WILDFIRE MITIGATION IN FLORIDA

Land use planning strategies and best development practices

FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS • FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

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Table of contents

This guide is a manual for communities at risk of wildland fire. Wildfires have struck every county in Florida in recent years. As more people move to Florida and development expands into areas of natural vegetation, we are likely to see even more wildfires in areas with human development. Although most homes are not in high-risk areas, all Floridians can be impacted by the smoke, highway closures, and economic impacts of wildfire. Elected officials, planners, architects, landscapers, developers, and other community stakeholders have a huge role to play in protecting Florida homes and communities from the effects of wildfire.

There are many ways to reduce the risk of wildfire. This guide identifies a number of wildfire mitigation strategies that communities have found helpful. Case studies, diagrams, and photographs are included to illustrate points made in each chapter. There is a glossary and list of resources at the end of the guide.

CHAPTER 1: FIRE ECOLOGY AND WILDFIRE MITIGATION IN FLORIDA

Chapter 1 provides an introduction to the natural role and behavior of fire in Florida's ecosystems, the threat of wildfire, and Florida's wildfire response system. This chapter then goes on to introduce the concept of the wildland-urban interface and to discuss the issues surrounding wildfire in the wildland-urban interface, including population growth pressures and assessing the level of risk from the wildfire hazard. The chapter concludes with a summary of what can be done about the wildfire problem, including an overview of fuel management activities and wildfire mitigation strategies. This chapter will be of interest to all readers.

CHAPTER 2: COMMUNITY PLANNING TO REDUCE WILDFIRE RISK

Chapter 2 examines the role of planning in community wildfire mitigation efforts. Planning strategies are discussed, including cooperative strategies, Comprehensive Plan Elements, Local Mitigation Strategies, and other planning approaches. Just as Florida planners examine the potential for flooding and other natural hazards, wildfire risk should also be considered during local strategic planning processes. The chapter discusses opportunities for identifying wildfire risk areas, such as those delineated by the Division of Forestry's Florida Wildfire Risk Assessment System (FRAS), to support planning decisions. This section also introduces the concept of including wildfire protection in local land-use and Comprehensive Plan processes. This material will be useful for local planners, elected officials, emergency professionals, business leaders, and citizens who want to address the wildfire hazard in their communities.

CHAPTER 3: DEVELOPMENT GUIDELINES AND STANDARDS FOR WILDFIRE MITIGATION

Chapter 3 examines the regulatory framework for protecting communities from wildland fire. Guidelines are provided for creating and adopting local wildfire mitigation ordinances to reflect Comprehensive Plan policies. This chapter explores the potential relationships and conflicts between local tree ordinances and wildfire mitigation ordinances. A short model vegetation management ordinance and a longer annotated model wildfire mitigation ordinance are provided for consideration in local communities. The model ordinances are put forth as a menu of options for potential adoption by informed local governments. This material will be of interest to local officials, community leaders, planners, codes enforcement professionals, fire protection professionals, wildland-urban interface land managers, and concerned citizens who have the desire to address the wildfire threat to their communities through regulatory avenues.

CHAPTER 4: NEIGHBORHOOD DESIGN FOR REDUCED WILDFIRE RISK

Chapter 4 brings things to a more practical level, discussing design principles for projects being built in wildfire-prone areas. This chapter

provides details and case studies about wildfire mitigation at the neighborhood and subdivision level, including information about infrastructure design and layout approaches to mitigate wildfire. Best development practices are included for community access, hydrants, roads, signs, and other factors that can support firefighting efforts. Innovative approaches are discussed, such as design and strategic use of perimeter and interior greenspace as wildfire breaks. Chapter 4 also includes information about wildfire hazard assessment for neighborhoods and developments. Developers, landscapers, community designers, and homeowner's associations will be interested in design features that can help to protect neighborhoods from wildfire in Florida.

CHAPTER 5: BUILDING CONSTRUCTION FOR REDUCED WILDFIRE RISK

Chapter 5 discusses the role of building construction practices and materials in wildfire mitigation in the wildland-urban interface. This chapter discusses the Florida Building Code, the Florida Fire Prevention Code, and other pertinent wildfire mitigation standards as they relate to building construction in Florida. Clear guidelines and case studies are provided for fire-resistant building in Florida. A cost-benefit analysis is provided for new construction and for modifying existing buildings for wildfire mitigation. This information will be useful for builders, designers, architects, and local codes enforcement professionals, as well as for homeowners considering building or modifying a home in a wildfire-prone area.

CHAPTER 6: LANDSCAPING FOR WILDFIRE MITIGATION

Chapter 6 focuses on what landscape designers, developers, and homeowners can do to protect wildland-urban interface landscapes from wildfire. Guidelines are provided for assessing wildfire risk and for taking simple actions in the home landscape. A rapid wildfire risk assessment chart is provided. Landscape maintenance actions are outlined according to level of risk, while wildfire reviews and Firewise demonstration houses are presented as examples. For homeowners and landscapers alike, Firewise landscape design and planting specifications are included. Lists of fire-prone and less-flammable plants are provided, and a brief cost-benefit analysis is presented for Firewise landscaping approaches.

READER GUIDE: *Wildfire Mitigation in Florida*

You are a...	Interested in...	Refer to...
General Reader	Learning more about the wildfire problem	Chapter 1
Elected Official	Setting policy for wildfire mitigation Designing regulatory approaches to wildfire mitigation	Chapter 2 Chapter 3
Planner	Planning for wildfire mitigation Planning regulatory approaches to wildfire mitigation Planning for wildfire-resistant developments or subdivisions	Chapter 2 Chapter 3 Chapter 4
Codes Enforcement Official	Regulatory approaches to wildfire mitigation Designing wildfire-resistant developments Features of wildfire-resistant building construction and landscapes	Chapter 3 Chapter 4 Chapters 5, 6
Fire Management Official	Cooperative planning for wildfire mitigation Wildfire risk assessment processes	Chapter 2 Chapters 2, 4, 6
Emergency Professional	Cooperative planning for hazard mitigation	Chapter 2
Architect or Landscape Architect	Designing wildfire-resistant developments Designing wildfire-resistant buildings Designing wildfire-resistant landscapes	Chapter 4 Chapter 5 Chapter 6
Developer or Builder or Landscaper	Designing and building wildfire-resistant developments Building wildfire-resistant structures Installing and maintaining wildfire-resistant landscapes	Chapter 4 Chapter 5 Chapter 6
Business Leader or Community Leader or Concerned Citizen	Community planning for wildfire mitigation	Chapter 2
Landowner or Forest Manager	Managing your land for wildfire mitigation	Chapter 2
Homeowners Association or Neighborhood Group	Making neighborhoods more resistant to wildfire	Chapter 4
Homeowner	Making houses and yards more resistant to wildfire	Chapters 5, 6

CHAPTER ONE

Fire ecology and wildfire mitigation in Florida

1
Fire ecology and wildfire mitigation in Florida

Introduction

THE NATURAL ROLE OF FIRE IN FLORIDA'S ECOSYSTEMS

Fire in natural areas is an important force to which nearly all the types of land ecosystems in North America have adapted. In Florida, fires keep ecosystems dynamic, diverse, and beautiful. In fact, Florida was named after the Spanish *Pascua florida,* which means "flowery Easter," because of the abundance of wildflowers encountered by early explorers.

Fire has been present since the peninsula known as Florida emerged from the sea. Prior to the arrival of humans, weather conditions and fuels determined the occurrence of fires. When the first humans arrived in Florida over 10,000 years ago, their activities provided new ignition sources for fire. Along with periodic natural fires, Native Americans used fire as a tool to shape the environment and to improve hunting. Lightning fires and fires set by early humans helped to maintain natural areas conducive to the growth of herbs, berries, wildflowers, grasses, and low shrubs. Later, when European settlers began colonizing Florida, they remarked upon the open forests and grasslands swept clean by fire.

An *ecosystem* is a complex community of interdependence and competition among trees, shrubs, flowers, grasses, animals, and microbes for soil, minerals, water, nutrients, and air. Because all parts of an ecosystem are interrelated, no one part can change without some effect on the entire system.

As more people moved to Florida in the 19th and 20th Centuries, roads and settlements became barriers to fire's spread across the landscape. Human activities also directly and indirectly altered local fuel levels by excluding fire from natural areas, by leaving behind debris from widespread tree harvesting operations, and by allowing wildland fuels to accumulate to unnaturally high concentrations. Wildland fuels in Florida typically include dead branches, grasses, leaves, and pine needles, as well as living grasses, herbs, and shrubs, such as saw palmetto and gallberry.

In the past, Floridians used fire to improve habitats and to reduce fuels. For example, in the 1800s and early 1900s, Florida cattle ranchers commonly used fire to improve grazing conditions. In the latter half of the 20th Century, prescribed fire was recognized as an important management tool for Florida's natural areas and commercial forests. Even with very aggressive prescribed burning and fuel management programs, however, Floridians have not been able to keep up with the

ECOLOGICAL AND SOCIAL BENEFITS OF FIRE IN THE FLORIDA LANDSCAPE

- Maintains native fire-adapted ecosystems in a healthy condition
- Maintains/improves habitat conditions for fire-adapted plants and animals
- Prevents heavy buildup of fuels and reduces the occurrence and severity of wildfires
- Improves nutritional quality of plants for wild and domestic grazing animals
- Promotes flowering of herbaceous plants and fruit production of woody plants
- Controls some tree diseases
- Adds ash to the soil, thus enhancing nutrient cycling increasing soil pH (reducing acidity)
- Maintains natural species composition in native forests (e.g., reduces the dominance of hardwood trees in pine forests)
- Reduces some weedy and invasive plants and helps to control others
- Reduces some insect pests and increases populations of insects that serve as food for game birds and other wildlife
- Increases visibility in the forest for recreation or hunting
- Creates aesthetically pleasing open forests and scenic vistas

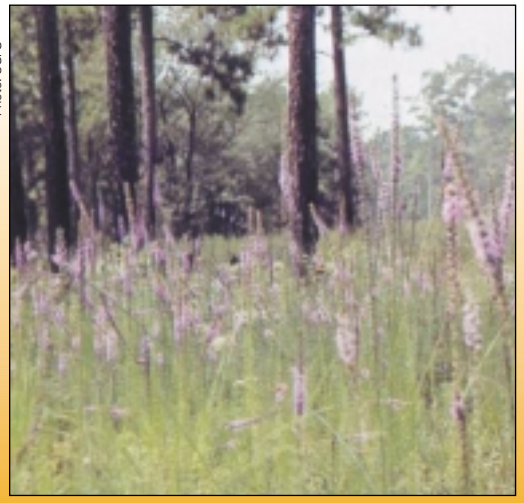


Photo: USFS

A fire-maintained ecosystem

fuel accumulations. The 20th Century closed with several years of large wildfires in Florida. Many homes were burned or damaged and many acres of timber were burned.

As a result of the accumulation of wildland fuels, Florida's natural areas and forests present a potential wildfire hazard that will continue to escalate in the 21st Century as development presses into wildland areas. There is a great need for clear, decisive "best development practices" to address wildfire protection and hazard mitigation in areas where development meets wildlands. This chapter will provide background information on the role of fire in Florida's ecosystems, the wildfire problem in the wildland-urban interface, and current wildfire mitigation practices in Florida.

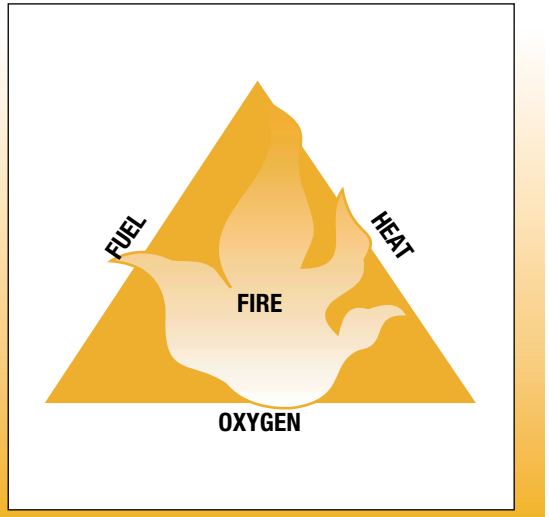
ECONOMIC AND SOCIAL IMPACTS OF FIRE IN THE FLORIDA LANDSCAPE

- Contributes to temporarily reduced air quality
- Contributes to smoke-fog conditions on low-lying highways, possibly contributing to motor vehicle accidents
- Contributes to the spread of some weedy and invasive plants in newly burned areas
- Can escape control if conditions unexpectedly change
- Causes damage to commercial pulp or timber forests and human property if it is uncontrolled
- May injure or kill some individual animals, although animal populations as a whole usually benefit from fire
- Creates a temporarily degraded (charred) landscape

FIRE'S THREE ESSENTIAL COMPONENTS

Fire is a self-propagating chemical reaction known as combustion. It can be defined as rapid oxidation of a material accompanied by the release of energy in the form of heat and light. The fire triangle illustrates that oxygen, heat, and fuel are necessary to create and sustain a fire. A fire cannot be maintained if any one of these three components is removed. If one or more of these components is reduced, fire becomes easier to prevent or suppress.

Oxygen is on one side of the fire triangle. Air supporting a fire must be at least 16 percent oxygen. The air in Earth's atmosphere contains about 21 percent oxygen. Smothering a fire can reduce the oxygen available for combustion. Small fires can be smothered with a fire flap tool or with a shovelful of sand, but larger fires are difficult to smother. Removal of the oxygen side of the fire triangle is impossible in large wildfires.



Heat is a second component of the fire triangle. Heat and temperature are closely related. Heat is the energy of molecules that have been excited into faster motion, while temperature is a measure of the magnitude of this molecular activity. Because temperature is a measure, it can be low or high (cold or warm). In order for ignition to occur, plant material must be heated to the point where volatile compounds escape in sufficient amounts to allow combustion, or about 655 +/- 72° F. (346 +/- 40° C.). The heat necessary to ignite a fire can come from many different sources, including human carelessness and lightning.

Fuel is the third side of the fire triangle. Fuel is any material capable of burning. In Florida, typical wildland fuels include litter (e.g., pine straw, dead leaves, twigs), grasses (e.g., wiregrass, cogon grass), shrubs (e.g., saw palmetto, gallberry), and trees (e.g., pine trees). Thus, the fuels in a Florida forest would include dried and dead materials, such as branches, grasses, leaves, and pine needles, as well as living grasses and shrubs, such as palmetto and gallberry and young pines. Many fire-adapted plants in Florida contain volatile resins that encourage fire's spread through the ecosystem. Human structures can also become fuel for fire. It is important to understand that fire does not discriminate between different types of fuels; fire will burn any available combustible material in its path.

1
Fire ecology and wildfire mitigation in Florida

The fire triangle can help us to understand how to prevent or suppress wildfires. For example, sources of heat/ignition like lightning, human carelessness, and arson are impossible to completely eliminate. Once ignition has occurred, heat can be reduced by adding water or fire retardant, but it is difficult to reduce the heat in a large wildfire.

In fact, two of the components of the fire triangle – oxygen and heat/ignition – are difficult to manage. Although fire prevention programs can be effective in reducing the number of ignitions, it is impossible to prevent ignition of all fires in Florida. Oxygen is part of the Earth's atmosphere and so is present whenever a wildfire burns. The weather that influences wildfire also is beyond human control.

Fire Behavior

Once a fire has started, weather, fuel type, and topography are the three major factors that shape fire behavior. Weather is perhaps the most important of these in Florida. Weather provides air to a fire through wind, influences the heat of a fire through air temperature, and affects the combustibility of fuels through patterns of humidity and rainfall.

It is clear that humans can have a significant influence on only the fuel side of the fire triangle. Therefore, managing fuel is the foremost strategy in protecting homes and forests from wildfires. In one survey, nearly 83 percent of fire managers identified the need for fuels reduction as the top priority for improving safety (cited in President Bush's *Healthy Forests Initiative,* 2002).

It is important to understand that fuel reduction does not mean eliminating forests, but rather managing them to be less likely to sustain a catastrophic wildfire. Fire behavior experts report that surface-level fuels (litters, grasses, and shrubs, but not trees) primarily feed wildfire. When surface-level fuels are reduced or removed, wildfires become easier to suppress. USDA Forest Service research (e.g., Cohen 2000b, Cohen 1999) has concluded that managing surface-level vegetation within the immediate vicinity of homes is the best approach to preventing the vast majority of structural wildfire losses in the wildland-urban interface.

There is an assortment of methods for fuel management, including prescribed fire, mechanical treatments (e.g., mowing, chopping), herbicides, biomass removal (e.g., pine straw harvesting, tree thinning, vegetation clearing), and grazing. The methods have varying benefits, costs, and levels of public acceptance. Most land managers agree that prescribed fire is the more economically and ecologically beneficial of the fuel reduction methods, despite issues with public perception and acceptance, public safety (smoke), and limitations of trained personnel and money. This guide will include information about the full range of fuel management choices.

Fuel loads are the small trees, bushes and other undergrowth in forests that, if built up over time, cause wildfires to burn faster and bigger. Weather cannot be controlled, but most fire experts agree that the dangerously high fuel-load levels in U.S. forests are a result of misguided forest-fire policy – a policy that has been in place for nearly a century. Forest managers for decades strived to put out every forest fire that developed. This method prevents the natural thinning of undergrowth that comes from regular, low-intensity fires. Forests with built-up undergrowth are ideal breeding grounds for high-intensity, high-speed fires. Although the "fight all fires" policy has ended, decades of built-up brush remain. (American Red Cross, 2002)

FLORIDA FIRE BEHAVIOR

Fuels for fire in Florida are the various dead and living materials in the natural environment that will burn. This includes dead pine needles, grasses, twigs, branches, and leaves, as well as live green vegetation, such as palmettos, gallberry, wiregrass, small pine trees, cabbage palms, and other shrubs and trees. These natural fuels are collectively called "wildland fuels." From the perspective of fire, fuels also include human constructions in the path of a wildfire, such as houses, outbuildings, decks, landscaping, woodpiles, wood fences, propane tanks, and other structures and storage facilities.

Fire behavior includes phenomena such as the way fuels ignite, the way flames develop, the intensity of the fire, and the way fire spreads across the landscape. The three main factors that influence fire behavior are weather, topography, and fuels.

Weather

Weather is the most variable influence on fire behavior, because it changes from season to season, day to day, and hour to hour. There are also longer weather cycles that influence fire

THREE TYPES OF WILDLAND FIRE IN FLORIDA

- **Surface Fire** burns in the surface fuel layer, above the surface of the soil but below the tree canopy. Surface fuels include everything from pine needles and twigs to shrubs and small trees up to 10 feet tall. The behavior of surface fire varies widely depending on the nature of the fuels.
- **Crown** or **Canopy Fire** burns in the aerial fuels in the tops of trees, which includes living and dead foliage, branches, twigs, lichens, and wood. An active crown fire involves the entire canopy of a forest, usually is supported by the heat generated by burning surface fuels, and is characterized by a solid wall of flame extending from the ground to above the treetops. Living canopy fuels usually have a higher moisture content and lower density than other fuels, and so are somewhat less likely to burn unless fire is channeled to the canopy by excessive heat from a surface fire or by "ladder fuels." Once a fire gets into the canopy, it becomes difficult to suppress, influenced by the wind, and likely to cause greater and longer-lasting damage. Crown fires are a greater threat to firefighter safety and to property.
- **Ground Fire** burns below the surface of the ground in dried fuels such as duff, muck, roots, logs, or peat. Because underground fuels are denser than surface or canopy fuels, they burn more slowly, but may also burn at higher relative moisture content. A ground fire can injure roots of trees and shrubs. Ground fires frequently are ignited by surface fires in dry swamps or marshes. Ground fires may burn for days, weeks, or months, causing surface-collapse hazards for firefighters and smoke problems on highways.

Photo: FDCA

Surface fire

Photo: FDOF

Crown fire

Photo: FDCA

Ground fire

behavior, such as the El Niño/La Niña Southern Oscillation (ENSO), which produces long-term cycles of wet and dry weather. For more details, see the discussion of weather effects and the Keetch-Byram Drought Index in the prescribed fire section of Chapter 2.

The elements of weather that have a direct effect on fire behavior include:

- Temperature;
- Relative humidity;
- Atmospheric stability/dispersion;
- Wind speed and direction;
- Precipitation (rain).

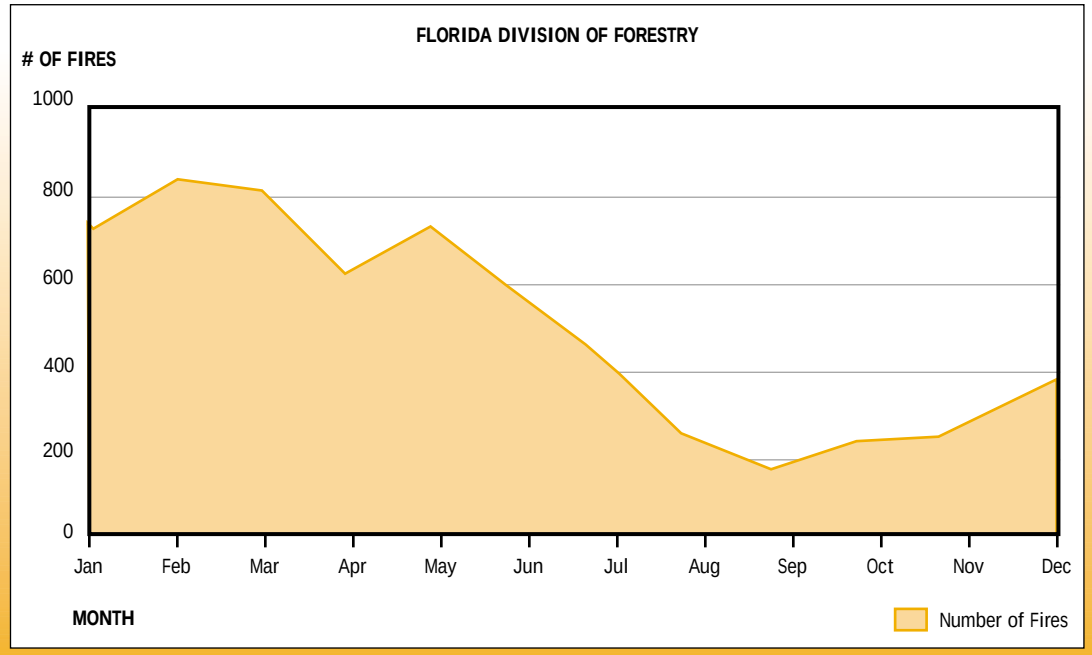
High temperatures, low relative humidity, atmospheric instability, and strong winds create the conditions necessary for disastrous wildfires.

1
Fire ecology and wildfire mitigation in Florida

Highest wildfire danger occurs during periods of low humidity combined with high temperatures, during extended droughts, and sometimes after the passage of dry weather fronts. Florida Division of Forestry (FDOF) data (1981-2002) indicates that the largest numbers of wildfires occur in January, February, and March, and the most acreage burns in wildfires in May and June. Late winter and spring bring dry weather, thus the most active part of Florida's fire season extends from December to June. Of course, Florida's fire season may vary under drought or other extenuating conditions. The FDOF emphasizes that Florida has a 12-month fire season, and that wildfires can occur whenever two weeks go by without rain in Florida.

Wind direction is an important factor in Florida wildfire. Prevailing winds determine in which direction and how fast a fire spreads. Winds in Florida often are related to the coast, with onshore winds during days when the land is warmed causing upward air currents, and offshore winds during the night when the water gives off stored warmth to the atmosphere. The "cape effect," discussed below, is a variation of the effects of coastline air movement on fire.

Wind speed and direction are even more important variables in fire behavior in the wild-land-urban interface because of the wind-channeling effects of buildings, land cover, and street layout. Because topography is not very significant in Florida, the built environment has an even more pronounced effect on air movement. Tree-lined streets, berms, and narrow spaces between buildings can act as wind channels, changing wind direction as much as 90 degrees from ambient, and causing eddies, vortices, and fire flare-ups due to increased wind speeds.



Average Number of Wildfires by Month, 1981-2002

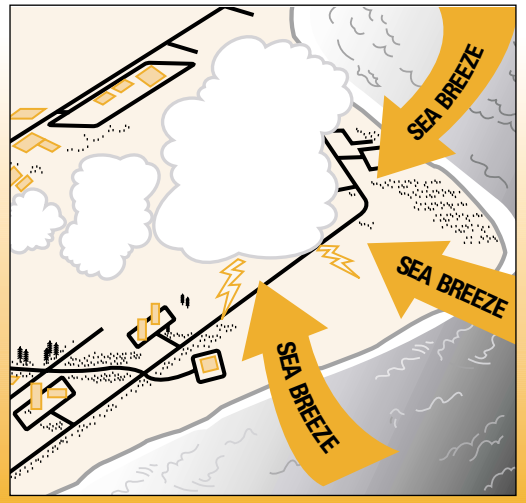
Topography

Topography is the unchanging factor influencing fire behavior. It is also the least important factor in Florida, because of the generally flat layout of the land. Topographical features that generally influence fire behavior include elevation, position on slope, aspect, steepness of slope, and shape of the country.

Of these factors, a shape of the country effect known as the "cape effect" has the most significant impact in Florida. An example of the cape effect is when a point of land receives incoming breezes from water on all sides, due to upward-moving convection currents over the land. These onshore breezes are enhanced in Florida in spring and summer months by the strong solar warming of the land. The area of convergence experiences atmospheric instability (high dispersion rates) and frequent thunderstorms, weather which contributes to extreme fire behavior. This effect can happen on capes (e.g., Canaveral, Apalachicola) or on a landmass

between two large water bodies (e.g., between Lake Okeechobee and the Atlantic coast, between Tampa Bay and the Gulf of Mexico, on a barrier island). Thinking on a broader scale, the cape effect influences the weather and fire behavior over the entire state because the peninsula lies between the Gulf of Mexico and the Atlantic Ocean.

The other way that topography influences Florida fire behavior is in how the landscape holds water with only minor depressions in elevation. In wet seasons, Florida's swamps, lakes, creeks, rivers, canals, and ponds act as natural firebreaks, slowing or preventing the spread of fires. These same features, however, may be obstacles to access for firefighting equipment. In dry years, organic matter in these basins may become fuel for ground fires.



The Cape Effect

CASE STUDY: FIRE BEHAVIOR IN THE 1998 FLORIDA WILDFIRES

The Florida wildfires of 1998 provide a vivid illustration of fire behavior factors at work. One of the strongest El Niño events ever recorded caused record rainfall across Florida during the winter of 1997-1998, causing flooding and rampant growth of vegetation. There also were hard freezes during the winter, causing an increase in the proportion of dead vegetative fuels in north and central Florida.

Drought conditions associated with the rebound La Niña cycle began in late March 1998 and continued through July, combined with a record heat wave during May and June of 1998. The first fires began in late April and May in north Florida, and numerous wildland-urban interface fires were burning in early June. From June 19-22 and again from June 30-July 2, 1998, more than 80 new wildfires were starting each day, the vast majority of them caused by dry lightning. The Keetch-Byram Drought Index (on a scale of 0 to 800) reached a peak statewide average of 725 and was over 750 in much of north and central Florida in late June and early July.

The combination of heavy living and dead fuels with accumulated fuels from years past led to several months of widespread, damaging wildfires, especially in Flagler, St. Johns, Volusia, and Brevard Counties. In the six weeks from June 1 to July 22, a total of eight fire complexes burned in north and central Florida, with a total of 2,282 new wildfires started and 499,477 acres burned. With firefighters from all over the country, the 1998 Florida wildfires may have been the largest wildland-urban interface wildfire campaign in U.S. history.

(Report of the Governor's Wildfire Response and Mitigation Review Committee, 1998)

Fuels

Fuels are perhaps the most important factor determining fire behavior in Florida. Florida's long growing season, ample sunshine, and high annual rainfall produce large amounts of vegetative fuels each year. Several features of fuels directly influence fire behavior, including:

- Fuel loading (quantity of fuel);
- Size and shape of fuel (finer fuels present more surface area for contact with oxygen, thus increasing the likelihood of ignition);
- Compactness of fuel (more open fuels present more contact with oxygen);
- Horizontal continuity of fuels (fire spreads in continuous fuels);
- Vertical continuity of fuels (ladder fuels can channel fire from the surface to the crowns of trees – ladder fuels include vines, low hanging branches, or a high understory layer of shrubs and small trees);
- Chemical content of fuels (some Florida plants, such as young pine trees, saw palmettos, gallberry, and cogon grass, contain volatile oils or resins).

Fuel moisture and fuel temperature also influence fire behavior, and can vary with the time

of day and with weather changes. For example, fuel moisture is closely related to relative humidity and precipitation levels, as well as to long-term wet and dry climatic cycles. In general, drying of surface vegetation and fuels contributes to increased wildfire risk in the afternoon of any Florida day, particularly during the months of December to June.

The proportion of living and dead fuels is another factor influencing fire behavior. This factor varies across seasons and years, depending on favorable weather for growth of living vegetation, and freezing weather, which increases levels of dead vegetation. A higher-than-normal ratio of dead to live vegetation, such as after an extended drought or after a hard freeze in north Florida, increases the heat output and severity of wildfires (FDOF 1989). This effect contributed to the behavior of the catastrophic 1998 wildfires in Florida.

Some human activities in the wildland-urban interface may also influence fuels in Florida wildlands:

- Buildup of fuels due in part to exclusion of fire and due in part to a discrepancy between the number of acres treated and the number of acres that need to be treated with prescribed fire each year. Although Florida treats more acres each year with prescribed fire than all other states combined, there is still a backlog of acres that need to be burned. In the past, natural fire cycles reduced accumulated fuels and resulted in less-intense surface fires;
- Overabundance of fuels in very dense pine plantations;
- Availability of fuels in wetlands dried by drainage or development projects;
- Proximity of human-constructed fuels (landscapes, buildings) to fire-prone wildland fuels;
- Careless or intentional human activities that lead to ignition of wildland fuels.

The vast majority of wildfires in Florida are surface fires. If a fire does burn as a crown fire, it is almost always supported by excessive surface fuels and channeled upward by ladder fuels. It is rare for a wildfire to burn only in the crowns of the trees without the support of surface fuels. Similarly, sub-surface ground fires usually begin with a surface fire that burns down into and smolders in organic sediments. Because surface fires are the root cause of the more dangerous canopy and ground fires, it makes sense that the reduction of surface-level fuels is the most important action to reduce the wildfire threat in the wildland-urban interface.

CASE STUDY: BENEFITS OF PRESCRIBED FIRE IN SLOWING WILDFIRE

The case of the Waldo wildfire of 1998 is one example of the value of prescribed fire in removing the fuels that feed wildfire. A large, uncontrolled wildfire was headed for the small rural town of Waldo in north Florida. Residents of Waldo had been evacuated, because their forested homes were at danger of being burned. The wildfire was burning in heavy surface fuels and in the crowns of densely planted pine trees. The wildfire had jumped a power line right-of-way, which was the last control line before the fire reached the town.

A FDOF pilot was flying overhead to guide firefighting efforts when the smoke suddenly cleared and the pilot reported a clear sky. When the head of the Waldo wildfire reached Mr. Clark Smith's 40-acre pine timber plantation, the wildfire split into two smaller parts that were more easily controlled. The portion of the fire that burned through Mr. Smith's property had flames only a few feet tall. Although Mr. Smith's mature trees are planted with their crowns touching, he had used prescribed fire on a regular basis to keep surface fuels to a minimum. There was not enough surface fuel to maintain the crown fire, and so the wildfire became a low-level surface fire on Mr. Smith's property. As a result, Waldo was spared and only one outbuilding was lost in the 7,000-acre fire.

"Most of us thought we had lost the town of Waldo," said Don West, FDOF Waccasassa District Manager who was at the Waldo fire, *"but when the fire hit Mr. Smith's property we were able to stop it because the fire came back down out of the crown where we could deal with it."*

FLORIDA'S FIRE-ADAPTED ECOSYSTEMS

Fire and water are among the primary forces shaping Florida's landscape. The Florida peninsula was alternately flooded and exposed many times over the eons. As Florida's climate changed over time, compositions of plant and animal species changed. Before pine forests dominated Florida, there was a time when Florida's forests were mostly oak and fire was less common.

For at least 12,000 years, Florida has been predominated by pine forests with periodic fire across much of the landscape. Florida's pine forests owe their form and structure to this long shared history with periodic fire. The long-term association of plant and animal species with fire leads to the development of adaptations, special plant and animal traits for survival of fire. Species lacking these adaptations to fire were gradually eliminated from frequently burned areas and were confined to areas where fires were less likely to occur, such as moist hammocks, river bottoms, or coastal zones.

Some of Florida's species provide clear examples of adaptations to fire. For example, southern pine trees have thick bark that insulates the inner, living tissues from fire's heat. Longleaf pine is so fire resistant that mature trees usually escape the injurious effects of low-level fire and become seed trees for the reforestation of new openings in the burned area. The Ocala sand pine exhibits another adaptation for coping with fire: the "serotinous" cones remain closed until a fire's intense heat opens the cones and allows the seeds to fall on fresh soil exposed by the passing fire. Seeds of many plants grow best under the conditions created by fire – exposed mineral soil, increased nutrients

Photo: SFWMD

Flatwoods ecosystem

Photo: FDEP

Sandhill ecosystem

Photo: FDOF

Sand pine scrub ecosystem

Photo: FDCA

Marsh ecosystem

provided by ash, and open areas with plenty of sunlight. In contrast, species less adapted to fire such as oaks, gums, and bays, prefer partial shade and plenty of soil moisture to sprout.

In order to understand fire behavior in Florida's wildlands, it is helpful to understand the different natural communities that exist in Florida. The natural community, or ecosystem, that exists on a site is very much determined by type of soil, amount of water present, and fire frequency. Therefore, the ecosystem that is present on a piece of land indicates a certain fire pattern for that property.

It is beneficial for Florida residents to understand the typical fire pattern for their area. For example, knowing that flatwoods ecosystems naturally burn in moderately intense fires every few years helps us to better understand why wildfire continues to challenge neighborhoods in the Palm Coast flatwoods of east-central Florida. Ecosystems with frequent or intense fire will have some level of wildfire risk. The following descriptions of fire-adapted ecosystems will aid in understanding the natural fire patterns of Florida.

Flatwoods and Wet Prairies

The flatwoods ecosystem is the most common ecosystem in Florida. Occurring between uplands and wetlands, flatwoods form the matrix around which much of Florida's other systems occur. Flatwoods occur on a 1- to 3-foot thickness of flat, moderately well-drained acidic, sandy soils, overlying an organic hardpan or clayey subsoil. Because the hardpan reduces the percolation of water, water often stands on the surface during rainy seasons.

The pine flatwoods ecosystem is dominated by an overstory of slash pine and/or longleaf pine and/or loblolly pine. Some flatwoods ecosystems occur without the pine overstory – these systems are called wet prairies. The ground-level vegetation is typically saw palmetto and shrubs in the heath (Ericaceae) family, such as gallberry, huckleberry, and fetterbush. Typical flatwoods animals include southeastern kestrel, pine warbler, Bachman's sparrow, cotton rat, black bear, raccoon, gray fox, bobcat, white-tailed deer, and a wide range of reptiles and amphibians.

The integrity of the pine flatwoods community depends on periodic fire. Historic and paleontologic records show that fire probably occurred every 3 to 7 years in flatwoods ecosystems. Fires in flatwoods ecosystems typically are of moderate intensity, depending on the height of the saw palmetto and shrub vegetation and other conditions.

Plants and animals inhabiting the flatwoods are adapted to periodic fire, and several species depend on fire. Fire reduces competition from hardwoods, creates soil conditions necessary for seed germination, recycles leaf litter and nutrients to ash, and increases the population vitality of some species. After a fire, many plants release seeds or send up new growth from underground stems or roots. Fires that are too frequent or too hot, however, can reduce regeneration of pine trees and eventually lead the system to become a treeless wet prairie. Without any fire, pine flatwoods can succeed to mesic or hydric hammock, if a wildfire does not intervene.

Many of Florida's undeveloped flatwoods currently are in slash pine plantations. Fire is a valuable management tool, but it is not part of the management program of some landowners managing pine plantations for fiber production on short rotations (15-20 years). There are thousands of acres of flatwoods plantations in Florida that do not receive fuel reduction treatments during the growth of the tree crop, and yet the ecosystem is adapted to burn every 3 to 7 years. With heavy accumulations of fuels, pine flatwoods can support very intense fires. Many of the severe Florida wildfires of 1998 were in flatwoods areas with dense pine plantations.

Sandhill

The sandhill ecosystem was once common throughout the Southeast, but has been changed or degraded by various human disturbances to less than 2 percent of its former range. The sandhill ecosystem is now considered to be a critically endangered ecosystem of the United States (USDOI 1995, Noss and Peters 1995).

The sandhill ecosystem (also known as "longleaf pine/turkey oak" or "high pine") is characterized as a forest of widely spaced longleaf pine trees with a sparse midstory of deciduous oaks and a fairly dense ground cover of grasses and herbs. As the name implies, the sandhill ecosystem occurs on gently rolling hills of deep marine-deposited and well-drained yellowish sandy soils. Some of the easily leached sandhill soil nutrients are brought back to the surface by the burrowing habits of sandhill animals.

The sandhill overstory is composed of longleaf pine trees, with a midstory of turkey oak and/or sand live oak trees, and a ground cover of wire-

grass and flowering plants. Typical plants include bluejack oak, sand post oak, sparkleberry, persimmon, winged sumac, bracken fern, partridge pea, milk pea, and wild indigo. Typical animals include bobwhite quail, ground dove, red-headed woodpecker, rufous-sided towhee, fox squirrel, and pocket gopher. The sandhill also exhibits a diverse array of reptiles and amphibians, supported in microhabitats created by the burrows of the gopher tortoise and small seasonal breeding ponds scattered throughout the ecosystem. The gopher tortoise, whose burrows provide habitat or shelter for hundreds of other species, is dependent on periodic fire to provide fresh browsing vegetation.

Fire is a dominant factor in the ecology of the sandhill ecosystem. The natural fire frequency in sandhill communities is every 2 to 5 years. Sandhills depend on frequent surface fires to reduce hardwood competition and to perpetuate pines and grasses. Without frequent fire, a sandhill will succeed to an oak hammock ecosystem. Unburned or cut-over sandhills may be dominated by turkey oak and will be colonized by weedy laurel oaks and other hardwood shrubs and trees.

Scrub

The scrub ecosystem (also known as "Florida scrub" or "sand pine scrub") occurs on sand ridges and dunes along former and present shorelines. The scrub ecosystem is found only along the coast of Florida and Alabama and along Florida's central spine. Development and citrus farming have reduced the amount of scrub in Florida by 75%, and it is considered to be an endangered ecosystem of the United States (USDOI 1995, Noss and Peters 1995). Scrubs of the Lake Wales Ridge in south-central Florida are particularly valued for having a large number of endemic (unique) plants and animals. Because of the large number of endangered and threatened scrub species, there are strong efforts to conserve remaining patches of scrub in Florida.

Scrub occurs in two major forms: as an open-canopy forest of low scrub oaks and shrubs, or as a closed-canopy forest of sand pines above low scrub oaks and shrubs. The ground cover is generally very sparse, being dominated by ground lichens or herbs interspersed with characteristic open patches of sand. If the scrub has a pine overstory, it is usually sand pine in the higher xeric (dry) scrub ecosystems, and sometimes slash or longleaf pines in the more mesic (moderately moist) scrub ecosystems. The midstory is composed of low sand live oaks and other shrubs, such as saw palmetto, rosemary, rusty lyonia, scrub hickory, and silk bay. Typical animals include the scrub jay, loggerhead shrike, yellow-rumped warbler, Florida mouse, and a number of reptiles, including the Florida scrub lizard and gopher tortoise.

The Florida scrub is a fire-maintained community. Ground vegetation is extremely sparse and leaf fall is minimal, thus reducing the chance of frequent surface fires. Therefore, scrub ecosystems historically burned less frequently than other pine ecosystems, with hot fires every 20 to 80 years. As scrub oaks and pines mature they retain most of their branches and build up large volumes of fuel in their crowns. When a fire does occur, this fuel supply ensures a hot, fast burning fire and all vegetation is reduced to ash and standing snags. The mineral ash and the heat of the fire generally facilitate the release of sand pine seeds within a few days. Other scrub plants are adapted to release seed or to regenerate from their roots in response to fire.

Because scrub conservation areas are often in close proximity to subdivisions and developments, and because of the intensity of the infrequent fires required to maintain the scrub, it is very important for homes and communities in scrub areas to be vigilant about fire protection and prevention and to be supportive of prescribed fire efforts to reduce fuels and maintain this unique ecosystem. Fire allows for the regeneration of the scrub community, which would succeed to a xeric hammock without fire.

Freshwater Marshes and the Everglades

Freshwater marshes (also known as "basin marshes") are a wetland ecosystem with herbaceous or shrubby vegetation. They are usually situated in depressions or along a slight slope in the landscape, as in the Everglades. Marsh ecosystems are wet an average of 200 days per year and the soils consist of acidic peat made up of organic matter derived from plants. Marshes are usually surrounded by other fire-adapted ecosystems, often flatwoods or wet prairies.

Marsh vegetation is low or shrubby, with no tall trees. Typical plants of the marsh include reeds, rushes, sawgrass, lotus, water primrose, arrowhead, willow, saltbush, elderberry, buttonbush, and dog fennel. Typical animals include various egrets and herons, bald eagle, the American alligator, a wide variety of frogs, water sirens, and other reptiles and amphibians.

1
Fire ecology and wildfire mitigation in Florida

Marshes are shaped by both water and fire. A fairly long hydroperiod (the amount of wet time each year) is critical to the maintenance of herbaceous marshes. Marshes need to be wet on average for about 200 days each year. A shorter hydroperiod would permit the invasion of shrubs, while a longer hydroperiod would convert the marsh into a lake. During seasons or years when marshes are dry, they are susceptible to fire. Fire perpetuates the open herbaceous community of the marsh by restricting shrub invasion and by limiting peat buildup, which would eventually fill in the marsh. The normal fire interval in marshes is every 1 to 3 years.

Maintaining the appropriate hydroperiod and fire regime is critical to the maintenance of marsh ecosystems. Water is necessary to maintain the wetland and fire is necessary to reduce shrub encroachment. Fires during severe droughts are problematic, however, because of the possibility of muck fires (fires burning in organic material under the soil surface). Prescribed fire must be used very carefully in marsh ecosystems.

Photo: SFWMD

Cypress swamps are maintained by infrequent fire, which reduces shrub competition and burns up organic matter that might otherwise fill up the swamp.

Other Ecosystems

Other Florida ecosystems, such as cypress swamps and hammocks, thrive in soils with more moisture and more organic matter than the sandy soils that support flatwoods, sandhills, and scrub systems. Oak leaves and other broad leaves tend to be less flammable than pine needles. These factors contribute to a reduced occurrence of fire in these systems. For example, cypress swamps in Florida burn an average of every 50 to 100 years. In severe drought, however, every Florida ecosystem has the potential to burn.

WHAT IS WILDFIRE?

Wildfire is defined as unwanted fire in the natural environment. Wildfires are relatively common, with more than 100,000 reported every year in the United States. Florida accounts for about 5,550 of these wildfires in a given year. There are probably several wildfires burning somewhere in Florida at this moment.

Large and fast-moving wildfires have burned in Florida during severe droughts several times in the 20th Century. For example, the 1935 Big Scrub Fire burned 35,000 acres of the Ocala National Forest in four hours. Likewise, the Buckhead Fire burned 100,000 acres between the Osceola National Forest and the Georgia line in a single day during the spring of 1956. Several Everglades fires of the early 1970s exceeded 50,000 acres in size. On May 17, 1985 – dubbed “Black Friday” – Florida

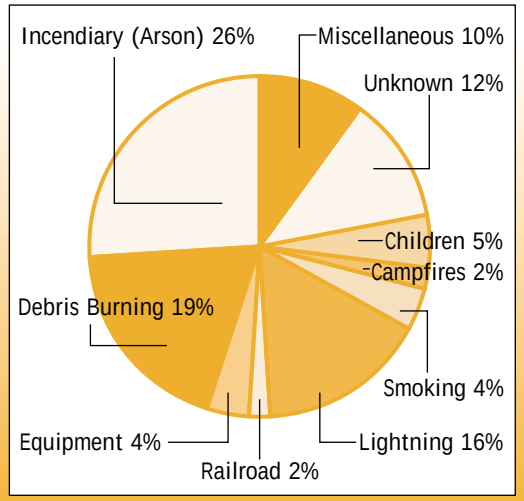
Photo: FDOF

1998 Florida Wildfire

***Wildfire* should not be confused with *prescribed fire,* which is the carefully planned use of fire by land managers to provide the ecological and social benefits of fire while minimizing side effects. Prescribed fire is addressed with the discussion of fuel management techniques in Chapter 2.**

experienced dozens of wind-driven fires in 29 counties and 400 homes were lost in a single day.

The 1998 Florida wildfires resulted in evacuations of 100,000 residents, closure of two interstate highways, burning of 500,000 acres, losses of over $600 million in tourism and other revenues, and damage or destruction of 337 homes and 33 businesses. In May 2001, a smoldering lightning fire flared up into the Mallory Swamp Fire. Because it was in remote Dixie and Lafayette Counties of north Florida, the wildfire did not burn any homes, but became one of the largest wildfires in Florida history by burning more than 60,000 acres and causing over $10 million in timber losses. Additional extreme wildfires have occurred in 2000-2003 in Florida and in the western U.S.



Average proportion of wildfires by cause, 1981-2002

Despite these examples, most wildfires in Florida burn less than 1,000 acres. During the 1980s the average Florida wildfire was 37 acres. During the 1990s, the average wildfire was less than 30 acres in size. Most of the wildfires that occur in Florida each year are small fires that are extinguished fairly quickly. Nevertheless, an average of 5,550 wildfires impact an average of about 218,000 acres each year in Florida (FDOF data, 1981-2002).

Lightning once was the major source of ignition of wildfire in Florida. Lightning strikes occur in Florida more than anywhere else in North America. Lightning now accounts for only about 20 percent of the wildfires reported, primarily because of the increase in human ignition sources, a decrease in acreage of natural areas, and changes in vegetation that reduce the likelihood of ignition by lightning. Today, humans ignite over 80 percent of Florida's wildfires, either from escaped yard-debris fires, acts of carelessness, or intentional actions (arson).

Weather patterns affect the number and size of wildfires that occur each year in Florida, governing the ease of ignition, rate of fire spread, and difficulty of control in a given type of fuel. Among the weather factors effecting occurrence of wildfire in Florida are precipitation patterns (i.e., drought) and the El Niño Southern Oscillation (ENSO) weather pattern, which is correlated with years of above-average rainfall followed by the La Niña drought pattern.

Although fire protection agencies work hard to reduce hazardous fuels and to prevent and suppress fires in Florida, wildfires still occur, as evidenced by the Palm Coast Fire of 1985 where 130 homes were lost in one afternoon. The Florida wildfires of 1998 further demonstrated how damaging wildfire could be. Forest ecosystems that are normally adapted to fire were damaged in the 1998 wildfires – the intensity of these fires was enough to kill mature trees and to sterilize the soils in some areas.

The impact of the 1998 wildfires was so significant that the Governor of Florida established an interagency wildfire response and mitigation committee to thoroughly review the causes of the wildfires and to suggest ways to improve wildfire response and mitigation. Interestingly, many of the homes lost in 1998 were in the same area affected by the 1985 Palm Coast Fire. An unnatural buildup of fuels compounded by extreme drought and lagging fuel management were responsible for many of Florida's wildfire disasters that have made news in recent years.

Since the Governor's report, changes include a redesign of the Unified State Command structure for wildfire response, designation of key liaisons between agencies within the command structure, implementation of unified public information programs, and increased training of emergency responders at

all levels. Accomplishments also have been made in the area of hazardous fuel treatment and assistance to land managers and local agencies in wildfire recovery activities, as well as in expanded wildfire mitigation activities, including the Firewise Communities program.

During many of these extreme fire events, state, federal, and local agencies were well aware of the elevated fire danger. For example, in 1998, Florida was experiencing severe drought conditions. The FDOF responded to these conditions by halting authorizations for open burning and by mobilizing firefighting forces in anticipation of wildfires. Unfortunately, the extremely dry conditions covered large areas of the state and no one could precisely predict where major wildfires would develop. More advanced predictive tools are being developed each year, but prediction of wildfires is still a difficult art.

Suppression or control of wildfires is crucial to the protection of life and property. Attempts to entirely exclude fire from Florida's wildlands will fail because fire is a natural element of these ecosystems. Fire cannot, and should not, be totally excluded from Florida's ecosystems. It is very important for residents to understand the distinction between wildfire and the wise use of prescribed fire in Florida's natural areas. Prescribed fire is a preferred and effective method of fuel management to prevent wildfire, and there are a number of other fuel management strategies available. Prevention of and protection from disastrous wildfires must be based on fuel management. The ongoing work of fuel reduction and management in Florida is very important.

I think the real issue is that we have a situation that has been unparalleled in the last 50 years right now, and that has to do with what I call 'the perfect storm' phenomenon of weather and fuel loads. We have the hottest, driest weather in perhaps 50 years; we have thousands of lightning strikes an hour; we have 300 new fires every day in the West, largely because of lightning strikes.
U.S. Secretary of Agriculture Dan Glickman, September 2000,
Speaking about the Western wildfires of summer 2000

FLORIDA'S WILDFIRE RESPONSE SYSTEM

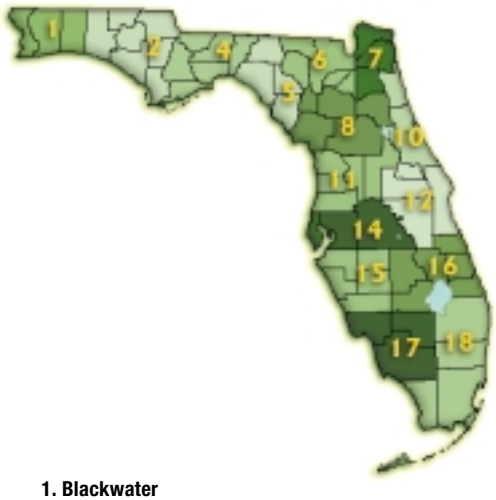
The Florida Division of Forestry (FDOF) was founded in 1927 in response to uncontrolled wildfires that burned during the 1920s. The FDOF has statutory responsibility (590.02 F.S.) to prevent, detect, suppress, and extinguish wildfires wherever they occur within Florida. The FDOF performs wildfire prevention through education and wildfire hazard mitigation programs. The agency also performs wildfire suppression (firefighting), management of 31 state forests totaling about 900,000 acres, urban and community forestry assistance, and forestry assistance to private landowners.

The FDOF relies heavily on federal, state, and local partners to fulfill its statutory responsibility for wildfire prevention and suppression. Because of this, the FDOF routinely conducts wildland fire training at the Florida Center for Wildfire and Forest Resources Management in Brooksville, through FDOF District offices around Florida, and at a statewide Wildland Fire Conference held every other year in Ocala. Although some fire lookout towers are still staffed on a seasonal basis, most wildfires in Florida are now reported by patrol aircraft or citizens who call 911. Mutual aid agreements throughout the state mean that county and/or municipal fire trucks frequently respond along with a FDOF firefighting unit.

In addition to fighting wildfires that threaten homes, property, and natural systems, the FDOF has four Fire Management Teams (called "mitigation teams") stationed around Florida. The sole mission of these teams is to help FDOF Districts identify and reduce hazardous fuel conditions on lands in the wildland-urban interface, areas where homes and natural areas mix. It is a priority for FDOF Districts to identify and treat high-hazard wildland-urban interface areas. Fire Management Teams augment these efforts by reducing hazardous fuels in these problem areas.

The Fire Management Teams have focused their efforts on high-hazard wildland areas within one-quarter mile of improved property. They use both mechanical treatments and prescribed fire to assist landowners in reducing heavy fuels on interface lands, with the understanding that landowners will continue fuel management treatments in the future.

Fire Management Teams are equipped with a "Type I" D-6 Caterpillar® bulldozer, two "Type III" tractor-plow units, a 1000-gallon "urban assault" engine, a "Type VI" 500-gallon woods engine, and



1. Blackwater
Munson (Milton), FL

2. Chipola River
Panama City, FL

4. Tallahassee
Tallahassee, FL

5. Perry
Perry, FL

6. Suwannee
Lake City, FL

7. Jacksonville
Bryceville, FL

8. Waccasassa
Gainesville, FL

10. Bunnell
Bunnell, FL

11. Withlacoochee
Brooksville, FL

12. Orlando
Orlando, FL

14. Lakeland
Lakeland, FL

15. Myakka River
Bradenton, FL

16. Okeechobee
Okeechobee, FL

17. Caloosahatchee
Ft. Myers, FL

18. Everglades
Davie, FL

Districts of the Florida Division of Forestry. Contact information is available at http://www.fl-dof.com/

PosiTrac® (6-foot) or GyroTrac® (8-foot) rotary mowers for mowing and chopping of heavy fuels. Teams are further equipped with all-terrain vehicles, pick-up trucks, drip torches, and hand tools.

Results for years 1999-2002 indicate that Fire Management Teams provided enhanced protection of 22,000 Florida properties valued at over $2 billion. In the same period, the teams treated 128,000 acres with prescribed fire. In 2001-2002, the teams provided enhanced protection for a total of 6,225 homes and 6,252 acres valued at over $995 million (FDOF data, 2003).

The FDOF recently has developed the Florida Wildfire Risk Assessment System (FRAS) that transforms information from satellite and aerial images into a wildfire hazard ranking of areas of Florida based on fuel types and levels. FRAS is a computer Geographic Information System (GIS) that allows planners and fire managers to analyze and view multiple map layers of landscape information in a compact form. This system is available for use by district FDOF offices and local planners to identify wildfire risk areas that may require fuel reduction treatments. This system is now being disseminated around Florida through FDOF's Fuels Management in the Wildland-Urban Interface training workshops. See Chapter 2 for more details about FRAS.

Although humans cannot control the ignition of all wildfires in Florida, the hazards associated with wildfire can be minimized with appropriate prevention and mitigation efforts. Although the FDOF serves Florida with comprehensive wildfire prevention and mitigation program, it is impossible to protect every home and community from wildfire. It is necessary for everyone to participate in community wildfire protection efforts. This guide is designed to help developers, planners, and residents of the wildland-urban interface take action as partners in wildfire protection and mitigation efforts.

The Wildland-Urban Interface

DEFINING THE WILDLAND-URBAN INTERFACE

Florida's forests and natural areas are increasingly affected by human development. This mixture of development and forests – the "wildland-urban interface" – has been identified as one of the main challenges for southern forests by the U.S.D.A. Forest Service, which has established the Southern Center for Wildland-Urban Interface Research and Information to study and provide guidance on wildland-urban interface issues in the southern U.S.

The wildland-urban interface is a concept that can be defined from a number of different perspectives. From a natural resource and geographic perspective, the wildland-urban interface is the zone where increased human influence and land-use conversion are changing and affecting natural areas and natural resource management. Other common definitions of the wildland-urban interface are based on sociopolitical, biophysical, and fire management perspectives.

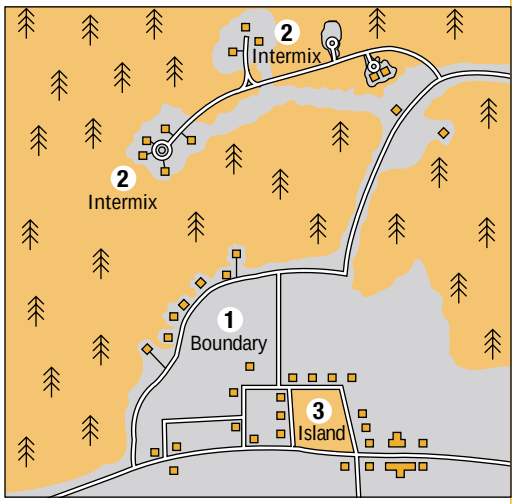
For example, from a sociopolitical perspective, the wildland-urban interface can be thought of as

1
Fire ecology and wildfire mitigation in Florida

CATEGORIES OF WILDLAND-URBAN INTERFACE

There are three major categories of wildland-urban interface. Depending on the set of conditions present, any of these areas may be at risk from wildfire. A wildfire risk assessment can determine the level of risk.

1. **"Boundary" wildland-urban interface** is characterized by areas of development where homes, especially new subdivisions, press against public and private wildlands, such as private or commercial forest land or public forests and parks. This is the classic type of wildland-urban interface, with a clearly defined boundary between the suburban fringe and the rural countryside.
2. **"Intermix" wildland-urban interface** areas are places where improved property and/or structures are scattered and interspersed in wildland areas. These may be isolated rural homes or an area that is just beginning to go through the transition from rural to urban land uses.
3. **"Island" wildland-urban interface,** also called "occluded" interface, are areas of wildland within predominantly urban or suburban areas. As cities or subdivisions grow, islands of undeveloped land may remain, creating remnant forests. Sometimes these remnants exist as parks, or as land that cannot be developed due to site limitations, such as wetlands.



Wildland-Urban Interface

The wildland-urban interface will not be going away. Its roots are not a fire problem at all. The interface is a result of urban sprawl, changing lifestyles, decentralized e-business, population growth, and other non-fire-specific conditions.
Jim Smalley, Firewise Communities, 2001

a place of interaction between potentially competing interests and political forces. These differing opinions might show up, for example, in the opposing views within a community over the value of a local undeveloped area. Some people may see managing for outdoor recreation and water filtration services as an important value, others may see managing for wood fiber or agricultural products as an important value, and still others may see more value in subdivisions and shopping areas to serve a growing population. For large-scale mapping purposes, the wildland-urban interface is often delineated with zones of human population density.

From a biophysical perspective, the interface can be defined as an area where physical changes to the structure and function of forest ecosystems are occurring because of increased urbanization. Characteristic changes of the wildland-urban interface include habitat fragmentation, reductions in connections among natural habitats, changes in the diversity of plants and animals, encroachment of invasive species, changes in stormwater runoff and quality, and increases in soil erosion.

The Wildland-Urban Interface from a Fire Management Perspective…

…an area where human development mingles with undeveloped wildlands and a set of conditions exist that make the area more vulnerable to wildfire.

From a fire management perspective, a basic definition of the wildland-urban interface is an area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. As fire is dependent on a certain set of conditions, the National Wildfire Coordinating Group has defined the wildland-urban interface as a "set of conditions" that exists in or near areas of wildland fuels, regardless of ownership. This set of conditions includes type of vege-

tation, building construction, road construction, accessibility, lot size, topography, and other factors such as weather and humidity. When these conditions are present in certain combinations, they make some communities more vulnerable to wildfire damage than others. This "set of conditions" method is perhaps the best way to define wildland-urban interface areas when planning for wildfire prevention, mitigation, and protection activities.

POPULATION GROWTH AND DEVELOPMENT PRESSURES

Recent census data show that a majority of the fastest-growing areas in the United States are in the wildland-urban interface. Growth of communities into wildfire-prone areas is one factor aggravating the wildland-urban interface fire problem. It is no surprise that some of these fastest growing communities are in Florida.

Between 1990 and 2000, Florida's total population increased by over 3 million, growing from 12.9 million to nearly 16 million residents. This represents an increase of 23.5 percent in the last decade of the 20th Century. Considered as a daily rate of growth, this represents a natural increase (number of births over number of deaths) of 123 births per day, plus an average of 711 new residents moving to Florida each day, or an average of 833 new people each day in Florida (Florida Office of Economic and Demographic Research, 2002). By 2020, Florida will overtake New York as the nation's third-most-populous state.

Coastal areas continue to attract people and 80 percent of Florida's population already lives within one mile of the coast. Because of coastal crowding, growth is now pushing inland from Florida's major coastal cities while Florida's inland suburbs and cities also are growing at a remarkable rate. Much of this new development is in areas that previously were in natural vegetation. With growing environmental awareness over the last several decades, developments in natural areas have become more and more popular with Florida residents. Many people want a Florida "home in the woods."

Florida's burgeoning population drives new development, constantly expanding the wildland-urban interface. Florida also is a case study of diverse demographics, with an increasing median age and dramatically increasing levels of a variety of racial and ethnic groups. New residents often are unfamiliar with the landscape and fire's role in Florida's natural systems.

All of these factors make Florida a bellwether state for developing and implementing solutions to wildland-urban interface problems. Florida is in the forefront of managing wildland-urban interface issues through comprehensive planning and land conservation programs. Florida purchases more land for conservation purposes than all other states combined through the Florida Forever (formerly Preservation 2000) program and related programs (e.g., Florida Communities Trust, Surface Water Improvement and Management). Many Florida counties administer complementary local land purchase and conservation programs.

THE WILDLAND-URBAN INTERFACE FIRE PROBLEM

The exclusion of fire from Florida's natural areas through much of the 20th century has allowed wildland fuels to build up to dangerous levels in many areas. Fire exclusion was necessary to allow forests to regenerate after the heavy logging of the early 20th Century, but human settlements and roads also inadvertently prevented natural fires from moving across the landscape as they once did. Fire disappeared from many of the ecosystems it once shaped and created.

The intersection of homes and forests in the Florida wildland-urban interface has complicated the wildfire problem in recent decades. Losses from fire in the wildland-urban interface are higher with each extreme wildfire year. The increase in destruction of homes and communities has occurred not just because of an increase in intensity of wildfires, but also because of the increased number of homes being built in or near wildfire-prone areas.

There are several major factors that aggravate the wildland-urban interface fire problem:

- Development pressures in wildfire-prone areas;
- Heavy accumulations of wildland fuels;
- Unusually severe weather patterns;
- Lack of strategic fuel management programs;
- Lack of public awareness and support of fuel reduction programs;
- Lack of awareness by builders and developers to design firewise landscapes and structures;
- Inadequate fire-fighting infrastructure;
- Inadequate community and individual wildfire preparedness.

1
Fire ecology and wildfire mitigation in Florida

Maybe, instead of focusing on how the fire was started and who's going to sue whom, we should be talking about reducing the risks in susceptible areas. We should be thinking about building disaster-resistant communities…and we should be thinking about the effects of sprawl and of new ways of developing our communities.
Nan Johnson, AICP, American Planning Association Magazine, July 2000

It is important to note that many of these factors have been addressed or mitigated in recent years in Florida, and this manual is part of that process. This manual will focus on the most manageable factors in the wildland-urban interface, including planning for development, determining fuel management needs, designing firewise landscapes and structures, and developing adequate infrastructure and community preparedness.

Despite the known benefits of fire, wildfires cannot be permitted to burn unchecked in a partially developed landscape. Yet as the inevitable release of energy through fire is postponed and fuels continue to accumulate, the probability of a devastating wildfire increases. Despite Florida's current role as a leader in prescribed burning – more acres burned each year than all other states combined – excessive fuels continue to accumulate and create a wildfire hazard. Furthermore, prescribed fire and other fuel management techniques are not one-time treatments. Fuel management treatments such as prescribed fire must be repeated on a regular basis.

There is an emerging understanding of the potential for houses to become fuel for wildfires in the wildland-urban interface. It is critical that communities become more aware and involved in wildfire preparedness and in fire management policy debates. The wildfire threat to homes and communities is influencing lives and policies at local, state, and national levels.

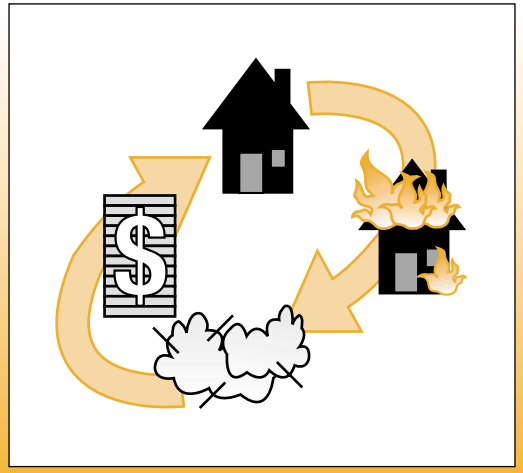
The problem of fire in the wildland-urban interface is just one symptom of a larger trend of human development changing forests and wildlands and affecting the condition, health, and management of natural resources in the wildland-urban interface. Demographics, economics, and land use planning and policy are major forces driving change in the wildland-urban interface. Management of both natural resources and human communities must change to meet the challenges in the interface environment.

UNDERSTANDING THE WILDFIRE DISASTER CYCLE

Wildfire is a natural event that can become a disaster because of the changes that humans have brought to fuel levels in natural systems. Human activities may either increase or decrease fuels in wildland areas. It is the increased fuels that can combine with other conditions to create a wildfire hazard.

The 1998-2002 Florida wildfires may be a harbinger of the future. Unless communities, organizations, and individuals take positive preventive action, it appears that wildfire disasters will continue to follow a predictable cycle. Planners will immediately notice that this cycle is similar to the repetitious hurricane disaster cycle in coastal communities:

1. Construction of homes or businesses in or near fire-adapted ecosystems;
2. Accumulations of fuels leading to inevitable wildfire in ecosystems adapted to fire;
3. Damage or destruction of unprotected structures by the wildfire;
4. Payments to rebuild or restore from insurance companies or the Federal Emergency Management Agency;
5. Rebuilding of homes or businesses in or near the same fire-adapted ecosystem, often with larger or more valuable structures with the same construction and landscaping approaches, along with expansion of new development in the wildland-urban interface;



Wildfire disaster cycle

6. Accumulations of fuels leading to inevitable wildfire in ecosystems adapted to fire;
7. Repetition of this cycle.

The population in and near Florida wildlands is rapidly growing, as are the numbers and values of homes. Often there is no effort to use fire-resistant building and landscaping materials or to address wildfire hazards around homes or on adjacent lands. Once a wildfire gets started, unprotected homes become a drain on firefighting forces, leaving fewer resources available for slowing the growth of the wildfire. This grim scenario can be averted. Considerable scientific knowledge and technology are available to guide fuel reduction, forest management, and fire-resistant homes and landscape design. Research and demonstration projects have been completed around the state and country and will be reviewed as case studies throughout this manual.

For example, a recent study has analyzed and modeled wildfire risk at a broad scale and has statistically linked fire probability with several variables, such as forest management, land use, and climatic factors (Prestemon et al. 2002). The model found that wildfire risk in the United States is lower if there has been a fire within the past 10 years, which acts to reduce fuel levels. The El Niño (moist) weather pattern was also related to reduced wildfire risk, except when it was closely followed by extreme La Niña drought, as it was in 1998 in Florida.

Confirming what is already known about the key roles of weather and fuels in determining wildfire spread and behavior, this model suggests that any fuel reduction practice that mimics natural fire will be more successful in reducing the severity of future wildfires. Although the presence of homes was not identified as a wildfire risk factor in this model, earlier reports have indicated that wildfire damage becomes worse with more wildland-urban interface and intermix development (e.g., Irwin 1987). The costs and potential losses from wildfire in the wildland-urban interface are incentives to further refine the understanding of the relationship between wildfire and human factors.

Advances have been made in understanding the dynamics of the wildfire disaster cycle. Landscape-level models of wildfire factors and case studies of past wildfire events lead to recommended actions for developers, builders, landscape architects, homeowners, neighborhoods, planners, and local governments to limit the vulnerability of life and property to wildfire.

ASSESSING THE LEVEL OF WILDFIRE RISK

Because not every interface area is at risk from wildfire, it is important to assess the level of wildfire risk before deciding on wildfire prevention and mitigation practices. A wildfire risk assessment will help the builder, developer, planner, or homeowner determine whether the area needs wildfire mitigation attention, and will help to direct wildfire mitigation to high-risk areas.

There are certain characteristics of wildland-urban interface areas at risk of being damaged in a wildfire. Four characteristics that define much of the wildfire risk in Florida are:

- Dense vegetation within 30 feet of homes;
- Combustible or vulnerable building materials, especially in roofing, siding, soffits, vents, and skirting;
- Inadequate access roads;
- Inadequate water systems or water systems dependent on electric power.

Other risk factors include aboveground and overhead utilities, large adjacent forest or wildland areas, extensive canal or ditch systems blocking firefighter access, and a high proportion of undeveloped or overgrown lots within a subdivision.

Several risk assessment tools are described in this manual:

- A rapid risk assessment chart for developers, builders, and homeowners is provided in Chapter 6;
- The FDOF's Wildfire Hazard Assessment Guide for Florida Homeowners, which is designed for use by neighborhoods or developers, is discussed in Chapter 5;
- The FDOF's Florida Wildfire Risk Assessment System for landscape-level risk assessment and hazard ratings is described in Chapter 2.

1
Fire ecology and wildfire mitigation in Florida

Solving the Problem is Everyone's Responsibility

WHAT NEEDS TO BE DONE

Most land managers and interagency working groups agree that wildfire mitigation efforts in high-risk areas of the wildland-urban interface should:

- Strategically plan for wildfire events;
- Involve and educate community members and various partner agencies and organizations to understand, prevent, and reduce the risk of wildfire;
- Implement appropriate fuel reduction strategies;
- Establish incentives for partners to take appropriate actions.

The most important point is the need for shared responsibility in addressing wildfire mitigation efforts. There is a great need for communication and cooperation among communities that are impacted by wildfires and agencies that have the technical expertise and responsibility for developing comprehensive land use plans, for preventing and suppressing wildfires, and for providing fire information to the public. These responsibilities should be shared among federal, state, and local agencies in collaboration with public and private partners and citizens. Local leadership is especially important in the wildfire mitigation process. Key to successful wildfire prevention and protection strategies is the interest of local citizens, developers, and planners, and the undertaking of local education, planning, and preventive actions.

We should look at fire prevention as our number one priority. Homes threatened and firefighters at risk are telling signs that we – the fire protection agencies and the community at large – have not done our job.
Mike Long, Director, Florida Division of Forestry

CASE STUDY: NATIONAL FIRE PLAN STRATEGIES

In the wake of the 2000 wildfires across the United States, the Secretaries of the U.S. Department of Interior and U.S. Department of Agriculture cooperated with the Governors of the U.S. to create the Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment. The team developed a 10-Year Comprehensive Strategy (August 2001) and an Implementation Plan (May 2002). These efforts are collectively known as the National Fire Plan (NFP). NFP cites increasing forest ecosystem health problems and states that past approaches to land management (e.g., planting of unnaturally dense forests, exclusion of fire) have contributed to more severe wildfires. Because millions of acres of land nationwide are classified at high risk for wildfire, the main goals of NFP are to:

- Improve prevention and suppression of wildfires
- Reduce hazardous fuels
- Restore the health of fire-adapted ecosystems
- Promote community awareness

The NFP strategy highlights the need for a comprehensive approach to reducing wildfire risk as growth in wildland-urban interface areas places more citizens and property at risk of wildfire. See http://www.fireplan.gov for a summary of projects and progress to date.

OVERVIEW OF WILDLAND FUELS AND FUEL MANAGEMENT STRATEGIES

Almost half of Florida's land is adapted to fire. It is now recognized that fire is an agent of change and renewal, essential for maintaining the forest, brush, marsh, and grassland ecosystems of Florida. Without fire, wildland fuels continue to accumulate in Florida's natural areas. Because fuels are such an important component of the fire behavior equation, it is important to understand the different categories of fuels in Florida and potential strategies for management of wildland fuels.

Florida Wildland Fuels

Florida surface fuels can be divided into four broad categories based on the primary type of fuel that is carrying the fire:

- Grass;
- Brush;

- Forest (timber) litter;
- Slash (tree harvesting residue).

Although houses and other structures are not mentioned as a fuel type, remember that fuels in the wildland-urban interface can include forest litter, living vegetation, structures (e.g., houses, outbuildings, wood fences), and yard storage accumulations (e.g., woodpiles, lawn furniture, propane tanks). Fuels have specific characteristics that can be used to predict how fire will behave when these fuels burn. More descriptions and photographs of wildland fuels are included in Chapter 2, in the discussion of the FDOF's Florida Wildfire Risk Assessment System.

CASE STUDY: FIREWISE COMMUNITIES

The evolution of the Firewise Communities concept began with the development of the National Wildland-Urban Interface Program in 1986, in response to the particularly bad fire season of 1985. Florida lost 600 homes that year, with 400 of those lost on Black Friday, May 17, 1985. The 1985 fire season revealed that the wildfire problem was national in scope and not just in Western forests. The idea was developed to implement an outreach program that would designate communities as "Firewise" if certain criteria were met. Firewise landscaping guidelines, publications, and videos were developed in the early 1990s and the Firewise Communities program was born. The Firewise Communities program is a model for raising awareness among a variety of groups about community responsibility for wildfire protection.

A Firewise Communities workshop prepares community leaders and fire services professionals to recognize wildland-urban interface fire hazards, deliver fire protection and mitigation information to residents, incorporate Firewise principles into landscapes and buildings, and use community planning efforts for wildfire mitigation. Firewise Communities are most successful when they involve a variety of community representatives, such as elected officials, planners, business leaders, homeowner association leaders, and fire service professionals.

Florida was one of the first states to develop a Firewise Communities program modeled after the national program. Communities involved in the program must arrange a preliminary wildfire risk assessment performed by a FDOF team, typically involving a local fire chief or emergency manager. The community then sets up a multi-disciplinary Firewise committee. A report of the wildfire risk assessment is filed with the committee, who then use the report to create specific solutions to effectively address the wildfire issues of the community. A permanent Firewise task force implements and maintains the program. After the community has completed the plan and at least one Firewise project, the community may be recognized as a Firewise Community USA. A description of the Firewise Communities USA recognition program is included in Chapter 5.

Fuel Management Strategies

The purpose of fuel management is to favorably alter expected fire behavior. Recall that fuels, weather, and topography influence fire behavior, and that fuel is one factor that humans can significantly influence. Fuel reduction, therefore, becomes the major avenue of influencing fire behavior and reducing the severity of wildfires.

Simply put, changing the quantity and physical properties of the fuels changes the way an area burns. In most cases, fuel management results in reduced spread rate, flame length, and intensity of a wildfire. This improved fire behavior allows fire protection agencies to be more successful in suppressing a wildfire. One of the main benefits often is a reduction in the overall size of the wildfire. The cost to suppress smaller wildfire is obviously less than the cost to suppress a larger wildfire.

There is no general prescription or formula for managing fuels. Management objectives differ for wilderness and intensively managed forest plantations or recreation areas. In areas where management objectives point toward maintaining, reproducing, or restoring natural forest communities, nature's method – fire – is a valuable and effective fuel management tool.

Although prescribed fire often is the most economically and ecologically sound technique for fuel management in Florida, there are several

CHARACTERISTICS OF FUELS RELATED TO FIRE BEHAVIOR

Fuel characteristic	Relationship to fire behavior
Height of surface fuel (fuel depth) and total available fuel (fuel load)	If fuel depth and load are heavy, flames will be longer and more heat will be released. As fuel depth and load are reduced, the flame length and heat are reduced.
Fuel loading by fuel size class (size classes range from fine to large fuels)	Fine fuels (e.g., pine needles) ignite more readily and burn more quickly. Larger fuels (e.g., branches) burn more slowly but generate more heat energy and can be difficult to extinguish.
Compactness of fuels	Fuels that are tightly compacted will not burn as well. Fuels that are loosely compacted will burn better. Fuels that are very loose (e.g., sparse tree branches) may not be able to burn unless a nearby fire heats them.
Vertical continuity of fuels (presence or absence of vertical fuels, called "ladder fuels")	Vertically continuous fuels, such as vines or understory trees, can carry fire into the canopy (crowns of trees). Breaks in vertical continuity can prevent wildfire from getting into the canopy.
Dead-to-live fuels ratio	Although some of Florida's live fuels are very volatile, they generally only ignite and burn once they are heated by burning dead fuels. If the ratio of dead fuels to live fuels is high (as after a drought or killing frost), the fire behavior is more intense.

(Adapted from Fuels Management in the Wildland-Urban Interface, FDOF 2002.)

classes of fuel management techniques that can be considered:

- Prescribed burning;
- Mechanical treatment (mowing, disking, chopping);
- Chemical treatment (herbicide application);
- Biomass removal (pine straw harvesting, vegetation or tree thinning, timber harvesting);
- Biomass conversion (grazing).

Whichever method is used, fuel reduction treatments are temporary and will typically reduce the wildfire threat for 3 to 5 years. Additional treatments are required on a regular basis to maintain fuels at an acceptable level to reduce the risk of wildfire. Chapter 2 includes a complete discussion and comparison of the various fuel management techniques.

CHAPTER TWO

Community planning to reduce wildfire risk

2
Community planning to reduce wildfire risk

The wildland-urban interface and the associated wildfire risk are a result of our collective land use decisions. We should use the land use planning process available to us to minimize our vulnerability to wildfire.
Jeff Bielling, AICP
Florida Division of Community Affairs, Division of Community Planning

Introduction

THE OPPORTUNITY TO PLAN FOR WILDFIRE MITIGATION

As the population grows and as coastal settlements become more crowded, much new development is occurring in inland areas of Florida. Just as Florida has one of the country's longest coastlines, the growth of inland development has created what may be one of the nation's most extensive wildland-urban interface zones. Because most of Florida's natural ecosystems are adapted to periodic fire, this wildland-urban interface is often an area of wildfire hazards.

This lengthy interface is affected by local land use decisions. Some problems associated with the wildland-urban interface have been exacerbated by past land-use decisions in the face of population pressures. The same local planning that helped to create this problem can now contribute to a reduced wildfire risk in the wildland-urban interface.

The planning process is generally divided into a series of logical steps – identify and assess the issue or problem, develop a strategy to address the issue, implement the strategy, and evaluate the effects. The planning process provides an excellent framework for addressing wildfire prevention and mitigation.

IDENTIFIED WEAKNESSES IN WILDFIRE MITIGATION PLANNING IN THE U.S.

- Wildfire is given low importance relative to other hazards
- The wildfire hazard is treated on a case-by-case or project-by-project basis rather than in a jurisdiction-wide or landscape-level context
- Comprehensive wildfire risk assessment information is lacking, or is misinterpreted or misused
- Land use plans encourage random "intermix" development by allowing low-density development in high-risk areas, potentially complicating the ability of emergency services to protect property
- High-risk wildfire zones are not clearly delineated, providing little support for informed land use decisions

(Adapted from Irwin 1987)

POTENTIAL SOLUTIONS TO WILDFIRE MITIGATION PLANNING PROBLEMS

- Support detailed research on wildfire mitigation problems, such as real mitigation costs, real losses from wildfire, tradeoffs between mitigation and suppression strategies, policy formation, and applied fire behavior and mitigation projects
- Support increased legislative attention and funding for wildfire mitigation planning
- Support state and federal involvement in local strategic planning efforts
- Use GIS mapping technology for clear delineation of wildfire risk areas and to monitor changing risk levels over time
- Improve land use planning by implementing wildfire mitigation strategies in high-risk areas, such as clustering of dwellings and firewise landscaping and building construction
- Address community wildfire protection in a comprehensive manner, involving agencies, organizations, local leaders, and citizens in strategic planning for wildfire mitigation

(Adapted from Irwin 1987)

Many opportunities exist to apply creative planning solutions to wildfire mitigation in Florida communities through local government comprehensive planning and local mitigation strategy (LMS) processes. These opportunities will be discussed in further detail in this chapter, along with the tools and methods that are available to support local planning processes. The legal basis for wildfire mitigation planning in Florida is discussed in Chapter 3, where development standards for wild-

fire mitigation are discussed and model ordinances are provided for adaptation in Florida communities.

Local Planning Strategies for Wildfire Mitigation

Rapid expansion of development in the wildland-urban interface presents a challenge to natural resource managers, planners, local governments, and emergency service providers. Like other natural hazards, wildfires do not respect political or jurisdictional boundaries, highlighting the necessity for cooperation in dealing with the wildfire problem. Agencies and citizens in the urban fringe must develop coordinated and effective efforts to address the wildland-urban interface fire problem.

Local Planning Strategies for Wildfire Mitigation

There are a number of actions that local communities can take to improve land use planning for wildfire mitigation:

- Identify high hazard areas within the community by using a Florida wildfire risk assessment tool such as the Wildfire Hazard Assessment Guide for Florida Homeowners or the Florida Wildfire Risk Assessment System, both from the Florida Division of Forestry
- Review comprehensive plans to ensure wildfire hazard mitigation has been addressed in the appropriate elements and is supported by risk assessment data and analysis. Resolve problems before development occurs
- Conduct wildfire prevention training for large cohesive community groups or neighborhoods
- Use wildfire hazard zones to specify conditions for the use and development of specific areas
- Cooperate with fire protection services or agencies to determine guidelines for use and development of wildfire-prone areas
- Promote the functional placement of open space (greenspace) for community wildfire protection zones (fuel management zones) in large developments or neighborhoods
- Review all proposals for subdivisions, lot splits, and other developments for fire protection needs during the site plan review process
- Include fire protection measures (e.g., emergency access, water systems, heliports, safety islands, fuel breaks, vegetation management, community protection zones) as part of overall wildfire mitigation
- Establish wildfire mitigation planning requirements for large-scale Developments of Regional Impact (DRIs) or Planned Developments (PDs, also called Planned Unit Developments or PUDs)

(Adapted from the Fire Safe Field Guide, California, 1999)

2
Community planning to reduce wildfire risk

SUMMARY OF APPROACHES TO WILDFIRE MITIGATION

A community may engage in one or more of these local planning strategies, at the same time or over a number of years. The community wildfire mitigation planning effort can be a stand-alone process or part of a larger comprehensive planning process. Communities should select the most appropriate approaches from a menu of strategies. Development review strategies are discussed in Chapter 3. This section examines each of the following planning strategies and considers the roles and responsibilities of various partners in wildfire mitigation planning efforts:

- Comprehensive and Community Planning Strategies
  - – Comprehensive Planning/Land Use Planning
  - – Strategic Planning/Local Mitigation Strategy Process
  - – Cooperative or Functional Planning for Wildfire Mitigation
- Social and Economic Strategies
  - – Public Education/Outreach Programs
  - – Incentives for Hazard Mitigation

COMPREHENSIVE AND COMMUNITY PLANNING STRATEGIES

It is very important for wildfire mitigation planning to be undertaken at the appropriate level. The federal government is very good at recognizing and planning for problems of national scale, but mitigation actions are best taken at the state and local level to effectively address the problem of wildland-urban interface wildfire. In addition to their role in wildfire suppression, the Florida Division of Forestry plays a very important role in wildfire mitigation and public information and education about wildfire protection.

Proactive planning is the best way for members of a community to cooperatively address wildfire concerns. Significant reductions in wildfire risk have been achieved in communities where planning for fire protection has been completed and implemented. The reverse can also be said to be true: that wildfire damages have been repetitively suffered in high-risk communities that have not adequately planned for or implemented wildfire hazard reduction. Palm Coast remains an example of this problem. Located in the fire-prone flatwoods of northeast Florida, the community has experienced wildfires that have destroyed hundreds of homes in 1985 and again in 1998. While wildfire protection specialists were, and are, aware of the problems in Palm Coast, the nature of the development – undeveloped lots with hazardous fuels interspersed among existing homes – has made it difficult to implement wildfire mitigation strategies.

Comprehensive Planning/Land Use Planning

Florida's Growth Management legislation (Florida Statutes Section 163.3167 *Local Government Comprehensive Planning and Land Development Regulation Act*) requires counties and municipalities to adopt a *Local Government Comprehensive Plan* to guide future growth and development. Comprehensive plans must include certain "elements" that address future land use, housing, transportation, infrastructure, coastal management (if applicable), conservation, recreation and open space, intergovernmental coordination, and capital improvements. Plans may also include optional elements. All comprehensive plan elements must be internally consistent with all other elements.

The Florida Department of Community Affairs (FDCA) has developed detailed rules that establish minimum criteria for the oversight and review of comprehensive plans and amendments (Chapter 9J-5 F.A.C.). These regulations specify that each plan element must include a series of goals, objectives, and policies that conform to the general requirements of the applicable statute and regulations.

A comprehensive plan provides long-term guidance for growth, local regulations for development, provisions for protection of public health and safety, and descriptions of community values and future expectations. It is a blueprint to guide orderly and appropriate growth and development in a jurisdiction. There are provisions for public involvement in comprehensive plan development and amendment. Plans and amendments may be

Compact development, growth boundaries, infill – the topics we read about in the planning literature – could literally be lifesavers. …Too often, we concentrate on fire trucks and sprinkler requirements. Shouldn't we be concerned about land-use planning strategies for preventing the next disaster?
Nan Johnson, AICP in American Planning Association Magazine, July 2000

Comprehensive plan policies should guide development decisions in wildland-urban interface areas to discourage expansion of the WUI. Urban sprawl creates the WUI and its associated fire protection problems.
Fuels Management in the Wildland Urban Interface
Florida Division of Forestry, 2002

challenged for failure to comply with state laws and regulations. After a comprehensive plan is completed, plan policies are generally implemented through local ordinances, known as Land Development Regulations (LDRs) or Land Development Codes (LDCs).

Land use planning is a community process to identify appropriate and compatible uses for land within a jurisdiction. Land use planning connects public safety considerations with the land in a given area. The responsibility and authority for regulating land use and development rests with the county or municipal government, with oversight from the FDCA.

The Future Land Use Element (FLUE) of the comprehensive plan designates the general distribution, location, and extent of the uses of land for future residential, commercial, industrial, agricultural, recreational, conservation, education, public, and other uses of land (Florida Statutes Section. 163.3177(6)(a)). The Comprehensive Plan must also include a Future Land Use Map (FLUM) that graphically identifies these specific purposes for which land may be used. A major focus of land use planning is to ensure that adjacent land uses are compatible with one another and suitable for the characteristics of a given area.

The FLUE and FLUM have great potential for protecting homes and businesses from wildfire if areas of elevated wildfire risk are clearly identified. To consider wildfire hazards in land use decisions, a community first must identify areas that are at risk of wildfire damage. The community can then identify and implement the appropriate steps to minimize potential wildfire damage in high-risk areas. Methods for assessing wildfire risk are discussed in the Tools section of this chapter.

Comprehensive plan policies for wildfire mitigation should be tailored to the unique characteristics of Florida's fire-adapted ecosystems. Policies from the western U.S. may not apply in Florida. For example, some literature about wildfire in the western United States recommends that structural density be limited in wildfire-prone areas. This recommendation is based primarily on the characteristics of wildfire as it rushes up a steep slope. Slope (topography) is not a major factor in wildfire behavior in Florida. Experience in Florida has shown that widely scattered rural homes are more difficult to protect from wildfire. Developments in wildfire-prone areas of Florida would benefit from being clustered housing surrounded by greenspace that also serves as a community fire protection zone. While hand crews fight fires in rugged western terrain, the presence of adequate infrastructure (e.g., all-weather access roads, adequate water systems, safety zones of reduced vegetation) is more important for Florida firefighting efforts that are typically undertaken with heavy machinery.

Beyond the FLUE and FLUM of the comprehensive plan, other elements where wildfire mitigation should be addressed include the Conservation, Intergovernmental Coordination, and Capital Improvements Elements. Below is an example of the Conservation and Open Space Element of the Alachua County (Florida) Comprehensive Plan, which now includes wildfire mitigation language.

Planners need better tools and increased awareness in order to address the wildfire problem. Later in this chapter, the Tools section gives a complete description of new approaches, including the Florida Division of Forestry's Florida Wildfire Risk Assessment System, which is available to support local government wildfire risk assessment. Chapter 3 includes model ordinances that can be adapted to the needs of local governments.

Strategic Planning/ Local Mitigation Strategy (LMS) Process

The goal of strategic planning for hazard mitigation is to maximize public safety and property and resource protection while minimizing the investment in protection resources. In general, a strategic planning process for wildfire mitigation would include an area-wide system for wildfire prevention and protection. The area could be any jurisdiction, such as a watershed, a local government, a community, or a neighborhood.

Elements of a strategic planning process for wildfire mitigation include:

WILDFIRE CONSIDERATIONS IN LAND USE PLANNING

The ultimate goal is to have the wildfire hazard considered in all land use decisions. There are a number of ways that wildfire considerations can become a part of applicable comprehensive land use plans:

- Comprehensive plans can recognize the fact that a wildfire hazard exists in the area
- Comprehensive plans can identify areas of risk based on a wildfire risk assessment
- Comprehensive plans can provide detailed descriptions of the wildfire hazard and recommendations for dealing with it
- Comprehensive plans can include considerations of wildfire hazards within land-use and other elements
- Comprehensive plans can address both structural and wildfire protection and mitigation in the fire protection and/or public safety elements
- Land-use policies can focus attention on the vulnerability of identified zones, neighborhoods, or properties to the wildfire hazard
- Decision makers can consider the wildfire hazard when comprehensive plan amendments cause rural lands to urbanize
- Decision makers can consider the wildfire hazard in development and redevelopment decisions, especially as part of the formal site plan review process

(Adapted from IBHS Community Land Use Project, www.ibhs.org).

CASE STUDY: ALACHUA COUNTY COMPREHENSIVE PLAN, CONSERVATION AND OPEN SPACE ELEMENT

Goal: To conserve, manage and restore or enhance the natural and human-related resources of Alachua County to ensure long-term environmental quality for the future.

5.0 HUMAN-RELATED RESOURCES

5.6. WILDFIRE MITIGATION

Objective 5.6: Protect life, property, and the economy by eliminating or minimizing the present and future vulnerability to wildfire hazards.

Policy 5.6.1 Areas of wildfire hazard within Alachua County shall be mapped and ranked using features such as plant community type and development stage, canopy cover, hydrography, soils, slope, aspect, and elevation. The initial mapping shall be based on the Fire Risk Assessment Model contracted by the Florida Division of Forestry for completion in 2002. Mapping shall be reviewed annually and, as necessary, updated in response to changing fuel conditions.

Policy 5.6.2 The County shall educate the public, especially those at high risk from wildfires, and make them aware of proactive steps that they can take to mitigate wildfire damage.

Policy 5.6.3 The County shall advance the directives and policies of local emergency management operational plans and the Alachua County Local Mitigation Strategy.

Policy 5.6.4 The County shall implement a Firewise Medal Community Program that involves community fire preparation, evaluation and awards for program involvement. The County shall seek recognition of this program by the state Firewise Communities Recognition Program.

Policy 5.6.5 Alachua County shall carefully consider all land uses in areas at risk from wildfire and restrict or prohibit certain land uses as necessary to assure public health, safety, and welfare and the protection of property. Land uses and specific development plans for which adequate wildfire mitigation cannot be provided, or that would preclude or severely limit the use of wildfire mitigation or natural resource management options such as prescribed fire, shall not be authorized in severe wildfire hazard areas.

CASE STUDY: ALACHUA COUNTY COMPREHENSIVE PLAN, CONSERVATION AND OPEN SPACE ELEMENT (continued)

Policy 5.6.6 Development in wildfire hazard areas shall comply with the following minimum standards:

1. All new development shall complete and implement a wildfire mitigation plan specific to that development, subject to review and approval by the Alachua County Fire Rescue Department, which shall be incorporated as part of the development plan approved for that development.
    a. The mitigation plan shall include project and parcel design features, such as defensible project perimeters, interior project fuel breaks, individual site defensible space, landscaping guidelines and plant material suggestions, and the placement of structures.
    b. The mitigation plan shall include provisions for periodic inspection by the County to verify construction, implementation, and maintenance of the wildfire mitigation features in accordance with the plan. The inspection period may range from once a year to once every three years depending upon the site conditions.
    c. The wildfire mitigation plan requirements shall be implemented for the entire life cycle of all developments requiring plans.
2. Structures shall be designed to minimize the potential for loss of life and property from wildfires, through requirements for outdoor sprinkler systems, fire-resistant building materials or treatments, landscaping with appropriate vegetation species, and site design practices.
3. Water storage facilities, accessible by standard firefighting equipment, shall be provided, dedicated, or identified for fighting wildfires. Where public supply is available, fire hydrants of sufficient pressure shall be required.
4. Streets, roads, driveways, bridges, culverts, and cul-de-sacs shall be designed to assure access by firefighting equipment, providing for weight class, cornering, turnaround and overhead clearance.

Policy 5.6.7 The County shall pursue available funding for community/volunteer service programs for fuel management on lands owned or managed by Alachua County.

Policy 5.6.8 The County shall implement a fuels management program that consists of the following:

1. Practices such as prescribed burning, mechanical fuel reduction, and thinning, as necessary and appropriate to reduce wildfire hazards consistent with natural resources protection.
2. Increased public awareness of the benefits of prescribed burning and the inevitability of resulting smoke.
3. Acknowledgment by occupants in areas where prescribed burning is appropriate that they have been informed that prescribed burning may be used to manage wildfire hazards and that smoke will be present.
4. Special focus on the wildland-urban interface as an area exposed to wildfire hazard.

Amendments as adopted April 8, 2002. Alachua County Department of Growth Management, Gainesville, FL 32601

- Delineation of areas by level of risk (e.g., low, medium, high, extremely high);
- Identification of problems, opportunities, gaps, and deficiencies
- Implementation of strategies for:
  - Fuel management,
  - Greenspace (open space) and fuel breaks,
  - Design for access, landscaping, building placement, and construction materials,
  - Water supply,
  - Signage;
- Preparation of trained personnel and equipment for wildfire protection;
- Establishment of agency and organizational interrelationships, including major risk groups, such as homeowners and property associations.

Impediments to strategic planning processes include developers or landowners who perceive the process as resulting in restrictions, government inertia, budget or personnel limitations, and a general lack of understanding of the threat.

Local Mitigation Strategy (LMS) Process

The LMS process is a specific strategic planning process undertaken in Florida. Florida has been a national leader in this arena of "all-hazards" mitigation planning. In 1998, Florida funded a $9 million initiative known as the Local Mitigation Strategy (LMS) process. LMS plans have the dual goals of:

1. Permanently reducing or eliminating long-term risks to people and property from the effects of a variety of hazards (including wildfire);
2. Guiding long-term disaster recovery efforts.

The LMS process specifically addresses local government concerns about the vulnerability of growing populations to natural disasters such as hurricanes, floods, and wildfires. A variety of hazard mitigation actions can be included in the LMS, such as land use planning to limit development in high-risk areas, programs for retrofitting existing structures to meet new building standards, state and local land acquisition programs that consider hazard mitigation as an element in ranking purchases, and a mix of hazard-reduction code enforcement, planning, and development practices. The LMS serves as a bridge between the local government comprehensive growth management plan, local emergency management plans, land development regulations, building codes, and relevant ordinances.

THE LOCAL MITIGATION STRATEGY PROCESS

- **Government coordination –** an inventory of hazard mitigation agencies, policies, agreements, conflicts, and potential local mitigation projects
- **Public participation –** establishment of a working group, public participation procedures, and plan adoption and coordination procedures
- **Evaluation and enhancement –** procedures for periodic review of the LMS and for broad participation in that review

The LMS process states that hazard mitigation should not be an impediment to the continued economic success of a community, but rather a way to create a safer and more economically and environmentally resilient community. Communities that can withstand natural disasters are healthier communities, less susceptible to the economic shocks and/or loss of life and property that can result from a natural disaster.

Just as in other types of cooperative planning strategies, the LMS process begins by determining who should be involved and what their roles and responsibilities will be. The LMS establishes greater coordination within levels of local government and between local and state and federal agencies. The LMS also provides for public participation in the strategic planning effort. Typical participants in an LMS process include local governments, local planners, emergency managers, building officials, public safety and public works directors, elected and appointed officials, agency representatives, community groups, and citizens. These representatives form a central working group to develop guiding principles and to oversee the LMS process.

The LMS might include analyses of the degrees of readiness, risk inventories, projections of wildfire scenarios, and inclusion of "lessons learned" by partners in previous disasters. A risk inventory would typically delineate areas at risk of a particular hazard. For example, coastal areas might be at higher risk of flooding, while wildland-urban interface areas might be at higher risk of wildfire. There are various modeling systems that help planners to assess risk, including the FDOF's Florida Wildfire Risk Assessment System.

Most of the counties in Florida have completed the basic LMS process and are now entering the implementation phase. The LMS process can be revisited to include wildfire concerns in areas where wildfire was not considered during the first round of LMS planning.

In the past, funding for wildfire mitigation planning efforts came from fire protection agencies, but funding of strategic planning programs is now often shared among local government planning agencies, with some costs passed on to developers and landowners. Grant funding is a potential source of support for wildfire mitigation planning activities. Some local government wildfire mitigation strategies have been completed with competitive grant funds from the FDCA's Emergency Management, Preparedness, and Assistance (EMPA) Trust Fund, implemented in 1994 (Chapter 9G-19 F.A.C.). EMPA funds have been granted to cities and counties around Florida for emergency management training and education activities, coordination of Community Emergency Response Teams (CERTs), enhanced communications systems, facilities and infrastructure improvements, wildland firefighting equipment, and other wildfire mitigation projects. For example, EMPA funds supported the development of Indian River County's 2000 *Comprehensive Wildfire Mitigation Plan* and Okeechobee County's 2002 *Local Countywide Wildfire Mitigation Plan*.

Other potential grant funding sources include the U.S. Federal Emergency Management Agency's (FEMA) Predisaster Mitigation Assistance program, FEMA's Hazard Mitigation Grant Program, and the U.S. Fire Administration's National Fire Grant program. Because these are competitive grant programs, they require thoughtful and well-documented proposals and a wait from submission to the time funding is received, but these sources are worth pursuing when funding becomes a major impediment to planning or implementation of wildfire mitigation activities for a community.

Cooperative or Functional Planning for Wildfire Mitigation

Cooperative planning is a broad community process that involves a range of entities and individuals taking responsibility for the resolution of hazard mitigation problems. Cooperative planning processes are undertaken as a partnership between governmental and non-governmental groups, and are generally undertaken outside of governmental planning frameworks. Cooperative decision-making provides an opportunity for citizens, organizations, and agencies, to reach a common understanding and take action toward the management of shared resources and values. This process is sometimes called functional planning because it works to creatively address a specific problem of community interest.

Cooperative or functional planning is achieved through voluntary partnerships. Factors that can lead to enhanced cooperation include a shared sense of threat, shared goals, a common sense of place, prior cooperation on other issues, and common interests. Cooperative strategies are enhanced by an effective and open process, use of good interpersonal skills, dedicated and open-minded participants, and support of the process with the necessary resources and technologies.

Examples of cooperative wildfire mitigation

THE LOCAL MITIGATION STRATEGY PRODUCT

- **Guiding principles –** goals for hazard mitigation and long-term recovery, recommendations from past disasters, linkages to relevant local policies and ordinances, coordination with local comprehensive plan goals, and exploration of policies at variance with LMS goals and objectives.
- **Hazard identification and vulnerability assessment –** a hazard assessment and map of the community, maps of land use patterns and development trends, maps of high-risk areas, descriptions of GIS capabilities, models of how a disaster might affect the community under various scenarios, an economic analysis, and a summary of the vulnerability assessment.
- **Mitigation initiatives –** policies and actions to mitigate the hazard, such as reduction of public expenditures in areas subject to repetitive damage, protection of critical facilities, removal of vulnerable infrastructure on hazardous sites, elimination or regulation of development in hazard-prone areas, protection of watersheds, diversification of an economy prone to disaster damages, prioritization of lands for hazard mitigation acquisition, policies for post-disaster reconstruction, identification of funding sources, and establishment of a task force to direct mitigation initiatives.

planning can be found across the country in the form of wildfire coordinating groups, neighborhood fire safety councils, prescribed burning cooperatives, volunteer fire protection departments, landowner associations, and prescribed fire councils. These cooperative groups often use subcommittees to deal with specific interest areas, such as prevention, training, equipment, fuel management, and public outreach, affording opportunities for participation of people from all walks of life in the cooperative planning process.

Success in cooperative planning efforts is inextricably tied to the commitment of the stakeholder groups involved in the process. Success is especially likely to be achieved if there are one or more individuals who are strong advocates for wildfire mitigation. These committed individuals typically initiate the cooperative process and are key to making sure that program implementation is realized.

A cooperative planning approach may be either informal or formal and it may or may not include a written agreement to clearly define roles and responsibilities. Some partnerships may prefer to remain informal and use voluntary effort to accomplish mitigation goals. If a cooperative partnership becomes more formal, a written agreement can establish standards, working relationships, and a legal basis for financial exchange as necessary (e.g., if agencies or groups are going to exchange financial support or personnel services). One good way for a cooperative planning effort to begin is for participants to develop a consensus document that clearly articulates the issues and mission of the group. The accompanying box describes the cooperative planning process in more detail.

CASE STUDY: FUNCTIONAL PLANNING IN FLORIDA'S PRESCRIBED FIRE COUNCILS

Florida has three Prescribed Fire Councils that were established in the 1970s and 1980s to promote understanding, education, and cooperation around prescribed fire issues. These councils are voluntary non-governmental organizations, and were not established in response to any statute or law, but rather for the promotion of prescribed burning in Florida. The missions of these groups include encouraging the exchange of information, techniques, and experiences among practitioners of prescribed fire and promoting public understanding of the importance and benefits of prescribed fire.

The Councils typically meet once or twice a year to exchange information and education among members. The meetings now satisfy a portion of the continuing education requirement for Florida certified prescribed burn managers. Prescribed fire council meeting topics range from policy and liability issues to weather, fuels management, equipment, endangered species, and special reports on "lessons learned" by fire managers in the field. Cooperators in the Councils include state agencies, federal agencies, universities, forest industry landowners, private landowners, private conservation organizations, counties, cattlemen's organizations, private consultants, local fire-rescue services, fire chief organizations, and individual certified prescribed burn managers.

Developing a Cooperative Approach to Wildfire Protection

The Firewise guidebook, *Developing a Cooperative Approach to Wildfire Protection,* includes several model agreements that may be used as part of a cooperative wildfire protection planning process. The guide identifies six steps to developing a cooperative wildfire mitigation program:

1. Identify partners and get commitment
2. Define the current situation (including areas and levels of risk)
3. Define roles and responsibilities
4. Set goals and objectives
5. Document and implement the plan
6. Evaluate and revise the plan as necessary

(Adapted from *Developing a Cooperative Approach to Wildfire Protection, 1988,* available at http://www.firewise.org/pubs/developing/)

1. Identify partners and get commitment

A cooperative planning program should be a shared responsibility among those who live and work in an area, including traditional partners such as state, local, and federal fire and planning agencies, but also nontraditional partners such as community groups, homeowners, non-governmental agencies, and citizens. It is important to identify and invite the participation of all stakeholders who might be affected by a wildfire. Potential non-governmental partners include homeowners/property associations, businesses, chambers of commerce, American Red Cross, power companies, and communications companies. Additional partners might include local emergency management agencies, the state forestry agency, and local school districts. Once all stakeholders have become engaged, a technical advisory committee can be formed to guide partnership efforts.

2. Define the current situation

This planning step usually involves gathering information, researching and analyzing the current wildfire situation in the community, identifying hazardous fuels/areas, describing current fire protection districts/equipment/personnel, and defining current suppression capabilities. Once this information is gathered, the situation can be defined in terms of wildfire hazard, current and potential wildfire risks, and values to be protected from wildfire. Mapping such as that provided by the Florida Wildfire Risk Assessment System (FRA) would be very useful at this stage. Local government GIS systems also provide valuable coverage of community characteristics that can be merged with FRA or other hazard data. Specific areas needing improvement can be easily identified at this point.

3. Define roles and responsibilities

Depending on their mission or interest in fire protection and their commitment to the planning process, each partner will be able to take a clearly defined role. A delineation of capabilities and roles will help to highlight strengths and weaknesses in current programs. For example, new partners may be identified and invited to participate if gaps are identified or if existing partners are not able to "cover all of the bases." This step allows all of the partners to better understand the larger scheme of things.

4. Set goals and objectives

Using the information gathered and the partners' capabilities, this step will establish clear goals for the community plan. Specific objectives can then be identified to address pressing problems and long-term issues. Partners may then consider sharing resources to address these objectives. Resources or projects to consider sharing include education/awareness programs, training, prevention and protection programs, communications/dispatch activities, weather services or equipment, and fire suppression resources.

5. Document and implement the plan

At the end of the goal-setting phase, a plan is usually put in writing so all partners can see the goals and responsibilities. Timelines and funding sources are identified for projects to be carried out under the plan. It is important to have a point person from the technical advisory committee monitor and urge implementation of plan goals the participating partners. When activities are completed, partners will report back to the point person so that implementation is tracked as part of the ongoing process. It is important to ensure that each cooperator understands the roles and responsibilities assigned to them under the plan. Sometimes a formal agreement is developed that all partners can agree to and sign. This agreement might take the form of a cooperative fire protection agreement, an annual operating plan, a cost-share agreement, a community protection plan, or any other form that works for the partnership. A discussion of the many types of reciprocal agreements can be found in the doument.

6. Evaluate and revise the plan

The plan should be reviewed and revised annually to make sure the document is current in the face of changing resources and procedures and to make sure the plan meets the needs of the partners for future events. It is important for the cooperators to understand that plans are meant to be revised to reflect changing conditions, and that this process of revision is a normal part of the cooperative planning process. Joint training exercises or joint educational programs may be one basis for evaluation of the plan's effectiveness.

The effort to build a local cooperative agreement may be time-consuming at first, but it is important to develop a plan that everyone supports. It is better to start with a simple plan that addresses the highest priorities, improves cross-boundary cooperation, and recognizes the unique qualities and skills of each agency or organization. The plan can later be revised or expanded as necessary. The most important thing is that the cooperators get to know each other. Familiarity among counterparts, agencies, and citizens leads to clear and open channels of communication that will be useful during the next wildfire threat to the community.

Wildfire is not the only natural resource challenge in the wildland-urban interface, but wildfire can become an organizing force for cooperation on a number of issues, including needs for recreational access, insect and disease control, water and wildlife management, and the growing need for environmental education to raise awareness and influence behaviors of all citizens.

SOCIAL AND ECONOMIC STRATEGIES

While state and local governments have a strong influence through comprehensive and strategic planning efforts, there are many other entities that have a role in how land is developed and redeveloped, and thus whether homes and businesses are at risk from wildfire hazards. These entities include architects, landscape designers, developers, builders, real estate agents, engineers, insurers, businesses, land managers, and property owners. It is important for all of these groups to understand the linkages between planning, development, and wildfire vulnerability. It is critical for education and economic incentive programs to address these groups.

The Firewise Communities program is one model for raising awareness in a community about these important issues. Cooperative planning and local mitigation strategy processes are other ways for local governments to address growing concerns about wildfire hazards in the expanding wildland-urban interface. Most of these strategies focus on stakeholder groups that are likely to be directly impacted by wildfire.

In addition to targeted stakeholder programs, the importance of raising general public awareness of wildfire mitigation needs and support for fuel management strategies cannot be overstated. There is little doubt that public misunderstanding of the need for prescribed burning was a factor in the buildup of fuels prior to the catastrophic 1998 wildfires. The Governor's report prepared after the 1998 wildfires specifically recommends that "The public…needs to gain an understanding of wildfire as a natural occurrence and the key role of

CASE STUDY: GREATER OKEFENOKEE ASSOCIATION OF LANDOWNERS (GOAL)

Fire has been a common natural event in the Okefenokee Swamp. Wildfires often burn acres of valuable commercial timber, but these same fires are of significant ecological benefit to the Okefenokee Swamp National Wildlife Refuge. Balancing these opposing needs for the benefits of fire and protection from fire led to the formation of the Greater Okefenokee Association of Landowners (GOAL: http://www.southernregion.fs.fed.us/goal).

GOAL provides landowners and interested parties with information about fire activity in the Okefenokee area. The mission of GOAL is to serve as a unified team for understanding fire dynamics in the Okefenokee system and for protecting and promoting forest resources in and around the Okefenokee Swamp to assure these resources will be available for future generations. GOAL recognizes that:

- Forest resources are the basis of major industries in the area
- The Okefenokee Swamp is a national treasure that provides economic and biological benefits to the local communities and the states of Georgia and Florida
- It is essential to have a coordinating committee for protection of public and private resources from fire and to provide an avenue for communications and strength in dealing with area issues

GOAL is a cooperative effort between the USDA Forest Service, the US Fish and Wildlife Service, Florida and Georgia forestry agencies, and local forest landowners. Currently, there are approximately eighty plus individuals involved in GOAL and representing entities such as private timber companies, private paper companies, private forest products manufacturing companies, mining companies, Georgia and Florida state forestry agencies, federal land management agencies, private consulting firms, and private landowners.

prescribed burns in wildfire mitigation" (Florida Department of Community Affairs 1998).

This shift in awareness toward the value of prescribed fire in preventing wildfire is also reflected in the changed message of Smokey Bear. Smokey originally said, "Only YOU can prevent forest fires." Smokey now says, "Only YOU can prevent wildfires." Smokey has officially embraced the need for prescribed fire as a fuel management technique in wildlands threatened by wildfire.

Public Education/ Outreach Programs

The Florida Division of Forestry (FDOF) has a statutory responsibility "to prevent, detect, suppress, and extinguish wildfires wherever they may occur on public or private land in this state and to do all things necessary in the exercise of such powers, authority, and duties," including providing public education about wildfire protection and prevention (590.02(1)(b) F.S.). The FDOF accordingly presents a number of educational programs to both adult and young audiences throughout Florida. See the FDOF website at http://www.fl-dof.com/.

Information and education programs should be an integral part of wildfire prevention and mitigation programs for the general public, the landscaping and building community, and elected officials. Community leaders and local government officials should know how to implement wildfire mitigation programs at the local level. Further public outreach should be undertaken to engender public support for wildfire mitigation activities. Providing public outreach and promoting participation in local government programs is becoming a primary function of some planning departments. Public participation in the development of comprehensive plans and land use decisions is a fundamental basis of growth management in Florida. By directing public attention to wildfire hazards, citizens will begin to understand the importance of wildfire mitigation actions.

There are a variety of public attitudes that must be addressed during any discussion of wildfire mitigation actions. Individual opinions vary, of course, but public opinion is generally in favor of more trees and more natural areas around communities. Many people want a home in a forested area. The public also has a certain level of denial about whether certain hazards will personally affect them. When considering the likelihood of disaster, most people think, "It won't happen to me." Lack of awareness or disregard for recommended mitigation practices in the face of the wildfire hazard has repetitively resulted in losses of wildland-urban interface homes. There are

CASE STUDY: FIREWISE COMMUNITIES USA RECOGNITION PROGRAM

Firewise Communities USA is a recognition program that provides citizens in a community with the knowledge and skills necessary to maintain an appropriate level of wildfire preparedness. The Florida Division of Forestry coordinates the Florida Firewise Communities USA recognition program.

In order to be recognized as a *Firewise Community USA*, a participating community must meet a set of standards, including:

- Enlist a wildland-urban interface fire specialist to complete a community assessment and create a plan that identifies agreed-upon solutions to be implemented by the community
- Sponsor a local Firewise Task Force to maintain the *Firewise Community USA* program and track progress and status of the program
- Observe a *Firewise Communities USA* awareness day each spring that is partly dedicated to carrying out a local Firewise project
- Invest a minimum of $2.00 per capita annually in Firewise projects, including work by municipal employees and volunteers and state and federal grants dedicated to that purpose
- Submit an annual report to *Firewise Communities USA* that documents how the community has met the goals of the program

A *Firewise Communities USA* program is frequently started in a community with a Firewise Communities workshop as described in Chapter 1. Once the community has met the standards and has completed at least one Firewise project, the community is awarded the *Firewise Communities USA* recognition. The community must seek recognition renewal each year, which includes submitting supporting documentation of continued participation through the Florida Division of Forestry. The reward for the community is in the *Firewise Communities USA* recognition and signs, and the knowledge that the community is safer in the face of the wildfire threat.

PUBLIC OUTREACH PROGRAMS FOR WILDFIRE PREVENTION AND PRESCRIBED FIRE AWARENESS

- Florida Wildfire Prevention CD-ROM (FDOF)
- Living on the Edge in Florida CD-ROM (FDOF)
- Fire in Florida's Ecosystems Curriculum and Educator Training Program (FDOF)
- Firewise Communities Training Workshops (FDOF)
- Firewise Communities USA Recognition Program (FDOF)
- Wildfire Prevention presentations for schools or homeowners (FDOF Districts)
- Career Day presentations at schools (FDOF Districts)
- Smokey Bear educational materials and programs (USFS, FDOF)
- Prescribed Fire awareness activities, workshops, legislative days (Florida's Prescribed Fire Councils)
- Prescribed Fire Awareness Week (second week of March, multiple agencies)
- Wildfire Awareness Week (second week of April, multiple agencies)
- National Fire Prevention Week (second week in October, multiple agencies)
- Numerous publications (all agencies)

also mixed attitudes about what is perceived as governmental interference in people's lives. Some citizens believe that government should allow people to live in areas at risk from flooding, wildfire, or other hazards, yet most citizens will expect society to protect and support them when a disaster occurs.

Economic Incentives for Hazard Mitigation

Compared to water and wind damage from storms, wildfire does not cause a very high level of losses to the insurance industry in Florida. Insurance discounts have not been implemented in Florida because of the relatively low level of losses. With increasingly large losses from wildfire, however, the insurance industry is beginning to develop programs to reduce wildfire losses in the western U.S. Insurance cost reductions can provide an incentive for wildfire mitigation in high-risk wildfire zones. Chapter 5 includes a discussion of the growing movement toward insurance incentives for wildfire mitigation actions.

EFFECTIVE AND LONG-TERM COMMUNITY WILDFIRE MITIGATION

Long-term maintenance of wildfire mitigation practices in high-risk areas is of special concern. Most wildfire mitigation processes address wildfire hazards only at the time of site preparation or development. It is particularly important for communities, neighborhoods, and developments to assign roles and responsibilities for long-term wildfire mitigation and fuel reduction practices. This can often be accomplished through neighborhood associations or by including maintenance requirements in deed restrictions.

Members of a community based wildfire mitigation or planning team should consider projects to:

- Involve and educate community members, with a special focus on the key messages discussed in the last few pages;
- Strategically plan for wildfire emergencies and fire protection;
- Help citizens understand that fire agencies cannot guarantee protection, especially where residents live in an area of known wildfire hazard;
- Support and implement fuel reduction strategies, including increased prescribed burning (any entity or person that seeks to undertake a prescribed burn in Florida must have prior authorization from the Florida Division of Forestry);
- Develop programs that increase public awareness wildfire danger and necessary mitigation actions, e.g., an annual brush-clearing days and "fire season preparedness" activities;
- Encourage the creation of zoned wildfire mitigation landscapes around homes, buildings, and communities (see Chapter 6);
- Encourage construction of buildings that are resistant to wildfire in hazardous areas (see Chapter 5);
- Proceed without waiting for insurance premium adjustments – the numbers of homes lost to wildfire are still not enough to justify discounts for firewise building practices;
- Establish creative incentives for all partners to take appropriate actions, e.g., provide community guidelines and incentives for

KEY MESSAGES FOR WILDFIRE MITIGATION EDUCATION PROGRAMS

- Florida's ecosystems are adapted to periodic fire. Florida's wildlands will occasionally burn in a wildfire unless fuels are removed with prescribed fire or some other fuel reduction treatment.
- Most wildfires are supported by surface vegetation and debris. Wildfire mitigation involves removing surface-level vegetation and debris. It may not be necessary to remove any mature trees to protect a home from wildfire.
- Most urban or suburban areas are at low risk of wildfire. Residents at high risk of wildfire – with homes located in the wild-land-urban interface – should take action to protect their property from wildfire damage and should encourage their neighbors to do likewise.
- Wildfires will be less damaging and costly to society if preventive and protective actions are taken. While it is government's responsibility to provide for the protection of public health, safety, and welfare, it is everyone's responsibility to protect homes, neighborhoods, and communities from the wildfire hazard.

CASE STUDY: FIRE IN FLORIDA'S ECOSYSTEMS CURRICULUM AND EDUCATOR TRAINING PROGRAM

The Florida Division of Forestry's Fire in Florida's Ecosystems (FIFE) Educator Training Program has reached nearly 1900 educators with a free curriculum package and training since 2000. The effort is designed as a program to reach Florida's young people in the wake of the 1998 Florida wildfires and to address a recognized need for more public outreach programs. FIFE focuses on the natural role of fire in Florida's ecosystems and on the use of prescribed fire to reduce fuels and prevent wildfire. The program has close to 100% adoption in the classroom and has reached nearly 300,000 students and over 650,000 citizens as of December 2003.

The curriculum package includes hands-on classroom activities, reading passages, videos, posters, the interactive Burning Issues CD-ROM, and study questions to help students prepare for state assessment tests. A typical educator training session includes practice with the activities, background on fire and prescribed fire issues in Florida, a presentation by a FDOF representative, and a tour of a fire-maintained landscape. The package and trainings are completely free of charge and are offered at schools, forests, nature centers, conferences, and other locations throughout the year. The FIFE curriculum and training schedule can be viewed at http://flame.fl-dof.com/FIFE.

Photo: FDOF/Pandion Systems

Teacher's at a *Fire in Florida's Ecosystems* training.

CASE STUDY: LIVING ON THE EDGE IN FLORIDA CD-ROM

The Florida Division of Forestry released the educational Living on the Edge in Florida CD-ROM in 2003. The CD uses video clips, documents, graphics, Internet links, and a companion website to provide an enjoyable and user-friendly way to learn about wildfire and wildfire protection in the wildland-urban interface. The CD begins with a tutorial on wildland fire and an introduction to the Firewise Communities program. Video clips discuss topics such as Firewise landscaping and factors in ignition of homes in wildfires. The CD is designed for use with small groups or individuals or in upper-level classrooms. The goal is to encourage community members, professionals, and homeowners to plan and take action for wildfire protection in the wildland-urban interface. The CD is available from the FDOF.

firewise improvements, such as reduced building permit fees for firewise improvements and reduced/waived new property assessment taxes on firewise improvements.

Long-term maintenance of a municipal, county, or regional wildfire mitigation strategy requires the participation of a number of partners. It is unlikely that any one of these partners could be effective in wildfire mitigation alone – the effort requires these groups to work together to protect lives and property from the wildfire hazard. There are a number of things that could be done by various wildfire mitigation partners to keep a long-term wildfire mitigation strategy working in Florida.

ROLES FOR LONG-TERM WILDFIRE MITIGATION ACTIONS NEEDED IN FLORIDA

- Homeowners and community associations can assume more responsibility for maintaining Firewise landscapes and buildings and community protection zones around properties.
- Local governments can assume more responsibility for wildfire mitigation through planning and zoning processes, local regulations, and development review.
- Local code-enforcement and law-enforcement departments can take a more active role in addressing landscape maintenance requirements mandated in the regulatory process.
- Local fire protection services can expand their role in wildfire mitigation and fire prevention education programs, and also in encouraging the long-term maintenance of wildfire mitigation practices, which can be accomplished through the adoption of wildfire mitigation regulations in concert with local governments.
- The Florida Division of Forestry can continue their work in implementing wildfire mitigation, wildfire education, and wildfire risk assessment programs. The FDOF is a clearinghouse for fire information and education, provides wildfire mitigation and prescribed burning services throughout the state, and now provides risk assessment data and guidance to local governments for assigning wildfire hazard ratings throughout the state.
- State agencies can encourage and support local efforts, particularly in rural areas where a low tax base may prevent smaller communities from funding efforts to address crucial wildfire mitigation.
- The insurance industry can implement proactive strategies to encourage long-term wildfire mitigation by providing discounts for homeowners who maintain wildfire mitigation status in high-risk zones. At some future date, insurance companies should consider requiring wildfire mitigation actions as a precondition to fire insurance in certain high-risk areas.
- Teachers can bring wildfire prevention and prescribed fire topics and activities into the classroom and can take students on field trips to fire-adapted and fire-maintained ecosystems in Florida.
- Business leaders and developers can take a leadership role in building wildfire-resistant communities and in helping the area to be designated a Firewise Community USA.
- Community leaders and elected officials can encourage all of these wildfire mitigation actions in the high-risk areas of the community as a movement toward enhanced public safety and welfare through wildfire hazard mitigation.

Tools for Risk Assessment and Fuel Management

LANDSCAPE-LEVEL RISK: THE FLORIDA WILDFIRE RISK ASSESSMENT SYSTEM (FRAS)

In order to address the wildland-urban interface wildfire problem in Florida and to improve public safety and prevent property losses such as those suffered in the wildfires of 1985, 1998, and 1999, the Florida Division of Forestry developed a process to assess wildfire hazards and risks, and the values to be protected, on a statewide basis.

The purpose of the Florida Wildfire Risk Assessment System (FRAS) is to identify the potential for serious wildfires within Florida and to set priorities for wildfire mitigation to reduce risk. FRAS is a computer-generated map (Geographic Information System or GIS) of the level of wildfire risk based on satellite imagery. The analysis divides the mapped areas into cells that are about 1/4-acre in size. Risk ratings can be generated for the entire state or for any portion of the state, and are graphically represented on a color-coded continuum from “red” high-risk areas to “green” low-risk areas.

The national Fire Behavior Prediction System (FBPS) has 13 fuel models used for predicting fire behavior through computer modeling of fuels. Through the FRAS process, the FBPS fuel models have been correlated to actual conditions, allowing for a uniform assignment of fuel models throughout Florida.

2
Community planning to reduce wildfire risk

FRAS calculates two indices for every 1/4-acre cell in Florida:

1. The **Wildland Fire Susceptibility Index** (WFSI) uses computer modeling to represent the likelihood of an acre burning by combining the factors of historic wildfire occurrence, expected fire behavior (fuels, weather, topography, and spread rate), and historic success rates for fire protection (how fast the fire spread and how big it got).
2. The **Fire Effects Index** (FEI) is an indication of the expected effects of a fire and combines an environmental effects rating with a fire suppression cost for the area under consideration. This index identifies areas that have environmental values at risk, including wildland-urban interface areas, utility corridors, pine forests (natural and planted), and critical facilities (airports, schools, hospitals, highways). This index includes a rating of areas where wildfires are expensive to suppress, as evaluated by fuel type (e.g., wildfires in muck soils are much costlier to suppress than those in grassy fuels).

These two indices are combined in a single rating of **Level of Concern** (ranging from 0 to 100) for every area of burnable vegetation in Florida. The Level of Concern is the best measure of wildfire risk because it combines both the likelihood of an acre burning and the expected effects of that wildfire into one measure.

Reducing the Wildland Fire Susceptibility Index can usually reduce a high Level of Concern. Because the WFSI is heavily dependent on the fuels that feed fire behavior, reducing fuels will moderate the wildfire's predicted spread and/or intensity and, therefore, lower the Level of Concern. If a high level of historic wildfire occurrence is contributing to a high Level of Concern, a wildfire prevention and protection outreach campaign may be implemented.

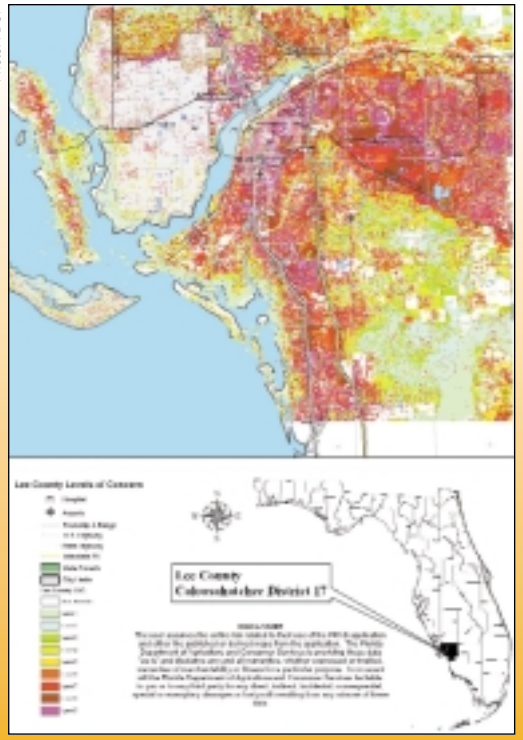
The FRA system also assigns each cell a **Fire Response Accessibility** rating, which is a relative measure of how long it would take firefighting resources to reach the cell. This allows users of the system to easily identify areas of low accessibility. If areas of low accessibility correspond with areas of high concern, this would indicate places where wildfire suppression resources might need to be added or enhanced and where there would be an increased need for ongoing wildfire mitigation activities.

Because FRAS can handle so much data over such a broad area at one time, it is a useful tool for setting priorities for fuel reduction and placement of firefighting resources in a given region, district, or county. The results of a FRAS analysis can be used to:

- Identify areas where mitigation (especially fuel reduction) may be of value;
- Allow agencies to work together and better define priorities for mitigation and emergency response;
- Develop a refined analysis of complex landscape and wildfire situations using GIS;
- Increase communication with local residents to address community priorities and needs.

The results of a FRAS analysis can be used at a local level to guide mitigation efforts and to communicate wildfire management issues to the public. Residents of interface areas that are assigned a high Level of Concern can be educated and involved in efforts to reduce wildfire risk in and around their neighborhoods.

Photo: FDOF



Sample FRAS map for Lee County, Florida

FLORIDA'S BASIC FUEL TYPES

As introduced in Chapter 1, the four major types of surface wildland fuels that carry fire in Florida are grass, brush, forest (timber) litter, and slash (tree harvesting residue).

Florida's fuel types have been correlated with the National Fire Behavior Prediction System (FBPS) fuel models in order to be able to use existing computer fire behavior models to make predictions in Florida. Because fuels have known characteristics that contribute to fire behavior, as summarized in Chapter 1, these correlations have allowed FDOF wildfire experts to refine the ability of FRAS to predict fuel loads and fire behavior in Florida. This information contributes to better planning for wildfire mitigation through fuel management practices.

FUELS MANAGEMENT ALTERNATIVES

The purpose of fuel management is to favorably alter expected fire behavior. Recall that fuels, weather, and topography influence flame height, rate of spread, and other characteristics of fire behavior. Florida's topography is an insignificant factor, and weather is a factor that is beyond human control. Therefore, fuel reduction becomes the major avenue of influencing fire behavior and reducing the severity of wildfires. Changing the physical properties of the fuels changes the way an area burns.

Recall from the table of fire behavior effects in Chapter 1 that the benefit of fuels management is a moderated rate of spread, flame length, and intensity of fire behavior. This altered fire behavior allows wildfire suppression activities to be more successful. One of the main benefits is a reduction in the overall size of a wildfire in treated areas. Smaller wildfires are less hazardous, and the cost to suppress smaller wildfires is less than the cost to suppress larger wildfires.

There is no general prescription or formula for reducing fuels. Wildland sites differ in management goals, which may range from essentially unmanaged wilderness to intensively managed forest plantation or recreation areas. Whichever fuels management method is chosen, treatments are temporary and will be effective in substantially reducing the wildfire threat for 3 to 5 years. Fuels management must happen on a regular and repetitive basis to maintain wildfire mitigation benefits. Otherwise, plants grow back and fuels build up to hazardous levels again.

The more times that fuel reduction is repeated on a site, the greater the long-term benefits. For example, with repetitive fuels management, a shrubby community can be gradually shifted to an herbaceous-grass community, which carries a reduced wildfire hazard. This change in community

Florida fuel type	FBPS fuel model(s)
Grass	1, 2, 3
Brush	4, 5, 6, 7
Forest (timber) litter	8, 9, 10
Slash (tree harvesting residue)	11, 12, 13

Photo: USFWS

Grass fuel type

Photo: FDCA

Brush fuel type

Photo: FDCA/FDOF/Padion Systems

Forest litter fuel type

Photo: FDCA/FDOF/Padion Systems

Slash fuel type

We've probably got the most dangerous situation in Florida's history in the amount of fuel that is out there on the ground. One problem is that new Florida residents complain about smoke and are resistant to wide-scale prescribed burning because they are unfamiliar with it. In addition, the pulpwood industry grows trees in increasingly dense plantations that result in extraordinary fuel loadings. Both of these situations have allowed fuels to build up to extremely dangerous levels. The answer to the problem is a lot of prescribed burning, thinning of trees, and reduction of vegetation.
Don West, FDOF Waccasassa District Manager

type has multiple benefits. Since many of Florida's fire-adapted ecosystems suffer from a lack of regular burning and an overabundance of shrubby vegetation, this shift in community type is tantamount to an ecological restoration of the site.

Prescribed burning and other fuels management treatments can provide many of the same benefits to ecosystems that were once provided by natural fires. For example, fire's natural role in reducing fuels is partly replaced in timber-producing areas by the harvest and removal of wood products. Although the slash (leftover residue of limbs and treetops) resulting from these activities creates another fuel problem, prescribed burning of slash or slash piles can reduce the fuel load and provide nutrients for newly planted pines and native species in the area.

The accompanying table provides a comparison of various fuel reduction approaches, including cost and effectiveness data for each approach. This information is adapted from the Fuels Management in the Wildland-Urban Interface training manual, available through the training offered at the Florida Center for Wildfire and Forest Resources Management Training at http://www.fl-dof.com/FCWFRMT.

FUELS MANAGEMENT TECHNIQUES

- Prescribed burning
- Mechanical treatments (mowing, chopping, disking)
- Herbicide treatment
- Biomass removal (pine straw harvesting, vegetation removal, tree thinning, timber harvesting)
- Biomass conversion (livestock grazing)
- Piling and burning (in areas without an overstory)

COMPARISON OF VARIOUS FUELS MANAGEMENT APPROACHES

Fuel treatment	Advantages	Concerns	Potential impacts	Seasonality and intensity of treatment	Application in WUI	Duration of effect	Cost
Prescribed Fire	• Removes available fuel and shrubs • Encourages herbaceous growth and supports native species and ecosystems • Recovery begins in weeks • Does not disrupt groundcover • Limited opportunity for invasive plants	• Complex planning and execution • Requires significant equipment and personnel • Smoke and fire sometimes create concern for public, neighbors, and news media • Extremely dependent on weather	• Risk to public safety from both smoke impacts (e.g., on roads) and escape of fire • Challenging to apply without harming overstory trees • May cause some temporary degradation of local air quality	• Can be done in almost any season • Spring and summer fires will kill more shrubs, but weather conditions are more variable • Intensity is dependent on weather • Can treat 100+ acres/day, depending on conditions	Difficulty depends on number of factors	4-6 years	$10-$150 per acre
Hand or Machine Piling and Burning or Chipping	• Moves most fuel to piles • Reduces shrub fuels and encourages herbaceous growth • Moderately easy • Minimal site disturbance, so works well around overstory trees	• Requires significant personnel or machinery • Piles must be small enough to be burned in one day • Burning requires care and attention to mop up • Burning is dependent on weather	• Smoke from burning can impact public, roads, and air quality • Machine piling may disrupt root systems, which can limit regrowth or damage tree roots	• Can be done anytime • Low-intensity treatment • Piles can be chipped if weather does not allow burning • Can treat up to 5 acres/day with enough personnel	Useful, may require extensive labor	3-7 years	$400-$800 per acre, depending on fuels and labor
Mowing	• Reduces shrubs to ground • Turns some fuels into mulch • Encourages herbaceous growth and generally increases species diversity • Requires limited equipment and personnel • Relatively independent of weather • Causes little disturbance to ground cover	• Does not reduce amount of fuel, merely changes structure • Has little impact to roots, so species like palmetto resprout quickly • Unsightly • Difficult to apply with overstory present	• Low risk to public safety, except material can be thrown up to 300 feet from large mowers • May cause some temporary degradation of local air quality from dust	• Can be done in almost any season, but must be done at moderate moisture levels to limit soil disturbance • Intensity is dependent on the size and design of the mower. Larger mowers mulch material better but encounter more obstacles • Can treat up to 10 acres/ day	Difficulty depends on number of obstacles to machinery	3-5 years	$40-$900 per acre

COMPARISON OF VARIOUS FUELS MANAGEMENT APPROACHES

Fuel treatment	Advantages	Concerns	Potential impacts	Seasonality and intensity of treatment	Application in WUI	Duration of effect	Cost
Chopping, Disking, Harrowing	• Reduces shrubs to ground • Disrupts resprouting of some shrubs (palmetto) • Encourages herbaceous growth • Generally increases species diversity • Requires limited equipment and personnel • Relatively independent of weather • Harrow exposes bare soil, limiting fire potential until regrowth occurs	• Does not reduce amount of fuel, merely changes structure • Difficult to apply with overstory present • Can disrupt root systems of some desirable vegetation (e.g., trees) • Unsightly • Harrowing exposes bare soil, increasing potential for erosion and invasive plant colonization	• Low risk to public safety • Significant risk to overstory trees due to root damage • May cause some temporary degradation of local air quality from dust	• Can be done in almost any season, but must be done at moderate moisture levels to limit soil disturbance • Intensity is dependent on the size and design of the chopper, disk or harrow • Can treat up to 10 acres/day	Difficulty depends on number of obstacles to machinery	3-7 years	$35-$80 per acre
Herbicide	• Can be applied to kill target species or all growth • Easy to apply • Provides long-term impact • Does not physically disturb soil • Limits opportunity for invasive plants • Generally independent of weather	• May encounter public opposition • Does not remove fuel • Creates increased flammability for a period immediately following treatment (standing dead fuels)	• May affect non-target species or overstory trees if improperly applied • May have unknown or unforeseen risks to public health, depending on chemical used	• Must be applied during growing season • Intensity is dependent on chemical and application rates • Can treat up to 15 acres/day	Difficulty based on concern of neighbors, level of toxicity	up to 10 years	$70-$110 per acre

COMPARISON OF VARIOUS FUELS MANAGEMENT APPROACHES

Fuel treatment	Advantages	Concerns	Potential impacts	Seasonality and intensity of treatment	Application in WUI	Duration of effect	Cost
Thinning (biomass removal)	• Reduces risk of crown fire by separating trees • May generate revenue • Equipment runs over and compacts shrubs • Minimal soil disturbance • Moderately dependent on weather • Encourages herbaceous growth	• Removes some crown fuel, but does not remove ground-level fuel • May encounter public opposition • Requires proper (moderate moisture) conditions • Creates increased flammability for the period immediately following treatment (slash residue) • Requires >20 acres to generate positive revenue	• Equipment may damage retained trees • May cause some temporary degradation of local air quality (dust)	• Need to avoid excessively wet periods to limit soil disturbance • Intensity depends on volume of trees harvested • Can treat up to 15 acres/day	Difficulty based on site features, concern of neighbors	5-7 years	Will produce revenue with enough volume and acreage
Grazing (biomass conversion)	• Defoliates most shrubs from ground up to 5 feet • Converts bulk of live and dead fuel to organic waste • Compacts duff, making it less likely to burn • Encourages herbaceous growth, favoring grasses • Generally increases species diversity • Easy to apply in the presence of obstacles • Minimal impact on non-target species (trees) and groundcover • Requires limited personnel and equipment • Strong public approval	• Costly on small lots due to animal transportation • Fencing or containment systems are necessary • Few operators are available • Need animal shelter or caretaker near site • Some desirable tree species may be girdled and killed by livestock eating bark • Supplemental mitigation methods may be necessary as livestock may not eat certain flammable plants (e.g., sheep eat saw palmetto but not gallberry)	• Very low risk to public safety • Animals may transport invasive plants, diseases, or pest species to site	• Can be implemented most of the year • Intensity depends on objectives: multiple treatments are necessary to kill woody plants; if used with other treatments, periodic grazing can maintain a site indefinitely • Can treat up to 10 acres/day with a large flock	Very useful in most areas, costly in smaller areas	2-5 years, depending on vegetation type and number of passes,	$200-$500 per acre; can be used to produce meat or revenue

(Adapted from Fuels Management in the Wildland-Urban Interface, Florida Division of Forestry, 2002)

SELECTING A FUELS MANAGEMENT METHOD

In order to select the right fuel treatment method, land managers must understand the costs, benefits, and environmental impacts of the treatments being considered. The land manager must also know the characteristics of the fuels and the site nominated for fuel reduction treatment. By evaluating each treatment option with respect to economic, aesthetic, public, and environmental impacts for that particular site, the land manager can select the most appropriate treatment.

It should also be noted that treatments may be mixed to achieve benefits that can not be realized by one treatment alone. Treatments may be spatially (adjacent to each other) or temporally (in sequence on the same site) mixed, as described in the accompanying boxes.

In dealing with public concerns about various fuel treatment approaches, neighbors may need to be reminded of the very real wildfire hazard in high-risk areas of Florida. Most Florida residents will remember the wildfires of recent years. With wildfire memories and with information about the levels of risk and the benefits of various fuels management treatments in preventing wildfire and in mimicking the benefits of natural fire in Florida's ecosystems, the public should be fairly supportive of fuel reduction practices to reduce the threat of wildfire.

A Survey of Florida Residents Regarding Three Alternative Fuel Treatment Programs (Loomis et al. 2000) gives some insight into the support of Florida citizens for various fuel treatment and wildfire mitigation alternatives. The main factors that influenced citizen support for various mitigation alternatives were program cost, confidence in the program to accomplish its objectives, comfort with the risks of the program, and perceptions of the effects of the program.

EXAMPLES OF TEMPORAL (TIME-SEQUENCE) MIXING OF FUELS MANAGEMENT TREATMENTS

- Chopping, mowing, grazing, or thinning to reduce/remove high shrubby vegetation followed by the use of prescribed fire every few years to maintain the site.
- Grazing to increase visibility and expose hazards such as fixed improvements or debris that might harm equipment or be hazardous in a prescribed fire, followed by the use of prescribed fire or mowing every few years to maintain the site.
- Chopping or thinning of vegetation to gain a short-term fuel reduction, followed by an herbicide treatment to gain long-term fuel reduction benefits.
- Herbicide treatment to kill vegetation, followed several months later by mowing or chopping to put the dead vegetation down on the ground, followed by prescribed burning several years later and every few years to maintain the site.

EXAMPLES OF SPATIAL (ADJACENT) MIXING OF FUELS MANAGEMENT TREATMENTS

- Grazing, mowing, or herbicide treatment near a highway or airport, combined with prescribed fire on the portion of the site further from the smoke-sensitive facility.
- Grazing along a canal bank or in areas where trees are too thick to allow access, combined with prescribed fire or mowing on open or flat areas of the site.
- Hand or machine piling and burning of fuels around at-risk homes, combined with the use of regular prescribed fire to maintain the greenspaces surrounding the high-risk area.
- Repetitive grazing of thick flatwoods by sheep to reduce palmetto cover, followed by regular prescribed fire every few years to maintain the site.

In particular, respondents were more supportive of programs that they understood, and support for fuel treatment programs was not influenced by citizens' past experience with wildfires. In other words, public outreach programs should go beyond simply promoting fears of destructive wildfire. This survey research suggests that ongoing campaigns to increase public awareness and understanding will result in increased acceptance of various wildfire mitigation approaches.

PRESCRIBED FIRE

Fire is neither all good nor all bad – it is a natural and powerful force. Fire can be an ally if it is applied in the proper place and time with expert management. Prescribed fire is a carefully planned and conducted event that requires proper FDOF authorization, scientific expertise, a dependable weather forecast, attention to safety concerns, and a clear understanding of expected outcomes. Properly managed prescribed fire can be used by land managers to mimic the ecological and social benefits of natural fire while minimizing the risks. Many land managers in Florida would agree that prescribed fire is the most economically and ecologically sound technique for fuel management.

Photo: FDCA/FDOF/Padon Systems

Prescirbed fire

The judicious use of prescribed fire brings numerous benefits. Some prescribed fires are used to reduce the buildup of fuel near populated areas such as communities and recreation areas. Burns are also used to manipulate vegetative succession or to increase food for game species such as wild turkey and deer. Sometimes prescribed fires are used to mimic lightning fires in order to restore and maintain native ecosystems.

Where land managers use prescribed fire as a management tool, plans must anticipate the behavior of fire to assure the outcome will be desirable. A prescription for a fire outlines a specific set of environmental conditions under which the burn may take place. Fuels exert a major influence over the behavior of prescribed fire. The fuel load and moisture content determine how quickly a fire spreads and how intense or hot a fire may become. Soil type and moisture level also must be considered when planning a prescribed fire. Soils and roots are influenced by fire depending on their moisture content, the amount of organic matter present, and the residence time of the fire at any given point.

Weather conditions are another important component affecting the movement and intensity of a fire. Daily conditions such as relative humidity and wind exert a strong influence on fire behavior. For example, prescribed burning when the relative humidity is low and winds are gusty is very risky because of the high probability that the fire will escape. Precipitation also has a major effect on fire behavior. Indices such as the Keetch-Byram Drought Index are available now to assist managers in planning for prescribed fire under safe moisture conditions.

The objectives of a particular prescribed burn help to determine the time of year that it should take place. Prescribed fires with the goal of reducing heavy fuel loads are often carried out during cooler and moister winter months, when the fire will be easier to control in heavy fuels. Prescribed fires that are designed to contribute to ecological restoration or maintenance are planned to mimic the historic fire regime and are usually performed during the spring lightning season when natural fires occurred. Hardwood invasions are best restricted by growing season fires, when the reduction of woody fuels is more effective than in the winter months. Fire timing is crucial to managers of ground-nesting game birds – most birds will re-nest after a fire and the fire will increase insect populations that feed the birds, but managers prefer not to burn when baby birds are known to be on the nest. Smoke management must be an important part of every prescribed burn plan to prevent pollution and visibility problems on highways.

Unfortunately, inappropriate weather conditions often prevent the use of prescribed fire by land managers. Long-term droughts or long wet periods may prevent burning a certain parcel for a number of years. Personnel, time, and equipment limitations also mean that many of Florida's wildlands and forests go unburned. When fire is not regularly used, fuels begin to build up to unnaturally high

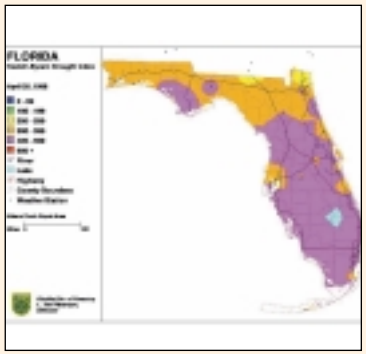
THE KEETCH-BYRAM DROUGHT INDEX

The Keetch-Byram drought index (KBDI) is a continuous reference scale for estimating the dryness of soil and duff layers. The index increases for each day without rain, depending on the daily high temperature, and decreases with rain. The scale ranges from 0 (moist) to 800 (dry). A prolonged drought (high KBDI) influences fire intensity because more fuel is available for combustion (i.e. fuels have a lower moisture content). In addition, dry organic material in the soil can lead to increased problems for fire suppression. High KBDI values are an indication that conditions are favorable for the occurrence and spread of wildfires, but drought is not by itself a prerequisite for wildfires. Other weather factors, such as wind, temperature, relative humidity and atmospheric stability, play a major role in determining the actual fire danger.

Photo: FDCA

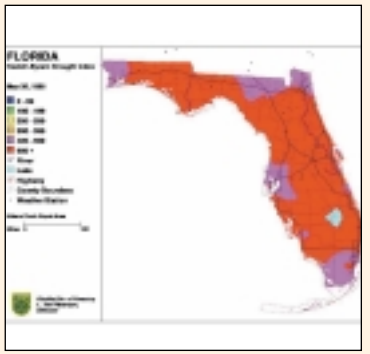
March 1998

Photo: FDOF



April 1998

Photo: FDCA



May 1998

levels, creating a hazard in forests and wildlands near wildland-urban interface homes.

The technical and scientific refinement of ways to use fire as a management tool has been a major subject of forest research. Scientists are focusing on forest fuel chemistry, fire behavior, meteorology, and other fields to best determine when and how excess fuels can be burned.

CHAPTER THREE

Development guidelines and standards for wildfire mitigation

3
Development guidelines and standards for wildfire mitigation

Introduction

Fire has played an influential role in Florida's ecosystems. For centuries, spring and summer lightning strikes have sparked fires across Florida. These natural fires were the driving force behind the lifecycles of a number of native plant and animal species. Human population growth and accompanying land development present a conflict with this ecological process. Suppression of wildfires has been necessary as a protective measure, and many fires have been kept small by the presence of settlements and roads. Today, prescribed burning and other fuel management techniques are regularly practiced throughout Florida, but land managers have been unable to keep up with fuel accumulations.

Accumulated wildland fuels and contributing weather conditions made the 1998-2000 wildfires some of the worst in Florida history, damaging homes and forests and costing millions of dollars. Wildfire has become a costly and dangerous natural hazard deserving of attention toward enhanced public safety, mitigation, and planning activities. Because wildfire protection and mitigation activities must occur at a local level and in concert with local land use and development decisions, regulations for wildfire protection are most effective at the local level.

This chapter identifies processes and regulatory language that can be adopted by local governments to address the wildfire hazard. This chapter discusses a number of regulatory approaches and reviews the balance that must be sought between wildfire mitigation activities and local ordinances that regulate tree removal and landscaping. Included here are some examples of what local governments in Florida have done, and what other local governments in the western United States have done, to effectively implement wildfire mitigation activities. This information is designed for local decision makers, elected officials, planners, codes officials, fire professionals, homeowner associations, and citizen leaders.

Model vegetation management and wildfire mitigation ordinances are provided for consideration by local governments, fire districts, or homeowner associations. The ordinance language here is provided as a model or a guideline for what local governments or neighborhood associations might do – it is not to be adopted verbatim, as most governments will have specific local form and content guidelines. The wildfire mitigation ordinances and the other chapters in this guide provide a menu of choices. Homeowner associations should consult an attorney for help when drafting neighborhood covenants.

It is important for local governments and homeowner associations to realize that they have many mitigation options to consider. Local governments and groups may choose from among recommendations on landscaping (Chapter 6), building construction (Chapter 5), and planning processes (Chapter 2) for elements to be included in local ordinances or covenants.

THE STATUTORY BASIS FOR WILDFIRE MITIGATION IN FLORIDA

Although regulatory approaches are not appropriate in every situation, local wildfire mitigation requirements can have a positive influence on the severity of future wildfires in the regulated area. There is a strong statutory basis for local wildfire hazard mitigation regulations in Florida.

Florida Statutes Chapter 187 State Comprehensive Plan is a direction-setting document designed to provide long-range policy guidance for the orderly social, economic, and physical growth of Florida. The State Comprehensive Plan (not to be confused with Local Government Comprehensive Planning discussed below) provides policy guidance for legislative action on a number of issues, including Public Safety, Natural Systems and Recreational Lands, and Land Use. The provisions of Chapter 187 provide guidance for hazard mitigation programs that protect public safety from natural disasters and provide incentives for the maintenance of rural landscapes and the guidance of sustainable development:

- **187.201(6) Public Safety** provides for protecting lives and property from natural and manmade disasters.
- **187.201(10) Natural Systems and Recreational Lands** provides for the acquisition, protection, and conservation of natural habitats, the protection of endangered species, and the restoration of degraded natural systems to a functional condition.
- **187.201(15) Land Use** recognizes the importance of protecting natural resources and quality of life by directing development into areas that have the resources, fiscal abilities, and infrastructure to accommodate growth in an environmentally acceptable manner. This section promotes incentives to encourage separation of urban and rural land

uses while protecting water supplies, resource development, and fish and wildlife habitat. It also encourages Florida to provide educational programs and research to meet state, regional, and local planning and growth-management needs.

Florida Statutes Section 163.3167 Local Government Comprehensive Planning and Land Development Regulation Act: Scope of Act (Part II Growth Policy of **Chapter 163 Intergovernmental Programs**) gives counties and municipalities the power and responsibility to develop guidelines for future growth and development by creating a Comprehensive Plan and implementing appropriate land development regulations. The Comprehensive Plan is composed of written and graphic materials that guide the orderly and balanced future economic, social, physical, environmental, and fiscal development of the area. Florida's Comprehensive Planning requirements have the following important features:

- All counties and municipalities are required to adopt a Comprehensive Plan to guide their physical development and growth
- Each government is encouraged to articulate, through a participatory public planning process, a vision for the future physical appearance and qualities of the community
- Comprehensive Plans are required to address issues such as future land use, conservation, coastal management (if applicable), housing, transportation systems, capital improvements, recreation, and infrastructure
- The future land use element (FLUE) and future land use map (FLUM) are required to designate the proposed location and distribution of land uses, such as residential, commercial, or agricultural uses;
- The timing and location of all future land uses are guided by the FLUE and FLUM;
- All local government land use decisions and actions must be consistent with the adopted comprehensive plan.

Florida Statutes Section 163.3177 Required and optional elements of comprehensive plan; studies and surveys identifies the following elements that must be included in each local Comprehensive Plan:

- Capital improvements;
- Future land-use plan (including a future land use map);
- Traffic circulation/transportation;
- General sanitary sewer, solid waste, drainage, potable water, natural groundwater, and aquifer recharge;
- Conservation;
- Recreation and open space
- Housing;
- Coastal management (if applicable);
- Intergovernmental coordination;
- Additional optional elements concerning community design, public safety, or other issues.

Portions of **Florida Statutes Section 163.3177 Required and optional elements of comprehensive plan; studies and surveys** have direct application to wildfire mitigation planning and
regulation efforts at the local government level:

- **163.3177(6)(d)** requires that local comprehensive plans provide for the conservation, use, and protection of natural resources in the area, including air, water, water recharge areas, wetlands, water wells, estuarine marshes, soils, beaches, shores, flood plains, rivers, bays, lakes, harbors, forests, fisheries and wildlife, marine habitat, minerals, and other natural and environmental resources. Such features shall be depicted on the future land use maps prepared with the plan.
- **163.3177(7)(h)** encourages the development of a public safety element for the protection of residents and property of the area from wildfire, hurricane, or manmade or natural catastrophe, including such necessary features for protection as evacuation routes and their control in an emergency, water supply requirements, minimum road widths, clearances around and elevations of structures, and similar matters.
- **163.3178** Coastal Management provides for the adoption of hazard mitigation policies for natural disasters for Florida's coastal counties.
- **163.3177(7)(l)** encourages the adopting of hazard mitigation/post-disaster redevelopment plans for local governments not required to prepare coastal management elements.

3
Development guidelines and standards for wildfire mitigation

Additional statues that may be applicable in certain areas in Florida include **Chapter 191 Independent Special Fire Control Districts** and the accompanying implementation statute, **Chapter 189 Special Districts: General Provisions.**

Florida Statutes Chapter 590 Forest Protection gives the Florida Division of Forestry primary responsibility to prevent, detect, suppress, and extinguish wildfires wherever they occur in Florida. In addition, some local jurisdictions further regulate burning of yard debris. Burning of household or industrial garbage (e.g., plastics, packaging, chemicals) is illegal in Florida, and, therefore, does not need to be regulated by a local wildfire mitigation ordinance.

Some local jurisdictions have regulated sources of ignition in order to prevent wildfires. For example, some jurisdictions have restricted the use or possession of explosives, hazardous materials, and other flammable materials, especially in commercial situations, and have also restricted outdoor burning and dumping of waste materials, ashes, and coals. Some jurisdictions choose to restrict smoking and the use of fireworks as potential ignition sources. A number of these restrictions are included in the model Urban-Wildland Interface Code ™ (International Fire Code Institute, 2000). It should also be noted that the National Fire Protection Association (NFPA) 299 Standard for Protection of Life and Property from Wildfire (1997) is fully incorporated by reference in the Florida Fire Prevention Code. Model codes are discussed in Chapter 5.

Local governments or neighborhood groups should do legal research to ensure that proposed ordinances or covenants do not conflict with existing burning and dumping regulations. Many potential hazards are already covered under existing Florida law, as noted above, while others may be unenforceable and unduly restrictive items to include in wildfire mitigation regulations. The goal is to develop local ordinances or covenants that are meaningful to local citizens and useful in promoting public safety and wildfire mitigation objectives.

Local Wildfire Mitigation Regulations

In addition to the planning approaches discussed in Chapter 2, communities may use regulatory approaches to address wildfire mitigation. Regulatory approaches for addressing the wildfire problem can follow naturally from the Local Mitigation Strategy (LMS) or Comprehensive Plan processes, or they might be undertaken as a stand-alone approach in communities vulnerable to wildfire damage.

FEATURES OF WILDFIRE MITIGATION REGULATIONS

A wildfire mitigation ordinance is a regulatory measure that can develop from the framework of a planning process, such as the Comprehensive Plan required in Florida's local jurisdictions. Statutory authority guides the planning process, and the planning process then leads to the necessary regulations. As a local regulation is being designed and considered, local governments should be asking themselves typical questions that are asked before a new regulation is promulgated:

- Is this regulation realistic?
- How can the desired behavior be encouraged with incentives?
- Are the punitive measures enforceable?
- How can this measure be administered in a cost-effective manner?

The intent of most wildfire mitigation regulations is to set criteria to be met in high-risk areas.

SOME FEATURES OF WILDFIRE MITIGATION REGULATIONS

- Careful selection of treatment measures that are specific to the local area covered by the regulation
- Clear standards for delineating high-risk wildfire zones
- Clear criteria to be met in high-risk zones, especially in guidelines for landscaping, building construction, vegetation management, infrastructure design, and firefighting water supply
- Prescriptions for long-term maintenance
- Involvement of local fire protection services and state forestry representatives on wildfire mitigation review boards
- Mitigation fees to fund fuel management programs

POTENTIAL REGULATORY APPROACHES TO WILDFIRE MITIGATION

- Wildfire mitigation standards in LDRs and/or subdivision regulations
- Wildfire mitigation included in the development review process
- Neighborhood covenants or deed restrictions that require wildfire mitigation
- Zoning to define high-risk wildfire areas and required action
- Special overlay districts to define high-risk wildfire areas and required actions
- Requirements for community protection or fuel management zones around high-risk communities
- Wildland-urban boundary zones (urban growth boundaries) that separate developed areas from high-risk wildland fuels
- Building and development performance standards

Identifying and delineating areas that are at risk from wildfire is often the first step in any regulatory action. Ensuring that Florida Division of Forestry and local fire protection services are involved in ordinance creation and are included on development review boards is another important feature of successful regulations. These wildfire experts bring another perspective to the wildfire implications of land development in a given area.

It is important to remember that the development of a local wildfire mitigation ordinance is a process of selecting from a menu of options. There are a variety of regulatory strategies and methods that can be employed and a variety of behaviors or materials to regulate. Each county or municipality should choose the things that are most important in their given situation. For example, a county might choose to incorporate landscaping and building construction guidelines in their existing Land Development Regulations (LDRs). Another community might use zoning regulations or an overlay district to carry out a wildfire mitigation policy. Another community might choose to work through a cooperative and voluntary planning process and avoid regulation altogether. Regulation could be adopted all at once, or through a phased approach to wildfire mitigation. The main goal is that high-risk communities begin to take concrete steps toward wildfire mitigation.

ADVANTAGES AND DISADVANTAGES OF REGULATORY APPROACHES

There are many advantages to regulatory approaches for wildfire mitigation. Specific regulations can mitigate the wildfire hazard to new construction in wildfire-prone areas. In the discussions that follow, there are a number of solid mechanisms for accomplishing wildfire mitigation. In addition, a model ordinance is provided that may be modified by local jurisdictions to regulate design and construction standards for new development in wildfire-prone areas. These approaches do not guarantee that new developments will be free from wildfire risk, but do provide methods to reduce the wildfire vulnerability of homes from neighboring high-risk areas.

Costs for regulatory approaches can be minimized if the ordinance or code being adopted is fit into an existing governmental structure. The benefits to public health, safety, and welfare are potentially large in high-risk areas.

Disadvantages of regulatory approaches are that they may require additional resources and expertise for local government review development plans, and they may create additional costs to developers that may or may not be acceptable to consumers. Regulations may also be viewed as unnecessarily restrictive by homeowners or citizens. There is also no guarantee that newer residents will maintain the wildfire mitigation standards, unless these provisions are included in deed restrictions or required in a homeowners' association plan for management of common areas. Community greenspaces sometimes are not managed or maintained after final development approval, as people tend to think of them as untouchable or self-maintaining areas. The type of maintenance needed in community greenspaces should be spelled out in the development order or in the covenants and restrictions of the subdivision. Finally, most regulatory approaches are not retroactive, so other approaches, such as incentives for retrofits or fuel reduction treatments, may be more realistic for developments that already exist in high-wildfire-risk areas.

EXAMPLES OF WILDFIRE MITIGATION REGULATIONS

A number of local Florida governments have integrated wildfire mitigation requirements into existing LDRs or in additional regulations. These communities have carefully chosen which requirements are necessary for their regulations. Florida wildfire mitigation ordinances typically focus on fuel reduction, wildfire-resistant building materials, defensible space landscaping, and minimum development standards, as well as requiring a minimum of two access routes into proposed developments in high-risk areas.

BALANCING WILDFIRE MITIGATION WITH TREE PROTECTION ORDINANCES

Although wildfire mitigation actions typically involve the reduction of surface vegetation, they may also require the thinning of trees – especially pine trees – in order to accomplish mitigation objectives. In many areas of Florida, it is important to ensure that the landscaping modifications of wildfire mitigation measures do not conflict with existing tree protection ordinances. Tree protection ordinances are an almost universal component of modern local land-use regulation and growth management plans in Florida. The majority of this regulation is aimed at preserving larger canopy trees and generally does not address preservation of smaller understory trees, shrubs, and groundcovers.

Tree ordinances typically define and regulate the management of publicly and privately owned trees by regulating the removal of trees associated with land clearing and development. In Florida, protecting trees through local ordinances has become common as a means of addressing the growing concern about damage to tree canopies caused by development and urbanization. In many instances, communities adopt tree ordinances in response to a specific (and often highly publicized) initiative to protect a specific tree or an area of tree canopy. Loss of large street trees, natural disasters such as storms and floods, and loss or

CASE STUDY: EXAMPLES OF FLORIDA WILDFIRE MITIGATION REGULATIONS AND POLICIES

Several jurisdictions in Florida have passed wildfire mitigation ordinances and related codes:

- **Flagler County Ordinance 98-14 –** Provides for wildfire mitigation through the designation of hazardous areas and the abatement of "public nuisance" of accumulated fuels in areas with brush and pine trees. The ordinance authorizes the owner or the county or state to perform wildfire mitigation work, including prescribed burning, on the hazardous areas. Any revenue generated by the sale of timber removed from private property by the county is used to fund nuisance abatement operations. An ordinance modeled after this one was adopted by the City of Palm Coast in Flagler County.
- **City of Ormond Beach Land Development Code Chapter III: Performance Criteria, Article 13A: Landscaping and Buffers –** This code specifies that firewise landscaping practices be included in building permit plot plans that are approved along with building permits, that firewise landscaping be used in buffers at the wildland-urban interface, that 30-foot firewise landscape zones be created around homes or developments at high or medium risk of wildfire, that developers carry out fuel reduction and wildfire mitigation strategies, and that developers supply a long-term wildfire mitigation management plan. This code covers an area including the Briargate Firewise Community.
- **City of North Port Ordinance 86-206 –** Buildup of underbrush thicker than 12 inches and growth of vegetation beyond property boundaries is prohibited. Because of the high number of absentee landowners, the city is authorized to conduct prescribed burns of privately owned areas. North Port is in Sarasota County, Florida.
- **Tallahassee-Leon County Amendment to the Comprehensive Plan, Conservation Element Policy 1.2.3 –** The amendment seeks to implement, maintain, and promote land management practices that enhance fire protection, including promoting the use of prescribed burning and sustainable silvicultural practices.
- **Alachua County Comprehensive Plan, Conservation and Open Space Element, Policy 5.6 Wildfire Mitigation –** See Case Study in Chapter 2.

removal of heritage or landmark trees are typical motivating factors in the development of tree protection ordinances.

Tree protection ordinances vary greatly in terms of scope and complexity. They range from simple tree protection and replacement standards to more comprehensive ordinances addressing natural resource issues beyond simple tree preservation. The Ft. Myers, Florida ordinance for example, is relatively simple and straightforward. It requires a permit for the removal of any tree larger than 4 inches in diameter and located within the city limits [City of Ft. Myers Ordinance 30-76]. On the other hand, the tree preservation ordinance of Broward County is more technical, establishing four categories of replacement requirements depending on the size and type of tree [Broward County Ordinance 27-342(K)]. Broward County's ordinance

CASE STUDY: EXAMPLES OF REGULATORY APPROACHES FROM THE WESTERN UNITED STATES

Local communities considering regulatory options may be able to learn lessons from other communities that have implemented wildfire mitigation regulations. Here are several examples of regulatory approaches to wildfire mitigation from high-risk areas of the western U.S.:

- **Santa Fe County, New Mexico, Urban Wildland Interface Code, Ordinance 2001-11 –** This ordinance deals with on-site fuel reduction/modification and fire-resistant building practices and materials in defined risk zones of the Wildland-Urban Hazard Area. The ordinance supplements the building and fire codes of Santa Fe County to mitigate the threat to life and property from the intrusion of wildland fire exposures, fire exposures from adjacent structures, and prevention of structure fires from spreading to wildland fuels. Vegetation management and defensible space regulations are voluntary, and the county works with individual communities toward education and compliance. It addresses structural renovations and additions with threshold square footage that triggers compliance with the new code.
- **Clark County, Washington, Wildland Urban Interface/Intermix Ordinance –** The 1993 Wildland Urban Interface/Intermix Ordinance is aimed at "minimizing the possibility of wildland fires involving structures and structural fires involving wildlands." The ordinance specifies NFPA 299 (now NFPA 1144) as the standard for subdivision, new development, and building construction. The ordinance applies specific protection requirements to WUI areas that are above 500 feet in elevation, with either slope greater than 25%, forest type vegetation, or outside an organized fire district. Some areas of particularly rough terrain below 500 foot elevation are also defined as WUI. The ordinance contains standards for access roads and infrastructure, along with a unique system of trade-offs for water requirements based on meeting access and building standards and defensible space.
- **Central Yavapai Fire District, Arizona, Fuels Management Requirements for New Developments –** A 2001 amendment to the Fire District Standards adopting Appendix IIA of the 1997 Uniform Fire Code to assist in controlling the accumulation of hazardous fuels around structures and along roadways in new developments. The rule addresses the clearance of brush and vegetative growth from structures and roads and requires fuel treatments to be conducted by the developers to create fuel breaks and the establishment of subdivision covenants requiring the creation and maintenance of defensible space by property owners. The NFPA 299 Standard is adopted as a standard for the Fire District. The Fire Chief or designate is responsible for enforcement and may issue citations for violations.
- **Eagle County, Colorado, Wildfire Regulations –** To address the threat of wildfire, Eagle County, home of Vail and Aspen ski areas, adopted these regulations in 2003. The regulations include Development Standards for new construction, roadway standards, water supply standards, planned development and subdivision standards, and building standards for wildfire mitigation, creation of defensible space, and the development of vegetation management plans for new developments.

also regulates any disturbance of the "canopy, sub-canopy, and groundcover" of "natural forest communities" greater than or equal to two acres in size [Broward County Ordinance 27-342(O)].

Tree protection is particularly important in light of the direct benefits that trees provide in wildland-urban interface areas. For example, recent research has demonstrated that trees do save residents money on their utility bills. Recent research compared two Florida municipalities using remotely sensed leaf area indices. Gainesville, Florida, had twice as much tree coverage as neighboring Ocala, and residents of Gainesville spend an average of $126.40 less each year on electricity. Along with differences in the soils and ecosystems in the two areas, another difference is the presence of a tree ordinance in Gainesville, which requires residents to get a permit to remove any tree more than 30 inches in diameter and requires builders to replace trees during development. If a Gainesville resident illegally removes a tree, they have to replace the tree on an inch-for-inch basis. The Ocala tree ordinance requires no permits, and if a protected tree is removed, it can be replaced with several smaller trees at least three inches in diameter (Jensen 2002). In another study, trees were found to provide benefits exceeding their management costs by a factor of at least two (*Georgia Forestry* Magazine 2001).

Despite the general focus of tree protection ordinances on larger canopy trees, there are some

CASE STUDY: ECOLOGICAL, ECONOMIC, AND SOCIAL BENEFITS OF TREES

Trees provide a number of benefits and services in urban and suburban areas, and larger trees maximize these benefits:

- Reduce energy use and air pollution
- Reduce human deaths associated with air pollution as a result
- Provide cooler summer temperatures
- Protect water quality and watersheds
- Reduce the need for stormwater facilities if they are planted to buffer impervious surfaces;
- Clean the air
- Enhance wildlife habitat
- Provide connections for wildlife across urban barriers
- Provide areas of cooling shade
- Increase property values
- Have a positive impact on the financial success of commercial areas
- Reduce property and violent crimes by as much as 50%;
- Reduce stress and mental fatigue
- Improve recovery time and decrease sense of pain for hospital patients
- Offer numerous other benefits to the mental and physical health of humans

(Adapted from *Georgia Forestry* Magazine 2001)

GENERAL REGULATORY APPROACHES TO TREE PROTECTION

Tree protection ordinances in Florida generally use one or a combination of the following regulatory approaches:

- **Protection of trees based on size;**
- **Protection of specific species of trees** such as mangroves [City of Ft. Myers Ordinance 30-76(b)]
- **Protection of special and specimen trees** often called "heritage" or "champion" trees [City of Gainesville Ordinance 30-257, 258]
- **Preservation of percentage of tree canopy** [City of Ft. Myers Ordinance 30-92]
- **Maintenance of buffer zones** between developed and undeveloped areas
- **Protection of special areas** [Broward County Ordinance 27-342 (O)]
- **Tree replacement standards** [Broward County Ordinance 27-342 (R)]
- **Tree removal mitigation requirements** [Broward County Ordinance 27-342 (R)]

ordinances that may prohibit mechanical or chemical treatment of understory vegetation. For example, the complex Broward County Tree Preservation Ordinance addresses a myriad of natural resource issues and designates special status to "natural forest communities" [Broward County Ordinance 27-342(O)]. "Natural forest community trees may be removed provided that the applicant adheres to…preservation requirements to the extent determined to be practicable by [officials]" [Broward County Ordinance 27-342(O)2].

Because tree ordinances generally focus on canopy trees, there will usually be no major conflict between wildfire mitigation activities and tree canopy protection. There are, however, several potential areas of divergence between the two sets of regulations:

- Mechanical fuel reduction treatments may damage tree roots;
- Thinning of trees to reduce wildfire hazard results in loss of tree cover (canopy);
- Wildfire mitigation may affect values in protected natural communities;
- Tree ordinances may maintain a tree canopy that is too thick in a high-risk wildfire area.

Despite these areas of potential conflict, wildfire mitigation ordinances usually can be developed within the constraints of existing tree ordinances. Tree removal is often not necessary to achieve wildfire mitigation goals, since it is reduction of surface fuels that is the highest priority to create a wildfire-resistant landscape and to reduce fuels on larger wildlands. In some cases, an exemption may be granted for removal of (protected) understory trees and shrubs upon recommendation of the local fire protection agency.

Many Florida communities actually encourage the management of vegetative fuels in the home landscape. For example, some local Florida communities have regulatory provisions aimed at removal of weed, brush, debris, and other "noxious" material for health, safety, and aesthetic reasons [Pasco County Code 42-1]. The Pasco County Code requires the removal of "grass, weeds, brush, or undergrowth exceeding 12 inches in height, debris or any noxious material of any kind that…tends to create a fire hazard endangering the lives and property of the citizens of the county" [Pasco County Code 42-1(a)].

When developing a wildfire mitigation ordinance, however, communities should be careful of using the phrase "clear vegetation." Mowing or chopping of vegetation with a tractor-mower, "bush hog," or GyroTrac® is not the same as removing vegetation (roots and all) with a bulldozer or root rake. Planners and codes enforcement officials should make sure that vegetation management definitions are clear and that general contractors understand the new ordinance – otherwise, communities may be encouraging vegetation clearance violations.

In special cases, exemptions may be granted for removal of trees causing a known hazard. Removal of trees on a residential lot may be exempt from tree protection ordinances in some areas. Thinning, tree removal, and/or root raking associated with agricultural (silvicultural) operations are exempt from tree ordinance protections. In situations such as a severe wildfire emergency, local tree protection ordinances usually allow tree removal as necessary to respond to the emergency.

STANDARDS FOR TREE PROTECTION DURING AND AFTER CONSTRUCTION

Many local governments in Florida have tree protection ordinances to designate trees for protection, to regulate construction activities within the development zone to safeguard existing trees, and to provide for the installation and maintenance of replacement trees. Local ordinances address the following kinds of construction impacts and maintenance issues:

- **Injuries to the branches and trunks of trees** caused by impacts from construction equipment [Broward County Ordinance 27-342(R), City of Coral Springs Ordinance 212(I)]
- **Injuries to the roots of trees** caused by excavation activity within close proximity to the tree, including digging, trenching, and grade changes [City of Coral Springs Ordinance 212(I)(3)(a)-(b)]
- **Other hazards** such as trash and toxic substance dumping or setting of fires [Broward County Ordinance 27-342(R)]
- **Replacement of protected trees** that die after project completion [City of Gainesville Ordinance 30-265(b)]
- **Maintenance of replacement trees** [Broward County Ordinance 27-342(M)]

See the accompanying box for examples of typical tree ordinance exemptions.

In practice, careful wildfire mitigation should be compatible with even the most stringent tree protection ordinance. For example, mechanical clearing of understory vegetation by mowing or chopping is generally not in violation of tree protection ordinances as long as trees and tree roots are not damaged in the process. Tree and root damage is usually not an issue at all in maintenance of individual defensible space, since small mowers and hand tools are primarily used. For mechanical wildfire mitigation treatments of larger areas that fall under tree ordinance protections, the use of root rakes could be in conflict with some local tree protection ordinances and should be avoided, unless it is part of agricultural (silvicultural) operations that typically are exempt from tree ordinance protections.

Most local tree protection regulations can be effective and simultaneously allow for wildfire mitigation measures in high or extreme wildfire hazard areas. Local officials, however, will need to evaluate any potential conflicts like those illustrated here on a case-by-case basis just as they would when evaluating conflicts between any proposed and existing municipal, county, and state regulations. In addition, despite the general focus of tree preservation ordinances on developers and excavators, local forestry and fire officials should be familiar with community tree ordinances and how they might restrict wildfire mitigation in certain situations or areas, and those responsible for implementing tree protection ordinances should recognize the value of fuel reduction in protecting homes and trees from extreme wildfire events.

TYPICAL EXEMPTIONS FROM TREE PROTECTION REGULATIONS

Florida counties and municipalities generally provide a variety of exemptions to their tree protection ordinances. The most common exemptions are:

- **Agricultural/silvicultural operations –** Most ordinances exempt farming and forestry activities, but may require the maintenance of a buffer zone [Alachua County Ordinance 347.08(a)-(b)].
- **Small lot size –** Most ordinances have a minimum limitation on the size of lot affected [Broward County Ordinance 27-342(F)(3)].
- **Residential development –** Small-lot and single-lot residential developments may be exempted from tree removal permit requirements [Alachua County Ordinance 347.08(a),(c)].
- **Diseased or dangerous trees –** Trees that pose a danger are almost always exempt from tree removal permit requirements [City of Ocala Ordinance 118-75, Broward County Ordinance 27-342(F)(2)].
- **Utilities –** Utilities generally are exempt from the requirement to obtain tree removal permits, provided they meet certain notice requirements to local government and private property owners [Broward County Ordinance 27-342(F)(9); City of Ft. Myers Ordinance 30-77)].
- **Emergency conditions –** Removal of trees under emergency conditions, such as severe weather other natural disasters, is universally exempted from permit requirements [Broward County Ordinance 27-342(F)(4)].

Regulatory Strategies for Wildfire Mitigation

LAND DEVELOPMENT REGULATIONS AND DEVELOPMENT REVIEW

Land Development Regulations

In Florida, local governments enact regulations on the development or improvement of land within their jurisdictions. Also called Land Development Regulations (LDRs) or Unified Land Development Codes, these regulations often appear in the form of subdivision regulations, zoning regulations, land use regulations, building codes, utility codes, and the like.

These regulations implement the land use patterns and development standards laid out in the local Comprehensive Plan (see discussion in Chapter 2). Comprehensive Plans are very useful for guiding and inspiring the direction of development in a community, and Comprehensive Plans take on the force of law as LDRs adopted by local governing bodies, along with provisions for enforcement and penalties for noncompliance. LDRs provide for orderly development and for

the protection of the health, safety, and general welfare of the citizens. When adopted, LDRs must be consistent with the Comprehensive Plan – if they are not consistent, the Comprehensive Plan has priority.

If a Comprehensive Plan includes provisions for wildfire hazard and mitigation, then the LDRs for that area should include wildfire mitigation codes to implement the Comprehensive Plan. The Comprehensive Plan and its implementing LDRs could include a variety of wildfire mitigation requirements, such as:

- Requirements that development in wildfire-prone areas meet certain design criteria, such as clustering within community protection zones;
- Requirements that development in wildfire-prone areas meet certain building construction and/or landscaping standards;
- Requirements for community protection zones (fuel management zones) around developments in wildfire-prone areas;
- Requirements for additional fire protection measures that correspond to the level of wildfire risk as identified by the risk assessment for the area;
- Requirements that a local fire department or the Florida Division of Forestry participate in reviews of development plans;
- Restrictions on development in wildfire-prone areas.

Zoning and Subdivision Regulations

Zoning is the way in which governments regulate the physical development of land and the specific uses to which property may be put. A zoning map adds specificity to the Future Land Use Element (FLUE) and Future Land Use Map (FLUM) of the Comprehensive Plan. The FLUE and FLUM specify the areas in which residential, industrial, recreational, or commercial activities may take place. Zoning regulations can be understood as a more-detailed subset of the FLUE and FLUM. Zoning specifies the character and types of uses allowed within each land use category and there may be several more specific zoning districts within each land use category. In some local jurisdictions, zoning is now becoming subsumed as a part of unified LDRs.

In addition to specifying the uses that can be made of land and buildings, zoning regulations also may govern the dimensional requirements for lots and buildings, the density and intensity of development, and activities such as types of businesses or other uses. Some zoning ordinances may also regulate the extraction of natural resources from land within the zoned area, while others designate areas for hospitals, parks, schools, and open space, and still others recognize places of historical significance within the community. Zoning also provides for variances and uses by special exception.

Zoning is a local activity. Though the existence of zoning is fairly universal, the classifications used to describe zoning are not necessarily uniform from one jurisdiction to the next. Zoning classifications are changed and updated through an application process for rezoning, or through exceptions granted as variances.

Subdivision is just what the name implies, dividing a single piece of property into smaller pieces, usually to sell as lots or to allow for development. The process of subdivision commonly involves a series of steps that include notice and comment by the public and hearings with area residents and government officials before approval is given. Local subdivision regulations govern this process. In some local jurisdictions, subdivision regulations are now being wrapped into a set of unified LDRs.

Zoning and subdivision processes can address wildfire concerns through the zoning of high-wildfire-risk areas with requirements for certain mitigation activities to take place in order for subdivision to be approved. In some cases, zoning and subdivision regulations can be varied through a planned development ordinance, which often provides greater flexibility and creativity in land use and may also include wildfire mitigation requirements.

Development Review

Development review is a step in the development of a lot or a subdivision where the landowner or developer submits a site plan proposal that shows the location of buildings, septic systems, roads, lots, public areas, easements, utilities, etc. Through the development review process, local planning authorities are able to ensure regulatory compliance and potentially negotiate for infrastructure improvements, dedications for schools and parks, use restrictions, and performance guarantees. Local governments

may place restrictions on certain areas, requiring improvements prior to sale or development, such as landscaping, building design and materials, access, road improvements, and water supply. There are, however, statutory and constitutional limitations on what or how much a local government may require.

The process through which development plans are reviewed usually involves a local development review board made up of development and building experts, planners, fire protection professionals, and/or interested citizens. For example, a typical development review committee is charged with the following powers and duties:

- To review and make recommendations on conceptual and preliminary development plans;
- To review and approve, or disapprove applications for final development approval;
- To review and approve, approve with conditions, or disapprove final development plans when authority to do so is conferred upon it as a condition of zoning approval;
- To review and make recommendations on plats, replats, and vacated plats;
- To review and make recommendations on developments of regional impact;
- To perform such other functions as directed by the local governing body.

It is not uncommon for local governments to require special planning actions at the time of development review. Required mitigation and management planning actions may address wildfire mitigation, storm and flood planning, visual aesthetics, wildlife habitat, groundwater, surface water storage areas, and other hazard mitigation and environmental concerns.

This is an appropriate time for local authorities to require wildfire mitigation actions for developments in high-risk areas. It is also the point where Comprehensive Plan policies in the form of LDRs directed at wildfire mitigation can be most useful. For example, a developer may be required to write and implement a wildfire mitigation plan that reduces wildfire risk prior to development. As a part of the wildfire mitigation plan, the local authority or review board may also require a long-term vegetation management plan for greenspaces in and around a development. Periodic long-term vegetation management is necessary to provide ongoing mitigation of the wildfire hazard in high-risk areas. A requirement for perpetual management could be transferred to a homeowner's association, as is sometimes done with stormwater management systems.

SPECIAL OVERLAY DISTRICTS

Overlay districts, also called "floating zones," are mapped areas with additional requirements beyond those of the underlying zoning district. An overlay district is typically applied when there is a special public interest in an area that is not served by the existing zoning. Generally, the underlying zoning determines the land use, while the overlay district may make additional requirements for building design, setbacks, or establish other requirements.

Overlay districts are enacted through a purposeful ordinance. Because the special feature identified in the overlay district may physically overlap several different zoning categories, it is sometimes easier to set up an overlay district than to rewrite multiple zoning categories. Overlay districts may be most useful because they are flexible, whereas general traditional zoning categories may be appropriate across the broader urban landscape but may not effectively address issues in one particular area. Overlay districts are best used to focus on a special land-use topic or issue, which makes them suited to the wildfire mitigation issues in many communities. It is most useful if the overlay district is limited to one or several large areas, rather than small areas scattered throughout a community. The model ordinance later in this chapter includes an example of implementation of a special overlay district strategy.

COMMUNITY PROTECTION ZONES / FUEL MANAGEMENT ZONES

In the wake of the 2002 wildfires around the United States, several groups have proposed the concept of Community Protection Zones (CPZs). These CPZs match the forestry concept of Fuel Management Zones (FMZs), wide swaths of managed vegetation within and around high-risk communities. CPZs protect communities from the threat of wildfire by providing appropriate fuel reduction treatments in a zone surrounding wildland-urban interface communities. Non-profit conservation organizations [e.g., Center for

Biological Diversity (2002), Sierra Club (2001)] favor CPZs because they can satisfy the dual goals of forest conservation and community protection.

The concept of CPZs has much to offer for wildland-urban interface communities. The key goals shared by most CPZ plans include:

- Protect homes and communities against wildfire through education and fuel reduction measures;
- Clear small-diameter trees and brush while maintaining mature trees in areas directly surrounding homes and in a belt around the entire community;
- Restore the natural role of fire in forest ecosystems with prescribed fire.

CPZs provide an area of reduced fuel adjacent to or surrounding a community, enhancing the ability of the community to defend itself from wildfire and augmenting the defensible space prepared by individual homeowners. It should be noted, however, that CPZs do not substitute for individual defensible space, since research has shown that most ignitions of homes from wildfire depend on the vegetation immediately surrounding the structure (e.g., Cohen 1999).

CPZs also enhance the ability, safety, and range of suppression options for firefighters to defend a community from wildfire. In areas where defensible space is not wide enough due to lot size limitations, an adjacent CPZ can provide space from which to defend against wildfire. The CPZ design is based on an assessment of the flame heights that might be generated by the adjacent forest, with zones usually about 100 to 300 feet wide (sometimes as much as 1600 feet wide). This allows firefighting to take place at the boundaries of the community rather than within and around each vulnerable home and structure in the community. Instead of defending individual homes, firefighters are able to more strategically defend the entire community.

A combination of properly implemented home defensible space and a CPZ is adequate to protect even extreme-risk communities from wildfire. Reasons for reducing fuels in forests beyond the immediate CPZ have more to do with protecting forest resources from wildfire than with protecting homes and communities from wildfire.

CASE STUDY: CHARACTERISTICS OF COMMUNITY PROTECTION ZONES FOR WILDFIRE MITIGATION

- Surface vegetation is managed on a regular basis through prescribed burning, mowing, or chopping
- Mature trees are thinned to create breaks in the continuity of tree crowns (less than 35% crown cover or minimum 10-foot spacing between the outer edges of tree crowns is the rule of thumb)
- Small-diameter understory trees are thinned to the same spacings as the overstory trees
- Ladder fuels are removed and branches are trimmed 10 feet from the ground
- Large, fire-resistant trees are retained, as these large trees slow the growth of brush through shading, reduce wind speeds, and block heat from an approaching wildfire
- Individual homes must still be protected per standard recommendations (Chapters 5-6), although the CPZ may form the outer zone of a home protection plan

(Adapted from *The Community Protection Zone,* Center for Biological Diversity, 2002)

GREENBELTS / URBAN GROWTH BOUNDARIES

Greenbelts are defined as permanent reservations or "belts" of open space surrounding a community and that create a boundary for development and preserve natural, agricultural, recreational, and scenic values beyond the urban fringe. The CPZs discussed above could be considered a special case of the greenbelt concept.

Greenbelts often include wetlands, river or stream corridors, trails, coastal areas, scenic vistas, and other special natural features. Greenbelts help local communities and landowners to safeguard ecosystems and their services (e.g., clean water and air), foster agricultural usage, and protect visually intact rural landscapes. Greenbelts were originally conceived to provide agricultural products to an urban area. While modern food transportation and storage have rendered this definition obsolete, the greenbelt concept is now being resurrected as part of "smart-growth" planning to provide boundaries to urban growth.

Photo: USFS

Photo: USFS

In the before-and-after photographs above, a new community protection zone has been provided for this subdivision next to San Felasco Hammock State Park in Alachua County, Florida. Underbrush has been cleared, but mature trees have been maintained in the buffer. The area will get green again as new vegetation begins to grow.

The urban growth boundary concept was created to strengthen and sustain a city's growth management efforts and to preserve the character and function of surrounding rural lands. Greenbelts are now being used as urban growth boundaries. Urban growth boundaries serve to limit sprawl development and encourage growth within existing communities through:

- Clearly identifying lands that are intended for urban use and lands that are intended to remain rural;
- Promoting environmentally and fiscally sustainable infill development where urban infrastructure already exists;
- Preserving surrounding wildlands, wetlands, and open space lands as a legacy for future generations;
- Protecting public health and safety by preventing urban development in areas subject to natural disasters;
- Providing property owners and the public with greater certainty about long term plans for urban development, thus discouraging excessive land speculation;
- Establishing criteria and a process for a comprehensive review of proposed urban growth boundary changes;
- Strengthening the consistency between city and county land use plans and development policies.

(Adapted from Greenbelt Alliance, www.greenbelt.org).

Several local governments in Florida use urban growth boundaries to direct and contain development. Urban growth boundaries have been adopted in Miami-Dade, Sarasota, and Alachua Counties. Several U.S. communities are now using Transfer of Development Rights (TDR) to create greenbelts to separate and buffer development from wildfire-prone areas: Jefferson County, Colorado, and the City of Teller, Colorado, are two places that have successfully instituted this concept.

PERFORMANCE CRITERIA AND BUILDING PERMIT REQUIREMENTS

The purpose of building codes is to regulate new construction by establishing minimum requirements for building systems to safeguard public health, safety, and general welfare. Building codes address all aspects of building construction, from fire protection and structural strength, to plumbing, electrical, and other systems. Building codes and building construction for wildfire mitigation are discussed in Chapter 5.

Prior to the issuance of a building permit, most local governments require an applicant to visit the zoning office to verify that the parcel is zoned for the proposed use. If there were a site restriction such as a regulation that required wildfire mitigation prior to construction, it would be obvious at this point. Language on the plat would remind the codes officials and developer to verify whether the development is in a high-risk zone, and to comply with wildfire mitigation requirements set forth in the local government's LDRs or development order.

Wildfire mitigation could also be required along with fire-resistant building requirements that are contained within the building codes themselves. See Chapter 5 for a discussion of specific building code requirements that could potentially be included for wildfire mitigation, in addition to those included in the model local wildfire mitigation ordinances in this chapter.

Model Vegetation Management Ordinance

A model vegetation (brush) management ordinance is provided here as a guide for development of covenants/deed restrictions or a local ordinance. This model language is not meant to be used verbatim. The community or local government should carefully decide which components of this ordinance language would be most useful or appropriate to the local situation. In addition, most local governments will have specific guidelines as to ordinance form and content, and other regulations that may impact the content of the vegetation management ordinance. Communities should consult a legal expert for help when drawing up an ordinance or a covenant document to be sure it does not conflict with existing regulations or a tree protection ordinance.

LOCAL PLANNING TOOLS FOR CREATING GREENBELTS AND OTHER WILDFIRE BUFFERS

- **Zoning and establishment of an urban growth boundary** are measures to improve the livability of cities and towns and make the most efficient use of land within a town in order to relieve pressure to develop surrounding rural areas.
- **Best use of concentrated infrastructure** can be accomplished as urban growth boundaries provide an incentive to focus development in areas where infrastructure already exists.
- **Open-space zoning or clustering requirements** seek to allow some development in rural areas without eliminating the defining features of the rural landscape: farmland, forests, and open space. Communities taking this approach allow landowners to subdivide into smaller lots, but also require them to permanently protect a portion of the original parcel from development. As an incentive, some communities give developers the right to build more units if they cluster the houses instead of building fewer units on larger lots. Providing CPZs around clustered developments can reduce wildfire hazard.
- **Transfer of development rights** (TDR) is a mechanism for willing landowners to sell or donate their development rights to a governmental entity or to a conservation or land trust organization. The landowner retains all other rights to the land, including the ability to sell or bequeath it. The conservation group or agency holds the easement of development rights to ensure that the land remains undeveloped. Owners can receive a local property tax break for conservation or agricultural status, and federal and state governments may provide income or estate tax incentives. Local governments can make decisions that support the easement donors' perpetual commitment to the rural landscape, for example, refraining from placing infrastructure in or through the conservation zone. (Adapted from Greenbelt Alliance, www.greenbelt.org)

3
Development guidelines and standards for wildfire mitigation

Vegetation Management Ordinance

An ordinance relating to the protection of human life, structures and natural resources from wildfire by providing for vegetation management around structures located in high wildfire hazard areas:

WHEREAS, the protection of human life, structures and natural resources serves the public interest of _____ (jurisdiction);

WHEREAS, vegetation management will provide for a defensible space that will provide better protection to the structure in the absence of trained firefighters and will allow firefighters better safety when protecting structures from wildfire; and,

WHEREAS, it is desirous to minimize destruction caused by wildfire in areas where brush and forests grow in close proximity to structures.

NOW THEREFORE BE IT ENACTED BY _____ (jurisdiction) as follows:

I. DEFINITIONS:

- **Brush –** Native or introduced vegetation growing in an uncultivated condition at a height of at least three feet.
- **Fuel –** Any living brush or dead litter (e.g., leaves, pine needles, twigs) that is capable of being burned in a wildfire.
- **Person –** Any individual, partnership, corporation, association, governmental agency, or other legal entity.
- **Staff –** The person(s) assigned the responsibility of administering and enforcing the provisions contained within.
- **Structure -** Any human construction with a floor area of greater than 100 square feet.
- **Wildlands –** Any open or forested land covered with brush, with or without a tree canopy.

II. CLEARANCE OF BRUSH

Any person owning, leasing, controlling, operating, or maintaining any structure(s) upon or adjoining wildlands, and any person owning, leasing, or controlling any land adjacent to such structure(s), shall at all times:

1. Maintain an area at least 30 feet wide around and adjacent to such structure(s) as an effective fuel break made by reducing brush or other flammable growth. This section shall not apply to mature trees, cultivated ornamental shrubbery, or low groundcovers, provided that they do not provide a means of readily transmitting a fire from wildlands to the structure.
2. Remove that portion of any tree or shrub that extends within 10 feet of a chimney or stovepipe.
3. Maintain the roof and gutters free of leaves, pine needles, or other flammable vegetative fuel.
4. Store firewood and exposed lumber piles at least 30 feet from any structure.
5. Keep areas used for outdoor cooking, yard debris burning, or fuel storage tanks at least 25 feet from the nearest brush.

III. ENFORCEMENT

Staff shall have the authority to enter upon said property to ensure compliance.

Violators of this ordinance will have 60 days upon written notification by Staff to correct violations.

If violations are not corrected within the prescribed 60 days, Staff shall have the authority to enter upon said property for the purpose of correcting said violations. The cost of correcting said violations may require a special assessment against each parcel and establish a lien on the property for the amount of the respective assessment until paid.

IV. VARIANCES

Variances from this ordinance may be sought from _____ (authority or board).

V. PUNISHMENT FOR VIOLATION

VI. EFFECTIVE DATE

Annotated Model Wildfire Mitigation Ordinance

The attached model ordinance goes into more depth to address the wildfire problem as a land use issue. The model ordinance is annotated with complete descriptions of the purpose and background of each section. Footnotes cite references as a source of further information. The model ordinance can serve as a guide for local governments by providing a framework for adaptation to local needs and circumstances.

Similar to coastal hazard reduction measures, the Wildfire Mitigation Ordinance seeks to focus risk reduction in defined wildfire hazard areas. The ordinance provides for a Wildfire Mitigation Review Board and a Wildfire Mitigation Official. The Wildfire Mitigation Official is charged with implementing the requirements of the ordinance. The Wildfire Mitigation Review Board appoints the Official and serves as an appellate body for affected landowners who wish to appeal an action of the Official. The Administration section of the ordinance describes the mechanisms for establishing the rules and regulations set out within the ordinance.

The Wildfire Mitigation Ordinance addresses three aspects of the wildfire hazard. First, classification of the Wildland-Urban Interface Area as an Overlay District delineates where the wildfire hazards are and what values need to be protected. Second, an assessment of areas within the Overlay District on the basis of their wildfire hazard characterizes the level of wildfire risk in each area. Finally, the wildfire hazard is abated through a Wildfire Mitigation Plan created and implemented by the landowner or developer, and later maintained by the residents or community association. These measures are encouraged with a series of prohibitions, penalties, and incentives suggested in the ordinance.

Note that this model language is not meant to be used verbatim. A community or local government should carefully decide which components of this ordinance language would be most useful or appropriate to the local situation. In addition, most local governments will have specific guidelines as to ordinance form and content, and other regulations that may affect the content of a vegetation management ordinance. Communities should consult a legal expert when drawing up an ordinance or a covenants document to be sure it does not conflict with existing regulations or a tree protection ordinance.

City or County of_____ , Florida

WILDFIRE MITIGATION ORDINANCE

Table of Contents

3
Development guidelines and standards for wildfire mitigation

City or County of_____ , Florida

WILDFIRE MITIGATION ORDINANCE

Annotated Model

ARTICLE 1. BASIS OF ORDINANCE

Commentary

Accurate and substantiated Findings of Fact are invaluable indicators that ordinances are warranted exercises of the police power by governments for the protection of the health, safety, and welfare of the governed. The Findings of Fact should be modified if necessary to be consistent with the adopting local government's normal formalities and procedures. Specific Findings of Fact should be tailored to the individual local government with respect to its specific resources, environmental conditions, and reason(s) for adopting the Wildfire Mitigation Ordinance.

SECTION I. FINDINGS OF FACT

This Ordinance shall be referred to as the City or County of_____Wildfire Mitigation Ordinance. The Board of Commissioners hereby makes the following findings:

A. Wildfire in the City or County of_____ has the potential to damage property and endanger human life.

B. Wildfire crowning in the pine tree canopy, a buildup of brush in close proximity to buildings, and a general buildup of vegetative fuels significantly correlate to the destruction or damage of buildings and personal property.[1]

C. The use of combustible building materials and the lack of fire-resistant materials in structures significantly correlate to the destruction of structures from wildfire.[2]

D. The continued presence and accumulation of highly flammable vegetation on real property in the City or County of_____ creates a present and imminent danger of wildfire, which could endanger the health, safety, and welfare of the citizens.[3]

E. Mitigating the existing wildfire hazard is vital to the residents of the City or County of_____.

F. The City or County of_____has the ability to identify areas that have a relatively severe risk of wildfire and the ability to prioritize those areas for systematic mitigation planning and implementation.

G. Systematic mitigation measures are necessary to avoid catastrophic impact to the community's economy and quality of life. Such systematic mitigation, to the extent it limits wildfire damage, will also help the community conserve its natural resources for aesthetic, environmental, and stormwater management processes.4

H. The risk of wildfire recurrence is substantial under expected droughty conditions. Dry weather patterns associated with increased wildfire activity are a part of the well-documented El Niño/La Niña Southern Oscillation phenomenon that occurs on a cyclic basis.[5]

SECTION II. ORDINANCE PURPOSE AND GOALS

Commentary

Section II "Ordinance Purpose and Goals," should be developed so as to be consistent with the appropriate elements of the local government's Comprehensive Plan as required by Florida Statutes Section 163.3177, "Required and optional elements of Comprehensive Plan; studies and surveys." For example, Section 163.3177 requires the Comprehensive Plan to include a future land use element with map, a traffic circulation element, a conservation element, and a recreation and open space element, among others. Because local Comprehensive Plans provide a policy framework for local ordinances, it is important that wildfire mitigation provisions be integrated into the Comprehensive Plan either separately or into various plan elements. Refer to Chapter 2 for a discussion on incorporating wildfire mitigation into the Comprehensive Plan process.

[1] Flagler County Ordinance No. 98-14, §1(D) citing a study conducted by the Florida Division of Forestry after the wildfires of May 1985.
[2] Protecting Florida Homes from Wildfire, A Guide for Planners, Developers and Fire Services. Florida Department of Agriculture and Consumer Services Division of Forestry at 13.
[3] Protecting Florida Homes from Wildfire at 1.
[4] Flagler County Ordinance No. 98-14, §1(J)(K).
[5] Flagler County Ordinance No. 98-14, §1(L).

This Ordinance recognizes that Florida's population and land use patterns are changing. Residential and commercial development is increasing in what is known as the Wildland-Urban Interface. Fire is a natural and essential process in many Florida ecosystems bordering on new development including sandhills, pine flatwoods, scrub, and marsh. Without fire, these ecosystems change and the organisms unique to the original habitat maintained by fire are lost. Red-cockaded woodpeckers, scrub jays, gopher tortoises, longleaf pines, and wiregrass are some species that depend on fire. The threat to lives and property from uncontrolled wildfire is dramatically increased by urbanization and elimination of the natural role of fire, factors which have increased fuel loading and changed ecological conditions. In addition, there are increases in combustible materials from new construction, often without appropriate hazard mitigation, without the use of fire resistant materials or construction techniques, and without defensible space or adequate water supply arrangements.[6]

This Ordinance is intended to promote the public health, safety, and general welfare of the citizens of the City or County of _____, Florida, to minimize the loss of life and property in the jurisdiction from uncontrolled wildfire, to provide for more efficient public expenditures in the protection of structures and facilities from wildfire, to regulate building construction so as to minimize the wildfire hazard to public and private property, and to encourage a value-added concept to enhance aesthetics and property values.[7]

SECTION III. DEFINITIONS

Commentary

To the extent possible, these definitions follow applicable language from the 2002 Florida Statutes, 2002 Florida Administrative Code, and/or have been adapted from scholarly treatises and other research documents. In building the local government's Wildfire Mitigation Ordinance, care should be exercised to use similar language where possible without creating conflicts with the terminology already adopted by the local government in its ordinances, regulations, or Comprehensive Plan.

"BIOMASS REMOVAL" means removal of fuel sources from wildfire-risk areas by methods including, but not limited to, grazing, pine straw harvesting, and brush removal, in a manner deemed appropriate by the Wildfire Mitigation Official in consultation with members of the local Wildfire Mitigation Review Board and the Florida Division of Forestry.

"BRUSH" means plant species that by virtue of their arrangement, chemical composition and growth pattern provide a ready path for fire to spread. Species included in this definition include saw palmetto, gallberry, fetterbush, and wax myrtle. Pine trees less than five (5) inches diameter at 4.5 feet above grade are included in this definition.[8]

"BUILDING" means any structure used or intended for supporting or sheltering any use or occupancy.[9]

"DEFENSIBLE SPACE" means the area, either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of an advancing fire and to create an area for fire suppression operations to occur.[10]

"DRIVEWAY" means a vehicular ingress and egress route that serves no more than two (2) buildings or structures, not including accessory buildings, or more than five (5) dwelling units.[11]

"EMERGENCY" means circumstances that are recognized as presenting an imminent danger of wildfire ignition or an ongoing wildfire.

"FIRE-PRONE VEGETATION" means native or non-native plant material generally recognized as

[6]Adapted from Title 15, Chapter 15.13.020, Wildland Urban Interface/Intermix Ordinance, Clark County, Washington. See also Prescribed Fire, A Prescription for a Healthy Florida, a brochure produced by the St. Johns River Water Management District.
[7]Adapted from Title 15, Chapter 15.13.020, Wildland Urban Interface/Intermix Ordinance, Clark County, Washington.
[8]Flagler County Ordinance No. 98-14, §2 at 3.
[9]Urban-Wildland Interface Code, International Fire Code Institute. Ch.2 §202 at 7.
[10]Urban-Wildland Interface Code, at 7.
[11]Id.

having highly flammable characteristics, including, but not limited to, saw palmetto, wax myrtle, gallberry, ornamental arborvitae, redcedar, juniper, and pine trees.

"FIREWISE BUILDING MATERIALS" means the use of materials and systems in the design and construction of a building or structure to safeguard against the spread of fire within a building or structure and the spread of fire to or from buildings or structures to the Wildland-Urban Interface area.[12]

"FUEL BREAK" means an area, strategically located for fighting anticipated fires, where the native vegetation has been permanently modified or replaced so that fires burning into it can be more easily controlled. Fuel breaks divide high-risk areas into smaller areas, interrupt fuel continuity, allow for easier wildfire control, and provide access for firefighting equipment.[13]

"FUEL REDUCTION" means a method of modifying fuel load by lessening the amount of flammable material.[14]

"LANDOWNER" means owners, lessees, developers, or any other persons having control of any property.

"MECHANICAL TREATMENT" means the alteration of fuel structure and characteristics by methods including, but not limited to, mowing, chopping, and harrowing, and in a manner deemed appropriate by the Wildfire Mitigation Official in consultation with the local Wildfire Mitigation Review Board.

"NONCOMBUSTIBLE MATERIAL" means material of which no part will ignite and burn when subjected to fire. To be considered noncombustible, a material shall conform to ASTM E136-79 or shall have a base of noncombustible material with a surfacing material not over 1/8 inch thick, which has a flame-spread rating of 50 or less. Flame spread rating as used herein refers to rating obtained according to tests conducted as specified in ASTM E84-91a.[15]

"NONCOMBUSTIBLE ROOFING MATERIAL" means cement shingles or sheets, exposed concrete slab roof, ferrous or copper shingles or sheets, slate shingles, clay or concrete roofing tile, or other approved roof covering of noncombustible material designated as Class A roofing material.[16]

"OVERLAY DISTRICT" means a zoning approach to land development regulation whereby property is classified and regulated supplemental to existing zoning regulations.

"PRESCRIBED BURNING" means burning conducted by the State Division of Forestry, by the Official, by the Landowner, or by an agent acting on behalf of the Landowner in accordance with regulations promulgated by the Florida Division of Forestry, intended to reduce the available fuel in a given area and also to achieve other land management goals.

"TIMBER HARVESTING" means the removal of commercially valuable timber.

"WILDLAND-URBAN INTERFACE (WUI)" means the geographical area where buildings and other human development meets or intermingles with wildland or vegetative fuels.[17]

"WILDFIRE" means the uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming buildings.[18]

"WILDFIRE MITIGATION OFFICIAL (OFFICIAL)" is the official designated by the City or County of _____ to interpret and enforce this Ordinance, or the Official's authorized representative.[19]

[12] Id.
[13] Id.
[14] Id.
[15] Urban-Wildland Interface Code, at 7. ASTM refers to the American Society for Testing Materials. ASTM determines voluntary consensus standards for materials, products, systems, and services. These standards serve as a basis for manufacturing, procurement, and regulatory activities. www.astm.org.
[16] Id.
[17] Id.
[18] Id.
[19] Id.

SECTION IV. ADOPTION OF THE WILDFIRE MITIGATION ORDINANCE

Commentary

The Wildfire Mitigation Ordinance may also be adopted by a local government as a reference document.

There is hereby adopted by the City or County of _____ Board of Commissioners, for the purpose of prescribing regulations mitigating the hazard to life and property from intrusion of fire from adjacent wildlands and buildings, and the prevention of structural fires from spreading to wildland fuels, that certain rule known as the Wildfire Mitigation Ordinance, and the same is hereby adopted and incorporated as fully as set out at length herein, and from the date on which this Ordinance shall take effect, the provisions thereof shall be controlling within the limits of the City or County of _____.[20]

SECTION V. ADMINISTRATION OF THE WILDFIRE MITIGATION ORDINANCE [21]

Commentary

The Board of Commissioners is encouraged to designate an existing local government board as the Wildfire Mitigation Review Board. For example, the existing Development Review Committee could sit as the Wildfire Mitigation Review Board. The Wildfire Mitigation Review Board should have at least three members, and approximately one-third of the Review Board members will be replaced or renewed each year by the Board of Commissioners. It is important that a local fire official or representative of the Florida Division of Forestry serve on the Wildfire Mitigation Review Board.

A planning director, chief building inspector, or local fire chief may be designated as the Wildfire Mitigation Official. The Official does not sit on the Wildfire Mitigation Review Board. The duties and qualifications of the Official may vary greatly depending on the local government's resources, size, and need for coordination with other staff or departments. For example, the local government may need to evaluate how the Official's rights and responsibilities will interact with the rights and responsibilities of the fire chief or building inspector. With regards to Section D liability provisions, local government officials will generally be protected from unlimited liability by Sovereign Immunity (768.28 F.S.).

In developing a Wildfire Mitigation Ordinance for adoption by a local jurisdiction, this model Ordinance should be adapted depending on local needs and conditions. For example, sections in this Model Wildfire Mitigation Ordinance regarding subjects covered adequately by existing state or local laws may be deleted and/or cited by reference in the locally adapted Ordinance.

A. **Wildfire Mitigation Review Board.** A Wildfire Mitigation Review Board (the Board) is hereby established to appoint the Official and serve as the appellate body set forth in Subsection G of this section.

   a. **Membership and Terms.** The Board shall have ___ members, all residing in the City or County of _____, and appointed by the Board of Commissioners. Initial terms shall be ___ for one year, ___ for two years, and ___ for three years. Terms thereafter shall be for three years each. Board members shall have experience in firefighting, forestry, landscape architecture, agriculture, building, or a similar field.[22]

   b. **Officers and employees.** The Wildfire Mitigation Review Board shall elect a chairman from among its members. The City or County of _____ shall provide all clerical assistance.[23]

   c. **Meetings.** The Wildfire Mitigation Review Board shall meet when a hearing is requested by a Landowner as described in Subsection G, to appoint an Official, or to conduct other official business as determined

[20] Id. at xi.
[21] Id. at 1-3. This section was adapted from the administrative format laid out in the Urban-Wildland Interface Code. The legislative, judiciary, and executive functions of this format are designed to provide adequate risk assessment, risk characterization, and risk abatement procedures to effectuate the goal of reduced wildfires. The appellate body created by this section is a due process safeguard for Landowners affected by any part of the Wildfire Mitigation Plan, or the orders, rules and regulations derived therefrom.
[22] Id.
[23] Id.

by the Board. A quorum shall be ___ members.[24]

d. **Hearings before the Wildfire Mitigation Review Board.** Any interested Landowner may appear before the Wildfire Mitigation Review Board to show that conditions or circumstances do not require the action prescribed by the Official. The Landowner may introduce witnesses as deemed necessary.[25]

B. **Wildfire Mitigation Official.** The designated Official herein shall enforce the Wildfire Mitigation Ordinance as adopted and amended. The Wildfire Mitigation Review Board shall appoint the Official, subject to the approval of the Board of Commissioners.[26]

C. **Authority of the Wildfire Mitigation Official.** The Official shall have the power to render interpretations of this Ordinance and to adopt and enforce supplemental rules to clarify the application of the Ordinance's provisions. Such interpretations and supplemental rules shall be in conformance with the intent and purpose of this Ordinance. A copy of such supplemental rules shall be filed with the clerk of the jurisdiction and shall be in effect immediately thereafter. Additional copies shall be available for distribution to the public.[27]

D. **Liability of the Wildfire Mitigation Official.** The Official charged with the enforcement of this Ordinance, acting in good faith and without malice in the discharge of the duties required by this Ordinance or other pertinent law or ordinance, shall not thereby be rendered personally liable for damages that may accrue to person or property as a result of an act or by reason of an act or omission in the discharge of such duties. A suit brought against the Official or employee because of such act or omission performed by the Official or employee in the enforcement of any provision of this Ordinance or other pertinent laws or ordinances implemented through the enforcement of this Ordinance or enforced by the code enforcement agency shall be defended by this jurisdiction until final termination of such proceedings, and any judgment resulting therefrom shall be assumed by this jurisdiction. The code enforcement agency or its parent jurisdiction shall not be held as assuming any liability by reason of the inspections authorized by this Ordinance or any permits issued under this Ordinance.[28]

E. **Wildfire Mitigation Ordinance Management.** In areas with overlapping jurisdictions, sections _____[insert appropriate sections] shall be enforced by _____[insert appropriate official or jurisdiction], and sections _____[insert appropriate sections] shall be enforced by _____[insert appropriate official or jurisdiction].[29]

F. **Wildfire Mitigation Ordinance Amendment.** Amendments deemed necessary and approved by the Board of Commissioners shall be inserted in this Ordinance.[30]

G. **Appeals.** Whenever the Official disapproves an application or refuses to grant a permit, or when it is claimed that the provisions of the Wildfire Mitigation Ordinance do not apply or that the true intent and meaning of the Ordinance have been misconstrued or wrongly interpreted, the applicant may appeal the decision of the Official to the Wildfire Mitigation Review Board. Appeals shall be made in writing and delivered or

[24] Id.
[25] Id.
[26] Id.
[27] Id.
[28] Id.
[29] Id.
[30] Id.

sent by U.S. Mail to the Wildfire Mitigation Review Board[31] at the following address:

_____

_____

_____

The appellant will then appear in a Hearing before the Wildfire Mitigation Review Board as described above.

Section VI. Severability

Should any court of competent jurisdiction declare any section or provision of this Ordinance invalid or unconstitutional, the declaration shall not affect the validity of this Ordinance as a whole or any part thereof that is not specifically declared to be invalid or unconstitutional.

ARTICLE 2. WILDFIRE MITIGATION ORDINANCE

Section I. Purpose

The purpose of the Wildfire Mitigation Ordinance is to provide a mechanism to identify, characterize, and mitigate areas of high wildfire risk. Properties within the City or County of _____, determined to have a wildfire risk that exists to a greater degree than that customarily recognized as normal by persons in the public service regularly engaged in preventing, suppressing, and extinguishing wildfires shall be identified as high-risk areas. Identification of high-risk areas shall be based upon data obtained from the Florida Division of Forestry's Wildfire Risk Assessment (FRA), the Florida Division of Forestry's Wildfire Hazard Assessment Guide for Florida Homeowners, or any other wildfire risk assessment method supported by competent and substantial evidence. After identification and characterization of high-risk areas, rules shall be promulgated to reduce the risk of wildfire and to provide for ongoing fuel reduction in high-risk areas. Risk levels shall be reevaluated every three years or at more frequent intervals as determined by the Official.

Commentary

A wildfire risk assessment system generally has three components: a number of scaled risk variables, a system to analyze the relationship between the risk variables, and a graphic representation illustrating the level of risk. Common risk variables include fuel, topography, weather, and availability of fire protection services. For example, in its Wildfire Mitigation Ordinance, Indian River County has identified several wildfire risk factors pertinent to Florida wildfire risk assessment, including subdivision design, vegetation, lightning frequency, proximity to highways and railroads, building construction, fire protection infrastructure, and utilities. Because the many wildfire risk assessment systems that exist for the Western United States are not tailored to Florida's needs, the Florida Division of Forestry has recently developed wildfire risk assessment systems that specifically apply to Florida.

The Florida Division of Forestry's Wildfire Risk Assessment System (FRA) provides an accurate broad-scale risk assessment and is one way to standardize methodology and promote inter-governmental cooperation. The FRA is a map-based GIS analysis of the level of wildfire risk for the entire state or for regions of the state. FRA will be available online for local governments, fire services, and other agencies and individuals to use. The FRA system can be used by the Official to determine wildfire risk for an entire jurisdiction or overlay district.

The Florida Division of Forestry's Wildfire Hazard Assessment Guide for Florida Homeowners provides various relevant factors and considerations for conducting on-site wildfire hazard risk assessment for individual buildings and neighborhoods. The Wildfire Hazard Assessment Guide can be used by the Official to determine wildfire risk for a specific area.

If a prescribed burn or other fuel reduction treatment is conducted in a high-risk area, the risk rating will be temporarily reduced because of the reduced availability of fuel. If fuel reduction treatments are continued on a regular basis, this reduced risk will be reflected in the wildfire risk assessment of the property and adjacent properties. Conversely, if fuel reduction practices are not carried out in a medium-risk area, the fuels may accumulate until the area becomes a high-risk area. This highlights the need to reevaluate the wildfire risk assessment on a regular basis. The Florida Division of Forestry plans to update the statewide FRA ratings every two years to adjust to changing

[31] Id.

conditions. Local governments may consider tying their regular wildfire risk reviews to FRA updates, to Comprehensive Plan reviews, to wildfire occurrences in the jurisdiction, or to a regular calendar schedule of some kind.

SECTION II. WILDLAND-URBAN INTERFACE AND HIGH-RISK AREAS[32]

A. **Policy.** The provisions of this section provide methodology to establish and record WUI areas based on the findings of fact. The objective of this section is to provide simple baseline criteria for determining WUI areas.[33]

B. **Identification of Wildland-Urban Interface Areas.** The Wildfire Mitigation Review Board shall identify the WUI areas within the jurisdiction. The WUI areas shall be based on the findings of fact attached hereto.

C. **Identification of High-Risk Areas.** The Official shall identify areas within the WUI that constitute a wildfire hazard based upon data obtained from the Florida Wildfire Risk Assessment (FRA), the Wildfire Hazard Assessment Guide for Florida Homeowners (WHAGFH), or any study supported by competent and substantial evidence.[34]

D. **Characterization of High-Risk Areas.** The Official shall make a determination of the severity of wildfire risk of different areas within the WUI and rank such areas accordingly. Areas of highest wildfire risk shall be given priority in wildfire mitigation conducted by the Official.[35]

E. **Mapping.** Both WUI and high-risk areas within the WUI shall be recorded on maps, here incorporated by reference, and filed with the planning office of the City or County of _____. These areas shall become effective immediately thereafter.

F. **Periodic Review of Wildland-Urban Interface and High-Risk Areas.** The Official shall reevaluate and recommend modification to the WUI and to the high-risk areas within the WUI, in accordance with Section II on a__-year basis or more frequently as deemed necessary by the Wildfire Mitigation Review Board.[36]

SECTION III. WILDFIRE HAZARD MITIGATION OVERLAY DISTRICT[37]

Commentary

The Wildfire Hazard Mitigation Overlay District should be based on a policy included in the local government's Comprehensive Plan pursuant to portions of *Florida Statutes Section 163.3177 Required and optional elements of comprehensive plan; studies and surveys* that support wildfire mitigation planning. Local governments may tie identification of a Wildfire Hazard Mitigation Overlay District(s) to the Florida Division of Forestry's Wildfire Risk Assessment System (FRA), the Florida Division of Forestry's Wildfire Hazard Assessment Guide, or any other method supported by competent and substantial evidence (see previous commentary). Triggers for regular reassessment of fuel conditions will be included as well.

A. **Purpose.** This Wildfire Hazard Mitigation Overlay District (the Overlay District) is intended to promote the ordinance purposes and goals in Article 1, Section II of this ordinance. Specific purposes are:

(1) To develop and maintain a map or

[32] Id. Section II is the identification and characterization mechanism of the Wildfire Mitigation Plan. Identification of the Wildland Urban Interface Area establishes what areas need to be protected from wildfire. Identification of the areas within the WUI containing a high degree of wildfire hazard establishes what areas are currently susceptible to wildfire. Ranking the hazardous areas is a mechanism by which the most susceptible areas may receive the needed mitigation first.

[33] Id.

[34] Id. See also Wildfire Hazard Assessment Guide for Florida Homeowners, Florida Division of Forestry, Department of Agriculture and Consumer Services, Charles H. Bronson, Commissioner. http://flame.fl-dof.com.

[35] Id.

[36] The periodic review of the Wildland-Urban Interface Area is necessary because the characteristics and boundaries of the area are not static. The evolving danger from wildfire must be monitored on a regular basis to ensure that the appropriate classification and protection is achieved on a continual basis. County Land Use Planning, How Can Planners Help the Fire Services In Protecting Homes from Wildfire; Guy R. Groves; Jefferson County Planning Department; Golden, Colorado. Paper Presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT. October 6-8, 1987.

[37] [Adapted from] Village of Ruidoso, California, Ordinance 2002-05. An ordinance establishing an Urban/Wildland interface overlay zone for the Village of Ruidoso.

otherwise to identify areas within the jurisdiction that allow for preliminary identification of wildfire hazard areas.
(2) To identify the process for assessing the wildfire hazard concurrent with the land planning process.
(3) To identify specific types of development to be subject to wildfire mitigation measures and the provisions of the Wildfire Mitigation Ordinance as adopted by the City or County of _____.
(4) To reference the standards with which development proposed in wildfire hazard areas must comply.[38]

B. **Applicability of the Overlay District.** The regulations contained in this article shall apply to all land areas identified as being within the Wildfire Hazard Mitigation Overlay District. Land use activities subject to this article are:
   a. Land use changes;
   b. Subdivisions;
   c. Site plans;
   d. Building permits;
   e. All special use permits, including conditional uses and variances.[39]

C. **Identification of the Overlay District.** The Overlay District shall be deemed an overlay on property in any zoning district that comes within the provisions of this article. The City or County of _____ may create a map to identify properties within the Overlay District or by such other method as will serve the purposes listed above and sufficiently identify the property. Any property identified as being within the Overlay District shall lawfully be designated as such, regardless of whether or not it is identified on any map. Land proposed for development shall be subject to on-site inspection by the Official for the purpose of determining a wildfire risk rating.[40]

D. **Duties of Official.** The Official of the City or County of _____ shall have responsibility for administration of this section.[41]

SECTION IV. FUEL REDUCTION

A. **Methods of Fuel Reduction.** Prescribed burning, mechanical treatment, biomass removal, chemical treatment, livestock grazing, and timber harvesting are possible methods of fuel reduction for wildfire mitigation.

B. **Selection of Mitigation Method.** The Landowner, developer, or other responsible party shall submit a proposal for wildfire mitigation to the Official. The Official, in consultation with the Mitigation Review Board, shall recommend the method of fuel reduction based on the nature and physical characteristics of area being mitigated. The Official shall not recommend a method of mitigation that would unreasonably endanger life or property. The landowner will prepare, or have prepared for the property, a Wildfire Mitigation Plan that includes a description of the initial fuel reduction method(s) and a description of ongoing fuel reduction practices and timetable.

C. **Performance of Mitigation Methods.** The responsible party may perform, or hire to be performed, the prescribed mitigation work. If the City or County of _____ performs the mitigation work or causes the work to be performed, their costs may be charged as a lien on the Landowner's property, net of any income derived from biomass removal (i.e., tree thinning or harvesting). The costs shall include all expenditures by the City or County of _____, or their authorized agents for labor, supplies, equipment use, contractors, and services related to implementing the Wildfire Mitigation Plan for the property.[42]

[38] Id.
[39] Id.
[40] Id.
[41] Id.

SECTION V. FIREWISE BUILDING MATERIALS[43]

Commentary

The installation of automatic sprinkler systems inside buildings is another requirement that might be considered by local governments. Because roofs and soffits are common entry points of embers in a wildfire, however, there is not universal agreement on the value of automatic sprinkler systems in saving structures threatened by wildfire.

A. **Building Materials for New Construction.** All new construction from development, including but not limited to, residential, commercial, or mobile home development shall use for construction materials:
   1. Noncombustible roofing materials;
   2. Noncombustible materials for balconies and decks;
   3. Noncombustible screening for attic vents;
   4. Heat-resistant (tempered, multi-layered, or wired) glass panels or fire-resistant plastic glazing for windows, glass doors, and skylights;
   5. Approved spark arresters for chimneys;
   6. Non-combustible skirting for raised homes or mobile homes.[44]

B. **Materials for Improvements on Existing Buildings.** Existing buildings within the Overlay District, shall use, when making any significant improvement or addition to the existing building:
   1. Noncombustible roofing materials;
   2. Noncombustible materials for balconies and decks;
   3. Noncombustible screening for attic vents;
   4. Heat-resistant (tempered, multi-layered, or wired) glass panels or fire-resistant plastic glazing for windows, glass doors, and skylights;
   5. Approved spark arresters for chimneys;
   6. Non-combustible skirting for raised homes or mobile homes.[45]

SECTION VI. CRITERIA FOR FUEL REDUCTION AREAS[46]

Commentary

Local governments may consider including a list of approved less-flammable plants and/or a list of hazardous fire-prone plants in this section for landscaping guidance. Plant lists are included in Chapter 6 of this handbook. Local governments will also want to consider how these provisions mesh with any other local environmental or tree protection ordinances, as discussed in the chapter introduction above. Fuel breaks (sometimes called fuel management zones) at the edge of a subdivision or development are usually between 100 to 300 feet wide.

A. **Fuel Within the Critical Radius of Individual Buildings.** Landowners of individual buildings shall manage fire-prone vegetation within thirty (30) feet of buildings, flammable materials, outdoor cooking areas, debris burning areas, and fuel storage tanks. Landowners shall not allow the accumulation of leaf litter and other flammable debris on roofs, eaves, gutters, or decks. Landowners shall trim back fire-prone vegetation that extends within ten (10) feet of the outlet of any chimney or stovepipe.[47]

B. **Environmental Considerations in Fuel Reduction.** Vegetation or cultivated groundcover, such as green grass, succulent native plants, or similar plants used as groundcover are allowed to be within the designated defensible space provided they

[42] Flagler County Ordinance No. 98-14, §4 (B).
[43] Protecting Florida Homes from Wildfire at 14. These various components of building material represent the most hazardous ignition sources on individual structures. For purposes of the Wildfire Mitigation Plan, the definition of "noncombustible" was adapted from Federal Regulations embodied in the Urban-Wildland Interface Code. However, the definition of "noncombustible" could be modified, thereby altering the degree of wildfire protection required of builders.
[44] Id.
[45] Id.
[46] Id. at 9-12. Section VI was designed to meet the requirements necessary for effective protection of individual structures from wildfire. This section helps to ensure that structures are provided a buffer from ignition and fuel sources. It also allows emergency personnel adequate ground to defend structures in the event of a wildfire.
[47] Id.

do not form a means of readily transmitting fire from fire-prone vegetation to the building. For all of their other benefits, trees are encouraged within the defensible space provided the horizontal distance between outer edges of the crowns of adjacent trees, and the outer edge of crowns of trees and buildings, chimney outlets, overhead electrical power lines, or unmodified fuel is not less than fifteen (15) feet.[48]

C. **Maintenance of Defensible Space.** Landowners are responsible for maintenance of defensible spaces. Maintenance of the defensible space shall include modifying or removing fire-prone vegetation within thirty (30) feet of buildings and keeping leaves, needles and other dead vegetative material regularly removed from roofs of buildings. Dead wood and litter shall be regularly removed from trees. Tree crowns extending near any building or chimney outlet shall be pruned to maintain a minimum horizontal clearance of ten (10) feet. Tree crowns within the defensible space shall be pruned to remove limbs within ten (10) feet of the ground. Ornamental conifers (such as cypress, cedars, junipers) that cannot be pruned to an aesthetically pleasing appearance should be removed.[49]

D. **Fuel Outside the Critical Radius of Individual Buildings.** Primary fuel breaks shall be constructed around the perimeter of new developments. Primary fuel breaks shall have a minimum width of twelve (12) feet and be maintained clear of fire-prone vegetation. Maximum advantage shall be taken of planned or existing parks, golf courses, waterways, and other open spaces where low volume fuel conditions are maintained. For all of their other benefits, trees are encouraged in the fuel break area provided the horizontal distance between outer edges of the crowns of adjacent trees, and the outer edge of crowns of trees and buildings, chimney outlets, overhead electrical facilities, or unmodified fuel is not less than five (5) feet.[50]

SECTION VII. TREE PROTECTION

Commentary

A major objective of the model wildfire mitigation ordinance is to reduce the vulnerability of structures within the overlay district or high-risk wildfire zone by regulating, to some degree, highly flammable vegetation in and around structures. It is not intended that the model wildfire mitigation ordinance denude the landscape nor render local tree protection ordinances ineffective. If the community does not already have a tree protection ordinance, provisions should be included in the wildfire mitigation ordinance to protect the urban tree canopy and the values associated with a healthy urban forest.

A. **Exempt Trees.** Due to their flammability, the below-listed trees within thirty (30) feet of any structure in the special overlay district are exempt from the provision of the City or County of _____ Tree Protection Ordinance (Section ___, Ordinance ___) and do not require a permit for removal:

[Attach list of flammable native and ornamental trees in the local area. See lists in Chapter 6 or consult more recent publications for recommendations.]

B. **Recommended Replacement Trees.** Because of their less-flammable nature, the below-listed trees are recommended for retention of existing trees or new planting within thirty (30) feet of any structure located in the special overlay district, and these trees quality for any Tree Protection credits provided under the City or County of _____ Tree Protection Ordinance (Section ___, Ordinance _____):

[Attach list of less-flammable native and non-invasive ornamental trees appropriate for planting in the local area. See lists in Chapter 6 or consult more recent publications for recommendations.]

[48] Id.
[49] Id.
[50] Id.

C. **Trees on Common Properties.** Residents of subdivisions or neighborhoods in the special overlay district are encouraged to protect and manage the trees and other natural vegetation of any greenspaces or natural areas owned or controlled in common by residents in accordance with a Wildfire Mitigation Plan developed under the provisions of this Ordinance and approved by the Wildfire Mitigation Official.

D. **Removal of Hazardous Vegetation.** In the performance of his/her duties, the Wildfire Mitigation Official may designate for removal any vegetation creating a wildfire hazard within thirty (30) feet of any structure in the special overlay district by requesting an exemption of any relevant sections of the City or County of _____ Tree Protection Ordinance (Ordinance ___).

E. **Pruning Standards.** All pruning of trees for the purpose of implementing the provisions of this Ordinance shall be done according to the tree-pruning standards established by the American National Standards Institute, ANSI A300.[51]

SECTION VIII. MINIMUM DEVELOPMENT STANDARDS[52]

Commentary

Use of wildfire mitigation practices such as firewise building and landscaping reduces the need for meeting these regulatory standards. The responsible agency should allow flexibility to adequately address these needs. For example, the need for adherence to the water system requirements could be offset by the presence of swimming pools or onsite wells. Waiver provisions could be incorporated. In addition, local lawmakers should consult with the Florida Division of Forestry and the National Fire Protection Association (NFPA) for standards that may be applicable to this section. Road, electrical, and water system requirements that might be appropriate for inclusion in this Ordinance or in the local Land Development Regulations (LDRs) are provided here.

A. **Road Construction Requirements.** Every new development shall have access directly off a road conforming to the following requirements:

a. **Access Routes.** Every new development shall have at least two ingress-egress routes for each subdivision. Every right of way shall include a minimum of two 12-foot all-weather traffic lanes and two 8-foot parking shoulders designed to accommodate firefighting equipment. Road curves shall have a centerline radius of at least 50 feet.

b. **Driveways** to all buildings shall be at least 12 feet wide and have a 16-foot high clearance.

c. **Dead-end roads** (Cul-de-sacs). Dead end roads (Cul-de-sacs) shall provide turnarounds at road ends of at least 50-foot radius. Dead end roads shall not be longer than 300 feet in length.

d. **Bridges.** Bridges shall have a minimum load capacity of a 30-ton gross vehicle weight capacity and a minimum width equal to the road serving the bridge. Major ingress-egress roads serving a development should have a minimum load capacity on bridges of 40 tons. Minimum vertical clearance shall be 16 feet. The maximum load and clearance shall be clearly posted at the approaches to all bridges.[53]

B. **Water System Requirements.** All new structural developments shall have a public water system to service domestic and

[51] Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance - Standard Practices. (Revision of ANSI A300 1995). The American National Standard for tree pruning is ANSI A300. Its development process was approved by the American National Standards Institute The A300 standard addresses pruning specifications across all geographic areas. Knowledge of the growth habits of tree species within a given environment may alter how the recommendations of A300 are interpreted. See http://www.ansi.org/.

[52] See Protecting Florida Homes from Wildfire at 14. This section addresses the wildfire risk from the perspective of land use and planning. These development standards represent the recommendations made in the above-cited source and are critical to establishing communities capable of effectively defending against wildfire. The measures are largely aimed at ensuring that development plan for the necessary emergency vehicle access and water supply. See also National Fire Protection Association, § 1142-44, Standards for Protection of Life and Property from Wildfire, (2002 Edition).

[51] Id.

emergency fire needs meeting the following requirements:[54]

a. **Water Mains.** All water main systems shall be designed to permit circulating flow. The minimum size water distribution main on which fire hydrants are located should be 6 inches. Water source and storage shall have the capacity to support the required fire flow for a minimum duration of two hours in addition to the maximum daily flow for other consumptive uses.[55]

b. **Fire Hydrants.** The type, size and location of fire hydrants shall meet the standard of the responsible fire authority or the NFPA. Hydrant spacing shall not exceed 1000 feet with minimum fire flow of 500 gallons per minute or equal to calculated fire flow, for developments with densities of two or less buildings per acre. Hydrant spacing shall not exceed 500 feet with a minimum fire flow of 750 gallons per minute at 20 pounds per square inch, for developments with densities of more than two buildings per acre.[56]

c. **Water Systems for Individual Buildings.** Buildings with individual private water supplies shall provide a minimum water storage capacity accessible to fire apparatus of 2500 gallons within 500 feet of the building. Compliance with minimum water storage requirements may be accomplished by the installation of tanks or cisterns. Tanks and cisterns shall have a hose connection valve to match _____[inset specifications of local fire protection responding agency]. Groups of buildings can provide a common source of water within 500 feet of all buildings and capacity that equals or exceeds 2500 gallons per building. Garden hose bibs shall be available near the building so that a garden hose can reach all the parts of the building.[57] If the water pressure is dependent on electrical power, a self-contained portable pump shall be readily available in case of power failure.[58]

d. **Large Volume Water Sources.** All potential large volume water sources shall be provided with all-weather access roads for firefighting equipment.[59]

e. **Protection of Pumps and Water Storage Facilities.** Water storage and pumping facilities shall be provided with a defensible space of not less than 30 feet clear of fire-prone vegetation or growth around and adjacent to such facilities. Portions of trees that extend to within 30 feet of combustible portions of water storage and pumping facilities shall be removed. When electrical pumps are used to provide the required water supply, such pumps shall be connected to a standby power source to automatically maintain electrical power in the event of power loss. The standby source shall be capable of providing power for a minimum of two hours in accordance with the Electrical Code of the City or County of _____.[60]

C. **Electrical Power System Requirements.**

a. **Underground Installation.** Electrical transmission lines shall be installed underground for all new structural developments. Underground electrical

[53] Id.
[54] Id. Physical measurements for water system requirements should be determined by local standards as they may vary from the national standards provided. See National Fire Protection Association, § 1142 (2002 Edition).
[55] Id.
[56] Id.
[57] Id.
[58] Id.
[59] Id.
[60] Id.

wires shall be buried at least thirty (30) inches below grade.[61]

SECTION IX. PUBLIC DISCLOSURE AND EDUCATION[62]

Commentary

A variety of educational literature and other materials are available from local, state, and federal agencies and charitable organizations that local governments should use to support this critical education component. These materials often are available at little or no cost for distribution to residents of high-risk wildfire areas.[63]

A. **Purpose.** Homeowner, builder, developer, and Realtor involvement is critical if effective wildfire mitigation is to be achieved. Many homeowners do not recognize that they live in an area that is susceptible to wildfire. Educating the homeowner begins with making the homeowner aware of the risks associated with wildfire, followed by a proactive program to provide the homeowner with information that identifies actions that they can take to help minimize the risks to themselves and their neighbors associated with uncontrolled wildfire.[64]

B. **Disclosure.** The fact that a building or undeveloped property is within a high-risk wildfire area or Overlay District must be revealed in writing to the buyer of said property by the selling Landowner, developer, or Realtor. All developers, builders, and Realtors shall be required to disclose to new residents the wildfire risks and potential nuisances posed by fuel management activities, including but not limited to, the smoke produced by prescribed burning activities.[65]

C. **Public Workshops.** The Official shall hold a series of public workshops at locations throughout the jurisdiction, designed to raise public awareness of the wildfire risk to public and private property. Builders, developers, and realtors shall be encouraged to attend at least one of these public workshops in order to gain a better understanding of the wildfire problem and the requirements of the Wildfire Mitigation Ordinance.

D. **Public Announcements and Informational Brochures.** The Official shall make informational brochures available to builders, Realtors, and homeowners, summarizing the provisions of the Wildfire Mitigation Ordinance as they regulate landscaping and construction, and explaining what actions are needed by homeowners to maintain their homes and landscapes to comply with this Ordinance. Further, the Official shall make available public announcements, via the internet and in written form, that send a clear message about wildfires and steps to take to mitigate potential damage.[66]

ARTICLE 3. ENFORCEMENT AND COMPLIANCE

Section I. Wildfire Nuisance

A. **Authority.** The City or County of _____ has the authority to determine, prescribe, and conduct the necessary wildfire mitigation methods necessary to comply with the Wildfire Mitigation Ordinance.

B. **Landowner Duty and Liability.** Landowners shall not create, maintain, or neglect to mitigate a wildfire nuisance on their property within the Wildfire Hazard Mitigation Overlay District, as determined by

[61] Id.
[62] [Adapted from] Indian River County Wildfire Mitigation Plan at 35.
[63] See The Natural Role of Fire, Revised August 1999. Joint production of the Florida Department of Agriculture & Community Services, and the USDA Forest Service; See Save Your Home from Florida Wildfires, 1998. Joint production of the Federal Emergency Management Agency and the Florida Division of Forestry; See Fire in Florida's Ecosystems, January 1998. Joint production of the Florida Division of Forestry, USDA Forest Service, The Nature Conservancy, and Tall Timbers Research Station.
[64] Id.
[65] Id., See also Florida Firewise Communities.
[66] Id.

_____[define standard wildfire risk assessment method to be used to determine nuisance]. If a Landowner fails to perform the necessary wildfire mitigation, the Official may issue a notice requiring the Landowner to develop a Wildfire Mitigation Plan to correct the situation within thirty (30) days of receiving notice. If the Landowner has not developed a Wildfire Mitigation Plan to mitigate the wildfire nuisance within thirty (30) days, the Official shall provide notice, in writing, that Landowner must plan for and perform the mitigation of the wildfire nuisance within ninety (90) days. If the Landowner does not plan for and perform the required mitigation within ninety (90) days of written notice, the Official may perform the required wildfire mitigation, at the expense of the Landowner. Cost shall be charged as a lien on Landowner's property, net of any income derived by the City or County of _____from biomass removal (e.g., tree thinning or harvesting). The costs shall include all expenditures by the City or County of _____, or their authorized agents for labor, supplies, equipment use, contractors, and services related to implementing the Wildfire Mitigation Plan for the property.[67]

C. **Removal of vegetation in emergency situations.** In an emergency, the Official shall perform or have performed any wildfire mitigation, without notice, at the expense of the owner.

D. **Right of Entry.** Whenever necessary to make an inspection to enforce any of the provisions of this Ordinance, or whenever the Official has reasonable cause to believe that there exists on any property any condition that makes such property unsafe, the Official is authorized to enter such property at all reasonable times to inspect the same or to perform any duty authorized by this Ordinance, provided that if such property is occupied, the Official shall first present credentials and request entry; and if such property is unoccupied, the Official shall first make a reasonable effort to locate the Landowner.[68]

E. **Refusal of Entry.** If such entry is refused, the Official shall have recourse to every remedy provided by law to secure entry. Landowners shall, after request is made as herein provided, promptly permit entry therein by the Official for the purpose of inspection and examination pursuant to Wildfire Mitigation Plan.[69]

F. **Penalties.** Persons operating or maintaining an occupancy, property, or vehicle subject to this Ordinance who allow a hazard to exist or fail to take immediate action to mitigate a hazard on such occupancy, property or vehicle when ordered or notified to do so by the Official shall be guilty of a misdemeanor and may be subject to civil penalty.[70]

SECTION II. INCENTIVES

Commentary

Ad valorem tax exemptions for community development may be granted only by ordinance of the jurisdiction, and only after the electors vote on a referendum to authorize the jurisdiction to adopt such ordinances. Florida Constitution Article VII, §3A details the purpose, amount, and period of ad valorem tax exemptions.

Some jurisdictions have implemented ordinances that increase insurance rates in areas with extremely high wildfire risk. The policy rationale for this differential is that policyholders in areas of lower risk should not be expected to subsidize the insurance rates of policyholders in areas of higher risk. These ordinances then offer reduced rate incentives to policyholders that comply with guidelines designed to mitigate property loss from wildfire.[71]

Some areas have instituted award or recognition programs for firewise landscaping and building practices. For example, the Firewise Communities USA program recognizes communities that have met specific fire protection

[67] Flagler County Ordinance No. 98-14, §4 (B).
[68] Adapted from Wildland-Urban Interface Code, International Fire Code Institute. Chapter 1 §107.3 at 4.
[69] Id.
[70] Id.

standards. Some local jurisdictions also offer firewise awards.

A. **Ad Valorem Tax Exemption.** The City or County of _____shall grant a one-time ad valorem tax exemption to Landowners in the Overlay District. The exemption shall apply to all improvements to real property made by or for the purpose of wildfire mitigation and conducted in accordance with a Wildfire Mitigation Plan. The amount of the exemption shall be equal to the costs for improvements made by or for the use of wildfire mitigation and in accordance with the Wildfire Mitigation Plan. The exemption shall be assessed, one-time, against the Landowner's ad valorem tax for the following year.

B. **Landowner Awards Program.** The City or County of _____shall identify Landowners in the Overlay District that have demonstrated results, collaboration and commitment to accomplish the goals of this Ordinance. The City or County of _____shall duly recognize these Landowners for effective wildfire mitigation and reduced wildfire risk to communities and natural resources. Landowner Awards shall be displayed in a place of recognition at the regular place of meeting of the City or County of _____Board of Commissioners.

SECTION III. EFFECTIVE DATE

This Ordinance shall take effect immediately upon passage and adoption.

ADOPTED on first reading the_____day of_____, 200__.

ADOPTED on second reading after due notice and hearing the_____day of_____, 200__.

BOARD OF COMMISSIONERS
CITY OR COUNTY OF_____, FLORIDA
By:_____

[71]See California - Insurance FAIR Plan, See also 2001 Fire Safe Insurance Guide, Monrovia, CA Fire Department.

CHAPTER FOUR

Neighborhood design for reduced wildfire risk

4
Neighborhood design for reduced wildfire risk

Introduction

WILDFIRE RISK FACTORS FOR FLORIDA DEVELOPMENTS

Florida's natural landscape provides many amenities to residents, including fresh air and water, abundant wildlife, and beautiful surroundings for homes and neighborhoods. Because wildfire is inevitable in Florida, however, it is important to design developments with wildfire in mind. Because development and natural areas are frequently in close proximity to each other, it is imperative to take wildfire into consideration during development design. In concert with wildfire concerns, development design should allow for the use of prescribed fire or other fuel management options for common areas or greenspaces in the community.

Post-fire studies have identified some of the factors that increase wildfire risk in Florida developments. For example, an analysis of the Florida Palm Coast wildfire of 1985, in which 99 homes were destroyed in one day, identifies five factors which together determine most (86%) of the risk to structures from wildfires in Florida. This analysis of both houses that burned and houses that survived the wildfire was able to determine five major risk factors:

- Whether the wildfire was a crown fire (fire intensity) was predictive of higher risk to structures
- Whether the structure used fiberglass or vinyl soffit vents (flammable materials) was predictive of higher risk to structures
- Whether the structure had concrete block wall construction (noncombustible materials) was predictive of lower risk to structures
- Location of the structure in relation to the wildfire (proximity to more extreme fire behavior) was predictive of higher risk to structures
- Brush clearance around the structure (in the direction of approaching wildfire) was predictive of lower risk to structures

(From Abt, Kelly, and Kuypers 1987)

Two of these factors – the intensity of the wildfire and the location of the structure in relation to the wildfire – may be beyond the influence of the site owner, especially if the wildfire is approaching from neighboring property under separate ownership. The analysis, however, supports the use of firewise landscaping (particularly defensible space around the structure) and the use of fire-resistant building materials (e.g., noncombustible soffits and fire-resistant wall construction) as major risk factors in determining whether a structure survives when a wildfire approaches.

Despite knowledge of these factors and efforts at preparing Florida for wildfires since the 1985 study, the wildfires of 1998 burned or damaged 370 homes and businesses in Florida, with over $600 million in costs and lost revenues. The efforts of over 15,000 firefighters on the scene in 1998 were valiant. Many homes and businesses were lost, but many homes also were protected during the wildfires. The buildings that survived benefited from homeowners and/or developers who made the right decisions about wildfire mitigation practices. With advance planning, architects, builders, and developers can play a significant role in reducing the impacts of wildfire on structures and neighborhoods in Florida.

Our growing population continues to spread from our communities into outlying areas where homes and wildland fuels intermingle. Unfortunately, homeowners who have moved to these areas to enjoy the benefits of being "close to nature" typically do not understand that the safety of their family, home, and neighborhood may well depend on action they take before wildfire occurs. Homeowners must, in essence, become partners with fire protection agencies.
Charles Bronson, Florida Commissioner of Agriculture, 2002

Wildfire Mitigation for Florida Developments

The recommendations of wildfire experts for developers and builders of communities in areas of high wildfire risk are simple and straightforward:

- Design developments that are easy to defend against wildfire;
- Design fire-resistant landscapes and

structures so that the need for wildfire intervention and suppression is reduced;

- Design developments to accommodate ongoing prescribed fire or other fuel reduction treatments to reduce large accumulations of fuels in common areas.

CASE STUDY: BRIARGATE FIREWISE COMMUNITY PILOT PROJECT, ORMOND BEACH, FLORIDA

The Briargate Firewise Community project in Ormond Beach is a planned 2,300-home subdivision in the Hunter's Ridge community. The developer and landscape designer are specifying Firewise building and landscaping practices throughout the community. Builders constructing homes in the community will be instructed to use fire-resistant building materials and employ design techniques that minimize the loss of a structure due to wildfire. Landscaping will provide defensible space around each house and employ Firewise plantings and mulches. The plan calls for thinning of trees on some lots and on common areas in the community to reduce wildfire hazard. Thinning timber can also improve the overall "health" of a forest by making it more resistant to adverse impacts from insects and diseases. Retention ponds are strategically placed for additional wildfire protection and fire-fighting water sources. From these measures, the developer expects a return of at least $129,000 from timber sales and reduced need for fill materials by using the material from the retention ponds.

Graphic: Bill Butler

The Briargate Firewise Community Plan

The developer of the subdivision is planning to market the homes on the same level as the marketing of homes that have a "storm-safe room" within the structure. Without deterring sales of homes for fear of a wildfire, the developer is providing a Firewise public information packet to all real estate agents, builders, and purchasers of homes in the community. The packet informs buyers that, in this part of Florida with a long history of wildfires, the risk of loss due to wildfire will be greatly reduced in Briargate as compared to an unprotected development. The packet will also provide a checklist of Firewise practices that each property owner can undertake to further protect their property.

DESIGNING FIREWISE DEVELOPMENTS IN FLORIDA

The basic steps for designing wildfire-resistant developments and neighborhoods in Florida are similar to the steps that planners use to protect communities from wildfire, as described in Chapter 2:

1. **Assess Wildfire Risk:** Identify the area to be evaluated. Is the development being built in a high-risk area? What is the level of wildfire risk? To answer these questions, look at.
   a. **Land use:** If the development is in an urban or suburban area that is basically "built out" and surrounded by other developments, it is probably at lower risk from wildfire.
   b. **Vegetation:** The type of vegetation on and within 300 feet of the property will be a key factor in its vulnerability to wildfire. Characteristics of the development will also come into play, for example, if undeveloped land will be in close proximity to buildings or developed areas.
2. **Plan and Design Developments for Wildfire-Prone Areas:** Determine what can be done to reduce wildfire risk. Plan future development and wildfire mitigation actions.
3. **Build Firewise Landscapes and Structures:** See Chapters 5 and 6 for best practices for landscaping and building

construction in wildfire-prone areas.

4. **Manage Developments to Minimize Wildfire Risk:** Plan for long-term and ongoing management to continuously treat fuels that build up in natural areas. Management is often carried out by a management agency or by the homeowners' association. Implement strategies to raise awareness among residents of wildfire risk and fuel management techniques, particularly the value of prescribed fire if it is being used on the property or neighboring properties. See Chapter 2 for a discussion and comparison of various fuel management techniques.

WILDFIRE HAZARD ASSESSMENT FOR FLORIDA NEIGHBORHOODS

The *Wildfire Hazard Assessment Guide for Florida Homeowners* has been published by the Florida Division of Forestry (2002) to assist homeowners, property associations, developers, and designers with the task of assessing and mitigating wildfire hazards in Florida neighborhoods. The guide was developed specifically to help neighborhoods and developers:

- Determine if a wildfire hazard exists;
- Evaluate the wildfire hazard in the neighborhood;
- Take action to mitigate the existing wildfire hazard.

A brief description of the assessment process is included here – the complete guide is available from the Florida Division of Forestry.

CASE STUDY: WILDFIRE HAZARD ASSESSMENT FOR FLORIDA HOMEOWNERS AND NEIGHBORHOODS

The Wildfire Hazard Assessment Guide for Florida Homeowners (FDOF 2002) divides the hazard assessment process into five distinct steps. It is helpful for the neighborhood association or developer to work with a team of fire service professionals to perform the hazard assessment. The basic steps of the hazard assessment are as follows:

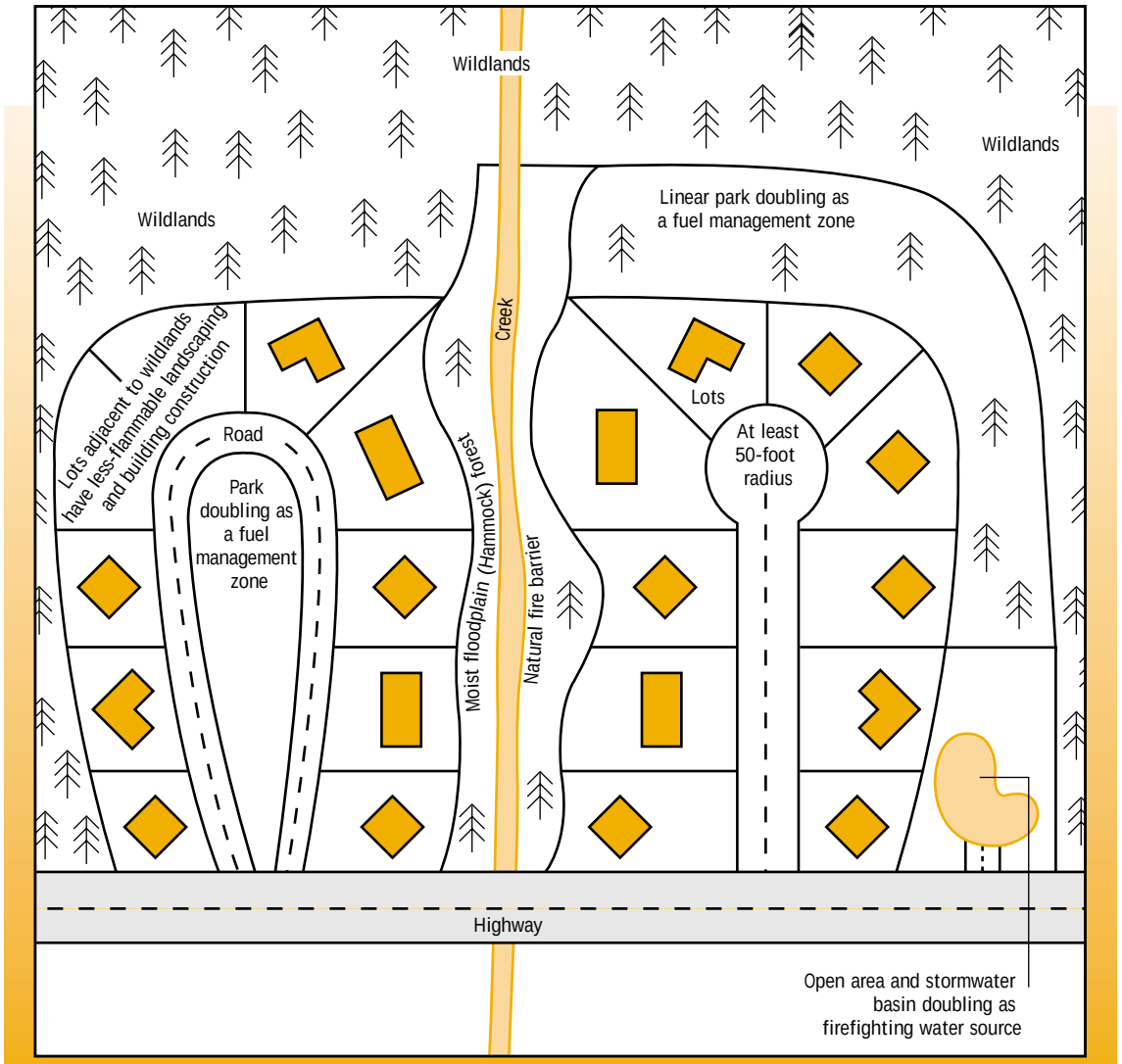
1. **Identify the area to be evaluated –** Determine the area to be evaluated based upon development characteristics such as lot size, development phase or neighborhood, etc.
2. **Identify the overall risk –** Does the area have a higher-than-average occurrence of wildfires? The local Division of Forestry office can help with this determination.
3. **Identify the fuel hazard type –** The *Wildfire Hazard Assessment Guide* provides a photographic catalog for the different types of vegetative fuels occurring in Florida. The fuel in the area will be assigned a low, medium, high, or extreme hazard rating.
4. **Complete a risk assessment checklist –** The *Wildfire Hazard Assessment Guide* includes a checklist that incorporates the information already gathered, and also asks about factors such as access, fire protection, utilities, and other neighborhood characteristics. An overall rating score is calculated at the end of the checklist process.
5. **Identify critical facilities to be protected –** Critical facilities need special protection from wildfire because they are necessary to maintain infrastructure function and services or because they might be hazardous if ignited. Critical facilities may need extra vegetation clearance (e.g., for a power substation) or extra planning for evacuation (e.g., for a nursing home) in order to ensure protection. It is best if protection for critical facilities is planned for during the early stages of development, but wildfire protection for additional or existing critical facilities may also be provided any time during the development process.
6. **Reassess on a regular basis –** Because vegetation is always growing and neighborhoods are always changing, there needs to be a schedule for regular assessment of the wildfire risk and for repetitive fuel reduction treatments. Wildland-urban interface areas probably should be reevaluated at three-year intervals.

(Adapted from the *Wildfire Hazard Assessment Guide for Florida Homeowners,* FDOF 2002)

Once the assessment process is complete, the neighborhood association or developer should create an action plan and take action to mitigate the wildfire hazards that were identified. Mitigation action plans start by addressing the areas of the subdivision that were identified as being at "high" or "extreme" risk, and then proceed to address long-term mitigation strategies. A typical mitigation action process would include:

- Immediate mitigation of "high" and "extreme" risk vegetation;
- Evacuation planning;
- General mitigation action planning for:
  - Fuel reduction,
  - Community education and awareness, and
  - Procedures or regulations to reduce future wildfire risk.

Through the assessment process, the developer or neighborhood association may realize that some of the wildfire risk stems from a lack of appropriate fuel management on adjacent public or private lands. Because wildfire often crosses property lines, it is essential that neighbors and landowners work together to solve the fuel management problem. Chapter 2 includes information about cooperative planning efforts that can be undertaken by a multitude of agencies, organizations, and individuals to reduce risks in wildfire-prone communities. Programs such as *Firewise Communities* can provide guidance to communities working through a wildfire hazard assessment process.



Ideal subdivision design

4
Neighborhood design for reduced wildfire risk

DESIGN FEATURES TO REDUCE WILDFIRE RISK

There are many factors that affect how vulnerable a development or neighborhood is to wildfire. The following factors, reviewed in more detail in the accompanying text, are important for the protection and survivability of neighborhoods during Florida wildfires:

- Infrastructure and access;
- Vegetation management and strategic placement of greenspaces (common areas);
- Building construction;
- Water supply for fire protection;
- Utilities;
- Level and style of development;
- Other factors.

Infrastructure and Access

Neighborhood and community design play a critical role in how quickly firefighters can respond to an advancing wildfire. Factors such as road and shoulder width, turnarounds, road surface materials, and visibility of street signs affect emergency access to neighborhoods as well as how safely residents can evacuate. Two clearly marked access routes should be provided to homes in all parts of a subdivision or neighborhood.

While topography is not a major concern in Florida fire behavior, the topography does provide obstacles limiting firefighter access in the form of rivers, lakes, creek, and swamps. Extensive ditch or canal or drainage systems in developments can further impede firefighter access.

Vegetation Management and Strategic Placement of Greenspaces

Location of greenspaces (common areas), parks, golf courses, utility corridors, roads, trees, stormwater ponds, and other landscape elements should be planned with a view toward wildfire protection. Properly managed greenspaces can be a barrier to the spread of wildfire into a neighborhood. Furthermore, the functional placement of required design elements (e.g., retention ponds, parks) can provide wildfire protection at little or no additional cost to the developer. Permanent greenspaces – or fuel management zones (FMZs) – should be planned around developments in high-risk areas, with an assigned responsibility for maintaining these

Photo: USFS

This subdivision has only one access route. Residents could be trapped if a wildfire closed off the entry road.

OPTIMUM CONDITIONS FOR INFRASTRUCTURE AND ACCESS FOR WILDFIRE MITIGATION:

- Two or more roads lead in/out of every neighborhood or development phase.
- Road width is 24 feet or greater, with 60-foot or greater right-of-way width.
- Roads have an all-weather hard surface with drivable 8-foot-wide shoulders.
- Road curves have a 50-foot or greater centerline radius.
- Bridges have a minimum 30-ton Gross Vehicle Weight (GVW) capacity and width equal to the road, with a higher capacity being provided for any bridges on major access roads.
- Most residences have direct access off the main road.
- Dead end roads are less than 300 feet long, with turnarounds of a 50-foot minimum outside radius.
- Residential driveways are at least 12 feet wide with vegetation cleared to a width and height of 16 feet.
- Street signs are visible and made of non-flammable materials.
- Canals or other water bodies do not limit firefighting access to greenspaces or buffer zones.
- All roads, driveways, bridges, and other access facilities are continuously maintained.

(Adapted from *Protecting Florida Homes from Wildfire – A Guide for Planners, Developers, and Fire Services,* FDOF 1989) Ordinance 30-77)].

areas for their fire protection benefits, as well as for their other functions. FMZs separating new developments and subdivisions from high-risk surrounding vegetation are particularly important. The best location and design of these features must be decided for each development based on an assessment of the fuels and potential exposures to wildfire in the area.

Experience in Florida shows that when wildfires start in the accumulated fuels of unmanaged wildlands, they are more likely to cause major structural losses in neighboring subdivisions. These "wildfires with a head start" are very difficult to stop when they encroach on populated areas at the wildland-urban interface. Structures at the edge of the interface are most vulnerable to these wildfires in high-risk areas.

Large wildland areas within or adjacent to a new development and under the same ownership (e.g., conservation set asides) should be included in wildfire mitigation planning efforts. For example, large tracts of forest land adjacent to a new development should be provided with FMZs and water supply or storage features, as well as regular fuel reduction treatments, in order to provide enhanced protection to the development area. All wildlands adjacent to inhabited areas should be continuously managed to reduce the accumulation of wildland fuels. Fuel reduction treatments on wildlands adjacent to development protect both the built community and the natural resources from disastrous wildfires. See Chapter 2 for a discussion of prescribed burning and other fuel management options.

Lot design within the development should allow a 30-foot-wide "defensible space" of reduced vegetation around each home. If zero lot lines are planned, then provisions should be made for reduction of hazardous fuel on neighboring parcels and in a FMZ around a unit or phase of the subdivision. Education of residents about wildfire risk and appropriate fuel management techniques can be a valuable tool – such educational information could be included in notification to new residents. Requirements for residents to maintain appropriate fuel reduction measures should be included in neighborhood "covenants" or deed restrictions. See Chapter 6 for a complete discussion of defensible space and fire-resistant landscaping.

When managing vegetation that feeds wildfire, the biggest concerns are how close the vegetation is to structures, the type of vegetation present, and how heavy the vegetative fuels are. Management of vegetation in areas immediately around structures can make the difference in whether the home will survive a wildfire or not. The area around a home or other building can be designed as a wildfire-resistant landscape, with the most intensely managed zone ("defensible space") closest to the structure, and less intensely managed zones further from the structure. Such a zoned landscape can protect structures from all but the most intense wildfire. During a wildfire, protection of individual structures by firefighters

OPTIMUM DESIGN OF GREENSPACES FOR WILDFIRE MITIGATION:

- Defensible space 30 feet wide is provided for individual structures.
- Fuel management zones are provided around the development perimeter and to break up large areas of continuous fuels within the development as necessary. Homes at an edge of the development that borders unmanaged wildlands are afforded extra protection through fuel management zones. Fuel management zones have a width of 100-200 feet. Mature trees can be retained in fuel management zones.
- Advantageous placements of parks, golf courses, waterways, or other greenspaces can provide the low-volume fuel conditions (i.e., fuel management zones) needed for wildfire protection.
- Greenspaces or fuel management zones are coordinated with ponds, streams, lakes, and drainage features, and public access routes and service roads throughout the development (i.e., water features do not block firefighter access to homes or greenspaces).
- Greenspaces or fuel management zones have all-weather access for firefighting equipment.
- Greenspaces or fuel management zones are regularly maintained with prescribed fire or other fuel management techniques to reduce the accumulation of hazardous fuels. (See Chapter 2 for a discussion of fuel management strategies).

is often not possible due to the extreme danger to firefighting personnel and the strain on limited resources. This is why it is important to design landscapes and structures so that the house can survive without the intervention of firefighters. Refer to Chapter 6 for a graphic representation and information on how to create a zoned firewise landscape.

Building Construction

Non-combustible building materials for the roof, soffits, siding, and skirting (for raised homes or mobile homes) can reduce the likelihood that a structure will ignite. For example, experience in Florida has shown that vinyl soffits and siding frequently melt and fall away from the house when exposed to the heat of a wildfire, leaving the attic and wall areas vulnerable to ignition from wind-blown embers. Embers may also be blown under raised homes, mobile homes, or wooden decks, igniting accumulated debris and the subfloor.

The closeness of adjacent structures may also present a hazard. For this reason, it is best if a majority of homes in a subdivision or neighborhood use firewise construction, so that the group of homes as a whole is more resistant to wildfire. Chapter 5 includes a complete discussion of factors in structural ignition and fire-resistant building practices.

OPTIMUM CONDITIONS FOR CONSTRUCTION FOR WILDFIRE MITIGATION:

- Individual structures are designed following fire-resistant building construction principles.
- Homes in the development have Class-A-rated or noncombustible roofing.
- Homes in the development have fire-resistant or noncombustible soffits, siding, and skirting (for raised homes or mobile homes).
- A majority of the lots in the development are built (i.e., few vacant lots).

(Adapted from *Wildfire Hazard Assessment Guide for Florida Homeowners,* FDOF, 2002)

Water Supply for Fire Protection

To successfully control a wildfire, suppression action is best taken while the wildfire is small. This requires a local and reliable water supply that is unaffected by loss of electrical power. Developments in hazardous areas with municipal water systems should have a pressurized hydrant system to support emergency firefighting needs. Land Development Regulations (LDRs) should specify hydrant spacing and flow characteristics necessary to protect the development.

In rural areas of Florida, helicopters are used to drop water on wildfires. In wildland-urban interface areas, helicopters save many homes threatened by wildfire. Lakes, ponds, and canals can be suitable helicopter dipping spots if they are a minimum of 4 feet deep year round with a 45 foot radius clear of obstructions and a 75 foot approach clearance in at least one direction. Developments in rural areas can be designed to provide helicopter-dipping spots. Developers may also consider providing all-weather ground access points and dry hydrants for lakes and ponds within neighborhoods for use by ground firefighting equipment.

OPTIMUM DESIGN FOR WATER SUPPLY FOR WILDFIRE MITIGATION:

- Developments link to municipal water supplies or provide a firefighting water supply in rural settings.
- Water systems meet firefighting needs as specified by local codes.
- Individual homes provide water systems as recommended in Chapter 5.

A reliable water source is important to fire-fighters' ability to protect individual structures in rural areas. In the absence of a pressurized fire hydrant system, swimming pools and ponds located throughout the neighborhood are suitable and are better choices than individual residential well systems or trucked-in water.

Utilities

Gas pipelines, electric lines, and septic systems can hinder wildfire suppression efforts and endanger firefighters if not considered as part of development planning. Overhead power lines may stretch, arc, or break when exposed to the radiant heat from wildfires, thus endangering firefighters and spreading the wildfire. Service entrance lines from power poles to homes are low and may create clearance problems for firefighting equipment. Wildfires in Florida have started when

OPTIMUM UTILITY DESIGN FOR WILDFIRE MITIGATION:

- Underground utilities are safer than aboveground utilities in a wildfire emergency.
- Existing aboveground utilities should have a well-maintained right-of-way.
- All utilities and septic systems are clearly marked to prevent problems for heavy firefighting equipment.

windblown trees come in contact with charged power lines. Existing overhead transmission lines should be regularly inspected and maintained by the local service provider to ensure that they are free of encroaching vegetation.

Underground utility installation is the best strategy for protecting utilities from wildfire in new developments. Heavy equipment is routinely used to fight wildfires in Florida. Brush trucks may fall into unmarked septic tanks and tractor-plow units may sever buried electric or gas lines. These hazards can endanger firefighters, delay wildfire suppression efforts, and contribute to the spread of the wildfire. Underground lines should be buried at least 30 inches below grade and should be clearly marked to avoid problems when heavy equipment is used to fight wildfires (*Protecting Florida Homes from Wildfire – A Guide for Planners, Developers, and Fire Services,* FDOF 1989).

Level and Style of Development

Phasing of development can have a significant role in the wildland-urban interface wildfire problem. If lots are sold and there is no development deadline, undeveloped (and usually unmanaged) lots will be interspersed with developed lots. This is the situation that led to the loss of many homes in two separate wildfires that occurred in the Palm Coast subdivision in 1985 and 1998, and Port St. Lucie subdivisions in 1999. The City of Palm Coast is now taking steps to protect homes from future wildfire threats by performing fuel reduction treatments on undeveloped lots within the development.

Patchy development schemes automatically create a wildland-urban "intermix" situation, which is a difficult and dangerous situation for wildfire suppression. Undeveloped lots may allow a wildfire to burn deep into a subdivision on many fronts. Because there is not a consolidated front and wildfire is scattered throughout a neighborhood, firefighters frequently have insufficient resources to protect all of the structures that need protection. Florida experience has shown that more homes are lost in intermix subdivisions.

If the number of undeveloped lots in a subdivision is few, then the danger of a wildfire burning into the subdivision is greatly reduced. This reduction in risk occurs as a subdivision is "built out." A few remaining undeveloped lots

Photo: FDOF

Fuel reduction treatments should be performed on undeveloped lots in subdivisions in high-risk areas. This Gyrotrac® is mowing and chopping heavy fuels in an undeveloped lot of the Palm Coast subdivision in Flagler County, Florida.

Photo: FDCA

Large developments should strive to completely build out each phase within a year or two so that homes are not left in the more risky intermix situation, as in this photo.

4
Neighborhood design for reduced wildfire risk

OPTIMUM LEVEL AND STYLE OF DEVELOPMENT FOR WILDFIRE MITIGATION:

- Empty lots in a development are regularly managed for fuel reduction.
- A majority of the lots in the development are built (i.e., few vacant lots).
- Homes are clustered so that surrounding fuel management zones or greenspaces can more easily protect them from wildfire.

(Adapted from *Wildfire Hazard Assessment Guide for Florida Homeowners,* FDOF, 2002)

Design for wildland fire safety should be done as part of the overall property development process if it is to be effective and economical, and all members of the development team should incorporate emergency fire conditions as an integral part of their development activities. …. Add-on fire safety, planned after a development has been designed or constructed, is inherently more expensive and generally less effective than that engineered as an integral part of the total residential development.

Brooke Smith, Wildland-Urban Interface Fire Engineer, 1987

less than 5 acres in size in a subdivision are not considered to be a danger unless they have extremely high fuel loads or high flammability characteristics or are rated an extreme hazard. Undeveloped lots with extreme fuel loads can be managed with a variety of fuel management techniques, given that there is a neighborhood association or authority pursuing a fuel management strategy. Once a neighborhood is more than two-thirds built, the wildfire hazard becomes low enough that mitigation treatments can focus on the edge of the subdivision interface with wildland areas (*Wildfire Hazard Assessment Guide for Florida Homeowners,* FDOF 2002).

If homes are clustered it is easier to provide a wildfire protection buffer to the entire group of homes. Clusters of homes can be surrounded by greenspaces acting as fuel management zones or "community protection zones." Within clustered developments, fire-resistant building construction should be maximized to limit the movement of fire from structure to structure. Chapters 2 and 3 include a detailed discussion of planning and regulatory approaches (i.e., clustering) to wildfire mitigation.

Additional Factors

Additional factors to consider in a neighborhood assessment:

- **Wildfire history:** Review the history of wildfire occurrence in the area. Whether started by lightning, arson, careless outdoor burning, or other causes, if there is a history of wildfire in the area, it is likely that the vegetation will support wildfires again in the future.
- **Special facilities:** No matter the level of risk determined for a given subdivision, special protective measures should be planned for facilities such as utilities substations, public safety stations, communications facilities, facilities providing storage for flammable or hazardous materials, materials-oriented businesses such as lumber yards or recycling centers, and smoke sensitive facilities such as schools, hospitals, or care centers. Special facilities can be clustered in "industrial" or "school" or "health care" zones with additional fuel management protection provided around each zone.
- **Organization for wildfire mitigation:** An organized homeowner's association (HOA) facilitates coordination with fire protection agencies and can contribute to a reduced wildfire risk by creating homeowner awareness of firewise construction and landscaping practices.

INTEGRATING WILDFIRE CONSIDERATIONS IN THE DEVELOPMENT PROCESS

The design and development of residential communities is a complicated and expensive process, with many regulations and codes to be met by the developer. Adding a wildfire mitigation expert to the development team probably will be a low priority for the developer. The wildland-urban interface wildfire problem is complicated enough, however, that it does help to have an expert opinion to guide the process of ensuring that a new community is less vulnerable to wildfire. Many

wildfire mitigation features can be designed into a community at little or no additional cost to the developer, but only if these features are considered during the early planning phases of the development.

The Wildfire Mitigation Plan

A wildfire mitigation plan may be a requirement of a local wildfire mitigation development review process or ordinance, such as the model ordinance presented in Chapter 3. A progressive developer might prepare a wildfire mitigation plan to be sure that all wildfire protection needs are met. The presence of a wildfire mitigation plan may actually be an advantage in marketing homes in a high-risk area. A wildfire expert should incorporate some or all of the following steps into a wildfire mitigation analysis and plan for a new development:

1. Analyze the characteristics of the site and establish a wildfire hazard rating for the site;
2. Make specific recommendations for reducing the wildfire risk before and after development;
3. Incorporate wildfire mitigation features into the development design;
4. Review the landscape and building plans for wildfire mitigation features;
5. Review factors related to emergency response:
    a. Water supply,
    b. Proximity to fire protection services,
    c. Emergency access and infrastructure,
    d. Fuel management zones (greenspaces) and vegetation maintenance.

Develop a plan for long-term management and maintenance of wildfire mitigation status by a management firm or committee of homeowners.

The wildfire expert may work with a committee of development representatives and homeowners from the beginning of the wildfire mitigation planning process, or the expert may provide a plan for later implementation by the developer and homeowners association. Either way, it is critical that there be some mechanism for long-term maintenance of the wildfire mitigation benefits to the community.

Fire Protection Needs During Development

While future wildfire mitigation needs for the development are addressed in the development plan, wildfire protection during the development process is often overlooked. In smaller developments, wildfire protection during the development period may not be a significant need, but it can be a major problem in large or phased developments that are built over a period of several years. Wildfire mitigation planning should address the period of development as well as the long-term needs of the community. In high-risk areas, it is prudent to have fire protection features in place before development begins. A wildfire protection expert can recommend what steps are necessary to protect the investment in a high-risk development area.

OPTIMUM PLANNING FOR WILDFIRE MITIGATION:

- A wildfire expert is included in developing a wildfire mitigation plan for the development.
- The developer implements the wildfire mitigation plan during construction of the community.
- A committee of developer representatives and/or homeowners is created to sustain a long-term wildfire mitigation initiative.

OPTIMUM CONDITIONS DURING DEVELOPMENT FOR WILDFIRE MITIGATION:

- At least two access routes are provided to all phases of development until the permanent road system is completed.
- Fire protection and prevention services are provided in cooperation with fire protection agencies.
- No residential occupancy is allowed in high-risk areas until fuel reduction measures have been completed as defined in the wildfire mitigation plan for the development.
- Phased development plans ensure that the first homes are not exposed to hazardous conditions (fuels) from adjacent vacant lots for more than one year.

4
Neighborhood design for reduced wildfire risk

PROVIDING FOR LONG-TERM PROTECTION FOR DEVELOPMENTS AND NEIGHBORHOODS

Long-Term Vegetation Management and Maintenance

Greenspaces or common areas in a development need regular vegetation management for fuel reduction, especially greenspaces that have been designated for wildfire protection purposes. Fuel reduction must be built into subdivision covenants so that it is not forgotten at some later date. The wildfire mitigation plan will specify which fuel treatment approaches are best for an area, and how often those fuel treatments need to be performed. See Chapter 2 for a discussion and comparison of various fuel treatment strategies.

Whatever the chosen method of fuel management, all fuel reduction treatments are temporary and will be effective in substantially reducing the wildfire threat for only 3 to 5 years. Additional treatments are regularly required to maintain a reduced risk of wildfire. Although prescribed fire is the most economically and ecologically sound technique for fuel management in Florida ecosystems, there are a number of fuel management techniques that can be employed in neighborhood green spaces and undeveloped lots:

- Prescribed burning;
- Mechanical treatments (mowing, chopping, disking);
- Herbicide treatment;
- Biomass removal (pine straw harvesting, vegetation removal, tree thinning, timber harvesting);
- Biomass conversion (livestock grazing);
- Piling and burning (in areas without an overstory).

Prescribed fire within neighborhoods should not be discounted as a fuel management strategy. It is common to perform prescribed burns within close proximity of homes without endangering the homes. For example, a demonstration project has shown that prescribed fire can be used to maintain and restore small remnants of longleaf pine sandhill ecosystems within suburban neighborhoods and around golf courses in north Florida. In the study, prescribed fire was found to increase the diversity and richness of flowering native plants in the remnant patches of forest, while being a cost-effective method to achieve management of remnants that would otherwise require more costly and labor-intensive fuel management approaches. The prescribed fire demonstration project was coupled with public education about the ecological and wildfire protection benefits. The prescribed burns enjoyed a high level of community support (Heuberger and Putz, 2003).

Homeowners' Associations

Plans for new or existing developments should provide for a well-organized management association or homeowners' association (HOA) that can continue long-term wildfire mitigation efforts. Although many people move to wildland-urban interface areas for privacy or retirement, and are reluctant to get involved in community associations, an active homeowners' association can be very effective in reducing wildfire risk.

HOAs will not only raise awareness within the neighborhood, but will also raise awareness in the community at large. HOAs also ask questions about how neighboring wildlands are managed and encourage fuel reduction practices on those neighboring lands. The end result may be a reduced risk of wildfires that start in wildland areas with fuel accumulations.

In high-risk neighborhoods where homeowners associations are inactive or nonexistent, it is local fire protection agencies and the FDOF that will encourage neighborhoods take action to mitigate the wildfire hazard. This process is already taking place, as many local governments and FDOF District

I live in a high wildfire risk area. After the Martin County Fire Prevention Officer spoke to our homeowners organization membership, it was amazing to see how quickly – within days! – homeowners took charge and cleared underbrush from their properties, as well as from the development's common areas. Public outreach by the local fire prevention officer is invaluable and probably is a strategy that can be implemented quickly statewide since nearly all fire-rescue departments have someone charged with the responsibility of meeting with public groups.
Link Walther, AICP, Florida Planning Consultant

offices are working with the statewide Fire Management Teams to reduce fuels in high-risk wildland-urban interface areas. It is important for the agencies to identify one or several people in a neighborhood who can become leaders and promoters of the wildfire mitigation effort. Peer-to-peer outreach among neighbors, with the help of fire agencies, may be more effective than additional regulation. If the story of the wildfire hazard is told well enough, people will gain a heightened awareness of their risk and will be willing to take action.

CASE STUDY: WEDGEFIELD ESTATES FIREWISE COMMUNITY USA

Wedgefield Estates is a community in eastern Orange County that banded together to become a *Firewise Community USA*. The effort provides educational information to homeowners, community awareness events, and ongoing mitigation projects (e.g., vegetation reduction, prescribed burns). The community began by forming a non-profit coordinating Firewise Committee. The Firewise Committee holds community events each year, tied to other community events or at the local home improvement center. At these events, the committee and volunteers distribute educational packages, fire-resistant plants, and information about the Firewise Communities program. The Florida Division of Forestry and Orange County Fire Department cooperate in wildfire mitigation activities throughout the community, including installing firelines, and performing demonstration fuel reduction treatments. The Wedgefield Estates Firewise Committee works with local elected officials and has experienced a high level of support from community members.

MODEL LANGUAGE FOR COMMUNITY COVENANTS

A good understanding of the wildfire risk in a development – among the developer, fire protection agencies, and residents – can lead to an improved degree of fire protection for residents and improved public support for fire prevention and mitigation practices. Local communities or homeowners groups may consider adopting a set of covenants or deed restrictions, with wording similar to the model documents presented in Chapter 3, for the purposes of defining wildfire risk and protecting the community from the wildfire hazard. Communities may also refer to the NFPA 1141 *Standard for Fire Protection in Planned Building Groups* for standards to include in a covenants document (NFPA 2002).

Photo: FDOF

Maintenance of community protection zones can help to save homes like this one from wildfire.

CHAPTER FIVE

Building construction for reduced wildfire risk

5
Building construction for reduced wildfire risks

Introduction

THE DANGER OF WILDFIRE TO THE BUILT ENVIRONMENT

At the heart of the wildland-urban interface wildfire problem is the loss of houses and other buildings. From the perspective of wildfire, human constructions are just another form of fuel. The problem is not new, but because of the dramatic increase in development in the wildland-urban interface, residential losses associated with wildfires have become a serious and growing fire-protection problem. Firefighting resources are often stretched thin when a large wildfire approaches a neighborhood.

In an extreme wildfire event, firefighters may not be able to protect each home. When firefighters arrive at a subdivision threatened by a wildfire, they must quickly assess which houses can be protected and which houses are hopeless, and they must preferentially protect homes rather than managing the growth and spread of the wildfire.

As recommended in Chapter 6, the home landscape in high-risk areas should be managed well beyond the 30-foot defensible space area in order to ensure protection of life and property. The ideal situation is for the structure and landscape to be designed and maintained to survive without the intervention of firefighters. Firefighters can withstand far less radiant heat than can wood siding, so a 30-foot defensible space is the minimum space needed to protect a home. By installing and maintaining a firewise landscape, structures are both better able to withstand the threat of ignition from radiant heat and firefighters are able to protect houses without endangering themselves in the process.

While Chapter 6 focuses on landscape issues, this chapter will focus on what can be done to limit the wildfire risk to houses, businesses, outbuildings, or any other structure that could be threatened by wildfire. While vegetative fuels and weather are major factors in wildfire behavior, the construction approach will determine how fire-resistant a structure will be when a wildfire approaches.

Wildfires in the wildland-urban interface differ from the typical structural fire that affects a single house or several houses. The more severe wildland-urban interface wildfire situations are characterized by:

- Rapid approach of wildfire to residential areas;
- Wildfire simultaneously threatening a large number of structures;
- Overextended firefighting resources resulting in unprotected residences;
- Ignited houses that typically are a total lost.

(Cohen & Butler 1998)

It only makes sense that a homeowner would want to keep a wildfire as far away from their house as possible – through appropriate firewise landscaping, for example – but it is also wise to consider how houses can be designed, built, and maintained to better survive the threat of an approaching wildfire. This chapter will make concrete and practical recommendations for firewise construction and retrofitting of homes in the wildland-urban interface.

In many places, building codes do not address the wildfire threat to structures at the wildland-urban interface. States may be slow to adjust building codes to accommodate wildfire risk-reduction

Photo: FDOF

A house lost in the 1998 Florida wildfires

The WUI fire problem can be characterized as the external fire exposure (flames and firebrands) of a residence resulting in ignitions that produce widespread, extreme losses. If residential fire losses did not occur during wildland fires, the WUI fire problem would not exist. Thus, the principal WUI fire issue becomes residential structure survival. (Cohen and Butler 1996)

features into building design, although some jurisdictions around the country are now addressing firewise design at the local level as discussed in Chapter 3. In most areas, designers, architects, landscape architects, developers, builders, homeowners, and neighborhood associations must take the initiative for wildfire protection improvements.

HOW STRUCTURES ARE IGNITED BY WILDFIRE

Vegetative or structural fuels must be heated to between 583 and 727 degrees Fahrenheit (306 to 386 degrees Celsius) in order to burn. There are two main ways that wildfire can create enough heat to move from vegetative fuels to ignite structures at the wildland-urban interface:

- Radiation
- Convection

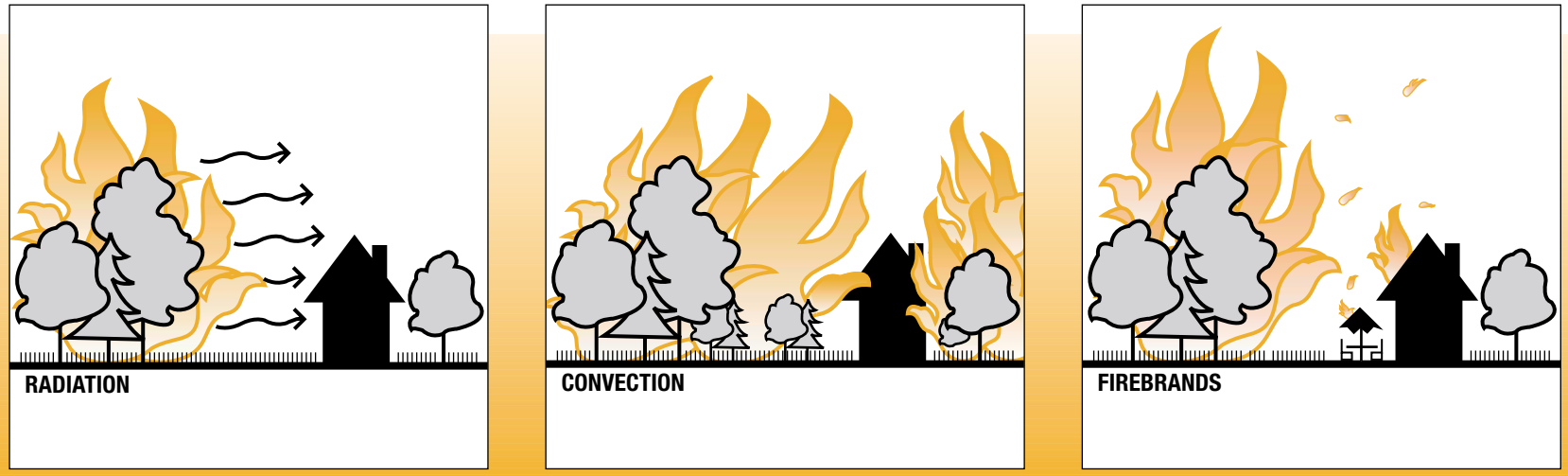
Another way that wildfire can threaten a home is through firebrands, floating embers that can lead to ignition of structures via either radiation or convection. These ignition factors are discussed below (as adapted from Cohen and Butler 1998).

Radiation – Heat Emanating from the Flames

Radiant heat from burning vegetation adjacent to a structure is the principal ignition factor for most houses lost to wildfire. Wildfires ignite fuels and structures by radiating heat, just like a radiator heats a room in the wintertime. Radiant heat ignites vegetation and structures without direct flame contact.

As an example of the real-life implications of radiant heat, one cause for the loss of houses in Florida wildfires is the presence of vinyl or fiberglass soffit vents. Radiant heat from a wildfire can melt these materials and cause them to fall away, allowing ignition of underlying materials or allowing firebrands to be drawn into the attic, which in turn ignites the house.

Distances for structural ignition from radiant heat sources have been tested at the USDA Forest Service's Fire Science Laboratory. "On the basis of severe-case assumptions of flame radiation and exposure time, [model] calculations indicate that large wildland flame fronts (e.g., forest crown fires) will not ignite wood surfaces (e.g., the typical variety of exterior wood walls) at distances greater than 40 meters [132 feet]" (Cohen 1999). Because



Radiation, convection, and firebrands are sources of ignition of structures in the wildland-urban interface.

of the ineffectiveness and inefficiency of clearing vegetation at distances very far from the structure, however, the researchers conclude that "effective fuel modification for reducing potential WUI fire losses need only occur within a few tens of meters from a home, not hundreds of meters or more from a home. This research indicates that home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings" (Cohen 1999). Because home ignitions depend on the characteristics of the home and immediate surroundings, researchers have observed between 86 and 95 percent wildfire survival for homes with nonflammable roofs and a vegetation clearance of 10 meters (33 feet) or more (Cohen 2000).

The results of Cohen's research underscore the importance of creating a 30-foot defensible space around structures in wildfire risk areas. In most cases, a 30-foot distance from fuels to the structure made a significant difference in whether the structure survived or not. The more space the better, but 30 feet is the minimum recommended distance that has shown positive results. Instead of looking at defensible space as an area for firefighters to work, defensible space should be thought of as the space necessary for a house to survive without firefighter intervention.

Cohen's research indicates that a reduction of flame height (e.g., through surface fuel reduction) and a reduction in the size of the flame front (e.g., through thinning of trees, so that trees burn individually instead of as a continuous wall of flame) can help to reduce the radiant heat reaching the exterior walls of the structure. Reducing the duration, or residence time, of the flame front also reduces potential ignition of structures. Fine fuels (e.g., grasses, twigs, leaves, pine needles) have flame durations of a minute or less and do not pose as much of a hazard as long-burning fuels, such as shrubs, woodpiles, or neighboring structures, which generate dangerous levels of radiant heat because of their long burning time.

Obstacles between the house and the wildfire can act to block incoming radiant heat from a wildfire. Fire-resistant vegetation, noncombustible walls, or features of the terrain (e.g., berms, hills) can be advantageously used or installed to act as barriers to radiant heat.

Convection – Direct Flame Contact

Wildfire also may ignite a structure through convection, which is direct contact of the flames with the structure. The wildfire itself may engulf the structure, or a smaller fire may start in vegetation or dead fuels next to a house, on a roof, or near a wood fence or deck and ignite the structure that way. Direct contact of flames that have ignited fuels next to a house is a major ignition factor for structures lost to wildfire in Florida and in other areas.

Firebrands – Flying Embers

Firebrands are another factor in structures lost to wildfire in Florida. Firebrands are airborne burning materials or embers that are carried upward by a wildfire and deposited elsewhere. Firebrands can be carried distances of a mile or more by upward convection air currents and associated winds of a wildfire. Firebrands especially are a danger in Florida because of the tendency of saw palmetto, cabbage palm, and other vegetation to form airborne embers in a wildfire. If a house is within a mile of a large wildland area, firebrands will be a contributing factor to the overall wildfire risk.

If a firebrand lands on a combustible roof, is pulled up around a melted soffit or attic vent, or floats under a combustible deck or raised building, it can easily ignite a structure by direct contact (convection). Firebrands also may ignite debris or nearby vegetation that in turn ignites the structure through radiant heat or convection. Protecting a house from ignition by firebrands involves maintaining a clean defensible space and protecting the structure itself from ignition by following the recommendations included in this chapter.

On the basis of severe-case assumptions of flame radiation and exposure time…calculations indicate that large wildland flame fronts…will not ignite wood surfaces…at distances greater than 40 meters [132 feet]. …home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings.
(Cohen 1999)

CASE STUDY: STRUCTURAL IGNITION FACTORS IN THE CERRO GRANDE FIRE, NEW MEXICO

The May 2000 Cerro Grande fire that burned 239 houses in Los Alamos provides a recent example of ignition by firebrands and convection. Evaluations show that the wildfire that burned through the developed areas of Los Alamos was a surface-level fire and that most houses could have been protected by simple measures such as removing pine needles from foundations and roofs and placing wood piles away from houses. The houses that were burned were often separated from the main fire by several roads, which would normally be an adequate firebreak, and yet they burned because airborne embers (firebrands) ignited pine straw on their roof or near their wood siding and the resulting flames directly ignited the building (Cohen 2000c). The Cerro Grande review underscores the importance of management of fuels and flammable debris in the defensible space in high-risk areas.

Assessing the Level of Risk from Wildfire

Before designers, builders, or homeowners proceed with the work of safeguarding structures from wildfire, it is important to identify and assess the actual level of risk, particularly if the house is in a wildland-urban interface area. Recall that Florida houses may not be at risk if they are located in urban or suburban areas surrounded by development. If a house, business, or other structure is in an area that is part of the wildland-urban interface, however, assessment of risk is an important first step. A rapid risk assessment process is provided in Chapter 6. A more detailed risk assessment for neighborhoods or developers of new subdivisions is provided in Chapter 4. The landscape-level Florida Wildfire Risk Assessment System for planners is discussed in Chapter 2.

The goal of the risk assessment process, therefore, is to implement an action plan to mitigate the wildfire risks that are identified. So that efforts and money are not wasted, it is very important to identify which areas of the landscape or structure need mitigation first. A typical Wildfire Mitigation Plan will address:

- Level of wildfire risk and site characteristics;
- Fuel management planning;
- Construction, location, and design of structures;
- Access, infrastructure, and water supply for firefighting.

Managing Fuels in the Landscape

Management of vegetative fuels is the principal approach to reducing the wildfire hazard to houses. Fuel management is not only necessary to protect the landscape from wildfire, but is critical to protect the structure itself from ignition. A Florida home at medium risk of wildfire should be surrounded by at least 30 feet of defensible space. Homeowners in high-risk or extreme-risk areas should go beyond the basic 30-foot defensible space and establish a zoned landscape of up to 100 feet wide to protect structures from ignition, as detailed in Chapter 6. Because home ignitions depend on the characteristics of the structure and its immediate surroundings, researchers have observed between 86 and 95 percent survival of wildfires for homes with nonflammable roofs and a vegetation clearance of 10 meters (33 feet) or more (Cohen 2000).

Fuel reduction does not imply a complete denuding of the landscape. A tree crown spacing of 15 feet for conifers and other fire-prone trees within the first landscape zone, and less spacing in subsequent zones, is sufficient to reduce radiant heat to at or below the level where ignition of wood siding occurs. Tree crown spacing is the amount of spacing between the outer edges of the foliage of mature trees. The predicted size of the mature tree must be taken into account when planting tree seedlings. Crown spacing is less critical for oaks and other less-flammable broadleaf trees. These recommendations apply to

Wildland fire and home ignition research indicates that a home's exterior and site characteristics significantly influence its ignitability and thus its chances for survival. Considering home and site characteristics when designing, building, siting, and maintaining a home can reduce WUI fire losses. (Cohen 2000)

houses located in high-risk or extreme-risk areas, and correspond to the zoned landscaping concepts and tree crown spacing guidelines provided in Chapter 6.

The value of defensible space and a firewise landscape cannot be overstated. Assuming that the landscape risk-reduction actions recommended in Chapter 6 have been taken, attention may then be turned to addressing risk factors for the structures themselves. Building materials and design can play a significant role in protecting a structure from ignition. At higher levels of risk, building construction factors become more important and more mitigation activities need to be done to protect a structure from ignition by a wildfire.

Building Practices to Protect Structures from Wildfire

Recall that houses and other structures can be just another form of fuel for a wildfire. The survival of structures in wildfires involves a two-pronged approach, which is discussed in detail below:

1. Protecting the structure from ignition;
2. Providing support for firefighting efforts in the event that the structure does ignite.

PROTECT THE STRUCTURE FROM IGNITION: BUILDING CODES FOR WILDFIRE MITIGATION

Building standards and building codes are created to regulate the design, construction, and maintenance of buildings and other structures. Building codes prescribe a minimum acceptable level of design and construction to protect the health, safety, and general welfare of the occupants of a building. Building codes are generally enforced by a codes enforcement authority in each jurisdiction and usually are developed and amended in each state through a process of expert committees and public involvement.

Since humans began building structures, experience has shown that poor design will increase a structure's potential to burn, buckle, or collapse under stress from storms, earthquakes, and other natural disasters. Building codes and standards benefit everyone in society by mandating minimum construction standards so that buildings can resist these challenges, thus protecting the building and neighboring structures and natural resources from damage or destruction. Identified below are several building codes and standards that apply to construction in Florida and that may address wildfire mitigation needs.

The Florida Building Code

The Florida Building Code (FBC, formerly the Florida Unified Building Code) was developed to serve the purposes of public safety, health, and general welfare through structural strength, stability, adequate light and ventilation, and safety from structural fire and other hazards of the built environment. The FBC applies to the construction, erection, alteration, modification, repair, equipment, use/occupancy, location, maintenance, removal, and demolition of every public and private building, structure, facility, or floating residential structure, or any appurtenances connected or attached to such buildings, structures, or facilities. It does not, however, apply to the manufacture of mobile homes as defined by federal law. The code also regulates the installation and maintenance of all electrical, gas, mechanical and plumbing systems.

The Florida Building Commission administers and updates the FBC through the work of many volunteer committees and under the Florida Department of Community Affairs (FDCA) Office of Building Codes and Standards. The statewide code incorporates building, electrical, plumbing, mechanical, and administrative sections with accessibility, energy efficiency, coastal construction, manufactured housing, and state agency codes. The most recent version of the FBC went into effect on March 1, 2002, as Florida Law Chapter 2001-186.

The FBC does not specifically address best building construction methods for wildfire mitigation, although it does include comprehensive provisions for structural fire safety and for interior and exterior fire resistance. Fire prevention is further addressed through the Florida Fire Prevention Code.

Florida Fire Prevention Code

The Florida Fire Prevention Code (FFPC) is Florida's first comprehensive statewide fire safety code, applying to all facilities in Florida except the Uniform Facilities listed under Florida Statutes Section 633.022. The FFPC became effective on January 1, 2002 after three years of meetings of several technical advisory committees and the Florida Fire Code Advisory Council. The FFPC is created under the mandate of Florida Statutes Chapter 633 Fire Prevention and Control, which mandates the State Fire Marshal to adopt by rule the FFPC, containing or incorporating by reference all fire

safety laws and rules that pertain to and govern the design, construction, erection, alteration, modification, repair, and demolition of public and private buildings, structures, and facilities and the enforcement of such fire safety laws and rules. The State Fire Marshal is required to adopt a new edition of the FFPC every third year.

The FFPC is a statewide fire safety code that applies to all local jurisdictions in Florida. There are provisions in the FFPC for locally adopted amendments for application within each jurisdiction, as long as such local amendments provide for a higher degree of life safety than the existing FFPC codes. Each locally adopted amendment is required to be submitted to the State Fire Marshal and the Florida Building Commission within 30 days of its adoption. Local wildfire mitigation codes may be considered to be amendments to the FFPC.

The FFPC is based on NFPA Standard 1 Uniform Fire Code (2000) and NFPA Standard 101 Life Safety Code (2000), and includes Florida Administrative Code Chapter 4A-60 (which addresses discrepancies between the FFPC and the FBC) and Chapter 5 of the State Requirements for Educational Facilities. NFPA 299 Standard for Protection of Life and Property from Wildfire (1997) is incorporated by reference in the FFPC. A new edition of the FFPC will be adopted in 2004, which will incorporate by reference the new NFPA 1144 Standard for Protection of Life and Property from Wildfire (2002).

National and International Building Standards for Wildfire Mitigation

Several national and international standards exist for wildfire mitigation in the wildland-urban interface. The goal of these national standards is to provide model codes for fire-resistant or ignition-resistant construction and landscapes that will offer reasonable protection from wildfire. These model standards are intended to facilitate uniformity in the construction industry:

- NFPA 1144 Standard for Protection of Life and Property from Wildfire, 2002 (formerly NFPA 299, 1997);
- International Fire Code Institute (IFCI), Urban-Wildland Interface Code, 2000;
- International Code Council (ICC), International Urban-Wildland Interface Code, 2003, based on a code previously adopted by the International Association of Fire Chiefs. ICC is the newly combined umbrella organization responsible for creating unified and consistent standard building codes for the U.S.

These model standards are not enforceable until they are adopted or referenced in a local government code. An administrative section that outlines penalty and enforcement clauses usually accompanies the adopting ordinance. The codes enforcement authority is then charged with the task of protecting the public health, safety, and welfare through enforcement of the model code for the local community. By their nature, building codes tend to be slow to change, because of how they develop and because builders and society want consistent building and landscape standards without frequent or radical changes in code requirements.

Most states have not yet adopted codes that address wildfire concerns for houses being built in the wildland-urban interface. For example, the Florida Building Code has not been modified to specifically address landscape and building design to reduce the risks of wildfire. An alternative approach is for local communities in fire-prone areas to adopt ordinances that address wildfire mitigation, such as the model ordinances presented in Chapter 3. Increasing public and homebuilder awareness of the role of building construction in wildfire mitigation is also an important approach.

Information from the national and international standards mentioned above has been incorporated into the recommendations provided in this manual. Without the guidance of code requirements, progressive designers, architects, developers, builders, homeowners, and neighborhood associations will want to take wildfire prevention and mitigation into their own hands by following the guidelines in this manual or the guidelines offered by other national wildfire mitigation programs.

GUIDELINES FOR FIREWISE BUILDING CONSTRUCTION

If an extreme wildfire overcomes the landscape defensible space, the exterior of the house or building should be able to prevent or retard the flames from burning into interior areas, such as soffits, attics, crawl spaces, walls, and rooms. Once a wildfire gets into interior areas, the house is very likely to be destroyed. Guidelines presented here for firewise building construction have been compiled from the following sources:

5
Building construction for reduced wildfire risks

CASE STUDY: FLASH BLUEPRINT FOR SAFETY™ PROFESSIONAL TRAINING PROGRAM

During June 2000, the Florida Department of Community Affairs (FDCA) and the Federal Alliance for Safe Homes (FLASH) convened a blue-ribbon panel of experts to design an education curriculum for homebuilders, homeowners, inspectors, and other audiences interested in disaster-resistant construction. The curriculum focuses on wind, flooding, and wildfire hazard mitigation for new and existing homes. Through collaboration with the Florida Division of Forestry, the group adopted Firewise practices as its core wildfire principles and now delivers online, classroom, CD-ROM, and town-meeting courses and seminars. The award-winning Blueprint for SafetyTM program offers free professional wildfire mitigation training, awareness program resources, and technical support. It reaches tens of thousands of stakeholders throughout the United States with the most current information about wildfire mitigation. Professionals from FEMA, the National Weather Service, and the fire services and emergency management community use Blueprint for SafetyTM to reach homebuilders, citizens, and others with crucial wildfire mitigation information. See www.blueprintforsafety.org for more information.

- The Firewise Construction Checklist found at www.firewise.org;
- The Federal Alliance for Safe Homes (FLASH), a non-profit disaster safety organization that offers the Blueprint for SafetyTM wildfire mitigation training program;
- The Institute for Business and Home Safety (IBHS), a non-profit insurance industry organization that provides Fortified for Safer Living guidelines and a checklist for homebuilding materials and design;
- The code documents referenced in the previous section.

Roof

After the fuels in the landscape, the roof is the next most vulnerable part of the property to wildfire. Roofs are susceptible to firebrands that may fall on them from a wildfire. Roofs are also vulnerable to radiant heat in the unlikely case of an extreme crown wildfire. The wildfire risk assessment in Chapter 6 should indicate if an extreme crown wildfire event is a possibility, so that extra protective action can be taken. Once the roof covering on a structure actually ignites, chances are high that the fire will destroy the rest of the structure. The roof is an important protective barrier to wildfire.

The best way to avoid rooftop ignition is to have a fire-resistant or noncombustible roof covering. Fire-resistant roofing materials are categorized as Class A, B, and C in accordance with the ASTM E108 test standard, which is a test for determining the rate of spread of flame in roofing materials. ASTM International, the former American Society for Testing and Materials, is a non-profit organization

FIRE-RESISTANT ROOF DESIGN

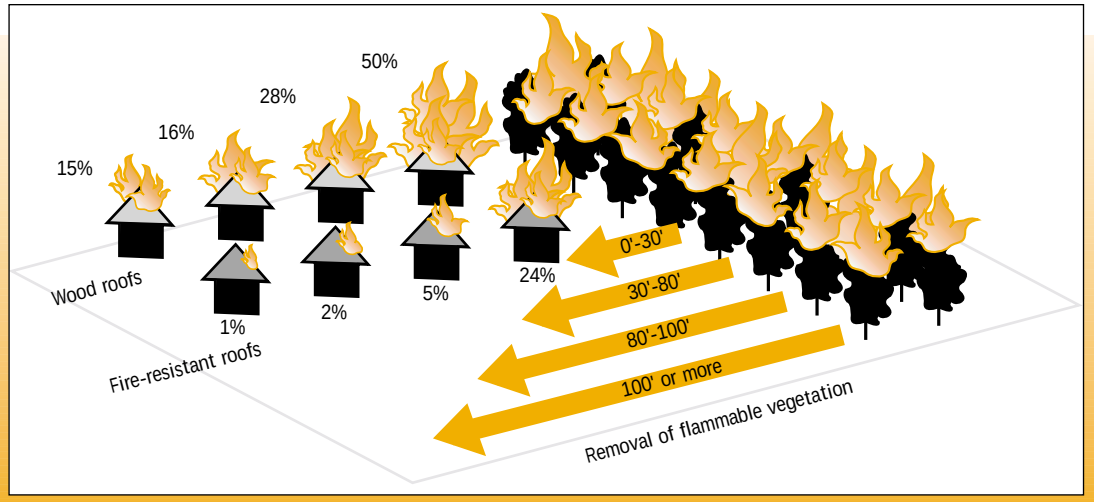
- The roof assembly has a Class A fire-resistive rating or is noncombustible.
- The roof design minimizes the collection of pine needles, leaves, and debris on roof (i.e., fewer gables).
- Rooftop and/or interior sprinkler systems may bring added protection in extreme-risk areas.

STANDARDS FOR ROOFING MATERIALS

Class A roof coverings are effective against severe fire exposures. Under such exposures, Class A roof coverings are not readily flammable, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and pose no firebrand hazard.

Class B roof coverings are effective against moderate fire exposures. Under such exposures, Class B roof coverings are not readily flammable, afford a moderate degree of fire protection to the roof deck, do not slip from position, and pose no firebrand hazard.

Class C roof coverings are effective against light fire exposures. Under such exposures, Class C roof coverings are not readily flammable, afford a measurable degree of fire protection to the roof deck, do not slip from position, and pose no firebrand hazard. (ASTM E108 Standard, www.astm.org)



Roof ignition as a function of distance from fire. (Adapted from Moore, 1981)

FIRE-RESISTANT EAVES, SOFFITS, VENTS, GUTTERS

- Eaves are enclosed with noncombustible material (e.g., metal).
- Soffit vents and other vent covers are non-combustible or fire-resistant material that blocks the passage of firebrands (e.g., 1/8-inch metal mesh).
- If vinyl soffits and/or siding are desired, they can be installed over a noncombustible liner (e.g., 1/8-inch metal mesh).
- Gutters and downspouts are made of fire-resistant or melt-away material.

that develops and publishes voluntary standards for materials, products, and services.

Class A rated roofing materials have the highest level of fire-resistance. Class A Rated roofing materials for firewise construction include 20-year, 25-year, and architectural-grade fiberglass composition shingles and shingles and shakes made from recycled materials (e.g., EcoShake®). Wood shingles may be purchased with a fire-retardant coating, but the shingles must be annually treated to maintain their fire-retardant qualities. Wood shake shingles are the most flammable roofing material, but they are rarely used in Florida's humid climate.

ASTM does not rate noncombustible roofing materials because they cannot be ignited. Noncombustible roofing materials are appropriate for high-risk areas. These materials include standing-seam or exposed-fastener metal roofing, fiber-cement shingles (such as HardiPlank® brand), concrete or clay tiles, and natural slate roofing.

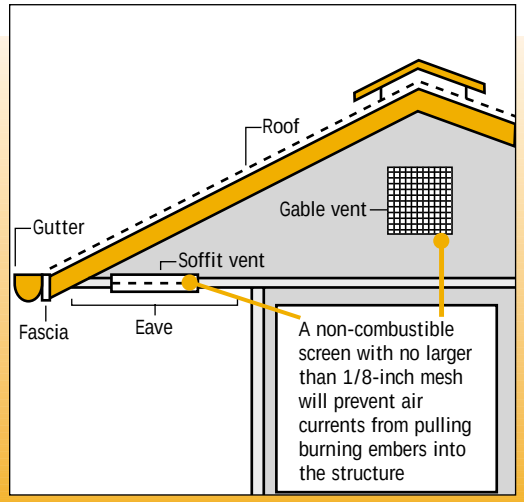
The Florida Building Code does not require Class A roofing. It does, however, require certain structural elements (e.g., roof structure, exterior walls) to have a fire resistance rating in accordance with ASTM E119, depending on the building size, use, and siting. ASTM E119 is a controlled test to determine the fire resistance of building construction and materials. Fire resistance is expressed in the number of hours the assembly will satisfactorily retain its structural integrity when exposed to fire.

Another factor to consider in the design stage of a home sited in the wildland-urban interface is the pitches and gables of the roof. Roofing planes or gables that tend to trap pine needles, leaves, and debris, or that could potentially trap flying firebrands, increase the chances of rooftop ignition if the roof is not regularly inspected and cleaned of debris. Keep the roof design and maintenance simple (i.e., fewer gables and pitches) in high-risk wildfire areas.

Eaves, Soffits, Vents, Gutters

The eaves of the house are often the closest point of the structure to the flames of a wildfire. Because eaves protrude from the edge of the house, they are vulnerable to both radiant and convective exposure. It is important to understand that because these features often are designed to ventilate attics or roof spaces and because of the

5
Building construction for reduced wildfire risks



Vent features of a house (not to scale)

strong convection currents created during a severe wildfire, super-heated air and embers may actually be sucked into soffit or fascia vents and into the attic or interior roof space, creating an interior fire that usually cannot be stopped.

In medium-, high-, or extreme-risk areas, eaves should be enclosed with noncombustible materials. The size of the soffit vents in the eaves should be minimized and the vents themselves should be made of noncombustible and non-melting material, such as metal. PVC, fiberglass, and vinyl are all vulnerable to melting or igniting under the influence of radiant heat. To limit the potential of combustion, all combustible vents should be replaced or underlain with noncombustible material to prevent embers from entering attics or crawl spaces.

If the roof has an internal space to ventilate summer heat, as is common in Florida, any eave-edge opening of the ventilated space should be screened with 1/8-inch mesh to prevent the entrance of firebrands or embers from a wildfire. Corrosion-resistant noncombustible materials that minimize home maintenance, such as galvanized or aluminum metal, are recommended for vent covers and protective mesh. Gutters and downspouts also should be made of either noncombustible materials or vinyl, which will fall away during the intense heat of a wildfire instead of igniting the home. Needless to say, old-fashioned wood gutters are a fire hazard.

The same recommendations apply for attic vents, subfloor vents, foundation vents, or other structural vents – that they be made of noncombustible and non-melting materials and be protected with 1/8-inch metal mesh to prevent embers from entering. If wind or convection currents push firebrands or flames through structural vents into a structure's crawl space or attic, the structure is likely to be destroyed.

Exterior Walls

It is important to prevent the ignition of exterior walls as the first line of defense against losing a house to wildfire. Exterior walls are vulnerable to both radiant and convective ignition. If defensible space and a zoned firewise landscape have been

CASE STUDY: THE IMPORTANCE OF NONCOMBUSTIBLE SOFFIT VENTS IN FLORIDA

An analysis of the Florida Palm Coast fire of 1985, in which 130 homes were damaged or destroyed, identified five factors, which together determined most (86%) of the risk to structures from wildfires in Florida. A regression analysis was used to look at houses that burned and survived the fire. The five factors that were most predictive were:

- Whether the fire was a crown fire (fire intensity);
- Whether the structure used fiberglass or vinyl (meltable/flammable) soffit vents;
- Whether the structure had (fire-resistant) block wall construction;
- Location of the structure in relation to extreme fire areas;
- Brush clearance around the structure (in the direction of the approaching fire).

Two of these factors, the intensity of the fire and the location of the structure in relation to extreme fire areas, are often beyond the control of the site owner. This analysis, however, supports the expert opinion that zoned fire-resistant landscaping (particularly brush clearance around the structure) and use of fire-resistant building construction materials (particularly noncombustible soffits and fire-resistant exterior walls) are major factors in determining whether a structure survives when a Florida wildfire approaches. Vinyl soffits in particular were identified as a problem in this post-event Florida wildfire analysis (Abt, Kelly and Kuypers 1987). Note that vinyl soffits may be installed over 1/8-inch metal mesh to prevent embers from entering the eaves of the house.

Photo: FDOF

Photo: FDOF

Photo: USFS

Photo: USFS

The top left photograph shows the melted soffits and soffit vents on a house that has survived a wildfire. These melted soffits could have allowed embers to enter the eaves of the house. The bottom left photograph shows a house with noncombustible metal soffits, roofing, and gutters, and masonry siding.

The top right photograph shows a house with vinyl siding that has melted in the radiant heat of a wildfire. The bottom right photograph shows a house with fire-resistant plank and masonry siding and melt-away vinyl railing that will fall away and not cause a fire hazard to the house.

FIRE-RESISTANT EXTERIOR WALLS

- Exterior walls in high-risk areas are built of fire-resistant materials (masonry, plaster/ stucco, or fiber-cement).
- Trim, shutters, and lattices are fire resistant or noncombustible.
- External doors are noncombustible or solid-core wood not less than 1-3/8 inches thick.

installed around a building as described in Chapter 6, radiant heat is unlikely to be hot enough to ignite an exterior wall. Although a fire on an exterior wall may not automatically transfer to the interior through the wall itself, fire on an exterior wall can more easily enter the home through the eaves, soffits, vents, windows, or attic areas. Once the fire reaches the interior of the structure, the structure is likely to be destroyed.

Some siding materials (e.g., vinyl, fiberglass) will burn only at very high temperatures, but will melt and fall away when exposed to radiant heat, exposing the sheathing or wall space to radiant heat or flames. Exterior wall materials that are resistant to radiant heat and flames include plaster, stucco, fiber cement (e.g., Hardiplank©), metal, and masonry (stone, brick, block).

If replacing exterior siding on an existing house is cost prohibitive, this is all the more reason to maintain a firewise landscape and take other risk reduction actions. It is possible to treat existing siding with a fire-retardant mixture. Fire-retardant treatments must be repeated on an annual

basis, however, to maintain protection of the combustible siding. It also is possible to coat a vulnerable house with fire-retardant foam (e.g., Barricade®) when a wildfire is approaching, but this practice involves considerable risk and cost to the homeowner and should only be considered after all other precautions discussed in this manual have been taken. Preventive measures are always better than last-minute actions when dealing with the wildfire threat.

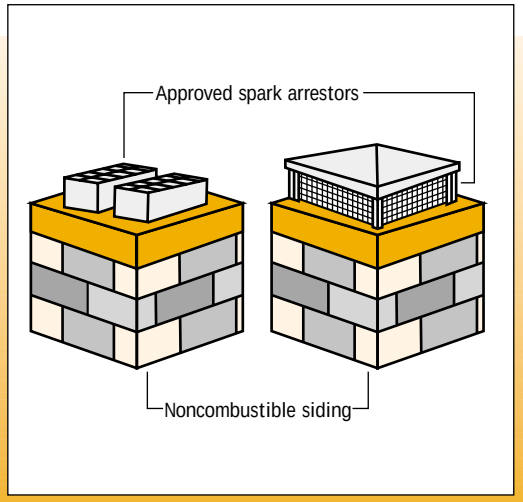
Chimneys

Chimneys can be a hazard in wildfire-prone areas. Embers from a fire in the fireplace can leave the chimney and ignite the roof or start a wildfire in the neighborhood, threatening the structure itself as well as neighboring structures and adjacent natural areas.

To easily protect both the structure and the surrounding forest from wildfire, every chimney should be fitted with an approved welded or woven wire-mesh spark arrestor. This feature has the added benefit of keeping birds and animals from entering or nesting in the chimney space. In addition, all siding on the chimney housing should be noncombustible material.

FIRE-RESISTANT CHIMNEYS

- All chimneys are fitted with approved spark arrestors (NFPA 1144).
- All chimney siding is noncombustible.



Properly protected chimneys

Crawl Spaces, Decks, Balconies, Carports, Fences, Attachments

Raised buildings (e.g., lakeside houses, mobile homes, manufactured houses, pole buildings) without skirting are more vulnerable to wildfire because firebrands or hot embers can be blown into the crawl space under the structure, increasing the possibility of ignition of accumulated debris and the subfloor. Decks, balconies, and other overhangs or attachments to a structure are often most vulnerable to ignition from convective exposure (direct contact with nearby flames) and from firebrands being blown under them to ignite debris or the underside of the attachment.

One solution is to enclose crawl spaces, decks, balconies, carports, and overhangs with noncombustible sheet skirting or metal mesh to prevent firebrands from getting under the house or attachment. Skirting or mesh has the added benefit of keeping debris and animals from getting under the deck or building. Clearing debris from under decks and overhangs is the minimum maintenance required in wildfire-prone areas. Note that Florida Building Code 2304.2.7 requires decks, fences, patios, planters, or other constructions that abut the exterior wall of the foundation or house to provide skirting that allows removal by screws or hinges for access for inspection and termite treatment.

Any feature of the property attached to the house should be considered a part of the building during a wildfire risk assessment. For example, an attached garage, storage space, or fence should be considered part of the structure. After the firewise

FIRE-RESISTANT CRAWL SPACES, DECKS, BALCONIES, CARPORTS, FENCES, ATTACHMENTS

- Decking material has at least a one-hour fire-resistive rating.
- Crawl spaces, decks, balconies, carports, and other attachments are enclosed with noncombustible material or screened with metal mesh.
- Combustible (wooden) sheds or fences are not attached to or adjacent to the house.
- Combustible attachments (wooden structures) such as fences and decks are separated from the house with sections of noncombustible or melt-away materials.

CASE STUDY: FENCING AT THE FIREWISE/FORTIFIED RETROFIT DEMONSTRATION HOUSE

The Firewise/Fortified Retrofit Demonstration House in Alachua County is a typical 20-year-old Florida home located in an area vulnerable to wildfire. The demonstration project was a joint effort of the U.S. Forest Service, the Florida Division of Forestry, the Florida Division of Emergency Management, Institute of Business and Home Safety, University of Florida Cooperative Extension Service, and Alachua County Fire Rescue.

The project demonstrated the use of firewise landscaping (see Chapter 6) and the use of firewise building materials to modify an existing home. Major modifications of the home included replacement of the cedar lap siding with Hardiplank® fiber-cement siding, replacement of the asphalt shingle roof with Class A roofing shingles, replacement of nylon window screens with aluminum screening, the addition of a spark arrestor on the chimney, replacement of a plastic skylight with a tempered glass skylight, and replacement of wooden fencing attached to the home with sections of noncombustible fencing.

Photo: USFS

Photo: USFS

Firewise Demonstration House fencing, before and after the Firewise retrofit. Vegetation has been cleared and the wooden fence attached to the home has been replaced with a metal fence.

landscaping recommendations in Chapter 6 have been completed, the vulnerability of these attachments can be further reduced by enclosing them with noncombustible or fire-resistant materials to reduce the possibility of ignition. Combustible (i.e., wooden) sheds and fences should not be adjacent to or touching a house. The problem can be addressed by separating the combustible attachment from the house (e.g., by moving a storage shed away from the house) or by providing a 12-foot-long noncombustible or melt-away connection between the house and the attachment (e.g., a 12-foot section of noncombustible metal or melt-away vinyl fencing between a wood fence and the house). As discussed in Chapter 6, woodpiles are kept outside of the 30-foot defensible space.

Windows, Glass Doors, Skylights

Radiant heat from a wildfire can cause glass window panes to fracture, leaving an opening for flames or firebrands to enter the interior of a structure. Heat-resistant (tempered or double-paned) glass should be used for windows in houses being built in high-risk or extreme-risk areas. If a wildfire approaches a house with tempered or multi-layered glass, some part of the house will probably ignite before the windows fracture. Tempered glass is required in Florida for glass doors, and many homes already are built with multi-layer glass windows to meet Florida Energy Code requirements.

If heat-resistant glass products are too expensive, minimizing the size of the windows can be an advantage. Solid fire-resistant exterior shutters are an option for houses in areas of extreme risk or for

FIRE-RESISTANT WINDOWS

- Exterior windows, glass doors, and skylights in high-risk areas are heat-resistant (tempered or double-paned) glass, or fire-resistant plastic glazing, especially windows facing wildfire-prone vegetation.
- Nylon or plastic window screens are replaced with aluminum or other metal mesh screens to prevent melting and entry of firebrands.
- Solid-core wood or metal exterior shutters may provide additional protection to vulnerable glazing on existing homes in high-risk areas.

retrofitting existing houses where window replacement is cost prohibitive.

Replacing nylon or plastic window screens with metal screens is a minimum first step for Florida houses in medium- or high-risk areas. Replacing the windows on an existing house is often cost prohibitive. Because of this, it becomes even more important in high-risk areas to keep the radiant heat of wildfire away from the building through the firewise landscaping described in Chapter 6, which also happens to be cost effective and easy to maintain.

Utilities

Aboveground utilities can be problematic in wildfire-prone areas. Overhead power lines may stretch or arc when exposed to radiant heat, may be a clearance problem for firefighting equipment, and may even cause a wildfire if windblown branches come into contact with live lines. Homeowners may not have a choice about utility locations when moving into a planned subdivision, but a utility company contractor usually maintains these lines.

Aboveground utility connections or wellheads at rural homes must be protected from wildfire through vegetation clearance and/or noncombustible housings. Well-marked underground utilities generally are preferable in high-risk rural areas. Underground utilities that are not marked, however, can be a problem for wildfire suppression in Florida due to the common use of heavy crawler dozers and fire plows to fight wildfire in Florida. Heavy equipment may sever buried lines or collapse unmarked septic tanks (DOF 2002).

All flammable materials should be stored more than 30 feet away from structures. Aboveground liquid propane (LP) gas tanks and woodpiles should not be located within 30 feet of the structure, as discussed in Chapter 6. Additional information about planning for neighborhood-wide utility design is included in Chapter 4.

FIRE-RESISTANT UTILITIES

- Well-marked underground utilities are preferable in rural areas.
- Liquid propane (LP) gas containers and woodpiles are located at least 30 feet from any structure and surrounded by 15 feet of cleared vegetation.
- Septic tank locations are marked to prevent collapse under heavy vehicles or equipment.

SUPPORT FOR WILDFIRE PROTECTION AND SUPPRESSION EFFORTS

In the worst-case scenario, a wildfire approaches and ignites a structure. At this point, any factors or hazards that slow or delay the response of firefighters create a greater chance that the house will be lost in the wildfire. Recall from the beginning of this discussion that the other half of the structural protection equation is to provide access and support for firefighting activities. There are a number of landscape, access, infrastructure, and water supply issues that must be addressed in order to provide full support for firefighting services.

Defensible Space

The first step in supporting firefighting activity is to create at least 30 feet of defensible space around the house as described in Chapter 6. The defensible space is so named because it provides space for the structure to "defend itself" from wildfire. The primary purpose of defensible space is to separate the structure from wildland fuels so that the structure can survive even in the absence of firefighting assistance. Defensible space secondarily allows firefighters the space to be better able to protect the house in the rare event that help is needed.

Access and Infrastructure

Street Signs and House Numbers

All street signs and house/site numbers should

be visible from the road and should be made of noncombustible materials. Wooden signs may burn during a wildfire, making it difficult for firefighters who may not be familiar with the layout of the roads. Clear labels make it easier for firefighters to quickly locate and defend threatened structures. Clear signage is a requirement of most local government emergency management departments that is not always enforced. Numbers and lettering should be at least 4 inches tall, mounted on a contrasting background, and visible from the road. Reflective numbers are useful in smoky conditions. Adequate signage is especially important in Florida where firefighters sometimes must find the best way into areas laced with canals or drainage ditches.

Roads, Bridges

Roadway and shoulder widths, road maintenance standards, turnarounds (cul-de-sacs), bridge design, road surface materials, and other features are important for support of wildfire suppression activities. These features affect how quickly and efficiently emergency crews can respond, as well as how easily residents can evacuate. Roads and bridges should be in good condition and should be at least 20 feet wide to accommodate firefighting equipment and allow for evacuation. Bridges should have a minimum capacity of 60,000 pounds (30 tons Gross Vehicle Weight) to allow for passage of heavy firefighting equipment. It is always better to have two routes of access into a property or subdivision; dead-end roads may require that residents pass through a wildfire in order to evacuate and may increase the chance that firefighters and their equipment are cut off from escape routes. Designing subdivisions with more than one access route is good general practice for other emergency purposes as well. Subdivision design standards are included in Chapter 4.

FIREFIGHTING SUPPORT AND ACCESS

- Homes have a 30-foot defensible space. Homes in high-risk areas have a 100-foot zoned firewise landscape.
- Homes have a noncombustible reflective street number visible from the road.
- Driveways are at least 12 feet wide with at least 15 feet of vertical and horizontal vegetation clearance.
- Drives longer than 150 feet have turnarounds. Drives longer than 200 feet have both turnarounds and pullouts.
- Gates open inward, have an entrance at least 2 feet wider than the driveway, and are at least 30 feet off the main road.
- Locked gates have a key box approved by the local fire department.
- Bridges have a capacity of 30 tons Gross Vehicle Weight.
- Neighborhoods in high-risk areas have at least two access routes.

Driveways and Gates

Driveways must be large enough to accommodate firefighting equipment. Typical fire trucks require a driveway at least 12 feet wide and with 15 feet of clearance from vegetation on sides and above the driveway. A 16-foot-wide driveway is preferable. Driveways longer than 150 feet need to provide a turnaround. Driveways longer than 200 feet should have both turnarounds and turnouts, which are spaces for firefighting equipment to pull off the side of the drive so that another piece of equipment can pass.

Gates should open inward and be wide enough to accommodate firefighting equipment, at least 2 feet wider than the width of the driveway. Gates should be at least 30 feet off the main road so that the equipment can pull off the road to open the gate. If the gate is locked, the lock should not be so strong that firefighters are unable to break it in an emergency. Gates may also be equipped with a key box or electronic opener approved by the local fire department.

Water Supply

Along with the plowing of firelines to break the continuity of vegetative fuels, the use of water is a key to successful wildfire suppression efforts. Sources of water for firefighting should be supplied in both rural and suburban wildland-urban interface settings.

In rural areas, firefighting efforts often involve aircraft as well as wheeled and tracked vehicles. Lakes, ponds, canals, and other bodies of water may be suitable sources for helicopter water buckets, which can drop between 100 and 1,000 gallons of water on a spreading wildfire. Helicopters and fixed-wing aircraft are very effective in protecting homes threatened by wildfire in Florida. A water supply should be within six to eight miles of the property to be useful for helicopter drops.

5
Building construction for reduced wildfire risks

WATER SUPPLY FOR FIREFIGHTING

- In remote areas without pressurized fire hydrants, a supply of water (pool, pond, or tank) is provided for firefighting.

In less remote wildland-urban interface areas, the suppression effort calls for a dedicated supply of water that is available to firefighters. Having a ready water supply that is not affected by power outages is much better than relying on individual residential wells or water brought in by tanker trucks. If numerous structures are simultaneously threatened by wildfire, wells or water tankers cannot adequately supply firefighting needs.

Regardless of source, the water supply should be within a twenty minute round trip from the source to the wildfire to provide the best level of protection. A pressurized hydrant system is the ideal, but where there are no fire hydrants, elevated water tanks, pools, ponds, or other static water sources should be available to provide a continuous supply of water for firefighting efforts. Suitable dry hydrants or drafting sites – where firefighting equipment can easily pull up to a water source or pool to fill up – should be provided throughout neighborhoods in high-risk areas. Dry hydrant specifications can be acquired from local fire protection agencies or from the Florida Division of Forestry. More specifications for neighborhood water supplies are included in Chapter 4.

Photo: FDOF

Helicopters and fixed-wing aircraft are often used to fight wildfire in FLorida. Nearby water supplies are important to the aerial attack of wildfire.

Costs and Benefits of Firewise Building Practices

Even if a homeowner maintains a firewise landscape and does everything else that they can to protect a Florida home from the wildfire hazard, it may still make sense to make some changes to the way that the house is designed or built. A summary of costs for modifications or new construction can provide a guide during the strategic planning of wildfire mitigation actions.

COSTS AND BENEFITS OF MODIFYING BUILDINGS FOR WILDFIRE MITIGATION

Modifying or retrofitting a house with firewise features can be a good investment, particularly if the house is in an area at high risk for wildfire. Homeowners should consider the items in the accompanying table that are high priority, and weigh the costs against the value of the property, the level of wildfire risk in the neighborhood, and the level of firewise landscaping that is provided. This decision must be made on a case-by-case basis. If a homeowner lives in a high- or extreme-risk area, it is important to complete the structural modifications in addition to firewise landscaping. Florida homeowners also should be sure to protect themselves from flood and wind damage, which are much more common sources of damage to Florida homes than wildfire.

COSTS AND BENEFITS OF NEW FIRE-RESISTANT CONSTRUCTION

The vast majority of the wildfires that occur in Florida never reach catastrophic status, meaning that they cause less than $25 million in insured losses for each event. Flooding and windstorms more frequently cause catastrophic insurance losses in Florida, while wildfires only account for about three percent of losses. Because wildfire is not considered to cause catastrophic losses in Florida, data for wildfire losses do not appear in insurance loss databases maintained by the insurance industry

COSTS AND BENEFITS OF WILDLIFE MITIGATION MODIFICATIONS TO EXISTING AND NEW HOMES IN FLORIDA

Item	Cost range*	Cost category	Benefit in high-risk areas	Notes
Carry out vegetation management plan	<$500	LOW	VERY HIGH	No additional cost beyond typical landscape installation.
Maintain vegetation management	<$500	LOW	VERY HIGH	No additional cost beyond typical landscape maintenance.
Install fire-resistant signs and address numbers	<$100	LOW	VERY HIGH	Low cost for high general benefit. Benefits beyond wildfire issues.
Modify vents	<$500	MED	VERY HIGH	Moderate cost for high benefits. Soffit vents are implicated in many Florida wildfire losses.
Enclose eaves, fascias, soffits	$300-$1000	MED	VERY HIGH	Moderate cost for high benefit.
(Re)Roof with Class A or noncombustible roofing	>$5000	HIGH	VERY HIGH	No additional cost for new structure with Class A shingles. High additional cost for new construction or modification with metal roofing. Metal roofing has a longer life.
Modify attic, subfloor, or basement vents	<$300	LOW	HIGH	Low cost for high benefit.
Install a spark arrestor on the chimney	<$300	LOW	HIGH	Low cost for high benefit.
(Re)Build driveways, bridges, gates to handle firefighting equipment	>$1000	HIGH	HIGH	No additional cost over typical new driveway costs. Some cost to retrofit. Benefits extend beyond firefighting.
Enclose crawl spaces, overhangs, attachments	$300-$1000	MED	MED	Moderate cost; benefit depends on style of attachment. Landscaping can protect attachments.

COSTS AND BENEFITS OF WILDLIFE MITIGATION MODIFICATIONS TO EXISTING AND NEW HOMES IN FLORIDA (continued)

Item	Cost range*	Cost category	Benefit in high-risk areas	Notes
(Re)Cover exterior walls with fire-resistant material	>$1000	HIGH	MED	Moderate additional cost for new structure. High cost for modification of existing structure. Not necessary in most cases if other protective actions are taken (e.g., landscaping).
Re)Place glazing with heat-resistant glass or fire-resistant plastic panels	>$1000	HIGH	LOW	Moderate additional cost for new structure. High cost for modification of existing structure. Not necessary in most cases if other protective actions are taken (e.g., shutters).

**Costs vary widely across Florida. These figures are approximate cost ranges. (Adapted from Institute for Business and Home Safety, www.ibhs.org)*

for Florida. As stated above, Florida homeowners should be sure to protect themselves from flood and wind damage, which are much more common sources of damage to Florida homes than wildfire.

Nevertheless, wildfire losses are beginning to receive attention from insurance companies in the western United States. In several states, wildfire insurance reforms and insurance discounts are being offered for firewise landscaping or noncombustible building materials. For example, Texas and several other states provide discounts for customers building homes using noncombustible fiber-cement siding material (e.g., Hardiplank®). As scientists predict more numerous and more extreme wildfires in the U.S. in the next 30 years, insurance companies will probably be doing more to address wildfire losses in the future.

CASE STUDY: INSURANCE COMPANIES RECOGNIZE WILDFIRE THREAT IN WESTERN U.S.

Florida insurance policies generally include wildfire coverage. Homeowners in states without wildfire insurance coverage may participate in a state-run risk pool, operated in 29 states and the District of Columbia. In some areas, intentional wildfires (arson) are not covered by insurance policies.

Damaging and expensive wildfires in the western U.S. in recent years have resulted in large insurance losses. In 2003, State Farm Insurance Company responded by launching a multi-state program aimed at reducing the risk of property loss from wildfire at the wildland-urban interface. The company is conducting an assessment of 21,000 subscriber homes in high-risk areas of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming to determine their susceptibility to wildfire. Homeowners will then have from 18 months to two years to clear brush around their homes and space trees at least 10 feet apart. Those who do not comply may lose their coverage, they are taking some action to reduce wildfire risk around their homes.

(Land Letter, Thursday, 17 July 2003, www.eenews.net; *USDA Forest Service Fire and Aviation Briefing Paper,* 20 August 2003; *Rocky Mountain News*, 21 May 2003.)

CHAPTER SIX

Landscaping for wildfire mitigation

6
Landscaping for wildfire mitigation

Introduction

Because of Florida's high rate of population growth, and because most of Florida's ecosystems are adapted to fire, the wildland-urban interface area is expected to increase in the future. This interface area presents additional complexities in preventing and fighting wildfires. Houses in the wildland-urban interface may be placed in conditions that put them at risk in the event of a wildfire.

Before wildfire mitigation activities are planned for a home site or community, it is important to assess the level of wildfire risk. If a neighborhood is at high risk for wildfire, residents should prepare for wildfires just as coastal residents might prepare for hurricane season. Unlike hurricanes, however, fire behavior is somewhat predictable from the fuels and conditions on a site. Fuel reduction, therefore, is an important step in wildfire mitigation. If a site slated for development is determined to be at high risk from wildfire, planners and developers should collaborate toward a design that reduces the wildfire threat. With wise planning, wildfire mitigation practices can protect Florida communities from wildfire.

This chapter will describe specific landscape practices to reduce hazardous fuels and to increase the chances that houses and other structures and materials will not be burned in the event of a wildfire. This chapter will address:

- Methods to assess wildfire risk;
- Guidelines for firewise landscape design;
- Cost-benefit analysis of firewise landscaping;
- Case studies of firewise Florida landscape designs.

Photo: FDCA/FDOF/Pandion Systems

This wildland-urban interface home has a heavy fuel load near the side yard.

Assessing the Level of Wildfire Risk

Homeowners, communities, and fire managers are beginning to engage in proactive planning to manage the factors that contribute to wildfire risk. The level of wildfire risk and predicted fire behavior can change across the landscape depending on fuels, land use, and weather conditions.

RAPID WILDFIRE RISK ASSESSMENT

Because wildfire risk is affecting more families in the growing wildland-urban interface, it is critical to plan carefully to channel mitigation efforts into the areas that are at the highest risk. Mitigation efforts spent on areas that do not need it are wasted, and these efforts may leave high-risk areas untreated for lack of time and resources. Deciding which areas need mitigation, and strategically planning which areas to mitigate first, is very important. This calls for some kind of risk assessment to take place in order to most efficiently and effectively target mitigation actions.

A rapid risk assessment process can give an idea of the level of risk around a house based on land uses and vegetation around a site. Individuals and groups can contact local Division of Forestry, Fire Department, Cooperative Extension Service, and/or Office of Emergency Management representatives for assistance in the risk assessment process. After determining the level of risk, the owner will be prepared to take mitigation action to reduce the level of wildfire risk as necessary.

At the most basic level, the three main factors that contribute to wildfire risk at an individual home site are:

- Vegetation;
- Location and surrounding land use;
- Building construction (discussed in Chapter 5).

Recall that research has shown that vegetation around the house and in the direction of approaching wildfire was a major predictive factor of risk to the structure (Abt, Kelly, and Kuypers 1987). The land use and type of vegetation surrounding a home are major risk factors that can be quickly assessed during a reconnaissance of the property. For the

quick risk assessment, take a walk around the site or around the outside of an existing house and outbuildings. Take note of the type, size, and density of plants around the site and on nearby land, if it is in view. The accompanying table can provide site owners with a rough estimate of the level of wildfire risk.

When conducting a risk assessment, it is also important to consider location and surrounding land use. Is there a history of wildfire in the area? Are large natural areas or forests located adjacent to or within a mile of the site? Are neighboring wildlands managed for fuel reduction with prescribed fire, mechanical methods (mowing, chopping), biomass reduction (harvesting of pine straw, thinning of trees), herbicides, or grazing? If not, the homeowner may wish to contact the neighboring landowner and encourage the use of fuel reduction techniques to reduce wildfire risk. Owners of larger tracts of land may contact the Florida Division of Forestry for help in completing a wildfire risk assessment and mitigation plan.

RAPID WILDFIRE RISK ASSESSMENT FOR FLORIDA PROPERTY OWNERS

Level of risk	Description of site
Low risk	• A clear view through the undeveloped area • Bare ground or few plants growing low to the ground • Improved pasture or widely spaced grassy clumps or plants • Scattered palmettos or shrubs up to 3 feet tall separated by patches of grass and sand • Grasses to 4 feet tall (except Cogongrass) • Continuous thin layer of pine needles under scattered pine trees • Large trees, or mostly broadleaf trees • Oak leaves or broad leaves covering the ground • Moist forest or hardwood swamp
Medium risk	• A clear view above the shrubs into the undeveloped area • Continuous thick layer of pine needles and scattered pine trees • Grasses 4 to 6 feet tall (or Cogongrass) • Palmetto/gallberry 3 to 6 feet tall with scattered pine trees • Scrub vegetation less than 6 feet tall, with or without sand pine • Dense, young pine 20-60 feet tall • Cypress swamp
High Risk	• No clear view into the undeveloped area because of dense growth • Thick, continuous grasses, weeds, or shrubs more than 3 feet tall • Palmetto/gallberry over 6 feet tall with scattered pine trees • Palmetto/gallberry 3 to 6 feet tall with dense pine canopy* • Thick vines growing up trees • Medium-size trees or cabbage palms beneath taller pine trees • Impenetrable shrubs or young pines • Scrub vegetation over 6 feet tall, with or without sand pine
Extreme Risk	• Palmetto/gallberry over 6 feet tall with dense pine canopy* • Sand pine scrub with dense pine canopy* • Dense Melaleuca

* Pine canopy has at least 75% crown closure to be considered dense.

[Adapted from Wildfire Hazard Assessment Guide for Florida Homeowners (FDOF 2002) and Landscaping in Florida with Fire in Mind (Monroe and Long 2001)]

6
Landscaping for wildfire mitigation

The basic steps to reduce the level of wildfire risk in the landscape are:

1. Determine the level of risk ➡ see the previous section on risk assessment.
2. Create a "zoned" landscape matched to the level of risk ➡ follow the instructions below.
3. Perform regular landscape maintenance ➡ follow the instructions provided later in this chapter.

BROADER-SCALE WILDFIRE RISK ASSESSMENTS

A more detailed risk assessment using the Wildfire Hazard Assessment Guide for Florida Homeowners (FDOF 2002) is designed for use in neighborhoods, particularly areas where wildfire has occurred in the past (see Chapter 4). The neighborhood risk assessment addresses many factors, such as accessibility, landscaping/vegetation, construction materials, water supply for wildfire suppression, location of utilities, structure location, and vacant lots. A checklist is helpful to homeowners on medium- or high-risk sites to clarify exactly what landscape and building features are contributing most to their increased risk.

A wide-area risk assessment can be performed with the Florida Wildfire Risk Assessment System (FRAS) discussed in Chapter 2. FRAS is a landscape-level risk assessment tool for planning for wildfire mitigation and land use decisions on a broader scale, useful for land use decision makers in local governments and planning agencies. FRAS is most useful to support local and regional wildfire mitigation planning approaches or for assessing level of risk for larger developments, regional plans, and future land use elements of local Comprehensive Plans.

Landscaping to Limit the Fuels for Wildfire

A house is more likely to withstand a wildfire if grasses, brush, trees, and landscape plants are selected and managed to reduce the wildfire's intensity. A wisely landscaped yard can greatly reduce the hazard by slowing the spread of a wildfire and keeping the wildfire as far away from buildings as possible. In addition, firewise landscaping increases the effectiveness of fire-resistant building construction materials, as discussed in Chapter 5. It is not necessary to remove all of the trees and vegetation in a landscape to protect the property from wildfire. Remember that the reduction of surface-level fuels is the most important action to reduce the wildfire threat in the wildland-urban interface.

CREATING A "ZONED" LANDSCAPE FOR WILDFIRE MITIGATION

A wildfire mitigation landscape involves creating a series of concentric zones around a house, depending on the level of risk from wildfire. The zone concept is designed with Florida's fire behavior, vegetation characteristics, and environmental conservation needs in mind. The objective of zoned landscaping is to progressively reduce vegetation flammability and fuel volume closer to the house or other structure to slow a wildfire's approach while reducing its intensity. The zones define where specific actions should be taken. The landscaping around detached garages, storage buildings, barns, and other structures should be included in the plan.

Fires need fuel to burn. Dead branches and needles burn quickly, as do some of Florida's fire-prone shrubs and trees. Remember that surface fuels contribute most to the level of wildfire risk in Florida. If an area of reduced surface vegetation is maintained around a house, a wildfire will not be able to get close enough to burn the landscape or buildings.

If the site is at medium risk of wildfire, the owners should create the first of the landscape zones, called the **defensible space.** Defensible space is an area of managed vegetation at least 30 feet wide. The basic defensible space should be created for all properties in areas at medium or higher risk of wildfire. Wildfire experts agree that structures with a defensible space of at least 30 feet will be more likely to survive a Florida wildfire.

The best *defensible space* is a "lean, clean, and green" area around a house.

If the site is at high or extreme risk, the owners should create a complete zoned landscape to protect the house and property and should consult

If the site is at low risk from wildfire:

- Adhere to state and local regulations for all outdoor burning.
- Follow guidelines in Chapter 5 for providing clear address labeling and firefighting access to the property.

If the site is at medium risk from wildfire:

- Create a "clean and green" 30-foot defensible space around the house as described below.
- Complete all of the low-risk recommendations.

If the site is at high or extreme risk from wildfire:

- Create a zoned firewise landscape up to 100 feet wide around the house as described below.
- Complete all of the low- and medium-risk recommendations.
- Seek additional expert guidance to protect the property from extreme wildfire risk.

Photo: FDCA/FDOF/Padion Systems

Low risk

Photo: FDCA/FDOF/Padion Systems

Medium risk

Photo: FDOF

High risk

Photo: USFS

Low risk

Photo: FDCA/FDOF/Padion Systems

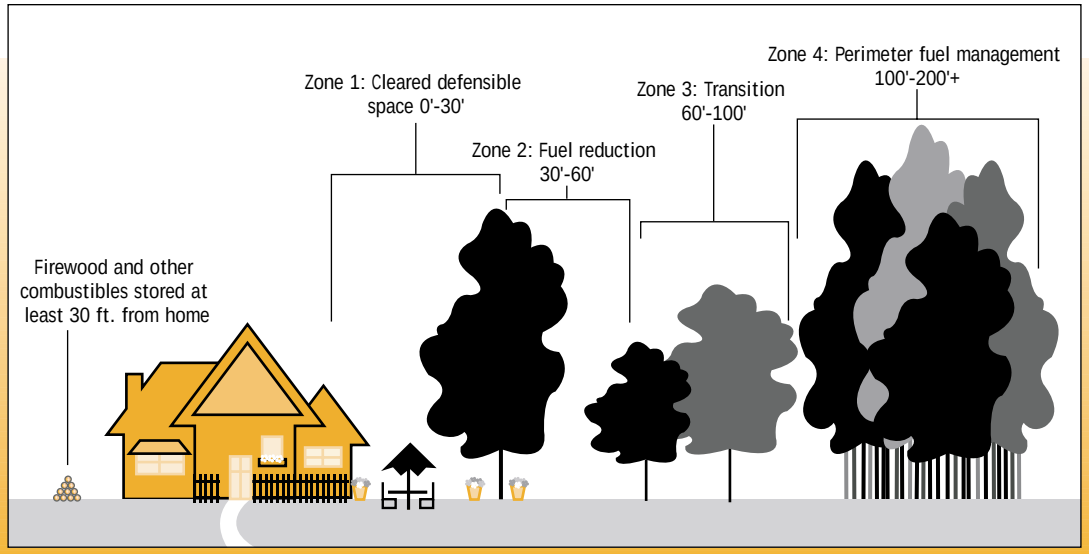
Medium risk

Photo: FDOF

High risk

with a wildfire expert to learn about further protective measures. In areas of high or extreme risk, a 30-foot defensible space may not be sufficient to protect a structure from ignition. In these cases, additional zones should be created beyond the basic defensible space.

These wildfire protection zones offer a flexible design technique that may vary for each property, depending on many factors, such as the type of vegetation involved, the type of building construction, the property boundaries, and other factors. The width and treatment of the zones may change with the conditions and size of a lot. On smaller lots, a 30-foot defensible space is not always possible. Homeowners should remember that any reduction of surface vegetation helps and that neighbors can work together in groups to create zoned areas. For properties over two acres in size, owners should create a zoned vegetation management plan for the purpose of reducing wildfire risk. The following recommendations have been adapted from Firewise Communities (www.firewise.org) and from the University of Florida's *Protecting Your Home From Forest Fires* (Monroe and Long 1999).



The wildfire mitigation landscaping zones around the house.

Zone 1: Defensible Space (0 to 30 feet from structures to be protected)

Zone 1 is the most important zone and is the area of maximum fuel reduction. This zone is also known as defensible space, defined as an area around a structure where fuels are modified and maintained so that the structure can survive a wildfire on its own even in the absence of firefighters. Defensible space also reduces the chance of a structural fire moving from the house to the surrounding forest and other houses. In order to be effective, the defensible space must be continually maintained. Here are some things that should be included in a defensible space plan:

- Keep all vegetation and organic mulches at least 5 feet from the house and other structures – use noncombustible separators such as gravel mulches, patios, walkways, driveways, stone walls, raised planters, or pools as fuel breaks directly adjacent to the house.
- Replace flammable plants with less flammable plants in the landscape (see suggestions later in this chapter) – plant grasses, flowers, and small shrubs that stay green and growing during the fire season.
- Arrange plants in mulched beds or islands separated by at least 10 feet of a low groundcover or turf.
- Remove stressed, diseased, or dying trees and plants.
- Remove or modify ladder fuels under pine trees or eaves.
- Thin pine trees to a 15-foot spacing between tree crowns.
- Be certain that there is a 16-foot-wide clearance between trees and structures or pools for use by firefighting equipment.
- Prune tree branches to 6-10 feet above the ground.

Ladder fuels, which channel fire from the ground to the treetops or eaves, are:

- Vines climbing on trees or walls;
- Small pine trees (up to 15 feet tall) under larger pine trees;
- Tall shrubs under pine trees or under eaves;
- Shrubs that are conical in shape under pine trees or under eaves.

Photo: FDCA

Photo: FDOF

Vines, tall shrubs, and small trees or palms can act as ladders leading wildfire into the crowns of the pine trees above.

- Prune tree branches to 10-15 feet away from roof, chimney, stovepipe, siding, and driveway.
- Do not keep firewood, flammable materials, storage buildings, or compost in Zone 1.
- Irrigate wisely (i.e., without wasting water) during dry seasons to keep groundcovers moist.

Zone 2: The Fuel Reduction Zone (30 to 60 feet)

Zone 2 is an area of moderate fuel reduction and modification that should be added in high- and extreme-risk conditions. The idea of Zone 2 is to break the continuity of the fuel available for a wildfire by thinning and grouping shrubs and reducing the presence of flammable plants. This zone should be extended along the driveway or other access road in order to provide a wildfire-free access zone. Reduce the fuels in Zone 2 in the following ways:

- Remove stressed, diseased, or dying trees and plants.
- Replace flammable plants with less flammable plants (optional – see suggestions later in this chapter).
- Mow or remove vegetation between shrubs to create separated shrub islands; arrange new planting in mulched beds or planting areas separated by groundcover.
- Remove or modify ladder fuels under pine trees.
- Consider thinning closely planted pine trees.
- Extend thinning along either side of the driveway and access road.
- Prune tree branches to 6-10 feet above the ground.
- Prune tree branches to 15 feet away from driveways and wooden fences.
- Firewood or flammable materials may be stored in Zone 2, but provide 15-foot vegetation clearance around propane tanks, barbeque grills, firewood piles, and flammable materials.
- Irrigate wisely (i.e., without wasting water) during dry seasons to keep groundcovers moist.

Zone 3: The Transition Zone (60 to 100 feet)

Zone 3 is a transition between the inner zones and the natural landscape beyond. This is an important zone if the site is at high or extreme

MATURE TREES FOR ENERGY CONSERVATION

Mature trees are unlikely to burn in a fire if surface fuels and shrubs have been reduced. Removing all the trees around a house would eliminate shade and increase temperatures during hot weather. Homeowners should maintain mature pine or oak trees or plant oak or other broadleaf trees within Zone 1 and Zone 2. Leaves from oak and broadleaf trees are less flammable than pine needles and may even prevent a fire from spreading near a house.

CASE STUDY: DEFENSIBLE SPACE AT THE CYPRESS KNOLL FIREWISE HOUSE, PALM COAST, FLORIDA

In the wake of the 1998 wildfires in central Florida, which burned a number of houses in Palm Coast, the City of Palm Coast adopted Ordinance 2001-11 (modeled after Flagler County 98-14) in an effort to reduce wildfire hazards in residential areas. The Cypress Knoll Firewise House was planned as a demonstration of both firewise landscaping principles and as a demonstration of the effects of the ordinance, which requires the reduction of vegetation on undeveloped lots that are adjacent to developed lots in the Palm Coast subdivisions.

The Cypress Knoll house was selected because it was at high risk from wildfire, with high-risk vegetation, no defensible space around the house, and highly flammable vegetation on the neighboring undeveloped lot. Vegetation on the neighboring lot was chopped using a GyroTrac® machine and Firewise landscaping principles were applied around the home site to further reduce risk of the wildfire.

Photo: Bill Butler/Firewise

Photo: Bill Butler/Firewise

Before and after pictures of the Cypress Knoll Firewise House in Palm Coast. Islands of native vegetation have been maintained in the landscape, but the fire-prone shrubs close to the house have been removed.

risk from wildfire. Fuel reduction in this zone can keep a hot crown fire from approaching and igniting the house or other structures. Here are some steps to take in Zone 3:

- Thin shrubs lightly.
- Mow or remove vegetation between shrubs to create separated shrub islands.
- Remove or modify ladder fuels under pine trees.

Zone 4: Perimeter Fuel Management Zone (100 to 200 feet and beyond)

Zone 4 is the area beyond the zoned landscape. This zone extends out 100+ feet from any structures that need protection. Periodic fuel reduction in Zone 4 will help to protect the house and property in the event of a wildfire. The goal is to slow an approaching wildfire, reduce the intensity of the wildfire, and keep the wildfire low on the surface. Fuel reduction techniques might include prescribed burning, mechanical methods (mowing, chopping), biomass removal (pine straw harvesting, thinning of trees), herbicides, or grazing. See Chapter 2 for more information on fuel reduction strategies for large properties.

- If the site owner also owns the property in Zone 4, engage in fuel management practices to reduce the risk of wildfire and protect the property.

CASE STUDY: LANDSCAPING AT THE FIREWISE/FORTIFIED RETROFIT DEMONSTRATION HOUSE

The Firewise/Fortified Retrofit Demonstration House in Alachua County is a typical 20-year-old Florida home located in an area vulnerable to wildfire. The demonstration project was a joint effort of the U.S. Forest Service, the Florida Division of Forestry, the Florida Division of Emergency Management, Institute of Business and Home Safety, University of Florida's Cooperative Extension Service, and Alachua County Fire Rescue.

The 2-acre property is located adjacent to state and private lands with fire-prone vegetation. When the house was built, barely enough space was cleared to place the structure on the lot. Fire-prone vegetation was within a few feet of the house. Part of the project demonstrated the use of firewise building materials to retrofit the existing home (see Chapter 5).

Photo: USFS

Photo: USFS

Before and after photographs from the Alachua County Firewise Demonstration House show landscaping improvements. Fire-prone cedars have been removed near the house and living groundcover has been installed. This homeowner wanted turfgrass in the new landscape, but homeowners may also use other fire-resistant groundcovers or mulches around the landscape.

The landscaping around the house also was modified. Landscape modifications included the removal of fire-prone plants, thinning of trees adjacent to the house, the creation of a defensible space around the house, and the reduction of fire-prone natural vegetation on the remainder of the lot. The homeowner wanted a groundcover of sod placed around the home, but other groundcover options would result in a more "natural" look.

- If Zone 4 falls in a neighborhood common area, management should be coordinated through the homeowners' association or community management. Properly managed common greenspaces can make an effective buffer to wildfire.
- If Zone 4 is owned by someone else, encourage and tolerate prescribed fire and other fuel management activities on the adjacent forest or natural lands.

INSTALLING THE FIREWISE LANDSCAPE

A homeowner can easily do the landscaping required for wildfire mitigation. If a property owner needs assistance in creating defensible space, landscape contractors can help by following these guidelines. For assistance with larger properties, a

LOW-MAINTENANCE PLANTS

Low-maintenance plants can provide the same level of fire resistance with less constant attention from the homeowner. Low-maintenance plants are:

- Drought-resistant
- Pest-resistant
- Native
- Non-invasive
- Slow-growing
- Wind-resistant
- Thrive without supplemental fertilizing (*Florida Yards and Neighborhoods)*

list of qualified prescribed fire and fuel reduction contractors may be available from the local Florida Division of Forestry or Cooperative Extension Service office.

Before planning a firewise landscape, property owners should review deed restrictions and check with local authorities for ordinances that may regulate tree or shrub removal on residential property. There also may be local ordinances governing clearance distances for brush and other flammable vegetation, disposal of debris, or other fire safety requirements. Local government planners, cooperative extension agents, or Florida Division of Forestry representatives can help property owners in developing a zoned landscape plan.

CHARACTERISTICS OF FIRE-PRONE VS. LESS-FLAMMABLE PLANTS

Fire-prone or **fire-tolerant** plants burn readily because they are adapted to survive in fire-dependant ecosystems and/or they may contain flammable compounds that support fire. Fire-tolerant plants have adaptations that help them to survive fire, like thick bark or extensive root systems.

Fire-prone plants are characterized by:

- Volatile oils, waxes, and/or resins indicated by leaves that are aromatic when crushed
- Narrow leaves or needles that are often evergreen
- Waxy or fuzzy leaves
- Accumulate fine, twiggy, dry, or dead material on the plant or on the ground under the plant
- Loose or papery bark or thick bark

Less-flammable plants are desirable in the firewise landscape because they are less likely to burn. Less-flammable plants are characterized by

- High moisture content in leaves
- Low oil or resin content in non-aromatic leaves
- Drought tolerance or drought resistance
- Minimal seasonal accumulation of dead vegetation, or accumulation of dead leaves that are somewhat resistant to fire because they hold moisture in the soil (e.g., large flat leaves)
- Limited foliage and few dead branches
- Open/loose branching habit
- Easy maintenance and pruning

PLANT CHOICES FOR THE FLORIDA FIREWISE LANDSCAPE

Flammability in plants depends on many variables including chemical composition, growing conditions, and maintenance. Choose plants that are suitable for the geographic region and the location in the landscape. Group plants with similar needs to minimize care. Select low-maintenance plants to ease yard work requirements.

Fire-Prone Plants

Fire-prone plants often contain flammable resins, oils, and/or waxes that ignite easily and burn intensely. Fire-prone plants will flame, not smolder, when preheated and ignited with a match. These plants are sometimes called “fire-tolerant”

FIRE-PRONE PLANTS TO BE REMOVED IN ZONE 1, REDUCED IN ZONE 2

Native plants	Native trees	Non-native plants and trees
Saw palmetto (*Serenoa repens*)	Cabbage palm (*Sabal palmetto*) and other native palms	Melaleuca (*Melaleuca quinquenervia*)*
Yaupon holly (*Ilex vomitoria*), Gallberry (*Ilex glabra*), and other native hollies	Red cedar (*Juniperus virginiana,* formerly *J. salicicola*)	Cogongrass (*Imperata cylindrical*)*
Pinewoods bluestem grass (*Andropogon arctatus*), Wiregrass (*Aristida stricta*), and some other native grasses	Young native pines: Longleaf pine (*Pinus palustris*), Slash pine (*P. elliottii*), Loblolly pine (*P. taeda*), Pond pine (*P. serotina*), Spruce pine (*P. glabra*),	Juniper (*Juniperus sp.*), Italian Cypress (*Cupressus sempervirens*), Arborvitae (*Platycladus orientalis* = *Thuja orientalis*), and other resinous ornamental plants
Wax myrtle (*Myrica cerifera*)		
Common reed (*Phragmites australis*)	Short-leaf pine (*P. echinata*)	Pampas grass (*Cortaderia selloana*)
Switchcane (*Arundinaria gigantea*)	Young or mature Sand pine (*Pinus clausa*)	Ornamental palm trees (*Arecaceae* family)
Greenbrier (*Smilax sp.*)		Brazilian pepper (*Schinus terebinthifolius*)*

**Invasive non-native plants and trees should be removed from all landscapes.*

plants because they are adapted to survive fire. Fire-prone plants should be removed in Zone 1 and thinned in Zone 2 of the firewise landscape. When it is not practical or desirable to remove a fire-prone plant, surrounding it with open space or less-flammable plants may reduce the hazard.

Less-Flammable Plants

In place of fire-prone plants, landscapers and homeowners should use less-flammable plants. Although no plant is absolutely fireproof, these plants are somewhat resistant to fire. Less-flammable plants are less likely to burn and take longer to ignite. These plants typically have a high leaf moisture content and/or low level of volatile oils or resins in their leaves. It is best to choose plants that are drought resistant and require low maintenance.

MAINTAINING A FIREWISE LANDSCAPE

As landscapes change over time, plants grow and spread, mulches dry out, and leaves and pine needles accumulate. These changes provide fuels that can accelerate a wildfire. Firewise landscapes require maintenance to retain their fire-resistant characteristics. For example, a less-flammable plant that is overgrown, accumulating dry or dead branches, or growing above dead vegetation can become a fire hazard. To return this plant to its less-flammable status, trim it back and clear away dead vegetation during annual or seasonal maintenance. Vines and ground covers can build up a heavy layer of foliage and dead leaves, which should be removed or mulched to reduce fuel for wildfire. The new growth on plants will be less flammable.

Proper maintenance over the long term will keep the landscape firewise. Healthy, well-maintained plants produce less fuel to burn. One approach is to select trees and shrubs that are easy to maintain and prune and which are less flammable without constant maintenance. The other approach is to regularly maintain the landscape. An annual landscape and home inspection should be performed during late fall (November) to prepare for the most active part of Florida's wildfire season, which is December through June. Landscapes in medium- or high-risk areas should be maintained on a seasonal (quarterly or semi-annual) basis. It is important to remember that vegetation grows at a fast rate in Florida's climate – if a home is in a medium-risk area and the landscape is not maintained, it could easily accumulate

LESS-FLAMMABLE PLANTS FOR FLORIDA LANDSCAPES

Native plants	Native trees	Non-native plants and trees**
Native azaleas (*Rhododendron sp.*)	Dogwood (*Cornus florida*)	Ornamental azaleas (*Rhododendron sp.*)
Coontie (*Zamia pumila*)	Eastern Redbud (*Cercis canadensis*)	Ornamental camellias (*Camellia sp.*)
Sparkleberry (*Vaccinium arboreum*)	Southern magnolia or Sweetbay (*Magnolia sp.*)	Fruiting plum or peach cultivars (*Prunus sp.*)
Chickasaw plum and other native plums (*Prunus sp.*)	Native oak trees (Quercus sp.)	Citrus (*Citrus sp.*)
Native Viburnums (*Viburnum sp.*)	Black cherry (*Prunus serotina*)	St. Augustinegrass (*Stenotaphrum secundatum*)
American Beautyberry (*Callicarpa americana*)	Soapberry (*Sapindus saponaria*)	Creeping lilyturf (*Liriope spicata*)
Buttonwood (*Conocarpus erectus*)	Eastern hophornbeam (*Ostrya virginiana*)	Mondo grass (*Ophiopogon jaburan*)
Sea grape (*Coccoloba uvifera*)	American sycamore (*Platanus occidentalis*)	Dracena (*Dracena marginata*)
Pigeon plum (*Coccoloba diversifolia*)	Red maple or Florida maple (*Acer sp.*)	Oleander (*Nerium oleander*)
Gumbo limbo (*Bursera simaruba*)	Sweetgum (*Liquidambar styraciflua*)	Century plant or other agaves (*Agave sp.*)
Native ferns (NOT Old-World or Japanese climbing ferns)	Winged elm (*Ulmus alata*) or other native elm species	Jacaranda (*Jacaranda mimosifolia*)
Sweet acacia (*Acacia farnesiana*)	Common persimmon (*Diospyros virginiana*)	Sago palm (*Cycas revoluta*)
Native black-olive (*Bucida sp.*) or wild olive (Osmanthus americanus or O. megacarpus) (NOT Russian olive, autumn olive, silverthorn, or black olive)	Sugarberry (*Celtis laevigata*)	Aloe (*Aloe vera*)
	Red or white mulberry (*Morus sp.*) (NOT paper mulberry)	
	Satinleaf (*Chrysophyllum oliviforme*)	
	Redbay (*Persea borbonia*)	
	Native ash trees (*Fraxinus sp.*)	
	West Indian mahogany (*Swietenia mahagoni*)	
	White fringetree (*Chionanthus virginicus*)	

***Non-native plants recommended here are not considered to be invasive.*

[The plant species listed in this and previous table were derived from a combination of experience and a review of the following sources: *Fire Wise Landscaping: Making Sensible Choices* (MacCubbin and Mudge, undated); *Flagler Horticulture: Making Your Landscape More Resistant to Wildfires* (Lippi and Kuypers, 1998); *Firewise Landscaping for Woodland Homes* (Alabama Forestry Commission, 1999); *Defensible Space Landscaping in the Urban/Wildland Interface: A Compilation of Fire Performance Ratings of Residential Landscape Plants* (UCFPL, 2003). Exotic plants were eliminated from the list per the Florida Exotic Pest Plants Council's lists of Category I and II invasive plants.]

enough fuel to become a high-risk landscape.

Too much or too little irrigation contributes to plant stress and disease. Too little irrigation leaves plants dry and stressed. Too much irrigation contributes to plant fungal diseases, is wasteful of Florida's limited water resources, and contributes to run-off and higher water bills. Regular maintenance of

SEASONAL (QUARTERLY) MAINTENANCE

- Rake up leaves, pine needles, dead limbs, and twigs in Zone 1 and dispose of them outside of Zone 1.
- Mow grasses or other groundcovers between shrub islands – mowing heights should be less than 8 inches in Zone 1, less than 12 inches in Zone 2, less than 24 inches in Zone 3.
- Irrigate wisely (i.e., without wasting water) during dry seasons to keep groundcover green.

ANNUAL (NOVEMBER) INSPECTION

- Remove dry weeds, brush, pine needles. and branches that have accumulated in Zone 1, on roof, and in gutters.
- Keep trees and shrubs pruned and in healthy condition – prune branches 6-10 feet above the ground and 15 feet away from roof, chimney, stovepipe, siding, outbuildings, and driveway.
- Remove yard trash and debris accumulations from Zone 1 – see disposal suggestions.

YARD WASTE DISPOSAL

Do not dispose of yard waste in piles or in a nearby vacant lot. Dispose of yard waste properly:

- Shred waste to use as mulch outside of Zone 1
- Compost waste in a pile outside of Zone 1;
- Take yard waste to the local recycling or composting center

an irrigation system will help ensure that the vegetation remains as firewise as possible during the most critical times of the year without wasting water. Consider these watering tips from the *Florida Yards and Neighborhoods* program:

- Water in the early morning (4-7am). This is the most efficient time because temperature and wind speeds are at their lowest and evaporation is reduced. Grasses are less susceptible to fungus if water is applied at the time dew normally forms.
- Follow this simple watering schedule for grass and other groundcovers: Apply 1/2-inch to 3/4-inch of water when the grass or groundcover shows signs of stress (bluish-gray color, folded leaves). Do not apply more water until symptoms reappear.
- Experiment with gradual reductions in irrigation to see if plants can tolerate less water. Some people use no irrigation yet have healthy plants.
- Water less in cool months (November-March), and turn off automatic systems in the summer when rainfall is consistent.

GUIDELINES FOR LANDSCAPE DESIGNERS, INSTALLERS, AND DEVELOPERS

Landscape architects, designers, installers, and developers have an important role to play in protecting Florida homes built in areas at high risk of wildfire. New developments should undertake a risk assessment before determining the necessary level of wildfire mitigation needed. A risk assessment framework that is appropriate for most areas of Florida includes:

1. Broad-area risk assessments to delineate high risk areas (see Chapter 2);
2. Risk assessments and mitigation plans for specific developments (see Chapter 4);
3. Mitigation plans for individual homes and neighborhoods (see Chapters 5 and 6).

The local Division of Forestry district office can assist with risk assessments. Chapter 4 includes information from the *Wildfire Hazard Assessment Guide for Florida Homeowners* checklist for neighborhoods. Chapter 2 discusses the Florida Wildfire Risk Assessment System (FRAS) for landscape-level risk assessment and planning.

6
Landscaping for wildfire mitigation

Firewise landscape design principles for Florida

Allow for a 30-foot-wide defensible space around structures, clear of ground-level vegetation and providing 16-foot-wide clearance between the trunks of trees and other features or structures for firefighting equipment access.

- Design a zoned landscape following the concepts discussed above.
- Use noncombustible design elements such as rock gardens, gravel mulches, patios, walkways, driveways, masonry walls, raised planters, or pools as fuel breaks directly adjacent to structures. Although organic mulch (e.g., pine bark) helps retain soil moisture, it should be kept away from structures because it is flammable when dry and may encourage termites when moist. Keep organic mulches at least 5 feet away from foundations.
- Choose the right plant for the right location. Group plants with similar maintenance needs to minimize care.
- Select low-maintenance, less-flammable, and drought-resistant native plants wherever possible. See lists provided in this chapter.
- Keep plantings open and uncrowded. Consider the size of mature plants and trees and space them accordingly in the design.
- Use shrub islands or patches of perennials rather than continuous beds of plantings. Do not design solid areas or borders of evergreen shrubs that will create an uninterrupted path for wildfire.
- Locate shrubs, vines, and small trees away from structures and large trees. Remember that wildfire can use shrubs and vines as ladder fuels to climb up into the tree canopy or eaves of a house.
- Place 10- to 15-foot strips or patches of living groundcovers (e.g., grasses) between shrub islands.
- Use large leafy trees on the east and west sides of a house to help keep it cool. Their flat leaves trap moisture on the ground and discourage fire. Pine trees provide good shade, however they require maintenance to trim lower branches and rake up pine needles. Follow the tree spacing guidelines that follow.
- As discussed in Chapter 5, use noncombustible or fire resistant building materials for decks, fences, and other attached structures whenever possible. If combustible (i.e., wooden) fencing, decks, or other structures are attached to the house, plan for firewise landscaping around these features, or place a 10-foot section of noncombustible material between the feature and the house (e.g., a section of metal fencing directly adjacent to the house).
- Follow the guidelines in Chapter 5 for designing homes and other structures in high-risk areas.
- Follow the guidelines in Chapter 4 for designing developments in high-risk areas.

TREE SPACING GUIDELINES

Studies of structural ignition from wildfire indicate that ignitions are unlikely to occur from burning vegetation beyond 100 meters (132 feet) from a structure, and that the vast majority of ignitions can be prevented with a simple 30-foot defensible space around structures. Therefore, clearing of vegetation and thinning of pine trees within 30 feet of the structure, and reduction of vegetation beyond that distance in a zoned firewise landscape, will prevent ignitions of most structures from the radiant heat of a wildfire (e.g., Cohen 1999, Cohen and Butler 1998).

Tree-spacing recommendations apply to fire-prone species (e.g., pines, cedars) and apply equally to thinning of mature trees or planting of new trees in the defensible space. Tree crown spacing is measured between the outer edges of the crowns of mature trees, so saplings must be spaced with consideration of the size of the mature tree.

Tree crown spacing for conifers (pines) and other fire-prone trees and shrubs should be at least 15 feet in the Zone 1 defensible space. Crown spacing can be reduced in each successive landscape zone further from the house, until tree crowns are touching in the forest beyond the landscape. Tree crown spacing is not as critical for oaks and other less-flammable trees and shrubs – the crowns of these species may be touching as they provide important shade for cooling and energy conservation in Florida's hot climate.

Balancing Wildfire Mitigation and Environmental Protection

When considering landscaping guidelines for wildfire mitigation, it is important to balance risk reduction with environmentally sound practices, including water and energy conservation, local tree ordinances, backyard wildlife habitat, and aesthetic sensibilities. For example, removing all of the vegetation and trees around a house also removes protection from wind and soil erosion and the cooling benefits of shade. Trees shading a house help conserve energy, buffer noise, and improve local air quality.

Fortunately, reduction of fuels can usually be accomplished without the removal of mature trees. In Florida, surface vegetation and ladder fuels are primarily responsible for sustaining wildfires and for carrying fire to the crowns of the trees. Thinning of trees may be necessary to ensure proper spacing, but Florida residents should be able to maintain trees around their houses while still addressing wildfire mitigation needs. It is important to maintain tree cover for ecological and home energy conservation benefits. A program to reduce ground vegetation, remove vines, separate shrubs into landscape islands, and trim lower branches is more appropriate for Florida than removing all of the trees from around a home. See Chapter 3 for a complete discussion of tree protection ordinances and wildfire mitigation.

Water conservation also is important in Florida. Although yard irrigation is often recommended to help reduce wildfire risk, no study has shown that lack of irrigation is a wildfire risk factor. In fact,

CASE STUDY: WATER CONSERVATION IN THE FIREWISE LANDSCAPE

Half of the residential water use in Florida is for outdoor irrigation. Florida residents can substantially reduce outdoor water consumption by using water-conserving plants and low-water-use landscaping principles. These recommendations combine the fundamentals of water conservation landscaping with firewise landscaping principles to create a landscape that will conserve water while protecting the property from wildfire:

- Carefully design your landscape with water-conserving and less-flammable plants. Native plants are usually better adapted to Florida's soils and climate. Limit irrigation to areas within 30 feet of the house.
- Select the right plant for the right place, considering a plant's sun or shade requirements and water needs. Group plants with similar maintenance needs.
- Keep plants that need regular watering in Zone 1 of the landscape, close to irrigation or hoses. Let Zone 2 be a place for "drought-tolerant" or low-water plants – plants that can survive mostly on Florida's abundant rainfall. In Zone 3 and beyond, rely on natural landscaping with native plants that are adapted to Florida. Choose less-flammable plants for all zones. Modify or design the irrigation system zones to fit the firewise landscape zones.
- Limit turf areas to Zone 1 of the firewise landscape. Turf is the biggest consumer of water in the landscape.
- Determine the acidity or alkalinity of your soil and plant accordingly. Mix composted organic matter into the top layers of the soil to help retain moisture and nutrients.
- Irrigate wisely. Drought-tolerant plants can survive on rainfall in Florida. Water only the Zone 1 plants and turf when they are dry. When watering is necessary, do it in the early morning and in accordance with water restrictions. Water trees, shrubs, flowers and ground covers with low-volume drip or spray heads or "soaker hoses" – this gets the water to the roots instead of into the runoff. Florida Statutes Section 373.62 Water conservation; automatic sprinkler systems requires that all new automatic sprinkler systems installed since 1991 "shall install, and must maintain and operate, a rain sensor device or switch that will override the irrigation cycle of the sprinkler system when adequate rainfall has occurred."
- Use noncombustible mulches or other noncombustible ground covers near the house. Use organic mulches in Zone 2 and beyond to reduce weeds, retain moisture, and slow erosion and runoff. Avoid cypress mulch.
- To properly maintain your landscape, water deeply without overwatering. Overwatering increases the risk of plant fungal diseases.
- Follow the firewise landscape maintenance recommendations.

(Adapted from Florida's Water Management Districts and Firewise Communities)

water-conservation landscaping can be compatible with firewise landscaping. A water-conservation landscape uses less water through creative, appropriate landscape design, emphasizing the use of the right plant in the right place, with proper maintenance and water-wise irrigation.

The best wildfire mitigation landscape practices involve reducing and replacing fire-prone plants with less-flammable plants in the home landscape. Less-flammable native plants are often also drought tolerant and may cut water use by 20 to 50 percent in addition to reducing mowing, fertilizing, and pruning requirements. Using less-flammable plants and trees addresses wildfire mitigation needs and conserves water and energy. The use of native plants and trees can provide the extra benefit of plants that are well suited to the site and climate, plants that thrive with less maintenance, plants that provide food and shelter for native wildlife, and plants that do not tend to escape and overpopulate natural ecosystems.

Cost-benefit Analysis of Firewise Landscaping

Because conditions vary so much from site to site, a cost-benefit analysis will be most meaningful when performed for a particular home or development. Nevertheless, a marginal (that is, relative) cost-benefit analysis can be used to compare general costs for standard practices vs. firewise practices.

In the case of landscape installation and maintenance, there is no additional cost to install and maintain a firewise landscape. Wise selection and placement of less-flammable plants is the only difference between a firewise landscape and a standard landscape. Most landscape architects and landscaping contractors can specify less-flammable plants from the lists provided in this manual or other sources. Less-flammable plants are readily available and do not cost more than fire-prone plants. Maintenance in concert with environmental guidelines (e.g., water conservation, energy conservation, retaining large trees around houses for shade) is always recommended for any landscape installation. These environmental practices save water, money, and energy, while also resulting in a more aesthetically pleasing landscape and tree canopy.

Modifying an existing landscape will incur a cost above the cost of simply maintaining an existing landscape. The cost of modifying a landscape is expected to be less than the cost for installation of an entirely new landscape. In some cases, the costs for modifying an existing landscape are low, and involve simply pruning, raking, or mowing to reduce surface fuels. A higher one-time investment may be justified if fire-prone plants are to be replaced with less-flammable plants. Maintenance costs for the modified landscape are the same as for the existing landscape. The firewise landscape is an easy project for homeowners who are currently able to maintain their own yard. For homeowners needing assistance, firewise guidelines are easy for landscape firms to follow.

In all cases, the benefit to be gained is the protection of the property from wildfire. The higher the level of risk, the greater the benefit gained from landscape modification. One consideration is the value of the structural resources being protected. Value in this case can refer to monetary value, cultural value, historic value, sentimental value, or other forms of value. For example, landscape modification would provide the most perceived benefit for a very high-value structure in a very high-risk environment.

Photo: FDOF

A water-conservation landscape can be both beautiful and fire-resistant.

COSTS AND BENEFITS OF CONVENTIONAL VS. FIREWISE LANDSCAPING

Costs	Conventional landscaping	Firewise landscaping
Installation of new landscape	Cost depends on area, design, size of lot, and extent of hired help.	No additional cost over conventional installation.
Retrofit of existing landscape	Not applicable.	Additional cost to retrofit existing landscape if plants are replaced. Some existing landscapes only require a shift in maintenance practices to gain firewise benefits.
Ongoing landscape maintenance	Cost depends on area, design, size of lot, and extent of hired help.	No additional cost over conventional maintenance.
Benefits	**Conventional landscaping**	**Firewise landscaping**
Energy and water conservation	Can be achieved equally well with either kind of landscape.	Can be achieved equally well with either kind of landscape.
Fire prevention and protection	Inferior in a conventional landscape in a high-risk area.	Superior with a firewise landscape in a high-risk area.
Wildlife habitat	Native plants provide superior habitat values.	Depends on plants. Native plants provide superior habitat values.

Glossary

Glossary

Adaptation – Alteration or change in or function of a plant or animal over successive generations that aids it in being better suited to live in its environment.

Aerial Fuels – Live and dead vegetation above the surface and in the forest canopy, including trees, branches, twigs, leaves and needles, cones, vines, and tall brush.

Aspect — A position facing a particular direction; exposure. For example, if a slope faces to the south, you would say that it has a southern aspect.

Canopy – Layer formed by the leaves and branches of the forest's tallest trees.

Chemical Reaction – Change in the nature of a material that prompts a transformation and/or release of energy. For example, fire transforms matter from solid into heat/energy, gas, and ash.

Combustion – A usually rapid chemical reaction in the presence of oxygen that produces heat and usually light.

Conifer – Cone-bearing tree or shrub. Some conifers are evergreens, like pines and cedars, and some conifers are deciduous, like cypress trees.

Convection – The continuous transfer of heat from one place to another, as from a wildfire flame to a building. Also, the circulatory motion that occurs when air heated by wildfire rises rapidly and new cooler air is pulled toward a wildfire. These air convection currents can carry firebrands up and deposit them elsewhere. Convection currents associated with an extreme wildfire can create a firestorm.

Crown Fire – A fire that burns primarily in the tops of live trees, spreading from tree to tree above the ground. Crown fires are almost always ignited by and supported by a surface fire below.

Debris Burning – Fire set for the purpose of clearing land or to burn yard trash (e.g., leaves, trimmings, dead branches). Escaped debris fires are a common cause of wildfire in Florida. Backyard burning of yard trash is regulated by local and state government in Florida and may be banned under high-risk conditions. Burning of household garbage (e.g., plastics, packaging) is illegal in most areas of Florida, as fumes harm air quality.

Defensible Space – A "clean" zone where fuels have been cleared, reduced, or changed to act as a barrier between an advancing wildfire and property to be protected. Defensible space usually is a 30-foot-wide vegetation management zone around a structure, although fuels should be thinned beyond this first zone in high-risk areas.

Dry Lightning – Lightning accompanying a thunderstorm in which little or no rain reaches the ground. Lightning from a dry storm may spark a wildfire since there is no rain to moisten vegetation.

Duff – The layer of decomposing organic material lying above the mineral soil and just below the surface layer of freshly fallen litter (e.g., twigs, needles, leaves). In wildfires that occur during dry times, the duff layer may burn, causing damaging scorching of tree roots and danger to firefighting personnel.

Ecosystem – An interacting system of energy, nutrients, water and other living and non-living components.

El Niño / La Niña – The cyclical warming (El Niño) and cooling (La Niña) of the equatorial Pacific off South America that results in significant changes in weather patterns in North America. In Florida, El Niño results in cooler and wetter weather, which can cause overgrowth of vegetation that can feed wildfires during the next La Niña cycle, which brings warmer and drier weather in Florida.

Endemic – Native to, characteristic of, and restricted to a certain locality or region.

Fire – A self-sustaining chemical reaction (combustion), in the presence of oxygen, heat, and fuel.

Fire-Adapted Ecosystem – An area where periodic fire maintains the natural structure and function of the ecosystem, inhabited by plants and animals that have special adaptations that help them survive fire.

Fire Behavior – The manner in which a wildland fire reacts to conditions of fuel, weather, and topography. Common terms used to describe fire behavior include smoldering, creeping, running, spotting, torching, blowing up, and crowning.

Fire Break – A natural or constructed barrier of limited fuels used to provide a control line from which to work during an active or future prescribed fire or wildfire.

Fire Exclusion – The act of keeping any and all fire out of a wildland or forest area. Fire exclusion usually is a combination of intentional or inadvertent actions. Intentional fire exclusion is when no fires are allowed to burn in an area (e.g., lack of support for prescribed burning). Inadvertent fire exclusion has resulted from human development blocking fire from its natural movement

across the landscape. As more roads, highways, and developments stand in the way of natural fire, it is even more important for land managers to use prescribed fire to reduce fuels and maintain ecosystems in wildlands.

Fire History – The chronological record of the occurrence of fire in an ecosystem or at a specific site. The fire history of an area may inform planners and residents about the level of wildfire hazard in that area.

Fire Return Interval – The average time (in years) between successive fires in an area or ecosystem. For example, the historic fire interval in Florida flatwoods ecosystem is every 3 to 10 years.

Fire Season – The time of year when wildland fires are most likely to occur, spread, and affect resources and homes. Although wildfires occur in every month in Florida, the highest months of wildfire activity are from December through June.

Fire Suppression – The work of containing or fighting a wildfire, beginning with its discovery and continuing until the fire is extinguished and mop-up is completed.

Fire Triangle – An aid to understanding fire in which the sides of a triangle are used to represent the three factors – oxygen, heat, and fuel – necessary for combustion. Removal or reduction of any of the three factors can help control or extinguish the fire.

Firebrands – Burning embers that float up into the air on the convection currents created by a fire. Firebrands are usually carried ahead of a large wildfire on the wind, and may fall back to the ground to cause spot fires or ignite homes beyond the wildfire perimeter.

Fuel(s) – The dead and living materials in a natural environment that will burn. This includes dead pine needles, grasses, twigs, branches, and trees, as well as living grasses, shrubs (e.g., saw palmetto, gallberry), and trees. At the wildland-urban interface, fuels may also include buildings.

Fuel Management / Fuel Reduction – Manipulation or removal of fuels to reduce the likelihood of ignition and to reduce potential damage in case of a wildfire. Fuel reduction methods include prescribed fire, mechanical treatments (mowing, chopping), herbicides, biomass removal (thinning or harvesting of trees, harvesting of pine straw), and grazing. Fuel management techniques may sometimes be combined for greater effect. Prescribed fire is generally accepted as the most economically and ecologically sound method for treating large acreages.

Fuel Management Zone / Community Protection Zone – A zone of reduced and managed wildland fuels surrounding a community in a high-risk area and designed to protect the community from wildfire.

Grazing – The feeding of livestock on growing plants. Grazing is sometimes used as a fuel reduction method in Florida forests and prairies at risk of fire.

Ground Fire / Muck Fire – A fire that burns in duff (dried muck) beneath the surface of the ground, mostly by smoldering or slow-moving combustion. Ground fires usually occur in dry marshes or swamps during a drought and are ignited by a passing surface fire. Muck fires may burn for days or weeks, creating a smoke hazard and a safety problem for firefighters, because underground pockets of fire can collapse under the weight of humans or equipment.

Herbicide – Any chemical substance used to kill or slow the growth of unwanted plants.

Hydric – Moist or wet. For example, a hydric hammock is an ecosystem that would be wet for a brief time each year and would be moist and shady all year long.

Hydroperiod – The frequency and duration of saturation of an ecosystem with water. When characterizing wetlands, the term hydroperiod describes that length of time during the year that the soil is either saturated or covered with water.

Invasive Species – Species that move into an area and threaten the natural ecosystem by becoming dominant in terms of cover, resource use, or other ecological impacts. Invasive species may be either native or non-native "weeds."

Keetch-Byram Drought Index (KBDI) – A continuous reference scale for estimating the moisture content of soil and duff layers, and thus vegetation. KBDI is used for fire management and planning purposes, with a numerical range from 0 (no moisture deficiency) to 800 (maximum drought). The Keetch-Byram Drought Index is posted daily at http://flame.fl-dof.com/fire_weather.

Ladder fuels – Fuels that allow a fire to spread from the ground level up to the forest canopy, leading to a crown fire. Ladder fuels include vines, hanging branches, shrubs, or an understory layer of small/medium flammable trees, such as young pines. Fuel reduction strategies often focus on reducing ladder fuels first.

Mechanical Treatment(s) – Ways to reduce hazardous fuels for the purpose of wildfire

prevention, such as roller chopping, mowing, and crushing. A GyroTrac® mower is often used by the Florida Division of Forestry for mechanical treatments on lands determined to have hazardous fuel levels.

Mesic – Conditions of moderate moisture or water supply. For example, a mesic flatwoods is a moderate flatwoods that is not too wet and not too dry.

Mitigation – The practice of making something less harsh or less severe. In wildfire mitigation, fuels are reduced so that wildfire will be less likely to occur and will be less severe when it does occur.

Noncombustible – Not capable of burning. For example, metal roofing is considered to be noncombustible roofing.

Non-native Species – An introduced species that evolved elsewhere that has been purposefully or accidentally spread by humans. Some non-native species are beneficial (e.g., vegetables) and some non-native species can become invasive species (e.g., melaleuca, air potato). Also called "exotic species."

Overstory – The tree layer of a forest ecosystem, as opposed to the midstory (shrub layer) and understory (ground cover layer).

Prescribed Fire – The planned application of fire to natural fuels in order to accomplish a specific management goal. Like a prescription for forest health, prescribed fire is done according a written plan for weather and safety conditions. Agencies use prescribed fire for many goals including to or reduce hazardous fuels that may increase the risk of wildfire. Prior to ignition, an authorization must be obtained from the Florida Division of Forestry.

Prescription – A plan of specific conditions under which a prescribed fire may be ignited for a given piece of land. A complete prescription must be prepared in advance of receiving an authorization to burn.

Pulpwood – Trees that are grown to be ground into pulp for making paper and other wood fiber products, such as diapers and rayon fiber. These trees are grown on a fairly short rotation, often 15 to 30 years.

Radiation – The transfer of heat by emitting energy in the form of waves or particles. A wildfire may give off enough radiant heat to ignite vegetation or structures from several feet away.

Serotinous – Any plant or plant part that is late in developing or flowering. Pinecones that have a delayed opening stimulated by fire are called serotinous. Florida pines that have serotinous cones include the pond pine and sand pine (Ocala variety).

Slash – Debris left after logging, pruning, thinning, or brush cutting. Slash includes logs, chips, bark, branches, stumps, and broken trees or brush that may be fuel for a wildfire.

Spark Arrester – An approved device installed atop a chimney, flue, or exhaust pipe to prevent the emission or entrance of sparks and embers.

Structural Fire – Fire originating in and burning any part or all of any home, building, shelter, or other structure.

Succession – The gradual replacement of one natural community by another as in the change from an open field to a mature, or climax, forest. In many areas of the eastern U.S., the climax forest is a hardwood forest. In the Southeast and West, however, many of the forests are fire-maintained climax forests of coniferous trees.

Surface Fire – A fire that burns leaf litter, fallen branches and other surface fuels on the forest floor, as opposed to ground fire and crown fire. The majority of wildfires in Florida are surface fires supported by accumulations of surface fuels and vegetation.

Timber – Trees suitable for sawing into lumber or plywood for building construction and other purposes. These trees are grown on a long rotation, often 50 years or more.

Understory – The plants of the lower levels of a forest ecosystem. The understory usually includes grasses, herbs, shrubs, and tree seedlings growing on the surface.

Wildfire – Any fire that is not meeting management objectives or is out of control, and thus merits a firefighting (suppression) response from the Florida Division of Forestry and/or local partners.

Wildland – An area with minimal development as evidenced by few structures and predominantly natural vegetation, and used for conservation, recreation, or agriculture/silviculture.

Wildland-Urban Interface – The zone where structures and other human development meets or intermingles with undeveloped wildland fuels and other natural features.

Xeric – Having very little moisture or dry conditions. The Florida Scrub is a xeric ecosystem.

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