protection, not property or infrastructure alone. Lastly, assessment of the wildland-urban interface extends no more than 1/2 to one mile from the houses to be protected.

## **Current Forest Service Treatments**

The U.S. Forest Service has only recently defined the wildland-urban interface (in the Cohesive Strategy 2000, and the USDA/USDI 2001 "Urban Wildland Interface Communities" notice). However, there are certain silvicultural treatments that the U.S. Forest Service has used consistently for decades to reduce fuel loads in areas directly adjacent to communities to protect houses from wildfire. The following prescriptions come not from any set Forest Service policy, but from prescriptions for fuel reduction projects adjacent to communities and houses. These prescriptions come primarily from the Kaibab and Coconino National Forests and deal primarily with ponderosa pine forest types. Currently, timber stand improvement contracts are used to accomplish the fuels reduction objectives in many ranger districts. In more rural areas, the WUI fuels projects rely more heavily on prescribed burning.

The fuels reduction efforts are generally implemented as two distinct treatments. The intensive zone involves a heavy thinning for the first 200 meters (one-eighth mile or 660 feet) from houses or private lands. The extensive zone involves a much more conservative treatment for up to a mile on the fire-prone (upwind) side of the town, and half a mile on the down-wind side of the town. (The prevalent wind direction throughout much of the Southwest is from the southwest, so the western and southwestern edges of town are often considered more fire-prone.)

The goal of the intensive zone treatment is to reduce the intensity of an approaching wildfire, preferably reducing it to a surface fire. This is accomplished by thinning the canopy, removing ladder fuels, and reducing the fuel load. This area can serve as a "defensible space", a fuelbreak, and a potential fireline. In the ponderosa pine forest, thinning is consistently prescribed to thin the area to a 40-60 square feet per acre basal area (Coconino and Kaibab National Forests). Such prescriptions often leave 75 trees or more per acre. The treatment includes cleanup of 100% of the slash through chipping and/or burning. An effort is made to eliminate all interlocking crowns in forest areas close to communities, and at the inside edge of the intensive zone.

The goal of the extensive zone treatment is to reduce the ability of the forest to sustain or initiate a crown fire. Groups of trees are left intact in the extensive zone, with interlocking crowns within the groups, but continuous canopy is thinned to separate tree groups. Ladder fuels are largely removed by cutting understory trees and high fire-risk trees (such as brush, doghair thickets, and trees heavily infected with dwarf mistletoe). In the ponderosa pine forest, the thinning treatment selectively removes trees up to 9 inches in diameter, and the target forest structure varies by site within projects, depending on the topography, priority of the structures at risk, and the surrounding forest density.

These prescriptions involve relatively heavy thinning, as the highest priorities are to reduce fuel loads and provide protection from wildfire. However, even these prescriptions generally account for the range of variation in fire seasons. That is, the treatments propose to reduce the window of high-risk fire days rather than attempt to completely eliminate the risk of wildfire under even the most extreme conditions (unusually dry years). Also, these treatments are most severe on the inside of the intensive zone immediately adjacent to communities, and are generally less severe

further away from houses where it is important to incorporate other objectives such as aesthetics and wildlife habitat.

## **Protecting Houses and Properties**

Many federal agencies and local governments have failed to understand that the only way to protect houses and communities is to implement projects that directly protect houses and communities. Jack Cohen, a research physical scientist for the US Forest Service, Intermountain Fire Sciences Laboratory, studies the threats of wildfire to communities and structures. A 1997 article by Cohen and Jim Saveland, a member of the US Forest Service, Vegetation Management and Protection Research Staff, stated, "If residential fire losses did not occur during wildland fires, the W-UI fire problem would not exist. Thus, the principal issue is residential structure survival... Any strategy for effectively reducing the W-UI fire problem must initially focus on residential fire resistance."

Cohen and Saveland (1997) noted that "... flames are an ignition threat only at close distances to a structure (actual distances depend on the flame and structure characteristics)... This finding suggests that nearby landscape vegetation and neighboring structures are important factors in structure ignitions. However, structures commonly ignite when fires are at distances too great for flame-heated ignitions, suggesting that firebrands are an extremely important source of ignition on and adjacent to a structure. Vegetation management beyond the structure's immediate vicinity has little effect on structure ignitions. That is, vegetation management adjacent to the structure would prevent ignitions from flame exposure; but vegetation management away from the structure would not affect ignition from flame exposure and would not significantly reduce ignitions from firebrands."

Cohen (2000) stated that "home ignitions are not likely unless flames and firebrand ignitions occur within 40 meters [131 feet] of the structure... The W-UI fire loss problem primarily depends on the home and its immediate site." Davis (1990) found a precipitous drop in structural loss at even 20 meters (66 feet) distance between the house and the wildland vegetation. He further found that roof flammability greatly influenced home loss... "The most effective step is to assure adequate clearance between structures and flammable vegetation." Such clearance would reduce the potential for flames of a crown fire to reach the structure. It would also reduce the potential for firebrands to ignite the house or set significant fires near the house.

Multiple researchers and agencies have identified the necessary precautions that individual landowners and homeowners must take to protect their houses and properties (Rains 2000, Flagstaff Fire Department 2000, Firewise 2000). Recommendations generally apply to the house and adjacent vegetation, and an area up to a 60 meter (200 feet) radius around the home. These recommendations include:

- Using fire-resistant materials in the building of houses, especially roofs;
- Removing flammable materials such as firewood and woody debris from directly adjacent to the house;
- Thinning dense groups of trees within 60 meters (200 feet) of the house;
- Pruning lower limbs from trees near the house;
- Mowing grasses, raking needle litter, and pruning ornamental shrubs; and
- Cleaning roofs and gutters of dead branches, leaves, and needles.

Cohen assessed the Cerro Grande fire in the week after the fire burned through Los Alamos. He stated, "Although the Cerro Grande Fire burned as an intense, continuous and active crown fire in certain areas, within several hundred yards or more of the Los Alamos residential area it burned as a surface fire—an underburn... The unconsumed vegetation surrounding destroyed homes at Los Alamos indicates that these [destroyed] homes were exposed to a low intensity surface fire, not a high intensity crown fire..."

[That is,] the Cerro Grande fire burning to the community was a surface fire. My examination suggests that the high ignitability of Los Alamos was principally due to the abundance and ubiquity of pine needles, dead leaves, cured vegetation, flammable shrubs, wood piles, etc. adjacent to, touching and/or covering the homes... In several cases, a scratch line that removed pine needles from the base of a wood wall kept the house from igniting."

Cohen and Saveland (1997) stated that fire suppression effectiveness in real-time situations is unpredictable and, therefore, structure survival depends strongly on structure ignitability. "Improved structure ignition resistance leads to improved suppression effectiveness by homeowners and fire agencies." Therefore, individual properties and houses need to be treated so that they may withstand fire should the fire department be unable to reach the houses during the fire, and also so that the fire department has increased success in protecting the house if they do reach it.

In summary, protecting houses from wildfire requires treating the house itself and the immediately surrounding area. This treatment does not necessarily require the removal of trees, and certainly not all trees, but is more of a cleanup of the area. Proper treatment will provide protection from crown fires, surface fires, and firebrands. Treating the property surrounding a house not only allows firefighters to more easily defend the house, but also increases the chance that the house can survive wildfire on its own.

## **Protecting Communities**

One of the primary concerns in community protection is the fear that fires that start in the wildland have the potential to enter the WUI as unstoppable, high-intensity crown fires. For this reason, communities and federal agencies have shown great interest in treating land beyond the individual properties and houses and into the surrounding forest. Since the foremost goal of WUI projects is to protect communities from wildfire, the most efficient and effective strategy is to reduce the fuel load in the areas directly adjacent to houses and communities.

Efforts of the U.S. Forest Service to decrease the potential for sustained crown fire have been described as reducing the amount of ground fuels, ladder fuels, and tree canopy fuels. Reducing ground fuels and raising the crown base height (height of the lowest tree branches with live foliage) limits the fuel load and fire intensity that could initiate a crown fire (Van Wagner 1977). Removing ladder fuels reduces the potential for ground fires to reach the tree crowns. Decreasing the extent of continuous canopy reduces the ability of a crown fire to pass from tree to tree or group to group (Flagstaff Fire Department 2000). However, current studies indicate that crown bulk density (the mass of flammable foliage per unit volume of the canopy) is more important than canopy closure (amount of continuous canopy between individual trees), or crown density (the area of foliage cover per area of canopy) in terms of fuels reduction (Agee 1996).

These ideas are most appropriately applied to the WUI by treating a narrow strip of forest directly adjacent to houses, similar to the way that the U.S. Forest Service has approached the "intensive zone" for decades. In such a treatment, the understory fuels and overall fuel loads are greatly reduced, the ladder fuels are removed, and the continuous canopy is fragmented. According to fire researchers, the protection of houses requires a treatment of only 20-60 meters (66-200 feet) around houses (Davis 1990, Cohen 2000). However, conventional Forest Service treatments of intensive zones are typically 200 meters (660 feet). Forest Service treatments have largely focused on reducing the canopy closure and crown density, when the reduction of fire risk requires reduction of crown bulk density (Agee 1996). Also, Forest Service treatments have largely removed entire trees, instead of raising crown base height by pruning lower branches.

According to the Forest Service Cohesive Strategy 2000, "The strategy does not require that every high, medium, or low risk acre be treated, nor does it eliminate all risks..." That is, the entire forest need not be treated to withstand forest fire; neither does it need to withstand fire under all conditions. James Agee, a fire researcher at the University of

Washington wrote (1996), " 'Fire-safe' forests are not fireproof, but will have: Surface fuel conditions that limit surface fireline intensity; Forest stands that are comprised of fire-tolerant trees, described in terms of species, sizes, and structures; A low probability that crown fires will either initiate or spread through the forest... One important caveat must be emphasized here: not every parcel of landscape can or need be treated to make it 'fire-safe' ".

Bailey (1991) wrote, "There is one general protection strategy that has proved its effectiveness in every locality—'defensible space'. Creating defensible space involves providing an area between a structure and the surrounding flammable vegetation that is sufficient to allow fire agencies to battle an oncoming wildfire before it reaches structures or to stop a structural fire before it ignites the wildland vegetation. With defensible space, the structure has a chance to survive on its own when fire personnel and equipment are not available- as often happens during a wildfire." Bailey proposed that defensible space accomplishes three critical objectives: "To prevent serious fires from ever starting. To provide firefighters with a "fighting chance" to stop a wildfire quickly and efficiently and to reduce the tragic cost in property, natural resources, and lives. To offer the possibility of a structure surviving on its own when fire personnel and equipment are strained and no immediate help is available...Defensible space can be as simple as a minimum 30-foot (9.14 m) clearing between homes and flammable vegetation or as complex as a greenbelt (or series of fuel breaks) surrounding a planned community" (Bailey 1991).

The concept of defensible space can be incorporated into the treatment of the WUI. Obviously, the intensive zone is a potential defensible space. In high-risk areas there may be need for a more extensive defensible space. While the extensive zone does not necessarily require any universal treatment, and generally would not require any drastic thinning, the area should be assessed for patches of high fire-risk, and the entire area could undergo light thinning to allow the reintroduction of prescribed fire. Prescribed fire could then be used to maintain lowered fire potential in the area.

As the WUI extends further from the houses and the edge of the community, the treatment will need to balance other objectives, such as ecosystem health and wildlife habitat. In a May, 2000 letter to Senator Bingaman, Forest Service Chief Dombeck stated, "Our objective would be to leave forested areas in the interface in a range of stand densities that more fully represent healthy forest conditions." Dombeck also stated the need for a 12-inch diameter cutting cap within the WUI treatments. That is, no tree with a diameter larger than 12-inches should be cut in the treatment of the WUI. This is especially appropriate within the ponderosa pine ecosystem where larger trees have shown a greater resistance to fire. The cap also provides some protection for the forest ecosystems, including protection of forest structure that is critical to wildlife habitat, during the efforts to protect communities from the risk of wildfire.

In summary, the WUI need not be extensively treated to protect communities. The most appropriate treatment for community protection is a significant fuels reduction in the intensive zone within 20 to 200 meters of the community. A light thinning treatment for 1/2 mile into the forest could allow prescribed fire to be utilized to maintain lowered fire potentials. The defensible space created by the treatments can provide a potential fireline around communities and provides firefighters a safe area in which to contain fires. The protection of ecosystems and wildlife habitat must be considered as an integral part of the WUI treatment.

## **Differentiating Between WUI and Wildland Forests**

A secondary concern in protecting communities from forest fires is that the heat rising off a forest fire can carry burning ash and even leaves and branches called firebrands that can ignite fires far from the front. These "lead fires" can start miles ahead of the advancing flames, but usually start within a half-mile of the flame front. Undoubtedly,

this is a danger for houses in the WUI, but the eradication of forest fire is not possible or desirable; it is not economically or ecological viable, and does not provide real community protection.

Cohen (2000) stated, "...if the community or home site is not considered in reducing WUI fire losses, extensive fuel reduction will be required. For highly ignitable homes, effective wildland fire actions must not only prevent fires from burning to home sites, but also eliminate firebrands that would ignite the home and adjacent flammable materials. To eliminate firebrands, wildland fuel reductions would have to prevent firebrand production from wildland fires for a distance of several kilometers away from homes." Therefore, the only effective way to protect communities from fires started by firebrands is not to treat into the wildland forest, but to treat the houses and surrounding properties.

"The wildland fuel characteristics beyond the home site have little if any significance to WUI home fire losses... The evidence suggests that wildland fuel reduction for reducing home losses may be inefficient and ineffective. Inefficient because wildland fuel reduction for several hundred meters or more around homes is greater than necessary for reducing ignitions from flames. Ineffective because it does not sufficiently reduce firebrand ignitions" (Cohen 1999). This is not to suggest that wildlands treatments have no effect on fire behavior. Such treatments can reduce the potential of severe wildfire in the wildland forest. However, they can not eliminate the risk of wildfire under extreme conditions, and they do not provide community protection from wildfire.

Although efforts to reduce the effects of wildfire beyond the homesite do not provide protection for houses and communities, there are other considerations in managing the areas adjacent to communities. For example, Cohen (1999) states, "... a WUI area could be a high priority for extensive vegetation management due to high aesthetic, watershed, erosion, or other values, but not for reducing potential home fire losses."

The Forest Service's Cohesive Strategy (2000) states that "The focus of this strategy is on restoring ecosystems that evolved with frequently occurring, low intensity fires" and lists its two top priorities as "wildland-urban interface" and "readily accessible municipal watersheds". However, the protection of the communities and their watersheds neither requires the "restoration" of ecosystems on a landscape scale nor necessarily benefits from such "restoration".

The restoration of natural ecosystem processes, such as frequent fire, hydrologic cycles, nutrient cycles, and competition, is an important part of managing the forests. However, the majority of the forest is not directly adjacent to communities, and restoration projects throughout the wildland forest do not protect houses and communities. While projects that directly protect houses and communities have a relative urgency, restoration work in the wildland forest should proceed under the rule of the precautionary principle. Projects within the wildland forest need to proceed cautiously, taking care to cause the minimum damage to the ecosystem while moving the forest toward a condition in which ecosystem processes can function naturally.

Some fire studies have analyzed treatments designed to prevent forests from initiating or sustaining wildfire in even the most extreme circumstances. However, using gust wind speed and extreme conditions to model the effects of fire and determining the treatments needed to protect against that fire lead to the same extreme thinning as would be needed to treat areas so that they are "fire-proof" in severe drought years. Such a severely thinned forest can itself be more fire-prone, due to large amounts of logging slash and raised soil temperatures. There may be extreme levels of soil compaction due to logging operations, leading to an explosion of exotic species and lower levels of understory vegetation. There may be serious impacts on wildlife habitat, due to the extreme change in forest structure.

Community protection from wildfire should not be used as a justification for restoration projects in the wildland forest. The wildland forest does not need to be restored to protect communities from fire, and restoration projects in the wildland forest do not

protect communities from wildfire. Restoration of the wildland forests should be strictly based on ecological needs, and the desire to reduce the intensity of wildfires in the wildland forest. Furthermore, restoration projects should not rely on WUI appropriations for support and funding.

## **Responsibility**

The discussion about the WUI includes the issue of responsibility, specifically the question of who is responsible for protecting private property from the threat of wildfire. "The interface fire problem is not just the responsibility of land managers. Many other groups must share responsibility for solving the problem—fire protection agencies; homeowners; local and regional planners and governing bodies; builders, contractors, and building and landscape architects; and insurance carriers and mortgage bankers" (Davis 1990).

The rhetoric of the past year has included numerous references to the responsibilities of other parties involved in the WUI issue. For example, the Forest Service's Cohesive Strategy 2000 stated, "No forest can be made fireproof. As homes and communities are built in the wildland interface, they face added risk of fire. Efforts to reduce hazardous fuels on federal lands must be coupled with efforts to assist private landowners to take preventative action in their own communities." However, the hundreds of millions of dollars appropriated for federal projects and the scale of many of the projects being considered testify to the willingness of the federal government to take responsibility for the protection of communities.

The federal projects can provide no community protection unless the individual homeowners protect their private properties and houses. Mary Jo Lavin, national director of Fire and Aviation Management for the U.S. Forest Service (1997) wrote, "W-UI residential fire safety can be improved, but only when individual residents take action will the risk of wildland fire be reduced. Homeowners must take primary responsibility for the survival of their homes from fire..." This is restated in the "Urban Wildland Interface Communities" notice, "Private landowners may help reduce this risk [of wildfire] by creating defensible space around their homes and businesses, and by using fire-resistant materials in building those structures. Without such precautionary measures, fuel reduction on Federal land in the vicinity may be ineffective in significantly reducing community risk."

Homeowners need to be responsible for their own property. Since the only effective home protection is treatment in, on, and around the house, homeowners must be responsible for protecting that property. At the same time, local communities must take responsibility for managing growth and development that extends into the surrounding forest. Local governments need to require developers to protect the new houses and require landowners to treat their own properties. On the other hand, the federal government is primarily responsible only for WUI projects that involve federal lands directly adjacent to private residences. In such projects, federal agencies should be able to supply funding and land management, and encourage cooperative efforts among federal and local agencies, and private landowners.

The cooperation of individuals, local governments, and federal agencies is important to coordinate the efforts of the various parties and support the efforts of each. It should not, however, be a device by which local governments and individuals rely on federally funded projects to provide wildfire protection. Currently, many communities are relying on the federal appropriations and huge projects to provide the protection. Unfortunately, this could lead to spending a huge amount of time, effort, and money, without providing adequate protection for communities. It also produces little incentive for communities to change their current plans for expansion and development into the surrounding forests.

Lavin (1997) wrote, "Possible assistance from federal wildland protection agencies includes: identification of high-hazard areas; fuel modification and reduction;

prevention of unwanted fires; firefighter training; and public awareness and education." She added that "The involvement of insurance companies is an often overlooked, but critical, element... [The] insurance industry can provide these homeowners with incentives for building with firewise materials and for reducing risks around their properties...". Without such incentives, or federal requirements, communities at risk of wildfire may have difficulty persuading individuals to spend the money to treat their properties.

In summary, it is ultimately the responsibility of the private landowner to protect his/her own house and property. It is the responsibility of the local government to manage the development of the community to be responsive to the dangers of wildfire, and to assist the private landowner in protecting private property. The federal government is responsible only for projects on public lands directly adjacent to private properties, and for providing education, assistance, and expertise to local communities.

## **Conclusions**

The Bureau of Land Management and U.S. Forest Service, as well as counties and local governments are currently proposing projects to utilize the funding appropriated for the 2001 fiscal year for WUI projects. In an apparent rush to capture funding, government agencies are proposing some projects that have previously been through the NEPA process as timber sales. However, many of these projects are not true WUI projects and do not protect communities from forest fire.

Forest Service Chief Dombeck (2000) wrote, "If emergency funds were available, we would limit their use to the urban-wildland interface or within designated municipal watersheds that are determined to be at higher risk of unnaturally occurring catastrophic fire. Our activities would focus on the least controversial areas by concentrating on restoring fire-dependent ecosystems and reducing fire risks adjacent to wildland urban interface." This does not describe many of the currently proposed projects outside the true WUI.

The Bureau of Land Management and U.S. Forest Service should be using the "Preliminary Criteria for Evaluating Risk to Communities" provided by the USDA/USDI "Urban Wildland Interface Communities" notice to set priorities for WUI projects. These criteria were Fire Behavior Potential, including forest fuels, slope, wind exposure, and fire history; Values At Risk, such as population density, community watersheds, and potential for economic loss; and Infrastructure, which refers to the condition of roads and water supplies available to firefighters. Unfortunately, these criteria ignore the actual ignition potential of the at-risk houses, as is determined by the treatment of individual houses and properties. Such a criterion was proposed by Bailey (1991), which would provide further guidance as to the extent of treatment that should be implemented on a site-to-site basis, and not just on a project basis.

Since the wildfire risk to houses depends primarily on the structure itself and its immediate vicinity, the primary responsibility lies with the homeowner. However, it is in the best interest of the community to work in cooperation with homeowners and federal agencies to coordinate the treatment of individual properties with larger WUI fuels reduction treatments.

Many proposed projects ignore the most important factor in protecting houses from wildfire: the treatment of the area directly surrounding the structure, specifically a radius up to 60 meters (200 feet). This area need not be cleared or clearcut, but must be treated to minimize the accumulation of flammable materials and remove any materials directly touching the house. Appropriate treatment includes using fire-resistant materials in the building of houses, especially roofs; removing flammable materials such as firewood and woody debris from directly adjacent to the house; thinning dense groups of trees within 60 meters (200 feet) of the house; pruning lower limbs from trees near the house; mowing grasses, raking needle litter, and pruning ornamental shrubs; and cleaning roofs and gutters of dead branches, leaves, and needles.

Forest treatment beyond the immediate area surrounding houses has little effect on community protection from wildfire. However, an intensive zone of 200 meters (660 feet) around communities can provide a defensible space and a potential fireline for firefighters. Treatment of this buffer should require the removal of ladder fuels and general fuels reductions. The surrounding forest 1/2 mile from the edge of the community should be assessed and, if needed, treated for fuels reduction.

Now that there is a clear idea of what the WUI is and how to treat it, the U.S. Forest Service and Bureau of Land Management need to propose projects that directly address the protection of WUI communities. These are projects that provide real wildfire protection for communities through treatment of houses and properties, and fuels reductions directly adjacent to communities.

## Literature Cited

- Agee, J. K. 1996. The influence of forest structure on fire behavior. Presented at the 17th Annual Forest Vegetation Management Conference. Redding, CA. January 16-18, 1996.
- Agee, J.K., B.Bahro, M.A. Finney, P.N. Omni, D.B. Sapsis, C.N. Skinner, J.W. van Wagtendonk, and C.P. Weatherspoon. 2000. The use of shaded fuelbreaks in landscape fire management. *Forest Ecology and Management* 127:55-66.
- Bailey, Dan W. 1991. The wildland-urban interface: social and political implications in the 1990's. *Fire Management Notes* 52(1): 11-18.
- Ball, John. 1997. On the urban edge. *Journal of Forestry* 95(10): 6-10.
- Butler, C.P. 1974. The urban/wildland interface. In: Proceedings of western states section of the Combustion Institute papers, vol. 74, no. 15; May 6-7, 1974; Spokane, WA. Pullman, WA: Washington State University; 1-17.
- Clark, Lee, and Kathryn D. Hardy. 1997. 1996 Alaskan wildland-urban interface fire-a catalyst for public involvement. *Fire Management Notes* 57(4): 7-9.
- Cohen, Jack D. 1999. Reducing the wildland fire threat to homes: where and how much? Draft of paper presented at the Fire economics, policy and planning: bottom line symposium, April 5-9, 1999, San Diego, CA.
- Cohen, Jack D. 2000. Preventing disaster: home ignitability in the wildland-urban interface. *Journal of Forestry* 98(3):15-21.
- Cohen, Jack, and Jim Saveland. Structure ignition assessment can help reduce fire damages in the W-UI. *Fire Management Notes* 57(4): 19-23.
- Davis, James B. 1990. The wildland-urban interface: paradise or battleground?. *Journal of Forestry* 88(1):26-31.
- Dombeck, Michael. U.S. Forest Service chief, United States Department of Agriculture. May 23, 2000. Letter to New Mexico Senator Jeff Bingaman.
- Flagstaff Fire Department. 2000. Flagstaff fuel management. Packet released by the Flagstaff Fire Department.
- Gorte, Ross W. 1995. Forest fires and forest health. Congressional Research Service, report for Congress. Testimony of Ross W. Gorte, specialist in natural resources policy, Environment and Natural Resources Policy Division. 95-511 ENR. Updated July 14, 1995.
- Graham, R.T., A.E. Harvey, T.B. Jain, and J.R. Tonn. 1999. The effects of thinning and similar stand treatments on fire behavior in western forests. USDA Forest Service General technical Report PNW-GTR-463, Pacific Northwest Research Station, Portland OR.
- Grand Canyon Forests Partnership. March, 2000. Flagstaff Area Fire Risk Assessment: A collaborative effort in cooperation with the Ponderosa Fire Advisory Council.
- Grand Canyon Forests Partnership. July, 2000. Flagstaff Urban Interface Restoration Strategy: A framework for restoring forest health-DRAFT. This was written by Gerritsma, and will not be finalized any time soon.

- Helms, James A. 1979. Positive effects of prescribed burning on wildfire intensities. *Fire Management Notes* 40:10-13.
- Hill, Barry T. 1999. Western National Forests: Nearby communities are increasingly threatened by catastrophic wildfires. US General Accounting Office. Testimony before the Subcommittee on Forests and Forest Health, Committee on Resources, House of Representatives. Statement of Barry T. Hill, Associate Director, Energy, Resources, and Science Issues, Resources, Community, and Economic Development Division. February 9, 1999.
- Johnson, Edward. Personal communication August 4, 2000. Silviculturalist, Kaibab National Forest.
- Lavin, Mary Jo. 1997. Managing fire risk to people, structures, and the environment. *Fire Management Notes* 57(4): 4-6.
- Plevel, Steve R. 1997. Fire policy at the wildland-urban interface: a local responsibility. *Journal of Forestry* 95(10): 12-17.
- Rains, Michael T. 2000. Statement of Michael T. Rains, Area Director, Northeastern Area State and Private Forestry, Forest Service, United States Department of Agriculture Oversight Hearing concerning the Cerro Grande Fire and general fire policy before the Committee on Energy and Natural Resources, United States Senate, July 27, 2000.
- Sackett, S.S., S.M. Haase, and M.G. Harrington. 1996. Lessons learned from fire use for restoring southwestern ponderosa pine ecosystems. Pages 53-60 in Covington, W., and P.K. Wagner (tech. Coords.), Conference on adaptive ecosystems restoration and management: restoration of cordilleran conifer landscapes of North America. USDA Forest Service General Technical Report RM-GTR-278, Rocky Mountain Research Station, Fort Collins, CO.
- Scott, J.H. 1998. Fuel reduction in residential and scenic forests: a comparison of three treatments in a western Montana ponderosa pine stand. USDA Forest Service Research Paper RMRS-RP-5, Ogden, UT: Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Slack, Peter. Firewise construction design and materials. Colorado State Forest Service
- USDA Forest Service. 2000. Environmental assessment for the implementation of a wildland fire use program within the Kaibab National Forest.
- USDA Forest Service. 2000. Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy.
- USDA Forest Service project records. Coconino National Forest: Skunk Hollow, FLEA, FR237; Kaibab National Forest: Spring Valley EA (Precommercial thin), Dry Park EA, Sherwood Forest (Frenchy), Tusayan.
- United States Department of Interior and United States Department of Agriculture. September 8, 2000. The National Fire Plan. Managing the Impact of Wildfires on Communities and the Environment: a Report to the President in Response to the Wildfires of 2000.
- United States Department of Interior and United States Department of Agriculture. 2001. Urban Wildland Interface Communities Within the Vicinity of Federal Lands that are at High Risk from Wildfire. *Federal Register*, January 4, 2001. Page 751-777.
- Van Wagner, C.E. 1977. Conditions for the start and spread of crown fire. *Canadian Journal of Fire Research*. 7(1): 23-24