Spirit Lakes Owners Association (SLOA)

Community Wildfire Protection Plan

February, 2014

ACCEPTANCE

The Spirit Lakes Owners Association (SLOA) Community Wildfire Protection Plan (CWPP) was developed in accordance with the guidelines set forth by the Healthy Forests Restoration Act of 2003 and the Colorado State Forest Services' Minimum Standards for CWPP's.

This CWPP is a collaborative effort to guide our stewardship management activities, including wildfire protection. The activities recommended in this plan are appropriate to meet our objectives and will benefit the natural resources and reduce the risk from wildland fire. This plan is voluntary, and where possible, we intend to apply the recommended practices, thus improving our community and increasing public safety.

The SLOA Community Wildfire Protection Plan has been reviewed and approved by the Members of the CWPP Committee.

_____ _____
Chairman Date

_____ _____
Date

_____ _____
Date

_____ _____
Chair Date
El Paso County Board of County Commissioners

_____
ATTEST

_____ _____
Larry Long, District Forester Date
Colorado State Forest Service

_____ _____
Trent Hartwig Chief, Falcon FPD Date

Preface to the Plan

Objectives of the plan

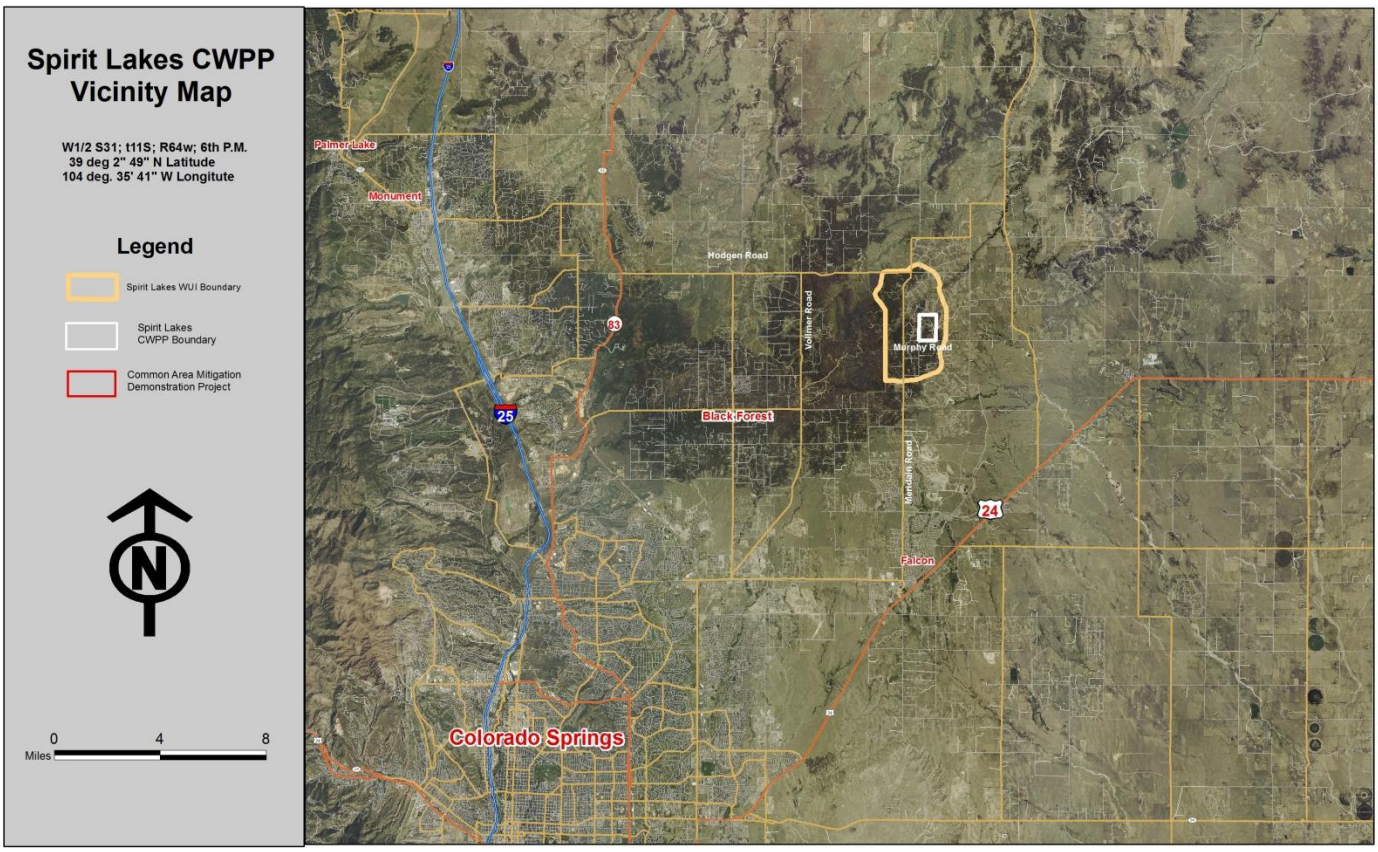
Priority 1: Provide adequate routes of ingress and egress for fire equipment to get to all areas of the community for effective fire suppression as well as adequate evacuation routes for community residents and domestic animals.

Priority 2: Establish appropriate defensible space around individual homes to allow for effective structure protection.

Priority 3: Provide adequate fire break around the periphery of the community to prevent spread of fire into adjoining communities.

Priority 4: Mitigation of watershed features throughout the community which are part of the Black Squirrel Creek Ground Water District. Drainage features feed into two lakes and a wet meadow area near the southeast boundary.

Slash material to be removed will be converted to mulch available to SLOA residents as well as neighboring communities. Larger material can be converted to lumber, firewood or other commercially viable material. In these cases, efforts will be made to contact mills, operators, etc. to see if commercial utilization would be feasible.



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I. COMMUNITY IDENTIFICATION AND DESCRIPTION

Location and General Description

The Spirit Lake community is situated on the east side of the Black Forest seven miles north of Falcon and 13 miles northeast of the Colorado Springs city limits. It occupies a unique ecological location in that the Platte-Arkansas Divide ridge transects the northern portion of the 237 acres and part of the eastern boundary of the property includes the contact of the Great Plains with the Ponderosa Pine ecosystem typical of the foothills of the Rocky Mountains. This abrupt change of forest to grassland and the interaction of soils provide an environment that supports increased species diversity unique to this community. The watershed features feed into a natural drainage system which includes two ponds and provides natural irrigation of the meadows in the central portion of the community.

Forests in Spirit Lakes are purely ponderosa pine. With the construction of the Denver and Rio Grande Railroad and development of Colorado Springs in 1871, the entire Palmer Divide was logged. Logging lasted until the early twentieth century. The trees now in the community are those that grew back after the cessation of logging around 1930. Mature trees are around 130 to150 years old and the canopy is closed. In addition there is a dense understory of trees. These two factors , a closed forest canopy wits dense ladder fuels beneath, contribute to the high fire hazard in the community.

Spirit Lakes Owners Association is a Colorado non-profit corporation developed on approximately 237 acres. The 46 wooded lots range from 2.5 to 8.5 acres. There are forty-two homes within and around the arc of Spiritwood Loop and Murphy Road. Many of the homes within the community include outbuildings and accommodation for horses. Over 82 acres have been designated as permanent open space for the use and enjoyment of property owners, along with wide, 50-foot bridle trails. This common area is maintained by and for the use of all property owners

All lands adjoining Spirit Lakes are privately held, and there is no federal or state land in the area.

SLOA is bordered on the north and west by the Woodlake community of homes and on the east by private homes.

Fire History

Numerous scientific studies indicate that the typical fire regime in the lower montane zone, including the Spirit Lakes, was one of mixed severity fires. The term means that, before fire suppression in the twentieth century, frequent, low intensity fires were the norm, but occasional high intensity fires did occur. Typically, low intensity fires occurred every 20 to 30 years. Frequent fires cleansed the area of fuel and thinned the vegetation. The forest management proposed in this plan will duplicate the natural low intensity fire regimen.

The recorded history of fires in the area is incomplete. It is a quirk of human memory that large fires are recorded while the smaller fires are forgotten. The early fire history of the area consists of the large fires that remained fixed in people's memories long after the event.

The first recorded fire in the area was the so called Big Burn of 1854. According to trappers who were in the area at the time, the fire was started on the south flank of Cheyenne Mountain by Arapahoe or Cheyenne Indians to drive the Utes from the area's hunting grounds.

The fire burned along the eastern face of the Rampart Range and up Fountain Creek Cañon. Some accounts say it burned as far as Wilkerson Pass. Old maps made in the 1890s show severely burned areas throughout the entire Pike National Forest.

El Paso County records list another fire on Cheyenne Mountain in 1890, started from burning brush on the Bush Ranch. Four hundred acres were burned, and the fire was eventually extinguished by a snow storm.[1]

GREEN MOUNTAIN FALLS CA. 1890. NOTICE HOW THE HILLS IN THE BACKGROUND ARE DENUDED FROM THE BIG BURN IN 1854. **PHOTO COURTESY OF THE UTE PASS HISTORICAL SOCIETY**

In 1950, a fire broke out on Fort Carson. Nine people, including a 14 year old volunteer firefighter, died as a result of the fire, and property loss was estimated in excess of three million dollars.[2]

As record keeping became more thorough, more small fires are documented in wildland urban interface areas. Later records show many smaller fires, not only in the foothills, but also in wooded enclaves within urban areas. Most of these were controlled quickly with little or no damage to structures.

Sometime in the 1950's there are unconfirmed stories of a significant fire in the Black Forest area, but there seems to be no historical documentation. Occasional fire scared trees in the area confirm that there were fires in the area.

"If you look at the Colorado Front Range as a whole, [the Waldo Cañon Fire] was not epic or unprecedented; it was just in a new location"

--Rick Stratton

The first recorded fire in the modern era was the April 1990 Berry Fire south west of Monument. The fire started in Gambel Oak south of the Monument Fire Center and burned rapidly to the top of the Rampart Range. The fire scar is still visible.

On April 28, 2002, a resident of Pine Glen was mowing his field when dry grass was ignited by the muffler of the mower. Fortunately westerly winds blew the Pine Glen Fire onto the Pineries Ranch

[1] Wegner, Rebecca (2004). *North Cheyenne Cañon Park and Stratton Open Space: Forest Health Assessment and Management Plan.* Colorado Springs Parks Recreation and Cultural Services.
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(now the El Paso County Pineries Open Space) and away from any homes. The fire burned 64 acres before it was controlled.

Two days later another fire broke out in the Glen area of Palmer Lake. It was quickly controlled, but could have been a tragic fire in a neighborhood that was choked with Gambel oak and homes built in the early years of the twentieth century. Several days later, juveniles playing with matches, ignited another fire in Gambel oak near houses at the west end of Baptist Road. Quick response and air support again prevented a tragedy. These fires were only a prelude to the June 2002 Hayman Fire.

Two years of severe drought preceded the tragedy of the Waldo Cañon Fire, and the fire ignited on a hot, dry day with strong winds. The Cedar Heights neighborhood above Garden of the Gods was first threatened, but a combination fuel breaks and defensible spaces completed by residents in previous years allowed firefighters to keep the fire out of that community.

On June 26th, 2012, strong downslope winds pushed the fire into the Mountain Shadows area. In a few short hours, two lives were lost, and 392 homes destroyed. The value of property lost is currently estimated as 350 million dollars, and the cost of suppression was $20, million. An additional $5 to 9 million will spent in on rehabilitation in the next few months but the true cost will take years to determine[3]. Even after the flames are extinguished, the costs restoration, flooding and environmental damage continue to mount.

Shortly after the Waldo Cañon Fire, Rick Stratton, Long-Term Fire Analyst for the USDA, Forest Service, published a preliminary report on the causes of home destruction in Mountain Shadows.[4] He reached these conclusions:

> " . . . [I]n the lower portion of Mountain Shadows, several things were apparent. (1) Home destruction was largely house-to-house due to overlapping [home ignition zones (HIZ)]. Therefore, if a home was burning, the adjacent home had a shared HIZ and in turn was in jeopardy. Similar to dominos, the destruction sequence ceased only when the fuel was absent (e.g., a road or vacant lot) or suppression efforts were successful. This destruction sequence was channeled and intensified by the wind. (2) Homes with flammable wood roofs were a large target and receptive fuel for firebrands. In some cases these homes initiated the house-to-house destruction and extended the reach of the fire further into the subdivision through thermal exposure and the lofting of burning debris to adjacent homes and vegetation. (3) Firefighters were overwhelmed in their attempt to prevent the residential fire spread due to multiple homes burning simultaneously. However, more homes would have been burned without their intervention.
>
> ". . . Homes farther up the hill are generally newer and spaced farther apart. Roofs are mostly tile or asphalt. Due to these two factors (non-ignitable roofs and separation distance), house-to-house destruction was lessened, but still evident (e.g. Brogans Bluff Dr.). One consistent way homes were ignited was from their decks that extended into the vegetated areas behind homes. These natural corridors ran parallel with the slope and acted as a fuse. Because the vegetation was part of the HIZ and the attached deck was part

[3] Carol Ekarius, Executive Director, Coalition for the Upper South Platte. 2013. Personal Communication.
[4] Stratton, Rick. (2012). *The Waldo Canon Fire: Fires on the Colorado Front Range and Home Destruction*. Pike and San Isabel National Forests.

of the home, the fire made the transition to the home. Like lower Mountain Shadows, it was evident that firefighting efforts saved several homes."

The Black Forest Fire is so fresh in the community's memory that a long elaboration of that tragedy is unnecessary. Although the flames are extinguished, the fire is a current tragedy not a historical one. No one needs to be reminded what happened;

While the history of the Black Forest Fire may be incomplete there has been a thorough analysis of the effectiveness of mitigation by the Pikes Peak Wildfire Prevention Partners.[5] The report found that individual mitigation on small lots was often overwhelmed by the untreated fuels adjoining them, but in communities where mitigation was done on a landscape level the fire did minimal damage.

"Community wide mitigation was found to be most effective in managing wildfire; even during extreme burning conditions. . . Firefighters were able to safely defend structures as the fire swept through the [Cathedral Pines] community"

-- *Black Forest Fire Assessment Team: Report to the Governor of Colorado*

The report cited Cathedral Pines as a successful example of community fire mitigation. Although the fire burned through two thirds of the community only one structure, located adjacent to unmitigated fuel outside the community, was burned. Not only did the homes survive, but fire damage to the forest was minimal and the forest recovered quickly.

The fire history of the region tells us that fire is as much a part of the natural environment as the trees themselves. After a century of fire exclusion, forests are thicker and more crowded with fuel to the point that wildfires are ever more difficult to control. Firefighters will always strive to protect lives and property, but their effectiveness depends on the foresight and preparation of landowners in advance of the fire.

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[5] Pikes Peak Wildfire Prevention Partners in Cooperation with the Black Forest Fire and Rescue Department and Falcon Fire Department. 2014. *Black Forest Fire Assessment Team Report to the Governor of Colorado*. Published at www.ppwpp.org

II. COMMUNITY ASSESSMENT

Community Values at Risk

Besides the forty-two homes and various outbuildings that comprise the Spirit Lakes community, wildfire would destroy a unique ecosystem of forest, aquatic meadows and high plains grassland meadows that are found in this community. The loss of watershed would lead to serious erosion of the open soil in the area as well as the destruction of habitat for the many birds and animals that thrive in the community.

Emergency Evacuation

NOTICE TO EVACUATE. In case of a fire or other emergency, the primary notification to evacuate will be issued by the El Paso County Sheriff by means of a reverse 911 call. Members should follow directions provided in the recorded message. Other notifications may come from local TV and Radio stations.

EVACUATION ROUTE. The primary evacuation route is south on Spiritwood Loop to Murphy Road then east toward Elbert Road or west to Meridian Road.

It is important to note that the fatalities in both the Waldo Cañon and Black Forest Fires were of residents who did not evacuate in time. In the event of a fire, the El Paso County Sheriff will determine the best evacuation routes and procedures based on expected fire behavior. Residents should heed the evacuations instructions given by the Sheriff without delay! If a fire is threatening the area, it is not necessary to wait for an evacuation order to leave.

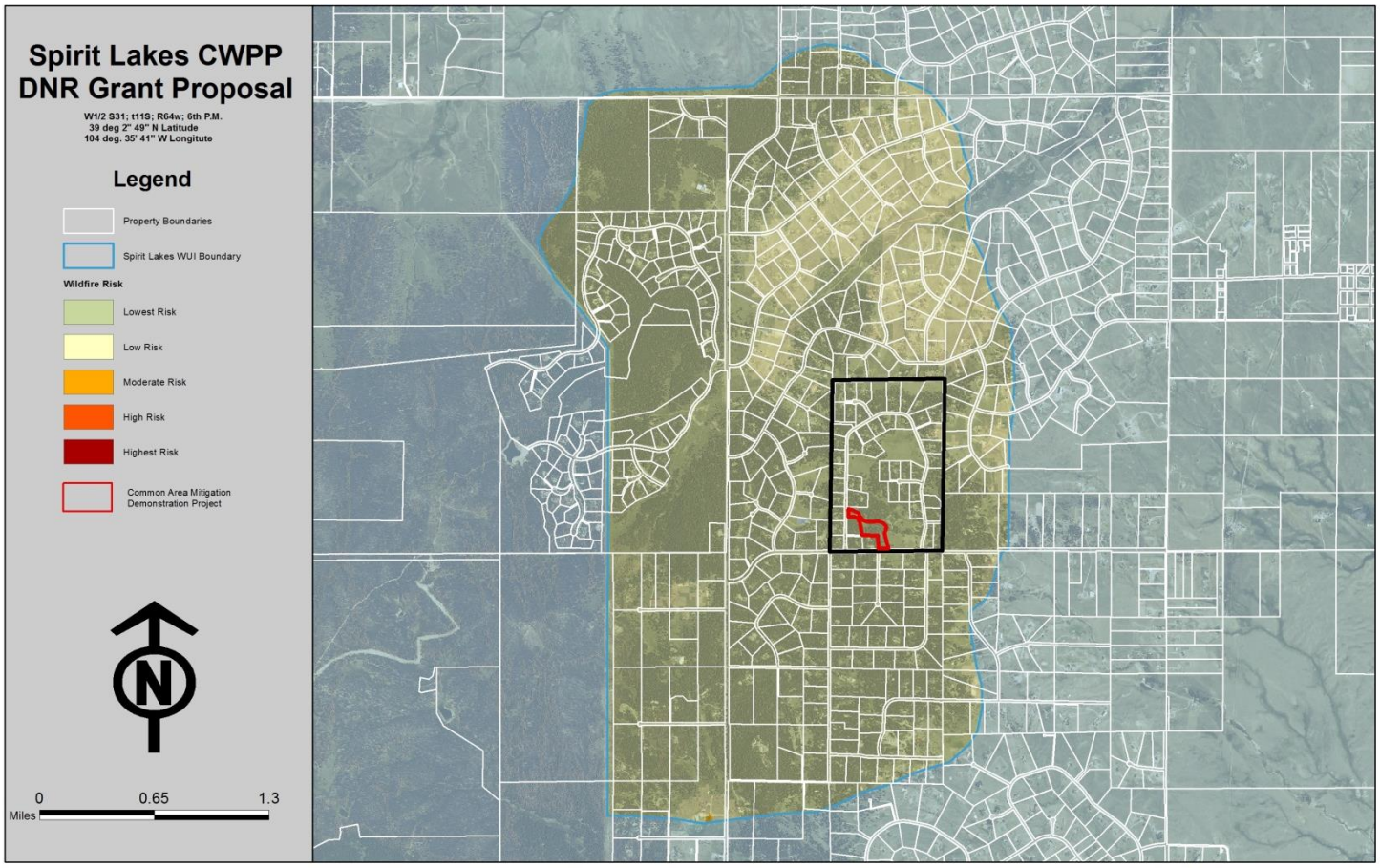
It is vitally important that residents are prepared to evacuate long before a fire or other disaster. Just as fire mitigation should be complete long before a fire threatens, a personal plan for evacuation should be prepared before it is needed. A personal evacuation plan should consist of:

- Papers, photos computer drives, prescriptions and other important items should be stored and ready to take a moment's notice.
- Be sure to have a bag packed with a change of clothes and personal items packed and ready.
- Keep a complete inventory, including photos of your home contents, of items in the home stored in a safe location if need to document insurance claims. Be sure you insurance coverage is adequate.
- Have a plan to shelter pets and livestock.
- Have a communication plan for all members of your family to stay in contact. Have an agreed upon meeting place, such as a friend's home, for family members in case you are separated.

Reverse 911 calls are not automatically routed to cellular phones. Residents who rely only on cellular phones should register their cell phones at: http://www.elpasoteller911.org/ to be certain of notifications.

Wildland Urban Interface Boundary

The wildland urban interface (WUI) boundary is defined as the area where a wildfire would be a threat to the community. The boundary WUI Boundary was designated in consultation with the Colorado State Forest Service. The western and northern boundaries are the edge of the Black Forest Burn scar. The eastern boundary is the edge of the trees east of the community, and the southern boundary is approximately one mile south of the community. This distance is based on the maximum distance embers were blown in the Black Forest Fire.



Wildfire Risk

Vegetation is dominated by the Ponderosa Pine forest and the many plants that thrive in the meadows. An ecological survey completed prior to the development of the Spirit Lakes community identified four major plant communities on the property:

1. Ponderosa Pine Forest
2. Wet Prairie Meadow
3. Aquatic Communities
4. High Plains Grassland

Within the Ponderosa Pine forest nearly forty different plants were identified as native to that particular community. Within the wet meadow areas another forty-five different plants were identified. The aquatic community is defined by the watershed drainage feature running from the western boundary of the development through the upper wet meadow area to the two ponds in the lower wet meadow. These areas are home to many grasses, sedges and rushes. The aquatic community of plants extends to a marshy wetland along the eastern boundary of Spirit Lakes.

While the wet prairie meadows and associated aquatic ecosystems are home to many more plant species than the forest ecosystem, the high plains grassland community is home to many more species yet. More than fifty different species of plants have been identified as thriving in this ecosystem. The High Plains Grasslands are defined by the two large meadows in the central common area of Spirit Lakes. The subirrigation of these meadows provides an ideal environment for a wide variety of short and mid-grass species to thrive as a separate plant community. The transition areas between various plant communities provide for an unusual mix of plants that would not otherwise be found growing together.

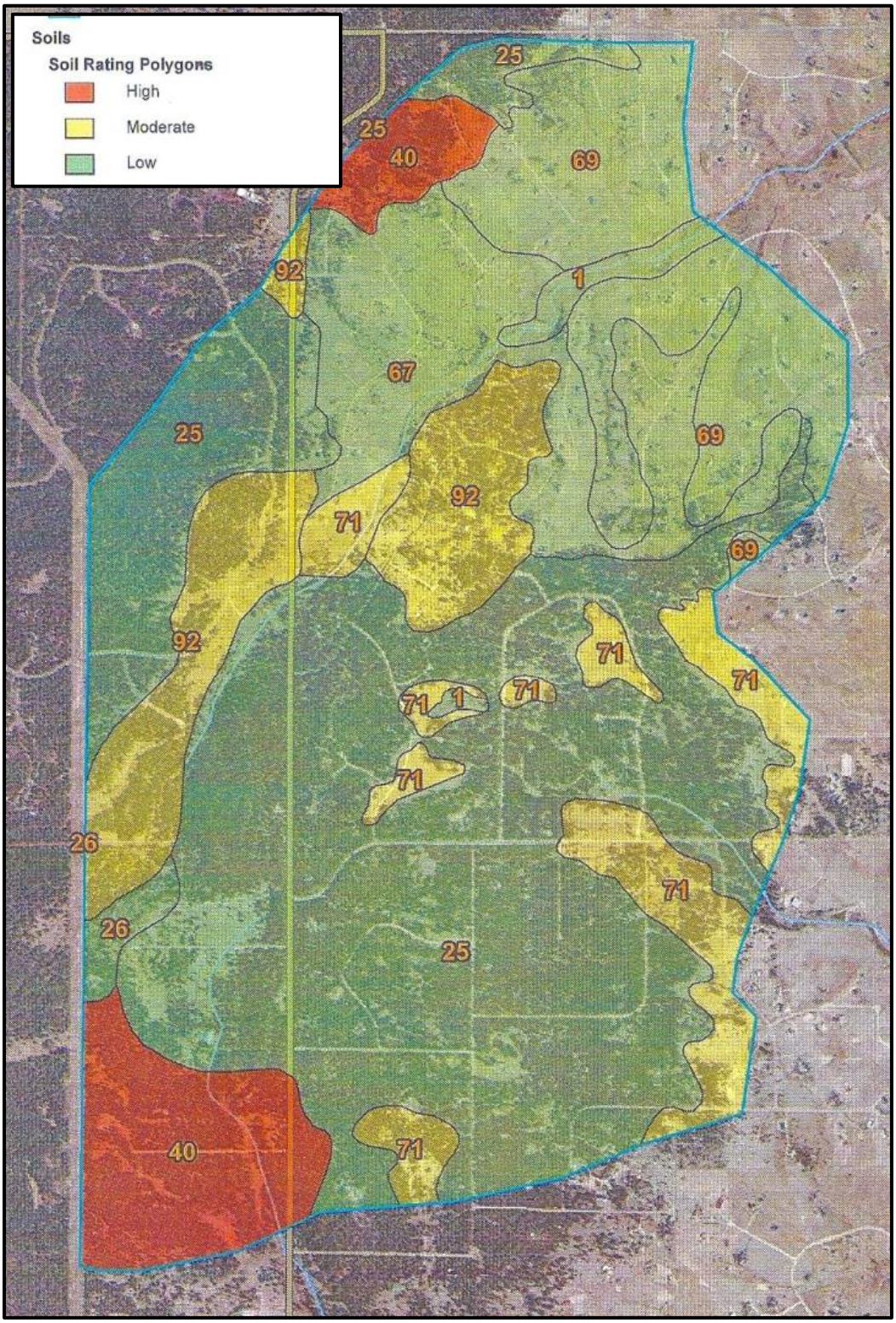
Considering the very unique and varied ecosystem that has developed in what is now the Spirit Lakes, it is imperative that appropriate measures be taken to mitigate the threat of wildfire which would destroy an ecosystem unlike any other in the surrounding area.

These fuels have high rates of spread under relatively mild weather conditions.

Local topography further aggravates fire behavior and control. The Spirit Lakes property slopes upward in a northerly direction from a low point of 7300 feet to the high point of 7477. Prevailing southwest winds would push the fire upslope through the whole community. But for a last minute wind shift, the 2013 Black Forest Fire would have been pushed into Spirit Lakes.

The area is dominated by sandy loam and pine needle duff beneath the timbered areas. This soil is very thin with little or no topsoil. The area is particularly susceptible to erosion and refractory to revegetation. Gully erosion would be a serious problem in the small drainages which originate on the ridge and at the north end of the lower dam. A severe wildfire within the WUI boundary would threaten the community for many years with the threat of flash

flooding and erosion. Natural Resources Conservation Service Soil data show that the soils in the WUI are sesceptible to damage by wildfire.



Predicted soil damage by fire. Source: Natural Resources Conservation Service

Potential for Damage by Fire— Summary by Map Unit — El Paso County Area, Colorado (CO625)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
1	Alamosa loam, 1 to 3 percent slopes	Low	Alamosa (85%)		30.8	1.1%
25	Elbeth sandy loam, 3 to 8 percent slopes	Low	Elbeth (85%)		1,338.7	48.5%
26	Elbeth sandy loam, 8 to 15 percent slopes	Low	Elbeth (85%)		23.3	0.8%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	High	Kettle (85%)	Texture/rock fragments (1.00)	236.2	8.6%
67	Peyton sandy loam, 5 to 9 percent slopes	Low	Peyton (85%)		299.6	10.9%
69	Peyton-Pring complex, 8 to 15 percent slopes	Low	Peyton (40%)		334.7	12.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	Moderate	Pring (85%)	Texture/rock fragments (0.50)	225.7	8.2%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	Moderate	Tomah (50%)	Texture/rock fragments (0.50)	271.8	9.8%
			Crowfoot (30%)	Texture/rock fragments (0.50)		
Totals for Area of Interest					**2,760.8**	**100.0%**

Potential for Damage by Fire— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Low	2,027.1	73.4%
Moderate	497.4	18.0%
High	236.2	8.6%
Totals for Area of Interest	**2,760.8**	**100.0%**

Soil damage as the result of a wildfire will threaten drinking water and property far beyond the Spirit Lakes Community. For example the 1935 flood that caused fatalities and millions of dollars of damage in Colorado Springs was the result of heavy rains in the Spirit Lakes area. Fire damaged soils would only exacerbate the potential for flooding downstream.

Preparedness to Respond

El Paso County

The El Paso County has detailed plans and agreements in place to respond to a wildfire anywhere within the County. The quoted passages below are taken directly from the *El Paso County Wildfire Protection Plan.*[6]

Inter-jurisdictional Cooperation

"First responders and community leaders recognize that wildland fire does not respect jurisdictional boundaries, and that large fires can only be managed by pooling resources. As a result, El Paso County enjoys general good cooperation among its many firefighting entities.

Standardized Command and Control

"All County fire departments use the Incident Command System (ICS) as a tool to manage interagency response operations. ICS clarifies roles and responsibilities in many common situations, such as when one area belongs to two overlapping jurisdictions, or when an area is not part of a fire protection jurisdiction.

Mutual and Automatic Aid

"County fire departments have executed several agreements to provide mutual and automatic mutual aid to each other upon request. Groups of neighboring departments have also set up local automatic aid agreements, so that all departments in that group are dispatched to any fire in any of their jurisdictions.

"The El Paso County Sheriff's Office participates in the Annual Wildfire Operating Plan for El Paso County Colorado. The Plan, updated annually, describes how County agencies coordinate wildfire suppression activities with those of the [Department of Public Safety (DPS)], the Forest Service, and the Bureau of Land Management. It outlines rules and procedures for requesting mutual aid, ordering out-of-county resources, radio communications, and air operations.

An Expanding Hierarchy of Resources

"The responsibility for wildfire suppression initially rests with the jurisdiction where the wildfire starts. The El Paso County Sheriff is responsible for suppression of wildfires that occur on unincorporated, non-federal land that is outside a fire protection district.

"If a wildland fire grows beyond a local fire protection district's ability to control, the Sheriff may appoint an incident management team to provide command and control over the fire

[6] Russell, Kathy (2011). *Community Wildfire Protection Plan for Unincorporated El Paso County*. El Paso County Sheriff's Office, Emergency Services Division. pp. 46, 47.

response. At that point, the Sheriff also may assume financial responsibility for firefighting expenses, on behalf of El Paso County.

"If the fire exceeds the County's capability to control, the Sheriff can request assistance from the Colorado [Department of Public Safety], under terms of the Emergency Fire Fund (EFF) Agreement. When EFF is implemented, [DPS] assumes responsibility and authority for all suppression activity until the fire has been controlled and management of the fire has been returned to the county.

County Support to Wildfire Responses

"El Paso County has a mature system for mobilizing County and community resources to support a wildfire response.

Public Notification and Warning

"The Sheriff's Office has several methods to notify and warn people who are threatened by an approaching wildfire:

- Automated telephone notification
- Local news media announcements
- When possible door-to-door warnings

Evacuation and Sheltering

"An Incident Commander may request evacuation of specified neighborhoods, or closure of certain roads; the actual evacuation is the responsibility of the Sheriff.

"The El Paso County Emergency Operations Center coordinates evacuation and sheltering for displaced persons, as well as their service animals, pets, and livestock."

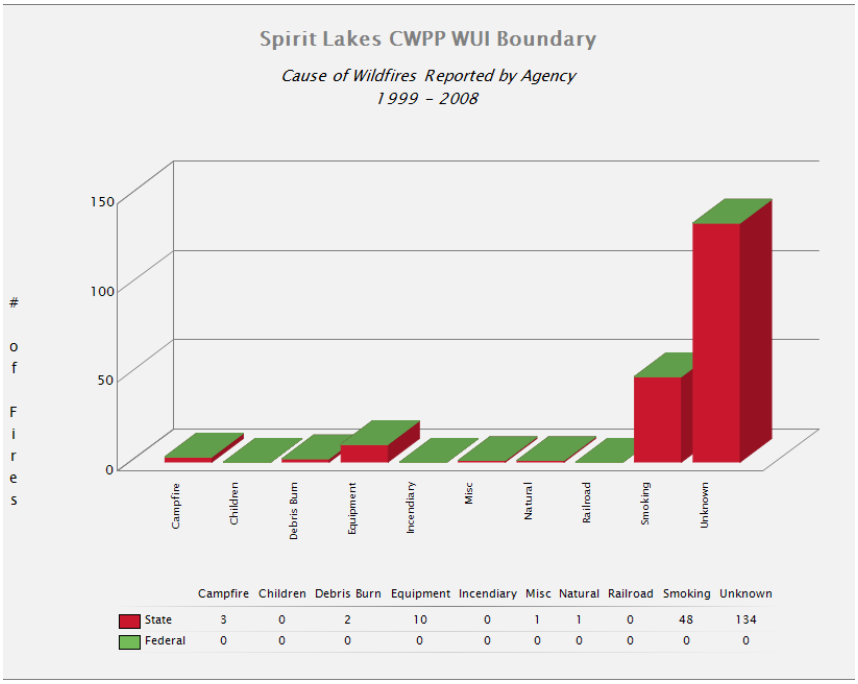
Falcon Fire Protection District

SLOA is in the Falcon Fire Protection District. Station 1 is located on Stapleton Rd. just east of Meridian Rd. This station houses 1 engine, 1 pumper tender, 1 tender, a brush truck, a QRV medical unit and an ambulance. There is a minimum of four personnel on duty at all times

III Risk of Ignition and Wildfire Occurrence

Causes of Wildfire Ignitions

Data collected from wildfire responding agencies between 1999 and 2008 indicate that the cause of most wildfires was unknown.



Reconstruction of fire history and forest dynamics in the neighboring upper South Platte landscape, which is located immediately north and west of the community, reveal (i) an average fire interval of about fifty years during the period 1300-1880, but no major fires between 1880 and 2002; (ii) a mix of non-lethal surface fire and lethal, stand replacing fire in the historic burns (mixed severity fire regime); and (iii) a striking increase in forest density from 1900-2002.

The extent of the high-severity Hayman burn in 2002 was unprecedented in the last 700 years, in part because of the dense forest conditions that had developed during the twentieth century, and in part because of the extreme drought and fire weather conditions that existed in 2002. Similar drought conditions contributed to the Waldo Cañon fire a decade later.

Low fuel moistures and relative humidity are common in the area, as are periods of high winds. When dry and windy conditions coincide the stage is set for large wildfires. Human population is increasing in the area. All recent large fires were caused by humans. Numerous fires are ignited each year by lightning. Except for portions of Florida, this area has some of the highest occurrence of lightning in the continental US.

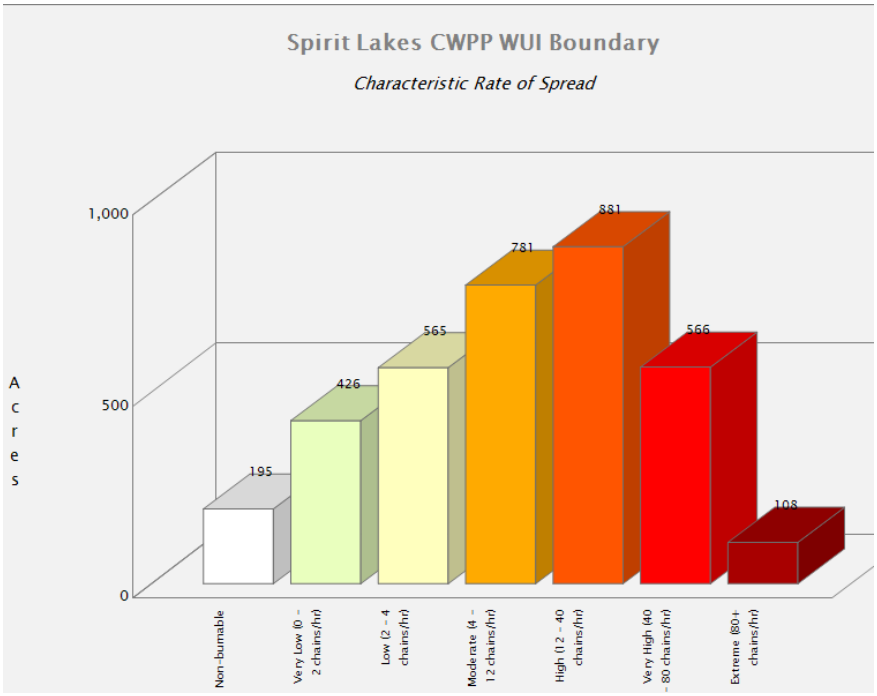
Fires originating in or near communities are the most immediate concern, but fires starting well beyond the boundaries of the planning area can have profound effects upon the communities. Rapid rates of spread and long distance spotting are the norms for fires in the vicinity. Areas classified as high to moderate fuel loading are the most worrisome.

Fuel Hazards

Factors Affecting Homes in the Wildland/Urban Interface The overall risk to the community from wildland fire is high. This section will discuss the factors considered that led to the overall rating.

The graphic at the right represents the CO-WRAP predicted rate of spread in chains per hour. A chain is 66 feet. Thus a moderate rate of spread (4 to 12 chains per hour) would equal 264 feet to 792 feet per hour. The height of a bar indicates the number of acres in the WUI boundary on which the rate of spread is predicted. The majority of the WUI would have a moderate to high rate of spread under the average fire weather assumed by CO-WRAP. High winds will increase the rate of spread beyond the CO-WRAP predictions.

There are forty-two homes in a forested Wildland/Urban Interface (WUI) of Spirit Lakes. Many include outbuildings for animals or equipment storage. The homes in this community have various risks of being destroyed by a wildfire. The amount of risk depends on the vegetative fuels, topography, weather events, and the construction of the home itself. It is important to understand these conditions and factors in order to make appropriate decisions about vegetative fuels reductions.



Fire Behavior at any time is dependent on three factors: weather, topography and fuels.

Weather: Weather influences fire behavior as both a long term and transient phenomenon. Long term weather trends such as extended drought increase the possibility of ignition and increase the rate of fire spread.

Large plants, trees and larger shrubs, recover moisture content slowly after a prolonged drought, and may remain drier than normal for several years after a drought ends. Grasses and herbaceous fuels may recover moisture quickly after a short rain, but also loose moisture quickly after short dry periods.

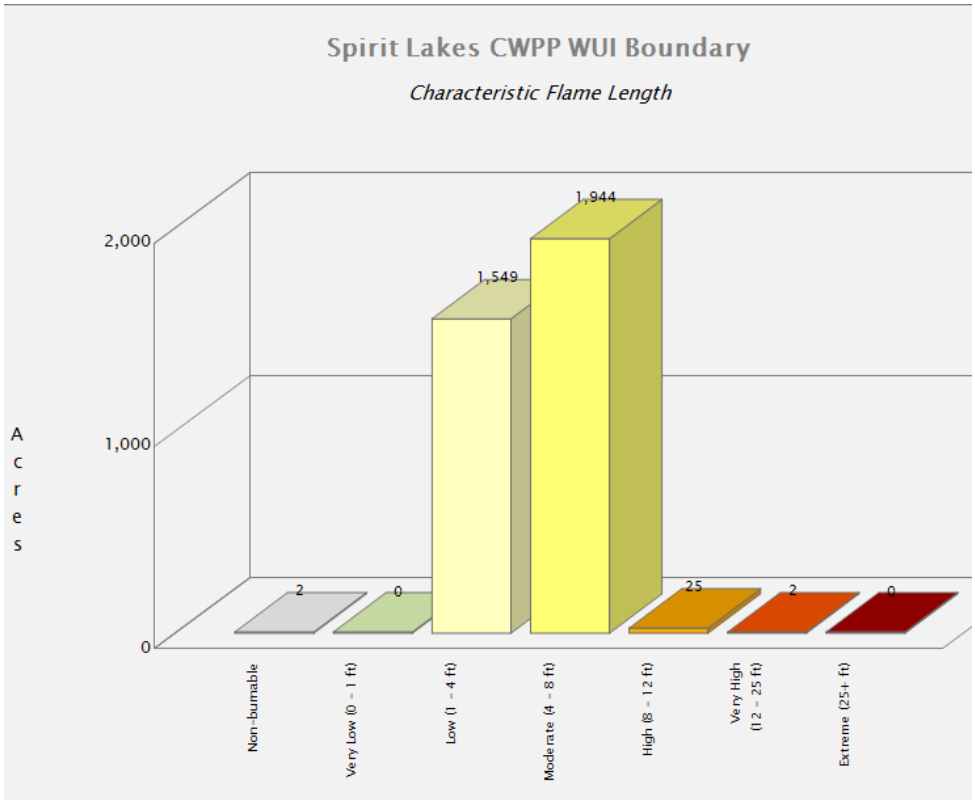
The intensity and spread of a wildfire is also affected by the weather conditions existing at the moment. For example, a large thunderstorm about 20 miles north of the Waldo Cañon Fire was responsible for pushing the fire down downslope into the Mountain Shadows neighborhood. High temperatures, low humidity, and strong winds increase the probability of ignition, intensity and rate of spread. Wind direction at any given moment is the primary determinant for the direction of fire spread.

Topography: Topography includes the degree of slope and the shape of the terrain. Hot gases rise in front of the fire along the slope face, pre-heating the vegetation above a fire. As slope increases the effect of the preheating and increased spread increases, and fires may move up to four times faster with flames twice as long than a fire on level ground.

Drainages act as chimneys that funnel heat and winds up the drainage. Homes in drainages, or at the tops of drainages, are particularly vulnerable to wildfires. The direction a slope faces, or its aspect, also influences fire behavior. South and west facing slopes tend to be drier and thus, exhibit more intense fire behavior than moister east and north facing slopes.

Fuels: The two fuel types in a WUI are vegetative and structural. Vegetative fuels consist of living and dead trees, bushes, and grasses. Typically, grasses ignite more easily and burn more quickly but with less intensity than trees. Fires can move quickly through grass and herbaceous vegetation, and these smaller fuels are often the kindling that moves fires to larger size fuels.

Any dead or living branches on the lower eight feet of trees or shrubs between 6 and 18 inches tall underneath trees are called ladder fuels. Ladder fuels help convert a ground fire to a crown fire (fire in the tree tops) that moves much more quickly and with more heat.



The length of flames is directly correlated with the amount of heat a fire produces. Flame lengths less than four feet can be attacked directly by hand crews, but flame lengths greater than four feet require indirect attack methods where firefighters must work a safe distance away from the flaming front. As seen in the graph above, CO_WRAP predicts one to eight foot flame length during average weather conditions over most of the area. As was all too evident in the Black Forest Fire, during adverse weather flames will reach the crowns and flame height may exceed 100 feet. Fuel modification in defensible spaces and fuel treatments is designed to reduce the amount of heat produced by a wildfire.

Non-vegetation fuels include houses, ancillary buildings, fences, and firewood piles. Structures in the WUI can be considered as additional fuel. In fact a burning structure can ignite a wildfire, and defensible space can prevent a burning structure from spreading fire to the surrounding vegetation as well as preventing a wildfire from igniting a structure.

Nor are hazardous fuels around a home limited to natural vegetation. Landscaping is often a fire hazard. During wildfires, many homes are lost because of the vegetation planted around the structure. Juniper (Pfizer) shrubs planted near foundations, landscape timbers, wood mulches and wood fences are often sources of home ignitions. Landscapes should be planned with the threat of wildfire in mind.

The important point to remember here is that neither typography nor weather can be altered. *Only fuels can be manipulated before a wildfire to reduce fire intensity or influence the fire spread.*

How Structures Catch Fire

There are three ways that a wildfire can transfer itself from natural vegetation, or burning homes, to other homes. They are through radiation, convection, and firebrands.

Radiation: Wildfires can spread to a home by radiating heat in the same way a radiator heats rooms in the wintertime. Radiated heat is capable of igniting combustible materials from a distance of 100 feet.

Convection: Direct contact with flames, or the wildfire's convective heat column—the hot air and gasses rising from the flames--may also ignite a home. This will most likely occur when trees or brush near a structure ignite and the flames touch a flammable part of the structure.

Firebrands: Firebrands are burning materials that detach from a fire during strong convection drafts in the burning zone. In most cases, the flame front passes quickly, but a shower of burning embers, or firebrands, impinges on the structure for some time before and after the flame front passes. Firebrands are most often the cause of home loss. Firebrands can be carried long distances – more than a mile – by the winds associated with a wildfire. Many homes in community are particularly vulnerable to firebrands.

A 2006 report by Traci Weaver emphasized the danger of home ignitions from burning embers.[7] Multiple wildfires raged across prairie and shrub land in North Central Texas from Dec. 27, 2005 to April 30, 2006. They killed 17 people, burned 1.6 million acres, and destroyed 440 homes. Many of the destroyed homes were made of brick, stone, and had metal roofs. Investigators pin-pointed the main cause of home destruction to burning embers that fell on top of, or were blown under, wooden porches without screening. Other losses were linked to firebrands entering attic vents, eaves and soffits, or radiant heat of burning grass that ignited wood decks.

The 2002 Hayman Fire burned 138,000 acres and 132 homes in 20 days. After Hayman, the homes burned were thoroughly studied to determine the manner in which they were burned. USDA Forest Service scientists Jack Cohen and Rick Stratton reported on the causes of home destruction in the *Hayman Fire Case Study*.[8] Surprisingly, 662 homes within the parameter of the fire were not

[7] Weaver, Traci, (2006): *Texas Fires Shed New Light on What it Meant to be Firesafe*. Texas Forest Service.
[8] Graham, Russell T., (2003): *Hayman Fire Case Study*. USDA Rock Mountain Research Station, Report RMRS-CTR-114.

destroyed. Many of the homes that survived did so without intervention by firefighters. The study objective was to determine if there were common factors among these surviving homes that might be helpful in preventing loss of homes in future wildfires.

They found that "torching" or intense crown fires within 30 feet of a structure destroyed 70 homes. If a house was destroyed but the surrounding trees did not burn, they assumed that embers or firebrands ignited it. Based on this logic, they concluded that 62 (47%) of the 132 homes destroyed in the Hayman Fire were ignited by surface fires or firebrands.

Cohen and Stratton found that home destruction was related more to a house and its site-specific surroundings than to the context of the larger Hayman Fire. If the vegetation around a house allowed high intensity fires to burn near them, they did not survive. If the vegetation permitted only low intensity fires, the structures had a good probability of surviving. Flammability of roofs, siding materials, and other house construction features raised or lowered the risk of flames igniting homes.

Home construction and Vulnerability to Wildfire:

The construction materials, location and even the shape of a structure influence its vulnerability to wildfire.[9] It is not the intent of this CWPP to suggest extensive alterations to homes that already exist in the community. Understanding how home construction affects the vulnerability of the structure to a wildfire helps residents plan defensible space projects to compensate for construction differences. When remodeling or home improvement projects are done plans can be made to reduce the ignitability of the buildings.

Decks and roofs are the most vulnerable parts of a structure. If either burns, the home will be lost. They are most likely to catch windblown firebrands, and air currents are more likely to form eddies that trap heat and in the irregular surfaces found in roofs and decks.

Fire restive roofs are extremely important. *Wood shake roofs have been the cause of many home losses due to firebrands.* Roof material with a class A rating indicates the best resistance to fire. Many roofing materials are available to homeowners but they vary in cost, weight and longevity. Homeowners should consult with a reputable building contractor to determine which roofing material will best suit their needs.

Even the most fire resistant roofs require maintenance. The most important item is to keep the roof—and gutters--free of debris. Combustible debris such as leaves and pine needles may ignite from firebrands and start the home on fire even with a class A roof. Combustible litter is most likely to accumulate in areas where one shape meets another such as gables and dormer windows. Gutters will also accumulate debris. These same areas are most likely to accumulate firebrands because of eddies in wind currents during a wildfire. Combustible debris should be removed anytime it accumulates.

Many homes in SLOA have flame retardant composition shingle roofing that is a class A roofing material. However home autopsies have shown that the small ridges in metal roofs where on panel over lays another can be openings where fire brands may collect directly on the plywood sub roof, leading to ignition of the plywood. The holes underneath such ridges should be plugged with caulking or a similar material.

[9] Slack, Peter, (2000): *Firewise Construction: Design and Materials.* Colorado State Forest Service.

The eves (the extension of the roof over the outside wall) are also vulnerable areas. Open eves, with the roof joists exposed, are particularly vulnerable because the irregular surfaces can trap hot gasses and fire brands. Enclosure of exposed eves (called a soffit) helps prevent this. It is best to construct soffits so that the lower edge of the soffit meets the wall at a 90^{o} angle. This reduces the amount of heated air and fire brands that might be trapped.

Vents, in roofs and foundations, are also areas of vulnerability, but are necessary to ventilate attics and crawl spaces to prevent moisture accumulation. During a wildfire, heated gasses and firebrands can enter attics or crawl spaces through vents. All vents should be screened with metal screening with openings of 1/8 inch or less. Soffit vents should be located as close to the edge of the eve as possible. Vegetation around foundation vents can create unintended vulnerability, particularly on the downhill side. Landscaping with noncombustible mulch within three to five feet of the foundation and underneath decks or porches is essential.

In addition to the roof, decks are extremely vulnerable to fire. The deck surface is exposed to fire brands and fire brands can collect underneath decks. Possibly the worst mistake any homeowner can make is to store any combustible material beneath a deck. Countless homes have been lost because of firewood, scrap lumber, even gasoline stored beneath a deck. Even motorized equipment, when left under a deck, with gas in the tank has caused home losses during fires.

Ideally the underside of decks should be enclosed with a non-combustible material. If that is not possible, covering the area under a deck with stone, concrete or rock mulch will make the deck safer. When decks are rebuilt use fire resistant materials.

Carefully consider the landscaping in the vicinity of decks as well. Avoid planting flammable shrubs, such as junipers, anywhere near decks. Potted plants or planters on decks may also increase the hazard. Even furniture with cushions or wooden frames may ignite from firebrands. The area of defensible space should be increased near decks, especially on the downhill side.

Fire resistance of windows and doors should be considered. If window glass breaks, firebrands will enter the house. The most fire resistant glass is low emissivity, tempered glass which withstands the heat of a fire for the longest period. Double pane windows last longer than single pane when exposed to the heat of a fire.

Window frames are also important. Metal frames offer the best protection. Vinyl frames usually do not burn but can melt when exposed to heat. Wooden frames will burn. Metal screening with on the outside of windows offers additional protection, but most windows are sold with nylon screening that will melt. Solid metal shutters offer the best protection, assuming the homeowner has the opportunity to close them before evacuating.

Wooden doors are obviously able to burn during a fire. The thicker the door the more resistant it will be. Metal doors are far superior, and glass in doors is subject to the same vulnerabilities as window glass. Well maintained weather stripping in outside doors will help prevent fire brands from entering a home.

IV Fuel Hazard Reduction

PRESCRIPTIONS FOR WILDFIRE HAZARD REDUCTION

Defensible Space vs. Fuel Breaks:

In a broad sense there are two generalized categories of mitigation. First is defensible space thinning in the Home Ignition Zone around structures to increase the chance that the structure will survive a wildfire. Second, is fuel break thinning away from structures to reduce severe fire behavior and give firefighters a safer place to work and possibly halt an approaching wildfire. Both approaches require thinning of the canopy and removal of ladder fuels. The approach will vary depending of the forest conditions existing on the area in question.

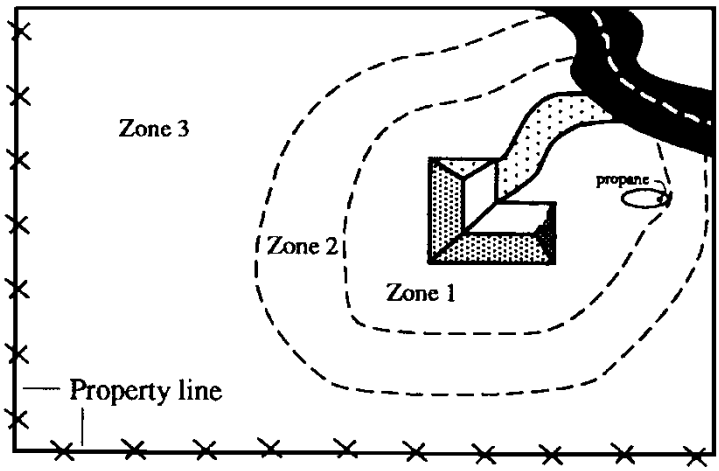


Diagram of the home ignition zone showing the three thinning zones.

THE HOME IGNITION ZONE:

Modification of vegetation around a structure to reduce fire intensity is called defensible space. The term "home ignition zone" (HIZ) is defined as a structure and the surrounding vegetation. A structure's vulnerability to wildfire depends on the surrounding vegetation, including landscaping, and the structure itself.

Protecting Homes in the HIZ: Thinning around homes is different than thinning for fuel breaks. Thinning in the HIZ is designed to protect structures from the heat of wildfires. Defensible space includes both thinning around structures to reduce the heat from burning vegetation and reducing flammability of the structures to protect them from wind born embers, radiation and convective heat. Further information about increasing the survivability of structures is found on the CSFS website at: http://csfs.colostate.edu/pages/pub-csfs2.html#wildfire .

Defensible space is defined as an area around a structure where existing vegetation is modified to slow the rate and intensity of an advancing wildfire. This includes selective removal of trees around structures in two or three concentric management zones. On slopes, increase the width of each zone on the downhill side. Fuels are reduced according to prescriptions for each zone.

Zone One: This is the closest zone to a structure, and extends 15-30 feet from the outermost edge of a structure including any decks. The management goal is to reduce or eliminate most large trees or shrubs within this zone so that the convective heat will not ignite the structure. A few tall trees may be left in zone one if the lowest branches are pruned so that they are well above a fire resistant roof. It is best to limit this to one or two trees near a structure. Treat such trees as part of the structure and create 15-30 feet of space outside the tree.

While it is necessary to remove combustible material in zone one within five feet of foundations and under decks, it is not necessary to so elsewhere. Needles on the forest floor act as mulch retaining moisture in the soil, reduce erosion, and add organic matter to the soil as they decay. If regeneration of new trees is an objective, however, it is desirable to expose some bare soil since this will promote seed germination and establishment. *Raking up pine needles is not a substitute for thinning and ladder fuel removal.*

Zone two: The width of zone two depends on the slope around the house. If the average slope angle is less than 5%, zone two extends out 70 feet from zone one (100 feet total distance around the house). As slopes increase, increase the width of zone two on the downhill side of the house, and increase the spacing between tree crowns.

The main fuels reduction guideline for zone two is to thin the trees to an average spacing of 10-feet crown separation. Clumps of two or three trees may be retained in this zone if the space between the clump and the adjoining trees is at least 30 feet. All ladder fuels under trees should be removed. The branches of large trees should be pruned to a height of 8 feet above ground, but small trees should have at least two-thirds of the green needles remaining.

Firefighters must be able to escape quickly if conditions suddenly deteriorate. Zone two should extend along both sides of driveways for a width of 30 feet from each edge of the drive. This is important to allow safe access and egress for emergency vehicles. Adequate clearance should be maintained to allow access for large structural fire trucks. Twelve feet of horizontal clearance and 13 feet of vertical clearance should be maintained. At the end of driveways, adequate room for a large fire engine to turn around should be maintained.

Zone three: The guideline for zone three is to thin the forest primarily to improve forest health. Spacing is less critical in this area but spaces should be made in the canopy. A useful rule of thumb is that a tree should receive sunlight from all four sides.

Silviculture and Wildfire Mitigation

Foresters manage trees not as individuals but in groups called stands. A stand of trees is defined as a group of trees that are similar with respect to age, species composition and other characteristics. Each stand is different from the ones nearby, and each landowner may have different objectives in addition to wildfire mitigation.

Thus, the information that follows is intended to be a general and highly simplified summary of the basic concepts of wildfire mitigation. It is only intended to give the reader an idea of how foresters approach the process of prescribing treatments for fire mitigation. When planning private fire hazard mitigation, an initial consultation with a forester is recommended. Specific prescriptions for any forest stand are best developed when the existing conditions of the stand and the landowner's specific objectives are known.

Although foresters may use many characteristics of trees to categorize them, the most common--and useful when discussing fire mitigation--is the tree's tolerance to shade. Shade tolerance means the ability of a tree to germinate and grow in the shade of other trees. Species of trees vary in their tolerance to shade, but they can be grouped by those that require sunlight for germination and those that require shade.

Shade Intolerant Trees

Shade intolerant trees are those that require full sunlight to sprout and grow to maturity. Shade intolerant trees are those that first colonize a site after a disturbance, such as wildfire, removes the existing trees. For this reason, ecologists call these pioneer species. Aspen, the most shade intolerant of local species, will send up new sprouts within days after a fire destroys the old trees. Shade intolerant trees common to this area include aspen and ponderosa pine.

It follows that if the trees in a particular area grow in following a disturbance, all the trees in a stand will be of roughly the same age. As the trees compete for sunlight, water and nutrients, the most vigorous become the dominant trees in the new stand. The dominant tree soon outgrows its siblings, yet the weak trees remain in the understory stunted and overtopped. Thus in shade intolerant stands, small trees are not young trees, but merely suppressed.

The ponderosa sections in this photo illustrate how tree diameter is not a reliable indicator of age. The center section is 100 years old; section 2 is 99; section 3 is 101; section 4 is 90; section 5 is 85; section 6 is 130; section 7 is 81. (Sculpture by Bill Wallace. Photo by Bill Buckman, courtesy of the Black Forest Slash & Mulch Program)

Following are some important species of shade intolerant trees with respect to fire mitigation:

Ponderosa pine: Of all the species of trees in the local area, ponderosa is the best adapted to survive a low intensity wildfire. First, the thick bark of the tree acts as insulation from the heat of the fire. Second, as the upper branches shade the lower branches, the low branches die, and in time, are broken off. Thus there are fewer low hanging branches to act as ladder fuels. Fires that burn in the grass and litter under a mature ponderosa rarely harm the tree.

Aspen: As noted earlier, aspen are the most shade intolerant of local trees. Unlike the ponderosa, aspen bark is thin and the tops of the trees are killed by even the coolest fire. The root system however is insulated from the fire's heat by the ground, and when the tree tops die, the roots respond by vigorously resprouting.

As a deciduous tree, aspen will not carry a fire in the tree crowns, thus fires drop to the ground in aspen stands. For this reason aspen are desirable trees to retain in fuel breaks and defensible spaces. Furthermore, aspen are desirable wildlife trees, and many stands are becoming shaded out by conifers due to years of fire suppression.

Since wildfire mitigation practices almost always require thinning, many landowners assume that aspen should be thinned as well, but they should not. Thinning aspen is rarely recommended since the falling trees wound the remaining trees. The bark on aspen is so thin that any wound will expose the tree to many different fungal diseases that are eventually fatal. Fire mitigation in aspen should be limited to removal of dead trees if care

is taken to avoid wounding live trees, cleaning up down dead wood, and removing conifer regeneration from the aspen understory.

Shade Tolerant Trees

Shade tolerant trees are those that will sprout from seed and grow in the shade of the existing forest canopy. Shade tolerant trees are usually found on the cooler moister north facing slopes of hillsides and in moist drainages. In fact, most shade tolerant trees require shading for the seedlings to survive. A seedling in direct sunlight will often be burned by the sun. As a result stands of shade tolerant trees contain trees of many ages. The most common shade tolerant trees in the area are Colorado blue spruce, Engelmann spruce, Douglas-fir, and white fir.

Spruce: Colorado blue and Engelmann spruce are so similar that they may be considered together for discussion of fire mitigation. Colorado blue spruce is usually found in lower altitudes (below 9,000 ft) while Engelmann spruce is usually found above 9,000 feet. The ability of seedlings to survive in the shade of mature trees usually creates dense forests with a closed canopy above and thickets of ladder fuels below. The typical fire regime in spruce is an infrequent stand replacing crown fire.

Spruces tend to be shallow rooted and excessive thinning of the upper canopy can result in wind throw in the remaining trees. Typically fire mitigation prescriptions for spruce require creating openings of one tenth acre or larger with clumped trees between the openings. Removal of small trees in the understory of the clumped trees reduces ladder fuel.

Douglas-fir: Typically Douglas-fir are found on cooler north facing slopes in lower elevations and mixed with spruce in higher elevations. It is in the lower elevation ponderosa pine forests where Douglas-fir has become the most serious concern for wildfire mitigation. After a century of fire suppression in lower elevation ponderosa pine stands the canopy has closed, shading the forest floor. As a result, Douglas-fir has invaded the understory of the ponderosa stands creating dense thickets of ladder fuels.

Douglas-fir are firmly rooted trees and can be thinned much the same as ponderosa pine. In lower elevation ponderosa stands most Douglas-fir should be eliminated, especially the ladder fuels. There is an important exception to this general rule where the ponderosa are infected with dwarf mistletoe. In such situations the landowner may choose to favor the Douglas-fir since they are immune to the ponderosa pine dwarf mistletoe. Special attention should be given to providing adequate separation between the crowns of larger trees and pruning the lower branches from the Douglas-fir to reduce ladder fuels.

Thinning and Fuel Reduction

Foresters use many methods of thinning depending on the specific objectives of the landowner. Fuel break thinning is most often accomplished by a process called thinning from below. Trees are usually removed or remain based on their height in the canopy.

For simplicity, trees can be divided in three levels in the forest canopy. The largest trees at the highest level of the canopy are called dominants. These are usually the most vigorous since they have the largest root systems, most leaf area and receive the most sunlight. Next are the co-dominant or intermediate trees. These trees occupy the middle level of the canopy, but tend to be crowded and of smaller diameter. They are less vigorous with smaller root systems and fewer leaves as the result of crowding by the dominant trees. At the lowest level of the forest canopy are the overtopped trees. These are completely shaded by the dominant and co-dominant trees.

Thinning from below on the Black Forest School Section. These trees were first thinned in about 1980, and dense regeneration was thinned again in 2008.

As noted earlier, it is a common misconception in shade intolerant stands that the diameter of a tree is an indicator of its age. Often the co-dominant and overtopped trees are as old as or older than the dominant trees. In pure shade intolerant stands young trees are usually found in openings in the canopy, and can be recognized by having a diameter proportionate to the tree height, and a conical shape. If there are truly young trees in the stand it is desirable to leave some to increase diversity. Thickets of young trees should be thinned to give adequate growing space.

Thinning from below removes all of the overtopped and most of the codominant trees. It is essential when thinning for fuel breaks to remove ladder fuels and create enough openings in the forest canopy to reduce the crown fire risk. Thinning from below is desirable in fuel reduction projects because it 1) leaves the most vigorous trees on the site, 2) creates openings in the forest canopy by removing the less vigorous co-dominants, and 3) eliminates ladder fuels by removing the overtopped trees, shrubs, and pruning lower limbs of remaining trees.

Slash Treatments

Slash treatments will always be needed to clean up the residue from any forest thinning treatments. Untreated slash will only increase the fire hazard—possibly undoing all the good of thinning. It can also attract undesirable insects to the area—primarily ips beetles and turpentine beetles. Slash treatment may be the most labor intensive, and, thus expensive, part of any fuel mitigation project.

Lop and Scatter: This treatment consists of using saws or equipment to cut the slash into smaller pieces so that the height of the remaining slash is reduced, usually less than 12 inches high by 24 inches long. It may be the only practical treatment in areas where chippers are unavailable, prohibitively expensive, or in inaccessible locations. It is usually the lowest cost treatment since no special equipment, other than a chainsaw, is required.

The treated slash is left to decompose, and until it breaks down it will be unsightly. Over the course of several winters, snow pack pushes the slash down and it decomposes. Decomposition usually requires three to five years or longer if larger material was present. It also creates an extremely flammable fuel bed until it decomposes, which can be easily ignited, and burns with high intensities. It should not be used adjacent to high values, such as homes, or areas prone to regular fire occurrence.

Lopped and scattered slash can also lead to problems with ips or turpentine beetles. The beetles may lay eggs in green slash and the brood may emerge to attack living trees. This problem can be alleviated by doing any forest restoration treatments requiring this method in the fall and winter when the beetles are not active and by cutting slash into small pieces that dry out quickly.

Chipping: Chipping is the grinding up of the slash into small pieces, usually less than a few inches in diameter. Material can be chipped and left, or removed for off-site disposal or as a product.

It requires mechanized equipment to perform the chipping. The slash must be brought to the chipper, unless it is an expensive mobile chipping piece of equipment. Either way, it can quickly become a very expensive operation.

Chipping is a common method of slash disposal in the defensible zones around structures. Chips do not significantly contribute to fire hazard around structures since they produce low intensity fire behavior. Large piles of chips should be avoided as they could smolder for a significant amount of time however. Chips should be spread along the ground to a depth of less than four inches.

Chipping is an effective means of treating wood infested with bark beetles since the insects will not survive in the small bits of wood. Green slash that is promptly chipped will not harbor infestations of ips, turpentine, or other bark beetles. Chips also can pull nitrogen out of the soil, reducing the productivity of the ground.

Community Chipping Projects: Many communities have found that an effective way to promote mitigation is to sponsor a community chipping program. They have discovered that landowners are quite willing to undertake the effort of thinning trees if there is a

simple low cost way to remove the slash. Community chipping usually consists of one of two approaches.

First is the community slash site where landowners may drop of the slash at a designated area. The slash is then ground and given away as mulch or used in some sort of reclamation activity. Most sites are open on designated days and manned by volunteers from the sponsoring community. Some slash sights that are not gated and are unmanned have reported some problems with illegal dumping, although this seems to be a rare occurrence. Rather than collection sites other communities have paid for roll off dumpsters to be placed at certain locations for collection of slash.

The second method is the drive by chipping program. The community contracts with a tree service or mitigation contractor to bring a chipper to the community on a certain day. Residents with slash to dispose of may drag it to the curb where the contractor will chip it on site. Commonly the chips are blown back onto the property. Usually an official from the homeowner's association or mitigation committee coordinates the program, and records the location of slash piles for the contractor.

Trampling, Crushing, or Roller Chopping: This is using heavy equipment, usually a dozer, to run over the slash, breaking it down in both size and height. It can be done with just the tracks or by also pulling a heavy, water filled drum with cutting blades welded on it.

It is very effective and can also crush and break up heavy fuels such as down logs. However, the slash must dry, usually for several seasons, to make this treatment truly effective. There is an increased fire hazard in the interim.

There is an additional benefit to crushing or trampling. The material is not only broken down, but also driven into the soil. This can add nutrients to the soil faster, create small pockets in the soil surface for holding water, and decrease the potential for erosion.

Pile Burning: Burning within the bounds of Spirit Lakes is prohibited by SLOA covenants

Maintenance

Survivable space, fuel break thinning, or any type of forest management, does not end when the initial project is finished. Continual maintenance is an essential part of any forest management program. Even in well managed forests trees will die, storms and wind will damage trees, and new trees will germinate.

Trees should be inspected every spring for any sign of damage from winter or spring snows or wind. Prune any broken branches if they are not too high in the tree, and trees bent by heavy winter snows should be removed. Check for any signs of insect activity or disease.

Late October is the best time to inspect trees for attack by mountain pine beetles. Beetles have finished attacking trees at this time, and there is adequate time to cut and treat the tree before the adult beetles fly the next July.

At five years check the canopy closure, especially in zones one and two. Remove any trees necessary to maintain openings in the canopy. Do any additional pruning or removal of trees and shrubs to eliminate ladder fuels.

After ten years, dense thickets of young trees (regeneration) may have become established, and these will need to be thinned. Not all regeneration should be cut since trees of various ages are important for forest diversity. Young trees in openings with adequate room to grow should remain. Regeneration that is likely to become ladder fuel or crowded by other trees should be cut. Depending on their objectives, landowners may want to consider removing some of the larger trees to make room for the younger ones.

V. IMPLEMENTATION AND MONITORING

Implementation

The table below lists all of the mitigation projects identified, their priority rankings and the lead agency for the projects. In addition to the projects in *Table 4*, approximately ten home sites are rated as high or extreme wildfire hazard and are in critical need of defensible space improvement In total, about seven small and large projects have been identified.

Fuel Treatment Table Spirit Lakes Community Wildfire Protection Plan

Treatment Area	Acres	Owner	Priority	Time Frame	Lead Agency	Treatment
S/W Corner of common area	3.5	SLOA	1	6 months	SLOA	Thin from below
Promote Defensible space and forest restoration on private properties throughout the community	237	Private	1	10 years	SOLA	Thin from below
Frequent mowing along Murphy Rd.	0.5	SLOA	2	Bi-monthly	SLOA	SLOA
Recognition as a Firewise Community	237	SLOA	2	Yearly	SLOA	N/A
Common area across from Lot #6	3.5	SLOA	3	6 months	SLOA	Thin from below
Annual review of plan	237	SLOA	N/A	Yearly	SLOA	N/A
Common area mowing	40	SLOA	4	As needed	SLOA	Contract mowing svc.
Mitigate along roads to widen fire break	10	SLOA	5	1-2 yrs	SLOA	Contractor
Widen existing utility right of way	6	SLOA	6	1-2 yrs	SLOA	Contractor
Update of CWPP in 2019	237	SLOA	N/A	N/A	SLOA	N/A
Complete Revision of CWPP in 2914	237	SLOA	N/A	N/A	SLOA	N/A

Monitoring

Monitoring is an important part of follow-up to the implementation of projects. HFRA instructs participants to establish, where interest is expressed by the communities, a collaborative multiparty monitoring process. This process should address reporting of

accomplishments, need for maintenance of treated areas, tracking of burned areas and the positive and negative ecological and social effects of the projects.

Monitoring in the Spirit Lakes Community Wildfire Protection Plan calls for an annual field review by the partners (participants) of accomplishments and need for maintenance. Based on this review, it calls for needed adjustments in the next years plan, as appropriate. Thirdly, it calls for a determination of interest and meeting by the partners for monitoring the ecological and social effects of projects.

APPENDIX A

INSECT AND DISEASE CONDITIONS

Literally thousands of insect and diseases are present in the forests surrounding the community--or any other forested area. Fortunately, like the common cold, most do no serious or lasting damage. But when in poor health, trees, like humans, are more prone to infection from other causes; the concept of preventive medicine applies to forests, as well. Maintaining forests in good health will prevent problems in the future. For the most part, forest insect and disease issues are typical for the region.

Every summer, insect and disease specialists from the USDA Forest Service and Colorado State Forest Service (CSFS) survey Colorado's forests from the air to monitor insect and disease outbreaks. These flights are an excellent means of finding new areas of insect and disease activity and monitoring trends in existing outbreaks. Maps of the previous year's findings are published in January and can be found on the CSFS website at http://csfs.colostate.edu/pages/common-insects.html.This link also contains more detailed information on the insect and disease issues presented here.

The unnaturally dense forest conditions that cause the potential for hazardous fire also create the potential for cyclical insect and disease outbreaks. Trees weakened by overcrowding and severe competition for water and sunlight are susceptible to invasion by insects and disease. When planning wildfire hazard mitigation projects, it is important to address current insect or disease issues and prevent those that are likely to become a problem. Following is information on some of the common forest insect and disease problems that have been identified in the region.

Well maintained forest have a multidude of benefits. They are resistant to catastrophic fires, insect and disease, sustain wildlife populations and are pleasant places to be. Colorado State Forest Service Photo by Dave Root

Dwarf Mistletoe

Dwarf mistletoe is a parasitic plant that robs moisture and nutrients from the host tree. Over many years, it causes the tree to decline in vigor and eventually may cause death. More commonly, the tree declines to the point where bark beetles attack and kill it.

Three common species of dwarf mistletoe are found in the region, each named after its principle host – ponderosa pine, lodgepole pine and Douglas-fir. Locally, ponderosa and lodgepole varieties grow on any pine species, but Douglas-fir dwarf mistletoe is exclusive to Douglas-fir trees. Spruce, true firs and deciduous trees are immune to all three species of dwarf mistletoe.

The most obvious symptom of dwarf mistletoe infection is the dense, distorted growth of the branches, called witch's brooms because they appear to be twisted or tied in knots. The shoots of ponderosa and lodgepole dwarf mistletoe are visible on the branch as thick fingerlike growths extending out of the branch or trunk. The shoots of ponderosa and lodgepole dwarf mistletoe are long and obvious to casual observation, but Douglas-fir dwarf mistletoe shoots are shorter than the needles and are not easy to see.

A ponderosa pine with advanced dwarf mistletoe infection. Note the heavy contorted "witch's brooms" in the lower branches. After long periods of infection, the needles at the top of the tree become sparse and shorter.
Colorado State Forest Service photo by Dave Root.

Mistletoe shoots are only reproductive structures with no photosynthetic function. Removing the shoots from a branch does not control dwarf mistletoe, except to temporarily halt seed production. Structures called sinkers, (analogous to roots in plants) embedded in the wood cause the damage, and the mistletoe plant continues to absorb the host tree's water and nutrients. Shoots that are removed grow back in two or three years.

During the growing season, dwarf mistletoe shoots develop berries containing a seed. In August, the berries fill with water and explode, shooting the seed as far as 40 feet. Most seeds strike branches of the host tree and do not travel the full 40 feet, so the expansion of dwarf mistletoe pockets averages two feet per year. When the seed strikes a branch, it germinates and the sinkers penetrate the bark into the tree's conductive tissues. The growing mistletoe begins to steal the tree's food and water. The first visible symptom of infection is swelling in the branch at the site of the growing mistletoe plant, but nubs of the emerging shoots won't be visible for three years and a shoot won't bear its first seeds until seven years after. As seeds spread, all susceptible trees

in the vicinity may become infected; it is extremely rare to find an isolated infected tree in the forest.

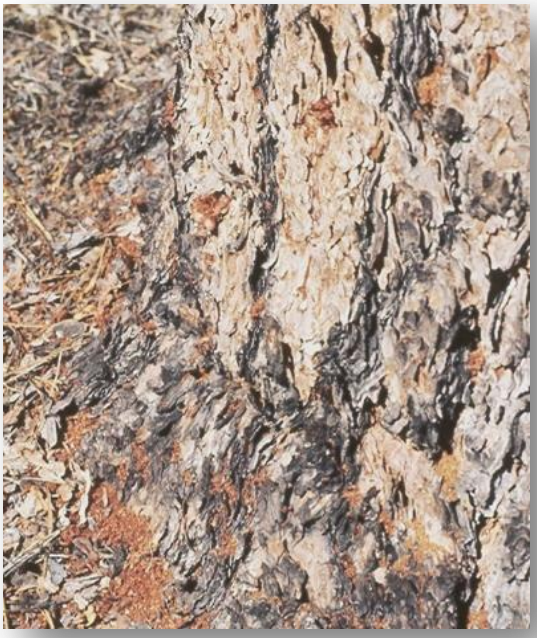
The tendency of mistletoe to infect all trees in a stand makes eradication difficult. No effective chemical treatment exists for mistletoe, and the only way to kill the parasite is to kill the host. In stands where only the susceptible species of tree exists, total eradication of the mistletoe would require a clearcut, which is unacceptable to most landowners.

Fortunately, mistletoe kills trees slowly, so it is not necessary to eradicate the parasite. The disease can be controlled by a program of thinning to increase tree vigor. Pruning the more heavily infected branches also helps, even if not all the mistletoe is eliminated. The final step in the process is to replant with non-susceptible species so that new trees will grow before the mistletoe kills the remaining trees.

The spread of mistletoe can be halted by a minimum 40-foot buffer zone between infected and non-infected trees. In this situation, cut 20 feet into non-infected trees to remove any mistletoe that is not yet visible; cut the remaining 20 feet into the infected stand. Non- infected trees outside the buffer should be checked each spring for mistletoe and any infected branches should be immediately pruned before seeds develop.

In forest stands with mixed tree species, it may be possible to eliminate all mistletoe by retaining only non-susceptible trees if they are in good health.

Dwarf mistletoe treatment is a complicated process that depends on the site conditions and the landowner's tolerance for cutting trees. In most cases, a combination of treatment methods will best suit the landowner's objectives. Consultation with a qualified forester is recommended to develop an effective and acceptable treatment plan.



Boring dust on a ponderosa pine after bark beetle attack. The reddish brown sawdust at the base of the tree and in the bark crevasses is a strong indication of successful beetle attack. Colorado State Forest Service photo by David Leatherman.

<u>Mountain pine beetle</u>

Due to the massive mountain pine beetle (MPB) epidemic in the western United States and Canada, MPB is the most feared insect in the forest. Unlike the Western Slope, mountain pine beetle is
at normal levels in the area. The beetles have crossed the Continental Divide in northern Park County and northern Larimer County, and activity currently is confined mostly to higher altitude lodgepole pine. It presently is not known if or when the beetles will reach into the lower-

elevation ponderosa forests, but where they have reached ponderosa, heavy mortality has occurred.

Adult beetles fly from midsummer through the first frost, although the vast majority fly between mid-July through the middle of September. Females seek a large, weak tree in which to mate and lay eggs. Vigorous trees generate enough pitch to prevent the female from burrowing through the bark, and this attempt by the tree to prevent entry creates the pitch tubes symptomatic of beetle attack. Pitch tubes are **not** a particularly reliable indicator of a successful attack. If pitch tubes are seen, check for reddish boring dust (fine sawdust) at the base of the tree and in the bark crevices. Boring dust is a more reliable indicator of successful attack.

Once a female penetrates the bark, she hollows out a circular mating chamber between the bark and the wood, releasing a pheromone (scent) to attract a mate. The pheromone also attracts additional females to the tree and the tree is attacked en masse. After mating, the female burrows up the trunk between the bark and wood laying eggs. She inoculates the tree with spores of bluestain fungus, which provides food for the larvae. The fungus clogs the tissues that conduct water throughout the tree, leading to death within a few weeks.

Eggs hatch within a few days. The developing larvae feed horizontally from the maternal gallery over winter. The vertical maternal gallery and horizontal larval galleries are characteristic of the mountain pine beetle. The feeding larvae spread the bluestain fungus horizontally through the tree, and it becomes visible in the wood around February. The presence of bluestain is absolute confirmation that beetles have successfully attacked a tree.

Mountain pine beetle galleries under the bark. The maternal beetle burrowed straight up the tree, creating the darker central gallery. Larval beetles feed horizontally, creating the smaller galleries. A larva is in the upper right and pupae in the lower left. Note the bluestain in the wood. Colorado State Forest Service photo by David Leatherman.

Woodpeckers feed on the larvae through the fall and winter. The holes made by the woodpeckers are a visual clue to an infested tree. Untrained observers often are confused by the holes woodpeckers make when they feed on beetle larvae and sapsuckers feed on the sap. Woodpecker feeding is characterized by random holes about one-half inch in diameter that make it appear as though the tree was peppered with a shotgun. Sapsuckers, on the other hand, make a small hole about one-eighth inch in diameter, and the holes are in straight lines or a grid pattern. Sapsuckers do not indicate the presence of beetles in the tree.

Although the tree is dead within a few weeks of successful attack, needles remain green until the following spring. Within the space of a few weeks, in late May or early June the tree will turn straw-yellow and then reddish-brown. Once beetles invade a tree, nothing can be done to save it;

the tree must be cut and disposed of in a way that will kill the beetles. No insecticide is available to kill beetles under the bark; thus, some sort of mechanical treatment is necessary. Any wood greater than four inches in diameter may harbor beetles and must be treated.

Following are treatment options for beetle-infested trees:

- Cut the tree and move all wood greater than four inches in diameter to a designated mountain pine beetle-safe site – usually an area at least one mile away from the nearest pine tree.
- Move all wood to a landfill or bury it under at least eight inches of dirt.
- Completely debark any wood that is larger than four inches in diameter.
- Chip the tree. Many tree services have chippers capable of chipping large diameter trees. The beetles are killed when the wood is chipped.
- Cover wood with at least six-mill clear plastic. This method, known as solar treatment, warms the wood to lethal temperatures and increases moisture, encouraging mold growth in the logs, which kills the beetles. Treat the wood properly for successful control. Cut into firewood lengths and stack no more than two logs high. Be sure there are no exposed stubs or sharp edges that might tear the plastic. Trench around the pile and, if possible, wet down the pile to encourage mold growth. Cover the pile with plastic, push the edges of the plastic into the trenches, and seal the edges with dirt. Check periodically to be sure the plastic has not torn. If torn, it can be repaired with duct tape.

It is best to check for infested trees in October of each year – remember that infested trees, although dead, are still green at this time. Pitch tubes and boring dust will be the most obvious clues. If infested trees are located early, there is adequate time to treat them.

While no insecticide effectively treats infested trees, spraying with insecticides such as carbaryl or permethrine prevents attack. Preventive sprays will not kill beetles under the bark. Spray trees between May 1st and July 1st each year for maximum effectiveness. It is not practical to spray every tree on a large tract of land, so choosing which trees to spray depends on the landowner's budget and the value of individual trees to the landowner. It is advisable to solicit bids from several different spray companies, as prices can vary widely. It also is wise to request and check references.

Thinning forests for increased health and vigor by far is the best preventive measure for mountain pine beetle. Because trees require several years to respond to thinning, it is best done before beetles reach epidemic levels. Follow thinning guidelines for wildfire mitigation to reduce susceptibility to MPB.

Ips (engraver) Beetles

There are several species of these small bark beetles that may infest ponderosa pine piñon pine or spruce. Piñon ips is active along the Highway 115 corridor south of Colorado Springs. The other species are always present in the forest, but are not currently at epidemic levels. Ips beetles usually attack trees less than four inches in diameter and, in such circumstances, may be useful in thinning dense stands of young trees. Thus, it usually is not considered as threatening as its larger cousin. Ips will attack larger trees if they are severely weakened by disease (most often dwarf

mistletoe), or are damaged by construction, lightning strikes or in horse corrals where soil compaction injures the roots. Like the mountain pine beetle, ips burrow beneath the bark and inoculate the tree with bluestain fungus, often following mountain pine beetles into larger trees.

The differences between mountain pine beetle and ips are significant to anyone implementing a forest management program. In contrast to MPB, which produce one generation per year, ips may produce up to four. Ips become active in spring when the weather exceeds 50 degrees F, developing from egg to adult within eight weeks. They continue to attack trees until the first fall frosts. For this reason, preventive spraying should be done with permethrine or carbaryl in April and repeated in July. When spraying preventively for ips, it is important to spray the branches, as well as the trunk.

The reddish-brown sawdust on this freshly cut ponderosa pine slash indicates it has been invaded by ips beetles. Adult beetles will emerge in eight weeks if the slash is not properly treated.

Colorado State Forest Service photo by Dave Root.

Ips attack causes no pitch tubes to form on live trees, so the only visual clue is boring dust or woodpecker holes in the trunk. Smaller trees quickly turn reddish-brown, but when they attack larger trees, ips often infest only the upper portion of the tree. The first symptom is browning of the top, but subsequent generations emerge and continue down the tree.

Ips will infest green slash and downed logs from forest management projects. If slash is not promptly treated, ips will emerge to attack living trees; treat slash within four to six weeks after cutting. If weather conditions permit, thinning trees in winter when ips are dormant will prevent problems with beetles in slash. However, slash cut after March 1 may still be green enough to attract ips when the weather warms.

Chipping slash will kill ips beetles. Lopping and scattering slash into lengths less than 24 inches promotes rapid drying and prevents infestation. Slash cut late in fall that is subsequently infested can be treated or piled and burned over the winter, but untreated slash left over the winter will produce live broods the following April. Due to their short lifecycle, solar treatment of ips-infested logs is ineffective. Bucking larger diameter logs and promptly splitting them into firewood accelerates the drying process and usually is effective in preventing ips infestations.

Many high value trees have been lost as a result of the common, and ultimately costly, practice of stacking firewood against green trees. Ips beetles will burrow out of infested firewood directly into standing trees.

References

Cranshaw, Whitney, David Leatherman, Boris Kondratieff, Paul Opler, and Casey Sclar. Nd. *Insects and Diseases of Woody Plants of the Central Rockies.* Bulletin 506A, Colorado State University Cooperative Extension.

Furniss, R.L., and Carolin, V.M. (1977). *Western Forest Insects.* Miscellaneous Publication No. 1339 USDS Forest Service.

Johnson, Warren T., and Lyon, Howard H. 1991. *Insects that Feed on Trees and Shrubs.* Comstock Publishing Associates, Cornell University Press.

Appendix B

Further Information

Websites:

Cost Share Assistance Database: http://nrdb.csfs.colostate.edu/
Colorado State Forest Service: http://www.csfs.colostate.edu/
CSFS, Woodland Park District: http://csfs.colostate.edu/pages/woodlandparkdist.html
Firewise Communities: http://www.firewise.org/
El Paso County: http://www.elpasoco.com/Pages/default.aspx
Park County: http://www.parkco.us/
Teller County: http://www.co.teller.co.us/
Colorado State University Extension: http://www.extension.colostate.edu/chaffee/
Pike National Forest: http://www.fs.usda.gov/psicc
Bureau of Land Management, Royal Gorge Field Office: http://www.blm.gov/co/st/en/fo/rgfo.html
Natural Resources Conservation Service: http://www.co.nrcs.usda.gov/

Publications:

Community Wildfire Protection Planning

How to evaluate a community Wildfire Protection Plan: http://csfs.colostate.edu/pdfs/eval_9-8-08_web.pdf
All Colorado CWPPs: http://csfs.colostate.edu/pages/CommunityWildfireProtectionPlans.html

Wildfire Mitigation

***CO Dept. of Revenue Tax Subtraction*:**
http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251915899901&ssbinary=true
Fuel Break Guidelines for Forested Communities: http://csfs.colostate.edu/pdfs/fuelbreak_guidellines.pdf
Protecting Your Home from Wildfire: Creating Wildfire Defensible Zones:
http://csfs.colostate.edu/pdfs/FIRE2012_1_DspaceQuickGuide.pdf
Firewise Landscaping: http://csfs.colostate.edu/pdfs/06303.pdf
Firewise Plant Materials: http://csfs.colostate.edu/pdfs/06305.pdf
Forest Home Fire Safety: http://csfs.colostate.edu/pdfs/06304.pdf
Grass Seed Mixtures to Reduce Wildfire Hazard: http://csfs.colostate.edu/pdfs/06306.pdf
Living With Fire: A guide to the Homeowner: http://csfs.colostate.edu/pdfs/LWF51303.pdf
Firewise Construction: Site Design and Building Materials:
http://csfs.colostate.edu/pdfs/firewise-construction2012.pdf

Forest Health and Management

Gambel Oak Management: http://csfs.colostate.edu/pdfs/06311.pdf
Landowner's Guide to Thinning: http://csfs.colostate.edu/pdfs/landowner_g4thin_scr.pdf
Landowner's Guide to Living With Bark Beetles: http://csfs.colostate.edu/pdfs/MPB_Newspaper_Insert_Final.pdf
Landowner Assistance Programs in Colorado:
http://csfs.colostate.edu/pdfs/Landowner-Assistance-Programs-rev112610.pdf

Forest Insect and Disease Information

Dwarf Mistletoe Management: http://csfs.colostate.edu/pdfs/DMT.pdf
Mountain Pine Beetle: http://csfs.colostate.edu/pdfs/MPB.pdf
Solar Treatment for Mountain Pine Beetle:
http://csfs.colostate.edu/pages/documents/Solar_Treatment_for_Mountain_Pine_Beetle_April_2009.pdf

Products used to Prevent Mountain Pine Beetle:
http://csfs.colostate.edu/pdfs/Web__Revision_June6_MPB_Prev_Products_QG.pdf
Ips Beetles: http://csfs.colostate.edu/pdfs/Ips.pdf
Western Spruce Budworm: http://csfs.colostate.edu/pdfs/05543.pdf
Firewood and House Log Insects: http://csfs.colostate.edu/pages/documents/firewood_insects.pdf
Protecting Trees During Construction: http://csfs.colostate.edu/pdfs/construction.pdf

Post Wildfire Recovery:

Insects and Disease Associated with Forest Fires: http://csfs.colostate.edu/pdfs/06309.pdf
Vegetative Recovery after Wildfire: http://csfs.colostate.edu/pdfs/06307.pdf
Soil Erosion Control After Wildfire: http://csfs.colostate.edu/pdfs/06308.pdf
Replanting in Burned Areas: Tips for Safety & Success:
http://csfs.colostate.edu/pdfs/FINAL-Post-FireReplanting-andSafetyTips-2013Feb11.pdf
Aspen Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Douglas-fir Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Gambel Oak and Serviceberry Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-gambel-oak-and-serviceberry.pdf
Piñon Pine and Juniper Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-PJ.pdf
Ponderosa Pine & Lodgepole Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-Ponderosa-and-lodgepole.pdf

Appendix C

Glossary of Forestry Terms

Abiotic Factors: The non-living components of the environment, such as air, rocks, soil, water, peat, and plant litter.

Afforestation: The establishment of trees on an area that has lacked forest cover for a very long time, or has never been forested.

Aerial fuels: Standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines: typically used in reference to the crowns of trees.

Cambium: A single layer of cells between the woody part of the tree and the bark. Division of these cells result in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: The forest cover of branches and foliage formed by tree crowns.

Chain: A measuring tape, often nylon, 50 meters or 75 meters in length, used to measure distances. This term is derived from an old unit of measurement (80 Chains = 1 mile).

Chimney: A topographical feature such as a narrow drainage on a hillside or the upper end of a box canyon that could channel wind, smoke or flames up the slope; acting as a fireplace chimney would to draw smoke and heat upward.

Class A Roof: Effective against severe fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class B Roof: Effective against moderate fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class C Roof: Effective against light fire test exposure, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a measurable degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Clearcut: An area of forest land from which all merchantable trees have recently been harvested.

Climax Forest: A forest community that represents the final stage of natural forest succession for its locality, i.e. for its environment.

Coarse Woody Debris (CWD): Sound and rotting logs and stumps that provide habitat for plants, animals, and insects, and a source of nutrients for soil development.

Colorado Champion Tree: The largest known tree of its species in the state. Trees are ranked by a point system based on three measurements: trunk circumference in inches at 4.5 feet above the ground, tree height in feet, and the average crown spread in feet.

Commercial Thinning: A silviculture treatment that "thins" out an overstocked stand by removing trees that are large enough to be sold as poles or fence posts. It is carried out to improve the health and growth rate of the remaining crop trees.

Competing Vegetation: Vegetation that seeks and uses the limited common resources (space, light, water, and nutrients) of a forest site needed by preferred trees for survival and growth.

Conifer: Cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood known commercially as "softwoods."

Conservation: Management of the human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. It includes the preservation, maintenance, sustainable utilization, restoration, and enhancement of the environment.

Crown fire / Crowning: A form of extreme wildland fire behavior consisting of fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

Deciduous: Perennial plants that are normally leafless for some time during the year.

Defensible Space: An area within the perimeter of a parcel, development, neighborhood, or community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires. The perimeter as used herein is the area encompassing the parcel or parcels proposed for construction and/or development, excluding the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures. In simplest terms, it is adequate space between structures and flammable vegetation which allows firefighters a safe working area from which they can attack an oncoming wildfire. Defensible Space is the best element of fire protection for individual property owners.

Defoliator: An agent that damages trees by destroying leaves or needles.

Dripline: The outer most leaves on a tree defines its dripline and the ground within the dripline is known as the drip zone; also defined as the area defined by the outermost circumference of a tree canopy.

Deforestation: The removal of a forest stand where the land is put to a non forest use.

Eave Opening: A vent located in an eve or soffit which allows airflow into the attic and/or walls of a structure.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size a log, pond, field, forest, or the earth's biosphere but

it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation; for example, forest ecosystem, old-growth ecosystem, or range ecosystem.

Escape route: A preplanned and understood route firefighters take to retreat from an unsafe or fire-threatened area and move to a safety zone or other low-risk area.

Extreme fire behavior: A level of fire behavior that ordinarily precludes firefighting methods involving direct attack on the fire. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Felling: The cutting down of trees.

Firebrands: Flaming or glowing fuels lofted into the air during intense burning by strong upward convection currents. Also referred to as airborne embers.

Fire break: A natural or constructed fuel-free barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fire front / Flame front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter.

Fire Dependent: Requiring one or more fires of varying frequency, timing, severity, and size in order to achieve optimal conditions for population survival or growth.

Fire Hazard Mitigation: Various methods by which existing fire hazards can be reduced in a certain area, such as fuel breaks, non-combustible roofing, spark arresters, etc.

Fire Management: The activities concerned with the protection of people, property, and forest areas from wildfire and the use of prescribed burning for the attainment of forest management and other land use objectives, all conducted in a manner that considers environmental, social, and economic criteria.

Fire Suppression: All activities concerned with controlling and extinguishing a fire following its detection.

Firewise: A National Fire Protection Association's (NFPA) program encouraging local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks.

Forest Fire: Any wildfire or prescribed burn that is burning in forest, grass, alpine, or tundra vegetation types.

Forest Type: A group of forested areas or stands of similar composition (species, age, height, and stocking) which differentiates it from other such groups.

Fuel: Any living or dead material that will burn.

Fuel break: An existing barrier or change in fuel type (to one that is less flammable than that surrounding it) or a wide strip of land on which the native vegetation has been modified or cleared, that acts as a buffer to fire spread so that fires burning into them can be more readily controlled. Often selected or constructed to protect a high value area from fire.

Fuel Management: The act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire in support of land management objectives.

Fuel reduction zone: An area similar to a fuel break but not necessarily linear, in which fuels have been reduced or modified to reduce the likelihood of ignition and/or to reduce fire intensity thereby lessening potential damage and resistance to control.

Germination: The development of a seedling from a seed.

Home Ignition Zone (HIZ): An area including the home and its immediate surroundings within which burning fuels could potentially ignite the structure; usually considered to be an area extending out roughly 100 feet from the home. The HIZ is often used to describe the area in which fuel modification measures should be taken to protect the home.

Ladder Fuels: Fuels that provide vertical continuity between the surface fuels and crown fuels in a forest stand, thus contributing to crown fires.

Lines of Effort: Tasks sets or sets of actions that are linked or coordinated with other task sets to accomplish a larger mission or reach a desired end state. Lines of effort allow leaders and decision makers to direct a variety of separate actions toward a unified result.

Maximum Density: The maximum allowable stand density above which stands must be spaced to a target density of well-spaced, acceptable stems to achieve free-growing status.

National Fire Protection Association (NFPA): A private, non-profit organization dedicated to reducing fire hazards and improving fire service.

Phloem: A layer of tree tissue just inside the bark that conducts food from the leaves to the stem and roots.

Pitch Tubes: A tubular mass of resin that forms on bark surface at bark-beetle entrance holes.

Prescribed Burning: Controlled application of fire to wildland fuels, in either their natural or modified state, under certain conditions of weather, fuel moisture, soil moisture, etc. as to allow the fire to be confined to a predetermined area and at the same time to produce results to meet planned land management objective.

Ready, Set, Go (RSG): A program, managed by the International Association of Fire Chiefs (IAFC), seeking to develop and improve the dialogue between fire departments and residents. The program helps fire departments teach individuals who live in high-risk wildfire areas how to best prepare themselves and their properties against fire threats.

Regeneration: The act of renewing tree cover by establishing young trees, naturally or artificially note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Saddle: A depression, dip or pass in a ridgeline; significant in wildland firefighting because winds may be funneled through a saddle, causing an increase in wind speed.

Safety zone: An area essentially cleared of flammable materials, used by firefighters to escape unsafe or threatening fire conditions. Safety zones are greatly enlarged areas in which firefighters can distance themselves from threatening fire behavior without having to take extraordinary measure to shield themselves from fire/heat.

Sapwood: The light-colored wood that appears on the outer portion of a cross-section of a tree.

Serotinous: Pertaining to fruit or cones that remain on a tree without opening for one or more years note in some species cones open and seeds are shed when heat is provided by fires or hot and dry conditions.

Shaded fuel break: A fuel break built in a timbered area where the trees within the break are thinned and limbed up to reduce crown fire potential, yet retain enough crown canopy to provide shade, thereby making a less favorable microclimate for surface fires.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Stand: A continuous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

Spot Fire / Spotting: Fires ignited beyond control lines or outside the perimeter of a fire by firebrands landing on/among flammable material. Spot fires/spotting are a form of extreme fire behavior typically resulting from high wind conditions.

Structure protection: A defensive strategy in wildland firefighting in which firefighters are assigned to evaluate, prepare and, when possible, defend structures/homes that may be threatened by a wildfire.

Structure triage: Evaluating and sorting structures/homes into categories based on their relative likelihood of surviving a wildland fire threat (*defensibility*). Triage decisions are based multiple factors and conditions occurring during an actual fire - weather, fire behavior, home ignition potential, defensible space, presence of escape routes, and availability of firefighting resources, among others - with the goal of doing the most good with the resources available.

Succession (or Ecological Succession): The replacement of one plant and/or animal species over time by another in progressive development toward climax vegetation.

Surface fuels: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-lying live vegetation.

Survivable space: A term typically used to describe the area around a structure/home indicating that fuels in the area have been reduced to the point that there is little or no serious fire threat to the structure; the structure has a high probability of surviving a wildland fire without anyone on scene providing active protection.

Thinning: A cutting made in an immature crop or stand primarily to accelerate diameter increment, but also, by suitable selection, to improve the average form of the tree that remain.

Torching: The burning of the foliage of a single tree or a small group of trees, from the bottom up. Sometimes, also called candling. Torching is an extreme form of fire behavior, similar to but less extreme than crowning in that crowning affects larger numbers, even entire stands of trees.

USDAFS: United States Department of Agriculture - Forest Service, what is commonly known as just "The Forest Service"

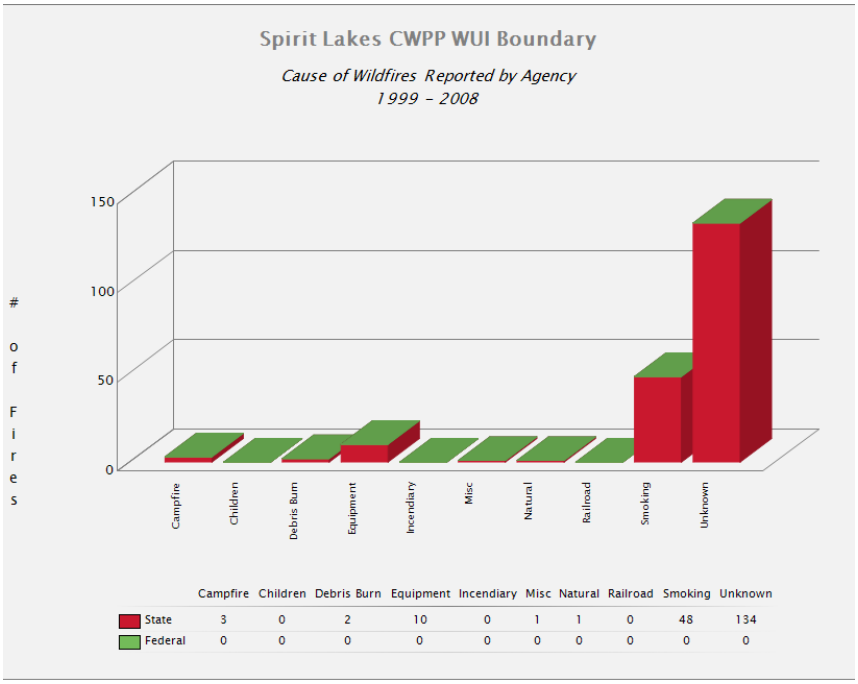
Windbreak: A strip of trees or shrubs maintained mainly to alter wind flow and microclimates in the sheltered zone, usually farm buildings.

Wildland-Urban Interface or Wildland-Urban Intermix (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Although ***Interface*** is the more general, more commonly used term; it technically refers specifically to the area where development and wildlands meet. ***Intermix*** indicates the presence of wildland vegetation/fuels intermingled throughout the developed area.

III Risk of Ignition and Wildfire Occurrence

Causes of Wildfire Ignitions

Data collected from wildfire responding agencies between 1999 and 2008 indicate that the cause of most wildfires was unknown.



Reconstruction of fire history and forest dynamics in the neighboring upper South Platte landscape, which is located immediately north and west of the community, reveal (i) an average fire interval of about fifty years during the period 1300-1880, but no major fires between 1880 and 2002; (ii) a mix of non-lethal surface fire and lethal, stand replacing fire in the historic burns (mixed severity fire regime); and (iii) a striking increase in forest density from 1900-2002.

The extent of the high-severity Hayman burn in 2002 was unprecedented in the last 700 years, in part because of the dense forest conditions that had developed during the twentieth century, and in part because of the extreme drought and fire weather conditions that existed in 2002. Similar drought conditions contributed to the Waldo Cañon fire a decade later.

Low fuel moistures and relative humidity are common in the area, as are periods of high winds. When dry and windy conditions coincide the stage is set for large wildfires. Human population is increasing in the area. All recent large fires were caused by humans. Numerous fires are ignited each year by lightning. Except for portions of Florida, this area has some of the highest occurrence of lightning in the continental US.

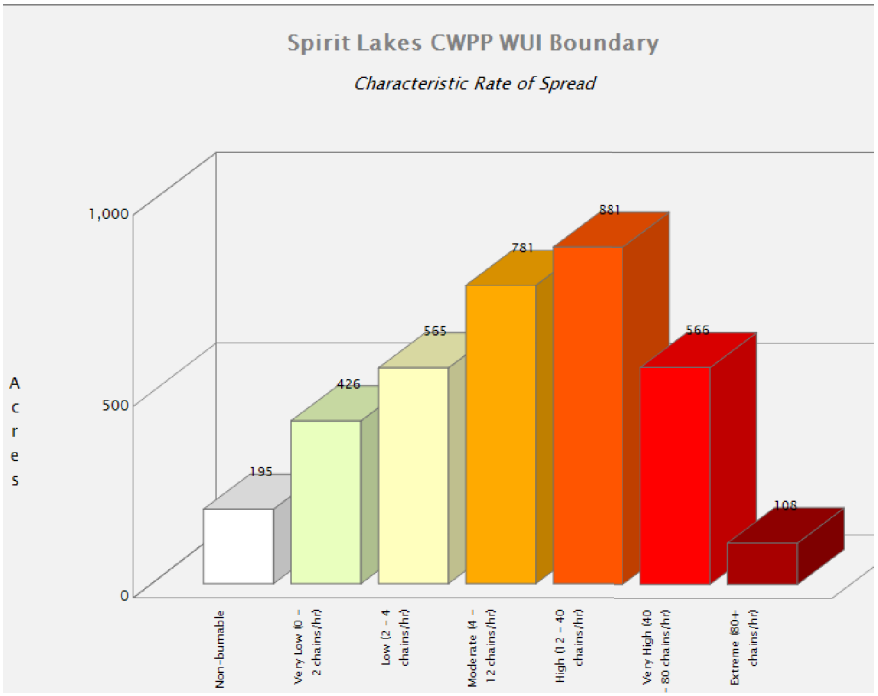
Fires originating in or near communities are the most immediate concern, but fires starting well beyond the boundaries of the planning area can have profound effects upon the communities. Rapid rates of spread and long distance spotting are the norms for fires in the vicinity. Areas classified as high to moderate fuel loading are the most worrisome.

Fuel Hazards

Factors Affecting Homes in the Wildland/Urban Interface The overall risk to the community from wildland fire is high. This section will discuss the factors considered that led to the overall rating.

The graphic at the right represents the CO-WRAP predicted rate of spread in chains per hour. A chain is 66 feet. Thus a moderate rate of spread (4 to 12 chains per hour) would equal 264 feet to 792 feet per hour. The height of a bar indicates the number of acres in the WUI boundary on which the rate of spread is predicted. The majority of the WUI would have a moderate to high rate of spread under the average fire weather assumed by CO-WRAP. High winds will increase the rate of spread beyond the CO-WRAP predictions.

There are forty-two homes in a forested Wildland/Urban Interface (WUI) of Spirit Lakes. Many include outbuildings for animals or equipment storage. The homes in this community have various risks of being destroyed by a wildfire. The amount of risk depends on the vegetative fuels, topography, weather events, and the construction of the home itself. It is important to understand these conditions and factors in order to make appropriate decisions about vegetative fuels reductions.



Fire Behavior at any time is dependent on three factors: weather, topography and fuels.

Weather: Weather influences fire behavior as both a long term and transient phenomenon. Long term weather trends such as extended drought increase the possibility of ignition and increase the rate of fire spread.

Large plants, trees and larger shrubs, recover moisture content slowly after a prolonged drought, and may remain drier than normal for several years after a drought ends. Grasses and herbaceous fuels may recover moisture quickly after a short rain, but also loose moisture quickly after short dry periods.

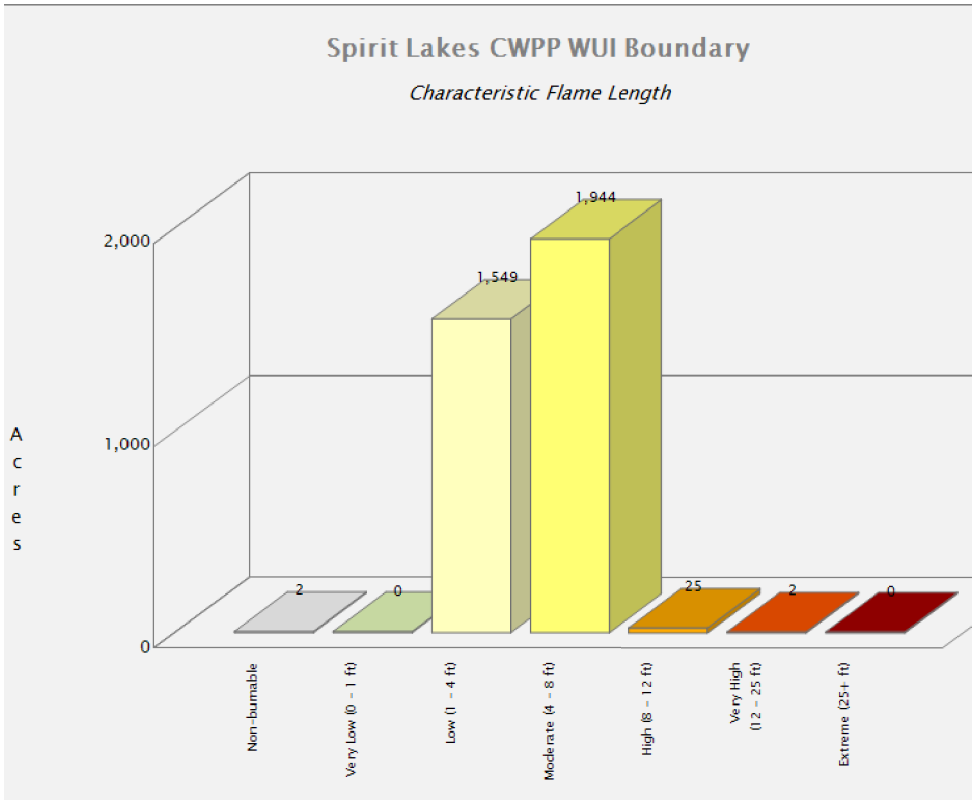
The intensity and spread of a wildfire is also affected by the weather conditions existing at the moment. For example, a large thunderstorm about 20 miles north of the Waldo Cañon Fire was responsible for pushing the fire down downslope into the Mountain Shadows neighborhood. High temperatures, low humidity, and strong winds increase the probability of ignition, intensity and rate of spread. Wind direction at any given moment is the primary determinant for the direction of fire spread.

Topography: Topography includes the degree of slope and the shape of the terrain. Hot gases rise in front of the fire along the slope face, pre-heating the vegetation above a fire. As slope increases the effect of the preheating and increased spread increases, and fires may move up to four times faster with flames twice as long than a fire on level ground.

Drainages act as chimneys that funnel heat and winds up the drainage. Homes in drainages, or at the tops of drainages, are particularly vulnerable to wildfires. The direction a slope faces, or its aspect, also influences fire behavior. South and west facing slopes tend to be drier and thus, exhibit more intense fire behavior than moister east and north facing slopes.

Fuels: The two fuel types in a WUI are vegetative and structural. Vegetative fuels consist of living and dead trees, bushes, and grasses. Typically, grasses ignite more easily and burn more quickly but with less intensity than trees. Fires can move quickly through grass and herbaceous vegetation, and these smaller fuels are often the kindling that moves fires to larger size fuels.

Any dead or living branches on the lower eight feet of trees or shrubs between 6 and 18 inches tall underneath trees are called ladder fuels. Ladder fuels help convert a ground fire to a crown fire (fire in the tree tops) that moves much more quickly and with more heat.



The length of flames is directly correlated with the amount of heat a fire produces. Flame lengths less than four feet can be attacked directly by hand crews, but flame lengths greater than four feet require indirect attack methods where firefighters must work a safe distance away from the flaming front. As seen in the graph above, CO_WRAP predicts one to eight foot flame length during average weather conditions over most of the area. As was all too evident in the Black Forest Fire, during adverse weather flames will reach the crowns and flame height may exceed 100 feet. Fuel modification in defensible spaces and fuel treatments is designed to reduce the amount of heat produced by a wildfire.

Shade Intolerant Trees

Shade intolerant trees are those that require full sunlight to sprout and grow to maturity. Shade intolerant trees are those that first colonize a site after a disturbance, such as wildfire, removes the existing trees. For this reason, ecologists call these pioneer species. Aspen, the most shade intolerant of local species, will send up new sprouts within days after a fire destroys the old trees. Shade intolerant trees common to this area include aspen and ponderosa pine.

The ponderosa sections in this photo illustrate how tree diameter is not a reliable indicator of age. The center section is 100 years old; section 2 is 99; section 3 is 101; section 4 is 90; section 5 is 85; section 6 is 130; section 7 is 81. (Sculpture by Bill Wallace. Photo by Bill Buckman, courtesy of the Black Forest Slash & Mulch Program)

It follows that if the trees in a particular area grow in following a disturbance, all the trees in a stand will be of roughly the same age. As the trees compete for sunlight, water and nutrients, the most vigorous become the dominant trees in the new stand. The dominant tree soon outgrows its siblings, yet the weak trees remain in the understory stunted and overtopped. Thus in shade intolerant stands, small trees are not young trees, but merely suppressed.

Following are some important species of shade intolerant trees with respect to fire mitigation:

Ponderosa pine: Of all the species of trees in the local area, ponderosa is the best adapted to survive a low intensity wildfire. First, the thick bark of the tree acts as insulation from the heat of the fire. Second, as the upper branches shade the lower branches, the low branches die, and in time, are broken off. Thus there are fewer low hanging branches to act as ladder fuels. Fires that burn in the grass and litter under a mature ponderosa rarely harm the tree.

Aspen: As noted earlier, aspen are the most shade intolerant of local trees. Unlike the ponderosa, aspen bark is thin and the tops of the trees are killed by even the coolest fire. The root system however is insulated from the fire's heat by the ground, and when the tree tops die, the roots respond by vigorously resprouting.

As a deciduous tree, aspen will not carry a fire in the tree crowns, thus fires drop to the ground in aspen stands. For this reason aspen are desirable trees to retain in fuel breaks and defensible spaces. Furthermore, aspen are desirable wildlife trees, and many stands are becoming shaded out by conifers due to years of fire suppression.

Since wildfire mitigation practices almost always require thinning, many landowners assume that aspen should be thinned as well, but they should not. Thinning aspen is rarely recommended since the falling trees wound the remaining trees. The bark on aspen is so thin that any wound will expose the tree to many different fungal diseases that are eventually fatal. Fire mitigation in aspen should be limited to removal of dead trees if care

APPENDIX A

INSECT AND DISEASE CONDITIONS

Literally thousands of insect and diseases are present in the forests surrounding the community--or any other forested area. Fortunately, like the common cold, most do no serious or lasting damage. But when in poor health, trees, like humans, are more prone to infection from other causes; the concept of preventive medicine applies to forests, as well. Maintaining forests in good health will prevent problems in the future. For the most part, forest insect and disease issues are typical for the region.

Every summer, insect and disease specialists from the USDA Forest Service and Colorado State Forest Service (CSFS) survey Colorado's forests from the air to monitor insect and disease outbreaks. These flights are an excellent means of finding new areas of insect and disease activity and monitoring trends in existing outbreaks. Maps of the previous year's findings are published in January and can be found on the CSFS website at http://csfs.colostate.edu/pages/common-insects.html.This link also contains more detailed information on the insect and disease issues presented here.

The unnaturally dense forest conditions that cause the potential for hazardous fire also create the potential for cyclical insect and disease outbreaks. Trees weakened by overcrowding and severe competition for water and sunlight are susceptible to invasion by insects and disease. When planning wildfire hazard mitigation projects, it is important to address current insect or disease issues and prevent those that are likely to become a problem. Following is information on some of the common forest insect and disease problems that have been identified in the region.

Well maintained forest have a multidude of benefits. They are resistant to catastrophic fires, insect and disease, sustain wildlife populations and are pleasant places to be. Colorado State Forest Service Photo by Dave Root

Dwarf Mistletoe

Dwarf mistletoe is a parasitic plant that robs moisture and nutrients from the host tree. Over many years, it causes the tree to decline in vigor and eventually may cause death. More commonly, the tree declines to the point where bark beetles attack and kill it.

Three common species of dwarf mistletoe are found in the region, each named after its principle host – ponderosa pine, lodgepole pine and Douglas-fir. Locally, ponderosa and lodgepole varieties grow on any pine species, but Douglas-fir dwarf mistletoe is exclusive to Douglas-fir trees. Spruce, true firs and deciduous trees are immune to all three species of dwarf mistletoe.

The most obvious symptom of dwarf mistletoe infection is the dense, distorted growth of the branches, called witch's brooms because they appear to be twisted or tied in knots. The shoots of ponderosa and lodgepole dwarf mistletoe are visible on the branch as thick fingerlike growths extending out of the branch or trunk. The shoots of ponderosa and lodgepole dwarf mistletoe are long and obvious to casual observation, but Douglas-fir dwarf mistletoe shoots are shorter than the needles and are not easy to see.

A ponderosa pine with advanced dwarf mistletoe infection. Note the heavy contorted "witch's brooms" in the lower branches. After long periods of infection, the needles at the top of the tree become sparse and shorter. Colorado State Forest Service photo by Dave Root.

Mistletoe shoots are only reproductive structures with no photosynthetic function. Removing the shoots from a branch does not control dwarf mistletoe, except to temporarily halt seed production. Structures called sinkers, (analogous to roots in plants) embedded in the wood cause the damage, and the mistletoe plant continues to absorb the host tree's water and nutrients. Shoots that are removed grow back in two or three years.

During the growing season, dwarf mistletoe shoots develop berries containing a seed. In August, the berries fill with water and explode, shooting the seed as far as 40 feet. Most seeds strike branches of the host tree and do not travel the full 40 feet, so the expansion of dwarf mistletoe pockets averages two feet per year. When the seed strikes a branch, it germinates and the sinkers penetrate the bark into the tree's conductive tissues. The growing mistletoe begins to steal the tree's food and water. The first visible symptom of infection is swelling in the branch at the site of the growing mistletoe plant, but nubs of the emerging shoots won't be visible for three years and a shoot won't bear its first seeds until seven years after. As seeds spread, all susceptible trees

in the vicinity may become infected; it is extremely rare to find an isolated infected tree in the forest.

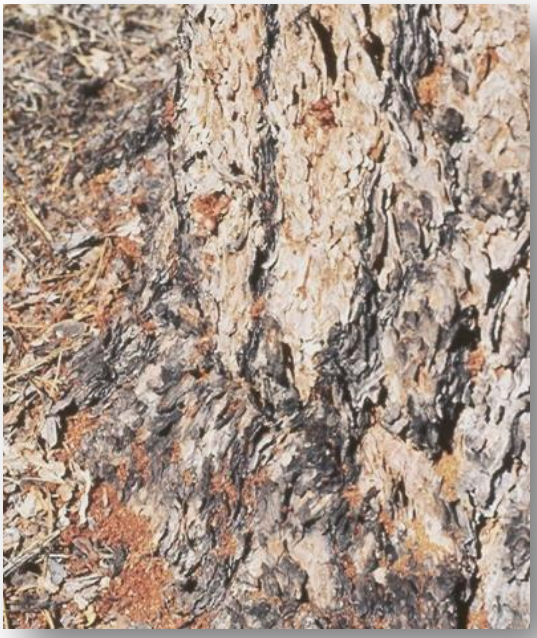
The tendency of mistletoe to infect all trees in a stand makes eradication difficult. No effective chemical treatment exists for mistletoe, and the only way to kill the parasite is to kill the host. In stands where only the susceptible species of tree exists, total eradication of the mistletoe would require a clearcut, which is unacceptable to most landowners.

Fortunately, mistletoe kills trees slowly, so it is not necessary to eradicate the parasite. The disease can be controlled by a program of thinning to increase tree vigor. Pruning the more heavily infected branches also helps, even if not all the mistletoe is eliminated. The final step in the process is to replant with non-susceptible species so that new trees will grow before the mistletoe kills the remaining trees.

The spread of mistletoe can be halted by a minimum 40-foot buffer zone between infected and non-infected trees. In this situation, cut 20 feet into non-infected trees to remove any mistletoe that is not yet visible; cut the remaining 20 feet into the infected stand. Non- infected trees outside the buffer should be checked each spring for mistletoe and any infected branches should be immediately pruned before seeds develop.

In forest stands with mixed tree species, it may be possible to eliminate all mistletoe by retaining only non-susceptible trees if they are in good health.

Dwarf mistletoe treatment is a complicated process that depends on the site conditions and the landowner's tolerance for cutting trees. In most cases, a combination of treatment methods will best suit the landowner's objectives. Consultation with a qualified forester is recommended to develop an effective and acceptable treatment plan.



Boring dust on a ponderosa pine after bark beetle attack. The reddish brown sawdust at the base of the tree and in the bark crevasses is a strong indication of successful beetle attack. Colorado State Forest Service photo by David Leatherman.

<u>Mountain pine beetle</u>

Due to the massive mountain pine beetle (MPB) epidemic in the western United States and Canada, MPB is the most feared insect in the forest. Unlike the Western Slope, mountain pine beetle is
at normal levels in the area. The beetles have crossed the Continental Divide in northern Park County and northern Larimer County, and activity currently is confined mostly to higher altitude lodgepole pine. It presently is not known if or when the beetles will reach into the lower-

elevation ponderosa forests, but where they have reached ponderosa, heavy mortality has occurred.

Adult beetles fly from midsummer through the first frost, although the vast majority fly between mid-July through the middle of September. Females seek a large, weak tree in which to mate and lay eggs. Vigorous trees generate enough pitch to prevent the female from burrowing through the bark, and this attempt by the tree to prevent entry creates the pitch tubes symptomatic of beetle attack. Pitch tubes are **not** a particularly reliable indicator of a successful attack. If pitch tubes are seen, check for reddish boring dust (fine sawdust) at the base of the tree and in the bark crevices. Boring dust is a more reliable indicator of successful attack.

Once a female penetrates the bark, she hollows out a circular mating chamber between the bark and the wood, releasing a pheromone (scent) to attract a mate. The pheromone also attracts additional females to the tree and the tree is attacked en masse. After mating, the female burrows up the trunk between the bark and wood laying eggs. She inoculates the tree with spores of bluestain fungus, which provides food for the larvae. The fungus clogs the tissues that conduct water throughout the tree, leading to death within a few weeks.

Eggs hatch within a few days. The developing larvae feed horizontally from the maternal gallery over winter. The vertical maternal gallery and horizontal larval galleries are characteristic of the mountain pine beetle. The feeding larvae spread the bluestain fungus horizontally through the tree, and it becomes visible in the wood around February. The presence of bluestain is absolute confirmation that beetles have successfully attacked a tree.

Mountain pine beetle galleries under the bark. The maternal beetle burrowed straight up the tree, creating the darker central gallery. Larval beetles feed horizontally, creating the smaller galleries. A larva is in the upper right and pupae in the lower left. Note the bluestain in the wood. Colorado State Forest Service photo by David Leatherman.

Woodpeckers feed on the larvae through the fall and winter. The holes made by the woodpeckers are a visual clue to an infested tree. Untrained observers often are confused by the holes woodpeckers make when they feed on beetle larvae and sapsuckers feed on the sap. Woodpecker feeding is characterized by random holes about one-half inch in diameter that make it appear as though the tree was peppered with a shotgun. Sapsuckers, on the other hand, make a small hole about one-eighth inch in diameter, and the holes are in straight lines or a grid pattern. Sapsuckers do not indicate the presence of beetles in the tree.

Although the tree is dead within a few weeks of successful attack, needles remain green until the following spring. Within the space of a few weeks, in late May or early June the tree will turn straw-yellow and then reddish-brown. Once beetles invade a tree, nothing can be done to save it;

the tree must be cut and disposed of in a way that will kill the beetles. No insecticide is available to kill beetles under the bark; thus, some sort of mechanical treatment is necessary. Any wood greater than four inches in diameter may harbor beetles and must be treated.

Following are treatment options for beetle-infested trees:

- Cut the tree and move all wood greater than four inches in diameter to a designated mountain pine beetle-safe site – usually an area at least one mile away from the nearest pine tree.
- Move all wood to a landfill or bury it under at least eight inches of dirt.
- Completely debark any wood that is larger than four inches in diameter.
- Chip the tree. Many tree services have chippers capable of chipping large diameter trees. The beetles are killed when the wood is chipped.
- Cover wood with at least six-mill clear plastic. This method, known as solar treatment, warms the wood to lethal temperatures and increases moisture, encouraging mold growth in the logs, which kills the beetles. Treat the wood properly for successful control. Cut into firewood lengths and stack no more than two logs high. Be sure there are no exposed stubs or sharp edges that might tear the plastic. Trench around the pile and, if possible, wet down the pile to encourage mold growth. Cover the pile with plastic, push the edges of the plastic into the trenches, and seal the edges with dirt. Check periodically to be sure the plastic has not torn. If torn, it can be repaired with duct tape.

It is best to check for infested trees in October of each year – remember that infested trees, although dead, are still green at this time. Pitch tubes and boring dust will be the most obvious clues. If infested trees are located early, there is adequate time to treat them.

While no insecticide effectively treats infested trees, spraying with insecticides such as carbaryl or permethrine prevents attack. Preventive sprays will not kill beetles under the bark. Spray trees between May 1st and July 1st each year for maximum effectiveness. It is not practical to spray every tree on a large tract of land, so choosing which trees to spray depends on the landowner's budget and the value of individual trees to the landowner. It is advisable to solicit bids from several different spray companies, as prices can vary widely. It also is wise to request and check references.

Thinning forests for increased health and vigor by far is the best preventive measure for mountain pine beetle. Because trees require several years to respond to thinning, it is best done before beetles reach epidemic levels. Follow thinning guidelines for wildfire mitigation to reduce susceptibility to MPB.

Ips (engraver) Beetles

There are several species of these small bark beetles that may infest ponderosa pine piñon pine or spruce. Piñon ips is active along the Highway 115 corridor south of Colorado Springs. The other species are always present in the forest, but are not currently at epidemic levels. Ips beetles usually attack trees less than four inches in diameter and, in such circumstances, may be useful in thinning dense stands of young trees. Thus, it usually is not considered as threatening as its larger cousin. Ips will attack larger trees if they are severely weakened by disease (most often dwarf

mistletoe), or are damaged by construction, lightning strikes or in horse corrals where soil compaction injures the roots. Like the mountain pine beetle, ips burrow beneath the bark and inoculate the tree with bluestain fungus, often following mountain pine beetles into larger trees.

The reddish-brown sawdust on this freshly cut ponderosa pine slash indicates it has been invaded by ips beetles. Adult beetles will emerge in eight weeks if the slash is not properly treated.

Colorado State Forest Service photo by Dave Root.

The differences between mountain pine beetle and ips are significant to anyone implementing a forest management program. In contrast to MPB, which produce one generation per year, ips may produce up to four. Ips become active in spring when the weather exceeds 50 degrees F, developing from egg to adult within eight weeks. They continue to attack trees until the first fall frosts. For this reason, preventive spraying should be done with permethrine or carbaryl in April and repeated in July. When spraying preventively for ips, it is important to spray the branches, as well as the trunk.

Ips attack causes no pitch tubes to form on live trees, so the only visual clue is boring dust or woodpecker holes in the trunk. Smaller trees quickly turn reddish-brown, but when they attack larger trees, ips often infest only the upper portion of the tree. The first symptom is browning of the top, but subsequent generations emerge and continue down the tree.

Ips will infest green slash and downed logs from forest management projects. If slash is not promptly treated, ips will emerge to attack living trees; treat slash within four to six weeks after cutting. If weather conditions permit, thinning trees in winter when ips are dormant will prevent problems with beetles in slash. However, slash cut after March 1 may still be green enough to attract ips when the weather warms.

Chipping slash will kill ips beetles. Lopping and scattering slash into lengths less than 24 inches promotes rapid drying and prevents infestation. Slash cut late in fall that is subsequently infested can be treated or piled and burned over the winter, but untreated slash left over the winter will produce live broods the following April. Due to their short lifecycle, solar treatment of ips-infested logs is ineffective. Bucking larger diameter logs and promptly splitting them into firewood accelerates the drying process and usually is effective in preventing ips infestations.

Many high value trees have been lost as a result of the common, and ultimately costly, practice of stacking firewood against green trees. Ips beetles will burrow out of infested firewood directly into standing trees.

References

Cranshaw, Whitney, David Leatherman, Boris Kondratieff, Paul Opler, and Casey Sclar. Nd. *Insects and Diseases of Woody Plants of the Central Rockies.* Bulletin 506A, Colorado State University Cooperative Extension.

Furniss, R.L., and Carolin, V.M. (1977). *Western Forest Insects.* Miscellaneous Publication No. 1339 USDS Forest Service.

Johnson, Warren T., and Lyon, Howard H. 1991. *Insects that Feed on Trees and Shrubs.* Comstock Publishing Associates, Cornell University Press.

Appendix B

Further Information

Websites:

Cost Share Assistance Database: http://nrdb.csfs.colostate.edu/
Colorado State Forest Service: http://www.csfs.colostate.edu/
CSFS, Woodland Park District: http://csfs.colostate.edu/pages/woodlandparkdist.html
Firewise Communities: http://www.firewise.org/
El Paso County: http://www.elpasoco.com/Pages/default.aspx
Park County: http://www.parkco.us/
Teller County: http://www.co.teller.co.us/
Colorado State University Extension: http://www.extension.colostate.edu/chaffee/
Pike National Forest: http://www.fs.usda.gov/psicc
Bureau of Land Management, Royal Gorge Field Office: http://www.blm.gov/co/st/en/fo/rgfo.html
Natural Resources Conservation Service: http://www.co.nrcs.usda.gov/

Publications:

Community Wildfire Protection Planning

How to evaluate a community Wildfire Protection Plan: http://csfs.colostate.edu/pdfs/eval_9-8-08_web.pdf
All Colorado CWPPs: http://csfs.colostate.edu/pages/CommunityWildfireProtectionPlans.html

Wildfire Mitigation

***CO Dept. of Revenue Tax Subtraction*:**
http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251915899901&ssbinary=true
Fuel Break Guidelines for Forested Communities: http://csfs.colostate.edu/pdfs/fuelbreak_guidellines.pdf
Protecting Your Home from Wildfire: Creating Wildfire Defensible Zones:
http://csfs.colostate.edu/pdfs/FIRE2012_1_DspaceQuickGuide.pdf
Firewise Landscaping: http://csfs.colostate.edu/pdfs/06303.pdf
Firewise Plant Materials: http://csfs.colostate.edu/pdfs/06305.pdf
Forest Home Fire Safety: http://csfs.colostate.edu/pdfs/06304.pdf
Grass Seed Mixtures to Reduce Wildfire Hazard: http://csfs.colostate.edu/pdfs/06306.pdf
Living With Fire: A guide to the Homeowner: http://csfs.colostate.edu/pdfs/LWF51303.pdf
Firewise Construction: Site Design and Building Materials:
http://csfs.colostate.edu/pdfs/firewise-construction2012.pdf

Forest Health and Management

Gambel Oak Management: http://csfs.colostate.edu/pdfs/06311.pdf
Landowner's Guide to Thinning: http://csfs.colostate.edu/pdfs/landowner_g4thin_scr.pdf
Landowner's Guide to Living With Bark Beetles: http://csfs.colostate.edu/pdfs/MPB_Newspaper_Insert_Final.pdf
Landowner Assistance Programs in Colorado:
http://csfs.colostate.edu/pdfs/Landowner-Assistance-Programs-rev112610.pdf

Forest Insect and Disease Information

Dwarf Mistletoe Management: http://csfs.colostate.edu/pdfs/DMT.pdf
Mountain Pine Beetle: http://csfs.colostate.edu/pdfs/MPB.pdf
Solar Treatment for Mountain Pine Beetle:
http://csfs.colostate.edu/pages/documents/Solar_Treatment_for_Mountain_Pine_Beetle_April_2009.pdf

Products used to Prevent Mountain Pine Beetle:
http://csfs.colostate.edu/pdfs/Web__Revision_June6_MPB_Prev_Products_QG.pdf
Ips Beetles: http://csfs.colostate.edu/pdfs/Ips.pdf
Western Spruce Budworm: http://csfs.colostate.edu/pdfs/05543.pdf
Firewood and House Log Insects: http://csfs.colostate.edu/pages/documents/firewood_insects.pdf
Protecting Trees During Construction: http://csfs.colostate.edu/pdfs/construction.pdf

Post Wildfire Recovery:

Insects and Disease Associated with Forest Fires: http://csfs.colostate.edu/pdfs/06309.pdf
Vegetative Recovery after Wildfire: http://csfs.colostate.edu/pdfs/06307.pdf
Soil Erosion Control After Wildfire: http://csfs.colostate.edu/pdfs/06308.pdf
Replanting in Burned Areas: Tips for Safety & Success:
http://csfs.colostate.edu/pdfs/FINAL-Post-FireReplanting-andSafetyTips-2013Feb11.pdf
Aspen Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Douglas-fir Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Gambel Oak and Serviceberry Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-gambel-oak-and-serviceberry.pdf
Piñon Pine and Juniper Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-PJ.pdf
Ponderosa Pine & Lodgepole Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-Ponderosa-and-lodgepole.pdf

Appendix C

Glossary of Forestry Terms

Abiotic Factors: The non-living components of the environment, such as air, rocks, soil, water, peat, and plant litter.

Afforestation: The establishment of trees on an area that has lacked forest cover for a very long time, or has never been forested.

Aerial fuels: Standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines: typically used in reference to the crowns of trees.

Cambium: A single layer of cells between the woody part of the tree and the bark. Division of these cells result in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: The forest cover of branches and foliage formed by tree crowns.

Chain: A measuring tape, often nylon, 50 meters or 75 meters in length, used to measure distances. This term is derived from an old unit of measurement (80 Chains = 1 mile).

Chimney: A topographical feature such as a narrow drainage on a hillside or the upper end of a box canyon that could channel wind, smoke or flames up the slope; acting as a fireplace chimney would to draw smoke and heat upward.

Class A Roof: Effective against severe fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class B Roof: Effective against moderate fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class C Roof: Effective against light fire test exposure, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a measurable degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Clearcut: An area of forest land from which all merchantable trees have recently been harvested.

Climax Forest: A forest community that represents the final stage of natural forest succession for its locality, i.e. for its environment.

Coarse Woody Debris (CWD): Sound and rotting logs and stumps that provide habitat for plants, animals, and insects, and a source of nutrients for soil development.

Colorado Champion Tree: The largest known tree of its species in the state. Trees are ranked by a point system based on three measurements: trunk circumference in inches at 4.5 feet above the ground, tree height in feet, and the average crown spread in feet.

Commercial Thinning: A silviculture treatment that "thins" out an overstocked stand by removing trees that are large enough to be sold as poles or fence posts. It is carried out to improve the health and growth rate of the remaining crop trees.

Competing Vegetation: Vegetation that seeks and uses the limited common resources (space, light, water, and nutrients) of a forest site needed by preferred trees for survival and growth.

Conifer: Cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood known commercially as "softwoods."

Conservation: Management of the human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. It includes the preservation, maintenance, sustainable utilization, restoration, and enhancement of the environment.

Crown fire / Crowning: A form of extreme wildland fire behavior consisting of fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

Deciduous: Perennial plants that are normally leafless for some time during the year.

Defensible Space: An area within the perimeter of a parcel, development, neighborhood, or community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires. The perimeter as used herein is the area encompassing the parcel or parcels proposed for construction and/or development, excluding the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures. In simplest terms, it is adequate space between structures and flammable vegetation which allows firefighters a safe working area from which they can attack an oncoming wildfire. Defensible Space is the best element of fire protection for individual property owners.

Defoliator: An agent that damages trees by destroying leaves or needles.

Dripline: The outer most leaves on a tree defines its dripline and the ground within the dripline is known as the drip zone; also defined as the area defined by the outermost circumference of a tree canopy.

Deforestation: The removal of a forest stand where the land is put to a non forest use.

Eave Opening: A vent located in an eve or soffit which allows airflow into the attic and/or walls of a structure.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size a log, pond, field, forest, or the earth's biosphere but

it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation; for example, forest ecosystem, old-growth ecosystem, or range ecosystem.

Escape route: A preplanned and understood route firefighters take to retreat from an unsafe or fire-threatened area and move to a safety zone or other low-risk area.

Extreme fire behavior: A level of fire behavior that ordinarily precludes firefighting methods involving direct attack on the fire. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Felling: The cutting down of trees.

Firebrands: Flaming or glowing fuels lofted into the air during intense burning by strong upward convection currents. Also referred to as airborne embers.

Fire break: A natural or constructed fuel-free barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fire front / Flame front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter.

Fire Dependent: Requiring one or more fires of varying frequency, timing, severity, and size in order to achieve optimal conditions for population survival or growth.

Fire Hazard Mitigation: Various methods by which existing fire hazards can be reduced in a certain area, such as fuel breaks, non-combustible roofing, spark arresters, etc.

Fire Management: The activities concerned with the protection of people, property, and forest areas from wildfire and the use of prescribed burning for the attainment of forest management and other land use objectives, all conducted in a manner that considers environmental, social, and economic criteria.

Fire Suppression: All activities concerned with controlling and extinguishing a fire following its detection.

Firewise: A National Fire Protection Association's (NFPA) program encouraging local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks.

Forest Fire: Any wildfire or prescribed burn that is burning in forest, grass, alpine, or tundra vegetation types.

Forest Type: A group of forested areas or stands of similar composition (species, age, height, and stocking) which differentiates it from other such groups.

Fuel: Any living or dead material that will burn.

Fuel break: An existing barrier or change in fuel type (to one that is less flammable than that surrounding it) or a wide strip of land on which the native vegetation has been modified or cleared, that acts as a buffer to fire spread so that fires burning into them can be more readily controlled. Often selected or constructed to protect a high value area from fire.

Fuel Management: The act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire in support of land management objectives.

Fuel reduction zone: An area similar to a fuel break but not necessarily linear, in which fuels have been reduced or modified to reduce the likelihood of ignition and/or to reduce fire intensity thereby lessening potential damage and resistance to control.

Germination: The development of a seedling from a seed.

Home Ignition Zone (HIZ): An area including the home and its immediate surroundings within which burning fuels could potentially ignite the structure; usually considered to be an area extending out roughly 100 feet from the home. The HIZ is often used to describe the area in which fuel modification measures should be taken to protect the home.

Ladder Fuels: Fuels that provide vertical continuity between the surface fuels and crown fuels in a forest stand, thus contributing to crown fires.

Lines of Effort: Tasks sets or sets of actions that are linked or coordinated with other task sets to accomplish a larger mission or reach a desired end state. Lines of effort allow leaders and decision makers to direct a variety of separate actions toward a unified result.

Maximum Density: The maximum allowable stand density above which stands must be spaced to a target density of well-spaced, acceptable stems to achieve free-growing status.

National Fire Protection Association (NFPA): A private, non-profit organization dedicated to reducing fire hazards and improving fire service.

Phloem: A layer of tree tissue just inside the bark that conducts food from the leaves to the stem and roots.

Pitch Tubes: A tubular mass of resin that forms on bark surface at bark-beetle entrance holes.

Prescribed Burning: Controlled application of fire to wildland fuels, in either their natural or modified state, under certain conditions of weather, fuel moisture, soil moisture, etc. as to allow the fire to be confined to a predetermined area and at the same time to produce results to meet planned land management objective.

Ready, Set, Go (RSG): A program, managed by the International Association of Fire Chiefs (IAFC), seeking to develop and improve the dialogue between fire departments and residents. The program helps fire departments teach individuals who live in high-risk wildfire areas how to best prepare themselves and their properties against fire threats.

Regeneration: The act of renewing tree cover by establishing young trees, naturally or artificially note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Saddle: A depression, dip or pass in a ridgeline; significant in wildland firefighting because winds may be funneled through a saddle, causing an increase in wind speed.

Safety zone: An area essentially cleared of flammable materials, used by firefighters to escape unsafe or threatening fire conditions. Safety zones are greatly enlarged areas in which firefighters can distance themselves from threatening fire behavior without having to take extraordinary measure to shield themselves from fire/heat.

Sapwood: The light-colored wood that appears on the outer portion of a cross-section of a tree.

Serotinous: Pertaining to fruit or cones that remain on a tree without opening for one or more years note in some species cones open and seeds are shed when heat is provided by fires or hot and dry conditions.

Shaded fuel break: A fuel break built in a timbered area where the trees within the break are thinned and limbed up to reduce crown fire potential, yet retain enough crown canopy to provide shade, thereby making a less favorable microclimate for surface fires.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Stand: A continuous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

Spot Fire / Spotting: Fires ignited beyond control lines or outside the perimeter of a fire by firebrands landing on/among flammable material. Spot fires/spotting are a form of extreme fire behavior typically resulting from high wind conditions.

Structure protection: A defensive strategy in wildland firefighting in which firefighters are assigned to evaluate, prepare and, when possible, defend structures/homes that may be threatened by a wildfire.

Structure triage: Evaluating and sorting structures/homes into categories based on their relative likelihood of surviving a wildland fire threat (*defensibility*). Triage decisions are based multiple factors and conditions occurring during an actual fire - weather, fire behavior, home ignition potential, defensible space, presence of escape routes, and availability of firefighting resources, among others - with the goal of doing the most good with the resources available.

Succession (or Ecological Succession): The replacement of one plant and/or animal species over time by another in progressive development toward climax vegetation.

Surface fuels: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-lying live vegetation.

Survivable space: A term typically used to describe the area around a structure/home indicating that fuels in the area have been reduced to the point that there is little or no serious fire threat to the structure; the structure has a high probability of surviving a wildland fire without anyone on scene providing active protection.

Thinning: A cutting made in an immature crop or stand primarily to accelerate diameter increment, but also, by suitable selection, to improve the average form of the tree that remain.

Torching: The burning of the foliage of a single tree or a small group of trees, from the bottom up. Sometimes, also called candling. Torching is an extreme form of fire behavior, similar to but less extreme than crowning in that crowning affects larger numbers, even entire stands of trees.

USDAFS: United States Department of Agriculture - Forest Service, what is commonly known as just "The Forest Service"

Windbreak: A strip of trees or shrubs maintained mainly to alter wind flow and microclimates in the sheltered zone, usually farm buildings.

Wildland-Urban Interface or Wildland-Urban Intermix (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Although ***Interface*** is the more general, more commonly used term; it technically refers specifically to the area where development and wildlands meet. ***Intermix*** indicates the presence of wildland vegetation/fuels intermingled throughout the developed area.